

San Joaquin Valley
AIR POLLUTION CONTROL DISTRICT



2016 Ozone Plan
for 2008 8-Hour Ozone Standard

Adopted - June 16, 2016







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Executive Summary

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Executive Summary

This *2016 Ozone Plan* addresses the federal mandates related to the 2008 8-hour ozone National Ambient Air Quality Standards (NAAQS). Building on decades of developing and implementing effective air pollution control strategies, this plan demonstrates that District regulatory measures meet and exceed federal Clean Air Act (CAA) requirements, includes additional commitments for potential further reductions in emissions, and ensures expeditious attainment.

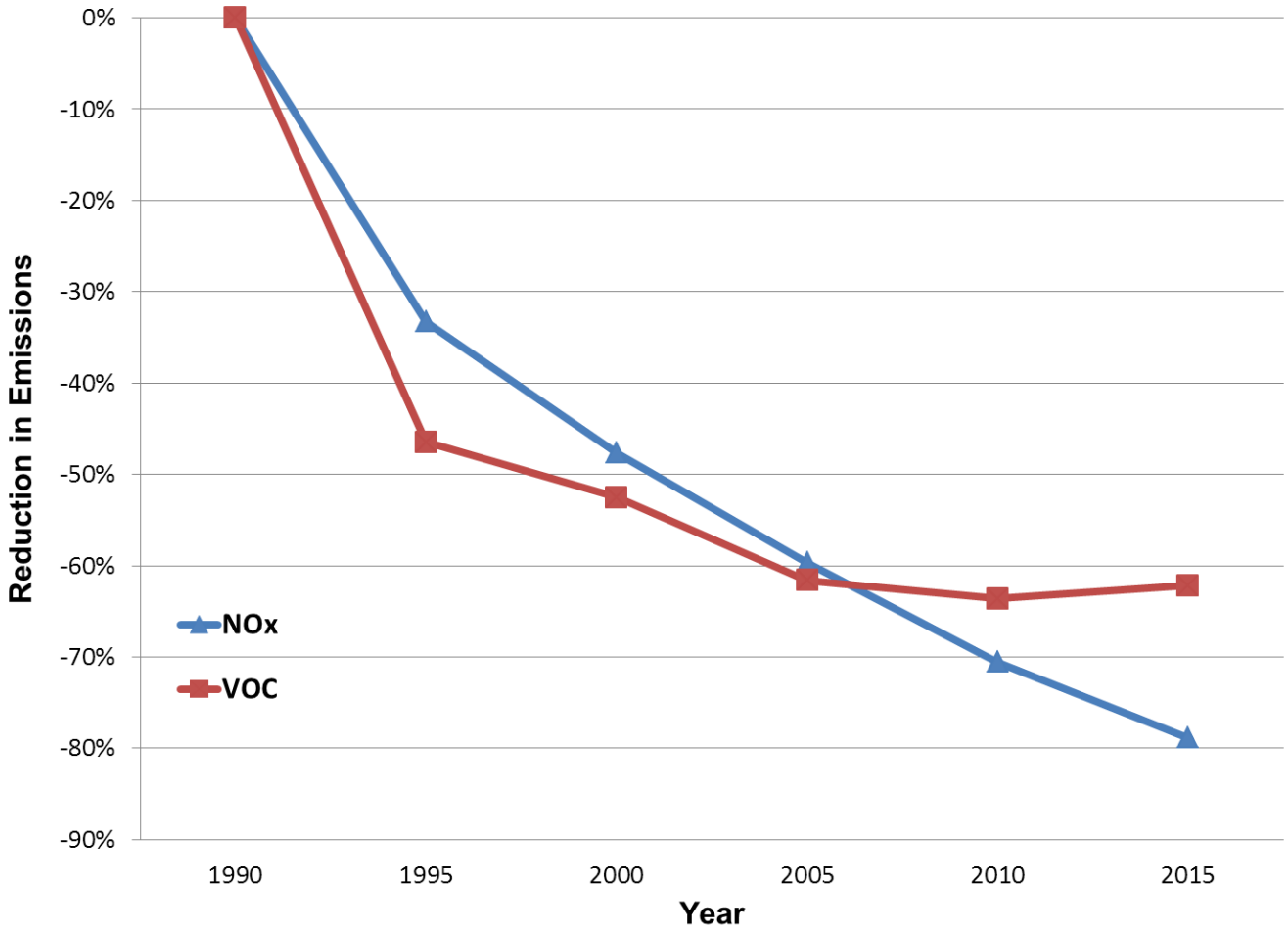
The deadline for the San Joaquin Valley (Valley) to attain the 2008 8-hour ozone standard is December 31, 2031. This requires another 207.7 tons per day in NOx reductions from stationary and mobile sources throughout the Valley. The measures identified in this plan do achieve the necessary reductions. The District could show expeditious attainment without the need to rely on "Black Box" provisions afforded under CAA §182(e)(5). Unfortunately, compliance with the contingency requirements under the federal Clean Air Act requires that the District hold back on 1.6 tons per day of NOx reductions. To ensure that the plan is approvable with the necessary contingencies, the plan needs to include a "Black Box". The District however hopes that the state Air Resources Board (ARB) or the federal Environmental Protection Agency (EPA) can adopt and implement necessary strategies relating to mobile sources resulting in further reductions in emissions that could satisfy contingency requirements and avoid delays in attaining the standard expeditiously.

The District is pursuing legislative efforts to modernize the Clean Air Act with common sense provisions that help prevent similar circumstances as described above for this plan or for future plans where the contingency requirements can actually lead to delayed attainment or reliance on undefined strategies under "Black Box" provisions.

Since 1992, the District has adopted numerous attainment plans to reduce ozone and particulate precursor emissions. Leaving no stone unturned, the District has implemented these plans and adopted over 600 rules and rule amendments that have resulted in significant emissions reductions. Many of the District's innovative rules and strategies, such as Indirect Source Review, Glass Melting Furnaces, and Conservation Management Practices, now serve as models for the rest of the nation. In addition to having the toughest air regulations in the nation, the District also has the most effective and efficient incentive grants program. Through implementation of District regulations and incentives, Valley businesses and residents have invested billions of dollars to reduce emissions. To date, the District's incentive programs have invested a total of $1.4 billion in public/private funding towards clean air projects, resulting in over 120,000 tons of emissions reduced.

Through these combined efforts, the Valley's air quality is better than it has been at any other time on record. The ozone precursor emissions in the Valley are at historically low levels with approximately 80% reduction in NOx stationary source emissions since 1990 (see Figure ES-1).

Figure ES-1 Decrease in NOx/VOC Emissions from Stationary Sources



Despite strings of triple digit temperature and multiple wildfires, in 2015, the Valley experienced a record setting clean ozone season, achieving:

- Lowest 8-hour ozone design value on record for the Valley, the official metric used to measure progress towards meeting federal ozone standards (Figure ES-2)
- Lowest number of days exceeding the federal 75 ppb 8-hour ozone standard (Figure ES-3)
- Zero unhealthy days in the month of July
- Third consecutive year without violating the federal 1-hour ozone standard
- 91% reduction in Valley residents exposure to high ozone concentrations above the 84 ppb standard since 2002 (73% reduction in population exposure for the 75 ppb standard)

As a part of the positive trend in ozone air quality, the Valley is also on track to meet the federal 8-hour ozone standard of 84 ppb ahead of the projected 2023 attainment date included in the *2007 Ozone Plan*. With the ongoing improving trend in ozone air quality,

EPA also recently approved the District's request for the 1-hour ozone clean data finding and has officially proposed to grant the San Joaquin Valley as attainment for the 1-hour ozone standard.

Figure ES-2 Decrease in Valley's 8-hr Ozone Design Value

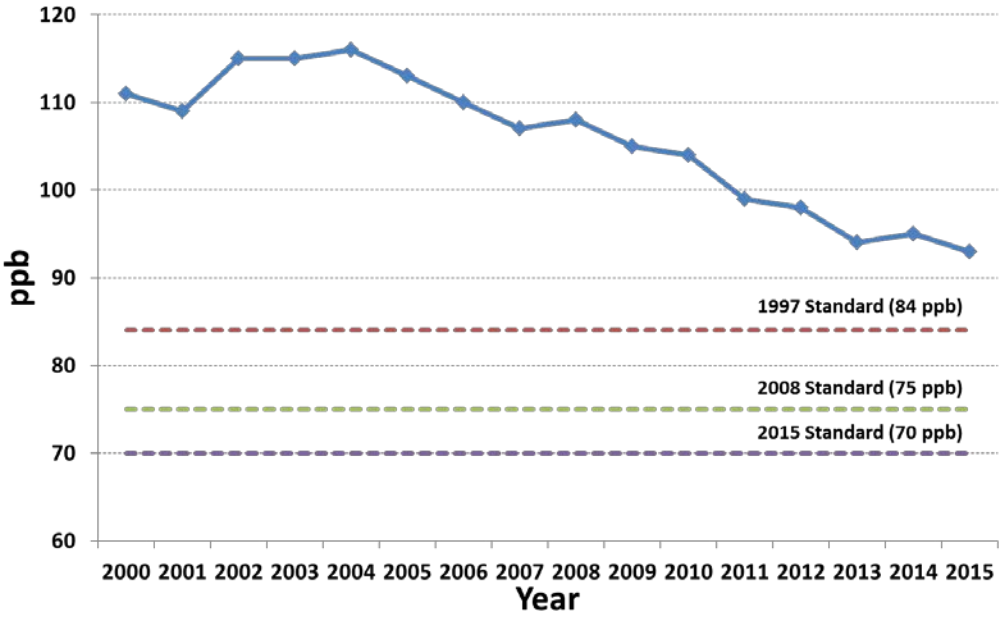
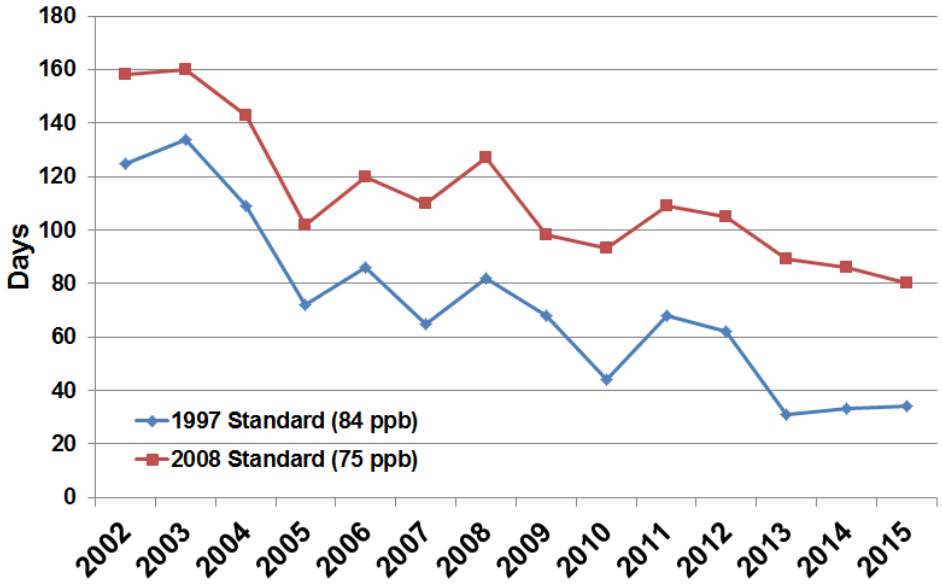


Figure ES-3 Decrease in Days Exceeding Federal Ozone Standards



Through the comprehensive stationary and mobile source control strategy that has been adopted from prior regulatory actions and that is now included in this plan, the San Joaquin Valley will reduce NOx emissions by over 60% between 2012 and 2031. The

ambient ozone concentrations will decrease dramatically in all areas of the Valley with Valley residents experiencing cleaner air over time. ARB used a modeled attainment test consistent with EPA's guidelines to predict future 8-hour ozone concentrations at each monitoring site in the Valley to demonstrate attainment. Modeling shows that the Valley will attain the 8-hour ozone standard by 2031 based on implementation of these ongoing control measures.

Extensive Public Process

This *2016 Ozone Plan* was prepared through an involved public process that provided multiple opportunities for the public and interested stakeholders to offer suggestions and comments for improving and strengthening the plan. The District initiated the public process for the *2016 Ozone Plan* in mid-2014. This public process included providing monthly updates at District Governing Board meetings, CAC meetings, and EJAG meetings. Each of these updates was accompanied by an opportunity for the public to provide comment, ask questions, or request additional information. Additionally, under the guidance of the District Governing Board, the Executive Director/Air Pollution Control Officer (APCO) formed the Public Advisory Workgroup (PAW) ad hoc committee. The PAW committee members consisted of representatives from regulated entities (industry, farms, dairy families and municipalities), community advocates, and advisors from EPA and ARB. The PAW committee held numerous meetings which were also open to the public. As part of the public process for developing this plan, the District also hosted a public workshop in May 2014 and two additional workshops in March 2016. These meetings provided opportunities for the public to provide verbal comments, and written comments have also been encouraged throughout development of this plan. These comments have been integral to the development of this plan, and have been incorporated as appropriate. A summary of significant comments and responses are summarized and posted as a part of this *2016 Ozone Plan.*

Leaving No Stone Unturned to Achieve Expeditious Attainment

As with all air quality attainment plans for the Valley, the District left no stone unturned in evaluating and identifying further opportunities to advance attainment of the ever-tightening ambient air quality standards for the development of this *2016 Ozone Plan*. This plan demonstrates that regulatory efforts of all sources of VOC and NOx emissions satisfy and even go beyond federal (Reasonably Available Control Technology) RACT standards. As part of our ongoing effort to identify additional emission reduction opportunities, the District is proposing in this plan to include regulatory commitments for evaluating the potential of including additional emission control requirements in District Rules 4311 (Flares) and 4694 (Wine Fermentation and Storage Tanks). Working closely with affected sources and through public development processes, the rule(s) will be amended to incorporate more stringent requirements as appropriate.

Upcoming Attainment Plans to Address Latest Federal Air Quality Standards

In addition to the multiple attainment plans that the District has already developed and implemented, the District is mandated under the Clean Air Act to develop and adopt a number of new ozone and particulate matter plans in the coming years. The degree of difficulty in meeting the new federal ambient air quality standards are unmatched by any other region in the nation.

Attainment of the latest standards will require transformative changes and development of innovative control strategies to significantly reduce emissions from mobile sources, which now make up over 85% of the Valley's NOx emissions (see Figure ES-4). In crafting attainment plans, the District explores all feasible opportunities to reduce stationary source emissions. However the magnitude of potential reductions from stationary sources is miniscule compared to reductions needed to attain the PM2.5 and ozone standards. The District, ARB, and EPA agree that the bulk of these emissions reductions will have to come from mobile sources, primarily through the deployment of incentive based measures.

Despite achieving significant emissions reductions through decades of implementing the most stringent stationary and mobile regulatory control program in the nation, NOx emissions reductions in the Valley must be reduced by an additional 90% in order to attain the latest federal ozone and PM2.5 standards that now encroach on natural background levels. This air quality challenge is unmatched by any other region in the nation.

With over 85% of the Valley's remaining ozone and PM2.5 precursor emissions now coming from mobile sources under state and federal jurisdiction, the Valley cannot reach attainment even if all stationary sources were to be shut down. While the District continues to leave no stone unturned in reviewing all existing stationary source categories and regulations for additional emissions reductions opportunities, attaining the federal standards is not possible without significant reductions in emissions from mobile source categories (see Figures ES-4 and ES-5).

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

Figure ES-4 San Joaquin Valley NOx Emissions and Federal Air Quality Standards

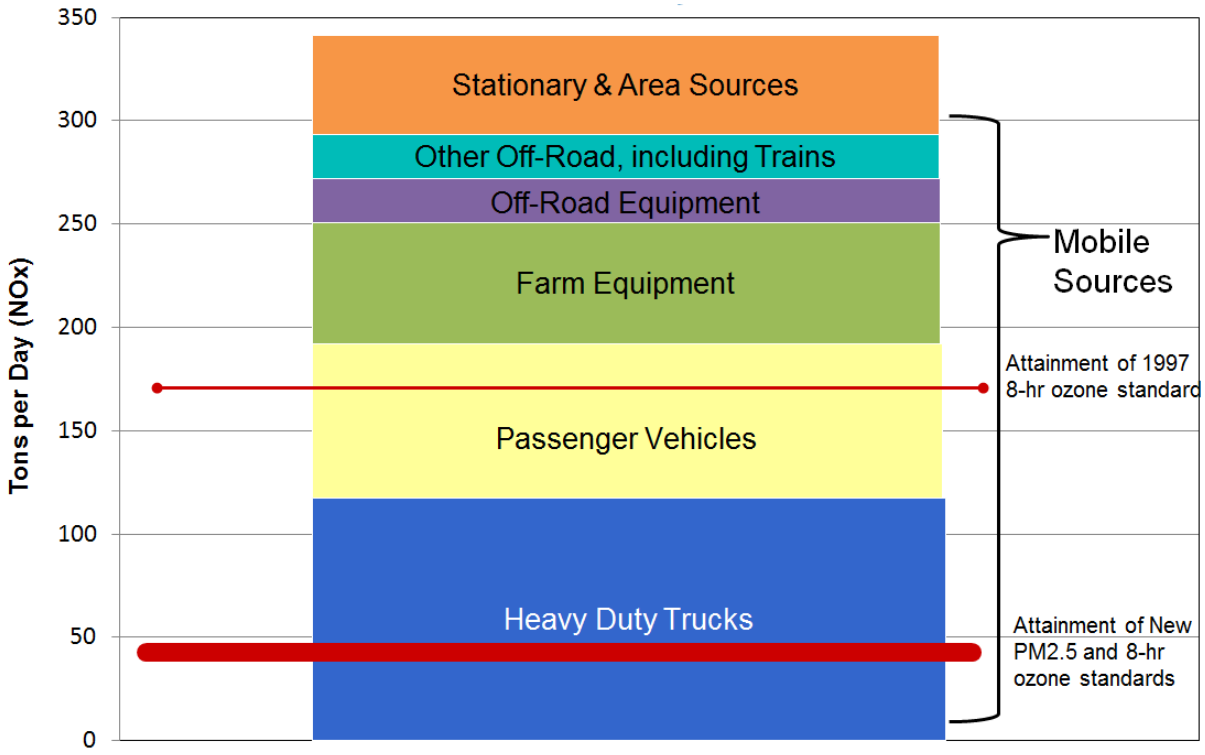


Figure ES-5 San Joaquin NOx Emission Inventory and Targets for Attainment of Federal Air Quality Standards

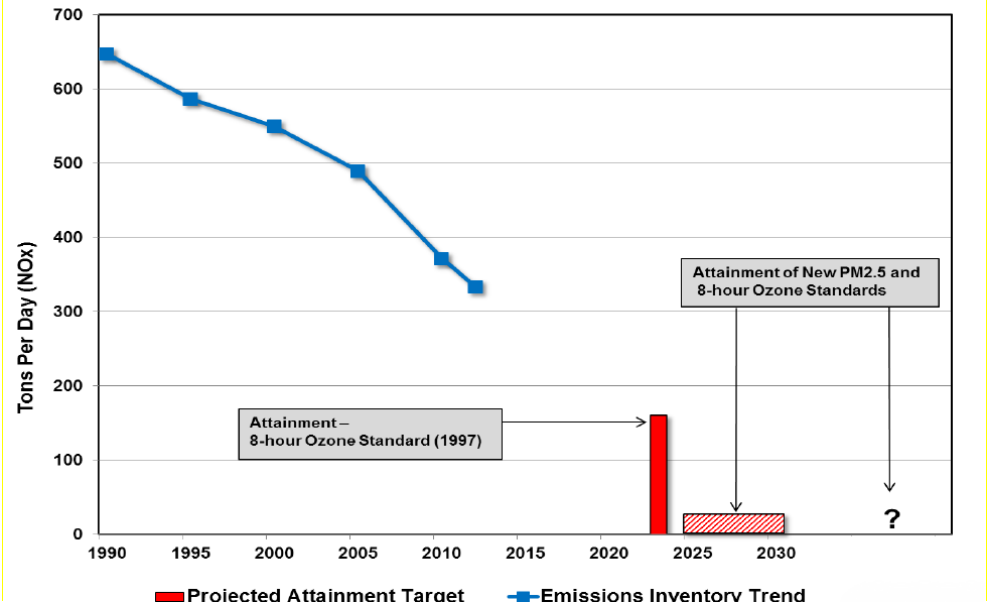


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Acronyms

ACRONYMS, ABBREVIATIONS, AND INITIALISMS

AADT: Annual Average Daily Trips
AB: Assembly Bill
ACC: Advanced Clean Cars
ACT: Alternative Control Techniques
AEO: Annual Energy Outlook
AERO: Advanced Emission Reduction Options
AERR: Air Emissions Reporting Requirements
AFO: Animal Feeding Operation
AIP: Achieved in Practice
AIRS: Atmospheric Infrared Sounder
AMI: Acute Myocardial Infarction
AMP: Air Monitoring Program
AMR: Annual Monitoring Report
AO: Agricultural Operations
APCD: Air Pollution Control District
APCO: Air Pollution Control Officer
AQ: Air Quality
AQAST: Air Quality Applied Science Team
AQI: Air Quality Index
AQIP: Air Quality Improvement Program
AQMD: Air Quality Management District
AQMP: Air Quality Management Plan
AQS: Air Quality System
ARB: California Air Resources Board
ARRA: American Reinvestment and Recovery Act
ATC: Authority to Construct
ATCM: Airborne Toxic Control Measure
BACM: Best Available Control Measure
BACT: Best Available Control Technology
BCs: Boundary Conditions
BEARPEX: Biosphere Effects on Aerosols and Photochemistry Experiment in 2007 and 2009
BEIGIS: Biogenic Emission Inventory GIS
BHP: Brake Horsepower
BMP: Best Management Practice
BTU: British Thermal Units
BVOC: Biogenic Volatile Organic Compounds
CAA: Clean Air Act
CABERNET: California Airborne BVOC Emission Research in Natural Ecosystem Transects in 2011
CAC: Citizens Advisory Committee

CAF: Confined Animal Facilities
CALFIRE: California Department of Forestry and Fire Protection
CalNex: Research at the Nexus of Air Quality and Climate Change conducted in 2010
CalTrans: California Department of Transportation
CalVAD: California Vehicle Activity Database
CARES: Carbonaceous Aerosols and Radiative Effects Study in 2010
CCAQS: Central California Air Quality Studies
CCDAQ: Clark County Department of Air Quality
CCOS: Central California Ozone Study
CDFA: California Department of Food and Agriculture
CE: Cost Effectiveness
CEC: California Energy Commission
CE-CERT: University of California, Riverside College of Engineering - Center for Environmental Research and Technology
CEIDARS: California Emission Inventory Development and Reporting System
CEMS: Continuous Emissions Monitoring System
CEPAM: California Emissions Projection Analysis Model
CEQA: California Environmental Quality Assessment
CFR: Code of Federal Regulations
CGYM: Clean Green Yard Machine
CH&SC: California Health and Safety Code
CIT: California Institute of Technology
CIMIS: California Irrigation Management Information
CM: Control Measures
CMAQ: Community Multi-Scale Air Quality
CMAQ: Congestion Mitigation and Air Quality
CMP: Conservation Management Practice
CNG: Compressed Natural Gas
CO: Carbon Monoxide
CO2: Carbon Dioxide
CPRC: California Public Resources Code
CRF: Capital Recovery Factor
CRPAQS: California Regional Particulate Air Quality Study
CSUF: California State University, Fresno
CTG: Control Techniques Guidelines
CVP: Central Valley Project
CVRP: Clean Vehicle Rebate Project
DAC: Direct Annual costs
DC: Direct Capital (costs)
DERA: Diesel Emission Reductions Act
DF: Deposition Fraction
DI: Direct Installation (cost)
Disover – AQ: Deriving Information on Surface Conditions from Column and Vertically Resolved Observations Relevant to Air Quality

District: San Joaquin Valley Air Pollution Control District
DMV: Department of Motor Vehicles
DOF: Department of Finance
DOGGR: California Department of Conservation's Division of Oil, Gas, and Geothermal Resources
DOT: Department of Transportation
DOW: Day of Week
DPR: Department of Pesticide Regulation
DPWK: Days per Week code
DTIM4: Direct Travel Impact Model
DV: Design Value
e-AIM: Extended Aerosol Inorganics Model
EC: Elemental Carbon
ECF: Efficiency Correction Factor
EF: Emission Factor
EF & EE: Engine, Fuel and Emission Engineering
EFMP: Enhanced Fleet Modernization Program
EIC: Emission Inventory Code
EJAG: Environmental Justice Advisory Group
EMFAC: Emission Factors Model
EPA: U.S. Environmental Protection Agency
ER: Emergency Room
ERC: Emission Reduction Credits
eTrip: Employer-Based Trip Reduction
ESP: Electrostatic Precipitator
FAF: Freight Analysis Framework
FDDA: Four- Dimensional Data Assimilation
FDEP: Florida Department of Environmental Protection
FDOC: Final Determination of Compliance
FEM: Federal Equivalent Method
FG: Flare Gas
FHWA: Federal Highway Administration
FMMP: Farmland Mapping and Monitoring Program
FMP: Flare Minimization Plan
FOFEM: First Order Fire Effects
FR: Federal Register
FRAP: Fire and Resource Assessment Program
FRIS: Farm and Ranch Irrigation Survey
FRM: Federal Reference Method
FY: Fiscal Year
GDFs: Gasoline Dispensing Facilities
GEOS-5: Goddard Earth Observing System Model, Version 5
GHG: Greenhouse Gas
GIS: Geographic Information System
GMAO: Global Modeling and Assimilation Office

GVWR: Gross Vehicle Weight Rating
HAL: Healthy Air Living
HC: Hydrocarbon
HD: Heavy Duty
HEPA: High-Efficiency Particulate Arresting (filtration systems)
HHDV: Heavy Heavy-Duty Vehicles
HMA: Hot-Mix Asphalt
HO: Hydroxyl Radical
HOTS: Heavy Oil Test Stations
HPDY: Hours per Day code
HRRS: Heath Risk Reduction Strategy
HVIP: Hybrid Truck and Bus Voucher Incentive Program
IAC: Indirect Annual Costs
IC: Internal Combustion
ICs: Initial Conditions
IEPR: Integrated Energy Policy Report
IOUs: Investor Owned Utilities
IMPROVE: Interagency Monitoring of Protected Visual Environments
IRP: International Registration Plan
ISD: In-station Diagnostic
ISR: Indirect Source Review
kW: Kilowatt
kWH: Kilowatt-hour
LAER: Lowest Achievable Emission Rate
lb/MMBtu: Pounds per Million British thermal units of heat output
LAI: Leaf Area Index
LDT: Light-Duty Trucks
LHDV: Light Heavy-Duty Vehicles
LMA: Land Management Agency
LPG: Liquefied Petroleum Gas
LTO: Low Temperature Oxidation
LSI: Large Spark Ignited
MACT: Maximum Achievable Control Technology
MCF: Thousand Cubic Feet
MCSF: Thousand Cubic Standard Feet
MCY: Motorcycles
MDA8: Maximum Daily Average 8-Hr. Ozone
MEGAN: Model of Emission of Gases and Aerosols from Nature
MH: Motor Homes
MHDV: Medium Heavy-Duty Vehicles
MMBtu/hr: Million British Thermal units per hour
MOU: Statement of Principles
MOZART: Model for Ozone and Related Chemical Tracers
MPO: Metropolitan Planning Organization
MSA: Metropolitan statistical area

MSM: Most Stringent Measure
MSW: Municipal Solid Waste
MW: Megawatt
NAAQS: National Ambient Air Quality Standards
NARR: North American Regional Reanalysis
NASA: National Aeronautics and Space Administration
NASS: National Agriculture Statistics Service
NCAR: National Center for Atmospheric Research
NESHAP: National Emission Standards for Hazardous Air Pollutants
NG: Natural Gas
ng/J: Nanograms per Joule of heat output
NO: Nitrogen Oxide
NOAA: National Oceanic and Atmospheric Administration
NOx: Oxides of Nitrogen
NPS: Nation Park Service
NRCS: Natural Resources Conservation Service
NSCR: Non-Selective Catalytic Reduction
NSPS: New Source Performance Standard
NSR: New Source Review
NTE: Not-to-Exceed
OAQPS: Office of Air Quality Planning and Standards (EPA)
OB: Other Buses
OBD: On-Board Diagnostics
OC: Organic Carbon
OFP: Ozone Forming Potential
OGV: Ocean-Going Vessels
OH: Hydroxyl Radicals
O & M: Operating and Maintenance
OMB: Office of Management and Budget
OMP: Operator Management Plan
ORVR: Onboard Refueling Vapor Recovery
PAH: Polycyclic Aromatic Hydrocarbons
PAN: Peroxy Acetyl Nitrate
PASS: Polluting Automobile Scrap and Salvage
PAW: Public Advisory Workgroup
PBW: Particle Bound Water
PCAPCD: Placer County Air Pollution Control District
PEC: Purchased Equipment Costs
PEER: Permit-Exempt Equipment Registration
PERP: Portable Equipment Registration Program
PFTs: Plant Functional Types
PG& E: Pacific Gas and Electric
PM: Particulate Matter
PM0.1: Ultrafine Particles

PM10: Particulate Matter that is 10 microns or less in diameter
PM2.5: Particulate Matter that is 2.5 microns or less in diameter
POA: Primary Organic Aerosols
PPB: Parts per billion
PPM: Parts per million
PPMV: Parts per million by volume
PPN: Particulate Protein Nitrogen
PSD: Particle Size Distribution
PST: Pacific Standard Time
PTFE: Poly Tetra Fluoro Ethylene
PUC: Public Utilities Commission
QA: Quality Assurance
QC: Quality Control
RAAN: Real-Time Air Quality Advisory Network
RACM: Reasonably Available Control Measures
RACT: Reasonably Available Control Technology
RAP: Reclaimed Asphalt Pavement
RARE: Regional Applied Research Effort
RAWS: Remote Automated Weather Stations
RBS: Risk-Based Strategy
REES: Regional Energy Efficiency Strategy
REHEX: Regional Human Exposure Model
REMI: Regional Economic Models, Inc.
REMOVE: REduce MOtor Vehicle Emissions
RFP: Reasonable Further Progress
RFP: Request for Proposals
RFQ: Request for Qualifications
RH: Relative Humidity
ROAR: Real-time Outdoor Activity Risk
ROP: Rate-of-Progress
ROS: Reactive Oxygen Species
RPS: Renewable Portfolio Standard
RRD: Respirable Road Dust
RRF: Relative Response Factors
RTO: Regenerative Thermal Oxidizer
RV: Recreational Vehicles
SA: Stationary Aggregated
SANDWICH: Sulfate, Adjusted Nitrate, Derived Water, Inferred Carbonaceous material balance approach
SAPRC: Statewide Air Pollution Research Center
SB: School Buses
SB: Senate Bill
SBA: Small Business Assistance
SBCAPCD: Santa Barbara County Air Pollution Control District

SBS: Sodium Bisulfate
SC: Source Category
SCAQMD: South Coast Air Quality Management District
SCC: Source Classification Code
SCF: Standard Cubic Feet
SCM: Suggested Control Measure
SCR: Selective Catalytic Reduction
SIP: State Implementation Plan
SLAMSs: State and Local Air Monitoring Stations
SJV: San Joaquin Valley
SJVAPCD: San Joaquin Valley Air Pollution Control District
SJVUAPCD: San Joaquin Valley Unified Air Pollution Control District
SMAQMD: Sacramento Metropolitan Air Quality Management District
SMAT: Speciated Modeled Attainment Test
SMOKE: Sparse Matrix Operator Kernel Emissions
SMS: Smoke Management System
SNCR: Selective Non-Catalytic Reduction
SOA: Secondary Organic Aerosol
SORE: Small Off-Road Engines
SOx: Oxides of Sulfur
STN: Speciated Trend Network
TAC: Toxic Air Contaminant
TAP: Technology Advancement Program
TAZ: Traffic Analysis Zone
TCI: Total Capital Investments
TITU: Tune in Tune Up
TMR: Total Mixed Ration
TOC: Total Organic Compounds
TOG: Total Organic Gases
TPA: Transportation Planning Agencies
Tpd: Tons per day
Tpy: Tons per year
TRU: Transport Refrigeration Unit
TSD: Technical Support Document
TSM: Total Selective Metals
TVP: True Vapor Pressure
TVP: Truck Voucher Program
UB: Urban Buses
UCSF: University of California, San Francisco
UFP: Ultrafine Particles
US: United States
USB: United States Background
USDA: United States Department of Agriculture
USDA-ARS: United States Department of Agriculture-Agricultural Research Service
USG: Unhealthy for Sensitive Groups

Valley: San Joaquin Valley
VCAPCD: Ventura County Air Pollution Control District
VDE: Visible Dust Emissions
VIP: Voucher Incentive Program
VMT: Vehicle Miles Traveled
VOC: Volatile Organic Compounds
WAAQS: Web-based Archived Air Quality System
WOE: Weight of Evidence
WMA: Warm-Mix Asphalt
WRAP: Western Regional Air Partnership
WRF: Weather and Research Forecast Model
WWTP: Wastewater Treatment Plan
XRF: X-ray Fluorescence
ZEV: Zero-Emission Vehicle
$\mu g/m^3$: Micrograms per Cubic Meter

Chapter 1

Introduction

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Chapter 1: Introduction

The U.S. Environmental Protection Agency (EPA) periodically reviews and establishes health-based air quality standards (also referred to as National Ambient Air Quality Standards, or NAAQS) for ozone, particulates, and other pollutants. Although the San Joaquin Valley (Valley) experiences unique and significant difficulties in achieving these increasingly stringent standards, air quality in the Valley has improved considerably. Over the past couple of decades, the San Joaquin Valley Air Pollution Control District (District) has implemented several generations of emissions control measures for stationary and area sources under its jurisdiction. Similarly, the California Air Resources Board (ARB) has adopted regulations for mobile sources. Together, these efforts represent the nation's toughest air pollution emissions controls and have greatly contributed to reduced ozone and particulate matter (PM) concentrations in the Valley, with the Valley experiencing a record clean ozone summer season in 2015. The significant progress to cleaner air has been greatly aided by the efforts of Valley businesses and residents.

This *2016 Plan for the 2008 8-Hour Ozone Standard* (*2016 Ozone Plan*) satisfies federal Clean Air Act (CAA) requirements under EPA's 2008 8-hour ozone standard. This plan builds upon the District's 1-hour ozone, 8-hour ozone and particulate matter (PM) strategies. Under these combined efforts, the Valley's 8-hour ozone concentrations have significantly improved and will continue to improve as the existing control measure strategy is implemented in the coming years. Furthermore, as the District continues to develop new attainment plans to address the latest federal ozone and PM2.5 standards in the coming years, significant additional emissions reductions are expected, particularly with respect to mobile sources under ARB and EPA jurisdiction that make up over 85% of remaining Valley emissions.

This *2016 Ozone Plan* follows the Governing Board Guiding Principles adopted at the February 2012 Governing Board public hearing. These principles are as follows:

1. With public health as our number one priority, meet the national ambient air quality standards as expeditiously as practicable.
2. Use sound science as the plan's foundation. This includes efforts to assess public health impacts, predict future air quality, determine the extent of emissions reductions needed, and evaluate the availability, effectiveness, and feasibility of emission control measures.
3. Consider the Valley's unique challenges and develop cost-effective strategies that provide adequate operational flexibility and minimize costs to Valley businesses.
4. Consider all opportunities for timely, innovative, and cost-effective emission reductions. Consider traditional regulations, but look beyond traditional regulations to incorporate monetary incentives, policy initiatives, guidance documents, and outreach, including working with cities and counties to incorporate attainment plan principles into their general plans.

5. Given that 80% of the Valley's NOx emissions originate from mobile sources, provide a balanced approach to reducing mobile and stationary source emissions.
6. Devise and implement reasonable strategies that involve the public in reducing emissions.
7. Prioritize strategies that contribute to the District's Health-Risk Reduction Strategy by achieving the greatest public health benefits.
8. Prioritize strategies that contribute to attainment of multiple air quality standards.
9. Recognize that there is no "silver bullet" for attainment. In this plan and upcoming attainment plans, every sector—from the public through all levels of government, businesses, and industry—must continue to reduce emissions.
10. Compel state and federal agencies to provide adequate resources and regulatory assistance to reduce emissions from sources under their jurisdiction.
11. Address air pollutant transport issues with air districts neighboring the Valley.
12. Provide ample opportunity for public participation and feedback in the design and implementation of these plans. Utilize the planning process to also inform participants of the Valley's air quality challenges and successes as well as actions that can be taken to improve Valley air quality.
13. Build off of the successes of the District's Technology Advancement Program by identifying further opportunities to continue fostering technology advancement, thus paving the way for new emissions control devices to be increasingly used in the San Joaquin Valley.

1.1 VALLEY'S UNIQUE CHALLENGES IN REDUCING OZONE

The Valley's geography and meteorology exacerbate the formation and retention of high levels of air pollution. Surrounding mountains and consistently stagnant weather patterns prevent the dispersion of pollutants that accumulate within the Valley. The Valley has significant naturally occurring biogenic emissions. The California landscape also allows for air pollutant transport within the Valley, as well as between the Valley and other air basins. The Valley's low precipitation levels, high temperatures, and light winds are conducive to elevated ozone levels. These natural factors will continue to impact the Valley's progress toward attainment of air quality standards.

To further exacerbate current air quality challenges, the Valley is one of the fastest growing regions in the state. Based on the revised 2015 to 2030 data from the California Department of Finance, the Valley's population is expected to increase by 25.3% (Table 1-1). In contrast, the total population for the State of California is projected to increase by only 13.3% over the same time period. Increasing population generally means increases in air pollutant emissions as a result of increased consumer product use and more automobile and truck vehicle miles traveled (VMT). In addition to

increased VMT resulting from increased Valley population, the Valley will see increased vehicular traffic along the State's major goods and people movement arteries, both of which run the length of the Valley.

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

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

** This reflects the population for all of Kern County, not just the portion monitored by the District.*

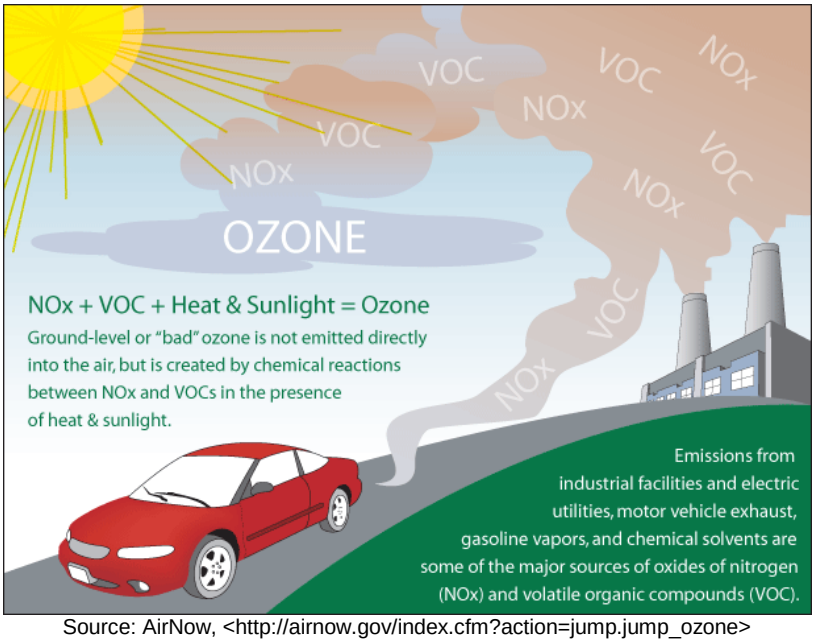
Although reducing mobile source emissions is critical to the Valley's attainment of federal air quality standards, the District does not have direct regulatory authority to reduce motor vehicle tailpipe emissions. Mobile source emissions are regulated by the EPA and ARB. The District collaborates with its interagency partners and uses innovative and non-regulatory approaches to reduce mobile source emissions, or a combination of regulatory and non-regulatory approaches such as District Rule 9610 (State Implementation Plan Credit for Emission Reductions Generated through Incentive Programs) and District Rule 9510 (Indirect Source Review).

1.2 OZONE AND ASSOCIATED HEALTH AND OTHER IMPACTS

Ozone is a gas of three oxygen atoms (O_3). Ground-level ozone is the main component of smog. It is not directly emitted into the atmosphere, but produced by photochemical reactions between oxides of nitrogen (NO_x) and volatile organic compounds (VOCs) in the presence of sunlight (see Figure 1-1). The Valley generally experiences the highest ozone concentrations on hot, sunny summer days with prolonged periods of stagnation.

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

Figure 1 - 1 Ozone Formation



Source: AirNow, <http://airnow.gov/index.cfm?action=jump.jump_ozone>

1.2.1 Health Impacts

Breathing ozone can trigger a variety of health problems, including chest pain, coughing, throat irritation, and congestion. It can reduce lung function and inflame the linings of the lungs. Repeated exposure may permanently scar lung tissue. Children are at a greater risk of experiencing negative health impacts because their lungs are still developing and they are more likely to be active outdoors when ozone levels are high, thus increasing their exposure. Studies have linked rising hospital admissions and emergency room visits to higher ozone levels.

The District has several strategies for reducing public health impacts associated with ozone, including the following:

- **District Air Quality Plans and Related District Regulations**. The District's air quality plans outline comprehensive strategies for emissions reductions to attain increasingly stringent federal air quality standards.

- **Real-Time Air Advisory Network (RAAN).** The District launched RAAN in 2010 to provide the most accurate and timely information about local air quality. RAAN combines real-time, local air quality information with specific health recommendations to help schools, parents, and others make informed decisions about when outdoor activities should be limited and for whom.

- **Air Quality Index (AQI) and Daily Air Quality Forecasting.** An AQI is a color-coded designation for the day that projects the forecasted air quality and recommends corresponding activity modifications based on pollution levels.

- **Health-Risk Reduction Strategy (HRRS).** The District Governing Board adopted the HRRS to maximize public health improvements resulting from the District's attainment strategies and related initiatives. The HRRS works in parallel with the District's other strategies to minimize cumulative population exposure to air pollution and the corresponding regional health risk.

- **Air Alerts.** An Air Alert notifies Valley residents of ongoing conditions that may lead to a federal ozone standard exceedance. When the District calls an Air Alert, Valley residents and businesses are advised to reduce vehicle use to proactively reduce emissions and protect public health.

1.2.2 Additional Effects of Ozone

In addition to public health, ozone affects Valley ecosystems and crops. Ozone damages plant cells and deteriorates leaf tissue, which reduces the plants' ability to photosynthesize and produce their own food. Plants respond by growing more leaves, which depletes carbohydrates stored in roots and stems. This weakens plants and makes them susceptible to disease, pests, cold, and drought. Ozone also reduces agricultural yields for many economically important crops, such as grapes, soybeans and cotton, and damages the leaves of trees and other plants, marring the appearance of cities, national parks, forests, and recreational areas.[2]

Furthermore, ozone can cause substantial damage to a variety of materials such as rubber, plastics, fabrics, paint, and metals. Over time, ozone exposure progressively damages both the functional and aesthetic qualities of these types of materials and products. The resulting increases in maintenance, upkeep, and replacement of materials can accumulate to significant economic losses.

1.3 NATIONAL AMBIENT AIR QUALITY STANDARDS

1.3.1 EPA's Standard Setting Process

Clean Air Act (CAA) Sections (§) 108 and 109 require EPA to set health-based standards for six criteria pollutants. EPA periodically reviews existing standards to consider the most recent health studies. These reviews are to be conducted every five years, though in the past, some standard revisions did not meet the 5-year deadline.

The review process for health-based standards starts as the Clean Air Scientific Advisory Committee (CASAC) analyzes available science. CASAC then suggests to EPA a range of revised standards that would protect public health from the adverse

[2] Journal of Experimental Botany. (October 2011). *How is Ozone Pollution Reducing Our Food Supply?* Retrieved from: http://jxb.oxfordjournals.org/content/early/2011/10/17/jxb.err317.full.pdf+html

effects of air pollution. CASAC consists of non-EPA experts in the fields of science, engineering, or the social sciences who are appointed by the EPA Administrator. The objective of the committee is to provide impartial, independent advice to EPA on the technical basis for the standard. Thousands of peer-reviewed scientific studies are considered as EPA formulates its proposed standard. EPA then proposes a standard and makes it available for public review and comments before promulgating the standard.

In evaluating and setting new air quality standards, federal law prohibits EPA from taking into account economic feasibility. However, economic feasibility issues may be considered as EPA promulgates its implementation rules.

Once a standard is set, EPA designates an area as *attainment* or *nonattainment* based on the most recent three years of air quality data available. For ozone, EPA classifies nonattainment areas as *marginal*, *moderate*, *serious*, *severe*, or *extreme*. The classification sets the attainment deadline and other planning requirements. The classification is to be based on certain air quality parameters, though areas can request reclassification with adequate documentation. On May 21, 2012, EPA designated the Valley as an Extreme nonattainment area for the federal 2008 8-hour ozone standard, effective July 20, 2012.[3]

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

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

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

Once EPA approves a SIP, that plan becomes federally enforceable. The plan can then be enforced by the public or EPA through lawsuits. In addition, failure to reach attainment by the deadline would result in the assessment of CAA §185 penalty fees.

[3]Air Quality Designations for the 2008 Ozone National Ambient Air Quality Standards, 77 Fed. Reg. 98, pp. 30088-30160. (2012, May 21). (to be codified 40 CFR Parts 50, 51, and 81) http://www.gpo.gov/fdsys/pkg/FR-2012-05-21/pdf/2012-11618.pdf

1.3.2 Federal Ozone Standards and Implementation

Table 1-2 summarizes EPA's ozone standards and the timing of attainment plans under those standards consistent with CAA requirements.

Table 1-2 Federal Air Quality Standards and Valley Status for Ozone

Federal Standard	Ozone Standards and Timelines			
	1979 1-hour	**1997 8-hour**	**2008 8-hour**	**2015 8-hour**
	124 ppb (1-hour average)	**84 ppb (8-hour average)**	**75 ppb (8-hour average)**	**70 ppb (8-hour average)**
1979–2003	EPA sets standard (1979)	EPA sets standard (1997)		
2004	SJV adopts attainment plan	EPA finalizes attainment designations and classifications		
2005	**EPA revokes standard**	EPA issues implementation rule		
2006	*Litigation reinstates portions of implementation requirements under the revoked standard*			
2007		SJV adopts *2007 Ozone Plan*		
2008			EPA sets standard	
2009				
2010	EPA approves SJV 2004 plan	Midcourse review		EPA proposes to revise standard to 60 or 70 ppb
2011	Ninth Circuit remands plan approval to EPA; EPA finds SJV failed to attain			EPA announces it will not revise the standard
2012	EPA finalizes withdrawal of approval of 2004 1-hour ozone plan. SJV plan withdrawn	EPA approves SJV's *2007 Ozone Plan*	EPA designates SJV as an Extreme nonattainment area	
2013	SJV adopts new 1-hour ozone plan		EPA proposes Implementation Rule	
2014	SJV submits attainment demonstration request based on 2011 – 2013 data	District/ARB revisits *2007 Ozone Plan*	RACT demonstration & Emission Inventory due to EPA	EPA proposes standard at 65-70ppm
2015	SJV submits second attainment demonstration request based on 2012 – 2014 data	**EPA revokes standard**	EPA finalizes Implementation Rule	EPA sets standard at 70ppm
2016	EPA proposes to approve 2013 1-hr Plan		SJV to adopt 8-hour ozone plan	*attainment plan timing tbd*
2017–2040		Final attainment deadline: 2024	Final attainment deadline: 2031	Estimated attainment deadline: 2037

EPA established the first ozone standard in 1979, setting this standard at 0.12 parts per million (ppm) over a 1-hour exposure or 124 parts per billion (ppb) when accounting for the adopted rounding conventions. An area meets the 1-hour ozone standard when, for each monitoring station, the 1-hour ozone levels do not exceed 124 ppb more than one day per year over any three-year period.[4] The CAA Amendments of 1990 established attainment planning requirements and attainment deadlines for the 1979 1-hour ozone standard, and the District subsequently adopted various 1-hour ozone plans and plan amendments. EPA revoked the 1-hour standard effective June 15, 2005,[5] maintaining that the 84 ppb 8-hour ozone standard adopted in 1997 was more health protective. In response, the District and other agencies nationwide shifted their ozone efforts to 8-hour ozone.

The District's *2007 Ozone Plan* demonstrates attainment of the 1997 8-hour ozone standard no later than the 2024 attainment deadline. EPA revoked the 1997 ozone standard for all purposes effective April 5, 2015.[6] However, because the District was designated nonattainment for the 1997 ozone standard at the time of revocation, the District is subject to an array of anti-backsliding requirements. As such, the District remains obligated to continue to implement the emissions controls as adopted in the *2007 Ozone Plan* in order to ensure that air quality does not get worse once the NAAQS is revoked.

In 2008, EPA revised its 8-hour ozone standard, lowering the standard to 75 ppb. EPA considered lowering the standard once again in 2010, but ultimately retained the 75 ppb standard. EPA designated the Valley as Extreme nonattainment of the 2008 8-hour ozone standard in 2012. This *2016 Ozone Plan*, for the 2008 standard is due on July 20, 2016, and the attainment date is December 31, 2031 using data from calendar years 2029, 2030, and 2031.

In 2015, EPA revised the 8-hour ozone standard again, lowering it from 75 ppb to 70 ppb. The estimated attainment deadline year is 2037 using data from calendar years 2035, 2036, and 2037.

Building on the District's *2007 Ozone Plan, 2008 PM2.5 Plan*, *2012 PM2.5 Plan, 2013 Plan for the Revoked 1-Hour Ozone Standard*, and *2015 PM2.5 Plan,* the District will continue to coordinate emission reduction strategies whenever possible to address multiple standards, to maximize efficiency for staff and stakeholders, and to maximize health benefits. Despite the complexity of overlapping standards and plans, efforts to reduce ozone precursors under one standard and plan will also help to meet ever-tightening ozone and particulate standards.

[4] National 1-Hour Primary and Secondary Ambient Air Quality Standards for Ozone, 40 C.F.R. §50.9 (2012)
[5] Air Quality Designations and Classifications for the 8-Hour Ozone National Ambient Air Quality Standards; Early Action Compact Areas with Deferred Effective Dates, 69 Fed. Reg. 84, pp. 23858–23951. (2004, April 30). (to be codified at 40 C.F.R. Part 81)
[6] Implementation of the 2008 National Ambient Air Quality Standards for Ozone: State Implementation Plan Requirements; Final Rule. 80 Fed. Reg. 44. pp. 12264-12319. (2015, March 6), (to be codified at 40 CFR Parts 50, 51, 52, et al.) (see p. 12287) http://www.gpo.gov/fdsys/pkg/FR-2015-03-06/pdf/2015-04012.pdf

The control measures adopted by the District and ARB in previous attainment plans are achieving significant reductions of ozone precursors. These measures and strategies will continue to achieve intended emissions reductions as they are implemented. These reductions have decreased both 1-hour ozone and 8-hour ozone concentrations. As a result, in 2015 the Valley experienced a record-setting clean ozone season, with the lowest number of exceedances of the 8-hr ozone standard of 75 ppb, lowest 8-hr ozone design value, and the third consecutive year with no violations of the 1-hr ozone standard. As a part of the positive trend in ozone air quality, the Valley is also on track to meet the federal 8-hour ozone standard of 84 ppb ahead of the projected 2023 attainment date included in the *2007 Ozone Plan*. With the ongoing improving trend in ozone air quality, EPA also recently approved the District's request for the 1-hour ozone clean data finding and has officially proposed to grant the San Joaquin Valley as attainment for the 1-hour ozone standard.

Furthermore, as the District continues to develop new attainment plans to address the latest federal ozone and PM2.5 standards in the coming year, significant additional emissions reductions are expected, particularly with respect to mobile sources under ARB and EPA jurisdiction that make up over 85% of remaining Valley emissions.

1.3.2.1 Implementation of the 2008 8-hour Ozone Standard

Once the federal government sets a standard, nonattainment areas are required to develop and adopt air quality attainment plans with commitments to reduce emissions and bring the area into attainment of the standard pursuant to CAA and EPA guidance documents. To develop a plan, these areas evaluate air quality data, emissions inventory data, and computer modeling results to determine the control measures (in the form of rules and non-regulatory programs) that are needed to meet the federal standards by the deadlines specified in the CAA. Control measure commitments in the plan are then implemented over a specified time to reduce emissions and improve public health.

During the plan development process, ARB conducts and funds air quality research; develops air quality models, emissions inventories, and statewide emission control measures and provides other plan development assistance to local air districts. Once nonattainment areas adopt their plans, ARB is responsible for preparing and submitting the California SIP to EPA. Following adoption, periodic plan revisions may be necessary to ensure reasonable further progress and to reflect the latest science and technology advancements. After an area's ambient air quality data meets the federal standard for three consecutive years, the area will request a finding of attainment.

This *2016 Ozone Plan* demonstrates that the Valley will attain the standard as expeditiously as practicable, no later than December 31, 2031. This requires another 207.7 tons per day in NOx reductions from stationary and mobile sources throughout the Valley. The measures identified in this plan do achieve the necessary reductions. The District could show expeditious attainment without the need to rely on "Black Box" provisions afforded under CAA §182(e)(5). Unfortunately, compliance with the contingency requirements under the federal Clean Air Act requires that the District hold

back on 1.6 tons per day of NOx reductions. To ensure that the plan is approvable with the necessary contingencies, the plan needs to include a "Black Box". The District however hopes that the state Air Resources Board or federal EPA can adopt and implement necessary strategies relating to mobile sources resulting in further reductions in emissions that could satisfy contingency requirements and avoid delays in attaining the standard expeditiously.

The attainment demonstration must be submitted by July 20, 2032, using the three year average data from calendar years 2029, 2030, and 2031.

1.4 CALIFORNIA STATE STANDARDS

California sets ambient air quality standards for several pollutants, including ozone. The California ambient air quality standards are considerably more stringent than the federal standards and are more protective of human health. California's 1-hour ozone standard is 90 ppb, and its 8-hour ozone standard has been established at 70 ppb since 2005.

Despite the more stringent California standards, California Health and Safety Code §39602 states, "Notwithstanding any other provision of this division, the state implementation plan shall only include those provisions necessary to meet the requirements of the [federal] CAA." Therefore, this *2016 Ozone Plan* focuses on demonstrating attainment with the federal NAAQS. While the federal standards provide the framework for SIPs, including this ozone plan, progress toward federal standards also brings areas closer to attainment of the lower, California standards.

1.5 PUBLIC PROCESS OF PLAN DEVELOPMENT

This *2016 Ozone Plan* was prepared through an involved public process that provided multiple opportunities for the public and interested stakeholders to offer suggestions and comments for improving and strengthening the plan (Table 1-3). The District initiated the public process for the *2016 Ozone Plan* in mid-2014. The public process included providing monthly updates at District Governing Board meetings, CAC meetings, and EJAG meetings. Each of these updates was accompanied by an opportunity for the public to provide comment, ask questions, or request additional information.

In addition, the District's Governing Board approved a public engagement initiative that outlined an extensive public process for the development of the *2016 Ozone Plan*. The public engagement initiative was designed in adherence with the following guiding principles:

1. Utilize effective means to get input from all affected stakeholders and subject matter experts in the design of the plan.
2. Provide for public engagement before each plan preparation milestone.
3. Provide routine updates to the public at large about the plan as it is developed.

4. Ensure efficiency and effectiveness by using existing infrastructure for public engagement.
5. Ensure process does not impede the District's ability to meet legally mandated deadlines and timeliness.

Under the guidance of the District Governing Board, the Executive Director/Air Pollution Control Officer (APCO) formed the Public Advisory Workgroup (PAW) ad hoc committee. The PAW committee members consisted of representatives from regulated entities (industry, farms, dairy families and municipalities), community advocates, and advisors from EPA and ARB. The PAW committee held numerous meetings which were also open to the public.

As part of the public process for developing this plan, the District also hosted a public workshop in May 2014 and two additional workshops in March 2016. These meetings provided opportunities for the public to provide verbal comments, and written comments have also been encouraged throughout development of this plan. These comments have been integral to the development of this plan, and have been incorporated as appropriate.

Table 1-3 *2016 Ozone Plan* Meetings

Date	Meeting Summary
5/23/2014	Public workshop to present and receive comments on the development of the upcoming plan for the 2008 8-hour ozone standard and public commenting
Mid-2014 through 2016	Monthly updates to the District's Governing Board, Citizen's Advisory Committee, and Environmental Justice Advisory Committee meetings
8/25/2015	PAW: Kick-off meeting – Discussed potential topics to be covered at PAW meetings throughout the plan development process, potential future meeting dates, expectations from both the District and the committee members moving forward.
9/30/2015	PAW: Emission Inventory Development in California – Discussed the emissions inventory development process, forecasting methodology, and spatial allocation including emissions gridding and model inventory development.
2/11/2015	PAW: Ozone SIP Modeling in the San Joaquin Valley – Discussed ozone SIP modeling process and the current San Joaquin Valley 8-hour ozone SIP.
3/22/2016	Public workshops (one workshop during business hours and one workshop in the evening) to present and receive comments on draft documents for the 2008 8-hour ozone standard
5/17/2016	Publication of the *Proposed 2016 Ozone Plan* on the District website and paper copies made available upon request for public review and comment, with an associated two week commenting period
6/16/2016	Public hearing for the adoption of the *Proposed 2016 Ozone Plan* with opportunities for public comment

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Chapter 2

Air Quality in the Valley: Challenges and Progress

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Chapter 2: Air Quality in the Valley: Challenges and Progress

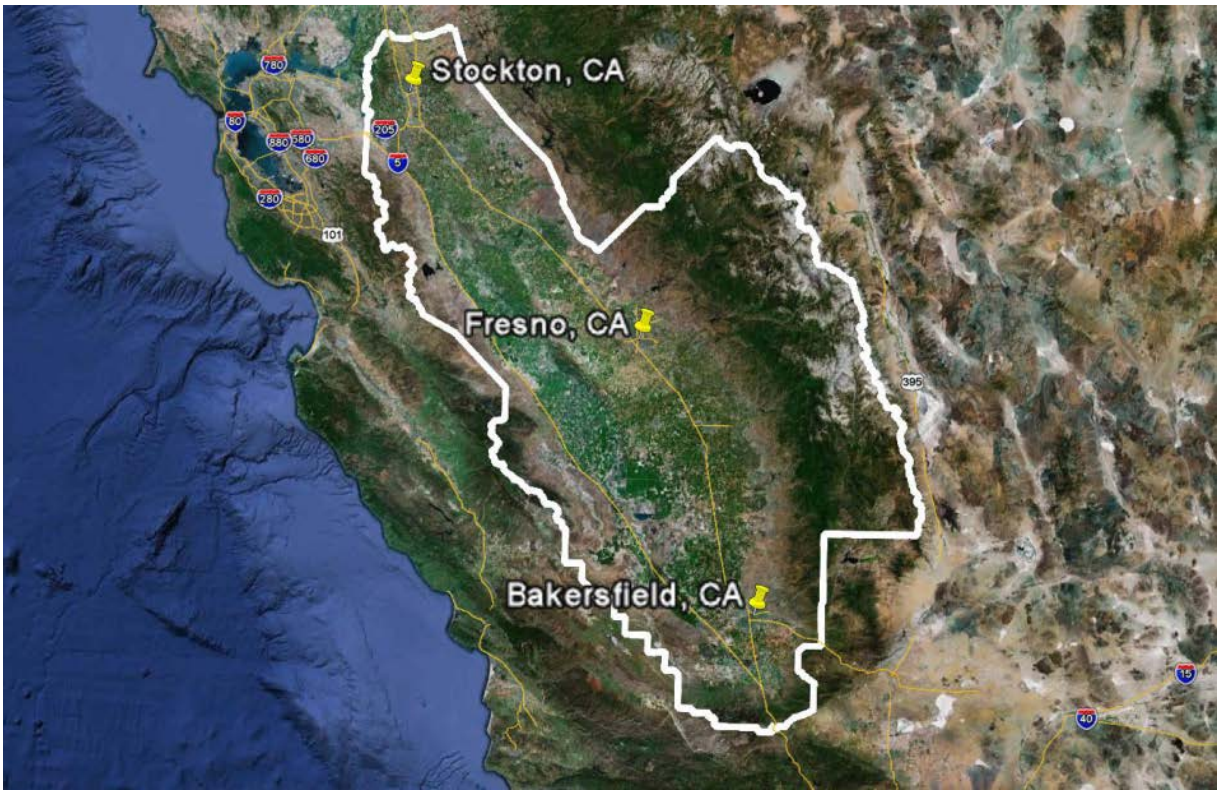
2.1 CHALLENGES OF THE NATURAL ENVIRONMENT

The challenges that the San Joaquin Valley (Valley) faces in attaining ever-tightening federal standards are unmatched by any other region in the nation. These challenges include the Valley's unique geography, topography, and meteorology combined with a rapidly growing population and jurisdictional and regulatory authority limits as discussed in this chapter.

2.1.1 Natural Conditions

The challenge of attainment in the Valley is grounded in the unique topographical and meteorological conditions found in the region. The Valley, as seen in Figure 2-1, is an intermountain basin comprised of nearly 25,000 square miles. The Valley's geography and meteorology exacerbate the formation and retention of high levels of air pollution. Surrounding mountains and consistently stagnant weather patterns prevent the dispersal of pollutants that accumulate within the Valley.

Figure 2 - 1 San Joaquin Valley Air Basin

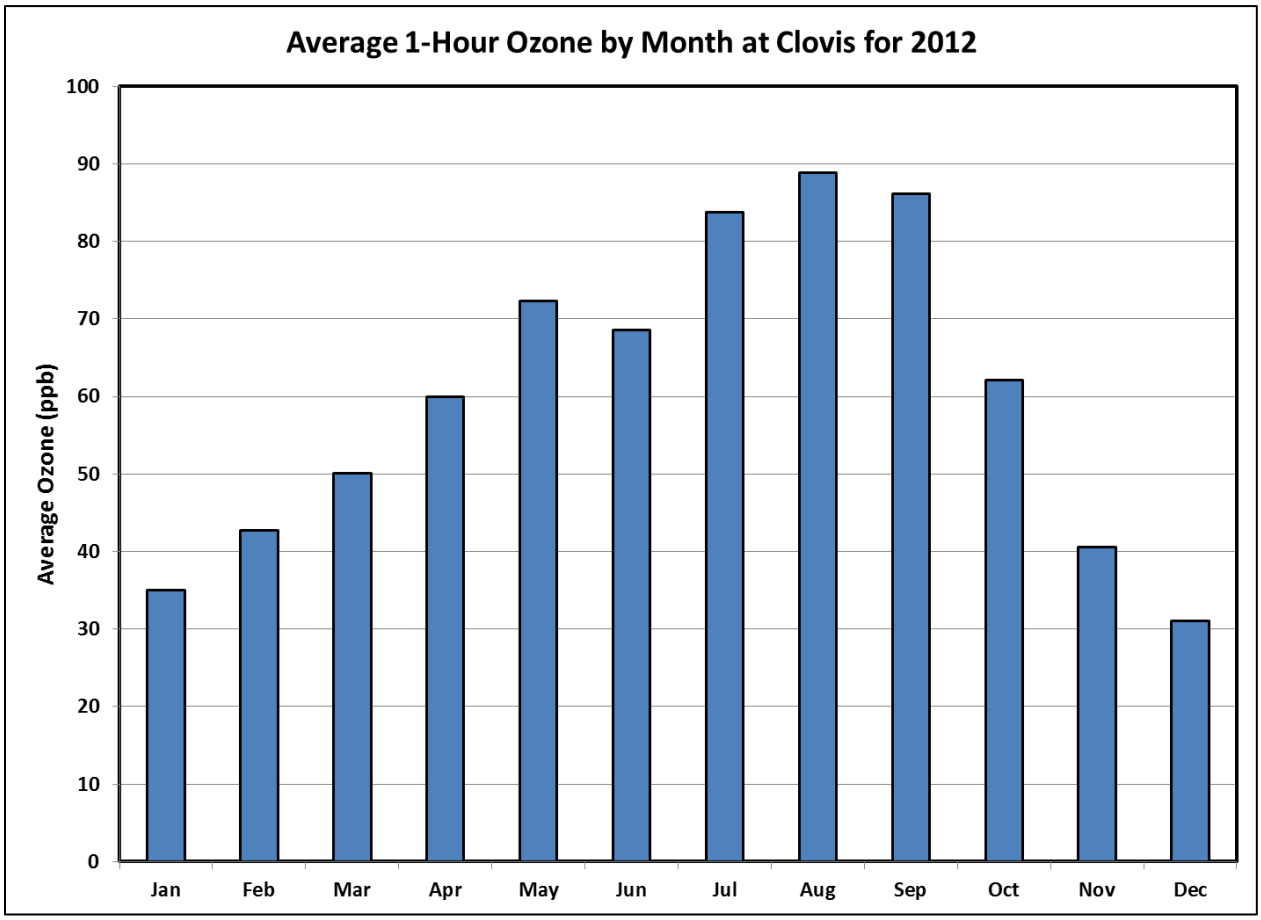


During the summer months, high temperatures, atmospheric stagnation, and temperature inversions create an environment conducive for the formation of elevated ozone levels. The Valley averages over 260 sunny days per year. Nearly 90% of the

annual precipitation in the Valley falls between the months of November through April, with little to none occurring during the summer months.

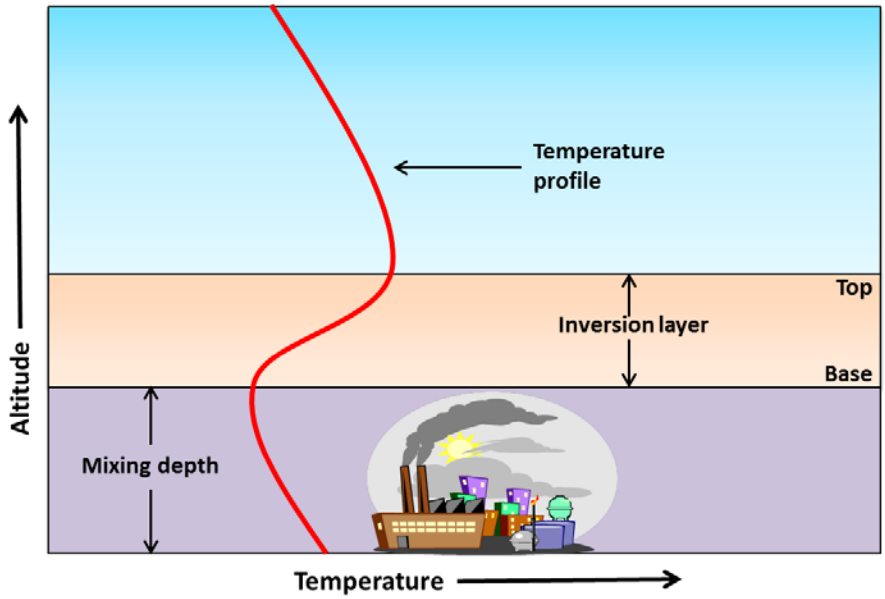
Ozone concentrations tend to be the highest from June to September, because high pressure systems that influence Valley meteorological and dispersion conditions occur most frequently during the summer months. As an example, Figure 2-2 shows the average 1-hour ozone concentration per month during 2012 for the Clovis air monitoring site. Ozone concentrations rise from the beginning of the year toward the summer where levels reach their peak by August when temperatures are usually the warmest and when high pressure and stagnation over the Valley are most common.

Figure 2 - 2 2012 Monthly Average Ozone at Clovis



Temperature inversions, or increasing temperature with increasing height (Figure 2-3), can prohibit vertical mixing of an air mass, thus trapping pollutants near the earth's surface. Put simply, the base of the inversion acts as a lid on the atmosphere, trapping pollution. During the ozone season, inversion events caused by high pressure systems cause air pollutant emissions to build up. Ozone precursors then react to form ozone, which can in turn build up concentrations from day to day under a prolonged period of atmospheric stagnation.

Figure 2 - 3 Effect of Temperature Inversion on Pollutant Dispersion



While these inversions are common in the Valley throughout the year, they have been further exacerbated by the extreme drought conditions experienced since 2013. Drought conditions are caused by circulating high pressure systems. High pressure systems create temperature inversions and limit not only precipitation but clouds from forming overhead. Without clouds, the Valley experiences even more hot days throughout the year, which assists ozone formation and has led to even longer periods of high ozone concentrations.

The Valley is also greatly affected by pollution transport. Winds, at ground level or at higher altitudes, transport pollutants from other regions into the Valley, within the Valley to areas downwind, and from the Valley into other regions. The amount of pollution transported from other areas into the Valley varies. Typically during an average ozone season day, surface winds pick up ozone precursors emitted in regions to the north of the Valley and transport them southeast toward the central and southern end of the Valley where ozone levels have the potential to form at their highest concentrations. Air flow also moves upslope along the Sierra Nevada Mountains during the day as the air heats up, and then moves downslope as the air cools in the evening. Further exacerbating these difficulties, the Valley is also being increasingly more affected by international ozone transport from China.

2.1.2 Summer Wildfires

California's summer wildfires have historically affected ozone levels in the Valley. These fires emit ozone precursors that can be transported by wind to the Valley. Although particulates in the smoke plume can sometimes reduce ozone formation rates by blocking sunlight, the precursors often react to form ozone. For example, during the summer of 2008, California experienced a record number of wildfires and the resulting

emissions caused serious public health impacts and unprecedented ozone levels in the Valley.

In the summer of 2015, the Valley's air quality was also impacted by a number of wildfires in the region. The largest fire impacting the Valley in 2015, the Rough Fire, was fast-moving, and consisted of heavy fuel loads with high emissions estimates per acre of fuel burned. As compared to the Valley's emissions, PM10 emissions from the Rough Fire at its peak day were 25 times greater than the PM10 emissions from the District's entire stationary, area, and mobile source inventories combined. Similarly, the Rough Fire's PM2.5, NOx and VOC emissions were 105, 8, and 16 times larger than the District's entire emissions inventory, respectively. Clearly, the emissions from a large wildfire can easily surpass emissions from all sources in the Valley, including all industrial, farming, and mobile sources, and overwhelm even the most robust emissions control programs.

Emissions from these wildfires, which often occur during the peak of the Valley's ozone season, can challenge the region's ability to attain federal ozone air quality standards. If the current drought affecting the western U.S. continues, wildfires may continue to become more severe, having an even larger effect on the Valley's air quality in the future.

2.1.3 Higher than Average Population Growth

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

Based on the revised 2015 to 2030 DOF data, the Valley's population is expected to increase by 25.3% (Table 2-1). In contrast, the total population for the State of California is projected to increase by only 13.3% over the same time period. Increasing population generally means increases in air pollutant emissions as a result of increased consumer product use and more automobile and truck vehicle miles traveled (VMT). In addition to increased VMT resulting from increased Valley population, the Valley will also see increased vehicular traffic along the State's major goods and people movement arteries, both of which run the length of the Valley.

Table 2-1 Estimated Valley Population by County, 2015-2030[1]

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

** This reflects the population for all of Kern County, not just the portion monitored by the District.*

Although reducing mobile source emissions is critical to the Valley's attainment of air quality standards, the District does not have direct regulatory authority to reduce motor vehicle tailpipe emissions. These emissions are regulated by the U.S. Environmental Protection Agency (EPA) and the California Air Resources Board (ARB). The District collaborates with its interagency partners and uses innovative and non-regulatory approaches to reduce mobile source emissions, or a combination of regulatory and non-regulatory approaches such as District Rule 9610 (State Implementation Plan Credit for Emission Reductions Generated through Incentive Programs) and District Rule 9510 (Indirect Source Review).

2.1.4 Jurisdictional Limits in Regulatory Authority

Attainment of air quality standards and the reduction of precursor emissions in the Valley require the cooperation of local and/or regional, state, and federal governments. At the federal level, the EPA is responsible for establishing federal motor vehicle emission standards. The EPA is also responsible for reducing emissions from locomotives, aircraft, heavy duty vehicles used in interstate commerce, and other sources such as off-road engines that are either preempted from state control or best regulated at the national level.

ARB establishes emission standards for on-road motor vehicles and some off-road sources. ARB also establishes fuel specifications and develops consumer product standards for meeting air quality goals in California. Other state agencies such as the Department of Pesticide Regulation (DPR), California Department of Transportation (CalTrans), and the Bureau of Automotive Repair also have responsibility for certain mobile and mobile-related emissions sources.

Air districts have authority to regulate stationary sources and some area sources of emissions. Districts cooperate with Regional Transportation Planning Agencies (TPAs)

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

to develop measures affecting local transportation activity that are included in an attainment plan. In turn, the TPAs coordinate the process to identify and evaluate potential control measures and compile local government commitments that will be included in the local or regional air quality plan. The primary jurisdiction of the District is therefore limited to less than 15% of the total NOx emissions inventory.

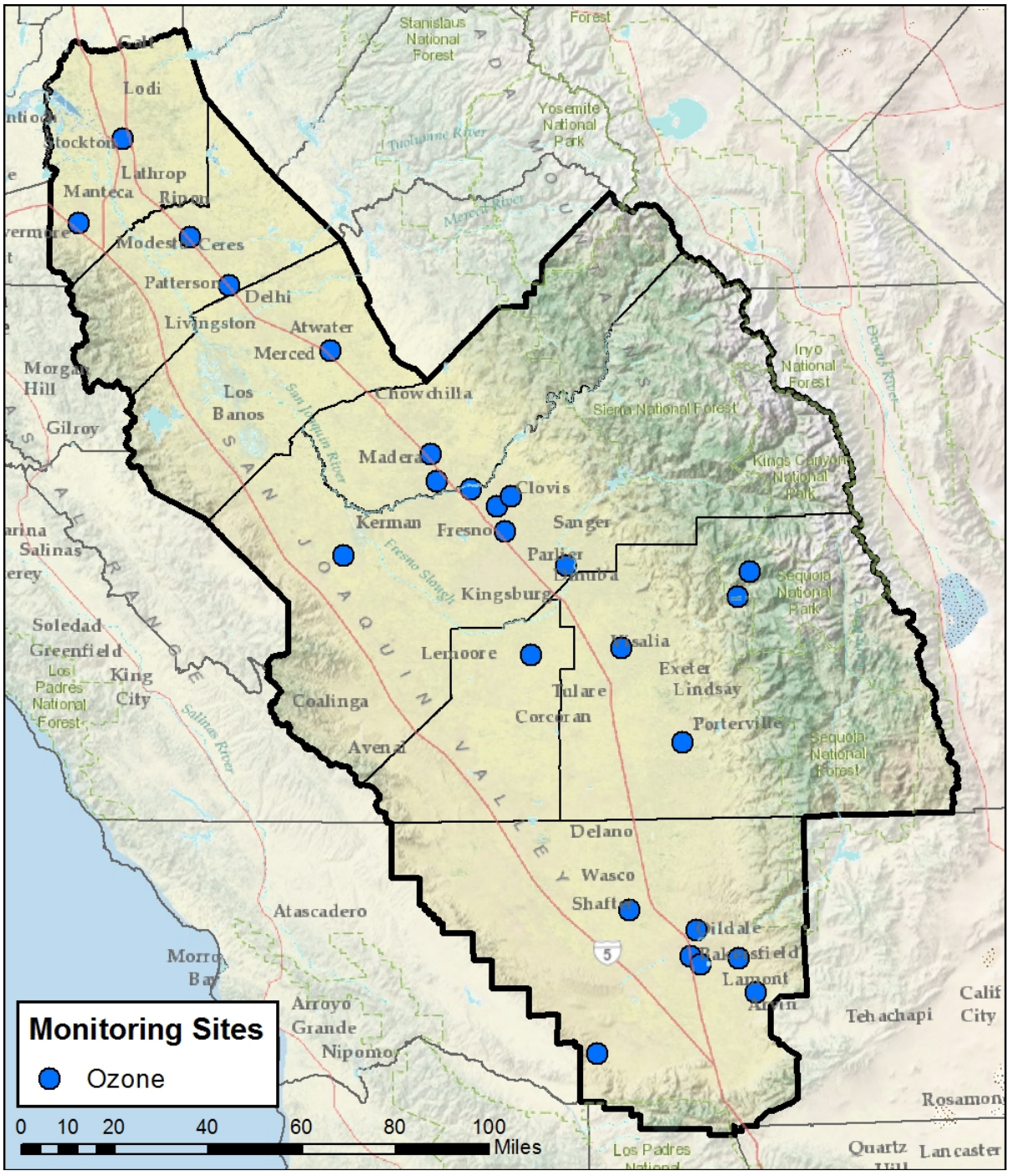
Although the responsibility for establishing the tailpipe emissions standards for the mobile sources belongs to state and federal governments, additional reductions are needed from mobile sources to reach attainment. Therefore, the District implements creative measures, such as trip reduction, green contracting, and enhanced indirect source review, to provide additional mobile source emissions reductions for the Valley and will continue to use incentive programs to accelerate mobile source emissions reductions.

2.2 OZONE AIR QUALITY PROGRESS

2.2.1 Ozone Monitoring Network

The District, ARB, and the National Park Service (NPS) together operate extensive air monitoring networks to measure progress towards attaining federal air quality standards. Ozone monitoring networks are designed to monitor areas with high population densities, areas with high pollutant concentrations, areas impacted by major pollutant sources, and areas representative of background concentrations. Together, the District, ARB, and NPS currently operate 25 ozone monitoring sites throughout the Valley (see Figure 2-4).

Figure 2 - 4 Ozone Monitoring Sites within the Valley



EPA requires air monitoring agencies to include a variety of monitoring site types in their air monitoring networks. The monitoring site types within the District's ozone monitoring network measure concentrations for population exposure, highest concentrations, regional transport, and background levels. Often more than one monitoring site type applies to a given location. Table 2-2 identifies the monitoring site types within the District's ozone monitoring network.

Table 2-2 Ozone Monitoring Site Types

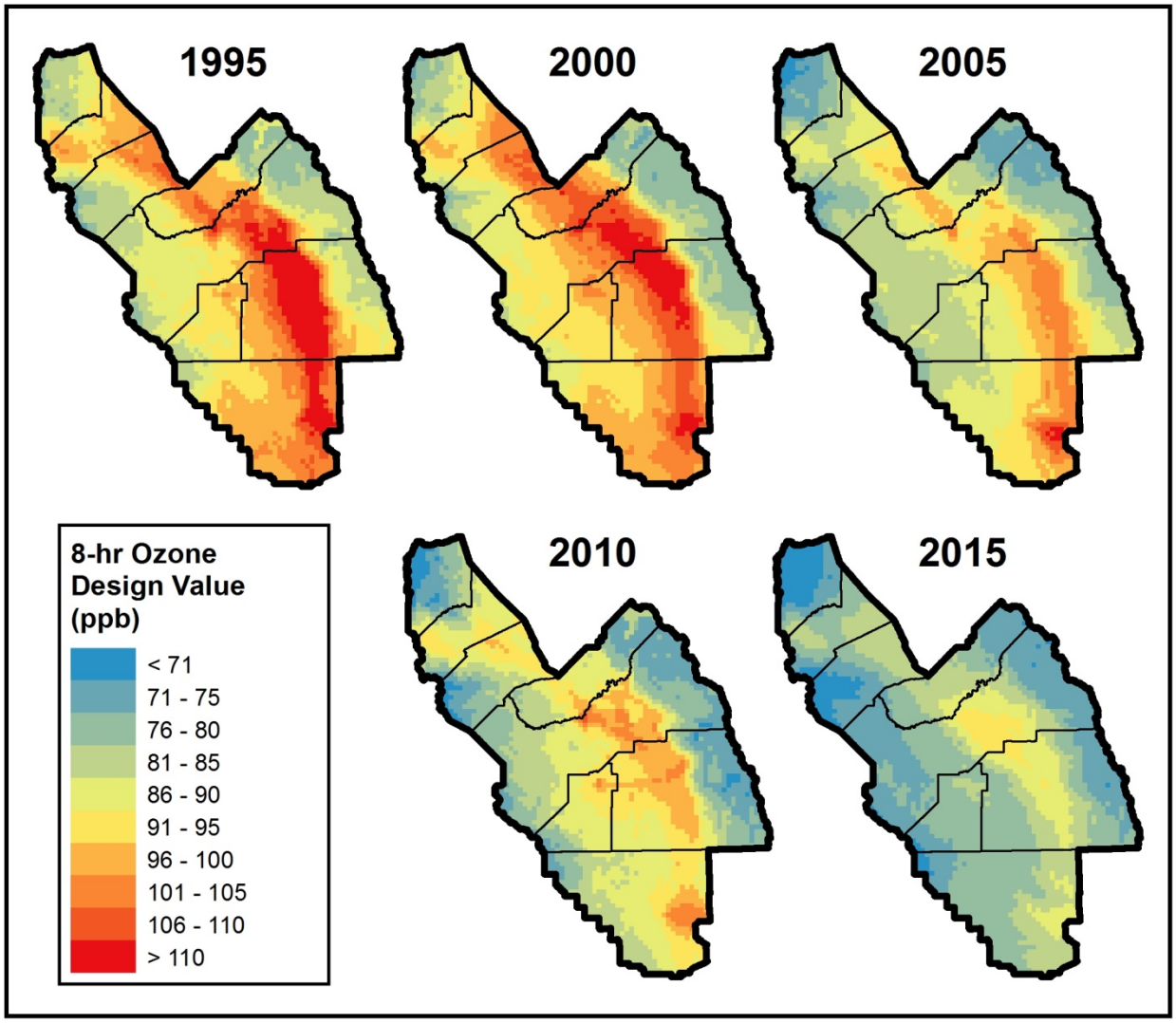
Site Name	Population Exposure	Highest Concentration	Regional Transport	Background Levels
Stockton–Hazelton*	✓			
Tracy–Airport		✓	✓	
Modesto–14th St*	✓			
Turlock	✓	✓		
Merced–Coffee	✓			
Madera–City	✓	✓		
Madera–Pump Yard				✓
Tranquility	✓			
Fresno–Sky Park	✓		✓	
Clovis–Villa	✓	✓		
Fresno-Garland*	✓	✓		
Fresno–Drummond	✓	✓	✓	
Parlier			✓	
Hanford–Irwin	✓	✓		
Visalia–Church St*	✓			
Porterville	✓			
Ash Mountain^		✓	✓	
Lower Kaweah^			✓	
Shafter*				✓
Oildale*			✓	
Bakersfield–California*	✓			
Edison*			✓	
Bakersfield–Muni		✓		
Arvin–Di Giorgio*		✓	✓	
Maricopa			✓	

^ Monitor operated by the National Park Service
* Monitor operated by ARB

2.2.2 Air Quality Progress

Ozone monitors yield hourly average concentrations of ozone, reported in parts per million (ppm) to three decimal places. The 1-hour ozone measurements collected by air monitors are also used to calculate 8-hour averages. Since 1995 the Valley has experienced a drastic improvement of overall exposure to ozone (see Figure 2-5). The District is continuing to implement emission control measures committed to in its most recent plans for attaining both the ozone and PM2.5 NAAQS.

