AVAQMD
Federal 70 ppb Ozone Attainment Plan (Western Mojave Desert Nonattainment Area)

For adoption on
1/17/2023

Antelope Valley Air Quality Management District
2551 W Avenue H
Lancaster, CA 93536

This document was prepared by the AVAQMD staff, with input from the MDAQMD staff. Significant portions of this document were prepared by, or are based on work done by, the California Air Resources Board and the South Coast Air Quality Management District staffs. The AVAQMD staff greatly appreciates the assistance of those agencies in the preparation of this document.

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Abbreviations and Acronyms

AQAP................. Air Quality Attainment Plan
AQMP................ Air Quality Management Plan (SCAQMD)
AVAQMD.......... Antelope Valley Air Quality Management District
CARB................. California Air Resources Board
FCAA................. Federal Clean Air Act
MPO................... Metropolitan Planning Organization
MDAQMD......... Mojave Desert Air Quality Management District
MPO................... Metropolitan Planning Organization
NAAQS.............. National Ambient Air Quality Standard
NO_X.................... Oxides of Nitrogen
NSR.................... New Source Review
O_3 .... Ozone
ppb...................... Parts per billion
RACM................ Reasonably Available Control Measure
RACT................. Reasonably Available Control Technology
ROG................... Reactive Organic Gases
RRF.................... Relative Reduction Factor
SAAQS .... State Ambient Air Quality Standard
SBCAPCD .... San Bernardino County Air Pollution Control District
SCAB .... South Coast Air Basin
SCAG................. Southern California Association of Governments
SCAQMD .... South Coast Air Quality Management District
SIP...................... State Implementation Plan
SSAB.................. Salton Sea Air Basin
TCM................... Transportation Control Measure
tposd................... Tons per Ozone Seasonal Day
UAM .... Urban Airshed Model
USEPA............... United States Environmental Protection Agency
VMT................... Vehicle Miles Traveled
VOC .... Volatile Organic Compounds
WMDONA......... Western Mojave Desert Ozone Nonattainment Area

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Executive Summary

The United States Environmental Protection Agency (USEPA) designated the Western Mojave Desert Nonattainment Area (WMDONA) as nonattainment for the 2015 70 ppb 8-hour ozone National Ambient Air Quality Standard (NAAQS)[1] pursuant to the provisions of the Federal Clean Air Act (FCAA). The Antelope Valley Air Quality Management District (AVAQMD or District) is included in the WMDONA. This plan addresses all Federal attainment planning requirements for the 70 ppb federal 8-hour ozone standard.

The District has reviewed and updated all elements of the ozone plan. The District will be in attainment of the 70 ppb ozone NAAQS by August 3, 2033.

This document includes the latest planning assumptions regarding population, vehicle activity and industrial activity. This document addresses all existing and forecast ozone precursor-producing activities within the District through the year 2032. This document includes all necessary information to allow general and transportation conformity findings to be made within the District.

[1] October 26, 2015 80 FR 65292

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CHAPTER 1 – Introduction and Background

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INTRODUCTION

Purpose

The Western Mojave Desert nonattainment area (as defined in 40 CFR 81.305) was designated nonattainment for the NAAQS for ozone by USEPA effective on October 26, 2015. The Western Mojave Desert Ozone Nonattainment Area (WMDONA) includes the AVAQMD portion of Los Angeles County, as well as the San Bernardino County portion of the MDAQMD. The AVAQMD has experienced ambient ozone concentrations in excess of the 8-hour ozone NAAQS. This document: (1) demonstrates that the AVAQMD will meet the primary required Federal ozone planning milestone, attainment of the 70 ppb 8-hour ozone NAAQS, by August 2033; (2) presents the progress the AVAQMD will make towards meeting all required ozone planning milestones; and (3) discusses the 2015 70 ppb 8-hour ozone NAAQS, preparatory to an expected non-attainment designation for the new NAAQS. This document satisfies 42 U.S.C. §§7410, 7502, 7504 and 7511a (FCAA §§110, 172, 174, and 182) regarding implementation plans, nonattainment plan provisions, planning procedures, and ozone plan submissions and requirements for the 70 ppb 8-hour NAAQS.

BACKGROUND

Regulatory History

The USEPA designated a portion of the southwestern desert part of San Bernardino County as nonattainment and classified it as Severe for the 8-hour standard. This area was classified based on an ozone design value calculated from 2014 through 2016 concentrations in the region. The Severe classification requires attainment of the 8-hour ozone NAAQS by August 2033, fifteen years after the date of designation.

The desert portion of Los Angeles County was established as its own air district as of July 1, 1997, the Antelope Valley Air Pollution Control District (AVAPCD), pursuant to former Health & Safety Code (H&SC) §40106 (Statutes 1996 ch 542, Repealed Statutes 2001 ch. 163). This air district was replaced by the AVAQMD on January 1, 2002, pursuant ot H&SC §41300 et seq (Statutes 2001 ch. 163). As a successor district to the SCAQMD, the AVAQMD assumes the authorities and duties of the SCAQMD for the Antelope Valley (H&SC §41302)

The SCAQMD addressed the desert portion of Los Angeles County in the 1991 AQMP, the 1994 AQMP, and the 1997 AQMP. The 1994 AQMP is the most recent ozone attainment plan for the desert portion of Los Angeles County that has been approved by USEPA. The USEPA has approved a revision to the 1997 AQMP that was adopted after the formation of the AVAPCD. The AVAMQD adopted the Federal 75 ppb Ozone Attainment Plan on March 21, 2017. This document replaces or updates all previously submitted federal ozone plans.

Regional Ozone Planning Chronology

1989 - CARB designates SEDAB as non-attainment for ozone SAAQS
1990 - CARB classifies the SEDAB as moderate ozone non-attainment
November 1990 - Adoption of Federal Clean Air Act Amendments
September 9, 1994 - Adoption of 1994 AQMP by SCAQMD
1996 - SEDAB is subdivided into the Mojave Desert Air Basin (MDAB) and the Salton Sea Air Basin (SSAB)
November 15, 1996 - Adoption of 1997 AQMP by SCAQMD
July 1, 1997 - AVAPCD formed
January 1, 2002 - AVAPCD changed to AVAQMD
April 20, 2004 - Adoption of AVAQMD 2004 Ozone Attainment Plan
May 20, 2008 - Adoption of AVAQMD Federal 8-hour Ozone Attainment Plan (Severe-17)
January 25, 2010 - Adoption of AVAQMD Federal 8-hour Ozone Attainment Plan (Severe-15)
July 20, 2012 - USEPA designates 75 ppb 8-hour nonattainment areas
October 26, 2015 – USEPA designates 70 ppb 8-hour nonattainment areas
March 21, 2017 – Adoption of AVAQMD 75 ppb Ozone Attainment Plan

Statement of Issues

The District is downwind of the Los Angeles basin, and to a lesser extent, is downwind of the San Joaquin Valley. Prevailing winds transport ozone and ozone precursors from both regions into and through the Mojave Desert Air Basin (MDAB) during the summer ozone season. These transport couplings have been officially recognized by CARB.[2] Local District emissions contribute to exceedances of both the national and state ambient air quality standards for ozone, but photochemical ozone modeling conducted by the SCAQMD and CARB indicates that the MDAB would be in attainment of both standards without the influence of this transported air pollution from upwind regions.

Federal Legal Requirements

The District must adopt a plan that provides for the implementation, maintenance and enforcement of the NAAQS within three years after promulgation of the NAAQS. The plan is to include enforceable emission limitations, provide for a monitoring program, provide for a permit program (including a New Source Review program), contingency measures, and air quality modeling (42 U.S.C. §7410(a); FCAA §110(a)). The District most recently met this requirement with the 75 ppb Ozone Attainment Plan. This document represents an update to that plan. The District has adopted enforceable emission limitations, has a monitoring system in place throughout the populated portions of the WMDONA, maintains a permit program (including a New Source Review program with an ambient air quality modeling requirement), and has performed an attainment demonstration using air quality modeling. This document identifies a contingency measure – see chapter 3.

This document incorporates all reasonably available control measures (RACM - all such measures have already been adopted for the WMDONA or are being committed to adoption in this plan). This document includes a comprehensive, accurate and current inventory of actual emissions (42 U.S.C. §7502(c)(3), 7511a(a)(1); FCAA §§172(c)(3), 182(a)(1)).

[2] "Ozone Transport: 2001 Review," April 2001, CARB identifies the South Coast Air Basin as having an overwhelming and significant impact on the Mojave Desert Air Basin (which includes the Mojave Desert) and the San Joaquin Valley as having an overwhelming impact on the MDAB.

This document discusses reasonable further progress (42 U.S.C. §§7502(c)(2), 7511a(b)(1); FCAA §§172(c)(2), 182(b)(1)) for the applicable periodic milestone dates (2017, 2023, 2026, 2029 and 2032) (42 U.S.C. §7511a(g); FCAA §182(g)).

This document has been coordinated with the transportation planning process (42 U.S.C. §7504; FCAA §174). The document includes an emission budget for the WMDONA, and also includes the on-road mobile source emission budget for the WMDONA.

This document updates the District emissions inventory (42 U.S.C. 7511a(a)(1); FCAA §182(a)(1)).

The District has an enhanced non-attainment pollutant monitoring program, requires reasonably available control technology (RACT) within the WMDONA, has a vehicle inspection and maintenance program, a De Minimis rule, and a gasoline vapor recovery rule. The District participates in the State's Clean-Fuel Vehicle Program, and performs periodic transportation activity consistency demonstrations (including a review of vehicle miles traveled growth) in conjunction with the Southern California Association of Governments (SCAG). The District controls oxides of nitrogen (NO_x) in addition to Volatile Organic Compounds (VOC) within the WMDONA, and is addressing both pollutants in this document. The District New Source Review (NSR) program defines sources emitting 25 tons per year or more as major and requires offsets at a 1.3 to 1 ratio (42 U.S.C. §§7511a(d), 7511a(d)(2); FCAA §§182(d) 182(d)(2)). Employer trip rules (42 U.S.C. §7511a(d)(1); FCAA §182(d)(1)) have been shown to be not cost-effective for the WMDONA due to low population density.

Pollutant Description and Health Effects

Ozone (O_3) is a colorless gas that is a highly reactive form of oxygen. It has a strong odor when highly concentrated. Ozone can occur naturally but can also be formed from other compounds through photochemistry, a complex system of reactions with hydrocarbons and oxides of nitrogen in the presence of sunlight (ultraviolet). The MDAB experiences ozone concentrations in excess of the state and Federal ambient air quality standards.

Ozone can cause respiratory irritation and discomfort, making breathing more difficult during exercise. Ozone can reduce the respiratory system's ability to remove inhaled particles, increase pulse rate, decrease blood pressure and reduce the body's ability to fight infection. After six hours of exposure a healthy person can have significant reduction of lung function. It is an irritant towards the skin, eyes, upper respiratory system, and mucous membranes, although symptoms disappear after exposure. It may also be a carcinogen.

Setting

The AVAQMD is the desert portion of Los Angeles County. The AVAQMD has been designated nonattainment for the 8-hour ozone NAAQS by USEPA as a portion of the WMDONA in 80 FR 65292. The ozone design value classifies the area as a Severe nonattainment area with 2032 as the required attainment year (42 U.S.C. 7511(a)(2); FCAA §181(a)(2)). The nonattainment area includes the entirety of the AVAQMD.

The AVAQMD covers 1200 square miles and included 219,628 persons as of the 1990 census (approximately 366,000 in 2015). The region is characterized by hot, dry summers and cool winters, with little precipitation. Air Force Plant 42 and a portion of Edwards Air Force Base are located in the area.

The primary roadways in the AVAQMD are State Route 14 and State Route 18. Both of these arterials carry a substantial amount of commute traffic from the region into the greater Los Angeles Basin.

The AVAQMD is primarily a bedroom community, but does have significant aerospace development and manufacturing on Plant 42 (Boeing, Lockheed Martin and Northrop Grumman all lease facilities on the base from the Air Force).

Ozone Trend

The WMDONA has experienced a substantial reduction in maximum 8-hour ozone concentrations, as displayed in Figure 1 (Trona and Blythe are not within the ozone nonattainment area but are shown for comparison). Note that the three stations closest to the South Coast Air Basin (the source of the majority of transported ozone and ozone precursors) have the highest historical ozone concentrations: Phelan, Hesperia and the Joshua Tree National Monument. The more distant or isolated stations (Barstow) have lower concentrations.

The WMDONA was significantly impacted by wildfire-elevated ozone concentrations during the 2017 through 2020 time period, as displayed in Figure 2 and Appendices C and D. Annual 8-hour ozone values were increased by a minimum of one part per billion and a maximum of nine parts per billion (Phelan in 2018). These wildfire exceptional events have been excluded from the ozone design value calculations and the resulting attainment demonstration forecast, as discussed in Chapter 4.

Figure 1 - Federal 8-Hour Ozone Design Value Trend

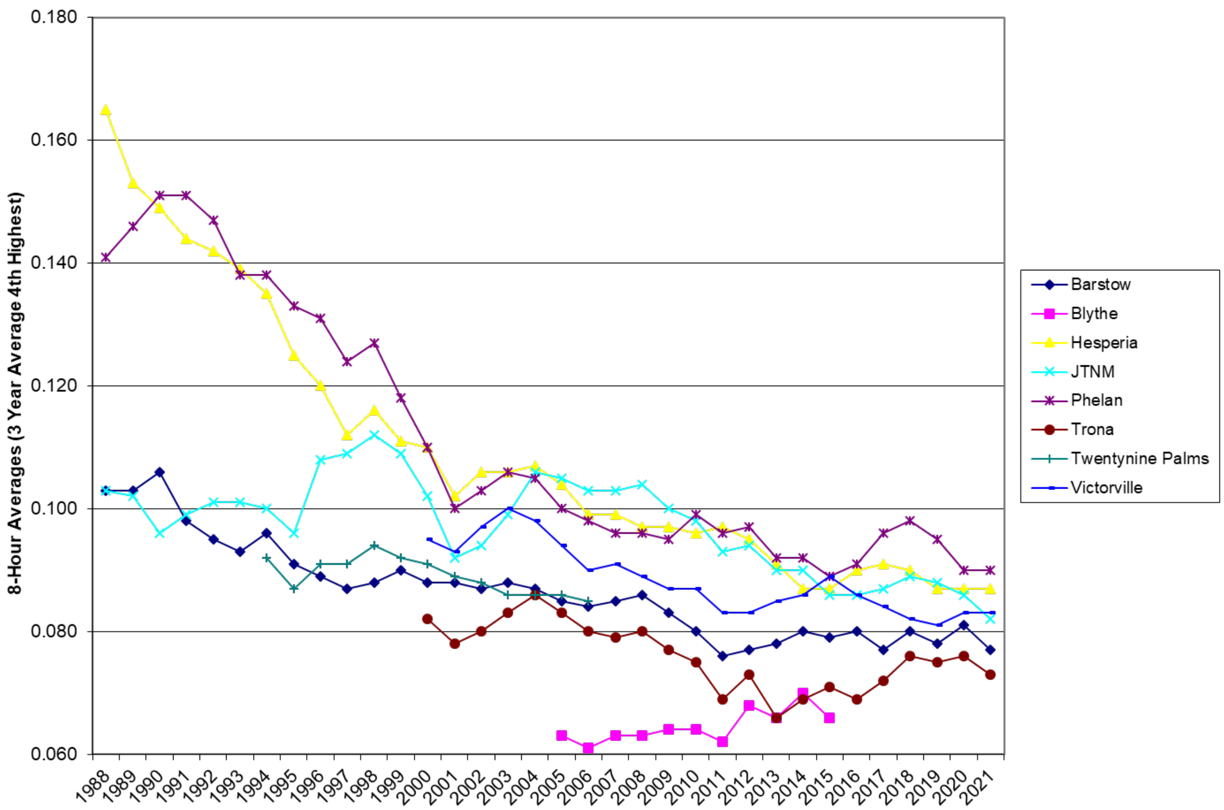
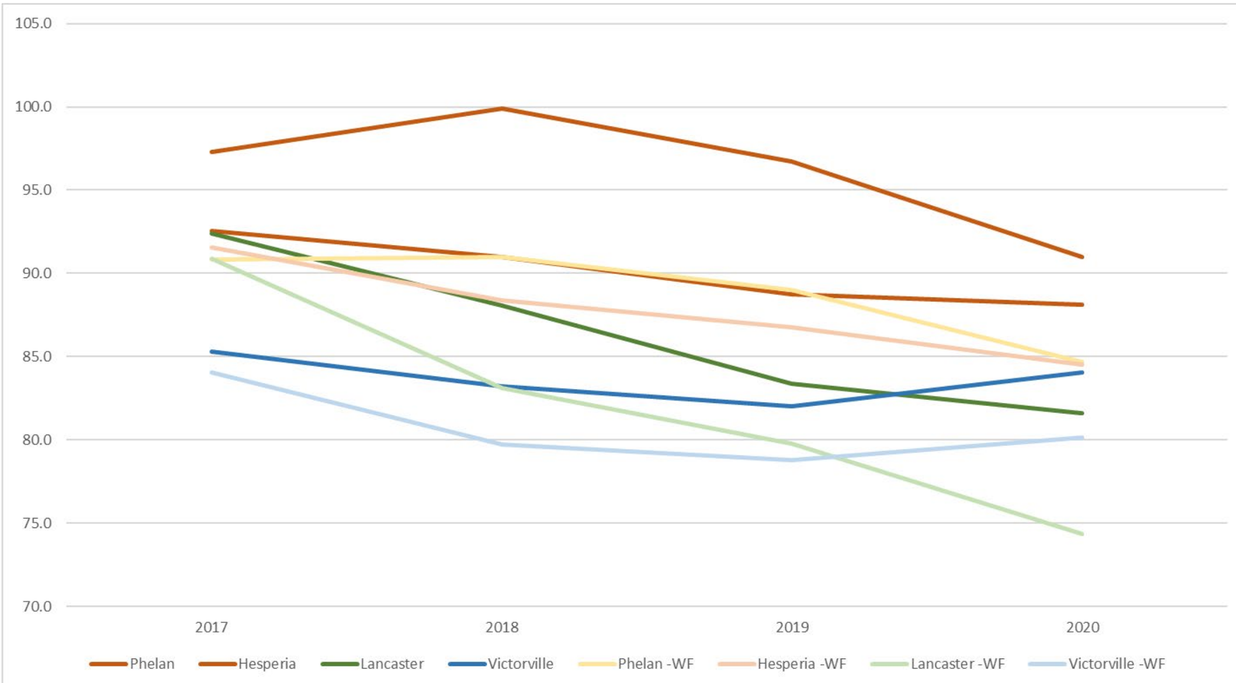


Figure 2 - Federal 8-Hour Ozone Design Value Wildfire Effect



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CHAPTER 2 – Emission Inventories

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EMISSIONS INVENTORY BACKGROUND

Emissions inventories are required by the Clean Air Act (CAA) and the Ozone SIP Requirements Rule for the 2015 ozone National Ambient Air Quality Standards (NAAQS), also called the Ozone Implementation Rule.[3] Specifically, they are required for those areas that exceed the health-based NAAQS. These areas are designated as nonattainment based on monitored exceedances of these standards. These nonattainment areas must develop an emissions inventory as the basis of a State Implementation Plan (SIP) that demonstrates how they will attain the standards by specified dates. This document describes the emissions inventory included in the Los Angeles-San Bernardino Counties (West Mojave Desert) 70 ppb 8-Hour Ozone SIP.

Emissions Inventory Overview

Emissions inventories are estimates of the amount and type of pollutants emitted into the atmosphere by facilities, mobile sources, and areawide sources. They are fundamental components of an air quality plan and serve critical functions such as:

1. the primary input to air quality modeling used in attainment demonstrations;
2. the emissions data used for developing control strategies; and
3. a means to track progress in meeting the emission reduction commitments.

The California Air Resources Board (CARB) and both the Antelope Valley Air Quality Management District and the Mojave Desert Air Quality Management District (Districts) have developed a comprehensive current emissions inventory consistent with the requirements set forth in Section 182(a)-(f) of the federal Clean Air Act[4]. CARB and District staff conducted a thorough review of the inventory to ensure that the emission estimates reflect accurate emissions reports for point sources and that estimates for mobile and areawide sources are based on the most recent approved models and methodologies.

CARB also reviewed the growth profiles for point and areawide source categories and worked with District staff to update them as necessary to ensure that the emission projections are based on data that reflect historical trends, current conditions, and recent economic and demographic forecasts.

The United States Environmental Protection Agency (U.S. EPA) regulations require that the emissions inventory for an Ozone SIP contain emissions data for the two precursors to ozone formation: oxides of nitrogen (NOx) and volatile organic compounds (VOC)[5]. The inventory included in this plan substitutes VOC with reactive organic gases (ROG), which, in general, represent a slightly broader group of compounds than those in U.S. EPA's list of VOCs.

INVENTORY BASE YEAR

40 CFR 51.1315(a) requires that the inventory year be selected consistent with the baseline year for the reasonable further progress (RFP) plan as required by 40 CFR 51.1310(b)[6], which states that the base year emissions inventory shall be the emissions inventory for the most recent calendar year of which a complete

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[3] Implementation of the 2015 National Ambient Air Quality Standards for Ozone: State Implementation Plan Requirements; (40 CFR part 51 Subpart AA; see also https://www.epa.gov/ground-level-ozone-pollution/implementation-2015-national-ambient-air-quality-standards-naaqs-ozone).

[4] Section 182(a)-(f) of the Act. https://www.govinfo.gov/content/pkg/USCODE-2013-title42/html/USCODE-2013-title42-chap85-subchapI-partD-subpart2-sec7511a.htm

[5] Section 182(a)(1) of the Act. https://www.govinfo.gov/content/pkg/USCODE-2013-title42/html/USCODE-2013-title42-chap85-subchapI-partD-subpart2-sec7511a.htm

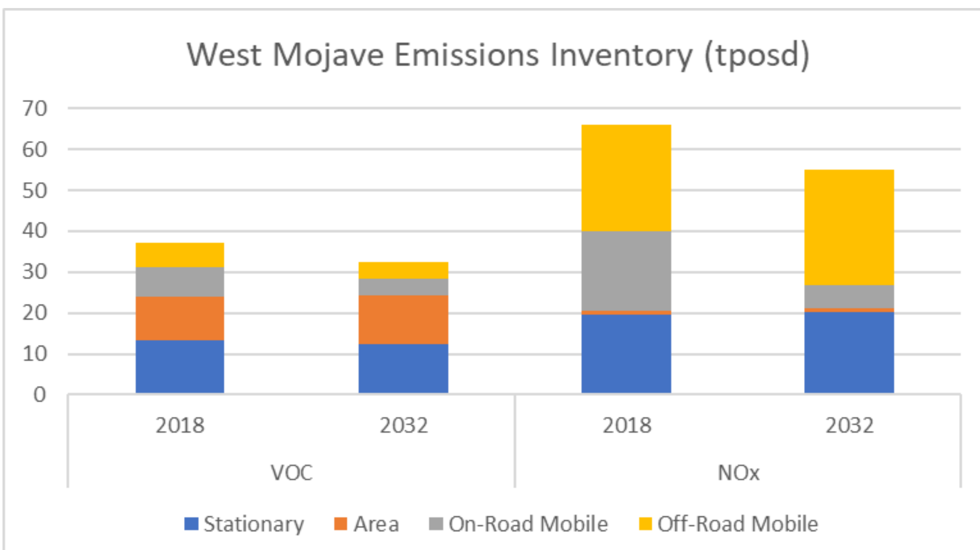
[6] 40 CFR 51.1315(a). https://www.govinfo.gov/content/pkg/CFR-2021-title40-vol2/pdf/CFR-2021-title40-vol2-sec51-1315.pdf.

triennial inventory is required to be submitted to EPA under the provisions of subpart A of 40 CFR part 51, Air Emissions Reporting Requirements, 40 CFR 51.1– 50. States may also use an alternative baseline emissions inventory provided that the year selected corresponds with the year of the effective date of designation as nonattainment for that NAAQS[7]. CARB selected the base year 2018 since that was the year U.S. EPA designated West Mojave Desert as nonattainment for the 70 ppb 8-Hour Ozone NAAQS[8]. The base year emission inventory is presented in Appendix A; a summary is presented in Table 1 below. Figure 3 presents the base year source category contributions in graphic format (VOC on the left, NO_x on the right). Mobile and area sources were the primary emitters in the WMDONA in 2018.

Table 1 - 2018 Base Year Summary

Tons per ozone seasonal day				
	VOC		NOx	
	2018	2032	2018	2032
Stationary	13.40	12.45	19.70	20.32
Area	10.52	11.86	0.90	0.88
On-Road Mobile	7.26	3.92	19.31	5.72
Off-Road Mobile	5.86	4.07	26.16	28.06
Totals:	**37.05**	**32.30**	**66.06**	**54.98**

Figure 3 - 2018 Base Year Comparisons



FORECASTED INVENTORIES

In addition to base year emissions, emissions projections are needed for a variety of reasons, including redesignation maintenance plans, the attainment projected inventory for a nonattainment area (NAA), and air quality modeling for attainment plans[9].

[7] 40 CFR 51.1310(b). https://www.govinfo.gov/content/pkg/CFR-2020-title40-vol2/pdf/CFR-2020-title40-vol2-sec51-1310.pdf.
[8] https://www.epa.gov/green-book/green-book-8-hour-ozone-2015-area-information.
[9] 40 CFR 51.114. https://www.govinfo.gov/content/pkg/CFR-2000-title40-vol2/pdf/CFR-2000-title40-vol2-sec51-114.pdf.

For stationary and area sources, forecasted inventories are a projection of the base year inventory that reflects expected growth trends for each source category and emissions reductions due to adopted control measures. CARB develops emission forecasts by applying growth and control profiles to the base year inventory. The stationary and area source emissions inventory for the West Mojave Desert 70 ppb Ozone SIP is modeled by the California Emission Projection Analysis Model (CEPAM), 2022 Emission Projections, Version 1.01.

Growth profiles for point and areawide sources are derived from surrogates, such as economic activity, fuel usage, population, and housing units, that best reflect the expected growth trends for each specific source category. Growth projections were obtained primarily from government entities with expertise in developing forecasts for specific sectors, or, in some cases, from econometric models. Control profiles, which account for emission reductions resulting from adopted rules and regulations, are derived from data provided by the regulatory agencies responsible for the affected emission categories.

Projections for on-road mobile source emissions are generated by CARB's EMFAC2017 model, which predicts activity rates and vehicle fleet turnover by vehicle model year, along with activity inputs from the metropolitan planning organization (MPO). Off-road mobile sources are forecasted with category-specific model or, where not available, CARB's OFFROAD2007.

CEPAM integrates the emission projections derived from these mobile source models to develop a comprehensive forecasted emission inventory. As with stationary sources, the mobile source models include control algorithms that account for adopted regulatory actions.

Forecasted WMDONA VOC and NO_x inventory summaries for each year of interest are presented in Figures 4 and 5 respectively (the base year is included in each figure for reference).

Figure 4 - Forecasted VOC Emission Inventories

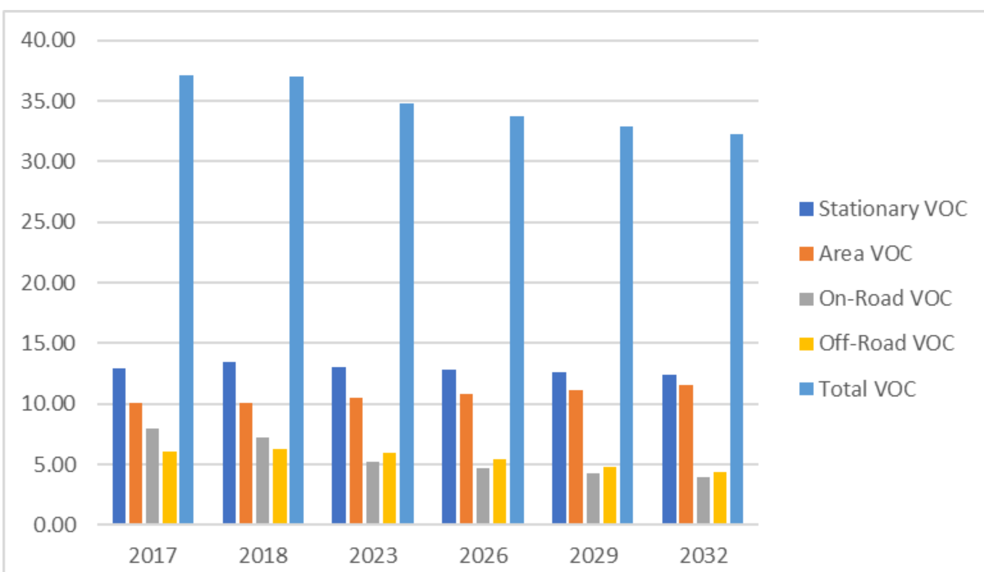
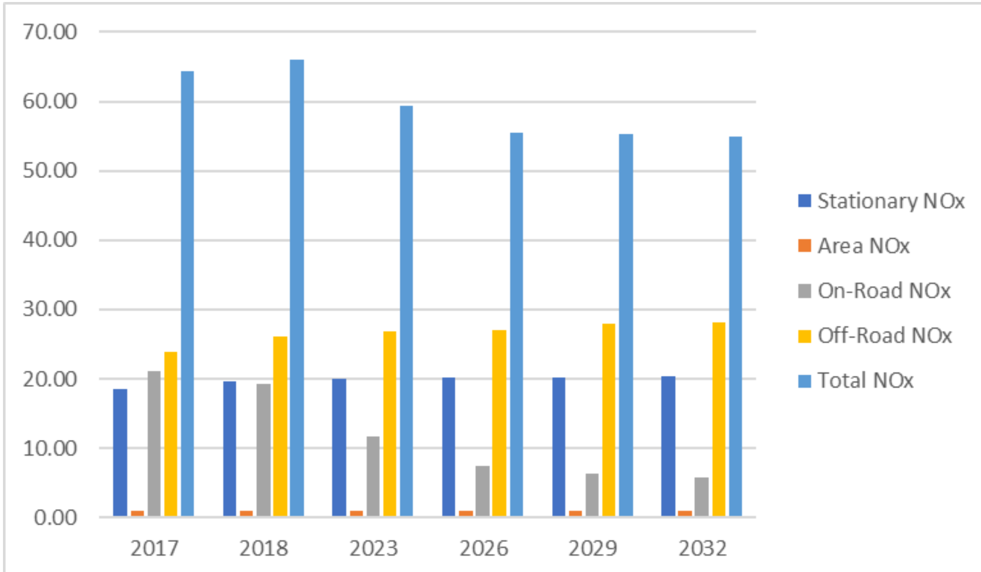


Figure 5 - Forecasted NOx Emission Inventories



TEMPORAL RESOLUTION

40 CFR 51.1315(c) requires emissions values included in the base year inventory to be actual ozone season day emissions as defined by 40 CFR 51.1300(q)[10]. Since ozone concentrations tend to be highest during the summer months, the emissions inventory used in the SIP is based on the summer season (May through October).

GEOGRAPHIC SCOPE

The West Mojave NAA consists of the western portion of San Bernardino County in the Mojave Desert Air Quality Management District and the entirety of the portion of Los Angeles County in the Antelope Valley Air Quality Management District. Since the western portion of San Bernardino County is split into a region not defined by county, air basin, or district boundaries, the District identified the facilities that fall in the NAA; for on-road sources, a special EMFAC2017 run was executed based on MPO activity specific to this sub-region, and the area and off-road source emissions in west San Bernardino were estimated using category-specific factors based on the spatial distribution of population and other activity parameters within the nonattainment region—these fractions were developed by District staff. The special split allocation method of each subcategory is shown in Table 2 below.

Table 2 - Allocation Method for the Western Portion of San Bernardino County

EICSUM or EIC	SOURCE CATEGORY	ALLOCATION METHOD
20	COGENERATION	HUMAN POPULATION
50	MANUFACTURING AND INDUSTRIAL	HUMAN POPULATION
52	FOOD AND AGRICULTURAL PROCESSING	HUMAN POPULATION
60	SERVICE AND COMMERCIAL	HUMAN POPULATION

[10] 40 CFR 51.1315(c). https://www.govinfo.gov/content/pkg/CFR-2021-title40-vol2/pdf/CFR-2021-title40-vol2-sec51-1315.pdf.

EICSUM or EIC	SOURCE CATEGORY	ALLOCATION METHOD
99	OTHER (FUEL COMBUSTION)	HUMAN POPULATION
110	SEWAGE TREATMENT	HUMAN POPULATION
120	LANDFILLS	HUMAN POPULATION
130	INCINERATORS	HUMAN POPULATION
140	SOIL REMEDIATION	HUMAN POPULATION
199	OTHER (WASTE DISPOSAL)	HUMAN POPULATION
210	LAUNDERING	HUMAN POPULATION
220	DEGREASING	HUMAN POPULATION
230	COATINGS AND RELATED PROCESS SOLVENTS	HUMAN POPULATION
240	PRINTING	HUMAN POPULATION
250	ADHESIVES AND SEALANTS	HUMAN POPULATION
299	OTHER (CLEANING AND SURFACE COATINGS)	HUMAN POPULATION
320	PETROLEUM REFINING	HUMAN POPULATION
330	PETROLEUM MARKETING	HUMAN POPULATION
399	OTHER (PETROLEUM PRODUCTION AND MARKETING)	HUMAN POPULATION
410	CHEMICAL	HUMAN POPULATION
420	FOOD AND AGRICULTURE	HUMAN POPULATION
430	MINERAL PROCESSES	HUMAN POPULATION
440	METAL PROCESSES	HUMAN POPULATION
450	WOOD AND PAPER	HUMAN POPULATION
499	OTHER (INDUSTRIAL PROCESSES)	HUMAN POPULATION
510	CONSUMER PRODUCTS	HUMAN POPULATION
520	ARCHITECTURAL COATINGS AND RELATED PROCESS SOLVENTS	HUMAN POPULATION
530	PESTICIDES/FERTILIZERS	HUMAN POPULATION
540	ASPHALT PAVING / ROOFING	HUMAN POPULATION
610	RESIDENTIAL FUEL COMBUSTION	HUMAN POPULATION
620	FARMING OPERATIONS	HUMAN POPULATION
660	FIRES	HUMAN POPULATION
670	MANAGED BURNING AND DISPOSAL	HUMAN POPULATION
690	COOKING	HUMAN POPULATION
710	LIGHT DUTY PASSENGER (LDA)	EMFAC2017 RUN SPECIFIC FOR WEST SAN BERNARDINO COUNTY
722	LIGHT DUTY TRUCKS - 1 (LDT1)	EMFAC2017 RUN SPECIFIC FOR WEST SAN BERNARDINO COUNTY
723	LIGHT DUTY TRUCKS - 2 (LDT2)	EMFAC2017 RUN SPECIFIC FOR WEST SAN BERNARDINO COUNTY

EICSUM or EIC	SOURCE CATEGORY	ALLOCATION METHOD
724	MEDIUM DUTY TRUCKS (MDV)	EMFAC2017 RUN SPECIFIC FOR WEST SAN BERNARDINO COUNTY
732	LIGHT HEAVY DUTY GAS TRUCKS - 1 (LHDV1)	EMFAC2017 RUN SPECIFIC FOR WEST SAN BERNARDINO COUNTY
733	LIGHT HEAVY DUTY GAS TRUCKS - 2 (LHDV2)	EMFAC2017 RUN SPECIFIC FOR WEST SAN BERNARDINO COUNTY
734	MEDIUM HEAVY DUTY GAS TRUCKS (MHDV)	EMFAC2017 RUN SPECIFIC FOR WEST SAN BERNARDINO COUNTY
736	HEAVY HEAVY DUTY GAS TRUCKS (HHDV)	EMFAC2017 RUN SPECIFIC FOR WEST SAN BERNARDINO COUNTY
742	LIGHT HEAVY DUTY DIESEL TRUCKS - 1 (LHDV1)	EMFAC2017 RUN SPECIFIC FOR WEST SAN BERNARDINO COUNTY
743	LIGHT HEAVY DUTY DIESEL TRUCKS - 2 (LHDV2)	EMFAC2017 RUN SPECIFIC FOR WEST SAN BERNARDINO COUNTY
744	MEDIUM HEAVY DUTY DIESEL TRUCKS (MHDV)	EMFAC2017 RUN SPECIFIC FOR WEST SAN BERNARDINO COUNTY
746	HEAVY HEAVY DUTY DIESEL TRUCKS (HHDV)	EMFAC2017 RUN SPECIFIC FOR WEST SAN BERNARDINO COUNTY
750	MOTORCYCLES (MCY)	EMFAC2017 RUN SPECIFIC FOR WEST SAN BERNARDINO COUNTY
760	HEAVY DUTY DIESEL URBAN BUSES (UB)	EMFAC2017 RUN SPECIFIC FOR WEST SAN BERNARDINO COUNTY
762	HEAVY DUTY GAS URBAN BUSES (UB)	EMFAC2017 RUN SPECIFIC FOR WEST SAN BERNARDINO COUNTY
771	SCHOOL BUSES - GAS (SBG)	EMFAC2017 RUN SPECIFIC FOR WEST SAN BERNARDINO COUNTY
772	SCHOOL BUSES - DIESEL (SBD)	EMFAC2017 RUN SPECIFIC FOR WEST SAN BERNARDINO COUNTY

EICSUM or EIC	SOURCE CATEGORY	ALLOCATION METHOD
777	OTHER BUSES - GAS (OBG)	EMFAC2017 RUN SPECIFIC FOR WEST SAN BERNARDINO COUNTY
778	OTHER BUSES - MOTOR COACH - DIESEL (OBC)	EMFAC2017 RUN SPECIFIC FOR WEST SAN BERNARDINO COUNTY
779	ALL OTHER BUSES - DIESEL (OBD)	EMFAC2017 RUN SPECIFIC FOR WEST SAN BERNARDINO COUNTY
780	MOTOR HOMES (MH)	EMFAC2017 RUN SPECIFIC FOR WEST SAN BERNARDINO COUNTY
810	AIRCRAFT	RATIO OF NUMBER OF AIRPORTS
840	RECREATIONAL BOATS	ESTIMATE OF ACTIVITY RATIO ON LAKE SILVERWOOD
850	OFF-ROAD RECREATIONAL VEHICLES	HUMAN POPULATION
860	OFF-ROAD EQUIPMENT	HUMAN POPULATION
870	FARM EQUIPMENT	HUMAN POPULATION
890	FUEL STORAGE AND HANDLING	HUMAN POPULATION
86088412109400	Transport Refrigeration Units-Transport Refrigeration Units-D-25-Exhaust	ESTIMATION OF HIGHWAY MILES RATIO
86088412109410	Transport Refrigeration Units-Transport Refrigeration Units-D-50-Exhaust	ESTIMATION OF HIGHWAY MILES RATIO
82082212100000	LOCOMOTIVES - SWITCHING	LOCATION OF RAIL YARD
82082312100000	LOCOMOTIVES - SHORT LINE	ESTIMATION OF RAIL MILES RATIO
82082512100000	PASSENGER TRANSIT	ESTIMATION OF RAIL MILES RATIO
82082712100000	LOCOMOTIVES - CLASS 1 LINE HAUL	ESTIMATION OF RAIL MILES RATIO
82082812100000	LOCOMOTIVES - INDUSTRIAL AND MILITARY	DISTRICT ESTIMATE

QUALITY ASSURANCE AND QUALITY CONTROL

CARB has established a quality assurance and quality control (QA/QC) process to ensure the integrity and accuracy of the emission inventories used in the development of air quality plans. QA/QC occurs at the various stages of SIP emission inventory development. Base year emissions are assembled and maintained in the California Emission Inventory Development and Reporting System (CEIDARS). CARB inventory staff works with air districts, which are responsible for developing and reporting point source emission estimates, to verify these data are accurate. The locations of point sources, including stacks, are checked to ensure they are valid. Area-wide source emissions estimates are developed by both CARB and District staff, and the methodologies are reviewed by both agencies before their inclusion in the emissions inventory. Mobile categories are verified with CARB mobile source staff for consistency with the on-road and off-road emission models. Additionally, CEIDARS is designed with automatic system checks to prevent errors, such as double counting of emission sources. At the final stage, CEPAM is thoroughly reviewed to validate the accuracy of growth and control application, and the output emissions are compared against prior approved versions of CEPAM to identify data anomalies.

Emission Inventory Components

A summary of the components that make up West Mojave Desert's 70 ppb Ozone SIP emissions inventory is presented in the following sections. These include mobile (on- and off-road) sources, stationary point sources, and areawide sources. Natural sources are not included.

MOBILE SOURCE EMISSIONS

CARB develops the emission inventory for the mobile sources using various modeling methods. These models account for the effects of various adopted regulations, technology types, fleet turnover, and seasonal conditions on emissions. Mobile sources in the emission inventory are composed of both on-road and off-road sources, described in the sections below.

On-Road Mobile Source Emissions

Emissions from on-road mobile sources, which include passenger vehicles, buses, and trucks, were estimated using outputs from CARB's EMFAC2017 model. The on-road emissions were calculated by applying EMFAC2017 emission factors to the transportation activity data provided by the local MPO. EMFAC2017 includes data on California's car and truck fleets and travel activity. Light-duty motor vehicle fleet age, vehicle type, and vehicle population were updated based on 2016 DMV data. The model also reflects the emissions benefits of CARB's recent rulemakings such as the Pavley Standards and Advanced Clean Cars Program and includes the emissions benefits of CARB's Truck and Bus Rule and previously adopted rules for other on-road diesel fleets.

EMFAC2017 utilizes a socio-econometric regression modeling approach to forecast new vehicle sales and to estimate future fleet mix. Light-duty passenger vehicle population includes 2016 DMV registration data along with updates to mileage accrual using Smog Check data. Updates to heavy-duty trucks include model year specific emission factors based on new test data, and population estimates using DMV data for in-state trucks and International Registration Plan (IRP) data for out-of-state trucks.

Additional information and documentation on the EMFAC2017 model is available at:
https://ww2.arb.ca.gov/our-work/programs/mobile-source-emissions-inventory/msei-road-documentation

<u>EMFAC2017 SAFE Vehicles Rules Off-Model Adjustment Removal</u>
On September 27, 2019, U.S. EPA and National Highway Traffic Safety Administration (NHTSA) published the "Safer Affordable Fuel-Efficient (SAFE) Vehicles Rule Part One: One National Program" (SAFE-1).[11] SAFE-1 revoked California's authority to set its own greenhouse gas emissions standards and set zero-emission vehicle mandates in California. On April 28, 2021, U.S. EPA reconsidered the 2019

[11] 84 FR 51310. https://www.govinfo.gov/content/pkg/FR-2019-09-27/pdf/2019-20672.pdf.

SAFE-1 by finding that the actions taken as a part of SAFE-1 were decided in error and are now entirely rescinded[12].
Therefore, any previously applied off-model adjustments as a result of SAFE-1 were removed in this inventory, resulting in a minor reduction in emissions.

EMFAC2017 ACT Off-Model Adjustment
The Advanced Clean Trucks (ACT) regulation was approved on June 25, 2020 and has two main components, a manufacturers zero-emission vehicle (ZEV) sales requirement and a one-time reporting requirement for large entities and fleets. The first component requires manufacturers to sell ZEVs as a percentage of annual truck and bus sales in California for vehicle model years 2024 and newer.

The ACT regulation impacts some of the underlying assumptions in CARB's EMFAC2017 model, which was used to assess emissions from on-road mobile sources. Therefore, CARB developed off-model adjustment factors in order to reflect the regulation. Adjustment factors were based on calculations in EMFAC2021, which models a percentage of California-certified ZEV sales for each EMFAC category and model year. More information on inventory modelling methods can be found in the ACT Initial Statement of Reasons (ISOR) Appendix F. These adjustment factors were calculated based on emission estimates using EMFAC2021 under two scenarios: (1) controlled scenario -estimated emissions with adopted regulations (EMFAC2021 default) and (2) uncontrolled scenario - estimated emissions without accounting for the benefits of adopted regulations, including ACT and other regulations Heavy-Duty Omnibus, Opacity, and ICT (described below). These adjustments, provided in the form of multipliers, were applied to emissions outputs from the EMFAC2017 model by the CEPAM external adjustment module to account for the impact of the ACT regulation. The ACT off-model adjustment factors were only applied to the medium- and heavy-duty truck sectors.

Additional information on ACT is available at:
https://ww2.arb.ca.gov/our-work/programs/advanced-clean-trucks

Additional information on EMFAC2021 technical details is available at:
https://ww2.arb.ca.gov/sites/default/files/2021-08/emfac2021_technical_documentation_april2021.pdf

EMFAC2017 Heavy-Duty Omnibus Off-Model Adjustment
On August 27, 2020, CARB adopted the Heavy-Duty (HD) Omnibus regulation, which would establish NOx engine emission standards 90 percent lower than today's technology. The Omnibus Regulation will dramatically reduce NOx emissions by comprehensively overhauling exhaust emission standards, test procedures, and other emissions-related requirements for California-certified heavy-duty engines with engine model years 2024 and newer.

The HD Omnibus regulation impacts some of the underlying assumptions in CARB's EMFAC2017 model, which was used to assess emissions from on-road mobile sources. Therefore, CARB developed off-model adjustment factors based on EMFAC2021 (described above) in order to reflect the regulation. These adjustments, provided in the form of multipliers, were applied to emissions outputs from the EMFAC2017 model by the CEPAM external adjustment module to account for the impact of the HD Omnibus regulation. The adjustment factors reflect the impact of all components of the HD Omnibus regulation on in-use (i.e.

[12] 87 FR 14332. https://www.govinfo.gov/content/pkg/FR-2022-03-14/pdf/2022-05227.pdf.

real-world) NOx emissions and deterioration-related emissions. More details on the inventory analysis for this regulation can be found in Appendix D of the HD Omnibus staff report.
The HD Omnibus off-model adjustment factors were only applied to on-road heavy-duty vehicles.

Additional information on the HD Omnibus regulation is available at:
https://ww2.arb.ca.gov/our-work/programs/heavy-duty-low-nox

EMFAC2017 Innovative Clean Transit Off-Model Adjustment
The Innovative Clean Transit (ICT) regulation was adopted by CARB in 2019 and targets reductions in transit fleets by requiring transit agencies to gradually transition their buses to zero-emission technologies. ICT has helped to advance heavy-duty ZEV deployment, with buses acting as a beachhead in the heavy-duty sector. Based on the size of the transit agencies, they are categorized as small and large agencies. Starting calendar year 2023, large agencies follow the phase-in schedule to have a certain percentage of their new purchases as zero emission buses (ZEB). For the small agencies, the start calendar year will be 2025. By 2030, all the agencies need to have 100% of their new purchases as ZEB.

The ICT regulation impacts some of the underlying assumptions in CARB's EMFAC2017 model, which was used to assess emissions from on-road mobile sources. Therefore, CARB developed off-model adjustment factors based on EMFAC2021 (described above) in order to reflect the regulation. These adjustments, provided in the form of multipliers, were applied to emissions outputs from the EMFAC2017 model by the CEPAM external adjustment module to account for the impact of ICT. More details on the inventory analysis for this regulation can be found in Appendix L of the ICT staff report. The ICT off-model adjustment factors were only applied to the urban buses (UBUS) category.

Additional information on the ICT regulation is available at:
https://ww2.arb.ca.gov/our-work/programs/innovative-clean-transit/ict-regulation

EMFAC2017 Heavy-Duty Inspection and Maintenance Off-Model Adjustment
On Dec. 9th, 2021, California Air Resources Board adopted Heavy-Duty Inspection and Maintenance (HD I/M) program, which controls emissions effectively from non-gasoline on-road heavy-duty vehicles with a gross vehicle weight rating (GVWR) greater than 14,000 pounds. Starting from calendar year 2023, the program drastically reduces NOx and PM 2.5 emissions by enforcing periodic testing and inspections for heavy-duty trucks operating in California.

The Heavy-Duty Inspection and Maintenance (HD I/M) regulation impacts some of the underlying assumptions in CARB's EMFAC2017 model, which was used to assess emissions from on-road mobile sources. Therefore, CARB developed off-model adjustment factors based on off-model analysis with EMFAC2021 in order to reflect the regulation. More information on this analysis is provided in Appendix D of the HD I/M staff report. Since this regulation was adopted after the release of EMFAC2021, these adjustment factors were calculated based on emission estimates under two scenarios: (1) EMFAC2021 with HD I/M analysis incorporated and (2) EMFAC2021 default, which does not include HD I/M. These adjustments, provided in the form of multipliers, were applied to emissions outputs from the EMFAC2017 model by the CEPAM external adjustment module to account for the impact of HD I/M. These off-model adjustment factors were applied to all diesel heavy-duty diesel categories.

Off-Road Mobile Source Emissions

Emissions from off-road sources are estimated using a suite of category-specific models or, where a new model was not available, the OFFROAD2007 model. Many of the newer models are developed to support recent regulations. The sections below summarize the updates made by CARB to specific off-road categories.

Recreational Marine Vessels

Pleasure craft or recreational marine vessel (RMV) is a broad category of marine vessel that includes gasoline-powered spark-ignition marine watercraft (SIMW) and diesel-powered marine watercraft. It includes outboards, sterndrives, personal watercraft, jet boats, and sailboats with auxiliary engines. This emissions inventory was last updated in 2014 to support the evaporative control measures. The population, activity, and emission factors were revised using new surveys, DMV registration information, and emissions testing.

Staff used economic data from a 2014 UCLA Economic Forecast to estimate the near-term annual sales of RMV (2014 to 2019). To forecast long-term annual sales (2020 and later), staff used an estimate of California's annual population growth as a surrogate.
Additional information is available at:
https://ww2.arb.ca.gov/our-work/programs/mobile-source-emissions-inventory/road-documentation/msei-documentation-offroad

Recreational Vehicles

Off-highway recreational vehicles include off-highway motorcycles (OHMC), all-terrain vehicles (ATV), off-road sport vehicles, off-road utility vehicles, sand cars, golf carts, and snowmobiles. A new model was developed in 2018 to update emissions from recreational vehicles. Input factors such as population, activity, and emission factors were re-assessed using new surveys, DMV registration information, and emissions testing. OHMC population growth is determined from two factors: incoming population as estimated by future annual sales and the scrapped vehicle population as estimated by the survival rate.

Additional information is available at:
https://ww2.arb.ca.gov/our-work/programs/mobile-source-emissions-inventory/road-documentation/msei-documentation-offroad

Fuel Storage and Handling

Emissions from portable fuel containers (gas cans) were estimated based on past surveys and CARB in-house testing. This inventory uses a composite growth rate that depends on occupied household (or business units), percent of households (or businesses) with gas cans, and average number of gas cans per household (or business) units.

Additional information is available at:
https://ww2.arb.ca.gov/our-work/programs/mobile-source-emissions-inventory/road-documentation/msei-documentation-offroad

Small Off-Road Engines (SORE)

Small off-road engines (SORE) are spark-ignition engines rated at or below 19 kilowatts (i.e., 25 horsepower). Typical engines in this category are used in lawn and garden equipment as well as other outdoor power equipment and cover a broad range of equipment. The majority of this equipment belongs to the Lawn & Garden (e.g., lawnmower, leaf blower, trimmer) and Light Commercial (e.g., compressor, pressure washer, generator) categories of CARB's SORE emissions inventory model.

The newly developed, stand-alone SORE2020 Model reflects the recovering California economy from the 2008 economic recession and incorporates emission results from CARB's recent in-house testing as well as CARB's most recent Certification Database. CARB also has conducted an extensive survey of SORE operating within California through the Social Science Research Center (SSRC) at the California State University, Fullerton (CSUF). Data collected through this survey provides the most up-to-date information regarding the population and activity of SORE equipment in California. The final SORE emissions included the adopted SORE rule in December 2021 as well as the 15-day changes after the Board hearing which allowed the pressure washers (greater than 5 hp) extra time for meeting the regulation. The SORE annual sales were forecasted using historic growth of the number of California households (DOF household forecasts, 2000 – 2008 and 2009 - 2018).
Additional information on SORE baseline emissions (without the adopted rule and 15-day changes) is available at:
https://ww2.arb.ca.gov/sites/default/files/2020-09/SORE2020_Technical_Documentation_2020_09_09_Final_Cleaned_ADA.pdf

Locomotives
All locomotive inventories were updated in 2020 and include linehaul (large national companies), switchers (used in railyards), passenger, and Class 3 locomotives (smaller regional companies). Data for each sector was supplied by rail operations, including Union Pacific and Burlington Northern, and Santa Fe Railway (BNSF) for linehaul and switcher operations. Data for other categories was supplied by the locomotive owners. Emission factors for all categories were based on U.S. EPA emission factors for locomotives. The inventory reflects the 2005 memorandum of understanding (MOU) with Union Pacific and BNSF. Growth rates were primarily developed from the FAF.

More information is available at:
https://ww2.arb.ca.gov/our-work/programs/mobile-source-emissions-inventory/road-documentation/msei-documentation-road

Military and Industry Locomotives
This new category includes military and Industrial (M&I) locomotive emission inventory and relies on the annual fuel consumption and engine information collected from 2011 to 2018. The M&I locomotive data was supplied by 39 private companies, 4 military rail groups, with a total of 85 locomotives. The subject locomotives typically consist of smaller, older switchers and medium horsepower (MHP, 2,301 to 3,999 hp) locomotives operating within the boundaries of a granary, plant, or industrial facility.

The updated methodology is currently in the process of being posted online. When it is completed, the methodology will be available at:
https://ww2.arb.ca.gov/our-work/programs/mobile-source-emissions-inventory/road-documentation/msei-documentation-road

Diesel Agricultural Equipment
The agricultural equipment inventory covers all off-road vehicles used on farms or first processing facilities (of all fuel types). It was updated in 2021 using a 2019 survey of California farmers and rental facilities, and the 2017 U.S. Department of Agriculture (USDA) agricultural census. Emission factors are based on the 2017 off-road diesel emission factor update. The inventory reflects incentive programs for agricultural equipment that were implemented earlier than August 2019. Agricultural growth rates were developed using historical data from the County Agricultural Commissioners' reports.

Additional information is available at:
https://ww2.arb.ca.gov/sites/default/files/2021-08/AG2021_Technical_Documentation_0.pdf

In-Use Off-Road Equipment
This category covers off-road diesel vehicles over 25 horsepower in construction, mining, industrial, and oiling drilling categories. The inventory was updated in 2022 based on the DOORS registration program. Activity was updated based on a 2021 survey of registered equipment owners, and emission factors were based on the 2017 off-road diesel emission factor update. The inventory reflects the In-Use Off-Road Equipment Regulations, as amended in 2011.

The updated methodology is currently in the process of being posted online. When it is completed, the methodology will be available at:
https://ww2.arb.ca.gov/our-work/programs/mobile-source-emissions-inventory/road-documentation/msei-documentation-road

Transportation Refrigeration Units - Diesel
The Transportation Refrigeration Units (TRU) inventory was updated in 2020 based on the TRU reporting program at CARB. The activity was developed based on 2010 surveys of facilities served by TRUs and 2017 to 2019 telematics data purchased from TRU manufacturers. Emission factors were developed specifically for TRUs based on TRU engine certification data reported to U.S. EPA as of 2018. The inventory reflects the TRU ATCM and 2021 amendments. Forecasting was based on IBISWorld reports forecast for related industries, and turnover forecasting was based on the past 20 years equipment population trends.

Additional information is available at:
https://ww2.arb.ca.gov/sites/default/files/barcu/board/rulemaking/tru2021/apph.pdf

Portable Equipment
Portable equipment inventory includes non-mobile diesel, such as generators, pumps, air compressors, chippers, and other miscellaneous equipment over 50 horsepower. This inventory was developed in 2017 based on CARB's registration program, 2017 survey of registered owners for activity and fuel, and the 2017 off-road diesel emission factor update. The inventory also reflects the Portable ATCM and 2017 amendments.

Because registration in PERP is voluntary, the PERP registration data was used as the basis for equipment population, with an adjustment factor used to represent the remaining portable equipment in the state. Estimates of future emissions beyond the base year were made by adjusting base year estimates for population growth, activity growth, and the purchases of new equipment (i.e. natural and accelerated turnover).

Additional information is available at:
https://ww3.arb.ca.gov/msei/ordiesel/perp2017report.pdf

Large Spark Ignition/Forklifts
The large spark ignition (LSI) inventory includes gasoline and propane forklifts, sweeper/scrubbers, and tow tractors. The inventory was updated in 2020 based on the LSI/forklift registration in the DOORS reporting system at CARB, and the sales data was provided by the Industrial Truck Association (ITA). Activity was based on a survey of equipment owners in the DOORS system, and emission factors were based on U.S. EPA's latest guidance for gasoline and propane engines. The inventory reflects the LSI regulation requirements and 2016 amendments.

The updated methodology is currently in the process of being posted online. When it is completed, the methodology will be available at:
https://ww2.arb.ca.gov/our-work/programs/mobile-source-emissions-inventory/road-documentation/msei-documentation-road

STATIONARY POINT SOURCES

The stationary source inventory is composed of point sources and area-wide sources. The data elements in the inventory are consistent with the data elements required by the AERR. The inventory reflects actual emissions from industrial point sources reported to the Districts by the facility operators through calendar year 2018.

Stationary point sources also include smaller point sources, such as gasoline dispensing facilities and laundering, that are not inventoried individually, but are estimated as a group and reported as a single source category. Emissions from these sources are estimated using various models and methodologies. Estimation methods include source testing, direct measurement by continuous emissions monitoring systems, or engineering calculations. Emissions for these categories are estimated by both CARB and the Districts.

Estimates for the categories below were developed by CARB and has been reviewed by CARB staff to reflect the most up-to-date information.

Stationary Nonagricultural Diesel Engines

This category includes emissions from backup and prime generators and pumps, air compressors, and other miscellaneous stationary diesel engines that are widely used throughout the industrial, service, institutional, and commercial sectors. The emission estimates, including emission forecasts, are based on a 2003 CARB methodology derived from the OFFROAD2007 model.

Additional information on this methodology is available at:
https://ww3.arb.ca.gov/ei/areasrc/arbfuelcombother.htm

Agricultural Diesel Irrigation Pumps

This category includes emissions from the operation of diesel-fueled stationary and mobile agricultural irrigation pumps. The emission estimates are based on a 2003 CARB methodology using statewide population and include replacements due to the Carl Moyer Program. Emissions are grown based on projected acreage for irrigated farmland from the California Department of Conservation's Farmland Mapping and Monitoring Program (FMMP), 2008.

Additional information on this category is available at: https://ww3.arb.ca.gov/ei/areasrc/fullpdf/full1-1.pdf

Laundering

This category includes emissions from perchloroethylene (perc) dry cleaning establishments. The emission estimates are based on a 2002 CARB methodology that used nationwide perc consumption rates allocated to the county level based on population and an emission factor of 10.125 pounds per gallon used. Emissions were grown based on Southern California Association of Governments (SCAG) total employment. Additional information on this methodology is available at: https://ww3.arb.ca.gov/ei/areasrc/arbcleanlaund.htm

Gasoline Dispensing Facilities

This category uses a 2015 CARB methodology to estimate emissions from fuel transfer and storage operations at gasoline dispensing facilities (GDFs). The methodology addresses emissions from underground storage tanks, vapor displacement during vehicle refueling, customer spillage, and hose permeation. The updated methodology uses emission factors developed by CARB staff that reflect more current in-use test data and also accounts for the emission reduction benefits of onboard refueling vapor recovery (ORVR) systems. The emission estimates are based on 2012 statewide gasoline sales data from the California Board of Equalization that were apportioned to the county level using fuel consumption estimates from EMFAC 2014. Emissions were grown based on EMFAC2017.

Additional information on this category is available at: https://ww2.arb.ca.gov/arb-petroleum-production-and-marketing-methodologies-petroleum-marketing

Gasoline Cargo Tank

This category uses a 2002 CARB methodology to estimate emissions from gasoline cargo tanks. These emissions do not include the emissions from loading and unloading of gasoline cargo tank product; they are included in the gasoline terminal inventory and gasoline service station inventory. Pressure-related fugitive emissions are volatile organic vapors leaking from three points: fittings, valves, and other connecting points in the vapor collection system on a cargo tank. 1997 total gasoline sales were obtained from the California Department of Transportation. The emission factors are derived from the data in the report, "Emissions from Gasoline Cargo Tanks, First Edition," published by the Air and Waste Management Association in 2002.

The initial emission estimates for 1997 were grown to 2012 using a growth parameter developed by Pechan based on gasoline and oil expenditures data. Emissions were grown according to fuel consumption from CARB's EMFAC 2017 mobile sources emission factors model.

Additional information on this methodology is available at: https://ww2.arb.ca.gov/arb-petroleum-production-and-marketing-methodologies-petroleum-marketing

AREA-WIDE SOURCES

Area-wide sources include categories where emissions take place over a wide geographic area, such as consumer products. Emissions from these sources are estimated using various models and methodologies.

Estimation methods include source testing, direct measurement by continuous emissions monitoring systems, or engineering calculations. Emissions for these categories are estimated by both CARB and the Districts.

Estimates for the categories below were developed by CARB and has been reviewed by CARB staff to reflect the most up-to-date information:

Consumer Products and Aerosol Coatings

The Consumer Product emission estimates utilized sales and formulation data from the CARB's mandatory survey of all consumer products sold in California for calendar years 2013 through 2015 (2015 Consumer Product Survey). The aerosol coatings estimates utilized sales and formulation data from a survey conducted by CARB in 2010. Based on the survey data, CARB staff determined the total product sales and total VOC emissions for the various product categories. Growth for personal care products is based on real disposable personal income projections per REMI version 2.4.3. No growth is assumed for aerosol coatings. Growth for all other consumer products is based on SCAG population projections.

Additional information on CARB's consumer products surveys is available at: https://ww2.arb.ca.gov/our-work/programs/consumer-products-program/consumer-commercial-product-surveys

Architectural Coatings

Architectural coatings are coatings applied to stationary structures and their accessories. They include house paints, stains, industrial maintenance coatings, traffic coatings, and many other products. Industrial maintenance coatings are high performance architectural coatings formulated for application to substrates, including floors, exposed to extreme environmental conditions (e.g., immersion in water, chronic exposure to corrosive agents, frequent exposure to temperatures above 121°C, repeated heavy abrasion). The architectural coatings category reflects emission estimates based on a 2014 comprehensive CARB survey for the 2013 calendar year. The emission estimates include benefits of the 2007 CARB Suggested Control Measures. These emissions are grown based on SCAG households forecast, 2020.

Additional information about CARB's architectural coatings program is available at: https://ww2.arb.ca.gov/carb-solvent-evaporation-methodologies-architectural-coatings-and-cleaningthinning-solvents

Pesticides

The California Department of Pesticide Regulation (DPR) develops month-specific emission estimates for agricultural and structural pesticides. Each calendar year, DPR updates the inventory based on the Pesticides Use Report, which provides updated information from 1990 through the 2018 calendar year. Agricultural pesticide emission forecasts for years 2019 and beyond are based on the average of the most recent five years. Growth for agricultural pesticides is based on CARB projections of farmland acres per FMMP, 2016. Growth for structural pesticides is based on SCAG household projections, 2020.

Additional information about CARB's pesticides program is available at: https://ww2.arb.ca.gov/carb-solvent-evaporation-methodologies-agricultural-and-non-agricultural-pesticides

Residential Wood Combustion

Residential Wood Combustion estimates are based off a 2011 CARB methodology. It reflects survey data on types of wood burning devices and wood consumption rates, updates to the 2002 U.S. EPA National Emission Inventory (NEI) emission factors, and improved calculation approaches.

CARB assumes no growth for this category based on the relatively stagnant residential wood fuel use over the past decade (according to the American Community Survey and US Energy Information Administration).

Additional information on this methodology is available at:
https://ww2.arb.ca.gov/carb-miscellaneous-process-methodologies-residential-fuel-combustion

Residential Natural Gas Combustion

CARB staff updated the methodology to reflect 2017 fuel use from the California Energy Consumption Database. Residential natural gas consumption by county was obtained from the 2019 California Energy Commission (CEC) California Energy Consumption Database. the heat content of natural gas to reflect 2017 values per the EIA State Energy Consumption, Price, and Expenditure Estimates. The emissions estimates reflect the most recent emissions factors from U.S. EPA's AP-42 for residential natural gas combustion. Growth is based on SCAG gas projections.

Additional information on this methodology is available at:
https://ww2.arb.ca.gov/carb-miscellaneous-process-methodologies-residential-fuel-combustion

Residential Distillate Oil and Liquefied Petroleum Gas

The residential distillate oil/liquefied petroleum gas (LPG) category includes emissions occurring in the residential sector. Distillate oil for heating is generally used in older homes and remote areas where natural gas lines are not available.

Activity is based on the number of housing units, population, and LPG and distillate oil capacities. The 1991 Fuels Report Working Paper published by the CEC was used to determine energy demand by fuel type in terms of the number of houses heated by a specific fuel in a particular area. Heating degree days (HDD) are used to estimate how many heating days are likely to occur in a particular area. This category uses emission factors from U.S. EPA's AP-42. Growth is based on SCAG gas projections.

Additional information on this methodology is available at:
https://ww2.arb.ca.gov/carb-miscellaneous-process-methodologies-residential-fuel-combustion

Farming Operations

CARB staff updated the non-cattle Livestock Husbandry methodology to reflect livestock population data based on the USDA's 2017 Census of Agriculture. Cattle emissions are primarily based on the 2012 Census of Agriculture. A seasonal adjustment was added to account for the suppression of dust emissions in months in which rainfall occurs. Growth profiles are based on CARB's projections of Census of Agriculture's historical livestock population trends, 2012. No growth is assumed for dairy and feedlots.

Additional information on CARB's methodology is available at:
https://ww2.arb.ca.gov/carb-miscellaneous-process-methodologies-farming-operations

Fires

Emissions from structural and automobile fires were estimated based on a 1999 CARB methodology using the number of fires and the associated emission factors. Estimates for structural fires are calculated using the amount of the structure that is burned, the amount and content of the material burned, and emission factors derived from test data. Estimates for automobile fires are calculated using the weight of the car and components and composite emission factors derived from AP-42 emission factors. No growth is assumed for this category.

Additional information on this methodology is available at:
https://ww2.arb.ca.gov/carb-miscellaneous-process-methodologies-fires

Managed Burning & Disposal – Agricultural Burning

The Agricultural Burning Managed Burning and Disposal category includes the open burning of agricultural residues (such as crop stubble and orchard pruning), weed abatement (such as ditch and canal bank burning), and other materials. CARB updated the emissions inventory to reflect burn data reported by air district staff for 2017. Emissions are calculated using crop specific emission factors and fuel loadings. Temporal profiles reflect monthly burn activity. Growth for agricultural burning is based on CARB projections of FMMP farmland acres, 2016. No growth is assumed for burning associated with weed abatement.

Additional information on this methodology is available at:
https://ww2.arb.ca.gov/district-miscellaneous-process-methodologies-managed-burning-and-disposal

POINT AND AREAWIDE SOURCE EMISSIONS FORECASTING AND CONTROL RULES

Emission forecasts (2019 and subsequent years) are based on growth profiles that in many cases incorporate historical trends up to the base year or beyond. The growth surrogates used to forecast the emissions from these categories were largely based on SCAG data. The emissions inventory also reflects emission reductions from point and areawide sources subject to District rules and CARB regulations. The rules and regulations reflected in the inventory are listed below in Table 3.

Table 3 - District and CARB Control Rules and Regulations Included in the Inventory

Agency	Rule/Reg No.	Rule Title	Source Categories Impacted
MOJ_APCD	MINERAL	NOX Emissions from Mineral processes	Mineral processes
CARB	ARCH_SCM	Architectural Coatings 2000 Suggested Control Measures (SCM)	Architectural coatings
CARB	AC_SCM2007	Architectural Coatings 2007 SCM	Architectural coatings
CARB	ARB_R003 & ARB_R003_A	Consumer Product Regulations & Amendments	Consumer products
CARB	ARB_R007	Aerosol Coating Regulations	Aerosol coatings
CARB	GDF_HOSREG	Gasoline Dispensing Facility Hose Emission Regulation	Petroleum marketing

Agency	Rule/Reg No.	Rule Title	Source Categories Impacted
CARB	ORVR	Fueling Emissions from ORVR Vehicles	Petroleum marketing
CARB	AG_IC_ENG	Agricultural IC Engine Emission Scalers	Agricultural irrigation internal combustion engines
CARB	NONAGICENG	Non-Agricultural IC Engine Emission Scalers	Non-agricultural internal combustion reciprocating engines

EXTERNAL ADJUSTMENTS

External adjustments were made in CEPAM to account for military growth and other unaccounted regulatory factors. The external adjustments reflected in the CEPAM2022v1.01 West Mojave Desert SIP inventory are listed below in Table 4.