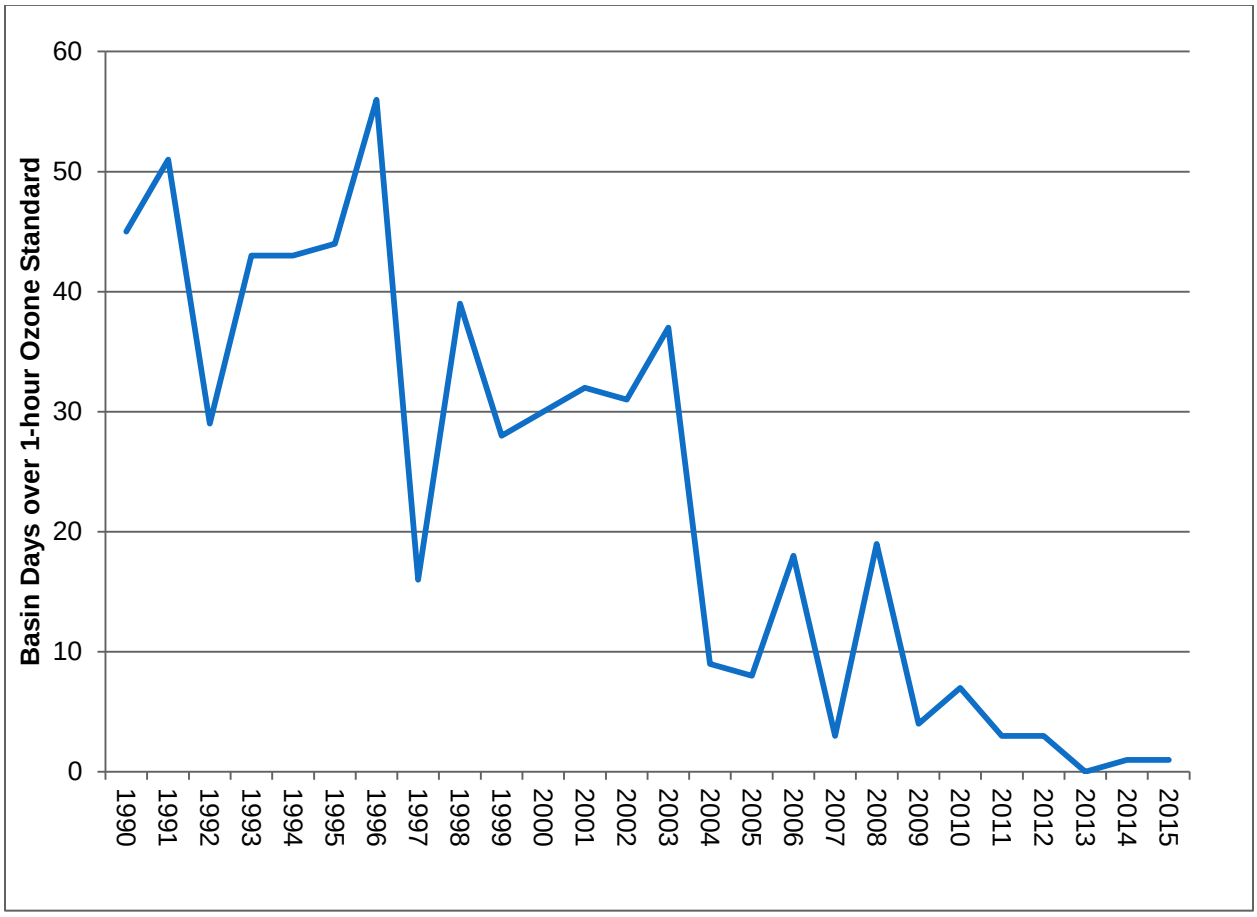
Figure 2 - 5 Improvement in 8-hour Ozone Design Values, 1995-2015



2.2.2.1 1-Hour Ozone Trends

1-hour ozone concentrations are indicative of the 8-hour ozone concentrations and provide insight as to the progress achieved for 8-hour ozone. The Valley has demonstrated tremendous progress in reducing exceedances of the federal 1-hour ozone standard of 124 parts per billion (ppb) (see Figure 2-6). In fact, through the year 2015, the Valley has completed the third consecutive year without violating the 1-hour ozone standard.

Figure 2 - 6 Basin Days Over the 1979 1-hour Ozone Standard (124 ppb)



2.2.2.2 8-Hour Ozone Progress

In addition to the great improvements in 1-hour ozone concentrations across the Valley, significant improvements have also been achieved for 8-hour ozone as well. Over the last 25 years of ozone monitoring, tremendous reductions have been observed in the design value for 8-hour ozone, days exceeding the federal 8-hour ozone standards, along with other metrics.

In the year 2015, despite strings of triple digit temperatures and multiple wildfires, the Valley had another record setting ozone season. In 2015, the Valley had the lowest number of days exceeding the current federal 75 ppb 8-hour ozone standard, and for the first time in recorded history, the Valley had zero Unhealthy AQI days in the month of July for ozone[2].

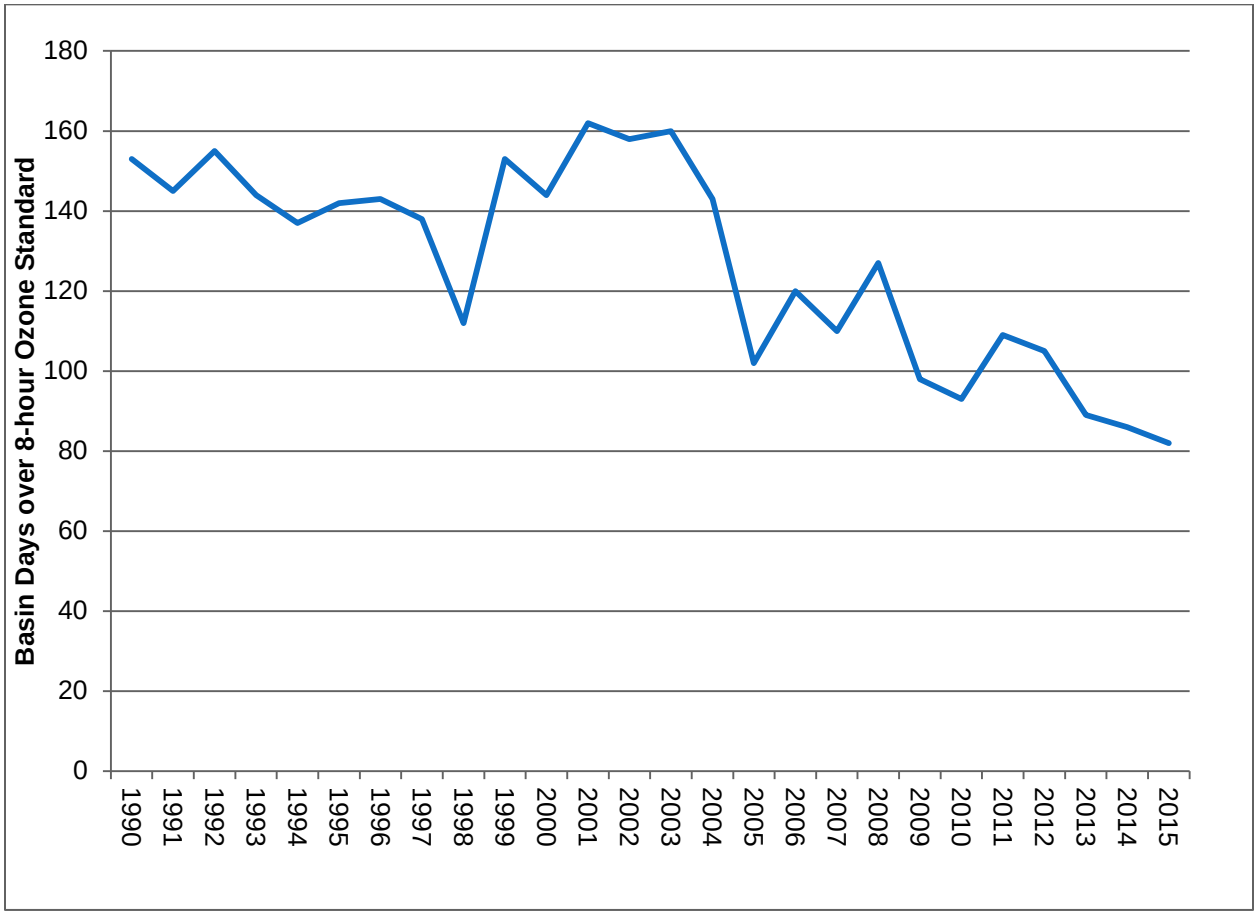
[2] Based on the 8-hour ozone AQI scale associated with the 75 ppb standard

Additionally in 2015, the Valley:

- Achieved the lowest 8-hour ozone design value on record for the Valley, the official metric used to measure progress towards meeting federal ozone standards.
- Completed the third consecutive year without violating the federal 1-hour ozone standard.
- Reduced the average number of days a resident experienced ozone levels above the 84 ppb and 75 ppb 8-hour ozone standards by 91% and 73%, respectively, since 2002.

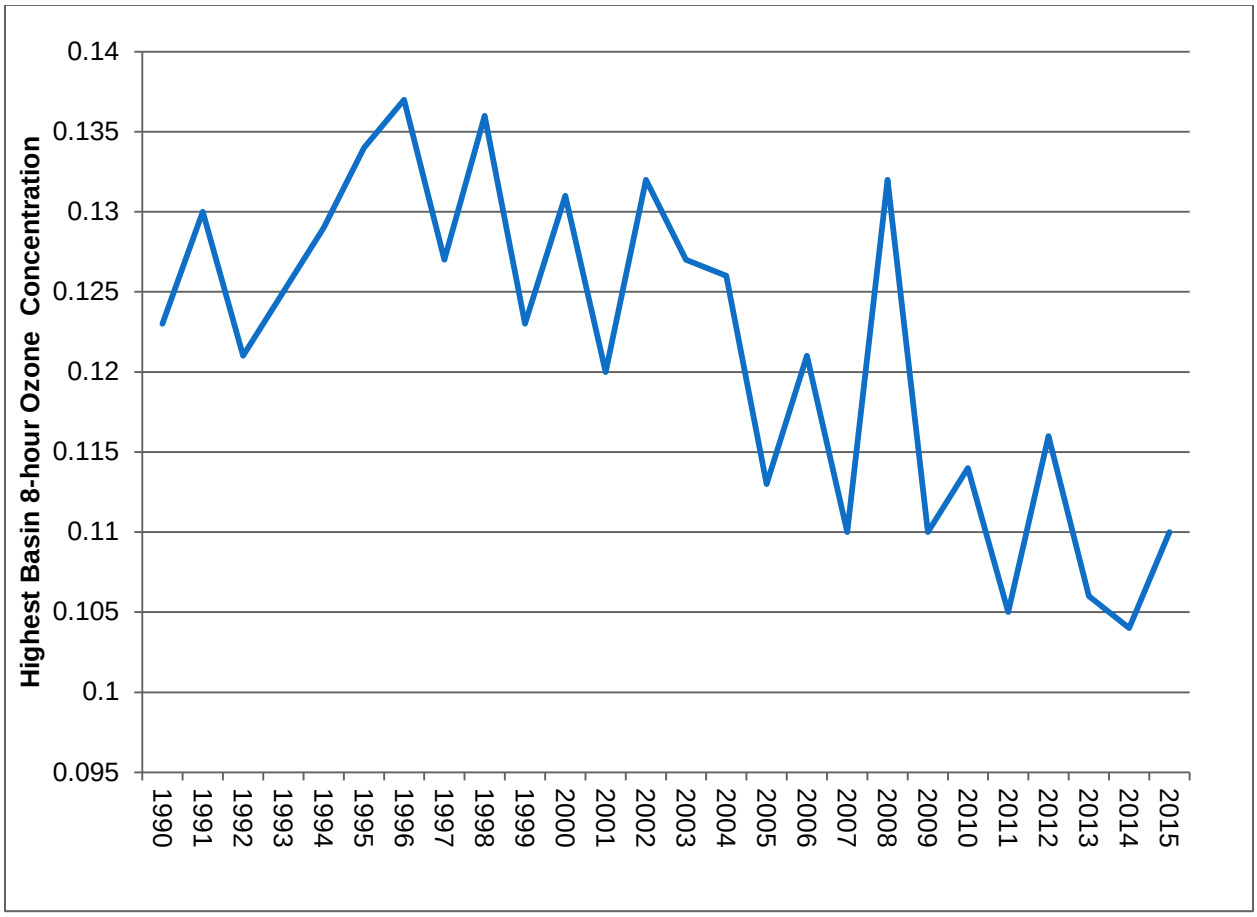
Since 1990, the Valley has experienced an over 40% decrease in the quantity of days with ozone concentrations above the 2008 8-hour ozone standard of 75 ppb (Figure 2-7).

Figure 2 - 7 Basin Days over the 2008 8-Hour Ozone Standard



Additionally, the Valley has undergone a 16% decrease in the maximum national 8-hour average ozone concentration since 1990 (Figure 2-8). The maximum national 8-hour average is the highest national 8-hour average ozone concentration in that year. The 8-hour average ozone value has lowered from 0.123 ppm in 1990 to 0.110 ppm in 2015.

Figure 2 - 8 Basin Maximum Average 8-Hour Ozone Concentrations



2.2.2.3 8-hour Ozone Design Value

For a given year, the fourth highest value is selected from the daily 8-hour maxima (as such, the highest three daily maximum 8-hour average ozone values each year do not count towards the attainment determination) and then averaged with corresponding values for the previous two years to determine attainment. The result is the three-year average of the annual fourth-highest daily maximum 8-hour ozone concentration, which is also called the "design value" for 8-hour ozone and is also the form of the standard. Table 2-3 illustrates a sample calculation. The 8-hour ozone NAAQS is met at a given monitor when the design value for that monitor is less than or equal to 0.075 ppm.

Table 2-3 Sample Design Value Calculation (Clovis Villa, 2015)

Year	Highest Daily Maximum Concentrations (ppm)			
	1st Highest	2nd Highest	3rd Highest	4th Highest
2013	0.104	0.097	0.092	**0.091**
2014	0.103	0.098	0.097	**0.097**
2015	0.098	0.095	0.093	**0.093**
			3 - Year Average:	**0.093**

As a part of the positive trend in ozone air quality, the Valley is also on track to meet the federal 8-hour ozone standard of 84 ppb ahead of the projected 2023 attainment date included in the *2007 Ozone Plan* (Figure 2-9). With the ongoing improving trend in ozone air quality, EPA also recently approved the District's 1-hour ozone clean data finding request and analysis and has officially proposed to designate the San Joaquin Valley as attainment for the 1-hour ozone standard.

Figure 2 - 9 Decrease in Valley's 8-hr Ozone Design Value

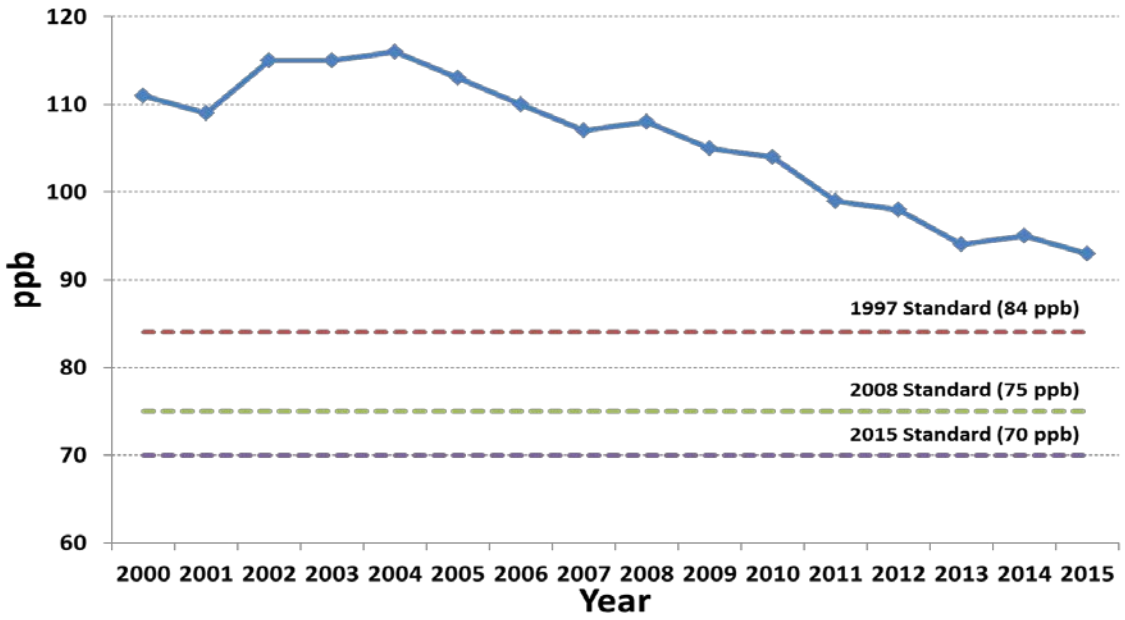
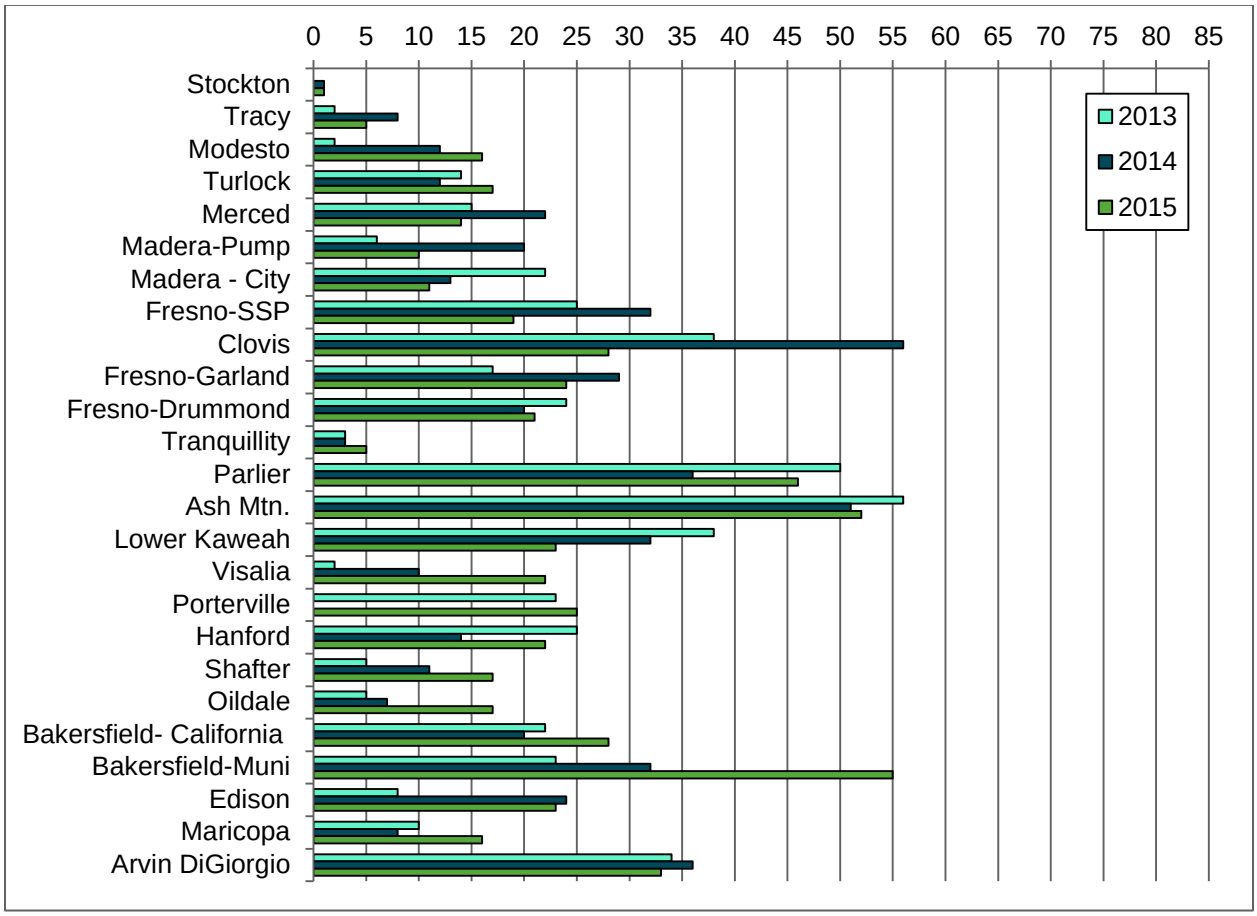


Figure 2-10 shows the number of days over the numeric value of the 8-hour standard by site for 2013, 2014, and 2015; although this is not used for attainment determinations, it illustrates that the areas of the Valley that tend to experience the greatest number of days above the 75 ppb ozone standard are Fresno/Clovis and its downwind area of Parlier, the elevated areas of Tulare County, and Bakersfield with its downwind area of Arvin. These areas will need to experience the greatest reduction in days exceeding the ozone standard for the Valley to reach attainment.

Figure 2 - 10 Quantity of Days Over the 2008 8-Hour Ozone Standard



2.3 CONCLUSION

In conclusion, although there are significant challenges in meeting the federal ozone standards, the control measures and strategies adopted by the District and ARB have resulted in substantial emissions reductions as reflected in the improving ozone metrics discussed above. Air quality will continue to improve as these measures and strategies are implemented in the coming years. In fact, current ozone trends project that the Valley will attain the 84 ppb standard before 2024, and ARB modeling analysis demonstrates that the Valley will attain the 75 ppb standard before 2031, without any further control measures other than what has already been committed to in previous plans.

Furthermore, as the District continues to develop new attainment plans to address the latest federal ozone and PM2.5 standards in the coming year, significant additional emissions reductions are expected, particularly with respect to mobile sources under ARB and EPA jurisdiction that make up over 85% of remaining Valley emissions.

Chapter 3

Implementation Requirements for 2008 8-hr Ozone Standard

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Chapter 3: Implementation Requirements for 2008 8-hr Ozone Standard

Federal Clean Air Act (CAA) Section (§)108 and §109 require the U.S. Environmental Protection Agency (EPA) to periodically review and establish health-based air quality standards (often referred to as National Ambient Air Quality Standards, or NAAQS) for six criteria pollutants, including ozone and particulates. Achieving the primary federal standards protects public health, reduces the region's health care costs, and improves the quality of life for residents of the San Joaquin Valley (Valley).

When EPA revises an air quality standard, it considers the extent to which existing EPA regulations and guidance are sufficient to implement the standard and whether any revisions or updates to those regulations and guidance would be helpful or appropriate in facilitating the implementation of the revised standards. Where the nature of revisions to a standard indicates that additional regulations or guidance may be helpful, EPA provides those to facilitate preparation of air quality attainment plans (also called state implementation plans, or SIPs). For example, EPA promulgated an implementation rule for the 2008 8-hour ozone NAAQS in 2015[1] (2015 Implementation Rule) to provide the necessary guidance to assist states with plan development. Existing regulations in 40 CFR (Code of Federal Regulations) Part 51 continue to be applicable to SIPs as well.

This chapter summarizes the Clean Air Act (CAA) requirements for areas designated as extreme nonattainment for the 2008 8-hour ozone standard of 75 parts per billion (ppb). California state standards and requirements for ozone are also summarized in this chapter.

3.1 PLAN ELEMENT SUBMITTAL DEADLINES

Table 3-1 summarizes the deadlines for specific plan elements. These deadlines are based on the designation date of an area as explained in the federal 2015 Implementation Rule and consistent with CAA requirements. EPA classified the Valley as an extreme nonattainment area effective July 20, 2012. [2015 Implementation Rule, pp. 12265-12268]

[1] Implementation of the 2008 National Ambient Air Quality Standards for Ozone: State Implementation Plan Requirements; Final Rule. 80 Fed. Reg. 44. pp. 12264-12319. (2015, March 6), (to be codified at 40 CFR Parts 50, 51, 52, et al.) http://www.gpo.gov/fdsys/pkg/FR-2015-03-06/pdf/2015-04012.pdf

Table 3-1 Submittal Due Dates for Plan Elements

Plan Element	Federal CAA §	Submittal Due Date
Emissions Inventory	182(a)(1)	July 20, 2014
Reasonably Available Control Technology (RACT) Demonstration	182(b)(2)	
Emission Statement	182(a)(3)(B)	
15 percent Rate of Progress plan*	182(b)(1)	July 20, 2015
New Source Review*	172(b)	
3 percent per year reasonable further progress plan	182(c)(2)	July 20, 2016
Serious and above area attainment demonstration plan	182(c)(2)	
Penalty Fee Program	185	July 20, 2022
Demonstration of attainment of the standard as expeditiously as practicable but not later than 20 years after designation (Extreme nonattainment area) (3-year average using data from calendar years 2029, 2030, 2031)	181(a)	July 20, 2032

*Per sections 3.3.1.5 and 3.10 of this plan, the District has already satisfied these requirements.

3.2 MODELING AND ATTAINMENT DEMONSTRATION FOR EXTREME NONATTAINMENT AREAS

Attainment demonstrations must be submitted within four years of the designation date and be based on photochemical grid modeling or an equivalent effective model.[2] The procedures for modeling ozone as part of an attainment demonstration are well developed and described in EPA's "Guidance on the use of Models and Other Analyses for Demonstrating Attainment of Air Quality Goals for Ozone, PM2.5, and Regional Haze." To demonstrate attainment, the modeling results for the nonattainment area must predict that emissions reductions will result in ozone concentrations that meet the standard based on the most recent three complete years of ambient air quality data prior to the area's attainment date. [2015 Implementation Rule, pp. 12269-12270]

As described in Chapter 6 (Attainment Demonstration, RACM, RFP, and Contingency) and Appendix H (Modeling Attainment Demonstration), photochemical modeling for this plan demonstrates that all areas of the Valley will attain the 2008 8-hour ozone NAAQS by the 2031 deadline.

3.3 REASONABLE FURTHER PROGRESS (RFP) DEMONSTRATION

Part D of the CAA contains three separate provisions regarding the RFP demonstration. The general requirement for nonattainment plans requires the plans to provide for reasonable further progress;[3] RFP is defined as "such annual incremental reductions in emissions" as required by CAA part D, or as required by EPA, for ensuring attainment of

[2] CAA §182(c)(2)(A)
[3] CAA §172(c)(2)

the NAAQS.[4] CAA subpart 2 contains specific percent reduction targets for ozone nonattainment areas classified as Moderate and above, and additional requirements specific to areas classified as Serious and above.

Areas classified as Moderate and above must reduce 15 percent of volatile organic compounds (VOC) emissions from the baseline anthropogenic emission within six years after November 15, 1990.[5] EPA refers to this RFP requirement as rate-of-progress (ROP). Whereas, areas classified as Serious and above are required to reduce VOC emissions from the baseline emissions equal to the following amount averaged over each consecutive 3-year period beginning six years after November 15, 1990 and until the attainment date:[6]

- At least three percent of baseline emissions each year; or
- An amount less than three percent of such baseline emissions each year, if the State demonstrates to the satisfaction of the Administrator that the plan reflecting such lesser amount includes all measures that can feasibly be implemented in the area, in light of technological feasibility.

To lessen the three percent requirement, a State must demonstrate to the satisfaction of the Administrator that the plan for the area includes the measures that are achieved in practice by sources in the same source category in a nonattainment area of the next higher classification. [7]

Reductions in oxides of nitrogen (NOx) may be substituted for VOC reductions provided those reductions would result in a reduction in ozone concentrations at least equivalent to that which would result from the amount of VOC emission reductions to meet the RFP requirement.[8] [2015 Implementation Rule, p. 12271]

Demonstration of RFP, as described above, is satisfied in Chapter 6 (Attainment Demonstration, RACM, RFP, and Contingency).

3.3.1 Additional Provisions to Address RFP under the 2008 Ozone NAAQS

In the 2015 Implementation Rule, EPA provides a number of provisions to address issues relevant to implementing RFP under the 2008 8-hour ozone standard as summarized below.

3.3.1.1 Baseline year

EPA is providing that states should use the calendar year for the most recently available triennial emission inventory at the time ROP/RFP plans are developed as the baseline year for RFP, which in the case of areas designated nonattainment in 2012 translates to

[4] CAA §171(1)
[5] CAA §182(b)(1)
[6] CAA §182(c)(2)(B)
[7] CAA §182(c)(2)(B)
[8] CAA §182(c)(2)(C)

2011. EPA recognizes that since the designations of most areas occurred on April 30, 2012, with an effective date 60 days after publication in the Federal Register, that 2012 is an appropriate alternative baseline year consistent with the CAA subpart 2 structure. States may use an alternate year between the years of 2008 to 2012 provided the state justifies such year is appropriate. [2015 Implementation Rule, pp. 12271-12272]

This 2016 Ozone Plan uses 2012 as the baseline year.

3.3.1.2 Emissions reductions from outside the nonattainment area

States may not take credit for VOC or NOx reductions occurring from sources outside the nonattainment area for purposes of meeting the 15% ROP and 3% RFP requirements of the CAA. [2015 Implementation Rule, p. 12273]

The District is not taking credit for emissions reductions that occur outside the nonattainment area when determining the emissions reduced to meet RFP for this 2016 Ozone Plan.

3.3.1.3 Emissions reductions measures for ROP/RFP requirements

All SIP-approved or federally promulgated emissions reductions that occur after the baseline emission inventory year from sources located in the nonattainment area are creditable for purposes of the ROP/RFP requirements, provided the reductions meet the standard requirements for creditability. [2015 Implementation Rule, p. 12274]

Only creditable emissions reductions have been used for the purposes of ROP/RFP, as demonstrated in Chapter 6 (Attainment Demonstration, RACM, RFP, and Contingency).

3.3.1.4 Pre-1990 control measures achieving de minimis reductions

EPA eliminated any obligation for states to continue to perform emissions reductions calculations for the pre-1990 control measures related to motor vehicle exhaust or evaporative emissions promulgated by January 1, 1990.[9] Therefore, States no longer need to perform the complicated calculations for these control measures to ensure that they are not credited toward the 15% ROP requirements. [2015 Implementation Rule, p. 12274]

For this 2016 Ozone Plan, no emissions reductions calculations are being performed for the pre-1990 control measures related to motor vehicle exhaust or evaporate emissions promulgated by January 1, 1990.

[9] CAA §182(b)(1)(D)(i)

3.3.1.5 ROP/RFP plan requirements for areas that fulfilled the 15% ROP plan requirement for VOC for a former ozone NAAQS

2008 ozone nonattainment areas that have previously met the CAA requirement for a 15% ROP VOC reduction plan for the entire area are not required to fulfill that requirement again, consistent with the 1997 8-hour ozone NAAQS.

EPA approved the District's 1994 Ozone Attainment Demonstration Plan and its 15% ROP demonstration in the Federal Register on January 8, 1997, effective February 7, 1997.[10] As such, the Valley has met the initial 15% ROP VOC reduction requirement.

For purposes of the 2008 ozone NAAQS, EPA interprets the RFP requirement of the CAA to require an area classified as Moderate and higher to achieve an average 3% annual reduction in VOC and/or NOx emissions for the first 6 years following the baseline year. [2015 Implementation Rule, p. 12276]

Demonstration of RFP is satisfied in Chapter 6 (Attainment Demonstration, RACM, RFP, and Contingency).

3.4 REASONABLY AVAILABLE CONTROL TECHNOLOGY (RACT) DEMONSTRATION

Plans for nonattainment areas must "provide for the implementation of all reasonably available control measures (RACM) as expeditiously as practicable (including such reductions in emissions from existing sources in the area as may be obtained through the adoption, at a minimum, of reasonably available control technology (RACT)) and shall provide for attainment of the national primary ambient air quality standards."[11]

3.4.1 Control Techniques Guidelines and Alternative Control Techniques

States are directed to refer to the existing Control Techniques Guidelines (CTGs) and Alternative Control Techniques (ACTs) documents for purposes of meeting RACT and all relevant information that is available at the time of the development of RACT SIP demonstration reports. Additionally, EPA is allowing, in some cases, for states to conclude that sources already addressed by RACT demonstrations for the 1979 1-hour and/or 1997 8-hour ozone standard do not need to implement additional controls to meet the 2008 8-hour ozone standard RACT requirement. In cases where controls were applied due to the 1979 1-hour or 1997 8-hour ozone NAAQS RACT requirement, EPA expects that any incremental emissions reductions from application of a second round of RACT controls may be small and, therefore, the cost for advancing that small additional increment of reduction may not be reasonable. [2015 Implementation Rule, pp. 12278-12280]

[10] 62 FR 1172
[11] CAA §172(c)(1)

The District adopted its 2014 RACT SIP on June 19, 2014 to satisfy requirements for the 2008 8-hour ozone standard pursuant to the proposed 2015 Implementation Rule guidance document. The 2014 RACT SIP analysis demonstrates that the District meets or exceeds RACT for all applicable NOx source categories. In addition, in developing this attainment plan, the District updated the RACT evaluation and included VOC sources in the evaluation in Appendix C (Stationary and Area Source Control Strategy Evaluations).

3.4.2 Area Wide Average Emission Rates

States may demonstrate as part of their NOx RACT SIP submittal that the weighted average NOx emission rate from all sources in the nonattainment area subject to RACT meets NOx RACT requirements; consistent with EPA's existing policy.[12] [2015 Implementation Rule, pp. 12278-12280]

The District did not use area wide average emission rates to demonstrate RACT in their 2014 RACT SIP, but instead analyzed each applicable EPA source category individually to demonstrate that the District meets or exceeds RACT.

3.4.3 Maximum Achievable Control Technology (MACT)

States may streamline their RACT analysis by including a discussion of the maximum achievable control technology (MACT) controls and considerations relevant to VOC RACT. Historically, states have been able to rely on MACT standards for purposes of showing that a source has met VOC RACT. [2015 Implementation Rule, pp. 12278-12280]

The analysis in Appendix C (Stationary and Area Source Control Strategy Evaluations) demonstrates that the District meets or exceeds RACT for all applicable EPA source categories. In addition, the District evaluated and compared the Valley's various emissions control measures to EPA's MACT controls, as applicable, in Appendix C (Stationary and Area Source Control Strategy Evaluations).

3.4.4 Implementation of RACT Measures

States must implement RACT measures as expeditiously as practicable, but no later than January 1, 2017 (the 5th year after the effective date of nonattainment designation). States have the discretion to require beyond-RACT reductions from any source, and have an obligation to demonstrate attainment as expeditiously as practicable.

Although there are scientific studies that indicate that ozone formation is NOx-limited in the Valley, and changes in anthropogenic VOC emissions will have little effect on ozone concentrations, EPA is not prepared to establish a specific definition of "negligible effect." Therefore, states will, continue to conduct RACT determinations as they historically have. Additionally, EPA does not anticipate that any current NOx-limited

[12] Nitrogen Oxides Supplement to the General Preamble, 57 FR 55625. (1992, November 25)

nonattainment areas will immediately need to develop substantive new VOC RACT SIP submissions, and therefore does not expect that retaining the current RACT guidance will have any near-term impact on states or VOC sources in current NOx-limited nonattainment areas.

The 2014 RACT SIP demonstration submitted to EPA in 2014, in combination with this 2016 Ozone Plan, satisfy requirements for the 2008 8-hour ozone standard. The 2014 RACT SIP analysis shows that the District meets or exceeds RACT for all applicable EPA source categories.

3.5 REASONABLY AVAILABLE CONTROL MEASURES (RACM) DEMONSTRATION

The RACM provision requires a demonstration that the state has adopted all reasonable measures to meet RFP requirements and to demonstrate attainment as expeditiously as practicable and thus that no additional measures that are reasonably available will advance the attainment date or contribute to RFP for the area. States should consider all available measures, including those being implemented in other areas, and adopt measures determined to be economically and technologically feasible and that will advance the attainment date or are necessary for RFP. [2015 Implementation Rule, pp. 12282-12283]

The District has comprehensively evaluated the Valley's various emissions sources and identified potential opportunities for additional emissions reductions in Appendix C (Stationary and Area Source Control Strategy Evaluations). Demonstration of RACM is satisfied in Chapter 6 (Attainment Demonstration, RACM, RFP, and Contingency).

3.6 NEW VEHICLE INSPECTION AND MAINTENANCE (I/M) PROGRAMS

No new I/M programs are currently required for areas being designated and classified nonattainment for the 2008 ozone NAAQS. [2015 Implementation Rule, p. 12283]

3.7 TRANSPORTATION CONFORMITY

Transportation conformity is required to ensure that transportation plans, transportation improvement programs (TIPs), and federally supported highway and transit projects are consistent with the purpose of the plan and will not cause new air quality violations, worsen existing violations, or delay timely attainment of the relevant standard or interim reductions and milestones. EPA's Transportation Conformity Rule[13] establishes the criteria and procedures for determining whether transportation activities conform to the SIP. In metropolitan areas (urbanized areas with a population greater than 50,000) the designated Metropolitan Planning Organization (MPO) and the Department of Transportation (DOT) must make a conformity determination with regard to the area's transportation plan and TIP for the 2008 ozone standard under the transportation conformity regulations no later than July 20, 2013 (1 year after the effective date of the nonattainment designation).

Existing 1997 8-hour ozone standard nonattainment and maintenance areas, regardless of their designation for the 2008 8-hour ozone standard, are no longer required to demonstrate transportation conformity for the 1997 8-hour ozone standard after that standard is revoked. States with previously approved Transportation Conformity plans should not need to revise those plans, unless they need to do so to ensure that existing state regulations apply in areas newly designated nonattainment for the 2008 8-hour ozone standard. [2015 Implementation Rule, pp. 12283-12284]

Demonstration of Transportation Conformity is satisfied in Appendix D (Mobile Source Control Strategy).

3.8 GENERAL CONFORMITY

Existing General Conformity Regulations remain appropriate for the 2008 ozone NAAQS and became applicable as of July 20, 2013 (one year after the effective date of nonattainment designations for the 2008 NAAQS). States with approved general conformity plans should not need to revise their plans unless they need to do so to ensure they are consistent with the April 5, 2010 revisions to the general conformity regulations to ensure the existing regulations apply in the appropriate newly designated areas. [2015 Implementation Rule, pp. 12283-12284]

[13] 40 CFR 51.390 and part 93, subpart A

3.9 CONTINGENCY MEASURES

Nonattainment areas are required to submit contingency measures for approval into the SIP. Contingency measures must provide for the implementation of specific measures without any further rulemaking action if the area fails to attain or meet a milestone for RFP or attainment.[14] Limited exceptions are allowed for Extreme nonattainment areas relying on plan provisions approved under CAA §182(e)(5).

The 3% contingency measure emissions reductions may be based entirely on NOx controls if the area has completed the initial 15% ROP VOC reduction and the state's analyses have demonstrated that NOx substitution would be most effective in bringing the area into attainment. The use of federal measures providing ongoing reductions into the future may also be used to meet contingency measure requirements for the 2008 ozone NAAQS.

The District has satisfied the 15% ROP VOC reduction requirement with the adoption and subsequent EPA approval of the District's 1994 Ozone Attainment Demonstration Plan and its 15% ROP demonstration. Additionally, this attainment plan demonstrates that the Valley is a NOx-limited area and NOx emissions reductions are the most effective way to bring the Valley into attainment.

EPA has discretion in approving Extreme nonattainment area plans that rely, in part, on future development of new control technologies for improvements of existing control technologies, where certain conditions are met.[15] This discretion can be applied as long as the state has demonstrated the following:

- All RACM, including RACT, have been included in the plan;
- The area's RFP demonstration during the first 10 years after designation does not rely on anticipated future technologies; and
- The state has submitted enforceable commitments to timely develop and adopt contingency measures to be implemented if the anticipated future technologies do not achieve planned reductions.

States may submit enforceable commitments to develop and adopt contingency measures meeting the requirements of CAA §182(e)(5) to satisfy the requirements for both attainment contingency measures in CAA §172(c)(9) and CAA §182(c)(9). CAA §182(e)(5) allows for provisions in an Extreme SIP that anticipate development of new control techniques or improvement of existing control technologies (i.e. "black box"). These enforceable commitments must obligate the state to submit the required contingency measures to EPA no later than three years before any applicable implementation date. [2015 Implementation Rule, pp. 12284-12286]

Modeling has demonstrated that the Valley will come into attainment of the 2008 8-hour ozone standard by 2031 without a Black Box. However, the federal Clean Air Act's

[14] CAA §172(c)(9) and §182(c)(9)
[15] CAA §182(e)(5)

antiquated requirement that additional emissions be withheld for attainment contingency purposes will now force the plan to rely on a Black Box to come into attainment by 2031. This is discussed in further detail in Chapter 6 (Attainment Demonstration, RACM, RFP, and Contingency).

3.10 NEW SOURCE REVIEW (NSR) REQUIREMENTS - MAJOR STATIONARY SOURCE THRESHOLDS

New Source Review (NSR) programs for nonattainment areas established in part D of the CAA contain specific requirements for the preconstruction review and permitting of new or modified major stationary sources of air pollutants.

The District satisfies this requirement through District Rule 4001 (New Source Performance Standards).

3.11 EMISSIONS INVENTORY

3.11.1 Emissions Inventory Requirements

States are required to submit periodic emissions inventories no later than the end of each 3-year period after submission of the base year inventory for the nonattainment area. The periodic inventory must include ozone season day emissions of VOC and NOx for point, nonpoint, and mobile sources and fire-related event emissions. States are required to use the reporting requirements of the Air Emissions Reporting Requirements (AERR) to determine the data elements required for such inventories, while including an additional requirement to report ozone season day emissions.

The base year inventory for the nonattainment area is due no later than 2 years after the effective date of designations, and the emissions included in this inventory must be ozone season day emissions as defined in CAA §51.1100(cc). Ozone season day emissions are the most appropriate temporal basis for developing the emissions to be included in this inventory, rather than summer day emissions as required by past implementation rules or the AERR.

Ozone season day emissions means an average day's emissions for a typical ozone season work weekday as defined in CAA §51.1100(cc). The state will select, subject to EPA approval, the particular month(s) in the ozone season and the day(s) in the work week to be represented. The selection of days should be coordinated with the conditions assumed in the development of RFP plans and/or emissions budgets for transportation conformity to allow comparability of daily emissions estimates. The days should represent the conditions that contribute to high ozone that led to a nonattainment designation. [2015 Implementation Rule, pp. 12289-12291]

The emissions inventory, based on average ozone season day emissions as described above, are reported in Appendix B (Emissions Inventory).

3.11.2 Emission Reporting Programs

States must develop emission reporting programs, called emission statement programs, for VOC and NOx sources.[16] Most areas that need an emission statement program, the Valley included, already have one in place due to a nonattainment designation for an earlier ozone standard. If an area has a previously approved emission statement rule in force for the 1997 8-hour ozone standard or the 1-hour ozone standard that covers all portions of the nonattainment area for the 2008 ozone standard, such rule should be sufficient for the purposes of the emission statement requirement for the 2008 ozone standard, and may be relied on to meet the emission statement requirement for the 2008 ozone standard. In cases when an existing emission statement requirement is still adequate to meet the requirements of this rule, states can provide the rationale for that determination to the EPA in a written statement in the plan to meet this requirement. States should identify the various requirements and how much each is met by the existing emission statement program. [2015 Implementation Rule, p. 12291]

The District adopted Rule 1160 "Emission Statements" on November 18, 1992 that applies to all owners and operators of any stationary source category which emits or may emit nitrogen oxides or reactive organic compounds and submits all information to the state as required by Section 182 (a)(3)(B) of the CAA. The District has been submitting emissions inventory data to the state since 1993 and has continued to do so each year thereafter. Unlike other inventory systems that are static, the District not only submits the required information, but looks to enhance its inventory system each year as new requirements are known or foreseen. This ensures that future information and data requirements are able to be collected, processes are streamlined, and data is managed in an efficient manner.

The District requests annual emissions inventories from all permitted sources in the San Joaquin Valley. This process starts in January of each year; the District sends (paper or email) each permitted facility an inventory statement or inventory survey form. An emissions inventory statement is required for those facilities that have actual emissions of greater than or equal to 25 tons and an emissions inventory survey form is required for sources that have potential emissions less than 25 tons. It should be noted that the 25 ton threshold is not only applied to NOx and VOC, but to CO, SOx, and PM10 / PM2.5 as well. The District processes approximately 4,500 facilities annually. This data is submitted to ARB by August of each year.

3.12 AMBIENT MONITORING REQUIREMENTS

EPA's ambient monitoring requirements establish minimum ozone monitoring requirements based on population and levels of ozone in an area to better prioritize monitoring resources.[17] The Photochemical Assessment Monitoring Station (PAMS) program collects enhanced ambient air measurements in ozone nonattainment areas

[16] CAA §182(a)(3)(B)
[17] 40 CFR part 58

classified as Serious, Severe, or Extreme, like the Valley.[18] These requirements are unchanged from previous EPA guidance. [2015 Implementation Rule, p. 12291]

The District's 2015 Air Monitoring Network Plan (Network Plan) was approved by EPA December 28, 2015. The Network Plan demonstrates that the District meets all federal ambient monitoring requirements and revises the network as needed when Valley population increases and other factors trigger the need for new monitors or other changes to the network.

3.13 QUALIFYING FOR A 1-YEAR ATTAINMENT DEADLINE EXTENSION

A nonattainment area may be eligible for a 1-year extension of its attainment date if that area that fails to attain the 2008 ozone standard by its attainment date and if for the attainment year the area's 4th highest daily maximum 8-hour ozone average is at or below the level of the standard. Thus to be eligible for the first 1-year extension, the 4th highest daily maximum 8-hour ozone value for an area would need to be at or below 0.075 parts per million (ppm). The area would be eligible for a second 1-year extension if the area's 4th highest daily maximum 8-hour ozone value, averaged over both the original attainment year and the first extension year, is at or below the level of the standard (0.075 ppm).[19] [2015 Implementation Rule, p. 12292]

The modeling performed for the development of this attainment plan demonstrates that the Valley will attain the standard by the 2031 attainment deadline, as reported in Appendix H (Modeling Attainment Demonstration). No extension of the deadline is being requested at this time.

3.14 IDENTIFICATION OF RURAL TRANSPORT AREAS

Ozone nonattainment areas that are rural in nature and that can demonstrate that sources in the area do not make a significant contribution to ozone concentrations measured in the area or in other areas may be determined to be "rural transport" nonattainment areas.[20] These areas are subject to Marginal nonattainment area requirements, regardless of the area's classification under CAA §181(a). This distinction was created for rural nonattainment areas whose ozone exceedances are the result of ozone and/or precursor transport into that area that is so overwhelming that the contribution of local emissions to concentrations above the level of the air quality standard is relatively minor and do not significantly contribute to ozone measured in other areas.

To qualify as a rural transport nonattainment area, the nonattainment area's boundary could not include or be adjacent to a current Office of Management and Budget (OMB)-defined metropolitan statistical area (MSA). Under this approach, any nonattainment

[18] CAA §182(c)(1)
[19] CAA §181(a)(5)
[20] CAA §182(h)

area associated with a Census-defined micropolitan area (areas with central county or counties containing an urban cluster of 10,000-49,999 people plus adjacent counties having a high degree of economic and social integration as measured through worker commuting) or an area too sparsely populated to be included in a census-defined statistical area, may be able to qualify as a rural transport nonattainment area. During the designation process for the 2008 ozone NAAQS, the EPA did not identify any nonattainment areas as rural transport areas. [2015 Implementation Rule, p. 12292]

EPA has not identified any rural transport areas within the Valley.

3.15 OZONE TRANSPORT

Many states are affected by transported ozone and ozone precursors from upwind states, and such transported pollution may contribute significantly to air pollution that exceeds the standards in those states. Additionally, domestic ozone air quality can also be affected by emissions sources located across United States borders in Canada and Mexico, and even from other continents. Contributions to ozone concentrations from sources outside of the United States can affect to varying degrees the ability of some areas to attain and maintain the 2008 ozone standard. The following is a summary of EPA guidance with respect to interstate and international ozone transport.

3.15.1 Interstate Transport

There are two CAA provisions identifying the states' responsibilities to address interstate transport. States are to include provisions in their infrastructure plans to prohibit any source or other type of emissions activity in one state from contributing significantly to nonattainment, or interfering with maintenance, of an air quality standard in another state.[21] States are directed to include provisions to establish a notification process in their infrastructure plans through which downwind jurisdictions can be alerted to specific sources of transported pollution.[22] The EPA implementation rule does not address these requirements relating to transport. EPA has committed to address the transport in a separate action. [2015 Implementation Rule, p. 12293]

3.15.2 International Transport

EPA may approve an attainment demonstration for a nonattainment area if:

- The attainment demonstration meets all other applicable requirements of the CAA; and
- The submitting state can satisfactorily demonstrate that, "but for emissions emanating from outside of the United States," the area would attain and maintain the ozone standard, including consideration of emissions from North America or intercontinental sources.[23]

[21] CAA §110(a)(2)(D)(i)
[22] CAA §126
[23] CAA §179B

Although monitored data cannot be excluded for a determination of whether an area has attained a standard based solely on the fact that data are affected by emissions from outside the United States, such data may be excluded from consideration if they were significantly influenced by exceptional events as described in CAA §319(b). Where international transport meets the criteria and procedural requirements contained in the EPA's Exceptional Events Rule,[24] it may be addressed by that rule. [2015 Implementation Rule, p. 12293]

3.16 CLEAN AIR ACT SECTION 182(F) NOx PROVISIONS

Per CAA §182(b)(2) and §182(f), ozone nonattainment areas are required to implement RACT for sources that are subject to CTGs and for major sources of VOC and NOx. Under certain circumstances an area may be granted a NOx waiver. A state with a previously approved NOx waiver for the 1979 1-hour or 1997 8-hour ozone standard would need to submit a new request for an exemption that is supported by analyses specific to the 2008 ozone standard. The new request should consider any relevant information developed after the 1979 1-hour or 1997 8-hour ozone standard waivers were granted. The January 14, 2005 memo[25] provides guidance on appropriate documentation for a waiver request for application to the 8-hour ozone program. [2015 Implementation Rule, p. 12294]

The District does not have a NOx waiver for the 1979 1-hour or the 1997 8-hour ozone standard and does not intend to request one for the 2008 8-hour ozone standard.

3.17 CLEAN FUELS

Section 182(e)(3) of the federal CAA directs extreme nonattainment areas to require: "that each new, modified, and existing electric utility and industrial and commercial boiler which emits more than 25 tons per year of oxides of nitrogen:

- Burn as its primary fuel natural gas, methanol, or ethanol (or comparable low polluting fuel), or
- Use advanced technology (such as catalytic control technology or other comparably effective control methods) for reduction of emissions of nitrogen."

District Rules 4305, 4306, and 4352 address NOx emission limits for the boilers in this category. Most of the boilers under Rules 4305 and 4306 are fired on natural gas and therefore satisfy the requirement of paragraph (A) above. Liquid-fuel fired boilers are also addressed by those rules and the applicable NOx emission limits satisfy the requirement of paragraph (B) above. Solid-fuel fired boilers are addressed by Rule 4352 and the applicable NOx emission limits satisfy the requirement of paragraph (B)

[24] 40 CFR 50.14
[25] Page, Stephen D., Director. Guidance on Limiting Nitrogen Oxides Requirements Related to 8-hour Ozone Implementation. Office of Air Quality Planning and Standards, to Air Directors, Regions I-X.

above. The District already complies with this requirement and there is no need to include additional control measures in this plan to satisfy this section of the federal CAA.

3.18 CALIFORNIA STATE STANDARDS

California sets ambient air quality standards for several pollutants, including ozone. The California ambient air quality standards are considerably more stringent than the federal standards and are more protective of human health. California's 1-hour ozone standard is 90 ppb, and its 8-hour ozone standard is 70 ppb. Despite the more stringent California standards, California Health and Safety Code §39602 states, "Notwithstanding any other provision of this division, the state implementation plan shall only include those provisions necessary to meet the requirements of the [federal] CAA." Therefore, this *2016 Ozone Plan* focuses on demonstrating attainment with the federal NAAQS. While the federal standards provide the framework for SIPs, including this ozone plan, progress toward federal standards also brings areas closer to attainment of the lower, California standards.

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Chapter 4

Scientific Foundation and Ozone Modeling Results

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Chapter 4: Scientific Foundation and Ozone Modeling Results

As a pollutant, ozone has been studied and measured in the San Joaquin Valley air basin (Valley) and across the nation for decades. The San Joaquin Valley Air Pollution Control District (District), California Air Resources Board (ARB), U.S. Environmental Protection Agency (EPA), and private partners have invested millions of dollars into the San Joaquin Valley-wide Air Pollution Study Agency (Study Agency) field studies, analyses, and modeling to build a strong scientific foundation for the District's ozone attainment plans. This *2016 Plan for the 2008 8-hour Ozone Standard* (*2016 Ozone Plan*) evaluates and builds upon existing scientific information to extend the District's ozone air pollution control strategy to attain the increasingly stringent National Ambient Air Quality Standards (NAAQS).

The Study Agency was established in 1985 under a joint-powers agreement between local counties and includes input from air districts, ARB, EPA, public and private industry representatives, and other governmental agencies to create a cooperative and unbiased research program. The Study Agency has developed and funded extensive ozone research specific to the Valley. The Study Agency's main purpose is to further the scientific understanding of regional air quality issues to assist regulatory agencies in attainment strategy and policy development.

This chapter summarizes the contributions to the Valley's 8-hour ozone levels, ozone research, trends in the Valley's 8-hour ozone concentrations, and projections of 8-hour ozone that show attainment of the 2008 standard by 2031. For more information, see Appendix A (Modeling Attainment Demonstration), Appendix B (Modeling Emissions Inventory), and Appendix I (Photochemical Modeling Protocol).

4.1 THE NATURE AND FORMATION OF OZONE

Ozone (O_3), a molecule of three oxygen atoms, is a product of atmospheric reactions involving volatile organic compounds (VOCs), oxides of nitrogen (NOx), the hydroxyl radical (HO), other radicals, and sunlight. As such, ozone is not emitted directly but, rather, is formed secondarily. Ozone is found in two regions of the Earth's atmosphere: the upper regions of the atmosphere (the stratosphere), where the ozone layer is effective in absorbing the sun's ultraviolet radiation; and ground-level (or tropospheric) ozone. At high concentrations, this ground-level ozone can be harmful to public health and can degrade the environment.

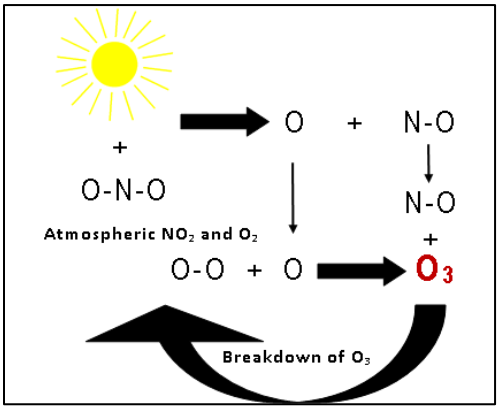
The Valley's ozone levels are a function of geography and natural environment (including meteorology), the production and presence of ozone precursors (e.g. NOx and VOCs), the atmospheric chemistry that controls the ozone life cycle, and the import of non-Valley emissions into the Valley. All of these factors, except geography, vary throughout the year, but during the summer months they combine to account for the Valley's highest annual ozone concentrations.

4.1.1 The Ozone Life Cycle

In a balanced atmosphere, where precursor VOC and NOx emissions are relatively low, ground-level ozone is created and destroyed at the same rate. This regulates diurnal ozone levels and keeps Ozone (O_3) at an acceptable background concentration. This ozone life cycle occurs continuously while sunlight is present, but ends at nightfall.

The following reactions summarize the equilibrium ozone life cycle process (see Figure 4-1):

Figure 4-1 Ozone Life Cycle

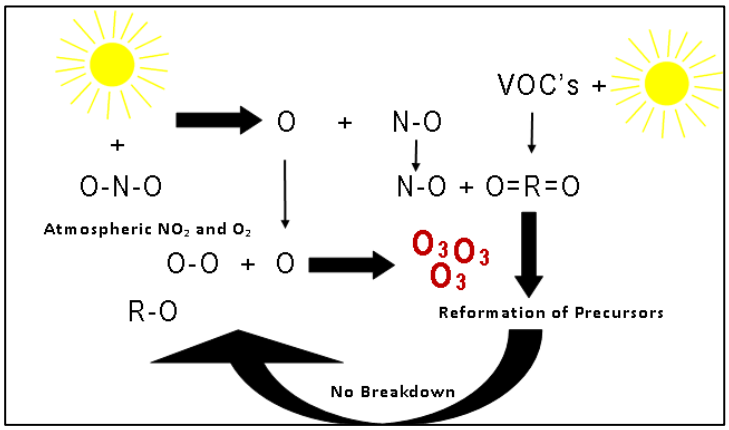


1. NO_2 + photon energy from the sun → NO + O
2. O + O_2 → O_3 (*ozone formed*)
3. O_3 + NO → NO_2 + O_2 (*ozone breaking down*) The O_3 molecule is a very strong oxidizing agent. It is very willing to give away the additional oxygen atom to another molecule and become the more stable O_2.

Unfortunately, ideal equilibrium in the Valley is rarely reached as the ozone life cycle becomes unbalanced in the presence of elevated VOC and NO_x emissions. Biogenic VOC emissions are especially high during the Valley's summer ozone season. The same photon energy that reacts with NO_2 in the balanced reaction set also reacts with ozone in the presence of water (humidity) to form hydroxyl radicals (HO) that quickly oxidize VOCs to produce peroxy radicals (RO_2), which in turn react quickly with dissociated NO to form NO2, bypassing the ozone consumption or breakdown process.

The following set of reactions summarizes this alternate chain of events (see Figure 4-2):

Figure 4 - 2 Alternate Ozone Cycle

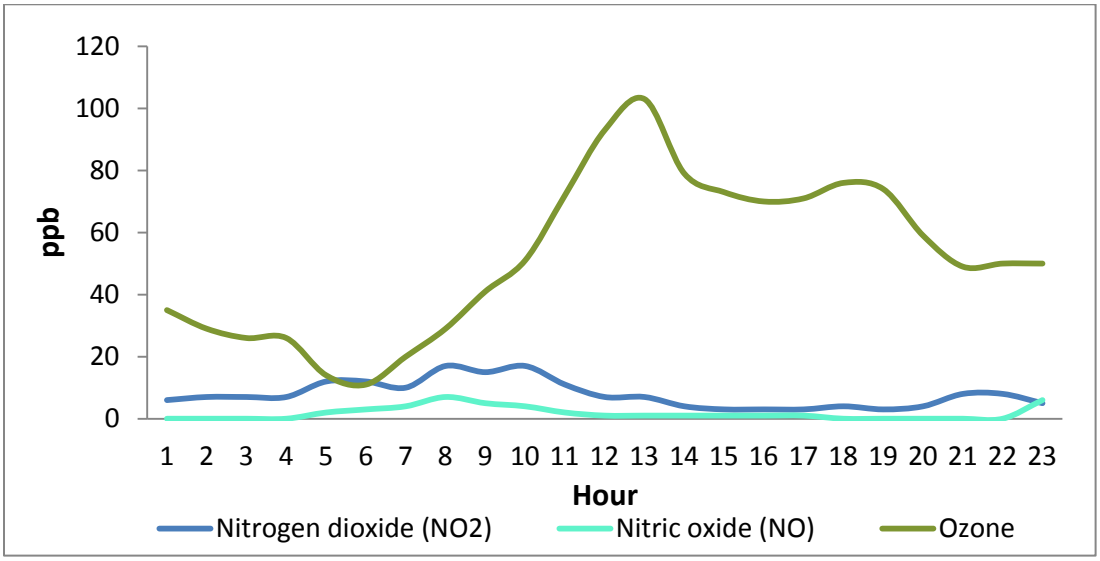


1. NO_2 + photon energy from the sun → NO + O
2. O + O_2 → O_3 (*ozone formed*)
3. RO_2 + NO → RO + NO_2 (*ozone does NOT break down*)

The multi-step breakdown of VOCs (mostly naturally occurring or biogenic) regenerates radicals, which work as the fuel, or catalyst, consuming the dissociated NO and driving the ozone production cycle and bypassing the breakdown of O_3.

This catalytic process is cut off at night, as this removes the photon energy input. Therefore, once the sun sets, ozone levels begin to fall. Figure 4-3 is an example of the diurnal photochemical ozone formation process under unbalanced conditions and shows the concentration of NO, NO_2, and ozone throughout the hours of a common summer day. The day begins with low ambient levels of NOx (NO and NO_2) and ozone. As the morning commute begins, motor vehicle traffic directly emits NOx pollutants create a rise in NOx concentration. The influx of NOx emissions between hours four and seven provide the initial startup of the rapid, unchecked photochemical production of ozone beginning at hour five and increasing into the late afternoon. As ozone production increases, NO and NO_2 are quickly consumed by the VOC reactions and these concentrations quickly approach zero. In the early evening, with waning sunlight and decreasing photon energy, ozone production ceases and its concentration rapidly diminishes as NO and NO_2 levels return to normal ambient levels.

Figure 4 - 3 Photochemical Process for a Valley Summer Ozone Day*



* Diurnal Photochemical Process (Fresno-Drummond, July 27, 2014)

While biogenic VOC emissions are prevalent throughout the Valley, additional VOC emissions from the combustion of fossil fuels combined with NOx emissions from the same mobile and stationary sources found in metropolitan areas helps give rise to the highest concentrations of ground-level ozone in the Valley.

4.1.2 Relative Roles of VOCs and NOx in Ozone Formation

Both VOC and NOx emissions contribute to the formation of ozone. Under high-NOx and low-VOC conditions, the reaction is more sensitive to the amount of VOCs and is considered a *NOx-rich regime*. Alternatively, when the atmosphere is under high-VOC and low-NOx conditions, the formation of ozone is influenced by a *NOx-limited regime*, which means ozone formation is sensitive to changes in NOx concentration.

Determination of an ozone formation regime requires an understanding of chemical kinetics and the ability to model the spatial and temporal intricacies of the interactions between reactants and products. To date, grid-based photochemical models remain the best available tool to determine relative precursor limitations. Modeling shows that the Valley is a *NOx-limited regime*, especially in projections of future years. For this reason, the District focuses its emissions reductions efforts on NOx reductions, as they are most effective in reducing Valley ozone concentrations.

As proven through extensive modeling and successful reduced ambient ozone levels based on NOx-centric strategies, developing VOC reduction strategies based on a *NOx-rich* regime would not be effective in the Valley. While understanding VOC reactivity is an important component of ozone plan analysis, the Valley's ozone formation has transitioned to a NOx-limited regime; therefore, NOx reductions are the most effective way to reduce Valley ozone concentrations.

4.1.3 The Propensities of Different VOCs to Form Ozone

The potential of VOCs to form ozone is specific to the type of VOC. VOCs include many different compounds, each with different properties that contribute differently to ozone formation. These differences in ozone forming potential, or *propensities*, of VOCs are quantified as ozone *reactivities*.

VOC *reactivity scales* have been developed to measure the ozone forming potential of individual VOCs,[1,2,3] of which the most frequently used is the *maximum incremental reactivity* (MIR) scale.[4,5] Incremental reactivity is defined as the amount of additional ozone formation, under optimal NOx conditions, resulting from an addition of a small amount of the given VOC to the system in which ozone is formed, divided by the amount of VOC added. While understanding VOC reactivity is an important component of ozone plan analysis, research and modeling have shown that the Valley has transitioned to a NOx-limited regime; therefore, NOx reductions are the most effective strategy for reducing Valley ozone concentrations.

4.1.4 Trans-Boundary Emissions and Policy-Relevant Background Ozone

As ozone research continues, evidence is mounting that ozone formation is not only affected by precursor emissions originating within the Valley, but is in part affected by trans-boundary emissions; in other words, pollutants are migrating from sources outside the Valley and settling within the Valley. This issue has given rise to the term *United*

[1] Bowman, F. M. & Seinfeld, J. H. (1994). Ozone Productivity of Atmospheric Organics. *Journal of Geophysical Research, 99*, 5309–5324.
[2] Bowman, F. M. & Seinfeld, J. H. (1994). Fundamental Basis of Incremental Reactivities of Organics in Ozone Formation in VOC/NOx Mixtures. *Atmospheric Environment, 28*, 3359–3368.
[3] Carter, W.P.L (1994). Development of Ozone Reactivity Scales for Volatile Organic Compounds. *Journal of the Air & Waste Management Association, 44*, 881–899.
[4] Carter, W.P.L (1994). Development of Ozone Reactivity Scales for Volatile Organic Compounds. *Journal of the Air & Waste Management Association, 44*, 881–899.
[5] Carter, W.P.L., Pierce, J.A., Luo, D., & Malkina, I.L. (1995). Environmental Chamber Study of Maximum Incremental Reactivities of Volatile Organic Compounds. *Atmospheric Environment, 29*, 2499–2511.

States Background (USB) ozone, previously referred to as *policy relevant background*, which is defined as the surface ozone concentration that would be present over the U.S. in the absence of North American anthropogenic (human caused) emissions. USB ozone includes emissions from both biogenic (plant life) and trans-boundary sources.

The 1990 amendments to the Clean Air Act (CAA) recognize the potential threat of trans-boundary ozone flow to attainment. While not absolved from implementing reasonably available controls to reduce emission from sources under their control, CAA §179B (International Border Areas), mandates that state, local, and regional authorities will not be penalized or otherwise burdened and held responsible for the impact of pollution emissions from foreign sources: [6]

> *Notwithstanding any other provision of law, any State that establishes to the satisfaction of the Administrator that, with respect to an ozone nonattainment area in such State, such State would have attained the national ambient air quality standard for ozone by the applicable attainment date, but for emissions emanating from outside of the United States, shall not be subject to the provisions of section 181(a)(2) or (5) or section 185.*[7]

As emissions in many other parts of the world increase, both the relative and absolute contributions of international transport to U.S. air quality problems have increased, especially in the western continental United States (U.S.). Evidence collected to date suggests that the incremental contributions of these flows into U.S. regions will affect air quality degradation on the same order of magnitude as the incremental air quality improvements that are expected to result from some of the tightening of the NAAQS.[8] As air districts, especially those along the west coast and in higher elevations in the western U.S., plan for attainment of the 2008 standard, and perhaps more stringent standards in the future, the understanding of such trans-boundary ozone flow will be of great importance.

The volume of research on trans-boundary ozone has grown considerably in the past 10 years. Transport of ozone to North America from Asia along prevailing air currents is now well-established in the scientific literature.[9] Driven by increasing fossil fuel combustion, tropospheric ozone concentrations entering the west coast of the U.S. have

[6] Clean Air Act, U.S.C. § 7509a.
[7] Carter, W.P.L., Pierce, J.A., Luo, D., & Malkina, I.L. (1995). Environmental Chamber Study of Maximum Incremental Reactivities of Volatile Organic Compounds. *Atmospheric Environment, 29*, 2499–2511. Note: The U.S. Chamber of Commerce and other interested parties have complained that EPA has provided no clear, consistent guidance to state, local, and regional authorities seeking to account for the impact of foreign emissions in calculating attainment of CAA standards.
[8] National Research Council. (2009). Global Sources of Local Pollution: An Assessment of Long-Range Transport of Key Air Pollutants to and from the United States. Washington, DC: The National Academies Press, p. 31. Retrieved from http://www.nap.edu/catalog.php?record_id=12743#toc
[9] Hudman, R. C., Jacob, D. J., Cooper, O. R., Heald, C.L., Park, R.J. ... Ryerson, T. (2004) Ozone Production in Transpacific Asian Pollution Plumes and Implications for Ozone Air Quality in California. *Journal of Geophysical Research: Atmospheres, 109,* D23S10.

increased by about 10 parts per billion (ppb) from the mid-1980s to the mid-2000s.[10] Closely related to this trend, NOx emissions from southern and eastern Asia increased 44% during the 2001 to 2006 timeframe. During the same period, NOx emissions in China rose 55%.[11] In contrast, European ozone precursor emissions decreased by more than 33% from 1990 to 2005 and by a comparable level in the U.S. from 1985 to 2008. Furthermore, a recent study of trans-boundary ozone flows into western North America from 1995 to 2008 found a comparable upward annual trend in ozone (0.80 ppb per year) on those days when air masses transported across the Pacific Ocean had originated in China, India, and Southeast Asia.[12]

Such understanding of trans-boundary flow has direct implications for establishing reasonably accurate USB levels. Air quality agencies will use the USB level to create accurate emission and transport models that form the foundation for cost-effective control measures. For example, if the Valley USB ozone level is underestimated, subsequent emission controls put on local, regional, or state precursor sources may fail to achieve expected ozone reductions. Ongoing research on trans-boundary and USB ozone will be key in future policy decisions and the establishment of subsequent federal ozone standards.

4.2 AIR QUALITY RESEARCH FOCUSED ON OZONE

Because of its unique combination of geography, meteorology, and chemistry, the Valley continues to be one of the most studied airsheds in the world. On a number of academic and professional fronts, including the efforts of the Study Agency, a substantial amount of research has focused on ozone in the Valley. In addition to Study Agency and District sponsored research, many academic groups, independent from the District, regularly study the air quality dynamics of Valley and contribute to the body of shared knowledge. It is this shared knowledge that informs the District's planning process and guides the ultimate success and implementation of its attainment plans.

4.2.1 Central California Ozone Study

The Central California Ozone Study (CCOS) is the most recent major Study Agency field program to analyze ozone in the Valley. CCOS was conducted during the summer of 2000 and included extensive monitoring throughout the Valley and surrounding regions to provide a robust and spatially dense dataset for a large portion of California. Many subsequent research projects have taken advantage of CCOS data to provide a better understanding of ozone in the Valley. The results from these studies have given academics and air quality regulators alike a more robust understanding of Valley ozone

[10] Oltmans, S. J., Lefohn, A. S., Harris, J. M., & Shadwick, D. S. (2008). Background Ozone Levels of Air Entering the West Coast of the U.S. and Assessment of Longer-Term Changes. *Atmospheric Environment, 42*, 6020–6038.
[11] Zhang, Q., Streets, D.G., Carmichael, G.R., He, K.B., Huo, H., Kannari, A. … Yao, Z.L.. (2009). Asian Emissions in 2006 for the NASA INTEX-B Mission. *Atmospheric Chemistry and Physics, 9*, 5131–5153. Retrieved from http://www.atmos-chem-phys.net/9/5131/2009/acp-9-5131-2009.pdf
[12] Cooper, O.R., Parrish, D.D., Stohl, A., Trainer, M., Nédélec, P., Thouret, V. … Avery, M.A. (2010). Increasing Springtime Ozone Mixing Ratios in the Free Troposphere over Western North America. *Nature, 463,* 344–348.

formation and have aided in the development of the most effective control strategies in the nation.

4.2.2 PAMS Monitoring

The District participates every year in EPA's enhanced Photochemical Assessment Monitoring Stations (PAMS) program. PAMS sites measure ozone precursors, including NOx and VOC, in addition to a variety of meteorological parameters in serious, severe, or extreme ozone nonattainment areas. The District's current PAMS monitoring network is comprised of two smaller networks focused on the Fresno and Bakersfield metropolitan statistical areas (MSAs) as shown in Figure 4-4. Each of these MSAs include three PAMS sites, with each site filling the role of either a Type 1, Type 2, or Type 3 site:

- Type 1 PAMS sites monitor morning upwind ozone and ozone precursor concentrations
- Type 2 PAMS sites monitor morning ozone and ozone precursor concentrations at the downwind edge of the central business district
- Type 3 PAMS sites monitor peak afternoon ozone concentration downwind of the MSA

PAMS monitoring sites are usually established at existing state and local air monitoring stations (SLAMSs). Table 4-1 summarizes the sites that make up the Valley's PAMS network. There is currently no Type 3 PAMS monitor in the Bakersfield MSA because the Arvin-Bear Mountain air monitoring site was closed in 2010. PAMS monitoring in Arvin will resume once a permanent air monitoring site in the area is established.

Table 4-1 San Joaquin Valley PAMS Monitoring Network

MSA	Type 1	Type 2	Type 3
Fresno	Madera-Pump	Clovis	Parlier
Bakersfield	Shafter	Bakersfield-Muni	--

Valley PAMS monitoring typically occurs each summer from June to August, when ozone concentrations tend to reach annual maximums. Through Valley PAMS monitoring, over 50 VOCs are measured and analyzed. Table 4-2 lists the targeted and measured compounds for the PAMS program.

Figure 4 - 4 Locations of the Valley PAMS Monitoring Network

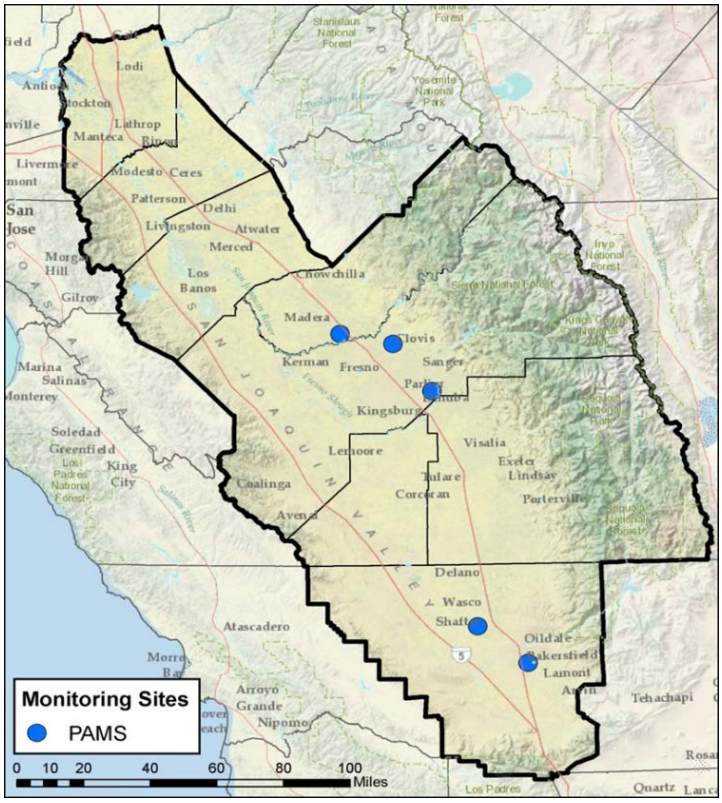


Table 4-2 PAMS VOC Target Species

Hydrocarbons			
Ethylene	t-2-pentene	2,3-dimethylpentane	n-Nonane
Acetylene	c-2-pentene	3-methylhexane	Isopropylbenzene
Ethane	2,2-Dimethylbutane	2,2,4-trimethylpentane	n-Propylbenzene
Propylene	Cyclopentane	n-Heptane	m-Ethyltoluene
Propane	2,3-dimethylbutane	Methylcyclohexane	p-Ethyltoluene
Isobutane	2-methylpentane	2,3,4-trimethylpentane	1,3,5-Trimethylbenzene
1-Butene	3-Methylpentane	Toluene	o-Ethyltoluene
n-Butane	2-Methyl-1-Pentene	2-methylheptane	1,2,4-trimethylbenzene
t-2-Butene	n-hexane	3-methylheptane	n-Decane
c-2-Butene	Methylcyclopentane	n-Octane	1,2,3-trimethylbenzene
Isopentane	2,4-dimethylpentane	Ethylbenzene	m-Diethylbenzene
1-Pentene	Benzene	m&p-Xylenes	p-Diethylbenzene
n-Pentane	Cyclohexane	Styrene	n-Undecane
Isoprene	2-methylhexane	o-Xylene	
Carbonyls			
Formaldehyde	Acetone	Acetaldehyde	

4.2.3 Transboundary Ozone Research in the Valley

The District began investigating the influence of transboundary background ozone following anomalously high ozone values measured at rural sites. A study by National Oceanic and Atmospheric Administration (NOAA) found evidence of trans-boundary ozone flow from Asia that significantly impacted ground-level ozone monitors in the northern Sacramento Valley. Additionally, daily flows of transboundary ozone were found to be highly correlated with ozone exceedance events in Butte County, CA.

Based on these results, the District awarded the University of California Davis a $130,000 research grant in 2011 for the installation of a transboundary ozone and PM2.5 monitoring station on Chews Ridge, east of Big Sur (see Figure 4-5). The site sits at 5,200 feet elevation and is the home of Monterey Institute for Research in Astronomy Observatory. The goal of this work was to investigate whether transboundary ozone was mixing downward into the Valley boundary layer and subsequently transported to ambient monitors. The project included bimonthly air flights over the Valley and the Chews Ridge during peak ozone season.

Figure 4 - 5 Chews Ridge in Relation to the Valley



In addition, the District awarded a $100,000 grant to the same UC Davis research team in 2013 to conduct a more intensive flight campaign over the course of the ozone season. A total of four experimental flights lasting three days occurred during periods of ozone buildup. Data collection included north to south Valley transects in the Valley boundary layer and free troposphere as well as spiral transects in the south Valley around Bakersfield. The research design built on previously published research by NOAA scientists in the 2010 CalNEX campaign that estimated Bakersfield ozone enhancements from transboundary flows of 12-23% on peak days.

In partnership with NASA's Air Quality Applied Science Team (AQAST), the District recently organized a scientific conference on transboundary anthropogenic ozone. The *2015 Transboundary Ozone Pollution Conference* provided a forum for researchers to share their latest findings in this field with air quality managers and other atmospheric scientists. Results from the District-funded UC Davis studies were among the many presentations that detailed the growing body of research and knowledge regarding ozone transport. The meeting was successful in guiding the District's policy and attainment strategies while encouraging all air quality entities to continue to fund meaningful research regarding USB ozone levels. All presentations from the conference can be accessed at http://www.valleyair.org/topc.

While the majority of the Valley's ozone pollution is caused by local sources and geological features that trap pollution, many modelers and researchers in attendance at the conference agreed that policy relevant background/baseline ozone levels are higher than originally estimated. While EPA asserts USB in the Valley is roughly 35 ppb,[13] recent field research and the development of updated models show baseline levels higher than 50 ppb. Given the District's unmatched challenges in mitigating ozone pollution, and the recently adopted new federal 8-hour ozone standard of 70 ppb, it is clear that further investigation in understanding and limiting transboundary ozone intrusion is necessary in order for the District to continue to plan for attainment.

[13] Zhang et al. (2011) Establishing Policy Relevant Background (PRB) Ozone Concentrations in the United States. Environmental Science & Technology, 45(22), 9484-97.

4.4 MODELING

[This section provided by the California Air Resources Board]

Modeling 8-Hour Ozone for the SJV's 2016 State Implementation Plan for the 75 ppb 8-Hour Ozone Standard

Photochemical modeling plays a crucial role in the SIP process to demonstrate attainment of air quality standards based on estimated future emissions and for the development of emissions targets necessary for attainment. Currently, the San Joaquin Valley nonattainment area (SJV or the Valley) is designated as an extreme ozone nonattainment area for the 2008 0.075 ppm (or 75 ppb) 8-hour ozone standard and must demonstrate attainment of the standard by 2031. Consistent with U.S. EPA guidelines for model attainment demonstrations (U.S. EPA, 2014[14]), photochemical modeling was used to estimate the future year 2031 ozone (O_3) design values (DVs) at each monitoring site in the Valley in order to show attainment of the standard by 2031.

The findings of the Valley's model attainment demonstration are summarized below. Additional information and a detailed description of the procedures employed in this modeling are available in the Modeling Attainment Demonstration and Modeling Protocol Appendices of this document.

The current modeling approach draws on the products of large-scale, scientific studies in the region, collaboration among technical staff of State and local regulatory agencies, as well as from participation in technical and policy groups within the region. (See Modeling Protocol Appendix for further details). In this modeling work, the Weather Research and Forecasting (WRF) numerical model version 3.6 was utilized to generate meteorological fields, while the Community Multiscale Air Quality (CMAQ) Model version 5.0.2 was used for modeling ozone in the Valley. Other relevant information, including the modeling domain definition, chemical mechanism, initial and boundary conditions, and emissions preparation can be found in the Modeling Protocol and Modeling Emissions Inventory Appendices.

Based on U.S. EPA modeling guidance (U.S. EPA, 2014[1]), modeling was used in a relative sense to project observed DVs to the future. The year 2012 was chosen as the starting point for the modeling and reference (or baseline) DV calculation based on analysis regarding the conduciveness of recent years' meteorological conditions to enhanced ozone formation (i.e., meteorology in 2012 was particularly favorable for ozone formation and buildup) and the availability of the most detailed emissions inventory. These reference DVs serve as the anchor point for estimating future year projected design values. The year 2031 was the future year modeled in this attainment demonstration since that is the year for which attainment must be demonstrated.

[14] U.S. EPA, 2014, Draft Modeling Guidance for Demonstrating Attainment of Air Quality Goals for Ozone, PM2.5 and Regional Haze, available at https://www.epa.gov/ttn/scram/guidance/guide/Draft_O3-PM-RH_Modeling_Guidance-2014.pdf

DVs are the three-year average of the annual 4th highest 8-hour O_3 mixing ratio observed at each monitor and are used to determine compliance with the standard. In the attainment demonstration, the U.S. EPA recommends using an average of three DVs to account for the year-to-year variability in meteorology, so DVs were calculated for the three year period ending in 2012, 2013, and 2014 and then the three DVs were averaged. This average DV is called a weighted DV (see the 2nd column of Table 4-4 for the weighted DVs utilized in the attainment demonstration modeling).

In order to use the modeling in a relative sense, three simulations were conducted: 1) base year simulation for 2012, which was used to verify that the model reasonably reproduced the observed air quality; 2) reference year simulation for 2012, which was the same as the base year simulation, but excluded exceptional event emissions such as wildfires; 3) future year simulation for 2031, which was the same as the reference year simulation, except projected emissions for 2031 were used in lieu of the 2012 emissions.

Table 4-3 summarizes the 2012 and 2031 SJV anthropogenic emissions used in the attainment demonstration modeling. Overall, anthropogenic NOx was projected to decrease by roughly 60% between 2012 and 2031 from 339.5 tpd to 131.9 tpd. In contrast, anthropogenic ROG was projected to decline by 12% from 337.2 tpd to 296.7 tpd. Biogenic ROG emissions were held constant between all simulations with summer average emissions estimated at 1323 tpd for the Valley.

Table 4-3 Summer emission inventory totals (CEPAM v1.03) for 2012 and 2031. Biogenic emission totals are averaged over May – September, 2012

Source	NOx			ROG		
	2012 [tpd]	2031 [tpd]	Percent Difference	2012 [tpd]	2031 [tpd]	Percent Difference
Stationary	42.4	29.5	-30	85.3	100	+17
Area	4.7	4.9	+4	147	152.7	+4
On-road Mobile	187.7	45.1	-76	60.4	18.3	-70
Off-road Mobile	104.7	52.4	-50	44.5	25.7	-42
Total	339.5	131.9	-61	337.2	296.7	-12
Biogenic	--		--	1323		--

As part of the model attainment demonstration, the fractional changes in ozone mixing ratios between the model reference year (2012) and model future year (2031) were calculated at each of the monitors following U.S. EPA modeling guidance (U.S. EPA,

2014[15]) and procedures outlined in the Modeling Protocol Appendix. These ratios, called "relative response factors" or RRFs, were calculated based on the ratio of future year modeled maximum daily average 8-hour (MDA8) ozone to modeled reference year MDA8 ozone (Equation 1).

$$\text{RRF} = \frac{\text{average MDA8 ozone}_{\text{future}}}{\text{average MDA8 ozone}_{\text{reference}}} \quad (1)$$

The site-specific RRF was then multiplied by the weighted DV for the corresponding monitor to predict the future year 2031 DVs (Table 4-4). The RRF approach was first applied in the SJV for the 2007 8-hour Ozone SIP[16] and later in the 2013 1-hour Ozone SIP[17]. In both cases, the RRF approach appropriately characterized emission targets for attainment. In the 2007 SIP, attainment was projected to occur in 2023 and all sites are currently on target for attainment of the 84 ppb standard, with many sites already having attained. In the 2013 SIP, attainment of the 124 ppb standard was projected by 2017 and the Valley has already achieved attainment. In addition, two peer-reviewed scientific publications focused primarily on areas outside of California (one from researchers at Rice University[18] and one from U.S. EPA scientists[19]), both found that the RRF approach is highly robust in its ability to predict future DVs.

Table 4-4 shows that all monitoring sites in the Valley are projected to have a future DV less than 75 ppb, so that the entire Valley is projected to attain the 75 ppb 8-hour O_3 standard by 2031 based on the substantial emission reductions from implementation of the current control program. The large projected decrease in DVs from 2012 to 2031 is consistent with recent peer-reviewed, published studies conducted by UC Berkeley researchers[20], which concluded that cumulative NO_x controls over time have successfully transitioned the southern and central portions of the SJV into a NO_x-limited chemistry regime where NO_x emission reductions are becoming increasingly effective at reducing ozone, while the northern portion of the SJV is currently transitioning to the same chemical regime. This is consistent with analysis on the changes in weekday vs. weekend ozone presented in the Modeling Protocol and Model Attainment Demonstration Appendices, where ozone on weekends is now generally lower than ozone on weekdays (in contrast to higher weekend ozone in the past), which is consistent with the NO_x-limited chemical regime.

[15] U.S. EPA, 2014, Draft Modeling Guidance for Demonstrating Attainment of Air Quality Goals for Ozone, PM2.5 and Regional Haze, available at https://www.epa.gov/ttn/scram/guidance/guide/Draft_O3-PM-RH_Modeling_Guidance-2014.pdf

[16] http://www.valleyair.org/Air_Quality_Plans/AQ_Final_Adopted_Ozone2007.htm

[17] http://www.valleyair.org/Air_Quality_Plans/Ozone-OneHourPlan-2013.htm

[18] Pegues, A.H., D.S. Cohan, A. Digar, C. Douglass, and R.S. Wilson (2012). Efficacy of recent state implementation plans for 8-hour ozone. *Journal of the Air & Waste Management Association*, 62, 252-261, doi: 10.1080/10473289.2011.646049.

[19] Foley. K., P. Dolwick, C. Hogrefe, H. Simon, B. Timin, and N. Possiel, (2015), Dynamic evaluation of CMAQ part II: Evaluation of relative response factor metrics for ozone attainment demonstrations, Atmospheric Environment, 103: 188–195, doi:10.1016/j.atmosenv.2014.12.039

[20] Pusede, S. E., and R. C. Cohen, 2012, On the observed response of ozone to NO_x and VOC reactivity reductions in San Joaquin Valley California 1995–present, Atmos. Chem. Phys., 12, 8323–8339.

As part of the attainment demonstration, U.S. EPA also requires analysis of ozone levels outside of the routine monitoring network (i.e., at areas between the monitors) to ensure that all regions within the Valley (even those without a monitor) are in attainment of the standard. This "unmonitored area" analysis combines observation based DVs with model based RRFs and ozone spatial gradients to estimate future DVs in unmonitored areas. Details of how the unmonitored area analysis is performed can be found in the Modeling Protocol and Model Attainment Demonstration Appendices. The unmonitored area analysis in the SJV showed that the areas with the highest future DVs were captured within the existing monitoring network and that all areas are projected to achieve the 75 ppb ozone standard.