Table 4 - External Adjustment IDs and Descriptions

Adjustment ID	Adjustment Description
HD_I/M	HD I/M Regulation adopted by CARB Dec 2021
NonAg_ICE	Update non-ag internal comb. engines to reflect 2003 ATCM and 2010 rule amend
TRUCK_REGS	Advanced clean trucks Omnibus Low NOx_Opacity ICT_UBUS adjustments

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CHAPTER 3 – Control and Contingency Measures

Existing Control Measures
Reasonably Available Control Technology
Reasonably Available Control Measures
Ozone Reasonable Available Control Measures Assessment – State Sources
CARB Commitment for the Western Mojave Desert
Contingency Measures
Reasonable Further Progress
Conformity Budgets
Transportation Conformity

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Existing Control Measures

The current District rules and regulations represent a broad set of control measures for District sources. The District has in place a New Source Review permitting program with a 25 ton per year major source threshold (for NOx and VOC) and a 1.3:1 offset ratio requirement. The District also experiences significant emissions reductions from the existing CARB mobile source control program (see Appendix F).

Reasonably Available Control Technology

Sections 182(b)(2) and 182(f) of the CAA require that ozone nonattainment areas implement Reasonably Available Control Technology (RACT) for sources that are subject to Control Technique Guidelines and for major sources of ozone precursors (42 U.S.C. §7511a). In 2019, the District performed an analysis of all major sources and applicable triggering requirements, along with the existing District rules and regulations at that time, to determine if additional RACT rulemaking was required.[13] That analysis addressed every existing major source of NOx and VOC as well as every applicable triggering requirement, and included Federal Negative Declarations for those categories which the District did not have a source. That analysis also identified two AVAQMD rules that may require revision to comply with then-current RACT, and committed to amending those rules as seen in Table 5 below

Table 5 - AVAQMD RACT Rule Adoption Schedule

Rule Title	Action	Adoption Date
1113 – Architectural Coatings	Update	Pending
1124 – Aerospace Assembly and Component Manufacturing Operations	Update	pending

Reasonably Available Control Measures

The CAA requires the implementation of all reasonably available control measures (RACM) as expeditiously as practicable and shall provide for attainment of the air quality standards.

USEPA has interpreted RACM to be those emission control measures that are technologically and economically feasible and when considered in aggregate would advance the attainment date by at least one year. Section 172(c)(1) of the CAA requires attainment plans to provide for the implementation of RACM as expeditiously as practicable. Specifically, the air district must consider a wide range of potential additional measures beyond those already being implemented to further control emissions from stationary sources, transportation, and other mobile sources. A potential additional measure is considered "reasonably available" and must be implemented if it would, either alone or in combination with other feasible measures, advance the predicted attainment year by one year (i.e., from 2032 to 2031). In other words, the reasonably available measures would need to reduce emissions to 2032 levels by 2031. Comparison of the 2031 and 2032 grown and controlled emissions inventory (Table 6 below) shows that a minimum of 0.357 tpd of NOx and 0.186 tpd of VOC would be required to advance the attainment date from 2032 to 2031.

[13] "70 ppb Ozone Standard Implementation Evaluation (70 ppb O3 Evaluation): RACT SIP Analysis; Federal Negative Declarations; and Emission Statement Certification," October 28, 2019

Table 6 - Emissions Reductions Required to Advance Attainment by One Year

Emissions in tons per ozone seasonal day from CEPAM2022v1.01	VOC	NOx
2032 Emissions Inventory	32.296	54.976
2031 Emissions Inventory	32.482	55.333
Emissions Reductions Needed in 2031 to Advance Attainment	**0.186**	**0.357**

RACM Criteria

The RACM requirement is rooted in Section 172(c)(1) of the Clean Air Act, which directs states to "provide for implementation of all reasonably available control measures as expeditiously as practicable". In its 1992 General Preamble for implementation of the 1990 Clean Air Act Amendments (57 FR 13498) EPA explains that it interprets Section 172(c)(1) as a requirement that states incorporate in a SIP all reasonably available control measures that would advance a region's attainment date. However, regions are obligated to adopt only those measures that are reasonably available for implementation in light of local circumstances.

In its opinion on Sierra Club v. EPA, decided July 2, 2002, the U.S. Court of Appeals for the DC Circuit upheld EPA's definition of RACM, including the consideration of economic and technological feasibility, potential of the measures to cause substantial widespread and long-term adverse impacts, collective ability of the measures to advance a region's attainment date, and whether an intensive or costly effort will be required to implement the measures. Consistent with EPA guidance and the U.S. District Court's opinion, the District has utilized the following criteria for evaluation of potential RACM measures:

- Will reduce emissions by the beginning of the 2031 ozone season
- Enforceable
- Technologically feasible
- Economically feasible
- Would not create substantial or widespread adverse impacts within the District
- Advance the attainment year by at least one year

An explanation of these criteria is given below.

Implementation Date

USEPA has traditionally instructed regions to evaluate RACM measures based on their ability to advance the region's attainment date. This means that implementation of a measure or a group of measures must enable the region to reduce ozone levels to the 70-ppb required to attain the eight-hour ozone standard at least one year earlier than expected. As the District currently expects to reduce ozone levels to 70 ppb during the 2032 ozone season, any RACM measures or group of RACM measures must enable the Western Mojave Ozone Nonattainment Area (NAA) to meet the 70-ppb standard by the beginning of the 2031 ozone season.

Enforceability

When a control measure is added to a SIP, the measure becomes legally binding, as are any specific performance targets associated with the measure. If the state or local government does not have the authority necessary to implement or enforce a measure, the measure is not creditable in the SIP and therefore cannot be declared a RACM. A measure is considered enforceable when all state or local government agencies responsible for funding, implementation and enforcement of the measure have committed in writing to its implementation and enforcement.

In addition to theoretical enforceability, a measure must also be practically enforceable. If a measure cannot practically be enforced because the sources are unidentifiable or cannot be located, or because it is otherwise impossible to ensure that the sources will implement the control measure, the measure cannot be declared a RACM. One exception is voluntary measures, such as those implemented under EPA's Voluntary Measures Guidance.

Technological Feasibility
All technology-based control measures must include technologies that have been verified by EPA. The region cannot take SIP credit for technologies that do not produce EPA-verified reductions.

Economic Feasibility and Cost Effectiveness
EPA guidance states that regions should consider both economic feasibility and cost of control when evaluating potential RACM measures. The District did not consider any measures deemed economically infeasible.

Substantial and Widespread Adverse Impacts
Some candidate RACM measures have the potential to cause substantial and widespread adverse impacts to a particular social group or sector of the economy. Due to environmental justice concerns, measures that cause substantial or widespread adverse impacts will not be considered RACM.

Advancement of the 70-ppb Ozone Standard
In order for measures to be collectively declared RACM, implementation of the measures must enable the District to demonstrate attainment of the 70-ppb ozone standard one full ozone season earlier than currently expected – calculated above as achieving at least 0.186 tpd of VOC and 0.357 tpd of NOx emissions reductions.

RACM Analysis Methodology

RACM only applies to sources not already addressed as part of a RACT analysis; therefore, the District utilized the most recent 2019 RACT analysis along with the most recent emissions inventory as a starting point to evaluate source categories without adequate existing control measures, and where control measures could be implemented to meet the relevant EPA criteria for RACM (listed above). Additionally, the District utilized a RACM evaluation conducted by USEPA in 2021[14] to identifying measures not yet implemented.

The District also reviewed RACM considered in other Districts, EPA's "Menu of Control Measures", and compared them to the District's emissions inventory and existing rules. Measures that addressed a top (>1%) VOC or NOx emitting category according to the inventory were further evaluated to determine whether the measures could be considered RACM according to the criteria established earlier in this chapter.

Identifying Potential RACM for Stationary Sources

In order to identify potential RACM, the District has relied upon an ongoing control measure evaluation process to adopt all feasible measures as required by State law. Specifically, the District is required to consider, for each emission source category, whether adopting the requirements of the most stringent of the adopted rules in the state would be feasible for local sources and thusly advance attainment by one year. Identifying potential additional control measures for consideration as RACM is challenging in the WMDONA as the District is already required to adopt a combination of all feasible control measures and, under federal law, RACT. The District has implemented all feasible control measures for emissions from stationary sources, and has submitted rules into the SIP as necessary to meet RACT requirements.

[14] EPA-R09-OAR-2020-0254

2021 USEPA RACM Analysis

In 2021, USEPA completed a RACM analysis focused on identifying potential NOx RACM measures by comparing applicable rules for stationary and area sources as part of an evaluation of the 2016 AVAQMD and MDAQMD Attainment Plans.[15] The analysis concentrated on NOx emissions rather than VOC, because the amount of NOx in the air controls the ozone formation (i.e., the WMAB is "NOX-limited"). Rules evaluated in the analysis included AVAQMD Rules 1110.2, 1111, 1121, 1134, 1146, and 1146.1, and MDAQMD Rules 1157, 1159, 1160, and 1161, with rules for the same source categories in other nonattainment areas. The evaluation identified three categories that could achieve additional reductions through implementation of new or increased measures. The results are summarized in Table 7 below.

Table 7 - 2021 RACM Analysis Summary

Rule	Source
Updated AVAQMD Rule 1121 & New MDAQMD Rule	Natural Gas Home Water Heaters and Swimming Pool Heaters
Updated AVAQMD Rule 1146, 1146.1	Boilers (>75,000 BTU-2 MMBTU/hr)
Updated MDAQMD Rule 1157	Boilers and Process heaters (<75,000 BTU-5 MMBTU/hr)

EPA determined that within the portion of the West Mojave Desert regulated by AVAQMD, the rules covering boilers and process heaters, small boilers and process heaters, and water heaters are Rules 1146, 1146.1 and 1121, respectively. These rules are as stringent as other Districts' for sources larger than 2 MMBTU, but do not regulate sources from 75,000 BTU to 2 MMBTU. Additionally, the rule covering water heaters less than 75,000 BTU (Rule 1121) is not as stringent as other districts' (see Attachment A). The MDAQMD rule for boilers is similar in stringency to other districts but does not cover sources smaller than 5 MMBTU. If AVAQMD implemented a rule of similar stringency as other districts for the smallest boilers and process heaters (75,000 BTU – 2 MMBTU) and water heaters, the expected annual emissions reductions would be small, because other districts that have limited the sale of new high emitting units still allow the use of existing units. These existing units continue to be used until replaced. Because water heaters have an expected lifespan of 10 to 15 years,[16] it may take 10 to 15 years to replace all the existing water heaters that would fall under the applicability of a potential new rule. USEPA conservatively estimated that implementation of a revised water heater rule for the AVAQMD and a new water heater rule for the MDAQMD would result in a 75 percent reduction in the overall inventory for these sources. Actual reductions from implementing more stringent rules for water heaters would likely be much lower, since the 10–15 year expected lifespan of the regulated units would suggest a gradual replacement schedule over several years, and the expected potential reductions associated with the revised rules will be modest particularly in the earlier years of implementation.

As previously stated, states must consider all potentially reasonable control measures for source categories in the nonattainment area to determine whether potential RACM would, if implemented individually or collectively, advance the area's attainment date by one year or more. With a conservative method that over-estimated the maximum emissions associated with implementing these additional RACM within the West Mojave Desert, EPA concluded that potential RACM would not exceed the 1.2 tpd in NOx reductions

[15] EPA-R09-OAR-2020-0254

[16] See storage (tanked) water heater in New Infographic and Projects to Keep Your Energy Bills Out of Hot Water, Department of Energy, April 19, 2013, https://www.energy.gov/articles/new-infographic-and-projects-keep-your-energy-bills-out-hot-water

required to theoretically advance the WMD 75 ppb Plan attainment date by one year. The District utilized the results of the USEPA analysis in combination with the District's 2017 RACT SIP Demonstration as a starting point for this RACM evaluation.

The District also conducted its own review of other District's rules. The District's review of other air districts' rules revealed source categories that are subject to more stringent requirements than the current District rules, however those were primarily in Extreme nonattainment areas or were not SIP-approved. Additionally, conservative estimates of reductions associated with implementing additional RACM within the West Mojave Desert NAA fall short of the emission reductions required to advance the attainment date by one year.

Identifying Potential RACM for Transportation Sources

Potential RACM also includes Transportation Control Measures (TCMs), which are strategies to reduce motor vehicle trips, vehicle miles traveled, or vehicle idling and associated pollutants. Given the overwhelming influence of pollutant transport from the SCAB and SJVAB and the minimal benefits generally associated with TCMs, no new TCMs implemented in the West Mojave Desert, alone or in combination with potential additional rules in this analysis, would contribute to advancing the area's attainment date by one year. Therefore, this analysis is focused on evaluating whether controls on stationary and area sources include all RACM necessary to demonstrate attainment as expeditiously as practicable. Both NOx and VOC focused measures were evaluated.

Identifying Potential RACM by Large Source Category

The District has assessed the top non-mobile sources of VOC and NOx in WMAB emissions inventory (Tables 8 and 9 below) and determined their percentage share of the District's total VOC or NOx emissions. The District then focused on source categories that contributed to more than 1% of the total NOx or VOC emission inventories.

Table 8 - Top Five 2032 NOx Non-Mobile Source Categories

Source Category	2018 tposd	2032 tposd	%	MD Rules	AV Rules
Mineral Processes, Other	13.219	13.219	24	1157, 1161	n/a
Mineral Processes, Cement Manufacturing	2.555	2.997	5	1161	n/a
Manufacturing and Industrial, Natural Gas	1.716	1.648	3	1157, 1159, 1160	1134, 1146
Internal Combustion Engines	1.045	1.296	2	1160	1110.2
Residential Water Heating, Natural Gas	0.575	0.560	1	none	1121

<u>NOx Category #1: Mineral Processes</u>

The largest individual stationary sources of NOx in the West Mojave Desert are three cement facilities, the Cemex Black Mountain Quarry Plant in Apple Valley, the Mitsubishi Cement Plant in Lucerne Valley, and the CalPortland Cement Plant in Oro Grande. These facilities are all located in the MDAQMD portion of WMD, and the emissions from each are controlled by Rule 1161. In Table 2, emissions from these facilities are spread across two subcategories, covering, respectively, cement manufacturing and other mineral processes.[17] In 2018, the EPA conditionally approved the District's RACT SIP based on the District's commitment to revise and resubmit several rules, including Rule 1161, for inclusion in the SIP.[18] In response to the conditional approval, MDAQMD adopted a revised Rule 1161 that CARB submitted for incorporation into the California SIP on May 18, 2018. Relative to the previous SIP-approved version of Rule 1161, the revised rule reduced NOx limits to 2.8 pounds of NOx per ton of clinker[19] produced for preheater-precalciner kilns and 3.4 pounds of NOx per ton of clinker produced for Portland cement kilns operating with more than 15 percent heat input from any combination of low carbon fuels.[20] However, the District's staff report indicated that the rule would not result in actual emissions reductions, because the cement kilns in WMD already meet the reduced emission limits.[21] More recently, USEPA proposed to fully approve the revised version of 1161 for inclusion in to the SIP. Because amended Rule 1161 represents RACT and is as stringent as other comparable District rules, there are no RACM available that would enable further emissions reductions in this source category.

<u>NOx Category #2: Manufacturing and Industrial Fuel Combustion (Various)</u>
Manufacturing and industrial operations combust various types of fuel (primarily natural gas) in a variety of ways, including space heating or for use in boilers and burners for specific processes. These operations are combined into this category. This category will comprise 2.99% of the total emissions for NOx in 2032. Within the WMD, both AVAQMD and MDAQMD regulate boilers and process heaters larger than 5 MMBTU, through AVAQMD Rule 1146 and MDAQMD Rule 1157. The EPA approved AVAQMD Rule 1146 as representing a reasonable level of control in our approval of the District's RACT SIP. The EPA determined that MDAQMD Rule 1157 did not represent RACT for these units, and conditionally approved the MDAMQD's RACT SIP based on the District's commitment to revise the rule with more stringent requirements. In response to the EPA's conditional approval, MDAQMD submitted a revised Rule 1157 that would reduce emissions of these larger boilers and process heaters by 57%, from 70 to 30 ppb.[22] Although the rule 1157 does not specifically mention boilers and process heaters from 1–5 MMBTU, natural gas boilers and process heaters equal to or greater than 2 MMBtu/hr are regulated by the District New Source Review (NSR) permit program. NSR is triggered at any minor source which emits, or has the potential to emit 25 pounds per day or more of any nonattainment air pollutant. Boilers and process heaters in this range typically are bought from vendors that either meet SCAQMD standards or are one level above meaning they are not ultra-low emissions but are low emission level performers and would meet Rule 1157 emission standards.

AVAQMD Rule 1146.1 regulates a subset of new and existing boilers and process heaters of this size, but only limits emissions for boilers larger than 2 MMBTU. However, AVAQMD also regulates any minor source which emits, or has the potential to emit 25 pounds per day or more of any nonattainment air pollutant through their NSR program. Further measures such as regulating 1-5 MMBtu boilers would not create enough in reductions to advance attainment, and any additional reductions would occur over several years as old boilers and process heaters reach the end of their operational lifespan.

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[17] A check of CARB's emissions data showed no emissions of NOx from mineral processing in AVAQMD for the most recent year, 2016 (see https://ww3.arb.ca.gov/ei/maps/2017statemap/dismap.htm, accessed on August 20, 2020).
[18] Approval of California Air Plan Revisions, MDAQMD, 83 FR 5921 (February 12, 2018)
[19] Clinker is a nodular material produced in the kilning stage during the production of cement. It is ground to a powder and used as the binder in many cement products.
[20] Based on a 30-day average. Separate limits apply to start-up and shut-down. Additionally, the rule offers an alternative emissions control that includes an aggregate minimum 90% reduction in NOx emissions from all kilns.
[21] Final Staff Report, Amendments to Rule 1161 – *Portland Cement Kilns*, MDAQMD, Amended on January 22, 2018.
[22] Letter dated May 18, 2018, from Richard Corey, CARB, to Alexis Strauss, EPA Region IX

NOx Category #3: Stationary I.C. Reciprocating Engines

Stationary reciprocating internal combustion engines are non-mobile piston engines that run on gaseous or liquid fuels. Though their use varies widely, examples of such engines can be found on compressors or rock crushers, or more typically used for emergency power systems critical to human life (i.e. emergency standby engines). Despite their widespread use, the category will comprise only 2.35 % of the total emissions inventory for NOx in 2032. In the MDAQMD portion of the WMAB, NOx emissions from these engines are regulated by MDAQMD 1160 – *Internal Combustion Engines*.

MD Rule 1160 was last updated in 2018 following a RACT SIP analysis for the 2008 ozone standard. The District concluded that Rule 1160 did not meet current RACT, and acknowledged the need to revise the rule, primarily the limits for oxides of nitrogen (NOx), in order to implement RACT. Based on subsequent commitments from the District and CARB to revise the rule, the EPA finalized a conditional approval of the applicable portion of the RACT SIPs on February 12, 2018 (83 FR 5921). The District adopted amendments to Rule 1160 on January 22, 2018 to implement RACT for this source category by strengthening emission limits, removing several enforceability issues, and clarifying applicability to include smaller engines located within the Non-attainment area (NAA). More specifically, the changes included broadened applicability, reducing the applicability threshold for units subject to the rule from 500 bhp to 50 bhp, reducing NOx emissions limits from 140 ppmv to 125 ppmv for spark-ignited lean burn engines, reducing NOx emissions limits 700 ppmv to 80 ppmv for compression-ignited engines, and a revised compliance schedule requiring newly applicable units to comply with the provision of the rules within 12 months. Because amended Rule 1160 represents RACT and is as stringent as other comparable District rules, there are no RACM available that would enable further emissions reductions in this source category. Finally, the MDAQMD is currently working with EPA to remove the Alternative Emission Reductions section from the rule in favor of source-specific emission limits. The District is also clarifying testing requirements for internal combustion engines in compliance with the rule, without emissions control equipment, including testing requirements and frequency.

In the Antelope Valley portion of the NAA, stationary reciprocating internal combustion engines are regulated by AVAQMD Rule 1110.2 - *Emissions from Stationary, Non-Road and Portable Internal Combustion Engines.* Rule 1110.2 was also amended in 2018 following a RACT SIP analysis for the 2008 ozone standard. Specifically, the AVAQMD updated the rule to reflect RACT by lowering the bhp threshold from 100 bhp to 50 bhp, clarifying several definitions, and removing select exceptions. Because amended Rule 1110.2 represents RACT and is as stringent as other comparable District rules, there are no RACM available that would enable further emissions reductions in this source category.

NOx Category #4: Residential Fuel Combustion – Water Heating

Water heating is source of residential fuel combustion. Cold water is typically brought into a special tank affixed typically with a natural gas burner. As the burner combusts, NOx emissions rise out of the tank through an internal vent and is eventually emitted outside of the home. Despite widespread use, this category will comprise only 1% of the total emissions inventory for NOx in 2032. Review of current SCAQMD Rules 1111 and 1121 has demonstrated that adoption of similar rules would reduce emissions from new installations but would result in insufficient emissions reductions by 2031 to meet the RACM criteria for advancing the attainment date.

Table 9 - Top Five 2032 VOC Non-Mobile Source Categories

Source Category	**2018 tposd**	**2032 tposd**	**%**	**MD Rules**	**AV Rules**
Consumer Products	5.860	7.098	22	n/a	n/a
Petroleum Marketing	4.516	3.342	10	46x (1, 2, 3)	46x (1, 2, 3)
Degreasing, Petroleum Naptha	2.803	2.874	9	442, 1104	1102, 1122, 1171
Livestock Husbandry	2.064	1.784	6	1119	1133
Degreasing, Unspecified	0.499	0.518	2	442, 1104	1102, 1122, 1171

<u>VOC Category #1: Consumer Products</u>

Consumer products are defined as chemically formulated products used by household and institutional consumers. The category will comprise almost 22% of the total emissions inventory for VOC in 2032. For thirty years, CARB has taken actions pertaining to the regulation of consumer products. Three regulations have set VOC limits for over 100 consumer product categories. These regulations have been amended frequently, and progressively stringent VOC limits and reactivity limits have been established. The program's most recent rulemaking occurred in 2020.

<u>VOC Category # 2: Petroleum Marketing Tank Cars and Trucks - Working Losses</u>

Fuel dispensing, storage and distribution has been regulated for decades in California, capturing VOC vapors displaced by the filling of vehicle gasoline tanks at refueling stations (Stage II Vapor Recovery). The advancement of zero-emission vehicle adoption has also contributed to reduced VOC emissions in the source category. The category will comprise 10.34% of the total emissions inventory for VOC in 2032. MDAQMD and AVAQMD Rules 461 - *Gasoline Transfer and Dispensing*, 462 - *Organic Liquid Loading*, and 463 - *Storage of Organic Liquids* regulate this source category in the WMAB. Concurrently, CARB implements statewide Enhanced Vapor Recovery program regulations to implement advanced state-of-the-art vapor control technology on an ongoing basis. Together, the emission control program for the source category is widely considered the most stringent in the nation, leaving no technological or economically feasible opportunity for further emission reductions. Consequently, there are no RACM available that would enable further emissions reductions in this source category.

<u>VOC Category #3: Degreasing</u>

Degreasing operations remove grease and oil from surfaces using various organic solvents. Degreasing operations (combined) will comprise approximately 10% of the total VOC emissions inventory in 2032. In the MDAQMD portion of the WMDONA, VOC emissions form degreasing operations are regulated through SIP approved rule 1104 - *Organic Solvent Degreasing Operations,*[23] which implements RACT level controls for Wipe Cleaning and degreasing operations using Organic Solvents. VOC emissions from degreasing operations in the AVAQMD portion of the NAA are primarily regulated through two SIP-approved rules;1122 – *Solvent Degreasers* and 1171 – *Solvent Cleaning Operations,* which implements RACT level controls for degreasing operations. Further RACM were not considered as this category is regulated by several SIP-approved rules and there is a lack of further available reductions through additional controls.

[23] 84 FR 31682, 7/2/2019

VOC Category #4: Farming Operations – Livestock Husbandry

Farming operations and livestock husbandry comprise approximately 5.52% of the emissions inventory for VOC in 2032. Rule 1119 includes control measures for the livestock categories identified in 17 CCR §86500(a), specifically: Beef Feedlots; Dairies; Other Cattle; Swine; Layers; and, Broiler, Turkey and Duck LCAFs. The large confined animal facility (LCAF) permit application will include an emissions mitigation plan which will list a specified number of VOC mitigation measures chosen from the measures listed in the rule for each emission area on their facility. This "cafeteria plan" provides flexibility to facilities considering that CAF facilities vary from one another and not all controls are feasible for all facilities.

Rule 1119 is applicable to any LCAF pursuant to the requirements of California Health and Safety Code §40724.6. Rule 1119 is primarily based on two SIP approved district rules: Imperial County Air Pollution Control District Rule 217 – Large Confined Animal Facilities (LCAF) Permits Required and San Joaquin Valley Unified Air Pollution Control District Rule 4570 – Confined Animal Facilities.[24] USEPA has indicated in the respective TSDs, that these two rules implement RACT-level controls. Therefore, proposed Rule 1119 should also meet the requirements for a RACT rule. The District has considered the benefits of adopting a similar rule for smaller CAF's which do not meet the LCAF threshold. However, requiring these controls of smaller sources would result in insufficient emissions reductions by 2031 to meet the RACM criteria for advancing the attainment date.

Other Potential RACM Stationary Measures

In addition to the non-mobile source control measures discussed above, the district evaluated several other potential RACM measures.

Residential Wood-Fired Heating

The district evaluated a voluntary wood stove and wood fireplace retrofit/swap program, and a wood combustion restriction program. These types of program is in place elsewhere in the state, but would not generate sufficient emissions reductions by 2031 to meet the RACM criteria for advancing the attainment date, or would generate the reductions outside of the ozone season, as most wood combustion occurs during the cold months.

Weed Abatement Open Burning

The district evaluated a seasonal open burning ban. This would not generate sufficient emissions reductions by 2031 to meet the RACM criteria for advancing the attainment date and would generate the reductions outside the ozone season, as most tumbleweed burning is in the spring, winter and fall.

Restaurant Cooling Operations

The district evaluated the adoption of SCAQMD Rule 1138 for control of emissions from restaurant cooking operations. This rule is already enforced in Antelope Valley through permitting, and would not generate sufficient emissions reductions by 2031 to meet the RACM criteria for advancing the attainment date.

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[24] Imperial County Air Pollution Control District Rule 217 – Large Confined Animal Facilities (LCAF) Permits Required (2/09/2016, 82 FR 26594, June 8, 2017), and San Joaquin Valley Unified Air Pollution Control District Rule 4570 – Confined Animal Facilities (October 21, 2010, 77 FR 2228, January 17, 2012)

Lawn Equipment
The district evaluated controls on lawn equipment. Mojave and Antelope Valley are already implementing a voluntary lawn equipment replacement program subsidizing the purchase of zero emission lawn equipment. Additional emission reductions would not be sufficient by 2031 to meet the RACM criteria for advancing the attainment date.

Increased Enforcement
The district evaluated increasing enforcement on existing sources. Mojave and Antelope Valley have robust existing compliance programs which feature at least annual inspections of every permitted source and aggressive enforcement in response to violations; increased enforcement is not evaluated to result in greater levels of compliance or new emissions reductions.

Fireworks
The district evaluated a ban on the sale and use of fireworks during the summer ozone season. Such a ban would not generate sufficient emissions reductions by 2031 to meet the RACM criteria for advancing the attainment date.

NON-MOBILE RACM SUMMARY AND CONCLUSIONS

The combination of potential additional Reasonably Available Control Measures for stationary sources (Appendix E), if adopted and implemented by 2031, could provide no more than 0.18 tons of VOC and 0.08 NOx reductions per day. This falls short of the 0.186 tons per day of VOC and 0.357 tons per day of NOx reductions that would be needed to advance attainment from 2032 to 2031, as illustrated in Table 6.

In conclusion, the District faces a significant challenge simply to attain the 2015 ozone NAAQS by 2032 with existing measures as planned, let alone one year earlier with consideration of RACM. The predicted ozone level in 2032 can only be achieved through the addition of CARB's non-mobile source control measures and upwind reductions in SSCAQMD and SJVAPCD. Furthermore, by attaining one year earlier than predicted, the District would not achieve the planned stationary and mobile source emission reductions anticipated between 2031 and 2032 included in emission inventories and modeling. This would effectively increase the amount of reductions necessary for RACM, above what is represented in Table 1. For example, mobile source NOx emissions are predicted to be higher in 2031 than 2032. The same can be said for CARB's commitment of 20.6 tpd of NOx per day by the predicted attainment year of 2032. It is likely that CARB's commitment would achieve less in 2031 with one less year of implementation. The "loss" of anticipated NOx reductions between 2031 and 2032 would require equal reductions from other RACM measures. Even with consideration of all potential RACM identified, there would not be sufficient NOx reductions to make up this gap. Consequently, it is clear that advancing attainment by one year is not practical nor feasible.

Therefore, none of the potential additional control measures are considered reasonably available and do not require adoption for the purposes of this 2015 ozone NAAQS RACM analysis and corresponding Attainment Plan. As stated above, the MDAB is downwind of the Los Angeles basin and San Joaquin Valley, and as a result is heavily influenced by the transport of ozone precursors from these regions. Additionally, photochemical ozone modeling conducted by the SCAQMD and CARB indicates that the Mojave Desert Air Basin (MDAB) would be in attainment without the influence of this transported air pollution from upwind regions. The WMDONA is dependent upon upwind reductions – reductions within the WMDONA will not expedite attainment due to the transport of ozone and ozone precursors from upwind areas. The current district permitting program and existing measures included in the State SIP

Strategy provide attainment of the ozone standard as expeditiously as practicable and meet RACM requirements.

Ozone Reasonable Available Control Measures Assessment – State Sources

The Clean Air Act (Act) requires the implementation of all reasonably available control measures (RACM) as expeditiously as practicable and shall provide for attainment of the air quality standards. This section demonstrates that for the 70 ppb 8-hour ozone standard, California's mobile source and consumer products measures meet the RACM requirement in the Western Mojave Desert nonattainment area.

RACM Requirements

U.S. EPA has interpreted RACM to be those emission control measures that are technologically and economically feasible and when considered in aggregate, would advance the attainment date by at least one year. Section 172(c)(1) of the Act requires SIPs to provide for the implementation of RACM as expeditiously as practicable. Given the severity of California's air quality challenges, CARB has implemented the most stringent mobile source emissions control program in the nation. CARB's comprehensive strategy to reduce emissions from mobile sources includes stringent emissions standards for new vehicles, in-use programs to reduce emissions from existing vehicle and equipment fleets, cleaner fuels that minimize emissions, and incentive programs to accelerate the penetration of the cleanest vehicles beyond that achieved by regulations alone. Taken together, California's mobile source program meets RACM requirements in the context of ozone nonattainment.

To ensure the State continues to meet RACM requirements and achieve its emissions reductions goals in the future, California continues to develop new programs and regulations to strengthen its overall mobile source program and to achieve new emissions reductions from mobile sources.

RACM For Mobile Sources

Waiver and Authorizations

While section 209 of the Act preempts other states from adopting emission standards and other emission-related requirements for new motor vehicles and engines that differ from the federal standards set by U.S. EPA, the Act provides California with the ability to seek a waiver or authorization from the federal preemption clause in order to enact emission standards and other emission-related requirements for new motor vehicles and engines, as well as new and in-use off-road vehicles and engines[25] – provided that the California standards are at least as protective as applicable federal standards.

Over the years, California has received waivers and authorizations for over 100 regulations. The most recent California standards and regulations that have received waivers and authorizations are: the Advanced Clean Cars (ACC) regulations for light-duty vehicles (including the Zero-Emission Vehicle (ZEV) and the Low-Emission Vehicle III (LEV III) regulations); the On-Board Diagnostics (OBD) regulation; the Heavy-Duty Idling, Malfunction and Diagnostics System Regulation; the In-Use Off-Road Diesel Fleets Regulation; the Large Spark Ignition (LSI) Fleet Regulation; and the Mobile Cargo Handling Equipment (CHE) regulation. Further, CARB has recently submitted waiver requests for: the Advanced Clean Transit (ACT) regulation; the Zero-Emission Airport Shuttle Buses Regulation; the Zero-Emission Powertrain Certification

[25] Locomotives and engines less than 175 horsepower (hp) used in farm and construction equipment are exempt from California's waiver authority.

Regulation, and the Heavy-Duty Omnibus Regulation. Other authorizations include the Off-Highway Recreational Vehicles and the Portable Equipment Registration Program (PERP).
Additionally, CARB obtained an authorization from U.S.EPA to enforce adopted emission standards for off-road engines used in yard trucks and two-engine sweepers. CARB adopted the off-road emission standards as part of its "Regulation to Reduce Emissions of Diesel Particulate Matter, Oxides of Nitrogen and Other Criteria Pollutants from In-Use Heavy-Duty Diesel-Fueled Vehicles," (Truck and Bus Regulation). The bulk of the regulation applies to in-use heavy-duty diesel on-road motor vehicles with a gross vehicle weight rating in excess of 14,000 pounds, which are not subject to preemption under section 209(a) of the Act and do not require a waiver under section 209(b).

The waiver and authorizations California has received are integral to the success and stringent emission requirements that characterize CARB's mobile source program. Due to California's unique waiver authority under the Act, no other state or nonattainment area has the authority to promulgate mobile source emission standards at levels that are more stringent than the federal standards. Other states can elect to match either the federal standards or the more stringent California standards. As such, no state or nonattainment area has a more stringent suite of mobile source emission control programs than California, implying a de-facto level of control that at least meets, if not exceeds, RACM.

CARB's Mobile Source Controls
CARB's current mobile source control program, along with efforts at the local and federal level, have been tremendously successful in reducing emissions of air pollutants, resulting in significantly cleaner vehicles and equipment in operation today.

CARB developed its 2022 State Strategy for the State Implementation Plan (2022 State SIP Strategy)[26] through a multi-step measure development process, including extensive public consultation, to develop and evaluate potential strategies for mobile source categories under CARB's regulatory authority that could contribute to expeditious attainment of the 70 ppb 8-hour ozone standard, as well as supporting attainment for other national and State air quality standards. This effort builds on the measures and commitments already made in the 2016 State SIP Strategy, and expands on the scenarios and concepts included in the 2020 Mobile Source Strategy, CARB's multi-pollutant planning effort that identifies the pathways forward to achieve the State's many air quality, climate, and community risk reduction goals. The Board adopted the 2022 State SIP Strategy in September 2022.

With the 2022 State SIP Strategy, CARB is pursuing an unprecedented variety of new measures to reduce emissions from the sources under our authority using all mechanisms available. The measures included in the 2022 State SIP Strategy encompass actions to establish requirements for cleaner technologies (both zero-emissions and near zero-emissions), deploy these technologies into the fleet, and to accelerate the deployment of cleaner technologies through incentives.

Light- and Medium-Duty Vehicles
Since setting the nation's first motor vehicle exhaust emission standards in 1966 that led to the first pollution controls, California has dramatically tightened emission standards for light-duty vehicles. Through CARB regulations, today's new cars pollute 99 percent less than their predecessors did thirty years ago. In 1970, CARB required auto manufacturers to meet the first standards to control NOx emissions along with hydrocarbon emissions, which together form smog. The simultaneous control of emissions from motor

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[26] CARB 2022 State Strategy for the State Implementation Plan (2022 State SIP Strategy) https://ww2.arb.ca.gov/resources/documents/2022-state-strategy-state-implementation-plan-2022-state-sip-strategy

vehicles and fuels led to the use of cleaner-burning gasoline that has removed the emissions equivalent of 3.5 million vehicles from California's roads.

Light- and medium-duty vehicles are currently regulated under California's ACC program, which includes the LEV III and ZEV programs. The ACC program combines the control of smog, soot-causing pollutants, and greenhouse gas emissions into a single coordinated package of requirements for model years 2015 through 2025. Since first adopted in 1990, CARB's LEV I and LEV II, and the ZEV Programs have resulted in the production and sales of hundreds of thousands of ZEVs in California. Advanced Clean Cars II(ACC II), a measure in the 2016 State SIP Strategy, is a significant effort critical to meeting air quality standards. ACC II, which was recently adopted by the CARB Board in August 2022, has the goal of cutting emissions from new combustion vehicles while taking all new vehicle sales to 100 percent zero-emission no later than 2035.

For passenger vehicles, the 2022 State SIP Strategy includes actions to increase the penetration of ZEVs by targeting ride-hailing services offered by transportation network companies through the Clean Miles Standard regulation in order to reduce GHG and criteria pollutant emissions, and promote electrification of the fleet. For motorcycles, the 2022 State SIP Strategy proposes more stringent exhaust and evaporative emissions standards along with zero-emissions sales thresholds. The primary goal of the On-Road Motorcycle New Emissions Standard measure is to reduce emissions from new, on-road motorcycles by adopting more stringent exhaust and evaporative emissions standards along with zero-emissions sales thresholds.

CARB is also active in implementing in-use programs for owners of older dirtier vehicles to retire them early. The "car scrap" programs, like Clean Cars 4 All and Clean Vehicle Rebate Project provide monetary incentives to replace old vehicles with zero-emission vehicles. Other California programs and goals such as the 2012 Governor's Executive Order to put 1.5 million zero-emission vehicles on the road by 2025 and will produce substantial and cost-effective emission reductions from the light-duty vehicle sector.

Taken together, California's emission standards, fuel specifications, and incentive programs for on-road light- and medium-duty vehicles represent all measures that are technologically and economically feasible within California. There are no additional measures that, when considered in aggregate, would advance the attainment date by at least one year.

Heavy-Duty Vehicles

California's heavy-duty vehicle emissions control program includes requirements for increasingly stringent new engine emission standards and addresses vehicle idling, certification procedures, on-board diagnostics, emissions control device verification, and in-use measures to ensure that emissions from the existing vehicle fleet remain adequately controlled. Taken together, the on-road heavy-duty vehicle program is designed to achieve an on-road heavy-duty diesel fleet with 2010 engines emitting 98 percent less NOx and PM2.5 than trucks sold in 1986.

Other significant in-use control measures CARB has in place include: the On-Road Heavy-Duty Diesel Vehicle (In-Use) Regulation; the Drayage (Port or Rail Yard) Regulation; the Public Agency and Utilities Regulation; the Solid Waste Collection Vehicle Regulation; the Heavy-Duty (Tractor-Trailer) Greenhouse Gas (GHG) Regulation, the Airborne Toxic Control Measures (ATCM) to Limit Diesel-Fueled Commercial Motor Vehicle Idling; the Heavy-Duty Diesel Vehicle Inspection Program; the Periodic Smoke Inspection Program (PSIP); the, Fleet Rule for Transit Agencies; the Lower-Emission School Bus Program; and Heavy-Duty Truck Idling Requirements.

In 2013, California recognized the heavy-duty engines could be cleaner and established optional low-NOx standards for heavy-duty diesel engines (Optional Reduced Emissions Standards for Heavy-Duty Engines regulation), with the most aggressive standard being 0.02 g/bhp-hr, 90 percent below the 2010 federal standard. Further, in 2021, CARB adopted the Heavy-Duty Engine and Vehicle Omnibus Regulation (Omnibus Regulation) which made the 0.02 g/bhp-hr a mandatory standard, and comprehensively overhauled how NOx emissions from new heavy-duty engines are regulated in California. The Omnibus Regulation also includes in-use standards that significantly reduce tailpipe NOx emissions during most vehicle operating modes, and revisions to the emissions warranty, useful life, emissions warranty and reporting information and corrective action procedures, and durability demonstration procedures.
To further control emissions from the in-use fleet, CARB adopted in 2021 the Heavy-Duty Inspection and Maintenance Regulation, which requires periodic demonstration that vehicles' emissions control systems are properly functioning in order to legally operate within the State. This regulation is designed to achieve criteria emissions reductions by ensuring that malfunctioning emissions control systems are timely repaired.

In June 2020, CARB adopted the ACT regulation, a first of its kind regulation requiring medium- and heavy-duty manufacturers to produce ZEVs as an increasing portion of their sales beginning in 2024. This regulation is expected to result in roughly 100,000 ZEVs by 2030 and nearly 300,000 ZEVs by 2035. Most recently in the ongoing efforts to go beyond federal standards and achieve further reductions, the 2022 State SIP Strategy includes the complementary Advanced Clean Fleets measure. Through this program, CARB is developing a medium and heavy-duty zero-emission fleet regulation with the goal of achieving a zero-emission truck and bus California fleet by 2045 everywhere feasible, and significantly earlier for certain market segments such as last mile delivery and drayage applications.

The 2022 State SIP Strategy also includes the Zero-Emissions Trucks Measure, which would accelerate the number of zero-emission heavy-duty vehicles beyond existing measures, and the Advanced Clean Fleets regulation. The Zero-Emissions Trucks Measure was developed in response to comments from the public related to turning over heavy-duty trucks at the end of their useful life. The Zero-Emissions Trucks Measure targets the replacement of older trucks in order to increase the number of heavy-duty ZEVs as soon as possible and reduces emissions from fleets not affected by the Advanced Clean Fleets measure. CARB is exploring new methods to replace older trucks, including market signal tools, that would not unduly burden low-income truckers, provide flexibility, and target reductions in the areas that need it most.

In addition, CARB's significant investment in incentive programs provides an additional mechanism to achieve maximum emission reductions from this source sector. California has a variety of programs to incentivize clean heavy-duty vehicles that include the Carl Moyer Air Quality Standards Attainment Program, the Hybrid and Zero-Emission Truck and Bus Voucher Incentive Project, the Truck Loan Program, and AB 617 Community Air Protection Funds.

Taken together, California's emission standards, fuel specifications, and incentive programs for on-road heavy-duty vehicles represent all measures that are technologically and economically feasible within California. There are no additional measures that, when considered in aggregate, would advance the attainment date by at least one year.

Off-Road Vehicles and Engines

California regulations for off-road equipment include not only increasingly stringent emission standards for new off-road diesel engines, but also in-use requirements and idling restrictions. CARB has programs in place to control emissions from various new off-road vehicles and equipment. CARB also has in-use

programs for off-road vehicles and equipment, including the In-Use Off-Road Diesel Fueled Fleets Regulation (Off-Road Regulation) and Large Spark-Ignition Engine Fleet Requirements Regulation, as well as incentive programs including the Clean Off-Road Equipment (CORE) Voucher Incentive Project. CARB adopted amendments to the small off-road engine regulations in December 2021, the Transport Refrigeration Unit Part 1 regulatory action in February 2022, and will be proposing the Zero-Emission Off-Road Forklift regulation in the next year.
The Off-Road Regulation, adopted in 2010, is an extensive program designed to accelerate the penetration of the cleanest equipment into California's fleets, and impose idling limits on off-road diesel vehicles. The program goes beyond emission standards for new engines through comprehensive in-use requirements for legacy fleets. CARB is also including in the 2022 State SIP Strategy a measure for amendments to the existing Off-Road Regulation. These amendments would create additional requirements to the currently regulated fleets by targeting the oldest and dirtiest equipment that is allowed to operate indefinitely under the current regulation's structure, potentially through an operational ban on the oldest and dirtiest equipment and limitations on vehicles added to a fleet.

The LSI Engine Fleet Requirements Regulation applies to operators of forklifts, sweeper/scrubbers, industrial tow tractors, and airport ground support equipment (GSE). The 2006 LSI rulemaking and 2010 amendments required operators of in-use fleets to achieve specific hydrocarbon + NOx fleet average emission level standards that became more stringent over time. CARB adopted amendments to the small off-road engine (SORE) regulations in December 2021 that will accelerate the transition of SORE equipment to Zero-Emission Equipment (ZEE). Deployment of ZEE is key to meeting the expected emission reductions in the 2016 State SIP Strategy.

As discussed in the 2016 State SIP Strategy, CARB is also developing new requirements to transition diesel-powered transport refrigeration units (TRUs) to zero-emission technology in two phases. CARB adopted the Part 1 amendments to the existing TRU ATCM in February 2022, which requires the transition of diesel-powered truck TRUs to zero-emission. As discussed in the 2022 State SIP Strategy, CARB plans to develop a subsequent Part 2 regulation to require zero-emission trailer TRUs, domestic shipping container TRUs, railcar TRUs, and TRU generator sets, for future Board consideration.

Additionally, the 2022 State SIP Strategy includes the Tier 5 Off-Road New Compression-Ignition Engine Standards measure to reduce NOx and PM emissions from new, off-road compression-ignition engines by adopting more stringent exhaust standards for all power categories. Compression-ignition engines are used in a wide range of off-road equipment including tractors, excavators, bulldozers, graders, and backhoes. The standards considered for this measure would be more stringent than required by current U.S. EPA and European Stage V nonroad regulations and would require the use of best available control technologies for both PM and NOx.

CARB is also developing a measure, as described in the 2022 State SIP Strategy, to accelerate the development and production of zero-emission off-road equipment and powertrains through the Off-Road Zero-Emission Targeted Manufacturer Rule. Existing zero-emission regulations and regulations currently under development target a variety of sectors (e.g., forklifts, cargo handling equipment, off-road fleets, small off-road engines, etc.) however, as technology advancements occur, more sectors, including wheel loaders, excavators, and bulldozers could be accelerated through this measure.

Further, CARB implements a number of incentive programs and projects to advance the turnover of off-road equipment to cleaner technologies. The Moyer Program has provided funding towards on- and off-road equipment for decades. The Clean Off-Road Equipment Voucher Incentive Project (CORE) is a newer project that is intended to accelerate deployment of advanced technology in the off-road sector and targets commercial-ready products that have not yet achieved a significant market foothold. For engines and equipment used in agricultural processes, CARB has the Funding Agricultural Replacement Measures for Emission Reductions (FARMER) program to support fleet turnover to cleaner engines.

Taken together, California's comprehensive suite of emission standards, fuel specifications, and incentive programs for off-road vehicles and engines represent all measures that are technologically and economically feasible within California. There are no additional measures, that, when considered in aggregate, would advance the attainment date by at least one year.

Fuels

As mentioned earlier, cleaner burning fuels also play an important role in reducing emissions from motor vehicles and engines in these source categories. CARB has adopted standards to ensure that the fuels sold in California are the cleanest in the nation. These programs include the California Reformulated Gasoline program (CaRFG), which controls emissions from gasoline, and the Ultra-Low Sulfur Diesel requirements (2006), which provide the nation's cleanest diesel fuel specifications and help to ensure that diesel fuels burn as cleanly as possible and work synergistically with cleaner-operating heavy-duty trucks equipped with advanced emission control systems that debuted in 2007, and the Low Carbon Fuel Standard. These fuel standards, in combination with engine technology requirements, ensure that California's transportation system achieves the most effective emission reductions possible.

Taken together, California's emission standards, fuel specifications, and incentive programs for other mobile sources and fuels represent all measures that are technologically and economically feasible within California. There are no additional measures that, when considered in aggregate, would advance the attainment date by at least one year.

Mobile Source Summary

California's long history of comprehensive and innovative emissions control has resulted in the most stringent mobile source control program in the nation. U.S. EPA has previously acknowledged the strength of the program through the waiver process, and in their approvals of CARB's regulations and District plans. In its 2021 approval of the West Mojave Desert 2016 Attainment Plan for the 75 ppb 8-hour ozone standard, which included the State's current control program and new measure commitments from the 2016 State SIP Strategy, U.S. EPA found that,

> "CARB and the Districts provide for the implementation of RACM for mobile sources of NO_X and VOC; there are no additional RACM that would advance attainment of the 2008 ozone NAAQS in the West Mojave Desert… therefore, the 2016 WMD Attainment Plan provides for the implementation of all RACM as required by [the] CAA."[27]

In addition to declarations that the mobile source control program meets RACM requirements, U.S. EPA has also provided past determinations that CARB's mobile source control programs meet the more rigorous Best Available Control Measure (BACM) requirements. As BACM requirements are considered a more

[27] 86 FR 53223 https://www.federalregister.gov/documents/2021/09/27/2021-20618/clean-air-plans-2008-8-hour-ozone-nonattainment-area-requirements-west-mojave-desert-california

stringent threshold to meet than RACM, U.S. EPA has stated that a determination that the control program has meet BACM requirements also constitutes a conclusion that it meets RACM requirements.[28] U.S. EPA has acknowledged CARB's mobile source control program as meeting BACM in their 2020 approval of the San Joaquin Valley's PM2.5 Serious Area Plan,[29] and in their 2019 approval of the South Coast's PM2.5 Serious Area Plan.[30] In their 2018 proposal for that approval, U.S. EPA noted that,

> "With respect to mobile sources, we recognize that CARB's current program addresses the full range of mobile sources in the South Coast through regulatory programs for both new and in-use vehicles… Overall, we believe that the program developed and administered by CARB and SCAG provide for the implementation of BACM for PM2.5 and PM2.5 precursors in the South Coast nonattainment area."[31]

In in their 2020 approval of the San Joaquin Valley's PM2.5 Serious Area 2018 Plan, [32] U.S. EPA further found that CARB's mobile source control program met the more stringent level of Most Stringent Measures (MSM). In their 2020 proposal for that plan, U.S. EPA found that,

> "CARB's programs constitute the most stringent emission control programs currently available for the mobile source and fuels categories, taking into account economic and technological feasibility."[33]

CARB has continued to substantially enhance and accelerate reductions from our mobile source control programs through the implementation of more stringent engine emissions standards, in-use requirements, incentive funding, and other policies and initiatives as described in the preceding sections. The CARB process for developing CARB's control measures includes an extensive public process and is consistent with U.S. EPA RACM guidance. Through this process, CARB found that with the current mobile source control program and new measures included in the 2022 State SIP Strategy, there are no additional reasonable available control measures that would advance attainment of the 70 ppb 8-hour ozone standard in the Western Mojave Desert nonattainment area. There are no reasonable regulatory control measures excluded from use in this plan; therefore, there are no emissions reductions associated with unused regulatory control measures. As a result, California's mobile source control programs fully meet the requirements for RACM.

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[28] "We interpret the BACM requirement as generally subsuming the RACM requirement (i.e., if we determine that the measures are indeed the ''best available,'' we have necessarily concluded that they are ''reasonably available''). Consequently, our proposed approval of the… provisions relating to the implementation of BACM also constitutes a proposed finding that the Plan provides for the implementation of RACM."
69 FR 5411 https://www.federalregister.gov/documents/2004/02/04/04-2264/approval-and-promulgation-of-implementation-plans-for-california-san-joaquin-valley-pm-10

[29] 85 FR 44192 https://www.federalregister.gov/documents/2020/07/22/2020-14471/clean-air-plans-2006-fine-particulate-matter-nonattainment-area-requirements-san-joaquin-valley

[30] 84 FR 3305 https://www.federalregister.gov/documents/2019/02/12/2019-01922/approval-and-promulgation-of-implementation-plans-california-south-coast-serious-area-plan-for-the

[31] 83 FR 49872 https://www.federalregister.gov/documents/2018/10/03/2018-21560/approval-and-promulgation-of-implementation-plans-california-south-coast-serious-area-plan-for-the

[32] 85 FR 44192 https://www.federalregister.gov/documents/2020/07/22/2020-14471/clean-air-plans-2006-fine-particulate-matter-nonattainment-area-requirements-san-joaquin-valley

[33] 85 FR 17382 https://www.federalregister.gov/documents/2020/03/27/2020-05914/clean-air-plans-2006-fine-particulate-matter-nonattainment-area-requirements-san-joaquin-valley

RACM for Consumer Products

Consumer products are defined as chemically formulated products used by household and institutional consumers. For thirty years, CARB has taken actions pertaining to the regulation of consumer products. Three regulations have set VOC limits for 129 consumer product categories. These regulations, referred to as the Consumer Product Program, have been amended frequently, and progressively stringent VOC limits and reactivity limits have been established. These are Regulation for Reducing VOC Emissions from Antiperspirants and Deodorants; Regulation for Reducing Emissions from Consumer Products; and Regulation for Reducing the Ozone Formed from Aerosol Coating Product Emissions, and the Tables of Maximum Incremental Reactivity Values. Additionally, a voluntary regulation, the Alternative Control Plan has been adopted to provide compliance flexibility to companies. The program's most recent rulemaking occurred in 2021 with amendments to Consumer Products Regulation and Method 310.

U.S. EPA also regulates consumer products. U.S. EPA's consumer products regulation was promulgated in 1998, however, federal consumer products VOC limits have not been revised since their adoption. U.S. EPA also promulgated reactivity limits for aerosol coatings. As with the general consumer products, California's requirements for aerosol coatings are more stringent than the U.S. EPA's requirements. Other jurisdictions, such as the Ozone Transport Commission states, have established VOC limits for consumer products which are modeled after the California program. However, the VOC limits typically lag those applicable in California.

In summary, California's Consumer Products Program, with the most stringent VOC requirements applicable to consumer products, meets RACM. There are no additional measures that, when considered in aggregate, would advance the attainment date by at least one year.

Proposed Control Measures

The District has not identified any feasible additional control measures for direct ozone precursor reduction purposes as a result of RACT or RACM analysis. However, the District is committing to adopting a new natural gas-fired residential water heater rule as a result of the RFP analysis below. This measure is expected to generate a maximum of 0.06 tpd of NOx reductions by 2032. In addition, the District will experience additional future emission reductions resulting from existing and proposed Federal and State control measures affecting mobile and area sources as discussed below.

CARB Commitment for the Western Mojave Desert

SIPs may contain enforceable commitments to achieve the level of emissions necessary to meet federal air quality standards, as defined by the attainment demonstration. The 2022 State SIP Strategy lists new SIP measures and quantifies potential emissions reduction SIP commitments for the Western Mojave Desert 8-hour ozone nonattainment area based on the measures identified and quantified to date. CARB adopted the 2022 State SIP Strategy measure commitment and schedule on September 22, 2022 that formed the basis of the commitments for emission reductions by the attainment deadlines for each region. CARB committed to adopt the emission reduction commitments alongside the respective nonattainment area's SIP. The commitments will consist of two components:

1. A commitment to bring an item to the CARB Board for defined new measures or take other specified actions within CARB's authority; and
2. A commitment to achieve aggregate emission reductions by specific dates.

As part of each SIP needing emission reductions from the State, the total aggregate emission reductions and the obligation to make certain proposals to the CARB Board or take other actions within CARB's authority specified in the 2022 State SIP Strategy would become enforceable upon approval by U.S. EPA. While the 2022 State SIP Strategy discusses a range of measures and actions, those measures and actions would still be subject to CARB's formal approval process and would not be final until the CARB Board takes action.

Commitment to Act on Measures

For each of the SIP measures shown in Tables 10 and 11, CARB commits to address each measure as described in this document. For each measure committed to, CARB staff would undertake the actions detailed for each measure. In the instance of measures that involve the development of a rule under CARB's regulatory authority, CARB would commit to bring a publicly noticed item before the CARB Board that is either a proposed rule, or is a recommendation that the CARB Board direct staff to not pursue a rule covering that subject matter at that time. This recommendation would be based on an explanation of why such a rule is unlikely to achieve the relevant emission reductions in the relevant timeframe, and would include a demonstration that the overall aggregate commitment will be achieved despite that rule not being pursued. This public process and CARB hearing would provide additional opportunity for public and stakeholder input, as well as ongoing technology review, and assessments of costs and environmental impacts.

The measures, as proposed by staff to the CARB Board or adopted by the CARB Board, may provide more or less than the initial emission reduction estimates. In addition, action by the CARB Board may include any action within its discretion.

Commitment to Achieve Emission Reductions

The following section describes the estimated emission reduction and potential commitment from the SIP measures identified and quantified to date for the Western Mojave Desert. The aggregate commitment of emissions reductions from State sources to be proposed for CARB Board consideration will be found in CARB's staff report for the Western Mojave Desert 70 ppb 8-hour ozone SIP when it is brought to the CARB Board.

While the 2022 State SIP Strategy includes estimates of the emission reductions from each of the individual new measures, CARB's overall commitment is to achieve the total emission reductions necessary from State-regulated sources to attain the federal air quality standards, reflecting the combined reductions from the existing control strategy and new measures. Therefore, if a particular measure does not get its expected emission reductions, the State's overall commitment to achieving the total aggregate emission reductions still exists. If actual emission decreases occur that exceed the projections reflected in the current emission inventory and the 2022 State SIP Strategy, CARB will submit an updated emissions inventory to U.S. EPA as part of a SIP revision. The SIP revision would outline the changes that have occurred and provide appropriate tracking to demonstrate that aggregate emission reductions sufficient for attainment are being achieved through enforceable emission reduction measures. CARB's emission reduction commitments may be achieved through a combination of actions including but not limited to the implementation of control measures; the expenditure of local, State or federal incentive funds; or through other enforceable measures.

Table 10 - Measures and Schedule

Measure	Agency	Action	Implementation Begins
On-Road Heavy-Duty			
Advanced Clean Fleets Regulation	CARB	2023	2024
Zero-Emissions Trucks Measure	CARB	2028	2030
On-Road Light-Duty			
On-Road Motorcycle New Emissions Standards	CARB	2022	2025
Clean Miles Standard	CARB	2021	2023
Off-Road Equipment			
Tier 5 Off-Road Vehicles and Equipment	CARB	2025	2029
Amendments to the In-Use Off-Road Diesel-Fueled Fleets Regulation	CARB	2022	2024
Transport Refrigeration Unit Regulation Part 2	CARB	2026	2028
Cargo Handling Equipment Amendments	CARB	2025	2026
Off-Road Zero-Emission Targeted Manufacturer Rule	CARB	2027	2031
Clean Off-Road Fleet Recognition Program	CARB	2025	2027
Spark-Ignition Marine Engine Standards	CARB	2029	2031
Other			
Consumer Products Standards	CARB	2027	2028
Zero-Emission Standard for Space and Water Heaters	CARB	2025	2030
Enhanced Regional Emission Analysis in State Implementation Plans[34]	CARB	2025	2023
Primarily-Federally and Internationally Regulated Sources – CARB Measures			
In-Use Locomotive Regulation	CARB	2023	2024
Future Measures for Aviation Emissions reductions	CARB	2027	2029

[34] Proposed CARB finalization

Table 11 - Measures and Schedule

Measures	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037
Advanced Clean Fleets			★	■													
Zero-Emissions Trucks Measure								★		■							
On-Road Motorcycle New Emissions Standards		★			■												
Clean Miles Standard	★		■														
Tier 5 Off-Road Vehicles and Equipment					★				■								
Amendments to the In-Use Off-Road Diesel Fueled Fleets		★		■													
Transport Refrigeration Unit Regulation Part 2						★		■									
Cargo Handling Equipment Amendments					★	■											
Off-Road Zero-Emission Targeted Manufacturer Rule							★				■						
Clean Off-Road Fleet Recognition Program					★		■										
Spark-Ignition Marine Engine Standards									★		■						
Consumer Products Standards							★	■									
Zero-Emission Standard for Space and Water Heaters					★					■							
Enhanced Regional Emission Analysis in SIPs			■														
In-Use Locomotive Regulation			★	■													
Future Measures for Aviation Emission Reductions							★		■								

* Yellow star represents the year for which action is proposed; dark blue represents the year implementation begins.

Statewide Emissions Reductions

The measures in the 2022 State SIP Strategy will provide emission reduction benefits throughout the State. Some of these benefits will come from current programs while the remainder of the benefits will come from new measures. Although the existing control program will provide mobile source emission reductions necessary to meet the attainment needs of many areas of the State, the new measures in the 2022 State SIP Strategy will provide further reductions to enhance air quality progress and achieve the 70 ppb 8-hour ozone standard.

Emission Reductions from Current Programs

Table 12 provides the remaining mobile source emissions under CARB and district current programs for the State and the Western Mojave Desert. Ongoing implementation of current control programs is projected to reduce mobile source NOx emissions from 2018 levels by 462 tpd Statewide, and 12 tpd in the Western Mojave Desert, in 2032. Achieving the benefits projected from the current control program will continue to require significant efforts for implementation and enforcement and thus represents an important element of the overall strategy.

Table 12 - Mobile Source Emissions under CARB and District Current Control Programs

Mobile Sources	NOx (tpd)			ROG (tpd)		
	2018	2032	Change	2018	2032	Change
Statewide[35]	1156.7	695.0	-40%	638.4	369.9	-42%
Western Mojave Desert[36]	45.5	33.8	-28%	13.5	8.3	-39%

Although most of the 2016 State SIP Strategy measure commitments have been adopted, there is one (Zero-Emission Forklift) that the CARB Board will be acting upon over the next year, and two that were recently adopted but are not yet accounted for in the baseline emissions inventory (Advanced Clean Cars II, Transport Refrigeration Unit Part 1). Table 13 below shows the timeline and anticipated emission reductions for these three measures.

[35] Source: 2022 CEPAM v1.01; represents the current baseline emissions out to 100 nautical miles with adopted CARB and district measures

[36] Source: 2022 CEPAM v1.01; represents the current baseline emissions with adopted CARB and district measures

Table 13 - Reductions from Remaining 2016 State SIP Strategy Measures[37]

Measure	Action	Implementation Begins	Statewide 2037 NOx (tpd)	Statewide 2037 ROG (tpd)	Western Mojave Desert 2032 NOx (tpd)	Western Mojave Desert 2032 ROG (tpd)
Advanced Clean Cars II	2022	2026	13.5	10.8	0.2	0.1
Transport Refrigeration Unit Part I	2022	2023-2024	1.3	1.0	<0.1	<0.1
Zero-Emission Forklift	2023	2026	1.7	0.3	<0.1	<0.1
Total			**16.5**	**12.0**	**0.2**	**0.1**

Emission Reductions from New Measures

The new measures contained in the 2022 State SIP Strategy commitment reflect a combination of State actions, and petitions and advocacy for federal and/or international action.

Statewide emissions reductions from the new measures identified and quantified to date in the 2022 State SIP Strategy are estimated to be 205.6 tpd of NOx and 40.9 tpd of ROG in 2037.

[37] Numbers may not add up due to rounding.

Western Mojave Desert

Air quality modeling indicates that NOx emissions reductions are needed in the South Coast Air Basin and within the Western Mojave Desert by 2032 in order to provide for attainment. A significant fraction of the needed reductions will come from the existing control program. In addition, as described above, a few measure commitments included in the 2016 State SIP Strategy have not yet been acted upon or were very recently adopted and are thus not yet in the baseline emissions inventory, as outlined in Table 4 above. Action will be taken on the remaining measures in the coming year.

Table 14 shows that collectively, emissions reductions from CARB's current control program, reductions from the remaining 2016 State SIP Strategy measures, and emissions reductions from the measures in the 2022 State SIP Strategy provide the emissions reductions needed from State sources to support attainment of the 70 ppb 8-hour ozone standard in the Western Mojave Desert. The measures in Table 15 reflect CARB commitments for State actions and the expected emissions reductions for the Western Mojave Desert. That said, the SIP is still under development and the emissions reductions may change as the attainment demonstration is finalized. The aggregate commitment of emissions reductions from State sources in the Western Mojave Desert to be proposed for CARB Board consideration will be found in CARB's staff report for the Western Mojave Desert 70 ppb 8-hour ozone SIP.

Table 14 - Western Mojave Desert NOx Emission Reductions from CARB Programs

CARB Programs in Western Mojave Desert	2032 NOx Emission Reductions (tpd)[38]
Current Control Program[39]	11.1
Potential CARB Emissions Reductions Commitments	20.6
2016 State SIP Strategy Measures (Not yet in baseline inventory)	0.2
New Measures	20.3
Total Reductions	**31.6**

[38] Numbers may not add up due to rounding.
[39] Source: 2022 CEPAM v1.01; represents the current baseline emissions with adopted CARB and district measures

Table 15 - Western Mojave Desert Expected Emissions Reductions from the 2022 State SIP Strategy[40]

Proposed Measure	2032 NOx (tpd)	2032 ROG (tpd)
On-Road Heavy-Duty		
Advanced Clean Fleets Regulation	0.6	<0.1
Zero-Emissions Trucks Measure	0.6	<0.1
Total On-Road Heavy-Duty Reductions	1.2	0.1
On-Road Light-Duty		
On-Road Motorcycle New Emissions Standards	<0.1	0.1
Clean Miles Standard	<0.1	<0.1
Total On-Road Light-Duty Reductions	<0.1	0.1
Off-Road Equipment		
Tier 5 Off-Road Vehicles and Equipment	<0.1	NYQ
Amendments to the In-Use Off-Road Diesel-Fueled Fleets Regulation	0.2	<0.1
Transport Refrigeration Unit Regulation Part 2	0.4	<0.1
Cargo Handling Equipment Amendments	<0.1	<0.1
Off-Road Zero-Emission Targeted Manufacturer Rule	NYQ	NYQ
Clean Off-Road Fleet Recognition Program	NYQ	NYQ
Spark-Ignition Marine Engine Standards	<0.1	<0.1
Total Off-Road Equipment Reductions	0.7	0.1
Other		
Consumer Products Standards	-	NYQ
Zero-Emission Standard for Space and Water Heaters	NYQ	NYQ
Enhanced Regional Emission Analysis in State Implementation Plans	NYQ	NYQ
Total Other Reductions		
Primarily-Federally and Internationally Regulated Sources – CARB Measures		
In-Use Locomotive Regulation	18.3	0.7
Future Measures for Aviation Emission Reductions	NYQ	NYQ
Total Primarily-Federally and Internationally Regulated Sources – CARB Measures Reductions	18.3	0.7
Aggregate Emissions Reductions	**20.3**	**1.0**

[40] Numbers may not add up due to rounding.

CARB MEASURES

On-Road Heavy-Duty

Advanced Clean Fleets Regulation

This measure accelerates zero-emission vehicle adoption in the medium- and heavy-duty sectors by setting zero-emission requirements for fleets and 100 percent ZEV sales requirement in California for manufacturers of Class 2b through 8 vehicles. The Advanced Clean Fleets Regulation will focus on strategies to ensure that the cleanest vehicles are deployed by government, business, and other entities in California to meet their transportation needs. The requirements would be phased-in on varying schedules for different fleets including public, drayage trucks, and high priority private and federal fleets. Public fleets would be required to phase-in purchase requirement starting at 50 percent of new purchases in 2024 and 100 percent starting in 2027. All drayage trucks operating at seaports and intermodal railyards would be required to be zero-emission by 2035. Drayage trucks will also have new registration and reporting requirements, starting in 2023. High priority private and federal fleets would be required to phase-in zero-emission vehicles as a percentage of the total fleet. The fleet requirements are based on zero-emission suitability and are phased-in by vehicle body type. The Advanced Clean Fleets Regulation would also include a requirement that 100 percent of Class 2b and above vehicle manufacturer sales in California are zero-emissions starting in 2040.

Zero-Emission Trucks Measure

This measure would increase the number of ZEVs and require cleaner engines to achieve emissions reductions from fleets that are not affected by the proposed Advanced Clean Fleets measure. This would include potential zero-emissions zone concepts around warehouses and sensitive communities if CARB is given new authority to enact indirect source rules in combination with strategies to upgrade older trucks to newer and cleaner engines. This would be a transitional strategy to achieve zero-emissions medium- and heavy-duty vehicles everywhere feasible by 2045.

On-Road Light-Duty

On-Road Motorcycles New Emissions Standards

This measure would reduce emissions from new, on-road motorcycles by adopting more stringent exhaust and evaporative emissions standards along with limited on-board diagnostics requirements and zero-emissions sales thresholds with an associated credit program to help accelerate the development of zero emissions motorcycles. The new exhaust emissions standards include substantial harmonization with the more stringent European motorcycle emissions standards already in place. The new evaporative emissions standards are based on more aggressive CARB off-highway recreational vehicle emissions standards that exist today. This measure also proposes significant zero-emission motorcycle sales thresholds beginning in 2028 and increasing gradually through 2035.

Clean Miles Standard

The Clean Miles Standard was adopted by CARB on May 20, 2021. The primary goals of this measure are to reduce GHG emissions from ride-hailing services offered by transportation network companies (TNCs) and promote electrification of the fleet by setting an electric vehicle mile target, while achieving criteria pollutant co-benefits. TNCs would be required to achieve zero grams CO_2 emissions per passenger mile traveled and 90 percent electric VMT by 2030.