Table 4-4 Base year Design Value, modeled RRF, and projected future year Design Value by site

Site Name	Weighted Base Year (2012) Design Value [ppb]	RRF	Future Year (2031) Design Value [ppb]
Clovis-N Villa Ave	95.7	0.7729	74
Sequoia and Kings Canyon Natl Park	93.0	0.7038	65
Fresno-Drummond St	92.3	0.7713	71
Parlier	92.0	0.7513	69
Fresno-Garland	90.7	0.7813	70
Arvin-DiGorgio	89.3	0.7242	64
Fresno-Sierra Skypark#2	89.0	0.7685	68
Edison	87.7	0.7398	64
Baker-5558 California Ave	86.7	0.7573	65
Porterville-1839 Newcomb St	86.3	0.7328	63
Hanford-S Irwin St	86.0	0.7538	64
Turlock-S Minaret St	86.0	0.8020	69
Oildale-3311 Manor St	84.7	0.7773	65
Madera-28621 Ave 14	84.7	0.7746	65
Sequoia Natl Park-Lower Kaweah	84.0	0.7302	61
Maricopa-Stanislaus St	83.3	0.7562	63
Shafter-Walker St	83.0	0.7557	62
Visalia-N Church St	82.3	0.7392	60
Merced-S Coffee Ave	81.7	0.8009	65
Madera-Pump Yard	79.3	0.7790	61
Tracy-Municipal Airport	79.3	0.8429	66
Tranquility-32650 West Adams Ave	76.3	0.7937	60
Modesto-14th St	76.0	0.8102	61
Stockton-Hazelton St	68.3	0.8446	57

Chapter 5

Attainment Strategy

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Chapter 5: Attainment Strategy

The District's strategy for attaining the 2008 8-hour ozone standard builds upon comprehensive strategies already in place from previously adopted District plans and strategies implemented by the California Air Resources Board (ARB) and is guided by the District's *Health Risk Reduction Strategy*. The District's multi-faceted approach to reducing emissions in the Valley consists of a combination of conventional and innovative control strategies. This chapter outlines the District's comprehensive attainment strategy which includes regulatory actions; incentive programs; technology advancement programs; policy and legislative activities; and public outreach, education, and communication.

As supported by extensive photochemical modeling conducted by ARB, the significant emissions reductions achieved by this comprehensive strategy in the coming years are projected to bring the Valley into attainment of the 2008 8-hour ozone standard by the 2031 attainment deadline. Unfortunately, given the antiquated *Clean Air Act* requirements for including contingency measures even in regions classified as "extreme" nonattainment, this attainment plan will be forced to reserve and defer emissions reductions and associated health benefits that would otherwise occur in an earlier timeframe to the final attainment year.

5.1 EXISTING COMPREHENSIVE REGULATORY CONTROL STRATEGY

EPA prefers reliance on control measures that have already been adopted over ones that have yet to be approved. EPA has gone so far as to disapprove attainment plans that demonstrated an over-reliance on unapproved measures. As such, the recognition of recently adopted and implemented District and ARB control measures is an important component of this plan.

5.1.1 District Stationary Source Regulations

The District's regulatory authority is centered on stationary sources and some area-wide sources, and the District's stringent and innovative rules on these sources, such as those for residential fireplaces, glass manufacturing, and agricultural burning, have set benchmarks for California and the nation. The District has implemented a comprehensive regulatory control strategy for over twenty years. Since 1992, the District has adopted over 600 rules and amendments to implement this aggressive control strategy. Many current rules are fourth or fifth generation, meaning that they have been revised and emission limits have been lowered, as new emission control technology has become available and cost effective. Additionally, the District has adopted innovative regulations such as Indirect Source Review and Employer-based Trip Reduction to reduce emissions from mobile sources within the District's limited jurisdiction over these sources.

The District's current rules and regulations reflect technologies and methods that are far beyond minimum required control levels. The aggressive regulations already adopted

under previous District attainment plans (*2007 Ozone Plan, 2008 PM2.5 Plan, 2012 PM2.5 Plan, 2013 Plan for the Revoked 1-hour Ozone Standard, 2015 Plan for the 1997 PM2.5 Standard*) serve as the basis for this *2016 Ozone Plan*. These adopted regulations will reduce emissions of oxides of nitrogen (NOx) and volatile organic compounds (VOCs) as they are fully implemented over the upcoming years, contributing to the Valley's progress toward attainment of the 2008 8-hour ozone standard.

The following table identifies many of the adopted District rules achieving new emissions reductions in and after 2012, the base year for this plan. However, it is important to note that even pre-2012 emissions reductions are contributing and will continue to contribute to the Valley's progress toward attainment.

Table 5-1 Adopted District Rules Achieving Reductions from Stationary Sources in and After 2012

District Rules		*Date Adopted or Last Amended*
4103	Open Burning	4/15/2010
4307	Boilers, Steam Generators, and Process Heaters 2 to 5 MMBtu/hr	5/19/2011
4308	Boilers, Steam Generators, and Process Heaters 0.075 to <2 MMBtu/hr	11/14/2013
4311	Flares	6/18/2009
4306/ 4320	Boilers, Steam Generators, and Process Heaters >5 MMBtu/hr	10/16/2008
4352	Solid Fuel Fired Boilers, Steam Generators and Process Heaters	12/15/2011
4354	Glass Melting Furnaces	5/19/2011
4565	Biosolids, Animal Manure, and Poultry Litter Operations	3/15/2007
4566	Organic Material Composting Operations	8/18/2011
4601	Architectural Coatings	12/17/2009
4605	Aerospace Assembly and Component Coating Operations	9/20/2007
4653	Adhesives and Sealants	9/16/2010
4682	Polystyrene, Polyethylene, and Polypropylene Products Manufacturing	9/20/2007
4684	Polyester Resin Operations	9/20/2007
4702	Internal Combustion Engines	8/18/2011
4905	Natural Gas-Fired, Fan-Type Residential Central Furnaces	1/22/2015
9610	State Implementation Plan Credit for Emission Reductions Generated Through Incentive Programs	6/20/2013

5.1.2 Area Source Regulations – ARB

The California Air Resources Board (ARB) shares jurisdictional authority of reducing emissions from area sources in California, and as such, has adopted many stringent regulations to reduce emissions from these sources. The District's and ARB's rules currently in place will ensure emissions will continue to be significantly reduced in the

coming years. Table 5-2 includes a list of regulations adopted or amended by ARB since 2000 that are applicable to area sources.

Table 5-2 Adopted ARB Regulations – Area Sources

ARB Regulation	Adoption Date	Category
Consumer Products Regulation	11/18/2010	Consumer Products
Aftermarket Catalyst Requirements	10/25/2007	Stationary
Vapor Recovery from Above-Ground Storage Tanks	6/21/2007	Stationary
Phase 3 Reformulated Gasoline Amendments	6/14/2007	Stationary
Airborne Toxic Control Measure for Stationary Compression Ignition Engines (Agricultural Eng. Exemption removal)	11/16/2006	Other
Distributed Generation Guidelines and Regulations	10/19/2006	Other
Airborne Toxic Control Measure for Stationary Compression Ignition Engines amendments	05/26/2005	Other
Airborne Toxic Control Measure for Stationary Compression Ignition Engines	12/11/2003	Other
Airborne Toxic Control Measure for Outdoor Residential Waste Burning	02/21/2002	Other
Distributed Generation Guidelines and Regulations	11/15/2001	Other
Architectural Coatings	6/22/2000	Stationary
Air Toxic Control Measure for Chlorinated Toxic Air Contaminants from Automotive Maintenance and Repair Facilities	04/27/2000	Other
Enhanced Vapor Recovery	6/22/2000	Stationary

5.2 REGULATORY CONTROL MEASURE COMMITMENTS

The District has evaluated all sectors and equipment types for additional emission reduction opportunities, as presented in Appendix C. The District has used the following key factors to evaluate potential emission reduction opportunities:

- **Technological Feasibility.** The District looked for any control technologies not already required that might be available to further reduce emissions from sources of air pollution in the Valley. This includes new technologies and technologies that may not have been cost-effective in the past. The technologies used in BACT guidelines; permits; and other air districts' rules, regulations, guidelines, and studies were reviewed for their feasibility, including how commercially available the technology currently is and whether the technology has been used in practice.

- **Cost-Effectiveness.** Cost-effectiveness is the cost of emissions controls compared to the amount of emissions reductions that would be achieved by those controls. The District does not have a pre-determined cost-effectiveness threshold, but control options with extremely high cost-effectiveness (high dollars per ton of pollutant reduction) are unreasonable and inappropriate for regulation.

Each control measure evaluation in Appendix C includes a discussion of the rule applicability, an overview of the emission inventory, and an evaluation for the technological feasibility and cost effectiveness analysis of identified potential emissions reductions opportunities.

This plan demonstrates that the District continues to meet or exceed RACT for all applicable EPA source categories. However, given the enormity of reductions needed to develop plans that demonstrate attainment with the latest federal ozone and PM2.5 standards, the District proposes the following commitments, as described in further detail below.

Table 5-3 Regulatory Control Measure Commitments

Rule	Rule Project Year	Emissions Reductions*	Implementation Date*
Rule 4311 Flares	2017	---	---
Rule 4694 Wine Fermentation and Storage Tanks	2018	---	---
*The District is not committing to a specific amount of emissions reductions or timeframe for the implementation of these control measures, which will be established as appropriate during the rule development process.			

5.2.1 Rule 4311 Flares

Flaring activities in the Valley emit 0.57 tpd of NOx emissions, representing 0.17% of the summer average NOx emissions in the Valley. Despite this relatively small amount of emissions, in keeping with its leave no stone unturned approach, the District has invested significant resources into evaluating potential emissions reductions opportunities from flares. The District has made these further study reports available at: http://www.valleyair.org/Air_Quality_Plans/PM_Plans.htm.

As demonstrated in Appendix C, District Rule 4311 meets RACT requirements, and has also been demonstrated as implementing Most Stringent Measures.[1] As a commitment included in the District's *2015 Plan for the 1997 PM2.5 Standard* (2015 PM2.5 Plan), District staff conducted a further study to review additional emission reduction opportunities under Rule 4311 that reached the following findings:

1. Even though operators of flares in the Valley have already taken extensive measures to reduce flaring through Rule 4311, additional minimization practices currently performed at some facilities may have the potential to be utilized at other facilities to further reduce flaring activities and emissions.

2. Ultra-low NOx technologies with the potential to further reduce emissions from flaring have recently become available and should be potentially required

[1] SJVUAPCD. *2015 Plan for the 1997 PM2.5 Standard*. Appendix C Best Available Control Measures and Most Stringent Measures (2015, April 16). Retrieved from http://www.valleyair.org/Air_Quality_Plans/PM25Plans2015.htm

through future rule amendments where technologically achievable and economically feasible.

Given the enormity of reductions needed to develop plans that demonstrate attainment with the latest federal ozone and PM2.5 standards and based on findings from the recent flare further study, the District commits to working closely with affected operators to undergo a regulatory amendment process for Rule 4311 as follows:

1. District commits to amend Rule 4311 to include additional ultra-low NOx flare emission limitations for existing and new flaring activities at Valley facilities to the extent that such controls are technologically achievable and economically feasible, by December 31, 2017.

2. District commits to amend Rule 4311 to include additional flare minimization requirements to the extent that such controls are technologically achievable and economically feasible, by December 31, 2017.

5.2.2 Rule 4694 Wine Fermentation and Storage Tanks

Fermentation of red and white wines generates VOC emissions (ethanol). Wine fermentation is a significant industry in the Valley with total projected emissions of 4.64 tpd of VOC in 2031. As demonstrated in Appendix C, District Rule 4694 meets RACT requirements.

Through ongoing review of wine fermentation permitting applications, the District has closely tracked the development of new emission control technologies for capturing ethanol emissions from wine fermentation processes. Technologies of interest have included scrubbers, condensers, activated carbon and thermal oxidizers. In recent years, several wine manufacturing facilities have successfully implemented or are experimenting with new emission control systems that capture ethanol emissions from some of their wine fermentation operations (see Appendix C). Two wineries currently utilize water scrubbers to capture ethanol emissions from wine fermentation tanks, and several other wineries have developed systems that utilize scrubbers and chilled vapor condensers. Preliminary cost effectiveness analyses results indicate the costs to be between $18,337 and $89,644 per ton of VOC reduced, depending on the size of the winery, fermentation tank configuration, type of wine, number of fermentation rotations, and other factors.

The District commits to working closely with affected operators to undergo a regulatory amendment process for Rule 4694 as follows:

1. Modeling shows that the Valley is a NOx-limited regime, especially in projections of future years. As such, VOC reductions are not as effective in reducing Valley ozone concentrations as NOx reductions. The District will evaluate the technological achievability and economic feasibility of implementing emission control technologies to reduce VOC emissions from wine fermentation processes and potential benefits to help reduce ozone

concentrations. Upon completion of this review, the District commits to amend Rule 4694 to include additional requirements to further reduce emissions from wine fermentation processes as appropriate by December 31, 2018.

5.3 RULE DEVELOPMENT PROCESS

The District places great value on innovation and full public participation in the development and adoption of regulations. Towards that end, the District's rule development process involves extensive interaction with affected sources to find the most effective means of achieving emissions reductions and a rigorous public engagement and commenting process (see Figure 5-1). Contrasting the broader plan development effort, the rule development process allows greater focus on a single sector or technology area. Early in the rule development process, prior to preparing a draft rule, staff researches technologies and explores options for emissions reductions, gathering preliminary data and performing literature reviews of relevant studies. Through the workshop process staff presents draft rule concepts and receives feedback on specific technology costs, technical insight, and general public comments. Staff uses this information gathering and discussion to refine the rule throughout the rule development process. Using this iterative process of gathering the most up-to-date cost and technical information, staff analyzes cost-effectiveness and potential emissions reductions. These analyses are shared with the public throughout the rule development process.

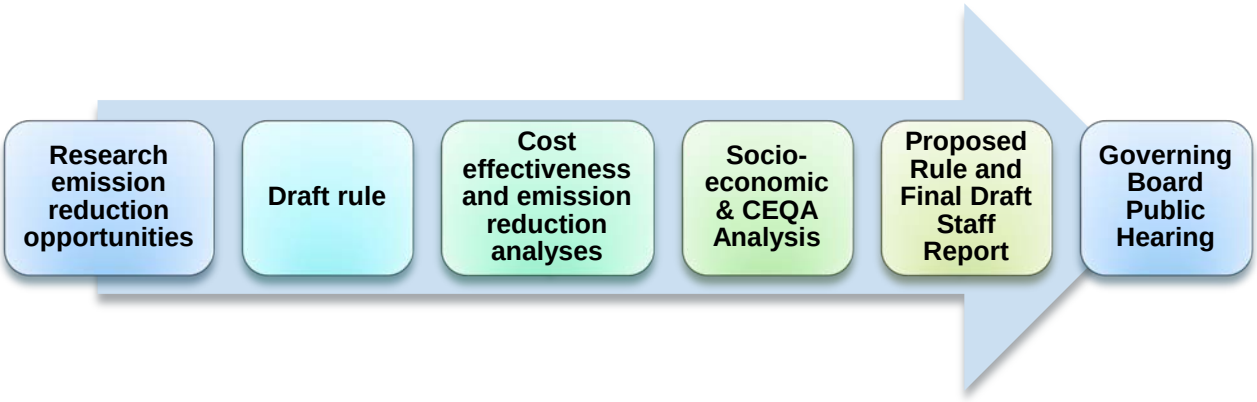
During the rule development process, a socioeconomic impact analysis is performed pursuant to California Health and Safety Code Section 40728.5. To the extent possible, the District minimizes significant economic and socioeconomic impacts by evaluating viable alternatives, adjusting proposed limits, or extending compliance schedules.

The proposed rule and Final Draft Staff Report, including the cost-effectiveness analysis, socioeconomic impact report, emissions reductions analysis, RACT analysis, and California Environmental Quality Assessment (CEQA) analysis are all presented to the District Governing Board during a public hearing. The Governing Board ultimately determines the balance between air quality improvement and rule impacts when adopting proposed rules.

Once adopted, the District forwards the rule through ARB to EPA for inclusion into the state implementation plan, as appropriate. EPA evaluates the rule, determines if the rule meets federal requirements, and provides an opportunity for further public comment. After this review and comment period, EPA will amend the SIP to include the new rule, as appropriate.

Beyond the rule development and adoption process, District staff will continue to engage the public and affected source operators throughout implementation and compliance. Additionally, District staff continues public outreach and education through notifications to stakeholders of the rule adoption, issuance of compliance bulletins, and assistance through the District's Small Business Assistance program.

Figure 5 - 1 Rule Development Process



5.4 MOBILE SOURCE CONTROL STRATEGY

5.4.1 ARB Mobile Source Regulations

Given the enormity of the reductions needed for attainment, mobile sources, particularly in the goods movement sector, must transition to zero and near-zero emission levels through the implementation of transformative measures. The District does not have the authority to implement regulations requiring ultra-low tailpipe emissions standards on mobile sources.

Since 1966, ARB has adopted and amended a number of regulations aimed at reducing exposure to diesel particulate matter (PM) and NOx from fuel sources, freight transport sources like heavy-duty diesel trucks, transportation sources like passenger cars and buses, and off-road sources like large construction equipment. Table 5-4 includes a list of all the regulations adopted or amended by ARB since 2000 that are applicable to mobile sources. Phased implementation of these regulations will produce emission reduction benefits through 2017 and beyond as the regulated fleets are retrofitted, and as older and dirtier fleet units are replaced with newer and cleaner models at an accelerated pace. Several rules in particular, including the Cleaner In-Use Heavy-Duty Trucks, the Cleaner In-Use Off-Road Equipment, the Advanced Clean Car Program, the Enhanced Fleet Modernization Program, and the Enhanced Smog-Check Program, will achieve significant emissions reductions critically needed to attain the ozone standard under this plan.

Table 5-4 Adopted or Amended ARB Mobile Source Regulations

ARB Regulation	Adoption Date	Category
Amendments to the Portable Fuel Container Regulation	02/18/2016	Vapor Recovery
Revisions to On-Board Diagnostics System Requirements	09/24/2015	On-Road

ARB Regulation	Adoption Date	Category
Amendments to Certification Procedures for Vapor Recovery Systems at Gasoline Dispensing Facilities: Aboveground Storage Tanks and Enhanced Conventional Nozzles	04/23/2015	Vapor Recovery
2015 Low Carbon Fuel Standard Amendments	02/19/2015	Fuel
Evaporative Emission Control Requirements for Spark-Ignition Marine Watercraft	02/19/2015	Vapor Recovery
Commercialization of Alternative Diesel Fuels Regulation	02/19/2015	Fuel
2014 Amendments to Zero Emission Vehicle Regulation	10/23/2014	On-road
Amendments to Low Emission Vehicle III Criteria Pollutant Requirements for Light-and Medium-Duty Vehicles the Hybrid Electric Vehicle Test Procedures, and the Heavy-Duty Otto-Cycle and Heavy-Duty Diesel Test Procedures	10/23/2014	On-road
Amendments to the Enhanced Fleet Modernization Program Regulation	06/26/2014	On-road
Truck and Bus Rule Update	04/24/2014	On-road
Heavy-Duty Greenhouse Gas Phase 1: On-Road Heavy Duty Greenhouse Gas Emissions Rule, Tractor-Trailer Rule, Commercial Motor Vehicle Idling Rule, Optional Emission Standards	12/12/2013	On-road
Minor Modifications to the Zero Emission Vehicle Regulation	10/24/2013	On-road
Alternative Fuel Certification Procedures	09/26/2013	Fuel
Off-Highway Recreational Vehicle Evaporative Emission Control	07/25/2013	Vapor Recovery
Amendments to Vapor Recovery for Gasoline Dispensing Facilities	07/25/2013	Vapor Recovery
Gasoline and Diesel Fuel Test Methods	01/25/2013	Fuel
Low Emission Vehicle III Greenhouse Gas and Zero Emission Vehicle Regulation Amendments for Federal Compliance Option	11/15/2012	On-road
Amendments to On-Board Diagnostics (OBD I and II) Regulations	08/23/2012	On-road
Amendments to Verification Procedures, Warranty, and In-Use Compliance Requirements for In-Use Strategies to Control Emissions from Diesel Engines	08/23/2012	On-road
Emergency Regulatory Amendments to the Tractor-Trailer Greenhouse Gas Regulation	02/29/2012	On-Road
Zero Emission Vehicle Standards for 2009 through 2017	01/26/2012	On-road
Advanced Clean Car Program	1/27/2012	On-road
Expanded Off-Road Recreational Vehicle Emission Standards	12/16/2011	Off-road
Cleaner In-Use Off-Road Equipment	12/17/2010	Off-road
Port Truck Modernization	12/17/2010	Off-road
Cleaner In-Use Heavy-Duty Trucks	12/16/2010	On-road
Accelerated Introduction of Cleaner Line-Haul Locomotives	06/24/2010	Other
Enhanced Fleet Modernization Program (formerly called the Expanded Vehicle Retirement Program)	06/24/2010	On-road
Smog Check Improvements	08/31/2009	On-road
Portable Outboard Marine Tanks	09/25/2008	Off-road
Clean Up Existing Harbor Craft	11/15/2007	Other
Voluntary Accelerated Retirement Regulation	12/07/2006	On-road
Emergency Regulation for Portable Equipment Registration Program, Airborne Toxic Control Measures and Portable and Stationary diesel-Fueled Engines	12/06/2006	Off-road
Airborne Toxic Control Measure for Stationary Compression Ignition Engines (Agricultural Eng. Exemption removal)	11/16/2006	Other
Distributed Generation Guidelines and Regulations	10/19/2006	Other
Zero Emission Bus Regulation	10/19/2006	On-road
Heavy-Duty In-Use Compliance Regulation	09/28/2006	On-road

ARB Regulation	Adoption Date	Category
On-Board Diagnostic II	09/28/2006	On-road
Off-Highway Recreational Vehicles and Engines	07/20/2006	Off-road
California Motor Vehicle Service Information Rule	06/22/2006	On-road
Portable Equipment Registration Program	06/22/2006	Off-road
Fork Lifts and Other Industrial Equipment (Large Off-Road Spark Ignition Engines > 1 liter)	05/26/2006	Off-road
Technical Amendments to Evaporative Exhaust and Evaporative Emissions Test Procedures	05/25/2006	On-road
Diesel Verification Procedure, Warranty & In-Use	03/23/2006	On-road
AB1009 Heavy-Duty Vehicle Smoke Inspection Program	01/26/2006	On-road
Diesel Particulate Matter Control Measure for On-Road Heavy-Duty Diesel-Fueled Vehicles Owned or Operated by Public Agencies and Utilities	12/08/2005	On-road
Mobile Cargo Handling Equipment at Ports and Intermodal Rail Yards	12/08/2005	Off-road
Marine Inboard Sterndrive Engines	11/17/2005	Off-road
Requirements to Reduce Idling Emissions from New and In-Use Trucks, Beginning in 2008	10/20/2005	On-road
2007-2009 Model-Year Heavy Duty Urban Bus Engines and the Fleet Rule for Transit Agencies	09/15/2005	On-road
Portable Fuel Containers (PFC) [Part 1 of 2]	09/15/2005	Off road
Portable Fuel Containers (PFC) [Part 2 of 2]	09/15/2005	Off road
On-Board Diagnostic System Requirements for 2010 and Subsequent Model-Year Heavy-Duty Engines (HD OBD)	07/21/2005	On-road
Airborne Toxic Control Measure for Stationary Compression Ignition Engines amendments	05/26/2005	Other
Transit Fleet Rule	02/24/2005	On-road
Off-Road Compression Ignition Engines	12/09/2004	Off-road
Emergency Regulation for Temporary Delay of Diesel Fuel Lubricity Standard	11/24/2004	Fuels
Diesel Fuel Standards for Harbor Craft & Locomotives	11/18/2004	Fuels
Greenhouse Gas	09/23/2004	On-road
Airborne Toxic Control Measure for Diesel Particulate from Diesel Fueled Commercial Vehicle Idling	07/22/2004	On-road
Urban Bus Engines/Fleet Rule for Transit Agencies	06/24/2004	On-road
Engine Manufacturer Diagnostic System Requirements for 2007 and Subsequent Model Heavy Duty Engines	05/20/2004	On-road
Heavy Duty Diesel Engine-Chip Reflash	03/27/2004	On-road
Airborne Toxic Control Measure for Diesel-Fueled Portable Engines	02/26/2004	Off-road
Modifications to the Statewide Portable Equipment Registration Program (PERP) Regulations	02/26/2004	Off-road
CA Motor Vehicle Service Information Rule	01/22/2004	On-road
Airborne Toxic Control Measure for Diesel Particulate for Transport Refrigeration Units	12/11/2003	On-road
Airborne Toxic Control Measure for Stationary Compression Ignition Engines	12/11/2003	Other
Diesel Retrofit Verification Procedure, Warranty and In-Use Compliance Requirements Amendments	12/11/2003	On-road
Small Off-Road Engines (SORE)	09/25/2003	Off-road
Solid Waste Collection Vehicles	09/24/2003	On-road
Off-Highway Recreation Vehicles	07/24/2003	Off-road
Specifications for Motor Vehicle Diesel Fuel	07/24/2003	Fuels
Zero Emission Vehicle Amendments for 2003	03/25/2003	On-road

ARB Regulation	Adoption Date	Category
Airborne Toxic Control Measure for Diesel Particulate from School Bus Idling	12/12/2002	On-road
Low Emission Vehicles II. Align Heavy Duty Gas Engine Standards with Federal Standards; minor administrative changes	12/12/2002	On-road
Revision to Transit Bus Regulations Amendments	10/24/2002	On-road
Diesel Retrofit Verification Procedure, Warranty and In-Use Compliance Requirements	05/16/2002	On-road
On-Board Diagnostic II Review Amendments	04/25/2002	On-road
Airborne Toxic Control Measure for Outdoor Residential Waste Burning	02/21/2002	Other
Voluntary Accelerated Light Duty Vehicle Retirement Regulations	02/21/2002	On-road
California Motor Vehicle Service Information Rule	12/13/2001	On-road
Distributed Generation Guidelines and Regulations	11/15/2001	Other
Low Emission Vehicle Regulations	11/15/2001	On-road
Heavy Duty Diesel Engine Standards for 2007 and Later	10/25/2001	On-road
Marine Inboard Engines	07/26/2001	Off-road
Zero Emission Vehicle Infrastructure and Standardization of Electric Vehicle Charging Equipment	06/28/2001	On-road
Zero Emission Vehicle Regulation Update	01/25/2001	On-road
Heavy Duty Diesel Engines "Not-to-Exceed (NTE)" Test Procedures	12/07/2000	On-road
Light-and Medium Duty Low Emission Vehicle Alignment with Federal Standards. Exhaust Emission Standards for Heavy Duty Gas Engines	12/07/2000	On-road
Air Toxic Control Measure for Chlorinated Toxic Air Contaminants from Automotive Maintenance and Repair Facilities	04/27/2000	Other
Transit Bus Standards	02/24/2000	On-road
Off-Road Compression Ignition Engines	01/27/2000	Off-road

5.4.2 ARB's Draft "Mobile Source Strategy"

As the District continues to develop new attainment plans to address the latest federal ozone and PM2.5 standards in the coming year, significant additional emissions reductions are needed, particularly with respect to mobile sources under ARB and EPA jurisdiction that make up over 85% of remaining Valley NOx emissions. Given this large contribution and limited local jurisdiction, ARB staff released a draft *Mobile Source Strategy* in October 2015 to address the upcoming attainment challenges facing the Valley and the State. This integrated strategy is designed to help California reach attainment of multiple federal air quality standards for ozone and PM2.5, achieve GHG emission reductions, reduce petroleum use, increase energy efficiency and use of renewable energy sources, and decrease the health risks from exposure to toxic air contaminants from transportation emissions.

The scope of actions in the proposed *Mobile Source Strategy* would establish zero and near-zero emission requirements, deploy these new technologies into the state fleet, require cleaner fuels, and ensure in-use performance of new vehicles. The *Mobile Source Strategy* highlights the use of incentives to accelerate fleet turnover and supports the use of advanced transportation technologies, such as intelligent transportation systems and autonomous vehicles, as a transformative control strategy. Additionally, ARB's strategy emphasizes the importance of federal regulations in the on-road heavy-duty sector.

ARB staff will incorporate the *Mobile Source Strategy* into *the Proposed 2016 State Strategy for the State Implementation Plan* (State SIP Strategy) to be considered by the Air Resources Board (Board) in September 2016. The State SIP Strategy will include a set of commitments for achieving additional NOx emission reductions from proposed mobile source control measures as required to bring the Valley into attainment with federal ozone and PM2.5 standards. The *Mobile Source Strategy* can be found at: http://www.arb.ca.gov/planning/sip/2016sip/2016mobsrc.htm.

5.4.3 Mobile Source Evaluation

Higher-emitting heavy-duty vehicles with long service lives can remain on the road for many years. Advancing the turnover of these fleets is a critical component of reducing emissions. To address this legacy fleet, ARB has adopted heavy-duty vehicle in-use control measures to significantly reduce PM and NOx emissions from existing diesel vehicles operating in California. Coupled with these regulatory measures, the District has invested significant resources through its incentive programs to accelerate fleet turnover through the deployment of the latest available vehicle technologies. As new technologies emerge and air quality standards become increasingly stringent, ARB's Draft *Mobile Source Strategy* proposes to continue developing fleet regulations and incentives programs that help these fleets transition to clean vehicles. Through the continued development of regulatory and incentives programs as laid out in their Mobile Source Strategy, in combination with the District's robust vehicle grant programs, these mobile source control measures will continue to significantly advance fleet turnover.

5.4.3.1 Heavy-Duty Trucks

In 2012, ARB adopted the On-Road Heavy-Duty Diesel Vehicles (In-Use) Regulation, later amended in 2014. The regulation applies to privately or federally owned, diesel-fueled trucks and buses that operate in California with a gross vehicle weight rating (GVWR) greater than 14,000 pounds. The regulation requires diesel trucks and buses to reduce emissions by replacing older trucks with newer diesel vehicles, retrofitting engines, and installing diesel particulate filters. Reductions are implemented through a compliance schedule based on the engine model year. By 2023, all trucks and buses must have engines certified to EPA's 2010 emission limits. As described in Appendix D of this *2016 Ozone Plan*, this rule has already achieved significant emission reductions will continue to achieve additional emission through 2023.

ARB's *Mobile Source Strategy* outlines a multifaceted approach to continue implementing control measures for these high-mileage heavy-duty trucks. The draft strategy proposes to provide more incentive funding for new technology, infrastructure, and purchase of advanced zero and near-zero on-road heavy-duty trucks. In addition, ARB proposes to develop future truck and bus regulations including a new near-zero emission engine standard (0.02 g NOx/hp-hr) at both the state and federal level.

As described in Appendix E of this Plan, the use of incentives funding through the Prop 1B and Truck Voucher incentive programs have helped accelerate the adoption of clean heavy-duty trucks thereby reducing emissions in this source category. By highlighting

the need for a new near-zero emissions tailpipe emissions standard at the state and national level, and in combination with the continued administration of a comprehensive incentive program, the District will work closely with ARB to ensure continued emissions reductions from heavy-duty trucks.

5.4.3.2 Public Fleets

Transit Fleets: Transit fleets are on-road vehicles operated by a public transit agency, including urban buses and other transit fleet vehicles. ARB adopted the Fleet Rule for Transit Agencies in 2000 in an effort to reduce both criteria pollutant emissions and exposure to toxic air contaminants from urban buses and transit fleet vehicles. Under this rule, all fleets must have achieved an overall 80% reduction in direct PM emissions and obtained a fleet average NOx emission level at or below 2.4 g NOx/bhp-hr by 2010. The rule also encourages the operation and use of zero-emission buses (ZEB) in California urban bus fleets, with the goal of gradually developing a California transit fleet composed of 15% zero-emission buses.

Table 5-5 ARB Transit Fleet Rule Requirements

	By 2008	By 2011
PM (Reduction from 2005 baseline)	40%	80%
Fleet Average NOx (g/bhp-hr)	3.2	2.4

South Coast adopted a similar public transit fleet rule in 2000, Rule 1192—Clean On-Road Transit Buses. This rule requires that public agencies purchase alternative fuel heavy–duty vehicles when buying or acquiring new transit vehicles or urban buses. However, since there is no actual emissions standard required, the South Coast rule is less stringent and is superseded by the statewide fleet regulation.

With the current ARB rule, NOx emissions from diesel urban buses in the Valley are going to decrease from the 2012 baseline year by 87% to 0.5 tpd NOx by 2031. Natural gas buses will see a 69% decrease from 0.2 tpd to 0.07 tpd NOx from 2012 to 2031. In an effort to continue accelerating emissions reductions, ARB's *Mobile Source Strategy* proposes to develop a new transit fleet regulation set to be adopted by ARB in 2016. This "Advanced Clean Transit" regulation would require new bus purchases to be zero emission, with a goal of 100 percent zero emission purchase in 2030 and full zero emission transit fleets in 2040. Implementation is estimated to begin in 2018 with a small percentage of new bus purchases required to be zero emission vehicles, incrementally increasing until 2030. No further action is recommended at this time given that ARB's proposed "Advanced Clean Transit" regulation fully addresses the limited emissions reductions opportunities that remain from this category.

Solid Waste Collection Vehicles: This source category includes waste-collection vehicles weighing more than 14,000 lbs. that collect waste for a fee. The statewide regulation for this source, the Solid Waste Collection Vehicles (SWCVs) Rule, was adopted in 2004 and requires such vehicles to install ARB-verified Best Available

Control Technology (BACT) devices to reduce diesel particulate emissions. South Coast developed a separate fleet rule which requires solid waste collection vehicle fleets to transition to operating entirely on alternative fuel beginning in 2011. This is different than ARB's rule in that it requires fleet transition to alternative fuels rather than imposing requirements to reduce particulate matter. However, since there is no actual emissions standard required, the South Coast rule does not achieve additional emissions reductions beyond the state regulation.

Over the years, the District has been active in providing incentive funding towards the replacement of the Valley's refuse fleets with the latest available vehicle technologies. In recent years, the District worked closely with ARB and CALSTART to develop a new state Hybrid Voucher Incentive Program (HVIP) that provides significant funding towards the replacement of existing refuse trucks with new hybrid electric vehicle technologies, with significant additional funding provided for projects that benefit disadvantaged communities.

Through the existing state fleet rule and ongoing efforts to accelerate fleet turnover to the latest available technologies through existing robust incentive programs, emissions from this category will be significantly reduced in the coming year. In fact, the Valley will see a 75% reduction in NOx from solid waste collection vehicles from the 2012 baseline year for total remaining emissions of 0.4 tpd NOx from this category in 2031. In developing its draft *Mobile Source Strategy*, ARB does not identify any remaining opportunities for feasible reductions in emissions from this source category.

School Buses: Over the years, the District has been active in providing incentive funding towards the replacement of the Valley's school bus fleets with the latest available vehicle technologies. The School Bus Replacement and Retrofit programs provide grant funding for new school buses and retrofit devices for buses that are already on the road. Public school districts in California that own their buses are eligible to receive funding. Eligible projects are funded with local, state, and federal funds including the Lower-Emission School Bus Program (Proposition 1B), DERA funding, and the American Reinvestment and Recovery Act (ARRA). Through December 2015, the District has provided funding to retrofit 2,254 school buses and replace 503 school buses that meet the latest PM and NOx standards.

ARB's school bus rule requires owners to have retired any school buses manufactured before April 1, 1977, by January 1, 2012. By Jan. 1, 2014, 100% of the remaining school bus fleet must have particulate filters (that reduce diesel PM emissions by 85 percent) installed. There is a delayed compliance date of January 1, 2018 for buses unable to be retrofitted, which must be replaced by this date with a bus meeting the current 2010 emissions standard. South Coast AQMD has Rule 1195—Clean On-Road School Buses, adopted in 2001 and amended in 2006. This rule requires newly purchased or leased school buses to be alternative fuel or to retrofit used or existing school buses with a California Air Resources Board (CARB) approved control device(s) to reduce air toxic and criteria pollutant emissions. District Rule 9310, described in section 5.2.4 in this chapter, pre-dates the ARB rule. Per the District rule, all school buses must either be retrofit or replaced by 2016. Since the state rule requires owners

to either retrofit existing vehicles to achieve significant PM reductions or purchase a new vehicle rated to 2010 standards or newer, the state regulation already achieves the most stringent emissions requirements and supersedes local rules.

Commercial Airport Ground Access: The San Joaquin Valley only has a few commercial airports that are very small in size compared to airports in more populated coastal regions of the state, and the emissions from this category are miniscule. There is no current statewide rule for airport shuttle buses.

In 2000, South Coast adopted Rule 1194 (Commercial Airport Ground Access Vehicles), which requires fleet operators to purchase lower emitting vehicles when replacing or adding vehicles, which was relevant when originally adopted and cleaner shuttle buses were in early stages of development. In their draft *Mobile Source Strategy*, ARB proposes to develop and propose a regulation, titled Zero Emissions Airport Shuttle Buses, to help deploy zero emission airport shuttles in order to further support market development of zero emission technologies in the heavy-duty sector beginning in 2020. Through this new strategy, ARB estimates less than 0.1 tpd of NOx emission reductions could be achieved with this measure implemented in South Coast, which has significantly more large airports with numerous shuttles**.** No further action is recommended at this time given that ARB's proposed Zero Emissions Airport Shuttle Buses regulation fully addresses the limited emissions reductions opportunities that remain from this category.

Public Agencies and Utilities (PAU): Over the years, the District has been active in providing incentive funding towards the replacement of the Valley's fleets with the latest available vehicle technologies. In recent years, the District worked closely with ARB and CALSTART to develop a new state Hybrid Voucher Incentive Program (HVIP) that provides significant funding towards the replacement of existing trucks, including utility trucks, with new hybrid electric vehicle technologies, with significant additional funding provided for projects that benefit disadvantaged communities.

Public Agencies and Utilities rules apply to remaining vehicles owned by municipalities or utilities not covered in the above categories. ARB's PAU Regulation was designed to reduce public exposure to diesel particulate matter emissions from these vehicles. The regulation requires owners to operate 100% of their fleet at or below a PM emissions level of 0.01 g/bhp-hr by 2016. While this regulation does not include a specific NOx requirement, it has been successful in advancing fleet turnover through the accelerated purchase of new cleaner diesel and alternative-fueled vehicles operating in PAUs. South Coast adopted a fleet rule for heavy-duty vehicles operated by public agencies and utilities, Rule 1196, which requires newly purchased vehicles to operate on gasoline or other alternative fuels. The state PAU fleet regulation supersedes the South Coast rule. In developing its draft *Mobile Source Strategy*, ARB does not identify any remaining opportunities for feasible reductions in emissions from this source category

5.4.4 District Mobile Source Control Strategies

Although the District does not have the authority to directly regulate the mobile sources, the District, in addition to providing incentives, has developed and implemented the following innovative control strategies to reduce emissions from these sources.

Rule 9410 Employer-Based Trip Reduction (eTRIP)
The District is the only government agency that is authorized under state law to impose this type of regulation on employers. The goal of eTRIP is to reduce single-occupancy-vehicle work commutes. The eTRIP rule requires the Valley's larger employers, representing a wide range of locales and sectors, to select and implement workplace measures that make it easier for their employees to choose ridesharing and alternative transportation. Because of the diversity of employers covered by eTRIP, the rule was built with a flexible, menu-based approach. Using eTRIP, employers choose from a list of measures, each contributing to a workplace that encourages employees to reduce their dependence on single-occupancy vehicles. Each eTRIP measure has a point value, and employer eTRIPs must reach specified point targets for each strategy over a phased-in compliance schedule (2010–2015). The District has continually provided employer assistance through training, guidance materials, promotional information, and online reporting options. Upon full implementation, the eTRIP rule will reduce NOx and VOC emissions from passenger vehicle commute trips by approximately 1.2 tpd. See www.valleyair.org/tripreduction.htm for further information about the eTRIP Rule.

Rule 9510 Indirect Source Review (ISR)
The District has longstanding statutory authority to regulate indirect sources of air pollution. District Rule 9510 was adopted in 2005 to reduce the impacts of growth in emissions resulting from new land development in the San Joaquin Valley. The rule applies to new residential and non-residential development projects, including transportation and transit projects, which equal or exceed established applicability thresholds. Developers of projects subject to Rule 9510 must reduce emissions occurring during construction and operational phases through on-site measures, or pay off-site mitigation fees. One hundred percent of all offsite mitigation fees are used by the District to fund emission reduction projects through its Incentives Programs, achieving emission reductions in behalf of the project.

Rule 9310 School Bus Fleets
The District adopted Rule 9310 in September 2006 to limit NOx, PM, and diesel toxic air contaminants from school bus fleets. Diesel-fueled school bus fleet operators must replace or retrofit all of their school buses to meet the applicable ARB and EPA emission standards for engines by 2016. The rule also requires all existing gasoline or alternative-fueled school buses and any diesel school buses manufactured after October 1, 2002 to be operated according to manufacturer specifications and, if replaced, meet all applicable ARB and EPA current-year emissions standards for the year of delivery of that school bus engine and fuel type.

5.5 TECHNOLOGY ADVANCEMENT

Despite major reductions in emissions and corresponding improvements in air quality, the San Joaquin Valley continues to face difficult challenges in meeting the federal ambient air quality standards. Achieving attainment of EPA's increasingly stringent ambient air quality standards will require the development and implementation of transformative zero/near-zero emissions technology over the coming decades.

On March 18, 2010, your Board approved the District's Technology Advancement Program, a strategic and comprehensive program to identify, solicit, and support technology advancement opportunities. The program's primary goal has been to advance technology and accelerate the deployment of innovative clean air technologies that can bring about emission reductions as rapidly as practicable. To date the District has undergone four rounds of Request for Proposals (RFPs) resulting in the successful demonstration of numerous innovative technologies.

The Technology Advancement Program (TAP) represents a significant step forward in the District's efforts to attain ever-tightening federal air quality standards and fulfill our public health mission. The Technology Advancement Program's primary goal is to advance technology and accelerate the deployment of innovative clean air technologies that can bring about emission reductions as rapidly as practicable. To address the Valley's needs with respect to both ozone and PM2.5, which are largely driven by NOx emissions, the Technology Advancement Program has placed a particular focus on NOx emissions reduction technologies. The Technology Advancement Program is implemented through a coordinated and collaborative process that engages technology developers and potential end-users through:

- Grant funding for technology advancement projects in the San Joaquin Valley through competitive processes
- Integration of technology advancement goals into existing grant programs
- Comprehensive outreach to identify potential technology and demonstration partners
- Ongoing review and feedback on new technologies
- Building partnerships with other agencies
- Building local capacity for research and development in the San Joaquin Valley

To encourage the development of technologies in source categories critical to the Valley's attainment goals, your Board established the following three technology focus areas:

- **Renewable Energy:** Zero and near-zero emission renewable energy technologies.

- **Waste Solutions:** Zero and near-zero emission technologies that minimize or eliminate emissions from waste management systems and processes, including waste-to-fuel systems, such as dairy digesters and other bio-fuel applications.

- **Mobile Sources:** Zero and near-zero emission technologies with emphasis on goods and people movement, off-road equipment, and agricultural equipment.

To date, the District has completed four Technology Advancement Program competitive funding RFPs, receiving over 130 proposals for clean technology demonstration projects through these RFPs. In total, your Board has approved 34 of the proposed projects for total funding of over $11 million, with successful demonstrations of zero emissions yard trucks, electric composting, ultra-low NOx biogas engines, and other technologies.

For more information on technology advancement efforts by the District, please refer to Appendix F.

5.6 HEALTH RISK REDUCTION STRATEGY

In September 2010, the District's Governing Board adopted the groundbreaking Risk-Based Strategy (RBS), which was later rebranded to the Health Risk Reduction Strategy (HRRS) in 2013. These policies were developed because the District recognizes that the Valley has a mature air quality program that has made considerable progress in reducing air pollutants on a mass basis, which has led to a steady escalation in costs per ton of pollution abatement. At the same time, new scientific discoveries are paving the way for more targeted, health-based control strategies that deliver greater health benefits in a more cost effective fashion. In other words, the strategies are designed to focus limited resources on measures that have been shown scientifically to provide the best benefit for public health. As a result, the District puts a greater emphasis on implementing control measures targeted at reducing health risks, such as the effects discussed in Section 1.3.1. Since its implementation, the District's HRRS has gained significant support from EPA, the scientific community, and industry representatives.

5.6.1 What is the Health Risk Reduction Strategy (HRRS)?

The conventional mass-based regiment for attaining federal air quality standards generally measures progress in protecting public health by comparing the total amount of emissions reduced on a Valley-wide basis to the Valley's target for total emissions needed for attainment based on modeling and worst-case projections. For example, under ozone attainment plans, progress is measured by the mass quantity of either NOx or VOC reduced across the Valley over time, regardless of the actual ozone concentration reductions and associated health benefits achieved by strategies throughout the Valley. In contrast to this broad approach for planning and measuring progress, the District implements its diverse control measures and strategies throughout the Valley with clear and quantifiable public health benefits that are not fully accounted for under the conventional approach.

Additionally, driven by a rapidly expanding body of scientific research, there is now a growing recognition that from an exposure perspective, the NAAQS metrics for progress are a necessary but increasingly insufficient measure of total public health risk associated with air pollutants. In particular, control strategies for sources of ozone do not necessarily account for qualitative differences in the nature of their emissions. Differences in the relative potency of ozone precursors, VOCs in particular, are not captured by a strict, mass-based approach to precursor controls. Thus, while the federal air quality standards and plan process are motivated by public health, the process set forward under the federal CAA does not guarantee that the public health benefits of control strategies will be maximized. In contrast, the HRRS does the following:

- Applies to regulatory, incentive, and outreach strategies
- Public health is the primary driver for prioritizing clean air actions by the District
- Recognizes that risk to the public is not always proportional to the mass rate of emissions; examples include:
    - NOx versus VOCs
    - Photochemical reactivity of VOCs
- Clean air strategies with the highest benefit to public health are prioritized first regardless of mass, such as control strategies for the following:
    - Lawn care emissions
    - Gross-polluting vehicles
- Greater weight given to emissions reductions in Environmental Justice communities
- Greater weight given to reducing pollutants that are most effective in improving public health, such as:
    - NOx reductions versus VOC reductions
- All decisions are science-based; District continues to invest in Valley-specific research on population exposure and risk

5.6.2 Implementation of the Health Risk Reduction Strategy

To reduce ozone-related health risks, the District implements the HRRS through a number of strategies. A number of District programs have been influenced by the underlying principles and goals of the HRRS and provide a model of the success and added potential benefits possible under this strategy. The following are some examples:

- **Prioritizing NOx reductions over VOC reductions** – NOx emissions reductions have been demonstrated through numerous research studies and modeling efforts to be the most effective control strategy (precursor) for reducing the formation of ozone in the Valley, with VOC reductions found to be much less effective than NOx reductions in reducing ambient ozone concentrations. This plan and the District's other adopted ozone attainment plans place great priority in reducing NOx emissions, and maximize the reduction of ambient ozone concentrations and associated health benefits. As the primary precursor to the

formation of PM2.5, reducing NOx emissions is also the focus of the Valley's attainment strategies to address federal PM2.5 standards.

- **Grant funding priority for reduction of NOx emissions** – NOx is a criteria pollutant and a precursor to both ozone and particulates. The reduction of NOx emissions in the Valley is vital for the District to expedite attainment of both PM2.5 and ozone air quality standards and associated health benefits. Given its health-based significance with respect to reducing both ozone and PM2.5 concentrations, the majority of the District's grant programs are focused on maximizing NOx emissions reductions.

- **Prioritized adoption of strategy commitment for reducing emissions from high-polluting residential and commercial lawn mowers** – Through the District's popular Clean-Green-Yard-Machine grant program, the District has replaced over 3,900 high-polluting gas-powered lawn mowers with clean electric mowers, thus decreasing the urban, localized health risks associated with the use of gas-powered equipment. The District has also expanded its lawn care strategy to the commercial sector by funding over 175 commercial lawn and garden projects.

- **Grant funding priority for reduction in motor vehicle emissions through "Tune-In Tune-Up" vehicle repair and vehicle scrappage programs** – Emissions produced from vehicle travel significantly contribute to the air quality problem in the Valley, with mobile sources as the leading contributor of air pollution in the Valley. Motor vehicle emissions are also one of the biggest sources of pollution in the Valley's urban population centers, and reducing vehicle emissions will provide for expedited public health benefits to Valley residents. Within this context, environmental justice communities facing the highest social and environmental vulnerabilities also face significant air quality and economic impacts resulting from the disproportionally higher number of older, high-polluting vehicles driven by residents of these communities. Given this health-based significance, the District prioritizes grant funding for programs that reduce motor vehicle emissions in low income communities. Vouchers have been offered for the replacement of older high-emitting vehicles with newer cleaner vehicles, and the Tune-In Tune-Up program offers vouchers for emissions-related repairs to high-emitting vehicles. Tune-In Tune-Up has focused its outreach in Valley environmental justice communities and has received a large level of interest, with over 21,000 vehicle repair vouchers offered to Valley residents.

- **Grant funding priority for emissions reductions in environmental justice communities** – Environmental justice communities typically have a higher exposure risk to air pollution and are consequentially more vulnerable to the associated adverse health effects caused by poor air quality. The District's Governing Board has prioritized grant funding for emissions reductions that provide benefits for environmental justice communities. District staff has worked

closely with the District's Environmental Justice Advisory Group to identify potential enhancements to incentive programs to increase benefits to, and participation by, environmental justice communities. One example of this is that the Public Benefit Grants Program provides significant scoring consideration for projects that benefit environmental justice communities.

- **Expanded outreach to environmental justice communities through permitting process** – Historically, the District has allowed extensive public review and input into the air quality permit issuance process, with procedures that extend beyond minimum state and federal requirements. The District has continued to enhance its permit issuance outreach efforts in environmental justice communities through increased workshops in those communities, expanded multilingual outreach, and increased utilization of web resources to make project information more easily available.

- **Timely air quality information provided to public through Real-Time Air Quality Advisory Network (RAAN)** – Launched in 2010, the District's innovative RAAN system uses real-time data from air monitoring stations throughout the Valley to provide hour-by-hour air quality updates to schools and other subscribers. Subscribers can use this information to make informed decisions and plan outdoor activities for times with the best air quality, reducing potential air quality health risks.

- **Air Quality Index (AQI) and Daily Air Quality Forecasting** – an AQI is a color-coded designation for the day that is used as a tool for projecting the forecasted air quality and recommends corresponding activity modifications based on pollution levels.

- **Air Alerts** – Air Alert is a notification that the Valley is currently experiencing conditions that may lead to a federal ozone standard exceedance. When the District calls an Air Alert, Valley residents and businesses are advised to put into place measures that reduce vehicle use to proactively reduce emissions and protect public health.

- **Web-Based Archived Air Quality (WAAQ) System** – The WAAQ System is a revolutionary web application developed by the District to let anyone retrieve historical neighborhood air quality information. A user can provide a specific address or location in the Valley and the system will retrieve various air quality information for that specific neighborhood displayed as a graphical chart. There are also options to compare air quality trends on a year-to-year basis.

- **Tracking and sponsoring of health research** – As part of the District's HRRS, the District is playing an active role in funding leading edge health research focusing on the Valley population. In 2010–2011, the District sponsored the first major epidemiological investigation of health effects of air pollution in the Valley, focusing on the populations of Modesto, Fresno, and Bakersfield. The study

found that daily exposure to high PM2.5 concentrations was significantly correlated with increased daily hospital and emergency room admission rates for asthma and other respiratory and cardiovascular diseases. In 2012, the District sponsored a follow-up epidemiological study to examine which of the chemical species found in Valley PM2.5 are most highly correlated with elevated ER and hospital admission rates. Results are expected to be published in the near future. In 2010, the District sponsored a pilot study of PM 0.1 (ultrafine particles) in Fresno. UCSF-Fresno investigated the quantity and spatial distribution of PM 0.1 plumes from motor vehicles, lawn care equipment, wood burning, and restaurants. Currently the District is funding a UC Davis research project to develop a model of PM0.1 population exposure in the Valley based on previous Valley observational research. PM0.1 exposure will be correlated with short- and long-term health effects by making use of the large body of Valley epidemiological data that has been generated by the previous studies described above. The District will continue to seek out and fund research opportunities that further the understanding of PM-related impacts on public health.

Building on the above strategies, this *2016 Ozone Plan* will continue to identify and prioritize control measures with the most benefit to public health. This public health-centered strategy will include the prioritization of stationary and area source control measures, mobile source control measures, incentive programs, public outreach, and other innovative strategies.

5.7 INCENTIVES

Incentive programs have become a crucial component of the District's overall strategy for achieving the emissions reductions necessary to bring the Valley into attainment. The District operates one of the largest and most well-respected voluntary incentive programs in California. Through strong advocacy at the state and federal levels, the District has appropriated $136 million in incentive funding in the 2015-2016 District Budget.[2] Since the District's inception in 1992, considerable funding has been expended in support of clean-air projects in the Valley and achieved significant emissions reductions with corresponding air quality and health benefits. The District typically requires match funding of 30% to 70% from grant recipients. To date, grant recipients have provided $653,243,285 in matching funds, with a combined District and grant recipient funding investment of more than $1.4 billion.

[2] SJVAPCD. Recommended Budget 2015-2016. p.68. (2015, May 21) Retrieved from http://www.valleyair.org/Board_meetings/GB/agenda_minutes/Agenda/2015/May/BudgetHearing/final/03.pdf

Table 5-6 Summary of Grant Expenditures and Results[3]

District Incentive Funding ($)	Grant Recipient Match Funding ($)	Emissions Reductions (tons)	Cost-Effectiveness ($/ton)
$751,520,858	$653,243,285	136,177	$5,519

Over the past 15 years, the incentive programs have been used to purchase, replace, or retrofit thousands of pieces of equipment.

In addition to funding the existing core incentive programs that have traditionally achieved highly cost-effective emissions reductions, the District continues to evaluate additional potential opportunities to expand the portfolio of programs available. As new funding sources and opportunities are identified, the District will continue to look for additional incentive programs and expansions to existing programs. See Appendix E for complete details on the District's emissions reductions incentives program.

5.8 LEGISLATIVE PLATFORM

Each year the District Governing Board adopts a legislative platform to guide District advocacy and policy efforts. Through state and federal lobbying efforts and delegation visits to Washington D.C., the District informs elected officials about Valley needs and concerns based on the priorities established in the legislative platform. With persistence, the District has secured support and additional incentive funding for programs critical to emissions reductions in the Valley. For complete details of the District's 2016 legislative priorities and general legislative priorities, please refer to the District webpage at http://www.valleyair.org/Board_meetings/GB/agenda_minutes/Agenda/2016/January/final/07.pdf.

5.9 EDUCATION AND PUBLIC OUTREACH

The District's mission to protect public health by improving air quality in the Valley relies on the public's awareness and understanding of the District's air-quality improvement programs. The Valley cannot meet these public health goals on the back of businesses alone. Valley businesses are subject to some of the most stringent air quality regulations in the nation. As Valley businesses continue to be subject to additional rounds of prohibitory regulations, the role of the public becomes increasingly important in reaching federal standards.

Emissions from public behavior such as driving, residential wood burning and lawn-care maintenance continue to be a key factor in the Valley's emissions inventory. Consequently, public acceptance of concepts such as alternative commute options, as well as specific clean-air strategies, such as Check Before You Burn, the Air Alert program and Healthy Air Living (HAL), requires widespread lifestyle changes. To that

[3] As of January 1, 2016.

end, the District Governing Board has placed a high priority on conducting an active and effective public education and outreach program.

The District's comprehensive public education and outreach program is composed of numerous elements that are designed to allow the District to leverage opportunities to advance the District's multiple strategic objectives, such as:

- Encourage and enlist the general public to do their part to reduce air pollution
- Empower and inform the public to protect themselves during episodes of poor air quality by providing them timely air quality information as well as scientific and comprehendible information on the health effects of air pollution
- Provide accurate and objective information about Valley efforts to reduce air pollution, measurable results and achievements, and challenges that remain.

For more information about the District's public education and outreach efforts, please refer to Appendix G.

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Chapter 6

Attainment Demonstration, RACM, RFP, and Contingency

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Chapter 6: Attainment Demonstration, RACM, RFP and Contingency Measures

Under the federal Clean Air Act, attainment plans are required to address a number of requirements related to demonstrating attainment by the required deadline and progress towards attainment. This chapter shows that this plan satisfies the following federal requirements:

- Attainment demonstration, including the use of CAA 182(e)(5) "Black Box" provisions afforded to extreme nonattainment areas
- Reasonably available control measures (RACM)
- Reasonable further progress (RFP)
- Contingency measures for RFP and attainment

6.1 ATTAINMENT DEMONSTRATION

Under the federal Clean Air Act, the District must demonstrate attainment as expeditiously as practicable, no later than the attainment deadline of 2031 using air monitoring data for the period of 2029, 2030, and 2031. This requires another 207.7 tons per day in NOx reductions from stationary and mobile sources throughout the Valley. The measures identified in this plan do achieve the necessary reductions. Through the comprehensive stationary and mobile source control strategy that has been adopted from prior regulatory actions and that is now included in this plan, the San Joaquin Valley will reduce NOx emissions by over 60% between 2012 and 2031. The ambient ozone concentrations will decrease dramatically in all areas of the Valley with Valley residents experiencing cleaner air over time. The California Air Resources Board (ARB) used a modeled attainment test consistent with U.S. Environmental Protection Agency (EPA) guidelines to predict future 8-hour ozone concentrations at each monitoring site in the Valley to demonstrate attainment. Modeling shows that the Valley will attain the 8-hour ozone standard by 2031 based on implementation of these ongoing control measures.

The District could show expeditious attainment without the need to rely on "Black Box" provisions afforded under CAA §182(e)(5). Unfortunately, compliance with the contingency requirements under the federal Clean Air Act requires that the District hold back on 1.6 tons per day of NOx reductions. To ensure that the plan is approvable with the necessary contingencies, the plan needs to include a "Black Box." The District, however, hopes that the state Air Resources Board or federal EPA can adopt and implement necessary strategies relating to mobile sources resulting in further reductions in emissions that could satisfy contingency requirements and avoid delays in attaining the standard expeditiously.

Table 6-1 San Joaquin Valley Attainment Demonstration

	Attainment Demonstration Analysis (2031 Attainment Deadline)	Emissions (tons NOx per day, Summer Average)
A	San Joaquin Valley Emissions with Adopted Control Strategy	131.9
B	Attainment Emissions Target	131.9
C	San Joaquin Valley Emissions with Adopted Control Strategy and Deferred Emissions Reductions to Satisfy Attainment Year Contingency Requirement	133.5
D	Black Box Emissions Reductions	1.6
E	San Joaquin Valley Emissions with Black Box Emissions Reductions (Line C – D)	131.9
Clean Air Act Attainment Demonstration Satisfied?		**YES**

As presented in Appendix J, the ARB used a modeled attainment test consistent with EPA guidelines to predict future 8-hour ozone concentrations at each monitoring site in the Valley and to demonstrate attainment. A photochemical model simulates the observed ozone levels using precursor emissions and meteorology in the region. The model also simulates future ozone levels based on projected changes in emissions while keeping the meteorology constant. This modeling is used to identify the relative benefits of controlling different ozone precursor pollutants and the most expeditious attainment date. Appendix I contains the modeling protocol for this plan. Appendix J contains a summary of the modeling process and results.

Without deferring emissions reductions to address the Clean Air Act attainment year contingency requirement, ARB's modeling shows that the Valley will attain the 8-hour ozone standard by 2031 based on implementation of the ongoing control measures. As illustrated in the following table, the monitoring site with the highest predicted ozone concentration is Clovis-N with a predicted design value at 74 parts per billion (ppb).

Table 6-2 Base-Year and Future-Year 8-hour ozone design values

Monitoring Station	Design Value (ppb)	
	2010-2012	2029-2031
Edison	93	64
Arvin DiGiorgio	91	64
Fresno-Garland	94	70
Clovis-N Villa Avenue	98	74
Fresno-Sierra Skypark_#2	92	68
Parlier	92	69
Sequoia and Kings Canyon	93	65
Bakersfield-California	89	65
Porterville	90	63
Sequoia Natl Park-Lower	81	61
Visalia-N Church Street	87	60
Oildale- Manor Street	89	65
Fresno-Drummond Street	95	71
Hanford-S Irwin Street	90	64
Modesto-14th Street	75	61
Shafter-Walker Street	86	62
Turlock-S Minaret Street	88	69
Tracy	80	66
Tranquility	77	60
Merced-S Coffee Avenue	83	65
Stockton-Hazelton Street	69	57
Maricopa-Stanislaus Street	87	63
Madera-Pump Yard	78	61
Madera-City	86	65

6.2 REASONABLY AVAILABLE CONTROL MEASURES (RACM) DEMONSTRATION

CAA Section 172(c)(1) requires attainment plans to provide for the implementation of RACM as expeditiously as practicable (including emissions reductions from existing sources in the areas as may be obtained through the adoption of at least reasonably available control technology) and shall provide for attainment of the standard.

Put another way, the total of all potential emissions reductions opportunities that are *not* included as plan commitments must not advance attainment by one year. Measures that are not necessary to satisfy reasonable further progress (RFP) or expeditious attainment are also not required RACM for the area.

To advance attainment by at least one year, the collective emissions reductions that could be achieved through unused but reasonably available controls would have to achieve the 2031 emissions levels by 2030. Modeling for this and other ozone plans has shown that the Valley is NOx limited. NOx emission reductions are most effective

in reducing Valley ozone concentrations, whereas Valley ozone is not as responsive to VOC emission reductions and therefore, VOC emission reductions have minimal impact on advancing attainment. Advancing attainment by one year would therefore depend on expediting NOx emission reductions.

6.2.1 District RACM Demonstration

Valley NOx emissions are already being significantly reduced as adopted regulations are fully implemented through fleet turn-over and normal equipment replacement. As illustrated in Appendix B to this plan, the majority of NOx emission reductions occurring between the 2012 base year and the 2031 attainment year come from mobile sources. These reductions cannot be expedited through additional stationary and area source regulations, for which the District has regulatory authority. Based on the difference between 2031 and 2030 NOx emissions levels, unused control measures would have to achieve 2.7 tons per day (tpd) of NOx emission reductions to advance attainment by one year. However, as previously discussed, there are no unused control measures in this plan because every reasonable control measure is used in this plan. As presented in Appendix C, all reasonable control measures under the District's jurisdiction are being implemented; therefore, there are no emissions reductions associated with unused regulatory control measures.

6.2.2 ARB RACM Demonstration

[This section provided by California Air Resources Board]

The Clean Air Act (the Act) requires a demonstration that control measures in ozone nonattainment areas meet a control level known as Reasonable Available Control Measures (RACM). At the State level, ARB is responsible for measures to reduce emissions from mobile sources and consumer products, and the Department of Pesticide Regulation (DPR) is responsible for emission reductions from pesticides. This chapter will discuss how California's measures for these categories meet RACM requirements.

6.2.2.1 RACM Requirements at the State Level

Subpart 1, section 172(c)(1) of the Act requires SIPs to provide for the implementation of RACM as expeditiously as practicable. 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.

6.2.2.2 Mobile Source Control Program

Given the severity of California's air quality challenges, ARB has implemented the most stringent mobile source emissions control program in the nation. ARB'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 program meets RACM requirements in the context of ozone nonattainment.

6.2.2.2.1 Waiver Approvals

While the Act preempts most states from adopting emission standards and other emission-related requirements for new motor vehicles and engines, it allows California to seek a waiver or authorization from the federal preemption to enact emission standards and other emission-related requirements for new motor vehicles and engines and new and in-use off-road vehicles and engines that are at least as protective as applicable federal standards, except for locomotives and engines used in farm and construction equipment which are less than 175 horsepower (hp).

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 Advanced Clean Cars (including ZEV and LEV III) for light duty vehicles, and On-Board Diagnostics, Heavy-Duty Idling, Malfunction and Diagnostics System, In-Use Off-Road Diesel Fleets, Large Spark Ignition Fleet, Mobile Cargo Handling Equipment for heavy-duty engines. Other authorizations include Off Highway Recreational Vehicles and the Portable Equipment Registration Program.

Finally, ARB obtained an authorization from U.S. EPA to enforce adopted emission standards for off-road engines used in yard trucks and two-engine sweepers. ARB 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).

6.2.2.2.2 Light- and Medium-Duty Vehicles

Light- and medium-duty vehicles are currently regulated under California's Advanced Clean Cars program including the Low Emission Vehicle III (LEV III) and Zero-Emission Vehicle (ZEV) programs. Other California programs such as the 2012 Governor Brown Executive Order to put 1.5 million zero-emission vehicles on the road by 2025, and California's Reformulated Gasoline program (CaRFG) will produce substantial and cost effective emission reductions from gasoline powered vehicles.

ARB is also active in implementing programs for owners of older dirtier vehicles to retire them early. The "car scrap" programs, like the Enhanced Fleet Modernization Program, and Clean Vehicle Rebate Project provide monetary incentives to replace old vehicles with zero emission vehicles. The Air Quality Improvement Program (AQIP) is a voluntary incentive program to fund clean vehicles.

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 in the context of a RACM assessment.

6.2.2.2.3 Heavy-Duty Vehicles

California's heavy-duty vehicle emissions control program includes requirements for increasingly tighter new engine standards and address vehicle idling, certification procedures, on-board diagnostics, emissions control device verification, and in-use vehicles. This 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.

Most recently in the ongoing efforts to go beyond federal standards and achieve further reductions, ARB adopted the Optional Reduced Emissions Standards for Heavy-Duty Engines regulation in 2014 that establishes the new generation of optional NOx emission standards for heavy-duty engines.

The recent in-use control measures include On-Road Heavy-Duty Diesel Vehicle (In Use) Regulation, Drayage (Port or Rail Yard) Regulation, Public Agency and Utilities Regulation, Solid Waste Collection Vehicle Regulation, Heavy-Duty (Tractor-Trailer) Greenhouse Gas Regulation, ATCM to Limit Diesel-Fueled Commercial Motor Vehicle Idling, Heavy-Duty Diesel Vehicle Inspection Program, Periodic Smoke Inspection Program, Fleet Rule for Transit Agencies, Lower-Emission School Bus Program, and Heavy-Duty Truck Idling Requirements. In addition, ARB's significant investment in incentive programs provides an additional mechanism to achieve maximum emission reductions from this source sector.

Taken together, California's emission standards, fuel specifications, and incentive programs for heavy-duty vehicles represent all measures that are technologically and economically feasible in the context of a RACM assessment.

6.2.2.2.4 Off-Road Vehicles and Engines

California regulations for off-road equipment include not only increasingly stringent standards for new off road diesel engines, but also in-use requirements and idling restrictions. The Off-Road Regulation 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.

Engines and equipment used in agricultural processes are unique to each process and are often re designed and tailored to their particular use. Fleet turnover to cleaner engines is the focus for these engines. In the San Joaquin Valley, where agriculture has a larger impact on air quality than in other areas of the state, state incentive programs have been leveraged with Federal and local incentives to provide farmers assistance to replace their older, higher-polluting equipment with the cleanest available technology. ARB is also working with the San Joaquin Valley Air Pollution Control

District on developing a pilot project that gives farmers opportunity to replace their high-emitting equipment through a trade-up system.

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 in the context of a RACM assessment.

6.2.2.2.5 Other Sources and Fuels

The emission limits established for other mobile source categories, coupled with U.S. EPA waivers and authorization of preemption establish that California's programs for motorcycles, recreational boats, off-road recreational vehicles, cargo handling equipment, and commercial harbor craft sources meet the requirements for RACM.

Cleaner burning fuels also play an important role in reducing emissions from motor vehicles and engines as ARB has adopted a number of more stringent standards for fuels sold in California, including the Reformulated Gasoline program, low sulfur diesel requirements, 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 in the context of a RACM assessment.

6.2.2.2.6 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 in their approval of ARB's regulations and through the waiver process. In its 2011 approval of the Valley's 8-hour ozone plan which included the State's current program and new measure commitments, U.S. EPA found that there were no further RACM that would advance attainment of the standard in the Valley.

Since then, ARB 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 ARB process for developing the proposed State measures included an extensive public process and is consistent with U.S. EPA RACM guidance. Through this process ARB found that there are no additional RACM that would advance attainment of the 75 ppb 8-hour ozone standard in the Valley from emissions reductions associated with unused regulatory control measures. As a result, California's mobile source control programs fully meet the requirements for RACM.

6.2.2.3 Consumer Products

Consumer products are defined as chemically formulated products used by household and institutional consumers. For more than twenty five years, ARB 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 2013.

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.

6.2.2.4 Pesticides

The DPR is the State agency responsible for regulating the application of pesticides, which are a significant source of VOCs in the San Joaquin Valley. DPR has adopted and implemented regulations to limit VOC emissions from use of agricultural fumigant and nonfumigant pesticides in the San Joaquin Valley. In October 2012, U.S. EPA approved DPR regulations requiring the use of low-emitting fumigation methods in the Valley and a commitment to manage VOC emissions from the use of pesticides to ensure they do not exceed 18.1 tons per day (tpd), as an average during the May-October period.[1] This emissions ceiling represents a 12 percent reduction from 1990 pesticide VOC emissions in the Valley. DPR is also required to annually prepare and make available to the public a pesticide emission inventory to track VOCs and determine compliance. U.S. EPA found the fumigant regulations provide for RACT for fumigant application in the San Joaquin Valley. Most recently, DPR amended the fumigant regulations effective April 2016, adding new low-emitting fumigation methods.

In February 2016, U.S. EPA proposed approval of nonfumigant regulations DPR adopted in 2013. Since nonfumigant emissions account for the majority of the pesticide

[1] 77 FR 65294, https://www.gpo.gov/fdsys/pkg/FR-2012-10-26/pdf/2012-26311.pdf

VOC emissions in the San Joaquin Valley, these regulations prohibit the use of certain high-VOC nonfumigant pesticides applied to specified crops in the San Joaquin Valley, if the estimated VOC emissions from nonfumigant use exceed 95 percent of the 18.1 tpd emissions ceiling for pesticides during the May-October ozone season. Once triggered, these prohibitions remain in effect until the estimated VOC emissions from nonfumigants comply with the VOC limit for at least two consecutive years. Requiring the restrictions during the ozone season and not year-round may have the added benefit of reducing emissions by shifting applications to other seasons, but would not provide additional emission reductions in the ozone season.

DPR is the regulator to reduce VOC emissions from the use of nonfumigant agricultural pesticides in the Valley, the most stringent in the State**.** As part of the regulation submittal process, DPR conducted an Analysis of Alternatives for Nonfumigant Pesticide Products. U.S. EPA found nonfumigant pesticides are subject to RACM but not to Reasonably Available Control Technology (RACT) requirements, because there are no major sources of nonfumigant VOCs in the Valley and no relevant U.S. EPA Technical Control Guidelines.[2] However, U.S. EPA pointed out that DPR has demonstrated these fumigant regulations are stringent enough to implement RACT-level controls on the application of pesticides. [3] U.S. EPA also indicated these rules are consistent with the Act requirements and existing guidance on enforceability, stringency, and SIP revisions.[2]

Based on DPR's assessment, no other state requires measures to reduce VOC emissions from pesticides. In summary, DPR's pesticide regulations represent all measures that are technologically and reasonably available in the context of the 2016 8-hour Ozone Plan.

6.2.3 Metropolitan Planning Organizations (MPOs) RACM Demonstration

As discussed in Appendix D of this plan, all reasonable control measures under MPO jurisdiction are being implemented. 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.

6.2.3.1 RACM Demonstration Conclusion

There are no reasonable regulatory control measures from any agency's jurisdiction that have been excluded from use in this plan; therefore, there are no emissions reductions associated with unused regulatory control measures.

[2] 81 FR 6481 https://www.gpo.gov/fdsys/pkg/FR-2016-02-08/pdf/2016-02314.pdf
[3] U.S. EPA, 2016, Technical Support Document for EPA's Proposed Rulemaking for the California State Implementation Plan Revisions to the Department of Pesticide Regulation Nonfumigant Regulations

6.3 REASONABLE FURTHER PROGRESS (RFP) & CONTINGENCY FOR RFP

[This section provided by California Air Resources Board]

Clean Air Act (CAA) sections 172(c)(2) and 182(b)(1) require attainment plans to provide for reasonable further progress (RFP). RFP is defined in CAA section 171(1) as annual incremental reductions for the purpose of ensuring attainment by the attainment year. This requirement to show steady progress in emission reductions between the baseline year and attainment date ensures that areas will not delay implementation of emission control programs until immediately before the attainment deadline.
There are two separate requirements for nonattainment areas depending upon their classification. The first is a one-time requirement for a 15 percent reduction in Reactive Organic Compounds (ROG, also commonly called Volatile Organic Compounds, or VOC) emissions between the years of 1990 and 1996 for nonattainment areas classified as moderate or above (section 182(b)(1)). The second is an additional 3 percent per year reduction of ozone precursor emissions until attainment for ozone nonattainment areas classified as serious or higher (section 182(c)(2)(B)).

In addition to the RFP requirements, CAA section 172(c)(9) requires that plans provide for contingency measures in case the area fails to make RFP. U.S. EPA has interpreted this requirement to represent one year's worth of emission reduction progress, amounting to 3 percent reductions, to be achieved by measures that are already in place or that would take effect without further rulemaking action.

6.3.1 Fifteen Percent ROG-only Rate of Progress Requirement

The March 2015 U.S. EPA implementation rule (Rule) for the 2008 8-hour ozone standard interprets the CAA RFP requirements, establishing requirements for RFP that depend on the area's classification and whether the area has an approved 15 percent ROG-only reduction plan for a previous ozone standard that covers all of the 2008 8-hour ozone nonattainment area (80 FR 12264). In 1997, EPA approved a 15 percent rate of progress plan for the San Joaquin Valley for the 1-hour ozone standard covering the entire nonattainment area for the 2008 8-hour ozone standard (62 FR 1150). As a result, the 15 percent ROG-only requirement has been met for the San Joaquin Valley.

6.3.2 Reasonable Further Progress Requirements

Per the Rule, the San Joaquin Valley must demonstrate an 18 percent reduction in ozone precursor emissions for the first six years of the attainment planning period, and an average emission reduction of 3 percent per year after that until the attainment date (80 FR 12264). As detailed in CAA section 182(b)(1)(C), these emission reductions must be achieved through existing programs.

The San Joaquin Valley RFP demonstration is achieved by forecasted emission reductions from existing control regulations as shown in the planning inventory. Both ROG and NOx emission reductions are needed to meet the RFP reduction targets. The

NOx substitution is used on a percentage basis to cover any percentage shortfall in ROG reduction.

The table below demonstrates that the Valley meets the RFP targets in the milestone years of 2018, 2021, 2024, 2027, 2030, and 2031, with a three percent contingency set-aside in 2018 and carried through to 2031 per the requirements of the Rule.

Table 6-3 San Joaquin Valley 2008 8-hour Ozone NAAQS Reasonable Further Progress (tons NOx/day, summertime inventory)

Year	2012	2018	2021	2024	2027	2030	2031
ROG (with existing Measures)	337.3	303.7	298.8	296.3	296.1	297.4	296.7
Required % change since previous milestone year (ROG or NOx)		18%	9%	9%	9%	9%	3%
Required % change since 2012 (ROG or NOx)		18%	27%	36%	45%	54%	57%
Target ROG levels		276.6	251.7	229.0	208.4	189.7	184.0
Shortfall (-)/ Surplus (+) in ROG reductions needed to meet target		-27.1	-47.1	-67.3	-87.7	-107.7	-112.7
Shortfall (-)/ Surplus (+) in ROG reductions needed to meet target, %		-8.0%	-14.0%	-20.0%	-26.0%	-32%	-33%
ROG reductions since 2012 used for contingency this milestone year, %		0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
ROG reductions shortfall previously provided by NOx substitution, %		0.0%	8.0%	14.0%	20.0%	26.0%	31.9%
Actual ROG reductions Shortfall (-)/ Surplus (+)		-8.0%	-5.9%	-6.0%	-6.1%	-5.9%	-1.5%
Year	2012	2018	2021	2024	2027	2030	2031
NOx (with existing measures)	339.6	230.4	200.5	159.0	144.8	134.6	131.9
Change in NOx since 2012		109.2	139.0	180.6	194.8	205.0	207.7
Change in NOx since 2012, %		32.2%	40.9%	53.2%	57.4%	60.4%	61.2%
NOx reductions since 2012 already used in ROG substitution & contingency through last milestone year, %		0.0%	11.0%	17.0%	23.0%	29.0%	34.9%
NOx reductions since 2012 available for ROG substitution & contingency in this milestone year, %		32.2%	29.9%	36.2%	34.4%	31.4%	26.2%
NOx reductions since 2012 used for ROG substitution in this milestone year, %		8.0%	5.9%	6.0%	6.1%	5.9%	1.5%
NOx reductions since 2012 used for contingency in this milestone year, %		3.0%	0.0%	0.0%	0.0%	0.0%	0.0%
NOx reductions since 2012 surplus after meeting ROG substitution & contingency needs in this milestone year, %		21.1%	24.0%	30.2%	28.4%	25.4%	24.7%
RFP shortfall (-) in reductions needed to meet target, if any, %		0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Total shortfall (-) for RFP and contingency, if any, %		0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
RFP met?		**YES**	**YES**	**YES**	**YES**	**YES**	**YES**
Contingency met?		**YES**	**YES**	**YES**	**YES**	**YES**	**YES**

6.4 CONTINGENCY FOR ATTAINMENT

Contingency measures are extra emissions reductions that go into effect without further regulatory action. In an attainment plan, the measures must be "extra" in the sense that the reductions are not accounted for in the attainment demonstration. Attainment contingencies are used if a region fails to attain a federal standard by the final attainment date. The need to implement attainment contingencies is based on ambient air quality data as the end of the attainment year. If EPA finds that an area fails to attain a standard on time, contingency reductions must be implemented automatically. Depending on the requirements associated with the standard in question, an area may have to adopt a new attainment plan or incur other penalties.

Additional guidance on the CAA contingency measure provisions is found in the General Preamble, 57 FR 13498, 13510-13512 and 13520. The guidance indicates that states should adopt and submit contingency measures sufficient to provide for three percent emissions reductions.

Attainment contingency can be satisfied from the additional reductions occurring between the attainment year and the following year – in this case, the reductions between 2031 and 2032. These reductions occur through continued implementation of adopted regulations. Similar to RFP, the 3% attainment contingency reductions can come from either VOC or NOx. The Valley is a NOx limited region, therefore NOx emissions reductions will be used to satisfy the attainment contingency.

Requiring contingency measures in extreme nonattainment areas is irrational and unnecessary. In fact, it can lead to delayed cleanup if measures are set aside for later implementation as a contingency. While requiring contingency measures is a well-intentioned provision, it does not make sense in areas such as the San Joaquin Valley that have been classified as "extreme" non- attainment for ozone. With no stones left unturned in such plans, requiring contingency measures in such areas makes no sense.

The District could show expeditious attainment without the need to rely on "Black Box" provisions afforded under CAA §182(e)(5). Unfortunately, compliance with the contingency requirements under the federal Clean Air Act requires that the District hold back on 1.6 tons per day of NOx reductions. To ensure that the plan is approvable with the necessary contingencies, the plan needs to include a "Black Box." The District however hopes that the state Air Resources Board or federal EPA can adopt and implement necessary strategies relating to mobile sources resulting in further reductions in emissions that could satisfy contingency requirements and avoid delays in attaining the standard expeditiously.

Table 6-4 Attainment Contingency Demonstration

	Attainment Contingency Demonstration	NOx (tons/day)
A	San Joaquin Valley Emissions with Adopted Control Strategy in 2031	131.9
B	San Joaquin Valley Emissions with Adopted Control Strategy in 2032	129.5
C	Required surplus emissions reductions needed to demonstrate 3% attainment contingency requirement	4
D	Emission reductions from existing measures achieved in 2032 (Line A – Line B)	2.4
E	Emissions reductions from existing control strategy deferred towards contingency requirement in 2032	1.6
F	**Attainment contingency met? (Line D + Line E) ≥ Line C**	**Yes**

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Appendix A

Ambient Air Quality Data

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Appendix A: Ambient Air Quality Data

The concentration of ambient ozone at any given location in the San Joaquin Valley air basin (Valley) is a function of meteorology, the natural environment, atmospheric chemistry, and ozone precursor emissions from both biogenic (natural) and anthropogenic (human caused) sources. The San Joaquin Valley Air Pollution Control District (District), the California Air Resources Board (ARB), and other agencies monitor ozone concentrations throughout the Valley. The U.S. Environmental Protection Agency (EPA) serves as the official repository of ambient ozone data.[1]

The District uses the collected data to show air quality improvement throughout the standardized design value and attainment test calculations, using EPA protocols to document basin-wide improvement and attainment of the National Ambient Air Quality Standards (NAAQS). As shown in this appendix, the design value data show steady, long-term air quality improvement.

The District also uses the data to evaluate the impact of changing daily, monthly, and annual ozone concentrations on public health. These trend analyses provide the District with critical information about how to develop control measures and incentive programs that contribute to the greatest public health improvements and greatest progress toward EPA air quality standards.

A.1 AMBIENT AIR QUALITY DATA

Table A-1 summarizes the annual fourth-highest daily maximum 8-hour average ozone concentrations for currently operating monitoring sites in the San Joaquin Valley (Valley) for the years 1990-2015. The calculation of the 3-year average of the annual fourth-highest daily maximum 8-hour average ozone concentration is explained further in Chapter 2. Table A-2 shows the 3-year average of the annual fourth-highest daily maximum 8-hour average ozone concentration for each site within the Valley for the years 1990-2015. A dash (-) means that there is insufficient (or no) data available to determine the value.

Attainment status is determined for each site by analyzing 2013 through 2015 ozone measurements[2]. If any monitoring site within the Valley has a design value that is greater than 0.075 ppm, then, by rules established by EPA, the entire air basin is nonattainment. Table A-3 summarizes the current attainment status on a site-by-site basis. Bold values indicate that one of the attainment tests is over the standard. Figure A-1 illustrates the San Joaquin Valley air basin map with 8-hour ozone design values on a site-by-site basis.

[1] U.S. Environmental Protection Agency; Technology Transfer Network (TTN), Air Quality System (AQS): AQS Web Application (2010). Available at https://www.epa.gov/aqs

[2] 40 CFR (Code of Federal Regulations) Part 50, Appendix I, Sections 2.2 and 2.3, require that attainment calculations be based on at least the most recent three complete years of quality reviewed data.

Table A-3 shows that two of the 25 air monitoring sites in the Valley currently meet the attainment test for 2008 8-hour ozone standard of 75 ppb in Stockton and Tranquillity. Twenty-Three (23) out of 25 sites are nonattainment for the 8-hour average ozone standard for the 2013-2015 time period. This is an improvement from 1999 to 2001 period where all sites were nonattainment. Figure A-1 shows the Valley-wide design values for 1990-2015. Figure A-2 shows 2015 design values plotted on a map. More air quality trend data can be found at <http://www.arb.ca.gov>.

Table A-1 Fourth Highest 8-hr Average Ozone (ppm)

Name	1990	1995	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
Stockton-Hazelton	0.083	0.090	0.076	0.076	0.074	0.075	0.073	0.073	0.083	0.075	0.077	0.070	0.070	0.066	0.072	0.064	0.071	0.069
Tracy-Airport	-	-	-	-	-	-	-	-	0.093	0.079	0.090	0.080	0.075	0.080	0.085	0.073	0.080	0.077
Modesto-14th St	0.097	0.095	0.086	0.091	0.087	0.082	0.080	0.089	0.090	0.076	0.090	0.079	0.073	0.074	0.078	0.075	0.081	0.083
Turlock	-	0.103	0.091	0.094	0.102	0.093	0.087	0.079	0.092	0.075	0.106	0.086	0.087	0.088	0.091	0.080	0.081	0.085
Merced-Coffee	-	0.107	0.103	0.096	0.105	0.107	0.096	0.083	0.087	0.087	0.105	0.080	0.090	0.082	0.079	0.083	0.082	0.083
Madera-City	-	-	-	-	-	-	-	-	-	-	-	-	0.090	0.081	0.087	0.085	0.082	0.083
Madera-Pump Yard	-	-	0.088	0.090	0.096	0.093	0.078	0.076	0.081	0.077	0.091	0.085	0.078	0.080	0.078	0.079	0.088	0.080
Tranquillity	-	-	-	-	-	-	-	-	-	-	-	-	0.077	0.079	0.077	0.075	0.075	0.077
Fresno-Sky Park	0.094	0.103	0.114	0.113	0.119	0.102	0.091	0.101	0.097	0.088	0.101	0.093	0.097	0.095	0.085	0.085	0.091	0.084
Clovis	-	0.108	0.104	0.110	0.104	0.097	0.085	0.093	0.094	0.092	0.108	0.099	0.103	0.096	0.097	0.091	0.097	0.093
Fresno-1st/Garland	0.103	0.108	0.104	0.104	0.109	0.106	0.092	0.101	0.101	0.094	0.108	0.100	0.098	0.090	0.095	0.084	0.090	0.087
Fresno-Drummond	0.103	0.089	0.099	0.097	0.110	0.104	0.091	0.086	0.085	0.079	0.093	0.097	0.087	0.102	0.096	0.086	0.084	0.088
Parlier	0.103	0.106	0.108	0.109	0.115	0.111	0.087	0.091	0.099	0.090	0.101	0.082	0.094	0.089	0.094	0.095	0.087	0.093
Hanford	-	0.080	0.105	0.093	0.101	0.092	0.088	0.085	0.086	0.080	-	-	0.103	0.086	**0.082**	**0.085**	0.086	0.085
Visalia-Church	0.102	0.104	0.099	0.099	0.102	0.096	0.089	0.095	0.092	0.086	0.105	0.091	0.096	0.079	0.088	0.074	0.078	0.087
Porterville	-	-	-	-	-	-	-	-	-	-	-	-	0.091	0.092	0.088	0.084	0.073	0.086
Lower Kaweah	0.096	0.095	0.090	0.096	0.108	0.100	0.095	0.097	0.097	0.091	0.101	0.080	0.077	0.081	0.087	0.087	**0.085**	0.083
Ash Mountain	-	-	0.105	0.104	0.107	0.110	0.099	0.107	0.104	0.099	0.112	0.098	0.094	0.096	0.095	0.090	0.089	0.088
Shafter	0.093	0.095	0.092	0.098	0.096	0.096	0.084	0.090	0.093	0.083	0.093	0.080	0.091	0.084	0.085	0.079	0.081	0.082
Oildale	0.098	0.101	0.103	0.097	0.102	0.100	0.094	0.096	0.100	0.090	0.104	0.087	0.093	0.087	0.088	0.078	0.078	0.082
Bakersfield-Golden	-	0.096	0.099	0.095	0.101	0.098	0.085	0.088	0.091	0.080	0.094	-	-	-	-	-	-	-
Bakersfield-California	-	0.107	0.102	0.099	0.101	0.101	0.091	0.099	0.107	0.085	0.101	0.086	0.093	0.087	0.087	0.084	0.084	0.088
Bakersfield-Muni	-	-	-	-	-	-	-	-	-	-	-	-	-	-	**0.099**	0.087	0.087	0.097
Edison	0.108	0.123	0.105	0.104	0.109	0.100	0.095	0.097	0.108	0.093	0.107	0.097	0.099	0.092	0.088	0.079	0.085	0.090
Arvin-Bear Mtn.	0.118	0.115	0.111	0.109	0.118	0.119	0.112	0.108	0.111	0.102	0.112	0.102	0.100	-	-	-	-	-
Arvin-Di-Giorgio	-	-	-	-	-	-	-	-	-	-	-	-	0.092	0.091	0.091	0.087	0.088	0.087
Maricopa	0.098	0.109	0.095	0.098	0.106	0.095	0.088	0.090	0.090	0.086	0.084	0.086	0.085	0.094	0.082	0.078	0.078	0.083

A dash (-) indicates that there is insufficient data available to determine the value.

Bold indicates that there were completeness issues with the data.

Table A-2 3-yr Average of the Annual Fourth-Highest Daily Maximum 8-hr Average Ozone Concentrations (ppm)

Name	1990	1995	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
Stockton	0.083	0.084	0.082	0.079	0.075	0.075	0.074	0.073	0.076	0.077	0.078	0.074	0.072	0.068	0.069	0.067	0.069	0.068
Tracy-Airport	-	-	-	-	-	-	-	-	-	-	0.087	0.083	0.081	0.078	0.080	0.079	0.079	0.076
Modesto-14th St	0.094	0.092	0.090	0.088	0.088	0.086	0.083	0.083	0.086	0.085	0.085	0.081	0.080	0.075	0.075	0.075	0.078	0.079
Turlock	-	0.095	0.096	0.091	0.095	0.096	0.094	0.086	0.086	0.082	0.091	0.089	0.093	0.087	0.088	0.086	0.084	0.082
Merced-Coffee	-	0.100	0.106	0.101	0.101	0.102	0.102	0.095	0.088	0.085	0.093	0.090	0.091	0.084	0.083	0.081	0.081	0.082
Madera-City	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.086	0.084	0.084	0.083
Madera-Pump Yard	-	-	0.089	0.088	0.091	0.093	0.089	0.082	0.078	0.078	0.083	0.084	0.084	0.081	0.078	0.079	0.081	0.082
Tranquillity	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.077	0.077	0.075	0.075
Fresno- Sky Park	0.102	0.104	0.111	0.108	0.115	0.111	0.104	0.098	0.096	0.095	0.095	0.094	0.097	0.095	0.092	0.088	0.087	0.086
Clovis	-	0.104	0.109	0.106	0.106	0.103	0.095	0.091	0.090	0.093	0.098	0.099	0.103	0.099	0.098	0.094	0.095	0.093
Fresno- 1st/Garland	-	0.108	0.108	0.104	0.105	0.106	0.102	0.099	0.098	0.098	0.101	0.100	0.102	0.096	0.094	0.089	0.089	0.087
Fresno- Drummond	0.102	0.093	0.104	0.099	0.102	0.103	0.101	0.093	0.087	0.083	0.085	0.089	0.092	0.095	0.095	0.094	0.088	0.086
Parlier	0.110	0.099	0.107	0.107	0.110	0.111	0.104	0.096	0.092	0.093	0.096	0.091	0.092	0.088	0.092	0.092	0.092	0.091
Hanford	-	-	0.102	0.098	0.099	0.095	0.093	0.088	0.086	0.083	-	-	-	-	0.090	0.084	0.084	0.085
Visalia-Church	0.106	0.107	0.102	0.099	0.100	0.099	0.095	0.093	0.092	0.091	0.094	0.094	0.097	0.088	0.087	0.080	0.080	0.079
Porterville	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.090	0.088	0.081	0.081
Lower Kaweah	0.094	0.102	0.093	0.094	0.098	0.101	0.101	0.097	0.096	0.095	0.096	0.090	0.086	0.079	0.081	0.085	0.086	0.085
Ash Mountain	-	-	-	0.104	0.105	0.107	0.105	0.105	0.103	0.103	0.105	0.103	0.101	0.096	0.095	0.093	0.091	0.089
Shafter	-	0.097	0.095	0.094	0.095	0.096	0.092	0.090	0.089	0.088	0.089	0.085	0.088	0.085	0.086	0.082	0.081	0.080
Oildale	0.103	0.099	0.101	0.097	0.100	0.099	0.098	0.096	0.096	0.095	0.098	0.093	0.094	0.089	0.089	0.084	0.081	0.079
Bakersfield- Golden	-	-	0.100	0.096	0.098	0.098	0.094	0.090	0.088	0.086	0.088	-	-	-	-	-	-	-
Bakersfield- California	-	-	0.101	0.100	0.100	0.100	0.097	0.097	0.099	0.097	0.097	0.090	0.093	0.088	0.089	0.086	0.085	0.085
Bakersfield-Muni	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.091	0.090
Edison	0.112	0.119	0.111	0.104	0.106	0.104	0.101	0.097	0.100	0.099	0.102	0.099	0.101	0.096	0.093	0.086	0.084	0.084
Arvin-Bear Mtn.	-	0.112	0.111	0.109	0.112	0.115	0.116	0.113	0.110	0.107	0.108	0.105	0.104	-	-	-	-	-
Arvin-Di-Giorgio	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.091	0.089	0.088	0.087
Maricopa	0.105	0.101	0.102	0.094	0.099	0.099	0.096	0.091	0.089	0.088	0.086	0.085	0.085	0.088	0.087	0.084	0.079	0.079

A dash (-) indicates that there is insufficient data available to determine the value.

Table A-3 Current[3] 8-hour Ozone Design Values and Attainment Status for the San Joaquin Valley Air Basin

County	Site	2013-2015 8-hour Ozone Design Values (ppm)	Meets Attainment Test
San Joaquin	Stockton	0.068	yes
San Joaquin	Tracy	0.076	no
Stanislaus	Modesto	0.079	no
Stanislaus	Turlock	0.082	no
Merced	Merced	0.082	no
Madera	Madera-Pump Yard	0.082	no
Madera	Madera-City	0.083	no
Fresno	Tranquillity	0.075	yes
Fresno	Fresno-Sky Park	0.086	no
Fresno	Clovis	0.093	no
Fresno	Fresno-Garland	0.087	no
Fresno	Fresno - Drummond	0.086	no
Fresno	Parlier	0.091	no
Kings	Hanford	0.085	no
Tulare	Ash Mountain	0.089	no
Tulare	Lower Kaweah	0.085	no
Tulare	Visalia	0.079	no
Tulare	Porterville	0.081	no
Kern	Shafter	0.080	no
Kern	Oildale	0.079	no
Kern	Bakersfield - California	0.085	no
Kern	Bakersfield - Muni	0.090	no
Kern	Edison	0.084	no
Kern	Arvin-Di-Giorgio	0.087	no
Kern	Maricopa	0.079	no
Valley	**All Sites**	**0.093**	**no**

[3] 2013-2015 are the design value years.

Figure A - 1 Valley Maximum 8-hour Ozone Design Value Trend

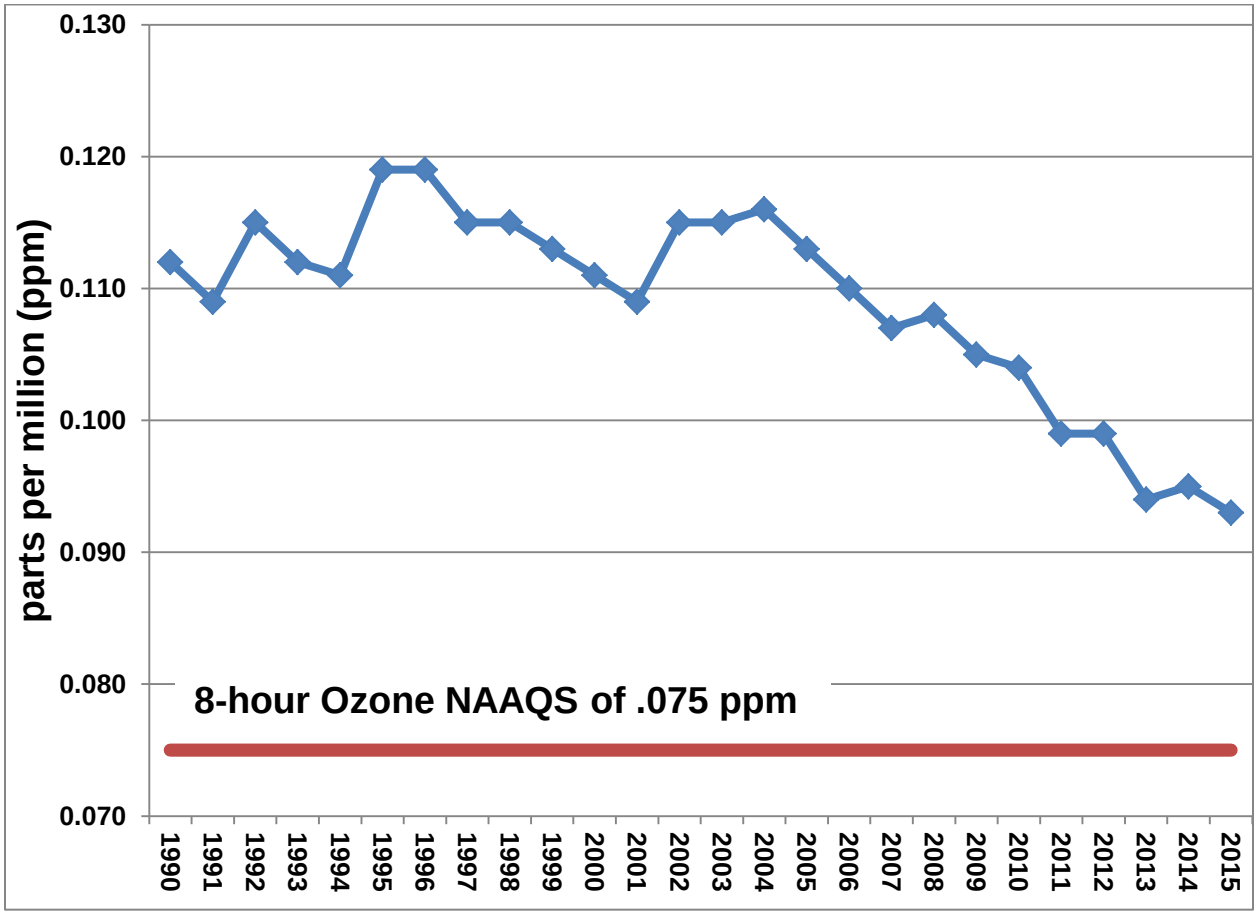
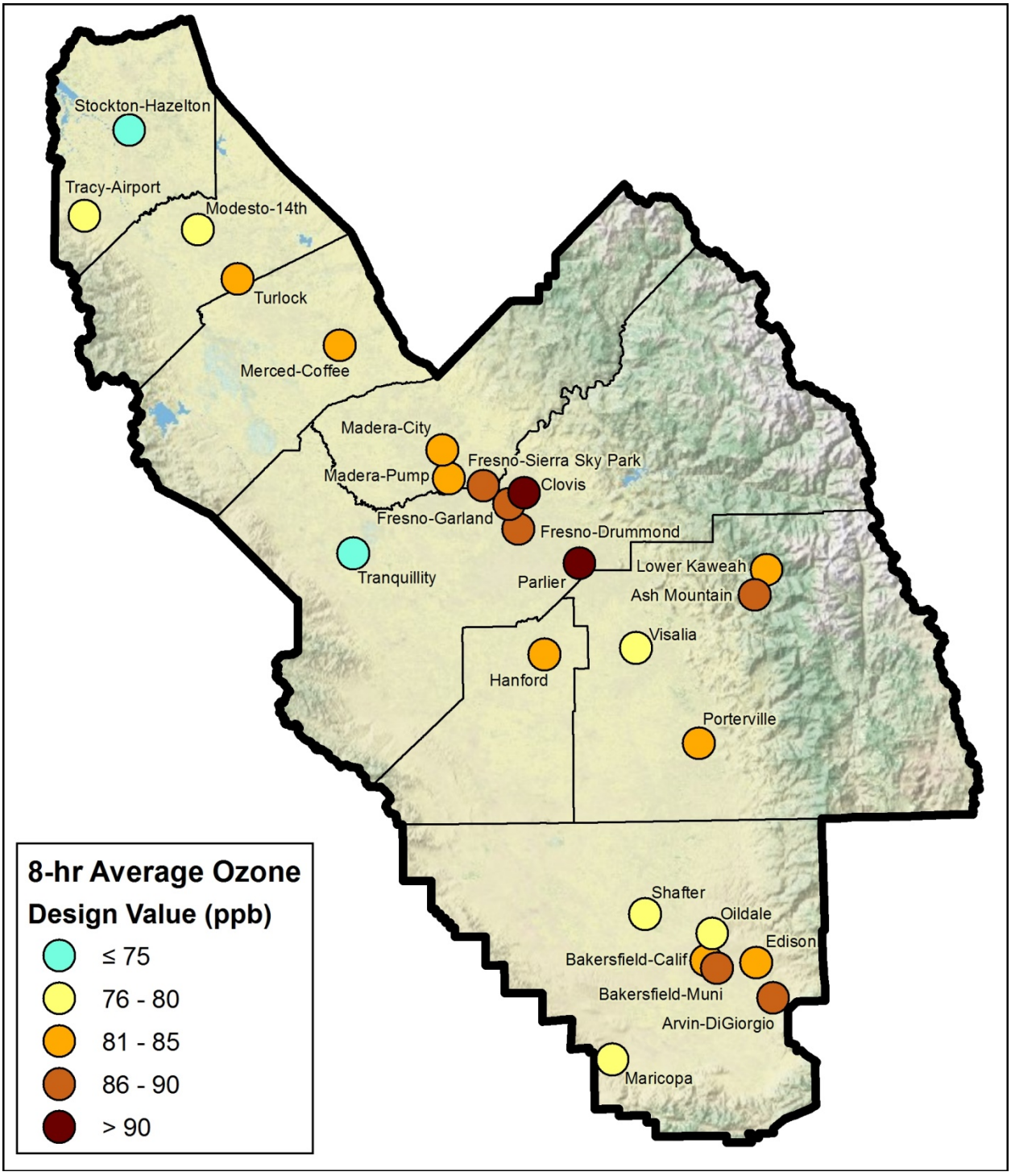


Figure A - 2 8-Hour Ozone Design Value (2015)



A.2 TREND AND SPATIAL VARIATIONS

A.3.1 Local Trends

Figures A-3 through A-5 revel the decreasing design value trends at Stockton, Clovis, and Edison. While ozone design values have generally been trending downward, there have been periods of upward trending as well. Design values increased Valley-wide in 2008 due to the summer wildfire impacts. In addition to causing elevated PM2.5 concentrations, wildfires also generate and transport ozone precursors (e.g. NOx and VOC). Since the design value calculation is a three-year average, the 2007-2009 and 2008-2010 design values for some sites were higher due wildfire smoke. Other instances of upward design value trends occurred for some air monitoring stations such as Hanford and Bakersfield-Municipal Airport which were either non-operational for extended periods of time due to construction or repairs. Such periods caused data completeness issues which skewed the design value calculations higher. Although upward trends have occurred from time to time, design values have still remained lower than they were in 1996.

In order to identify factors that will help determine a successful strategy for attainment of the 8-hour ozone standard, the District and ARB continue to evaluate air quality data and trends. In addition, comparisons of trend analyses, modeling results, and other analyses will be conducted as support analysis for the regulatory decision-making process.

Figure A - 3 Stockton 8-hour Ozone Design Value Trend, 1990-2015

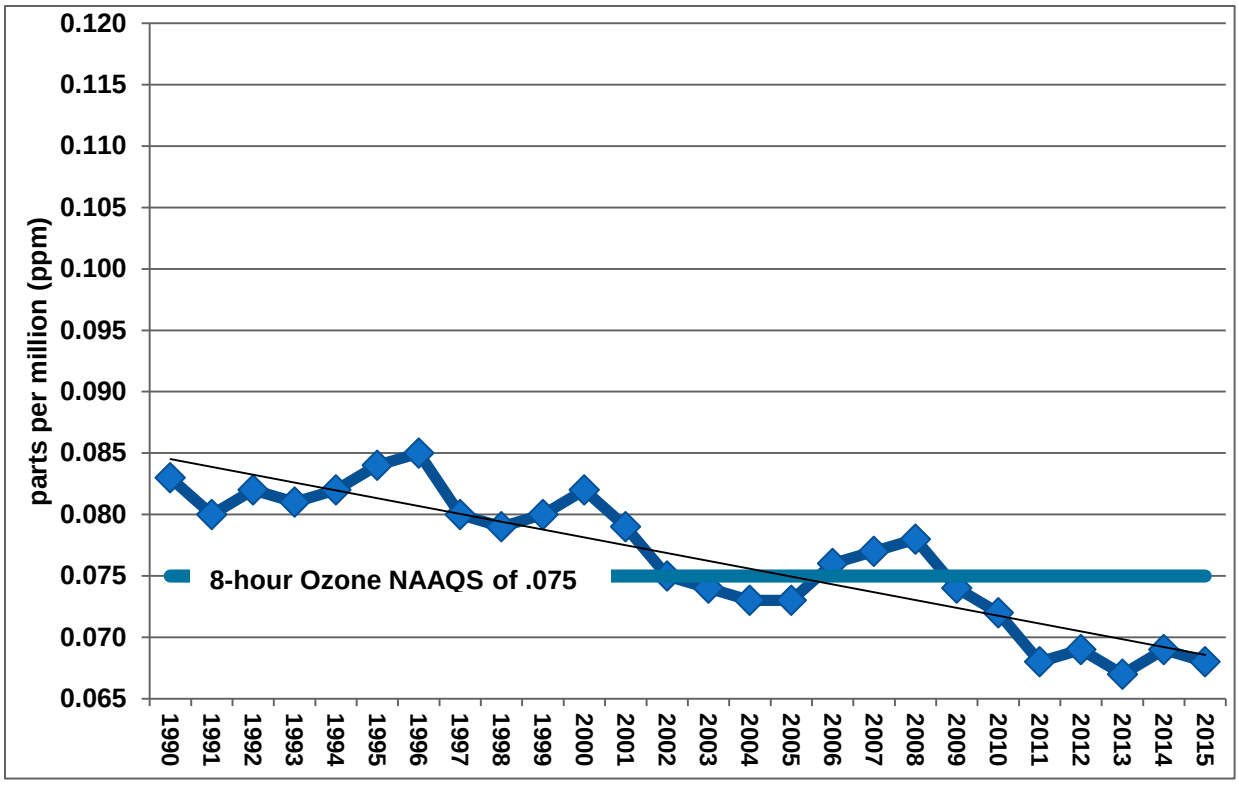


Figure A - 4 Clovis 8-hour Ozone Design Value Trend, 1992-2015

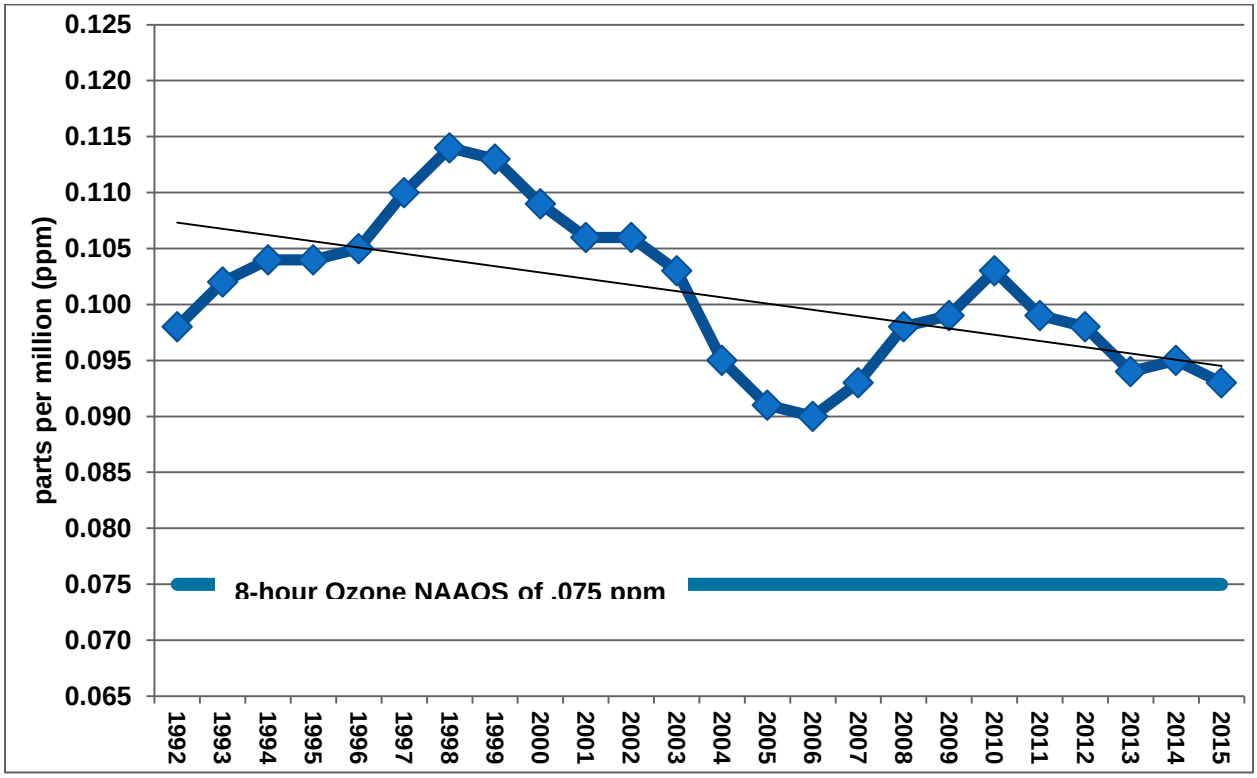
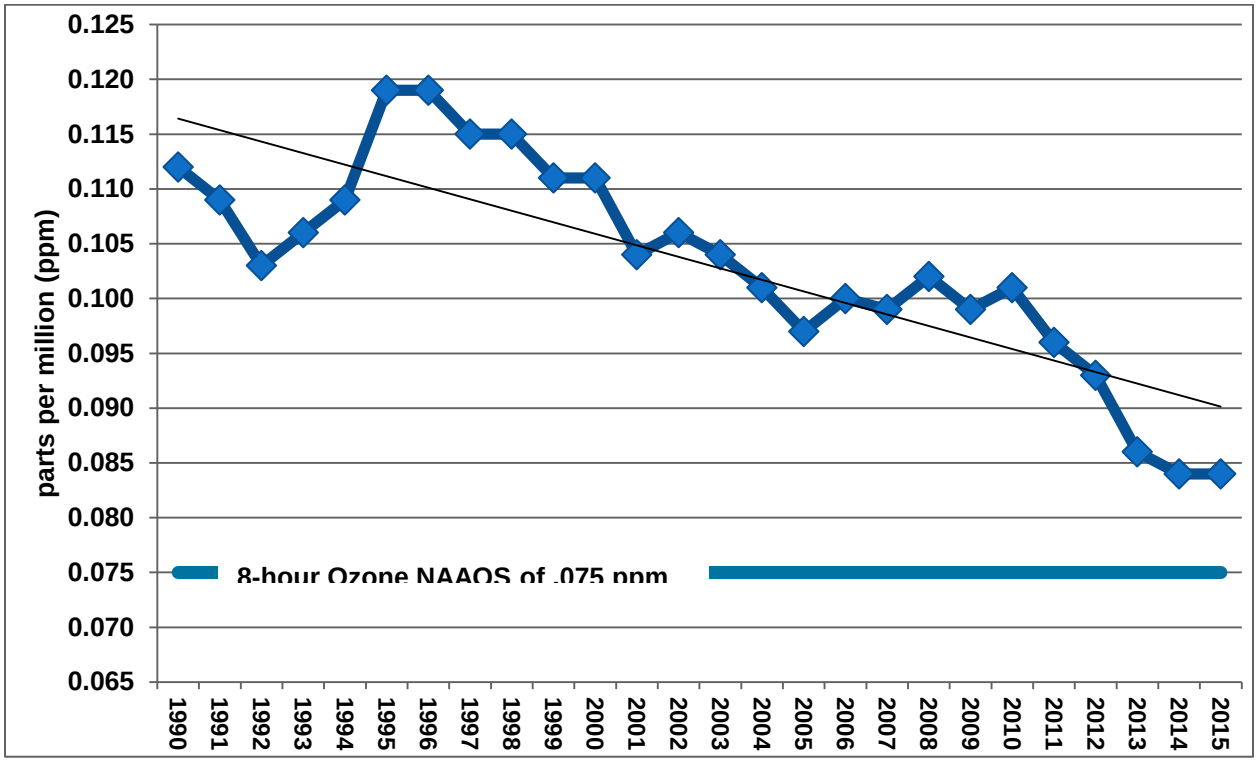


Figure A - 5 Edison 8-hour Ozone Design Value Trend, 1990-2015



A.3.2 Number of Days Above the 8-hour Ozone NAAQS

The regulatory 8-hour ozone attainment status for the Valley is based upon the design value being less than or equal to 0.075 ppm. Previous figures (A-1, A-3 through A-5) demonstrate examples of trends using the 3-year average of the annual fourth-highest daily maximum 8-hour average concentration vs. year for a particular site and entire basin. Another way to examine the ozone air quality data is to determine the number of days where the 8-hour ozone concentration is greater than 0.075 ppm. (Note that the number of days greater than 0.075 ppm is not used in determining the attainment status of the Valley. It is solely used in determining the number of days of exposure to levels above the level of the NAAQS for 8-hour ozone.)

Figures A-6, A-7, and A-8 show the number of days over the level of the 8-hour ozone standard for the Modesto-14th, Fresno – Drummond, and Shafter air monitoring sites, respectively. On each of these figures, the number of days over the ozone standard for the entire basin is included to emphasize that the number of days at individual sites is generally much lower than the total number of days for the entire basin. Table A-4 summarizes the number of days above the 8-hour ozone standard for each regulatory air monitoring site in the Valley from 1990-2015. The basin-wide count represents the number of days that at least one site had at minimum one 8-hr average above the ozone NAAQS of 0.075ppm. On a site-by-site basis, a majority of the Valley residents are not being exposed to as many days over the level of the 8-hour standard as the basin-wide total shows. In fact, the average number of days a resident experienced ozone levels above the 1997 and 2008 8-hour ozone standards have been reduced by 91% and 73%, respectively, since 2002.

Figure A - 6 Number of Days Over the 8-hour Ozone Standard: Modesto-14th

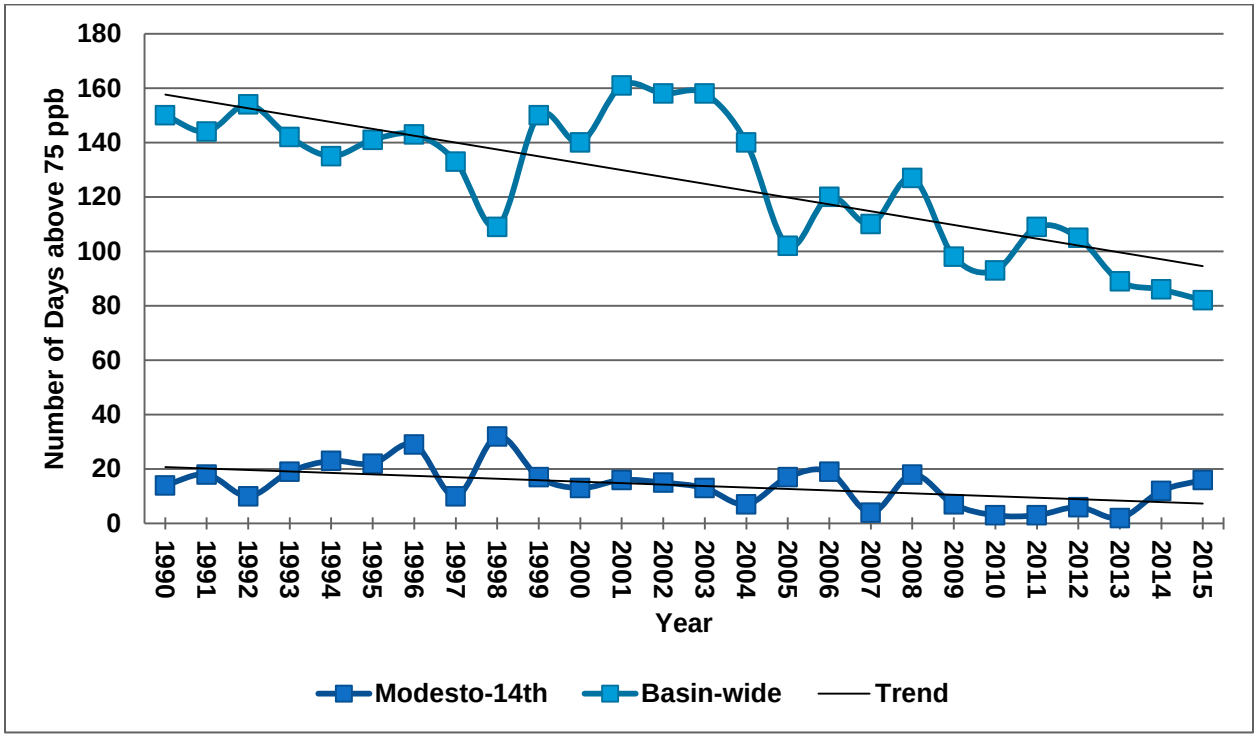


Figure A - 7 Number of Days Over the 8-hour Ozone Standard: Fresno – Drummond

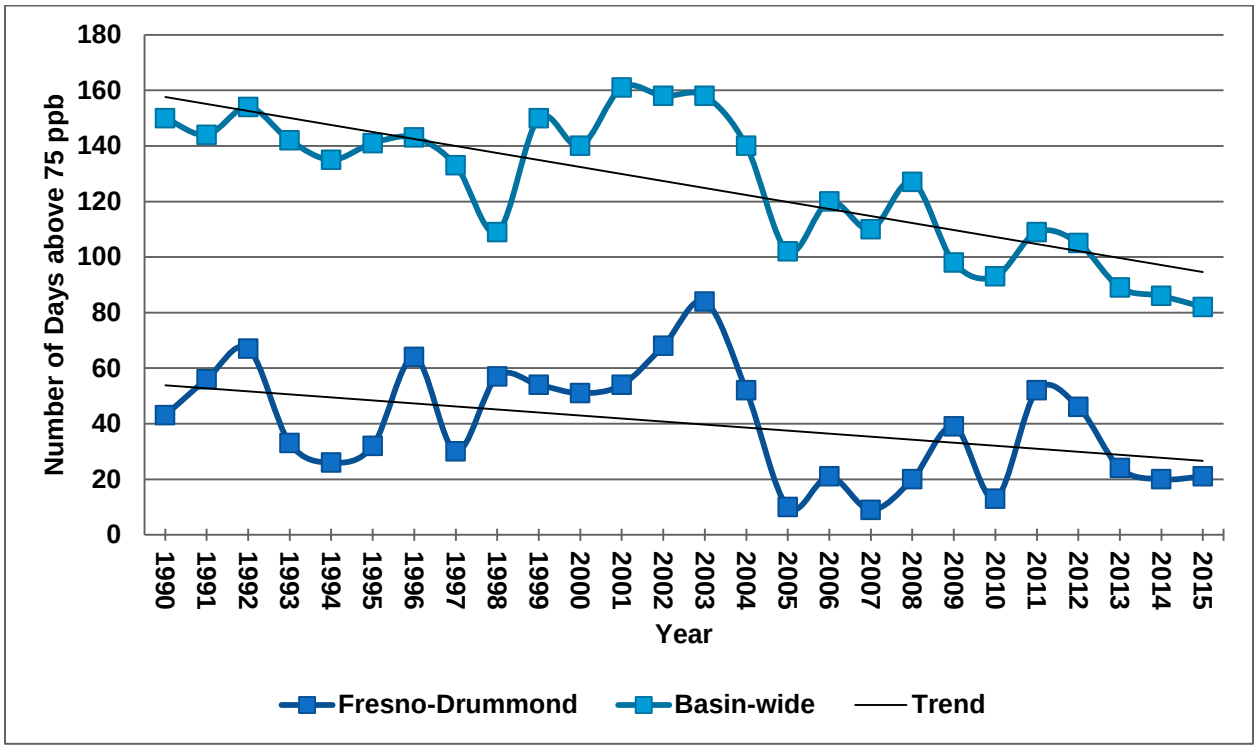


Figure A - 8 Number of Days Over the 8-hour Ozone Standard: Shafter

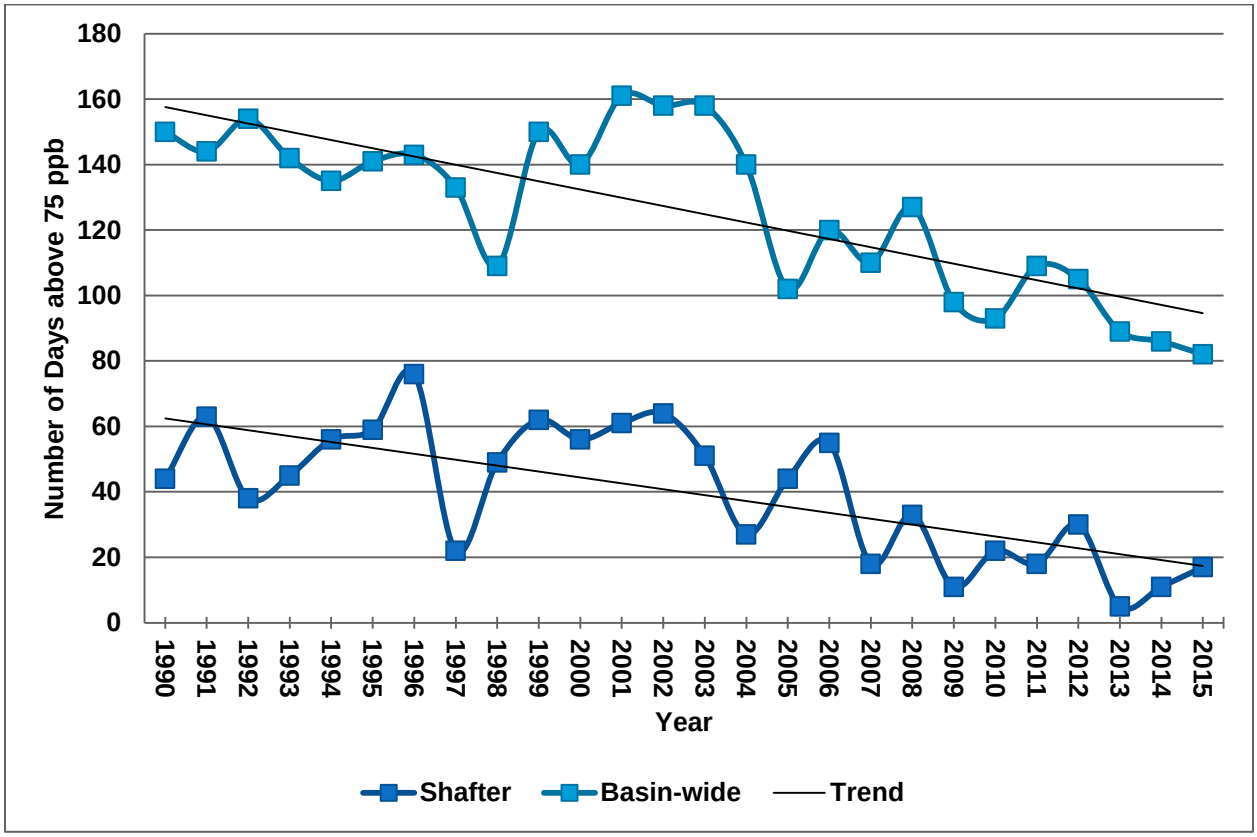


Table A-4 Number of Days Above the 8-Hour Ozone Standard of 0.075 ppm

REGULATORY SITE	1990	1995	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
Stockton-Hzltn	8	11	4	6	3	2	2	1	13	3	4	2	2	0	2	0	1	1
Tracy	--	--	--	--	--	--	--	--	22	6	16	8	3	8	16	2	8	5
Modesto-14th	14	22	13	16	15	13	7	17	19	4	18	7	3	3	6	2	12	16
Turlock	--	33	29	13	40	40	12	5	24	3	29	18	10	17	35	14	12	17
Merced-Coffee	--	73	66	61	89	92	47	20	30	18	33	15	14	19	9	15	22	14
Madera-City	--	--	--	--	--	--	--	--	--	--	--	--	11	15	30	22	13	11
Madera-Pump	--	--	30	37	40	42	7	5	15	5	24	13	8	8	7	6	20	10
Fresno-SSP	--	64	109	130	131	67	30	37	54	18	39	34	35	45	19	25	32	19
Fresno-Drummond	43	32	51	54	68	84	52	10	21	9	20	39	13	52	46	24	20	21
Clovis	--	68	71	92	62	61	30	38	51	30	44	48	39	49	57	38	56	28
Fresno-1st/Garland	55	79	67	66	66	82	48	55	69	37	62	51	26	33	47	17	29	24
Parlier	66	45	93	122	130	136	41	46	61	30	51	26	30	43	62	50	36	46
Tranquillity	--	--	--	--	--	--	--	--	--	--	--	--	7	7	6	3	3	5
Hanford	--	11	91	43	62	45	25	24	37	8	--	--	41	28	8	25	14	22
Visalia-Church	53	64	70	53	59	65	40	46	51	31	60	48	34	17	37	2	10	22
Porterville	--	--	--	--	--	--	--	--	--	--	--	--	43	47	44	23	0	25
Ash Mountain	--	--	58	117	117	112	94	78	86	83	74	72	66	84	82	56	51	52
Lower Kaweah	63	50	33	65	107	75	49	56	62	70	73	18	9	31	41	38	32	23
Shafter	44	59	56	61	64	51	27	44	55	18	33	11	22	18	30	5	11	17
Oildale	59	69	71	74	72	84	77	61	70	41	49	37	30	29	46	5	7	17
BFL-California	--	88	77	83	75	86	46	71	79	25	40	34	28	25	56	22	20	28
Bakersfield-Golden	--	50	67	62	62	64	38	27	38	14	21	--	--	--	--	--	--	--
Bakersfield-Muni	--	--	--	--	--	--	--	--	--	--	--	--	--	--	61	23	32	55
Edison	102	112	92	90	98	81	66	55	68	44	79	60	47	47	42	8	24	23
Arvin-Bear Mtn.	124	113	105	118	125	144	133	90	99	89	102	80	66	--	--	--	--	--
Arvin-DiGiorgio	--	--	--	--	--	--	--	--	--	--	--	--	28	36	53	34	36	33
Maricopa	74	98	39	86	97	72	53	43	45	23	20	31	12	49	24	10	8	16
Average	59	60	62	69	75	71	44	39	49	28	42	33	25	30	35	19	20	22
Basin-wide Days Over	150	141	140	162	158	158	140	102	120	110	127	98	93	109	105	89	86	82

A dash (-) indicates that there is insufficient data available to determine the value.

A.3 DIFFERENCE BETWEEN URBAN AND RURAL OZONE RESPONSE

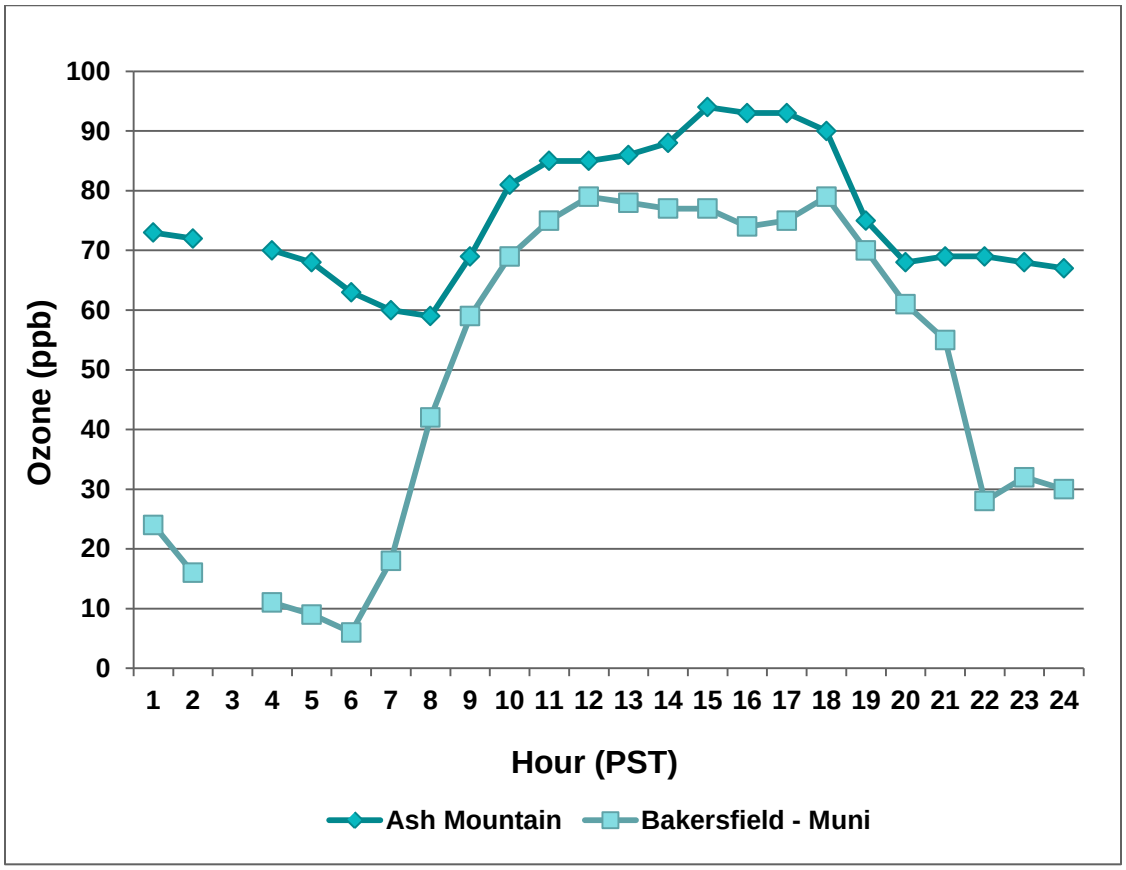
The difference between how ozone levels change in urban areas versus rural areas is most evident during the nighttime hours when ozone formation ceases. At night, fresh NOx emissions in urban areas interact with and remove or scavenge existing ozone. This process causes a rapid change which results in very low nighttime ozone concentrations.

Rural areas, on the other hand, have fewer sources of fresh NOx emissions and do not experience the same ozone removal process that occurs in urban areas. Since ozone is either transported directly to rural areas, or it is created, in part, by precursors that have been transported to those areas, there are not enough fresh scavenging emissions to remove the ozone quickly. Thus ozone in rural areas may remain elevated for longer durations during a 24-hour period.

Figure A-9 shows how urban and rural ozone levels vary due to the differences in local emissions during a day. The diurnal increase and decrease in ozone levels at the Bakersfield – Municipal Airport air monitoring station are quite distinct, whereas, the diurnal response of the ozone levels at Ash Mountain is more subtle. The urban mechanism described above is evident in the ozone data at Bakersfield, where there are higher emissions of NOx and volatile organic compounds (VOC) available. After sunrise, there is a dramatic rise in ozone because sunlight is now available to drive the creation of ozone from the available NOx and VOC. After the sun sets, chemical reactions and deposition result in a drop in ozone concentrations, which typically continues its downward trend until dawn.

The Ash Mountain monitoring station, which is located at the entrance of Sequoia National Park at 1,500-foot elevation, demonstrates the hourly ozone response in a rural area. On summer days, ozone and precursors can be transported to Ash Mountain from other locations. At this location, there are significantly lower hourly emissions of NOx as compared to urban areas such as Bakersfield or Fresno. At Ash Mountain, the amount of NOx available to scavenge the ozone is much lower. Because much less ozone scavenging occurs at Ash Mountain compared to the amount of scavenging that occurs in urban areas, Ash Mountain can experience elevated ozone concentrations throughout a 24-hour period. Since the ozone concentration is already fairly high at dawn, only a relatively small amount of additional ozone can cause levels at Ash Mountain to exceed federal standards. All areas with small populations and low NOx emissions that are located in regions subject to ozone transport can experience a similar ozone pattern. This pattern can occur at foothills of the Sierra Nevada and Tehachapi mountain ranges.

Figure A - 9 Ozone Concentrations (ppb) at Ash Mountain and Bakersfield Municipal Airport on August 24, 2014



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Appendix B

Emissions Inventory

2016 PLAN FOR THE 2008 8-HOUR OZONE STANDARD

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Appendix B: Emissions Inventory

B.1 INTRODUCTION

An emissions inventory is a systematic listing of air pollution sources along with the amount of pollution emitted from each source or category over a given time period. Emissions inventories represent estimates of the air pollution emissions from given sources; they are not measurements of ambient concentrations. Emissions inventory data are used as the primary input for air quality modeling, used for developing control strategies, and provide a means to track progress in meeting emissions reduction commitments. More specifically, the inventories in this appendix are used to evaluate and propose control measures, to track emissions for Rate of Progress (ROP), to track Emissions Reduction Credits (ERCs), to establish motor vehicle conformity budgets for transportation planning, and to assist in demonstrating attainment of the NAAQS.

Pollution sources are grouped by major industry sectors. The following are examples of pollution sources by key sectors:

- Industrial or stationary point sources—power plants and oil refineries;
- Area-wide sources—consumer products and residential fuel combustion;
- On-road sources—passenger vehicles and heavy-duty trucks;
- Off-road mobile sources—aircraft, trains, ships, recreational boats, construction equipment, and farm equipment; and
- Non-anthropogenic (natural) sources—biogenic (or vegetation), geogenic (petroleum seeps), and wildfires.

Tables B-1 and B-2 reflect anthropogenic emissions (i.e., emissions generated by human activity). Only anthropogenic emissions are subject to regulatory requirements. However, biogenic volatile organic compounds emissions (BVOC) from vegetation are evaluated and estimated for photochemical modeling. Total volatile organic compound (VOC) emissions from biogenic sources can overwhelm anthropogenic VOC emissions, particularly during the Valley's ozone season (Table B-3). Appendix D, California Air Resources Board (ARB) Photochemical Modeling Protocol, contains a more thorough discussion of BVOCs.

The U.S. Environmental Protection Agency (EPA) establishes requirements pertaining to emissions information that must be included as part of the SIP submittal package. Plans for ozone are to include emissions inventories for oxides of nitrogen (NOx) and VOCs.

As discussed in Chapter 2 and throughout the *2016 8-Hour Ozone Plan*, the Valley's attainment challenges under the national 2008 8-hour ozone standard occur in the summer months. For this reason, this plan focuses on summer (May through October) average daily emissions inventories, with emissions presented as tons per day (tpd).

Emissions inventories are usually developed at various geographical resolutions encompassing district, air basin, and county levels. The inventories presented in this appendix are the total emissions for the San Joaquin Valley Air Basin.

This appendix includes emissions for the San Joaquin Valley Air Basin for the years 2012, 2015, and 2018 through 2031. The base year (the year from which the inventory is projected forward and backward) for these inventories is 2012. The year 2015 has been included as a reference point for the current year. Years 2018 through 2031 have been included, as they represent attainment milestones. 2031 is the latest possible attainment deadline for the federal 2008 8-hour ozone standard.

The tables in this appendix include:

- Table B-1 NOx Emissions (Summer Daily Averages in Tons per Day)
- Table B-2 VOC Emissions (Summer Daily Averages in Tons per Day)
- Table B-3 Valley-Wide Biogenic Emissions for 2012 in Tons per Day

B.2 EMISSIONS INVENTORY TABLES

Table B-1 NOx Emissions (Summer Daily Averages in Tons per Day)

NOx (tpd)																
SUMMARY CATEGORY NAME	**SUMMER AVERAGE**															
	2012	**2015**	**2018**	**2019**	**2020**	**2021**	**2022**	**2023**	**2024**	**2025**	**2026**	**2027**	**2028**	**2029**	**2030**	**2031**
STATIONARY SOURCES																
FUEL COMBUSTION																
ELECTRIC UTILITIES	4.5	4.3	4.5	4.5	4.5	4.5	4.5	4.6	4.6	4.7	4.7	4.8	4.8	4.9	4.9	5.0
COGENERATION	1.7	1.8	2.0	2.1	2.1	2.2	2.2	2.2	2.2	2.3	2.3	2.3	2.3	2.4	2.4	2.4
OIL AND GAS PRODUCTION (COMBUSTION)	3.2	2.8	2.5	2.5	2.4	2.3	2.2	2.2	2.1	2.0	2.0	1.9	1.8	1.8	1.7	1.7
PETROLEUM REFINING (COMBUSTION)	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.1	0.1	0.1	0.1	0.1
MANUFACTURING AND INDUSTRIAL	5.2	5.2	5.1	5.1	5.1	5.2	5.2	5.2	5.2	5.2	5.2	5.3	5.3	5.3	5.4	5.4
FOOD AND AGRICULTURAL PROCESSING	15.5	10.5	6.9	6.6	6.4	6.1	5.8	5.6	5.3	5.1	4.9	4.6	4.4	4.2	4.0	3.9
SERVICE AND COMMERCIAL	4.2	4.2	4.3	4.3	4.3	4.4	4.3	4.4	4.4	4.4	4.4	4.4	4.4	4.4	4.4	4.5
OTHER (FUEL COMBUSTION)	0.7	0.6	0.6	0.6	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5
*** TOTAL FUEL COMBUSTION**	**35.2**	**29.4**	**26.1**	**25.9**	**25.5**	**25.3**	**24.9**	**24.7**	**24.4**	**24.3**	**24.1**	**23.9**	**23.8**	**23.6**	**23.5**	**23.4**
WASTE DISPOSAL																
SEWAGE TREATMENT	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
LANDFILLS	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2
INCINERATORS	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
SOIL REMEDIATION	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

NOx (tpd)																
SUMMARY CATEGORY NAME	**SUMMER AVERAGE**															
	2012	**2015**	**2018**	**2019**	**2020**	**2021**	**2022**	**2023**	**2024**	**2025**	**2026**	**2027**	**2028**	**2029**	**2030**	**2031**
OTHER (WASTE DISPOSAL)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
*** TOTAL WASTE DISPOSAL**	**0.2**	**0.3**	**0.3**	**0.3**	**0.3**	**0.3**	**0.3**	**0.3**	**0.3**	**0.3**	**0.3**	**0.3**	**0.3**	**0.3**	**0.3**	**0.3**
CLEANING AND SURFACE COATINGS																
LAUNDERING	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
DEGREASING	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
COATINGS AND RELATED PROCESS SOLVENTS	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
PRINTING	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
ADHESIVES AND SEALANTS	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
OTHER (CLEANING AND SURFACE COATINGS)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
*** TOTAL CLEANING AND SURFACE COATINGS**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**
PETROLEUM PRODUCTION AND MARKETING																
OIL AND GAS PRODUCTION	0.4	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.2	0.2
PETROLEUM REFINING	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
PETROLEUM MARKETING	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
OTHER (PETROLEUM PRODUCTION AND MARKETING)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
*** TOTAL PETROLEUM PRODUCTION AND MARKETING**	**0.4**	**0.4**	**0.4**	**0.4**	**0.4**	**0.4**	**0.4**	**0.3**	**0.3**	**0.3**	**0.3**	**0.3**	**0.3**	**0.3**	**0.3**	**0.3**
INDUSTRIAL PROCESSES																
CHEMICAL	0.3	0.3	0.3	0.3	0.3	0.3	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4
FOOD AND AGRICULTURE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

NOx (tpd)																
SUMMARY CATEGORY NAME	**SUMMER AVERAGE**															
	2012	**2015**	**2018**	**2019**	**2020**	**2021**	**2022**	**2023**	**2024**	**2025**	**2026**	**2027**	**2028**	**2029**	**2030**	**2031**
MINERAL PROCESSES	0.2	0.2	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3
METAL PROCESSES	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
WOOD AND PAPER	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
GLASS AND RELATED PRODUCTS	6.0	4.1	4.3	4.3	4.4	4.5	4.7	4.7	4.7	4.7	4.7	4.7	4.7	4.7	4.7	4.7
ELECTRONICS	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
OTHER (INDUSTRIAL PROCESSES)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
*** TOTAL INDUSTRIAL PROCESSES**	**6.6**	**4.6**	**4.9**	**4.9**	**5.0**	**5.2**	**5.3**	**5.3**	**5.4**	**5.4**	**5.4**	**5.4**	**5.4**	**5.4**	**5.5**	**5.5**
**** TOTAL STATIONARY SOURCES**	**42.4**	**34.7**	**31.7**	**31.5**	**31.1**	**31.1**	**30.9**	**30.7**	**30.4**	**30.3**	**30.1**	**29.9**	**29.8**	**29.7**	**29.5**	**29.5**
AREA-WIDE SOURCES																
SOLVENT EVAPORATION																
CONSUMER PRODUCTS	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
ARCHITECTURAL COATINGS AND RELATED PROCESS SOLVENTS	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
PESTICIDES/FERTILIZERS	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
ASPHALT PAVING / ROOFING	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
*** TOTAL SOLVENT EVAPORATION**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**
MISCELLANEOUS PROCESSES																
RESIDENTIAL FUEL COMBUSTION	3.9	3.9	3.9	3.9	3.9	3.9	3.9	3.9	3.9	3.9	3.9	4.0	4.0	4.0	4.0	4.0
FARMING OPERATIONS	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
CONSTRUCTION AND DEMOLITION	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
PAVED ROAD DUST	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
UNPAVED ROAD DUST	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

NOx (tpd)																
SUMMARY CATEGORY NAME	**SUMMER AVERAGE**															
	2012	**2015**	**2018**	**2019**	**2020**	**2021**	**2022**	**2023**	**2024**	**2025**	**2026**	**2027**	**2028**	**2029**	**2030**	**2031**
FUGITIVE WINDBLOWN DUST	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
FIRES	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
MANAGED BURNING AND DISPOSAL	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8
COOKING	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
OTHER (MISCELLANEOUS PROCESSES)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
*** TOTAL MISCELLANEOUS PROCESSES**	4.7	4.8	4.8	4.8	4.8	4.8	4.7	4.7	4.7	4.7	4.8	4.8	4.8	4.8	4.8	4.9
**** TOTAL AREA-WIDE SOURCES**	4.7	4.8	4.8	4.8	4.8	4.8	4.7	4.7	4.7	4.7	4.8	4.8	4.8	4.8	4.8	4.9
MOBILE SOURCES																
ON-ROAD MOTOR VEHICLES																
LIGHT DUTY PASSENGER (LDA)	9.7	7.1	5.1	4.6	4.2	3.9	3.6	3.3	3.1	2.9	2.7	2.6	2.5	2.3	2.2	2.1
LIGHT DUTY TRUCKS - 1 (LDT1)	2.9	1.9	1.2	1.0	0.9	0.8	0.7	0.6	0.6	0.5	0.4	0.4	0.4	0.3	0.3	0.3
LIGHT DUTY TRUCKS - 2 (LDT2)	7.1	5.2	3.5	3.0	2.7	2.4	2.2	2.0	1.9	1.7	1.6	1.5	1.4	1.4	1.3	1.2
MEDIUM DUTY TRUCKS (MDV)	9.9	7.8	5.6	5.0	4.4	3.8	3.3	2.9	2.5	2.2	2.0	1.8	1.6	1.5	1.3	1.2
LIGHT HEAVY DUTY GAS TRUCKS - 1 (LHDV1)	2.8	2.3	1.8	1.7	1.5	1.4	1.3	1.2	1.1	1.0	0.9	0.8	0.7	0.7	0.6	0.5
LIGHT HEAVY DUTY GAS TRUCKS - 2 (LHDV2)	0.4	0.3	0.2	0.2	0.2	0.2	0.2	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
MEDIUM HEAVY DUTY GAS TRUCKS (MHDV)	0.8	0.5	0.3	0.3	0.3	0.2	0.2	0.2	0.2	0.1	0.1	0.1	0.1	0.1	0.1	0.1
HEAVY HEAVY DUTY GAS TRUCKS (HHDV)	0.2	0.2	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1

NOx (tpd)																
SUMMARY CATEGORY NAME	**SUMMER AVERAGE**															
	2012	**2015**	**2018**	**2019**	**2020**	**2021**	**2022**	**2023**	**2024**	**2025**	**2026**	**2027**	**2028**	**2029**	**2030**	**2031**
LIGHT HEAVY DUTY DIESEL TRUCKS - 1 (LHDV1)	11.2	9.1	7.1	6.4	5.8	5.2	4.7	4.2	3.7	3.3	2.9	2.6	2.3	2.0	1.8	1.6
LIGHT HEAVY DUTY DIESEL TRUCKS - 2 (LHDV2)	2.9	2.2	1.6	1.4	1.2	1.1	0.9	0.8	0.7	0.6	0.5	0.4	0.3	0.3	0.2	0.2
MEDIUM HEAVY DUTY DIESEL TRUCKS (MHDV)	17.3	13.4	10.5	9.7	7.9	6.2	6.1	4.8	4.9	5.0	5.1	5.1	5.1	5.2	5.2	5.2
HEAVY HEAVY DUTY DIESEL TRUCKS (HHDV)	115.2	78.4	63.1	61.6	59.0	54.9	50.5	32.0	31.8	31.6	31.4	31.0	30.9	30.7	30.6	30.5
MOTORCYCLES (MCY)	0.8	0.8	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7
HEAVY DUTY DIESEL URBAN BUSES (UB)	3.5	2.7	2.0	1.7	1.6	1.4	1.3	1.1	1.0	0.9	0.8	0.7	0.6	0.6	0.5	0.4
HEAVY DUTY GAS URBAN BUSES (UB)	0.2	0.2	0.2	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
SCHOOL BUSES (SB)	1.1	1.0	0.9	0.8	0.8	0.7	0.7	0.7	0.6	0.6	0.5	0.5	0.4	0.4	0.4	0.3
OTHER BUSES (OB)	1.2	0.9	0.7	0.7	0.6	0.5	0.5	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3
MOTOR HOMES (MH)	0.4	0.3	0.2	0.2	0.2	0.2	0.2	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
*** TOTAL ON-ROAD MOTOR VEHICLES**	**187.7**	**134.4**	**104.9**	**99.4**	**92.2**	**84.0**	**77.2**	**55.3**	**53.6**	**52.0**	**50.5**	**49.0**	**47.8**	**46.7**	**45.8**	**45.1**
OTHER MOBILE SOURCES																
AIRCRAFT	2.6	2.5	2.5	4.6	4.6	4.6	4.6	4.6	4.6	4.6	4.6	4.6	4.6	4.6	4.6	4.6
TRAINS	12.8	14.0	13.8	13.5	13.2	12.9	12.6	12.3	11.9	11.6	11.3	11.0	10.7	10.4	10.1	9.8
SHIPS AND COMMERCIAL BOATS	1.1	1.0	0.9	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	1.1	1.0
RECREATIONAL BOATS	2.2	2.0	1.9	1.9	1.8	1.8	1.8	1.7	1.7	1.7	1.6	1.6	1.6	1.6	1.5	1.5
OFF-ROAD RECREATIONAL VEHICLES	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.2	0.2	0.2	0.2	0.2	0.2
OFF-ROAD EQUIPMENT	24.7	23.9	21.2	20.2	19.9	19.1	17.7	17.0	16.7	15.4	14.8	14.2	13.8	13.4	13.1	12.8

NOx (tpd)																
SUMMARY CATEGORY NAME	**SUMMER AVERAGE**															
	2012	**2015**	**2018**	**2019**	**2020**	**2021**	**2022**	**2023**	**2024**	**2025**	**2026**	**2027**	**2028**	**2029**	**2030**	**2031**
AGRICULTURAL CONSTRUCTION EQUIPMENT	5.8	5.1	4.5	4.33	4.1	3.8	3.6	3.4	3.2	3.0	2.8	2.6	2.5	2.3	2.2	2.0
AGRICULTURAL TRACTORS	47.2	42.1	37.8	36.5	34.4	32.4	30.5	28.7	27.1	25.6	24.1	22.8	21.5	20.3	19.2	18.2
OTHER FARM EQUIPMENT	8.3	7.2	6.3	6.1	5.6	5.2	4.8	4.4	4.1	3.8	3.5	3.3	3.1	2.9	2.7	2.5
FUEL STORAGE AND HANDLING	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
*** TOTAL OTHER MOBILE SOURCES**	**104.7**	**98.0**	**89.0**	**88.1**	**84.6**	**80.7**	**76.5**	**73.1**	**70.2**	**66.6**	**63.7**	**61.1**	**58.7**	**56.4**	**54.4**	**52.4**
**** TOTAL MOBILE SOURCES**	**292.4**	**232.4**	**193.9**	**187.5**	**176.8**	**164.7**	**153.7**	**128.5**	**123.8**	**118.6**	**114.2**	**110.0**	**106.5**	**103.2**	**100.2**	**97.5**
GRAND TOTAL FOR SAN JOAQUIN VALLEY	**339.6**	**271.8**	**230.4**	**223.8**	**212.7**	**200.5**	**189.4**	**163.9**	**159.0**	**153.6**	**149.1**	**144.8**	**141.1**	**137.7**	**134.6**	**131.9**

Table B-2 VOC Emissions (Summer Daily Averages in Tons per Day)

VOC (tpd)																
SUMMARY CATEGORY NAME	**SUMMER AVERAGE**															
	2012	**2015**	**2018**	**2019**	**2020**	**2021**	**2022**	**2023**	**2024**	**2025**	**2026**	**2027**	**2028**	**2029**	**2030**	**2031**
STATIONARY SOURCES																
FUEL COMBUSTION																
ELECTRIC UTILITIES	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2
COGENERATION	0.5	0.5	0.5	0.5	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6
OIL AND GAS PRODUCTION (COMBUSTION)	1.2	1.1	1.0	1.0	1.0	1.0	0.9	0.9	0.9	0.9	0.9	0.8	0.8	0.8	0.8	0.8
PETROLEUM REFINING (COMBUSTION)	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
MANUFACTURING AND INDUSTRIAL	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2
FOOD AND AGRICULTURAL PROCESSING	1.3	1.1	0.8	0.7	0.7	0.7	0.7	0.6	0.6	0.6	0.6	0.6	0.6	0.5	0.5	0.5
SERVICE AND COMMERCIAL	0.5	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6
OTHER (FUEL COMBUSTION)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
*** TOTAL FUEL COMBUSTION**	**4.1**	**3.7**	**3.4**	**3.4**	**3.3**	**3.3**	**3.3**	**3.2**	**3.2**	**3.2**	**3.1**	**3.1**	**3.1**	**3.1**	**3.1**	**3.1**
WASTE DISPOSAL																
SEWAGE TREATMENT	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
LANDFILLS	1.5	1.6	1.6	1.7	1.7	1.7	1.8	1.8	1.8	1.8	1.9	1.9	1.9	2.0	2.0	2.0
INCINERATORS	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
SOIL REMEDIATION	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
OTHER (WASTE DISPOSAL)	21.4	22.1	22.7	23.0	23.4	23.7	24.1	24.8	25.2	25.5	25.9	26.2	27.0	27.4	27.7	28.0
*** TOTAL WASTE DISPOSAL**	**23.0**	**23.9**	**24.5**	**24.9**	**25.2**	**25.6**	**26.0**	**26.8**	**27.2**	**27.6**	**27.9**	**28.3**	**29.2**	**29.5**	**29.9**	**30.2**
CLEANING AND SURFACE COATINGS																
LAUNDERING	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
DEGREASING	1.5	1.6	1.6	1.6	1.6	1.6	1.7	1.7	1.7	1.7	1.7	1.7	1.7	1.7	1.7	1.7
COATINGS AND RELATED PROCESS SOLVENTS	7.8	8.5	9.0	9.1	9.2	9.4	9.5	9.7	9.9	10.0	10.2	10.3	10.5	10.6	10.8	10.8
PRINTING	4.9	5.1	5.4	5.5	5.6	5.7	5.8	5.9	6.0	6.1	6.2	6.3	6.4	6.5	6.6	6.6

VOC (tpd)																
SUMMARY CATEGORY NAME	**SUMMER AVERAGE**															
	2012	**2015**	**2018**	**2019**	**2020**	**2021**	**2022**	**2023**	**2024**	**2025**	**2026**	**2027**	**2028**	**2029**	**2030**	**2031**
ADHESIVES AND SEALANTS	0.6	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5
OTHER (CLEANING AND SURFACE COATINGS)	6.2	6.6	7.1	7.2	7.3	7.5	7.6	7.8	7.9	8.0	8.2	8.3	8.4	8.6	8.7	8.7
*** TOTAL CLEANING AND SURFACE COATINGS**	**21.0**	**22.5**	**23.7**	**24.1**	**24.4**	**24.8**	**25.2**	**25.6**	**26.0**	**26.4**	**26.8**	**27.2**	**27.6**	**28.0**	**28.4**	**28.4**
PETROLEUM PRODUCTION AND MARKETING																
OIL AND GAS PRODUCTION	13.1	12.2	11.4	11.2	10.9	10.7	10.5	10.2	10.0	9.8	9.6	9.4	9.2	9.0	8.8	8.6
PETROLEUM REFINING	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8
PETROLEUM MARKETING	6.1	5.6	5.5	5.5	5.5	5.5	5.5	5.5	5.5	5.5	5.6	5.6	5.6	5.7	5.7	5.7
OTHER (PETROLEUM PRODUCTION AND MARKETING)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
*** TOTAL PETROLEUM PRODUCTION AND MARKETING**	**20.0**	**18.7**	**17.8**	**17.5**	**17.3**	**17.0**	**16.8**	**16.6**	**16.3**	**16.1**	**15.9**	**15.8**	**15.6**	**15.4**	**15.3**	**15.1**
INDUSTRIAL PROCESSES																
CHEMICAL	4.8	5.0	5.2	5.3	5.4	5.5	5.7	5.8	5.9	6.0	6.2	6.4	6.5	6.7	6.8	7.0
FOOD AND AGRICULTURE	11.2	11.7	12.5	12.7	12.9	13.1	13.3	13.5	13.7	13.8	14.0	14.1	14.3	14.4	14.5	14.6
MINERAL PROCESSES	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.4	0.4	0.4	0.4	0.4
METAL PROCESSES	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2
WOOD AND PAPER	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
GLASS AND RELATED PRODUCTS	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
ELECTRONICS	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
OTHER (INDUSTRIAL PROCESSES)	0.8	0.8	0.9	0.9	0.9	0.9	0.9	1.0	1.0	1.0	1.0	1.0	1.0	1.1	1.1	1.1
*** TOTAL INDUSTRIAL PROCESSES**	**17.2**	**18.0**	**19.1**	**19.4**	**19.8**	**20.1**	**20.4**	**20.8**	**21.1**	**21.4**	**21.7**	**22.1**	**22.4**	**22.7**	**23.0**	**23.3**
**** TOTAL STATIONARY SOURCES**	**85.3**	**86.7**	**88.5**	**89.3**	**90.0**	**90.8**	**91.6**	**92.9**	**93.8**	**94.7**	**95.5**	**96.5**	**97.9**	**98.8**	**99.7**	**100.0**
AREA-WIDE SOURCES																
SOLVENT EVAPORATION																
CONSUMER PRODUCTS	21.5	20.8	21.7	22.0	22.3	22.6	22.9	23.2	23.6	23.9	24.2	24.6	24.9	25.2	25.6	25.9
ARCHITECTURAL COATINGS AND RELATED PROCESS SOLVENTS	10.2	10.4	10.9	11.0	11.2	11.4	11.6	11.7	11.9	12.1	12.3	12.5	12.6	12.8	13.0	13.2
PESTICIDES/FERTILIZERS	15.8	15.1	14.9	14.8	14.7	14.7	14.6	14.5	14.5	14.4	14.3	14.3	14.2	14.1	14.0	14.0

VOC (tpd)																
SUMMARY CATEGORY NAME	**SUMMER AVERAGE**															
	2012	**2015**	**2018**	**2019**	**2020**	**2021**	**2022**	**2023**	**2024**	**2025**	**2026**	**2027**	**2028**	**2029**	**2030**	**2031**
ASPHALT PAVING / ROOFING	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9
*** TOTAL SOLVENT EVAPORATION**	**48.4**	**47.2**	**48.3**	**48.7**	**49.1**	**49.5**	**49.9**	**50.4**	**50.8**	**51.3**	**51.7**	**52.2**	**52.6**	**53.1**	**53.5**	**54.0**
MISCELLANEOUS PROCESSES																
RESIDENTIAL FUEL COMBUSTION	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5
FARMING OPERATIONS	95.9	95.9	95.9	95.9	95.9	95.9	95.9	95.9	95.9	95.9	95.9	95.9	95.9	95.9	95.9	95.9
CONSTRUCTION AND DEMOLITION	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
PAVED ROAD DUST	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
UNPAVED ROAD DUST	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
FUGITIVE WINDBLOWN DUST	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
FIRES	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
MANAGED BURNING AND DISPOSAL	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5
COOKING	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7
OTHER (MISCELLANEOUS PROCESSES)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
*** TOTAL MISCELLANEOUS PROCESSES**	**98.6**	**98.5**	**98.6**	**98.6**	**98.6**	**98.6**	**98.6**	**98.6**	**98.6**	**98.7**	**98.7**	**98.7**	**98.7**	**98.7**	**98.7**	**98.7**
**** TOTAL AREA-WIDE SOURCES**	**147.0**	**145.7**	**146.9**	**147.3**	**147.7**	**148.1**	**148.6**	**149.0**	**149.5**	**149.9**	**150.4**	**150.9**	**151.3**	**151.8**	**152.2**	**152.7**
MOBILE SOURCES																
ON-ROAD MOTOR VEHICLES																
LIGHT DUTY PASSENGER (LDA)	17.8	13.0	9.0	8.2	7.5	7.1	6.7	6.3	6.1	5.9	5.8	5.6	5.5	5.3	5.2	5.0
LIGHT DUTY TRUCKS - 1 (LDT1)	6.3	4.6	3.1	2.7	2.4	2.2	2.0	1.9	1.7	1.6	1.5	1.4	1.3	1.2	1.1	0.9
LIGHT DUTY TRUCKS - 2 (LDT2)	8.8	7.0	5.2	4.8	4.4	4.2	4.0	3.9	3.8	3.7	3.6	3.5	3.4	3.3	3.2	3.1
MEDIUM DUTY TRUCKS (MDV)	8.7	8.1	6.9	6.5	6.1	5.7	5.3	4.9	4.6	4.4	4.2	4.0	3.8	3.6	3.5	3.3
LIGHT HEAVY DUTY GAS TRUCKS - 1 (LHDV1)	2.4	2.0	1.6	1.5	1.4	1.3	1.2	1.1	1.0	0.9	0.9	0.8	0.8	0.7	0.7	0.6
LIGHT HEAVY DUTY GAS TRUCKS - 2 (LHDV2)	0.3	0.2	0.2	0.2	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.0	0.0
MEDIUM HEAVY DUTY GAS TRUCKS (MHDV)	0.8	0.4	0.2	0.2	0.2	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1

VOC (tpd)																
SUMMARY CATEGORY NAME	**SUMMER AVERAGE**															
	2012	**2015**	**2018**	**2019**	**2020**	**2021**	**2022**	**2023**	**2024**	**2025**	**2026**	**2027**	**2028**	**2029**	**2030**	**2031**
HEAVY HEAVY DUTY GAS TRUCKS (HHDV)	0.1	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
LIGHT HEAVY DUTY DIESEL TRUCKS - 1 (LHDV1)	0.5	0.4	0.4	0.4	0.3	0.3	0.3	0.3	0.3	0.2	0.2	0.2	0.2	0.2	0.2	0.2
LIGHT HEAVY DUTY DIESEL TRUCKS - 2 (LHDV2)	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
MEDIUM HEAVY DUTY DIESEL TRUCKS (MHDV)	1.5	1.0	0.7	0.6	0.4	0.2	0.2	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
HEAVY HEAVY DUTY DIESEL TRUCKS (HHDV)	8.5	3.2	2.0	2.0	1.9	1.9	1.8	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3
MOTORCYCLES (MCY)	3.8	3.6	3.5	3.5	3.4	3.4	3.4	3.4	3.4	3.4	3.4	3.4	3.4	3.4	3.4	3.4
HEAVY DUTY DIESEL URBAN BUSES (UB)	0.2	0.2	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.0	0.0	0.0	0.0	0.0
HEAVY DUTY GAS URBAN BUSES (UB)	0.1	0.1	0.1	0.1	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
SCHOOL BUSES (SB)	0.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
OTHER BUSES (OB)	0.2	0.1	0.1	0.1	0.1	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
MOTOR HOMES (MH)	0.1	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
*** TOTAL ON-ROAD MOTOR VEHICLES**	**60.5**	**44.2**	**33.2**	**30.8**	**28.7**	**26.9**	**25.5**	**23.7**	**22.8**	**22.0**	**21.4**	**20.7**	**20.1**	**19.5**	**18.9**	**18.3**
OTHER MOBILE SOURCES																
AIRCRAFT	3.0	3.0	3.0	3.9	3.9	3.9	3.9	3.9	3.9	3.9	3.9	3.9	3.9	3.9	3.9	3.9
TRAINS	0.8	0.7	0.7	0.6	0.6	0.6	0.6	0.6	0.5	0.5	0.5	0.5	0.5	0.5	0.4	0.4
SHIPS AND COMMERCIAL BOATS	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
RECREATIONAL BOATS	11.5	9.9	8.5	8.1	7.6	7.2	6.8	6.5	6.1	5.8	5.4	5.1	4.9	4.6	4.4	4.2
OFF-ROAD RECREATIONAL VEHICLES	3.5	3.1	3.0	3.0	2.9	2.8	2.7	2.7	2.6	2.5	2.5	2.4	2.4	2.3	2.3	2.3
OFF-ROAD EQUIPMENT	11.5	10.3	9.3	9.2	9.0	9.1	9.0	8.9	8.9	8.8	8.8	8.8	8.8	8.8	8.8	8.9
AGRICULTURAL CONSTRUCTION EQUIPMENT	0.8	0.7	0.6	0.6	0.6	0.5	0.5	0.5	0.5	0.4	0.4	0.4	0.4	0.4	0.4	0.3

VOC (tpd)																
SUMMARY CATEGORY NAME	**SUMMER AVERAGE**															
	2012	**2015**	**2018**	**2019**	**2020**	**2021**	**2022**	**2023**	**2024**	**2025**	**2026**	**2027**	**2028**	**2029**	**2030**	**2031**
AGRICULTURAL TRACTORS	7.4	6.6	5.9	5.6	5.4	5.2	4.9	4.7	4.5	4.3	4.2	4.0	3.8	3.7	3.5	3.3
OTHER FARM EQUIPMENT	3.1	2.4	1.9	1.7	1.6	1.5	1.4	1.3	1.3	1.2	1.1	1.1	1.0	1.0	1.0	0.9
FUEL STORAGE AND HANDLING	2.8	2.4	2.2	2.2	2.1	2.1	2.0	2.0	1.9	1.9	1.9	1.9	1.9	1.8	1.8	1.3
*** TOTAL OTHER MOBILE SOURCES**	**44.5**	**39.3**	**35.2**	**34.9**	**33.8**	**32.9**	**31.9**	**31.1**	**30.3**	**29.5**	**28.8**	**28.1**	**27.6**	**27.1**	**26.6**	**25.7**
**** TOTAL MOBILE SOURCES**	**105.0**	**83.5**	**68.3**	**65.7**	**62.5**	**59.8**	**57.4**	**54.8**	**53.1**	**51.5**	**50.1**	**48.8**	**47.7**	**46.5**	**45.5**	**43.9**
GRAND TOTAL FOR SAN JOAQUIN VALLEY	**337.3**	**315.9**	**303.7**	**302.2**	**300.2**	**298.8**	**297.6**	**296.7**	**296.3**	**296.1**	**296.1**	**296.1**	**296.8**	**297.1**	**297.4**	**296.7**

Table B-3 Valley-Wide Biogenic Emissions for 2007 in Tons per Day

Month	Isoprene	Methylbutenol	Terpenes	Other VOC	Total VOC
January	1.8	8.3	11.1	23.0	44.2
February	3.8	16.0	17.7	45.8	83.2
March	39.4	37.5	37.0	85.7	199.6
April	148.5	106.7	85.6	179.7	520.4
May	299.7	191.9	130.1	252.1	873.9
June	466.4	295.4	192.8	364.5	1319.0
July	566.4	332.8	245.6	444.2	1589.0
August	556.2	312.5	256.3	424.4	1549.5
September	269.5	169.3	157.0	237.6	833.4
October	39.8	57.4	59.6	94.3	251.0
November	4.1	15.8	16.4	34.7	71.0
December	1.5	7.3	8.7	26.6	44.0

B.3 EMISSION STATEMENTS

According to Section 182 (a)(3)(B) of the Clean Air Act (CAA), States with areas designated as nonattainment for ozone must require emission statement data from sources of volatile organic compounds (VOC) or oxides of nitrogen (NOx) in those areas. This requirement applies to all ozone nonattainment areas regardless of the classification (Marginal, Moderate, etc.). Emission statements should be submitted by November 15, 1993, and annually thereafter. Section 182 (a)(3)(B) (ii) of the CAA allows the State to waive the requirement for emission statements for classes or categories of sources with less than 25 tons per year of actual plant-wide NOx or VOC emissions if the State provides an inventory of emissions from the class or category based on the use of emission factors established by EPA or other methods acceptable to EPA.

The District adopted Rule 1160 “Emission Statements” on November 18, 1992 that applies to all owners and operators of any stationary source category which emits or may emit nitrogen oxides or reactive organic compounds and submits all information to the state as required by Section 182 (a)(3)(B) of the CAA. The District has been submitting emissions inventory data to the state since 1993 and has continued to do so each year thereafter. Unlike other inventory systems that are static, the District not only submits the required information, but looks to enhance its inventory system each year as new requirements are known or foreseen. This ensures that future information and data requirements are able to be collected, processes are streamlined, and data is managed in an efficient manner.

The District requests annual emissions inventories from all permitted sources in the San Joaquin Valley. This process starts in January of each year; the District sends (paper or email) each permitted facility an inventory statement or inventory survey form. An emissions inventory statement is required for those facilities that have actual emissions of greater than or equal to 25 tons and an emissions inventory survey form is required

for sources that have potential emissions less than 25 tons. It should be noted that the 25 ton threshold is not only applied to NOx and VOC, but to CO, SOx, and PM10 / PM2.5 as well. The District processes approximately 4,500 facilities annually. This data is submitted to ARB by August of each year.

B.4 EMISSIONS INVENTORY DOCUMENTAITON FOR THE SAN JOAQUIN VALLEY 2016 75 PPB 8-HOUR OZONE STATE IMPLEMENTATION PLAN

[This section provided by California Air Resources Board]

Emissions inventories are one of the fundamental building blocks in the development of a State Implementation Plan (SIP or Plan). In simple terms, an emissions inventory is a systematic listing of the sources of air pollution along with the amount of pollution emitted from each source or category over a given time period. This document presents a summary of the data sources, along with revisions and improvements made to the emissions inventory included in the San Joaquin Valley 8-hour Ozone Plan.

The California Air Resources Board (ARB) and San Joaquin Valley Unified Air Pollution Control District (District) have developed a comprehensive, accurate, and current emissions inventory consistent with the requirements set forth in Section 182(a)(1) of the federal clean air act. ARB and District staff conducted a thorough review of the inventory to ensure that the emission estimates reflect accurate emission reports for point sources, and that estimates for mobile and area-wide sources are based on the most recent models and methodologies. Staff also reviewed the growth profiles for point and areawide source categories, and updated 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.

Emissions Inventory Overview

Emissions inventories are estimates of the amount and type of pollutants emitted into the atmosphere by industrial facilities, mobile sources, and areawide sources such as consumer products and paint. 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 United States Environmental Protection Agency (U.S. EPA) regulations require that the emissions inventory contain emissions data for the two precursors to ozone formation: oxides of nitrogen (NOx) and volatile organic compounds (VOC).

Agency Responsibilities

ARB and District staff worked jointly to develop the emissions inventory for the San Joaquin Valley 8-hour ozone nonattainment area. The District worked closely with operators of major stationary facilities in their jurisdiction to develop the point source emission estimates. ARB staff developed the emission inventory for mobile sources, both on-road and off-road. The District and ARB shared responsibility for developing estimates for the nonpoint (areawide) sources such as paved road dust and agricultural burning. ARB worked with several State and local agencies such as the Department of Transportation (Caltrans), the Department of Motor Vehicles (DMV), the Department of

Pesticide Regulation (DPR), the California Energy Commission (CEC), and regional transportation agencies to assemble activity information necessary to develop the mobile and area-wide source emission estimates.

Base Year and Forecasted Inventories

The base year inventory forms the basis for all future year projections and also establishes the emission levels against which progress in emission reductions will be measured. U.S. EPA regulations establish that the base year inventory should be preferably consistent with the triennial reporting schedule required under the Air Emissions Reporting Requirements (AERR) rule. However, U.S. EPA allows a different year to be selected if justified by the state. ARB worked with the local air districts to determine the base year that should be used across the State. Since the South Coast Air Quality Management District typically aligns their base year inventory with the data collection period for their Multiple Air Toxics Exposure Study, which was last conducted in 2012, ARB selected 2012 as the base year to maintain consistency across the various plans being developed in the State.

In addition to a base year inventory, U.S. EPA regulations also require future year inventory projections for specific milestone years. Forecasted inventories are a projection of the base year inventory that reflects expected growth trends for each source category and emission reductions due to adopted control measures. ARB develops emission forecasts by applying growth and control profiles to the base year inventory.

Growth profiles for point and areawide sources are derived from surrogates such as economic activity, fuel usage, population, housing units, etc., that best reflect the expected growth or decline rates 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 mobile source emissions are generated by models that predict activity rates and vehicle fleet turnover by vehicle model year. As with stationary sources, the mobile source models include control algorithms that account for all adopted regulatory actions.

Temporal Resolution

Planning inventories typically include annual as well as seasonal (summer and winter) emission estimates. Annual emission inventories represent the total emissions over an entire year (tons per year), or the daily emissions produced on an average day (tons per day). Seasonal inventories account for temporal activity variations throughout the year, as determined by category-specific temporal profiles. Since ozone concentrations tend to be highest during the summer months, the emission inventory used in the Plan is based on the summer season (May through October).

Geographical Scope

The inventories presented in this Plan include emissions for the seven full counties (Fresno, Kings, Madera, Merced, San Joaquin, Stanislaus, and Tulare) and the portion of Kern County that comprise the San Joaquin Valley Air Basin.

Quality Assurance and Quality Control

ARB has established a quality assurance and quality control (QA/QC) process involving ARB and District staff to ensure the integrity and accuracy of the emissions 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). ARB inventory staff works with District staff, who 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 emission estimates are developed by ARB staff as well as some District staff. The methodologies for estimating these are reviewed by ARB and district staff before their inclusion in the emission inventory. Additionally, CEIDARS is designed with automatic system checks to prevent errors such as double counting of emission sources. The system also makes various reports available to assist staff in their efforts to identify and reconcile anomalous emissions.