Off-Road Equipment

Tier 5 Off-Road Vehicles and Equipment

This measure would reduce NOx and particulate matter (PM) emissions from new off-road compression-ignition (CI) engines by adopting more stringent exhaust standards for all power categories, including those that do not currently utilize exhaust aftertreatment such as diesel particulate filters and selective catalytic reduction. This measure would be more stringent than required by current U.S. EPA and European Stage V nonroad regulations and would require the use of best available control technologies.

For this measure, CARB staff would develop and propose standards for new off-road CI engines including the following: aftertreatment-based PM standards for engines less than 19 kilowatt (kW) (25 horsepower [hp]), aftertreatment-based-NOx standards for engines greater than or equal to 19 kW (25 hp) and less than 56 kW (75 hp), and more stringent PM and NOx standards for engines greater than or equal to 56 kW (75 hp). Other possible elements include enhancing in-use compliance, proposing more representative useful life periods, and developing a low load test cycle. It is expected that this comprehensive off-road Tier 5 regulation would rely heavily on technologies manufacturers are developing to meet the recently approved low NOx standards and enhanced in-use requirements for on-road heavy-duty engines.

Amendments to the In-Use Off-Road Diesel-Fueled Fleets Regulation

This measure would further reduce emissions from the in-use off-road diesel equipment sector by adopting more stringent requirements to the In-Use Off-Road Diesel-Fueled Fleets Regulation. These amendments would create additional requirements to the currently regulated fleets by targeting the oldest and dirtiest equipment that is allowed to operate indefinitely under the current regulation's structure.

The amendments would include an operational backstop to the current In-Use Off-Road Diesel-Fueled Fleets Regulation for most Tier 0, 1, and 2 engines between 2024 and 2032. This will allow a 12-year phase out of these oldest engines. Along with the operational backstop, adding vehicle provisions in the current regulation will be extended to phase in a limitation on the adding of Tier 3 and Tier 4i vehicles to fleets. The amendments also include proposed new requirements for most fleets to use renewable diesel, proposed requirements for prime contractors and public works awarding bodies to increase the enforceability of the regulation, and optional flexibility provisions for fleet adoption of zero-emission vehicles. Additional modifications could include clarification to implementation and sunset provisions that would have allowed small fleets to continue to operate vehicles that could not be retrofitted with a verified diesel emission control strategy indefinitely.

Transport Refrigeration Unit Regulation Part 2 (Non-Truck TRUs)

This measure is the second part of a two-part rulemaking to transition diesel-powered transport refrigeration units (TRUs) to zero-emission technologies. This measure would require zero-emission equipment for non-truck TRUs (trailer TRUs, domestic shipping container TRUs, railcar TRUs, TRU generator sets, and direct-drive refrigeration units).

Cargo Handling Equipment Amendments

This measure would start transitioning Cargo Handling Equipment (CHE) to full zero-emission in 2026, with over 90 percent penetration of ZE equipment by 2036. Based on the current state of zero-emission CHE technological developments, the transition to zero-emission would most likely be achieved largely through the electrification of CHE. This assumption about aggressive electrification is supported by the fact that currently some electric RTG cranes, electric forklifts, and electric yard tractors are already commercially available. Other technologies are in early production or demonstration phases.

Off-Road Zero-Emission Targeted Manufacturer Rule
The Off-Road Zero-Emission Targeted Manufacturer Rule would accelerate the development and production of zero-emission off-road equipment and powertrains. Existing zero-emission regulations and regulations currently under development target a variety of sectors (e.g., forklifts, cargo handling equipment, off road fleets, Small Off-Road Engines (SORE), etc.). However, as technology advancements occur, more sectors including wheel loaders, excavators, and bulldozers could be accelerated. Fully addressing control of emissions from new farm and construction equipment under 175 horsepower that are preempted, will require partnership on needed Federal zero-emission standards for off-road equipment.

This measure would require manufacturers of off-road equipment and/or engines to produce for sale zero-emission equipment and/or powertrains as a percentage of their annual statewide sales volume. Sales/production mandate levels would be developed based on the projected feasibility of zero-emission technology to enter and grow in the various off-road equipment types currently operating in California. This measure is expected to increase the availability of zero-emission options in the off-road sector and support other potential measures that promote and/or require the purchase and use of such options. A targeted manufacturer regulation will need to take into account parameters such as the number of equipment and engine manufacturers producing off-road equipment for sale in California, along with sales volumes, to ensure that such an effort is cost effective and technologically feasible.

Clean Off-Road Fleet Recognition Program
This measure would create a non-monetary incentive to encourage off-road fleets to go above and beyond existing regulatory fleet rule compliance and adopt advanced technology equipment with a strong emphasis on zero-emission technology. The Clean Off-Road Fleet Recognition Program would provide a standardized methodology for contracting entities, policymakers, state and local government, and other interested parties to establish contracting criteria or require participation in the program to achieve their individual policy goals.

The Clean Off-Road Fleet Recognition Program framework would encourage entities with fleets to incorporate advanced technology and zero-emission vehicles into their fleets, prior to or above and beyond regulatory mandates based on fleet size. The program would provide standardized criteria or a rating system for participation at various levels to reflect the penetration of advanced technology and zero-emission vehicles into a fleet. Levels could be scaled over time as zero-emission equipment becomes more readily available. CARB anticipates the next several years of technology advancements and demonstrations to drive the stringency of the rating system. Participation in the program would be voluntary for entities with fleets, however, designed in a manner that provides them motivation to go beyond business as usual. The program would offer value for entities with fleets to participate by potentially providing them increased access to jobs/contracts, public awareness, and marketing opportunities.

Spark-Ignition Marine Engine Standards
For this measure, CARB will develop and propose catalyst-based standards for outboard and personal watercraft engines less than or equal to 40 kW in power that will gradually reduce

emission standards to approximately 70 percent below current levels. For outboard and personal watercraft engines under 40 kW, more stringent exhaust standards will be developed and proposed based on the incorporation of electronic fuel injection that will gradually reduce emission standards 40 percent below current levels. This measure would require a 5.0 g/kW-hr HC+NOx standard for outboard engines and personal watercraft engines at or above 40 kW in power and a 10.0 g/kW-hr HC+NOx standard for engines less than 40 kW.

In addition to requiring more stringent exhaust standards, CARB is considering actions consistent with Executive Order N-79-20 that would require a percentage of outboard and personal watercraft vessels to be propelled by zero-emission technologies for certain applications. Outboard engines less than 19 kW, which are typically not operated aggressively or for extended periods, could potentially be phased-out and gradually replaced with zero-emission technologies. Some personal watercraft applications could also potentially be replaced with zero-emission technologies.

Other

Consumer Products Standards
This measure will further reduce VOC and equivalent VOC emissions from consumer products to expedite attainment of national ambient air quality standards for ozone. As with previous rulemakings, emission reductions will be achieved by setting regulatory standards applicable to the content of consumer products. To meet emission reduction targets for the measure, CARB staff will evaluate categories with relatively high contributions to ozone formation, whether currently regulated or unregulated. Staff will consider the merits of proposing VOC content standards as well as reactivity limits. Staff developing proposed amendments to the Consumer Products Regulation will also consider investigating concepts for expanding manufacturer compliance options, market-based approaches, and reviewing existing exemptions. Staff will work with stakeholders to explore mechanisms that would encourage the development, distribution, and sale of cleaner, very low, or zero-emitting products. In undertaking these efforts staff will prioritize strategies that achieve the maximum feasible reductions in ozone forming, toxic air contaminant, and GHG emissions. This measure complements a parallel measure in CARB's Climate Change Scoping Plan Update, to be considered by the CARB Board in 2022, to phase down use of HFC-152a and other GHGs in consumer products.

Zero-Emission Standard for Space and Water Heaters
For this measure, CARB would develop and propose zero GHG emission standards for space and water heaters sold in California; CARB could also work with air districts to further tighten district rules to drive zero-emission technologies. This measure would not mandate retrofits in existing buildings, but some buildings would require retrofits to be able to use the new technology that this measure would require. Beginning in 2030, 100 percent of sales of new space and water heaters (for either new construction or replacement of burned-out equipment in existing buildings) would need to meet zero-emission standards. It is expected that this regulation would rely heavily on heat pump technologies currently being sold to electrify new and existing homes.

Enhanced Regional Emissions Analysis in SIPs
The primary goal of this measure is to reduce criteria pollutant and GHG emissions that come from on-road mobile sources through reductions in VMT. In addition, lowering VMT will help alleviate traffic congestion, improve public health, reduce consumption of fossil fuels, and

reduce infrastructure costs. CARB is exploring three options to reduce ROG and NOx emissions through reductions in VMT. First, CARB will consider whether and how to change the process for developing Motor Vehicle Emissions Budget (MVEB) by evaluating the existing MVEB development process to meet NAAQS. In addition, CARB will assess and improve the Reasonably Available Control Measures (RACM) analysis in the SIP by providing a comprehensive list of Transportation Control Measures (TCMs) and emission quantification methodology. Finally, CARB will consider updating the guidelines for the California Motor Vehicle Registration Fee (MV Fees) Program and the Congestion Mitigation and Air Quality Improvement (CMAQ) Program to fund a broader range of transportation and air quality projects that advance new approaches and technologies in reducing air pollution.

PRIMARILY-FEDERALLY AND INTERNATIONALLY REGULATED SOURCES – CARB MEASURES

In addition to reducing emissions from the above sources, it is critical to achieve emissions reductions from sources that are primarily regulated at the federal and international level. It is imperative that the federal government and other relevant regulatory entities act decisively to reduce emissions from these primarily-federally and internationally regulated sources of air pollution. CARB and the air districts in California have taken actions to not only petition federal agencies for action, but also to directly reduce emissions using programmatic mechanisms within our respective authorities. CARB continues to explore additional actions, many of which may require a waiver or authorization under the Clean Air Act, as described below.

In-Use Locomotive Regulation

This measure would use mechanisms available under CARB's regulatory authority to accelerate the adoption of advanced, cleaner technologies, and include zero emission technologies, for locomotive operations. The In-Use Locomotive Regulation would apply to all locomotives operating in the State of California with engines that have a total rated power of greater than 1,006 horsepower, excluding locomotive engines used in training of mechanics, equipment designed to operate both on roads and rails, and military locomotives. The measure reduces emissions by increasing use of cleaner diesel locomotives and zero emission locomotives through a spending account, in-use operational requirements, and by an idling limit. By July 1, 2024, a spending account would be established for each locomotive operator. Funds in the account would only be used toward Tier 4 or cleaner locomotives until 2030, and at any time toward zero-emission locomotives, zero-emission pilot or demonstration projects, or zero-emission infrastructure.

For the in-use operational requirements, beginning January 1, 2030, only locomotives built after January 1, 2007 may operate in California. Each year after January 1, 2030, only locomotives less than 23 years old may operate in California. Additionally, under the in-use operational requirements, starting January 1, 2030, all switch, industrial, and passenger locomotives operating in California with an original engine build date 2030 or newer will be required to be zero emission. Starting January 1, 2035, all freight line haul locomotives operating in California with an original engine build date 2035 or newer must be zero emission. Locomotives equipped with automatic engine stop/start systems are to idle no more than 30 minutes unless an exemption applies. Also, locomotive operators would report locomotive engine emissions levels and activity on an annual basis.

Future Measures for Aviation Emissions Reductions

Future measures for aviation would reduce emissions from airport and aircraft related activities. The identified emission sources for the aviation sector are main aircraft engines, auxiliary power units (APU), and airport ground transportation. Emission reductions can be achieved by pursuing incentive and regulatory measures.

CARB would evaluate federal, state, and local authority in setting operational efficiency practices to achieve emission reductions. Operational practices include landing, takeoff, taxi, and running the APU, and contribute to on-ground and near-ground emissions. Near ground emissions are emissions between ground level up to 3,000 feet. Operational practices such as de-rated take-off and reduced power taxiing have the potential to achieve emission reductions.

CARB would similarly work with U.S. EPA, Air Districts, airports, and industry stakeholders in a collaborative effort to develop regulations, voluntary measures, and incentive programs. CARB would evaluate the incentive amounts that would be required to encourage aircrafts to voluntarily use cleaner engines and fuels. Incentives to encourage the use of cleaner engines and fuels for aircraft in California would involve identification of funding sources and implementation mechanisms such as development of new programs.

Contingency Measures

Contingency measures are required by the Clean Air Act to be implemented should an area fail to make reasonable further progress or attain the NAAQS by the required date. Over the last few years, multiple court decisions in the 9th circuit and nation-wide have effectively disallowed the SIP-approved approach which CARB and the districts have historically used to meet contingency measure requirements. CARB continues to strive to meet the requirements, but U.S. EPA has not yet released comprehensive and updated guidance encompassing the full scope of contingency measure requirements, in light of the results of the varying court decisions. Guidance is needed for CARB, and other air agencies across California and the U.S., to ensure that any resources devoted to creating, adopting, and implementing a measure will result in one that meets the requirements and be approved into the SIP.

Additionally, California faces the most difficult air quality challenges in the nation and, accordingly, leads the country with the most stringent air pollution control programs. Historically, U.S. EPA guidance required contingency measures to achieve approximately one year's worth of emission reductions. CARB's control programs are advanced, and primarily-federally regulated sources contribute over half of the emissions. Thus, opportunities for a triggered contingency measure that can be implemented by the State and result in one year's worth of emission reductions in the required time frame are not readily available. Further, if any measure that could achieve this level of emission reductions existed, it would be adopted to improve air quality and support attainment of NAAQS, and would not be withheld for contingency purposes. Even with recent court decisions, U.S. EPA has the opportunity to justify a revised approach for contingency measures recognizing the maturity of control programs or allow states to provide a reasoned justification for achieving less than the required amount. California continues to work towards meeting contingency measure requirements, but U.S. EPA must issue guidance to provide clarity and direction for states to move forward and pursue contingency measures that will meet the requirements.

Contingency Measure Background

The Clean Air Act specifies that SIPs must provide for contingency measures, defined in section 172(c)(9) as "specific measures to be undertaken if the area fails to make reasonable further progress, or to attain the national primary ambient air quality standard by the attainment date…." The Clean Air Act is silent though on the specific level of emission reductions that must flow from contingency measures. In the absence of specific requirements for the amount of emission reductions required, in 1992, U.S. EPA conveyed that the contingency measures should, at a minimum, ensure that an appropriate level of emissions reduction progress continues to be made if attainment of RFP is not achieved and additional planning by the State is needed (57 Federal Register 13510, 13512 (April 16, 1992)). Further, U.S. EPA ozone guidance states that "contingency measures should represent one year's worth of progress amounting to reductions of 3 percent of the baseline emissions inventory for the nonattainment area". U.S. EPA, though, has accepted contingency measures that equal less than a year's worth of progress when the circumstances fit under "U.S. EPA's long-standing recommendation that states should consider 'the potential nature and extent of any attainment shortfall for the area' and that contingency measures 'should represent a portion of the actual emissions reductions necessary to bring about attainment in the area.'"[41]

Historically, U.S. EPA allowed contingency measure requirements to be met via excess emission reductions from ongoing implementation of adopted emission reduction programs, a method that CARB has used for a contingency measure and U.S. EPA has approved in the past. In 2016, in *Bahr v. U.S. Environmental Protection Agency*[42] *(Bahr),* the 9th Circuit Court of Appeals determined U.S. EPA erred in approving a contingency measure that relied on an already-implemented measure for a nonattainment area in Arizona, thereby rejecting U.S. EPA's longstanding interpretation of section 172(c)(9). U.S. EPA staff interpreted this decision to mean that contingency measures must include a future action triggered by a failure to attain or failure to make reasonable further progress. This decision was applicable to the states covered by the 9th Circuit Court. In the rest of the country, U.S. EPA was still approving contingency measures using their pre-Bahr stance. In January 2021, in *Sierra Club v. Environmental Protection Agency*[43], the United States Court of Appeals for the D.C. Circuit, ruled that already implemented measures do not qualify as contingency measures for the rest of the country (*Sierra Club*).

In response to *Bahr* and as part of the 75 ppb 8-hour ozone SIPs due in 2016, CARB developed the statewide Enhanced Enforcement Contingency Measure (Enforcement Contingency Measure) as a part of the *2018 Updates to the California State Implementation Plan* to address the need for a triggered action as a part of the contingency measure requirement. CARB worked closely with U.S. EPA regional staff in developing the contingency measure package that included the triggered Enforcement Contingency Measure, a district triggered measure and emission reductions from implementation of CARB's mobile source emissions program. However, as part of the *San Joaquin Valley 2016 Ozone Plan for 2008 8-hour Ozone Standard* SIP action, U.S. EPA wrote in their final approval that the Enforcement Contingency Measures did not satisfy requirements to be approved as a "standalone contingency measure" and approved

[41] See, e.g. 78 Fed.Reg. 37741, 37750 (Jun. 24, 2013), approval finalized with 78 Fed.Reg. 64402 (Oct. 29, 2013).
[42] *Bahr v. U.S. Environmental Protection Agency,* (9th Cir. 2016) 836 F.3d 1218.
[43] *Sierra Club v. Environmental Protection Agency,* (D.C. Cir. 2021) 985 F.3d 1055.

it only as a "SIP strengthening" measure. U.S. EPA did approve the district triggered measure and the implementation of the mobile reductions along with a CARB emission reduction commitment as meeting the contingency measure requirement for this SIP.

Subsequently, the Association of Irritated Residents filed a lawsuit against the U.S. EPA for their approval of various elements within the *San Joaquin Valley 2016 Ozone Plan for 2008 8-hour Ozone Standard*, including the contingency measure. The 9th Circuit Court of Appeals issued its decision in *Association of Irritated Residents v. EPA*[44] (*AIR*) that U.S. EPA's approval of the contingency element was arbitrary and capricious and rejected the triggered contingency measure that achieves much less than one year's worth of emission reductions. Most importantly, the 9th Circuit Court said that, in line with U.S. EPA's longstanding interpretation of what is required of a contingency measure and the purpose it serves, together with *Bahr*, all reductions needed to satisfy the Clean Air Act's contingency measure requirements need to come from the contingency measure itself <u>and</u> the amount of reductions needed for contingency should not be reduced by the fact of surplus emission reductions from ongoing programs absent U.S. EPA formally changing its historic stance on the amount of reductions required. U.S. EPA staff has interpreted AIR to mean that triggered contingency measures must achieve the entirety of the required one year's worth of emission reductions on their own. In addition, surplus emission reductions from ongoing programs cannot reduce the amount of reductions needed for contingency.

In response to *Bahr* and *Sierra Club*, in 2021, U.S. EPA convened a nation-wide internal task force to develop guidance to support states in their development of contingency measures. That task force is now also considering the impact of *AIR*. U.S. EPA has indicated that the contingency measure guidance may be released fall 2022. The SIPs for the 70 ppb 8-hour ozone standard are due to U.S. EPA August 3, 2022. In their updated guidance, U.S. EPA needs to recognize that many state control programs are mature and opportunities to withhold measures for contingency are scarce.

Since *Bahr*, CARB has worked closely with our U.S. EPA regional office in developing contingency measures with little success. CARB is committed to meeting the Clean Air Act requirements for contingency measures, but without finalized national guidance on this complex issue, it is not a good use of resources to pursue contingency measures that may not ultimately coincide with the upcoming new guidance.

CARB'S OPPORTUNITIES FOR CONTINGENCY MEASURES

Much has changed since U.S. EPA's 1992 guidance on contingency measures. Control programs across the country have matured as have the health-based standards. Ozone standards have strengthened in 2008 and 2015 with attainment dates out to 2037. California has the only two extreme areas in the country. Control measures identified for these areas must be implemented for meeting the standard and not held in reserve.

To address contingency measure requirements given the courts' decisions and current U.S. EPA guidance, CARB and local air districts would need to develop a measure or measures that, when triggered by a failure to attain or failure to meet RFP, will achieve one year's worth of emissions

[44] *Association of Irritated Residents v. U.S. Environmental Protection Agency*, (9th Cir. 2021) 10 F.4th 937

reductions for the given nonattainment area, or approximately 3 percent of total baseline emissions.

Given CARB's wide array of mobile source control programs, the relatively limited portion of emissions primarily regulated by the local air district, and the fact that primarily-federally regulated sources are expected to account for approximately 54 percent of statewide NOx emissions by 2032[45], finding a single triggered measure that will achieve the required reductions would be nearly impossible. That said, even discounting the amount to reflect the proportion that is primarily-federally regulated, approximately 1.4 percent of total baseline emissions would still be needed. Even targeting a lower percentage, additional control measures that can be identified by CARB are scarce or nonexistent that would achieve the require emissions reductions needed for a contingency measure.

Adding to the difficulty of identifying available control measures, not only does the suite of contingency measures need to achieve a large amount of reductions, but they will also need to achieve these reductions in the year following the year in which the failure to attain or meet RFP has been identified. Control measures achieving the level of reductions required may take years to implement and will likely not result in immediate reductions. In the 2022 State SIP Strategy, CARB's three largest NOx reduction measures, In-Use Locomotive Regulation, Zero -Emission Standards for Space and Water Heaters and Advanced Clean Fleets, rely on accelerated turnover of older engines/trucks. Buildup of infrastructure and equipment options limits the availability to have significant emission reductions in a short amount of time. Unless U.S. EPA changes its historic stance or finds a reasoned justification for requiring less than the stated amount, adopting a single triggered measure that can be implemented and achieve the necessary reductions in the time frame required is scarce in California and may not be possible.

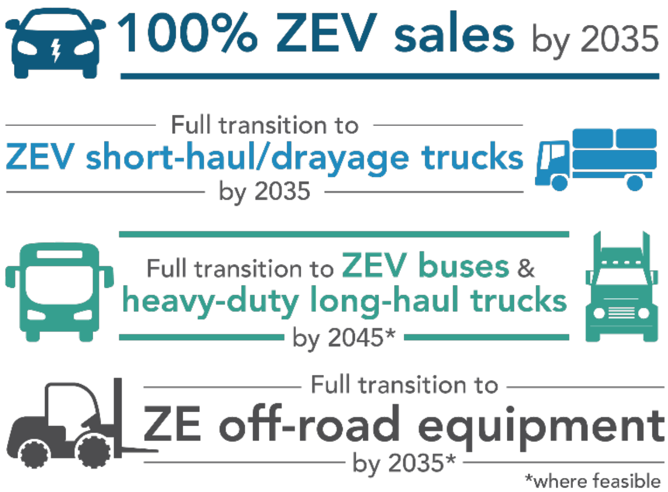
CARB has over 50 years of experience reducing emissions from mobile and other sources of pollution under State authority. The Reasonably Available Control Measures for State Sources analysis illustrates the reach of CARB's current programs and regulations, many of which set the standard nationally for other states to follow. Few sources CARB has primary regulatory authority over remain without a control measure, and all control measures that are in place support the attainment of the NAAQS. There is a lack of additional control measures that would be able to achieve the necessary reductions for a contingency measure. Due to the unique air quality challenges California faces, should such additional measures exist, CARB would pursue those measures to support expeditious attainment of the NAAQS and would not reserve such measures for contingency purposes. Nonetheless, CARB continues to explore options for potential statewide contingency measures utilizing its authorities in anticipation of U.S. EPA's written guidance. CARB anticipates that U.S. EPA's guidance will allow an assessment of viability of such a state-wide measure.

A central issue in considering a statewide contingency measure under CARB's authority, is that CARB is already fully committed to the "drive to zero" effort. In 2020, Governor Newsom signed Executive Order N-79-20 (Figure 1) that established a first-in-the-nation goal for 100 percent of California sales of new passenger cars and trucks to be zero-emission by 2035. The Governor's order set a goal to transition 100 percent of the drayage truck fleet to zero-emission

[45] Source: CARB 2022 CEPAM v1.01; based on 2032 emissions totals.

by 2035, all off-road equipment where feasible to zero-emission by 2035, and the remainder of the medium- and heavy-duty vehicles to zero-emission where feasible by 2045.

Figure 1. Governor Newson Executive Order N-79-20



CARB is committed to achieving these goals. Thus, CARB's programs not only go beyond emissions standards and programs set at the federal level, but many include zero-emissions requirements or otherwise, through incentives and voluntary programs, drive mobile sources to zero-emissions, as listed in Table 16 below. CARB is also exploring and developing a variety of new measures to drive more source categories to zero-emissions and reduce emissions even further, as detailed in the 2022 State Strategy for the State Implementation Plan. With most source categories being driven to zero-emissions, opportunities for which a triggered measure that could reduce emissions by the amount required for contingency measures are scarce.

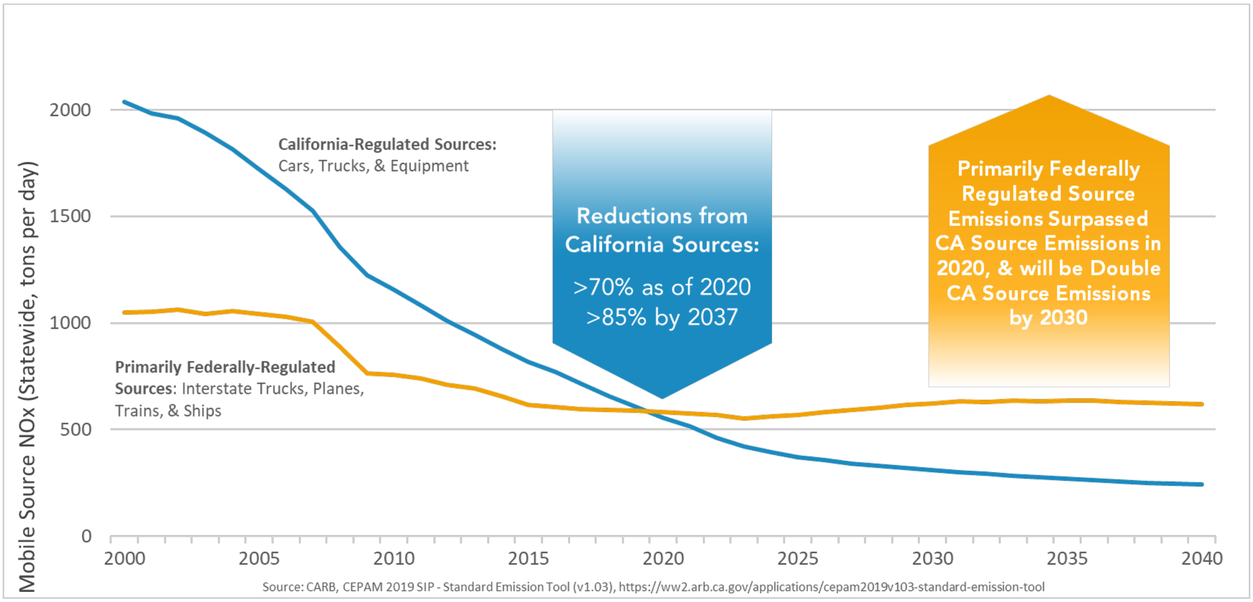
Table 16 - Emissions Sources and Respective CARB Programs with a Zero-Emissions Requirement/Component

Emission Source	Regulatory Programs
Light-Duty Passenger Vehicles and Light-Duty Trucks	• Advanced Clean Cars Program (I and II*), including the Zero Emission Vehicle Regulation • Clean Miles Standard *
Motorcycles	• On-Road Motorcycle Regulation*
Medium Duty-Trucks	• Advanced Clean Cars Program (I and II*), including the Zero Emission Vehicle Regulation • Zero-Emission Powertrain Certification Regulation • Advanced Clean Trucks Regulation • Advanced Clean Fleets Regulation*
Heavy-Duty Trucks	• Zero-Emission Powertrain Certification Regulation • Advanced Clean Trucks Regulation • Advanced Clean Fleets Regulation*

Heavy-Duty Urban Buses	• Innovative Clean Transit • Advanced Clean Fleets Regulation*
Other Buses, Other Buses – Motor Coach	• Zero-Emission Airport Shuttle Regulation • Advanced Clean Fleets Regulation*
Commercial Harbor Craft	• Commercial Harbor Craft Regulation
Recreational Boats	• Spark-Ignition Marine Engine Standards*
Transport Refrigeration Units	• Airborne Toxic Control Measure for In-Use Diesel-Fueled Transport Refrigeration Units (Parts I and II*)
Industrial Equipment	• Zero-Emission Forklifts* • Off-Road Zero-Emission Targeted Manufacturer Rule*
Construction and Mining	• Off-Road Zero-Emission Targeted Manufacturer Rule*
Airport Ground Support Equipment	• Zero-Emission Forklifts*
Port Operations and Rail Operations	• Cargo Handling Equipment Regulation • Off-Road Zero-Emission Targeted Manufacturer Rule*
Lawn and Garden	• Small Off-Road Engine Regulation • Off-Road Zero-Emission Targeted Manufacturer Rule*
Ocean-Going Vessels	• At Berth Regulation
Locomotives	• In-Use Locomotive Regulation*

*Indicates program or regulation is in development

There are few sources remaining without a control measure implemented by CARB, and those that do remain are primarily-federally regulated sources. This includes interstate trucks, ships, locomotives, aircraft, and certain categories of off-road equipment, constituting a large source of potential emissions reductions. Since these are primarily regulated at the federal and, in some cases, international level, options to implement a contingency measure with reductions approximately equivalent to one year's worth of emission reductions are limited.



SUMMARY – CARB CONTINGENCY MEASURES

At this time, CARB is including a zero-emission component in most of our regulations, both those already adopted and those that are in development, and the vast majority of these regulations are statewide. Beyond the wide array of sources CARB has been regulating over the last few decades, and especially considering those we are driving to zero-emission, there are few sources of emissions left for CARB to implement additional controls upon under its authorities. The few source categories that do not have control measures are primarily-federally and internationally regulated.

Given the courts' decisions over the last few years, CARB and local air districts will need to implement contingency measures that, when triggered, would achieve one year's worth of emissions reductions, or at least the relevant portion equivalent to the contribution of sources primarily regulated at the State and local level, unless a reasoned rationale for achieving less emission reductions can be provided. Considering the air quality challenges California and local air districts face, CARB would implement the measure to support expeditious attainment of the NAAQS as the Clean Air Act requires rather than withhold it for contingency measure purposes. Should there be a measure achieving the required emission reductions, the measure would likely take more than one year to reduce the necessary emissions.

CARB fully intends to meet the contingency requirement as required by the Clean Air Act, but written U.S. EPA guidance that addresses the dilemma California faces is needed to provide direction and clarity for CARB and local air districts to develop and adopt approvable contingency measures. CARB continues to explore potential contingency measures while awaiting U.S. EPA's written guidance. Further, since it's been about 30 years, since U.S. EPA developed the guidance, this may be the time for U.S. EPA to update the guidance by formally changing its historic stance on the amount of reductions required to meet the contingency measure requirement and allowing states with mature control programs to demonstrate that contingency measure opportunities are scarce.

LOCAL CONTINGENCY MEASURE

As discussed above with regard to RACT and RACM, the District is already implementing all feasible reasonable stationary control measures (and the State is already implementing all feasible non-mobile control measures). Any measures which are applicable and feasible are in place – no opportunities exist to obtain the tons per day of emission reductions required by the contingency measure requirement within the stationary source categories subject to the District's control authority. Any measure that could achieve this level of stationary source reductions would be adopted to improve air quality and support attainment of the NAAQS, and would not be withheld for contingency purposes. Nonetheless, the District can commit to a contingent control measure which will obtain some emission reductions if needed.

The District reaffirms the use of the State Enhanced Inspection and Maintenance (Enhanced I&M) Program as a contingency measure. The District will implement the State of California's version of Enhanced I&M in those areas of the Western Mojave Desert Nonattainment Area (WMD) which are currently only subject to the State Basic Inspection and Maintenance (Basic I&M) Program should a contingency measure be triggered by failure to attain the Federal 8-hour ozone standard.

Within thirty (30) days of a finding by U.S. EPA as published in the Federal Register that the WMD has either failed to meet a Reasonable Further Progress (RFP) milestone for the 2008 National Ambient Air Quality Standards (NAAQS) or has failed to attain said NAAQS by the applicable attainment deadline then the Executive Director/Air Pollution Control Officer for the District shall make a formal request to the California Bureau of Automotive Repair (BAR) requesting implementation of the Enhanced I&M Program throughout the entirety of the area of the WMD subject to the jurisdiction of the District. Pursuant to the provisions of Health & Safety Code 44003(c) the BAR would initiate the Enhanced I&M Program and notify affected persons and stakeholders of the updated requirement without the need for additional formal regulatory action on the part of either the District or BAR.

This contingency measure will generate a minimum of 0.03 tons per day of VOC reductions and 0.04 tons per day of NOx reductions.

Reasonable Further Progress

Sections 172(c)(2) and 182(b)(1) of the Clean Air Act (Act) require ozone attainment plans to provide for Reasonable Further Progress (RFP). RFP is defined in section 171(1) of the Act as "…such annual incremental reductions in emissions of the relevant air pollutant as are required…for the purpose of ensuring attainment of the applicable national ambient air quality standard by the applicable date." This requirement to demonstrate steady progress in emission reductions between the baseline year and attainment date ensures that areas will begin lowering air pollution in a timely manner and not delay implementation of control programs until immediately before the attainment deadline.

There are two separate RFP requirements for ozone nonattainment areas depending upon their classification. For ozone nonattainment areas classified as Moderate or above, there is a one-time requirement for a 15 percent reduction in reactive organic gases (ROG) emissions over the first six years of the planning period (section 182(b)(1)). For ozone nonattainment areas classified as Serious or higher, section 182(c)(2)(B) of the Act has an additional requirement to demonstrate 3 percent per year cumulative reduction of ozone precursors averaged over each consecutive three-year period until attainment.

In 2017, U.S. EPA approved a 15 percent ROG-only rate of progress demonstration for the Western Mojave Desert (WMD) for the 80 ppb 8-hour ozone standard covering the entire nonattainment area for the 70 ppb 8-hour ozone standard.[46] As such, the requirement under section 182(b)(1) of the Act to demonstrate a reduction in ROG in the first 6 years of the attainment planning period has been met for the WMD.

For the 182(c)(2)(B) RFP requirement for Serious and higher areas, U.S. EPA guidance allows for oxides of nitrogen (NOx) substitution to demonstrate the annual 3 percent reductions of ozone precursors if it can be demonstrated that substitution of NOx emission reductions (for ROG reductions) yields equivalent ozone reductions.[47] Additional U.S. EPA guidance states that certain conditions are needed to use NOx substitution in an RFP demonstration.[48] First, an equivalency demonstration must show that cumulative RFP emission reductions are consistent with the NOx and ROG emission reductions determined in the ozone attainment demonstration. Second, the reductions in NOx and ROG emissions should be consistent with the continuous RFP emission reduction requirement. The guidance states that "Any combination of VOC (ROG) and NOx emission reductions which totals 3 percent per year and meet other SIP consistency requirements described in this document are allowed."

Photochemical modeling included in the attainment demonstration shows that NOx reductions are critical for the WMD to reach attainment, see Chapter 4 for more information on the modeling. And in accordance with U.S. EPA guidance for implementation of the 70 ppb 8-hour ozone standard attainment plans, *Implementation of the 2015 National Ambient Air Quality Standards for Ozone: Nonattainment Area State Implementation Plan Requirements*, the emissions reductions in the RFP demonstration occur inside the nonattainment area, are achieved through existing control regulations, and start from a baseline year of 2017.[49]

The WMD 70 ppb 8-hour ozone RFP demonstration was developed using CARB's California Emissions Projection Analysis Model (CEPAM), 2022 Emission Projections, Version 1.01, see Chapter 2 and Appendix D for more information on the planning emissions inventory. In order to demonstrate consistency between the RFP demonstration and the motor vehicle emissions budgets (MVEB), a line-item adjustment was made in the RFP demonstration to account for the differences in the on-road mobile source emissions projections in the CEPAM inventory and the total MVEBs which are rounded up to the nearest tenth of a ton, see Chapter 3 for more information on the MVEBs.

Table 17 demonstrates that while ROG and NOx emissions are reduced over the planning period, the cumulative ROG and NOx emission reductions in the WMD do not meet the RFP targets in the milestone years of 2023, 2026, 2029, or in the attainment year, 2032.

[46] 82 FR 28560 https://www.gpo.gov/fdsys/pkg/FR-2017-06-23/pdf/2017-12966.pdf
[47] P1001E8Z.PDF (epa.gov)
[48] https://www3.epa.gov/ttn/naaqs/aqmguide/collection/cp2/19931201_oaqps_nox_substitution_guidance.pdf
[49] 83 FR 62998 https://www.govinfo.gov/content/pkg/FR-2018-12-06/pdf/2018-25424.pdf

Table 17 - WMD 70 ppb ozone RFP Demonstration
(tpd, summer planning inventory, CEPAM 2022 version 1.01)

Year	2017	2023	2026	2029	2032
ROG emissions (tpd)	37.10	34.76	33.74	32.84	32.30
MVEB Rounding Margin (tpd)		0.07	0.01	0.04	0.04
Baseline ROG + Rounding Margin (tpd)		34.84	33.75	32.88	32.34
Required % change since 2017		18%	27%	36%	45%
Target ROG Level (tpd)		30.42	27.08	23.74	20.40
Shortfall (-)/ Surplus (+) in ROG (tpd)		-4.42	-6.67	-9.14	-11.94
Shortfall (-)/ Surplus (+) in ROG, %		-11.9%	-18.0%	-24.6%	-32.2%
Year	2017	2023	2026	2029	2032
NOx emissions (tpd)	64.38	59.38	55.53	55.33	54.98
MVEB Rounding Margin (tpd)*		0.05	0.03	0.00	0.00
Baseline NOx + Rounding Margin (tpd)		59.43	55.56	55.33	54.98
Change in NOx since 2017 (tpd)		4.95	8.82	9.05	9.40
Change in NOx since 2017, %		7.7%	13.7%	14.1%	14.6%
NOx reductions since 2017 used for ROG substitution in this milestone year, %		7.7%	13.7%	14.1%	14.6%
NOx reductions since 2017 surplus after meeting ROG substitution needs in this milestone year, %		0.0%	0.0%	0.0%	0.0%
RFP shortfall (-), if any		-4%	-4%	-11%	-18%
RFP Met?		NO	NO	NO	NO

* In order to be most conservative, 0.00 values are used when the corresponding MVEB was lower than comparable emissions in CEPAM due to updated adjustment factors used in the MVEB at the direction of U.S. EPA

Note: numbers may not add up due to rounding

However, the Act provides an alternative for meeting RFP requirements if the area cannot demonstrate reductions of 3 percent per year through the attainment year. Section 182(c)(2)(B)(ii) of the Act allows nonattainment areas to demonstrate RFP if they include in their SIP "all measures that can feasibly be implemented in the area, in light of technological achievability" and "measures that are achieved in practice by sources in the same source category in nonattainment areas of the next higher classification." The next higher classification is extreme and includes SCAQMD and San Joaquin Valley APCD.

The District has reviewed achieved in practice measures for various District source categories in both higher classification districts, as presented in the RACM discussion above and summarized in Appendix E. Of those measures, the District has determined that the residential natural gas fired water heating measure specifying the cleanest NOx standard for new residential water heaters (represented by SCAQMD Rule 1121) is both achieved in practice and applicable to WMDONA sources. This measure will generate NOx reductions from one of the largest non-mobile source categories, and NOx reductions are in greatest shortfall in the RFP demonstration. Accordingly, both districts hereby commit to adopting a natural gas-fired residential water heating rule to require the cleanest NOx standard for new residential water heaters. With this commitment, the WMDONA meets RFP requirements for the 70 ppb 8-hour ozone standard.

Controlled Emission Inventories

As the District is not proposing any additional local control measures with significant emission reductions, the controlled emission inventory is identical to the forecasted emission inventory.

General Conformity Budgets

The forecasted emission inventories presented in this document are the emission budgets for general conformity purposes, as no additional control measures with quantified emission reductions are proposed. A project subject to the general conformity test must be demonstrated to conform with the applicable portion of the forecasted emission inventory. For a project that falls between forecasted years, a linearly interpolated inventory may be calculated. For a project that falls after 2032, use 2032.

Transportation Conformity

The California Air Resources Board (CARB) has prepared the motor vehicle emissions budget (MVEB)[50] for the 70 parts per billion (ppb) 8-hr ozone NAAQS. The MVEB is the maximum allowable emissions from motor vehicles within an air basin and is used for determining whether transportation plans and projects conform to the applicable State Implementation Plan (SIP).

Under section 176(c) of the Clean Air Act, federal agencies may not approve or fund transportation plans and projects unless they conform with the regional SIP. Conformity with the SIP requires that transportation activities do not (1) cause or contribute to new air quality violations, (2) increase the frequency or severity of any existing violation, or (3) delay the timely attainment of NAAQS. Quantifying on-road motor vehicle emissions and comparing those

[50] Federal transportation conformity regulations are found in 40 CFR Part 51, subpart T – Conformity to State or Federal Implementation Plans of Transportation Plans, Programs, and Projects Developed, Funded or Approved Under Title 23 U.S.C. of the Federal Transit Laws. Part 93, subpart A of this chapter was revised by the EPA in the August 15, 1997 Federal Register.

emissions with the MVEB established in the SIP determines transportation conformity between air quality and transportation planning.

The MVEB is set for each criteria pollutant or its precursors for each milestone year and the attainment year of the SIP. Subsequent transportation plans and programs produced by transportation planning agencies must demonstrate that the emissions from the proposed plan, program, or project do not exceed the MVEB established in the applicable SIP. The MVEB established in this SIP apply as a "ceiling" or limit on transportation emissions for the Southern California Association of Governments (SCAG) for the years in which they are defined and for all subsequent years until another year for which a different budget is specified, or until a SIP revision modifies the budget. The Western Mojave Desert comprises the southwestern portion of San Bernardino County (Mojave Desert Air Quality Management District) and the northeastern portion of Los Angeles County (Antelope Valley Air Quality Management District) for the 70 ppb 8-hr ozone SIP. The milestone years and the attainment year of the SIP (also referred to as the plan analysis years) are 2023, 2026, and 2032.

Methodology

The MVEB for the 70 ppb 8-hour ozone SIP is established based on guidance from the U.S. EPA on the motor vehicle emission categories and precursors that must be considered in transportation conformity determinations as found in the transportation conformity regulation and final rules as described below.

The MVEB must be clearly identified and precisely quantified, and consistent with applicable Clean Air Act requirements for reasonable further progress and attainment toward meeting NAAQS. Further, it should be consistent with the emission inventory and control measures in the SIP.

The 70 ppb 8-hr ozone SIP establishes the budget for reactive organic gases (ROG) and nitrogen oxide (NOx) emissions, which are ozone precursors, using emission rates from California's motor vehicle emission model, EMFAC2017 (V.1.0.3),[51] using activity data (vehicle miles traveled [VMT] and speed distributions) from SCAG's 2020 Regional Transportation Plan (RTP) / Sustainable Communities Strategy (SCS).[52]

On August 15, 2019, the U.S. EPA approved EMFAC2017 for use in SIPs and to demonstrate transportation conformity.[53] The EMFAC model estimates emissions from two combustion processes (start and running) and four evaporative processes (hot soak, running loss, diurnal, and resting loss). In addition, the emissions output from the EMFAC2017 model was adjusted using off-model adjustments to account for the impacts of recently adopted regulations and regulations currently under development that are not reflected in the EMFAC2017 model.[54] The regulations incorporated in this way are the Heavy-Duty Warranty Phase 1, Innovative Clean Transit (ICT), Amendments to the Heavy-Duty Vehicle Inspection Program (HDVIP), Periodic Smoke Inspection Program (PSIP), Advanced Clean Trucks (ACT), Heavy-Duty (HD) Omnibus,

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[51] More information on data sources can be found in the EMFAC technical support documentation at: https://ww2.arb.ca.gov/our-work/programs/mobile-source-emissions-inventory/msei-road-documentation

[52] SCAG Connect SoCal 2020 RTP/SCS https://scag.ca.gov/sites/main/files/file-attachments/0903fconnectsocal-plan_0.pdf?1606001176

[53] U.S. EPA approval of EMFAC2017 can be found at 84 FR 41717 https://www.federalregister.gov/d/2019-17476

[54] Off-Model Adjustment Factors to Account for Recently Adopted Regulations in EMFAC2017 Model https://ww2.arb.ca.gov/our-work/programs/mobile-source-emissions-inventory

Advanced Clean Cars II (ACC II), and Advanced Clean Fleets (ACF), which are part of the 2022 State SIP Strategy.

The MVEB for this SIP was developed to be consistent with the on-road emissions inventory[55] and attainment demonstration using the following method:

1) Used the EMFAC2017 model to produce an initial/preliminary calculation of the on-road motor vehicle emissions totals (average summer day) for the appropriate pollutants (ROG and NOx) using 2020 RTP / SCS activity data.
2) Applied the off-model adjustments to account for recently adopted regulations.
3) Subtracted expected emission reductions from ACC II and ACF to be consistent with the on-road control measures in the California SIP Strategy.[56]
4) Rounded the totals for both ROG and NOx upward to the nearest tenth ton.

Motor Vehicle Emissions Budget

The MVEB in Table 18 was established according to the methodology outlined above and in consultation[57] with SCAG, the Mojave Desert Air Quality Management District, Antelope Valley Air Quality Management District, U.S. EPA, the Federal Highway Administration (FHWA), and the Federal Transit Administration (FTA). The MVEB is consistent with the emission inventories and control measures in the 70 ppb 8-hr ozone SIP. This MVEB will be effective once U.S. EPA determines it is adequate.

Table 18 contains a detailed MVEB for each milestone and attainment year for the Western Mojave Desert region. In addition, it provides emissions from the EMFAC 2017 model, recently adopted regulations, and regulations currently under development using off-model adjustments for both ROG and NOx emissions. The final MVEB is rounded upwards to the nearest tenth.

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[55] More information about the on-road motor vehicle emission budget can be found in Chapter XX of the plan.
[56] 2022 State Strategy for the State Implementation Plan https://ww2.arb.ca.gov/resources/documents/2022-state-strategy-state-implementation-plan-2022-state-sip-strategy
[57] To satisfy the requirements established in 40 CFR Part 93, Section 118(e)(4)(ii).

Table 18 - Transportation Conformity Budgets for the 2015 8-hour Ozone NAAQS

Western Mojave Desert Totals (Tons/Day)	2023		2026		2029		2032	
	ROG	NOx	ROG	NOx	ROG	NOx	ROG	NOx
Vehicular Exhaust	5.23	11.90	4.70	11.53	4.27	11.49	3.94	11.84
Reductions from HD warranty, ICT, HDVIP/PSIP, ACT, and HD Omnibus Regulations[a]	0.00	0.24	0.00	4.20	0.01	5.34	0.02	6.22
Reductions from developing regulations using off-model adjustments[b]	-	-	-	-	-	-	0.18	0.76
Total[c]	5.23	11.66	4.69	7.33	4.26	6.15	3.74	4.86
Motor Vehicle Emission Budget[d]	5.3	11.7	4.7	7.4	4.3	6.2	3.8	4.9

Source: EMFAC2017 v1.03

[a] This reflects the adjustment factor for Heavy-Duty Vehicle Warranty Phase 1, ICT, HDVIP/PSIP, ACT, and HD Omnibus regulations.

[b] This reflects the on-road commitments for ACCII and ACF from the draft 2022 State SIP Strategy.

[c] Values from EMFAC2017 v1.03 may not add up due to rounding.

[d] Motor vehicle emission budget is rounded up to the nearest tenth of a tpd.

CHAPTER 4 – Attainment Demonstration

Modeling Approach Overview
Modeling Domain
Model Inputs
Modeling Results

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ATTAINMENT DEMONSTRATION

This chapter paraphrases and reiterates information from the most recent SCAQMD/CARB ozone model runs, the runs performed for the 2022 SCAQMD AQMP. For further information, please refer to Appendix V of that document.[58]

The FCAA required the use of photochemical air quality modeling to evaluate whether a proposed control strategy will result in attainment of the applicable ozone standard. Recognizing the uncertainty inherent in large-scale air quality models, recent Federal guidance has also required an evaluation of supplementary data, known as a weight of evidence analysis. A weight of evidence analysis can also be used to support an attainment demonstration if photochemical modeling indicates that the control strategy will result in future ozone concentration that will approach but not quite reach the standard – this weight of evidence analysis is included in Appendix D.

Modeling Approach Overview

The WMDONA, which includes a portion of the District, is a small portion of the complex greater Southern California airshed. Ozone and ozone precursors are known to flow (or be transported), under the influence of winds, throughout Southern California. The most technically accurate method of evaluating ozone concentrations, ozone emissions, and future ozone behavior is through a large modeling project that includes all of the affected areas in Southern California (and a portion of northern Mexico). The modeling effort has been performed as a joint project by all of the air districts in the region and CARB, with SCAQMD and CARB staff and resources doing the primary work. This regional modeling effort has allowed the most accurate understanding and prediction of future ozone concentrations for Southern California.

The modeled attainment demonstration in this plan was prepared using photochemical dispersion and meteorological tools developed in response to USEPA modeling guidelines, and recommendations from air quality modeling experts. The Urban Airshed Model (UAM) is the regional modeling system preferred by USEPA and CARB for analyzing ozone non-attainment areas. The UAM predicts future ambient ozone concentrations under historical conditions that led to high ambient ozone concentrations. These conditions are typically multi-day 'episodes' in which the State and Federal ozone standards were exceeded. The UAM also evaluates ozone precursor emissions, local and regional meteorology, and regional topography to calculate ozone concentrations. These calculations are performed on an hourly basis throughout the modeled episode, thus allowing the UAM to stimulate changing conditions (i.e. night, day and wind).

Meteorological fields were generated using the Weather Research and Forecasting (WRF) meteorological model, and the required modeling emissions inventories were developed by CARB and SCAQMD staff. The ozone air quality modeling utilized the Community Multiscale Air Quality (CMAQ) modeling platform and SAPRC07 chemistry, with initial and boundary conditions based on estimates of clean-air concentrations. Analysis of the model outputs included the estimation of 1-hour and 8-hour ozone concentrations for each ozone monitoring site within the domain, as well as statistical measures comparing observed and simulated ozone

[58] "2022 AQMP Appendix V - Modeling and Attainment Demonstrations," SCAQMD, 2022

concentrations. These analyses were used to evaluate model performance by sub-region within the domain.

Modeling Domain

The modeling domain is based on the domain defined for the 1997 Southern California Ozone Study and includes the SCAB and the surrounding coastal, desert and mountain areas, including the District. This model domain includes the upwind sources within SCAQMD, which are responsible for the overwhelming ozone transport into the District. The northern boundary of the model extends into Santa Barbara and Kern counties, while the southern boundary extends in Mexico. The eastern boundary of the modeling domain extends into the desert portions of San Bernardino and Riverside counties, while the western boundary extends into the Pacific Ocean. The domain horizontal grid is 156 by 102 cells, with a cell resolution of four kilometers. The domain has a vertical resolution of 30 layers.

Model Inputs

SCAQMD performed the UAM attainment demonstration using data maintained by CARB and the District. The emissions inventory used for the UAM is consistent with the emissions inventory presented in the appendices to this document.

Design Values and Wildfire Events

An ozone design value (or DV) is a statistical value representing the highest consistent eight hour ozone concentration at a monitoring site for a given year and the previous two years. The desert portion of the ozone nonattainment area experienced numerous anomalous wildfire events during the 2017-2020 design value evaluation range. Most notably the Phelan site was impacted by wildfire ozone, which is also the site with the highest ozone concentrations during the 2017-2020 years. The District has selected a weighted average of two years to minimize the impact of wildfire ozone (consistent with U.S. EPA guidance, the 2018 and 2019 design values are averaged with the average of the fourth highest ozone value from 2018 and 2019). As is shown in Table 19 below, excluding wildfire ozone reduces the base year design value by at least 2 ppb and as much as 7 ppb:

Table 19 - Wildfire Influence on Design Values

Wildfire Days Included							
Site	2017 DV	2018 DV	2019 DV	2020 DV	2018 4th High	2019 4th High	Weighted Average DV (2018-2019)
Phelan	0.096	0.098	0.095	0.090	0.094	0.085	**94**
Hesperia	0.091	0.090	0.087	0.087	0.088	0.085	**87**
Lancaster	0.089	0.085	0.082	0.080	0.087	0.076	**82**
Victorville	0.084	0.082	0.081	0.083	0.087	0.078	**81**
Wildfire Days Excluded							
Site	2017 DV	2018 DV	2019 DV	2020 DV	2018 4th High	2019 4th High	Weighted Average DV (2018-2019)
Phelan	0.090	0.090	0.088	0.083	0.086	0.081	**87**
Hesperia	0.090	0.087	0.085	0.083	0.083	0.085	**85**
Lancaster	0.089	0.081	0.078	0.073	0.077	0.075	**78**
Victorville	0.083	0.079	0.078	0.079	0.081	0.078	**78**

Unmonitored Area Analysis

An unmonitored area analysis was conducted to estimate 8-hour ozone design values in unmonitored locations. This analysis uses both the measurement design values and the modelled ozone profiles throughout the modeling domain. Details of this analysis are presented in Appendix 5, Chapter 5 of the 2022 SCAQMD AQMP.[59] The same procedures and methodology were used for the South Coast Air Basin unmonitored area analysis.

Five-year weighted design values were calculated for all monitoring stations within and in the vicinity of the modeling domain for the 2016 to 2020 period. Only stations that met the data completeness requirement for each of the 5 years were included in the analysis. A model gradient adjustment method was implemented to determine base year ozone in unmonitored locations. The adjustment method selected the nearest monitors and calculated the ratio of the top five modeled 8-hour ozone values during July-September at unmonitored and monitored locations. It then multiplied the ratio by the measured design values while applying an inverse distance weight; thus, monitors nearest to the unmonitored location carried the greatest weight. Figure 1 illustrates the spatial distribution of 8-hour ozone 5-year weighted design values calculated using the model gradient adjustment method. Mojave Desert AQMD provided custom 5-year weighted 2016-2020 design values for Phelan, Hesperia, Victorville, and Lancaster to discard days affected by wildfires considered as exceptional events; all other monitors used design values retrieved through U.S. EPA’s Air Quality System.

[59] http://www.aqmd.gov/home/air-quality/clean-air-plans/air-quality-mgt-plan

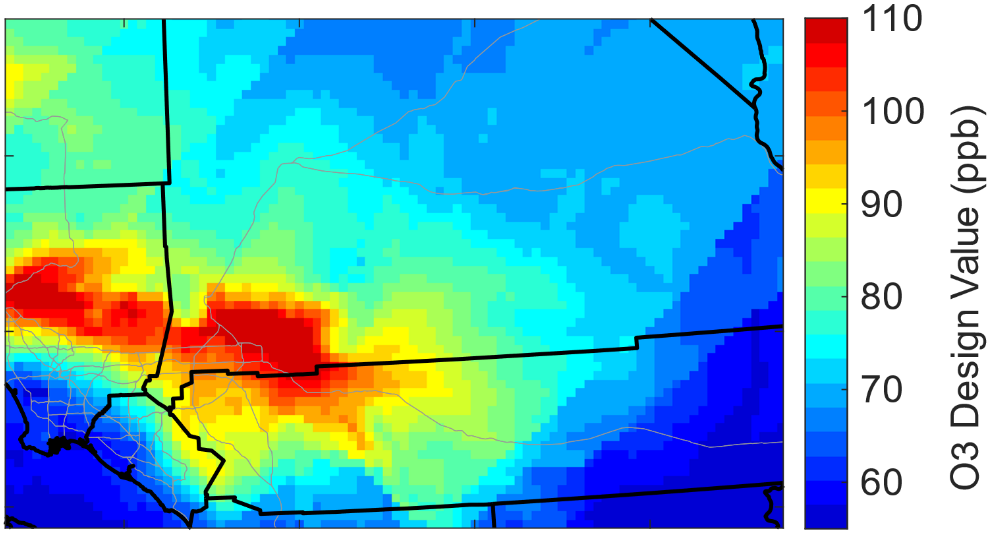

Figure 6 - 5-Year Weighted 2016-2020 Design Values

The relative response factors representing the ratio between the 2032 simulated ozone and the base-year (2018) simulated ozone are presented below in Figure 2. The 2032 simulation corresponded to the 2032 control scenario described in Appendix V of the 2022 AQMP.

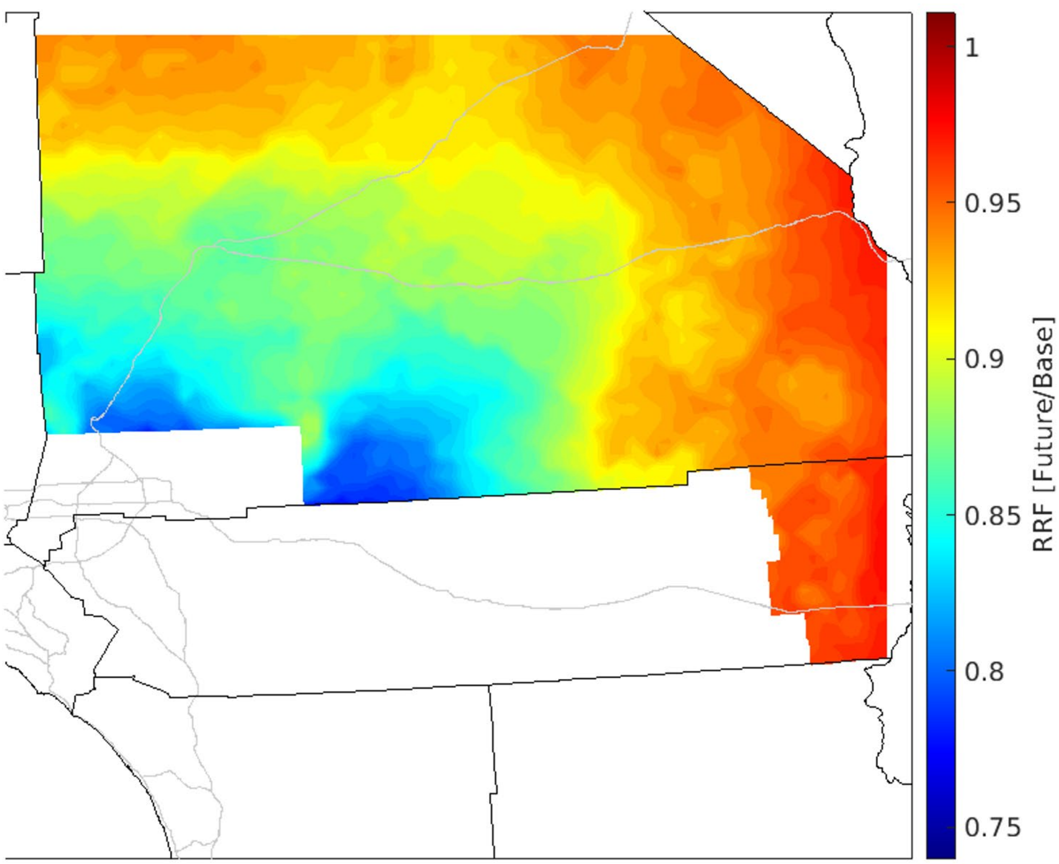

Figure 7 - 2032 RRF Fields

The relative response factors suggest that ozone will decrease faster in the southwestern area of the air basin. The eastern portion of the district along the Arizona border will exhibit the slowest decrease in future ozone concentrations. The calculated RRF field is then used to project the model gradient adjusted measurement field to simulate future year concentrations. Figure 3 shows the predicted future ozone concentrations for 2032 in the Mojave Desert Air Basin.

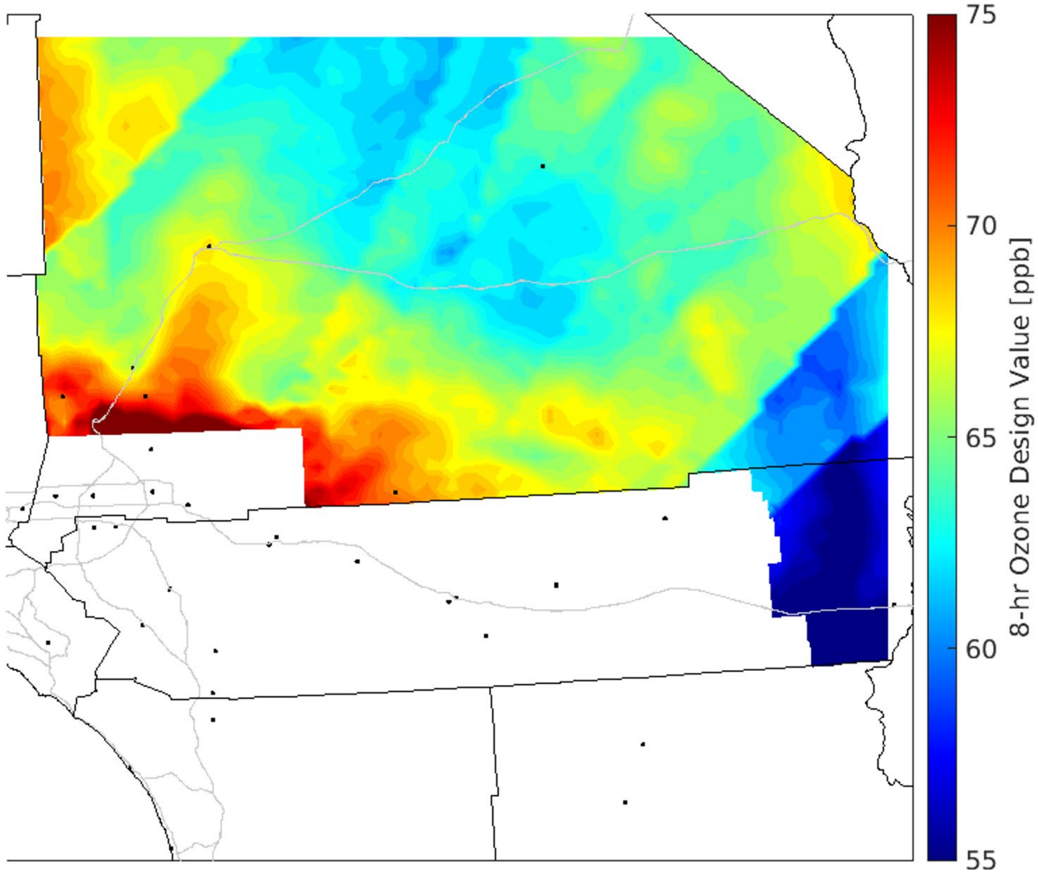

Figure 8 - 2032 Predicted 8-hr Ozone Design Values
(Monitoring Stations are notated with black dots)

The southwestern corner of the Mojave Desert Air Basin bordering the South Coast Air Basin is projected to exhibit the highest concentrations. The maximum ozone design value is projected to be 84.2 ppb south of Hesperia.

Model Performance Statistical Evaluation

The statistics used to evaluate 8-hour average CMAQ ozone performance include the following:

<u>Statistic for O_3</u>	<u>Definition</u>
Daily-Max Bias Error Unpaired	Average of the differences in observed and predicted daily maximum values. Negative values indicate under-prediction. $BiasError = \frac{1}{N}\sum(Obs - Pred)$

Daily-Max Bias Error Paired	Average of the differences in daily maximum observed value and the corresponding predicted concentration at the hour that the observational maximum was reached. Negative values indicate under-prediction. $BiasError = \frac{1}{N}\sum(Obs - Pred)$
Daily-Max Gross Error Unpaired	Average of the absolute differences in observed and predicted daily maximum values $GrossError = \frac{1}{N}\sum\lvert Obs - Pred\rvert$
Daily-Max Gross Error Paired	Average of the absolute differences in daily maximum observed value and the corresponding predicted concentration at the hour that the observational maximum was reached. $GrossError = \frac{1}{N}\sum\lvert Obs - Pred\rvert$
Normalized Daily-Max Bias Error Unpaired	Average of the quantity: difference in observed and predicted daily maximum values normalized by the observed daily maximum values. Negative values indicate under-prediction. $NormBiasError = \frac{1}{N}\sum\left(\frac{Obs-Pred}{Obs}\right)\cdot 100$
Normalized Daily-Max Bias Error Paired	Average of the quantity: difference in daily maximum observed value and the corresponding predicted concentration at the hour that the observational maximum was reached normalized by the observed daily maximum concentration. Negative values indicate under-prediction. $NormBiasError = \frac{1}{N}\sum\left(\frac{Obs-Pred}{Obs}\right)\cdot 100$
Normalized Daily-Max Gross Error Unpaired	Average of the quantity: absolute difference in observed and predicted daily maximum values normalized by the observed daily maximum concentration $NormGrossError = \frac{1}{N}\sum\left\lvert\frac{Obs-Pred}{Obs}\right\rvert\cdot 100$
Normalized Daily-Max Gross Error Paired	Average of the quantity: absolute difference in daily maximum observed value and the corresponding predicted concentration at the

	hour that the observational maximum was reached normalized by the observed daily maximum concentration $NormGrossError = \frac{1}{N}\sum\left\|\frac{Obs-Pred}{Obs}\right\| \cdot 100$
Peak Prediction Accuracy Unpaired	Difference in the maximum of the observed daily maximum and the maximum of the predicted daily maximum normalized by the maximum of the observed daily maximum $PPA = \frac{(maximum(Pred) - \mathrm{maximum}(Obs))}{\mathrm{maximum}(Pred)}$

Predicted concentrations are extracted from model output in the grid cell that each monitoring station resides.

The modeling results for the Western Mojave Desert Area are based modeling performed by the South Coast AQMD as part of its 2022 Air Quality Management Plan. Details on the modeling can be found in Appendix V of South Coast AQMP.[60] We evaluated the base year average regional model performance for maximum daily 8-hour Ozone (MDA8) during May through September 2018 for days when Basin MDA8 ozone levels were at least 60 ppb. Ozone performance criteria are presented in Table 19. Only stations with more than 74.5% (EPA's data completeness requirement) of the hourly measurements during each month of the ozone season were included in the analysis. Ozone measurements from monitors in Blythe, Black Rock Canyon, Hesperia, s1001 (Mojave National Park and Preserve- Kelso Mountains), Victorville, Phelan, and Barstow were compiled for the analysis.

[60] Appendix V, Modeling and Attainment Demonstrations; combined-appendix-v.pdf (aqmd.gov)

TABLE 19 - 2018 Base Year MDA8 Ozone Performance for Days When Regional 8-Hour Maximum ≥ 60 ppb in the "Mojave" region

	May	Jun	Jul	Aug	Sep
Number of days with regional MDA8 >= 60 ppb	28	30	31	31	21
Number of data points	203	206	211	211	155
MDA8 Mean Pred. Unpaired [ppb]	64.7	70.5	67.8	67.3	63.8
MDA8 Mean Pred. Paired [ppb]	63.4	68.4	64.9	65	61.2
MDA8 Obs. [ppb]	61.4	68.4	66.6	67.3	57.1
MDA8 Bias Err. Unpaired [ppb]	3.3	2.1	1.2	0.1	6.7
MDA8 Bias Err. Paired [ppb]	2	-0.1	-1.7	-2.3	4.1
MDA8 Gross Err. Unpaired [ppb]	7.5	11.1	10.3	10.9	11.4
MDA8 Gross Err. Paired [ppb]	7.3	10.9	10.8	11.2	11
Norm MDA8 Bias Err. Unpaired [%]	7.5	8.7	5.6	5.2	17.8
Norm MDA8 Bias Err. Paired [%]	5.3	5.3	1.2	1.5	13.4
Norm MDA8 Gross Err. Unpaired [%]	13.3	20.3	17.6	19.3	24.4
Norm MDA8 Gross Err. Paired [%]	12.8	19.4	18	19.3	23.2
Peak Prediction Accuracy Unpaired [%]	-8	-10.3	-2	-5	9.9

Figure 9 illustrates the model performance of daily maximum 8-hour ozone. MDA8 ozone values are generally slightly over-predicted, but most of the data lie within 10% of the measured values. The "unpaired" MDA8 bias error metric indicates that the model is positively biased (over-prediction) during all months with bias error values of 3.4 ppb, 2.4 ppb, 0.8 ppb, and 6.8 ppb during May, June, July, and September, respectively, except during August with negative bias (under-prediction) of 0.4 ppb; "paired" bias error metric indicates positive bias during May, June, and September with bias error values of 2.0 ppb, 0.2 ppb, and 4.2 ppb, respectively, but negative bias during July (-2.0 ppb) and August (-2.9 ppb).

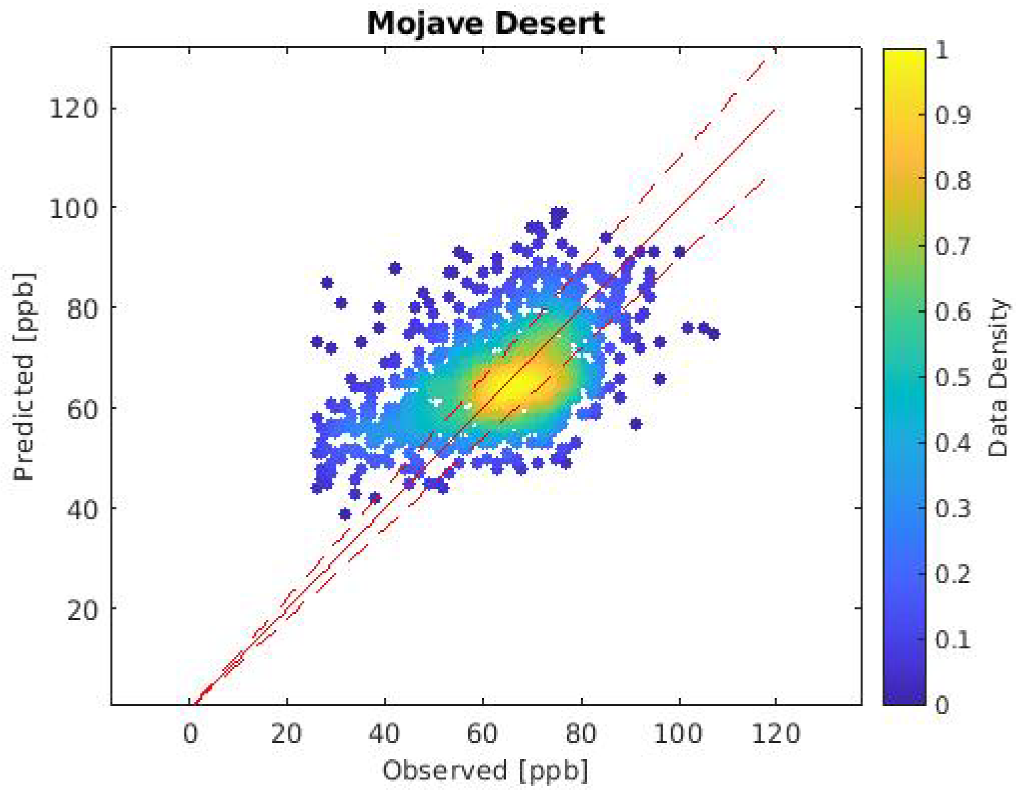

Figure 9 - Density Scatter Plot of Maximum Daily 8-hour (MDA8) Values in WMDONA
Dashed lines indicate the bounds of 10% agreement.

Figures 10-16 include model performance scatter plots of 2018 MDA8 ozone predictions versus observations color-coded by weekends versus weekdays; both the MDA8 data points and a generalized linear model fit (line) with 95 percent confidence interval (shaded area) along with 1:1 line are shown in the scatter plots. The model performance of MDA8 predictions is similar on weekday versus weekend data points; the slope of fitted line is almost identical for the two datasets (weekend vs. weekday). While an ozone weekend effect is well documented in the South Coast Air Basin, it is assumed that the Mojave Desert exhibits little to no weekend effect. This is consistent with the plots which demonstrate no apparent weekend effect for these stations, providing further evidence that the model performs reasonably well.

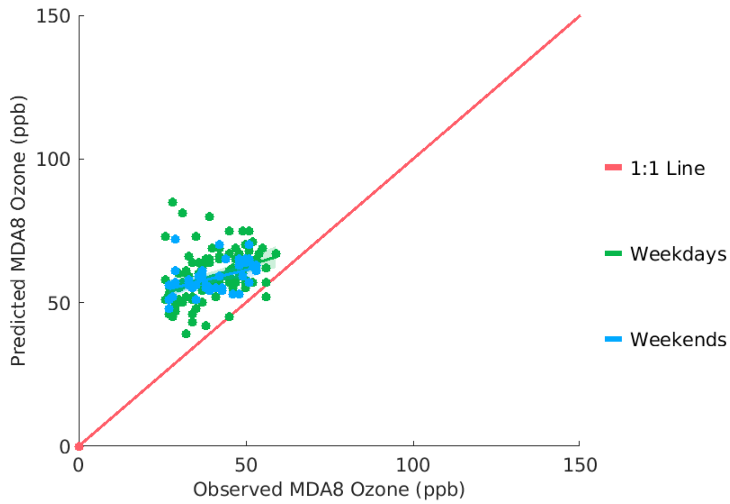

Figure 10
Maximum daily 8-hour average (MDA8) model performance at Blythe (s9003) during May-September 2018.

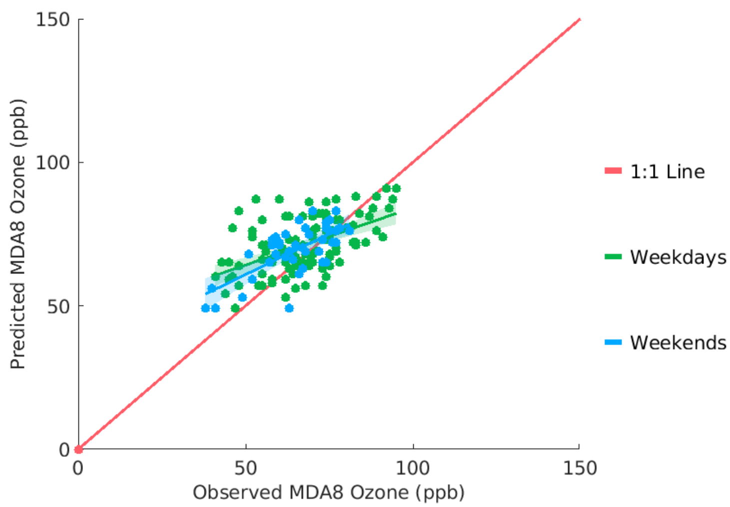

Figure 11
Maximum daily 8-hour average (MDA8) model performance at Black Rock Canyon (s9002) during May-September 2018.

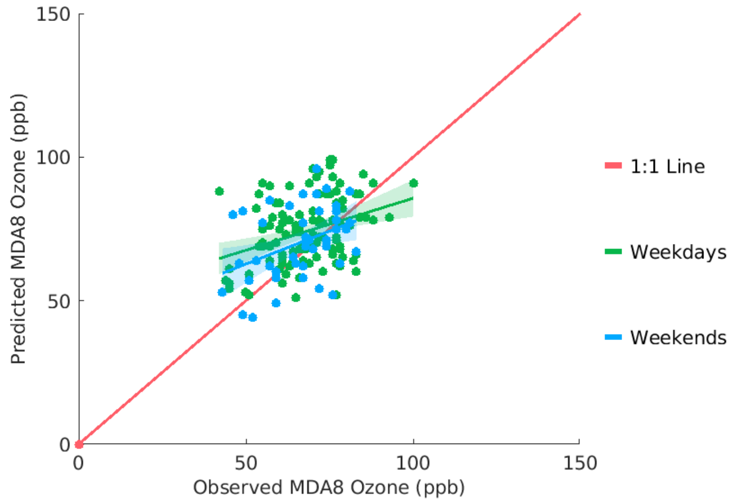

Figure 12
Eight-hour daily maxima model performance at Hesperia (s4001) during May-September 2018.

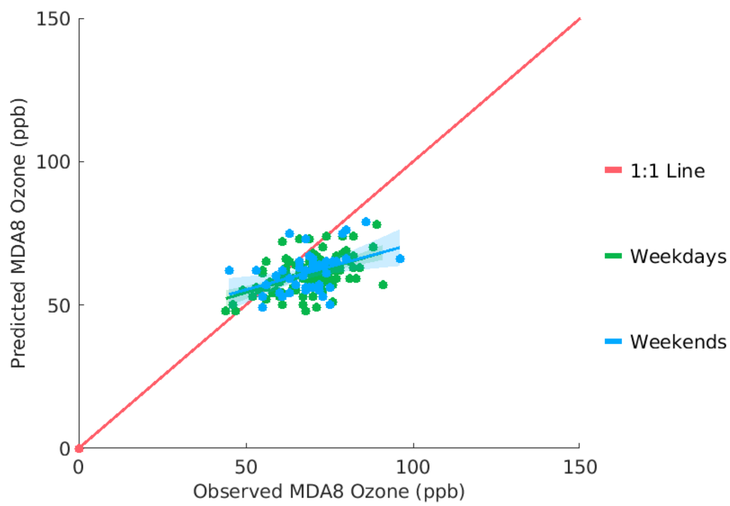

Figure 13
Eight-hour daily maxima model performance at site Mojave National Park and Preserve- Kelso Mountains (s1001) during May-September 2018.

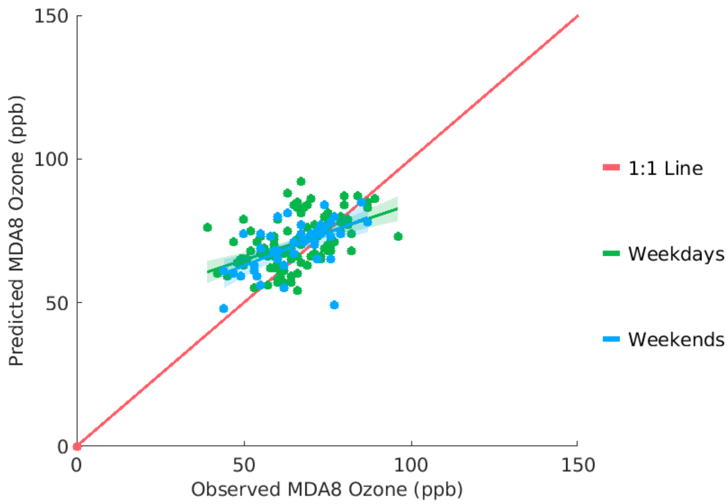

Figure 14
Eight-hour daily maxima model performance at Victorville (s306) during May-September 2018.

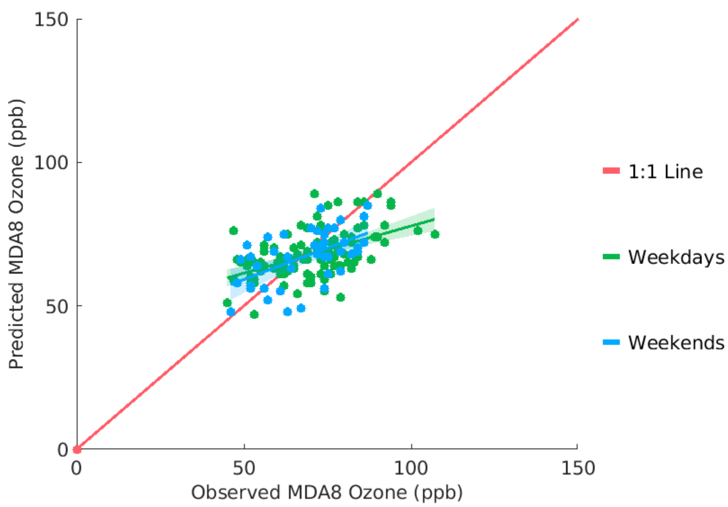

Figure 15
Eight-hour daily maxima model performance at Phelan (s12) during May-September 2018.

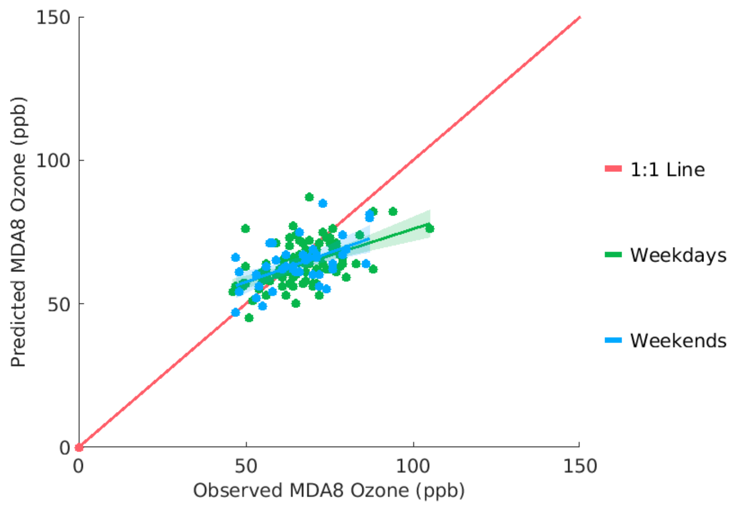

Figure 16
Eight-hour daily maxima model performance at Barstow (s1) during May-September 2018.

DISCUSSION ON OZONE INTRUSION

Transport from upper troposphere and lower stratosphere is prevalent in winter and spring, and contribution of aloft ozone from long-range transport generally peaks in spring. While there is no evidence of a specific transport event during the ozone modeling season of 2018, ozone curtain plots along the west-east and south-west show elevated ozone concentrations above 2,000 meters in May and June. Figure 9 shows the location of the monitoring station at Phelan and the west-east and south-north transects. Figure 10 shows the curtain plots for monthly average ozone concentrations along the west-east transect for the months of May and June, and Figure 11 shows the curtain plots along the south-north transect. The curtain plots for May show high concentrations of ozone at 8,000 meters and progressively decreasing with decreasing altitude, but with still some high ozone at the altitude of Phelan possibly enhanced by the ozone coming from the high troposphere. The curtain plots for June do not exhibit high ozone at 8,000 meters but show a band of high ozone at 3,000 meters, which is largely contributed by long-range transport. This band of high ozone aloft ends up mixing with the ozone produced locally.

Figure 17
Location of the monitoring station at Phelan and west-east and south-north transects

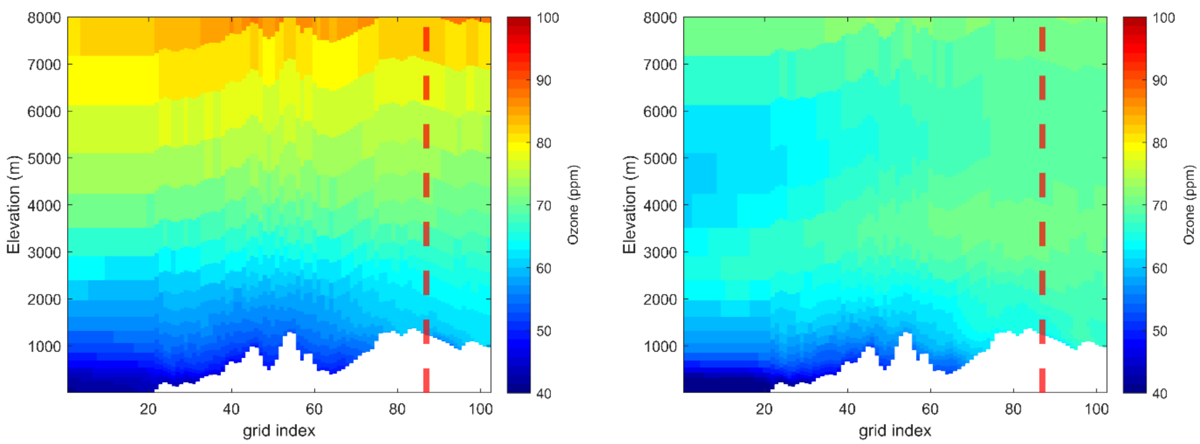

Figure 18
Ozone curtain plots of the ozone monthly average along west-east transect for May (left) and June (right)

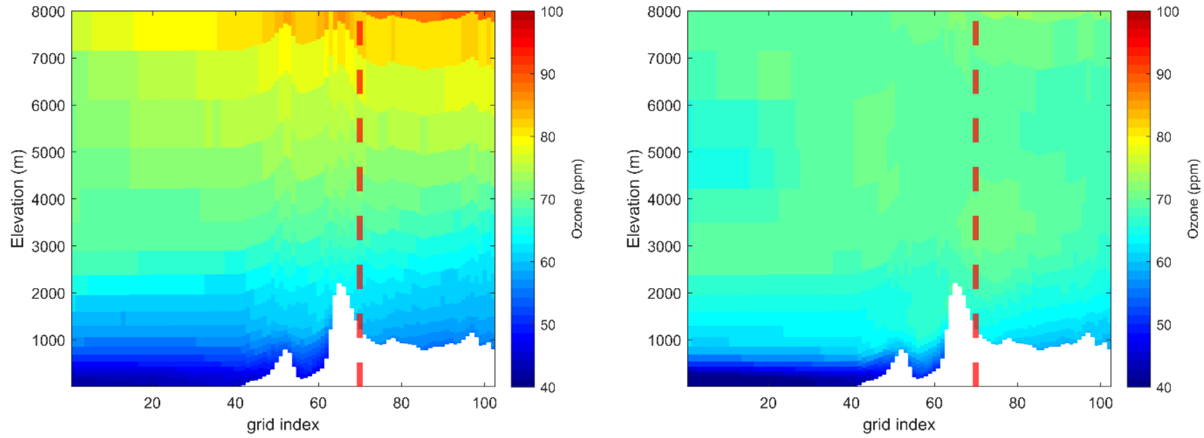

Figure 19
Ozone curtain plots of the ozone monthly average along south-north transect for May (left) and June (right)

Modeling Results

Table 20 details the base and future year design values for all stations with design values that meet the data completeness criteria. The base design value represents the 5-year weighted 8-hr ozone design value from 2018 (average of the 8-hour ozone design values for 2018, 2019 and 2020). Some high ozone days were excluded in the design value calculations for the base years due to the influence of wildfires. Discussion on the wildfire events is included in Appendices C and D. Future design values were determined with comprehensive meteorological and chemical transport modelling and spatially resolved emissions projections following the United States Environmental Protection Agency (US PEA) guidance. To bridge the gap between air quality model predictions and measurements, the U.S. EPA recommends the use of relative response factors (RRFs). In this approach, future year concentration predictions require two elements: base year design values and RRFs. The RRF is simply a ratio of the future year predicted air quality to the simulated air quality in the base year, representing the model-predicted change in air quality in response to predicted emissions changes. Future year concentrations are estimated by multiplying the non-dimensional RRF by the base year design value, thus applying the model-predicted change in air quality directly to the measured concentrations in the base year. Assuming any potential modeling biases are similar in the base and future years, the RRF approach acts to minimize their impact on predictions. Details are documented in the Appendix V of South Coast AQMD's Draft Final 2022 AQMP. The RRF for this region were calculated using modeled values for the months of July through September. While there are potential high ozone days in May and June, there is evidence that ozone concentrations in high elevation stations, like Phelan (altitude 4,193 feet), are affected by ozone intrusion from mid to upper troposphere, rendering ozone concentrations insensitive to emission controls. These events happen more frequently in late Spring than other seasons, as discussed in the next section, and hence, RRF calculations exclude modeled values for May and June.

The Western Mojave Desert stations are expected to exceed the 70 ppb 8-hour ozone standard in 2032 if no additional emission reductions are introduced beyond already adopted controls. Additional emissions reduction commitment from CARB's 2022 State SIP Strategy and South

Coast AQMD by 2032 will bring the region to attainment, with Phelan as the design site with a design value of 70.8 ppb. In addition, emission reductions required to attain the 70 ppb 8-hour ozone standard in the South Coast Air Basin will continue contributing to further reducing the ozone concentrations in the Western Mojave Desert air basin through 2037. Detailed ozone concentrations in the base year (2018) and future milestone year 2032 and an attainment scenario are presented in Table 20.

Table 20 - Base Year and Future Year Design Values

Station Name	AQS Station Number	5-year weighted 2018 Design Value	Base 2032 Design Value	2032 with controls Design Values*
Barstow**	060710001	78.3	71.3	68.7
Phelan-Beekley Road and Phelan Road	060710012	87.0	75.8	70.8
Victorville-14306 Park Avenue	060710306	78.7	68.6	63.9
Hesperia-Olive Street	060714001	85.0	74.3	68.8
Joshua Tree-National Monument**	060719002	88.0	74.4	68.2
Lancaster-43301 Division Street	060379033 (LA County)	77.3	67.9	64.2

* Emission controls include South Coast AQMD's defined measures for stationary sources from the Draft Final 2022 AQMP and CARB's measures for mobile sources from the 2022 State SIP Strategy. Emissions reductions reflected in this scenario is summarized in Table 4-18 of the Draft Final 2022 AQMP.

** 5-year weighted design values for the monitors at Barstow and Joshua Tree are calculated without excluding any fire events

The modeling results show that the WMDONA will attain the 8-hour ozone NAAQS (70 ppb) prior to the 2032 attainment deadline for Severe ozone nonattainment areas.

Appendices

A - Base Year Emission Inventory
B - Planning Emission Inventories
C - Annual Ambient Monitoring Data and Wildfire Identified Days Summary
D - Weight of Evidence Analysis
E - Ozone RACM Assessment
F - ARB Adopted Mobile Source Programs

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APPENDIX A - BASE YEAR EMISSION INVENTORY

2018 Baseline Emissions Inventory (tons per ozone seasonal day)			
CATEGORY	**SUB CATEGORY**	**VOC**	**NOx**
FUEL COMBUSTION	ELECTRIC UTILITIES	0.030	0.370
FUEL COMBUSTION	COGENERATION	0.000	0.011
FUEL COMBUSTION	OIL AND GAS PRODUCTION (COMBUSTION)	0.000	0.000
FUEL COMBUSTION	MANUFACTURING AND INDUSTRIAL	0.142	2.103
FUEL COMBUSTION	FOOD AND AGRICULTURAL PROCESSING	0.002	0.028
FUEL COMBUSTION	SERVICE AND COMMERCIAL	0.133	1.185
FUEL COMBUSTION	OTHER (FUEL COMBUSTION)	0.006	0.042
WASTE DISPOSAL	SEWAGE TREATMENT	0.017	0.000
WASTE DISPOSAL	LANDFILLS	0.206	0.030
WASTE DISPOSAL	INCINERATORS	0.001	0.019
WASTE DISPOSAL	SOIL REMEDIATION	0.002	0.000
WASTE DISPOSAL	OTHER (WASTE DISPOSAL)	0.054	0.003
CLEANING AND SURFACE COATINGS	LAUNDERING	0.008	0.000
CLEANING AND SURFACE COATINGS	DEGREASING	4.750	0.000
CLEANING AND SURFACE COATINGS	COATINGS AND RELATED PROCESS SOLVENTS	1.617	0.001
CLEANING AND SURFACE COATINGS	PRINTING	0.009	0.000
CLEANING AND SURFACE COATINGS	ADHESIVES AND SEALANTS	0.072	0.000
CLEANING AND SURFACE COATINGS	OTHER (CLEANING AND SURFACE COATINGS)	0.006	0.000
PETROLEUM PRODUCTION AND MARKETING	OIL AND GAS PRODUCTION	0.000	0.000
PETROLEUM PRODUCTION AND MARKETING	PETROLEUM REFINING	0.001	0.000
PETROLEUM PRODUCTION AND MARKETING	PETROLEUM MARKETING	5.379	0.000
PETROLEUM PRODUCTION AND MARKETING	OTHER (PETROLEUM PRODUCTION AND MARKETING)	0.001	0.000
INDUSTRIAL PROCESSES	CHEMICAL	0.204	0.010
INDUSTRIAL PROCESSES	FOOD AND AGRICULTURE	0.015	0.000
INDUSTRIAL PROCESSES	MINERAL PROCESSES	0.464	15.857
INDUSTRIAL PROCESSES	METAL PROCESSES	0.001	0.000
INDUSTRIAL PROCESSES	WOOD AND PAPER	0.029	0.000
INDUSTRIAL PROCESSES	GLASS AND RELATED PRODUCTS	0.000	0.000
INDUSTRIAL PROCESSES	ELECTRONICS	0.000	0.000
INDUSTRIAL PROCESSES	OTHER (INDUSTRIAL PROCESSES)	0.255	0.036
	Stationary Totals:	*13.405*	*19.696*
SOLVENT EVAPORATION	CONSUMER PRODUCTS	5.860	0.000
SOLVENT EVAPORATION	ARCHITECTURAL COATINGS AND RELATED PROCESS SOLVENTS	0.905	0.000
SOLVENT EVAPORATION	PESTICIDES/FERTILIZERS	0.071	0.000
SOLVENT EVAPORATION	ASPHALT PAVING / ROOFING	0.483	0.000
MISCELLANEOUS PROCESSES	RESIDENTIAL FUEL COMBUSTION	0.141	0.868
MISCELLANEOUS PROCESSES	FARMING OPERATIONS	2.064	0.000
MISCELLANEOUS PROCESSES	CONSTRUCTION AND DEMOLITION	0.000	0.000
MISCELLANEOUS PROCESSES	PAVED ROAD DUST	0.000	0.000
MISCELLANEOUS PROCESSES	UNPAVED ROAD DUST	0.000	0.000
MISCELLANEOUS PROCESSES	FUGITIVE WINDBLOWN DUST	0.000	0.000
MISCELLANEOUS PROCESSES	FIRES	0.021	0.005
MISCELLANEOUS PROCESSES	MANAGED BURNING AND DISPOSAL	0.048	0.023
MISCELLANEOUS PROCESSES	COOKING	0.537	0.000
MISCELLANEOUS PROCESSES	OTHER (MISCELLANEOUS PROCESSES)	0.000	0.000
	Area Totals:	*10.128*	*0.896*

ON-ROAD MOTOR VEHICLES	LIGHT DUTY PASSENGER (LDA)	2.200	1.495
ON-ROAD MOTOR VEHICLES	LIGHT DUTY TRUCKS - 1 (LDT1)	0.676	0.390
ON-ROAD MOTOR VEHICLES	LIGHT DUTY TRUCKS - 2 (LDT2)	1.154	0.979
ON-ROAD MOTOR VEHICLES	MEDIUM DUTY TRUCKS (MDV)	1.156	1.076
ON-ROAD MOTOR VEHICLES	LIGHT HEAVY DUTY GAS TRUCKS - 1 (LHDGT1)	0.332	0.228
ON-ROAD MOTOR VEHICLES	LIGHT HEAVY DUTY GAS TRUCKS - 2 (LHDGT2)	0.031	0.025
ON-ROAD MOTOR VEHICLES	MEDIUM HEAVY DUTY GAS TRUCKS (MHDGT)	0.036	0.069
ON-ROAD MOTOR VEHICLES	HEAVY HEAVY DUTY GAS TRUCKS (HHDGT)	0.001	0.001
ON-ROAD MOTOR VEHICLES	LIGHT HEAVY DUTY DIESEL TRUCKS - 1 (LHDDT1)	0.049	1.632
ON-ROAD MOTOR VEHICLES	LIGHT HEAVY DUTY DIESEL TRUCKS - 2 (LHDDT2)	0.015	0.476
ON-ROAD MOTOR VEHICLES	MEDIUM HEAVY DUTY DIESEL TRUCKS (MHDDT)	0.052	1.174
ON-ROAD MOTOR VEHICLES	HEAVY HEAVY DUTY DIESEL TRUCKS (HHDDT)	0.415	10.886
ON-ROAD MOTOR VEHICLES	MOTORCYCLES (MCY)	1.111	0.300
ON-ROAD MOTOR VEHICLES	HEAVY DUTY DIESEL URBAN BUSES (UBD)	0.002	0.060
ON-ROAD MOTOR VEHICLES	HEAVY DUTY GAS URBAN BUSES (UBG)	0.000	0.002
ON-ROAD MOTOR VEHICLES	SCHOOL BUSES - GAS (SBG)	0.000	0.001
ON-ROAD MOTOR VEHICLES	SCHOOL BUSES - DIESEL (SBD)	0.005	0.328
ON-ROAD MOTOR VEHICLES	OTHER BUSES - GAS (OBG)	0.008	0.024
ON-ROAD MOTOR VEHICLES	OTHER BUSES - MOTOR COACH - DIESEL (OBC)	0.001	0.028
ON-ROAD MOTOR VEHICLES	ALL OTHER BUSES - DIESEL (OBD)	0.002	0.029
ON-ROAD MOTOR VEHICLES	MOTOR HOMES (MH)	0.013	0.109
	On-Road Mobile Totals:	*7.261*	*19.314*
OTHER MOBILE SOURCES	AIRCRAFT	1.176	0.961
OTHER MOBILE SOURCES	TRAINS	0.992	21.316
OTHER MOBILE SOURCES	RECREATIONAL BOATS	0.227	0.036
OTHER MOBILE SOURCES	OFF-ROAD RECREATIONAL VEHICLES	0.324	0.017
OTHER MOBILE SOURCES	OFF-ROAD EQUIPMENT	2.925	2.523
OTHER MOBILE SOURCES	OFF-ROAD EQUIPMENT (PERP)	0.026	0.309
OTHER MOBILE SOURCES	FARM EQUIPMENT	0.191	0.994
OTHER MOBILE SOURCES	FUEL STORAGE AND HANDLING	0.396	0.000
	Other Mobile Totals:	*6.259*	*26.156*
	WMDONA Totals:	**37.052**	**66.061**

APPENDIX B - PLANNING EMISSION INVENTORIES

VOC/ROG (tons per ozone seasonal day)							
Type	**CATEGORY**	**SUB CATEGORY**	**2017**	**2023**	**2026**	**2029**	**2032**
Stat	FUEL COMBUSTION	ELECTRIC UTILITIES	0.04	0.03	0.03	0.03	0.03
Stat	FUEL COMBUSTION	COGENERATION	0.00	0.00	0.00	0.00	0.00
Stat	FUEL COMBUSTION	MANUFACTURING AND INDUSTRIAL	0.15	0.14	0.14	0.14	0.14
Stat	FUEL COMBUSTION	FOOD AND AGRICULTURAL PROCESSING	0.00	0.00	0.00	0.00	0.00
Stat	FUEL COMBUSTION	SERVICE AND COMMERCIAL	0.11	0.14	0.14	0.15	0.15
Stat	FUEL COMBUSTION	OTHER (FUEL COMBUSTION)	0.01	0.01	0.01	0.01	0.01
Stat	WASTE DISPOSAL	SEWAGE TREATMENT	0.02	0.02	0.02	0.02	0.02
Stat	WASTE DISPOSAL	LANDFILLS	0.20	0.22	0.23	0.24	0.24
Stat	WASTE DISPOSAL	INCINERATORS	0.00	0.00	0.00	0.00	0.00
Stat	WASTE DISPOSAL	SOIL REMEDIATION	0.00	0.00	0.00	0.00	0.00
Stat	WASTE DISPOSAL	OTHER (WASTE DISPOSAL)	0.05	0.06	0.06	0.06	0.06
Stat	CLEANING AND SURFACE COATINGS	LAUNDERING	0.00	0.01	0.01	0.01	0.01
Stat	CLEANING AND SURFACE COATINGS	DEGREASING	4.48	4.87	4.91	4.92	4.88
Stat	CLEANING AND SURFACE COATINGS	COATINGS AND RELATED PROCESS SOLVENTS	1.41	1.69	1.73	1.76	1.76
Stat	CLEANING AND SURFACE COATINGS	PRINTING	0.01	0.01	0.01	0.01	0.01
Stat	CLEANING AND SURFACE COATINGS	ADHESIVES AND SEALANTS	0.07	0.07	0.07	0.07	0.07
Stat	CLEANING AND SURFACE COATINGS	OTHER (CLEANING AND SURFACE COATINGS)	0.02	0.01	0.01	0.01	0.01
Stat	PETROLEUM PROD AND MKTG	OIL AND GAS PRODUCTION	0.00	0.00	0.00	0.00	0.00
Stat	PETROLEUM PROD AND MKTG	PETROLEUM REFINING	0.00	0.00	0.00	0.00	0.00
Stat	PETROLEUM PROD AND MKTG	PETROLEUM MARKETING	5.48	4.78	4.42	4.15	3.99
Stat	PETROLEUM PROD AND MKTG	OTHER (PETROLEUM PRODUCTION AND MARKETING)	0.00	0.00	0.00	0.00	0.00
Stat	INDUSTRIAL PROCESSES	CHEMICAL	0.21	0.21	0.22	0.23	0.23
Stat	INDUSTRIAL PROCESSES	FOOD AND AGRICULTURE	0.01	0.02	0.02	0.02	0.02
Stat	INDUSTRIAL PROCESSES	MINERAL PROCESSES	0.40	0.48	0.48	0.49	0.50
Stat	INDUSTRIAL PROCESSES	METAL PROCESSES	0.00	0.00	0.00	0.00	0.00
Stat	INDUSTRIAL PROCESSES	WOOD AND PAPER	0.04	0.03	0.03	0.04	0.04
Stat	INDUSTRIAL PROCESSES	OTHER (INDUSTRIAL PROCESSES)	0.25	0.26	0.26	0.27	0.27
Area	SOLVENT EVAPORATION	CONSUMER PRODUCTS	5.75	6.19	6.48	6.76	7.10
Area	SOLVENT EVAPORATION	ARCHITECTURAL COATINGS AND RELATED SOLVENTS	0.89	0.98	1.02	1.08	1.13
Area	SOLVENT EVAPORATION	PESTICIDES/FERTILIZERS	0.10	0.08	0.08	0.08	0.08
Area	SOLVENT EVAPORATION	ASPHALT PAVING / ROOFING	0.45	0.53	0.55	0.57	0.60
Area	MISCELLANEOUS PROCESSES	RESIDENTIAL FUEL COMBUSTION	0.14	0.14	0.14	0.14	0.14
Area	MISCELLANEOUS PROCESSES	FARMING OPERATIONS	2.09	1.94	1.88	1.83	1.78
Area	MISCELLANEOUS PROCESSES	FIRES	0.02	0.02	0.02	0.02	0.02
Area	MISCELLANEOUS PROCESSES	MANAGED BURNING AND DISPOSAL	0.09	0.05	0.05	0.05	0.05
Area	MISCELLANEOUS PROCESSES	COOKING	0.52	0.58	0.61	0.64	0.67
Mobile	ON-ROAD MOTOR VEHICLES	LIGHT DUTY PASSENGER (LDA)	2.46	1.54	1.36	1.22	1.12
Mobile	ON-ROAD MOTOR VEHICLES	LIGHT DUTY TRUCKS - 1 (LDT1)	0.75	0.46	0.38	0.30	0.24
Mobile	ON-ROAD MOTOR VEHICLES	LIGHT DUTY TRUCKS - 2 (LDT2)	1.26	0.85	0.76	0.68	0.60
Mobile	ON-ROAD MOTOR VEHICLES	MEDIUM DUTY TRUCKS (MDV)	1.25	0.80	0.68	0.59	0.52
Mobile	ON-ROAD MOTOR VEHICLES	LIGHT HEAVY DUTY GAS TRUCKS - 1 (LHDGT1)	0.37	0.23	0.19	0.18	0.14
Mobile	ON-ROAD MOTOR VEHICLES	LIGHT HEAVY DUTY GAS TRUCKS - 2 (LHDGT2)	0.03	0.02	0.02	0.01	0.01
Mobile	ON-ROAD MOTOR VEHICLES	MEDIUM HEAVY DUTY GAS TRUCKS (MHDGT)	0.04	0.02	0.02	0.02	0.02
Mobile	ON-ROAD MOTOR VEHICLES	HEAVY HEAVY DUTY GAS TRUCKS (HHDGT)	0.00	0.00	0.00	0.00	0.00
Mobile	ON-ROAD MOTOR VEHICLES	LIGHT HEAVY DUTY DIESEL TRUCKS - 1 (LHDDT1)	0.05	0.03	0.02	0.02	0.01
Mobile	ON-ROAD MOTOR VEHICLES	LIGHT HEAVY DUTY DIESEL TRUCKS - 2 (LHDDT2)	0.02	0.01	0.01	0.01	0.01
Mobile	ON-ROAD MOTOR VEHICLES	MEDIUM HEAVY DUTY DIESEL TRUCKS (MHDDT)	0.06	0.00	0.00	0.00	0.00
Mobile	ON-ROAD MOTOR VEHICLES	HEAVY HEAVY DUTY DIESEL TRUCKS (HHDDT)	0.46	0.23	0.25	0.27	0.29
Mobile	ON-ROAD MOTOR VEHICLES	MOTORCYCLES (MCY)	1.15	1.01	0.98	0.95	0.94
Mobile	ON-ROAD MOTOR VEHICLES	HEAVY DUTY DIESEL URBAN BUSES (UBD)	0.00	0.00	0.00	0.00	0.00
Mobile	ON-ROAD MOTOR VEHICLES	HEAVY DUTY GAS URBAN BUSES (UBG)	0.00	0.00	0.00	0.00	0.00
Mobile	ON-ROAD MOTOR VEHICLES	SCHOOL BUSES - GAS (SBG)	0.00	0.00	0.00	0.00	0.00
Mobile	ON-ROAD MOTOR VEHICLES	SCHOOL BUSES - DIESEL (SBD)	0.01	0.00	0.00	0.00	0.00
Mobile	ON-ROAD MOTOR VEHICLES	OTHER BUSES - GAS (OBG)	0.01	0.01	0.01	0.01	0.01
Mobile	ON-ROAD MOTOR VEHICLES	OTHER BUSES - MOTOR COACH - DIESEL (OBC)	0.00	0.00	0.00	0.00	0.00
Mobile	ON-ROAD MOTOR VEHICLES	ALL OTHER BUSES - DIESEL (OBD)	0.00	0.00	0.00	0.00	0.00
Mobile	ON-ROAD MOTOR VEHICLES	MOTOR HOMES (MH)	0.02	0.01	0.00	0.00	0.00
Mobile	OTHER MOBILE SOURCES	AIRCRAFT	1.14	1.21	1.22	1.24	1.25
Mobile	OTHER MOBILE SOURCES	TRAINS	0.92	1.00	0.98	1.02	1.00
Mobile	OTHER MOBILE SOURCES	RECREATIONAL BOATS	0.24	0.18	0.16	0.14	0.13
Mobile	OTHER MOBILE SOURCES	OFF-ROAD RECREATIONAL VEHICLES	0.34	0.26	0.23	0.19	0.16
Mobile	OTHER MOBILE SOURCES	OFF-ROAD EQUIPMENT	2.99	2.82	2.35	1.79	1.42
Mobile	OTHER MOBILE SOURCES	OFF-ROAD EQUIPMENT (PERP)	0.03	0.02	0.02	0.02	0.02
Mobile	OTHER MOBILE SOURCES	FARM EQUIPMENT	0.03	0.15	0.13	0.11	0.10
Mobile	OTHER MOBILE SOURCES	FUEL STORAGE AND HANDLING	0.41	0.34	0.31	0.30	0.29
		Totals (tons per ozone seasonal day):	**37.10**	**34.76**	**33.74**	**32.84**	**32.30**

NOx (tons per ozone seasonal day)							
Type	**Category**	**Sub Category**	**2017**	**2023**	**2026**	**2029**	**2032**
Stat	FUEL COMBUSTION	ELECTRIC UTILITIES	0.38	0.39	0.37	0.34	0.34
Stat	FUEL COMBUSTION	COGENERATION	0.01	0.01	0.01	0.01	0.01
Stat	FUEL COMBUSTION	MANUFACTURING AND INDUSTRIAL	2.19	2.07	2.09	2.06	2.03
Stat	FUEL COMBUSTION	FOOD AND AGRICULTURAL PROCESSING	0.03	0.03	0.02	0.02	0.02
Stat	FUEL COMBUSTION	SERVICE AND COMMERCIAL	1.00	1.27	1.33	1.39	1.44
Stat	FUEL COMBUSTION	OTHER (FUEL COMBUSTION)	0.05	0.04	0.04	0.05	0.05
Stat	WASTE DISPOSAL	LANDFILLS	0.03	0.03	0.03	0.03	0.03
Stat	WASTE DISPOSAL	INCINERATORS	0.02	0.02	0.02	0.02	0.02
Stat	WASTE DISPOSAL	OTHER (WASTE DISPOSAL)	0.00	0.00	0.00	0.00	0.00
Stat	CLEANING AND SURFACE COATINGS	COATINGS AND RELATED PROCESS SOLVENTS	0.00	0.00	0.00	0.00	0.00
Stat	PETROLEUM PROD AND MKTG	PETROLEUM MARKETING	0.00	0.00	0.00	0.00	0.00
Stat	INDUSTRIAL PROCESSES	CHEMICAL	0.01	0.01	0.01	0.01	0.01
Stat	INDUSTRIAL PROCESSES	MINERAL PROCESSES	14.77	16.03	16.16	16.27	16.31
Stat	INDUSTRIAL PROCESSES	OTHER (INDUSTRIAL PROCESSES)	0.01	0.04	0.04	0.04	0.04
Area	MISCELLANEOUS PROCESSES	RESIDENTIAL FUEL COMBUSTION	0.87	0.94	0.90	0.86	0.85
Area	MISCELLANEOUS PROCESSES	FIRES	0.00	0.00	0.00	0.00	0.00
Area	MISCELLANEOUS PROCESSES	MANAGED BURNING AND DISPOSAL	0.05	0.02	0.02	0.02	0.02
Mobile	ON-ROAD MOTOR VEHICLES	LIGHT DUTY PASSENGER (LDA)	1.73	0.87	0.71	0.62	0.59
Mobile	ON-ROAD MOTOR VEHICLES	LIGHT DUTY TRUCKS - 1 (LDT1)	0.45	0.21	0.16	0.12	0.09
Mobile	ON-ROAD MOTOR VEHICLES	LIGHT DUTY TRUCKS - 2 (LDT2)	1.14	0.52	0.39	0.31	0.26
Mobile	ON-ROAD MOTOR VEHICLES	MEDIUM DUTY TRUCKS (MDV)	1.23	0.54	0.38	0.27	0.22
Mobile	ON-ROAD MOTOR VEHICLES	LIGHT HEAVY DUTY GAS TRUCKS - 1 (LHDGT1)	0.26	0.14	0.10	0.08	0.06
Mobile	ON-ROAD MOTOR VEHICLES	LIGHT HEAVY DUTY GAS TRUCKS - 2 (LHDGT2)	0.03	0.02	0.01	0.01	0.01
Mobile	ON-ROAD MOTOR VEHICLES	MEDIUM HEAVY DUTY GAS TRUCKS (MHDGT)	0.08	0.03	0.03	0.02	0.02
Mobile	ON-ROAD MOTOR VEHICLES	HEAVY HEAVY DUTY GAS TRUCKS (HHDGT)	0.00	0.00	0.00	0.00	0.00
Mobile	ON-ROAD MOTOR VEHICLES	LIGHT HEAVY DUTY DIESEL TRUCKS - 1 (LHDDT1)	1.81	0.98	0.67	0.46	0.30
Mobile	ON-ROAD MOTOR VEHICLES	LIGHT HEAVY DUTY DIESEL TRUCKS - 2 (LHDDT2)	0.53	0.29	0.21	0.15	0.11
Mobile	ON-ROAD MOTOR VEHICLES	MEDIUM HEAVY DUTY DIESEL TRUCKS (MHDDT)	1.31	0.43	0.37	0.34	0.31
Mobile	ON-ROAD MOTOR VEHICLES	HEAVY HEAVY DUTY DIESEL TRUCKS (HHDDT)	11.64	6.94	3.76	3.31	3.28
Mobile	ON-ROAD MOTOR VEHICLES	MOTORCYCLES (MCY)	0.31	0.26	0.26	0.25	0.25
Mobile	ON-ROAD MOTOR VEHICLES	HEAVY DUTY DIESEL URBAN BUSES (UBD)	0.07	0.02	0.01	0.01	0.01
Mobile	ON-ROAD MOTOR VEHICLES	HEAVY DUTY GAS URBAN BUSES (UBG)	0.00	0.00	0.00	0.00	0.00
Mobile	ON-ROAD MOTOR VEHICLES	SCHOOL BUSES - GAS (SBG)	0.00	0.00	0.00	0.00	0.00
Mobile	ON-ROAD MOTOR VEHICLES	SCHOOL BUSES - DIESEL (SBD)	0.34	0.27	0.24	0.20	0.15
Mobile	ON-ROAD MOTOR VEHICLES	OTHER BUSES - GAS (OBG)	0.03	0.01	0.01	0.01	0.01
Mobile	ON-ROAD MOTOR VEHICLES	OTHER BUSES - MOTOR COACH - DIESEL (OBC)	0.03	0.01	0.01	0.01	0.01
Mobile	ON-ROAD MOTOR VEHICLES	ALL OTHER BUSES - DIESEL (OBD)	0.04	0.01	0.01	0.01	0.01
Mobile	ON-ROAD MOTOR VEHICLES	MOTOR HOMES (MH)	0.12	0.07	0.06	0.05	0.04
Mobile	OTHER MOBILE SOURCES	AIRCRAFT	0.90	0.99	1.00	1.01	1.03
Mobile	OTHER MOBILE SOURCES	TRAINS	19.73	22.97	23.65	24.86	25.19
Mobile	OTHER MOBILE SOURCES	RECREATIONAL BOATS	0.04	0.03	0.03	0.03	0.03
Mobile	OTHER MOBILE SOURCES	OFF-ROAD RECREATIONAL VEHICLES	0.02	0.02	0.02	0.02	0.02
Mobile	OTHER MOBILE SOURCES	OFF-ROAD EQUIPMENT	2.67	1.91	1.62	1.40	1.24
Mobile	OTHER MOBILE SOURCES	OFF-ROAD EQUIPMENT (PERP)	0.33	0.18	0.15	0.13	0.12
Mobile	OTHER MOBILE SOURCES	FARM EQUIPMENT	0.12	0.73	0.61	0.51	0.43
		Totals (tons per ozone seasonal day):	**64.38**	**59.38**	**55.53**	**55.33**	**54.98**

APPENDIX C - ANNUAL AMBIENT MONITORING DATA SUMMARY

WMDONA Maximum Ozone Values and Design Values

	Maximum Eight Hour Ozone Average (ppm)						
	Barstow	Hesperia	JTNM	Lancaster	MNP	Phelan	Victorville
1988	0.12	0.17	0.11	0.13		0.16	0.14
1989	0.11	0.15	0.12	0.15		0.16	0.13
1990	0.10	0.18	0.10	0.11		0.20	0.13
1991	0.14	0.17	0.12	0.11		0.15	0.16
1992	0.10	0.16	0.12	0.14		0.17	0.15
1993	0.11	0.15	0.11	0.13		0.14	0.14
1994	0.11	0.14	0.13	0.11		0.16	0.12
1995	0.10	0.12	0.11	0.11		0.17	0.12
1996	0.11	0.13	0.12	0.10		0.15	0.13
1997	0.11	0.13	0.12	0.10		0.13	0.12
1998	0.09	0.13	0.12	0.12		0.14	0.14
1999	0.11	0.12	0.12	0.08		0.11	0.10
2000	0.09	0.13	0.10	0.12		0.12	0.11
2001	0.10	0.10	0.09	0.10		0.12	0.10
2002	0.10	0.12	0.11	0.11		0.12	0.11
2003	0.10	0.13	0.12	0.12		0.13	0.13
2004	0.08	0.12	0.11	0.10		0.10	0.09
2005	0.09	0.12	0.11	0.10		0.12	0.11
2006	0.09	0.12	0.11	0.11		0.11	0.11
2007	0.09	0.11	0.11	0.10		0.10	0.09
2008	0.10	0.11	0.11	0.10		0.11	0.10
2009	0.09	0.10	0.10	0.10		0.10	0.10
2010	0.08	0.10	0.11	0.10		0.11	0.09
2011	0.08	0.11	0.10	0.10		0.10	0.09
2012	0.08	0.10	0.10	0.10	0.08	0.11	0.09
2013	0.09	0.08	0.09	0.09	0.09	0.10	0.10
2014	0.09	0.09	0.10	0.09	0.08	0.10	0.10
2015	0.08	0.11	0.09	0.10	0.08	0.09	0.11
2016	0.08	0.10	0.09	0.09	0.08	0.11	0.09
2017	0.08	0.09	0.10	0.09	0.08	0.12	0.08
2018	0.11	0.10	0.10	0.10	0.10	0.11	0.10
2019	0.08	0.09	0.09	0.08	0.08	0.09	0.08
2020	0.10	0.09	0.10	0.08	0.09	0.09	0.09
2021	0.09	0.10	0.09	0.08		0.11	0.10

8-Hour Trend		
	Max	Design V
1988	0.167	0.165
1989	0.161	0.153
1990	0.198	0.151
1991	0.173	0.151
1992	0.165	0.147
1993	0.147	0.139
1994	0.155	0.138
1995	0.170	0.137
1996	0.146	0.131
1997	0.133	0.124
1998	0.144	0.127
1999	0.122	0.118
2000	0.132	0.110
2001	0.117	0.102
2002	0.123	0.106
2003	0.130	0.106
2004	0.119	0.107
2005	0.123	0.105
2006	0.124	0.103
2007	0.109	0.103
2008	0.110	0.104
2009	0.104	0.100
2010	0.114	0.099
2011	0.113	0.097
2012	0.108	0.097
2013	0.097	0.092
2014	0.100	0.092
2015	0.105	0.090
2016	0.109	0.091
2017	0.118	0.096
2018	0.107	0.098
2019	0.090	0.095
2020	0.099	0.090
2021	0.106	0.090

2015 Wildfire Identified Days

	Ozone (ppb)						
2015	**Hesperia**	**Lancaster**	**Phelan**	**Victorville**	**Satellite Observed Smoke**	**Advisories**	**Fires**
18-Apr	79.9						
19-Apr	83.0			76.8			
29-Apr	78.5						
28-May			80.6				
29-May	86.3	88.4	79.8	78.6			
30-May		92.9	81.8		Possible Smoke/Haze seen over Mojave Desert Basin		
31-May			83.3				
14-Jun	78.1		78.8	78.3			
15-Jun		85.8					
16-Jun	83.4	95.7		82.3			
17-Jun	94.3	103.2		87.5			Lake Fire
18-Jun	105.5	94.1	77.3	95.8	Smoke Observed, Lake Fire	Smoke Advisory	Lake Fire
19-Jun			84.4	106.1	Smoke Observed, Lake Fire	Smoke Advisory	Lake Fire
20-Jun		102.8	92.8	100.8	Smoke Observed, Lake Fire	Smoke Advisory	Lake Fire
22-Jun		101.2	86.9	88.0	Smoke Observed, Lake Fire	Smoke Advisory	Lake Fire
23-Jun		96.4	90.0	79.6	Smoke Observed, Lake Fire	Smoke Advisory	Lake Fire
24-Jun	96.5	103.5	85.0	93.9	Smoke Observed, Lake Fire	Smoke Advisory	Lake Fire
25-Jun	92.9	98.3		79.9	Smoke Observed, Lake Fire	Smoke Advisory	Lake Fire
26-Jun			89.2		Cloudy, No Observed Smoke		Lake Fire
30-Jun		90.5			Cloudy, No Observed Smoke		Lake Fire
2-Jul	79.8		86.3	77.0			Lake Fire
3-Jul			85.7				Lake Fire
16-Jul	89.0			86.2			Lake Fire
25-Jul	80.3		78.7	82.1			Lake Fire
27-Jul	79.2						Lake Fire
28-Jul		97.4					Lake Fire
11-Aug	79.7				Observed Smoke in Sierras		
18-Aug	83.1	89.0		81.0	Observed Smoke in Sierras looks to be blowing into Mojave Basin		
19-Aug	92.3	86.2		93.0	Smokey Mojave Basin from Rough Fire		
20-Aug	93.3	91.4		90.1	Smokey Mojave Basin from Rough Fire		
21-Aug	84.4	94.1	80.4	81.2	Hazey		
22-Aug	84.3	91.2	82.3	82.4			
23-Aug			77.7				
26-Aug			78.7				
27-Aug			76.7				
2-Sep		86.2					
10-Sep		88.1					

2016 Wildfire Identified Days

	Ozone (ppb)							
2016	**Phelan**	**Hesperia**	**Lancaster**	**Victorville**	**Advisory**	**PM2.5**	**Sat Ob Smoke**	**Fires**
6/3/2016		91.9	91.2	82.2				
6/4/2016			81.8				Smoke Observed in Temecula	Temecula
6/8/2016	90.9			77.3				
6/9/2016	84.8	89.2		75.5				
6/17/2016		94.6		81.5		LAN (43.19)	Smoke Observed in Goleta	Sherpa
6/22/2016		93.9		86.0	Yes		Smoke/Haze Observed in Glendora	San Gabriel Complex
6/25/2016	85.5	87.5	85.5	83.5		LAN (35.05)	Smoke Observed Near Lake Isabella, Hazy over Mojave Desert	San Gabriel Complex
6/26/2016			90.9				Smoke Observed Near Lake Isabella, Hazy over Mojave Desert	San Gabriel Complex
6/29/2016	87.5							
6/30/2016	80.6					LAN (42.34)		
7/5/2016	84.2	90.9		82.0				
7/6/2016	81.2		85.4					
7/7/2016	88.1	89.4		78.9				
7/8/2016	84.6							
7/9/2016			81.5			LAN (43.35)		
7/11/2016	82.5	89.3		77.5				
7/12/2016				76.9				
7/13/2016	88.1	93.1	86.5	81.5				
7/14/2016	87.7	91.1						
7/15/2016	88.2		89.2	76.6				
7/16/2016			86.2			LAN (30.63)		
7/17/2016			81.5					
7/23/2016	83.0			75.5	Yes	LAN (99.95)	Heavy Smoke Observed over AV and MD	Sand, Soberanes
7/24/2016			87.0		Yes	LAN (173.31	Smoke Observed Over AV and MD	Sand, Soberanes
7/27/2016	99.9	92.6		80.3	Yes		Some Smoke over Mojave Basin	Sand, Soberanes
7/28/2016	110.0	99.3	93.6	83.5	Yes		Lots of smoke floating down from big sur	Sand, Soberanes
7/29/2016	103.4	87.0	98.7		Yes		Smokey haze over much of Southern CA	Sand, Soberanes
8/2/2016		87.2						Sand, Soberanes
8/4/2016			84.4			VV (40)		Sand, Soberanes
8/5/2016	82.8	90.2		77.7				Sand, Soberanes
8/6/2016			82.0					Sand, Soberanes
8/8/2016			84.9		Yes		Smoke Observed over Big Bear	Pilot
8/9/2016		89.3		78.8	Yes		Hazy Smoke Conditions from BB Fire	Pilot
8/10/2016		91.8	85.5	81.1	Yes			Pilot
8/11/2016			81.2				Smoke Observed	Pilot
8/15/2016		87.9		77.9	Yes			Chimney
8/23/2016			81.3	77.0			Smokey Haze observed over Mojave Desert from Fires in Sierra, and 3 up the coast from Santa Barbara to Big Sur	Blue Cut, Cedar, Rey, Santa Barbara
8/24/2016	93.8						Same conditions from the day prior	Blue Cut, Cedar, Rey, Santa Barbara
8/25/2016		86.6	85.3				Still Smokey	Blue Cut, Cedar, Rey, Santa Barbara
8/30/2016	95.3	87.7						Bogart

2017 Wildfire Identified Days

	Ozone (ppb)								
2017	**Phelan**	**Hesperia**	**Lancaster**	**Victorville**	**Advisory**	**PM2.5**	**Sat Ob Smoke**	**Hysplit Supports**	**Fires**
6/3/2017			83.1						
6/14/2017	92.1	82.0	82.0	77.0	Yes				
6/15/2017	95.4	91.1		71.6		LAN (50.12)			
6/16/2017	97.5	93.3	86.7	82.2					
6/17/2017	109.6	91.3	84.1	81.1		LAN (46.26)		Yes Lake	Lake, Oakwood
6/18/2017	100.4	88.6		76.8				Yes Hwy Fire	Lake, Highway
6/19/2017	119.5	91.0	80.5	76.1	Yes			Yes Lake	Lake, Highway, Holcomb
6/20/2017	110.1	83.2	85.0	75.4	Yes				Highway, Holcomb
6/21/2017		85.4	79.5		Yes				Highway, Holcomb
6/24/2017		82.5			Yes				Highway, Holcomb
6/29/2017		92.8							Manzanita, Hill
6/30/2017	97.3		81.3	73.4					Manzanita, Tarina
7/1/2017	99.8	90.2	81.3	71.3					
7/3/2017	98.4	84.0	84.7	74.9					
7/4/2017		89.7				LAN (30.46)		Yes, Eagle Fire	Eagle
7/5/2017	104.2			72.5				Yes, Eagle Fire	Eagle
7/6/2017	98.1	82.0		73.0					
7/7/2017			85.0		Yes				
7/13/2017	97.7	87.6		79.8	Yes	LAN (35.53)		Yes, Whittier Fire	Whittier, Jenninges
7/14/2017	110.2			73.8	Yes			Yes, Whittier Fire	Bridge, Whittier
7/15/2017	99.0		87.4	71.0	Yes		Smoke over Tehacipis and San Gabriels	Yes, Whittier Fire	Bridge, Whittier
7/16/2017		94.8			Yes	VV (50)		Yes, Whittier Fire	Whittier
7/17/2017		89.1			Yes	LAN (31.41) VV (38)		Yes, Whittier Fire	Whittier
7/19/2017		86.4	77.0		Yes				
7/20/2017			82.0		Yes				
7/21/2017	92.6	82.1	87.4	76.7	Yes				
7/22/2017	92.5		83.3	79.9	Yes				
7/23/2017	98.1			74.4	Yes	VV (32)			High
7/28/2017			79.3						
7/29/2017			76.9						
8/4/2017	94.9	86.7	78.7	75.0					
8/7/2017	93.8			71.0					
9/30/2017			85.1						

2018 Wildfire Identified Days

2018	Ozone (ppb)									
Dates	Hesp	Lanc	Phe	Vic	Adv?	PM2.5	PurpleAir (max 1 hr av)	Sat Ob Smoke	Hysplit Supports	Fires
5/8/2018	80.5		87.3	82.0		VIC (16)	H-8.3			
6/4/2018		80.3				(LAN) 1 -hr 45.48	V-13.1, P-10.3, H-6.1		Yes	Stone
6/8/2018	88.9			83.4		VIC (15)	P-10.7, H-9.8			
6/20/2018		83.0	92.8	80.0		LAN (19)	P-10.8, H-12.4			
6/21/2018	84.5		90.7	87.6	Yes	VIC (20)	P-19.8, H-21.9		Yes - Yankee Fire	Yankee
6/22/2018	100.9		107.4	97.4	Yes	VIC (16)	V-12.8, P-17.38, H-16.8	Strato intrusion?	Yes - Yankee Fire	Yankee
6/23/2018	82.6	78.8	88.4	85.4	Yes	VV 1-hr (36)	V-18.2, P-24, H-19.5		Yes - Yankee Fire	Yankee, Canyon
6/24/2018		77.8			Yes	Lan (17)	P-19.8, H- 24.66		Yes - Canyon, Yankee	Yankee, Canyon
6/25/2018	87.3	78.9	85.0	81.0	Yes	VIC (15), LAN (14.7)	V-10.7, P-9, H-10.9		Yes- Canyon	Canyon
6/26/2018	94.3	78.7	94.8	90.0	Yes	VIC (13), LAN (15)	V-7.0, P-10.3, H-10.7		Yes- Canyon	Canyon
6/27/2018	81.0	76.3	92.7	80.9		VIC (12), LAN (15)	P-11.5, H-9.9			
7/7/2018		77.9				LAN (23)	P-9.3, H-12.5			Valley, Holiday, Pendleton, West
7/8/2018		77.1				LAN (19)	H-18.6		No	Valley, Holiday, Pendleton, West
7/9/2018			91.0			LAN (12) Vic (44/51)	V-10.3, P-10.5, H-9.2			Valley, Holiday, Pendleton, West
7/10/2018	80.3			83.1		VIC (25)	V-9.2, P-11, H-10.7		Yes	Valley, Holiday, Pendleton, West
7/14/2018			87.1				P-10.6, H-35.43			Gray, Valley, Ferguson
7/16/2018			84.7	79.9		VIC (18)	V-11.7, P-13.6, H-10.8	Yes		
7/17/2018	83.3	79.7	89.0	79.4		VIC (16), LAN (21)	V-13.4, P-16, H-13.1	Yes		
7/26/2018		84.5			Yes	LAN 1-hr (58)	V-39.1, P-38.4, H-34	Yes		Cranston, Ferguson
7/27/2018	85.5	90.1	103.4	81.9	Yes	VIC (21), LAN 1-hr (32)	V-35.3, P-34.4, H-24.7	Yes		Cranston, Ferguson, Mendo Cmplx
7/28/2018		81.6			Yes	LAN (23)	V-31.8, P-30, H-35.6	Yes		Cranston, Ferguson, Mendo Cmplx
7/30/2018	84.7	78.1	90.3		Yes	LAN (24)	V-25.8, P-29.2, H-13.9	Yes		Cranston, Ferguson, Mendo Cmplx
8/3/2018				87.6	Yes	VIC (17), LAN (13)	V-25, P-18.2, H-19.9	Yes		Cranston, Ferguson, Mendo Cmplx
8/4/2018	81.9	88.3	86.8	88.0	Yes	LAN (66) VIC (49)	V-63.2, P-101.1, H-34.4	Yes		Cranston, Ferguson, Mendo Cmplx
8/7/2018	88.6	105.1	95.0	80.0	Yes	LAN (51) & VV (40)	V-54.6, P-160, H-44.5	Yes		Cranston, Ferguson, Mendo Cmplx, Holly
8/8/2018			87.2	85.0	Yes	LAN (40) & VV (118)	V-102.4, P-61.4, H-93	Yes		Cranston, Ferguson, Mendo Cmplx, Holly
8/9/2018		95.4			Yes	LAN (149) & VV (62)	V-177.8, P-78.5, H-143.1	Yes		Cranston, Ferguson, Mendo Cmplx, Holly
8/10/2018	83.8			82.4	Yes	Lan (48) & VV (67)	V-99.9, P-52, H-234.7	Yes		Cranston, Ferguson, Mendo Cmplx, Holly
8/17/2018		78.3				LAN (20)	P-15.7, 17.4			
8/18/2018	84.2			79.5		VIC (21)	P-27.6, H-27.5			
8/19/2018			85.3				P-20, H-19.4			
8/20/2018	82.2		85.2				V-21.2, P-19.9, H-22.7	Yes		
8/26/2018	81.0		84.7				P-27.6, H-29.6			
8/31/2018	83.9						P-10.5, H-11			
9/10/2018		79.4				LAN (23)	V-8.4, P-17.8, H-9.2	Yes	Yes	Fork
9/11/2018	82.7	77.8		78.6		VIC (13), LAN (21)	P-7.6, 10.9			

2019 Wildfire Identified Days

	Ozone (ppb)								
2019	**Phe**	**Hesp**	**Lanc**	**Victo**	**PM2.5**	**PurpleAir (max 1 hr av)**	**Sat Ob Smoke**	**Hysplit Supports**	**Fires**
4/19/2019			70.7						
5/3/2019			72.9						
6/5/2019	81.5	78.9	70.8	75.4					
6/6/2019				75.9					
6/19/2019	82.0	82.6	70.3	78.4					
6/24/2019	78.2								
6/30/2019	79.0	79.5		78.6					
7/1/2019	78.6	79.2		78.7					
7/2/2019	80.9			75.7					
7/5/2019				74.2					
7/6/2019			71.5						
7/11/2019				76.9					
7/12/2019		86.3	70.0						
7/15/2019		78.6							
7/16/2019			70.6						
7/22/2019	76.0	87.8		81.3					
7/26/2019		82.5							
7/27/2019		88.9		78.2					
7/29/2019		80.8	79.1	76.4		L-12.6			
7/30/2019		83.8	73.0			L-17.7, H-39.2			Star
8/2/2019		86.4	76.9	81.0		L-6.9, H-8.1			
8/3/2019	**90.5**	**84.0**	**74.5**			**H-10.9, L-11.7, P-9.3, V-11.6**	**Hazy**	**Yes, Five Fire**	**Five Fire, La Barisa**
8/4/2019	81.5								
8/5/2019	90.7		71.6					No	Toro
8/7/2019	82.2								
8/8/2019	80.1					H-18.6, P-22.3, V-16			
8/12/2019		79.6	76.6						
8/14/2019		80.4		78.6					
8/15/2019	81.3		73.8						
8/16/2019	90.7		73.0	76.5	VV 55	L-10.9, P-17.1			Border, West
8/20/2019	85.8								
8/21/2019	84.9	79.5		78.0					
8/22/2019	82.3	83.3	82.1	82.2		H-36.1			Yucca
8/26/2019			80.1			H-19.4, V-22.3			
8/30/2019	78.1	79.6	73.2						
8/31/2019		86.2		76.7		H-17.1, V-16.3			
9/1/2019	77.1					V-20.4			
9/7/2019				77.6					
9/14/2019	78.0	79.3	76.5	77.8					
10/3/2019			69.8	75.7		H-15.3			

2020 Wildfire Identified Days

2020	Ozone (ppb) Phel	Hesp	Lanc	Victo	Adv?	PM2.5	PurpleAir (max 1 hr av)	Sat Ob Smoke	Hysplit?	Fires
4/29/2020		82.5		74.5			H-28.2, V-15.6			
5/5/2020		83.5		79.6			H-17.3, V-7.5			
5/6/2020		79.4					H-17.0, V-7.8			
5/7/2020	84.0	92.5	69.5	80.8			H-12.4, L-13.1, p-5.7			
5/8/2020	81.7	89.0	81.4	85.9			H-14.8, L-21.4, p-10.7			Hollister
5/9/2020		78.7	70.5	76.6			H-19.1, L-14.7			
5/27/2020	88.6	78.4					H-14.9, P-13			
6/4/2020			69.2				L-14.4,			
6/11/2020		88.2	79.6	88.4			H-47.2, L-33.2, P-21.2			Many
6/22/2020	84.6						P-17.7			
6/23/2020	82.4						P-14			
6/24/2020	93.1						P-21.9		Yes	58, Grade
6/26/2020	81.6	77.3					H-15.9			
6/27/2020				77.8						
7/2/2020				74.7	Yes					
7/3/2020			67.3				L-7.1,			
7/6/2020	82.6						P-14.6			Soledad
7/8/2020				79.7						
7/9/2020	87.7	85.6		81.7			H-7.6, P-13.3			
7/19/2020				76.9						
7/20/2020		80.3		83.2			H-15.1		No	Easton
7/21/2020	91.6						P-15.5		No	Easton, Hog, Gold
7/27/2020	82.0						P-13			
7/29/2020	92.4		66.7				L-9.3, P-126.3			Brook
8/1/2020			68.7		Yes		H-6.6, P-6.7, V-5.7	Apple		Apple
8/2/2020	85.9		68.0	78.2	Yes		H-22.9, P-31.9, V-24.1	Apple		Apple
8/7/2020				74.9	Yes		H-9.1, P-9.1,V-8.0	Apple		Apple, Stagecoach
8/16/2020			68.4		Yes	LAN (95) VV (43)	H-117.5, L-176.6, P-176.6, V-72.9	Yes		Stagecoach, Lake, Ranch2
8/17/2020	89.4	76.9	72.3			LAN (110) VV (32)	H-52.2, P-68.9, V-38.6	Yes		Stagecoach, Lake, Ranch2, Lightning Complex
8/19/2020		91.9		83.7	Yes	LAN (81) VV (67)	H-97.6, L-200.3, P-78.5, V-140.8	Yes		Stagecoach, Lake, Ranch2, Lightning Complex
8/20/2020	93.6	95.3		95.1	Yes	LAN (79) VV (94)	H-201.4, L-197.8, P-221.1, V-164.8	Yes		Stagecoach, Lake, Ranch2, Lightning Complex
8/21/2020	89.4	89.5		90.7	Yes	LAN (146) VV (72)	H-179, L- 323.8, P-66.4, V-160.0	Yes		Stagecoach, Lake, Ranch2, Lightning Complex
8/26/2020		77.0					H-23.3, P-9.5			Stagecoach
8/30/2020			67.9				P-6.6			Stagecoach
9/3/2020	84.8	78.9	77.3	78.6		LAN (33)	H-31.7, P-26.5, V-28.1	Yes		Stagecoach
9/4/2020	92.7		77.6	77.7		VV (108)	H-23.8, P-28.3, V-294.2	Yes		Stagecoach
9/14/2020	82.0	77.4	79.6			LAN (56) VV (51)	H-66, P-144.5, V-92.9	Bobcat Soup		Bobcat
9/15/2020			84.1			LAN (83) VV (67)	H-66.1, L-142.6, P-160.1, V-74.9	Bobcat Soup		Bobcat
9/16/2020	81.7	88.1		82.4		LAN (47) VV (62)	H-102.5, L-81.1, P-140.7, V-106.9	Bobcat Soup		Bobcat
9/17/2020			81.5			LAN (51) VV (59)	H-55.4, L-89.6, P-69.6, V-49.6	Bobcat		Bobcat
9/24/2020			69.7			LAN (57) VV (55)	H-94.6, L-86.4, P-98.6, V-102.2	Bobcat		Bobcat
9/25/2020			67.2			LAN (38)	H-25.3, L-86.4, P-30.1, V-19.9	Bobcat		Bobcat
10/4/2022		78.7				LAN (48) VV (39)	H-68.9, P-54.9, V-53.1	Bobcat		Bobcat
10/6/2020			68.8			LAN (45)	H-42.6, L-65.7, P-33.8, V-40.1			Bobcat

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APPENDIX D – WMD 8 HOUR WEIGHT OF EVIDENCE

Weight of Evidence

Western Mojave Desert

Attainment Plan for the 0.070 ppm 8-Hour Ozone SIP

(prepared by CARB staff)

November 2022

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Introduction

The Western Mojave Nonattainment Area (Western Mojave) includes the southwestern Mojave Desert Air Basin portion of San Bernardino County, which is under the jurisdiction of the Mojave Desert Air Quality Management District (MDAQMD), and the northeastern Antelope Valley portion of Los Angeles County, which is under the jurisdiction of the Antelope Valley Air Quality Management District (AVAQMD). Western Mojave is currently classified as a severe nonattainment area for the 0.070 parts per million (ppm) 8-hour federal ozone standard (0.070 ppm standard) with a 2032 attainment deadline. Photochemical modeling is a required element of the Western Mojave State Implementation Plan (SIP) to determine whether existing and future additional control strategies provide the reductions needed to meet the federal standard by the attainment deadline. To address the uncertainties inherent to modeling assessments, U.S. Environmental Protection Agency (U.S. EPA) guidance recommends that supplemental analyses accompany all model attainment demonstrations.[61]

To complement regional photochemical modeling analyses included in the Western Mojave SIP, the following Weight of Evidence (WOE) demonstration includes detailed analyses of anthropogenic emissions, measured ozone data, and population exposure trends. Analyses of air mass transport mechanisms and meteorological patterns coincident with elevated ozone concentrations in Western Mojave are also included.