Future year emissions are estimated using the California Emission Projection Analysis Model (CEPAM). Growth and control factors are reviewed for each category and year along with the resulting emission projections. Year to year trends are compared to similar and past datasets to ensure general consistency. Emissions for specific categories are checked to confirm they reflect the anticipated effects of applicable control measures. Mobile categories are verified with mobile source staff for consistency with the on-road and off-road emission models.

A summary of the information supporting the San Joaquin Valley 8-hour ozone SIP emissions inventory is presented in the sections below.

Point Sources

The emissions inventory reflects actual emissions from industrial point sources reported to the District by the facility operators through calendar year 2012. The stationary sources subject to these reporting requirements are determined by the District based on the requirements set forth in U.S. EPA's AERR rule. U.S. EPA requires that the data elements in the emission inventory within the boundaries of the nonattainment areas be consistent with the detail required by the AERR rule. The data elements in the 2012 baseline inventory are consistent with the data elements required by the AERR rule.

Estimation methods include source testing, direct measurement by continuous emissions monitoring systems, or engineering calculations. The point source categories are listed in Table 1.

Table 1
Point Source Categories

Source Category	Subcategory
Fuel Combustion	Electric Utilities Cogeneration Oil and Gas Production (Combustion) Petroleum Refining (Combustion) Manufacturing and Industrial Food and Agricultural Processing Service and Commercial Other (Fuel Combustion)
Waste Disposal	Sewage Treatment Landfills Incinerators Soil Remediation Other (Waste Disposal)
Cleaning and Surface Coatings	Laundering Degreasing Coatings and Related Process Solvents Printing Adhesives and Sealants Other (Cleaning and Surface Coatings)
Petroleum Production and Marketing	Oil and Gas Production Petroleum Refining Petroleum Marketing Other (Petroleum Production and Marketing)

Table 1
Point Source Categories

Source Category	Subcategory
Industrial Processes	Chemical
	Food and Agriculture
	Mineral Processes
	Metal Processes
	Wood and Paper
	Glass and Related Products
	Electronics
	Other (Industrial Processes)

Stationary Area Sources

The point source inventory also includes emissions from stationary area sources, which are categories such as internal combustion engines and gasoline dispensing facilities that are not inventoried individually, but are estimated as a group and reported as a single source category. The District's methodologies encompassing over sixty individual stationary area source subcategories are available at: http://www.valleyair.org/Air_Quality_Plans/EmissionsMethods/EmissionsMethods.htm

While emission estimates for most stationary area sources are provided by the District, the estimates for the following categories were developed by ARB:

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 ARB methodology derived from the OFFROAD model. Additional information on this methodology is available at: http://www.arb.ca.gov/ei/areasrc/FULLPDF/FULL1-2.pdf

Agricultural Irrigation Pumps

Emissions from agricultural irrigation pumps are estimated from a model developed by ARB staff. Air districts with significant irrigated agricultural acreage provided estimates of the population and emissions from stationary and mobile diesel-fueled agricultural irrigation pumps. These data were reconciled with equipment population estimates from the 2003 US Department of Agriculture Farm and Ranch Irrigation Survey (FRIS). The inventory also reflects the number of pumps that have been replaced to date under the Carl Moyer Program. Emissions are forecasted using irrigated cropland acreage trends. Additional information on this methodology is available at: http://www.arb.ca.gov/regact/agen06/attach2.pdf

Laundering

This category includes emissions from perchloroethylene (perc) dry cleaning establishments. The emission estimates are based on a 2002 ARB 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 from the original estimates to 2012 using population growth trends from the California Department of Finance. Additional information on this methodology is available at:
http://www.arb.ca.gov/ei/areasrc/onehtm/one3-1.htm

Degreasing

This category includes emissions from the use of solvents in degreasing operations in the manufacturing and maintenance industries. The emission estimates from this source category are based on a 1996 study by E.H. Pechan and Associates, Inc. (Pechan) titled, "Solvent Cleaning/Degreasing Source Category Emission Inventory." To estimate degreasing emissions, Pechan collected activity data by surveying solvent users in two major groups: manufacturing and maintenance. Emissions were estimated for 32 equipment and solvent pairs. For the manufacturer's survey, the emission factor for pure solvents is the density of the particular solvent. The emission factor for solvent blends is the density of the solvent multiplied by the total organic gas (TOG) content of the solvent. Exhaust controls were taken into account if used. For the maintenance survey, the emission factors are the density of the solvent with no exhaust controls. The 1993 emissions estimates were grown to 2012 based on manufacturing output data developed by Pechan. Additional information on this methodology is available at:
http://www.arb.ca.gov/ei/areasrc/onehtm/one3-2.htm

Oil and Gas Production

ARB staff updated the emission inventory for oil and natural gas production, which included the revision of emission estimates and the addition of emission categories that previously were not estimated. The revised emissions were calculated with a software tool developed by U.S. EPA that generates county-level emissions for upstream oil and gas activity. This tool uses 2011 as the base year, with activity data taken from the California Division of Oil, Gas, and Geothermal Resources (DOGGR) and an industry database, and default emission factors provided in an associated report. Staff incorporated data from ARB's 2007 Oil and Gas Industry Survey (e.g., typical component counts) and feedback from individual air districts (e.g., minimum controls required to operate in a certain district, with associated control factors) to improve these parameters and further adjust the tool's output. Emissions estimates for 2012 and other years were forecasted using the historical trend in statewide oil production from DOGGR, which assumes a 2.2 percent annual decline.

Gasoline Dispensing Facilities

ARB staff developed an updated 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 ARB 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 the 2012 statewide gasoline sales data from the California Board of Equalization that were apportioned to the county level using fuel consumption estimates from ARB's on-road mobile sources model (EMFAC). Additional information on this category is available at:
http://www.arb.ca.gov/ei/areasrc/arbpetprodmarkpm.htm

Areawide Sources

Areawide sources are categories such as consumer products, fireplaces, and agricultural burning for which emissions occur over a wide geographic area (see Table 2). Emissions for these categories are estimated by both ARB and the local air districts using various models and methodologies.

Table 2
Areawide Sources

Source Category	Subcategory
Solvent Evaporation	Consumer Products
	Architectural Coatings and Related Solvents
	Pesticides/Fertilizers
	Asphalt Paving and Roofing
Miscellaneous Processes	Residential Fuel Combustion
	Farming Operations
	Fires
	Managed Burning and Disposal
	Cooking

A summary of the areawide methodologies is presented below:

Consumer Products

The consumer products category reflects the three most recent surveys conducted by ARB staff for the years 2003, 2006, and 2008. Together these surveys collected updated product information and ingredient information for approximately 350 product categories. Based on the survey data, ARB staff determined the total product sales and total VOC emissions for the various product categories. The growth trend for most consumer product subcategories is based on the latest DOF human population growth projections, except for aerosol coatings. Staff determined that a no-growth profile would be more appropriate for aerosol coatings based on survey data that show relatively flat sales of these products over the last decade. Additional information on ARB's consumer products surveys is available at:
http://www.arb.ca.gov/consprod/survey/survey.htm.

Architectural Coatings

The architectural coatings category reflects emission estimates based on the comprehensive survey for the 2004 calendar year. The emission estimates include benefits of the 2003 and 2007 ARB Suggested Control Measures. These emissions are grown based on the growth in housing units. Additional information about ARB's architectural coatings program is available at:
http://www.arb.ca.gov/coatings/arch/arch.htm

Pesticides

The 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 to the most current data year available. The inventory includes estimates through the 2012 calendar year. Emission forecasts for years 2013 and beyond are based on the average of the most recent five years.

Asphalt Paving/Roofing

Asphalt paving and asphalt roofing emissions were estimated using methodologies developed by the District. VOC emissions are estimated based on tons of paving applied in 2008 or the amount of asphalt used for roofing in 2007, and a default emission factor for each type of asphalt operation. The growth profile for asphalt paving is based on construction employment from the REMI forecasting model. No growth is assumed for asphalt roofing, as the industry has been moving toward the use of more advanced alternative materials. The inventory reflects the emission reductions from District Rule 4641. The District methodologies are available at:
http://www.valleyair.org/Air_Quality_Plans/EmissionsMethods/MethodForms/Current/AsphaltPaving2008.pdf,
and
http://www.valleyair.org/Air_Quality_Plans/EmissionsMethods/MethodForms/Current/AsphaltRoofing2007.pdf

Residential Wood Combustion

The residential wood combustion methodology uses fuel consumption data from various surveys, including newer sales data for manufactured logs, and emission factors from U.S. EPA's National Emission Inventory. The fireplace wood consumption rate for 2008 and previous years is based on a 1997 firewood usage survey sponsored by the District. To reflect the episodic wood burning curtailment requirements in District Rule 4901 that became fully effective in 2009, the fireplace wood consumption rate for 2009 and subsequent years is based on the values suggested in a report by U.S. EPA staff and others entitled "A Recommended Procedure for Compiling Emission Inventory National, Regional and County Level Activity Data for the Residential Wood Combustion Source Category." Staff assumed no growth for this category because of limits in new construction and the stringency of the District's rule. Additional information on this methodology is available at:
http://www.arb.ca.gov/ei/areasrc/arbmiscprocresfuelcom.htm

Residential Natural Gas Combustion

The inventory for residential natural gas combustion emissions is based on 2006 data provided by the District. Emissions are estimated based on the percentages of total natural gas consumed by various residential uses (space heating, water heating, cooking, other) obtained from the California Energy Commission (CEC), and U.S. EPA AP-42 emission factors. Emissions were grown from 2006 using CEC projections of natural gas consumption. The water heating inventory reflects the emission reductions from District Rule 4902. The District's methodology is available at: http://www.valleyair.org/Air_Quality_Plans/EmissionsMethods/MethodForms/Current/ResidentialNG2006.pdf

Farming Operations

The dairy, feedlot, and range cattle emission estimates reflect livestock population data from the U.S. Department of Agriculture's (USDA) 2012 Census of Agriculture, and emission factors for dairy support cattle provided by District staff. The emission estimates for other livestock categories are based on the USDA 2007 Census of Agriculture. Dairy emissions growth assumptions were set to no-growth based on an analysis of the SJV historical dairy cow population, which shows a relatively flat profile since 2007. Other livestock categories reflect a no-growth assumption based on an earlier analysis that found no significant growth. The emissions reflect updated District control profiles to account for control requirements, including VOC controls from District Rule 4570. Additional information on ARB's methodology is available at: http://www.arb.ca.gov/ei/areasrc/arbmiscprocresfarmop.htm

Fires

Emissions from structural and automobile fires were estimated using ARB's March 1999 methodology. Structural fire emissions estimates are based on rates of structural and content material loss per fire, average combustible content, and an emission factor per ton of material burned. Automobile fire emissions are based the number of vehicle fires per year and a composite emission factor from US EPA's AP-42 (April 1973). Structural fire emissions were grown based on the growth in occupied households, and automobile fire emissions were grown based on population projections from the California Department of Finance. ARB's methodology is available at: http://www.arb.ca.gov/ei/areasrc/arbmiscprocfires.htm

Managed Burning & Disposal

The managed burning and disposal category is based on emissions data reported by District staff for 2012. Emissions are calculated using crop specific emission factors and fuel loadings. The agricultural burning emissions were grown based on linear regression analyses of the 2000-2009 farmland acreage. Staff used a no-growth assumption for forest management emissions based on analyses of District reported data that don't show a discernible trend. No-growth was also used for weed abatement, as the emission levels for this category have been fairly stable since 2005. ARB's methodology for managed burning is available at: http://www.arb.ca.gov/ei/see/see.htm.

Commercial Cooking

The commercial cooking inventory is based on emissions data reported by the District for 2008. The emissions estimates were developed from the number of restaurants, the number and types of cooking equipment, the food type, and emission factors from U.S. EPA's 2002 National Emissions Inventory. The growth profile reflects the latest population projections provided by the California Department of Finance (DOF). The inventory also reflects the emission reductions from District Rule 4692. Additional information on the District's methodology is available at: http://www.arb.ca.gov/ei/areasrc/districtmeth/sjvalley/CommercialCooking2006.pdf

Point and Areawide Source Emissions Forecasting

Emission forecasts (2013 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 are presented in Table 3 below.

Table 3
Growth Surrogates for Point and Areawide Sources

Source Category	Subcategory	Growth Surrogate
Electric Utilities	Natural Gas	CEC Integrated Energy Policy Report (IEPR 2013)
	Other Fuels	Annual Energy Outlook 2011(AEO 2011): Energy consumption forecasts
Cogeneration	Natural Gas	IEPR 2013
	Other Fuels	AEO 2011
Oil and Gas Production (Combustion)	All	DOGGR statewide total oil production (2.2% annual decline)
Petroleum Refining	All	No growth – facilities operating at capacity
Manufacturing & Industrial	Natural Gas	IEPR 2013
	Other Fuels	AEO 2011
Food & Agricultural Processing	Ag Irrigation Pumps	Farmland acreage
	Other	IEPR 2013 & AEO 2011
Service & Commercial	Natural Gas	IEPR 2013
	Other Fuels	AEO 2011
Other (Fuel Combustion)	I.C. Reciprocating Engines	Cal. Department of Finance (DOF) population projections
	Other	AEO 2011
Sewage Treatment	All	Regional Economic Models, Inc. (REMI) industry-specific outputs
Landfills	Stationary Aggregated (SA) Sources	DOF population projections

Table 3
Growth Surrogates for Point and Areawide Sources

Source Category	Subcategory	Growth Surrogate
	Point Sources	REMI industry-specific outputs
Incinerators	All	REMI industry-specific outputs
Soil Remediation	All	REMI industry-specific outputs
Other (Waste Disposal)	SA Sources	DOF Population projections
Other (Waste Disposal)	Point Sources	REMI industry-specific outputs
Laundering	SA Sources	DOF Population projections
	Point Sources	REMI industry-specific outputs
Degreasing	Cold Cleaning, Petroleum Naphtha	No growth post 2008 due to sharp decline in petroleum naphta use
Degreasing	Other	REMI industry-specific outputs
Coatings & Related Process Solvents	All	REMI industry-specific outputs
Printing	All	REMI industry-specific outputs
Adhesives & Sealants	All	REMI industry-specific outputs
Other (Cleaning & Surface Coatings)	All	REMI industry-specific outputs
Oil & Gas Production	All	DOGGR statewide total oil production (2.2% annual decline)
Petroleum Marketing	Gasoline Dispensing Facilities	Gasoline consumption projections (EMFAC2014)
	Natural Gas Transmission Losses	DOGGR and CEC natural gas consumption
	Point Sources	REMI industry-specific outputs
Other (Petroleum Production & Marketing)	All	REMI industry-specific outputs
Chemical	All	REMI chemical manufacturing output
Food & Agriculture	All	REMI food manufacturing output
Mineral Processes	Cement Concrete Manufacturing & Fabrication	REMI cement and concrete products manufacturing output
	Cement (Portland & Others) Manufacturing	AEO 2011
	Other	REMI non-metallic mineral product manufacturing output
Metal Processes	All	REMI industry-specific outputs
Wood & Paper	All	REMI wood product and paper manufacturing output
Glass & Related Products	Flat Glass	Construction equipment curve, capped at pre-recession levels
	Container Glass	No growth

Table 3
Growth Surrogates for Point and Areawide Sources

Source Category	Subcategory	Growth Surrogate
Other (Industrial Processes)	All	REMI manufacturing Output
Consumer Products	Consumer Products	Population projections
Consumer Products	Aerosol Coatings	No growth
Architectural Coatings & Thinners	All	Household projections
Pesticides & Fertilizers	Agricultural Pesticides	Farmland acreage
	Structural Pesticides	Housing expenditures
Asphalt Paving & Roofing	Asphalt Paving	Construction employment
	Asphalt Roofing	No growth
Residential Fuel Combustion	Wood Stoves & Fireplaces	No growth
	Others	Natural gas consumption
Farming Operations	Dairy Livestock	No growth
	Other Livestock	No growth
Fires	Structural Fires	Household projections
	Automobile Fires	Population projections
Managed Burning & Disposal	Ag Burning - Prunings or Field Crops	Farm land acreage
	Forest Management	No Growth
	Weed Abatement	No Growth
Cooking	All	Population projections

Control Profiles

The emissions inventory reflects emission reductions from point and areawide sources subject to District rules. The local rules reflected in the inventory are listed in Table 4 below.

Table 4
District Rules Included in the SIP Inventory

Rule No.	Rule Title	Source Categories Impacted
4103	Open Burning	Agricultural burning
4204	Cotton Gins	Agricultural crop processing losses - Cotton ginning facilities
4305	Boilers, Process Heaters, and Steam Generators	Fuel combustion - Boilers, Process Heaters, and Steam Generators
4306	Boilers, Process Heaters, and Steam Generators	Fuel combustion - Boilers, Process Heaters, and Steam Generators
4307	Boilers, Process Heaters, and Steam Generators	Fuel combustion - Boilers, Process Heaters, and Steam Generators
4308	Boilers, Process Heaters, and Steam Generators	Fuel combustion - Boilers, Process Heaters, and Steam Generators
4309	Dryers, Dehydrators, and Ovens	Laundering; manufacturing & industrial; service & commercial
4320	Boilers, Process Heaters, and Steam Generators - Advanced Options for Emission Reduction	Fuel combustion - Boilers, Process Heaters, and Steam Generators
4352	Solid Fuel Fired Boilers, Steam Generators and Process Heaters	Fuel combustion - Boilers, Process Heaters, and Steam Generators
4354	Glass Melting Furnaces	Glass and related processes
4401	Steam-Enhanced Crude Oil Production Well Vents	Oil and gas production
4402	Crude Oil Production Sumps	Oil and gas production
4404	Heavy Oil Test Station - Kern County	Oil and gas production
4408	Glycol Dehydration Systems	Oil and gas production
4409	Components at Gas/Oil Production Facilities	Oil and gas production
4453	Refinery Vacuum Producing Devices or Systems	Petroleum refining
4455	Components at Refineries & Chemical Plants	Petroleum refining
4550	Conservation Management Practices	Agricultural operations, dust, and managed burning
4565	Biosolids, Animal Manure, and Poultry Litter Operations	Composting operations

Table 4
District Rules Included in the SIP Inventory

Rule No.	Rule Title	Source Categories Impacted
4566	Organic Material Composting Operations	Composting operations
4570	Confined Animal Facilities	Livestock operations
4601	Architectural Coatings	Architectural coatings
4602	Motor Vehicle and Mobile Equipment Coating Operations	Coating and related processes
4603	Surface Coating of Metal Parts and Products	Coating and related processes
4604	Can and Coil Coating Operations	Coating and related processes
4605	Aerospace Assembly and Component Coating Operations	Coating and related processes
4606	Wood Coating Operations	Coating and related processes
4607	Graphic Arts	Coating and related processes; printing
4610	Glass Coating Operations	Coating and related processes
4612	Automotive Coatings	Coating and related processes
4621	Gasoline Transfer into Stationary Storage Containers, Delivery Vessels, and Bulk Plants	Petroleum marketing
4622	Gas Transfer into Vehicle Storage Tanks	Petroleum marketing
4623	Storage of Organic Liquids	Oil and gas production; petroleum refining; petroleum marketing
4624	Organic Liquid Loading	Petroleum marketing
4625	Wastewater Separators	Petroleum refining - Wastewater treatment
4641	Cutback, Slow Cure, and Emulsified Asphalt Paving and Maintenance Operations	Asphalt paving & roofing
4642	Solid Waste Disposal Sites	Landfills; waste disposal
4651	Volatile Organic Compound Emissions from Decontaminated Soil	Waste disposal - Soil remediation
4653	Adhesives and Sealants	Adhesives & sealants
4661	Organic Solvents	Coatings and related process solvents; cleaning and surface coatings
4662	Organic Solvent Degreasing Operations	Degreasing; thinning and cleanup solvent uses
4663	Organic Solvent Cleaning, Storage and Disposal	Degreasing; thinning and cleanup solvent uses; cleaning & surface coating
4672	Petroleum Solvent Dry Cleaners	Laundering

Table 4
District Rules Included in the SIP Inventory

Rule No.	Rule Title	Source Categories Impacted
4681	Rubber Tire Manufacturing	Chemical - Rubber and rubber products manufacturing
4682	Polystyrene	Chemical - Plastic and plastic products manufacturing
4684	Polyester Resin Operations	Chemical - Plastic and plastic products manufacturing
4691	Vegetable Oil Processing Operations	Food and agriculture
4692	Commercial Charbroiling	Cooking
4693	Bakery Ovens	Food and agriculture
4701	Internal Combustion Engines (Phase 1)	Fuel combustion
4702	Internal Combustion Engines (Phase 2)	Fuel combustion
4703	Stationary Gas Turbines	Fuel combustion
4901	Wood Burning Fireplaces and Wood Burning Heaters	Residential wood combustion
4902	Residual Water Heaters	Residential fuel combustion - Water heating
REG VIII	Regulation VIII -- PM Control for Fugitive Dust	Construction and demolition; paved and unpaved road dust; fugitive windblown dust; mineral processes

On-Road Mobile Sources

Emissions from on-road mobile sources, which include passenger vehicles, buses, and trucks, were estimated using ARB's EMFAC2014 model. The on-road emissions were calculated by applying EMFAC2014 emission factors to the transportation activity data provided by the local SJV transportation agencies from their 2014 adopted Regional Transportation Plan.

EMFAC2014 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 2012 California Department of Motor Vehicles data. The model also reflects the emissions benefits of ARB's recent rulemakings such as the Pavley Standards and Advanced Clean Cars Program, and includes the emissions benefits of ARB's Truck and Bus Rule and previously adopted rules for other on-road diesel fleets.

EMFAC2014 utilizes a socio-econometric regression modeling approach to forecast new vehicle sales and to estimate future fleet mix. Light-duty passenger vehicle population includes 2012 Department of Motor Vehicles (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 EMFAC2014 model is available at: http://www.arb.ca.gov/msei/categories.htm#emfac2014

Off-Road Mobile Sources

Emissions from off-road sources were estimated using either a newer suite of category-specific models or, where a new model was not available, the OFFROAD2007 model. Many of the newer models were developed to support recent regulations, including in-use off-road equipment, ocean-going vessels and others. The sections below summarize the updates made to specific off-road categories.

Oil and Gas Wells: Workover Rigs, Drill Rigs and Support Equipment Allocation

The allocation of drill and work-over rigs and support equipment (such as pumps) for oil and gas wells was updated within the SJV Air Basin to reflect the physical location of wells instead of the registration location. This allocation was done at the county level, where the number of wells within a county in the SJV Air Basin was used to determine that county's share of emissions from specified equipment. The physical location and count of wells was updated using Division of Oil, Gas and Geothermal Resources (DOGGR) Well Finder data, from September, 2013, supplied to ARB by the District. (DOGGR data are available at: http://www.conservation.ca.gov/dog/Pages/Wellfinder.aspx)

Ocean-Going Vessels (OGV)

Staff updated the OGV activity growth rates and NOx emission calculations in September 2013. These updates reflect more recently available long-term economic forecasts and historical data from 2006 to 2012. ARB staff updated the long-term growth factors for container ships, auto ships, tankers, and cruise ships. Additional information is available at:
http://www.arb.ca.gov/msei/categories.htm#offroad_motor_vehicles

Cargo Handling Equipment

The emissions inventory for the Cargo Handling Equipment category has been updated to reflect new information on equipment population, activity, recessionary impacts on growth, and engine load. The new information includes regulatory reporting data which provide an accounting of all the cargo handling equipment in the State including their model year, horsepower and activity. Additional information is available at:
http://www.arb.ca.gov/msei/categories.htm#offroad_motor_vehicles

Pleasure Craft and Recreational Vehicles

A new model was developed in 2011 to estimate emissions from pleasure craft and recreational vehicles. In both cases, population, activity, and emission factors were re-assessed using new surveys, registration information, and emissions testing. Additional information is available at:
http://www.arb.ca.gov/msei/categories.htm#offroad_motor_vehicles

In-Use Off-Road Equipment

ARB developed this model in 2010 to support the analysis for amendments to the In-Use Off-Road Diesel Fueled Fleets Regulation. Staff updated the underlying activity forecast to reflect more recent economic forecast data, which suggests a slower rate of recovery through 2024 than previously anticipated. Additional information is available at: http://www.arb.ca.gov/msei/categories.htm#offroad_motor_vehicles

Locomotives

In 2014, ARB developed a revised inventory for line-haul locomotive activity in California. The new model is based primarily on activity data reported to ARB by the major rail lines for calendar year 2011. To estimate emissions, ARB used duty cycle, fuel consumption and activity data reported by the rail lines. Activity is forecasted for individual train types and is consistent with ARB's ocean-going vessel and truck growth rates. Fuel efficiency improvements are projected to follow Federal Railroad Association projections and turnover assumptions are consistent with U.S. EPA projections. Additional information is available at:
http://www.arb.ca.gov/msei/categories.htm#offroad_motor_vehicles

Transport Refrigeration Units (TRU)

This model reflects updates to activity, population, growth and turn-over data, and emission factors developed to support the 2011 amendments to the Airborne Toxic Control Measure for In-Use Diesel-Fueled Transport Refrigeration Units. Additional

information is available at:
http://www.arb.ca.gov/msei/categories.htm#offroad_motor_vehicles

Fuel Storage and Handling

Emissions for fuel storage and handling were estimated using the OFFROAD2007 model. Additional information is available at:
http://www.arb.ca.gov/msei/categories.htm#offroad_motor_vehicles

Diesel Agricultural Equipment

The inventory for agricultural diesel equipment (such as tractors, harvesters, combines, sprayers and others) was revised based on a 2008 survey of thousands of farmers, custom operators, and first processors. The survey data, along with information from the 2007 USDA Farm Census, was used to revise almost every aspect of the agricultural inventory, including population, activity, age distribution, fuel use, and allocation. This updated inventory replaces general information on farm equipment in the United States with one specific to California farms and practices. The updated inventory was compared against other available data sources such as Board of Equalization fuel reports, USDA tractor populations and age, and Eastern Research Group tractor ages and activity, to ensure the results were reasonable and compared well against outside data sources. Agricultural growth rates through 2050 were developed through a contract with URS Corp and UC Davis, in cooperation with the SJV agricultural community. Additional information is available at:
http://www.arb.ca.gov/msei/categories.htm#offroad_motor_vehicles

Mobile Source Forecasting

The table below summarizes the data and methods used to forecast future-year mobile source emissions by broad source category groupings.

Table 5
Growth Surrogates for Mobile Sources

Category	Growth Methodology
On-Road Sources	
All	Match total VMT projections provided by Municipal Planning Organizations
Off-Road Gasoline Fueled Equipment	
Lawn & Garden	Household growth projection
Off-Road Equipment	Employment growth projection
Recreational Boats	Housing starts (short-term) and human population growth (long-term)
Recreational Vehicles	Housing starts (short-term) and human population growth (long-term)
Off-Road Diesel-Fueled Equipment	
Commercial Harbor Craft	Growth rates provided by District, except for tugs and fishing vessels. Fishing fleet growth rates were adjusted to reflect a decline in fish landings. Assumed no growth for tugboats.
Construction and Mining	California construction employment data from U.S. Bureau of Labor Statistics
Farm Equipment	2011 study of forecasted growth by URS Corp, with SJV Advisory Committee funding.
Industrial Equipment	California construction employment data from Bureau of Labor Statistics
Oil Drilling	California oil and gas extraction gross domestic product from the U.S. Bureau of Economic analysis, oil company diesel fuel use published by the U.S. Energy Information Administration, California rotary rig counts from Baker Hughes, and California oil and gas extraction employment from the U.S. Bureau of Labor Statistics
Ocean-Going Vessels	Projected commodity tonnage in the Freight Analysis Framework (FAF) Model developed by the Federal Highway Administration
Trains (line haul)	International/premium train growth tied to OGV forecast; Domestic train growth tied truck growth
Transport Refrigeration Units	Projection of historical Truck/Trailer TRU sales from ACT Research, adjusted for recession.

Appendix C

Stationary and Area Source Control Strategy Evaluations

2016 PLAN FOR THE 2008 8-HOUR OZONE STANDARD

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Appendix C: Stationary and Area Source Control Strategy Evaluations

The San Joaquin Valley (Valley) faces significant challenges in meeting federal air quality standards (also called National Ambient Air Quality Standards, or NAAQS). The San Joaquin Valley Air Pollution Control District (District) has demonstrated leadership in developing and implementing groundbreaking regulatory strategies to reduce emissions. Tough and innovative rules, such as those for indirect source review, residential wood burning, glass manufacturing, and agricultural burning, have set benchmarks for California and the nation.

The District has adopted many regulatory control measures under the District's air quality attainment plans, including but not limited to the *2007 Ozone Plan, 2008 PM2.5 Plan, 2012 PM2.5 Plan, 2013 Plan for the Revoked 1-Hour Ozone Standard (2013 Ozone Plan)*, and the *2015 Plan for the 1997 PM2.5 Standard (2015 PM2.5 Plan).* District attainment plans contain commitments that serve as control measures to reduce emissions and attain the federal air quality standards. Under the U.S. Environmental Protection Agency (EPA) policy, there is a preference for reliance on control measures that have already been adopted. Table C-1 below identifies control measures the District has already adopted that are contributing to attainment of the 2008 8-hour ozone standard. These adopted District rules will continue to achieve new emissions reductions after 2012, the base year for this plan. However, it's important to note that even pre-2012 emissions reductions are contributing, and will continue to contribute, to the Valley's progress toward clean air.

Table C-1 District Rules Achieving New Emissions Reductions After 2012

District Rules		*Date Adopted or Last Amended*
4103	Open Burning	4/15/2010
4307	Boilers, Steam Generators, and Process Heaters 2 to 5 MMBtu/hr	5/19/2011
4308	Boilers, Steam Generators, and Process Heaters 0.075 to <2 MMBtu/hr	11/14/2013
4311	Flares	6/18/2009
4306/ 4320	Boilers, Steam Generators, and Process Heaters >5 MMBtu/hr	10/16/2008
4352	Solid Fuel Fired Boilers, Steam Generators and Process Heaters	12/15/2011
4354	Glass Melting Furnaces	5/19/2011
4565	Biosolids, Animal Manure, and Poultry Litter Operations	3/15/2007
4566	Organic Material Composting Operations	8/18/2011
4601	Architectural Coatings	12/17/2009
4605	Aerospace Assembly and Component Coating Operations	9/20/2007
4653	Adhesives and Sealants	9/16/2010
4682	Polystyrene, Polyethylene, and Polypropylene Products Manufacturing	9/20/2007

District Rules		Date Adopted or Last Amended
4684	Polyester Resin Operations	9/20/2007
4702	Internal Combustion Engines	8/18/2011
4905	Natural Gas-Fired, Fan-Type Residential Central Furnaces	1/22/2015
9610	State Implementation Plan Credit for Emission Reductions Generated Through Incentive Programs	6/20/2013

The analyses summarized in this appendix are the result of a robust and exhaustive effort on the part of the District to identify potential emission reduction opportunities. District staff from multiple departments with expertise in the applicable sectors contributed to this effort. The evaluations in this appendix capture relevant background information, examine potential emission reduction opportunities for technological and economic feasibility, and make recommendations for appropriate District actions moving forward.

CONTROL MEASURE EVALUATION METHODOLOGY

Control Measure Evaluations

Each stationary and area source control measure evaluation summarized in this appendix is organized following a thorough and consistent analysis methodology. This methodology includes sections for the following discussions and analyses:

- Emissions inventory
- Rule Description
- Regulatory evaluation of Federal, State, and local regulations, including an assessment of Reasonably Available Control Technology (RACT)
- Summary potential emission reduction opportunities identified and the associated analysis of such opportunities
- Summary of the evaluation findings.

Although this methodology is followed for each individual stationary and area source control measure evaluation, additional sections may be added as appropriate to provide a more complete summary of the analysis performed. The following is a description of the sections in the control measure analyses.

Emissions Inventory

Each control measure evaluation contains an emission inventory table that identifies the summer average emissions of oxides of nitrogen (NOx) and volatile organic compound (VOC) for the respective control measure for multiple years between 2012, the baseline year for this plan, and 2031, the attainment year. As discussed in detail in Chapter 4, ozone is a product of atmospheric reactions involving VOCs, NOx, the hydroxyl radical (OH), other radicals, and sunlight. As such, although some District rules control multiple

emissions including oxides of sulfur (SOx) and particulate matter (PM), this appendix focuses on NOx and VOC emission inventories and emission reduction opportunities.

The emissions data provided in the emission inventory table is presented as a summer average in tons of emissions per day (tpd) since ozone exceedances occur in the summer months in the Valley. Consistent with the Districts Health Risk Reduction Strategy, to ensure the emissions reductions efforts of this plan contribute to improved air quality and progress toward attainment of the 2008 8-hour ozone standard, the focus is on emissions and activities in the summer months. The data is a compilation of the data sources identified in the emission inventory appendix (see Appendix B).

Rule Description

This section of each control measure will provide a general overview of the rule, including rule applicability, types of sources subject to rule requirements, rule adoption/ amendment history, and any other additional pertinent details, as relevant to the control measure evaluation.

How does the District rule compare with federal and regulations?

This section of the control measure evaluation includes a comparison of District rules to federal air quality regulations and standards. Research of federal regulations includes literature review of the following regulations and guidance documents:

- **CTG**: Control Techniques Guidelines[1]
- **ACT**: Alternative Control Techniques[2]
- **NSPS**: New Source Performance Standards[3]
- **NESHAP**: National Emission Standards for Hazardous Air Pollutants[4]
- **MACT**: Maximum Achievable Control Technology[5]

How does the District rule compare with California State regulations?

Generally, state regulations are specific to mobile sources and area sources such as consumer products. However, sometimes ARB will adopt a *Suggested Control Measure* (SCM) for area sources, such as the SCM for architectural coatings promulgated in September of 2007. Additionally, there are some California Health and Safety Code (CH&SC) requirements and ARB Airborne Toxic Control Measures (ATCM)[6] that apply to stationary and area sources. Most of the rules evaluated in this plan do not have an ARB regulation or SCM associated with their source category. The

[1] EPA. Control Techniques Guidelines. Retrieved from http://www.epa.gov/groundlevelozone/SIPToolkit/ctgs.html
[2] EPA. Alternative Control Techniques. Retrieved from http://www.epa.gov/groundlevelozone/SIPToolkit/ctgs.html
[3] EPA. 40 CFR 60 – Standards of Performance for New Stationary Sources (NSPS). Retrieved from http://www.tceq.state.tx.us/permitting/air/rules/federal/60/60hmpg.html
[4] EPA. 40 CFR 61 – National Emission Standards for Hazardous Air Pollutants (NESHAPs). Retrieved from http://www.tceq.state.tx.us/permitting/air/rules/federal/61/61hmpg.html
[5] EPA. 40 CFR 63 – Maximum Achievable Control Technology (MACT). Retrieved from http://www.tceq.state.tx.us/permitting/air/rules/federal/63/63hmpg.html
[6] California Air Resources Board (ARB). Airborne Toxic Control Measures (ATCMs). Retrieved from http://www.arb.ca.gov/toxics/atcm/atcm.htm

District has included and evaluated all relevant state guidelines identified within the applicable control measure evaluations.

How does the District rule compare to rules in other air districts?

Every control measure was compared to analogous regulations adopted by California's most progressive air districts. Investigation of control strategies and measures in other air districts and agencies includes, but is not limited to the following air districts:

- **BAAQMD**: Bay Area Air Quality Management District[7]
- **SCAQMD**: South Coast Air Quality Management District[8]
- **SMAQMD**: Sacramento Metropolitan Air Quality Management District[9]
- **VCAPCD**: Ventura County Air Pollution Control District[10]

In the cases where other air districts or air agencies in other states have been identified as having a more stringent analogous rule, those rules are also summarized and evaluated in this section of the control measure evaluation.

Potential Emission Reduction Opportunities

The District reviewed each control measure to identify potential opportunities for emissions reductions. The results of this review are summarized in this section of the control measure analysis. All potential emission reduction opportunities identified were evaluated for technological and economic feasibility:

- **Technological feasibility** – The technological feasibility analysis determines if a potential opportunity to reduce emissions is viable for existing facilities and operators in the Valley, given their current operating needs and restrictions. District analysis of technological feasibility includes a literature review of BACT guidelines; District permits; environmental and technological studies; EPA and ARB guideline documents; and other air districts' rules, regulations, and guidelines, to identify potential opportunities and determine the technological feasibility of any identified potential opportunities.

- **Economic feasibility** – To determine economic feasibility, a cost effectiveness analysis is conducted to evaluate the economic reasonableness of an air pollution control measure or technology as it applies to operators in the Valley. A cost effectiveness analysis examines the added cost, in dollars per year, of the control technology or technique, divided by the emissions reductions achieved, in tons per year.

[7] Bay Area Air Quality Management District (BAAQMD). Rules and Regulations. Retrieved from http://www.baaqmd.gov/Divisions/Planning-and-Research/Rules-and-Regulations.aspx
[8] South Coast Air Quality Management District (SCAQMD). Rules and Regulations. Retrieved from http://www.aqmd.gov/home/regulations/rules/scaqmd-rule-book/table-of-contents
[9] Sacramento Metropolitan Air Quality Management District (SMAQMD). Rules and Regulations. Retrieved from http://www.airquality.org/rules/
[10] Ventura County Air Pollution Control District (VCAPCD). Rules and Regulation. Retrieved from http://www.vcapcd.org/Rulebook/RuleIndex.htm

The District reviewed staff reports and studies from other air districts, EPA technical guidance documents, and applicable study data from the scientific community to assist in evaluating the technological and economic feasibility of potential emission reduction opportunities.

Evaluation Findings

This section includes a summary of the District's findings from the full control measure evaluation and includes any recommendations, such as a new or amended rule or further study actions. See Chapter 5 for a summary of all proposed recommendations.

The *Evaluation Findings* section also includes a brief conclusion whether the District rule under evaluation satisfies, does not satisfy, or is not subject to federal Reasonably Available Control Technology (RACT) requirements. RACT is "the lowest emission limitation that a particular source is capable of meeting by the application of control technology that is reasonably available considering technological and economic feasibility" (44 FR 53762; September 17, 1979). Per Sections 182(b)(2) and 182(f) of the federal Clean Air Act, ozone nonattainment areas are required to implement RACT for sources that are subject to Control Techniques Guidelines (CTG) issued by EPA and for "major sources" of VOCs and NOx, which are ozone precursors.

RACT changes over time as new technologies become feasible and cost-effective, thus making them reasonable to require. The District has conducted comprehensive reviews of all NOx and VOC rules for compliance with federal RACT requirements. For these reviews, the District evaluates all District rules against federal rules, regulations, and technology guidelines, as well as any comparable rules and compliance methods from California's most technologically progressive air districts. In response to the District's *2009 RACT SIP* and related rule amending projects, EPA has issued federal actions documenting their approval of District rules and their concurrence that District rules are at least as stringent as RACT levels. In fact, these efforts show that many District rules are more stringent than established RACT standards. The District adopted its *2014 RACT Demonstration for the 8-Hour Ozone State Implementation Plan (2014 RACT SIP)* on June 19, 2014 to satisfy requirements for the 2008 8-hour ozone standard. The *2014 RACT SIP* analysis shows that the District continues to meet or exceed RACT for all applicable EPA source categories. The RACT evaluations in this appendix continue to build on the foundation established by these previous analyses.

C.1 RULE 4103 OPEN BURNING

C.1.1 *Emissions Inventory (Summer Average – Tons per day)*

	2012	2015	2018	2021	2024	2027	2029	2030	2031
NOx	0.77	0.76	0.76	0.75	0.75	0.74	0.74	0.74	0.73
VOC	0.91	0.91	0.90	0.89	0.89	0.88	0.88	0.87	0.87

C.1.2 District Rule 4103 Description

The provisions of Rule 4103 apply to open burning conducted in the Valley, with the exception of prescribed burning and hazard reduction burning, as defined in Rule 4106 (Prescribed Burning and Hazard Reduction Burning). The purpose of Rule 4103 is to permit, regulate, and coordinate the use of open burning while minimizing smoke impacts on the public.

Rule 4103 was originally adopted on June 18, 1992 and it has been amended several times to incorporate state law requirements. In 2003, California Senate Bill (SB) 705 (CH&SC Section (§) 41855.5 and 41855.6) established a schedule for specific types of agricultural material to no longer be openly burned in the field, but provided for a postponement of the phase-out where justified by technical and economic impediments. The air quality impacts from open burning in the Valley are of significant concern for the District and Valley growers; as such, Valley growers have reduced open burning through the use of sustainable agricultural practices. Those practices have contributed to a significant reduction in PM emissions since 1992.

The historical practice for disposing of agricultural materials, such as prunings and orchard removals, is to burn the materials. Burning agricultural materials provided an economically feasible method for the timely disposal of these materials, helped prevent the spread of plant diseases, and controlled weeds and pests. As part of implementing SB 705 and enhancing the effectiveness of the District's burn reduction efforts, in 2004 the District established the Smoke Management System (SMS), a more refined method of authorizing or prohibiting individual burns, based on modeled smoke impacts. Rule 4103 and the District's SMS have reduced the total acreage of agricultural materials burned in the Valley to date by more than 80% since 2002.

Agricultural Burn Reports

The most recent amendments to Rule 4103, in April 2010, incorporated the provisions of CH&SC §41855.5 and §41855.6 directly into the rule to more efficiently allow the District to consider the feasibility of non-burning alternatives for specific crops and materials. The amendments also require the District to prepare a Staff Report and Recommendations on Agricultural Burning and then to review and update once every five years to determine if there are feasible alternatives to open burning.

In 2010, the District prepared the *2010 Final Staff Report and Recommendations on Agricultural Burning (2010 Report)* which evaluated each crop category identified in CH&SC §41855.5 and provided recommendations for allowing or prohibiting the open burning of categories as outlined by the senate bill. Based upon the *2010 Report and* the lack of feasible alternatives to open burning, the ARB provided a two year concurrence on the District's recommended postponements. In 2012, the District prepared the *2012 Update: Recommendations on Agricultural Burning (2012 Report)* which re-evaluated the technological and economical impediments for the crop categories that had been postponed. Based upon the *2012 Report, and* the continued lack of feasible alternatives to open burning, the ARB provided an additional three year concurrence on the District's recommended postponements.

In 2015, the District prepared the *2015 Agricultural Burning Review (2015 Review),* which demonstrated that in the three years since the 2012 evaluation, the availability of technologically achievable and economically feasible alternatives to agricultural burning has significantly worsened due to the severe drought conditions in the Valley and the demise of the biomass industry that historically has provided an alternative to open burning for the considerable amount of agricultural material generated in the Valley. In the *2015 Review* the District requested continued ARB concurrence for the postponement of the remaining crop categories through 2020. In December 2015, ARB granted a five-year concurrence with the assessment for limited exemptions to the phase-out of agricultural burning, consistent with requirements in the CH&SC.[11]

Smoke Management System

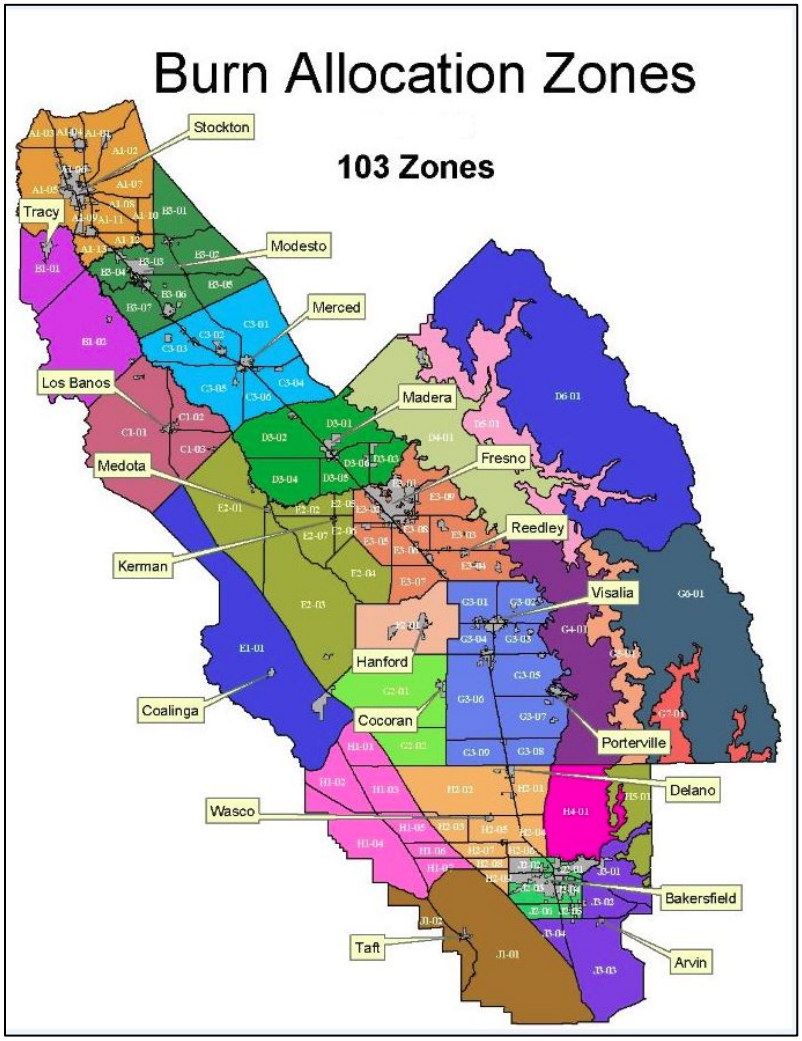
In 2004, the District established the Smoke Management System (SMS), a refined method of authorizing or prohibiting individual open burns based on modeling the air quality impacts of smoke. The entity requesting a burn permit must first provide the District with information about the acres and type of burn material, the specific location of the burn, and the date of the burn. This information is entered into the SMS, where acres are converted to tons of fuel burned using a fuel loading factor based on the specific crop to be burned. Emissions are calculated by multiplying the tons of fuel burned by a crop specific emission factor. A burn request will be authorized after analysis and review from the District Compliance staff, and only if sufficient emissions have been allocated to the burn zone.

The proper management of burning allocations under the SMS ensures that open burning of agricultural materials does not cause any violations of health-based ambient air quality standards, open burning has only been permitted under the District's comprehensive SMS, which uses real-time meteorological information to analyze the impact of burning on air quality and appropriately limit burn allocation by area.

[11] ARB concurrence with San Joaquin Valley Air Pollution Control District determination. Letter to Mr. Samir Sheikh from Kurt Karperos, Deputy Executive Officer of the ARB. (2015, December 23)

Under the District's SMS program, the Valley is divided into 103 zones, see figure C-1 below. The amount of burning allowed in a given zone on a specific day is based on factors such as the local meteorology, the air quality conditions, the atmospheric holding capacity, the amount of burning already approved or happening in a given area, and the potential impacts on downwind populations. In order to avoid violations of relevant air quality standards, District staff must reduce and balance the impacts of agricultural burning, wildfires, and prescribed burning. In some cases when the wildfire smoke impacts are severe, no agricultural burning is allowed. In the summer of 2015 when wildfire smoke impacted the Valley's air quality, the agricultural community had to be flexible to wait for the next burn window to appear. During this period, District staff worked hard to find burn windows under good to marginal dispersion conditions to allow agricultural burning to continue in the middle of the wildfire season.

Figure C-1 Agricultural Burn Zones Defined in the District SMS



Check Before You Burn Season

During the wood-burning season from November through February, the District implements even tighter open burning restrictions based on the daily residential wood-burning declarations issued for the Check Before You Burn program. With the recent amendment of Rule 4901, residential wood-burning with unregistered devices is no longer allowed when an area's forecasted PM2.5 concentration is expected to be greater than or equal to 20 µg/m^3. This threshold is now lower compared to past years when it was set at 30 µg/m^3. To be consistent with the residential wood-burning declaration, an area's burn zones in SMS are allocated zero emissions when residential wood-burning is prohibited in that area. Following similar procedures discussed above, zones directly adjacent to an area where residential wood-burning is restricted are also allocated zero emissions. Under this policy, agricultural burning is placed under tighter control during the winter season and burning is only allowed when air quality is expected to be below 20 µg/m^3. This happens when meteorological conditions are projected to be conducive for pollutant dispersion, which is well below the current federal 24-hour average PM2.5 standard of 35 µg/m^3.

Burn Prohibition Date Postponements

Through the *2010 Report,* the District made the determination, consistent with the CH&SC requirements, to postpone the burn prohibition dates and allow continued burning of certain crop categories (see table below).

Table C-2 Burn Permits Allowed for the Following Crops

Crop Category	Burn Permits Prohibited	Burn Permits Allowed
Field Crops	Alfalfa, asparagus, barley stubble, beans, corn, cotton, flower straw, hay, lemon grass, oat stubble, pea vines, peanuts, safflower, sugar cane, vegetable crops, and wheat stubble	Rice stubble up to 70% of the total acreage of rice farmed by the operator per year Residual rice stubble, spot burning of rice stubble, and burning of weeds and vegetative materials on rice field levees and banks
Prunings	Apricot crops, avocado crops, bushberry crops, cherry crops, Christmas trees, citrus crops, date crops, eucalyptus crops, kiwi crops, nectarine crops, nursery prunings, olive crops, pasture or corral trees, peach crops, persimmon crops, pistachio crops, plum crops, pluot crops, pomegranate crops, prune crops, rose crops, and fig crops	Apple crops, pear crops, and quince crops
Weed Abatement	Berms, fence rows, pasture, grass, and bermuda grass	Weed abatement activities affecting ponding and levee banks

Crop Category	Burn Permits Prohibited	Burn Permits Allowed
Orchard Removals	Orchard removal matter of more than 15 acres at a single location, per calendar year, citrus crops > 3,500 acres	Citrus crops < 3,500 acres, apple crops, pear crops, quince crops, and orchard removal matter from a total of 15 acres or less of orchard removal at a single location, per calendar year
Vineyard Removals	None at this time	Vineyard removal materials from grape and kiwi crops
Surface Harvested Prunings	Grape canes (defined as "vineyard materials"), grape vines, and prunings of almond, walnut, and pecan crops for each agricultural operation whose total nut acreage at all agricultural operation sites is 3,500 acres or more	Raisin trays (defined as "vineyard materials"), and up to 20 acres of prunings per year for almond, walnut, and pecan crops for agricultural operations whose total nut acreage at all agricultural operation sites is less than 3,500 acres with a case-by-case allowance of additional burn requests based on economic feasibility
Other Materials	Brooder paper and deceased goats	Diseased beehives

Effects of Drought on Agricultural Burning

California is currently suffering through the worst drought in recorded history. Despite improved atmospheric conditions during the winter of 2014-2015, precipitation remained well below average for most of the Valley. Snow pack levels during winter of 2014-2015 hit a record low at 6% of normal. Since January 2014, the Governor declared California to be in a state of Drought Emergency, and the entire Valley is under “exceptional” drought conditions. Federal and state surface water deliveries are at an all-time low of zero- to twenty-percent allocation, and cities and towns have implemented a mandatory 25% reduction in water usage.

The drought conditions described above have resulted in a significant increase in fallowed land, with far more expected to follow. To date hundreds of thousands of acres of orchards, vineyards and other agricultural crops have been fallowed in the San Joaquin Valley in response to the drought. Removal of agricultural material has increased significantly and is expected to continue increasing for several more years. With the biomass industry in jeopardy, the extra agricultural material has nowhere to go.

C.1.3 How does District Rule 4103 compare with federal rules and regulations?

C.1.3.1 EPA – Control Technique Guidelines (CTG)

EPA CTG requirements are not applicable to this source category.

C.1.3.2 EPA – Alternative Control Techniques (ACT) Document

EPA ACT requirements are not applicable to this source category.

C.1.3.3 Standards of Performance for New Stationary Sources (NSPS)

EPA NSPS requirements are not applicable to this source category.

C.1.3.4 National Emission Standards for Hazardous Air Pollutants (NESHAPs) and Maximum Achievable Control Technologies (MACTs)

EPA NESHAP and MACT requirements are not applicable to this source category.

C.1.4 How does District Rule 4103 compare to California State regulations?

California Health and Safety Code (CH&SC) Section (§) 41850-41866 (Agricultural Burning) is the California state regulation applicable to agricultural open burning activities.

The District has continued to work closely with the stakeholders to identify economically feasible alternatives to open burning of various agricultural materials and to meet its legal obligation under the CH&SC. To fulfill the state law requirements, the District has implemented the requirements for most crop categories identified in CH&SC §41855.5. In addition to those requirements, the state law authorizes the District to postpone the burn prohibition dates for specific types of agricultural material if the District makes three specific determinations and the Air Resources Board (ARB) concurs. The determinations are: (1) there are no economically feasible alternatives to open burning for that type of material; (2) open burning for that type of material will not cause or substantially contribute to a violation of an air quality standard; and (3) there is no long-term federal or state funding commitment for the continued operation of biomass facilities in the Valley or the development of alternatives to burning.

The District amended Rule 4103 in April 2010 to incorporate CH&SC requirements and committed the District to review its determinations for any postponed crops and materials at least once every five years. In 2010, the District also evaluated each crop category identified in CH&SC §41855.5 to determine any technologically and economically feasible alternatives to open burning. After working extensively with stakeholders to understand viable alternatives to open burning and the associated costs, the District provided recommendations for allowing or prohibiting the open burning of agricultural material categories in the District's *2010 Final Staff Report and Recommendations on Agricultural Burning*. ARB concurred with the District's determinations and recommendations; however, ARB made a one-time request that the District re-visit the 2010 findings after two years to determine if additional reductions in open burning were feasible.

The District revisited its 2010 analysis in 2012 and submitted those findings to ARB. The 2012 Report showed that in the two years since the 2010 Report, there had been no significant changes in the economic feasibility of various alternatives to agricultural burning. The amount of agricultural materials accepted at biomass facilities continued to fluctuate based on market conditions and there were no long-term federal or state funding commitments for the operation of biomass facilities or development of

alternatives to burning. EPA finalized approval for Rule 4103 on January 4, 2012 and deemed this rule as at least meeting RACT requirements.[12] The District reevaluated the availability of alternatives to open burning in the *2014 Reasonably Available Control Technology Demonstration for the 8-Hour Ozone State Implementation Plan* (*2014 RACT SIP*) and again in its *2015 Review*. Based on information provided in the *2015 Review*, ARB concurred that the limited exemptions are appropriate through 2020.

C.1.5 How does this rule compare to rules in other air districts?

C.1.5.1 Bay Area AQMD

C.1.5.1.1 Regulation 5 (Open Burning)

The requirements of Rule 4103 are more stringent than the requirements in Regulation 5. Regulation 5 was last amended on June 19, 2013 to add new fee requirements. The amendments did not implement any requirements more stringent than the current requirements in District Rule 4103.

C.1.5.2 Sacramento Metropolitan AQMD

C.1.5.2.1 Rule 407 (Open Burning)

The requirements of Rule 4103 are more stringent than the requirements in Rule 407.

C.1.5.3 South Coast AQMD

C.1.5.3.1 Rule 444 (Open Burning)

The requirements of Rule 4103 are more stringent than the requirements in Rule 444. Rule 444 was last amended on July 12, 2013 to address beach burning activities. The amendments apply to sources that do not exist within District's boundaries. Rule 444 also restricts burning on residential wood combustion curtailment days. As discussed in detail above, this is a practice that has already been implemented by the District within the Valley.

C.1.5.4 Ventura County APCD

C.1.5.4.1 Rule 56 (Open Burning)

The requirements of Rule 4103 are more stringent than the requirements in Rule 56.

[12] Revisions to the California State Implementation Plan, San Joaquin Valley Unified Air Pollution Control District, 75 Fed. Reg. 2, pp 214-217 (2012, January 4). (to be codified at 40 CFR Part 52)

C.1.6 Potential Emission Reduction Opportunities

A number of alternatives to open burning have been identified with potential to reduce emissions form this source category. Those alternatives are described in detail below and include the following:

- Biomass power plants
- Pyrolysis
- Bio-char
- Bio-oil
- High solids anaerobic digestion
- Composting
- Fiberboard
- Mulch/land application/soil incorporation
- Cellulosic ethanol production

C.1.6.1.1 Biomass Power Plants

Biomass power plants are a significant alternative to the open burning of agricultural material and the emissions associated with it. Biomass burning of agricultural material is preferable to open burning as it combusts the material more completely, results in fewer emissions, and provides an alternative source of energy in the Valley.

The biomass industry is primarily the product of the Public Utility Regulatory Policy Act (PURPA) which was enacted in 1978 at the height of the energy crisis to promote the use of alternative nonutility power generation. Today, these facilities are fully depreciated and have lost, or are nearing the ends of, their long-term contracts to sell their power to the utilities. In addition, biomass facilities are facing numerous obstacles to remain in operation including price disadvantage, demand for intermittent power instead of baseload power, and lack of federal and state funding.

Much has changed in the energy markets since PURPA was implemented. Natural gas has replaced oil for electricity generation, and supplies of natural gas have increased, driving down the wholesale cost of electricity. California has adopted a Renewable Portfolio Standard (RPS) that requires 33% of the power that is purchased by utilities be renewable. This has driven competition to fill the renewable energy needs of the state. Under the RPS, Investor Owned Utilities (IOUs) have tended to favor lower cost intermittent sources of renewable power, such as solar and wind. This has left the biomass industry in a position where the power that they produce is not desirable, since most biomass plants provide baseload power instead of intermittent power, and the current rate being paid for power does not allow them to remain viable.

Given the current energy policy, the biomass industry does not compete well under the current procurement policies of the state's IOUs. Historically, the biomass facilities have demanded 12-13 cents per kilowatt-hour, which has been necessary to retain economic viability. Pricewise, this places biomass facilities at a competitive disadvantage with other renewable fuels that can be procured at a much lower cost. Under the state's RPS, program pricing information is confidential, however, anecdotal

evidence is that currently the IOUs are purchasing power from solar and wind facilities at approximately 8 cents per kilowatt-hour.
Another factor that negatively impacts the competitive position of biomass generated power is due to the fact that such plants provide "baseload" power. As baseload generators, biomass facilities cannot produce power that can be turned on quickly, and therefore, cannot meet the power system's demand for "ramping services". The demand for ramping services is compounded by continued increase in the use of wind and solar renewable sources, which is partially triggered by the state's RPS goals. If current trends persist, this issue will worsen in the future. It is estimated that by 2020, solar and wind will account for three-quarters of the state's renewable power and 20% of the state's total electricity supply. The net effect of this is a further transition away from baseload generators to more flexible generators that can be turned-on and turned-off when needed. Under this scenario, not only do biomass facilities have difficulty competing directly on price, but they also do not provide the type of power that is desired. While under this scenario the state can meet its renewable power goals, the potential loss of biomass plants can impact the state's broader greenhouse gas reduction goals under AB 32 by increasing GHG emissions in sectors that currently rely on biomass plants for disposal of materials including the agricultural industry, landfills, and forests.

The biomass industry also struggles to provide consistent service to farmers needing timely removal of material to ensure the land is ready for the next planting season. In the past, lack of coordination and available storage for biomass fuels has caused uncertainty over the timing of material removal. The inability to guarantee consistent acceptance of agricultural biomass offers further confirmation that remaining crop categories should be allowed to continue open burning. A complete prohibition of open burning would result in a massive increase in agricultural material requiring disposal, placing an even greater strain on an already precarious situation.

As shown in Table C-3, since 2012, five Valley biomass facilities have shut down operations. In addition, the Valley's largest biomass plant (Covanta Delano) has stopped receiving new material as of November 1, 2015, and has informed the District that they plan to shut down operations at the end of the year because they have been unable to secure a viable Purchase Power Agreement.

Table C-3 Status of Biomass Facilities in the Valley

Facility Name	City	Capacity (MW)	Status
Rio Bravo Fresno	Fresno	28.5	
Covanta Mendota, LP	Mendota	30.0	CLOSED Dec. 2015
Madera Power, LLC	Madera	28.5	CLOSED Feb. 2012
Ampersand Chowchilla Biomass, LLC	Chowchilla	12.5	
Merced Power. LLC	Merced	13.0	
Thermal Energy Dev Partnership, LP	Tracy	20.5	CLOSED Oct. 2014
DTE Stockton, LLC	Stockton	54.0	
Covanta Delano, Inc.	Delano	56.5	DORMANT Dec. 2015
Sierra Power Corporation	Terra Bella	9.4	CLOSED Jan. 2014

Facility Name	City	Capacity (MW)	Status
Mt. Poso Cogeneration Company, LLC	Bakersfield	49.9	
CRES Inc. d/b/a Dinuba Energy	Dinuba	11.5	CLOSED Sept. 2015

The loss of these facilities has considerably reduced the available options to dispose of agricultural wood waste, especially material from large orchard removals. As a result, many agricultural growers have lost the primary economically feasible disposal option for their orchard removal material. This could not come at a worse time as there has been an increase in the number of large orchard removals over the past year due in large part to the effects of the extreme drought emergency currently facing the state.

The biomass industry has long relied on a combination of state and federal financial incentives to directly support their relatively higher production costs. These incentives have ranged from tax credits to monetary grants, but have all expired over the last decade. Examples of these programs include the federal Renewable Electricity Production Tax Credit, expired in 2013, state Existing Renewable Facilities Program, expired in 2011, and state Biomass-to-Energy incentive Grant Program, expired in 2003. Therefore, there are currently no long-term federal or state funding commitments for the operation of biomass facilities or development of alternatives to burning.

Potential Technologies to Provide Alternatives to Agricultural Open Burning

The District has found no breakthroughs in technologically achievable and economically feasible alternatives to open burning and traditional biomass power plants. While every effort should be taken to save this existing resource, the District believes that there is an urgent need to investigate other alternatives for the disposal of agricultural waste material. The following are potential technologies that the District may pursue through the District's Technology Advancement Program. Funding from the California Energy Commission, Department of Energy, and others will also be needed.

Pyrolysis – Gasification: Pyrolysis is a possible path to convert agricultural biomass to higher value products. Pyrolysis is the heating of an organic material, such as biomass, in the absence of oxygen. It is the first step of producing a flammable gas called synthetic gas (syngas). Burning syngas offers certain advantages over directly burning biomass because the gas can be cleaned and filtered to remove problematic chemical compounds. Using syngas is also potentially more efficient than direct combustion of biomass because the gas can be combusted at higher temperatures. Syngas can also be used to produce methanol and hydrogen, or converted into a liquid fuel; with lower emissions than existing biomass combustion power plants, this is a viable alternative for farm-scale or small-scale power production. There are currently a few operational units in California, including two in the Valley.

Bio-char: Bio-char is a name for charcoal when it is used for particular purposes, especially as a soil amendment. Like charcoal, bio-char is created by pyrolysis of biomass. Bio-char can increase soil fertility and agricultural productivity. Bio-char can also be processed into activated carbon that can be used for the removal of specific compounds from gaseous and liquid streams.

Bio-oil: Bio-oil, sometimes also known as bio-crude or pyrolysis oil is a mixture of organic compounds that is distilled from the products of fast pyrolysis of biomass at about 500°C. Bio-oil can be used as fuel in boilers and also used in power generation equipment. Bio-oil also can be upgraded to renewable transportation fuels, as well. However, bio-oil with high cellulosic materials such as orchard debris is not currently commercially viable.

High Solids Anaerobic Digestion: Anaerobic digestion is a viable process that can be used to convert woody biomass, agricultural wastes, and municipal solid wastes into methane gas. Anaerobic digesters that process large amounts of woody biomass will require the use of chemical treatment or enzymes to speed the breakdown of cellulose.

Composting Biomass: Composting is the process by which organic material is broken down aerobically by bacteria and other microorganisms to form a biologically stable organic substance suitable as a soil amendment and plant fertilizer. Organic waste decomposes naturally in the presence of water, warmth, and oxygen. Composting accelerates the process by adding moisture and maintaining an elevated temperature. Biomass is one of the sources of organic material for composting operations, but woody biomass must be well mixed with high nitrogen concentration materials to be an effective compost component.

Fiberboard: Biomass can be treated and processed to produce fiberboard that can be used in the manufacture of various products. Fiberboard is a type of engineered wood product that is made out of wood fibers that are bonded together with resin. Types of fiberboard include particleboard, medium-density fiberboard, and hardboard. Fiberboard is frequently used in many industries, such as furniture production, and is generally made with waste material from wood processing facilities.

Biomass Used as Mulch/Land Application/Soil Incorporation: Chipped or shredded agricultural biomass materials can be used to produce wood mulch. Wood mulch can be a mixture of shredded wood, bark, and compost. Wood mulch can be used in landscape projects or for erosion control. The material is primarily used to reduce erosion by protecting bare soil from rainfall impacts, increasing water infiltration, and reducing runoff. A significant portion of pruned orchard material is currently shredded in-row and used as mulch in the orchard. The shredded material can be left on the ground or can be incorporated into the soil when the field is tilled. Over time, the material decomposes into the soil, which adds valuable organic material to the soil and can lead to better water infiltration and soil quality.

Cellulosic Ethanol Production: Cellulosic ethanol is an advanced next-generation biofuel that can be made from agricultural wastes, wood chips, switch grass, corn stover, forest wastes, fast-growing trees, and other plant material. Currently, ethanol produced in the United States is most commonly produced from corn kernels. In the United States, corn ethanol is primarily used as an alternative or additive to gasoline. Advanced biofuels are those that do not rely on the starch in corn kernels. Production of large quantities of ethanol from woody biomass will likely require the use of chemical treatment or

enzymes to speed the breakdown of the cellulose in the biomass. Currently, the production of cellulosic ethanol is still predominately in the demonstration phase of development.

C.1.7 Evaluation Findings

Rule 4103 currently has in place the most stringent measures feasible to implement in the Valley and therefore meets or exceeds federal RACT requirements for this source category. As the District continues to develop future attainment plans to address increasingly stringent federal air quality standards, this source category will be re-evaluated for additional potential opportunities to reduce emissions.

C.2 RULE 4106 PRESCRIBED BURNING AND HAZARD REDUCTION BURNING

C.2.1 *Emissions Inventory (Summer Average – Tons per day)*

	2012	2015	2018	2021	2024	2027	2029	2030	2031
NOx	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04
VOC	0.57	0.57	0.57	0.58	0.58	0.58	0.58	0.58	0.58

C.2.2 District Rule 4106 Description

Adopted in June 2001 and approved by EPA as a SIP amendment in February 2002,[13] Rule 4106 is applicable to range improvement burning, forest management burning, wildland vegetation management burning, and hazard reduction burning within the Valley. Prescribed burning generally includes forest waste, fire hazard reduction, rangeland management, wildlife habitat improvement, and ecosystem (forest health) burning. The adoption of Rule 4106 incorporated provisions made necessary by the March 23, 2000 amendment of Title 17 of the California Code of Regulations.

Recognizing the importance of both prescribed burning and hazard reduction burning, the purpose of Rule 4106 is to permit, regulate, and coordinate the use of prescribed burning and hazard reduction burning while minimizing smoke impacts on the public. Through this rule, the District has expended considerable resources to ensure that the ignition of burn projects is only allowed when air quality and dispersion conditions are favorable, thus lessening the health impacts on Valley citizens and on air quality in the Valley.

C.2.3 How does District Rule 4106 compare with federal rules and regulations?

C.2.3.1 EPA – Control Technique Guidelines (CTG)

EPA CTG requirements are not applicable to this source category.

C.2.3.2 EPA – Alternative Control Techniques (ACT) Document

EPA ACT requirements are not applicable to this source category.

C.2.3.3 Standards of Performance for New Stationary Sources (NSPS)

EPA NSPS requirements are not applicable to this source category.

[13] 67 Federal Register 39, pp. 8894-8897 (to be codified at 40 CFR Part 52). (2002, February 27). *Revisions to the California State Implementation Plan, San Joaquin Valley Unified Air Pollution Control District*. Retrieved from https://www.federalregister.gov/articles/2002/02/27/02-4526/revisions-to-the-california-state-implementation-plan-san-joaquin-valley-unified-air-pollution.

C.2.3.4 National Emission Standards for Hazardous Air Pollutants (NESHAPs) and Maximum Achievable Control Technologies (MACTs)

EPA NESHAP and MACT requirements are not applicable to this source category.

C.2.4 How does District Rule 4106 compare with California State regulations?

There are no state regulations applicable to this source category.

C.2.5 How does District Rule 4106 compare to rules in other air districts?

C.2.5.1 Bay Area AQMD

C.2.5.1.1 Regulation 5 (Open Burning)

The requirements in Rule 4106 are as stringent as or more stringent than those in Regulation 5.

C.2.5.2 Sacramento Metropolitan AQMD

C.2.5.2.1 Rule 501 (Agricultural Burning)

The requirements in Rule 4106 are as stringent as or more stringent than those in Rule 501.

C.2.5.3 South Coast AQMD

C.2.5.3.1 Rule 444 (Open Burning)

The requirements in Rule 4106 are as stringent as or more stringent than those in Rule 444.

C.2.5.4 Ventura County APCD

C.2.5.4.1 Rule 56 (Open Burning)

The requirements of Rule 4106 are as stringent as or more stringent than those in Rule 56.

C.2.5.5 Other Air Quality Control Agencies

C.2.5.5.1 Placer County APCD

Placer County APCD Rule 301 (Nonagricultural Burning Smoke Management)
The requirements of Rule 4106 are as stringent as or more stringent than those in Rule 301.

Placer County APCD Rule 303 (Prescribed Burning Smoke Management)
The requirements of Rule 4106 are as stringent as or more stringent than those in Rule 303.

C.2.6 Potential Emission Reduction Opportunities

In its *2015 Plan for the 1997 PM2.5 Standard* (*2015 PM2.5 Plan*) the District evaluated this source category to determine if there are any feasible emission reduction opportunities. This extensive evaluation included the evaluation of potential emission reduction opportunities such as the mechanical removal of materials; the use of firebox air curtain burners; reorganization of hazard reduction zones, chipping, and biomass removal programs. The District found that Rule 4106 currently has in place the most stringent measures feasible to implement in the Valley.[14] The District re-evaluated the aforementioned options and has determined that no additional feasible opportunities have been developed in the last 12 months since the adoption of the *2015 PM2.5 Plan.* Therefore, there are no additional emission reduction opportunities at this time.

C.2.7 Evaluation Findings

According to the federal CAA §182(b)(2) and (f) this source category is not subject to federal RACT requirements because this source category has no sources subject to EPA CTGs and these sources are not "major sources" of VOCs and NOx, as confirmed by EPA in the Technical Support Document (TSD) for the partial approval of the Districts 2009 RACT SIP.[15] However, pursuant to the District's No Stone Left Unturned philosophy, Rule 4106 was evaluated as a part of this plan development effort.

Rule 4106 currently has in place the most stringent measures feasible to implement in the Valley and therefore would meet or exceed federal RACT requirements for this source category were they applicable. As the District continues to develop future attainment plans to address increasingly stringent federal air quality standards, this source category will be re-evaluated for additional potential opportunities to reduce emissions.

[14] SJVUAPCD. 2015 Plan for the 1997 PM2.5 Standard. Appendix C Best Available Control Measures and Most Stringent Measures (2015, April 16). Retrieved from http://www.valleyair.org/Air_Quality_Plans/PM25Plans2015.htm

[15] U.S. EPA. Region IX Air Division. Technical Support Document for EPA's Notice of Proposed Rulemaking for the California State Implementation Plan. Prepared by Stanley Tong. (2011, August 29). https://www.regulations.gov/#!documentDetail;D=EPA-R09-OAR-2011-0723-0006

C.3 RULE 4301 FUEL BURNING EQUIPMENT

C.3.1 *Emissions Inventory (Summer Average – Tons per day)**

	2012	2015	2018	2021	2024	2027	2029	2030	2031
NOx	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
VOC	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a

*The emission inventory is not specific to Rule 4301. See Rules 4306, 4307, 4308, 4309, 4352, and 4703 for the individual emissions inventories.

C.3.2 District Rule 4301 Description

Rule 4301 was last amended in 1992 and applies to all types of fuel burning equipment, except air pollution control equipment. The purpose of this rule is to limit emissions of air contaminants from fuel burning equipment by specifying maximum emission rates for SOx, NOx, and PM (identified in the rule as combustion contaminant emissions). EPA finalized approval of the 1992 amendments to Rule 4301 on May 18, 1999 and deemed this rule as being at least as stringent as established RACT requirements.

Rule 4301 has a very broad applicability, as it applies to all types of fuel burning equipment. Since its early adoption in 1992, it has largely been superseded by several District rules with more stringent NOx requirements for specific types of fuel burning equipment. See the control measure evaluations for Rules 4306, 4307, 4308, 4309, 4352, and 4703 for more specific information about the individual fuel burning equipment source categories.

C.3.3 How does District Rule 4301 compare with federal rules and regulations?

C.3.3.1 EPA – Control Technique Guidelines (CTG)

Several District rules have superseded Rule 4301 with more stringent requirements. Comparisons of those District rules to the applicable federal rules are discussed within those control measure evaluations.

C.3.3.2 EPA – Alternative Control Techniques (ACT) Document

Several District rules have superseded Rule 4301 with more stringent requirements. Comparisons of those District rules to the applicable federal rules are discussed within those control measure evaluations.

C.3.3.3 Standards of Performance for New Stationary Sources (NSPS)

Several District rules have superseded Rule 4301 with more stringent requirements. Comparisons of those District rules to the applicable federal rules are discussed within those control measure evaluations.

C.3.3.4 National Emission Standards for Hazardous Air Pollutants (NESHAPs) and Maximum Achievable Control Technologies (MACTs)

Several District rules have superseded Rule 4301 with more stringent requirements. Comparisons of those District rules to the applicable federal rules are discussed within those control measure evaluations.

C.3.4 How Does District Rule 4301 compare with California State regulations?

Several District rules have superseded Rule 4301 with more stringent requirements. Comparisons of those District rules to the applicable state rules are discussed within those control measure evaluations.

C.3.5 How does District Rule 4301 compare to rules in other air districts?

C.3.5.1 Bay Area AQMD

There are no analogous rules for this source category.

C.3.5.2 Sacramento Metropolitan AQMD

There are no analogous rules in Sacramento Metro AQMD for this source category.

C.3.5.3 South Coast AQMD

C.3.5.3.1 Rule 474 (Fuel Burning Equipment—Oxides of Nitrogen)

The requirements of Rule 4301 are more stringent than the requirements in Rule 474.

C.3.5.4 Ventura County APCD

There are no analogous rules in Ventura County APCD.

C.3.6 Potential Emission Reduction Opportunities

No additional emission reduction opportunities have been identified at this time.

C.3.7 Evaluation Findings

The NOx requirements of this rule have been superseded by the requirements of other District rules that satisfy RACT and go beyond RACT for fuel burning equipment. All units subject to Rule 4301 are subject to a more specific NOx rule discussed elsewhere in this appendix. See the control measure evaluations for Rules 4306, 4307, 4308, 4309, 4352, and 4703.

C.4 RULE 4302 INCINERATOR BURNING

C.4.1 *Emissions Inventory (Summer Average – Tons per day)*

	2012	2015	2018	2021	2024	2027	2029	2030	2031
NOx	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03
VOC	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01

C.4.2 District Rule 4302 Description

This rule applies to any incinerator activity or equipment. The purpose of this rule is to limit air pollution by prohibiting the use of any incinerator except for multiple-chamber incinerators or one equally effective in controlling air pollution. EPA finalized approval of the 1993 amendments to Rule 4302 on August 19, 1999 and deemed this rule as being at least as stringent as established RACT requirements: 64 FR 45170, http://www.gpo.gov/fdsys/pkg/FR-1999-08-19/pdf/99-21164.pdf

C.4.3 How does District Rule 4302 compare with federal rules and regulations?

C.4.3.1 EPA – Control Technique Guidelines (CTG)

EPA CTG requirements are not applicable to this source category.

C.4.3.2 EPA – Alternative Control Techniques (ACT) Document

EPA ACT requirements are not applicable to this source category.

C.4.3.3 Standards of Performance for New Stationary Sources (NSPS)

C.4.3.3.1 NSPS - 40 CFR 60 Subpart E (Standards of Performance for Incinerators)

Rule 4302 is more stringent than the requirements in the NSPS because the NSPS exempts all facilities with less than 50 tons per day charging rate. All facilities in the Valley produce less than 50 tons per day but are still subject to Rule 4302.

C.4.3.4 National Emission Standards for Hazardous Air Pollutants (NESHAPs) and Maximum Achievable Control Technologies (MACTs)

EPA NESHAP and MACT requirements are not applicable to this source category.

C.4.4 How Does District Rule 4302 compare with California State regulations?

There are no state regulations applicable to this source category.

C.4.5 How does District Rule 4302 compare to rules in other air districts?

C.4.5.1 Bay Area AQMD

There are no analogous rules for this source category.

C.4.5.2 Sacramento Metropolitan AQMD

C.4.5.2.1 Rule 408 (Incinerator Burning)

The requirements of Rule 4301 are as stringent as or more stringent than the requirements in Rule 408.

C.4.5.3 South Coast AQMD

C.4.5.3.1 Rule 473 (Disposal of Solid and Liquid Wastes)

The requirements of Rule 4302 are as stringent as or more stringent than the requirements in Rule 473.

C.4.5.4 Ventura County APCD

C.4.5.4.1 Rule 57 (Incinerators)

The requirements of Rule 4302 are more stringent than the requirements in Rule 57.

C.4.6 Potential Emission Reduction Opportunities

No additional emission reduction opportunities have been identified at this time.

C.4.7 Evaluation Findings

Rule 4302 currently has in place the most stringent measures feasible to implement in the Valley and therefore meets or exceeds federal RACT requirements for this source category. As the District continues to develop future attainment plans to address increasingly stringent federal air quality standards, this source category will be re-evaluated for additional potential opportunities to reduce emissions.

C.5 RULE 4306 AND RULE 4320 ADVANCED EMISSION REDUCTION OPTIONS FOR BOILERS, STEAM GENERATORS, AND PROCESS HEATERS GREATER THAN 5.0 MMBTU/HR

C.5.1 *Emissions Inventory (Summer Average – Tons per day)*

	2012	2015	2018	2021	2024	2027	2029	2030	2031
NOx	1.91	1.55	1.42	1.28	1.15	1.04	0.98	0.95	0.91
VOC	0.68	0.65	0.61	0.58	0.55	0.53	0.51	0.51	0.5

C.5.2 District Rule 4306/4320 Description

Rules 4306 and 4320 apply to any gaseous fuel or liquid fuel fired boiler, steam generator, or process heater with a total rated heat input greater than 5 million British thermal units per hour (MMBtu/hr). The purpose of these rules is to limit NOx and carbon monoxide (CO) emissions from boilers, steam generators, and process heaters of this size range.

Rule 4320 is the third generation rule for this source category. The first District rule for this source category, Rule 4305 (Boilers, Steam Generators, and Process Heaters), was adopted on December 16, 1993. Rule 4305 was superseded by Rule 4306 (Boilers, Steam Generators, and Process Heaters – Phase 3) on September 18, 2003 to implement a NOx control measure from the District's ozone and PM10 attainment plans, lowering the NOx emissions limits in Rule 4305. Since adoption, Rule 4306 has been amended twice.

The amendment of Rule 4306 in October 2008 was initially proposed to lower the NOx emission limit from 9 ppmv to 6 ppmv for units greater than 20 MMBtu/hr. It was determined that the proposed NOx limits could be accomplished by using selective catalytic reduction (SCR) or a combination of SCR and ultra-low NOx burners (ULNBs), thus making the lower limits technologically feasible. However, through the public workshop process and additional research it was also determined that most of the units subject to Rule 4306 have undergone several generations of NOx controls, and consequently, certain applications of SCR may not be cost effective and/or technological infeasible because of physical limitations. Therefore, the lower NOx limits were included in new Rule 4320 and an option was provided in the rule that allows for the payment of an annual emissions fee based on total actual emissions, rather than installation of additional NOx controls. These fees are used by the District to achieve cost effective NOx reductions through District incentive programs, the District's Technology Advancement Program, and other routes. The previous versions of Rule 4305 and 4306 combined with the implementation of Rule 4320 achieve approximately 96% control of NOx emissions from this source category.

The implementation of Rule 4320 does not substitute the requirements of Rule 4306, but enforces requirements supplementary to Rule 4306. As such, this evaluation is applicable to both Rule 4306 and Rule 4320.

Facilities with units subject to this rule represent a wide range of industries, including but not limited to electrical utilities, cogeneration, oil and gas production, petroleum refining, manufacturing and industrial processes, food and agricultural processing, and service and commercial facilities.

To recognize the operational and technical differences between different types of equipment subject to Rules 4306 and 4320, the different equipment types were separated into several major categories, with different requirements, including the following:

- Units with a total rated heat input greater than 5.0 MMBtu/hr to 20.0 MMBtu/hr
- Units with a total rated heat input greater than 20.0 MMBtu/hr
- Oilfield steam generators of all ratings and fuel types
- Refinery units of all ratings and fuel types
- Low-use units limited by a Permit to Operate to an annual heat input greater than 1.8 billion Btu/year but less than or equal to 30 billion Btu/year
- Units at a wastewater treatment facility using less than 50% PUC quality fuel
- Small specialty units operated by a small producer

C.5.3 How does District Rule 4306/4320 compare with federal rules and regulations?

C.5.3.1 EPA – Control Technique Guidelines (CTG)

EPA CTG requirements are not applicable to this source category.

C.5.3.2 EPA – Alternative Control Techniques (ACT) Document

C.5.3.2.1 ACT - EPA-453/R-93-034 (Alternative Control Techniques Document – NOx emissions from Process Heaters)

The requirements of Rules 4306/4320 are as stringent as or more stringent than the requirements in the ACT.

C.5.3.2.2 ACT - EPA-453/R-93-022 (Alternative Control Techniques Document – NOx Emissions from Industrial/Commercial/Institutional Boilers)

The requirements of Rules 4306/4320 are as stringent as or more stringent than the requirements in the ACT.

C.5.3.2.3 ACT - EPA-453/R-93-023 (Alternative Control Techniques Document – NOx Emissions from Utility Boilers)

The requirements of Rules 4306/4320 are as stringent as or more stringent than the requirements in the ACT.

C.5.3.3 Standards of Performance for New Stationary Sources (NSPS)

C.5.3.3.1 NSPS - 40 CFR 60 Subpart D (Standards of Performance for Fossil-Fuel Fired Steam Generators for Which Construction Is Commenced After August 17, 1971)

The requirements of Rules 4306/4320 are as stringent as or more stringent than the requirements in the NSPS.

C.5.3.3.2 NSPS - 40 CFR 60 Subpart Db (Standards of Performance for Industrial- Commercial-Institutional Steam Generating Units)

The requirements of Rules 4306/4320 are as stringent as or more stringent than the requirements in the NSPS.

C.5.3.3.3 NSPS - 40 CFR 60 Subpart Dc (Standards of Performance for Small Industrial- Commercial-Institutional Steam Generating Units)

The requirements of Rules 4306/4320 are as stringent as or more stringent than the requirements in the NSPS.

C.5.3.4 National Emission Standards for Hazardous Air Pollutants (NESHAPs) and Maximum Achievable Control Technologies (MACTs)

C.5.3.4.1 NESHAP/MACT - 40 CFR 63 Subpart DDDDD (NESHAP for Major Sources: Industrial, Commercial, and Institutional Boilers and Process Heaters)

The requirements of Rules 4306/4320 are as stringent as or more stringent than the requirements in the NESHAP.

C.5.4 How Does District Rule 4306/4320 compare with California State regulations?

There are no state regulations applicable to this source category.

C.5.5 How does District Rule 4306/4320 compare to rules in other air districts?

C.5.5.1 Bay Area AQMD

C.5.5.1.1 Regulation 9 Rule 7 (Nitrogen Oxides and Carbon Monoxide from Industrial, Institutional and Commercial Boilers, Steam Generators and Process Heaters)

The requirements in Rules 4306/4320 are as stringent as or more stringent than those in Rule 9-7.

C.5.5.1.2 Regulation 9 Rule 10 (Nitrogen Oxides and Carbon Monoxide from Boilers, Steam Generators and Process Heaters in Petroleum Refineries)

The requirements in Rules 4306/4320 are as stringent as or more stringent than those in Rule 9-10.

C.5.5.2 Sacramento Metropolitan AQMD

C.5.5.2.1 Rule 411 (NOx from Boilers, Process Heaters and Steam Generators)

The requirements in Rules 4306/4320 are as stringent as or more stringent than those in Rule 411.

C.5.5.3 South Coast AQMD

C.5.5.3.1 Rule 1146 (Emissions of Nitrogen from Industrial, Institutional, and Commercial Boilers, Steam Generators, and Process Heaters)

The requirements in Rules 4306/4320 are as stringent as or more stringent than those in Rule 1146.

C.5.5.4 Ventura County APCD

C.5.5.4.1 Rule 74.15 (Boilers, Steam Generators and Process Heaters)

The requirements in Rules 4306/4320 are as stringent as or more stringent than those in Rule 74.15.

C.5.6 Potential Emission Reduction Opportunities

In its *2015 PM2.5 Plan,* the District evaluated this source category to determine if there are any feasible emission reduction opportunities. This extensive evaluation included the evaluation of potential emission reduction opportunities such as low temperature oxidation; EMx; PM2.5 limits for alternative fuels; and PM potential emissions reductions from ESP and Scrubber technologies. The District evaluation determined that Rule

4306/4320 has the most stringent measures feasible to implement in the Valley.[16] The District re-evaluated the aforementioned options and has determined that no additional feasible opportunities have been developed in the last 12 months since the adoption of the *2015 PM2.5 Plan.* Therefore, there are no additional emission reduction opportunities at this time.

C.5.7 Evaluation Findings

Rules 4306 and 4320 currently have in place the most stringent measures feasible to implement in the Valley and therefore meet or exceed federal RACT requirements for this source category. As the District continues to develop future attainment plans to address increasingly stringent federal air quality standards, this source category will be re-evaluated for additional potential opportunities to reduce emissions.

[16] SJVUAPCD. 2015 Plan for the 1997 PM2.5 Standard. Appendix C Best Available Control Measures and Most Stringent Measures (2015, April 16). Retrieved from http://www.valleyair.org/Air_Quality_Plans/PM25Plans2015.htm

C.6 RULE 4307 BOILERS, STEAM GENERATORS AND PROCESS HEATERS–2.0 MMBTU/HR TO 5.0 MMBTU/HR

C.6.1 *Emissions Inventory (Summer Average – Tons per day)*

	2012	2015	2018	2021	2024	2027	2029	2030	2031
NOx	0.49	0.40	0.36	0.33	0.29	0.26	0.25	0.24	0.23
VOC	0.17	0.16	0.15	0.15	0.14	0.13	0.13	0.13	0.13

C.6.2 District Rule 4307 Description

This rule applies to any gaseous fuel or liquid fuel fired boiler, steam generator, or process heater with a total rated heat input of 2.0 million British thermal units per hour (MMBtu/hr) up to and including 5.0 MMBtu/hr. The purpose of this rule is to limit emissions of NOx, carbon monoxide (CO), sulfur dioxide (SO2), and particulates from units subject to this rule.

Rule 4307 was adopted on December 15, 2005 to establish emissions limits and control requirements for these units which were previously exempt because of their smaller size. Since its adoption, the rule has been amended three times. The October 2008 amendments strengthened the rule by removing some exemptions, imposing NOx limits of 9 or 12 ppmv for new and replacement units, and adding a menu-approach for particulate matter control that also encompasses SOx controls. The rule was amended again in 2011 to specifically incorporate tree nut pasteurizers as a separate type of unit. EPA published a direct final approval of the 2011 amendments to Rule 4307 on February 12, 2015 and deemed this rule as being at least as stringent as established RACT requirements. NOx emissions have been controlled by over 84% for units in this source category.

Based on District permits information, there are currently 540 permitted and Permit-Exempt Equipment Registration (PEER) units subject to Rule 4307 requirements. Facilities with units subject to this rule represent a wide range of industries, including but not limited to, medical facilities, educational institutions, office buildings, prisons, military facilities, hotels, and industrial facilities.

C.6.3 How does District Rule 4307 compare with federal rules and regulations?

C.6.3.1 EPA – Control Technique Guidelines (CTG)

EPA CTG requirements are not applicable to this source category.

C.6.3.2 EPA – Alternative Control Techniques (ACT) Document

C.6.3.2.1 ACT - EPA–453/R-93-034 (Alternative Control Techniques Document–NOx Emissions from Process Heaters)

The requirements of Rule 4307 are as stringent as or more stringent than the requirements in the ACT.

C.6.3.2.2 ACT - EPA–453/R-94-022 (Alternative Control Techniques Document–NOx Emissions from Industrial/Commercial/Institutional Boilers)

The requirements of Rule 4307 are as stringent as or more stringent than the requirements in the ACT.

C.6.3.2.3 ACT - EPA–453/R-94-023 (Alternative Control Techniques Document–NOx Emissions from Utility Boilers)

The requirements of Rule 4307 are as stringent as or more stringent than the requirements in the ACT.

C.6.3.3 Standards of Performance for New Stationary Sources (NSPS)

EPA NSPS requirements are not applicable to this source category.

C.6.3.4 National Emission Standards for Hazardous Air Pollutants (NESHAPs) and Maximum Achievable Control Technologies (MACTs)

C.6.3.4.1 NESHAP/MACT - 40 CFR 63 Subpart DDDDD (NESHAP for Major Sources: Industrial, Commercial, and Institutional Boilers and Process Heaters)

The requirements of Rule 4307 are as stringent as or more stringent than the requirements in the NESHAP.

C.6.4 How Does District Rule 4307 compare with California State regulations?

There are no state regulations applicable to this source category.

C.6.5 How does District Rule 4307 compare to rules in other air districts?

C.6.5.1 Bay Area AQMD

C.6.5.1.1 Regulation 9 Rule 7 (Nitrogen Oxides and Carbon Monoxide from Industrial, Institutional, and Commercial Boilers, Steam Generators, and Process Heaters)

The requirements in Rule 4307 are as stringent as or more stringent than those in Rule 9-7.

C.6.5.1.2 Regulation 9 Rule 10 (Nitrogen Oxides and Carbon Monoxide from Boilers, Steam Generators and Process Heaters in Petroleum Refineries)

The requirements in Rule 4307 are as stringent as or more stringent than those in Rule 9-10.

C.6.5.2 Sacramento Metropolitan AQMD

C.6.5.2.1 Rule 411 (NOx from Boilers, Process Heaters and Steam Generators)

The requirements in Rule 4307 are as stringent as or more stringent than those in Rule 411.

C.6.5.3 South Coast AQMD

C.6.5.3.1 Rule 1146.1 (Emissions of Oxides of Nitrogen from Small Industrial, Institutional, and Commercial Boilers, Steam Generators, and Process Heaters)

The requirements in Rule 4307 are as stringent as or more stringent than those in Rule 1146.1.

C.6.5.4 Ventura County APCD

C.6.5.4.1 Rule 74.15.1 (Boilers, Steam Generators, and Process Heaters)

The requirements in Rule 4307 are as stringent as or more stringent than those in Rule 74.15.1.

C.6.6 Potential Emission Reduction Opportunities

In its *2015 PM2.5 Plan,* the District evaluated this source category to determine if there are any feasible emission reduction opportunities. This extensive evaluation included the evaluation of potential emission reduction opportunities such as EMx; PM2.5 limits for alternative fuels; and potential emissions reductions for an ESP and scrubber. The District evaluation determined that Rule 4307 has the most stringent measures feasible to implement in the Valley.[17] The District re-evaluated the aforementioned options and has determined that no additional feasible opportunities have been developed in the last 12 months since the adoption of the *2015 PM2.5 Plan.* Therefore, there are no additional emission reduction opportunities at this time.

[17] SJVUAPCD. 2015 Plan for the 1997 PM2.5 Standard. Appendix C Best Available Control Measures and Most Stringent Measures (2015, April 16). Retrieved from http://www.valleyair.org/Air_Quality_Plans/PM25Plans2015.htm

C.6.7 *Evaluation Findings*

Rule 4307 currently has in place the most stringent measures feasible to implement in the Valley and therefore meets or exceeds federal RACT requirements for this source category. As the District continues to develop future attainment plans to address increasingly stringent federal air quality standards, this source category will be re-evaluated for additional potential opportunities to reduce emissions.

C.7 RULE 4308 BOILERS, STEAM GENERATORS AND PROCESS HEATERS–0.075 MMBTU/HR TO LESS THAN 2.0 MMBTU/HR

C.7.1 *Emissions Inventory (Summer Average – Tons per day)*

	2012	2015	2018	2021	2024	2027	2029	2030	2031
NOx	0.91	0.74	0.67	0.61	0.55	0.5	0.47	0.45	0.43
VOC	0.32	0.31	0.29	0.28	0.26	0.25	0.24	0.24	0.24

C.7.2 District Rule 4308 Description

This rule applies to any person who supplies, sells, offers for sale, installs, or solicits the installation of any boiler, steam generator, process heater or water heater with a rated heat input capacity greater than or equal to 0.075 MMBtu/hr and less than 2.0 MMBtu/hr. The purpose of this rule is to limit NOx and carbon monoxide (CO) emissions from units within this source category. As a point of sale rule, Rule 4308 achieves emissions reductions as units subject to the rule are replaced over time. This rule has resulted in more than 93% control of emissions from this source category.

Rule 4308 was adopted on October 20, 2005 to establish NOx emissions limits for these units which were previously exempt from District regulations because of their small size. The rule was amended in December 2009 to lower the NOx emissions limits to 20 ppmv for units fired on natural gas, with the exception of instantaneous water heaters and pool heaters greater than or equal to 0.075 MMBtu/hr but less than or equal to 0.4 MMBtu/hr. In 2013, the District determined that a 20 ppmv limit was now technologically feasible and cost effective for instantaneous water heaters 0.075 MMBtu/hr to 0.4 MMBtu/hr; as such, that emission limit was lowered during the November 2013 amendment of Rule 4308. EPA published a direct final approval the 2013 amendments to Rule 4308 on February 12, 2015.

Units subject to Rule 4308 are used in settings including, but not limited to, apartment buildings, large homes, small businesses, commercial buildings, manufacturing facilities, government facilities, restaurants, hotels, hospitals, educational institutions, and religious organizations. Affected persons include water heater manufacturers, plumbing wholesalers, supply stores, plumbers, contractors, and end-users. This point-of-sale approach allows the District to achieve NOx emission reductions without forcing immediate replacement of existing units to comply with rule requirements and thus placing an undo financial burden on the consumer.

C.7.3 How does District Rule 4308 compare with federal rules and regulations?

C.7.3.1 EPA – Control Technique Guidelines (CTG)

EPA CTG requirements are not applicable to this source category.

C.7.3.2 EPA – Alternative Control Techniques (ACT) Document

C.7.3.2.1 ACT - EPA–453/R-93-034 (Alternative Control Techniques Document—NOx Emissions from Process Heaters)

The requirements of Rule 4308 are as stringent as or more stringent than the requirements in the ACT.

C.7.3.2.2 ACT - EPA–453/R-94-022 (Alternative Control Techniques Document—NOx Emissions from Industrial/Commercial/ Institutional Boilers)

The requirements of Rule 4308 are as stringent as or more stringent than the requirements in the ACT.

C.7.3.2.3 ACT - EPA–453/R-94-023 (Alternative Control Techniques Document—NOx Emissions from Utility Boilers)

The requirements of Rule 4308 are as stringent as or more stringent than the requirements in the ACT.

C.7.3.3 Standards of Performance for New Stationary Sources (NSPS)

EPA NSPS requirements are not applicable to this source category.

C.7.3.4 National Emission Standards for Hazardous Air Pollutants (NESHAPs) and Maximum Achievable Control Technologies (MACTs)

EPA NESHAP and MACT requirements are not applicable to this source category.

C.7.4 How Does District Rule 4308 compare with California State regulations?

There are no state regulations that apply to this source category.

C.7.5 How does District Rule 4308 compare to rules in other air districts?

C.7.5.1 Bay Area AQMD

C.7.5.1.1 Regulation 9 Rule 6 (Nitrogen Oxides Emissions from Natural Gas-Fired Boilers and Water Heaters)

The requirements in Rule 4308 are as stringent as or more stringent than those in Rule 9-6.

C.7.5.1.2 Regulation 9 Rule 7 (Nitrogen Oxides and Carbon Monoxide from Industrial, Institutional, and Commercial Boilers, Steam Generators, and Process Heaters)

The requirements in Rule 4308 are as stringent as or more stringent than those in Rule 9-7.

C.7.5.2 Sacramento Metropolitan AQMD

C.7.5.2.1 Rule 411 (NOx from Boilers, Process Heaters and Steam Generators)

The requirements in Rule 4308 are as stringent as or more stringent than those in Rule 411.

C.7.5.2.2 Rule 414 (Water Heaters, Boilers and Process Heaters Rated Less Than 1,000,000 Btu per Hour)

The requirements in Rule 4308 are as stringent as or more stringent than those in Rule 414.

C.7.5.3 South Coast AQMD

C.7.5.3.1 Rule 1146.2 (Emissions of Oxides of Nitrogen From Large Water Heaters and Small Boilers and Process Heaters)

The requirements in Rule 4308 are as stringent as or more stringent than those in Rule 1146.2.

C.7.5.4 Ventura County APCD

C.7.5.4.1 Rule 74.11.1 (Large Water Heaters and Small Boilers)

The requirements in Rule 4308 are as stringent as or more stringent than those in Rule 74.11.1.

C.7.5.4.2 Rule 74.15.1 (Boilers, Steam Generators, and Process Heaters)

VCAPCD Rule 74.15.1 was amended on June 23, 2015 to implement new NOx emission limits for new and replacement units outside of the applicability of this rule. The requirements in Rule 4308 are as stringent as or more stringent than those in Rule 74.15.1.

C.7.5.5 Other Air Quality Control Agencies

C.7.5.5.1 Placer County APCD (PCAPCD) – Rule 247 (Natural Gas-Fired Water Heaters, Small Boilers and Process Heaters)

The requirements in Rule 4308 are as stringent as or more stringent than those in Rule 247.

C.7.6 Potential Emission Reduction Opportunities

In its *2015 PM2.5 Plan,* the District evaluated this source category to determine if there are any feasible emission reduction opportunities. This extensive effort included an evaluation of the rule exemptions for units in mobile homes and in recreational vehicles. The District evaluation determined that Rule 4308 has the most stringent measures feasible to implement in the Valley. [18] The District re-evaluated the aforementioned options and has determined that no additional feasible opportunities have been developed in the last 12 months since the adoption of the *2015 PM2.5 Plan.* Therefore, there are no additional emission reduction opportunities at this time.

C.7.7 Evaluation Findings

Rule 4308 currently has in place the most stringent measures feasible to implement in the Valley and therefore meets or exceeds federal RACT requirements for this source category. As the District continues to develop future attainment plans to address increasingly stringent federal air quality standards, this source category will be re-evaluated for additional potential opportunities to reduce emissions.

[18] SJVUAPCD. 2015 Plan for the 1997 PM2.5 Standard. Appendix C Best Available Control Measures and Most Stringent Measures (2015, April 16). Retrieved from http://www.valleyair.org/Air_Quality_Plans/PM25Plans2015.htm

C.8 RULE 4309 DRYERS, DEHYDRATORS, AND OVENS

C.8.1.1.1 *Emissions Inventory (Summer Average – Tons per day)*

	2012	2015	2018	2021	2024	2027	2029	2030	2031
NOx	0.22	0.24	0.26	0.28	0.29	0.31	0.32	0.33	0.34
VOC	0.20	0.21	0.23	0.25	0.26	0.27	0.28	0.29	0.29

C.8.2 District Rule 4309 Description

Rule 4309 is applicable to any dryer, dehydrator, or oven that is fired on gaseous fuel, liquid fuel, or is fired on gaseous and liquid fuel sequentially, and the total rated heat input for the unit is 5.0 million British thermal units per hour (5.0 MMBtu/hr) or greater. The purpose of this rule is to limit NOx and carbon monoxide (CO) emissions from these units, which result from the combustion of fuel in the burners. The rule enforces NOx emission limits between 3.5-12 ppmv for four categories of equipment, achieving approximately 34% control of total NOx emissions.

Rule 4309 was adopted on December 15, 2005 and has not been amended. EPA finalized approval of Rule 4309 on May 30, 2007 and deemed this rule as being at least as stringent as established RACT requirements.

Dryers, dehydrators, and ovens are utilized in a broad range of industries. Analyses performed for the rule adoption separated the unit types into four broad industry groups: dehydrators; asphalt/concrete; milk, cheese, and other dairy processing; and other. Dryers, dehydrators, and ovens currently operate either seasonally or year-round depending on the industry and the unit's purpose within the process. There are 126 units subject to this rule, ranging in size from 5.0 MMBtu/hr to 200 MMBtu/hr.

C.8.3 How does District Rule 4309 compare with federal rules and regulations?

C.8.3.1 EPA – Control Technique Guidelines (CTG)

EPA CTG requirements are not applicable to this source category.

C.8.3.2 EPA – Alternative Control Technology (ACT)

C.8.3.2.1 ACT - EPA – 453/R-94-004 (Alternative Control Techniques Document–NOx Emissions from Cement Manufacturing)

The requirements of Rule 4309 are as stringent as or more stringent than the requirements in the ACT.

C.8.3.3 Standards of Performance for New Stationary Sources (NSPS)

EPA NSPS requirements are not applicable to this source category.

C.8.3.4 National Emission Standards for Hazardous Air Pollutants (NESHAPs) and Maximum Achievable Control Technologies (MACTs)

EPA NESHAP and MACT requirements are not applicable to this source category.

C.8.4 How does District Rule 4309 compare with California State regulations?

There are no state regulations applicable to this source category.

C.8.5 How does District Rule 4309 compare to regulations from other air districts?

C.8.5.1 Bay Area AQMD

There are no analogous rules for this source category.

C.8.5.2 Sacramento Metro AQMD

There are no analogous rules for this source category.

C.8.5.3 South Coast AQMD

C.8.5.3.1 Rule 1147 (NOx Reductions from Miscellaneous Sources)

The requirements of Rule 4309 are as stringent as or more stringent than the requirements in Rule 1147.

C.8.5.4 Ventura County APCD

There are no analogous rules for this source category.

C.8.6 Potential Emission Reduction Opportunities

In its *2015 PM2.5 Plan,* the District evaluated this source category to determine if there are any feasible emission reduction opportunities. This extensive effort included an evaluation of asphalt plants; dehydrators; and dryers. The District evaluation determined that Rule 4309 has the most stringent measures feasible to implement in the Valley. [19] The District re-evaluated the aforementioned options and has determined that no additional feasible opportunities have been developed in the last 12 months since the adoption of the *2015 PM2.5 Plan.* Therefore, there are no additional emission reduction opportunities at this time.

[19] SJVUAPCD. 2015 Plan for the 1997 PM2.5 Standard. Appendix C Best Available Control Measures and Most Stringent Measures (2015, April 16). Retrieved from http://www.valleyair.org/Air_Quality_Plans/PM25Plans2015.htm

C.8.7 Evaluation Findings

Rule 4309 currently has in place the most stringent measures feasible to implement in the Valley and therefore meets or exceeds federal RACT requirements for this source category. As the District continues to develop future attainment plans to address increasingly stringent federal air quality standards, this source category will be re-evaluated for additional potential opportunities to reduce emissions.

C.9 RULE 4311 FLARES

C.9.1 Emissions Inventory (Summer Average – Tons per day)

	2012	2015	2018	2021	2024	2027	2029	2030	2031
NOx	0.57	0.56	0.55	0.54	0.54	0.53	0.53	0.53	0.52
VOC	1.64	1.54	1.45	1.37	1.29	1.21	1.17	1.14	1.12

C.9.2 District Rule 4311 Description

Rule 4311 was adopted in June 2002 to establish flaring requirements and reduce VOC, NOx, and SOx emissions from operations involving the use of flares, with the exception of a limited list of sources identified in the rule. Amendments were adopted on June 15, 2006 and June 18, 2009. The September 2009 amendment incorporated requirements for flare minimization plans and increased the stringency of existing requirements for sulfur emissions.

Flaring is a high temperature oxidation process used to burn combustible components, primarily hydrocarbons, of waste gases from industrial operations, primarily for the purpose of controlling emissions and as a safety device. The majority of waste gases flared are natural gas, propane, ethylene, propylene, butadiene and butane.

Combustion efficiency depends on flame temperature, residence time in the combustion zone, vent gas flammability, auto ignition temperature, heating value, and turbulent mixing. When operated at an optimal combination of these factors, flares have a destruction efficiency of 98 percent or greater. Complete combustion converts all VOCs to CO_2 and water; however incomplete combustion generates air pollutants such as NOx, sulfur dioxide, carbon monoxide, and particulate matter. Additionally, there is a possibility of release of hydrocarbons if they have not been completely combusted. To prevent the creation of smoke or soot, which is influenced by fuel characteristics and the amount and distribution of oxygen in the combustion zone, most industrial flares are steam-assisted or air-assisted. In some cases, another fuel must be added to flare gas to achieve the minimum heating value of 200-250 Btu/ft^3 required for complete combustion.

There are two general types of flares: open and enclosed flares. Flares are further categorized by the height of the flare tip, and by the method of enhancing combustion by mixing at the flare tip (i.e., steam-assisted, air-assisted, pressure assisted, or non-assisted).

Ground flares, which are not typically found in the Valley, vary in complexity and can consist of either conventional flare burners discharging horizontally with no enclosures or multiple burners in refractory-lined steel enclosures.

Flaring in the San Joaquin Valley

Flares serve two basic functions: as a safety device during unforeseeable and unpreventable emergency situations/standby situations and less commonly as a primary emissions control device for VOC emissions. As safety devices, flares are necessary to prevent catastrophic consequences such as the release of toxic gases and explosions, which could result in loss of property, injury, and loss of human life. In the Valley, the vast majority of flares are employed as emergency/standby control devices, which is in direct contrast with other regions, such as North Dakota, where flares are used for primary disposal of waste gas from oil and natural gas production. Also, while regions like North Dakota utilize flares to combust associated gas during the initial extraction phase of the production process (i.e., directly from the well), Valley flares are typically used further down the process chain, primarily as a safety device associated with gas collection systems, resulting in far lower quantities of flared gas.

Valley operators have generally evaluated all feasible and cost effective options for handling and disposing of the associated/waste gases generated by their facilities and installing a flare as the primary method of disposal would be the last resort. In addition to Rule 4311 requirements to evaluate and implement all feasible measures to reduce flaring activities, other associated rules also implement stringent capture and control of these gases. Therefore, most facilities have made significant investments to capture and utilize these process gases in a variety of methods and this ability has allowed facilities to maximize income generation. Some capture and treat these gases and sell them to natural gas/utility providers (generates monetary income), while others utilize these gases on-site to fuel equipment that generates electricity and/or provides process heating (saves fuel costs). In fact, most Valley facilities regard flaring events as a significant monetary cost, through directly lost profits or increased fuel costs.

In the District's evaluation of Valley flaring activities,[20] nearly all of the flaring events were either one-time events due to new control equipment installation or maintenance of existing equipment, and therefore not repeated, or in response to emergency situations or process upsets. For example, one Valley facility (light oil production facility) experienced abnormally high flaring due to the sales transmission pipeline being offline for repairs. Another facility (wastewater treatment plant) normally uses the fuel onsite to produce electricity and process heating but could not do so because additional air pollution control devices were being installed.

Flares in the Valley subject to the requirements in Rule 4311 are employed by a diverse group of industries for a wide variety of applications, as illustrated by the below list. In contrast, other air districts' flare rules generally limit the applicability of their rules to petroleum production facilities or refineries.

- Gas plants
- Heavy oil production/ thermally enhanced oil recovery

[20] SJVAPCD. (2014). *Rule 4311 (Flares) Further Study*. Retrieved February 3, 2015 from: http://valleyair.org/Air_Quality_Plans/docs/R4311.pdf.

- Light oil production
- Refinery operations
- Wastewater treatment plants
- Cheese production
- Wine
- Dairy operations
- Flat glass production
- Correctional facility

C.9.3 How does District Rule 4311 compare with federal rules and regulations?

C.9.3.1 EPA – Control Technique Guidelines (CTG)

EPA CTG requirements are not applicable to this source category.

C.9.3.2 EPA – Alternative Control Technology (ACT)

EPA ACT requirements are not applicable to this source category.

C.9.3.3 Standards of Performance for New Stationary Sources (NSPS)

C.9.3.3.1 NSPS - 40 CFR 60.18 (General Control Device and Work Practice Requirements)

The requirements of Rule 4311 are as stringent as or more stringent than the requirements in the NSPS.

C.9.3.3.2 NSPS - 40 CFR 65.147 (Flares)

The requirements of Rule 4311 are as stringent as or more stringent than the requirements in the NSPS.

C.9.3.3.3 NSPS - 40 CFR 60 Subpart OOOO (Standards of Performance for Crude Oil and Natural Gas Production, Transmission and Distribution)

The requirements of Rule 4311 are as stringent as or more stringent than the requirements in the NSPS.

C.9.3.3.4 NSPS - 40 CFR 60 Subpart Ja (Standards of Performance for Petroleum Refineries for Which Construction, Reconstruction, or Modification Commenced After May 14, 2007)

The requirements of Rule 4311 are as stringent as or more stringent than the requirements in the NSPS.

C.9.3.4 National Emission Standards for Hazardous Air Pollutants (NESHAPs) and Maximum Achievable Control Technologies (MACTs)

C.9.3.4.1 NESHAP/MACT - 40 CFR 63 Subpart SS (National Emission Standards for Closed Vent Systems, Control Devices, Recovery Devices and Routing to a Fuel Gas System or a Process)

The requirements of Rule 4311 are as stringent as or more stringent than the requirements in the NESHAP.

C.9.4 How does District Rule 4311 compare with California State regulations?

There are no state regulations applicable to this source category.

C.9.5 How does District Rule 4311 compare to regulations from other air districts?

The table below compares major elements of Rule 4311 with the rules in the Bay Area, South Coast, and Ventura County air districts.

C.9.5.1 Bay Area AQMD

C.9.5.1.1 Regulation 12 Rule 11 (Flare Monitoring at Petroleum Refineries)

The requirements in Rule 4311 are as stringent as or more stringent than those in Rule 12-11.

C.9.5.1.2 Regulation 12 Rule 12 (Flares at Petroleum Refineries)

The requirements in Rule 4311 are as stringent as or more stringent than those in Rule 12-12.

C.9.5.2 Sacramento Metro AQMD

There are no analogous rules for this source category.

C.9.5.3 South Coast AQMD

C.9.5.3.1 Rule 1118 (Control of Emissions from Refinery Flares)

The requirements in Rule 4311 are as stringent as or more stringent than those in Rule 1118.

C.9.5.4 Ventura County APCD

C.9.5.4.1 Rule 54 (Sulfur Compounds)

The requirements in Rule 4311 are as stringent as or more stringent than those in Rule 54.

C.9.5.5 Other Air Quality Control Agencies

C.9.5.5.1 Santa Barbara County Air Pollution Control District (SBCAPCD) Rule 359 (Flares and Thermal Oxidizers) [21]

Rule 4311 is as stringent as or more stringent than those in Rule 359, as demonstrated in the extensive analysis presented in the District's *2015 PM2.5 Plan*.[22]

C.9.5.5.2 State of North Dakota Century Code 38-08-06.4[23] - Industrial Commission Order[24]

Rule 4311 is as stringent as or more stringent than those in the South Dakota Rule, as demonstrated in the extensive analysis presented in the District's *2015 PM2.5 Plan*.[25]

Potential Emission Reduction Opportunities

Flaring activities in the Valley emit 0.57 tpd of NOx emissions, representing 0.17% of the summer average NOx emissions in the Valley. Despite this relatively small amount of emissions, in keeping with its leave no stone unturned approach; the District has invested significant resources into evaluating potential emissions reductions opportunities from flares. In fact, after determining that the rule implements the most stringent measures feasible to implement in the Valley, in its *2015 PM2.5 Plan,* the District committed to perform another flare further study to continue to seek out additional emission reduction opportunities. The further study reports are available on the District's website at http://www.valleyair.org/Air_Quality_Plans/PM_Plans.htm.

C.9.6 Evaluation Findings

As demonstrated above, District Rule 4311 meets RACT requirements, and has also been demonstrated as implementing Most Stringent Measures.[26] As a commitment included in the District's *2015 Plan for the 1997 PM2.5 Standard* (*2015 PM2.5 Plan*), District staff conducted a further study to review additional emission reduction opportunities under Rule 4311 and reached the following findings:

1. Even though operators of flares in the Valley have already taken extensive measures to reduce flaring through Rule 4311, additional minimization practices

[21] Santa Barbara County Air Pollution Control District. (1994, June 28). *Rule 359 Flares and Thermal Oxidizers. Retrieved February 13, 2015 from http://www.ourair.org/wp-content/uploads/rule359.pdf.*
[22] SJVUAPCD. *2015 Plan for the 1997 PM2.5 Standard*. Appendix C Best Available Control Measures and Most Stringent Measures (2015, April 16). Retrieved from http://www.valleyair.org/Air_Quality_Plans/PM25Plans2015.htm
[23] North Dakota Legislative Branch. (2013, August). *Century Code 38-08-06.4 Flaring of Gas Restricted – Imposition of Tax – Payment of Royalties – Industrial Commission Authority. Retrieved February 13, 2015 from* http://www.legis.nd.gov/cencode/t38c08.pdf?20150213153521.
[24] North Dakota Industrial Commission. (2014, July 1). *Order of the Commission*. Obtained February 3, 2015 from https://www.dmr.nd.gov/oilgas/or24665.pdf.
[25] SJVUAPCD. *2015 Plan for the 1997 PM2.5 Standard*. Appendix C Best Available Control Measures and Most Stringent Measures (2015, April 16). Retrieved from http://www.valleyair.org/Air_Quality_Plans/PM25Plans2015.htm
[26] SJVUAPCD. *2015 Plan for the 1997 PM2.5 Standard*. Appendix C Best Available Control Measures and Most Stringent Measures (2015, April 16). Retrieved from http://www.valleyair.org/Air_Quality_Plans/PM25Plans2015.htm

currently performed at some facilities may have the potential to be utilized at other facilities to further reduce flaring activities and emissions.

2. Ultra-low NOx technologies with the potential to further reduce emissions from flaring have recently become available and should be potentially required through future rule amendments where technologically achievable and economically feasible.

Given the enormity of reductions needed to develop plans that demonstrate attainment with the latest federal ozone and PM2.5 standards and based on findings from the recent flare further study, the District commits to working closely with affected operators to undergo a regulatory amendment process for Rule 4311 as follows:

1. District commits to amend Rule 4311 to include additional ultra-low NOx flare emission limitations for existing and new flaring activities at Valley facilities to the extent that such controls are technologically achievable and economically feasible, by December 31, 2017.

2. District commits to amend Rule 4311 to include additional flare minimization requirements to the extent that such controls are technologically achievable and economically feasible, by December 31, 2017.

C.10 RULE 4313 LIME KILNS

C.10.1 Emissions Inventory (Summer Average – Tons per day)

	2012	2015	2018	2021	2024	2027	2029	2030	2031
NOx	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
VOC	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

The emissions inventory for the lime kiln source category is 0.00 tons per day because there are no lime kilns in operation in the Valley

C.10.2 District Rule 4313 Description

Rule 4313 was adopted in 2003 to limit NOx emissions from the operation of lime kilns. Lime kilns can be used in a variety of manufacturing and processing operations, including food and agriculture. EPA approved District Rule 4313 on September 4, 2003 and deemed this rule as being at least as stringent as established RACT requirements. There are currently no lime kilns operating in the Valley. At the time of rule adoption, there were a total of three lime kilns in operation in the Valley. These lime kilns were operated at two sugar processing plants; however, these plants have been non-operational since 2008. If any lime kilns were to begin operation in the Valley in the future it would be required to meet District BACT requirements, per District Rule 2201 (New and Modified Stationary Source Review Rule). There are no lime kilns currently going through the District's permitting process to become operational in the Valley, nor are any lime kilns expected to be operated in the Valley in the future.

C.10.3 How does District Rule 4313 compare with federal rules and regulations?

C.10.3.1 EPA – Control Technique Guidelines (CTG)

EPA CTG requirements are not applicable to this source category.

C.10.3.2 EPA – Alternative Control Technology (ACT)

EPA ACT requirements are not applicable to this source category.

C.10.3.3 Standards of Performance for New Stationary Sources (NSPS)

C.10.3.3.1 NSPS - 40 CFR 60 Subpart HH (Standards of Performance for Lime Manufacturing Plants)

The provisions of this subpart are applicable to each rotary lime kiln used in the manufacturing of lime. However, this subpart only has requirements for the particulate matter (PM) emissions from the rotary lime kilns. The purpose of this analysis is to

evaluate this source for NOx and VOC emission reduction opportunities, and is not applicable to this evaluation.

C.10.3.4 National Emission Standards for Hazardous Air Pollutants (NESHAPs) and Maximum Achievable Control Technologies (MACTs)

C.10.3.4.1 NESHAP - 40 CFR 63 Subpart AAAAA (National Emission Standards for Hazardous Air Pollutants for Lime Manufacturing Plants)

The provisions of this NESHAP are applicable to each rotary lime kiln used in the manufacturing of lime. However, this NESHAP only has requirements for the PM emissions from the rotary lime kilns. The purpose of this analysis is to evaluate NOx and VOC emission reduction opportunities.

C.10.4 How does District Rule 4313 compare with California State regulations?

There are no state regulations applicable to this source category.

C.10.5 How does District Rule 4313 compare to regulations from other air districts?

C.10.5.1 Bay Area AQMD

Bay Area AQMD has no analogous rules for this source category.

C.10.5.2 Sacramento Metro AQMD

Sacramento Metro AQMD has no analogous rules for this source category.

C.10.5.3 South Coast AQMD

South Coast AQMD has no analogous rules for this source category.

C.10.5.4 Ventura County APCD

Ventura County APCD has no analogous rules for this source category.

C.10.6 Potential Emission Reduction Opportunities

There are no emission reduction opportunities from lime kilns in the Valley.

C.10.7 Evaluation Findings

There are no lime kilns in operation in the Valley, nor are any expected to be operated in the Valley in the future. However, if any lime kilns were to begin operating in the Valley, it would be required to meet District BACT requirements, which by definition are beyond RACT. As such, Rule 4313 meets or exceeds federal RACT requirements for this source category.

C.11 RULE 4352 SOLID FUEL FIRED BOILERS, STEAM GENERATORS, AND PROCESS HEATERS

C.11.1 Emissions Inventory (Summer Average – Tons per day)

	2012	2015	2018	2021	2024	2027	2029	2030	2031
NOx	2.97	3.27	3.59	3.78	3.95	4.12	4.24	4.27	4.32
VOC	0.08	0.09	0.11	0.12	0.12	0.13	0.13	0.13	0.13

C.11.2 District Rule 4352 Description

The purpose of Rule 4352 is to limit NOx and carbon monoxide (CO) emissions from any boiler, steam generator or process heater fired on solid fuel. Prior to September 14, 1994 solid fuel fired units were exempt from the requirements of District Rule 4305. The adoption of Rule 4352 established NOx limits of 200 parts per million by volume (ppmv) for municipal solid waste facilities (MSW), 0.35 pounds per million British thermal units per hour (lb/MMBtu) for biomass facilities, and 0.20 lb/MMBtu for all other solid fuel fired units. Since its adoption, the rule has been amended three times. The December 2011 amendments strengthened the rule by lowering NOx emissions limits for all three source categories. However, no emissions reductions were quantified because the rule amendments were meant to satisfy EPA RACT requirements and all units were determined to be operating at the new emission limits. EPA finalized approval of Rule 4352 on November 6, 2012 and deemed this rule as being at least as stringent as established RACT requirements.

While previous rule-amending projects for Rule 4352 have not quantified specific emissions reductions, the use of biomass facilities in the Valley has fostered emissions reductions. As an energy source, biomass can either be used directly or converted into other energy products such as biofuel. Biomass facilities in the Valley reduce the amount of pollutants created by open burning practices and the landfilling of potential biofuels such as agricultural materials, and urban and forest wood waste products by utilizing these materials. The District has reduced the total acreage of agricultural materials burned in the Valley to date by more than 80%.

Boilers, steam generators, and process heaters are used in a broad range of industrial, commercial, and institutional settings. Units subject to this rule fire on a variety of solid fuels: coal, petroleum coke, biomass, tire-derived fuel, and MSW. Although the output from units subject to the rule could be utilized in many settings, all of the operators within the Valley use the units' output to generate electricity.

The two primary methods of controlling NOx emissions from boilers, steam generators, and process heaters are either to change the combustion parameters to reduce NOx formation (i.e., combustion modification) or to treat the NOx formed in the process before the NOx is emitted into the atmosphere (i.e., post-combustion control or flue gas treatment).

C.11.3 How does District Rule 4352 compare with federal rules and regulations?

C.11.3.1 EPA – Control Technique Guidelines (CTG)

EPA CTG requirements are not applicable to this source category.

C.11.3.2 EPA – Alternative Control Technology (ACT)

C.11.3.2.1 ACT - EPA–453/R-94-022 (Alternative Control Techniques Document– NOx Emissions from Industrial/Commercial/ Institutional Boilers)

The requirements of Rule 4352 are as stringent as or more stringent than the requirements in the ACT.

C.11.3.2.2 ACT - EPA – 453/R-94-023 (Alternative Control Techniques Document– NOx Emissions from Utility Boilers)

The requirements of Rule 4352 are as stringent as or more stringent than the requirements in the ACT.

C.11.3.3 Standards of Performance for New Stationary Sources (NSPS)

C.11.3.3.1 NSPS - 40 CFR 60 Subpart Cb (Emission Guidelines and Compliance Times for Municipal Waste Combustors that are Constructed on or before December 19, 1995)

The requirements of Rule 4352 are as stringent as or more stringent than the requirements in the NSPS.

C.11.3.3.2 NSPS - 40 CFR 60 Subpart D (Standards of Performance for Fossil-Fuel-Fired Steam Generators for which Construction is Commenced after August 17, 1971)

The requirements of Rule 4352 are as stringent as or more stringent than the requirements in the NSPS.

C.11.3.3.3 NSPS - 40 CFR 60 Subpart Db (Standards of Performance for Industrial-Commercial-Institutional Steam Generating Units)

The requirements of Rule 4352 are as stringent as or more stringent than the requirements in the NSPS.

C.11.3.4 National Emission Standards for Hazardous Air Pollutants (NESHAPs) and Maximum Achievable Control Technologies (MACTs)

C.11.3.4.1 NESHAP - 40 CFR 63 Subpart DDDDD (NESHAP for Major Sources: Industrial, Commercial, and Institutional Boilers and Process Heaters)

40 CFR 63 Subpart DDDDD was amended on January 31, 2013 to include new emission limits for PM, CO, and total selective metals (TSM), replace numeric dioxin emission limits with work practice standards, add new subcategories of facilities, and add alternative monitoring approaches. The District evaluated the requirements contained within this NESHAP. The requirements of Rule 4352 are as stringent as or more stringent than the requirements in the NESHAP.

C.11.4 How does District Rule 4352 compare with California State regulations?

There are no state regulations applicable to this source category.

C.11.5 How does District Rule 4352 compare to regulations from other air districts?

C.11.5.1 Bay Area AQMD

C.11.5.1.1 Regulation 9 Rule 7 (Nitrogen Oxides and Carbon Monoxide from Industrial, Institutional, and Commercial Boilers, Steam Generators, and Process Heaters)

The requirements in Rule 4352 are as stringent as or more stringent than those in Rule 9-7.

C.11.5.1.2 Regulation 9 Rule 11 (Nitrogen Oxides and Carbon Monoxide from Electric Power Generating Steam Boilers)

The requirements in Rule 4352 are as stringent as or more stringent than those in Rule 9-11.

C.11.5.2 Sacramento Metro AQMD

C.11.5.2.1 Rule 411 (NOx from Boilers, Process Heaters, and Steam Generators)

The requirements in Rule 4352 are as stringent as or more stringent than those in Rule 411.

C.11.5.3 South Coast AQMD

C.11.5.3.1 Rule 1146 (Emissions of Oxides of Nitrogen from Industrial, Institutional, and Commercial Boilers, Steam Generators, and Process Heaters)

The requirements in Rule 4352 are as stringent as or more stringent than those in Rule 1146.

C.11.5.4 Ventura County APCD

There are no analogous rules for this source category.

C.11.6 Potential Emission Reduction Opportunities

In its *2015 Plan for the 1997 PM2.5 Standard* (*2015 PM2.5 Plan*) the District evaluated this source category to determine if there are any feasible emission reduction opportunities. This extensive effort included the evaluation of potential emission reduction opportunities such as long term solutions for the biomass industry; the addition of selective catalytic reduction technology; electrostatic precipitators, baghouses, and cyclones; and scrubbers. The District found that Rule 4352 currently has in place the most stringent measures feasible to implement in the Valley.[27] The District re-evaluated the aforementioned options and has determined that no additional feasible opportunities have been developed in the last 12 months since the adoption of the *2015 PM2.5 Plan*. Therefore, there are no additional emission reduction opportunities at this time.

C.11.7 Evaluation Findings

Rule 4352 currently has in place the most stringent measures feasible to implement in the Valley and therefore meets or exceeds federal RACT requirements for this source category. As the District continues to develop future attainment plans to address increasingly stringent federal air quality standards, this source category will be re-evaluated for additional potential opportunities to reduce emissions.

[27] SJVUAPCD. 2015 Plan for the 1997 PM2.5 Standard. Appendix C Best Available Control Measures and Most Stringent Measures (2015, April 16). Retrieved from http://www.valleyair.org/Air_Quality_Plans/PM25Plans2015.htm

C.12 RULE 4354 GLASS MELTING FURNACES

C.12.1 *Emissions Inventory (Summer Average – Tons per day)*

	2012	2015	2018	2021	2024	2027	2029	2030	2031
NOx	6.04	4.08	4.31	4.54	4.69	4.69	4.69	4.69	4.69
VOC	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02

The emissions in this emission inventory table represent the emissions from both this rule and from Rule 4610 (Glass Coating Operations).

C.12.2 District Rule 4354 Description

The provisions of Rule 4354 are applicable to glass melting furnaces in the Valley. The purpose of this rule is to limit NOx, SOx, volatile organic compounds (VOC), carbon monoxide (CO), and PM emissions from glass melting furnaces.

Rule 4354 was adopted on September 14, 1994 and has been subsequently amended six times. Rule 4354 was amended September 16, 2010 to strengthen the NOx emission limits in the rule; EPA finalized approval for these amendments on August 29, 2011. Rule 4354 was subsequently amended again in May 19, 2011 to implement updated start-up requirements; EPA finalized approval of the 2011 amendments to Rule 4354 on January 31, 2013 and deemed this rule as being as stringent as, if not more stringent than, established RACT requirements. As a result of this stringent prohibitory rule and continuing efforts on behalf of this industry to reduce emissions, the Valley is home to glass-making facilities with glass melting furnaces that utilize the most advanced low-NOx firing technology.

Industrial glass making is a continuous process with raw materials supplied to the furnace at the front end, and product taken off the line at the back end of the process. The raw materials for making glass are silica sand and soda ash. Melting these basic materials and forming them into the desired product geometry creates the final glass product. The different end products vary widely in raw material additives, processing equipment and conditions, and product quality requirements. The emission limits of Rule 4354 depend on the type of glass produced, furnace firing technology and the emission-averaging period.

Rule 4354 is among the most stringent rules in the nation for glass melting furnaces. The NOx emission limits contained within Rule 4354 require the installation of the best available NOx technology (i.e. oxy-fuel firing or SCR systems).

C.12.3 How does District Rule 4354 compare with federal rules and regulations?

C.12.3.1 EPA – Control Technique Guidelines (CTG)

EPA CTG requirements are not applicable to this source category.

C.12.3.2 EPA – Alternative Control Technology (ACT)

C.12.3.2.1 ACT - EPA-435/R-94-037 (Alternative Control Techniques Document—NOx Emissions from Glass Manufacturing)

This ACT document outlines the available control techniques for three types of glass melting furnaces – container glass, flat glass and pressed-and-blown glass. The document lists no specific NOx emission limit, although it does suggest estimated percent NOx reduction from uncontrolled levels. In not having a specific NOx limit for any of the subject furnaces, the document does not define RACT for the three types of glass. As such, the requirements of Rule 4354 are as stringent as or more stringent than the requirements in the ACT.

C.12.3.3 Standards of Performance for New Stationary Sources (NSPS)

C.12.3.3.1 NSPS - 40 CFR 60 Subpart CC (Standards of Performance for Glass Manufacturing Plants)

This NSPS targets the control of particulate matter from the specified glass manufacturing processes. As such, it defines applicable RACT for these sources. The requirements of Rule 4354 are as stringent as or more stringent than the requirements in the NSPS.

C.12.3.3.2 NSPS - 40 CFR 60 Subpart PPP (Standards of Performance for Wool Fiberglass Insulation Manufacturing Plants)

This NSPS targets the control of particulate matter from the specified glass manufacturing processes. As such, it does not regulate NOx or VOC for this source category; therefore this NSPS does not define applicable RACT for this source category.

C.12.3.4 National Emission Standards for Hazardous Air Pollutants (NESHAPs) and Maximum Achievable Control Technologies (MACTs)

C.12.3.4.1 NESHAP/ MACT - 40 CFR 61 Subpart N (National Emission Standard for Inorganic Arsenic Emissions from Glass Manufacturing Plants)

40 CFR 61 Subpart N was last amended February 27, 2014; however, this NESHAP only regulates inorganic arsenic emissions and therefore does not apply to this control measure source category evaluation.

C.12.3.4.2 NESHAP/MACT - 40 CFR 63 Subpart NNN (National Emission Standards for Hazardous Air Pollutants for Wool Fiberglass Manufacturing Plants)

The portion of this MACT that applies to glass melting furnaces is specific to particulate matter emission limits and subsequent recordkeeping. As such, it does not regulate

NOx or VOC for this source category; therefore this MACT standard does not define applicable RACT for this source category.

C.12.3.4.3 NESHAP/MACT - 40 CFR 63 Subpart SSSSSS (National Emission Standards for Hazardous Air Pollutants for Glass Manufacturing Area Sources)

The portion of this MACT that applies to glass melting furnaces is specific to particulate matter emission limits and subsequent recordkeeping. As such, it does not regulate NOx or VOC for this source category; therefore this MACT standard does not define applicable RACT for this source category.

C.12.4 How does District Rule 4354 compare with California State regulations?

There are no state regulations specific to glass melting furnaces.

C.12.5 How does District Rule 4354 compare to regulations from other air districts?

C.12.5.1 Bay Area AQMD

C.12.5.1.1 Regulation 9 Rule 12 (Nitrogen Oxide Emissions from Glass Melting Furnaces)

Regulation 9-12 was adopted on January 19, 1994, and never amended, regulates the NOx emissions from glass melting furnaces with the exception of furnaces in which all the heat required for melting is provided by electric current and furnaces with a production capacity of 5 short tons of glass per day or less. The rule has a single NOx emission limit of 5.5 pounds of NOx per ton of glass pulled; however, there are no flat glass melting furnaces within the Bay Area AQMD, meaning the emission limit has not been achieved in practice in the Bay Area AQMD. The requirements in Rule 4354 are as stringent as or more stringent than those in Rule 9-12. EPA approved the District's 2009 RACT SIP on January 10, 2012 and deemed this rule as being at least as stringent as established RACT requirements. EPA reconfirmed this RACT determination when approving the District's 2011 amendments to the rule on January 31, 2013.

C.12.5.2 Sacramento Metro AQMD

There are no analogous rules for this source category.

C.12.5.3 South Coast AQMD

C.12.5.3.1 Rule 1117 (Emissions of Oxides of Nitrogen from Glass Melting Furnaces)

Adopted in 1982 and subsequently amended in 1984, South Coast AQMD Rule 1117 has a single NOx limit of 4.0 pounds per ton glass pulled, however the limit does not apply to tableware glass, flat glass, or fiberglass furnaces – these are specifically exempt under Rule 1117. Meaning Rule 1117 applies only to container glass furnaces. Alternative emission control plans are allowed which let emissions to be averaged over more than one furnace as long as the total emissions are no greater than if each furnace was individually meeting the emission limit. Rule 4354 has lower NOx limits for container glass than South Coast Rule 1117. The District rule also goes beyond the South Coast AQMD rule to limit NOx emissions from flat glass and fiberglass furnaces. Additionally, the alternative emission control plan in District Rule 4354 requires a 10% reduction in total emissions for the averaged group of furnaces over controlling the furnaces individually.

District Rule 4354 is far more stringent than SCAQMD Rule 1117. District Rule 4354 requires a NOx limit of 1.5 lbs per ton of glass produced for container glass plants, while SCAQMD Rule 1117 requires a NOx limit of 4.0 lbs per ton of glass produced. Even though the District limit is at 1.5 lbs per ton of glass produced, the majority of glass plants in the Valley produce emissions much lower than the Rule limit.

It's important to note that the achievable NOx emissions level for glass furnaces is affected by factors other than the emission control device used. These other factors include the stability of the glass pull rate over an extended period of time, and the condition and age of the refractories and furnace insulation. When the operator adjusts the pull rate of the furnace in response to the market need, additional NOx emissions may occur during the transition time while the low-NOx oxy-fuel burners adjust to accommodate the new pull rate. To maintain high temperature levels, glass furnaces require high levels of heat input which is independent from the level of glass pulled each day but is specific to each glass furnace. In addition to this "baseline" heat input, additional energy is necessary to melt glass. This variable heat input required to melt glass fluctuates according to the quantity of glass pulled and is added to the "baseline" heat input. As a result, the total heat input necessary to melt a ton of glass varies according to the overall quantity of glass melted in conjunction with the intersect characteristics of the glass furnace. Consequently, the lb-NOx/ton varies in similar ways and is impacted by the glass pull rate.

The container glass furnaces in operation in the Valley manufacture a large variety of sizes and shapes of still and sparkling wine glass bottles, requiring the operators to utilize their furnaces in a fashion that results in a less stable pull rate in far varying conditions than facilities located in the South Coast which are mainly producing beer bottles. Due to the less stable pull rate, additional NOx emissions are expected during the change in the fire rate of the burners as explained above. Additionally, in response to business demands on the wine industry, Valley facilities must operate furnaces with a

high degree of flexibility and variable operational conditions causing constant changes in the furnace pull rate and variations in NOx emissions.

Finally, as furnaces age, the refractory is not as effective at retaining heat in the furnace. Therefore, under such conditions, the burner fire rate must be increased over time to maintain the same overall furnace and glass temperature and NOx on a lb/ton basis is expected to increase accordingly. The combination of these factors results in a situation where the NOx emission rate varies significantly over production conditions, campaign, and furnace life. Therefore, a simple comparison cannot be made between glass plants and their associated emissions limits and a thorough evaluation assessing all the multiple factors must be taken into consideration.

C.12.5.4 Ventura County APCD

There are no analogous rules for this source category.

C.12.6 Potential Emission Reduction Opportunities

In its *2015 Plan for the 1997 PM2.5 Standard* (*2015 PM2.5 Plan*) the District evaluated this source category to determine if there are any feasible emission reduction opportunities. This extensive effort included the evaluation of SOx limits for container glass plants. The District found that Rule 4354 currently has in place the most stringent measures feasible to implement in the Valley.[28] The District re-evaluated the aforementioned options and has determined that no additional feasible opportunities have been developed in the last 12 months since the adoption of the *2015 PM2.5 Plan.* Therefore, there are no additional emission reduction opportunities at this time.

C.12.7 Evaluation Findings

Rule 4354 currently has in place the most stringent measures feasible to implement in the Valley and therefore meets or exceeds federal RACT requirements for this source category. As the District continues to develop future attainment plans to address increasingly stringent federal air quality standards, this source category will be re-evaluated for additional potential opportunities to reduce emissions.

[28] SJVUAPCD. 2015 Plan for the 1997 PM2.5 Standard. Appendix C Best Available Control Measures and Most Stringent Measures (2015, April 16). Retrieved from http://www.valleyair.org/Air_Quality_Plans/PM25Plans2015.htm

C.13 RULE 4401 STEAM-ENHANCED CRUDE OIL PRODUCTION WELLS

C.13.1 *Emissions Inventory (Summer Average – Tons per day)*

	2012	2015	2018	2021	2024	2027	2029	2030	2031
NOx	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
VOC	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a

Emissions from this category are mapped to other emission source categories.

C.13.2 District Rule 4401 Description

This rule applies to all steam-enhanced crude oil production wells and any associated VOC collection and control systems. The purpose of this rule is to limit VOC emissions from these sources. The primary source of VOC emissions from the wells is the casing vent. The emissions from a casing vent are usually controlled through the operation of a VOC collection and control device.

The rule prohibits the operation of a steam-enhanced crude oil production well, except cyclic wells meeting certain requirements, unless the uncontrolled VOC emissions from any well vent are reduced by at least 99 percent by weight, or, if several steam-enhanced crude oil production well vents are connected to a vapor collection and control system, this rule requires that total uncontrolled VOC emissions be reduced by at least 99 percent.

Fugitive VOC emissions can also occur from oil and gas flowing through the various components (such as valves and flanges) that are part of the piping from the wells to the emission control system. Rule 4401 contains a schedule that specifies the number of allowable component leaks based on the number of wells connected to a vapor collection and control system. Rule 4401 requires an operator, upon detection of a leak, to affix a readily visible tag bearing the date on which the leak is detected. Rule 4401 further requires an operator to repair a leak within fifteen calendar days; failure to repair the leak would constitute a violation of the rule.

EPA finalized approval of the 2011 amendments to Rule 4401 on November 16, 2011 and deemed this rule as being at least as stringent as established RACT requirements.[29] EPA further confirmed this RACT determination when they finalized a partial approval/partial disapproval of the *2009 RACT SIP* on January 10, 2012 and again deemed this rule as being at least as stringent as established RACT requirements.[30]

[29] EPA. Revisions to the California State Implementation Plan, San Joaquin Valley Unified Air Pollution Control District; Final Rule. 76 Fed. Reg. 221, pp. 70886 – 70887. (2011, November 16). (to be codified at 40 CFR Part 52). Retrieved from http://www.gpo.gov/fdsys/pkg/FR-2011-11-16/pdf/2011-29466.pdf

[30] EPA. Partial Approval and Partial Disapproval of Air Quality Implementation Plans; California; San Joaquin Valley; Reasonably Available Control Technology for Ozone; Final Rule. 77 Fed. Reg. 6, pp 1417 – 1427. (2012, January

C.13.3 How does District Rule 4401 compare with federal rules and regulations?

C.13.3.1 EPA – Control Technique Guidelines (CTG)

EPA CTG requirements are not applicable to this source category.

C.13.3.2 EPA – Alternative Control Technology (ACT)

EPA ACT requirements are not applicable to this source category.

C.13.3.3 Standards of Performance for New Stationary Sources (NSPS)

EPA NSPS requirements are not applicable to this source category.

C.13.3.4 National Emission Standards for Hazardous Air Pollutants (NESHAPs) and Maximum Achievable Control Technologies (MACTs)

EPA NESHAP and MACT requirements are not applicable to this source category.

C.13.4 How does District Rule 4401 compare with California State regulations?

There are no state regulations applicable to this source category.

C.13.5 How does District Rule 4401 compare to regulations from other air districts?

C.13.5.1 Bay Area AQMD

There are no analogous rules for this source category.

C.13.5.2 Sacramento Metro AQMD

There are no analogous rules for this source category.

C.13.5.3 South Coast AQMD

C.13.5.3.1 Rule 1148 (Thermally Enhanced Oil Recovery Wells)

South Coast AQMD Rule 1148 (Thermally Enhanced Oil Recovery Wells) was adopted on November 5, 1982 and has not been amended. Rule 1148 requires that ROG emissions from a steam drive well not to exceed 4.5 lb/day or if steamed drive wells are connected to vapor control system ROG emissions from the control system shall average no more than 4.5 lb/day/connected well.

Using CARB emissions factor for uncontrolled steam drive well of 220 lb-VOC/day, Rule

10). (to be codified at 40 CFR Part 52). Retrieved from http://www.gpo.gov/fdsys/pkg/FR-2012-01-10/pdf/2012-139.pdf

4401's 99% control requirement equates to 2.2 lb/day/well, which is more stringent than 4.5 lb/day/well (heavy oil production results in no methane or ethane, meaning 100% of ROGs are considered VOCs).

South Coast AQMD Rule 1148 does not specify any fugitive VOC leak detection and repair provisions whereas Rule 4401 specifies the number of allowable component leaks based on the number of wells connected to a vapor collection and control system. Rule 4401 requires an operator, upon detection of a leak, to affix a readily visible tag bearing the date on which the leak is detected. Rule 4401 further requires an operator to repair a leak within fifteen (15) calendar days; failure to repair the leak would constitute a violation of the rule.

South Coast AQMD Rule 1148 contains a six month exemption for steam drive wells if steam is injected more frequently than 45 days and amount of steam injection expressed as water is more than 2,000 barrels. Rule 4401 provides exemptions for up to 40 cyclic wells owned by a company that are undergoing pilot testing and well stimulation. Rule 4401 also exempts for up to 5 cyclic wells (20 cyclic wells for small producer) if wells are located more than 1000 feet from an existing well control system operated by the company and operation is under District permit. South Coast AQMD Rule 1148 does not limit number of wells that can be exempt and Rule 4401 does not limit duration of exemption. Therefore exemptions in the both rules cannot be compared directly.

Both South Coast AQMD Rule 1148 and Rule 4401 require annual testing of vapor control systems. However District Rule waives this testing requirement if uncondensed vapors are incinerated in fuel burning equipment, internal combustion engine or in a smokeless flare.

C.13.5.4 The requirements in Rule 4401 are as stringent as or more stringent than those in Rule 1148.Ventura County APCD

There are no analogous rules for this source category.

C.13.6 Potential Emission Reduction Opportunities

No additional emission reduction opportunities have been identified at this time.

C.13.7 Evaluation Findings

Rule 4401 currently has in place the most stringent measures feasible to implement in the Valley and therefore meets or exceeds federal RACT requirements for this source category. As the District continues to develop future attainment plans to address increasingly stringent federal air quality standards, this source category will be re-evaluated for additional potential opportunities to reduce emissions.

C.14 RULE 4402 CRUDE OIL PRODUCTION SUMPS

C.14.1 *Emissions Inventory (Summer Average – Tons per day)*

	2012	2015	2018	2021	2024	2027	2029	2030	2031
NOx	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
VOC	2.41	2.25	2.11	1.97	1.85	1.73	1.65	1.62	1.58

C.14.2 District Rule 4402 Description

District Rule 4402 controls VOC emissions from crude oil production sumps located at facilities that produce heavy crude oil. Rule 4402 requires sumps to have a flexible floating cover, rigid floating cover, or fixed roof cover. The flexible floating cover has to be equipped between the sump wall and the cover edge, and the gap between the wall and at every point around the perimeter must not exceed 1 inch. The fixed-roof cover must have a PV and meet certain specific requirements. If sumps are replaced with above-ground fixed roof tanks, the tanks must comply with the provisions of Rule 4623.

This rule applies to all first, second, and third stage sumps at facilities producing, gathering, separating, processing, and/or storing crude oil in an oil field. The purpose of this rule is to limit VOC emissions from these sources. EPA finalized a partial approval/partial disapproval of the *2009 RACT SIP* on January 10, 2012, but EPA specified that Rule 4402 was one of the few rules not approved as RACT as part of the RACT SIP approval.[31] EPA finalized approval of the 2011 amendments to Rule 4402 on October 22, 2012 and deemed this rule as being at least as stringent as established RACT requirements.[32]

C.14.3 How does District Rule 4402 compare with federal rules and regulations?

C.14.3.1 EPA – Control Technique Guidelines (CTG)

EPA CTG requirements are not applicable to this source category.

C.14.3.2 EPA – Alternative Control Technology (ACT)

EPA ACT requirements are not applicable to this source category.

C.14.3.3 Standards of Performance for New Stationary Sources (NSPS)

EPA NSPS requirements are not applicable to this source category.

[31] 77 FR 1417, http://www.gpo.gov/fdsys/pkg/FR-2012-01-10/pdf/2012-139.pdf
[32] 77 FR 64427, http://www.gpo.gov/fdsys/pkg/FR-2012-10-22/pdf/2012-25810.pdf

C.14.3.4 National Emission Standards for Hazardous Air Pollutants (NESHAPs) and Maximum Achievable Control Technologies (MACTs)

EPA NESHAP and MACT requirements are not applicable to this source category.

C.14.4 How does District Rule 4402 compare with California State regulations?

There are no state regulations applicable to this source category.

C.14.5 How does District Rule 4402 compare to regulations from other air districts?

C.14.5.1 Bay Area AQMD

There are no analogous rules for this source category.

C.14.5.2 Sacramento Metro AQMD

There are no analogous rules for this source category.

C.14.5.3 South Coast AQMD

There are no analogous rules for this source category.

C.14.5.4 Ventura County APCD

C.14.5.4.1 Rule 71.4 (Petroleum Sumps, Pits, Ponds and Well Cellars)

The control requirements of Rule 4402 are essentially the same as Rule 71.4. Although VCAPCD Rule 71.4 prohibits the use of first stage sumps, the District believes that other VCAPCD either do not have first stage sumps or such sumps have been replaced with tanks. Although use of first stage sumps is allowed by District Rule 4402, it does not necessarily mean that the rule is less stringent than other air districts' rules, for the following reason. If first stage sumps are replaced with tanks, the tanks would be subject to another rule that control emissions from the storage of organic liquids. District Rule 4623 (Storage of Organic Liquids) applies to tanks that have a capacity of at least 1,100 gallons that store organic liquids with a true vapor pressure (TVP) of 0.5 psia or greater. The tank VOC control requirements are based on the tank size and true vapor pressure (TVP) of the stored organic liquid. Organic liquids with a TVP less than 0.5 psia would not be subject to the VOC control requirements of Rule 4623. Replacing first stage sump with a tank could result in an unintended consequence that the tank would either be totally uncontrolled or less effectively controlled compared to Rule 4402 because the TVP might be lower than the control trigger level specified in Rule 4623.

Based on the District's Permit database, staff has determined that there are only very few permitted small-size first-stage sumps for processing heavy crude oil that were issued to very small producers (less than 150 barrels of oil/day production) and they are not major sources (less than 10 tons per year of VOC or NOx). The source testing

required by Rule 4623, shows the TVP of the heavy crude oil is less than 0.5 psia. As discussed above, prohibiting the use of first stage sumps would essentially force operators to replace the sumps with tanks, which could result in the tanks being exempt from Rule 4623 because the TVP is less than 0.5 psia. Although Rule 4402 allows the use of first stage sumps, the controls are equal to or better than that which would be required for such materials stored in tanks. Furthermore, it is important to mention that the District's 2007 survey of crude oil sumps[4] revealed that there are no active first stage sumps operating in the San Joaquin Valley.

Therefore, the requirements in Rule 4402 are as stringent as or more stringent than those in Rule 71.4.

C.14.5.5 Other Air Quality Control Agencies

Santa Barbara APCD - Rule 344 (Petroleum Sumps, Pits and Well Cellars)
Rule 4402 exempts small producers' second and third stage sumps less than 1,000 square feet surface area used exclusively for heavy crude oil. Another exemption is provided for very small producer second and third stage sumps less than 5,000 square feet used exclusively for heavy crude oil. Small producer is defined in the rule as a producer whose oil production does not exceed 6,000 barrels/day. Very small oil producer is defined in Rule 4402 as a producer whose oil production does not exceed 150 barrels/day, similar to SBCAPCD Rule 344. The requirements in Rule 4402 are as stringent as or more stringent than those in Rule 344.

C.14.6 Potential Emission Reduction Opportunities

No additional emission reduction opportunities have been identified at this time.

C.14.7 Evaluation Findings

Rule 4402 currently has in place the most stringent measures feasible to implement in the Valley and therefore meets or exceeds federal RACT requirements for this source category. As the District continues to develop future attainment plans to address increasingly stringent federal air quality standards, this source category will be re-evaluated for additional potential opportunities to reduce emissions.

C.15 RULE 4404 HEAVY OIL TEST STATION —KERN COUNTY

C.15.1 *Emissions Inventory (Summer Average – Tons per day)*

	2012	2015	2018	2021	2024	2027	2029	2030	2031
NOx	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
VOC	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

The inventory for this source category is 0.00 tpd because there are no Heavy Oil Test Stations (HOTS) in operation in the Valley.

C.15.2 District Rule 4404 Description

This rule applies to the operation of heavy oil test stations with tanks that vent directly to the atmosphere. The purpose of this rule is to limit VOC emissions from the operation of heavy oil test stations. A HOTS is a tank setting comprised of both a family tank and one or more test tanks. A family tank directly receives crude oil production from more than one steam drive well through individual production lines with discharge into the tank. A test tank tests the production rate from a single steam drive well.

Rule 4404 prohibits operation of HOTS unless the VOC emissions are reduced by at least 99%. Except during sampling, gauging, and PV valve vent, any tank roof opening must be equipped with a cover, seal, or lid with no visible gap and maintained in a gas-tight condition.

Requirements of this rule are applicable to HOTS that are atmospheric tanks. A review of the District's permit database and observations of Compliance Division indicate that there are no atmospheric HOTS operating in the Valley. All previous HOTS operations are now employing pressure vessels which do not vent to the atmosphere. These unvented pressure vessels are exempt from District permitting per section 6.13 of District Rule 2020. Therefore, the VOC emissions from this source category are zero.

C.15.3 How does District Rule 4404 compare with federal rules and regulations?

C.15.3.1 EPA – Control Technique Guidelines (CTG)

EPA CTG requirements are not applicable to this source category.

C.15.3.2 EPA – Alternative Control Technology (ACT)

EPA ACT requirements are not applicable to this source category.

C.15.3.3 Standards of Performance for New Stationary Sources (NSPS)

EPA NSPS requirements are not applicable to this source category.

C.15.3.4 National Emission Standards for Hazardous Air Pollutants (NESHAPs) and Maximum Achievable Control Technologies (MACTs)

EPA NESHAP and MACT requirements are not applicable to this source category.

C.15.4 How does District Rule 4404 compare with California State regulations?

There are no state regulations applicable to this source category.

C.15.5 How does District Rule 4404 compare to regulations from other air districts?

C.15.5.1 Bay Area AQMD

Bay Area AQMD has no analogous rules for this source category.

C.15.5.2 Sacramento Metro AQMD

Sacramento Metro AQMD has no analogous rules for this source category.

C.15.5.3 South Coast AQMD

South Coast AQMD has no analogous rules for this source category.

C.15.5.4 Ventura County APCD

Ventura County has no analogous rules for this source category.

C.15.6 Potential Emission Reduction Opportunities

There are no atmospheric HOTS in operation in the Valley. All HOTS operations now employ pressure vessels that do not vent to the atmosphere, and such vessels are exempt from District permitting per section 6.13 of District Rule 2020.

C.15.7 Evaluation Findings

Rule 4404 currently has in place the most stringent measures feasible to implement in the Valley and therefore meets or exceeds federal RACT requirements for this source category.

C.16 RULE 4407 IN-SITU COMBUSTION WELL VENTS

C.16.1 Emissions Inventory (Summer Average – Tons per day)

	2012	2015	2018	2021	2024	2027	2029	2030	2031
NOx	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
VOC	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

The emission inventory for this source category is 0.00 tpd because there are no in-situ combustion well vents operating in the Valley.

C.16.2 District Rule 4407 Description

District Rule 4407 controls VOC emissions from in-situ combustion well vents. The rule applies to all crude oil production wells where production has been enhanced by in-situ combustion. In situ-combustion is defined in the rule as a thermal crude oil recovery process in which air is injected into an oil reservoir and in-place petroleum oxidizes at an accelerated rate. The heat of combustion and combustion products enhance oil production by decreasing oil viscosity and pressurizing the reservoir. In-situ combustion well is any crude oil production well which produces from the same zone in which an air injection well is completed and lies within 1,000 feet from an injection well.

District Rule 4407 prohibits operation of any in-situ combustion well unless the well vent is connected to an emission control device which abates 85% by weight of entering VOC gases or is connected to a fuel burning equipment (furnace, boiler, etc) or a smokeless flare. All components (piping, valves, fittings, pumps, compressors, etc.) should be maintained in good repair and must be inspected for leaks on a quarterly basis. If no more than 2% of all components of the collection system are found to be leaking during each three consecutive quarterly inspections, the inspection frequency may be changed from quarterly to annual. The total number of leaks in a collection system should not exceed 2% of all the components in the collection system. Upon detection of a leak, the operator should affix a visible tag indicating the date of detection of the leak and the tag must remain in place until the leak is repaired. A leaking component must be repaired within 15 days of leak detection, but a ten day extension to repair a leak may be granted provided the operator demonstrates that necessary and sufficient actions have been taken to correct the leak. Failure to repair a leak after the ten day extension constitutes a violation of the rule.

District Rule 4407 requires annual testing of the VOC control efficiency of the control and collection system (testing should be conducted during June, July, August, or September of each year if the system's control efficiency is dependent upon ambient temperature). The APCO may waive the test requirement if all uncondensed VOC emissions are collected by a collection and control system are burned in fuel burning equipment or a smokeless flare.

Currently there are no in-situ combustion crude oil wells operating in the Valley.

C.16.3 How does District Rule 4407 compare with federal rules and regulations?

C.16.3.1 EPA – Control Technique Guidelines (CTG)

EPA CTG requirements are not applicable to this source category.

C.16.3.2 EPA – Alternative Control Technology (ACT)

EPA ACT requirements are not applicable to this source category.

C.16.3.3 Standards of Performance for New Stationary Sources (NSPS)

EPA NSPS requirements are not applicable to this source category.

C.16.3.4 National Emission Standards for Hazardous Air Pollutants (NESHAPs) and Maximum Achievable Control Technologies (MACTs)

EPA NESHAP and MACT requirements are not applicable to this source category.

C.16.4 How does District Rule 4407 compare with California State regulations?

There are no state regulations applicable to this source category.

C.16.5 How does District Rule 4407 compare to regulations from other air districts?

C.16.5.1 Bay Area AQMD

Bay Area AQMD has no analogous rules for this source category.

C.16.5.2 Sacramento Metro AQMD

Sacramento Metro AQMD has no analogous rules for this source category.

C.16.5.3 South Coast AQMD

South Coast AQMD has no analogous rules for this source category.

C.16.5.4 Ventura County APCD

Ventura County APCD has no analogous rules for this source category.

C.16.6 Potential Emission Reduction Opportunities

There are no in-situ combustion well vents operating in the Valley and thus no emission reduction opportunities for this category exist.

C.16.7 Evaluation Findings

There are no in-situ combustion well vents operating in the Valley and thus no emission reduction opportunities for this category exist. Any facility beginning use of such activity would be required to meet District BACT requirements, per District Rules 2201 (New and Modified Stationary Source Review Rule).

Rule 4407 currently has in place the most stringent measures feasible to implement in the Valley and therefore meets or exceeds federal RACT requirements for this source category. As the District continues to develop future attainment plans to address increasingly stringent federal air quality standards, this source category will be re-evaluated for additional potential opportunities to reduce emissions.

C.17 RULE 4408 GLYCOL DEHYDRATION SYSTEMS

C.17.1 Emissions Inventory (Summer Average – Tons per day)

	2012	2015	2018	2021	2024	2027	2029	2030	2031
NOx	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
VOC	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a

The emissions from this rule are accounted for in the discussion for Rule 4409 (Components at Light Crude Oil Production Facilities, Natural Gas Production Facilities, and Natural Gas Processing Facilities).

C.17.2 District Rule 4408 Description

This rule applies to any glycol dehydration system with a glycol dehydration vent that is subject to permitting requirements pursuant to Regulation II (Permits). The purpose of this rule is to limit VOC emissions from these sources.

C.17.3 How does District Rule 4408 compare with federal rules and regulations?

C.17.3.1 EPA – Control Technique Guidelines (CTG)

EPA CTG requirements are not applicable to this source category.

C.17.3.2 EPA – Alternative Control Technology (ACT)

EPA ACT requirements are not applicable to this source category.

C.17.3.3 Standards of Performance for New Stationary Sources (NSPS)

EPA NSPS requirements are not applicable to this source category.

C.17.3.4 National Emission Standards for Hazardous Air Pollutants (NESHAPs) and Maximum Achievable Control Technologies (MACTs)

C.17.3.4.1 NESHAP/MACT - 40 CFR 63 Subpart HH (National Emission Standards for Hazardous Air Pollutants for Oil and Natural Gas Production)

The requirements of Rule 4408 are as stringent as or more stringent than the requirements in the NESHAP, since Rule 4408 requires controls on systems producing much smaller flow rates than the NESHAP threshold.

C.17.4 How does District Rule 4408 compare with California State regulations?

There are no state regulations applicable to this source category.

C.17.5 How does District Rule 4408 compare to regulations from other air districts?

C.17.5.1 Bay Area AQMD

There are no analogous rules for this source category.

C.17.5.2 Sacramento Metro AQMD

There are no analogous rules for this source category.

C.17.5.3 South Coast AQMD

There are no analogous rules for this source category.

C.17.5.4 Ventura County APCD

C.17.5.4.1 Rule 71.5 (Glycol Dehydrators)

The requirements in Rule 4408 are as stringent as or more stringent than those in Rule 71.5.

C.17.6 Potential Emission Reduction Opportunities

No additional emission reduction opportunities have been identified at this time.

C.17.7 Evaluation Findings

Rule 4408 currently has in place the most stringent measures feasible to implement in the Valley and therefore meets or exceeds federal RACT requirements for this source category. As the District continues to develop future attainment plans to address increasingly stringent federal air quality standards, this source category will be re-evaluated for additional potential opportunities to reduce emissions.

C.18 RULE 4409 COMPONENTS AT LIGHT CRUDE OIL PRODUCTION FACILITIES, NATURAL GAS PRODUCTION FACILITIES, AND NATURAL GAS PROCESSING FACILITIES

C.18.1 Emissions Inventory (Summer Average – Tons per day)

	2012	2015	2018	2021	2024	2027	2029	2030	2031
NOx	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
VOC	1.21	1.13	1.06	0.99	0.93	0.87	0.83	0.81	0.79

This emission inventory table is comprised of the emission inventory of sources subject to Rules 4408 (Glycol Dehydration Systems), Rule 4409 (Components at Light Crude Oil Production Facilities, Natural Gas Production Facilities, and Natural Gas Processing Facilities), Rule 4453 (Refinery Vacuum Producing Devices or Systems), and Rule 4454 (Refinery Process Unit Turnaround).

C.18.2 District Rule 4409 Description

This rule applies to components containing or contacting VOC streams at light crude oil production facilities, natural gas production facilities, and natural gas processing facilities. The purpose of this rule is to limit VOC emissions from leaking components at these facilities.

C.18.3 How does District Rule 4409 compare with federal rules and regulations?

C.18.3.1 EPA – Control Technique Guidelines (CTG)

C.18.3.1.1 CTG - EPA-450/3-83-007 (Control of Volatile Organic Compound Equipment Leaks from Natural Gas/Gasoline Processing Plants)

The requirements of Rule 4409 are as stringent as or more stringent than the requirements in the CTG.

C.18.3.2 EPA – Alternative Control Technology (ACT)

EPA ACT requirements are not applicable to this source category.

C.18.3.3 Standards of Performance for New Stationary Sources (NSPS)

C.18.3.3.1 NSPS - 40 CFR 60 Subpart OOOO (Standards of Performance for Crude Oil and Natural Gas Production, Transmission and Distribution)

The requirements of Rule 4409 are as stringent as or more stringent than the requirements in the NSPS.

C.18.3.4 National Emission Standards for Hazardous Air Pollutants (NESHAPs) and Maximum Achievable Control Technologies (MACTs)

C.18.3.4.1 NESHAP/MACT - 40 CFR 63 Subpart HH (National Emission Standards for Hazardous Air Pollutants from Oil and Natural Gas Production Facilities)

The requirements of Rule 4409 are as stringent as or more stringent than the requirements in the NESHAP.

C.18.4 How does District Rule 4409 compare with California State regulations?

There are no state regulations applicable to this source category.

C.18.5 How does District Rule 4409 compare to regulations from other air districts?

C.18.5.1 Bay Area AQMD

C.18.5.1.1 Regulation 8 Rule 18 (Equipment Leaks),

The requirements in Rule 4409 are as stringent as or more stringent than those in Rule 8-18.

C.18.5.1.2 Regulation 8 Rule 22 (Valves and Flanges at Chemical Plants)

The requirements in Rule 4409 are as stringent as or more stringent than those in Rule 8-22.

C.18.5.1.3 Regulation 8 Rule 28 (Episodic Releases From Pressure Relief Devices at Petroleum Refineries and Chemical Plants)

The requirements in Rule 4409 are as stringent as or more stringent than those in Rule 8-28.

C.18.5.2 Sacramento Metro AQMD

There are no analogous rules for this source category.

C.18.5.3 South Coast AQMD

C.18.5.3.1 Rule 1173 (Control of Volatile Organic Compound Leaks and Releases from Components at Petroleum Facilities and Chemical Plants)

The requirements in Rule 4409 are as stringent as or more stringent than those in Rule 1173.

C.18.5.4 Ventura County APCD

C.18.5.4.1 74.7 (Fugitive Emissions of Reactive Organic Compounds at Petroleum Refineries and Chemical Plants), and

The requirements in Rule 4409 are as stringent as or more stringent than those in Rule 74.7.

C.18.5.4.2 Rule 74.10 (Components at Crude Oil and Natural Gas Production and Processing Facilities)

The requirements in Rule 4409 are as stringent as or more stringent than those in Rule 74.10.

C.18.6 Potential Emission Reduction Opportunities

No additional emission reduction opportunities have been identified at this time.

C.18.7 Evaluation Findings

Rule 4409 currently has in place the most stringent measures feasible to implement in the Valley and therefore meets or exceeds federal RACT requirements for this source category. As the District continues to develop future attainment plans to address increasingly stringent federal air quality standards, this source category will be re-evaluated for additional potential opportunities to reduce emissions.

C.19 RULE 4453 REFINERY VACUUM PRODUCING DEVICES OR SYSTEMS

C.19.1.1.1 *Emissions Inventory (Summer Average – Tons per day)*

	2012	2015	2018	2021	2024	2027	2029	2030	2031
NOx	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
VOC	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a

The emissions from this rule are accounted for in the discussion for Rule 4409 (Components at Light Crude Oil Production Facilities, Natural Gas Production Facilities, and Natural Gas Processing Facilities).

C.19.2 District Rule 4453 Description

This rule applies to any vacuum producing device or system, including hot wells and accumulators installed in a refinery operation. The purpose of this rule is to limit VOC emissions from refinery vacuum producing devices or systems.

C.19.3 How does District Rule 4453 compare with federal rules and regulations?

C.19.3.1 EPA – Control Technique Guidelines (CTG)

C.19.3.1.1 CTG – EPA-450/2-77-025 (Control of Refinery Vacuum Producing Systems, Wastewater Separators, and Process Unit Turnarounds)

The requirements of Rule 4453 are as stringent as or more stringent than the requirements in the CTG.

C.19.3.2 EPA – Alternative Control Technology (ACT)

EPA ACT requirements are not applicable to this source category.

C.19.3.3 Standards of Performance for New Stationary Sources (NSPS)

EPA NSPS requirements are not applicable to this source category.

C.19.3.4 National Emission Standards for Hazardous Air Pollutants (NESHAPs) and Maximum Achievable Control Technologies (MACTs)

EPA NESHAP and MACT requirements are not applicable to this source category.

C.19.4 How does District Rule 4453 compare with California State regulations?

There are no state regulations applicable to this source category.

C.19.5 How does District Rule 4453 compare to regulations from other air districts?

C.19.5.1 Bay Area AQMD

C.19.5.1.1 Regulation 8 Rule 9 (Vacuum Producing Systems)

The requirements in Rule 4453 are as stringent as or more stringent than those in Rule 8-9.

C.19.5.2 Sacramento Metro AQMD

There are no analogous rules for this source category.

C.19.5.3 South Coast AQMD

C.19.5.3.1 Rule 465 (Refinery Vacuum-Producing Devices or Systems)

The requirements in Rule 4453 are as stringent as or more stringent than those in Rule 465.

C.19.5.4 Ventura County APCD

C.19.5.4.1 Rule 74.8 (Refinery Vacuum Producing Systems, Wastewater Separators and Process Turnarounds)

The requirements in Rule 4453 are as stringent as or more stringent than those in Rule 74.8.

C.19.6 Potential Emission Reduction Opportunities

No additional emission reduction opportunities have been identified at this time.

C.19.7 Evaluation Findings

Rule 4453 currently has in place the most stringent measures feasible to implement in the Valley and therefore meets or exceeds federal RACT requirements for this source category. As the District continues to develop future attainment plans to address increasingly stringent federal air quality standards, this source category will be re-evaluated for additional potential opportunities to reduce emissions.

C.20 RULE 4454 REFINERY PROCESS UNIT TURNAROUND

C.20.1.1.1 *Emissions Inventory (Summer Average – Tons per day)*

	2012	2015	2018	2021	2024	2027	2029	2030	2031
NOx	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
VOC	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a

The emissions from this rule are accounted for in the discussion for Rule 4409 (Components at Light Crude Oil Production Facilities, Natural Gas Production Facilities, and Natural Gas Processing Facilities).

C.20.2 District Rule 4454 Description

This rule applies to any refinery vessel containing VOCs, unless exempted. The purpose of this rule is to limit VOC emissions resulting from the purging, repair, cleaning, or otherwise opening or releasing pressure from a refinery vessel during a process unit turnaround.

C.20.3 How does District Rule 4454 compare with federal rules and regulations?

C.20.3.1 EPA – Control Technique Guidelines (CTG)

C.20.3.1.1 CTG – EPA-450/2-77-025 (Control of Refinery Vacuum Producing Systems, Water Separators and Process Unit Turnarounds)

The requirements of Rule 4454 are as stringent as or more stringent than the requirements in the CTG.

C.20.3.2 EPA – Alternative Control Technology (ACT)

EPA ACT requirements are not applicable to this source category.

C.20.3.3 Standards of Performance for New Stationary Sources (NSPS)

EPA NSPS requirements are not applicable to this source category.

C.20.3.4 National Emission Standards for Hazardous Air Pollutants (NESHAPs) and Maximum Achievable Control Technologies (MACTs)

C.20.3.4.1 40 CFR 63 Subpart CC (National Emission Standards for Hazardous Air Pollutants from Petroleum Refineries

The applicable MACT guideline was amended in 2010; however, the amendments did not implement any requirements more stringent than what is required in Rule 4454. The requirements of Rule 4454 are as stringent as or more stringent than the requirements in the MACT.

C.20.4 How does District Rule 4454 compare with California State regulations?

There are no state regulations applicable to this source category.

C.20.5 How does District Rule 4454 compare to regulations from other air districts?

C.20.5.1 Bay Area AQMD

C.20.5.1.1 Regulation 8 Rule 10 (Process Vessel Depressurization)

The requirements in Rule 4454 are as stringent as or more stringent than those in Rule 8-10.

C.20.5.2 Sacramento Metro AQMD

There are no analogous rules for this source category.

C.20.5.3 South Coast AQMD

C.20.5.3.1 SCAQMD Rule 1123 (Refinery Process Turnarounds)

The requirements in Rule 4454 are as stringent as or more stringent than those in Rule 1123.

C.20.5.4 Ventura County APCD

C.20.5.4.1 Rule 74.8 (Refinery Vacuum Producing Systems, Wastewater Separators and Process Turnarounds)

The requirements in Rule 4454 are as stringent as or more stringent than those in Rule 74.8.

C.20.6 Potential Emission Reduction Opportunities

No additional emission reduction opportunities have been identified at this time.

C.20.7 Evaluation Findings

Rule 4454 currently has in place the most stringent measures feasible to implement in the Valley and therefore meets or exceeds federal RACT requirements for this source category. As the District continues to develop future attainment plans to address increasingly stringent federal air quality standards, this source category will be re-evaluated for additional potential opportunities to reduce emissions.

C.21 RULE 4455 COMPONENTS AT PETROLEUM REFINERIES, GAS LIQUIDS PROCESSING FACILITIES, AND CHEMICAL PLANTS

C.21.1.1.1 *Emissions Inventory (Summer Average – Tons per day)*

	2012	2015	2018	2021	2024	2027	2029	2030	2031
NOx	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
VOC	0.40	0.40	0.40	0.40	0.40	0.40	0.40	0.40	0.40

C.21.2 District Rule 4455 Description

This rule applies to components containing or contacting VOC at petroleum refineries, gas liquid processing facilities, and chemical plants. The purpose of this rule is to limit VOC emissions from leaking components at these facilities.

C.21.3 How does District Rule 4455 compare with federal rules and regulations?

C.21.3.1 EPA – Control Technique Guidelines (CTG)

C.21.3.1.1 CTG - EPA-450/3-83-007 (Control of Volatile Organic Compound Equipment Leaks from Natural Gas/Gasoline Processing Plants)

The requirements of Rule 4455 are as stringent as or more stringent than the requirements in the CTG.

C.21.3.2 EPA – Alternative Control Technology (ACT)

EPA ACT requirements are not applicable to this source category.

C.21.3.3 Standards of Performance for New Stationary Sources (NSPS)

C.21.3.3.1 NSPS (40 CFR 60 Subpart OOOO—Standards of Performance for Crude Oil and Natural Gas Production, Transmission and Distribution)

The requirements of Rule 4455 are as stringent as or more stringent than the requirements in the NSPS.

C.21.3.4 National Emission Standards for Hazardous Air Pollutants (NESHAPs) and Maximum Achievable Control Technologies (MACTs)

C.21.3.4.1 NESHAP/MACT – 40 CFR 63 Subpart HH (National Emission Standards for Hazardous Air Pollutants from Oil and Natural Gas Production Facilities)

The requirements of Rule 4455 are as stringent as or more stringent than the requirements in the NESHAP/MACT.

C.21.4 How does District Rule 4455 compare with California State regulations?