Air quality analyses indicate that progress towards attainment is being made at all Western Mojave sites. However, in 2020, all regulatory sites in Western Mojave exceeded the 0.070 ppm standard by 14 to 29 percent. Photochemical modeling analyses for Western Mojave indicate that with the removal of May and June shoulder months from the photochemical model, as well as removing fire impacted days provided by the District from design values projects that Western Mojave can meet the 0.070 ppm standard by the 2032 attainment date.

Area Description

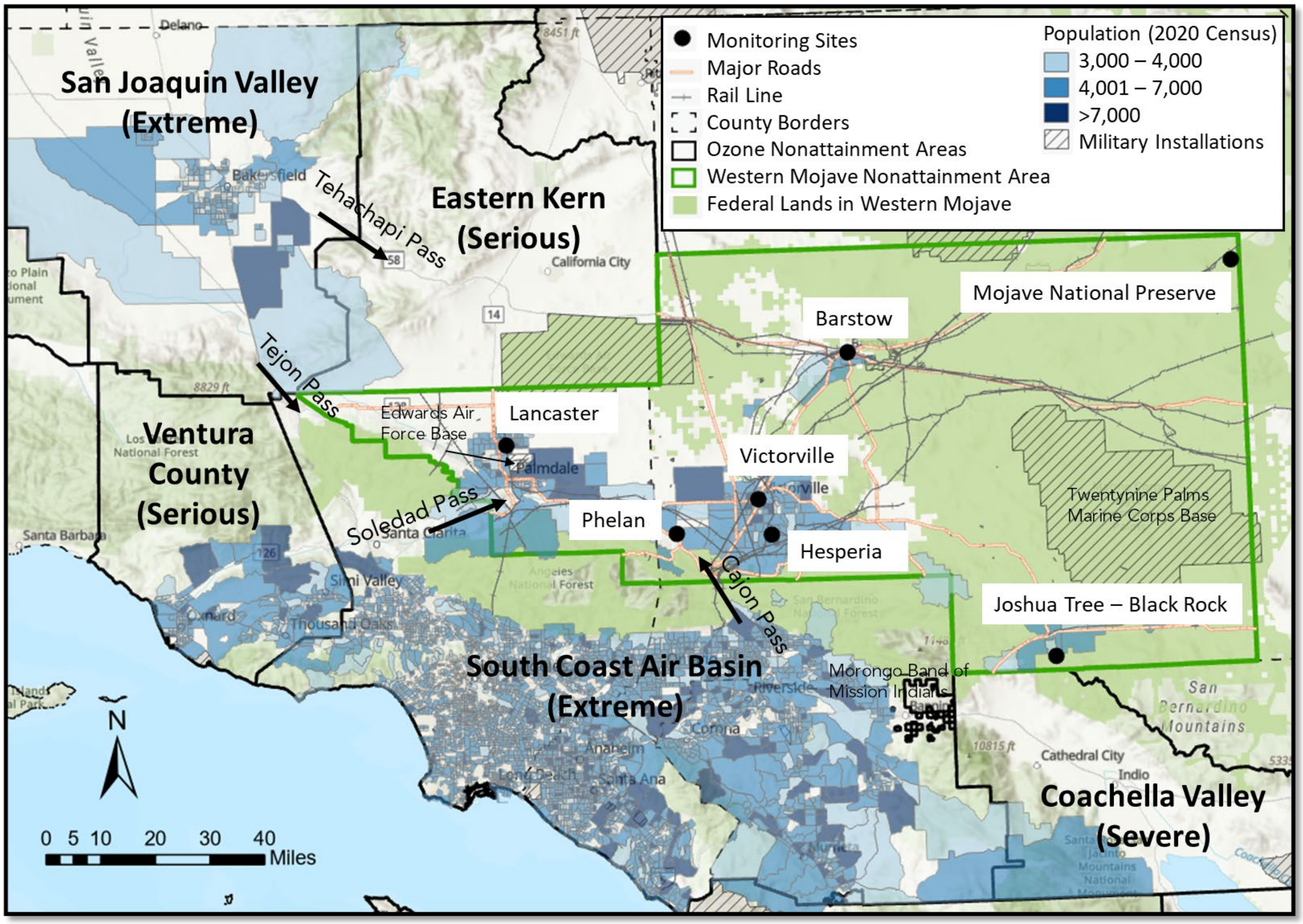
Western Mojave is considered a high desert climate. Terrain elevations range from 2,000 to 5,000 feet and the amount of average annual precipitation ranges from four to six inches. The Sierra Pelona, San Gabriel, and San Bernardino Mountains are located to the southwest and separate the South Coast Air Basin from the Western Mojave Nonattainment Area. The Tehachapi and southern Sierra Nevada Mountains are located in Kern County to the northwest and separate the San Joaquin Valley from the Eastern Kern Nonattainment Area, which borders Western Mojave to northwest.

Western Mojave includes more than 8,000 square miles (Figure D-1). The majority of the land is under the jurisdiction of the federal government and managed by the National Park Service (NPS), U.S. Forest Service, and Bureau of Land Management. Western Mojave includes portions of Joshua Tree National Park and the Mojave National Preserve, federally protected areas renowned for diverse ecology and striking landscapes. Portions of several military installations also lie within the Western Mojave

[61] U.S. EPA Modeling Guidance for Demonstrating Air Quality Goals for Ozone, PM2.5 and Regional Haze. https://www.epa.gov/sites/default/files/2020-10/documents/o3-pm-rh-modeling_guidance-2018.pdf

Nonattainment Area. The largest installations include Twentynine Palms Marine Corps Base and Edwards Air Force Base.

Figure D-1: Area Map of Western Mojave and Surrounding Areas



Western Mojave is home to more than 900,000 people. Most of the population is concentrated in a handful of moderate sized cities. Lancaster, in Los Angeles County, and Victorville, in San Bernardino County, are the largest cities in Western Mojave. Locally, the primary industries include aerospace, cement production, agriculture, mining, and healthcare. However, a significant fraction of the Western Mojave workforce commutes to jobs in urban Los Angeles and the greater San Bernardino area.

The area serves as a major transit corridor between southern California and Las Vegas, with several major highways running through Western Mojave, including Interstate-15, Interstate 40, and State Highway 395. The city of Barstow, in the northern portion of the nonattainment area, is a major hub for the multiple rail lines that traverse the high desert. Infrastructure related to resource distribution, including electricity transmission lines and water, oil, and gas pipelines run throughout the high desert area. The area has also garnered a great deal of attention in recent years due to the emergence of solar and wind energy developments.

The Los Angeles County portion of Western Mojave is under the jurisdiction of the AVAQMD, whereas the San Bernardino portion of Western Mojave is under the jurisdiction of the MDAQMD. Collectively, AVAQMD and MDAQMD operate five ozone monitoring sites in Western Mojave. AVAQMD operates the Lancaster ozone monitoring site and MDAQMD operates the Phelan, Victorville, Hesperia and Barstow monitoring sites. The NPS operates the Joshua Tree-Black Rock and Mojave National Preserve monitoring sites. The Joshua Tree-Black Rock monitor is considered regulatory and is operated year-round; whereas the Mojave National Preserve monitor is considered non-regulatory and is operated seasonally, typically between May and October. Since the Mojave National Preserve monitor is non-regulatory, the data are not considered for attainment determinations. However, the data is useful for regional analyses and is consistent with the spatial patterns indicated by the data from regulatory monitoring sites in Western Mojave. The number of exceedance days and the annual fourth highest ozone concentrations at the Mojave National Preserve site were similar to Barstow, albeit generally a little lower, which is consistent with its far downwind location.

Ozone concentration data indicate a spatial gradient among the monitors in Western Mojave. The highest concentrations are typically measured at monitors in the southwest portion of the nonattainment area, particularly at sites in closest proximity to the mountain ranges that separate Western Mojave from the South Coast. The lowest concentrations are typically measured at the far downwind sites of Barstow and Mojave National Preserve, in the northern/northeastern portions of the nonattainment area. This suggests that ozone concentrations in Western Mojave are mainly due to transport from the upwind South Coast Air Basin, and lesser extent the San Joaquin Valley, and that the local emissions do not contribute significantly to ozone formation in the area.

Table D-1: Ozone Design Values at Western Mojave Monitoring Sites

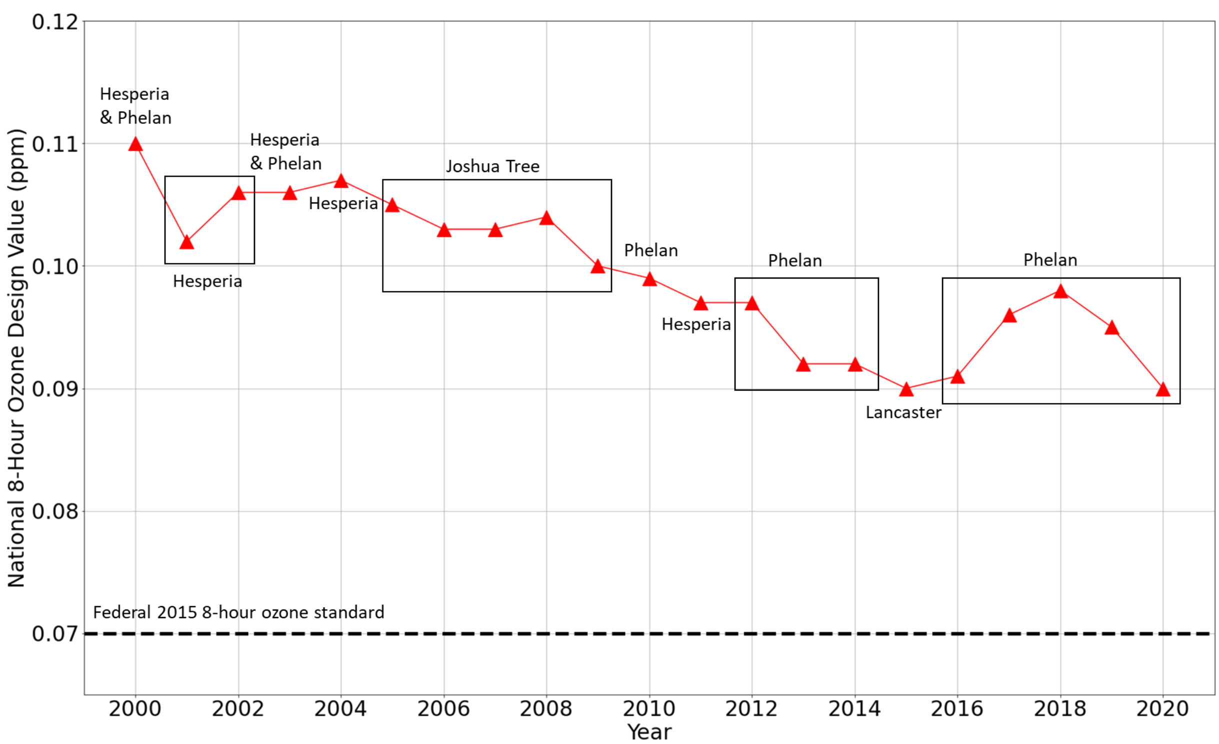
Site Name	AQS ID	County	District	2016 Design Value (ppm)	2017 Design Value (ppm)	2018 Design Value (ppm)	2019 Design Value (ppm)	2020 Design Value (ppm)
Lancaster	060379033	Los Angeles	Antelope Valley AQMD	0.088	0.089	0.085	0.082	0.080
Barstow	060710001	San Bernardino	Mojave Desert AQMD	0.080	0.077	0.080	0.078	0.081
Hesperia	060714001	San Bernardino	Mojave Desert AQMD	0.090	0.091	0.090	0.087	0.087
Phelan	060710012	San Bernardino	Mojave Desert AQMD	0.091	0.096	0.098	0.095	0.090
Victorville	060710306	San Bernardino	Mojave Desert AQMD	0.086	0.084	0.082	0.081	0.083
Joshua Tree-Black Rock	060719002	San Bernardino	National Park Service	0.086	0.087	0.089	0.088	0.086

Site Name	AQS ID	County	District	2016 Design Value (ppm)	2017 Design Value (ppm)	2018 Design Value (ppm)	2019 Design Value (ppm)	2020 Design Value (ppm)
Mojave National Preserve*	060711001	San Bernardino	National Park Service	0.077	0.076	0.079	0.078	0.081

* Data are non-regulatory

As shown in Table D-1, ozone design values are generally similar at Hesperia, Phelan, and Joshua Tree; and ranged from 0.086 to 0.090 ppm in 2020. The lowest design values are typically measured at Barstow, where the 2020 design value was 0.081 ppm; however, in 2020 Lancaster had the lowest design value at 0.080 ppm. Phelan is currently the design value site for Western Mojave; however, Joshua Tree, Lancaster and Hesperia have been design value sites in past years (Figure D-2). Photochemical modeling analyses indicate that Phelan will be the design value site in the years leading up to the attainment deadline and represents the greatest challenge for attainment in Western Mojave.

Figure D-2: Design Value Trend for the Western Mojave Nonattainment Area



Conceptual Model

Weather in Western Mojave is dominated by mostly sunny days, warm to hot temperatures, and light to moderate midday winds during the summer months. These conditions are conducive to the formation and buildup of ozone. However, limited local emissions sources, relative to neighboring ozone nonattainment areas to the south and west, are not adequate to produce the magnitude of peak ozone concentrations and the quantity of ozone exceedance days observed in Western Mojave. The transport of emissions from the South Coast Air Basin, and to a lesser extent the San Joaquin Valley, is the predominant cause of high ozone concentrations and exceedances in Western Mojave. The meteorology, terrain, distribution of emissions, and transport mechanisms are the key factors for understanding the ozone challenges in Western Mojave.

Meteorology and Terrain

In Western Mojave, ozone exceedance days are most common in the late spring throughout the summer months. Conditions in the high desert at this time of year are routinely characterized by sunny, hot, and dry conditions. Clear sky conditions coupled with low humidity lead to rapid surface heating and the warming of the air above the ground, which promote deep convective mixing as evidenced by large mixing heights in high desert areas.[62] Research has indicated that these large mixing heights are conducive to entrainment of layers aloft into the near-surface air sampled by monitors in Western Mojave.[63] The high elevation of Western Mojave, combined with routinely large mixing heights, can allow pollution derived from a wide range of sources and transported aloft to mix down into the surface layer.[64,65,66]

The high desert area, where Western Mojave is situated, is a convergence zone for air flowing out of the South Coast Air Basin and the San Joaquin Valley, the only extreme ozone nonattainment areas in the United States. High temperatures and low humidity promote the development of a thermal low, a non-frontal area of low pressure, which contributes to routine development of a deep mixing layer in the high desert. Development of this thermal low routinely establishes a surface pressure differential between the high desert and upwind areas, which promotes transport from the South Coast Air Basin and the San Joaquin Valley into the high desert.

In the South Coast Air Basin, a persistent temperature inversion and confining terrain limit dispersion of air and emissions. Prevailing onshore winds are deflected by the complex terrain that flanks the edge of the coastal plain and air subsequently converges at the foot of the mountains that separate the South Coast Air Basin from the high desert. The Soledad Pass and Cajon Pass in the San Gabriel and San Bernardino Mountains, respectively, serve as major transport corridors for air moving from the South Coast Air Basin to the high desert.

Similar to the South Coast Air Basin, air masses within the San Joaquin Valley are largely confined by a persistent temperature inversion and the complex terrain on the western, southern, and eastern sides

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[62]Whiteman, C.D., (2000). Mountain Meteorology: Fundamentals and Applications, Oxford University Press, Inc., New York, NY (355 pp.).
[63]VanCuren, R. (2015). Transport aloft drives peak ozone in the Mojave Desert. Atmospheric Environment, 109, 331-341.
[64]Langford, A. et al., (2012). Stratospheric influence on surface ozone in the Los Angeles area during late spring and early summer of 2010. J. Geophys. Res. Atmos. 117, http://dx.doi.org/10.1029/2011JD016766.
[65]Lin, M., et al., (2012a). Springtime high surface ozone events over the western United States: Quantifying the role of stratospheric intrusions. J. Geophys. Res. Atmos. 117, http://dx.doi.org/10.1029/2012JD018151.
[66]Lin, M., et al., (2012b). Transport of Asian ozone pollution into surface air over the western United States in spring. J. Geophys. Res. 117, http://dx.doi.org/10.1029/2011JD016961.

of the San Joaquin Valley. Local, terrain-forced winds, which parallel the axis of the valley floor and generally flow from north to south in the summer months, cause air to converge in the southern San Joaquin Valley. The primary route for air to exit the San Joaquin Valley is through mountain gaps and over minor passes at the southern end of the San Joaquin Valley.[67] The Tehachapi Pass, located at the foot of the San Joaquin Valley in the Tehachapi Mountains and to the northwest of Western Mojave, is the primary conduit for air to move from the San Joaquin Valley to the high desert.

Regional Transport

Due to the meteorological and terrain effects discussed above, the air flow and transport of emissions from the South Coast Air Basin is the major source of ozone pollution in Western Mojave. Similar impacts from the San Joaquin Valley are also evident, but they are less frequent and severe.

In addition to the terrain-following, near-surface transport of air masses, research has shown that the air masses moving through mountain gaps and passes in southern California contain multiple, distinct pollutant layers at various altitudes.[68] These filamentous layers of pollution are the result of the interaction of spatially distributed emission sources, prevailing meteorology, and complex terrain in the upwind air basins. Terrain and meteorological conditions promote the lofting of surface derived pollution, which results in horizontal pollutant transport across multiple altitudes.

As air moves through the mountain gaps and passes, it warms and accelerates. Upon exiting the gaps and passes, the accumulated momentum is depleted causing air masses to slow and disperse. As these layers disperse, transported pollution may become entrained in the near-surface air of downwind areas.

To illustrate the routine contribution of transport to ozone measured at Western Mojave sites, Figure D-3 shows the average diurnal pattern in ozone between April and September at the six regulatory monitoring sites. The diurnal patterns at select sites in the South Coast Air Basin are also included in Figure D-3 to illustrate typical patterns for photochemical production of ozone from local sources. The production of ozone occurs through photochemical reactions, ozone derived from local pollution sources generally increases with available solar radiation.

For instance, the diurnal ozone pattern at Pico Rivera, a regulatory monitoring site located in an urban area of the South Coast Air Basin, is indicative of ozone production from local emission sources. The local ozone production regime is characterized by a predawn minimum concentration near zero followed by a persistent increase in concentrations between sunrise and midday. Peak concentrations are typically reached shortly after midday, but tend to be brief, and then decrease as solar insolation diminishes later in the day.

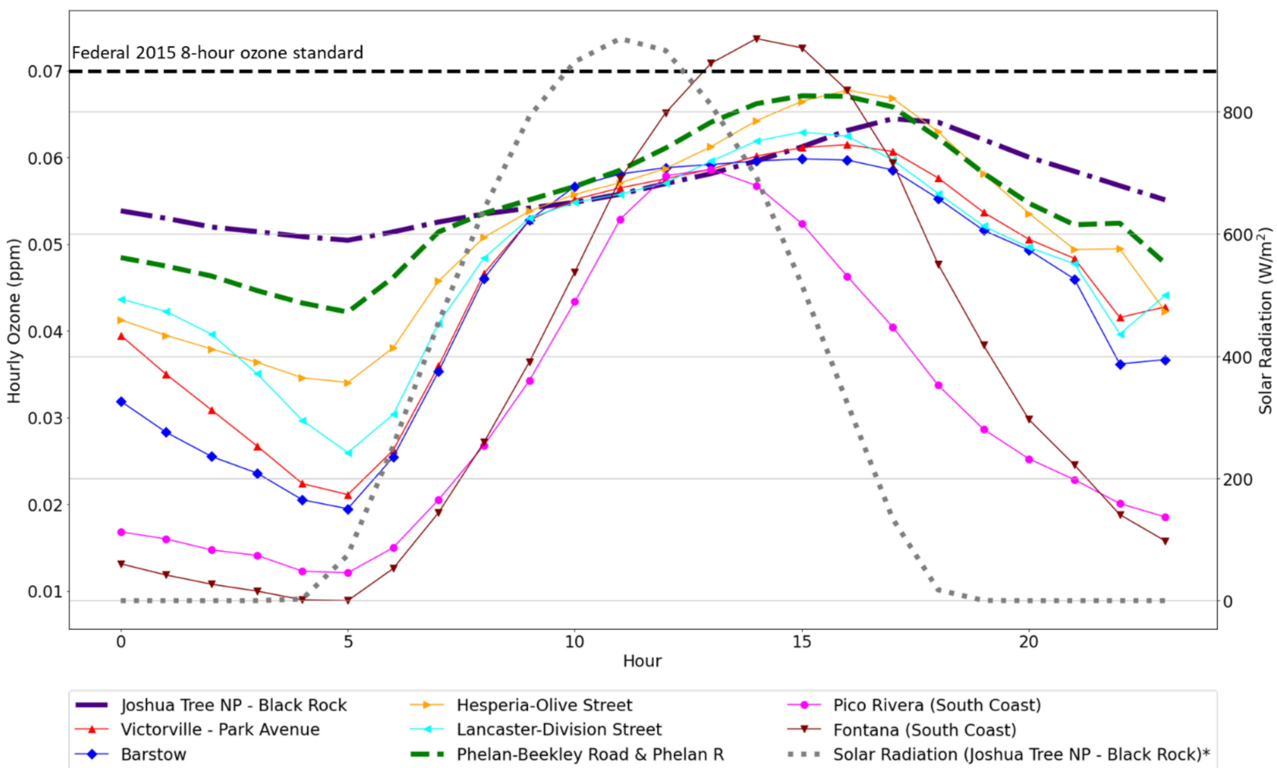
The diurnal ozone pattern at Fontana is also indicative of ozone production from local sources but illustrates a distance-weighted time lag in peak concentration, due to the location of Fontana, a short distance downwind of Pico Rivera. Relative to Pico Rivera, peak concentrations at Fontana are

[67] Beaver, S. and Palazoglu, A., (2009). Influence of synoptic and mesoscale meteorology on ozone pollution potential for San Joaquin Valley of California, Atmospheric Environment, 43, 1779-1788.
[68] Smith, T.B. and Edinger, J.G. (1983). Utilization of Remote Sensing Data in the Evaluation of Air Pollution Characteristics in the South Coast/Southeast Desert Air Basin, ARB Contract No. A2-106-32

generally an hour later and tend to reach higher concentrations than those at Pico Rivera. The higher concentrations at Fontana are also typical of a near-downwind site. Emissions from nearby, upwind areas have undergone more photochemical processing, with limited dilution by the time they are intercepted by the near-downwind monitor, resulting in higher peak ozone concentrations.

The smooth, bell-shaped curve of the diurnal ozone plots at both South Coast Air Basin sites shown in Figure D-3 is consistent with the pattern expected for urban sites impacted by photochemically derived ozone. As discussed earlier, the pattern is characterized by a persistent gradual increase in ozone throughout the morning hours, followed by a brief but notable peak shortly after solar insolation reaches peak intensity, followed by a persistent gradual decrease throughout the evening hours.

Figure D-3: Average Diurnal Pattern in Hourly Ozone Concentrations during April-September in 2016-2020



*2019-2020 only; 2016-2018 data were not available. Complete records of solar radiation data from South Coast sites were also not available for 2016-2020.

In contrast to the South Coast Air Basin sites, ozone at Western Mojave sites steadily increases between sunrise and 0900 then plateaus until just after midday. Prior to sunrise, ozone concentrations typically reach their lowest point at all the sites, but there is a difference between the average lowest concentrations across the sites of up to approximately 0.030 ppm. This difference can largely be explained by the proximity of each site to direct NO_x emissions, which break down ozone, especially in the absence of sunlight. This drop in ozone concentrations is most evident at Victorville and Barstow. While the most rural site, Joshua Tree, experiences little to no decrease in ozone concentrations, and the decrease is more likely attributable to deposition and interaction with other molecules in the air.

However, as soon as the sun rises, emissions, which transported into the area the previous day and are derived from local sources, quickly convert to ozone and a shallow temperature inversion typically confines the near-surface layer to several hundred feet, leading to a rapid rise in concentrations. Once temperatures are warm enough, the inversion dissipates and the atmosphere mixes vertically. This mixing dilutes the ozone that had already formed, but because additional ozone continues to form, ozone concentrations plateau, as evidenced by the nearly flat portion of the diurnal profile during the last morning hours.

Between 1300 and 1500, ozone steadily increases again and peaks between 1500 and 1600. At this time of the day, surface winds are generally from the south and transport emissions from the South Coast Air Basin into Western Mojave. The largest increases and highest peak concentrations are at Lancaster, Phelan, Hesperia, and Joshua Tree, the sites in closest proximity to the mountain ranges between the South Coast Air Basin and Western Mojave.

The increase between the midday plateau and afternoon peak at these sites amounts to 0.008 to 0.01 ppm. This afternoon peak suggests that ozone concentrations at these sites are mainly influenced by regional transport rather than local emissions. The transport could be near the surface and/or aloft, which would reach the surface through vertical mixing in the atmosphere during the afternoon hours.

The coincident timing of peak concentrations at Western Mojave sites suggests that the primary mechanism for regional transport may be through top-down entrainment rather than near-surface transport.[69] Mixing heights in Western Mojave are generally higher than those in South Coast Air Basin, thus pollutants from upwind areas will undergo more dilution and measured peak concentrations will typically be lower than those in the upwind source areas.

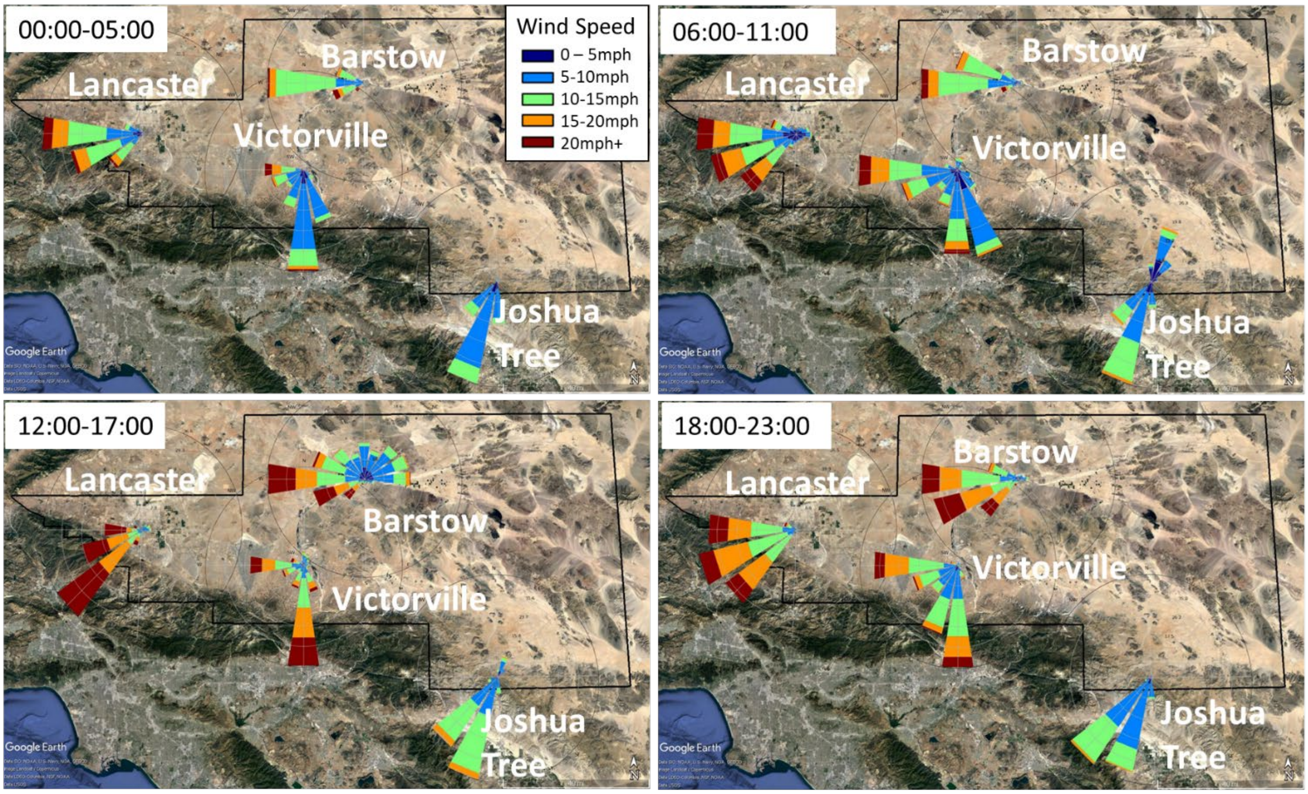
Average peak hourly ozone concentrations at Barstow and Victorville (Figure II-1) are generally lower than peak concentrations at the other Western Mojave sites. Dilution, resulting from longer transit from upwind urban areas, and titration resulting from local emissions of oxides of nitrogen (NO_x) likely contribute to reduced peak concentrations at Barstow and Victorville, respectively.

The diurnal patterns in ozone at Western Mojave sites, shown in Figure II-1, are likely reflective of ozone transport from surrounding areas. Wind data for Lancaster, Barstow and Victorville was obtained using the Iowa Environmental Mesonet from Iowa State University[70], the wind data for Joshua Tree was measured at the regulatory ozone monitoring station. The wind data indicates that the increased speed of prevailing winds is largely coincident with peak afternoon/evening ozone concentrations (Figure D-4), which is further indicative of a transport dominated ozone regime. Furthermore, wind directions depicted by the wind roses also show the dominance of transport from the South Coast Air Basin.

[69] VanCuren, R. (2015). Transport aloft drives peak ozone in the Mojave Desert. Atmospheric Environment, 109, 331-341.

[70] Iowa State University. Iowa Environmental Mesonet. Accessed 4/6/2022. https://mesonet.agron.iastate.edu/request/download.phtml?network=CA_ASOS

Figure D-4: Patterns in Prevailing Winds in the Mojave Nonattainment Area



Available wind data varied slightly among sites. For the above figure, data for April through September from 2016 to 2020 was included in the wind analyses at all sites except Joshua Tree. Data from April through September from 2019 to 2020 was included for Joshua Tree.

Analyses of Air Mass Trajectories on Exceedance Days

To gain further insight into the potential source areas and transport corridors that may contribute to ozone on exceedance days in Western Mojave, back trajectories were computed using the desktop-based version of the National Oceanographic and Atmospheric Administration's (NOAA) Air Resources Laboratory HYbrid Single Particle Lagrangian Integrated Trajectory (HYSPLIT) model.[71,72,73] The HYSPLIT model was run for all exceedance days in 2020 at the regulatory ozone monitoring sites in Western Mojave using the NAM12 meteorological model data.

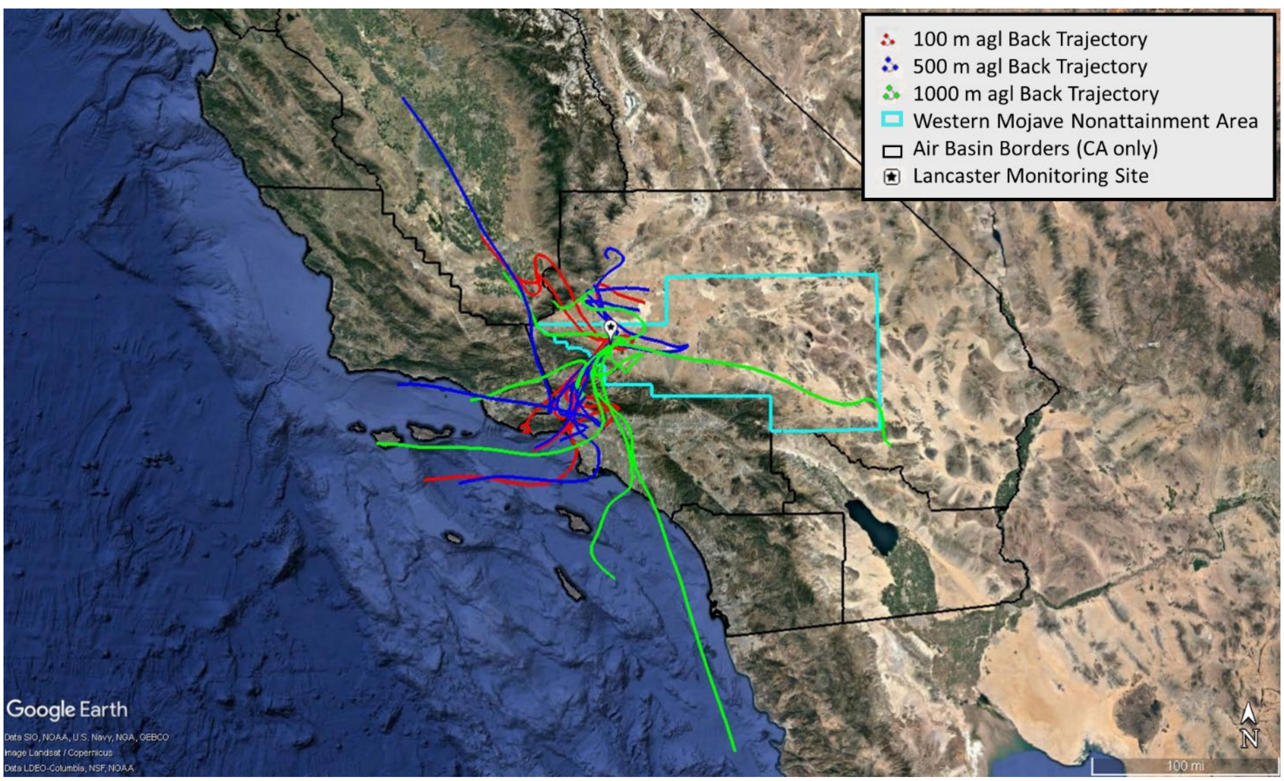
Research has indicated that pollutant transport may occur at a range of altitudes, not just in near-surface air masses. Given that large mixing heights are expected for the high desert area during much

[71]National Oceanographic and Atmospheric Administration's (NOAA) Air Resources Laboratory HYbrid Single Particle Lagrangian Integrated Trajectory (HYSPLIT) model. https://www.ready.noaa.gov/HYSPLIT_traj.php
[72]Rolph, G.D. (2016). Real-time Environmental Applications and Display sYstem (READY) Website (http://www.ready.noaa.gov). NOAA Air Resources Laboratory, College Park, MD.
[73]Stein, A.F., Draxler, R.R, Rolph, G.D., Stunder, B.J.B., Cohen, M.D., and Ngan, F., (2015). NOAA's HYSPLIT atmospheric transport and dispersion modeling system, Bull. Amer. Meteor. Soc., 96, 2059-2077, http://dx.doi.org/10.1175/BAMS-D-14-00110.1

of the high ozone season, back trajectories were initiated from the monitoring sites at 100 m above ground level (agl), 500 m agl, and 1000 m agl at the peak hour for each exceedance day. Maps of the 24-hour back trajectories are shown in Figure D-5 through Figure D-10. These figures provide a visual representation of the geographic extent of potential source areas on exceedance days. The maps of the back trajectories initiated from 500 m agl indicate fairly well-defined transport corridors to each site, which are consistent with well-established terrain following wind flow patterns. The maps of the back trajectories initiated from 1000 m agl indicate a broad regional potential source area, extending through the South Coast Air Basin and the San Joaquin Valley, for ozone on 2020 exceedance days in Western Mojave.

Back trajectories at Lancaster (Figure D-5) indicate a well-defined transport corridor from South Coast Air Basin through the Soledad Pass with potential routine contribution from the San Joaquin Valley. Studies have indicated that, while the depth of the mixed layer in the San Joaquin Valley is fairly shallow, mixing heights increase in the southern end of the valley due to convergence of air in an area surrounded by confining terrain.[74,75] Air masses from the San Joaquin Valley could subsequently be lofted over the southern Sierra Nevada Mountains or exit through gaps and passes en route to Lancaster.

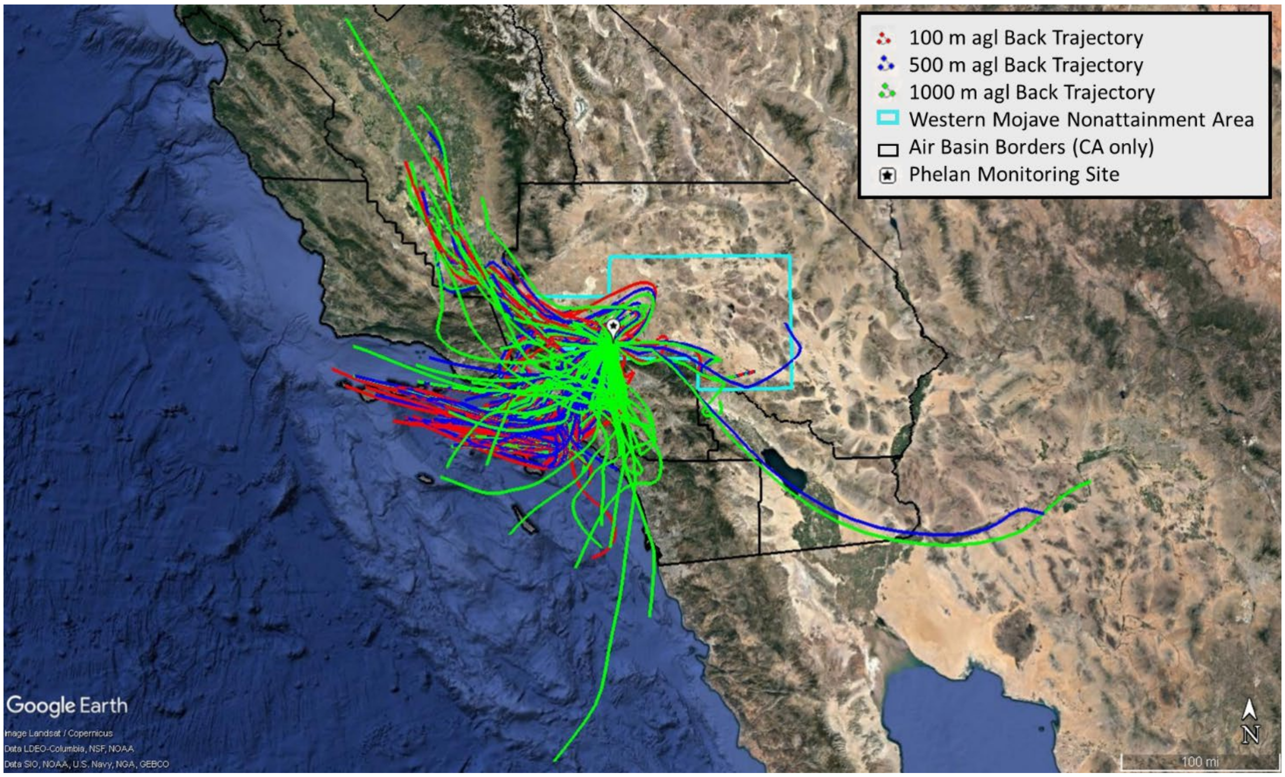
Figure D-5: Back Trajectories for 2020 Exceedance Days at Lancaster



[74]Beaver, S. and Palazoglu, A., (2009). Influence of synoptic and mesoscale meteorology on ozone pollution potential for San Joaquin Valley of California, Atmospheric Environment, 43, 1779-1788.
[75]Trousdell, J. F., Conley, S. A., Post, A., and Faloona, I. C., (2016). Observing Entrainment Mixing, Photochemical Ozone Production, and Regional Methane Emissions by Aircraft Using a Simple Mixed-Layer Model, Atmos. Chem. Phys. Discuss., doi:10.5194/acp-2016-635, in review.

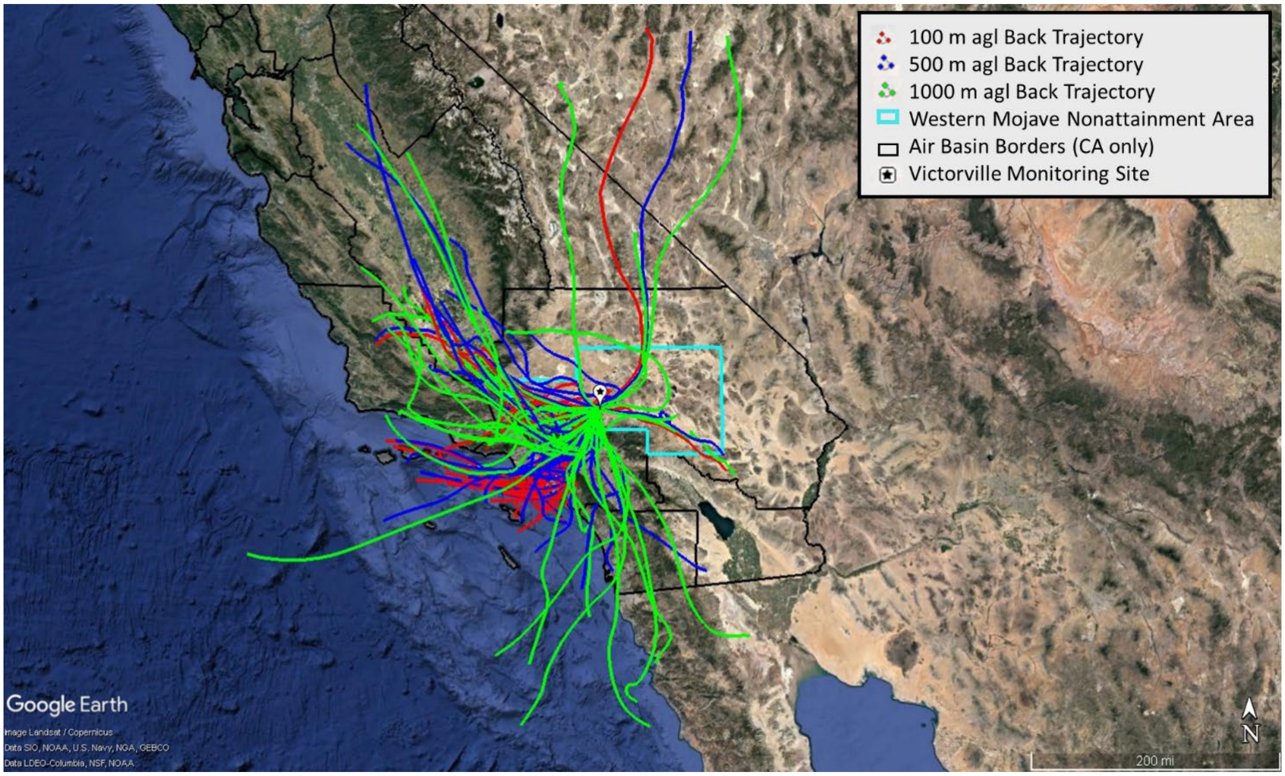
Back trajectories initiated from Phelan (Figure D-6) indicate two well defined corridors between the South Coast Air Basin and Phelan. The trajectories indicate that air masses intercepted at Phelan traveled, in near equal frequency, through the Cajon Pass, between the San Gabriel and San Bernardino Mountains, and through the Soledad Pass, between the Sierra Pelona and San Bernardino Mountains. The trajectories show extension from the San Joaquin Valley, especially at the 1000 m agl, suggesting that some of the air entering the high desert via the Soledad Pass may have previously passed through the San Joaquin Valley.

Figure D-6: Back Trajectories for 2020 Exceedance Days at Phelan



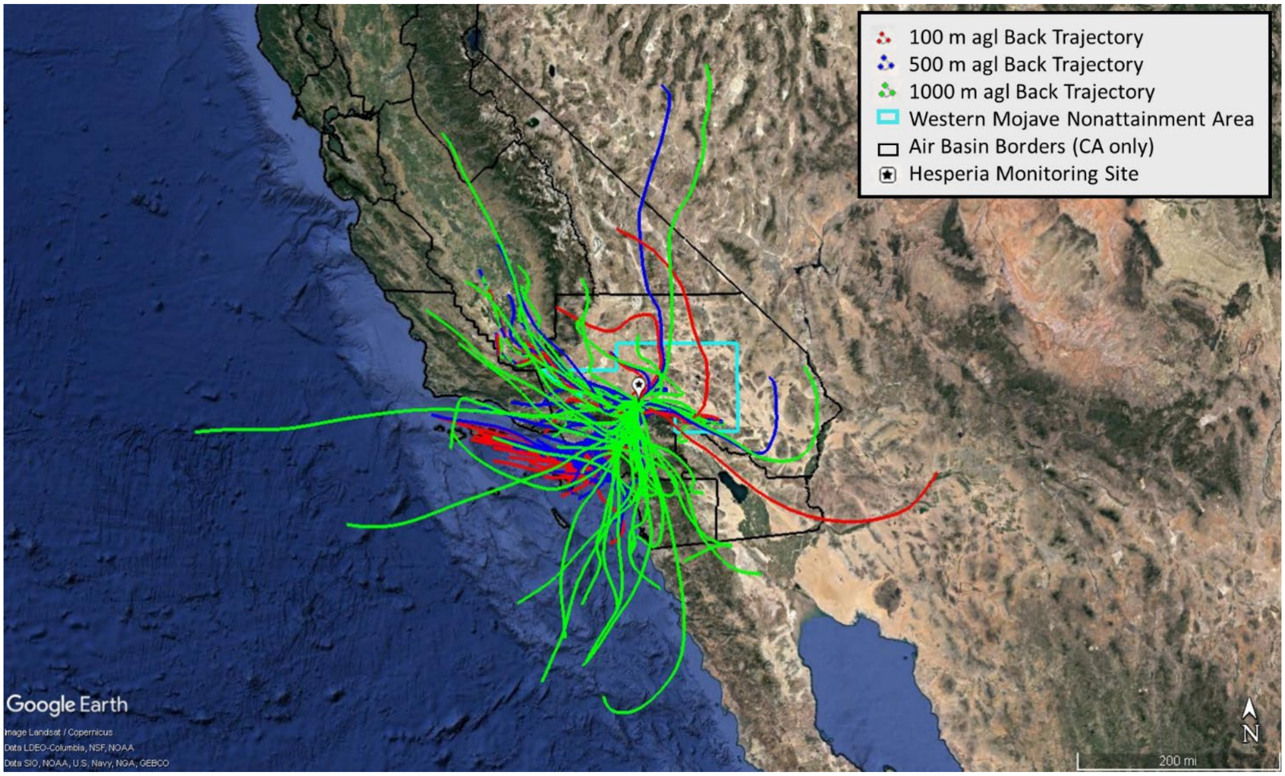
Trajectories initiated from Victorville (Figure D-7) show that transport from the South Coast Air Basin occurs primarily through the Cajon pass, and through the Soledad Pass. San Joaquin Valley may also be a source region for air intercepted at the site.

Figure D-7: Back Trajectories for 2020 Exceedance Days at Victorville



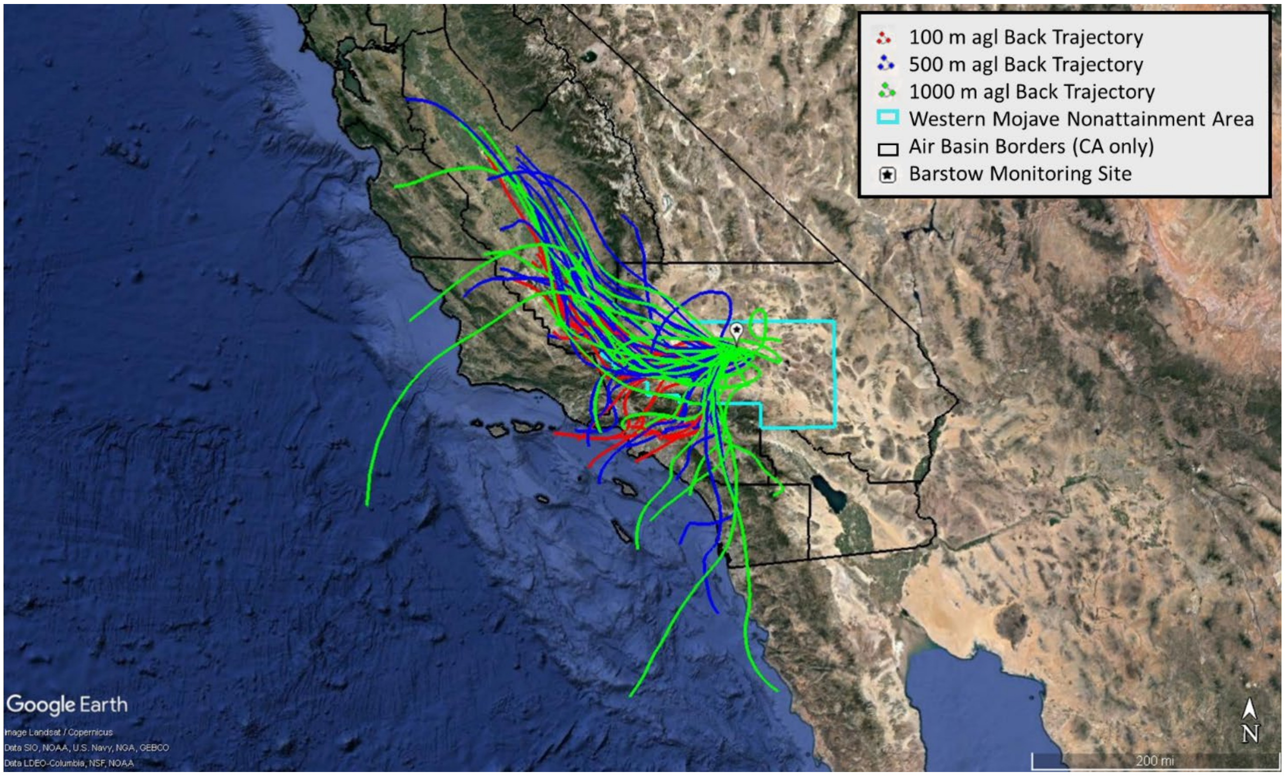
Back trajectories initiated from Hesperia (Figure D-8) show that air masses primarily exit the South Coast Air Basin via the Cajon Pass. The trajectories also show that pollution from the San Joaquin Valley and western San Diego County may also contribute to air quality at Hesperia on exceedance days.

Figure D-8: Back Trajectories for 2020 Exceedance Days at Hesperia



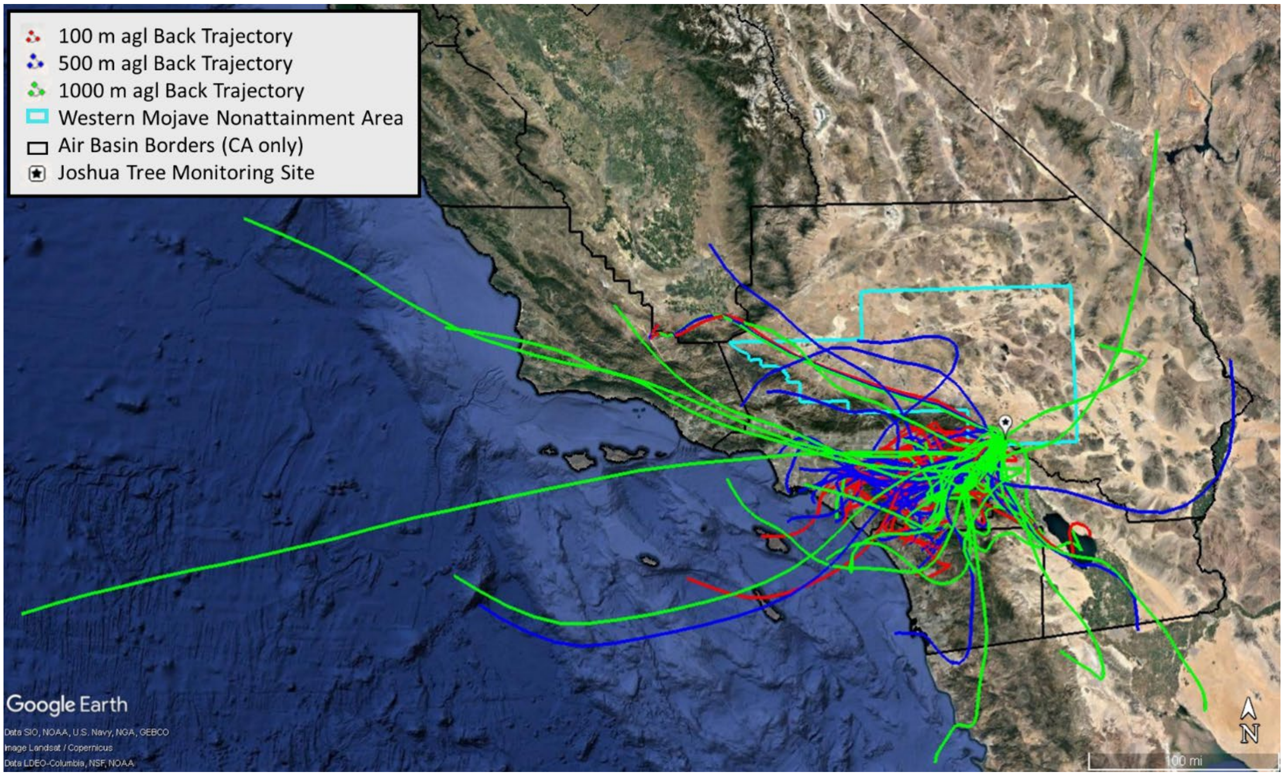
Back trajectories initiated from Barstow (Figure D-9) illustrate the convergence of air in the high desert from numerous source areas. Transit via the Tehachapi Pass, Soledad Pass, and Cajon Pass is represented, suggesting that emissions from the South Coast Air Basin and San Joaquin Valley potentially contribute to exceedance days at Barstow. The footprint of the trajectories initiated from 1000 m agl is similar to those trajectories initiated from 500 m agl, and 100 m agl indicating that air masses are well-mixed when they are intercepted at the site.

Figure D-9: Back Trajectories for 2020 Exceedance Days at Barstow



Back trajectories at Joshua Tree (Figure D-10) are indicative of routine transport from the South Coast Air Basin, primarily by way of the San Gorgonio Pass, with occasional extension to the San Joaquin Valley to the north as well as San Diego and Imperial Counties to the south.

Figure D-10: Back Trajectories for 2020 Exceedance Days at Joshua Tree



Upwind and Downwind Trends

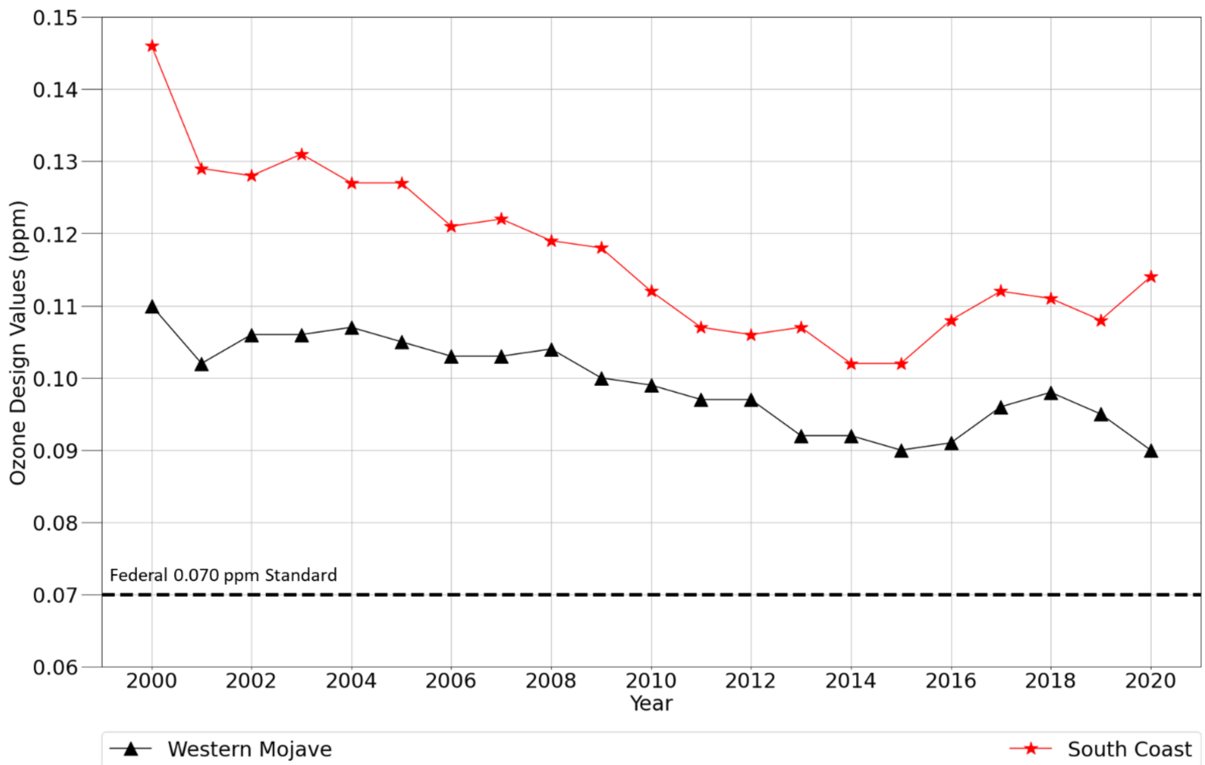
Maximum design values within each of the Western Mojave (downwind) and South Coast Air Basin (upwind) nonattainment areas were compared to demonstrate that progress in the South Coast Air Basin was translating to similar progress in Western Mojave. In Figure D-11, the design value trends for the two regions, from 2000 through 2020, track well with each other, especially considering the complex nature of the ozone challenges in both areas. The difference in the maximum design values between the South Coast Air Basin and Western Mojave have been fairly consistent over the years, generally ranging from 0.02 ppm in the earlier years to 0.01 ppm in more recent years. Between 2000 and 2020, the South Coast Air Basin design value decreased by 22 percent while in Western Mojave, the design value decreased by 18 percent.

The decline in design values, illustrates the significant progress made between 2000 and 2020 and the linkage between the upwind South Coast Air Basin extreme nonattainment area and Western Mojave. Despite the design values still being above the 0.070 ppm standard at each of the monitoring sites in Western Mojave, ozone air quality has improved throughout the region in response to reductions in upwind ozone precursor emissions. Air quality data analyses presented in the Ozone Air Quality Trends section indicates that the monitoring sites are continuing to make progress toward attainment.

Additionally, as ozone design values continue to improve in the South Coast Air Basin, the magnitude of ozone transport and the impact on ozone concentrations in Western Mojave will be reduced.

Wildfires have impacted ozone levels over all of California, including Western Mojave and South Coast Air Basin, over the past years. 2016, 2017, 2018 and 2020 were extreme years for wildfires, with numerous wildfires active during the June through October. During the wildfires, additional ozone precursors are released that can impact design values across the State. The additional ozone precursors emitted from wildfires could have contributed to the increase in design values seen in both the South Coast Air Basin and Western Mojave for 2016-2020 (Figure D-11).

Figure D-11: Ozone Design Value Trends in Western Mojave and South Coast



Phelan and San Bernardino Trends

The design values from Phelan (downwind) and the South Coast Air Basin San Bernardino (upwind) monitoring sites were compared to show that Phelan is influenced by ozone transported in from South Coast Air Basin. Figure D-12 shows the location of the two monitoring sites, Phelan, and San Bernardino, as well as the Cajon Pass. The Cajon pass is one of the dominant paths that air masses travel to reach Phelan and transport air masses directly to Phelan from South Coast Air Basin.

San Bernardino monitoring site was selected for the comparison due to it being a downwind site within the South Coast Air Basin nonattainment area and upwind of Phelan. The San Bernardino monitoring sites provides an incite as to the ozone concentration of air masses as they pass through the Cajon Pass and reach Phelan.

The Phelan monitoring site is in a low population density area. The monitoring site was placed initially to gain an understanding of the transport from South Coast Air Basin into Western Mojave and how that transport affects air quality within Western Mojave.

Figure D-12: Map of Phelan and San Bernardino Monitoring site locations

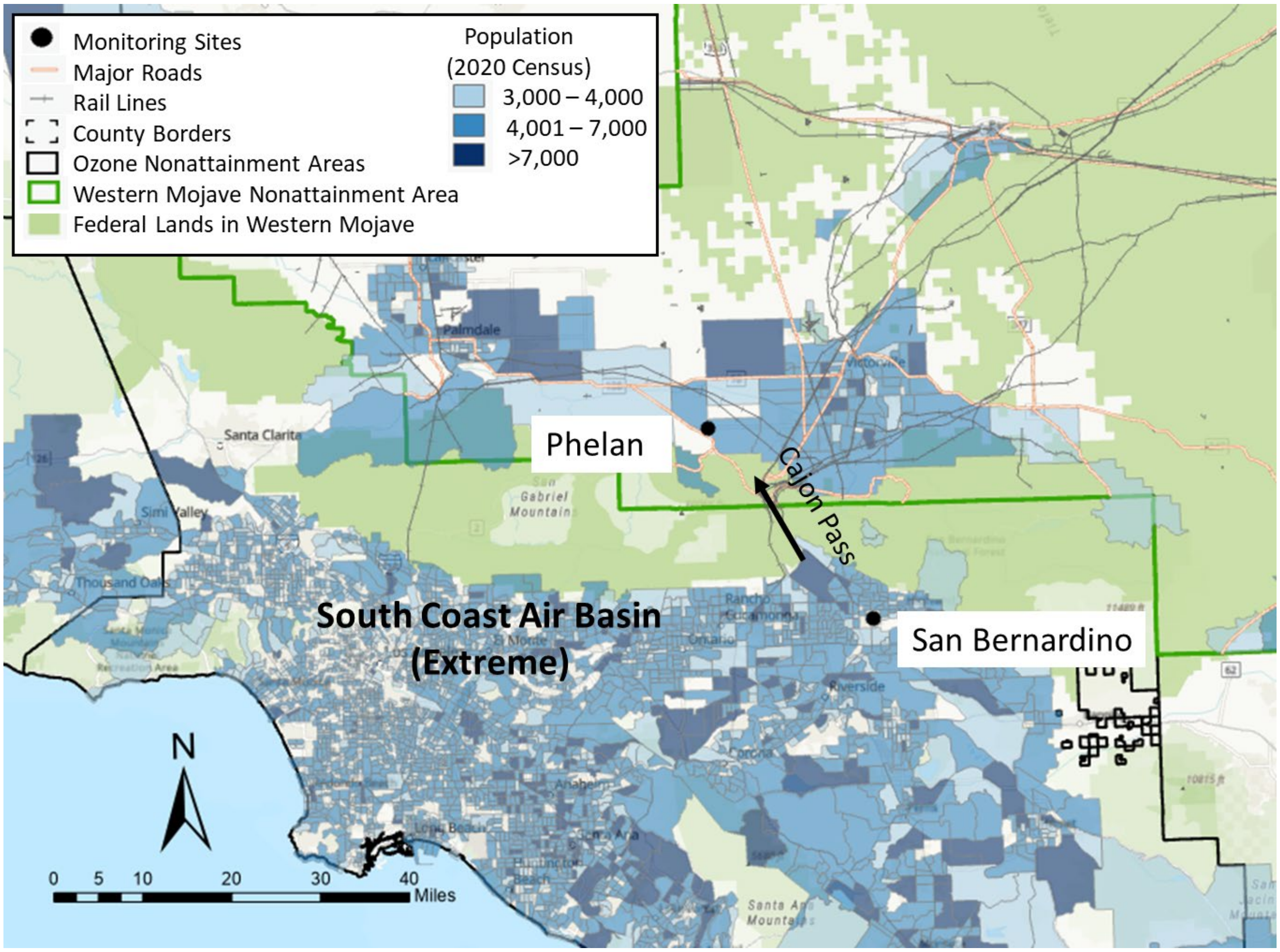
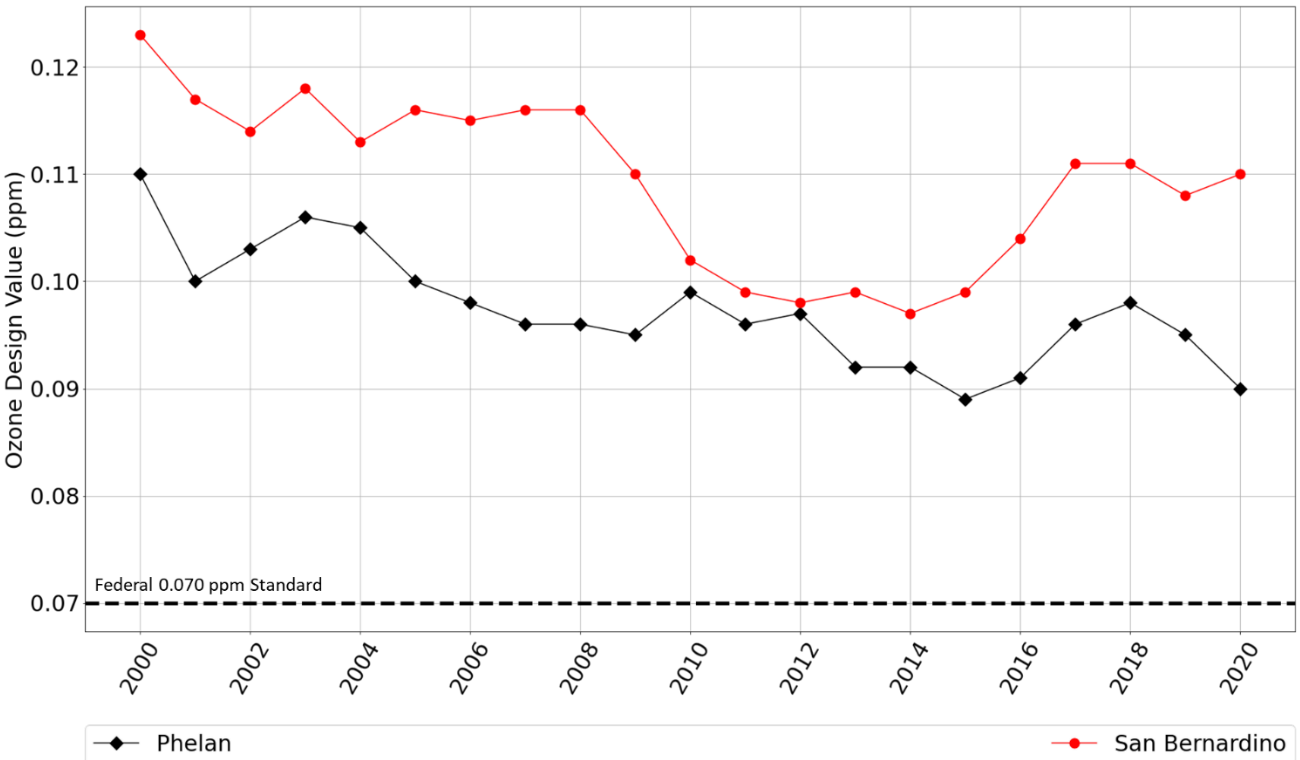


Figure D-13, shows the comparison of the ozone design value for the past two decades at Phelan and San Bernardino monitoring sites. The design values track well with each other, especially considering the complex nature of the ozone challenges in both areas. This is easily seen in the most recent years when around 2015-2017 the design value increased at both sites, with a larger and earlier increase at San Bernardino compared to Phelan.