There are no state regulations applicable to this source category

C.21.5 How does District Rule 4455 compare to regulations from other air districts?

C.21.5.1 Bay Area AQMD

C.21.5.1.1 Regulation 8 Rule 18 (Equipment Leaks)

The requirements in Rule 4455 are as stringent as or more stringent than those in Rule 8-18.

C.21.5.1.2 Regulation 8 Rule 22 (Valves and Flanges at Chemical Plants)

The requirements in Rule 4455 are as stringent as or more stringent than those in Rule 8-22.

C.21.5.1.3 Regulation 8 Rule 28 (Episodic Releases From Pressure Relief Devices at Petroleum Refineries and Chemical Plants)

The requirements in Rule 4455 are as stringent as or more stringent than those in Rule 8-28.

C.21.5.2 Sacramento Metro AQMD

There are no analogous rules for this source category.

C.21.5.3 South Coast AQMD

C.21.5.3.1 Rule 1173 (Control of Volatile Organic Compound Leaks and Releases from Components at Petroleum Facilities and Chemical Plants)

The requirements in Rule 4455 are as stringent as or more stringent than those in Rule 1173.

C.21.5.4 Ventura County APCD

C.21.5.4.1 Rule 74.7 (Fugitive Emissions of Reactive Organic Compounds at Petroleum Refineries and Chemical Plants)

The requirements in Rule 4455 are as stringent as or more stringent than those in Rule 74.7.

C.21.5.4.2 Rule 74.10 (Components at Crude Oil and Natural Gas Production and Processing Facilities)

The requirements in Rule 4455 are as stringent as or more stringent than those in Rule 74.10.

C.21.6 Potential Emission Reduction Opportunities

No additional emission reduction opportunities have been identified at this time.

C.21.7 Evaluation Findings

Rule 4455 currently has in place the most stringent measures feasible to implement in the Valley and therefore meets or exceeds federal RACT requirements for this source category. As the District continues to develop future attainment plans to address increasingly stringent federal air quality standards, this source category will be re-evaluated for additional potential opportunities to reduce emissions.

C.22 RULE 4565 BIOSOLIDS, ANIMAL MANURE, AND POULTRY LITTER OPERATIONS

C.22.1.1.1 *Emissions Inventory (Summer Average – Tons per day)*

	2012	2015	2018	2021	2024	2027	2029	2030	2031
NOx	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
VOC	21.35	22.11	22.68	23.71	25.18	26.22	27.39	27.73	28.02

This emission inventory table includes emissions for sources subject to this rule and Rule 4566 (Organic Material Composting Operations).

C.22.2 District Rule 4565 Description

Rule 4565 was adopted on March 15, 2007. The provisions of this rule limit VOC emissions from facilities whose throughput consists entirely or in part of Biosolids, animal manure, or poultry litter. Rule 4565 is applicable to operations that landfill, land apply, compost, or co-compost these materials.

C.22.3 How does District Rule 4565 compare with federal rules and regulations?

C.22.3.1 EPA – Control Technique Guidelines (CTG)

EPA CTG requirements are not applicable to this source category.

C.22.3.2 EPA – Alternative Control Technology (ACT)

EPA ACT requirements are not applicable to this source category.

C.22.3.3 Standards of Performance for New Stationary Sources (NSPS)

EPA NSPS requirements are not applicable to this source category.

C.22.3.4 National Emission Standards for Hazardous Air Pollutants (NESHAPs) and Maximum Achievable Control Technologies (MACTs)

EPA NESHAP and MACT requirements are not applicable to this source category.

C.22.4 How does District Rule 4565 compare with California State regulations?

There are no state regulations applicable to this source category.

C.22.5 How does District Rule 4565 compare to regulations from other air districts?

C.22.5.1 Bay Area AQMD

There are no analogous rules for this source category.

C.22.5.2 Sacramento Metro AQMD

There are no analogous rules for this source category.

C.22.5.3 South Coast AQMD

C.22.5.3.1 Rule 1133.2 (Emission Reductions from Co-Composting Operations)

Rule 1133.2 was adopted on January 10, 2003, and has not been amended. This rule is applicable to new and existing co-composting operations operating within the jurisdictional boundaries of the South Coast AQMD. Rule 1133.2 requires operators of new operations to conduct all active co-composting within the confines of an enclosure that meets specific requirements. In lieu of compliance with rule requirements, these operations have the option to submit a compliance plan. During the development of the District's *2015 PM2.5 Plan*[33] the District conducted an extensive analysis comparing the requirements of Rule 4565 to Rule 1133.2. The District determined that overall Rule 4565 is more stringent than Rule 1133.2. This determination is further supported by the District's 2009 RACT SIP demonstration report[34] and the District's 2013 Plan for the Revoked 1-hour Ozone Standard,[35] as approved by EPA.[36]

C.22.5.4 Ventura County APCD

There are no analogous rules for this source category.

C.22.6 Potential Emission Reduction Opportunities

No additional emission reduction opportunities have been identified at this time.

C.22.7 Evaluation Findings

Rule 4565 currently has in place the most stringent measures feasible to implement in the Valley and therefore meets or exceeds federal RACT requirements for this source category. As the District continues to develop future attainment plans to address increasingly stringent federal air quality standards, this source category will be re-evaluated for additional potential opportunities to reduce emissions.

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[33] SJVUAPCD. *2015 Plan for the 1997 PM2.5 Standard*. Appendix C Best Available Control Measures and Most Stringent Measures (2015, April 16). Retrieved from http://www.valleyair.org/Air_Quality_Plans/PM25Plans2015.htm

[34] SJVAPCD. *Reasonably Available Control Technology Demonstration for Ozone State Implementation Plans*. (2009, April 16). Retrieved from: http://www.valleyair.org/Air_Quality_Plans/docs/RACTSIP-2009.pdf

[35] SJVAPCD. *2013 Plan for the Revoked 1-Hour Ozone Standard.* (2013, September 19). Retrieved from: http://www.valleyair.org/Air_Quality_Plans/OzoneOneHourPlan2013/AdoptedPlan.pdf

[36] EPA. *Clean Air Plans; 1-Hour and 1997 8-Hour Ozone Nonattainment Area Requirements; San Joaquin Valley, California;* final rule. 81 Fed. Reg. 65, pp. 19492 – 19495. (2016, April 5) (to be codified at 40 CFR Part 52).

C.23 RULE 4566 ORGANIC MATERIAL COMPOSTING OPERATIONS

C.23.1.1.1 *Emissions Inventory (Summer Average – Tons per day)*

	2012	2015	2018	2021	2024	2027	2029	2030	2031
NOx	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
VOC	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a

The emissions from this source category are included in the emission inventory table for Rule 4565 (Biosolids, Animal Manure, and Poultry Litter Operations).

C.23.2 District Rule 4566 Description

District Rule 4566, was adopted on August 18, 2011, to limit VOC emissions from composting facilities whose feedstock consists of greenwaste and/or foodwaste. District Rule 4566 applies to operations that stockpile and compost greenwaste and foodwaste.

C.23.3 How does District Rule 4566 compare with federal rules and regulations?

C.23.3.1 EPA – Control Technique Guidelines (CTG)

EPA CTG requirements are not applicable to this source category.

C.23.3.2 EPA – Alternative Control Technology (ACT)

EPA ACT requirements are not applicable to this source category.

C.23.3.3 Standards of Performance for New Stationary Sources (NSPS)

EPA NSPS requirements are not applicable to this source category.

C.23.3.4 National Emission Standards for Hazardous Air Pollutants (NESHAPs) and Maximum Achievable Control Technologies (MACTs)

EPA NESHAP and MACT requirements are not applicable to this source category.

C.23.4 How does District Rule 4566 compare with California State regulations?

There are no state regulations applicable to this source category.

C.23.5 How does District Rule 4566 compare to regulations from other air districts?

C.23.5.1 Bay Area AQMD

There are no analogous rules for this source category.

C.23.5.2 Sacramento Metro AQMD

There are no analogous rules for this source category.

C.23.5.3 South Coast AQMD

C.23.5.3.1 Rule 1133.3 (Greenwaste Composting)

Rule 1133.3 was adopted on July 8, 2011, and has not been amended. The purpose of this rule is to reduce fugitive emissions of VOC and ammonia from greenwaste and foodwaste composting operations. During the development of the District's *2015 PM2.5 Plan*[37] the District conducted an extensive analysis comparing the requirements of Rule 4566 to Rule 1133.3. The District determined that overall; Rule 4566 is more stringent than Rule 1133.3. This determination is further supported by the District's 2009 RACT SIP demonstration report[38] and the District's 2013 Plan for the Revoked 1-hour Ozone Standard,[39] as approved by EPA.[40]

C.23.5.4 Ventura County APCD

There are no analogous rules for this source category.

C.23.6 Potential Emission Reduction Opportunities

In its *2015 PM2.5 Plan* the District evaluated this source category to determine if there are any feasible emission reduction opportunities. Through this extensive effort the District found that Rule 4566 currently has in place the most stringent measures feasible to implement in the Valley.[41] The District re-evaluated the aforementioned options and has determined that no additional feasible opportunities have been developed in the last 12 months since the adoption of the *2015 PM2.5 Plan.* Therefore, there are no additional emission reduction opportunities at this time.

C.23.7 Evaluation Findings

Rule 4566 currently has in place the most stringent measures feasible to implement in the Valley and therefore meets or exceeds federal RACT requirements for this source category. As the District continues to develop future attainment plans to address increasingly stringent federal air quality standards, this source category will be re-evaluated for additional potential opportunities to reduce emissions.

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[37] SJVUAPCD. *2015 Plan for the 1997 PM2.5 Standard*. Appendix C Best Available Control Measures and Most Stringent Measures (2015, April 16). Retrieved from http://www.valleyair.org/Air_Quality_Plans/PM25Plans2015.htm

[38] SJVAPCD. *Reasonably Available Control Technology Demonstration for Ozone State Implementation Plans*. (2009, April 16). Retrieved from: http://www.valleyair.org/Air_Quality_Plans/docs/RACTSIP-2009.pdf

[39] SJVAPCD. *2013 Plan for the Revoked 1-Hour Ozone Standard.* (2013, September 19). Retrieved from: http://www.valleyair.org/Air_Quality_Plans/OzoneOneHourPlan2013/AdoptedPlan.pdf

[40] EPA. *Clean Air Plans; 1-Hour and 1997 8-Hour Ozone Nonattainment Area Requirements; San Joaquin Valley, California;* final rule. 81 Fed. Reg. 65, pp. 19492 – 19495. (2016, April 5) (to be codified at 40 CFR Part 52).

[41] SJVUAPCD. *2015 Plan for the 1997 PM2.5 Standard*. Appendix C Best Available Control Measures and Most Stringent Measures (2015, April 16). Retrieved from http://www.valleyair.org/Air_Quality_Plans/PM25Plans2015.htm

C.24 RULE 4570 CONFINED ANIMAL FACILITIES

C.24.1 Emissions Inventory (Summer Average – Tons per day)

	2012	2015	2018	2021	2024	2027	2029	2030	2031
NOx	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
VOC	95.90	95.90	95.90	95.90	95.90	95.90	95.90	95.90	95.90

C.24.2 District Rule 4570 Description

District Rule 4570, was originally adopted on June 15, 2006 and was most recently amended on October 21, 2010. The purpose of this rule is to limit emissions of VOCs from Confined Animal Facilities (CAFs). District Rule 4570 applies to facilities where animals are corralled, penned, or otherwise caused to remain in restricted areas and primarily fed by a means other than grazing for at least 45 days in any twelve-month period. In addition to limiting VOC emissions, District Rule 4570 also includes measures that limit ammonia (NH3) emissions from these operations; the required measures have reduced ammonia emissions by over 100 tpd[42] (this reduction is reflected in the emissions inventory data above). The analysis below focuses on how District Rule 4570 limits NH3 emissions in comparison to other rules and regulations.

A. Types of Confined Animal Facilities

Confined Animal Facilities are used for the raising of animals including, but not limited to, cattle, calves, chickens, ducks, goats, horses, sheep, swine, rabbits, and turkeys, which are corralled, penned, or otherwise caused to remain in restricted areas for commercial agricultural purposes and fed by a means other than grazing. (CH&SC §39011.5 (a)(1)). The major categories of Confined Animal Facilities are listed below.

- Dairy Operations - Dairy operations are those operations producing milk or animals for facilities that produce milk.
- Poultry Operations - Poultry facilities operate either as layer ranches for egg production or as broiler ranches where birds are grown for the fresh meat market.
- Beef Cattle Feeding Operations – Beef cattle facilities are facilities that raise beef cattle (heifers and steers) for their meat.
- Swine Operations – These operations raise pigs for their meat. The production cycle for hogs has three (3) phases: farrowing (giving birth), nursing, and finishing.

[42] Appendix F of the Staff Report for the June 2009 re-adoption of Rule 4570, starting on the 329th page of the pdf available here http://www.valleyair.org/Board_meetings/GB/agenda_minutes/Agenda/2009/June/Agenda%20Item_10_June_18_2009.pdf

B. Rule 4570 Applicability Thresholds

The thresholds for a facility to be classified as a large CAF in the Valley and the thresholds for a facility to be subject to District Rule 4570 are shown in the following table. The large CAF thresholds are based on the definition of a large CAF adopted by ARB as required by California Senate Bill (SB) 700. District Rule 4570 applies to confined animal facilities that have the capacity to house a number of animals equal to or exceeding the Rule 4570 regulatory thresholds, which are lower than the large CAF thresholds for certain facilities.

Table C-4 Rule 4570 Thresholds for Regulation

Livestock Category	SJVAPCD Large CAF Thresholds	Rule 4570 Regulatory Thresholds
Dairy	1,000 milking cows	500 milking cows
Beef Feedlots	3,500 beef cattle	3,500 beef cattle
Other Cattle Facility	7,500 calves, heifers, or other cattle	7,500 calves, heifers, or other cattle
Poultry Facilities		
Chicken	650,000 head	400,000 head
Duck	650,000 head	400,000 head
Turkey	100,000 head	100,000 head
Swine Facility	3,000 head	3,000 head
Horses Facility	3,000 head	3,000 head
Sheep and Goat Facilities	15,000 head of sheep, goats, or any combination of the two	15,000 head of sheep, goats, or any combination of the two
Any livestock facility not listed above	30,000 head	30,000 head

C. Emission Control Requirements of District Rule 4570

District Rule 4570 requires multiple mitigation measures from the following CAF categories: Dairy, Beef Feedlots, Other Cattle Facilities, Swine Facilities, Poultry facilities, and various other smaller operations. Each of these facilities consists of multiple sources of emissions within the facility. Since these facilities generally cover a large area and have different processes, a single mitigation measure or technology is generally not sufficient to control overall emissions from the facility. Mitigation measures required by Rule 4570 have been tailored for each source of emissions, thereby ensuring that the overall emissions from a facility are reduced. The current methodology in Rule 4570 allows for the greatest overall control from the entire facility.

District Rule 4570 recognized the following five emission sources for all of the CAFs: Feed, Housing, Solid Waste, Liquid Waste, and Land Application of Manure. Rule 4570 requires each CAF to implement a certain number of mitigation measures for each of these sources. District Rule 4570 also distinguishes between the different types of housing configurations (freestall vs open corrals) for cattle and, as such, requires specific mitigation measures for each type of housing. By requiring mitigation

measure(s) for each source of emissions at a facility, District Rule 4570 ensures that reductions are achieved throughout the facility.

C.24.3 How does District Rule 4570 compare with federal rules and regulations?

C.24.3.1 EPA – Control Technique Guidelines (CTG)

EPA CTG requirements are not applicable to this source category.

C.24.3.2 EPA – Alternative Control Technology (ACT)

EPA ACT requirements are not applicable to this source category.

C.24.3.3 Standards of Performance for New Stationary Sources (NSPS)

EPA NSPS requirements are not applicable to this source category.

C.24.3.4 National Emission Standards for Hazardous Air Pollutants (NESHAPs) and Maximum Achievable Control Technologies (MACTs)

EPA NESHAP and MACT requirements are not applicable to this source category.

C.24.4 How does District Rule 4570 compare with California State regulations?

There are no state regulations applicable to this source category.

C.24.5 How does District Rule 4570 compare to regulations from other air districts?

As the largest agricultural area in California, the District took the lead in devising a list of mitigation measures for the various emission sources during the initial development of District Rule 4570. This list of mitigation measures was essentially utilized, almost identically, by all air districts in their rules. However, during the last amendments to District Rule 4570, all of the mitigation measures were reevaluated in light of the latest available science. In comparison to the previous version of the rule, the current rule has lower threshold limits to bring in additional CAFs, requires additional mitigation measures, clarifies previous mitigation measures, and adds additional monitoring, testing, and recordkeeping to improve enforceability.

C.24.5.1 Bay Area AQMD

C.24.5.1.1 Regulation 2 Rule 10 (Large Confined Animal Facilities)

The requirements in Rule 4570 are as stringent as or more stringent than those in Rule 2-10.

C.24.5.2 Sacramento Metro AQMD

C.24.5.2.1 SMAQMD Rule 496 (Large Confined Animal Facilities)

The requirements in Rule 4570 are as stringent as or more stringent than those in Rule 496.

C.24.5.3 South Coast AQMD

C.24.5.3.1 Rule 223 (Emission Reduction Permits for Large Confined Animal Facilities)

The requirements in Rule 4570 are as stringent as or more stringent than those in Rule 223. In fact, the SCAQMD recently identified District Rule 4570 as the most stringent rule for this source category.[43]

C.24.5.3.2 Rule 1127 (Emission Reductions from Livestock Waste)

The requirements in Rule 4570 are as stringent as or more stringent than those in Rule 1127.

C.24.5.4 Ventura County APCD

VCAPCD Rule 23 (Exemptions from Permit)

The requirements in Rule 4570 are as stringent as or more stringent than those in Rule 23.

C.24.5.5 Other Air Quality Control Agencies

C.24.5.5.1 Imperial County Air Quality Management District (ICAPCD) Rule 217 (Large Confined Animal Facilities Permits Required) and ICAPCD Policy Number 38 (Recommended Mitigation Measures for Large Confined Animal Facilities)

The requirements in Rule 4570 are as stringent as or more stringent than those in Rule 217 and ICAPCD Policy Number 38.

C.24.5.5.2 Butte County Air Pollution Control District (BCAQMD) Rule 450 (Large Confined Animal Facilities)

[43] South Coast Air Quality Management District (June 6, 2014). Reasonably Available Control Technology Demonstration. http://www.aqmd.gov/docs/default-source/Agendas/Governing-Board/2014/2014-jun6-031.pdf?sfvrsn=2

The requirements in Rule 4570 are as stringent as or more stringent than those in Rule 450.

C.24.5.5.3 Yakima Regional Clean Air Agency

The Yakima Regional Clean Air Agency adopted recommended practices for dairy operations on March 8, 2012 in their document *Air Quality Management Policy and Best Management Practices for Dairy Operations*. The policy requires preparation of an annual Air Quality Management Plan and implementation of Best Management Practices to reduce emissions from dairy operations; however, the requirements of District Rule 4570 are more stringent and specific.

C.24.6 Potential Emission Reduction Opportunities

In its *2015 PM2.5 Plan* the District evaluated this source category to determine if there are any feasible emission reduction opportunities. This extensive effort included the evaluation of this rule compared to analogous rules, policies, and procedures in other air districts, and identified potential emission reduction opportunities. The District found that Rule 4570 currently has in place the most stringent measures feasible to implement in the Valley.[44] This determination is further supported by the District's 2009 RACT SIP demonstration report[45] and the District's 2013 Plan for the Revoked 1-hour Ozone Standard,[46] as approved by EPA.[47] The District re-evaluated the aforementioned options and has determined that no additional feasible opportunities have been developed in the last 12 months since the adoption of the *2015 PM2.5 Plan.* Therefore, there are no additional emission reduction opportunities at this time.

C.24.7 Evaluation Findings

Rule 4570 currently has in place the most stringent measures feasible to implement in the Valley and therefore meets or exceeds federal RACT requirements for this source category. As the District continues to develop future attainment plans to address increasingly stringent federal air quality standards, this source category will be re-evaluated for additional potential opportunities to reduce emissions.

[44] SJVUAPCD. *2015 Plan for the 1997 PM2.5 Standard*. Appendix C Best Available Control Measures and Most Stringent Measures (2015, April 16). Retrieved from http://www.valleyair.org/Air_Quality_Plans/PM25Plans2015.htm
[45] SJVAPCD. *Reasonably Available Control Technology Demonstration for Ozone State Implementation Plans*. (2009, April 16). Retrieved from: http://www.valleyair.org/Air_Quality_Plans/docs/RACTSIP-2009.pdf
[46] SJVAPCD. *2013 Plan for the Revoked 1-Hour Ozone Standard.* (2013, September 19). Retrieved from: http://www.valleyair.org/Air_Quality_Plans/OzoneOneHourPlan2013/AdoptedPlan.pdf
[47] EPA. *Clean Air Plans; 1-Hour and 1997 8-Hour Ozone Nonattainment Area Requirements; San Joaquin Valley, California;* final rule. 81 Fed. Reg. 65, pp. 19492 – 19495. (2016, April 5) (to be codified at 40 CFR Part 52).

C.25 RULE 4601 ARCHITECTURAL COATINGS

C.25.1.1.1 *Emissions Inventory (Summer Average – Tons per day)*

	2012	2015	2018	2021	2024	2027	2029	2030	2031
NOx	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
VOC	8.24	8.37	8.72	9.11	9.57	9.99	10.27	10.47	10.60

C.25.2 District Rule 4601 Description

District Rule 4601 was adopted on April 11, 1991 and has been subsequently amended five times. This rule reduces VOC emissions from sources subject to this rule by establishing VOC content limits for architectural coatings. Rule 4601 is applicable to any person who supplies, sells, offers for sale, applies, or solicits the application of any architectural coating, or who manufactures, blends, or repackages any architectural coating for use within the District. The purpose of this rule is to limit VOC emissions from these sources.

C.25.3 How does District Rule 4601 compare with federal rules and regulations?

C.25.3.1 EPA – Control Technique Guidelines (CTG)

EPA CTG requirements are not applicable to this source category.

C.25.3.2 EPA – Alternative Control Technology (ACT)

EPA ACT requirements are not applicable to this source category.

C.25.3.3 Standards of Performance for New Stationary Sources (NSPS)

EPA NSPS requirements are not applicable to this source category.

C.25.3.4 National Emission Standards for Hazardous Air Pollutants (NESHAPs) and Maximum Achievable Control Technologies (MACTs)

EPA NESHAP and MACT requirements are not applicable to this source category.

C.25.4 How does District Rule 4601 compare with California State regulations?

Rule 4601 is at least as stringent as the applicable ARB Suggested Control Measure (SCM) for Architectural Coatings, promulgated in September 2007. ARB's adoption of the SCM established consistent VOC content standards for architectural coatings used in California based on multiple years of public processes, which included exhaustive research and collaborative efforts between ARB and coating manufacturers.

C.25.5 How does District Rule 4601 compare to regulations from other air districts?

C.25.5.1 Bay Area AQMD

C.25.5.1.1 Regulation 8 Rule 3 (Architectural Coatings)

The requirements in Rule 4601 are as stringent as or more stringent than those in Rule 8-3.

C.25.5.2 Sacramento Metro AQMD

C.25.5.2.1 Rule 442 (Architectural Coatings)

The requirements in Rule 4601 are as stringent as or more stringent than those in Rule 442.

C.25.5.3 South Coast AQMD

C.25.5.3.1 Rule 1113 (Architectural Coatings)

The requirements in Rule 4601 are as stringent as or more stringent than those in Rule 1113. While there are some limits within the rule that go beyond RACT, the District is implementing the most stringent limits feasible given the Valley's unique characteristics. This determination is further supported by the District's 2009 RACT SIP demonstration report[48] and the District's 2013 Plan for the Revoked 1-hour Ozone Standard,[49] as approved by EPA.[50]

C.25.5.4 Ventura County APCD

C.25.5.4.1 Rule 74.2 (Architectural Coatings)

The requirements in Rule 4601 are as stringent as or more stringent than those in Rule 74.2.

C.25.6 Potential Emission Reduction Opportunities

No additional emission reduction opportunities have been identified at this time.

C.25.7 Evaluation Findings

According to the federal CAA §182(b)(2) and (f) this source category is not subject to federal RACT requirements because this source category has no sources subject to EPA CTGs and these sources are not "major sources" of VOCs and NOx, as confirmed by EPA in the Technical Support Document (TSD) for the partial approval of the

[48] SJVAPCD. *Reasonably Available Control Technology Demonstration for Ozone State Implementation Plans*. (2009, April 16). Retrieved from: http://www.valleyair.org/Air_Quality_Plans/docs/RACTSIP-2009.pdf
[49] SJVAPCD. *2013 Plan for the Revoked 1-Hour Ozone Standard.* (2013, September 19). Retrieved from: http://www.valleyair.org/Air_Quality_Plans/OzoneOneHourPlan2013/AdoptedPlan.pdf
[50] EPA. *Clean Air Plans; 1-Hour and 1997 8-Hour Ozone Nonattainment Area Requirements; San Joaquin Valley, California;* final rule. 81 Fed. Reg. 65, pp. 19492 – 19495. (2016, April 5) (to be codified at 40 CFR Part 52).

Districts 2009 RACT SIP.[51] However, pursuant to the District's No Stone Left Unturned philosophy, Rule 4601 was evaluated as a part of this plan development effort.

Rule 4601 currently has in place the most stringent measures feasible to implement in the Valley. As the District continues to develop future attainment plans to address increasingly stringent federal air quality standards, this source category will be re-evaluated for additional potential opportunities to reduce emissions.

[51] U.S. EPA. Region IX Air Division. Technical Support Document for EPA's Notice of Proposed Rulemaking for the California State Implementation Plan. Prepared by Stanley Tong. (2011, August 29). https://www.regulations.gov/#!documentDetail;D=EPA-R09-OAR-2011-0723-0006

C.26 RULE 4602 MOTOR VEHICLE ASSEMBLY COATINGS

C.26.1 Emissions Inventory (Summer Average – Tons per day)

	2012	2015	2018	2021	2024	2027	2029	2030	2031
NOx	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
VOC	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

The emissions inventory for this source category is 0.00 tpd because there are no facilities operating in the Valley.

C.26.2 District Rule 4602 Description

This rule is applicable to any person who applies VOC-containing coatings to new automobiles, light-duty trucks, heavier vehicles, and other parts coated along with these bodies or body parts during the assembly process and associated solvent cleaning activities. The purpose of this rule is to limit VOC emissions from motor vehicle assembly coating operations.

There are currently no motor vehicle assembly operations in the Valley. Any such facilities beginning operation in the Valley in the future would be required to meet District BACT requirements, per District Rules 2201 (New and Modified Stationary Source Review Rule), which by definition are equal to or more stringent than RACT, and 4001 (New Source Performance Standards).

C.26.3 How does District Rule 4602 compare with federal rules and regulations?

C.26.3.1 EPA – Control Technique Guidelines (CTG)

C.26.3.1.1 CTG - EPA 453/R-08-006 Control Techniques Guidelines for Automobile and Light-Duty Truck Assembly Coatings

Rule 4602 implements EPA CTG requirements and therefore is as stringent as the applicable CTG requirements.

C.26.3.2 EPA – Alternative Control Technology (ACT)

EPA ACT requirements are not applicable to this source category.

C.26.3.3 Standards of Performance for New Stationary Sources (NSPS)

EPA NSPS requirements are not applicable to this source category.

C.26.3.4 National Emission Standards for Hazardous Air Pollutants (NESHAPs) and Maximum Achievable Control Technologies (MACTs)

EPA NESHAP and MACT requirements are not applicable to this source category.

C.26.4 How does District Rule 4602 compare with California State regulations?

There are no state regulations applicable to this source category.

C.26.5 How does District Rule 4602 compare to regulations from other air districts?

C.26.5.1 Bay Area AQMD

Bay Area AQMD has no analogous rules for this source category.

C.26.5.2 Sacramento Metro AQMD

Sacramento Metro AQMD has no analogous rules for this source category.

C.26.5.3 South Coast AQMD

South Coast AQMD has no analogous rules for this source category.

C.26.5.4 Ventura County APCD

Ventura County APCD has no analogous rules for this source category.

C.26.6 Potential Emission Reduction Opportunities

There are no motor vehicle assembly operations in the Valley; there are no emissions or emission reduction opportunities for this source category.

C.26.7 Evaluation Findings

There are no motor vehicle assembly operations in the Valley; there are no emissions or emission reduction opportunities for this source category.

C.27 RULE 4603 SURFACE COATING OF METAL PARTS AND PRODUCTS, PLASTIC PARTS AND PRODUCTS, AND PLEASURE CRAFTS

C.27.1 Emissions Inventory (Summer Average – Tons per day)

	2012	2015	2018	2021	2024	2027	2029	2030	2031
NOx	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
VOC	1.00	1.10	1.17	1.25	1.32	1.38	1.42	1.44	1.44

C.27.2 District Rule 4603 Description

The provisions of this rule apply to the surface coating of metal parts or products, large appliances' parts or products, metal furniture, plastic parts and products, and pleasure crafts, and to the organic solvent cleaning and storage and disposal of all solvents and waste solvent materials associated with such coatings. The purpose of this rule is to limit VOC emissions from these coatings.

C.27.3 How does District Rule 4603 compare with federal rules and regulations?

Rule 4603 is at least as stringent as the applicable federal CTG, ACT, NSPS, MACT, and NESHAP since the requirements have not been strengthened for these regulations since the Rule 4603 RACT approval.

C.27.3.1 EPA – Control Technique Guidelines (CTG)

C.27.3.1.1 CTG – EPA-453/R-07-004 (Control Techniques Guidelines for Large Appliance Coatings)

The requirements of Rule 4603 are more stringent than the requirements in the CTG.

C.27.3.1.2 CTG – EPA-453/R-07-005 (Control Techniques Guidelines for Metal Furniture Coatings)

The requirements of Rule 4603 are more stringent than the requirements in the CTG.

C.27.3.1.3 CTG – EPA-450/2-78-015 (Control of Volatile Organic Emissions from Existing Stationary Sources – Volume VI: Surface Coating of Miscellaneous Metal Parts and Products)

The requirements of Rule 4603 are more stringent than the requirements in the CTG.

C.27.3.1.4 CTG – EPA-453/R-08-003 (Control Techniques Guidelines for Miscellaneous Metal and Plastic Parts Coatings)

The requirements of Rule 4603 are more stringent than the requirements in the CTG.

C.27.3.2 EPA – Alternative Control Technology (ACT)

C.27.3.2.1 ACT – EPA-453/R-94-015 (Alternative Control Techniques Document – Industrial Cleaning Solvents)

The requirements of Rule 4603 are more stringent than the requirements in the ACT.

C.27.3.3 Standards of Performance for New Stationary Sources (NSPS)

C.27.3.3.1 NSPS – 40 CFR 60 Subpart EE (Surface Coating of Metal Furniture)

The requirements of Rule 4603 are more stringent than the requirements in the NSPS.

C.27.3.3.2 NSPS – 40 CFR 60 Subpart SS (Industrial Surface Coating of Large Appliances)

The requirements of Rule 4603 are more stringent than the requirements in the NSPS.

C.27.3.4 National Emission Standards for Hazardous Air Pollutants (NESHAPs) and Maximum Achievable Control Technologies (MACTs)

C.27.3.4.1 NESHAP/MACT – 40 CFR Part 63 Subpart MMMM (NESHAP for Surface Coating of Miscellaneous Metal Parts and Products).

The requirements of Rule 4603 are more stringent than the requirements in the NESHAP.

C.27.3.4.2 NESHAP/MACT – 40 CFR Part 63 Subpart NNNN (NESHAP for Surface Coating of Large Appliances)

The requirements of Rule 4603 are more stringent than the requirements in the NESHAP.

C.27.3.4.3 NESHAP/MACT – 40 CFR Part 63 Subpart RRRR (NESHAP for Surface Coating of Metal Furniture)

The requirements of Rule 4603 are more stringent than the requirements in the NESHAP.

C.27.4 How does District Rule 4603 compare with California State regulations?

There are no state regulations applicable to this source category.

C.27.5 How does District Rule 4603 compare to regulations from other air districts?

C.27.5.1 Bay Area AQMD

C.27.5.1.1 Regulation 8 Rule 14 (Surface Coating of Large Appliances and Metal Furniture)

The requirements in Rule 4603 are as stringent as or more stringent than those in Rule 8-14

C.27.5.1.2 Regulation 8 Rule 19 (Surface Coating of Miscellaneous Parts and Products)

The requirements in Rule 4603 are as stringent as or more stringent than those in Rule 8-19.

C.27.5.2 Sacramento Metro AQMD

C.27.5.2.1 SMAQMD Rule 451 (Surface Coating of Miscellaneous Metal Parts and Products)

SMAQMD Rule 451 was amended in 2010, but the rule requirements are not more stringent than the requirements in Rule 4603.

C.27.5.3 South Coast AQMD

C.27.5.3.1 SCAQMD Rule 1106.1 (Pleasure Craft Coating Operations)

The requirements in Rule 4603 are as stringent as or more stringent than those in Rule 1106.1.

C.27.5.3.2 SCAQMD Rule 1107 (Coating of Metal Parts and Products)

The requirements in Rule 4603 are as stringent as or more stringent than those in Rule 1107.

C.27.5.4 Ventura County APCD

C.27.5.4.1 Rule 74.12 (Surface Coatings of Metal Parts and Products)

The requirements in Rule 4603 are as stringent as or more stringent than those in Rule 74.12.

C.27.6 Potential Emission Reduction Opportunities

No additional emission reduction opportunities have been identified at this time.

C.27.7 Evaluation Findings

Rule 4603 currently has in place the most stringent measures feasible to implement in the Valley and therefore meets or exceeds federal RACT requirements for this source category.

C.28 RULE 4604 CAN AND COIL COATING OPERATIONS

C.28.1 *Emissions Inventory (Summer Average – Tons per day)*

	2012	2015	2018	2021	2024	2027	2029	2030	2031
NOx	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
VOC	0.31	0.33	0.35	0.37	0.39	0.40	0.42	0.43	0.43

C.28.2 District Rule 4604 Description

This rule applies to can and coil coating operations and to organic solvent cleaning, storage, and disposal associated with can and coil coating operations. The purpose of this rule is to limit VOC emissions from these operations.

C.28.3 How does District Rule 4604 compare with federal rules and regulations?

C.28.3.1 EPA – Control Technique Guidelines (CTG)

C.28.3.1.1 CTG–EPA-450/2-77-022 (Control of Volatile Organic Emissions from Existing Stationary Sources – Volume II: Surface Coating of Cans, Coils, Paper, Fabrics, Automobiles, and Light-Duty Trucks

The requirements of Rule 4604 are more stringent than the requirements in the CTG.

C.28.3.2 EPA – Alternative Control Technology (ACT)

EPA ACT requirements are not applicable to this source category.

C.28.3.3 Standards of Performance for New Stationary Sources (NSPS)

C.28.3.3.1 NSPS – 40 CFR 60 Subpart TT (Standards of Performance for Metal Coil Surface Coating)

The requirements of Rule 4604 are more stringent than the requirements in the NSPS.

C.28.3.4 National Emission Standards for Hazardous Air Pollutants (NESHAPs) and Maximum Achievable Control Technologies (MACTs)

C.28.3.4.1 NESHAP/MACT – 40 CFR 63 Subpart KKK (National Emission Standards for HAPs: Surface Coating of Metal Cans)

The requirements of Rule 4604 are more stringent than the requirements in the NESHAP/MACT.

C.28.3.4.2 NESHAP/MACT – 40 CFR 63 Subpart SSSS (National Emission Standards for HAPs: Surface Coating of Metal Coil)

The requirements of Rule 4604 are more stringent than the requirements in the NESHAP.

C.28.4 How does District Rule 4604 compare with California State regulations?

There are no state regulations applicable to this source category.

C.28.5 How does District Rule 4604 compare to regulations from other air districts?

C.28.5.1 Bay Area AQMD

C.28.5.1.1 Regulation 8 Rule 11 (Metal Container, Closure and Coil Coating)

The requirements in Rule 4604 are as stringent as or more stringent than those in Rule 8-11.

C.28.5.2 Sacramento Metro AQMD

C.28.5.2.1 Rule 452 (Can Coating)

The requirements in Rule 4604 are as stringent as or more stringent than those in Rule 452.

C.28.5.3 South Coast AQMD

C.28.5.3.1 Rule 1125 (Metal Container, Closure, and Coil Coating Operations)

The requirements in Rule 4604 are as stringent as or more stringent than those in Rule 1125.

C.28.5.4 Ventura County APCD

There are no analogous rules for this source category.

C.28.6 Potential Emission Reduction Opportunities

There are BACT guidelines that are more stringent than what is required in Rule 4604. However, these requirements are beyond RACT and not technologically feasible or cost effective for all sources applicable to Rule 4604. This determination is further supported by the District's 2013 Plan for the Revoked 1-hour Ozone Standard, as approved by EPA.[52]

[52] EPA. *Clean Air Plans; 1-Hour and 1997 8-Hour Ozone Nonattainment Area Requirements; San Joaquin Valley, California;* final rule. 81 Fed. Reg. 65, pp. 19492 – 19495. (2016, April 5) (to be codified at 40 CFR Part 52).

C.28.7 Evaluation Findings

Rule 4604 currently has in place the most stringent measures feasible to implement in the Valley and therefore meets or exceeds federal RACT requirements for this source category. As the District continues to develop future attainment plans to address increasingly stringent federal air quality standards, this source category will be re-evaluated for additional potential opportunities to reduce emissions.

C.29 RULE 4605 AEROSPACE ASSEMBLY AND COMPONENT COATING OPERATIONS

C.29.1 *Emissions Inventory (Summer Average – Tons per day)*

	2012	2015	2018	2021	2024	2027	2029	2030	2031
NOx	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
VOC	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01

C.29.2 District Rule 4605 Description

This rule applies to the manufacturing, assembling, coating, masking, bonding, paint stripping, surface cleaning, service, and maintenance of aerospace components; the cleanup of equipment; and the storage and disposal of solvents and waste solvent materials associated with these operations. The purpose of this rule is to limit the emissions of VOCs from these sources.

C.29.3 How does District Rule 4605 compare with federal rules and regulations?

C.29.3.1 EPA – Control Technique Guidelines (CTG)

C.29.3.1.1 CTG – EPA-453/R-97-004 (Control of Volatile Organic Compound Emissions from Coating Operations at Aerospace Manufacturing and Rework Operations)

The requirements of Rule 4605 are more stringent than the requirements in the CTG.

C.29.3.1.2 CTG – EPA-450/2-77-022 (Control of Volatile Organic Emissions from Solvent Metal Cleaning)

The requirements of Rule 4605 are as stringent as or more stringent than the requirements in the CTG.

C.29.3.2 EPA – Alternative Control Technology (ACT)

EPA ACT requirements are not applicable to this source category.

C.29.3.3 Standards of Performance for New Stationary Sources (NSPS)

EPA NSPS requirements are not applicable to this source category.

C.29.3.4 National Emission Standards for Hazardous Air Pollutants (NESHAPs) and Maximum Achievable Control Technologies (MACTs)

C.29.3.4.1 NESHAP/MACT – 40 CFR 63 Subpart GG (National Emission Standards for HAPs: Aerospace Manufacturing and Rework Facilities)

The requirements of Rule 4605 are more stringent than the requirements in the NESHAP/MACT.

C.29.4 How does District Rule 4605 compare with California State regulations?

There are no state regulations applicable to this source category.

C.29.5 How does District Rule 4605 compare to regulations from other air districts?

C.29.5.1 Bay Area AQMD

C.29.5.1.1 Regulation 8 Rule 29 (Aerospace Assembly and Component Coating Operations)

The requirements in Rule 4605 are as stringent as or more stringent than those in Rule 8-29.

C.29.5.2 Sacramento Metro AQMD

C.29.5.2.1 SMAQMD Rule 456 (Aerospace Coating Operations)

The requirements in Rule 4605 are as stringent as or more stringent than those in Rule 456.

C.29.5.3 South Coast AQMD

C.29.5.3.1 Rule 1124 (Aerospace Assembly and Component Manufacturing Operations)

The requirements in Rule 4605 are as stringent as or more stringent than those in Rule 1124.

C.29.5.4 Ventura County APCD

C.29.5.4.1 Rule 74.13 (Aerospace Assembly and Component Manufacturing Operations)

The requirements in Rule 4605 are more stringent than those in Rule 74.13.

C.29.6 Potential Emission Reduction Opportunities

No additional emission reduction opportunities have been identified at this time.

C.29.7 Evaluation Findings

Rule 4605 currently has in place the most stringent measures feasible to implement in the Valley and therefore meets or exceeds federal RACT requirements for this source category. As the District continues to develop future attainment plans to address increasingly stringent federal air quality standards, this source category will be re-evaluated for additional potential opportunities to reduce emissions.

C.30 RULE 4606 WOOD PRODUCTS AND FLAT WOOD PANELING PRODUCTS COATING OPERATIONS

C.30.1 *Emissions Inventory (Summer Average – Tons per day)*

	2012	2015	2018	2021	2024	2027	2029	2030	2031
NOx	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
VOC	1.47	1.60	1.73	1.80	1.91	1.98	2.07	2.10	2.10

C.30.2 District Rule 4606 Description

This rule applies to the application of coatings to wood products, including furniture, cabinets, flat wood paneling, and custom replica furniture. The rule also applies to organic solvent cleaning, and to the storage and disposal of all solvents and waste solvent materials associated with such coating operations. The purpose of this rule is to limit the emissions of VOCs from these operations.

C.30.3 How does District Rule 4606 compare with federal rules and regulations?

C.30.3.1 EPA – Control Technique Guidelines (CTG)

C.30.3.1.1 CTG – EPA-453/R-96-007 (Control of Volatile Organic Compound Emissions from Wood Furniture Manufacturing Operations)

The requirements of Rule 4606 are as stringent as or more stringent than the requirements in the CTG.

C.30.3.1.2 CTG – EPA-453/R-06-004 (Control Techniques Guidelines for Flat Wood Paneling Coatings)

The requirements of Rule 4606 are as stringent as or more stringent than the requirements in the CTG.

C.30.3.2 EPA – Alternative Control Technology (ACT)

EPA ACT requirements are not applicable to this source category.

C.30.3.3 Standards of Performance for New Stationary Sources (NSPS)

EPA NSPS requirements are not applicable to this source category.

C.30.3.4 National Emission Standards for Hazardous Air Pollutants (NESHAPs) and Maximum Achievable Control Technologies (MACTs)

C.30.3.4.1 NESHAP/MACT – 40 CFR 63 Subpart JJ (National Emission Standards for Wood Furniture Manufacturing)

The requirements of Rule 4606 are more stringent than the requirements in the NESHAP.

C.30.4 How does District Rule 4606 compare with California State regulations?

There are no state regulations applicable to this source category.

C.30.5 How does District Rule 4606 compare to regulations from other air districts?

C.30.5.1 Bay Area AQMD

C.30.5.1.1 Regulation 8 Rule 32 (Wood Products Coatings)

Regulation 8 Rule 32 was amended in 2009 to include VOC limits that go beyond RACT for "Custom and Contract Furniture." EPA's partial approval of the *2009 RACT SIP,* which includes Rule 4606, further demonstrates that the BAAQMD limits are beyond RACT.

C.30.5.2 Sacramento Metro AQMD

C.30.5.2.1 Rule 463 (Wood Product Coatings)

The requirements in Rule 4606 are as stringent as or more stringent than those in Rule 463.

C.30.5.3 South Coast AQMD

C.30.5.3.1 Rule 1136 (Wood Product Coatings)

The requirements in Rule 4606 are as stringent as or more stringent than those in Rule 1136.

C.30.5.3.2 Rule 1104 (Wood Flat Stock Coating Operations)

The requirements in Rule 4606 are as stringent as or more stringent than those in Rule 1104.

C.30.5.4 Ventura County APCD

C.30.5.4.1 Rule 74.30 (Wood Products Coatings)

The requirements in Rule 4606 are as stringent as or more stringent than those in Rule 74.30.

C.30.6 Potential Emission Reduction Opportunities

No additional emission reduction opportunities have been identified at this time.

C.30.7 Evaluation Findings

Rule 4606 currently has in place the most stringent measures feasible to implement in the Valley and therefore meets or exceeds federal RACT requirements for this source category. As the District continues to develop future attainment plans to address increasingly stringent federal air quality standards, this source category will be re-evaluated for additional potential opportunities to reduce emissions.

C.31 RULE 4607 GRAPHIC ARTS AND PAPER FILM, FOIL, AND FABRIC COATINGS

C.31.1 *Emissions Inventory (Summer Average – Tons per day)*

	2012	2015	2018	2021	2024	2027	2029	2030	2031
NOx	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
VOC	5.18	5.48	5.76	6.05	6.33	6.66	6.87	6.98	6.98

C.31.2 District Rule 4607 Description

This rule is applicable to graphic arts printing operations; digital printing operations; paper, film, foil, or fabric coating operations; and the organic solvent cleaning materials and processes associated with such operations. The purpose of this rule is to limit VOC emissions from these operations.

C.31.3 How does District Rule 4607 compare with federal rules and regulations?

C.31.3.1 EPA – Control Technique Guidelines (CTG)

C.31.3.1.1 CTG – EPA-450/2-77-008 (Control of Volatile Organic Emissions from Existing Stationary Sources – Volume II: Surface Coating of Cans, Coils, Paper, Fabrics, Automobiles, and Light-Duty Trucks

The requirements of Rule 4607 are as stringent as or more stringent than the requirements in the CTG.

C.31.3.1.2 CTG – EPA-450/2-78-033 (Control Techniques Guidelines for Control of VOCs from Existing Stationary Sources – Volume VIII: Graphic Arts- Rotogravure and Flexography

The requirements of Rule 4607 are as stringent as or more stringent than the requirements in the CTG.

C.31.3.1.3 CTG – EPA-453/R-06-002 (Control Techniques Guidelines for Offset Lithographic Printing and Letterpress Printing)

The requirements of Rule 4607 are as stringent as or more stringent than the requirements in the CTG.

C.31.3.1.4 CTG – EPA-453/R-06-003 (Control Techniques Guidelines for Flexible Package Printing)

The requirements of Rule 4607 are as stringent as or more stringent than the requirements in the CTG.

C.31.3.1.5 CTG – EPA-453/R-07-003 (Control Techniques Guidelines for Paper, Film, and Foil Coatings)

The requirements of Rule 4607 are as stringent as or more stringent than the requirements in the CTG.

C.31.3.2 EPA – Alternative Control Technology (ACT)

EPA ACT requirements are not applicable to this source category.

C.31.3.3 Standards of Performance for New Stationary Sources (NSPS)

C.31.3.3.1 NSPS – 40 CFR 60 Subpart QQ (Standards of Performance for the Graphic Arts Industry: Publication Rotogravure Printing)

The requirements of Rule 4607 are as stringent as or more stringent than the requirements in the NSPS.

C.31.3.3.2 NSPS – 40 CFR 60 Subpart RR- Standards of Performance for Pressure Sensitive Tape and Label Surface Coating Operations)

The requirements of Rule 4607 are as stringent as or more stringent than the requirements in the NSPS.

C.31.3.4 National Emission Standards for Hazardous Air Pollutants (NESHAPs) and Maximum Achievable Control Technologies (MACTs)

C.31.3.4.1 NESHAP/MACT – 40 CFR 63 Subpart KK (National Emission Standards for the Printing and Publishing Industry)

The requirements of Rule 4607 are as stringent as or more stringent than the requirements in the NESHAP/MACT.

C.31.3.4.2 NESHAP/MACT – 40 CFR 63 Subpart JJJJ (National Emission Standards for Hazardous Air Pollutants: Paper and Other Web Coating)

The requirements of Rule 4607 are as stringent as or more stringent than the requirements in the NESHAP/MACT.

C.31.3.4.3 NESHAP/MACT – 40 CFR 63 Subpart OOOO (National Emission Standards for Hazardous Air Pollutants: Printing, Coating, and Dyeing of Fabrics and Other Textiles)

The requirements of Rule 4607 are as stringent as or more stringent than the requirements in the NESHAP/MACT.

C.31.4 How does District Rule 4607 compare with California State regulations?

There are no state regulations applicable to this source category.

C.31.5 How does District Rule 4607 compare to regulations from other air districts?

C.31.5.1 Bay Area AQMD

C.31.5.1.1 Regulation 8 Rule 4 (General Solvent and Surface Coating Operations)

The requirements in Rule 4607 are as stringent as or more stringent than those in Rule 8-4.

C.31.5.1.2 Regulation 8 Rule 12 (Paper, Fabric and Film Coating)

The requirements in Rule 4607 are as stringent as or more stringent than those in Rule 8-12.

C.31.5.1.3 Regulation 8 Rule 20 (Graphic Arts Printing and Coating Operations)

The requirements in Rule 4607 are as stringent as or more stringent than those in Rule 8-20.

C.31.5.2 Sacramento Metro AQMD

C.31.5.2.1 Rule 450 (Graphic Arts Operations)

The requirements in Rule 4607 are as stringent as or more stringent than those in Rule 450.

C.31.5.3 South Coast AQMD

C.31.5.3.1 Rule 1128 (Paper, Fabric, and Film Coating Operations)

The requirements in Rule 4607 are as stringent as or more stringent than those in Rule 1128.

C.31.5.3.2 Rule 1130 (Graphic Arts)

The requirements in Rule 4607 are as stringent as or more stringent than those in Rule 1130.

C.31.5.3.3 Rule 1130.1 (Screen Printing Operations)

The requirements in Rule 4607 are as stringent as or more stringent than those in Rule 1130.1.

C.31.5.3.4 Rule 1171 (Solvent Cleaning Operations)

The requirements in Rule 4607 are as stringent as or more stringent than those in Rule 1171.

C.31.5.4 Ventura County APCD

C.31.5.4.1 Rule 74.19 (Graphic Arts)

The requirements in Rule 4607 are as stringent as or more stringent than those in Rule 74.19.

C.31.5.4.2 Rule 74.19.1 (Screen Printing Operations)

The requirements in Rule 4607 are as stringent as or more stringent than those in Rule 74.19.1.

C.31.5.4.3 Rule 74.3 (Paper, Fabric, and Film Coating Operations)

The requirements in Rule 4607 are as stringent as or more stringent than those in Rule 74.3.

C.31.6 Potential Emission Reduction Opportunities

No additional emission reduction opportunities have been identified at this time.

C.31.7 Evaluation Findings

Rule 4607 currently has in place the most stringent measures feasible to implement in the Valley and therefore meets or exceeds federal RACT requirements for this source category. As the District continues to develop future attainment plans to address increasingly stringent federal air quality standards, this source category will be re-evaluated for additional potential opportunities to reduce emissions.

C.32 RULE 4610 GLASS COATING OPERATIONS

C.32.1 Emissions Inventory (Summer Average – Tons per day)

	2012	2015	2018	2021	2024	2027	2029	2030	2031
NOx	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
VOC	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a

The emissions from this rule are accounted for in the discussion for Rule 4354 (Glass Melting Furnaces).

C.32.2 District Rule 4610 Description

The requirements of this rule apply to any major source that coats glass products with VOC-containing materials. The purpose of this rule is to limit the emissions of VOCs from the coating of glass products. There are only two glass coating operations in the District, and neither emits enough VOCs to be considered a major source.

C.32.3 How does District Rule 4610 compare with federal rules and regulations?

C.32.3.1 EPA – Control Technique Guidelines (CTG)

EPA CTG requirements are not applicable to this source category.

C.32.3.2 EPA – Alternative Control Technology (ACT)

EPA ACT requirements are not applicable to this source category.

C.32.3.3 Standards of Performance for New Stationary Sources (NSPS)

EPA NSPS requirements are not applicable to this source category.

C.32.3.4 National Emission Standards for Hazardous Air Pollutants (NESHAPs) and Maximum Achievable Control Technologies (MACTs)

EPA NESHAP and MACT requirements are not applicable to this source category.

C.32.4 How does District Rule 4610 compare with California State regulations?

There are no state regulations applicable to this source category.

C.32.5 How does District Rule 4610 compare to regulations from other air districts?

C.32.5.1 Bay Area AQMD

C.32.5.1.1 Regulation 8 Rule 4 (General Solvent and Surface Coating Operations)

The requirements in Rule 46010 are as stringent as or more stringent than those in Rule 8-4.

C.32.5.2 Sacramento Metro AQMD

There are no analogous rules for this source category.

C.32.5.3 South Coast AQMD

C.32.5.3.1 SCAQMD Rule 1145 (Plastic, Rubber, Leather, and Glass Coatings)

SCAQMD adopted VOC limits in Rule 1145 that go beyond RACT for one-component, two-component, optical, and mirror backed roll coatings. This determination is further supported by the District's 2009 RACT SIP demonstration report[53] and the District's 2013 Plan for the Revoked 1-hour Ozone Standard,[54] as approved by EPA.[55]

C.32.5.4 Ventura County APCD

There are no analogous rules for this source category.

C.32.6 Potential Emission Reduction Opportunities

No additional emission reduction opportunities have been identified at this time.

C.32.7 Evaluation Findings

Rule 4610 currently has in place the most stringent measures feasible to implement in the Valley and therefore meets or exceeds federal RACT requirements for this source category. As the District continues to develop future attainment plans to address increasingly stringent federal air quality standards, this source category will be re-evaluated for additional potential opportunities to reduce emissions.

[53] SJVAPCD. *Reasonably Available Control Technology Demonstration for Ozone State Implementation Plans*. (2009, April 16). Retrieved from: http://www.valleyair.org/Air_Quality_Plans/docs/RACTSIP-2009.pdf
[54] SJVAPCD. *2013 Plan for the Revoked 1-Hour Ozone Standard.* (2013, September 19). Retrieved from: http://www.valleyair.org/Air_Quality_Plans/OzoneOneHourPlan2013/AdoptedPlan.pdf
[55] EPA. *Clean Air Plans; 1-Hour and 1997 8-Hour Ozone Nonattainment Area Requirements; San Joaquin Valley, California;* final rule. 81 Fed. Reg. 65, pp. 19492 – 19495. (2016, April 5) (to be codified at 40 CFR Part 52).

C.33 RULE 4612 MOTOR VEHICLE AND MOBILE EQUIPMENT COATING OPERATIONS

C.33.1 Emissions Inventory (Summer Average – Tons per day)

	2012	2015	2018	2021	2024	2027	2029	2030	2031
NOx	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
VOC	1.53	1.57	1.59	1.56	1.59	1.62	1.64	1.65	1.65

C.33.2 District Rule 4612 Description

This rule applies to any person who supplies, sells, offers for sale, manufactures, or distributes any automotive coating for use within the District, as well as any person who uses, applies, or solicits the use or application of any automotive coating within the District. The purpose of this rule is to limit VOC emissions from coatings of motor vehicles, mobile equipment, and associated parts and components, and associated organic solvent cleaning, storage, and disposal.

C.33.3 How does District Rule 4612 compare with federal rules and regulations?

C.33.3.1 EPA – Control Technique Guidelines (CTG)

C.33.3.1.1 CTG – EPA-450/2-76-028 (Control of Volatile Organic Emissions from Existing Stationary Sources – Volume I: Control Methods for Surface Coating Operations)

The requirements of Rule 4612 are as stringent as or more stringent than the requirements in the CTG.

C.33.3.1.2 CTG – EPA-450/2-77-008 (Control of Volatile Organic Emissions from Existing Stationary Sources – Volume II: Surface Coating of Cans, Coils, Paper, Fabrics, Automobiles, and Light-Duty Trucks)

The requirements of Rule 4612 are as stringent as or more stringent than the requirements in the CTG.

C.33.3.1.3 CTG – EPA-453/R-08-006 (Control Techniques Guidelines for Automobile and Light-Duty Truck Assembly Coatings)

The requirements of Rule 4612 are as stringent as or more stringent than the requirements in the CTG.

C.33.3.2 EPA – Alternative Control Technology (ACT)

C.33.3.2.1 ACT – EPA-453/R-94-017 (Alternative Control Techniques Document – Surface Coating of Automotive/Transportation and Business Machine Plastic Parts)

The requirements of Rule 4612 are as stringent as or more stringent than the requirements in the ACT.

C.33.3.3 Standards of Performance for New Stationary Sources (NSPS)

C.33.3.3.1 NSPS – 40 CFR 60 Subpart MM (Standards of Performance for Automobile and Light-Duty Truck Surface Coating Operations)

The requirements of Rule 4612 are as stringent as or more stringent than the requirements in the NSPS.

C.33.3.4 National Emission Standards for Hazardous Air Pollutants (NESHAPs) and Maximum Achievable Control Technologies (MACTs)

C.33.3.4.1 NESHAP/MACT - 40 CFR 63 Subpart IIII (National Emission Standards for HAPs: Surface Coating of Automobiles and Light-Duty Trucks)

The requirements of Rule 4612 are as stringent as or more stringent than the requirements in the NESHAP/MACT.

C.33.4 How does District Rule 4612 compare with California State regulations?

C.33.4.1.1 ARB SCM for Automotive Coatings

The ARB SCM was adopted on October 20, 2005 and has not been updated since. Rule 4612 is as stringent as or more stringent than the requirements in the ARB SCM.

C.33.5 How does District Rule 4612 compare to regulations from other air districts?

C.33.5.1 Bay Area AQMD

C.33.5.1.1 Regulation 8 Rule 45 (Motor Vehicle and Mobile Equipment Coating Operations)

The requirements of Rule 4612 are as stringent as or more stringent than the requirements in Rule 8-45. SCAQMD Rule 1151 and BAAQMD Regulation 8 Rule 45 were last amended before the *2009 RACT SIP* was compiled. These rules contain VOC limits that go beyond RACT for two categories (Pre-Coat and Topcoat–Metallic/Iridescent). EPA's partial approval of the *2009 RACT SIP,* which includes Rule 4612, further demonstrates that the SCAQMD and BAAQMD limits are beyond RACT.

This determination is further supported by the District's 2013 Plan for the Revoked 1-hour Ozone Standard,[56] as approved by EPA.[57]

C.33.5.2 Sacramento Metro AQMD

C.33.5.2.1 SMAQMD Rule 459 (Automotive, Mobile Equipment, and Associated Parts and Components Coating Operations)

The requirements of Rule 4612 are as stringent as or more stringent than Rule 459.

C.33.5.3 South Coast AQMD

C.33.5.3.1 Rule 1151 (Motor Vehicle and Mobile Equipment Non-Assembly Line Coating Operations)

The requirements of Rule 4612 are as stringent as or more stringent than the requirements in Rule 1151. SCAQMD Rule 1151 and BAAQMD Regulation 8 Rule 45 were last amended before the *2009 RACT SIP* was compiled. These rules contain VOC limits that go beyond RACT for two categories (Pre-Coat and Topcoat–Metallic/Iridescent). EPA's partial approval of the *2009 RACT SIP,* which includes Rule 4612, further demonstrates that the SCAQMD and BAAQMD limits are beyond RACT. This determination is further supported by the District's 2013 Plan for the Revoked 1-hour Ozone Standard,[58] as approved by EPA.[59]

C.33.5.4 Ventura County APCD

C.33.5.4.1 VCAPCD Rule 74.18 (Motor Vehicle and Mobile Equipment Coating Operations)

The requirements of Rule 4612 are as stringent as or more stringent than the requirements in Rule 74.18.

C.33.6 Potential Emission Reduction Opportunities

No additional emission reduction opportunities have been identified at this time.

C.33.7 Evaluation Findings

Rule 4612 currently has in place the most stringent measures feasible to implement in the Valley and therefore meets or exceeds federal RACT requirements for this source

[56] SJVAPCD. *2013 Plan for the Revoked 1-Hour Ozone Standard.* (2013, September 19). Retrieved from: http://www.valleyair.org/Air_Quality_Plans/OzoneOneHourPlan2013/AdoptedPlan.pdf
[57] EPA. *Clean Air Plans; 1-Hour and 1997 8-Hour Ozone Nonattainment Area Requirements; San Joaquin Valley, California;* final rule. 81 Fed. Reg. 65, pp. 19492 – 19495. (2016, April 5) (to be codified at 40 CFR Part 52).
[58] SJVAPCD. *2013 Plan for the Revoked 1-Hour Ozone Standard.* (2013, September 19). Retrieved from: http://www.valleyair.org/Air_Quality_Plans/OzoneOneHourPlan2013/AdoptedPlan.pdf
[59] EPA. *Clean Air Plans; 1-Hour and 1997 8-Hour Ozone Nonattainment Area Requirements; San Joaquin Valley, California;* final rule. 81 Fed. Reg. 65, pp. 19492 – 19495. (2016, April 5) (to be codified at 40 CFR Part 52).

category. As the District continues to develop future attainment plans to address increasingly stringent federal air quality standards, this source category will be re-evaluated for additional potential opportunities to reduce emissions.

C.34 RULE 4621 GASOLINE TRANSFER INTO STATIONARY STORAGE CONTAINERS, DELIVERY VESSELS, AND BULK PLANTS

C.34.1 Emissions Inventory (Summer Average – Tons per day)

	2012	2015	2018	2021	2024	2027	2029	2030	2031
NOx	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
VOC	1.53	1.57	1.59	1.56	1.59	1.62	1.64	1.65	1.65

C.34.2 District Rule 4621 Description

Rule 4621 applies to all operations that transfer gasoline between delivery vessels and storage containers and loading racks that are used to load organic liquids with a True Vapor Pressure of 1.5 psi or greater. The purpose of this rule is to limit VOC emissions from stationary storage containers, delivery vessels, and bulk plants.

C.34.3 How does District Rule 4621 compare with federal rules and regulations?

C.34.3.1 EPA – Control Technique Guidelines (CTG)

C.34.3.1.1 EPA-450/2-77-026 Control of Hydrocarbons from Tank Truck Gasoline Loading Terminals

The requirements of Rule 4621 are as stringent as or more stringent than the requirements in the CTG.

C.34.3.1.2 EPA-450/2-77-035 Control of Volatile Organic Emissions from Bulk Gasoline Plants

The requirements of Rule 4621 are as stringent as or more stringent than the requirements in the CTG.

C.34.3.1.3 EPA-450/2-78-051 Guideline for Control of Volatile Organic Compound Leaks from Gasoline Tank Trucks and Vapor Collection Systems

The requirements of Rule 4621 are as stringent as or more stringent than the requirements in the CTG.

C.34.3.2 EPA – Alternative Control Technology (ACT)

C.34.3.2.1 EPA-450/R-75-102 Alternative Control Technology Document for Stage I Vapor Control Systems on Gasoline Service Stations

The requirements of Rule 4621 are more stringent than the requirements in the ACT.

C.34.3.3 Standards of Performance for New Stationary Sources (NSPS)

EPA NSPS requirements are not applicable to this source category.

C.34.3.4 National Emission Standards for Hazardous Air Pollutants (NESHAPs) and Maximum Achievable Control Technologies (MACTs)

EPA NESHAP and MACT requirements are not applicable to this source category.

C.34.4 How does District Rule 4621 compare with California State regulations?

Rule 4621 aligns with ARB's certified Recovery System requirements.

C.34.5 How does District Rule 4621 compare to regulations from other air districts?

C.34.5.1 Bay Area AQMD

C.34.5.1.1 Regulation 8 Rule 7 (Gasoline Dispensing Facilities)

The requirements in Rule 4621 are as stringent as or more stringent than those in Rule 8-7.

C.34.5.1.2 Regulation 8 Rule 39 (Gasoline Bulk Plants and Gasoline Deliver Vehicles)

The requirements in Rule 4621 are as stringent as or more stringent than those in Rule 8-39.

C.34.5.2 Sacramento Metro AQMD

C.34.5.2.1 SMAQMD Rule 448 (Gasoline Storage Containers)

The requirements in Rule 4621 are as stringent as or more stringent than those in Rule 448.

C.34.5.3 South Coast AQMD

C.34.5.3.1 SCAQMD Rule 461 (Gasoline Transfer and Dispensing)

The requirements in Rule 4621 are more as stringent as or stringent than those in Rule 461.

C.34.5.4 Ventura County APCD

C.34.5.4.1 Ventura County APCD Rule 70 (Storage and Transfer of Gasoline)

The requirements in Rule 4621 are as stringent as or more stringent than those in Rule 70.

C.34.6 Potential Emission Reduction Opportunities

No additional emission reduction opportunities have been identified at this time.

C.34.7 Evaluation Findings

Rule 4621 currently has in place the most stringent measures feasible to implement in the Valley and therefore meets or exceeds federal RACT requirements for this source category. As the District continues to develop future attainment plans to address increasingly stringent federal air quality standards, this source category will be re-evaluated for additional potential opportunities to reduce emissions.

C.35 RULE 4622 GASOLINE TRANSFER INTO MOTOR VEHICLE FUEL TANKS

C.35.1 Emissions Inventory (Summer Average – Tons per day)

	2012	2015	2018	2021	2024	2027	2029	2030	2031
NOx	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
VOC	1.81	1.68	1.56	1.48	1.46	1.46	1.48	1.49	1.48

C.35.2 District Rule 4622 Description

This rule applies to any gasoline storage and dispensing operation or mobile fueler from which gasoline is transferred into motor vehicle fuel tanks. The purpose of this rule is to limit emissions of gasoline vapors from these sources.

C.35.3 How does District Rule 4622 compare with federal rules and regulations?

C.35.3.1 EPA – Control Technique Guidelines (CTG)

C.35.3.1.1 CTG - EPA-450/2-78-051 (Control of Volatile Organic Compound Leaks from Gasoline Tank Trucks and Vapor Collection Systems)

The requirements of Rule 4622 are as stringent as or more stringent than the requirements in the CTG.

C.35.3.2 EPA – Alternative Control Technology (ACT)

EPA ACT requirements are not applicable to this source category.

C.35.3.3 Standards of Performance for New Stationary Sources (NSPS)

EPA NSPS requirements are not applicable to this source category.

C.35.3.4 National Emission Standards for Hazardous Air Pollutants (NESHAPs) and Maximum Achievable Control Technologies (MACTs)

C.35.3.4.1 NESHAP/MACT - 40 CFR Subpart 63 CCCCCC (National Emission Standards for Hazardous Air Pollutants for Source Category: Gasoline Dispensing Facilities)

The requirements of Rule 4622 are as stringent as or more stringent than the requirements in the NESHAP/MACT.

C.35.4 How does District Rule 4622 compare with California State regulations?

There are no state regulations applicable to this source category.

C.35.5 How does District Rule 4622 compare to regulations from other air districts?

C.35.5.1 Bay Area AQMD

C.35.5.1.1 Regulation 8 Rule 7 (Gasoline Dispensing Facilities)

The requirements in Rule 4622 are as stringent as or more stringent than those in Rule 8-7.

C.35.5.2 Sacramento Metro AQMD

C.35.5.2.1 SMAQMD Rule 449 (Transfer of Gasoline into Vehicle Fuel Tanks)

The requirements in Rule 4621 are more as stringent as or stringent than those in Rule 449.

C.35.5.3 South Coast AQMD

C.35.5.3.1 SCAQMD Rule 461 (Gasoline Transfer and Dispensing)

The requirements in Rule 4621 are more as stringent as or stringent than those in Rule 461.

C.35.5.4 Ventura County APCD

C.35.5.4.1 VCAPCD Rule 70 (Storage and Transfer of Gasoline)

The requirements in Rule 4622 are as stringent as or more stringent than those in Rule 70.

C.35.6 Potential Emission Reduction Opportunities

No additional emission reduction opportunities have been identified at this time.

C.35.7 Evaluation Findings

Rule 4622 currently has in place the most stringent measures feasible to implement in the Valley and therefore meets or exceeds federal RACT requirements for this source category. As the District continues to develop future attainment plans to address increasingly stringent federal air quality standards, this source category will be re-evaluated for additional potential opportunities to reduce emissions.

C.36 RULE 4623 STORAGE OF ORGANIC LIQUIDS

C.36.1 Emissions Inventory (Summer Average – Tons per day)

	2012	2015	2018	2021	2024	2027	2029	2030	2031
NOx	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
VOC	2.72	2.58	2.44	2.32	2.20	2.08	2.01	1.99	1.95

C.36.2 District Rule 4623 Description

This rule applies to any tank with a capacity of 1,100 gallons or greater in which any organic liquid is placed, held, or stored. The purpose of this rule is to limit VOC emissions from the storage of organic liquids.

C.36.3 How does District Rule 4623 compare with federal rules and regulations?

C.36.3.1 EPA – Control Technique Guidelines (CTG)

C.36.3.1.1 CTG – EPA-450/2-77-036 (Control Techniques Guideline Document for Control of Volatile Organic Emissions from Storage of Petroleum Liquids in Fixed Roof Tanks)

The requirements of Rule 4623 are as stringent as or more stringent than the requirements in the CTG.

C.36.3.1.2 CTG – EPA-450/2-78-047 (Control Techniques Guideline Document for Control of Volatile Organic Emissions from Petroleum Liquid Storage in External Floating Roof Tanks)

The requirements of Rule 4623 are as stringent as or more stringent than the requirements in the CTG.

C.36.3.2 EPA – Alternative Control Technology (ACT)

C.36.3.2.1 ACT – EPA 453/R-94-001 (Alternative Control Techniques Document for Volatile Organic Liquid Storage in Floating and Fixed Roof Tanks)

The requirements of Rule 4623 are as stringent as or more stringent than the requirements in the ACT.

C.36.3.3 Standards of Performance for New Stationary Sources (NSPS)

C.36.3.3.1 NSPS – 40 CFR 60 Subpart Kb (a)(3)(i) (Standards of Performance for Volatile Organic Liquid Storage Vessels for Which Construction, Reconstruction, or Modification Commenced After July 23, 1984)

The requirements in Rule 4621 are more as stringent as or stringent than those in the NSPS.

C.36.3.4 National Emission Standards for Hazardous Air Pollutants (NESHAPs) and Maximum Achievable Control Technologies (MACTs)

EPA NESHAP and MACT requirements are not applicable to this source category.

C.36.4 How does District Rule 4623 compare with California State regulations?

There are no state regulations applicable to this source category.

C.36.5 How does District Rule 4623 compare to regulations from other air districts?

C.36.5.1 Bay Area AQMD

C.36.5.1.1 Regulation 8 Rule 5 (Storage of Organic Liquids)

The requirements in Rule 4623 are as stringent as or more stringent than those in Rule 8-5.

C.36.5.2 Sacramento Metro AQMD

There are no analogous rules for this source category.

C.36.5.3 South Coast AQMD

C.36.5.3.1 South Coast Rule 463 (Organic Liquid Storage)

The requirements in Rule 4623 are as stringent as or more stringent than those in Rule 463. This determination is further supported by the District's 2013 Plan for the Revoked 1-hour Ozone Standard,[60] as approved by EPA.[61]

C.36.5.4 Ventura County APCD

C.36.5.4.1 Rule 71.2 (Storage of Reactive Organic Compound Liquids)

The requirements in Rule 4623 are as stringent as or more stringent than those in Rule 71.2

[60] SJVAPCD. *2013 Plan for the Revoked 1-Hour Ozone Standard.* (2013, September 19). Retrieved from: http://www.valleyair.org/Air_Quality_Plans/OzoneOneHourPlan2013/AdoptedPlan.pdf

[61] EPA. *Clean Air Plans; 1-Hour and 1997 8-Hour Ozone Nonattainment Area Requirements; San Joaquin Valley, California;* final rule. 81 Fed. Reg. 65, pp. 19492 – 19495. (2016, April 5) (to be codified at 40 CFR Part 52).

C.36.6 Potential Emission Reduction Opportunities

There are District BACT standards more stringent than what is currently required in Rule 4623; however, additional add-on controls are beyond RACT and are not technologically feasible and cost effective for all facilities subject to Rule 4623. This determination is further supported by the District's 2013 Plan for the Revoked 1-hour Ozone Standard,[62] as approved by EPA.[63]

C.36.7 Evaluation Findings

Rule 4623 currently has in place the most stringent measures feasible to implement in the Valley and therefore meets or exceeds federal RACT requirements for this source category. As the District continues to develop future attainment plans to address increasingly stringent federal air quality standards, this source category will be re-evaluated for additional potential opportunities to reduce emissions.

[62] SJVAPCD. *2013 Plan for the Revoked 1-Hour Ozone Standard.* (2013, September 19). Retrieved from: http://www.valleyair.org/Air_Quality_Plans/OzoneOneHourPlan2013/AdoptedPlan.pdf

[63] EPA. *Clean Air Plans; 1-Hour and 1997 8-Hour Ozone Nonattainment Area Requirements; San Joaquin Valley, California;* final rule. 81 Fed. Reg. 65, pp. 19492 – 19495. (2016, April 5) (to be codified at 40 CFR Part 52).

C.37 RULE 4624 TRANSFER OF ORGANIC LIQUID

C.37.1 Emissions Inventory (Summer Average – Tons per day)

	2012	2015	2018	2021	2024	2027	2029	2030	2031
NOx	0.03	0.04	0.05	0.05	0.05	0.06	0.06	0.06	0.06
VOC	1.11	1.15	1.20	1.25	1.31	1.39	1.44	1.45	1.45

C.37.2 District Rule 4624 Description

This rule applies to organic liquid transfer facilities. The purpose of this rule is to limit VOC emissions from the transfer of organic liquids.

C.37.3 How does District Rule 4624 compare with federal rules and regulations?

C.37.3.1 EPA – Control Technique Guidelines (CTG)

C.37.3.1.1 CTG - EPA-450/2-77-035 (Control of Volatile Organic Emissions from Bulk Plants)

The requirements of Rule 4624 are as stringent as or more stringent than the requirements in the CTG.

C.37.3.2 EPA – Alternative Control Technology (ACT)

EPA ACT requirements are not applicable to this source category.

C.37.3.3 Standards of Performance for New Stationary Sources (NSPS)

C.37.3.3.1 NSPS - 40 CFR 60 Subpart Kb (a)(3)(i) (Volatile Organic Liquid Storage Vessel)

The requirements of Rule 4624 are as stringent as or more stringent than the requirements in the NSPS.

C.37.3.4 National Emission Standards for Hazardous Air Pollutants (NESHAPs) and Maximum Achievable Control Technologies (MACTs)

C.37.3.4.1 NESHAP/MACT – 40 CFR 63 Subpart EEE (Organic Liquids Distribution (Non-Gasoline))

The requirements of Rule 4624 are as stringent as or more stringent than the requirements in the NESHAP/MACT.

C.37.4 How does District Rule 4624 compare with California State regulations?

There are no state regulations applicable to this source category.

C.37.5 How does District Rule 4624 compare to regulations from other air districts?

C.37.5.1 Bay Area AQMD

C.37.5.1.1 Regulation 8 Rule 6 (Terminals and Bulk Plants)

The requirements in Rule 4624 are as stringent as or more stringent than those in Rule 8-6.

C.37.5.1.2 Regulation 8 Rule 39 (Gasoline Bulk Plants and Gasoline Delivery Vehicles)

The requirements in Rule 4624 are as stringent as or more stringent than those in Rule 8-39.

C.37.5.1.3 Regulation 8 Rule 33 (Gasoline Bulk Terminals and Gasoline Delivery Vehicles)

Rule 8-33 was amended in April 2009 to require an emissions limit of 0.04lb VOC/1,000 gallons, which is lower than the RACT limit in current District Rule 4624 (0.08lb VOC/1,000 gallons liquid loaded). The BAAQMD Regulation 8 Rule 33 limit is beyond RACT. This determination is further supported by the District's 2013 Plan for the Revoked 1-hour Ozone Standard,[64] as approved by EPA in 2016.[65]

C.37.5.2 Sacramento Metro AQMD

C.37.5.2.1 SMAQMD Rule 447(Organic Liquid Loading)

The requirements in Rule 4624 are as stringent as or more stringent than those in Rule 447.

C.37.5.3 South Coast AQMD

C.37.5.3.1 SCAQMD Rule 462 (Organic Liquid Loading)

The requirements in Rule 4624 are as stringent as or more stringent than those in Rule 462.

[64] SJVAPCD. *2013 Plan for the Revoked 1-Hour Ozone Standard.* (2013, September 19). Retrieved from: http://www.valleyair.org/Air_Quality_Plans/OzoneOneHourPlan2013/AdoptedPlan.pdf

[65] EPA. *Clean Air Plans; 1-Hour and 1997 8-Hour Ozone Nonattainment Area Requirements; San Joaquin Valley, California;* final rule. 81 Fed. Reg. 65, pp. 19492 – 19495. (2016, April 5) (to be codified at 40 CFR Part 52).

C.37.5.3.2 SCAQMD Rule 1142 (Marine Tank Vessel Operations)

The requirements in Rule 4624 are as stringent as or more stringent than those in Rule 1142.

C.37.5.4 Ventura County APCD

C.37.5.4.1 VCAPCD Rule 70 (Storage and Transfer of Gasoline)

The requirements in Rule 4624 are as stringent as or more stringent than those in Rule 70.

C.37.5.4.2 VCAPCD Rule 71.3 (Transfer of Reactive Organic Compound Liquids)

The requirements in Rule 4624 are as stringent as or more stringent than those in Rule 71.3.

C.37.6 Potential Emission Reduction Opportunities

No additional emission reduction opportunities have been identified at this time.

C.37.7 Evaluation Findings

Rule 4624 currently has in place the most stringent measures feasible to implement in the Valley and therefore meets or exceeds federal RACT requirements for this source category. As the District continues to develop future attainment plans to address increasingly stringent federal air quality standards, this source category will be re-evaluated for additional potential opportunities to reduce emissions.

C.38 RULE 4625 WASTEWATER SEPARATORS

C.38.1 Emissions Inventory (Summer Average – Tons per day)

	2012	2015	2018	2021	2024	2027	2029	2030	2031
NOx	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
VOC	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07

C.38.2 District Rule 4625 Description

This rule applies to wastewater separators including air flotation units, as defined in this rule. The requirements of this rule only apply to the separation of crude oil and water after custody transfer. The purpose of this rule is to limit VOC emissions from wastewater separators by requiring vapor loss control devices, recordkeeping, inspection, and test methods.

C.38.3 How does District Rule 4625 compare with federal rules and regulations?

C.38.3.1 EPA – Control Technique Guidelines (CTG)

C.38.3.1.1 CTG - EPA-450/2-77-025 (Control of Refinery Vacuum Producing Systems, Water Separators and Process Unit Turnarounds)

The requirements of Rule 4625 are as stringent as or more stringent than the requirements in the CTG.

C.38.3.2 EPA – Alternative Control Technology (ACT)

EPA ACT requirements are not applicable to this source category.

C.38.3.3 Standards of Performance for New Stationary Sources (NSPS)

C.38.3.3.1 NSPS – 40 CFR 60 Subpart QQQ (Standards of Performance for VOC Emissions from Petroleum Refinery Wastewater Systems)

The requirements of Rule 4625 are as stringent as or more stringent than the requirements in the NSPS.

C.38.3.4 National Emission Standards for Hazardous Air Pollutants (NESHAPs) and Maximum Achievable Control Technologies (MACTs)

C.38.3.4.1 NESHAP/MACT – 40 CFR 63 Subpart VV (National Emission Standards for Oil-Water Separators and Organic-Water Separators)

The requirements of Rule 4625 are as stringent as or more stringent than the requirements in the NESHAP/MACT.

C.38.4 How does District Rule 4625 compare with California State regulations?

There are no state regulations applicable to this source category.

C.38.5 How does District Rule 4625 compare to regulations from other air districts?

C.38.5.1 Bay Area AQMD

C.38.5.1.1 Regulation 8 Rule 8 (Wastewater (Oil-Water) Separators)

The requirements in Rule 4625 are as stringent as or more stringent than those in Rule 8-8.

C.38.5.2 Sacramento Metro AQMD

There are no analogous rules for this source category.

C.38.5.3 South Coast AQMD

C.38.5.3.1 SCAQMD Rule 1176 (VOC Emissions from Wastewater Systems)

The requirements in Rule 4625 are as stringent as or more stringent than those in Rule 1176.

C.38.5.4 Ventura County APCD

C.38.5.4.1 Rule 74.8 (Refinery Vacuum Producing Systems, Wastewater Separators and Process Turnarounds)

The requirements in Rule 4625 are as stringent as or more stringent than those in Rule 74.8.

C.38.6 Potential Emission Reduction Opportunities

No additional emission reduction opportunities have been identified at this time.

C.38.7 Evaluation Findings

Rule 4625 currently has in place the most stringent measures feasible to implement in the Valley and therefore meets or exceeds federal RACT requirements for this source category. As the District continues to develop future attainment plans to address increasingly stringent federal air quality standards, this source category will be re-evaluated for additional potential opportunities to reduce emissions.

C.39 RULE 4641 CUTBACK, SLOW CURE, AND EMULSIFIED ASPHALT, PAVING, AND MAINTENANCE OPERATIONS

C.39.1 Emissions Inventory (Summer Average – Tons per day)

	2012	2015	2018	2021	2024	2027	2029	2030	2031
NOx	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
VOC	0.76	0.76	0.77	0.77	0.77	0.79	0.79	0.80	0.80

C.39.2 District Rule 4641 Description

This rule applies to the manufacture and use of cutback asphalt, slow cure asphalt, and emulsified asphalt for paving and maintenance operations. The purpose of this rule is to limit VOC emissions by restricting the application and manufacturing of certain types of asphalt for paving and maintenance operations.

C.39.3 How does District Rule 4641 compare with federal rules and regulations?

C.39.3.1 EPA – Control Technique Guidelines (CTG)

C.39.3.1.1 CTG - EPA-450/2-77-037 (Control of Volatile Organic Compounds from Use of Cutback Asphalt)

The requirements of Rule 4641 are as stringent as or more stringent than the requirements in the CTG.

C.39.3.2 EPA – Alternative Control Technology (ACT)

EPA ACT requirements are not applicable to this source category.

C.39.3.3 Standards of Performance for New Stationary Sources (NSPS)

EPA NSPS requirements are not applicable to this source category.

C.39.3.4 National Emission Standards for Hazardous Air Pollutants (NESHAPs) and Maximum Achievable Control Technologies (MACTs)

EPA NESHAP and MACT requirements are not applicable to this source category.

C.39.4 How does District Rule 4641 compare with California State regulations?

There are no state regulations applicable to this source category.

C.39.5 How does District Rule 4641 compare to regulations from other air districts?

C.39.5.1 Bay Area AQMD

C.39.5.1.1 Regulation 8 Rule 15 (Emulsified and Liquid Asphalts)

The requirements in Rule 4641 are as stringent as or more stringent than those in Rule 8-15.

C.39.5.2 Sacramento Metro AQMD

C.39.5.2.1 SMAQMD Rule 453 (Cutback and Emulsified Asphalt Paving Materials)

The requirements in Rule 4641 are as stringent as or more stringent than those in Rule 453.

C.39.5.3 South Coast AQMD

C.39.5.3.1 SCAQMD Rule 1108 (Cutback Asphalt)

The requirements in Rule 4641 are as stringent as or more stringent than those in Rule 1108.

C.39.5.3.2 SCAQMD Rule 1108.1 (Emulsified Asphalt)

The requirements in Rule 4641 are as stringent as or more stringent than those in Rule 1108.1.

C.39.5.4 Ventura County APCD

C.39.5.4.1 VCAPCD Rule 74.4 (Cutback Asphalt)

The requirements in Rule 4641 are as stringent as or more stringent than those in Rule 74.4.

C.39.6 Potential Emission Reduction Opportunities

Although Rule 4641 currently only regulates VOC emissions, the District made a commitment in the *2015 PM2.5 Plan* to conduct a further study to evaluate Warm Mix Asphalt (WMA) for the purposed of reducing NOx emissions associated with asphalt production. Using WMA instead of hot mix asphalt (HMA) results in lower temperatures necessary for production, storage, and transport. The District collaborated with asphalt industry stakeholders and policy makers to conduct a further study in order to gain an understanding of the use of warm mix technologies in the Valley and to identify potential opportunities and barriers for adoption of this technology.

This study found that WMA has the potential to reduce emissions by using less fuel and the potential to provide safer conditions by producing less odor and fumes. However, in the Valley, many barriers still remain. Poor paving performance in the Valley's high summer heat, lack of confidence in WMA technology, an insufficient number of pilot projects to support feasibility in the Valley, lack of Caltrans WMA specifications to support proper WMA usage, and not enough demand to provide the needed economies of scale to achieve the identified cost benefits have all hindered widespread adoption of WMA throughout the Valley.

The results of this further study effort are available here:
http://www.valleyair.org/Air_Quality_Plans/PM_Plans.htm

C.39.7 Evaluation Findings

Rule 4641 currently has in place the most stringent measures feasible to implement in the Valley and therefore meets or exceeds federal RACT requirements for this source category. As the District continues to develop future attainment plans to address increasingly stringent federal air quality standards, this source category will be re-evaluated for potential emission reduction opportunities.

C.40 RULE 4642 SOLID WASTE DISPOSAL SITES

C.40.1 Emissions Inventory (Summer Average – Tons per day)

	2012	2015	2018	2021	2024	2027	2029	2030	2031
NOx	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
VOC	1.37	1.42	1.48	1.55	1.63	1.70	1.76	1.78	1.81

C.40.2 District Rule 4642 Description

The provisions of this rule apply to any solid waste disposal sites with a gas collection system and/or control device in operation, or undergoing maintenance or repair. The purpose of this rule is to reduce VOC emissions from solid waste disposal sites.