This increase in design values is believed to be due largely to meteorology and the transition from a Volatile Organic Compounds (VOC)-limited region to a NO_x-limited region, as well as increased wildfires throughout California. As South Coast Air Basin and Western Mojave become more NO_x-limited regions the current and new NO_x emission reduction commitments from CARB and South Coast will drive ozone concentrations down even further for the future years. Additionally, in 2020 NO_x emissions decreased by up to 20 percent due to the additional NO_x emission reductions caused by the pandemic, resulting in a 0-2 ppb decrease in ozone[76]. This suggests that NO_x emission control strategies in upwind areas such as South Coast are expected to be effective in reducing ozone levels in future years. NO_x- and VOC-limited regions is discussed further detail in the Ozone Air Quality Trends section.

Figure D-13: Ozone Design Value Trends at Phelan and San Bernardino Regulatory Sites



Anthropogenic Emissions

Tropospheric (ground-level) ozone is a secondary pollutant that is formed by NO_x and VOC emissions through complex non-linear photochemical reactions. VOC are also referred to as Reactive Organic Gases (ROG) and these two terms are used interchangeable in this document. Anthropogenic emissions from mobile sources, industrial facilities and electric utilities, gasoline vapors, and chemical solvents are some of the major sources of NO_x and ROG.

Data from the California Air Resources Board's (CARB) California Emission Projection Analysis Model (CEPAM) 2022 Southern California (SoCal) Ozone SIP Inventory for Summer (version 1.01 with approved external adjustments) were used to evaluate trends in anthropogenic emissions of ozone precursors, NO_x and ROG, in Western Mojave, South Coast Air Basin and San Joaquin Valley (Figure D-14).

[76]Schroeder, J., Chenxia, C., Xu, J., Ridley, D., Lu, J., Bui, N., Yan, F., Avise, J. (2022), Changing Ozone Sensitivity in the South Coast Air Basin during the COVID-19 Period. https://doi.org/10.5194/acp-2022-178

Distribution of Ozone Precursor Emissions

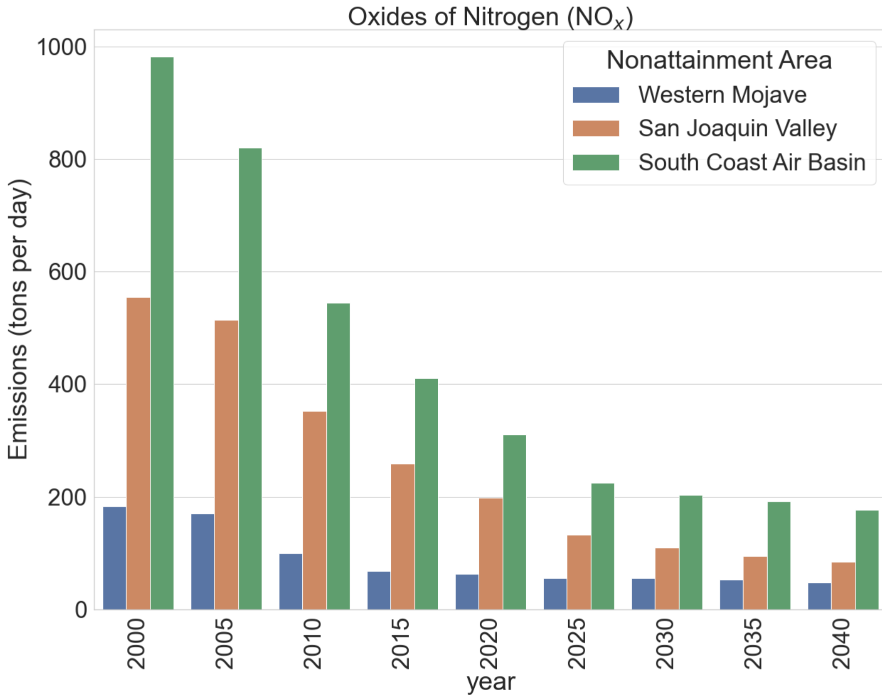
Emission control programs have substantially reduced the amounts of both NO_x and ROG emitted by various sources throughout the Western Mojave, South Coast Air Basin and San Joaquin Valley. Emissions in Western Mojave are significantly lower than those in upwind areas. In 2020, NO_x emissions in the South Coast Air Basin were almost five times greater than Western Mojave emissions, whereas anthropogenic emissions of ROG in the South Coast Air Basin were nearly eleven times greater (Figure D-14). Emissions in the San Joaquin Valley were also much larger than those in Western Mojave.

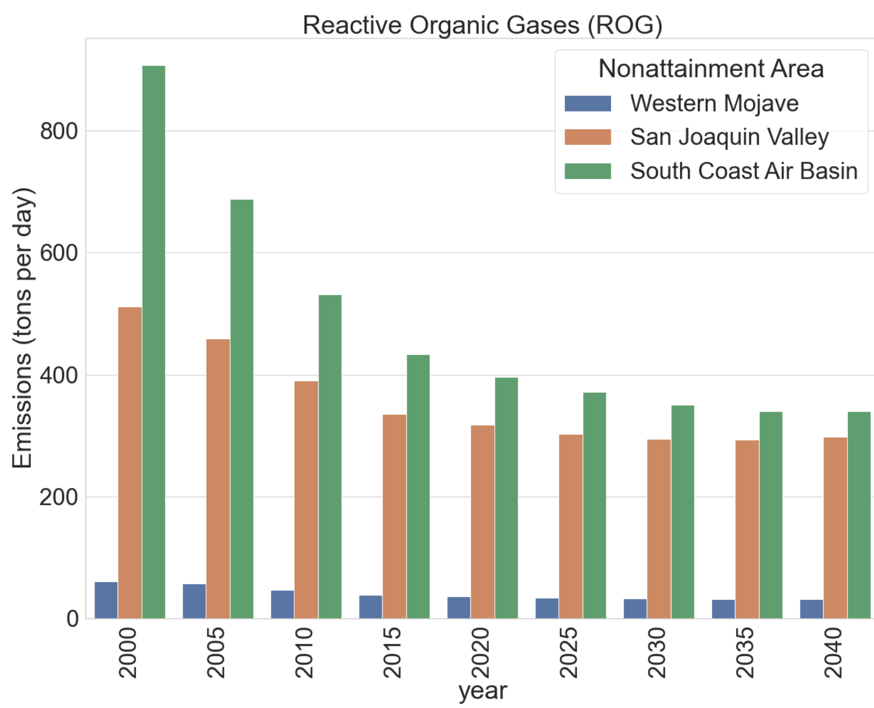
The difference in emission between the three areas provides a clear indication that transport of emissions from the upwind source areas, and predominantly from the South Coast Air Basin, is the key factor controlling ozone air quality in Western Mojave. The NO_x trends shown in Figure D-14 are using baseline NO_x reductions based on current emissions reductions programs. Current and new NO_x reduction commitments will drive the NO_x emission reductions even further for the future years.

The connection between ozone, a secondary pollutant, and emissions of ozone precursor compounds is characterized by considerable temporal and spatial variability. In general, as air masses travel downwind from major emissions source areas, entrainment of fresh emissions, atmospheric reactions, depositional processes, and dilution increase the ROG/NO_x ratio. As a result, ozone formation in downwind suburban and rural areas is typically regard as NO_x-limited.[77] Given Western Mojave's downwind location from the only two extreme ozone nonattainment areas in the country, it is expected that ozone formation would be limited by available NO_x emissions.

[77]Finlayson-Pitts, B.J., Pitts, J.N., 2000. Chemistry of the Upper and Lower Atmosphere. Academic Press, San Diego CA (969 pp.)

Figure D-14: Comparison of Anthropogenic NO_x and ROG Emissions in Western Mojave and Surrounding Extreme Nonattainment Areas





As discussed earlier, regional transport significantly contributes to peak ozone concentrations in Western Mojave and ultimately, progress towards achieving ozone air quality goals in Western Mojave will be largely dependent upon emissions reductions in upwind areas. While emission reductions in areas upwind of Western Mojave are essential, understanding local emissions within Western Mojave and changes in the various sectors are also important for determining if additional local rules and regulations would assist the region in meeting attainment goals.

Trends in Anthropogenic Precursor Emissions

Between 2000 and 2020, Western Mojave (Figure D-15) achieved substantial reductions in ozone precursor emissions:

- Total NO_x emissions declined by 65 percent; and
- Total ROG emissions declined by 40 percent.

Similar emissions reductions were also seen in the South Coast Air Basin (Figure D-14) during the same period, with decreases of 68 percent for NO_x and 56 percent for ROG, and in the San Joaquin Valley (Figure D-14), with decreases of 64 percent for NO_x and 38 percent for ROG.

Going forward from 2020, current emission control programs will further reduce emissions in Western Mojave by 2032, namely:

- Total NO_x emissions will decline an additional 13 percent; and
- Total ROG emissions will decline an additional 11 percent.

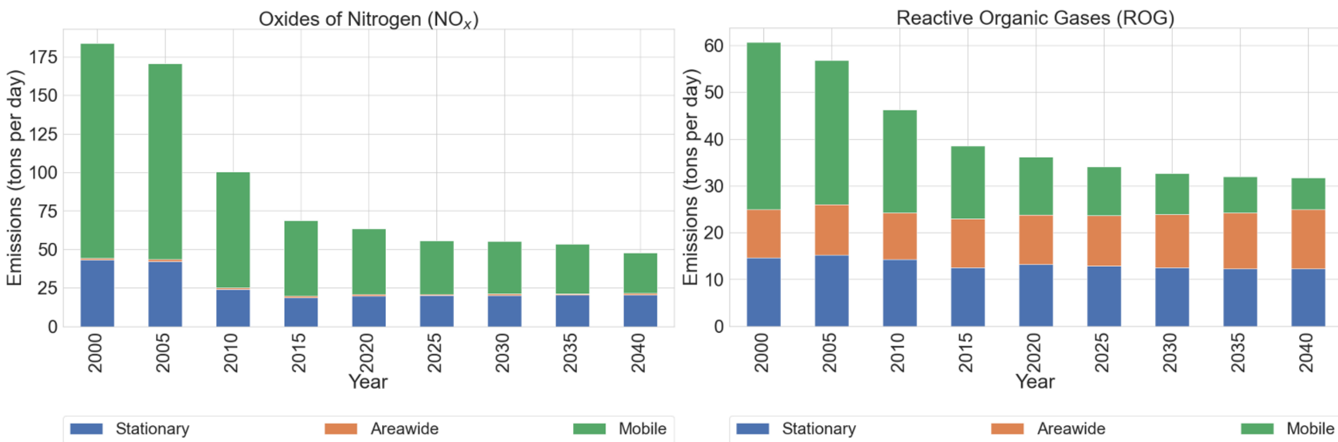
Emissions reductions, under the current emission control programs, are also predicted to reduce emissions in South Coast Air Basin with total NO_x emissions decreasing by 36 percent and total ROG emissions decreasing by 13 percent by 2032. The San Joaquin Valley will see similar emissions reductions, with decreases of 48 percent for total NO_x emissions and 8 percent for total ROG emissions by 2032. Additional control measures that will be implemented in the future in Western Mojave, South Coast Air Basin, and the San Joaquin Valley will further reduce emissions from the current modeled estimates.

The NO_x and ROG reductions in both South Coast Air Basin and the San Joaquin Valley, will aid in reducing ozone precursor emissions and therefore ozone concentrations in Western Mojave. Analyses (Conceptual Model section) indicated that transport from these areas routinely contributes to ozone air quality in Western Mojave and progress towards attainment in Western Mojave will depend on continued progress in upwind areas.

Breakdown of NO_x and ROG Emissions

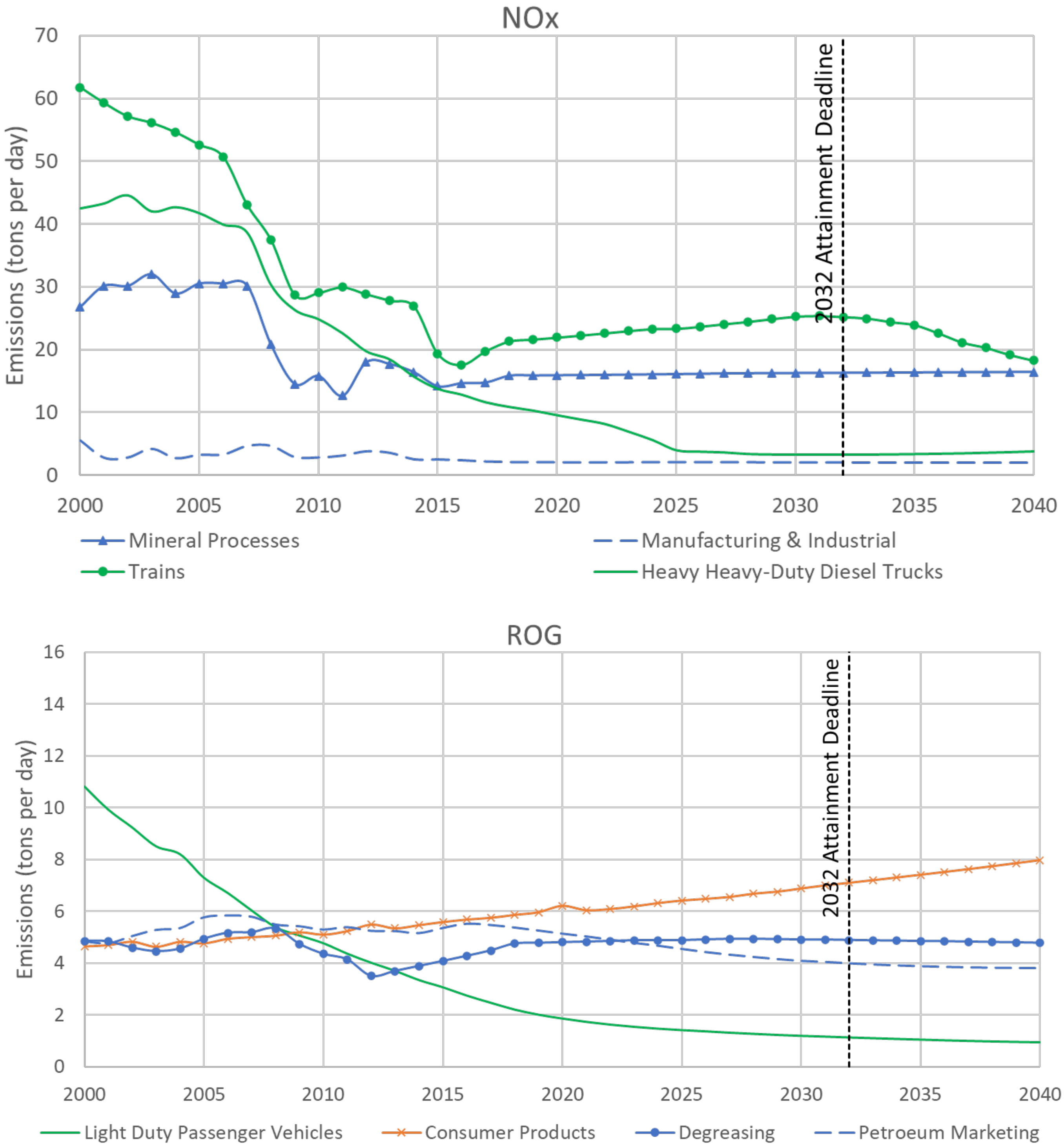
The Western Mojave emissions inventories are dominated by mobile sources, which accounted for 67 percent of NO_x emissions and 34 percent of ROG emissions in 2020. In contrast, stationary and areawide sources accounted for 31 percent and 2 percent of NO_x emissions, respectively. Stationary and areawide sources accounted for 37 percent and 29 percent of ROG emissions, respectively. In comparison to 2020, mobile sources are expected to account for 61 percent of NO_x emissions and 26 percent of ROG emissions in 2032.

Figure D-15: Inventory of Western Mojave Ozone Precursor Emissions



As State mobile source controls continue to be implemented, the overall magnitude of precursor emissions are projected to decline modestly, as noted above, while the categorical distribution of emissions is projected to shift considerably. When the NO_x emissions inventory is considered in whole, the top four individual source subcategories are trains, heavy heavy-duty diesel trucks, mineral processes, and manufacturing & industrial processes. As shown in Figure D-16, between 2000 and 2020, emissions from these top four source categories followed a generally decreasing trend. Emissions in 2020 from trains were 65 percent lower than in 2000, while emissions from heavy heavy-duty diesel trucks, mineral processes, and manufacturing & industrial processes were 78 percent, 40 percent, and 63 percent lower in 2020 than in 2000, respectively.

Figure D-16: Emissions from Top 4 NO_x and ROG Source Categories in Western Mojave*



* Consistent with Figure D-15: mobile sources are in green; stationary sources are in blue; and areawide sources are in orange.

The top four ROG source categories are petroleum marketing, light duty passenger vehicles, consumer products, and degreasing. Between 2000 and 2020, ROG emissions from light duty passenger vehicles decreased significantly. Similar to heavy heavy-duty diesel truck emissions, light duty passenger vehicle emissions are expected to continue to decrease steadily through 2032. Emissions from petroleum marketing increased between 2000 and 2006 then decreased through 2020. Modest reductions in petroleum marketing emissions are projected to continue in the years ahead. Emissions from consumer products, which include hair spray, rubbing alcohol, and personal care products, among the top sub-categories, remained relatively stable between 2000 and 2020. Modest annual increases amounting to less than 0.1 tons per day (tpd) are projected between 2020 and 2032.

One effort that is expected to offset some of the projected emissions increases in the coming years is the District continuing to adopt new rules that will reduce emissions from several source categories, including: power and chemical plants, landfills, gas stations, dry cleaners, coating operations, boilers, and furnaces.[78] The additional rules, along with current and new emission reduction commitments from CARB, South Coast Air Basin and the San Joaquin Valley will drive the NO_x and ROG emission reductions even further for the future years. Additional reductions from the federal government will also help drive the NO_x emissions lower within Western Mojave for future years.

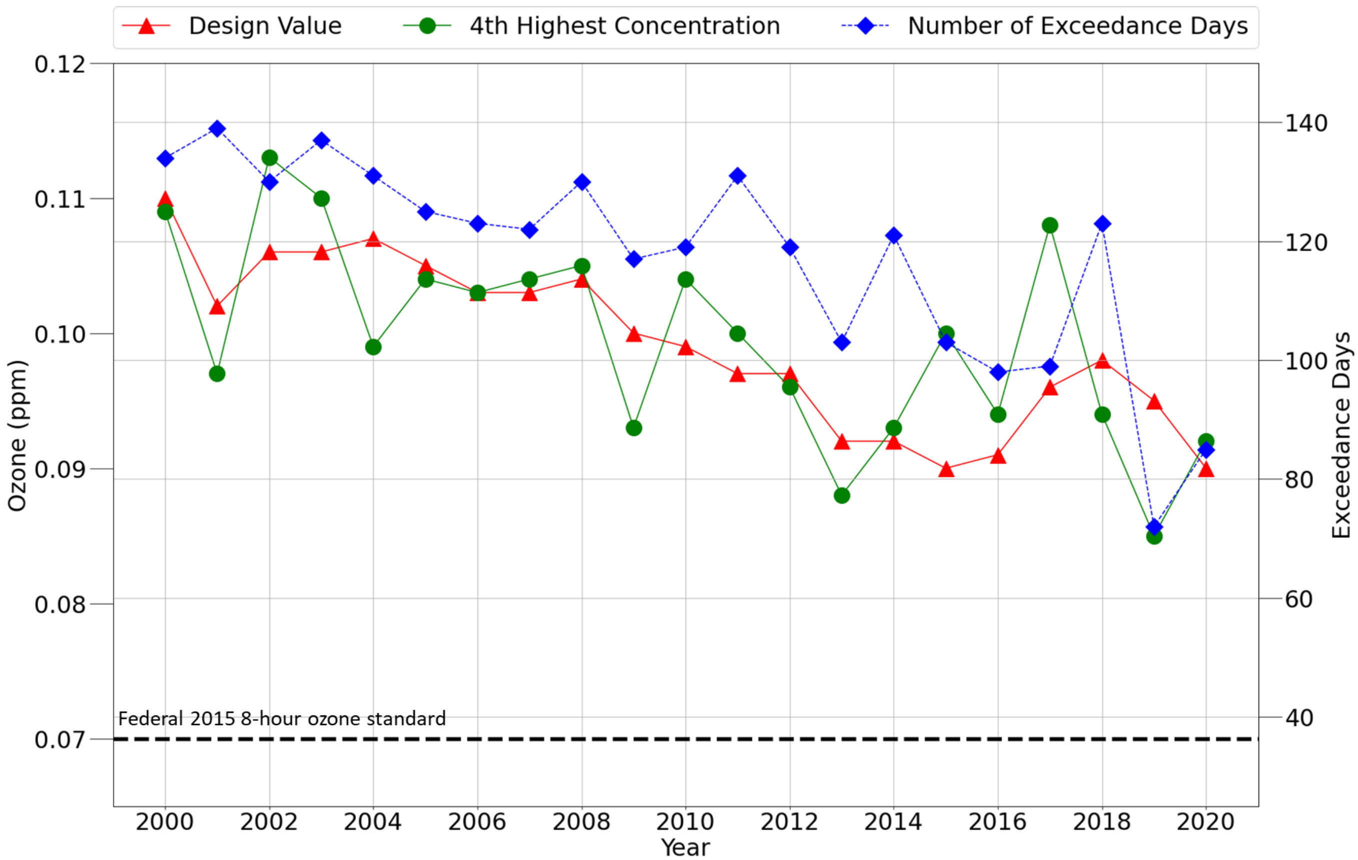
Ozone Air Quality Trends

The monitoring sites at Victorville and Lancaster were established in 2000 and 2001, respectively; the other four regulatory monitoring sites were established prior to 2000. The time scale considered in the analyses of ambient measurements, 2000 to 2020, was selected to provide the most complete and representative sample of current air quality and progress toward air quality goals throughout Western Mojave.

Air quality in Western Mojave has improved in recent decades. Between 2000 and 2020, Western Mojave's design value decreased by 18 percent, from 0.110 ppm to 0.090 ppm (Figure D-17).

[78] Mojave Desert AQMD and Antelope Valley AQMD Federal 75 ppb Ozone Attainment Plans for the Western Mojave Desert Nonattainment Area. https://ww3.arb.ca.gov/planning/sip/planarea/wmdaqmp/2016sip_staffreport.pdf

Figure D-17: 2000 – 2020 Western Mojave Ozone Summary Statistics

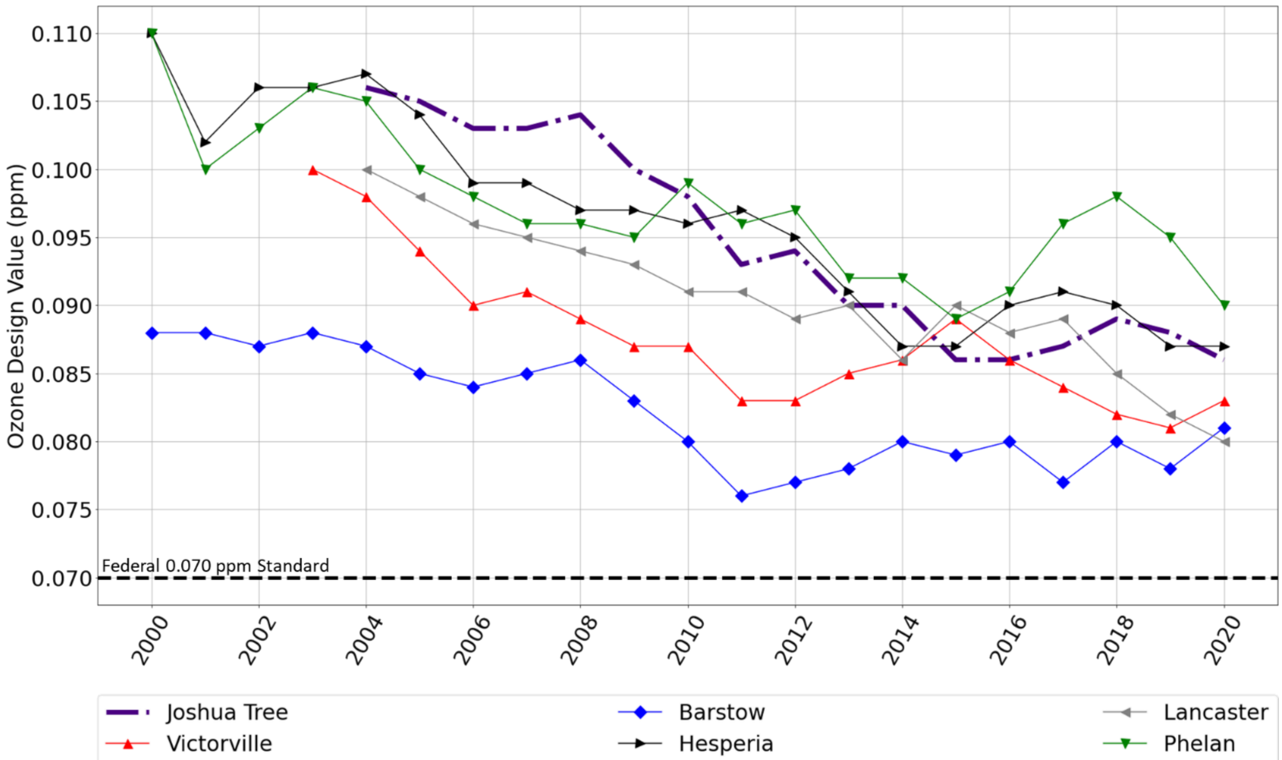


The annual fourth highest daily maximum 8-hour ozone concentration decreased from a high of 0.113 ppm in 2002 to 0.092 ppm in 2020, a decrease of 19 percent. Further, using the maximum number of exceedance days, Western Mojave experienced 85 exceedance days in 2020, which is down 37 percent from a high of 134 days in 2002.

Ozone Design Values

In 2020, all regulatory sites in Western Mojave exceeded the 0.070 ppm standard (Figure D-18) by more than ten percent.

Figure D-18: Ozone Design Values at Western Mojave Monitoring Sites



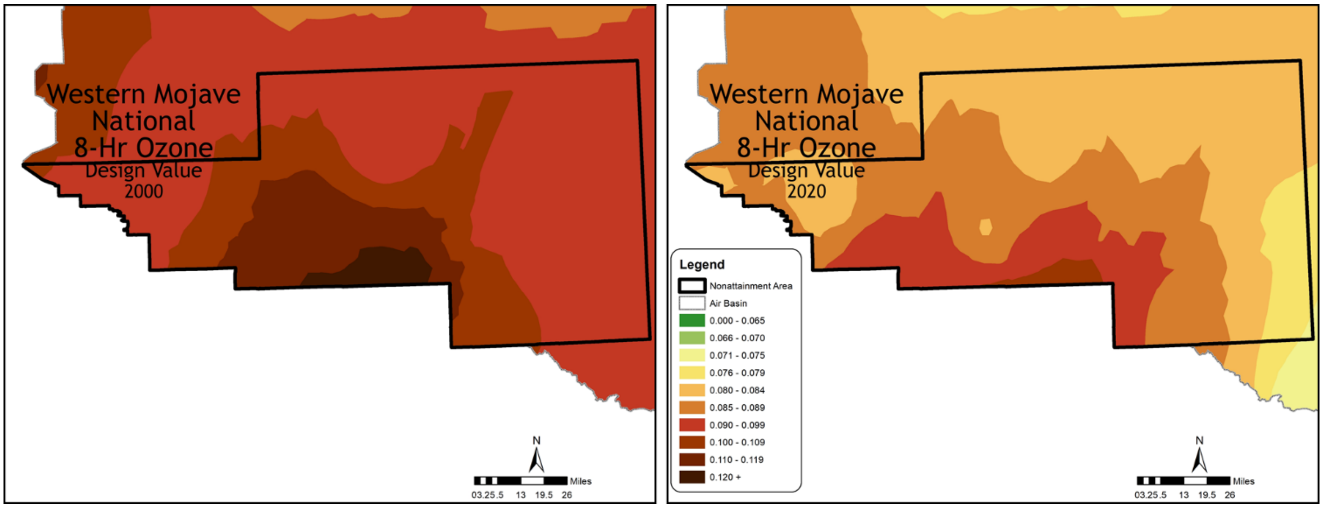
While an overall decreasing trends over the past two decades was noticeable at each site, progress was most pronounced at the high ozone sites, Hesperia, Phelan, and Joshua Tree with where the design values decreased by 21, 18 and 16 percent, respectively. Since 2002 and 2004, when the first design values were available, Victorville and Lancaster have seen a decrease in design value of 14 and 18 percent, respectively. Barstow, typically the site with the lowest design value, has seen a decrease of 8 percent over the past two decades.

Population Exposure

Inverse distance weighting (IDW) was applied to spatially interpolate design values from monitoring sites throughout California and provide a visual representation of ozone air quality in Western Mojave. In 2000, all of Western Mojave exceeded the 0.070 ppm standard by more than 0.015 ppm.

As indicated by the map for 2020, which is shown in Figure D-19, air quality has improved throughout the majority of Western Mojave. The northernmost and easternmost areas of Western Mojave had the largest improvements while areas in the southwest, adjacent to the San Gabriel and San Bernardino Mountains, remain above 0.090 ppm.

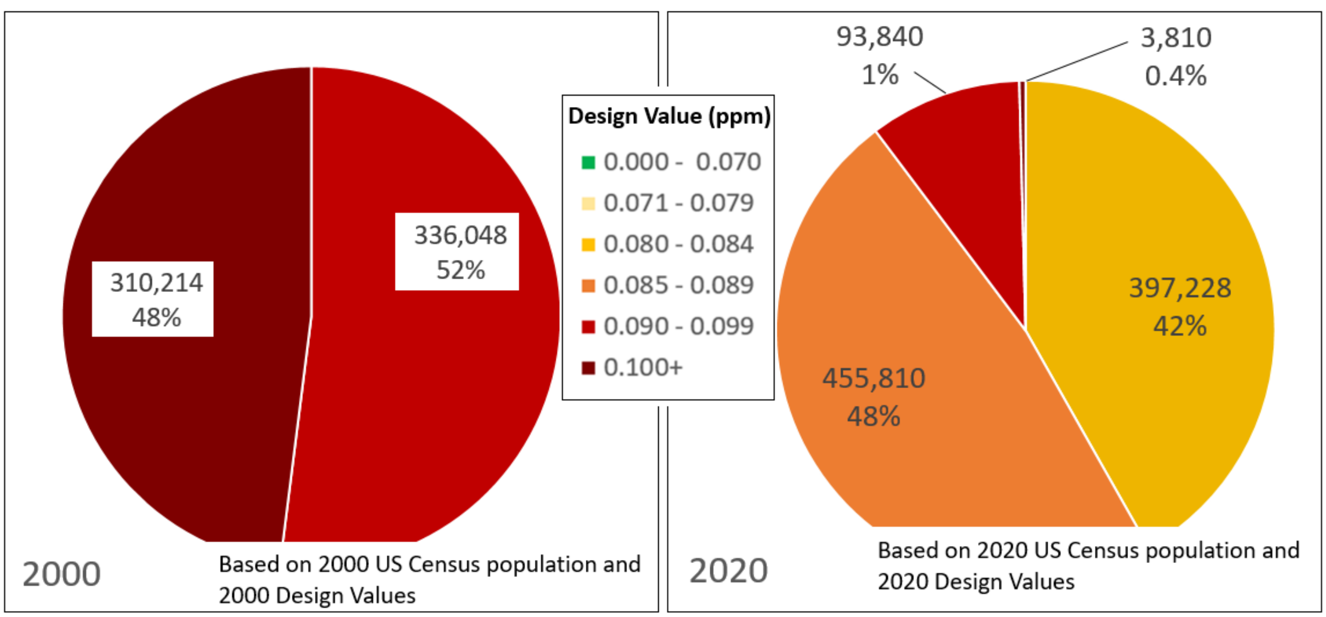
Figure D-19: Contour Maps Representing the Spatial Distribution of Ozone Design Values in the Western Mojave Nonattainment Area in 2000 and 2020*



* Contour maps were developed using used inverse distance weighting (IDW) to spatially interpolate design values

To evaluate changes in population exposure, spatial analysis tools were used to overlay county level census data with the design value contour maps. As shown in Figure D-20, between 2000 and 2020, the number of people residing in areas of Western Mojave that substantially exceeded the 0.070 ppm standard declined. In 2000, 100 and 48 percent of the population resided in areas with ozone air quality that was more than 20 and 40 percent above the 0.070 ppm standard, respectively.

Figure D-20: Population Distribution by Ozone Design Value in 2000 and 2020



In 2020, the number of people residing in areas where ozone air quality was more than 20 and 40 percent above the 0.070 ppm standard was down to 48 and 0.4 percent of the population, respectively. Which is a notable improvement from 2000. While substantial progress is evident, all areas of Western Mojave remain above the 0.070 ppm standard and a continued, coordinated effort will be necessary to meet ozone air quality standards.

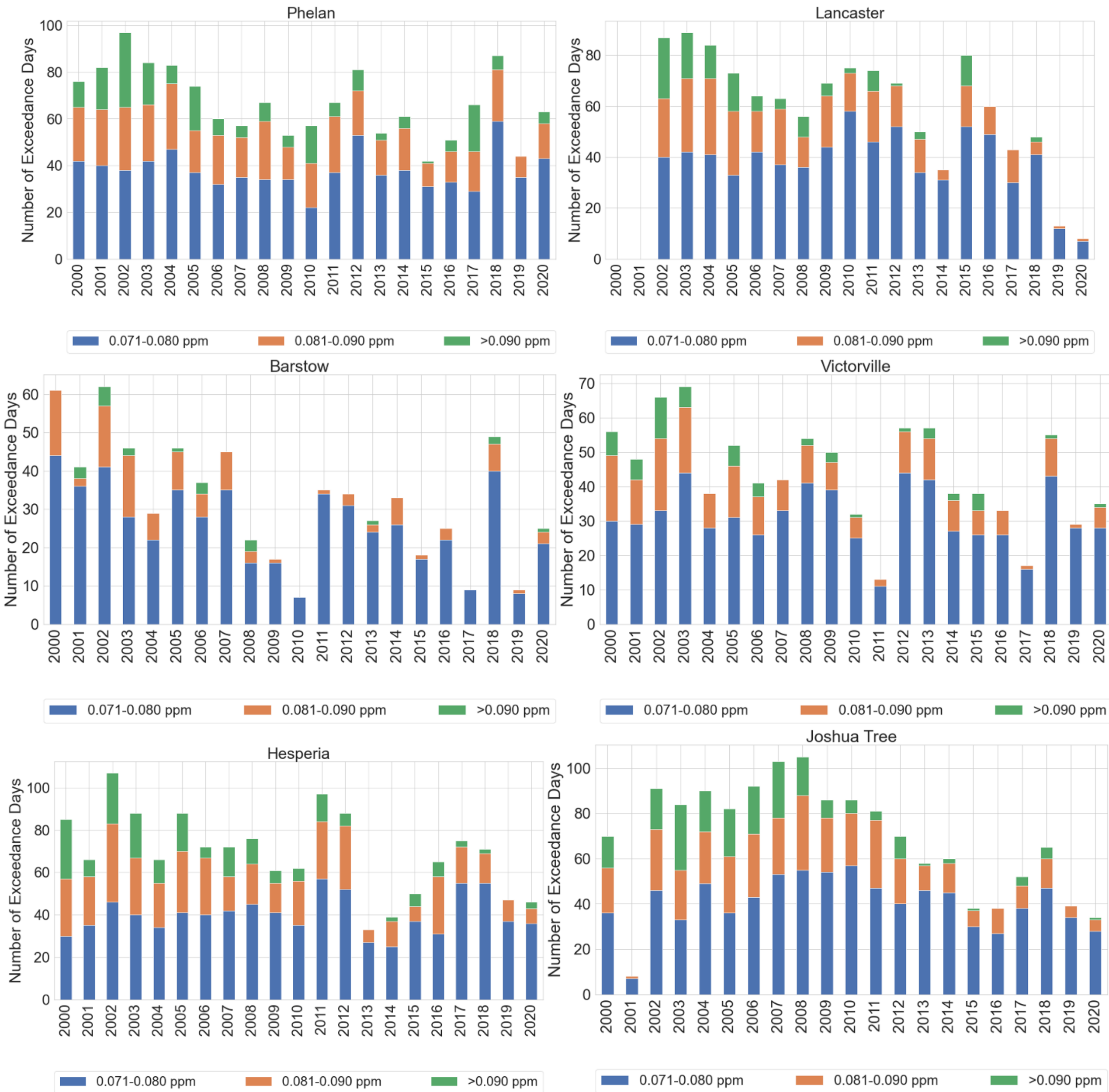
Exceedance Days

Since 2000, progress has been made in reducing both the frequency of and magnitude of ozone concentrations on exceedance days in Western Mojave (Figure D-21). At Phelan, the 2020 design value site for Western Mojave, the number of exceedance days declined by 17 percent, from a high of 76 days in 2000 to 63 days in 2020.

The frequency of exceedance days varies considerably on an interannual and site to site basis. Despite this inherent variability, between 2000 and 2020, the frequency of exceedance days decreased by an average of about four days per year at Lancaster, two days per year at Joshua Tree, Barstow, and Hesperia, and one day per year at Victorville and Phelan.

The magnitude of ozone concentrations on exceedance days also declined between 2000 and 2020. On exceedance days prior to 2004, the maximum 8-hour ozone concentrations ranged from 0.071 to 0.132 ppm, up to 89 percent above the 0.070 ppm standard. In contrast, maximum 8-hour ozone concentrations on exceedance days in 2020 ranged from 0.071 to 0.106 ppm. The decrease in the frequency and magnitude of ozone concentrations on exceedance days in Western Mojave is consistent with the progress reported for the South Coast Air Basin and San Joaquin Valley, nonattainment areas that are the primary source areas for ozone measured at Western Mojave regulatory sites.

Figure D-21: Frequency of and Maximum Concentrations on Ozone Exceedance Days in Western Mojave



Weekend Effect

The occurrence of higher ozone concentrations on weekends compared to weekdays has been widely acknowledged and the focus of many studies in the South Coast Air Basin.[79,80] This is known as the "ozone weekend effect" (WE). The WE is a well-known phenomenon in many urbanized areas where emissions of ozone precursors, especially NO_x, decrease substantially on weekends while the measured levels of ozone increase on weekends. The decrease in NO_x emissions is typically due to the reduced heavy-duty truck activity and emissions on weekends.[80]

Given the proximity of the South Coast Air Basin and the established transport corridors between the South Coast Air Basin and Western Mojave, analysis of potential WE in Western Mojave was conducted. The WE is shown in Figure D-22 by plotting the April to September daily maximum 8-hour ozone on a weekday (Wednesday) vs weekend (Sunday), with each year represented as a different color. A value above the solid 1:1 line suggests a VOC-limited regime, while a value below the solid 1:1 line suggests a NO_x-limited regime.

In a NO_x-limited regime, reductions in NO_x emissions are expected to reduce ambient ozone levels. In a VOC-limited regime, reductions in NO_x emissions may have a counterproductive effect. These varying effects of NO_x reductions are due to the non-linear chemistry of ozone formation involving NO_x and VOC emissions.

The average WE for Western Mojave between 2000 to 2020 is shown in Figure D-22. Prior to 2005 Western Mojave is mostly in a VOC-limited regime and enters a transition regime between 2005-2015. During the VOC-limited and transition regimes decrease NO_x emissions could lead to an increase in ozone concentrations, this could have contributed to the increase in design values seen in 2017 to 2019. Wildfires and meteorology are also believed to have played a role in the increased ozone concentrations during 2017-2019. Starting in 2016 the area appears to have transitioned into a NO_x-limited regime. This is likely the result of the diminishing WE in the South Coast[80], which have led to lower levels of ozone transported from upwind areas on weekend days.

Being in a NO_x-limited regime suggests that the current and new NO_x emission reduction commitments from CARB, South Coast and the San Joaquin Valley will drive ozone concentrations down even further for the future years. In 2020 NO_x emissions decreased by up to 20 percent due to the additional NO_x emission reductions caused by the pandemic, resulting in a 0-2 ppb decrease in ozone[81]. This suggests that NO_x emission control strategies in upwind areas such as South Coast Air Basin and the San Jaquan Valley are expected to be effective in reducing ozone levels in future years.

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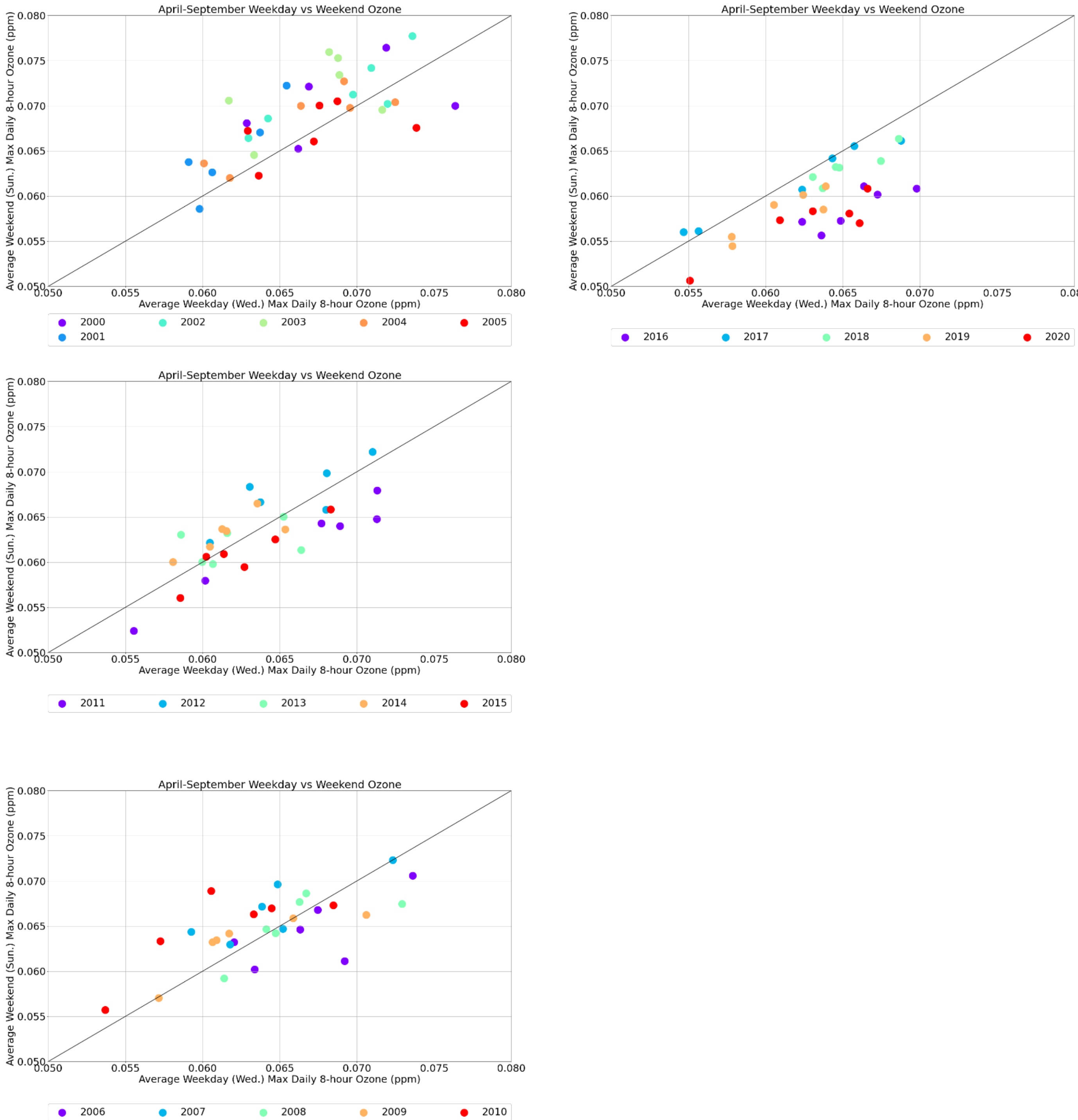
[79]Baidar, S., et al. (2015), Weakening of the weekend ozone effect over California's South Coast Air Basin, Geophys. Res. Lett., 42, doi:10.1002/2015GL066419.
[80]Cai, C., Avise, J., Kaduwela, A., DaMassa, J., Warneke, C., Gilman, J. B., et al. (2019). Simulating the weekly cycle of NOx-VOC-HOx-O3 photochemical system in the South Coast of California during CalNex-2010 campaign. Journal of Geophysical Research: Atmospheres, 124, 3532–3555. https://doi.org/10.1029/2018JD029859
[81]Schroeder, J., Chenxia, C., Xu, J., Ridley, D., Lu, J., Bui, N., Yan, F., Avise, J. (2022), Changing Ozone Sensitivity in the South Coast Air Basin during the COVID-19 Period. https://doi.org/10.5194/acp-2022-178

Figure D-22: Average Weekend Effect from 2000 to 2020 in Western Mojave



Wildfires

Wildfires have impacted California ozone levels over the past years. The WOE includes analysis that assesses the dates that were impacted by wildfires and analyzes them in order to gain a better understanding on how the additional ozone precursors during the wildfire events could have impacted the design values for 2016-2020.

2016, 2017, 2018 and 2020 were extreme years for wildfires, with numerous wildfires active during the June through October, leading to many potential wildfires impacted days in the Western Mojave and higher ozone levels due to the wildfire smoke. Table D-2 through Table D-6 list some of the wildfires that were active between June through December in 2016 to 2020.

Table D-2. 2016 Wildfires active in June through October[82]

Fire	Start	Containment	Latitude	Longitude	Total Acres
Sherpa	6/15/2016	7/12/2016	34.776	-119.643	7,474
Erskine	6/23/2016	7/12/2016	35.6115	-118.45628	48,019
Pine	6/30/2016	6/30/2016	34.701	-119.144	2,304
Deer	7/1/2016	7/11/2016	35.20993	-118.72272	1,785
Curry	7/1/2016	7/5/2016	36.0749	-120.452041	2,944
Kuehner	7/1/2016	7/1/2016	34.27619	-118.63264	45
Sage	7/9/2016	7/16/2016	34.36763	-118.57245	1109
Soberanes	7/22/2016	10/12/2016	36.45994	-121.89938	132,100
Hart	8/4/2016	8/7/2016	35.24504	-118.60344	100
Pilot	8/7/2016	8/16/2016	34.28771	-117.27338	8,110
Mineral	8/9/2016	8/18/2016	36.09974	-120.51057	7,050
Chimney	8/13/2016	9/6/2016	35.70595	-120.98316	46,344
Blue Cut	8/16/2016	8/23/2016	34.30372	-117.49342	36,274
Ceder	8/16/2016	9/30/2016	35.7506	-118.5678	29,322
Range	8/26/2016	8/29/2016	35.2013	-118.7212	518
Havilah	8/28/2016	8/28/16	35.4976	-118.5097	304
Holy	8/31/2016	9/5/2016	33.6542	-117.5221	150
Ken	9/3/2016	9/4/2016	34.25858	-117.4415	20
Spring	9/7/2016	9/9/2016	34.3183	-117.3189	50
Canyon	9/17/2016	9/27/2016	34.63445	-120.54421	12,518
Roblar	07/21/16	7/30/2016	33.393	-117.35093	1,245

82 Cal Fire 2016 Incidents. Accessed 11/24/2021. https://www.fire.ca.gov/incidents/2016/

Table D-2. 2017 Wildfires active in June through November[83]

Fire	Start	Containment	Latitude	Longitude	Total Acres
Lake	6/17/2017	1/9/2018	34.55607	-118.60703	800
Highway	6/18/2017	6/28/2017	35.53456	-118.66733	1,522
Holcomb	6/19/2017	1/9/2018	34.2976	-116.826	1,503
Schaeffer	6/24/2017	8/10/2017	Sequoia National Forest		16,031
Salmon August Complex	6/25/2017	12/8/2017	41.841	-123.474	65,888
Placerita	6/25/2017	1/9/2018	34.37443	-118.49343	760
Manzanita	6/26/2017	1/9/2018	33.530045	-116.59442	6,309
Mart	6/27/2017	1/9/2018	34.14575	-117.17813	670
Silver	7/4/2017	1/9/2018	34.304722	-117.3125	13
Parkfield	7/8/2017	7/11/2017	35.86949	-120.57894	1,816
Garza	7/9/2017	7/21/2017	35.93273	-120.20014	48,889
Long Valley	7/11/2017	7/21/2017	40.07045	-120.14013	83,733
Hidden	7/12/2017	1/9/2018	34.149	-117.189	46
Bridge	7/14/2017	4/12/2018	34.09773	-117.10567	460
Detwiler	7/16/2017	8/24/2017	37.61757	-120.21321	81,826
Seine	7/22/2017	1/9/2018	34.139	-117.199	20
Dollar	7/22/2017	1/9/2018	34.20152	-117.14466	85
High	7/23/2017	1/9/2018	34.41204	-117.03031	170
Modoc July Complex	7/24/2017	8/16/2017	Modoc National Forest		83,120
Orleans Complex	7/25/2017	8/26/2017	Six Rivers National Forest		27,276
Gorman	7/28/2017	1/9/2019	34.792882	-188.85194	135
Mile	7/31/2017	1/9/2018	34.19076	-117.26969	100
Parker 2	8/3/2017	8/29/2017	Modoc National Forest		7,697
South Fork	8/13/2017	11/27/2017			7,000
Blaine	8/13/2017	1/9/2018	33.98212	-117.30819	1,044
Eclipse Complex	8/15/2017	11/29/2017	41.841	-123.474	78,698
Pier	8/29/2017	11/29/2017	36.15356	-118.74103	36,556
Castaic	8/31/2017	3/22/2018	34.52055	-118.62882	30
La Tuna	9/1/2017	1/9/2018	34.22957	-118.2674	7,194
Palmer	9/2/2017	1/9/2018	33.97471	-117.09984	3,874
Lion	9/24/2017	12/2/2017	36.27138	-118.48555	18,900

[83] Cal Fire 2017 Incidents. Accessed 11/24/2021. https://www.fire.ca.gov/incidents/2017/

Table D-3. 2018 Wildfires active in June through November[84]

Fire	Start	Containment	Latitude	Longitude	Total Acres
Airline	6/4/2018	6/14/2018	36.40755	-120.99322	1,314
Stone	6/4/2018	1/4/2019	34.5486	-118.31138	1,352
Portola	6/12/2018	1/4/2019	34.11052	-118.42789	20
Yankee	6/15/2018	7/1/2018	35.73629	-120.75593	1,500
Canyon	6/23/2018	1/4/2019	34.53765	-118.75495	62
Creek	6/30/2018	1/4/2019	34.17711	-117.15381	33
Valley	7/6/2018	1/4/2019	34.09557	-116.95881	1,350
Box	7/6/2018	1/4/2019	34.22526	-117.40967	100
Ferguson	7/13/2018	11/28/2018	37.655	-119.886	96,901
Klondike	7/16/2018	11/28/2018	42.369	-123.86	175,528
Taylor Creek	7/16/2018	10/11/2018	42.528	-123.571	52,389
Carr	7/23/2018	8/30/2018	40.654	-122.624	229,651
Pico	7/23/2018	1/4/2019	34.38039	-118.60441	128
Mendocino Complex (Ranch)	7/27/2018	9/19/2018	39.243	-123.103	410,203
Mendocino Complex (River)	7/27/2018	8/10/2018	39.047	-123.12	48,920
Donnell	8/1/2018	1/4/2019	38.349	-119.929	36,450

Table D-4. 2019 Wildfires active in June through November[85]

Fire	Start	Containment	Latitude	Longitude	Total Acres
Boulder	6/5/2019	6/11/2019	35.344	-199.914	1,127
McMillan	6/12/2019	6/24/2019	35.663	-120.411	1,764
Lonoak	6/26/2019	6/26/2019	36.284	-120.948	2,546
Walker	9/4/2019	9/25/2019	40.061	-120.681	54,612
Cow	9/6/2019	11/21/2019	36.284	-118.228	1,975
Kincade	10/23/2019	11/6/2019	38.792	-122.78	77,758
Five	8/3/2019	8/5/2019	34.6779	-118.7524	156
West Butte	8/13/2019	8/17/2019	34.6755	-118.3422	105
Milpas	7/22/2019	7/25/2019	34.4239	-117.1032	81

[84] Cal Fire 2018 Incidents. Accessed 11/24/2021. https://www.fire.ca.gov/incidents/2018/
[85] Cal Fire 2019 Incidents. Accessed 04/19/2022. https://www.fire.ca.gov/incidents/2019/

Table D-5. 2020 Wildfires active in July through December[86]

Fire	Start	Containment	Latitude	Longitude	Total Acres
Red Salmon Complex	7/27/2020	11/17/2020	41.168	-123.407	144,679
Loyalton Fire	8/14/2020	9/14/2020	39.70244	-120.14347	47,029
CZU Lightning Complex	8/16/2020	9/22/2020	37.17162	-122.22275	86,509
August Complex	8/16/2020	11/11/2020	39.776	-122.673	1,032,648
River Fire	8/16/2020	9/4/2020	36.60239	-121.62161	48,088
LNU Lightning Complex	8/17/2020	10/2/2020	38.48193	-122.14864	363,220
North Complex Fire	8/18/2020	12/3/2020	39.69072	-121.22718	318,935
Carmel Fire	8/18/2020	9/4/2020	36.4463	-121.68181	6,905
SCU Lightning Complex	8/18/2020	10/1/2020	37.43944	-121.30435	396,624
Dolan Fire	8/19/2020	12/31/2020	36.123	-121.602	124,924
SQF Complex Fire (Includes Castle Fire and Shotgun Fire)	8/21/2020	1/6/2021	36.255	-118.497	174,178
Creek Fire	9/4/2020	12/24/2020	37.19147	-119.26118	379,895
Slater Fire (includes Devil Fire)	9/7/2020	12/10/2020	41.86889	-123.44963	157,229
Ranch 2	8/13/2020	10/5/2020	34.160265	-117.910498	4,237
Lake	8/12/2020	9/28/2020	34.679	-118.452	31,089
Soledad	7/5/2020	7/10/2020	34.467915	-118.328877	1,525
Brook	7/29/2020	8/1/2020	34.25143	-117.45479	185
El Dorado	9/5/2020	11/16/2020	34.08045	-116.98669	22,744
Pitzer	7/17/2020	7/20/2020	34.39464	-116.97557	119

Summary of Event

Table D-7 shows the potential wildfire impacted dates and the affected sites for the years 2016 through 2020; although not all wildfires impacted each site on any given day. These dates are assumed to be unusual event days, due to the excess ozone precursor emissions from the wildfire activities and the removal of these dates drops the 4th highest ozone date for most sites and therefore, reduced the design value. Note that wildfire emissions may have impacted ozone concentrations on other dates and sites not listed here and may require further analysis.

[86] Cal Fire 2020 Incidents. Accessed 11/24/2021. https://www.fire.ca.gov/incidents/2020/

Table D-6. 2016 through 2020 List of Dates and Sites affected by Wildfires

Date	Site(s)
7/27/2016	Hesperia & Phelan
7/28/2016	Hesperia & Phelan
7/29/2016	Phelan
6/17/2017	Phelan
6/18/2017	Phelan
6/19/2017	Phelan
6/20/2017	Phelan
7/5/2017	Phelan
7/14/2017	Phelan
6/21/2018	Phelan
6/22/2018	Phelan
7/9/2018	Phelan
7/17/2018	Phelan
7/27/2018	Phelan
7/30/2018	Phelan
8/7/2018	Hesperia & Phelan
8/3/2019	Phelan
8/16/2019	Phelan
6/24/2020	Phelan
7/29/2020	Phelan
8/2/2020	Phelan
8/17/2020	Phelan
8/19/2020	Hesperia
8/20/2020	Hesperia & Phelan
8/21/2020	Hesperia & Phelan
9/4/2020	Phelan
9/16/2020	Hesperia

All sites aside from Phelan and Hesperia show attainment by 2032, based on modeling and air quality trend analysis. With the removal of fire impacted dates, and therefore adjusted design values, the modeling and air quality trend analysis for both Phelan and Hesperia shows attainment by 2032. The dates listed in Table D-7 were provided by the District and the supporting evidence and can be found in Appendix C.

Attainment Projections

Air Quality Trends

Figure D-23 through Figure D-28 show the regulatory monitoring sites in Western Mojave and their official and adjusted design values alongside the projected 2032 design value. The adjusted design value was calculated from average of the adjusted 4th high value for the past three years for each of the sites, after the fire impacted dates were removed (Table D-8).

The increase in the design values seen between 2016 and 2020 is likely due to the increased number and intensity of wildfires seen throughout California during the past five years. Meteorology is also believed to have played a role in the increased ozone concentrations during 2017-2019.

Table D-7. Adjusted Design Values Compared to the Official Design Values for the Regulatory Sites Currently Operating in Western Mojave (in ppm)

Site	Design Value (ppm)	2016	2017	2018	2019	2020
Phelan	Official	0.091	0.096	0.098	0.095	0.090
Phelan	Adjusted	0.088	0.090	0.090	0.088	0.084
Hesperia	Official	0.090	0.091	0.090	0.087	0.087
Hesperia	Adjusted	0.090	0.091	0.088	0.086	0.085

Phelan (Figure D-23), and Hesperia (Figure D-24) monitoring sites show the fire impacted adjusted design values for 2016-2020 after fire impacted days have been removed (Table D-8). Adjusted design values were not needed for Joshua Tree (Figure D-25), Victorville (Figure D-26), Barstow (Figure D-27), and Lancaster (Figure D-28) as air quality trends predict they will attain the 0.070 ppm standard by 2032 without removal of fire impacted days.

Figure D-23. 2016-2020 Adjusted DV and 2032 Predicted DV for Phelan Monitoring Station

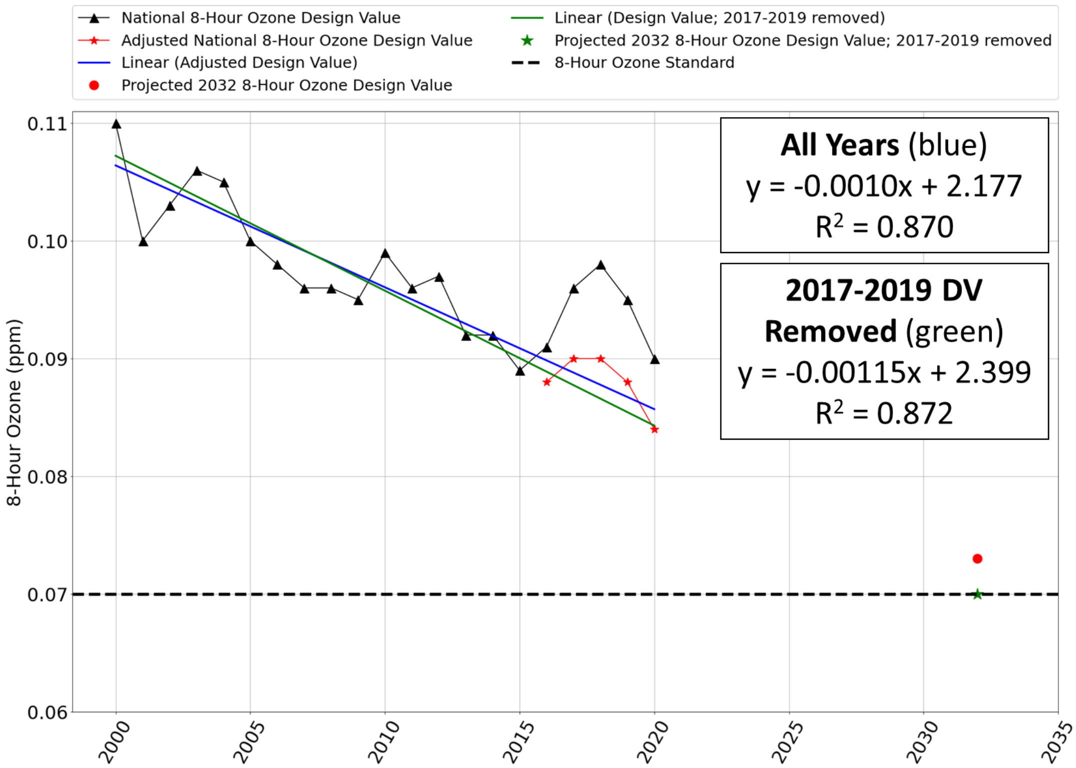


Figure D-23 shows the adjusted design values along with the 2032 predicted design value for Phelan. A linear trend line (blue) using the adjusted design values (red star markers) after fire impacted days were removed, predicts that by 2032 Phelan will reach 0.071 ppm. However, the 2017-2019 increase in design value is still present in the adjusted design value trend, which is believed to be an abnormal spike in ozone concentrations due to meteorology. In order to show a typical trend line, without the fire impacted and meteorological inflicted design values, 2017-2019 design values were removed, and the green trend line was calculated. The green trend line suggests that under a typical trend line Phelan will attain the 0.070 ppm standard by 2032.

The increase in design values, in 2017, is believed to be due largely to meteorology and the transition from a VOC-limited region to a NO_x-limited region, as well as increased wildfires throughout California. As Western Mojave, and upwind areas such as South Coast Air Basin, become more NO_x-limited the current and new NO_x emission reduction commitments from CARB and South Coast will drive ozone concentrations down even further for the future years. Additionally, in 2020 NO_x emissions decreased by up to 20 percent due to the additional NO_x emission reductions caused by the pandemic, resulting in a 0-2 ppb decrease in ozone[87]. This suggests that NO_x emission control strategies in upwind areas such as South Coast Air Basin are expected to be effective in reducing ozone levels in future years.

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[87]Schroeder, J., Chenxia, C., Xu, J., Ridley, D., Lu, J., Bui, N., Yan, F., Avise, J. (2022), Changing Ozone Sensitivity in the South Coast Air Basin during the COVID-19 Period. https://doi.org/10.5194/acp-2022-178

Figure D-24. Official DV and 2032 Predicted DV for Hesperia Monitoring Station

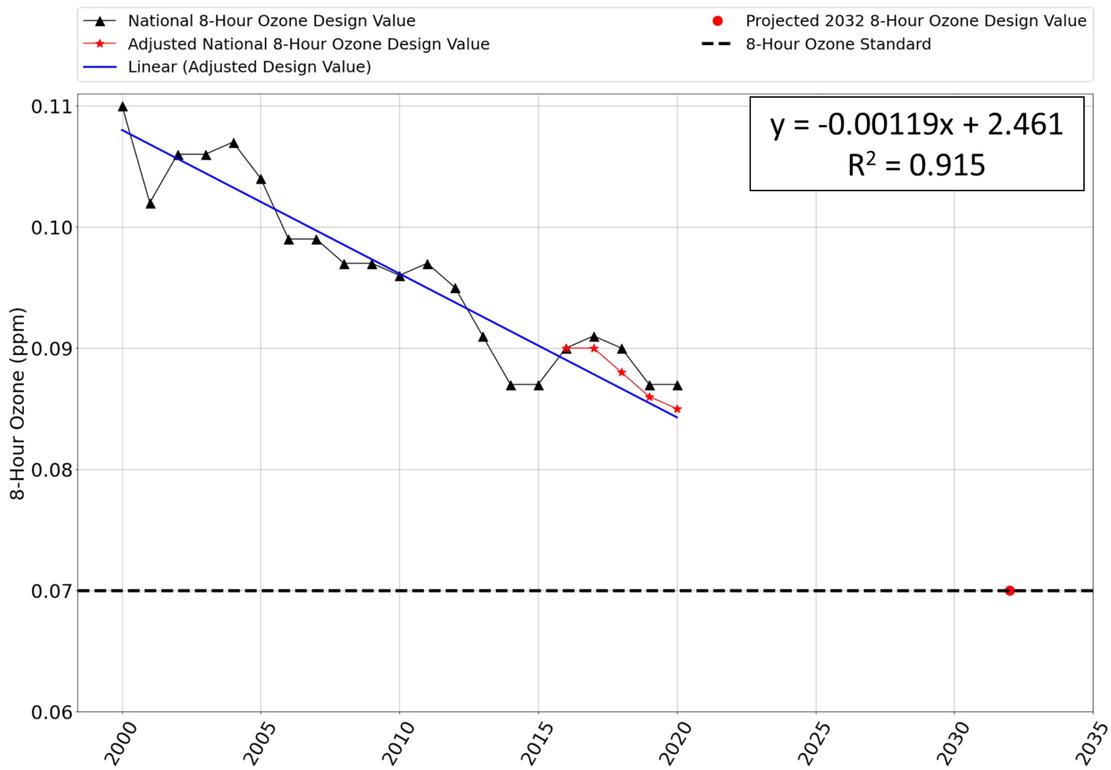


Figure D-24 shows the adjusted design values along with the 2032 predicted design value for Hesperia. The linear trend line (blue) using the adjusted design values (red triangle markers) after fire impacted days were removed, predicts that by 2032, Hesperia will attain the 0.070 ppm ozone standard.

Figure D-25 through Figure D-28 shows the remaining regulatory ozone sites (Joshua Tree, Victorville, Barstow, and Lancaster) predicted 2032 design value. The trend lines for all the remaining regulatory sites suggests they all will attain the 0.070 ppm ozone standard by 2032.

Figure D-25. Official DV and 2032 Predicted DV for Joshua Tree Monitoring Station

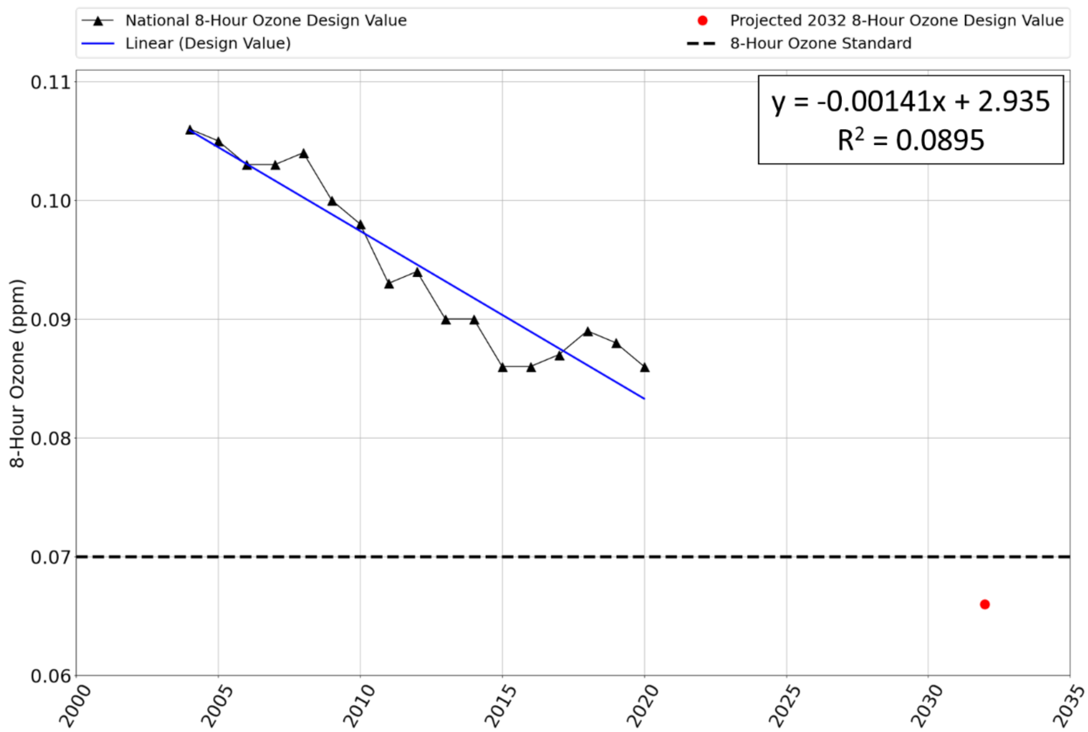


Figure D-26. Official DV and 2032 Predicted DV for Victorville Monitoring Station

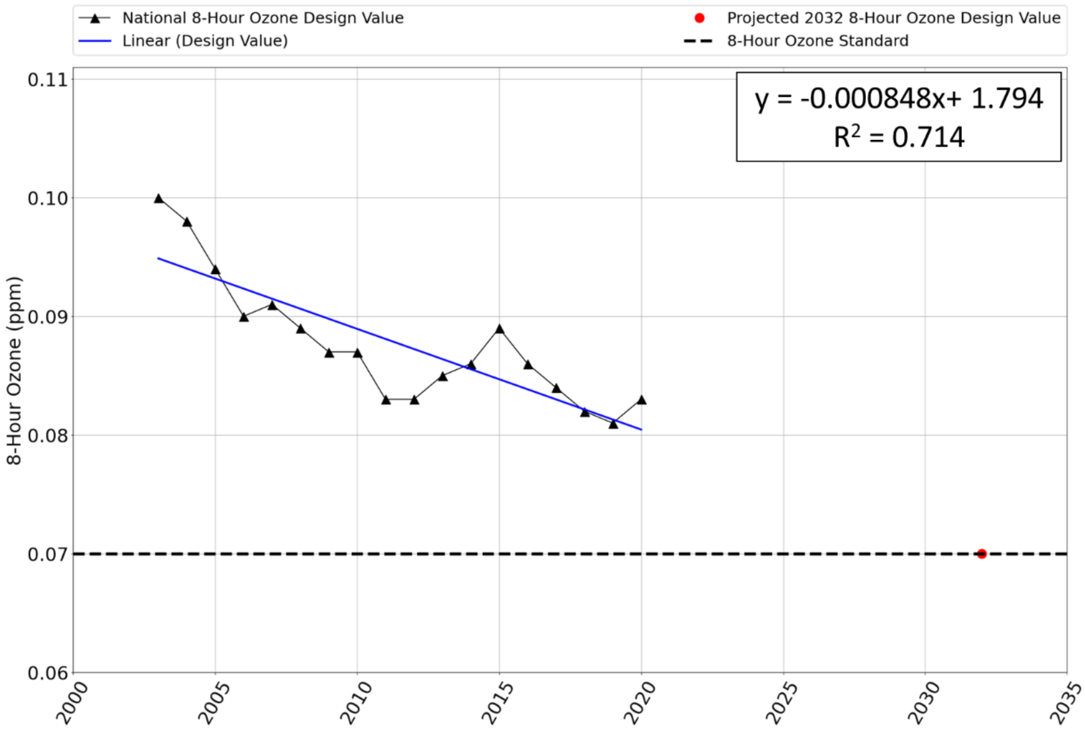


Figure D-27. Official DV and 2032 Predicted DV for Barstow Monitoring Station

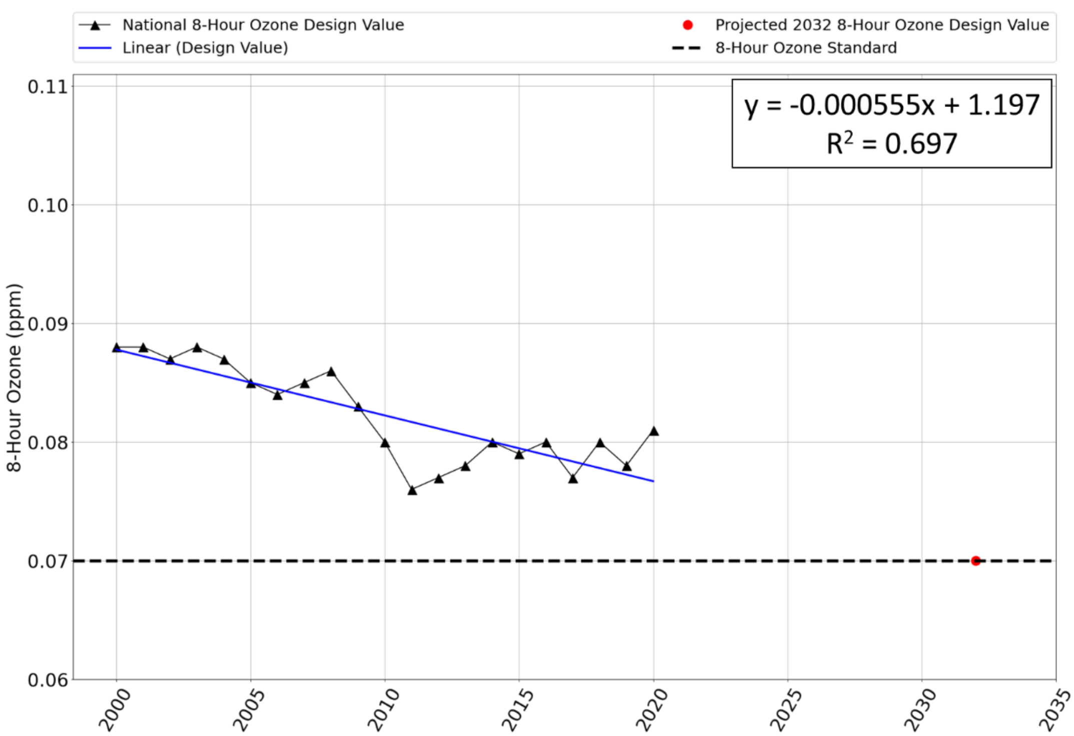
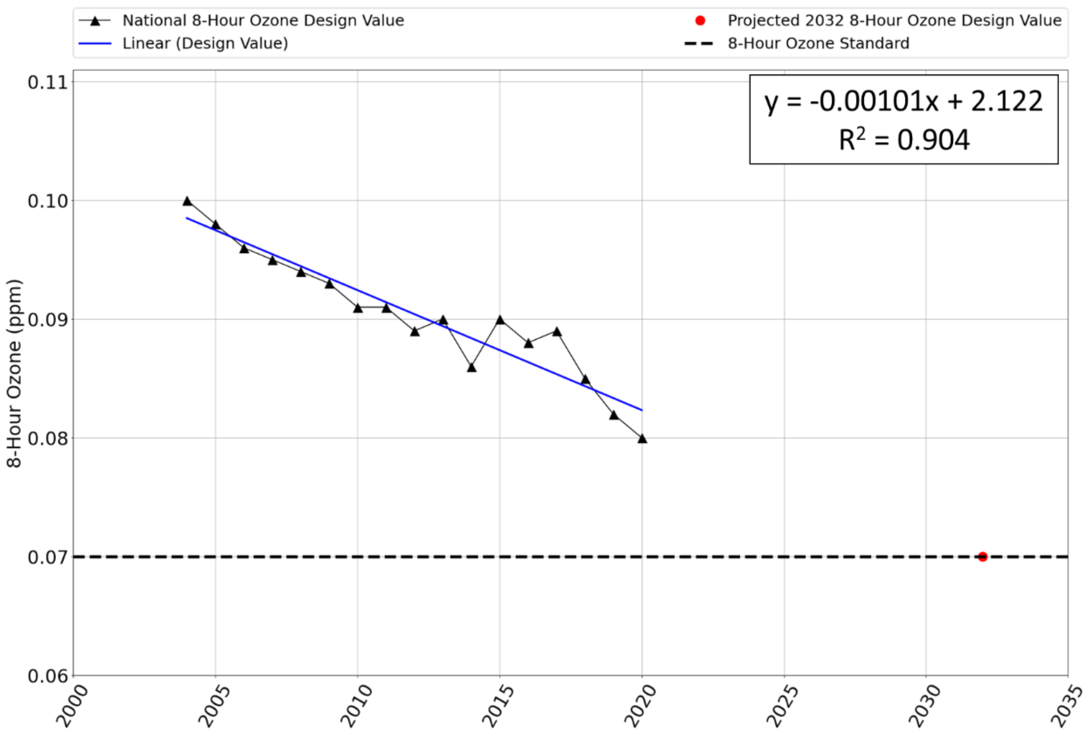


Figure D-28. Official DV and 2032 Predicted DV for Lancaster Monitoring Station



Photochemical Modeling Results

Photochemical modeling reflecting the current emission control programs was completed by the South Coast AQMD in April 2022. The results show that, with the inclusion of future emission reduction commitments from CARB and South Coast AQMD, the removal of May and June shoulder months from the photochemical model, as well as adjusted design values based on the removal of fire impacted days; photochemical modeling projects that Western Mojave can meet the 0.070 ppm standard by the 2032 attainment date.

2021 Ozone Data

With extended periods of high temperatures, minimal precipitation, and a large number of wildfires, conditions in 2021 were particularly favorable for ozone production throughout California. The 2021 design value site for Western Mojave is Phelan and the design value is 0.090 ppm, the same as 2020.

As shown in Table D-9, no sites had increase in design values between 2020 and 2021. The 2021 design values at Hesperia, Phelan and Victorville were equal to the 2020 design values. Lancaster, Barstow and Joshua Tree saw a decrease between 2020 and the 2021 design values.

Table D-8: Comparison of 2020 and 2021 Design Values

Site Name	Design Value (ppm)			Exceedance Days		
	2020	2021	2020 to 2021 Change	2020	2021	2020 to 2021 Change
Lancaster	0.080	0.075	-0.005	8	3	-5
Barstow	0.081	0.077	-0.004	25	20	-5
Hesperia	0.087	0.087	0	46	55	9
Phelan	0.090	0.090	0	63	75	12
Victorville	0.083	0.083	0	35	34	-1
Joshua Tree	0.086	0.082	-0.004	34	37	5

Conclusions

Western Mojave is currently classified as a severe nonattainment area with a 2032 attainment date. This WOE evaluated ambient ozone data, precursor emission data, meteorology, and population exposure trends to complement the regional photochemical modeling analysis conducted to evaluate Western Mojave's progress towards attainment.

- The transport of emissions from the South Coast Air Basin, and to a lesser extent the San Joaquin Valley, is the predominant cause of high ozone concentrations and exceedances in Western Mojave. The meteorology, terrain, distribution of emissions, and transport mechanisms are the key factors driving the ozone nonattainment challenge.
- Western Mojave emissions are a fraction of the emissions in the South Coast Air Basin and San Joaquin Valley. Analyses indicate that transport from these areas routinely contributes to ozone air quality in Western Mojave and progress towards attainment in Western Mojave will depend on continued progress in upwind areas.
- Evaluation of wind trajectories and peer reviewed literature confirms that the high desert terrain and transport mechanisms are very complex, and that transport can occur at both the surface and from top-down entrainment. Transport from South Coast Air Basin to the Antelope Valley portion of the nonattainment area occurs through the Soledad pass; transport to the central portion of the Western Mojave occurs through the Cajon Pass; and transport to the far eastern portion of Western Mojave occurs through the Banning Pass. Transport impacts from the San Joaquin Valley occur via the Tehachapi Mountains to the northern portion of Western Mojave.
- Analysis of diurnal patterns of hourly ozone concentrations shows that Western Mojave monitoring sites have late afternoon peaks, indicative of downwind transport impacted

sites. Wind roses show that prevailing winds originate in the South Coast Air Basin, further strengthening the understanding of transport mechanisms.

- Although transport is the dominant cause of the air quality problem, the Western Mojave continues to make progress in reducing ozone precursor emissions. Between 2000 and 2020, total NO_x emissions in Western Mojave declined by 65 percent and total ROG emissions declined by 40 percent. Large emission reductions also occurred during the same 2000-2020 timeframe in the South Coast Air Basin with decreases of 68 percent for NO_x and 56 percent for ROG.
- Ozone precursor emissions in Western Mojave are expected to continue to decline between 2020 and the 2032 attainment year, with NO_x decreasing by an additional 13 percent and ROG decreasing by an additional 11 percent. Similar reductions are also expected in the major upwind emission sources areas, based on currently adopted control measures, with NO_x and ROG decreasing by 36 percent and 13 percent, respectively, in the South Coast Air Basin, and 48 percent and 8 percent, respectively, in the San Joaquin Valley. Further reductions in emissions from the current modeled estimates are expected in the future with the implementation of additional control measures in Western Mojave, South Coast Air Basin, and the San Joaquin Valley.
- Considerable progress was achieved in reducing ozone. Since 2000, the design value decreased by 18 percent, from 0.110 to 0.090 ppm. The decrease in design values can be attributed to implementation of federal, state, and regional emission control programs, which have led to substantial declines in emissions of ozone precursors.
- Both the frequency of exceedance days and the magnitude of concentrations on exceedance days have improved. Since 2002, the number of exceedance days in the Western Mojave decreased by 41 percent (from 104 days to 63 days). The fourth highest concentrations on exceedance days decreased from 0.113 ppm to 0.092 ppm, a decrease of 19 percent.
- Exceedance days were examined to determine if there were currently any weekday/weekend differences. These analyses indicate that while there were subtle differences at several sites in the early 2000s, there is little evidence of such differences in recent years. This shift is likely a result of the diminished weekend effect in the South Coast Air Basin, which led to lower levels of ozone transported on weekend days.
- Based on current air quality trends all site aside from Hesperia and Phelan shows attainment by 2032. Hesperia shows attainment by 2032 after adjusting the 2016-2020 design values with the removal of a total of seven fire impacted days. Phelan is close to attainment and with the additional reductions from CARB, South Coast, and San Juaquin Valley, it is believed that Phelan will attain by 2032.
- With the inclusion of future emission reduction commitments from CARB and South Coast AQMD, the removal of May and June shoulder months from the photochemical model, as well as removing fire impacted days provided by the District from design values projects then photochemical modeling projects that Western Mojave can meet the 0.070 ppm standard by the 2032 attainment date.

In summary, all of the fire impacted days, meteorological, emissions, and ozone air quality analyses presented in this WOE, are in agreement with model projections and indicate that

Western Mojave will be able to meet the federal standard of 0.070 ppm by the 2032 attainment date.

Appendix

This appendix contains the analyses used to determine probable wildfire impacts contributing to ozone exceedances at the Western Mojave sites. This appendix is narrowed down to only wildfires impacted dates which influenced at least one Western Mojave site ozone 4th high during 2016-2020 as listed in Table D-10.

Table D-9: Western Mojave Wildfire Summary Analysis for Exceedance Days

		Max 8-hr Ozone (ppm)			$PM_{2.5}$ (µg/m^3)*	
Date	Affected Site	Phelan	Hesperia	Air Now Tech Smoke	Max 1-hr	24-hr
7/27/2016	Hesperia & Phelan	0.099	0.092	Y	15	9.3
7/28/2016	Hesperia & Phelan	0.109	0.098	Y	22	11.8
7/29/2016	Phelan	0.102	-	Y	25	15
7/27/2018	Phelan	0.102	-	Y	24	13.5
8/7/2018	Hesperia & Phelan	0.094	0.088	Y	59	18.6
8/17/2020	Phelan	0.088	-	Y	32	18.7
8/19/2020	Hesperia	-	0.091	Y	67	30
8/20/2020	Hesperia & Phelan	0.093	0.094	Y	94	43.9
8/21/2020	Hesperia & Phelan	0.089	0.089	Y	72	33.2
9/4/2020	Phelan	0.092	-	Y	110	21
9/16/2020	Hesperia	-	0.087	Y	64	40.6

* $PM_{2.5}$ data pulled from Victorville monitoring site

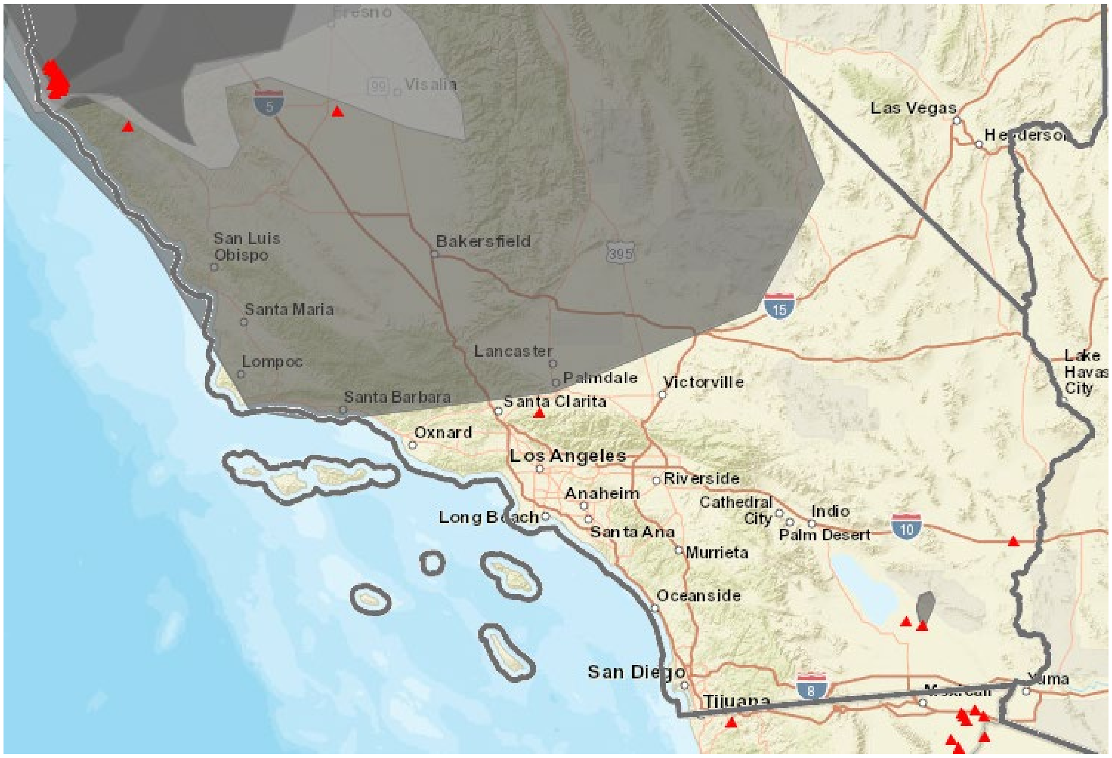
A. Imagery

The Hazard Mapping System (HMS) Fire and Smoke[88] were used for visually determining whether wildfire smoke was likely transported from an active wildfire to the general area aloft near a site during the day of an associated exceedance of the 8-hour ozone NAAQS. HMS Fire and Smoke products from NOAA are manually created by NOAA satellite analysts utilizing multiple visible satellite imagery sources as time and data allows to show active wildfire locations and estimated smoke coverage and density for a given day.

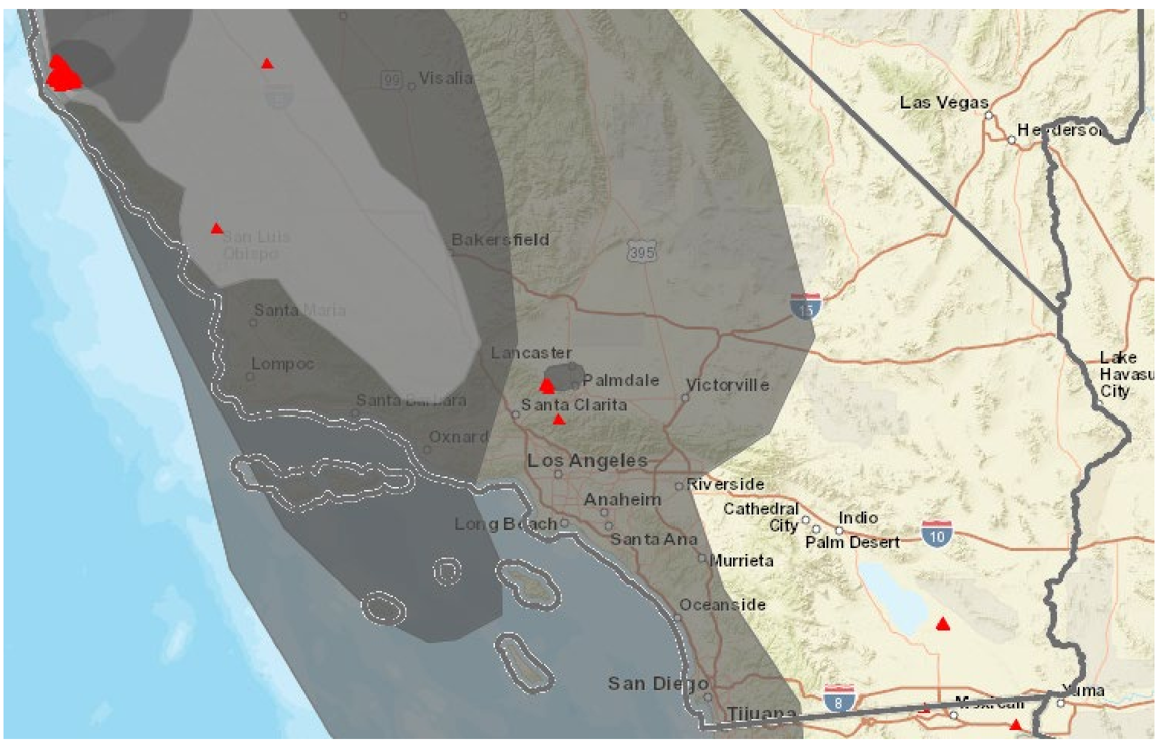
[88] https://www.ospo.noaa.gov/Products/land/hms.html

Figure D-29: HMS Fire and Smoke

July 27, 2016

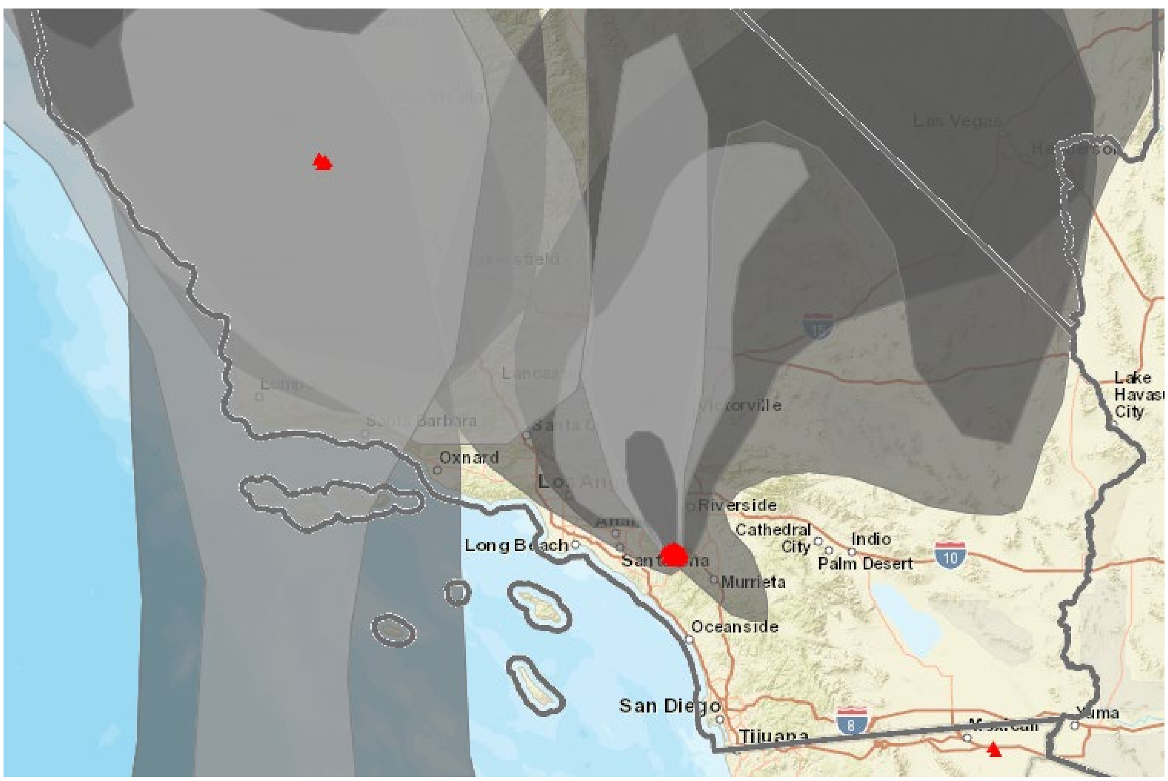


July 28, 2016

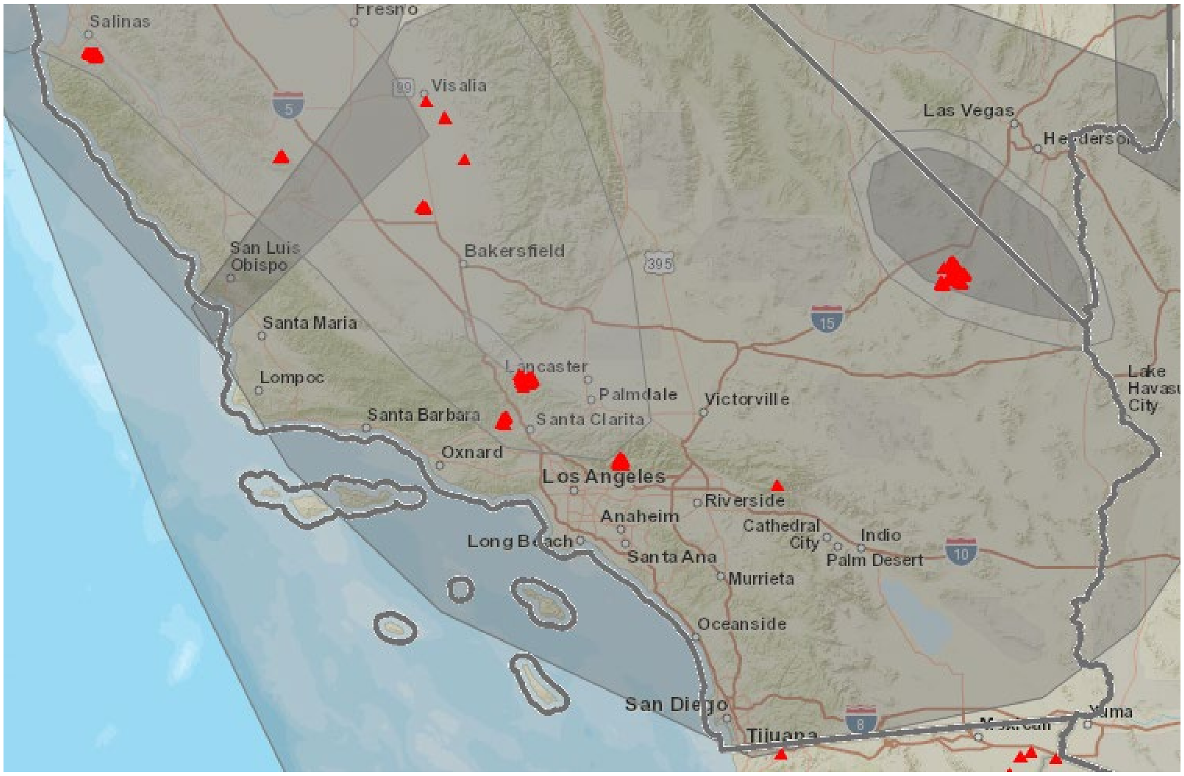


July 29, 2016

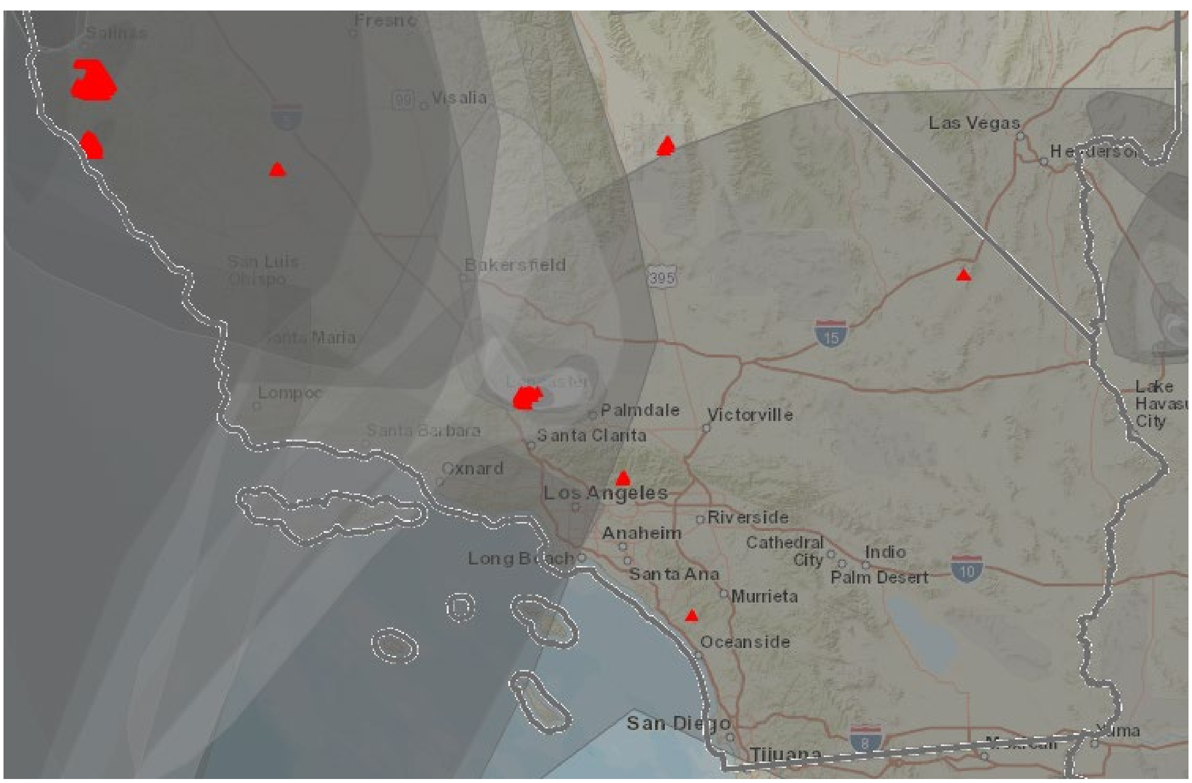
August 07, 2018



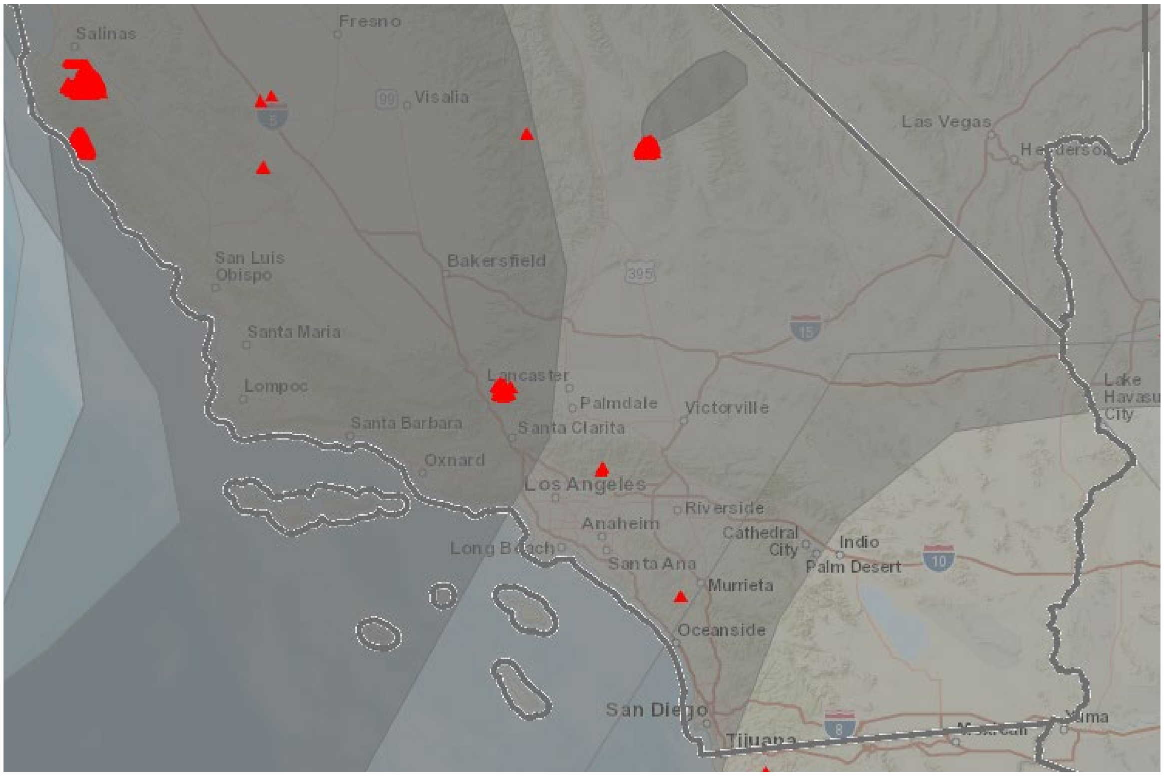
August 17, 2020



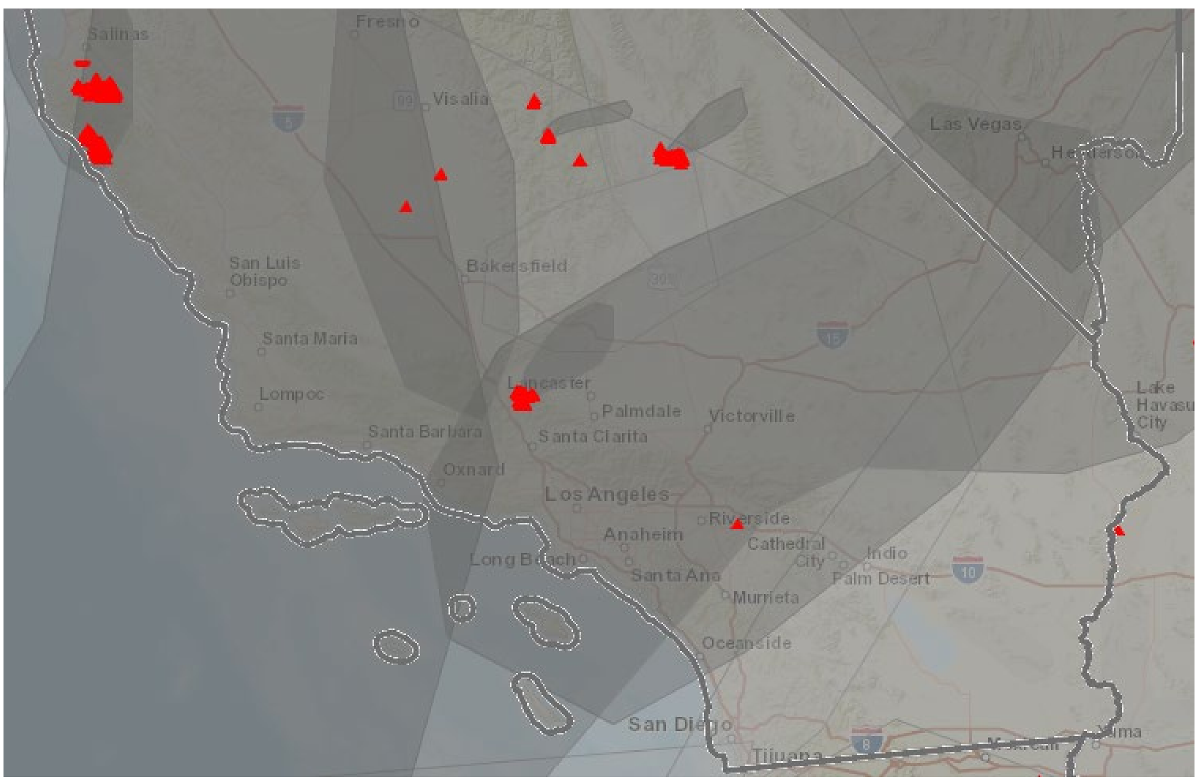
August 19, 2020



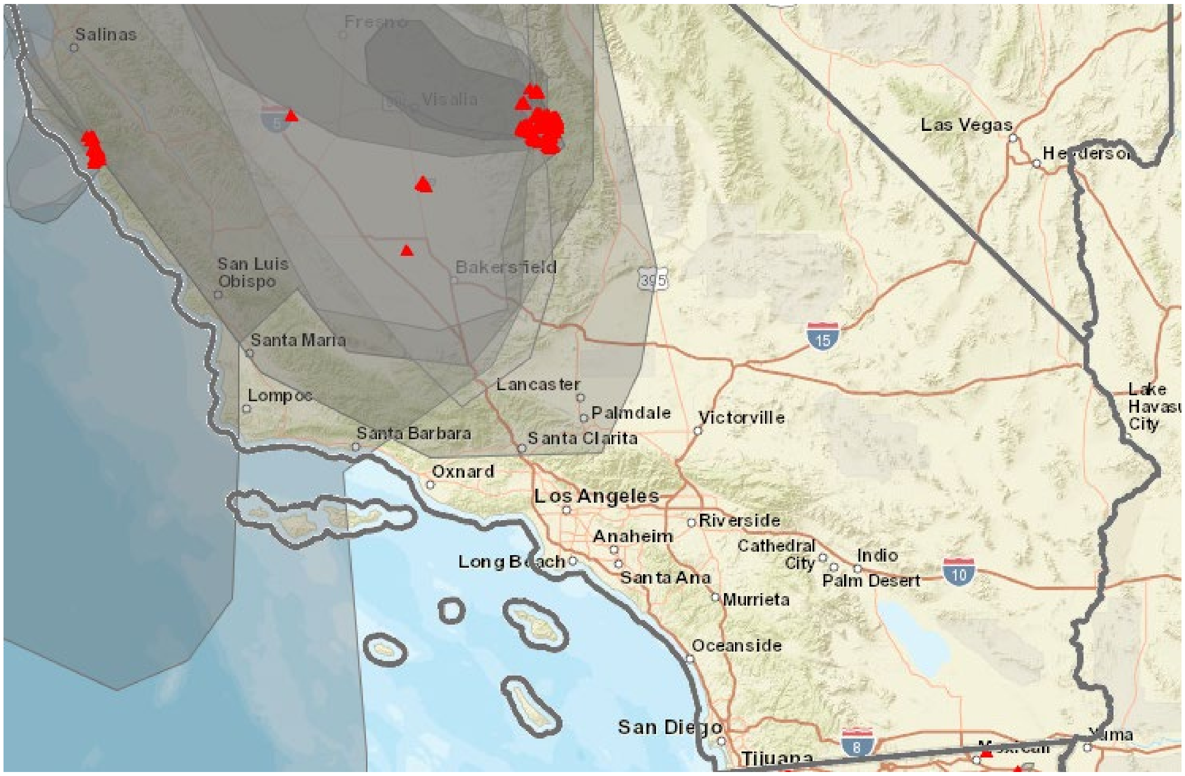
August 20, 2020



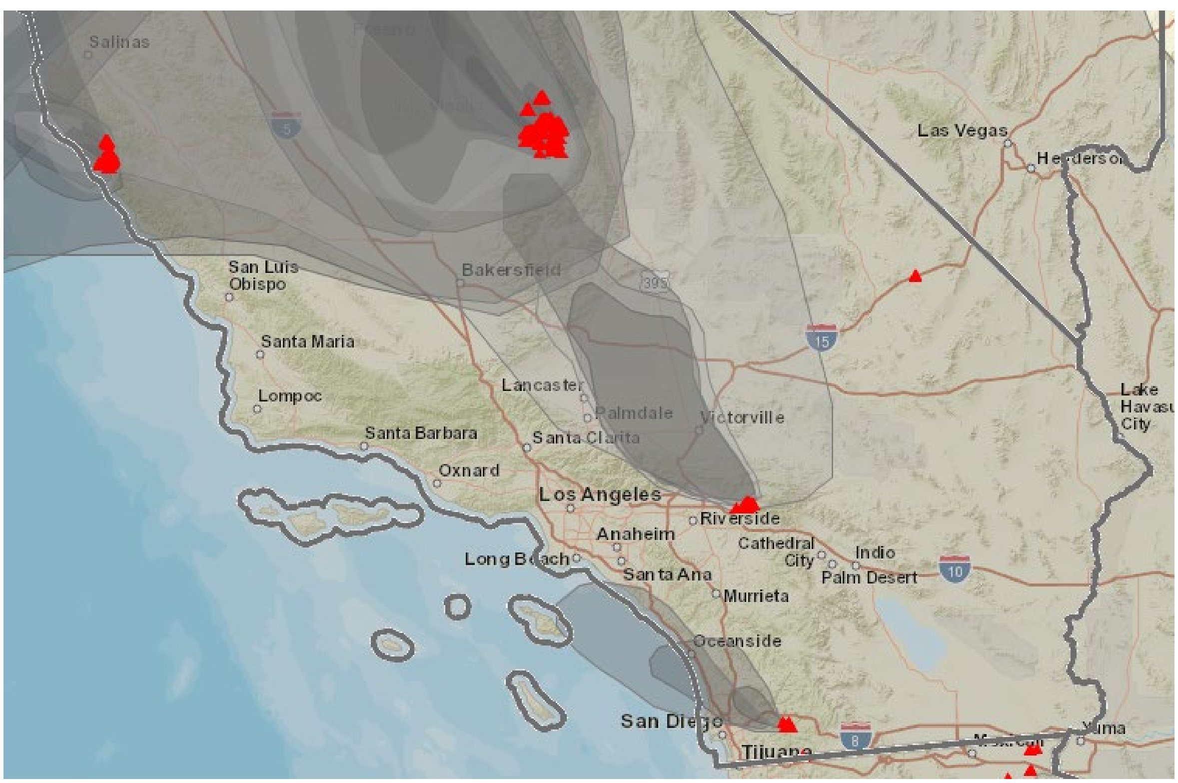
August 21, 2020



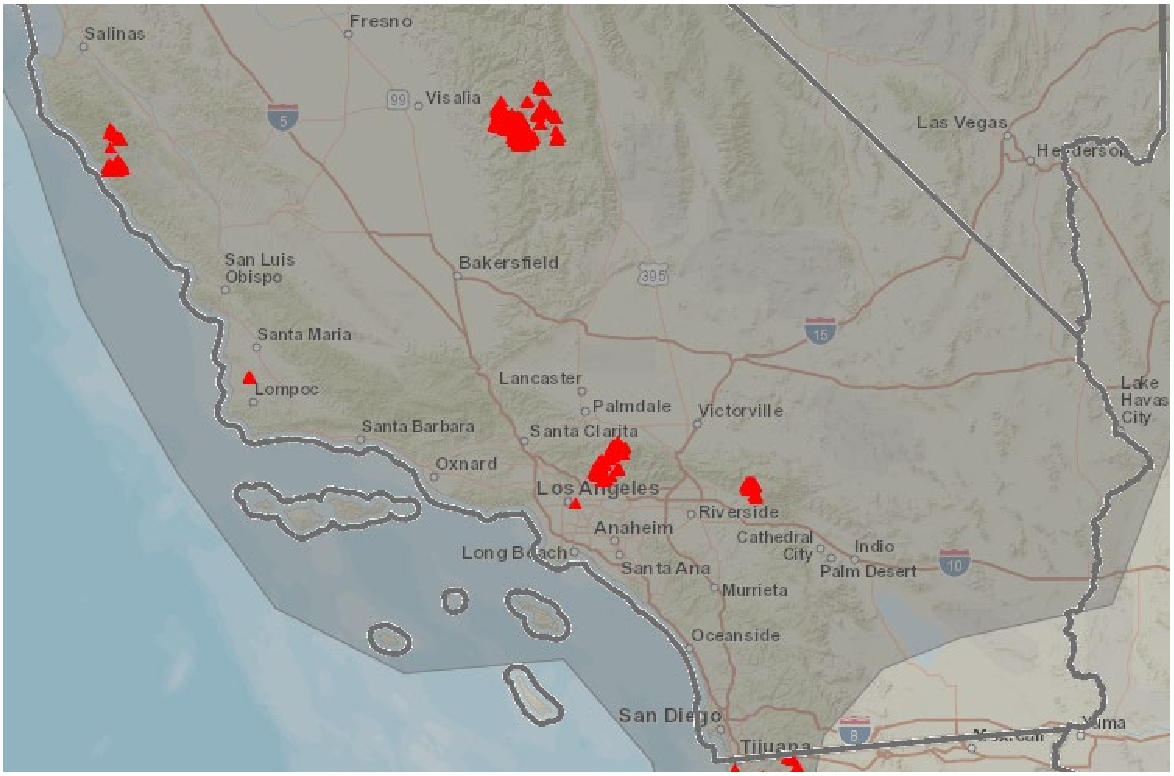
September 04, 2020



September 05, 2020



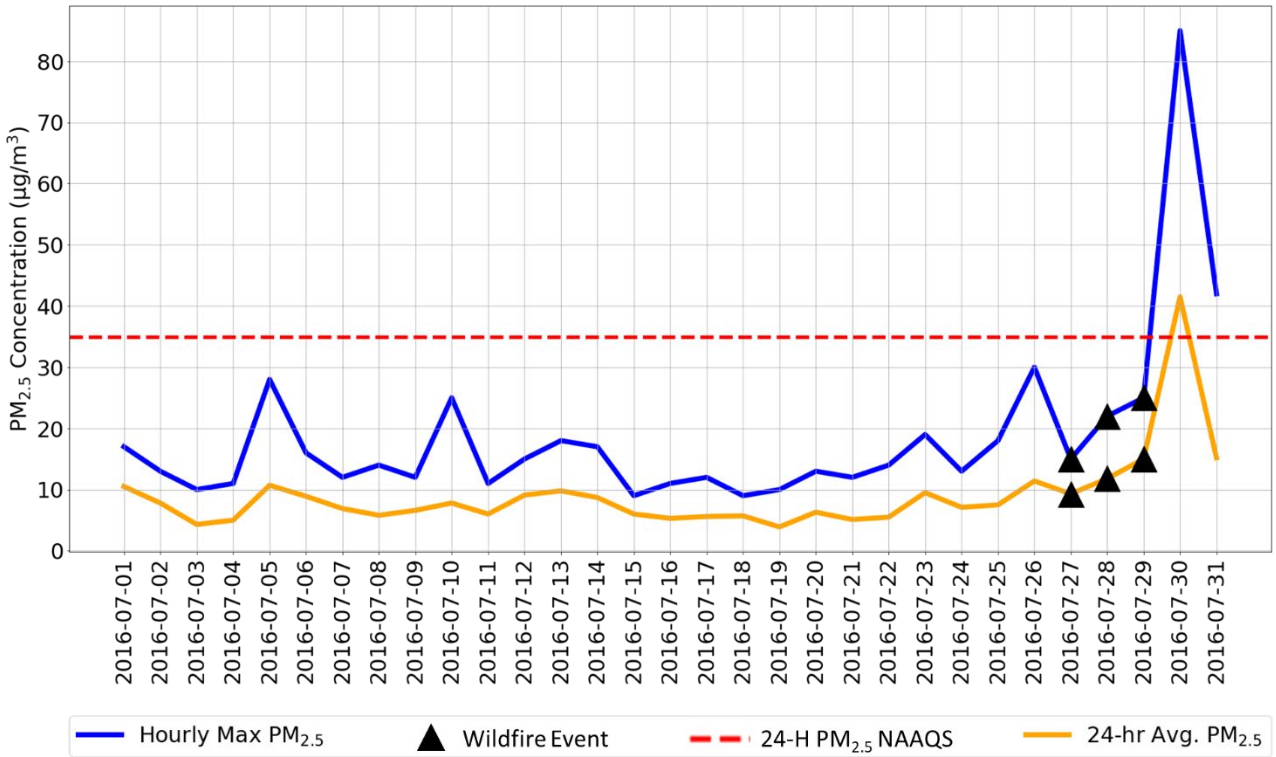
September 16, 2020



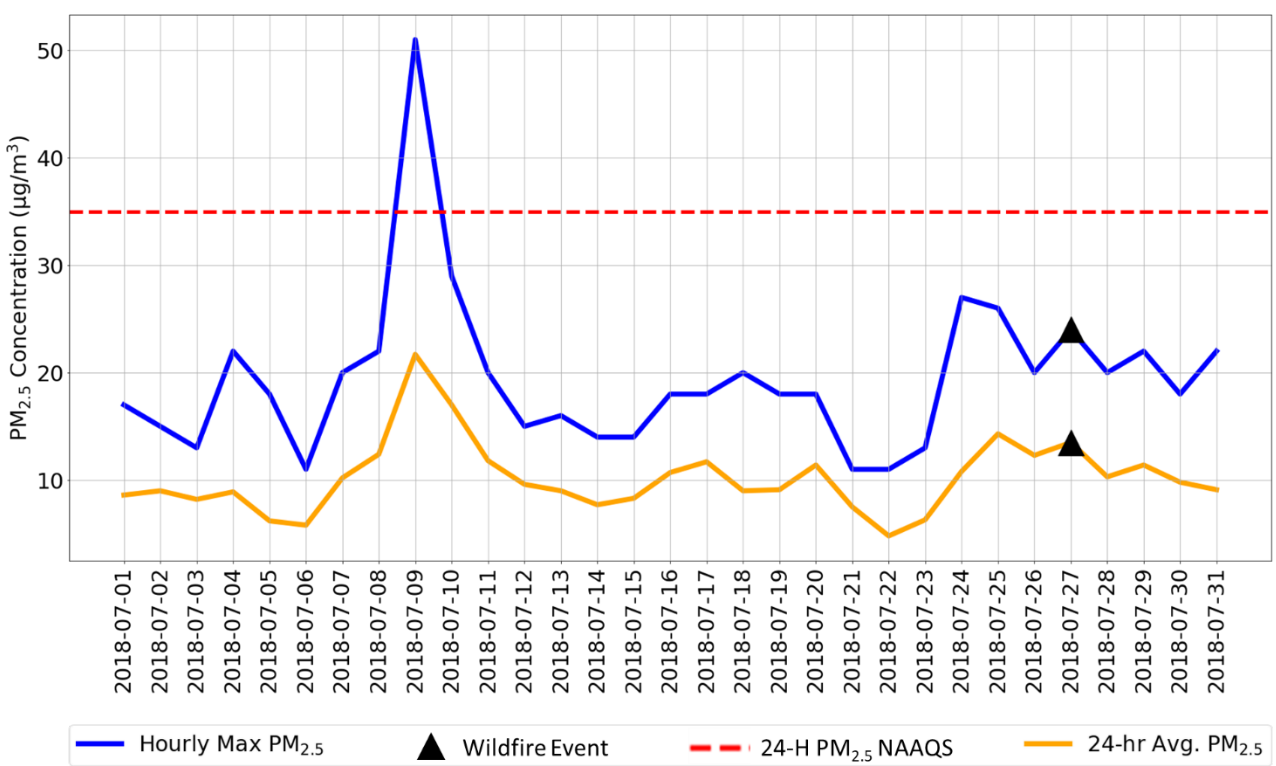
A. PM$_{2.5}$

Daily maximum 1-hour and 24-hour averaged PM$_{2.5}$ concentration plots for each month at Victorville - Park Avenue (AQS ID# 060710306). Data acquired from CARB's Aerometric Data Analysis and Management (ADAM) and Air Quality and Meteorological Information System (AQMIS) databases.

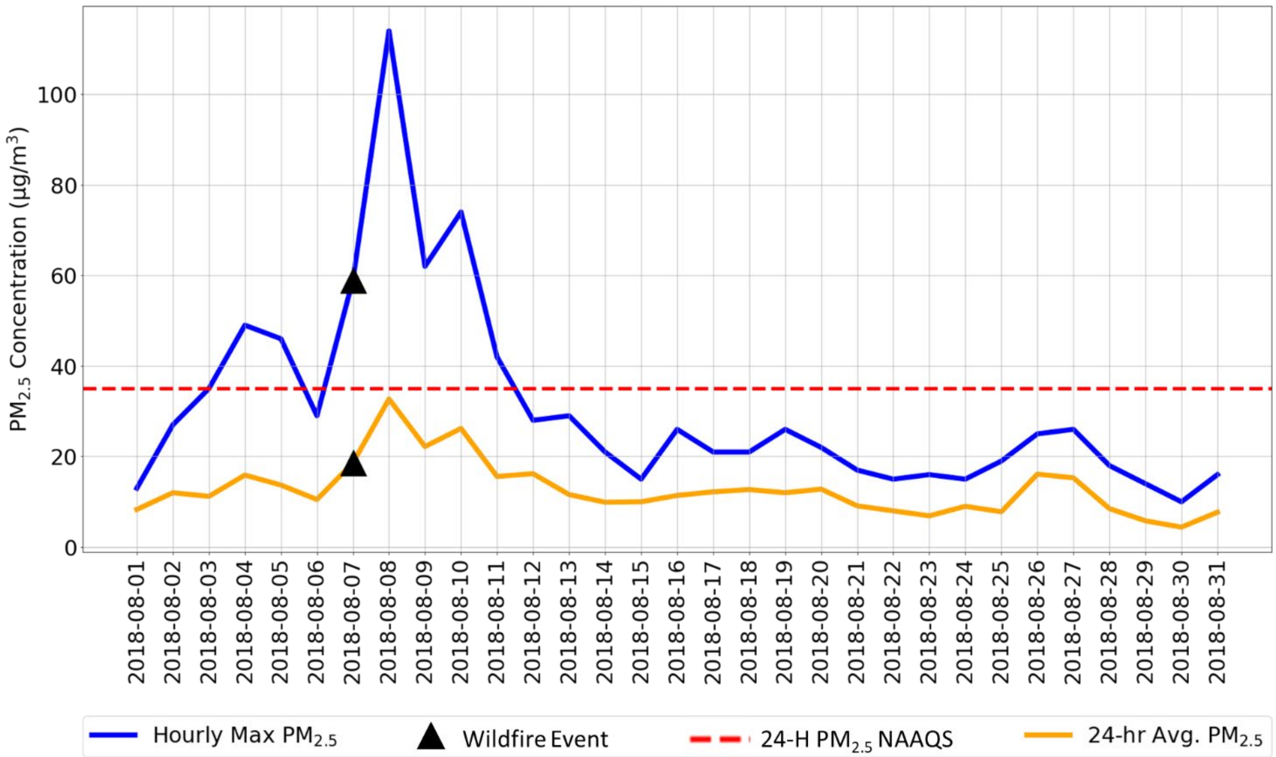
July 2016



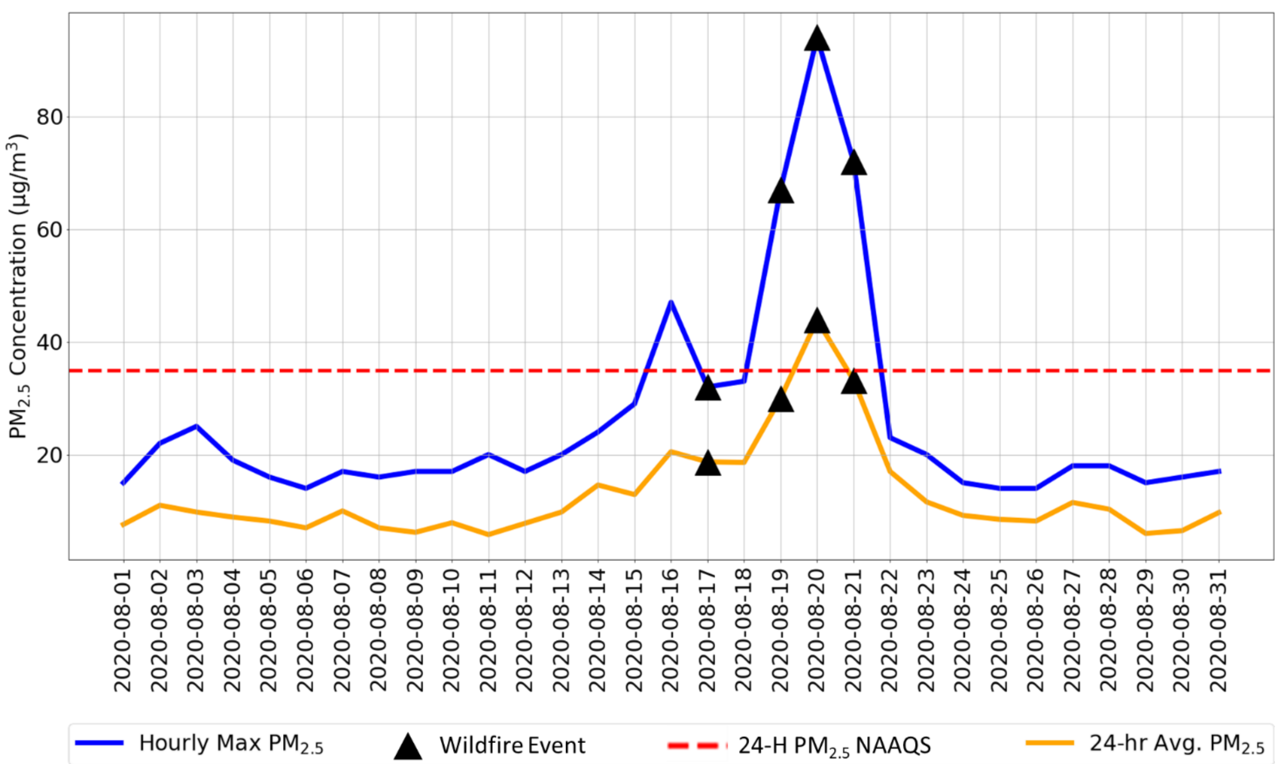
July 2018



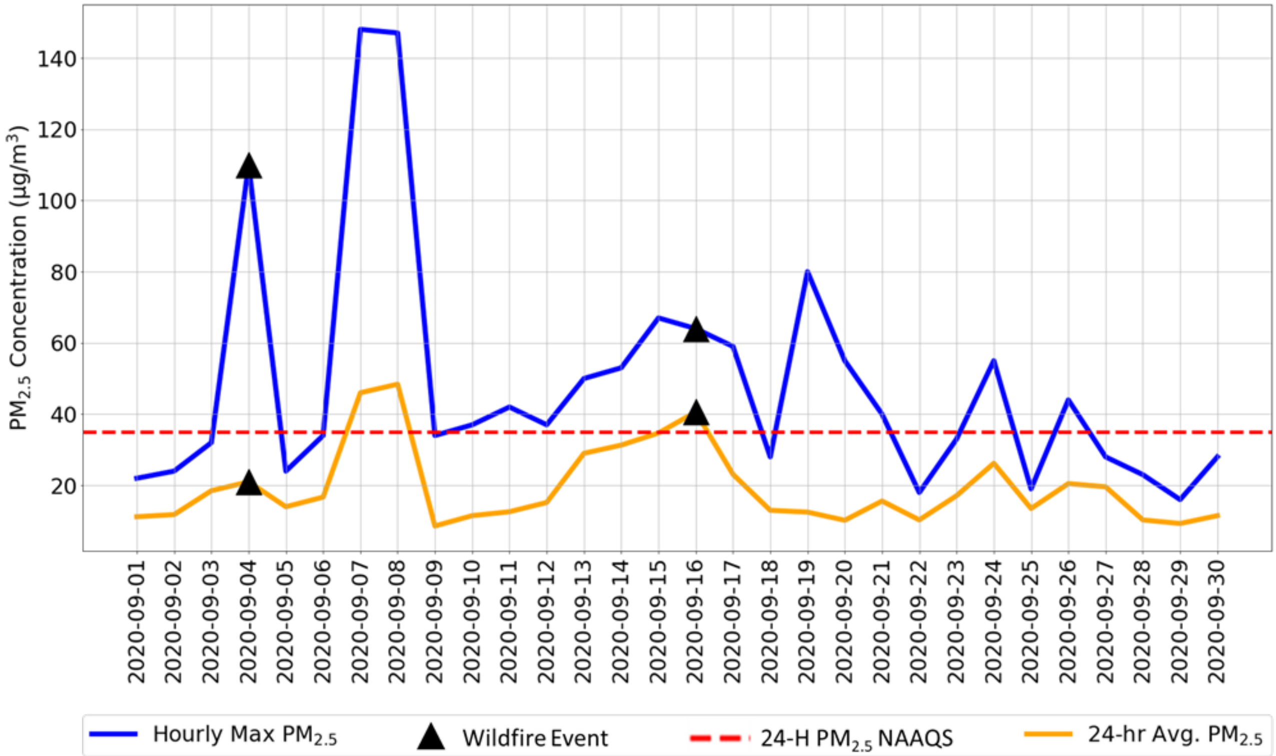
August 2018



August 2020



September 2020



APPENDIX E – RACM ANALYSIS SUPPORT

Other District Rule Analyses

- Stationary Gas Turbines
- Internal Combustion Engines
- Boilers, Process Heaters and Water Heaters
- Cement Kilns
- Miscellaneous Fuel Burning

Potential RACM Measure Summary

Stationary Gas Turbines

District			AVAQMD	**MDAQMD**	VCAPCD	ICAPCD	SMAQMD	SJVAPCD	SCAQMD
Rule Number			1134	1159	74.23	400.1	413	4703	1134
NO_x Limits (ppm)	Gaseous Fuel	>10 MW	5 (SCR + DLN) 25 (SCR or DLN, <877 hours)	5 (SCR + DLN) 25 (SCR or DLN)	9 x E/25 (w/ SCR), 15 x E/25 (w/o SCR) [2024: Natural Gas 2.5, Digester 9]	42	9 (SCR) 15 (no SCR)	3-5 (>200 hours) 25 (<200 hours)	9xE/25, 12xE/25 (no SCR, <60 MW), 15xE/25 (no SCR, >60 MW)
		>2-10 MW	25 (DLN) 35 (SCR, no DLN available)	25 (DLN) 35 (SCR no DLN available)	25 x E/25 (2.9 to <10.0 MW) [2024: Natural Gas 2.5, Digester 9]	42	25 (2.9-10 MW, >877 hours) 42 (2.9-10 MW, <877 hours)	5 (>877 hours & >3 MW) 9 (<877 hours & > 3 MW)	9xE/25 15xE/25 (no SCR) 25xE/25 (>60% sewage digester gas)
		>0.3-2 MW	42 (DLN)	42 (DLN)	42 (0.3 to <2.9 MW) [2024: Natural Gas 2.5, Digester 9]	42 (1-2 MW)	42 (RACT & BARCT)	9 (0.3 – 3 MW)	25xE/25
	Liquid Fuel	>10 MW	25 (SCR & DLN) 42 (SCR or DLN, <877 hours)	25 (SCR + DLN) 42 (SCR or DLN)	25 x E/25 (w/SCR) 42 x E/25 (w/o SCR) [2024: 30]	65	25 (SCR) 42 (no SCR)	25 (>200 hours) 42 (<200 hours)	See above
		>2-10 MW	65	65	65 [2024: 30]	65	65	25	See above
		>0.3-2 MW	50	50	65 [2024: 30]	65 (1-2MW)	65 (RACT & BARCT)	25 (>0.3-3 MW)	See above
Alternatives			25 ppm limit for digester gas or landfill gas (0.3-10 MW)	SoCal Gas 90 & 225 ppm for specific turbines	< 877 hours, 42 ppm for gaseous fuel, and 65 ppm for liquid fuel	>1 MW		For two or more units, the unit emissions may be aggregated but must be 90% controlled. Turbines with 95% effective emissions control devices	
Applicability			>0.3 MW > 877 hours per year	>0.3 MW > 877 hours per year	>0.3 MW	>400 hours/year and during 15-minute start-up or shutdown (2 hours for co-gen).	>0.3 MW or > 3 MMBTU	>0.3 MW or > 3 MMBTU	>0.3 MW
Selected Exemptions			Emergency Generators <200 hours per year		<200 hours – exempt		Emergency Standby Units with limited maintenance or operation	Emergency standby units used <100 hours per year, R&D labs and firefighting and flood control	Laboratory R&D, firefighting and flood, chemical processing, located in South East Desert Air Basin…

Internal Combustion Engines

District		AVAQMD	MDAQMD	VCAPCD	BAAQMD	Imperial Co. APCD	SMAQMD	SCAQMD	SJVAPCD
		1110.2	1160	74.9	Reg. 9, Rule 8	400.3	412	1110.2	4702
Limits (ppm)	NOx	36 (General) 80 (Diesel) 535 or a turbo-charger, after-cooler and 4-degree injection timing retard (Portable)	50 (Rich Burn) 140 (Lean Burn) 125 (Lean Burn) 700 (Diesel) 80 (Diesel)	25 (Rich Burn) 45 (Lean Burn) 80 (Diesel)	70	90 (Rich Burn) 150 (Lean-Burn) 600 (Diesel)	RACT: 50 (Rich Burn), 120 (Lean Burn) and 700 Diesel BARCT 65 and 80 (Diesel)	Electrification or 11 ppm	11 (Rich & Lean Burn) Tier 4 emissions (diesel) except Tier 3 for non-certified (Tier 1-4) 50-500 hp and 500-750 operating less than 1000 hours
	VOC	250 (General) 240 (Portable)	106 ppm	250 (Rich Burn) 750 (Lean Burn) 750 (diesel)	180 (<170HP) 110(>170HP)	None	RACT: NMHC – 250 (Rich Burn and Diesel) or 750	Electrification or 30 ppm	250 (Rich Burn) 750 (Lean Burn)
Alternatives			NO_X control: 90% (Rich Burn), 80% (Lean Burn), >30% (Diesel) 90% (Diesel), +10% add'l control, 1990 baseline option	NO_X control: 96% (Rich-Burn), 94% (Lean-Burn) 90% (Diesel)	Best Available Control Technology: 22 ppm		NO_X control: 90% (Rich Burn), 90% (Lean Burn) 90% (Diesel)	Ag engines must meet Tier 4, landfill gas – 11 ppmv high use and 36-45 x Corr. Factor (for low use)	For a group of engines: 90% reduction
Applicability		>50 Brake Horsepower (BHP)	>500 BHP	>50 BHP	>50 BHP	>50 BHP	Only applies when located a major stationary source of NO_X emissions	>50 BHP	Limited requirement >25 bhp, fully regulated at >50 bhp
Exemptions		Subject to other rules (e.g. registered as State-wide portable equipment)	<100 hours, or subject to other rules (e.g. Ag Engines regulated under Rule 1160.1)	>50 hours/year	Ag Engines, <100 hours AND <1000 HP or <200 hours AND <1000 HP Equipment subject to statewide	Emergency stand-by engines used less than 100 hours per year	Exemption varies with engine type and size (e.g., for spark ignition engines 50-75 BHP 200 hours and 400-525 BHP 40 hours)	Orchard wind machines, emergency standby engines, laboratory R&D, equipment subject to	Selected ag engines (e.g., sprayers bailers and harvest equipment), engine, used to propel implements of husbandry, and
					portable equipment rules			statewide portable equipment rules…	engines power wind machines.

Rules in red have been submitted by the State for inclusion in the SIP, but not yet approved. MDAQMD is currently collaborating with USEPA on revisions to Rule 1160.

Boilers, Process Heaters and Water Heaters

District		AVAQMD	MDAQMD	BAAQMD	SBAQMD	SMAQMD	SJVAPCD	SCAQMD
Rule Number		1146, 1146.1, 1121	1157	Regulation 9, Rule 4, Rule 6 and 7	360, 361, 342, 352	414 and 411	4307, 4308, and 4320, 4905	1146, 1146.1, 1146.2, 1111
NO_x Limits – Gaseous Fuel	>5 MMBTU	30 – 40 ppm	70 ppm (0.084 lb/MMBTU) 30 ppm (0.036 lbs/MMBtu)	15 (5-20 MMBTU) 9 (20-75 MMBTU) 5 (>75MMBTU)	30 ppm (7-9 ppm if the units is new, separate limits for landfill gas)	15 ppm (<20 MMBTU/hr) 9 ppm (>20 MMBTU/hr)	6-9 (<20 MMBTU/hr) 5-7 (>20 MMBTU/hr)	5 (>20 MMBTU/hr) 9 (<20 MMBTU/hr), 12 (atmosph. unit), 15 digest. gas), 25 (landfill gas)
NO_x Limits – Gaseous Fuel	2-5 MMBTU	30 ppm	NG Boilers ≥ 2MMBtu/hr regulated through District NSR permit program.	30 ppm	9 – 12 ppm	30 ppm (1-5 MMBTU/hr)	30 (existing) 9-12 (new or replacementt)	9-12, 15 (digester gas), 25 (landfill gas)
NO_x Limits – Gaseous Fuel	75K-2 MMBTU	NA	NA	14 ng/joule	20 ppm or 14 ng/joule (55 ppm or 40 ng/joule for pool and spa heaters)	14 ppm (55 ng/joule) pool/spa 40ppm (55ng/j) (75K-1 MMBTU/hr)	20 ppm (includes pool heaters >400k BTU) 40 (pool heaters 75k - 400k BTU)	30 ppm (>1 MMBTU/hr, older units require retrofit) 14 ng/j (<1 MMBTU/hr for new units only)
NO_x Limits – Gaseous Fuel	Furnace	**40 ng/j**	NA	**40**	**40**	NA	**14 ng/j, 40 ng/j for mobile homes**	**14 ng/j, 40ng/j for mobile homes**
NO_x Limits – Gaseous Fuel	Water heater	**40 ng/j** **50 ng/j (mobile home)**	NA	**10 ng/joule**	**15 ppm or 10 ng/joule**	**10 ppm (15 ng/j)**	**14 ng/j, mobile home 40 or fee payment**	**15 ppm (10 ng/j), mobile home 55 ppm (40 ng/j) or pay fee**
NO_x Limits	Liquid Fuel	Same as above	Liquid & Solid: 115 ppm (0.15 lb/MMBTU) 40 ppm (0.052 lbs/MMBtu)	40 ppm	20 for LPG	40 ppm	30/77 (75k-2MMBTU/hr) 40 (existing 2-5 MMBTU) 40 (>5 MMBTU/hr only during nat. gas curtailm't)	40 ppm (>5MMBTU) Same as above for 75k – 2MM BTU/hr.
Applicability		5 MMBTU, exceptions for large units at electric utilities and petroleum refineries	Existing Rule: Applies only to permitted units Potential New Rule: Applies to any unit with >5 MMBTU heat input	Separate limits for landfill or digester gas, limits *do apply* to swimming pool heaters,			Separate limits for oilfield steam generators >5 MMBTU	Boilers at petroleum refineries regulated separately,
Selected Exemptions and Limitations		< 90,000 therms per year fuel use for 1146 and <18,000 therms for 1146.1	70-125 ppm for boilers at solar generating facilities operating at <40% rated heat input PUC regulated electric power generating units	If device uses <10% annual maximum heat capacity	Water heaters for manufactured homes and RVs 361 – low use exemption 1.8 MMBTU	Low Fuel Use MMBTU/Therms/yr 1-2.5/<40,000 2.5-5 70,000 5-100 <200,000 >100/<300,000	Water heaters for RVs	Water heaters for RVs, residential water heaters not subject to retrofit requirements for 1-2 MMBTU/hr units

Rules in Red have been submitted by the State for inclusion in the SIP, but not yet approved.
Shaded cells mean rules are applicable to the sale of new equipment (i.e. older equipment may continue to be used).
Bold – only for natural gas units, Blue – Rules are not approved into the California SIP

Cement Kilns			
District	MDAQMD	Eastern Kern	BAAQMD
Rule	1161	425.3	Regulation 9 Rule 13
NO_X Limits	Preheater-Precalciner Kilns: 6.4 lb/ton of clinker Long Dry Kilns: 6.4 lb/ton of clinker Short Dry Kilns: 7.2 lb/ton of clinker Preheater-Precalciner Kilns: 2.8 lb/ton of clinker Portland Cement Kiln: 3.4 lb/ton of clinker All limits are 30-day avg. Plus one of the following: Combustion controls, Low NO_X burners, Staged combustion, NO_X-reducing fuels	6.4 lb/ton of clinker (30-day avg.) 11.6 lb/ton of clinker (24-hour avg.) Preheater-Precalciner Kilns: 2.8 lb/ton of clinker Portland Cement Kiln: 3.4 lb/ton of clinker	Preheater-Precalciner Kilns: 2.3 lbs NO_X per ton of clinker
Alternatives	17,000 – 30,000 lb NO_X per day during startup and shutdown. Aggregate emissions limit, 90% reduction of total NO_X and meet RACT limit (6.4-7.2 lb/ton clinker).		
Selected Exemptions	Separate limits for start-up and shutdown that are limited to no more than 14 days per year.		

Rule in red have been submitted by the State for inclusion in the SIP, but not yet approved by EPA. Note: Other districts may have cement kiln rules but not operating cement kilns.

		Miscellaneous Fuel Burning Equipment						
District		AVAQMD	MDAQMD	VCAPCD	SDAQMD	SCAQMD	SJVAPCD	ICAPCD
		474	474	74.34	68	1147	4301	400
NOX Limits (ppm)	Gas	300 (555-1786 MMBTU) 225 (1786-2143 MMBTU) 125 (>2143 MMBTU)	125 ppm	30 – 60 ppm depending on equipment type (dryer, heater incinerator, etc.)	125	30-60 ppm depending on process temperature	140 lbs/hour	140 lbs per hour
	Liquid	Liquid & solid limits: 400 (555-1786 MMBTU) 325 (1786-2143 MMBTU) 225 (>2143 MMBTU)	225 ppm		225	40-60 ppm depending on temperature		
Alternatives		For steam producing equipment, 125 ppm for gaseous and 225 for liquid/solid fuel	Limits are average if both gaseous and liquid/solid fuel	80 ppm limit for units with annual heat input rate <$9x10^9$			Other rules limit dryers, dehydrators, ovens (4309)	
Applicability		>555 MMBTU/hr	Heat input >1,775 MMBTU/hr and not regulated under other rules	Heat Input >5 MMBTU/hr, limits apply to specific units (e.g. dryers, heaters, incinerator, furnaces, duct burners…)	Heat input >50 MMBTU/hr	Heat input >325,000 BTU/hr, For units with NOX emissions that require a permit, but are not subject to other NOX control rules	Fuel burning equipment	Stationary fuel burning equipment
Selected Exemptions				Air pollution control equipment, units subject to other rules	Some boiler-steam turbine gen sets, diesel engines for emergency power	Units covered under other rules, char broilers, remediation units fueled by propane butane, or lpg, where natural gas is unavailable…	Air pollution control equipment	
Last Amended		December 1981	August 1997	December 2016	September 1994	September 2011	May 1992	September 1999

Source	Potential Measure	Description	Advance Attainment date?	RACM?	Explanation	Estimated 2031 Reductions (tpd VOC)	Estimated 2031 Reductions (tpd NOx)
Residential natural-gas fired water heating	Residential water heater rule for gas-fired heaters	NOx standards for new residential water heaters (Gas), SCAQMD Rule 1121	no	no	Emissions reduction impact of new equipment minimal by 2031; not enough reductions	0.00	0.06
Residential natural gas-fired heating	Low-Emission Furnaces	Adopt SCAQMD Rule 1111: NOx Emissions from Natural Gas Fired, Fan-Type Central Furnaces	no	no	Emissions reduction impact of new equipment minimal by 2031; not enough reductions	0.00	0.01
Residential wood-fired heating	Voluntary Wood stove and fireplace retrofit/swap program	Voluntary swap program for homes with gas-fired stoves/fireplaces	no	no	Emissions reduction impact of new equipment minimal by 2031; not enough reductions	0.01	0.01
Weed abatement open burning	Seasonal Tumbleweed burn ban	Ban tumbleweed burns during ozone season	no	no	Not enough reductions; most burn days outside of ozone season	0.01	0.00
Restaurant cooking Operations	Control emissions from restaurant sources	Adopt SCAQMD Rule 1138: Control of Emissions from Restaurant Operations	no	no	Already regulated in AV; not enough reductions	0.07	0.00
Livestock husbandry	Rule for smaller CAF's	Adopt a rule similar to 1119 for small CAFs, SJVAPCD Rule 4570	no	no	Large CAFs already regulated; not enough reductions	0.09	0.00
Lawn equipment	Voluntary lawn equipment replacement program	Already implemented, electric lawn equipment replacement	no	no	reductions not quantifiable, varies annually and depends on equipment usage	0.00	0.00
All Sources	Increased enforcement	increased inspections of sources	no	no	Provides no new emissions reductions		
Fireworks	Firework ban	Ban on all fireworks and sale of fireworks during ozone / wildfire season	no	no	particulate control measure, very limited ozone benefit; lack of reductions	0.00	0.00
Boilers	Rule for boilers less than 1 MMBTU	Adopt SMAQMD Rule 414	no	no	Emissions reduction impact of new equipment minimal by 2031; not enough reductions	0.00	0.01
Boilers	Rule for boilers 1-2 MMBTU	Adopt SMAQMD Rule 411	no	no	Emissions reduction impact of new equipment minimal by 2031; not enough reductions	0.00	0.01
					Totals:	0.18	0.08

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APPENDIX F - CARB ADOPTED MOBILE SOURCE PROGRAMS

(prepared by CARB staff)

I. Key Mobile Source Regulations and Programs Providing Emission Reductions

Given the severity of California's air quality challenges and the need for ongoing emission reductions, the California Air Resources Board (CARB or Board) has implemented the most comprehensive mobile source emissions control program in the nation. CARB's comprehensive program relies on four fundamental approaches:

- Stringent emissions standards that minimize emissions from new vehicles and equipment;
- In-use programs that target the existing fleet and require the use of the cleanest vehicles and emissions control technologies;
- Cleaner fuels that minimize emissions during combustion; and,
- Incentive programs that remove older, dirtier vehicles and equipment and replace those vehicles with the cleanest technologies.

This multi-faceted approach has spurred the development of increasingly cleaner technologies and fuels and achieved significant emission reductions across all mobile source sectors that go far beyond national programs or programs in other states. These efforts extend back to the first mobile source regulations adopted in the 1960s, and pre-date the federal Clean Air Act Amendments (Act) of 1970, which established the basic national framework for controlling air pollution. In recognition of the pioneering nature of CARB's efforts, the Act provides California unique authority to regulate mobile sources more stringently than the federal government by providing a waiver of preemption for its new vehicle emission standards under Section 209(b). This waiver provision preserves a pivotal role for California in the control of emissions from new motor vehicles, recognizing that California serves as a laboratory for setting motor vehicle emission standards. Since then, CARB has consistently sought and obtained waivers and authorizations for its new motor vehicle regulations. CARB's history of progressively strengthening standards as technology advances, coupled with the waiver process requirements, ensures that California's regulations remain the most stringent in the nation.

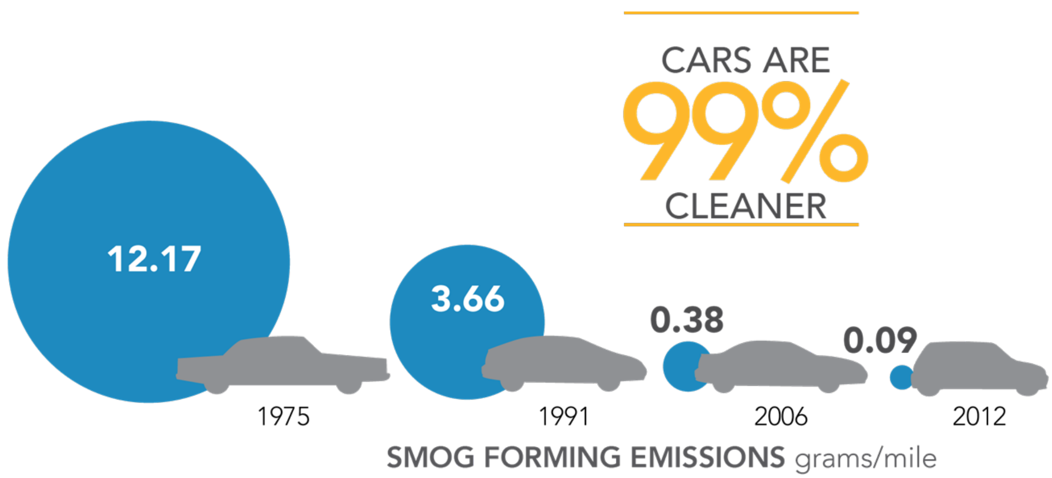
In 1998, CARB identified diesel particulate matter as a toxic air contaminant. Since then, CARB adopted numerous regulations aimed at reducing exposure to diesel particulate matter while concurrently providing reductions in oxides of nitrogen (NOx) from freight transport sources like heavy-duty diesel trucks, transportation sources like passenger cars and buses, and off-road sources like large construction equipment. Phased implementation of these regulations will continue to produce emission reduction benefits through 2037 and beyond, as the regulated fleets are retrofitted, and as older and dirtier portions of the fleets are replaced with newer and cleaner models at an accelerated pace.

Further, CARB and District staff work closely on identifying and distributing incentive funds to accelerate cleanup of vehicles and engines. Key incentive programs include: Low Carbon Transportation, Air Quality Improvement Program, VW Mitigation Trust, Community Air Protection, Carl Moyer Program, Goods Movement Program, Clean Off-Road Equipment (CORE) and Funding Agricultural Replacement Measures for Emission Reductions (FARMER). These incentive-based programs work in tandem with regulations to accelerate deployment of cleaner technology.

A. Light-Duty Vehicles

Figure F-1 illustrates the trend in CARB smog forming emission standards for light-duty vehicles. Cars are 99 percent cleaner than they were in 1975 due to CARB's longstanding light-duty mobile source program. Since setting the nation's first motor vehicle exhaust emission standards in 1966 that led to the first pollution controls, California has dramatically tightened emission standards for light-duty vehicles. In 1970, CARB required auto manufacturers to meet the first standards to control NOx emissions along with hydrocarbon emissions. The simultaneous control of emissions from motor vehicles and fuels led to the use of cleaner-burning reformulated gasoline (RFG) that has removed the emissions equivalent of 3.5 million vehicles from California's roads. Since CARB first adopted it in 1990, the Low Emission Vehicle Program (LEV and LEV II) and Zero-Emission Vehicle (ZEV) Program have resulted in the production and sales of hundreds of thousands of zero-emission vehicles (ZEVs) in California.

Figure F-1: Light-Duty Emission Standards



As a result of these efforts, light-duty vehicle emissions in the Western Mojave Desert have been reduced significantly since 1990 and will continue to go down through 2032. From today, light-duty vehicle NOx emissions are projected to decrease by over 62 percent in 2032. Key light-duty programs include Advanced Clean Cars (ACC), On-Board Diagnostics, Reformulated Gasoline, Incentive Programs, and the Enhanced Smog Check Program.

1. Advanced Clean Cars

CARB's groundbreaking ACC program is now providing the next generation of emission reductions in California, and ushering in a new zero emission passenger transportation system. The success of this program is evident: California is the world's largest market for Zero Emission

Vehicles (ZEVs), with over 87 models available today, including battery-electric, plug-in hybrid electric, and fuel cell electric vehicles. A wide variety are now available at lower price points, attracting new consumers. As of February 2022, Californians, who drive only 10 percent of the nation's cars, now account for over 40 percent of all zero-emission cars in the country. The U.S. makes up about half of the world market. This movement towards commercialization of advanced clean cars has occurred due to CARB's ZEV requirements, part of ACC, which affects passenger cars and light-duty trucks.

CARB's ACC Program, approved in January 2012, is a pioneering approach of a 'package' of regulations that - although separate in construction - are related in terms of the synergy developed to address both ambient air quality needs and climate change. The ACC program combines the control of smog, soot causing pollutants and greenhouse gas (GHG) emissions into a single coordinated package of requirements for model years 2015 through 2025. The program assures the development of environmentally superior cars that will continue to deliver the performance**,** utility, and safety vehicle owners have come to expect

The ACC Program also included amendments affecting the current ZEV requirements through the 2017 model year in order to enable manufacturers to successfully meet 2018 and subsequent model year requirements. These ZEV amendments are intended to achieve commercialization through simplifying the regulation and pushing technology to higher volume production in order to achieve cost reductions. The ACC Program will continue to achieve benefits into the future as new cleaner cars enter the fleet and displace older and dirtier vehicles.

Going beyond these regulations, California will be transitioning to zero emissions. In support of California's transition to zero-emission vehicles, in 2020, Governor Newsom signed Executive Order N-79-20[89] which established a goal that 100 percent of California sales of new passenger cars and trucks be zero-emission by 2035. Advanced Clean Cars II (ACC II), a measure in the 2016 State SIP Strategy, is a significant effort critical to meeting air quality standards, and was recently adopted by the CARB Board in August 2022. ACC II is consistent with the Governor Newson's Executive Order and has the goal of cutting emissions from new combustion vehicles while taking all new vehicle sales to 100 percent zero-emission no later than 2035.

With this order and many other recent actions, Governor Newsom has recognized that air pollution remains a challenge for California that requires bold action. Zero-emission vehicle commercialization in the light-duty sector is well underway. Longer-range battery electric vehicles are coming to market that are cost-competitive with gasoline fueled vehicles and hydrogen fuel cell vehicles are now also seeing significant sales. Autonomous and connected vehicle technologies are being installed on an increasing number of new car models. A growing network of retail hydrogen stations is now available, along with a rapidly growing battery charger network.

[89] Executive Order N-79-20 https://www.gov.ca.gov/wp-content/uploads/2020/09/9.23.20-EO-N-79-20-Climate.pdf

2. On Board Diagnostics (OBD)

OBD systems serve an important role in helping to ensure that engines and vehicles maintain low emissions throughout their full life. OBD systems are designed to identify when a vehicle's emission control systems or other emission-related computer-controlled components are malfunctioning, causing emissions to be elevated above the vehicle manufacturer's specifications. Many states currently use the OBD system as the basis for passing and failing vehicles in their inspection and maintenance programs, as is exemplified by California's Smog Check program.

California's first OBD regulation required manufacturers to monitor some of the emission control components on vehicles starting with the 1988 model year. In 1989, CARB adopted OBD II, which required 1996 and subsequent model year passenger cars, light duty trucks, and medium duty vehicles and engines to be equipped with second generation OBD systems. The Board has modified the OBD II regulation in regular updates since initial adoption to address manufacturers' implementation concerns and, where needed, to strengthen specific monitoring requirements. Most recently, the Board amended the regulation in 2021 to require manufacturers to implement Unified Diagnostic Services (UDS) for OBD communications, which will provide more information related to emissions-related malfunctions that are detected by OBD systems, improve the usefulness of the generic scan tool to repair vehicles, and provide needed information on in-use monitoring performance. UDS implementation would be required for all 2027 and subsequent model year light- and medium-duty vehicles and engines, as well as some heavy-duty vehicles and engines.

3. California Enhanced Smog Check Program

The Bureau of Automotive Repair (BAR) is the State agency charged with administration and implementation of the Smog Check Program. The Smog Check Program is designed to reduce air pollution from California registered vehicles by requiring periodic inspections for emission-control system problems, and by requiring repairs for any problems found. In 1998, the Enhanced Smog Check program began in which Smog Check stations relied on the BAR-97 Emissions Inspection System (EIS) to test tailpipe emissions with either a Two-Speed Idle (TSI) or Acceleration Simulation Mode (ASM) test depending on where the vehicle was registered. For instance, vehicles registered in urbanized areas received an ASM test, while vehicles in rural areas received a TSI test.

In 2009, the following requirements were added in to improve and enhance the Smog Check Program, making it more inclusive of motor vehicles and effective on smog reductions:

- Low pressure evaporative test;
- More stringent pass/fail cutpoints;
- Visible smoke test; and
- Inspection of light- and medium-duty diesel vehicles.

The next major change in the Program was due to AB 2289, adopted in October 2010, a new law restructuring California's Smog Check Program, streamlining and strengthening inspections, increasing penalties for misconduct, and reducing costs to motorists. This new law, supported by CARB and BAR, promised faster and less expensive Smog Check inspections by talking advantage of the second generation of OBD software installed on all vehicles. The new law also directs vehicles without this equipment to high-performing stations, helping to ensure that these cars comply with current emission standards. This program will reduce consumer costs by having stations take advantage of diagnostic software that monitors pollution-reduction components and tailpipe emissions. Beginning mid-2013, testing of passenger vehicles using OBD was required on all vehicles model years 2000 or newer.

4. Reformulated Gasoline (CaRFG)

Since 1992, CARB has been regulating the formulation of gasoline through the California Reformulated Gasoline program (CaRFG). The CaRFG program has been implemented in three phases, and has resulted in California gasoline being the cleanest in the world. California's cleaner-burning gasoline regulation is one of the cornerstones of the State's efforts to reduce air pollution and cancer risk. Reformulated gasoline is fuel that meets specifications and requirements established by CARB, which reduced motor vehicle toxics by about 40 percent and reactive organic gases by about 15 percent. The results from cleaning up fuel can have an immediate impact as soon as it is sold in the State. Vehicle manufacturers design low-emission emission vehicles to take full advantage of cleaner-burning gasoline properties.

5. Incentive Programs

There are many different incentive programs focusing on light-duty vehicles that produce extra emission reductions beyond traditional regulations. Incentive programs encourage both the early retirement of dirty, older cars and the purchase of newer, lower-emitting vehicle engines and technologies. Several State and local incentive funding pools have been used historically -- and remain available -- to fund the accelerated turnover of on-road heavy-duty vehicles.

The State, in partnership with the local air districts, has a well-established history of using incentive programs to advance technology development and deployment, and to achieve early emission reductions. Since 1998, CARB and California's local air districts have been administering incentive funding to accelerate the deployment and turnover to cleaner vehicles, starting with the Moyer Program. In recognition of the key role that incentives play in complementing State and local air quality regulations to reduce emissions, the scope and scale of California's air quality incentive programs has since greatly expanded. Each of CARB's incentive programs has its own statutory requirements, goals, and categories of eligible projects that collectively provide for a diverse and complex incentives portfolio. CARB uses this portfolio approach to incentives to accelerate development and early commercial deployment of the cleanest mobile source technologies and to improve access to clean transportation.

The Fiscal Year (FY) 2021-22 State Budget included an unprecedented level of investment in ZEVs, with $2.3 billion allocated for CARB over the next three years, specifically dedicated to incentive-based turnover of mobile source vehicles and equipment, as part of a $3.9 billion comprehensive, multi-agency package to accelerate progress toward the State's zero-emission vehicle goals established under Executive Order N-79-20. With the 2022-23 State Budget, Governor Newsom is further reinforcing California's commitment to transitioning away from combustion vehicles with an additional $6.1 billion in ZEV investments over the next 5 years.

a) Low Carbon Transportation Investments and Air Quality Improvement Program (Clean Transportation Incentives)

California's Low Carbon Transportation Investments and the Air Quality Improvement Program form CARB's major incentive funding program, which works in concert with the State's larger portfolio of clean transportation investments. Together, the Low Carbon Transportation Investments and Air Quality Improvement Program are known as the Clean Transportation Incentives program; they provide mobile source incentives to reduce greenhouse gas, criteria pollutant, and toxic air contaminant emissions through the deployment of advanced technology and clean transportation in the light-duty and heavy-duty sectors.

The Clean Transportation Incentives Program is part of California Climate Investments, and is designed to accelerate the transition to advanced technology low carbon freight and passenger transportation, with a priority on providing health and economic benefits to California's most disadvantaged communities, and with a focus on increasing deployment of zero-emission vehicles and equipment wherever possible. Low Carbon Transportation Investments are supported by California's Cap-and-Trade auction proceeds. The Air Quality Improvement Program (AQIP) is a mobile source incentive program that focuses on reducing criteria pollutant and diesel particulate emissions with concurrent GHG reductions. AQIP is appropriated from the Air Quality Improvement Fund.

Each year, the legislature appropriates funding to CARB for the Low Carbon Transportation Investments and Air Quality Improvement Programs, and allocations are used to fund multiple programs in the passenger vehicle, on-road heavy-duty, and off-road vehicle sectors, including: the Clean Vehicle Rebate Project (CVRP); Enhanced Fleet Modernization Program and Plus-Up Pilot Project (Clean Cars 4 All); and the Hybrid and Zero-Emission Truck and Bus Voucher Incentive Project (HVIP).

i.Clean Vehicle Rebate Program (CVRP)

As one of the programs funded through the Clean Transportation Incentives program, CVRP is a vehicle purchasing incentives program that provides consumer rebates to reduce the price for new ZEV purchases, and is designed to offer vehicle rebates on a first-come, first-serve basis for light-duty ZEVs, plug-in hybrid electric vehicles, and zero-emission motorcycles. In FY 2021-22, CVRP was allocated $525 million.

ii.Clean Cars 4 All (CC4A)

Clean Cars 4 All (formerly known as the Enhanced Fleet Modernization Program Plus-Up Pilot Project) is another Clean Transportation Incentives program for passenger vehicles. Clean Cars 4 All provides incentives for lower-income consumers living in and near disadvantaged communities who scrap their old vehicles and purchase new or used hybrid, plug-in hybrid, or zero-emission vehicle replacement vehicles. The budget for FY 2021-22 included $75 million for the statewide expansion of CC4A.

iii.Other Clean Transportation Equity Investments

CARB also funds a suite of transportation equity pilot projects aimed at increasing access to clean transportation and mobility options for priority populations in disadvantaged and low-income communities, and for lower-income households. This includes clean vehicle ownership projects, clean mobility options, streamlining access to funding and financing opportunities, and increasing community outreach, education and exposure to clean technologies. Clean Transportation Equity pilot projects exemplify the importance of understanding the unique needs across communities and provide lessons for how we most directly address barriers to collectively achieve our equity, air quality, and climate goals. Major Clean Transportation Equity Investment programs include: Clean Mobility Options, Clean Mobility in Schools, Financing Assistance; and Sustainable Transportation Equity Project **(**STEP). Clean Transportation Equity Investment projects were allocated $150 million in the FY 2021-22 budget, which includes the $75 million for CC4A mentioned above.

Financing Assistance provides eligible consumers buy-down and financing opportunities to purchase or lease a new or used clean vehicle, such as a conventional hybrid electric vehicle (HEV), plug-in hybrid (PHEV), or battery electric vehicle (BEV). Clean Mobility in Schools Projects are located within disadvantaged communities, and are intended to encourage and accelerate the deployment of new zero-emission school buses, school fleet vehicles, passenger cars, lawn and garden equipment, and can incorporate alternative modes of transportation like transit vouchers, active transportation elements, and bicycle share programs. In the light-duty sector, some of the Clean Mobility Options programs that CARB funds include the Clean Mobility Options Voucher Pilot Program (CMO). CMO provides voucher-based funding for low-income, tribal, and disadvantaged communities to fund zero-emission shared and on-demand services such as carsharing, ridesharing, bike sharing, and innovative transit services. STEP is a new transportation equity pilot program that funds zero-emission carsharing, bike sharing, public transit and shared mobility subsidies, among other projects.

b) Moyer Program

The Carl Moyer Memorial Air Quality Standards Attainment Program (Moyer Program), funded by dedicated revenue from the DMV's smog abatement fee and a fee on the purchase of new tires, provides approximately $60 million in grant funding annually through local air districts for cleaner-than-required engines and equipment. Since 1998, approximately $1 billion has been allocated to date. In the light-duty sector, the Moyer Program encourages voluntarily retirement of older, more polluting passenger vehicles through a Voluntary Accelerated Vehicle

Retirement Program (VAVR), which is a car scrappage or old vehicle buy-back program that encourages the accelerated removal of higher-polluting vehicles that have passed their biennial Smog Check Test inspection, to be replaced with newer, cleaner vehicles or alternative transportation options.

c) Consumer Assistance Program

California's voluntary vehicle retirement program, the Consumer Assistance Program (CAP), is administered by BAR and provides low-income consumers repair assistance including up to $1,200 in emissions-related repairs if their vehicle fails its biennial Smog Check Test inspection, and/or up to $1,500 per vehicle for retiring operational vehicles at BAR-contracted dismantler sites.

B. Medium- and Heavy-Duty On-Road Trucks

Due to the benefits of CARB's longstanding heavy-duty mobile source program, heavy-duty on-road vehicle emissions in the Western Mojave Desert have been reduced significantly since 1990 and will continue to decrease through 2032. From today, medium- and heavy-duty NOx emissions are projected to decrease by approximately 72 percent in 2032. Key programs contributing to those reductions include new heavy-duty engine standards, cleaner diesel fuel requirements, California's Truck and Bus Regulation and incentive programs.

1. Heavy-Duty Engine Standards

Since 1990, heavy-duty engine NOx emission standards have become dramatically more stringent, dropping from 6 grams per brake horsepower-hour (g/bhp-hr) in 1990 down to the current 0.2 g/bhp-hr standard, which took effect in 2010. In addition to mandatory NOx standards, there have been several generations of optional lower NOx standards put in place over the past 15 years. Most recently in 2015, engine manufacturers were allowed to certify to three optional NOx emission standards of 0.1 g/bhp-hr, 0.05 g/bhp-hr, and 0.02 g/bhp-hr (i.e., 50 percent, 75 percent, and 90 percent lower than the current mandatory standard of 0.2 g/bhp-hr). The optional standards allow local air districts and CARB to preferentially provide incentive funding to buyers of cleaner trucks, and to encourage the development of cleaner engines.

2. Optional Low-NOx Standards for Heavy-Duty Diesel Engines

In 2013, California established optional low-NOx standards for heavy-duty diesel engines (Optional Reduced Emissions Standards for Heavy-Duty Engines regulation), with the most aggressive standard being 0.02 g/bhp-hr, 90 percent below the federally required standard. The optional low-NOx standards were developed to pave the way for more stringent mandatory standards by encouraging manufacturers to develop and certify low-NOx engines, and incentivizing potential customers to purchase these low-NOx engines. By 2019, a total of fifteen engines families, some using natural gas and others using liquefied petroleum gas, had been certified to the optional low-NOx standards.

3. Heavy-Duty Engine and Vehicle Omnibus Regulation

In 2021, CARB comprehensively overhauled how NOx emissions from new heavy-duty engines are regulated in California through the adoption of the Heavy-Duty Engine and Vehicle Omnibus Regulation which reduces NOx emissions from the engines in medium- and heavy-duty vehicle classes. The Omnibus Regulation includes NOx certification emission standards and in-use standards that significantly reduce tailpipe NOx emissions during most vehicle operating modes such as high-speed steady-state, transient, low load urban driving, and idling modes of operation. Additionally, revisions to the emissions warranty, useful life, emissions warranty and reporting information and corrective action procedures, and durability demonstration procedures provide additional emission benefits by encouraging more timely repairs to emission-related malfunctions and encouraging manufacturers to produce more durable emission control components, thereby reducing the rate at which engine emission controls fail and emissions increase.

4. Cleaner In-Use Heavy-Duty Trucks (Truck and Bus Regulation)

California's Truck and Bus Regulation or In-Use Heavy-Duty Truck Rule was first adopted in December 2008. This rule represents a multi-year effort to turn over the legacy fleet of heavy-duty on-road engines and replace them with the cleanest technology available. In December 2010, CARB revised specific provisions of the In-Use Heavy-duty Truck Rule, in recognition of the deep economic effects of the recession on businesses and the corresponding decline in emissions.

Starting in 2012, the Truck and Bus Regulation phases in requirements applicable to an increasingly larger percentage of California's truck and bus fleet over time, so that by 2023 nearly all older vehicles will be upgraded to have exhaust emissions meeting 2010 model year engine emissions levels. The regulation applies to nearly all diesel-fueled trucks and buses with a gross vehicle weight rating (GVWR) greater than 14,000 pounds that are privately or federally owned, including on-road and off-road agricultural yard goat trucks, and privately and publicly owned school buses. Moreover, the regulation applies to any person, business, school district, or federal government agency that owns, operates, leases or rents affected vehicles. The regulation also establishes requirements for any in-State or out-of-state motor carrier, California-based broker, or any California resident who directs or dispatches vehicles subject to the regulation. Finally, California sellers of a vehicle subject to the regulation would have to disclose the regulation's potential applicability to buyers of the vehicles. Approximately 170,000 businesses in nearly all industry sectors in California, and almost a million vehicles that operate on California roads each year are affected. Some common industry sectors that operate vehicles subject to the regulation include: for-hire transportation, construction, manufacturing, retail and wholesale trade, vehicle leasing and rental, bus lines, and agriculture.

In 2017, California passed legislation ensuring compliance with the Truck and Bus Regulation through the California Department of Motor Vehicles (DMV) vehicle registration program. Starting January 1, 2020, DMV verifies compliance to ensure that vehicles subject to the Truck and Bus Regulation meet the requirements prior to obtaining DMV vehicle registration. The law requires the DMV to deny registration for any vehicle that is non-compliant or has not reported to CARB as compliant or exempt from the Truck and Bus Regulation.

CARB compliance assistance and outreach activities that are key in support of the Truck and Bus Regulation include:

- The Truck Regulations Upload and Compliance Reporting System (TRUCRS), an online reporting tool developed and maintained by CARB staff;
- The Truck and Bus regulation's fleet calculator, a tool designed to assist fleet owners in evaluating various compliance strategies;
- Targeted training sessions all over the State; and
- Out-of-state training sessions conducted by a contractor.

CARB staff also develops regulatory assistance tools, conducts and coordinates compliance assistance and outreach activities, administers incentive programs, and actively enforces the entire suite of regulations. Accordingly, CARB's approach to ensuring compliance is based on a comprehensive outreach and education effort.

5. Heavy-Duty Inspection and Maintenance Regulation

To ensure heavy-duty trucks remain clean in-use, CARB adopted in 2021 the Heavy-Duty Inspection and Maintenance Regulation, which requires periodic demonstrations that vehicles' emissions control systems are properly functioning in order to legally operate within the State. This regulation is designed to achieve criteria emissions reductions by ensuring that malfunctioning emissions control systems are repaired in a timely fashion.

6. Heavy-Duty On-Board Diagnostics (HD OBD)

OBD systems serve an important role in helping to ensure that engines and vehicles maintain low emissions throughout their full life. OBD systems monitor virtually all emission controls on gasoline and diesel engines, including catalysts, particulate matter (PM) filters, exhaust gas recirculation systems, oxygen sensors, evaporative systems, fuel systems, and electronic powertrain components as well as other components and systems that can affect emissions when malfunctioning. The systems also provide specific diagnostic information in a standardized format through a standardized serial data link on-board the vehicles. The use and operation of OBD systems ensure reductions of in-use motor vehicle and motor vehicle engine emissions through improvements in emission system durability and performance.

The Board originally adopted comprehensive Heavy-Duty OBD regulations in 2005 for model year 2010 and subsequent heavy-duty engines and vehicles, referred to as HD OBD. In 2009, the Board updated the HD OBD regulation, adopted specific enforcement requirements, and aligned the HD OBD with OBD requirements for medium-duty vehicles. In 2021, the Board again amended the HD OBD regulation; the 2021 amendments require manufacturers to implement Unified Diagnostic Services for OBD communications, which will provide more information related to emissions-related malfunctions that are detected by OBD systems, improve the usefulness of the generic scan tool to repair vehicles, and provide needed information on in-use monitoring performance.

7. Clean Diesel Fuel

Since 1993, CARB has required that diesel fuel have a limit on the aromatic hydrocarbon content and sulfur content of the fuel. Diesel powered vehicles account for a disproportionate amount of diesel particulate matter, which is considered a toxic air contaminant in California. In 2006, CARB required a low-sulfur diesel fuel to be used not only by on-road diesel vehicles but also for off-road engines. The diesel fuel regulation allows alternative diesel formulations as long as emission reductions are equivalent to the CARB formulation.

8. Advanced Clean Truck Regulation (ACT)

In June 2020, CARB adopted the Advanced Clean Trucks regulation, a first of its kind regulation requiring medium- and heavy-duty manufacturers to produce ZEVs as an increasing portion of their sales beginning in 2024. The Advanced Clean Trucks regulation is a manufacturers ZEV sales requirement and a one-time reporting requirement for large entities and fleets. This regulation is expected to result in roughly 100,000 heavy-duty ZEVs operating on California’s roads by 2030 and nearly 300,000 heavy-duty ZEVs by 2035. With the adoption of the Advanced Clean Trucks regulation, CARB Resolution 20-19 directs staff to return to the Board with a zero-emission fleet rule and sets the following targets for transitioning California’s heavy-duty vehicle sectors to ZEVs:

- 100 percent zero-emission drayage, last mile delivery, and government fleets by 2035;
- 100 percent zero-emission refuse trucks and local buses by 2040;
- 100 percent zero-emission-capable vehicles in utility fleets by 2040; and
- 100 percent zero-emission everywhere else, where feasible, by 2045.

As mentioned earlier, the Governor signed Executive Order N-79-20 in September 2020, which directs CARB to adopt regulations to transition the State’s transportation fleet to ZEVs. This includes transitioning the State’s drayage fleet to ZEVs by 2035 and transitioning the State’s truck and bus fleet to ZEVs by 2045 where feasible.

9. Innovative Clean Transit (ICT) and Zero-Emission Airport Shuttle Regulation

To achieve the needed emission reductions from heavy-duty applications, CARB is driving the use of zero-emission heavy-duty vehicles in strategic applications, including urban transit buses and airport ground transportation. The Innovative Clean Transit regulation was the first of these programs. It was adopted in December 2018 and requires all public transit agencies to gradually transition to a 100 percent zero-emission bus fleet and encourages them to provide innovative first- and last-mile connectivity and improved mobility for transit riders. Beginning in 2029, 100 percent of new purchases by transit agencies must be Zero Emission Buses, with a goal for full transition by 2040. It applies to all transit agencies that own, operate, or lease buses in California with a GVWR greater than 14,000 lbs. It includes standard, articulated, over-the-road, double-decker, and cutaway buses.

The Zero-Emission Airport Shuttle Regulation, adopted in June 2019, requires airport shuttle operators in California to transition to 100 percent ZEV technologies. Airport shuttle operators must begin adding zero-emission shuttles to their fleets in 2027, and complete the transition to ZEVs by the end of 2035. The regulation applies to airport shuttle operators who own, operate, or lease vehicles at any of the 13 California airports regulated under this rule.

10. Incentive Programs

There are many different incentive programs focusing on heavy-duty vehicles that accelerate turnover to cleaner technologies, and thereby produce extra emission reductions beyond traditional regulations. Several State and local incentive funding pools have been used historically -- and remain available -- to fund the accelerated turnover of on-road heavy-duty vehicles.

a) Low Carbon Transportation Investments and Air Quality Improvement Program (Clean Transportation Incentives)

In addition to funding passenger vehicle incentive programs, the Low Carbon Transportation Investments and the Air Quality Improvement Program (Clean Transportation Incentives) also provides incentive funding for heavy-duty vehicles. This program both funds projects to accelerate fleet and engine turnover to cleaner existing technologies through the Hybrid and Zero-Emission Truck and Bus Voucher Incentive Project (HVIP) and Truck Loan Assistance program, as well as funding demonstration and pilot projects.

Beyond the vehicle purchasing incentives programs (CVRP and Clean Cars 4 All) and Clean Transportation Equity Investments, an additional $873 million was allocated in the FY 2020-2021 budget for on-road heavy-duty trucks and off-road equipment. CARB provides these incentive funds following the principles of the portfolio approach, meaning that funding is provided across multiple sectors and applications – as well as across multiple technologies to support both the technologies that are providing emission reductions today, as well as those that are needed to meet future goals as the technology matures. This includes funding for demonstration and pilot projects, vouchers for advanced clean technologies, and financing and support for small fleets transitioning to cleaner technologies. Additionally, this year funding was set aside specifically for drayage trucks, transit buses, and school buses, all of which are primed to rapidly transition to zero-emission.

i.Hybrid and Zero-Emission Truck and Bus Voucher Incentive Project (HVIP)

CARB's Hybrid and Zero-Emission Truck and Bus Voucher Incentive Project (HVIP) serves as the cornerstone program in CARB's advanced technology heavy-duty incentive portfolio. HVIP has provided funding since 2010 to support the long-term transition to cleaner combustion and zero-emission vehicles in the heavy-duty market. The program helps offset the higher costs of clean vehicles, and additional incentives are available for providing disadvantaged community benefits. HVIP responds to a key market challenge by making clean vehicles more affordable for fleets through point-of-purchase price reductions. With an HVIP voucher, technology-leading vehicles can be as affordable as their traditional fossil-fueled counterparts, enabling fleets of all sizes to deploy advanced technologies that are cleaner and quieter. HVIP is the earliest model in the United States to demonstrate the function, flexibility, and effectiveness of first-come first-served incentives that reduce the incremental cost of commercial vehicles. HVIP is fleet-focused, providing a streamlined and user-friendly option to encourage purchases and leases of advanced clean trucks and buses throughout California. Approved dealers are a key part of HVIP success and are trained to facilitate the application process**.** Vocations include freight and drayage trucks, delivery vans, utility vehicles, transit, school, and shuttle buses, refuse trucks, and more. In FY 2021-22, the Legislature allocated $569.5 million for HVIP.

ii.Truck Loan Assistance Program

CARB's Truck Loan Assistance Program was created through a one-time appropriation of approximately $35 million in the 2008 State Budget to implement a heavy-duty loan program that assists on-road fleets affected by the Truck and Bus Regulation and the Heavy-Duty Tractor-Trailer Greenhouse Gas Regulation. CARB has continued to operate this program with subsequently appropriated AQIP funds of around $28 million annually to provide financing opportunities to small-business truckers who don't meet conventional lending criteria and are unable to qualify for traditional financing for cleaner trucks. As of February 2022, about $187 million in Truck Loan Assistance Program funding has been provided to small business truckers for the purchase of approximately 36,000 cleaner trucks, exhaust retrofits, and trailers. In FY 2021-22, $28.6 million was allocated for the Truck Loan Assistance Program.

iii.Demonstration and Pilot projects

In addition to funding HVIP and the Truck Loan Assistance Program, the Clean Transportation Incentives program is the only program in CARB's portfolio, and one of the only programs in the State, that funds demonstration and pilot projects to support early market deployment of nascent zero-emission technologies. The purpose of the Advanced Technology Demonstration and Pilot Projects is to help accelerate the next generation of advanced technology vehicles, equipment, or emission controls, which are not yet commercialized. As such, it provides a testing ground for innovative projects focused on improving access to clean transportation for priority communities. In FY 2021-22, $80 million was allocated for heavy-duty advanced technology demonstration and pilot projects, which are intended to help bring to market-readiness zero emission (ZE) heavy-duty technologies that are poised to deploy commercially in the near future in both on- and off-road applications. This includes zero-emission long-haul trucks, strategic truck range extenders, and ZE applications along freight facilities/corridors.

In heavy-duty applications, the goods movement sector is a focus for incentive funding, with CARB funding multiple demonstration and pilot programs to drive zero-emission technologies in last mile delivery trucks, drayage trucks, and heavy-duty trucks and tractors. The *USPS Zero-Emission Delivery Truck Pilot Commercial Deployment Project* is deploying battery electric last-mile delivery trucks in the USPS fleet, together with the associated charging infrastructure. The project will demonstrate the practicality and economic viability of the widespread adoption of a variety of ZE medium- and heavy-duty vehicle technologies in delivery applications. The *Battery Electric Drayage Truck Demonstration* project is a $40 million Statewide demonstration of forty-four zero-emission battery electric and plug-in hybrid drayage trucks that, since 2018, have been in operation serving major California ports in five air districts (San Joaquin Valley, South Coast, Bay Area, Sacramento, and San Diego). Battery electric drayage trucks are used to transport cargo to or from California's ports and intermodal rail yards. Installation of charging infrastructure that enables safe charging of the trucks for statewide demonstration is also included as part of this project. To accelerate the deployment of zero-emission technologies in heavier freight applications, the $44.8 million *Volvo Low Impact Green Heavy Transportation Solutions* project is funding Class 8 heavy-duty battery electric trucks equipped with battery electric tractors to facilitate creation of a zero-emission goods movement system from the Ports of Long Beach and Los Angeles to four freight handling facilities in disadvantaged communities.

Clean transportation incentives have also funded demonstration and pilot projects for ZE urban transit buses. The $22.3 million *Fuel Cell Electric Bus Commercialization Consortium* in the Bay Area and Southern California is funding battery and fuel cell urban transit buses, which will better serve communities' transit needs, substantially reduce greenhouse gas emissions, eliminate criteria pollutants, and provide economic benefits.

iv.Clean Transportation Equity Investments

As mentioned earlier, Clean Mobility in Schools Projects are also encouraging and accelerating the deployment of new zero-emission heavy-duty engines and vehicles, including battery electric school buses and clean school fleet vehicles.

b) Moyer Program

In addition to funding passenger vehicle incentive programs, the Moyer Program provides monetary grants to private companies and public agencies to clean up their heavy-duty engines beyond that required by law through retrofitting, repowering or replacing their engines with newer and cleaner ones. These grants are issued locally by air districts. Projects that reduce emissions from heavy-duty on-road engines qualify, including heavy-duty trucks, drayage trucks, emergency vehicles, public agency and utility vehicles, school buses, solid waste collection vehicles, and transit fleet vehicles.

As the regulatory, technological and incentives landscape has changed significantly since the creation of the Moyer Program and to address evolving needs, the Legislature has periodically modified the program to better serve California. Most recently, Senate Bill (SB) 513 (Beall, 2015) has provided new opportunities for the Moyer Program to contribute significant emission reductions alongside implemented regulations, advance zero and near-zero technologies, and combine program funds with those of other incentive programs.

In the FY 2021-22 budget, the Legislature appropriated an additional $45 million in Moyer Program funding to support the replacement of diesel trucks with ultra-low NOx trucks certified to meet the 0.02 g/bhp-hr NOx standard or lower. Currently, only the San Joaquin Valley Air Pollution Control District and the South Coast Air Quality Management District would be eligible for these funds. In November 2021, the Board approved increases to the Moyer Program cost-effectiveness limits and funding caps for optional advanced technology and zero-emission replacement projects for on-road heavy-duty trucks. Increasing the cost-effectiveness thresholds is designed to increase funding opportunities, and ensures that the Moyer Program continues to focus on developing the most advanced zero-emission and low emission technologies, consistent with encouraging further emissions reductions. These changes included increasing the threshold for on-road zero-emission vehicles, which includes zero-emission school buses, from $100,000 to $500,000 per unit.

The Moyer Program also funds CARB's On-Road Heavy-Duty Voucher Incentive Program (VIP), which provides funding opportunities for small fleet owners with 10 or fewer vehicles to quickly replace their older heavy-duty diesel or alternative fuel vehicles. Under this program, fleet owners may be eligible for funding of up to $410,000 for replacing their existing vehicle(s) to be scrapped and replaced by new trucks (zero-emission or certified to the optional 0.02 g/bhp-hr NOx standard), or up to $50,000 for replacing their existing fleet with used vehicles with 2013 model year or later engines. Air districts have the discretion to set certain local eligibility requirements based upon local priorities.

c) Goods Movement Emission Reduction Program (Prop 1B)

The Prop 1B Program was created to reduce exposure for populations living near freight corridors and facilities that were being adversely impacted by emissions from goods movement. This program provided incentives to owners of equipment used in freight movement to upgrade to cleaner technologies sooner than required by law or regulation. Voters approved $1 billion in total funding for the air quality element of the Prop 1B Program to complement $2 billion in freight infrastructure funding under the same ballot initiative.

Beginning in 2008, the Goods Movement Emission Reduction Program funded by Prop 1B has funded cleaner trucks for the region's transportation corridors; the final increment of funds implemented projects through 2020. The $1 billion program was a partnership between CARB and local agencies, air districts, and seaports to quickly reduce air pollution emissions and health risk from freight movement along California's trade corridors. While all Prop 1B Program funds have been awarded to the local air districts for implementation, the program framework exists to serve as a mechanism to award clean truck funds through newer funding programs.

d) Volkswagen (VW) Mitigation Trust

In 2015, after a CARB-led investigation, in concert with the United States Environmental Protection Agency (U.S. EPA), VW admitted to deliberately installing emission defeat devices on nearly 600,000 VW, Audi, and Porsche diesel vehicles sold in the United States, approximately 85,000 of which were sold in California. The VW California settlement agreement includes both a Mitigation Trust to mitigate the excess NOx emissions caused by the company's use of illegal defeat devices in their vehicles, as well as a ZEV Investment Commitment to help grow the State's expanding ZEV program. The Mitigation Trust includes approximately $423 million for California to be used as specified in the settlement agreement. Per the Beneficiary Mitigation Plan approved by CARB in 2018, this funding will be used to replace older heavy-duty trucks, buses, and freight vehicles and equipment with cleaner models, with a focus on zero-emission technologies where available and cleaner combustion everywhere else, as well as to fund light-duty ZEV infrastructure. In addition, there have been mitigation funds established as the result of other settlements from which funding is used to support clean technologies.

e) Community Air Protection Incentives (AB 617 | Community Air Protection Program)

Since the 2016 State SIP Strategy elucidated the need for additional legislative assistance in funding turnover programs to accelerate the deployment and adoption of cleaner technologies, the Legislature has since 2017 established a number of new incentive programs that are implemented through CARB through various budget bills. The State Legislature has provided substantial funding to achieve early emissions reductions in the communities most impacted by air pollution. In its 2018 funding allocation, the Legislature expanded the possible uses of AB 617 funds to include Moyer and Proposition 1B eligible projects with a priority on zero-emission projects, zero-emission charging infrastructure, stationary source projects, and additional projects consistent with the CERPs.

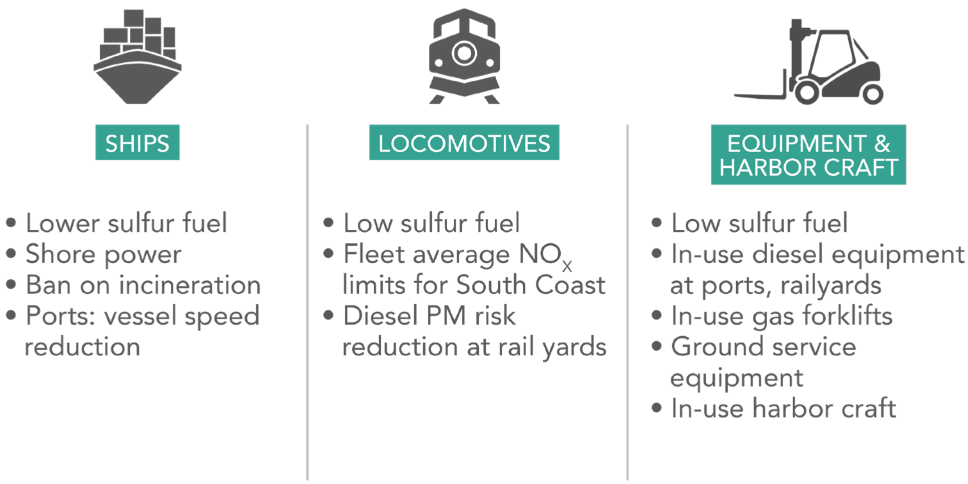
CARB and air districts partner to run the programs, with CARB developing guidelines and the districts administering funds for their regions. In most cases throughout the State, selected communities have identified mobile source emissions as a target for reductions. It is likely that a significant portion of the AB 617-allocated funding will incentivize the accelerated turnover to cleaner vehicles and equipment in and around low-income and disadvantaged communities.

C. Off-Road Sources

Off-road sources encompass equipment powered by an engine that does not operate on the road. Sources vary from ships to lawn and garden equipment and for example, include sources like locomotives, aircraft, tractors, harbor craft, off-road recreational vehicles, construction equipment, forklifts, and cargo handling equipment.

Figure F-2 illustrates the comprehensive suite of emission control measures applicable to the broad variety of engines and vehicle that fall under the Off-Road category. As a result of these emission control efforts, off-road emissions in the Western Mojave Desert have been reduced significantly since 1990 and will continue to decrease through 2032. From today, NOx emissions from off-road sources that are not primarily regulated Federally are projected to decrease by over 52 percent by 2032. Key programs in this sector include the Off-Road Engine Standards, Locomotive Engine Standards, Clean Diesel Fuel, Cleaner In-Use Off-Road Regulation and In-Use Large Spark Ignition (LSI) Fleet Regulation.

Figure F-2: Off-Road Vehicle and Equipment Control Programs



1. Off-Road Engine Standards

The Clean Air Act preempts states, including California, from adopting requirements for new off-road engines less than 175 HP used in farm or construction equipment. California may adopt emission standards for in-use off-road engines pursuant to Section 209(e)(2), but must receive authorization from U.S. EPA before it may enforce the adopted standards.

CARB first approved regulations to control exhaust emissions from small off-road engines (SORE) such as lawn and garden equipment in December 1990 with amendments in 1998, 2003, 2010, 2011, 2016, and 2021. The 1990 - 2016 regulations were implemented through three tiers of progressively more stringent exhaust emission standards that were phased in between 1995 and 2008. The most recent suite of amendments (December 2021) requires most newly manufactured SORE engines be zero emission starting in 2024.

Manufacturers of forklift engines are subject to new engine standards for both diesel and Large Spark Ignition (LSI) engines. Off-road diesel engines were first subject to engine standards and durability requirements in 1996 while the most recent Tier 4 Final emission standards were phased in starting in 2013. Tier 4 emission standards are based on the use of advanced after-treatment technologies such as diesel particulate filters and selective catalytic reduction. LSI engines have been subject to new engine standards that include both criteria pollutant and durability requirements since 2001 with the cleanest requirements phased-in starting in 2010.

To control emissions from Transport Refrigeration Units (TRUs), CARB adopted in 2004 the Airborne Toxic Control Measure (ATCM) for In-Use Diesel-Fueled TRUs, TRU Generator Sets, and Facilities where TRUs Operate, which set increasingly stringent engine standards to reduce diesel particulate matter emissions from TRUs and TRU generator sets. The ATCM for TRUs was subsequently amended in 2010 and 2011, and most recently in February 2022, as the first phase of CARB's current push to develop new requirements to transition diesel-powered TRUs to zero-emission technology in two phases. The February 2022 adoption, Part 1 amendments to the existing TRU Airborne Toxic Control Measure (ATCM), requires the transition of diesel-powered truck TRUs to zero-emission. CARB plans to develop a subsequent Part 2 regulation to require zero-emission trailer TRUs, domestic shipping container TRUs, railcar TRUs, and TRU generator sets, for future Board consideration.

2. Cleaner In-Use Off-Road Equipment (Off-Road Regulation)

The Off-Road Regulation was first approved in 2007 and subsequently amended in 2010 in light of the impacts of the economic recession. Equipment affected by this regulation are used in construction, manufacturing, the rental industry, road maintenance, airport ground support and landscaping. In December 2011, the Off-Road Regulation was modified to include on-road trucks with two diesel engines.

The Off-Road Regulation will significantly reduce emissions of diesel PM and NOx from the over 150,000 in-use off-road diesel vehicles that operate in California. The Regulation affects dozens of vehicle types used in thousands of fleets by requiring owners to modernize their fleets by replacing older engines or vehicles with newer, cleaner models, retiring older vehicles or using them less often, or by applying retrofit exhaust controls.

The Off-Road Regulation imposes idling limits on off-road diesel vehicles, requires a written idling policy, and requires a disclosure when selling vehicles. The Regulation also requires that all vehicles be reported to CARB and labeled, restricts the addition of older vehicles into fleets, and requires fleets to reduce their emissions by retiring, replacing, or repowering older engines, or installing verified exhaust retrofits. The requirements and compliance dates of the Off-Road Regulation vary by fleet size.

Fleets are subject to increasingly stringent restrictions on adding older vehicles. The regulation also sets performance requirements. While the regulation has many specific provisions, in general by each compliance deadline, a fleet must demonstrate that it has either met the fleet average target for that year, or has completed the Best Available Control Technology requirements. The performance requirements of the Off-Road Regulation were phased in from January 1, 2014 through January 1, 2019.

Compliance assistance and outreach activities in support of the Off-Road Regulation include:

- The Diesel Off-road On-line Reporting System, an online reporting tool developed and maintained by CARB staff;
- The Diesel Hotline (866-6DIESEL), which provides the regulated public with questions about the regulations and access to CARB staff. Staff is able to respond to questions in English, Spanish and Punjabi; and
- The Off-road Listserv, providing equipment owners and dealerships with timely announcement of regulatory changes, regulatory assistance documents, and reminders for deadlines.

3. Clean Diesel Fuel

Since 1993, CARB has required that diesel fuel have a limit on the aromatic hydrocarbon content and sulfur content of the fuel. Diesel powered vehicles account for a disproportionate amount of the diesel particulate matter which is considered a toxic air contaminant by the State of California. In 2006, CARB required a low-sulfur diesel fuel to be used not only by on-road diesel vehicles but also for off-road engines. The diesel fuel regulation allows alternative diesel formulations as long as emission reductions are equivalent to the CARB formulation.

4. Locomotive Engine Standards

The Clean Air Act and the U.S. EPA national locomotive regulations expressly preempt states and local governments from adopting or enforcing “any standard or other requirement relating to the control of emissions from new locomotives and new engines used in locomotives” (U.S. EPA interpreted new engines in locomotives to mean remanufactured engines, as well). U.S. EPA has approved two sets of national locomotive emission regulations (1998 and 2008). In 1998, U.S. EPA approved the initial set of national locomotive emission regulations. These regulations primarily emphasized NOx reductions through Tier 0, 1, and 2 emission standards. Tier 2 NOx emission standards reduced older uncontrolled locomotive NOx emissions by up to 60 percent, from 13.2 to 5.5 g/bhphr.

In 2008, U.S. EPA approved a second set of national locomotive regulations. Older locomotives upon remanufacture are required to meet more stringent particulate matter (PM) emission standards which are about 50 percent cleaner than Tier 0-2 PM emission standards. U.S. EPA refers to the PM locomotive remanufacture emission standards as Tier 0+, Tier 1+, and Tier 2+. The new Tier 3 PM emission standard (0.1 g/bhphr), for model years 2012-2014, is the same as the Tier 2+ remanufacture PM emission standard. The 2008 regulations also included new Tier 4 (2015 and later model years) locomotive NOx and PM emission standards. The U.S. EPA Tier 4 NOx and PM emission standards further reduced emissions by approximately 95 percent from uncontrolled levels.

In April 2017, CARB petitioned U.S. EPA for rulemaking, seeking the amendment of emission standards for newly built locomotives and locomotive engines and lower emission standards for remanufactured locomotives and locomotive engines. The petition asks U.S. EPA to update its standards to take effect for remanufactured locomotives in 2023 and for newly built locomotives in 2025. The new emission standards would provide critical criteria pollutant reductions, particularly in the disadvantaged communities that surround railyards. U.S. EPA has not yet responded to this petition.

5. Large Spark-Ignition (LSI) Engines and Forklifts

Forklift fleets are subject to in-use fleet requirements either under the LSI fleet regulation, if fueled by gasoline or propane, or under the off-road diesel fleet regulation, if fueled by diesel. Both regulations require fleets to retire, repower, or replace higher-emitting equipment in order to maintain fleet average standards.

Large spark-ignition engines, which are defined as spark-ignition (i.e., Otto-cycle) engines greater than 25 horsepower, are used in a variety of equipment, including, but not limited to, forklifts, airport ground support equipment (GSE), sweeper/scrubbers, industrial tow tractors, generator sets, and irrigation pumps. LSI equipment is found in approximately 2,000 fleets throughout the state operating at warehouses and distribution centers, seaports, airports, railyards, manufacturing plants, and many other commercial and industrial facilities.

CARB first adopted emission standards for off-road LSI engines in 1998. The original LSI regulation required engine manufacturers to certify new LSI engines to a 3.0 gram per brake horsepower-hour (g/bhp-hr) standard that, by 2004, represented a 75 percent reduction in emissions compared with uncontrolled LSI. Building on this success, in 2002, U.S. EPA subsequently harmonized the national standard with California's standard, starting with the 2004 model year and adopted a more stringent 2.0 g/bhp-hr standard for 2007 and subsequent model year engines. The federal program demonstrated that additional reductions from new engines were technically feasible and cost-effective. In the 2003 State Implementation Plan for Ozone (2003 SIP), California committed to two additional LSI measures—one for the development of more stringent new engine standards and another for the development of in-use fleet requirements.

CARB adopted these two LSI measures in a 2006 rulemaking, which harmonized California's standard with U.S. EPA's 2.0 g/bhp-hr standard starting with the 2007 model year, set forth a more stringent 0.6 g/bhp-hr California standard starting with the 2010 model year, and established in-use LSI fleet requirements. The 0.6 g/bhp-hr standard represents a 95 percent emission reduction versus uncontrolled LSI engines and is still in effect today.

The in-use element of the 2006 rulemaking, adopted as the Large Spark-Ignition Engine Fleet Requirements Regulation (LSI Fleet Regulation), which was eventually amended in 2010 and 2016, requires fleet operators with four or more LSI forklifts to meet fleet average emission standards. The 2006 LSI rulemaking and 2010 amendments required specific hydrocarbon + NOx fleet average emission level standards that became increasingly more stringent over time. The focus of the 2016 amendments was to collect data from fleet operators in order to inform the development of requirements that would support the broad-scale deployment of Zero-

Emission equipment in LSI applications. The 2016 amendments also required fleet operators to report key compliance information to CARB, and extended to 2023 requirements from the prior LSI Fleet Regulations that were otherwise due to sunset in 2016.

6. Cargo Handling Equipment (CHE)

Cargo handling equipment (CHE) include yard trucks (hostlers), rubber-tired gantry cranes, container handlers, forklifts, dozers, and other types. The Cargo Handling Equipment (CHE) Regulation established requirements for in-use and newly purchased diesel-powered equipment at ports and intermodal rail yards. CARB adopted the CHE in 2005, which established best available control technology (BACT) for new and in-use mobile CHE that operate at California's ports and intermodal rail yards through accelerated turnover of older equipment through retrofits and/or replacement to cleaner on- or off-road engines. Since 2006, the CHE Regulation has resulted in reductions of diesel PM and NOx at ports and intermodal rail yards throughout California.

7. Incentive Programs

There are many different incentive programs focusing on off-road mobile sources that increase the penetration of cleaner technologies into the market. The incentive programs encourage the purchase of cleaner off-road combustion engines and equipment, and zero-emission technologies. CARB is expanding incentives for zero-emission off-road equipment through targeted demonstration and pilot project categories in the off-road sector, and increased funding.

a) Low Carbon Transportation Investments and Air Quality Improvement Program (Clean Transportation Incentives)

As mentioned earlier, $873 million was allocated in the FY 2020-2021 budget for off-road equipment and on-road heavy-duty trucks under the Clean Transportation Incentives programs. In the off-road sector, major programs include the Clean Off-Road Equipment Voucher Incentive Project (CORE), and Demonstration and Pilot Programs. Off-road equipment categories that are prioritized for funding include agricultural and construction equipment, small off-road engines (SORE) such as lawn and garden equipment, heavier cargo handling equipment (CHE), and ZE applications at railyards, marine ports, freight facilities, and along freight corridors.

i.Clean Off-Road Equipment Voucher Incentive Project

The Clean Off-Road Equipment Voucher Incentive Project (CORE) is a voucher project similar to HVIP, but for advanced technology off-road equipment. CORE is intended to accelerate deployment of advanced technology in the off-road sector by providing a streamlined way for fleets to access funding that helps offset the incremental cost of such technology. CORE targets commercial-ready products that have not yet achieved a significant market foothold. By promoting the purchase of clean technology over internal combustion options, the project is expected to reduce emissions, particularly in areas that are most impacted, help build confidence in zero-emission technology in support of CARB strategies and subsequent regulatory efforts where possible, and provide other sector-wide benefits, such as technology transferability, reductions in advanced-technology component costs, and larger infrastructure investments. CORE provides vouchers to California purchasers and lessees of zero-emission off-road equipment on a first-come, first-served basis, with increased incentives for equipment located in disadvantaged communities.

CARB launched CORE at the end of 2019 through a one-time $40 million allocation in the fiscal year 2017-18 Funding Plan to support zero-emission freight equipment through CORE. Since that time, CORE has been allocated significant additional funds, including $194.95 million from the FY 2021-22 budget. This allocation includes $30 million of dedicated funds appropriated by the Legislature in SB 170 to provide incentives for professional landscaping services in California operated by small businesses or sole proprietors to purchase zero-emission small off-road equipment.

ii.Demonstration and Pilot Projects

As mentioned earlier, in FY 2021-22, $80 million was allocated for off-road and on-road heavy-duty advanced technology demonstration and pilot projects. CARB is focusing funding on off-road demonstration and pilot projects that include heavier cargo handling equipment (CHE), clean equipment in rail, marine, and ports applications, and zero-emission equipment along freight facilities/corridors.

For the *Port of LA Multi-Source Facility Demonstration Project*, the Los Angeles Harbor Department (Port of LA) was awarded $14.5 million to operate multiple near zero- or zero-emission technologies to move goods from ships through the Green Omni Terminal. This project is demonstrating the viability of electrified CHE, forklifts, and a ships at-berth vessel emissions control system. The *Zero-Emission Freight "Shore to Store"* Project will use $41.1 million to fund electric yard tractors, hydrogen fuel cell Class 8 on-road trucks, and a large capacity hydrogen fueling station in Ontario, CA. Additional zero- and near zero-emission freight facility projects include a $5.8 million *Zero-Emission for California Ports* project at the Port of LA, which will fund hybrid fuel cell and electric yard trucks, as well as hydrogen fueling stations. Further, the San Joaquin Valley's *Net-Zero Farming and Freight Facility Demonstration Project* is funding battery electric trucks equipped with all-electric transport refrigeration units (eTRUs) to facilitate clean freight transport, and transportation of agricultural produce between packing and warehouse facilities.

b) Funding Agricultural Replacement Measures for Emission Reductions (FARMER)

California's agricultural industry consists of approximately 77,500 farms and ranches, providing over 400 different commodities, making agriculture one of the State's most diverse industries. In recognition of the strong need and this industry's dedication to reducing their emissions, the Legislature has allocated over $323 million towards the Funding Agricultural Replacement Measures for Emission Reductions (FARMER) Program since 2017. The program provides funding through local air districts for incentivizing the introduction of lower-emissions agricultural harvesting equipment, heavy-duty trucks, agricultural pump engines, tractors, and other equipment used in agricultural operations. Since October 2019, the FARMER Program also includes a project category for demonstration projects and modifications to the zero-emission agricultural utility terrain vehicle (UTV), heavy-duty agricultural truck, and off-road mobile agricultural equipment trade-up pilot project categories. As of September 30, 2021, the FARMER Program has spent $289.7 million on over 6,600 pieces of agricultural equipment and will reduce 1,120 tons of PM2.5 and 18,700 tons of NOx over the lifetime of the projects, Statewide.

c) Moyer Program

In addition to funding on-road incentives, the Moyer Program provides monetary grants to reduce emissions from off-road equipment such as construction and agricultural equipment, marine vessels and locomotives, forklifts, TRUs, and airport ground support equipment.

d) Goods Movement Emission Reduction Program (Prop 1B)

As discussed earlier, Proposition 1B was a $1 billion partnership between CARB and local agencies, air districts, and seaports to quickly reduce air pollution emissions and health risk from freight movement along California's trade corridors. Over the course of six years, the program has upgraded ships at-berth, cargo handling equipment, locomotives, TRUs, and harbor craft.

II. Conclusion

In conclusion, CARB has implemented the most comprehensive mobile source emissions control program in the nation. CARB's mobile source control program is robust and targets all sources of emissions through a four-pronged approach. First, increasingly stringent emissions standards drive the use of the cleanest available engines and equipment, and minimize emissions from new vehicles and equipment. Second, to speed the turnover of older, dirtier engines and equipment to cleaner new equipment, in-use programs target emissions from the existing fleet by requiring vehicle and fleet owners to transition legacy fleets and vehicles to the cleanest vehicles and emissions control technologies. Third, incentive programs help fleet owners to replace older, dirtier vehicles and equipment with the cleanest technologies, while also facilitating the development of the next generation of clean technologies that are needed to meet future air quality targets. Finally, cleaner fuels minimize emissions from all combustion engines being used across the State. This multi-faceted approach has not only spurred the development and use of increasingly cleaner technologies and fuels, it has also provided significant emission reductions across all mobile source sectors that go far beyond national programs or programs in other states.