C.40.3 How does District Rule 4642 compare with federal rules and regulations?

C.40.3.1 EPA – Control Technique Guidelines (CTG)

EPA CTG requirements are not applicable to this source category.

C.40.3.2 EPA – Alternative Control Technology (ACT)

EPA ACT requirements are not applicable to this source category.

C.40.3.3 Standards of Performance for New Stationary Sources (NSPS)

C.40.3.3.1 NSPS – 40 CFR 60 Subpart CC (Emission Guidelines and Compliance Times for Municipal Solid Waste Landfills)

The requirements of Rule 4642 are as stringent as or more stringent than the requirements in the NSPS.

C.40.3.4 National Emission Standards for Hazardous Air Pollutants (NESHAPs) and Maximum Achievable Control Technologies (MACTs)

C.40.3.4.1 MACT – 40 CFR 63 Subpart AAAA (National Emission Standards for Hazardous Air Pollutants from Municipal Solid Waste Landfills)

EPA NESHAP requirements are not applicable to this source category. The requirements of Rule 4642 are as stringent as or more stringent than the requirements in the MACT.

C.40.4 How does District Rule 4642 compare with California State regulations?

There are no state regulations applicable to this source category.

C.40.5 How does District Rule 4642 compare to regulations from other air districts?

C.40.5.1 Bay Area AQMD

C.40.5.1.1 Regulation 8 Rule 34 (Solid Waste Disposal Sites)

The requirements in Rule 4642 are as stringent as or more stringent than those in Rule 8-34.

C.40.5.2 Sacramento Metro AQMD

C.40.5.2.1 SMAQMD Rule 485 (Municipal Landfill Gas)

The requirements in Rule 4642 are as stringent as or more stringent than those in Rule 485.

C.40.5.3 South Coast AQMD

C.40.5.3.1 SCAQMD Rule 1150 (Excavation of Landfill Sites)

The requirements in Rule 4642 are as stringent as or more stringent than those in Rule 1150.

C.40.5.3.2 SCAQMD Rule 1150.1 (Control of Gaseous Emissions from Municipal Solid Waste Landfills)

The requirements in Rule 4642 are as stringent as or more stringent than those in Rule 1150.1.

C.40.5.4 Ventura County APCD

C.40.5.4.1 Rule 74.17.1 (Municipal Solid Waste Landfills)

The requirements in Rule 4642 are as stringent as or more stringent than those in Rule 74.17.1.

C.40.6 Potential Emission Reduction Opportunities

No additional emission reduction opportunities have been identified at this time.

C.40.7 Evaluation Findings

Rule 4642 currently has in place the most stringent measures feasible to implement in the Valley and therefore meets or exceeds federal RACT requirements for this source category. As the District continues to develop future attainment plans to address increasingly stringent federal air quality standards, this source category will be re-evaluated for additional potential opportunities to reduce emissions.

C.41 RULE 4651 SOIL DECONTAMINATION OPERATIONS

C.41.1 Emissions Inventory (Summer Average – Tons per day)

	2012	2015	2018	2021	2024	2027	2029	2030	2031
NOx	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
VOC	0.11	0.11	0.12	0.12	0.13	0.13	0.14	0.14	0.14

C.41.2 District Rule 4651 Description

This rule applies to operations involved in the excavation, transportation, handling, decontamination, and disposal of contaminated soil. The purpose of this rule is to limit VOC emissions from soil that has been contaminated with a VOC-containing liquid.

C.41.3 How does District Rule 4651 compare with federal rules and regulations?

C.41.3.1 EPA – Control Technique Guidelines (CTG)

EPA CTG requirements are not applicable to this source category.

C.41.3.2 EPA – Alternative Control Technology (ACT)

EPA ACT requirements are not applicable to this source category.

C.41.3.3 Standards of Performance for New Stationary Sources (NSPS)

EPA NSPS requirements are not applicable to this source category.

C.41.3.4 National Emission Standards for Hazardous Air Pollutants (NESHAPs) and Maximum Achievable Control Technologies (MACTs)

EPA NESHAP and MACT requirements are not applicable to this source category.

C.41.4 How does District Rule 4651 compare with California State regulations?

There are no state regulations applicable to this source category.

C.41.5 How does District Rule 4651 compare to regulations from other air districts?

C.41.5.1 Bay Area AQMD

C.41.5.1.1 Regulation 8 Rule 40 (Aeration of Contaminated Soil and Removal of Underground Storage Tanks)

The requirements in Rule 4651 are as stringent as or more stringent than those in Rule 8-40.

C.41.5.2 Sacramento Metro AQMD

There are no analogous rules for this source category.

C.41.5.3 South Coast AQMD

C.41.5.3.1 SCAQMD Rule 1166 (Volatile Organic Compound Emissions from Decontamination of Soil)

The requirements in Rule 4651 are as stringent as or more stringent than those in Rule 1166.

C.41.5.4 Ventura County APCD

There are no analogous rules for this source category.

C.41.6 Potential Emission Reduction Opportunities

No additional emission reduction opportunities have been identified at this time.

C.41.7 Evaluation Findings

Rule 4651 currently has in place the most stringent measures feasible to implement in the Valley and therefore meets or exceeds federal RACT requirements for this source category. As the District continues to develop future attainment plans to address increasingly stringent federal air quality standards, this source category will be re-evaluated for additional potential opportunities to reduce emissions.

C.42 RULE 4652 COATINGS AND INK MANUFACTURING

C.42.1 Emissions Inventory (Summer Average – Tons per day)

	2012	2015	2018	2021	2024	2027	2029	2030	2031
NOx	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
VOC	0.01	0.01	0.01	0.01	0.01	0.01	0.02	0.02	0.02

C.42.2 District Rule 4652 Description

The provisions of this rule apply to all coatings and ink manufacturing operations. The purpose of this rule is to limit VOC emissions from these operations.

C.42.3 How does District Rule 4652 compare with federal rules and regulations?

C.42.3.1 EPA – Control Technique Guidelines (CTG)

EPA CTG requirements are not applicable to this source category.

C.42.3.2 EPA – Alternative Control Technology (ACT)

EPA ACT requirements are not applicable to this source category.

C.42.3.3 Standards of Performance for New Stationary Sources (NSPS)

EPA NSPS requirements are not applicable to this source category.

C.42.3.4 National Emission Standards for Hazardous Air Pollutants (NESHAPs) and Maximum Achievable Control Technologies (MACTs)

EPA NESHAP and MACT requirements are not applicable to this source category.

C.42.4 How does District Rule 4652 compare with California State regulations?

There are no state regulations applicable to this source category.

C.42.5 How does District Rule 4652 compare to regulations from other air districts?

C.42.5.1 Bay Area AQMD

C.42.5.1.1 Regulation 8 Rule 35 (Coating, Ink and Adhesive Manufacturing)

Although there are some VOC limits in Rule 8-35 that differ in stringency in comparison to District Rule 4652, Rule 4652 is overall at least as stringent as Rule 46. This

determination is further supported by the District's 2013 Plan for the Revoked 1-hour Ozone Standard,[66] as approved by EPA in 2016.[67]

C.42.5.2 Sacramento Metro AQMD

C.42.5.2.1 Rule 466 (Solvent Cleaning)

Although there are some VOC limits in Rule 466 that differ in stringency in comparison to Rule 4652, Rule 4652 is overall more stringent than Rule 466. This determination is further supported by the District's 2013 Plan for the Revoked 1-hour Ozone Standard,[68] as approved by EPA in 2016.[69]

C.42.5.3 South Coast AQMD

C.42.5.3.1 Rule 1141.1 (Coatings and Ink Manufacturing)

The requirements in Rule 4652 are as stringent as or more stringent than those in Rule 1141.1.

C.42.5.4 Ventura County APCD

There are no analogous rules for this source category.

C.42.6 Potential Emission Reduction Opportunities

No additional emission reduction opportunities have been identified at this time.

C.42.7 Evaluation Findings

According to the federal CAA §182(b)(2) and (f) this source category is not subject to federal RACT requirements because this source category has no sources subject to EPA CTGs and these sources are not "major sources" of VOCs and NOx, as confirmed by EPA in the Technical Support Document (TSD) for the partial approval of the Districts 2009 RACT SIP.[70] However, pursuant to the District's No Stone Left Unturned philosophy, Rule 4652 was evaluated as a part of this plan development effort.

Rule 4652 currently has in place the most stringent measures feasible to implement in the Valley and therefore would meet or exceed federal RACT requirements for this

[66] SJVAPCD. *2013 Plan for the Revoked 1-Hour Ozone Standard.* (2013, September 19). Retrieved from: http://www.valleyair.org/Air_Quality_Plans/OzoneOneHourPlan2013/AdoptedPlan.pdf
[67] EPA. *Clean Air Plans; 1-Hour and 1997 8-Hour Ozone Nonattainment Area Requirements; San Joaquin Valley, California;* final rule. 81 Fed. Reg. 65, pp. 19492 – 19495. (2016, April 5) (to be codified at 40 CFR Part 52).
[68] SJVAPCD. *2013 Plan for the Revoked 1-Hour Ozone Standard.* (2013, September 19). Retrieved from: http://www.valleyair.org/Air_Quality_Plans/OzoneOneHourPlan2013/AdoptedPlan.pdf
[69] EPA. *Clean Air Plans; 1-Hour and 1997 8-Hour Ozone Nonattainment Area Requirements; San Joaquin Valley, California;* final rule. 81 Fed. Reg. 65, pp. 19492 – 19495. (2016, April 5) (to be codified at 40 CFR Part 52).
[70] U.S. EPA. Region IX Air Division. Technical Support Document for EPA's Notice of Proposed Rulemaking for the California State Implementation Plan. Prepared by Stanley Tong. (2011, August 29). https://www.regulations.gov/#!documentDetail;D=EPA-R09-OAR-2011-0723-0006

source category were they applicable. As the District continues to develop future attainment plans to address increasingly stringent federal air quality standards, this source category will be re-evaluated for additional potential opportunities to reduce emissions.

C.43 RULE 4653 ADHESIVES AND SEALANTS

C.43.1 Emissions Inventory (Summer Average – Tons per day)

	2012	2015	2018	2021	2024	2027	2029	2030	2031
NOx	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
VOC	0.57	0.54	0.52	0.51	0.49	0.49	0.48	0.47	0.47

C.43.2 District Rule 4653 Description

This rule is applicable to any person who supplies, sells, offers for sale, or applies any adhesive product, sealant product, or associated solvent used within the District. The purpose of this rule is to reduce emissions of VOCs from these operations.

EPA finalized a partial approval/partial disapproval of the *2009 RACT SIP* on January 10, 2012 and deemed this rule as being at least as stringent as established RACT requirements: 77 FR 1417, http://www.gpo.gov/fdsys/pkg/FR-2012-01-10/pdf/2012-139.pdf. EPA finalized approval of the 2010 amendments to Rule 4653 on February 13, 2012 and deemed this rule as being at least as stringent as established RACT requirements: 77 FR 7536, http://www.gpo.gov/fdsys/pkg/FR-2012-02-13/pdf/2012-3172.pdf

C.43.3 How does District Rule 4653 compare with federal rules and regulations?

C.43.3.1 EPA – Control Technique Guidelines (CTG)

C.43.3.1.1 CTG – EPA-453/R-08-005 (Control Techniques Guidelines for Miscellaneous Industrial Adhesives)

The requirements in Rule 4653 are as stringent as or more stringent than those in the CTG.

C.43.3.2 EPA – Alternative Control Technology (ACT)

EPA ACT requirements are not applicable to this source category.

C.43.3.3 Standards of Performance for New Stationary Sources (NSPS)

EPA NSPS requirements are not applicable to this source category.

C.43.3.4 National Emission Standards for Hazardous Air Pollutants (NESHAPs) and Maximum Achievable Control Technologies (MACTs)

EPA NESHAP and MACT requirements are not applicable to this source category.

C.43.4 How does District Rule 4653 compare with California State regulations?

There are no state regulations applicable to this source category.

C.43.4.1.1 ARB's RACT/Best Available Retrofit Control Technology (BARCT) - Determination of Reasonably Available Control Technology and Best Available Retrofit Control Technology for Adhesives and Sealants

The requirements of Rule 4653 are as stringent as or more stringent than the requirements in the BARCT.

C.43.5 How does District Rule 4653 compare to regulations from other air districts?

C.43.5.1 Bay Area AQMD

C.43.5.1.1 Regulation 8 Rule 51 (Adhesive and Sealant Products)

The requirements in Rule 4653 are as stringent as or more stringent than those in Rule 8-51.

C.43.5.2 Sacramento Metro AQMD

C.43.5.2.1 SMAQMD Rule 460 (Adhesives and Sealants)

The requirements in Rule 4653 are as stringent as or more stringent than those in Rule 460.

C.43.5.3 South Coast AQMD

C.43.5.3.1 SCAQMD Rule 1168 (Adhesive and Sealant Applications)

The requirements in Rule 4653 are as stringent as or more stringent than those in Rule 1168.

C.43.5.4 Ventura County APCD

C.43.5.4.1 Rule 74.20 (Adhesives and Sealants)

The requirements in Rule 4653 are as stringent as or more stringent than those in Rule 74.20.

C.43.6 Potential Emission Reduction Opportunities

No additional emissions reductions opportunities have been identified at this time. This determination is further supported by the District's *2013 Plan for the Revoked 1-hour Ozone Standard*,[71] as approved by EPA.[72]

C.43.7 Evaluation Findings

Rule 4653 currently has in place the most stringent measures feasible to implement in the Valley and therefore meets or exceeds federal RACT requirements for this source category. As the District continues to develop future attainment plans to address increasingly stringent federal air quality standards, this source category will be re-evaluated for additional potential opportunities to reduce emissions.

[71] SJVAPCD. *2013 Plan for the Revoked 1-Hour Ozone Standard.* (2013, September 19). Retrieved from: http://www.valleyair.org/Air_Quality_Plans/OzoneOneHourPlan2013/AdoptedPlan.pdf

[72] EPA. *Clean Air Plans; 1-Hour and 1997 8-Hour Ozone Nonattainment Area Requirements; San Joaquin Valley, California;* final rule. 81 Fed. Reg. 65, pp. 19492 – 19495. (2016, April 5) (to be codified at 40 CFR Part 52).

C.44 RULE 4661 ORGANIC SOLVENTS

C.44.1 Emissions Inventory (Summer Average – Tons per day)

	2012	2015	2018	2021	2024	2027	2029	2030	2031
NOx	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
VOC	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a

Rule 4661 establishes limits for the use of organic solvents, however their emissions are represented in the rules that regulate their use: Rule 4662 (Organic Solvent Degreasing Operations), and Rule 4663 Organic Solvent Cleaning, Storage, and Disposal).

C.44.2 District Rule 4661 Description

This rule applies to any source operation that uses organic solvents, with the exception of operations exempted under Section 4.0 of the rule (generally, the manufacture or transport of organic solvents or any source operation that is subject to or exempted by another District rule). The purpose of this rule is to limit VOC emissions from the use of organic solvents. EPA finalized approval of the 2007 amendments to Rule 4661 on May 5, 2010 and deemed this rule as being at least as stringent as established RACT requirements.[73]

C.44.3 How does District Rule 4661 compare with federal rules and regulations?

C.44.3.1 EPA – Control Technique Guidelines (CTG)

C.44.3.1.1 CTG - EPA-453/R-06-001 2006/09 (Control Techniques Guidelines for Industrial Cleaning Solvents)

The requirements of Rule 4661 are as stringent as or more stringent than the requirements in the CTG.

C.44.3.2 EPA – Alternative Control Technology (ACT)

C.44.3.2.1 ACT - EPA-453/R-94-015 1994/02 (Industrial Cleaning Solvents)

The requirements of Rule 4661 are as stringent as or more stringent than the requirements in the ACT.

C.44.3.3 Standards of Performance for New Stationary Sources (NSPS)

EPA NSPS requirements are not applicable to this source category.

[73] 75 FR 24406, http://www.gpo.gov/fdsys/pkg/FR-2010-05-05/pdf/2010-10402.pdf

C.44.3.4 National Emission Standards for Hazardous Air Pollutants (NESHAPs) and Maximum Achievable Control Technologies (MACTs)

C.44.3.4.1 NESHAP/MACT – 40 CFR 63 Subpart T (National Emission Standards for HAPs: Halogenated Solvent Cleaning)

The requirements of Rule 4661 are as stringent as or more stringent than the requirements in the NESHAP.

C.44.4 How does District Rule 4661 compare with California State regulations?

There are no state regulations applicable to this source category.

C.44.5 How does District Rule 4661 compare to regulations from other air districts?

C.44.5.1 Bay Area AQMD

C.44.5.1.1 Regulation 8 Rule 11 (Metal Container, Closure and Coil Coating)

No requirements in Rule 8-11 are more stringent than those in Rule 4661.

C.44.5.2 Sacramento Metro AQMD

C.44.5.2.1 SMAQMD Rule 441 (Organic Solvents)

The requirements in Rule 4661 are as stringent as or more stringent than those in Rule 441.

C.44.5.3 South Coast AQMD

C.44.5.3.1 SCAQMD Rule 1171 (Solvent Cleaning Operation)

The requirements in Rule 4661 are as stringent as or more stringent than those in Rule 1171.

C.44.5.4 Ventura County APCD

There are no analogous rules for this source category.

C.44.6 Potential Emission Reduction Opportunities

No additional emission reduction opportunities have been identified at this time.

C.44.7 Evaluation Findings

Rule 4661 currently has in place the most stringent measures feasible to implement in the Valley and therefore meets or exceeds federal RACT requirements for this source category. As the District continues to develop future attainment plans to address

increasingly stringent federal air quality standards, this source category will be re-evaluated for additional potential opportunities to reduce emissions.

C.45 RULE 4662 ORGANIC SOLVENTS DEGREASING OPERATIONS

C.45.1 Emissions Inventory (Summer Average – Tons per day)

	2012	2015	2018	2021	2024	2027	2029	2030	2031
NOx	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
VOC	1.05	1.05	1.06	1.06	1.06	1.07	1.08	1.08	1.08

C.45.2 District Rule 4662 Description

This rule applies to all organic solvent degreasing operations. The purpose of this rule is to limit VOC emissions and hazardous air pollutant emissions from these operations. EPA finalized approval of the 2007 amendments to Rule 4662 on July 30, 2009 and deemed this rule as being at least as stringent as established RACT requirements.[74]

C.45.3 How does District Rule 4662 compare with federal rules and regulations?

C.45.3.1 EPA – Control Technique Guidelines (CTG)

C.45.3.1.1 CTG - EPA 450/2-77-022 1977/11 (Control of Volatile Organic Emissions from Solvent Metal Cleaning

The requirements of Rule 4662 are as stringent as or more stringent than the requirements in the CTG.

C.45.3.1.2 CTG - EPA 453/R-06-001 Control Technique Guidelines for Industrial Cleaning Solvents

The requirements of Rule 4662 are as stringent as or more stringent than the requirements in the CTG.

C.45.3.2 EPA – Alternative Control Technology (ACT)

EPA ACT requirements are not applicable to this source category.

C.45.3.3 Standards of Performance for New Stationary Sources (NSPS)

EPA NSPS requirements are not applicable to this source category.

C.45.3.4 National Emission Standards for Hazardous Air Pollutants (NESHAPs) and Maximum Achievable Control Technologies (MACTs)

EPA NESHAP and MACT requirements are not applicable to this source category.

[74] 74 FR 37948, http://www.gpo.gov/fdsys/pkg/FR-2009-07-30/pdf/E9-18001.pdf

C.45.4 How does District Rule 4662 compare with California State regulations?

There are no state regulations applicable to this source category.

C.45.5 How does District Rule 4662 compare to regulations from other air districts?

C.45.5.1 Bay Area AQMD

C.45.5.1.1 Regulation 8 Rule 16 (Solvent Cleaning Operations)

BAAQMD does not have a rule that specifically covers organic solvent degreasing operations, but conveyorized solvent cleaner operation requirements are included in Regulation 8, Rule 16 (Solvent Cleaning Operations). The requirements in Rule 4662 are as stringent as or more stringent than those in Rule 8-16.

C.45.5.2 Sacramento Metro AQMD

C.45.5.2.1 SMAQMD Rule 454 (Degreasing Operations)

The requirements of Rule 4663 are as stringent as or more stringent than the requirements in rule 454.

C.45.5.3 South Coast AQMD

C.45.5.3.1 SCAQMD Rule 1122 (Solvent Degreasers)

The requirements of Rule 4663 are as stringent as or more stringent than the requirements in rule 1122.

C.45.5.4 Ventura County APCD

C.45.5.4.1 Rule 74.6 (Surface Cleaning and Degreasing)

The requirements of Rule 4663 are as stringent as or more stringent than the requirements in rule 74.6.

C.45.6 Potential Emission Reduction Opportunities

No additional emissions reductions opportunities have been identified at this time. This determination is further supported by the District's 2013 Plan for the Revoked 1-hour Ozone Standard,[75] as approved by EPA.[76]

C.45.7 Evaluation Findings

[75] SJVAPCD. *2013 Plan for the Revoked 1-Hour Ozone Standard.* (2013, September 19). Retrieved from: http://www.valleyair.org/Air_Quality_Plans/OzoneOneHourPlan2013/AdoptedPlan.pdf

[76] EPA. *Clean Air Plans; 1-Hour and 1997 8-Hour Ozone Nonattainment Area Requirements; San Joaquin Valley, California;* final rule. 81 Fed. Reg. 65, pp. 19492 – 19495. (2016, April 5) (to be codified at 40 CFR Part 52).

Rule 4662 currently has in place the most stringent measures feasible to implement in the Valley and therefore meets or exceeds federal RACT requirements for this source category. As the District continues to develop future attainment plans to address increasingly stringent federal air quality standards, this source category will be re-evaluated for additional potential opportunities to reduce emissions.

C.46 RULE 4663 ORGANIC SOLVENT CLEANING, STORAGE, AND DISPOSAL

C.46.1 Emissions Inventory (Summer Average – Tons per day)

	2012	2015	2018	2021	2024	2027	2029	2030	2031
NOx	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
VOC	0.62	0.66	0.71	0.74	0.8	0.82	0.86	0.87	0.87

C.46.2 District Rule 4663 Description

This rule applies to organic solvent cleaning performed outside a degreaser during the production, repair, maintenance, or servicing of parts, products, tools, machinery, equipment, or in general work areas at stationary sources. This rule also applies to the storage and disposal of all solvents and waste solvent materials at stationary sources. The purpose of this rule is to limit VOC emissions from these processes. EPA finalized approval of the 2007 amendments to Rule 4663 on July 30, 2009 and deemed this rule as being at least as stringent as established RACT requirements. [77]

C.46.3 How does District Rule 4663 compare with federal rules and regulations?

C.46.3.1 EPA – Control Technique Guidelines (CTG)

C.46.3.1.1 CTG - EPA-453/R-06-001 2006/09 (Control Techniques Guidelines for Industrial Cleaning Solvents)

The requirements of Rule 4663 are as stringent as or more stringent than the requirements in the CTG.

C.46.3.2 EPA – Alternative Control Technology (ACT)

C.46.3.2.1 ACT - EPA-453/R-94-015 1994/02 (Alternative Control Techniques Document--Industrial Cleaning Solvents)

The requirements of Rule 4663 are as stringent as or more stringent than the requirements in the ACT.

C.46.3.3 Standards of Performance for New Stationary Sources (NSPS)

EPA NSPS requirements are not applicable to this source category.

C.46.3.4 National Emission Standards for Hazardous Air Pollutants (NESHAPs) and Maximum Achievable Control Technologies (MACTs)

[77] FR 74 37948, http://www.gpo.gov/fdsys/pkg/FR-2009-07-30/pdf/E9-18001.pdf

EPA NESHAP and MACT requirements are not applicable to this source category.

C.46.4 How does District Rule 4663 compare with California State regulations?

There are no state regulations applicable to this source category.

C.46.5 How does District Rule 4663 compare to regulations from other air districts?

C.46.5.1 Bay Area AQMD

C.46.5.1.1 Regulation 8 Rule 16 (Solvent Cleaning Operations)

The requirements in Rule 4663 are as stringent as or more stringent than those in Rule 8-16.

C.46.5.2 Sacramento Metro AQMD

C.46.5.2.1 SMAQMD Rule 441 (Organic Solvents)

The requirements in Rule 4663 are as stringent as or more stringent than those in Rule 441.

C.46.5.3 South Coast AQMD

C.46.5.3.1 SCAQMD Rule 1171(Solvent Cleaning Operation)

The requirements in Rule 4663 are as stringent as or more stringent than those in Rule 1171.

C.46.5.4 Ventura County APCD

There are no analogous rules for this source category.

C.46.6 Potential Emission Reduction Opportunities

No additional emission reduction opportunities have been identified at this time.

C.46.7 Evaluation Findings

Rule 4663 currently has in place the most stringent measures feasible to implement in the Valley and therefore meets or exceeds federal RACT requirements for this source category. As the District continues to develop future attainment plans to address increasingly stringent federal air quality standards, this source category will be re-evaluated for additional potential opportunities to reduce emissions.

C.47 RULE 4672 PETROLEUM SOLVENT DRY CLEANING OPERATIONS

C.47.1 Emissions Inventory (Summer Average – Tons per day)

	2012	2015	2018	2021	2024	2027	2029	2030	2031
NOx	0.05	0.05	0.05	0.06	0.06	0.06	0.06	0.06	0.07
VOC	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

C.47.2 District Rule 4672 Description

This rule applies to petroleum solvent washers, dryers, solvent filters, settling tanks, vacuum stills, and other containers and conveyors of petroleum solvents used in petroleum solvent dry cleaning facilities. The purpose of this rule is to limit VOC emissions from petroleum solvent dry cleaning operations.

EPA finalized approval of the 1992 amendments to Rule 4672 on March 9, 2010 and deemed this rule as being at least as stringent as established RACT requirements: 75 FR 10690, http://www.gpo.gov/fdsys/pkg/FR-2010-03-09/pdf/2010-4967.pdf EPA finalized a partial approval/partial disapproval of the *2009 RACT SIP* on January 10, 2012 and deemed this rule as still being at least as stringent as established RACT requirements: 77 FR 1417, http://www.gpo.gov/fdsys/pkg/FR-2012-01-10/pdf/2012-139.pdf

C.47.3 How does District Rule 4672 compare with federal rules and regulations?

C.47.3.1 EPA – Control Technique Guidelines (CTG)

EPA CTG requirements are not applicable to this source category.

C.47.3.2 EPA – Alternative Control Technology (ACT)

EPA ACT requirements are not applicable to this source category.

C.47.3.3 Standards of Performance for New Stationary Sources (NSPS)

C.47.3.3.1 NSPS – 40 CFR 60 Subpart JJJ (Standards of Performance for Petroleum Dry Cleaners)

The requirements of Rule 4672 are as stringent as or more stringent than the requirements in the NSPS.

C.47.3.4 National Emission Standards for Hazardous Air Pollutants (NESHAPs) and Maximum Achievable Control Technologies (MACTs)

EPA NESHAP and MACT requirements are not applicable to this source category.

C.47.4 How does District Rule 4672 compare with California State regulations?

There are no state regulations applicable to this source category.

C.47.5 How does District Rule 4672 compare to regulations from other air districts?

C.47.5.1 Bay Area AQMD

C.47.5.1.1 Regulation 8 Rule 17 (Petroleum Dry Cleaning Operations)

The requirements in Rule 4672 are as stringent as or more stringent than those in Rule 8-17.

C.47.5.2 Sacramento Metro AQMD

C.47.5.2.1 Rule 444 (Petroleum Solvent Dry Cleaning)

The requirements in Rule 4672 are as stringent as or more stringent than those in Rule 444.

C.47.5.3 South Coast AQMD

C.47.5.3.1 Rule 1102 (Dry Cleaners Using Solvent Other Than Perchloroethylene)

The requirements in Rule 4672 are as stringent as or more stringent than those in Rule 1102.

C.47.5.4 Ventura County APCD

C.47.5.4.1 Rule 74.5.1 (Petroleum Solvent Dry Cleaning)

The requirements in Rule 4672 are as stringent as or more stringent than those in Rule 74.5.1.

C.47.6 Potential Emission Reduction Opportunities

No additional emission reduction opportunities have been identified at this time.

C.47.7 Evaluation Findings

Rule 4672 currently has in place the most stringent measures feasible to implement in the Valley and therefore meets or exceeds federal RACT requirements for this source category. As the District continues to develop future attainment plans to address increasingly stringent federal air quality standards, this source category will be re-evaluated for additional potential opportunities to reduce emissions.

C.48 RULE 4681 RUBBER TIRE MANUFACTURING

C.48.1 Emissions Inventory (Summer Average – Tons per day)

	2012	2015	2018	2021	2024	2027	2029	2030	2031
NOx	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
VOC	0.00	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01

There are no sources in the Valley. There are no emissions from this source category.

C.48.2 District Rule 4681 Description

This rule applies to rubber tire and recapping tread stock manufacturing facilities. The purpose of this rule is to limit emissions of VOC from these facilities.

EPA finalized approval of the 1993 amendments to Rule 4681 on August 17, 1998 and deemed this rule as being at least as stringent as then established RACT requirements.[78]

The District adopted a Negative Declaration on December 16, 2010 to satisfy Clean Air Act CTG RACT requirements for this source category. There are currently no rubber tire manufacturers operating in the Valley. Any rubber tire manufacturers beginning operation in the Valley in the future would be required to go beyond CTG RACT requirements and meet District BACT requirements, per District Rules 2201 (New and Modified Stationary Source Review Rule).

C.48.3 How does District Rule 4681 compare with federal rules and regulations?

C.48.3.1 EPA – Control Technique Guidelines (CTG)

C.48.3.1.1 CTG – EPA-450-2-78-030 (Control of Volatile Organic Emissions from Manufacture of Pneumatic Rubber Tires)

The requirements of Rule 4681 are as stringent as or more stringent than the requirements in the CTG.

C.48.3.2 EPA – Alternative Control Technology (ACT)

EPA ACT requirements are not applicable to this source category.

[78] 63 FR 43881, http://www.gpo.gov/fdsys/pkg/FR-1998-08-17/pdf/98-21900.pdf

C.48.3.3 Standards of Performance for New Stationary Sources (NSPS)

C.48.3.3.1 NSPS – 40 CFR 60 Subpart BBB (Standards of Performance for the Rubber Tire Manufacturing Industry)

The requirements of Rule 4681 are as stringent as or more stringent than the requirements in the NSPS.

C.48.3.4 National Emission Standards for Hazardous Air Pollutants (NESHAPs) and Maximum Achievable Control Technologies (MACTs)

EPA NESHAP and MACT requirements are not applicable to this source category.

C.48.4 How does District Rule 4681 compare with California State regulations?

There are no state regulations applicable to this source category.

C.48.5 How does District Rule 4681 compare to regulations from other air districts?

C.48.5.1 Bay Area AQMD

There are no analogous rules for this source category.

C.48.5.2 Sacramento Metro AQMD

There are no analogous rules for this source category.

C.48.5.3 South Coast AQMD

There are no analogous rules for this source category.

C.48.5.4 Ventura County APCD

There are no analogous rules for this source category.

C.48.6 Potential Emission Reduction Opportunities

No additional emission reduction opportunities have been identified at this time.

C.48.7 Evaluation Findings

There are no rubber tire manufacturers in operation in the Valley, nor are any expected to be operated in the Valley in the future. However, if any rubber tire manufacturers were to begin operating in the Valley, it would be required to meet District BACT requirements, which by definition are beyond RACT. As such, Rule 4681 meets or exceeds federal RACT requirements for this source category.

C.49 RULE 4682 POLYSTYRENE, POLYETHYLENE, AND POLYPROPYLENE PRODUCTS MANUFACTURING

C.49.1 Emissions Inventory (Summer Average – Tons per day)

	2012	2015	2018	2021	2024	2027	2029	2030	2031
NOx	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
VOC	0.30	0.31	0.32	0.34	0.36	0.39	0.41	0.42	0.42

C.49.2 District Rule 4682 Description

The provisions of this rule apply to the manufacturing, processing, and storage of products composed of polystyrene, polyethylene, or polypropylene. The purpose of this rule is to limit emissions of VOCs, trichlorofluoromethane, and dichlorofluoromethane from this source category. EPA finalized approval of the 2011 amendments to Rule 4682 on September 20, 2012 and deemed this rule as being at least as stringent as established RACT requirements.[79]

C.49.3 How does District Rule 4682 compare with federal rules and regulations?

C.49.3.1 EPA – Control Technique Guidelines (CTG)

There are two federal CTGs guidelines that regulate the manufacturing of raw polystyrene, polyethylene, and polypropylene. The facilities subject to Rule 4682 use these raw materials in their manufacturing processes, but do not manufacture such material on site; as such, these regulations do not apply to this source category. EPA CTG requirements are not applicable to this source category.

C.49.3.2 EPA – Alternative Control Technology (ACT)

C.49.3.2.1 ACT – EPA-450/3-90-020 (Control of VOC Emissions from Polystyrene Foam Manufacturing)

The requirements of Rule 4682 are as stringent as or more stringent than the requirements in the ACT.

C.49.3.3 Standards of Performance for New Stationary Sources (NSPS)

[79] 77 FR 58312, http://www.gpo.gov/fdsys/pkg/FR-2012-09-20/pdf/2012-21218.pdf

C.49.3.3.1 NSPS – 40 CFR Part 60 Subpart DDD (Standards of Performance for Volatile Organic Compound (VOC) Emissions from the Polymer Manufacturing Industry)

There is a NSPS guideline that regulates the manufacturing of raw polystyrene, polyethylene, and polypropylene. The facilities subject to Rule 4682 use these raw materials in their manufacturing processes, but do not manufacture such material on site; as such, these regulations do not apply to this source category.

C.49.3.4 National Emission Standards for Hazardous Air Pollutants (NESHAPs) and Maximum Achievable Control Technologies (MACTs)

EPA NESHAP and MACT requirements are not applicable to this source category.

C.49.4 How does District Rule 4682 compare with California State regulations?

There are no state regulations applicable to this source category.

C.49.5 How does District Rule 4682 compare to regulations from other air districts?

C.49.5.1 Bay Area AQMD

C.49.5.1.1 Regulation 8 Rule 52 (Polystyrene, Polypropylene and Polyethylene Foam Product Manufacturing Operations)

The requirements in Rule 4682 are as stringent as or more stringent than those in Rule 8.

C.49.5.2 Sacramento Metro AQMD

There are no analogous rules for this source category.

C.49.5.3 South Coast AQMD

C.49.5.3.1 SCAQMD Rule 1175 (Control of Emissions from the Manufacture of Polymeric Cellular (Foam) Products

The requirements in Rule 4682 are as stringent as or more stringent than those in Rule 1175.

C.49.5.4 Ventura County APCD

There are no analogous rules for this source category.

C.49.6 Potential Emission Reduction Opportunities

No additional emission reduction opportunities have been identified at this time.

C.49.7 Evaluation Findings

Rule 4682 currently has in place the most stringent measures feasible to implement in the Valley and therefore meets or exceeds federal RACT requirements for this source category. As the District continues to develop future attainment plans to address increasingly stringent federal air quality standards, this source category will be re-evaluated for additional potential opportunities to reduce emissions.

C.50 RULE 4684 POLYESTER RESIN OPERATIONS

C.50.1 Emissions Inventory (Summer Average – Tons per day)

	2012	2015	2018	2021	2024	2027	2029	2030	2031
NOx	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
VOC	0.23	0.24	0.24	0.26	0.28	0.30	0.31	0.32	0.33

C.50.2 District Rule 4684 Description

The provisions of this rule apply to commercial and industrial polyester resin operations, fiberglass boat manufacturing operations, organic solvent cleaning, and the storage and disposal of all solvents and waste solvent materials associated with such operations. The purpose of this rule is to reduce VOC emissions from these operations.

EPA finalized approval of the 2011 amendments to Rule 4684 on February 6, 2012 and deemed this rule as being at least as stringent as established RACT requirements.[80] Rule 4684 was recently amended in 2011 to add new specialty coating categories, lower VOC limits, and raise control system effectiveness limits to match existing limits in other air districts. There were no additional feasible emission reduction opportunities that were identified at that time.

C.50.3 How does District Rule 4684 compare with federal rules and regulations?

C.50.3.1 EPA – Control Technique Guidelines (CTG)

C.50.3.1.1 CTG – EPA-450/3-83-006 (Control of Volatile Organic Compound Emissions from Manufacture of High-Density Polyethylene, Polypropylene, and Polystyrene Resins)

The requirements of Rule 4684 are as stringent as or more stringent than the requirements in the CTG.

C.50.3.1.2 CTG – EPA-453/R-08-004 (Control Technique for Fiberglass Boat Manufacturing Materials)

The requirements of Rule 4684 are as stringent as or more stringent than the requirements in the CTG.

C.50.3.2 EPA – Alternative Control Technology (ACT)

EPA ACT requirements are not applicable to this source category.

[80] 77 FR 5709, http://www.gpo.gov/fdsys/pkg/FR-2012-02-06/pdf/2012-2599.pdf

C.50.3.3 Standards of Performance for New Stationary Sources (NSPS)

EPA NSPS requirements are not applicable to this source category.

C.50.3.4 National Emission Standards for Hazardous Air Pollutants (NESHAPs) and Maximum Achievable Control Technologies (MACTs)

C.50.3.4.1 NESHAP/MACT – 40 CFR Part 61 Subpart VVVV (National Emission Standards for Hazardous Air Pollutants for Boat Manufacturing)

The requirements of Rule 4684 are as stringent as or more stringent than the requirements in the NESHAP/MACT.

C.50.4 How does District Rule 4684 compare with California State regulations?

There are no state regulations applicable to this source category.

C.50.5 How does District Rule 4684 compare to regulations from other air districts?

C.50.5.1 Bay Area AQMD

C.50.5.1.1 Regulation 8 Rule 50 (Polyester Resin Operations)

The requirements in Rule 4684 are as stringent as or more stringent than those in Rule 8-50.

C.50.5.2 Sacramento Metro AQMD

C.50.5.2.1 Rule 465 (Polyester Resin Operations)

The requirements in Rule 4684 are as stringent as or more stringent than those in Rule 465.

C.50.5.3 South Coast AQMD

C.50.5.3.1 Rule 1162 (Polyester Resin Operations)

The requirements in Rule 4684 are as stringent as or more stringent than those in Rule 1162.

C.50.5.4 Ventura County APCD

C.50.5.4.1 Rule 74.14 (Polyester Resin Material Operations)

The requirements in Rule 4684 are as stringent as or more stringent than those in Rule 74.14.

C.50.6 Potential Emission Reduction Opportunities

No additional emission reduction opportunities have been identified at this time.

C.50.7 Evaluation Findings

Rule 4684 currently has in place the most stringent measures feasible to implement in the Valley and therefore meets or exceeds federal RACT requirements for this source category. As the District continues to develop future attainment plans to address increasingly stringent federal air quality standards, this source category will be re-evaluated for additional potential opportunities to reduce emissions.

C.51 RULE 4691 VEGETABLE OIL PROCESSING OPERATIONS

C.51.1 Emissions Inventory (Summer Average – Tons per day)

	2012	2015	2018	2021	2024	2027	2029	2030	2031
NOx	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
VOC	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

C.51.2 District Rule 4691 Description

This rule applies to facilities that extract oil from vegetable sources such as cottonseeds and corn. The purpose of this rule is to limit VOC emissions from vegetable oil processing operations. EPA finalized approval of the original 1991 District Rule 461.2 (Vegetable Oil Processing Operations), which subsequently became District Rule 4691, on January 18, 1994.[81]

C.51.3 How does District Rule 4691 compare with federal rules and regulations?

C.51.3.1 EPA – Control Technique Guidelines (CTG)

EPA CTG requirements are not applicable to this source category.

C.51.3.2 EPA – Alternative Control Technology (ACT)

EPA ACT requirements are not applicable to this source category.

C.51.3.3 Standards of Performance for New Stationary Sources (NSPS)

EPA NSPS requirements are not applicable to this source category.

C.51.3.4 National Emission Standards for Hazardous Air Pollutants (NESHAPs) and Maximum Achievable Control Technologies (MACTs)

C.51.4 EPA NESHAP/MACT requirements are not applicable to this source category. How does District Rule 4691 compare with California State regulations?

There are no state regulations applicable to this source category.

C.51.5 How does District Rule 4691 compare to regulations from other air districts?

[81] 59 FR 2535, http://www.gpo.gov/fdsys/pkg/FR-1994-01-18/html/94-1059.htm

C.51.5.1 Bay Area AQMD

C.51.5.1.1 Regulation 8 Rule 41 (Vegetable Oil Manufacturing Operations)

The requirements in Rule 4691 are as stringent as or more stringent than those in Rule 8-41.

C.51.5.2 Sacramento Metro AQMD

There are no analogous rules for this source category.

C.51.5.3 South Coast AQMD

There are no analogous rules for this source category.

C.51.5.4 Ventura County APCD

There are no analogous rules for this source category.

C.51.6 Potential Emission Reduction Opportunities

No additional emission reduction opportunities have been identified at this time.

C.51.7 Evaluation Findings

Rule 4691 currently has in place the most stringent measures feasible to implement in the Valley and therefore meets or exceeds federal RACT requirements for this source category. As the District continues to develop future attainment plans to address increasingly stringent federal air quality standards, this source category will be re-evaluated for additional potential opportunities to reduce emissions.

C.52 RULE 4692 COMMERCIAL CHARBROILERS

C.52.1 Emissions Inventory (Summer Average – Tons per day)

	2012	2015	2018	2021	2024	2027	2029	2030	2031
NOx	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
VOC	0.39	0.41	0.43	0.45	0.47	0.49	0.51	0.51	0.52

C.52.2 District Rule 4692 Description

The Rule 4692 source category includes charbroiling equipment located in restaurants, including hospitals, educational institutions, military, and government facilities. The purpose of this rule is to limit VOC and PM emissions from commercial charbroiling.

The original rule, adopted in March 2002, reduced PM2.5 emissions from chain-driven charbroilers by 84%. The September 2009 rule amendment expanded rule applicability to more chain-driven charbroilers, reducing 25% of the remaining PM2.5 chain-driven charbroiler emissions. EPA finalized approval for Rule 4692 on November 3, 2011.

C.52.3 How does District Rule 4692 compare with federal rules and regulations?

C.52.3.1 EPA – Control Technique Guidelines (CTG)

EPA CTG requirements are not applicable to this source category.

C.52.3.2 EPA – Alternative Control Technology (ACT)

EPA ACT requirements are not applicable to this source category.

C.52.3.3 Standards of Performance for New Stationary Sources (NSPS)

EPA NSPS requirements are not applicable to this source category.

C.52.3.4 National Emission Standards for Hazardous Air Pollutants (NESHAPs) and Maximum Achievable Control Technologies (MACTs)

EPA NESHAP and MACT requirements are not applicable to this source category.

C.52.4 How does District Rule 4692 compare with California State regulations?

There are no state regulations applicable to this source category.

C.52.5 How does District Rule 4692 compare to regulations from other air districts?

C.52.5.1 Bay Area AQMD

C.52.5.1.1 Regulation 6 Rule 2 (Commercial Cooking Equipment)

BAAQMD Regulation 6 Rule 2 regulates both chain-driven and under-fired units. Newly installed under-fired units with more than 10 square feet of cooking area are required to limit emissions to 1 lb of PM10 per 1,000 lbs of cooked beef. Effective January 2013, the same emissions requirements also apply to pre-existing units. However, as the BAAQMD rule is implemented, a significant portion of under-fired charbroilers are below the applicability thresholds for grill size or amount of food cooked, and are thus exempt from rule requirements. In addition, BAAQMD has been unable to enforce this rule because no control technologies have been certified.

The applicability thresholds for grill size in District Rule 4692 are lower than those in BAAQMD Regulation 6 Rule 2. However, because BAAQMD Regulation 6 Rule 2 is not currently being enforced for under-fired charbroilers, District Rule 4692 is effectively more stringent.

C.52.5.2 Sacramento Metro AQMD

Sacramento Metro AQMD has no analogous rules for this source category.

C.52.5.3 South Coast AQMD

South Coast AQMD has no analogous rules for this source category.

C.52.5.4 Ventura County APCD

C.52.5.4.1 Rule 74.25 (Restaurant Cooking Operations)

The District evaluated the requirements contained within VCAPCD's Rule 74.25 and found no requirements more stringent than those already in Rule 4692.

C.52.6 Potential Emission Reduction Opportunities

Under-fired charbroiler technologies are still un-tested in real-life applications and need further evaluation and demonstration at Valley restaurants before these technologies can be considered as requirements to Rule 4692. Technological feasibility issues and logistical issues such as the need to modify hoods and exhaust systems and reinforce roof supports in addition to the purchase, installation, maintenance, and labor costs must all be evaluated.

During the summer of 2015 the Governing Board approved $750,000 to fund the Restaurant Charbroiler Technology Partnership (RCTP) program which provides funding for restaurants to install particulate control systems for under-fired charbroilers as demonstration projects to assess their feasibility and effectiveness. This information will assist in evaluating potential amendments to Rule 4692. The first demonstration

unit funded under the RCTP program started operation in September 2015. Several additional projects are expected to be funded in the near future.

At this time, no additional potential emission reduction opportunities are available for this source category.

C.52.7 Evaluation Findings

According to the federal CAA §182(b)(2) and (f), this source category is not subject to federal RACT requirements, because this source category has no sources subject to EPA CTGs and are not "major sources" of VOCs and NOx, as confirmed by EPA in the Technical Support Document (TSD) for the partial approval of the Districts 2009 RACT SIP.[82] However, pursuant to the District's No Stone Left Unturned philosophy, Rule 4692 was evaluated as a part of this plan development effort.

Rule 4692 currently has the most stringent control requirements. The District has no recommendations for future actions from this source category as a part of this attainment plan. As the District continues to develop future attainment plans to address increasingly stringent federal air quality standards, this source category will be re-evaluated for additional potential opportunities to reduce emissions.

[82] U.S. EPA. Region IX Air Division. Technical Support Document for EPA's Notice of Proposed Rulemaking for the California State Implementation Plan. Prepared by Stanley Tong. (2011, August 29). https://www.regulations.gov/#!documentDetail;D=EPA-R09-OAR-2011-0723-0006

C.53 RULE 4693 BAKERY OVENS

C.53.1 Emissions Inventory (Summer Average – Tons per day)

	2012	2015	2018	2021	2024	2027	2029	2030	2031
NOx	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
VOC	0.31	0.32	0.34	0.36	0.37	0.39	0.40	0.41	0.41

C.53.2 District Rule 4693 Description

The requirements of this rule apply to bakery ovens operated at major source facilities, which emit VOCs during the baking of yeast-leavened products. The purpose of this rule is to limit VOC emissions from these sources. EPA finalized approval of the 2002 adoption of Rule 4693 on April 26, 2004 and deemed this rule as being at least as stringent as established RACT requirements.[83]

C.53.3 How does District Rule 4693 compare with federal rules and regulations?

C.53.3.1 EPA – Control Technique Guidelines (CTG)

EPA CTG requirements are not applicable to this source category.

C.53.3.2 EPA – Alternative Control Technology (ACT)

C.53.3.2.1 ACT – EPA-453/R-92-017 (Alternative Control Technology Document for Bakery Oven Emissions)

The requirements of Rule 4691 are as stringent as or more stringent than the requirements in the ACT.

C.53.3.3 Standards of Performance for New Stationary Sources (NSPS)

EPA NSPS requirements are not applicable to this source category.

C.53.3.4 National Emission Standards for Hazardous Air Pollutants (NESHAPs) and Maximum Achievable Control Technologies (MACTs)

EPA NESHAP and MACT requirements are not applicable to this source category.

C.53.4 How does District Rule 4693 compare with California State regulations?

There are no state regulations applicable to this source category.

[83] 69 FR 22441, http://www.gpo.gov/fdsys/pkg/FR-2004-04-26/pdf/04-9279.pdf

C.53.5 How does District Rule 4693 compare to regulations from other air districts?

C.53.5.1 Bay Area AQMD

C.53.5.1.1 Regulation 8 Rule 42 (Large Commercial Bread Bakeries)

The requirements in Rule 4693 are as stringent as or more stringent than those in Rule 8-42.

C.53.5.2 Sacramento Metro AQMD

C.53.5.2.1 SMAQMD Rule 458 (Large Commercial Bread Bakeries)

The requirements in Rule 4693 are as stringent as or more stringent than those in Rule 458.

C.53.5.3 South Coast AQMD

C.53.5.3.1 SCAQMD Rule 1153 (Commercial Bakery Ovens)

The requirements in Rule 4693 are as stringent as or more stringent than those in Rule 1153.

C.53.5.4 Ventura County APCD

There are no analogous rules for this source category.

C.53.6 Potential Emission Reduction Opportunities

No additional emissions reductions opportunities have been identified at this time. This determination is further supported by the District's 2013 Plan for the Revoked 1-hour Ozone Standard,[84] as approved by EPA.[85]

C.53.7 Evaluation Findings

Rule 4693 currently has in place the most stringent measures feasible to implement in the Valley and therefore meets or exceeds federal RACT requirements for this source category. As the District continues to develop future attainment plans to address increasingly stringent federal air quality standards, this source category will be re-evaluated for additional potential opportunities to reduce emissions.

[84] SJVAPCD. *2013 Plan for the Revoked 1-Hour Ozone Standard.* (2013, September 19). Retrieved from: http://www.valleyair.org/Air_Quality_Plans/OzoneOneHourPlan2013/AdoptedPlan.pdf

[85] EPA. *Clean Air Plans; 1-Hour and 1997 8-Hour Ozone Nonattainment Area Requirements; San Joaquin Valley, California;* final rule. 81 Fed. Reg. 65, pp. 19492 – 19495. (2016, April 5) (to be codified at 40 CFR Part 52).

C.54 RULE 4694 WINE FERMENTATION AND STORAGE TANKS

C.54.1 Emissions Inventory (Summer Average – Tons per day)

	2012	2015	2018	2021	2024	2027	2029	2030	2031
NOx	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
VOC	3.56	3.72	3.98	4.18	4.35	4.50	4.58	4.61	4.64

C.54.2 District Rule 4694 Description

Rule 4694 was adopted on December 15, 2005 to reduce VOC emissions from the fermentation and bulk storage of wine, or achieve equivalent reductions from alternative emission sources. This rule is applicable to any winery fermenting wine and/or storing bulk containers with the exception of wineries with baseline fermentation emissions of less than 10 tpy or is limited by a District permit condition to a Potential To Emit of less than 10 tpy VOC emissions from fermentation, or storage tanks made of concrete and/or wood.

The rule requires facilities to reduce the VOC emissions from fermentation by 35% of their baseline emissions annually. Tanks over 5,000 gallons in volume must be equipped with pressure/vacuum relieve valves operating within 10% of the maximum allowable working pressure of the tank, and the temperature of stored wine must be maintained at or below 75 degrees Fahrenheit. The rule exempts storage tanks constructed primarily of concrete or wood and wineries that emit less than 10 tons of VOC per year.

General Process Description
Wine making involves three major steps: grapes are harvested, crushed, and then fermented. Rule 4694 focuses on the third step of this process, wine fermentation which is typically a batch process. The majority of the volume of the State of California's wine production occurs in the Valley. The majority of wine production in the Valley occurs at large wineries, with annual wine production capacities of tens of millions of gallons. Wine fermentation is a significant industry in the Valley with total projected emissions of 4.64 tpd of VOC in 2031.

Ethanol is the primary VOC produced during wine fermentation. Many different types of established technologies can be used to control ethanol emissions. Five types of VOC controls are:

1. Oxidation (conversion of the VOC to CO_2);
2. Absorption ("scrubbers", which transfer the VOC in air emissions to a liquid waste stream);
3. Adsorption (often using activated carbon, which transfers the VOC in the air onto a solid substrate);

4. Condensation (conversion of the VOC gases into liquids); and
5. Biological control systems (e.g., bio-filters or bio-scrubbers)

C.54.3 How does District Rule 4691 compare with federal rules and regulations?

C.54.3.1 EPA – Control Technique Guidelines (CTG)

EPA CTG requirements are not applicable to this source category.

C.54.3.2 EPA – Alternative Control Technology (ACT)

EPA ACT requirements are not applicable to this source category.

C.54.3.3 Standards of Performance for New Stationary Sources (NSPS)

EPA NSPS requirements are not applicable to this source category.

C.54.3.4 National Emission Standards for Hazardous Air Pollutants (NESHAPs) and Maximum Achievable Control Technologies (MACTs)

EPA NESHAP and MACT requirements are not applicable to this source category.

C.54.4 How does District Rule 4694 compare with California State regulations?

There are no state regulations applicable to this source category.

C.54.5 How does District Rule 4694 compare to regulations from other air districts?

C.54.5.1 Bay Area AQMD

There are no analogous rules for this source category.

C.54.5.2 Sacramento Metro AQMD

There are no analogous rules for this source category.

C.54.5.3 South Coast AQMD

There are no analogous rules for this source category.

C.54.5.4 Ventura County APCD

There are no analogous rules for this source category.

C.54.6 Potential Emission Reduction Opportunities

Through ongoing review of wine fermentation permitting applications, the District has closely tracked the development of new emission control technologies for capturing ethanol emissions from wine fermentation processes. Technologies of interest have included scrubbers, condensers, activated carbon and thermal oxidizers. In recent years, several wine manufacturing facilities have successfully implemented or are experimenting with new emission control systems that capture ethanol emissions from some of their wine fermentation operations. Two wineries currently utilize water scrubbers to capture ethanol emissions from wine fermentation tanks, and several other wineries have developed systems that utilize scrubbers and chilled vapor condensers. Preliminary cost effectiveness analyses results indicate the costs to be between $18,337 and $89,644 per ton of VOC reduced, depending on the size of the winery, fermentation tank configuration, type of wine, number of fermentation rotations, and other factors.

C.54.7 Evaluation Findings

As demonstrated above, District Rule 4694 meets RACT requirements.

The District commits to working closely with affected operators to undergo a regulatory amendment process for Rule 4694 as follows:

Modeling shows that the Valley is a NOx-limited regime, especially in projections of future years. As such, VOC reductions are not as effective in reducing Valley ozone concentrations as NOx reductions. The District will evaluate the technological achievability and economic feasibility of implementing emission control technologies to reduce VOC emissions from wine fermentation processes and potential benefits to help reduce ozone concentrations. Upon completion of this review, the District commits to amend Rule 4694 to include additional requirements to further reduce emissions from wine fermentation processes as appropriate by December 31, 2018.

C.55 RULE 4695 BRANDY AGING AND WINE AGING OPERATIONS

C.55.1 Emissions Inventory (Summer Average – Tons per day)

	2012	2015	2018	2021	2024	2027	2029	2030	2031
NOx	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
VOC	7.04	7.35	7.87	8.26	8.60	8.89	9.05	9.12	9.17

C.55.2 District Rule 4695 Description

Adopted on September 19, 2009, Rule 4695 is applicable to brandy aging and wine aging operations in the Valley. The purpose of this rule is to limit VOC emissions from these operations. EPA finalized approval of Rule 4695 on August 4, 2011 and deemed this rule as meeting RACT requirements.[86]

C.55.3 How does District Rule 4695 compare with federal rules and regulations?

C.55.3.1 EPA – Control Technique Guidelines (CTG)

EPA CTG requirements are not applicable to this source category.

C.55.3.2 EPA – Alternative Control Technology (ACT)

EPA ACT requirements are not applicable to this source category.

C.55.3.3 Standards of Performance for New Stationary Sources (NSPS)

EPA NSPS requirements are not applicable to this source category.

C.55.3.4 National Emission Standards for Hazardous Air Pollutants (NESHAPs) and Maximum Achievable Control Technologies (MACTs)

EPA NESHAP and MACT requirements are not applicable to this source category.

C.55.4 How does District Rule 4695 compare with California State regulations?

There are no state regulations applicable to this source category.

C.55.5 How does District Rule 4695 compare to regulations from other air districts?

[86] Environmental Protection Agency. EPA. *Revision to the State Implementation Plan, San Joaquin Valley Unified Air Pollution Control District;* Final rule. 76 Federal Register Fed. Reg. 150 (2011, August 4), pp. 47076 – 47077. (To be codified at 40 CFR Part 52). Retrieved from http://www.gpo.gov/fdsys/pkg/FR-2011-08-04/pdf/2011-19384.pdf

C.55.5.1 Bay Area AQMD

There are no analogous rules for this source category.

C.55.5.2 Sacramento Metro AQMD

There are no analogous rules for this source category.

C.55.5.3 South Coast AQMD

There are no analogous rules for this source category.

C.55.5.4 Ventura County APCD

There are no analogous rules for this source category.

C.55.6 Potential Emission Reduction Opportunities

No additional emissions reductions opportunities have been identified at this time. This determination is further supported by the District's 2013 Plan for the Revoked 1-hour Ozone Standard,[87] as approved by EPA.[88]

C.55.7 Evaluation Findings

Rule 4695 currently has in place the most stringent measures feasible to implement in the Valley and therefore meets or exceeds federal RACT requirements for this source category. As the District continues to develop future attainment plans to address increasingly stringent federal air quality standards, this source category will be re-evaluated for additional potential opportunities to reduce emissions.

[87] SJVAPCD. *2013 Plan for the Revoked 1-Hour Ozone Standard.* (2013, September 19). Retrieved from: http://www.valleyair.org/Air_Quality_Plans/OzoneOneHourPlan2013/AdoptedPlan.pdf

[88] EPA. *Clean Air Plans; 1-Hour and 1997 8-Hour Ozone Nonattainment Area Requirements; San Joaquin Valley, California;* final rule. 81 Fed. Reg. 65, pp. 19492 – 19495. (2016, April 5) (to be codified at 40 CFR Part 52).

C.56 RULE 4702 INTERNAL COMBUSTION ENGINES

C.56.1 Emissions Inventory (Summer Average – Tons per day)

	2012	2015	2018	2021	2024	2027	2029	2030	2031
NOx	16.83	11.68	8.16	7.30	6.46	5.79	5.36	5.16	5.05
VOC	1.55	1.27	0.96	0.89	0.79	0.73	0.69	0.67	0.66

C.56.2 District Rule 4702 Description

Rule 4702 applies to any internal combustion (IC) engine rated at 25 brake horsepower (bhp) or greater. The purpose of this rule is to limit NOx, carbon monoxide (CO), VOC, and SOx emissions from units subject to this rule.

The District's original IC engine rule, Rule 4701 (Internal Combustion Engines – Phase 1), was adopted on May 21, 1992, superseded by Rule 4702, adopted on August 21, 2003, and subsequently amended five times. The rule established NOx limits between 25-50 ppmv achieving 90-96% control for non-agricultural operation rich-burn engines, and 65-75 ppmv achieving 85-90% control for non-agricultural operation lean-burn engines. Through years of implementing increasingly stringent requirements, Rules 4701 and 4702 have achieved significant reductions of NOx and PM emissions.

Substantial emission reductions from agricultural IC engines have also been achieved through a combination of regulatory efforts and incentive actions. Rule 4702 has effectively reduced emissions from agricultural engines by 84% since the 2005 amendments to the rule, with substantial investments being made by the affected sources to comply with the rule. The rule was further strengthened in August 2011 when rule amendments implemented more stringent NOx limits as low as 11 ppmv for non-agricultural operations spark-ignited engines. Additional emission reductions are forthcoming under Rule 4702 as compliance dates for emission control requirements continue to approach over the coming years.

An internal combustion engine is any engine that operates by burning its fuel inside the engine. Engines generate power by the combustion of an air/fuel mixture. The main types of engines are spark-ignited engines and compression-ignited (or diesel) engines. In the case of spark-ignited engines, a spark plug ignites the air/fuel mixture. Spark-ignited engines come in several designs such as: two-stroke and four-stroke, rich-burn and lean-burn, turbocharged and naturally aspirated. Spark-ignited engines may use one or more fuels, such as natural gas, propane, butane, liquefied petroleum gas, oil field gas, digester gas, landfill gas, methanol, ethanol, and gasoline. Compression-ignited engines rely on heating of the inducted air during the compression stroke to ignite the injected diesel fuel. In addition to being classified into spark-ignited and compression-ignited, IC engines can be further classified as either two-stroke or four-stroke engines. Most diesel engines are four-stroke, while larger diesel engines often

are two-stroke. Natural gas-fired spark-ignited engines are usually four-stroke, but some operators prefer two-stroke engines for their applications.

Engines are used by a variety of private businesses and public agencies throughout the Valley for a number of purposes, primarily for powering pumps, compressors, or electrical generators. Examples of businesses and industries that use engines include: schools and universities, agriculture, oil and gas production and pipelines, petroleum refining, manufacturing facilities, food processing, electrical power generation, landfill and waste water treatment facilities, and water districts. Many engines are limited or low use in nature, such as emergency standby engines that provide backup power when electric service is interrupted.

C.56.3 How does District Rule 4702 compare with federal rules and regulations?

C.56.3.1 EPA – Control Technique Guidelines (CTG)

There are no EPA Control Technique Guidelines (CTG) requirements for this source category.

C.56.3.2 EPA – Alternative Control Technology (ACT)

C.56.3.2.1 EPA – 453/R-93-032 (Alternative Control Techniques Document – NOx Emissions from Stationary Reciprocating Internal Combustion Engines)

The District evaluated the requirements contained within the EPA – 453/R-93-032 ACT document and found no requirements that were more stringent than those already in Rule 4702.

C.56.3.3 Standards of Performance for New Stationary Sources (NSPS)

C.56.3.3.1 40 CFR 60 Subpart IIII (Standards of Performance for Stationary Compression Ignition Internal Combustion Engines)

The District evaluated the requirements contained within 40 CFR 60 Subpart IIII and found no requirements that were more stringent than those already in Rule 4702.

C.56.3.3.2 40 CFR 60 Subpart JJJJ (Standards of Performance for Stationary Spark Ignition Internal Combustion Engines)

The District evaluated the requirements contained within 40 CFR 60 Subpart JJJJ and found no requirements that were more stringent than those already in Rule 4702.

C.56.3.4 National Emission Standards for Hazardous Air Pollutants (NESHAPs) and Maximum Achievable Control Technologies (MACTs)

C.56.3.4.1 40 CFR 63 Subpart ZZZZ (NESHAP for Stationary Reciprocating Internal Combustion Engines)

The District evaluated the requirements contained within 40 CFR 63 Subpart ZZZZ NESHAP and found no requirements that were more stringent than those already in Rule 4702.

C.56.4 How does District Rule 4702 compare with California State regulations?

C.56.4.1 17 CCR 93114 (ATCM to Reduce Particulate Emissions from Diesel-Fueled Engines—Standards for Nonvehicular Diesel Fuel)

The District implements the requirements of 17 CCR 93114 through Rule 4702 and the District's new source review permitting program (Rule 2201).

C.56.4.2 17 CCR 93115 (ATCM for Stationary Compression Ignition Engines)

The District implements the requirements of 17 CCR 93115 through Rule 4702 and the District's new source review permitting program (Rule 2201).

C.56.5 How does District Rule 4702 compare to regulations from other air districts?

C.56.5.1 Bay Area AQMD

C.56.5.1.1 Regulation 9 Rule 8 (Nitrogen Oxides and Carbon Monoxide from Stationary Internal Combustion Engines)

The District evaluated the requirements contained within BAAQMD's Regulation 9 Rule 8 and found no requirements that were more stringent than those already in Rule 4702.

C.56.5.2 Sacramento Metro AQMD

C.56.5.2.1 Rule 412 (Stationary Internal Combustion Engines Located at Major Stationary Sources of NOx)

The District evaluated the requirements contained within SMAQMD's Rule 412 and found no requirements that were more stringent than those already in Rule 4702.

C.56.5.3 Ventura County APCD

C.56.5.3.1 Rule 74.9 (Stationary Internal Combustion Engines)

The District evaluated the requirements contained within VCAPCD's Rule 74.9 and found no requirements that were more stringent than those already in Rule 4702.

C.56.5.4 South Coast AQMD

C.56.5.4.1 Rule 1110.2 (Emissions from Gaseous- and Liquid-Fueled Engines) and Rules 2000 – 2020 (RECLAIM program)

South Coast Air Quality Management District (SCAQMD) regulates the emissions from IC engines through a combination of control measures. SCAQMD 1110.2 is directly applicable to IC engines and includes emissions limitations for various applications. SCAQMD's RECLAIM program (Rules 2000 – 2020) allows most operators to purchase credits in lieu of instituting engine emissions controls otherwise required under SCAQMD 1110.2. Given these overlapping sets of requirements, Rule 4702 must be compared in context of both regulations. Additionally, many of the engine applications found in the Valley vary substantially from engine applications in SCAQMD; for example, engines used for agricultural irrigation pumping that exist in the Valley and are no longer found in SCAQMD. While not directly comparable, the following tables compare the emission limits between SCAQMD Rule 1110.2 and District Rule 4702.

Table C-5 Comparison of District and SCAQMD NOx Emission Limits for Non-Agricultural Operations (Non-AO) Spark-Ignited Waste Gas Engines Rated at > 50 bhp (corrected to 15% oxygen on a dry basis)

Engine Type	District NOx Limit (ppmv)	SCAQMD NOx Limit (ppmv)
Waste Gas Fueled (Rich-Burn)	50	*Until 01-01-16* bhp ≥ 500: 36 x ECF[89] bhp < 500: 45 x ECF[92] *On and after 01-01-16* 11 ppmv
Waste Gas Fueled (Lean-Burn)	65 ppmv or 90% reduction	*Until 01-01-16* bhp ≥ 500: 36 x ECF[92] bhp < 500: 45 x ECF[92] *On and after 01-01-16* 11 ppmv

[89] The efficiency correction factor (ECF) is 1.0, unless: 1) The engine operator has measured the engine's net specific energy consumption, in compliance with ASME Performance Test Code PTC 17 -1973, at the average load of the engine; and 2) the ECF-corrected emission limit is made a condition of the engine's permit to operate. The ECF is never less than 1.0 so in some cases the SCAQMD limits could potentially be less stringent than the District's NOx limits.

Table C-6 Comparison of District and SCAQMD NOx Emission Limits for Non-AO Spark-Ignited Engines Rated > 50 bhp (corrected to 15% oxygen on a dry basis)

Engine Type	District NOx Limit (ppmv)	SCAQMD NOx Limit (ppmv)
1. Rich-Burn		
Rich-Burn Engine (except for below special applications)	11	11
Cyclic Loaded, Field Gas Fueled	50	11
Limited Use	25	11[90]
2. Lean-Burn Engines		
Lean-Burn Engine (except for below special applications)	11	11
Two-Stroke, Gaseous Fueled, > 50 bhp and < 100 bhp	75	11
Limited Use	65	11
Lean-Burn Engine used for gas compression	65 ppmv or 93% reduction	11

Table C-7 Comparison of District and SCAQMD NOx Emission Limits for Agricultural Operations (AO) Spark-Ignited Engines Rated > 50 bhp (corrected to 15% oxygen on a dry basis)

Engine Type	District NOx Limit	SCAQMD NOx Limit
1. Rich-Burn	90 ppmv or 80% reduction	11
2. Lean-Burn	150 ppmv or 70% reduction	11
3. Certified and installed on or before June 16, 2005	Meet a Certified Spark-Ignited Engine Standard of HC + NOx < 0.6 g/bhp-hr	11

Medium and large operators in the South Coast Air Basin are most likely part of the South Coast RECLAIM program and are subsequently not required to meet the engine emission limitations included in Rule 1110.2. All facilities that emit over a certain threshold are required to participate in the RECLAIM program. As part of the RECLAIM program, certain companies receive emission allocations every year, usable for 12 months. The portion of the allocation not needed to offset the operator's own emissions can be sold to other companies. If the operator does not receive an emission allocation, they must buy emission credits from operators with unused emission allocations. In this way, the RECLAIM program is similar to a cap-and-trade program. The District does not have a RECLAIM-type program for this source category; therefore, all operators are required to meet the stringent emission limitations included in Rule 4702.

[90] SCAQMD exempt units that operate less than 500 hours from this limit; District defines "limited use" units as those operating less than 4,000 hours and only exempts engines operating less than 200 hours.

Although the SCAQMD emission level of 11 ppm has not yet been proven as technologically feasible in agricultural settings and it is unclear what percentage of facilities are complying with the current SCAQMD NOx limits for non-ag categories, the District evaluated the cost-effectiveness and feasibility of implementing an 11 ppmv NOx emission limit for the following categories of IC engines:

- Non-Agricultural Operations (Non-AO) Waste Gas Engines
- Non-AO Spark-Ignited Engines
  - Cyclic Loaded, Field Gas Fueled
  - Limited Use Engines
    - Lean-Burn Engines
    - Rich-Burn Engines
  - Two-Stroke, Gaseous Fueled Engines 50-100 bhp
  - Lean-Burn Engines Used for Gas Compression
- Agricultural Operations (AO) Spark-Ignited Engines

The District also evaluated the cost-effectiveness and feasibility of implementing intermediate NOx emission limits for AO spark-ignited engines that more closely match the current NOx emission limits for non-AO limited use rich-burn and lean-burn engines.

To determine potential emissions reductions, the District used the following equations:

NOx = (BHP x HR x EF x LF) / (CF)

Where:

NOx = Current annual NOx emissions or potential annual NOx emissions in ton/year
BHP = engine power
HR = annual hours of operation
EF = NOx emission factor
LF = engine load factor
CF = conversion factor from grams to pounds

The estimated annual NOx emissions reduction was calculated using the following equation:

Potential Emissions Reduction = current annual NOx emissions – potential NOx annual NOx emissions

NON-AGRICULTURAL OPERATIONS (NON-AO) WASTE GAS ENGINES

The District analyzed the technological feasibility of lowering the NOx emission limit for waste gas engines and determined that due to the variability of waste gas, additional levels of NOx control on existing waste gas engines can pose significant technical and feasibility challenges. Waste gas includes landfill gas, which is generated at landfills, and digester gas, which is generated from anaerobic digestion. Both landfill and digester gas result from the decomposition of organic matter by microorganisms in the absence of oxygen. Unlike pipeline natural gas, the composition of waste gas is not consistent or guaranteed. The heating value and composition of the gas (e.g. methane and oxygen contents) will vary with the type of materials that enter the landfill or digester and can also fluctuate seasonally or even daily. Both landfill and digester gases contain impurities, such as siloxanes, sulfur compounds, and halides. Landfill gas also contains entrained particulate matter, and both landfill and digester gas may contain particulate that results from combustion of the impurities in the gas. The contaminants in waste gas can coat and/or poison catalysts, rendering them ineffective. Because of its variable composition and contaminants, untreated waste gas is not interchangeable with pipeline-quality natural gas, and extensive and costly cleanup would be necessary to allow the use of catalytic emission controls needed to achieve 11 ppmv. This is not a practical option for most existing waste gas-fired engines, which were not designed to include the required gas systems and catalytic controls.

In addition to the District's efforts to identify additional potential technology options for this category, SCAQMD has also been evaluating this issue. In February 2008, SCAQMD amended Rule 1110.2 to include an 11 ppmv limit for waste gas engines rated at > 50 bhp. The original compliance date for this emissions limit was July 1, 2012, with the assumption that SCAQMD would complete a Technology Assessment to verify the feasibility of available control technologies for waste gas engines. However, SCAQMD had to amend Rule 1110.2 in September 2012 to extend the compliance deadline for waste gas engines from 2012 to 2016 in order to allow for more time to complete their Final Technology Assessment, which is currently still incomplete and has yet to identify feasible technology options. Additionally, these sources may also be in a position to avoid installing additional NOx control technologies through their participation in SCAQMD's RECLAIM program.

District Rule 4702 contains the most stringent limits feasible for existing waste gas-fueled engines based on the use of combustion processes that minimize emissions without the use of post-combustion catalytic controls. Therefore, Rule 4702 meets or exceeds RACT for non-AO waste gas-fueled spark-ignited engines.

OTHER NON-AO SPARK-IGNITED ENGINES

Cyclic Loaded, Field Gas Fueled

Cyclic-loaded, field gas fueled engines can achieve some level of control, but not the stringent level of control that can be imposed on engines that operate in a narrow and more stable range of loads. The exhaust gas temperature of cyclic loaded engines

varies as a function of the engine load; however, catalyst chemistry is dependent on a minimum temperature to be effective in reducing emissions. When the cyclic load engine is operating in a particular engine load range, the exhaust gas temperature can reach the catalyst's effective range and allow for emissions to be well-controlled; however, as the engine cycles out of this load range, the exhaust gas temperature becomes too low for effective emissions control. Since the exhaust temperature fluctuates frequently for this category of units, it is technologically infeasible to require a lower NOx limit for cyclic loaded field-gas fueled engines. The current emission limit for this category of engines meets or exceeds RACT for these sources.

Limited Use Engines

During the 2011 amendments to Rule 4702, the District created this category of engines based on the high costs and cost effectiveness associated with the installation of additional controls for these engines (< 4,000 hours of operation). As discussed in the staff report, the NOx emission reductions foregone from not lowering the existing NOx limits to 11 ppmv for limited use engines was insignificant (about 0.004 tons per day in 2011).[91]

However, because the evaluation was conducted in 2011, the District re-evaluated the cost effectiveness of lowering the NOx emission limits to 11 ppmv for limited use non-AO rich-burn and lean-burn engines. The costs in the analyses below were gathered from information in the District's Permits database, IC engine manufacturers, and operators.

Limited Use Lean-Burn Engines

When evaluating the ability to lower NOx emissions to 11 ppmv, an operator can either retrofit the existing lean-burn IC engine with a selective catalytic reduction (SCR) system or install a new lean-burn engine with an SCR system. In many cases, retrofitting an existing IC engine is technologically infeasible or may require substantial additional unanticipated costs (such as the incompatibility of an older engine with less sophisticated operating controls with additional control technology, additional labor/maintenance costs, etc.). However, for the purpose of evaluating all potential controls, the District has included both options in the below analysis.

[91] SJVAPCD. (2011, August 18). *Adopt Revised Proposed Amendments to Rule 4702 (Internal Combustion Engines).* Retrieved from http://www.valleyair.org/Board_meetings/GB/agenda_minutes/Agenda/2011/August/Agenda_Item_10_Aug_18_2011.pdf

Table C-8 Annual Costs for Retrofitting an Existing Limited Use Lean-Burn Engine and Installing a New Limited Use Lean-Burn Engine with SCR

Item	Assumptions/Methodology	Cost
Average Engine Power Rating	1,100 brake horsepower (bhp)	n/a
Annual Operation	2,500 hours (hr)	n/a
Capital Costs		
New Engine Cost (without SCR)	Includes: engine, freight, installation, start-up, additional equipment (belt guards, fuel connection, etc.), and tax	$110,656
Annualized Engine Capital Costs (10 years, 10%)	0.163 x New Engine Cost	**$18,037**
SCR Equipment Costs		
SCR System	$73,000 per engine	$73,000
550 gallon double wall plastic urea tank and accessories	$5,270 per tank	$5,270
3 hp rotary screw air compressor with dryer and receiver tank	$5,875 per compressor package	$5,875
Total SCR Equipment Costs	Equipment costs x 20% profit/mark-up	$100,974
SCR Installation Costs		
Start-up and Commissioning Rate	$1,500/day; assume 1 day for each system	$1,500
Electrical upgrade to power compressor	n/a	$0
Total SCR Installation Costs		$1,500
Total SCR Capital Costs	SCR Equipment Costs + SCR Installation Costs	$102,474
Annualized SCR Capital Costs (10 years, 10%)	0.163 x Total SCR Capital Costs	**$16,703**
Annual Operating and Maintenance Costs		
Annual Reagent (urea) Cost	$3 per gallon; 1 gallon/hr Cost = $3 x 2,500 hr	$7,500
Annual Increase in Fuel Cost (due to drop in fuel efficiency with SCR)	Fuel usage = 9,322.5 standard cubic feet per hour (scf/hr) Fuel cost (per 1,000 scf) = $7.36 Fuel cost (per hour) = (9,322.5 x $7.36) / 1,000 Fuel cost (per year) = hourly cost x 2,500 hr 2.5% drop in fuel efficiency Added Fuel Cost = Annual fuel cost x 2.5%	$4,288
Annual Electricity Cost (for compressor)	3 hp compressor = 2.24 kW power rating Electricity rate for industrial operations = $0.132/kW-hr Hourly electricity cost = 2.24 kW x $0.132/kW-hr Daily meter charge = $49.281 Annual electricity cost = hourly cost x 2500 hr Annual meter charge = daily meter charge x 365 days Total utility cost = Annual electricity cost + Annual meter charge	$18,728

Item	Assumptions/Methodology	Cost
Annual Catalyst Cost	Life of catalyst = 5 years Cost per catalyst = $5,000 Catalyst costs for 10 years = $5,000 x 2 Annualized cost = $10,000 x 0.163	$1,630
Annual Maintenance Cost	Maintenance = $0.02 per bhp per hour of operation Annual cost = $0.02 x 1,100 bhp x 2,500 hr	$55,000
Annual Operating & Maintenance (O&M) Costs	Annual O&M = Annual Reagent Cost+ Annual Increase in Fuel Cost + Annual Electricity Cost + Annual Catalyst Cost + Annual Maintenance Cost	**$87,147**
Annual Cost for Retrofit of LB Engine with SCR	Annualized SCR Capital Cost + Annual O&M Cost	**$103,850**
Annual Cost for New LB Engine with SCR	Annualized Engine Capital Cost + Annualized SCR Capital Cost + Annual O&M Cost	**$121,887**

The emissions reductions are calculated below:

BHP = 1,100 bhp
HR = 2,500 hours/year (hr/yr)
EF1 = 0.78 g-NOx/bhp-hr (equivalent to 65 ppmvd NOx at 15% O2; assuming 35% thermal efficiency)
EF2 = 0.132 g-NOx/bhp-hr (equivalent to 11 ppmvd NOx at 15% O2; assuming 35% thermal efficiency)
LF = 0.8
CF = 453.6 grams/pound (g/lb)

Current NOx = (BHP x HR x EF1 x LF) / (CF)
= (1,100 bhp x 2,500 hr/yr x 0.78 g-NOx/bhp-hr x 0.8) / (453.6 g/lb)
= 3,783 lb-NOx/year

Potential NOx = (BHP x HR x EF2 x LF) / (CF)
= (1,100 bhp x 2,500 hr/yr x 0.132 g-NOx/bhp-hr x 0.8) / (453.6 g/lb)
= 640 lb-NOx/year

Potential Emissions Reduction = Current NOx – Potential NOx
Potential Emissions Reduction = (3,783-640 lb) x (1 ton / 2,000 lb)
Potential Emissions Reduction = 1.57 tons/year

Cost Effectiveness*:* The cost effectiveness is the added cost, in dollars per year, of the control technology, divided by the emissions reductions achieved, in tons per year. Based on the calculations above, the cost effectiveness of retrofitting or replacing current limited use lean-burn spark-ignited engines is as follows:

- Retrofitted limited use lean-burn engine with SCR: $66,146/ton of NOx reduced
- New limited use lean-burn engine with SCR: $77,635/ton of NOx reduced

As demonstrated in the analysis and summary above, it is not cost effective to require the retrofit or replacement of limited use lean-burn engines to achieve 11 ppmv.

Limited Use Rich-Burn Engines

When evaluating the ability to lower NOx emissions to 11 ppmv, an operator will generally retrofit the existing rich-burn IC engine with a nonselective catalytic reduction (NSCR) system. In many cases, retrofitting an existing IC engine is technologically infeasible or may require substantial additional unanticipated costs (such as the incompatibility of an older engine with less sophisticated operating controls with additional control technology, additional labor/maintenance costs, etc.). However, for the purpose of evaluating potential controls in this category, the District has included the less costly, potentially feasible scenario of retrofitting an existing rich-burn engine with NSCR in the below analysis.

Table C-9 Annual Costs for Retrofitting an Existing Limited Use Rich-Burn Engine

Item	Assumptions/Methodology	Cost
Average Engine Power Rating	500 bhp	n/a
Annual Operation	2,500 hours (hr)	n/a
Capital Costs		
New Catalyst System	Includes: catalyst, air-to fuel ratio controller, ignition system, and installation	$75,000
Annualized Catalyst Capital Cost (10 years, 10%)	0.163 x New Catalyst System	**$12,225**
Annual Cost for Retrofit of RB Engine with New Catalyst	Annualized Catalyst Capital Cost	**$12,225**

The emissions reductions are calculated below:

BHP = 500 bhp
HR = 2,500 hours/year (hr/yr)
EF1 = 0.30 g-NOx/bhp-hr (equivalent to 25 ppmvd NOx at 15% O2; assuming 35% thermal efficiency)
EF2 = 0.132 g-NOx/bhp-hr (equivalent to 11 ppmvd NOx at 15% O2; assuming 35% thermal efficiency)
LF = 0.8
CF = 453.6 grams/pound (g/lb)

Current NOx = (BHP x HR x EF1 x LF) / (CF)
= (500 bhp x 2,500 hr/yr x 0.30 g-NOx/bhp-hr x 0.8) / (453.6 g/lb)
= 661 lb-NOx/year

Potential NOx = (BHP x HR x EF2 x LF) / (CF)
= (500 bhp x 2,500 hr/yr x 0.132 g-NOx/bhp-hr x 0.8) / (453.6 g/lb)
= 291 lb-NOx/year

Potential Emissions Reduction = Current NOx – Potential NOx
Potential Emissions Reduction = (661 - 291 lb) x (1 ton / 2,000 lb)
Potential Emissions Reduction = 0.19 tons/year

Cost Effectiveness: The cost effectiveness is the added cost, in dollars per year, of the control technology, divided by the emissions reductions achieved, in tons per year. Based on the calculations above, the cost effectiveness of retrofitting limited use rich-burn spark-ignited engines is as follows:

- Retrofitted limited use rich-burn non-AO engine with new catalyst: $64,342/ton of NOx reduced

As demonstrated in the analysis and summary above, it is not cost effective to require the retrofit of limited use rich-burn engines to achieve 11 ppmv, even without including additional substantial costs, such as annual operating and maintenance costs.

Two-Stroke, Gaseous Fueled Engines 50-100 bhp
There is no control technology compatible with two-stroke, gaseous fueled engines, including SCR, which will allow these units to achieve a NOx emission limit below 75 ppmv. An 11 ppmv NOx emission limit is not technologically feasible for these engines; the current limit implements RACT for two-stroke, gaseous fueled engines less than 100 bhp.

Lean-Burn Engines Used in Gas Compression
Similar to the "Limited Use" engine category, during the 2011 amendments to Rule 4702, the District created this category of engines based on the technological infeasibility to control these types of engines. Lean-burn engines used in gas compression in the Valley are used in natural gas distribution and storage service, and these engines frequently experience changing load conditions. As noted in EPA's Stationary IC Engine Technical Support Document[92], SCR use is problematic for these engines due to the fluctuations over a broad range of conditions. For this reason, EPA states that there is an insufficient basis to conclude that SCR is an appropriate technology for large lean-burn engines used for gas compression. The current emission limit is achievable through low-NOx combustion technology, which includes changes to the engine's timing, enhanced control of the air-fuel ratio, and other changes that lower NOx emissions. Due to the technological complexities associated with lean-burn engines used in gas compression, the current emissions limit implements RACT for these units.

[92] EPA. (2003, October). *Stationary Reciprocating Internal Combustion Engines Technical Support Document for NOx SIP Call*.

AO SPARK-IGNITED ENGINES

Over the past decade, AOs have invested significant capital to retrofit and replace thousands of irrigation pump and other engines reducing emissions by over 80% in this category, and continue to do so as emission limitations and associated compliance deadlines come into effect under Rule 4702. In addition to the high cost-effectiveness and potential technical infeasibility associated with retrofitting or replacing existing AO spark-ignited engines, requiring additional costly controls on existing AO engines is economically challenging and potentially infeasible.

AO Rich-Burn and Lean-Burn Engine Retrofit Evaluation

Retrofitting existing spark-ignited rich-burn and lean-burn engines poses several challenges that are not present when installing new, replacement engines. The District had to overcome many obstacles and challenges in retrofitting existing AO engines when the District adopted its current emission limits and has worked closely with AO engine owners and operators and control system manufacturers to ensure compliance with this stringent emission limit. Efforts to ensure compliance with the current rule limit are continuing today. However, lowering the emission limits even further would present a number of challenges with respect to technological feasibility as outlined in the following list.

1. Engine power losses from adding controls
2. Existing engines may require overhaul
3. Existing engines cannot meet lower emissions levels due to narrower margin of compliance
4. Control systems must be custom designed
5. Errors generated during control system installation
6. Retrofit controls can damage an engine
7. Engine can damage a control system
8. Compliance costs
9. Engines operated in remote locations

1. Engine power losses from adding controls

An engine is chosen based on its ability to provide the required power output at a reasonable engine speed (rpm) that will not over-stress the engine over its expected service life. Add-on emission control systems result in additional loads that the engine may not have been originally designed to accommodate. In addition, due to the extreme drought conditions, engine owners and operators have needed to increase the power output for well pump engines as the water table has dropped. As the engines work harder to pump water, there is less power output available to accommodate emission control systems.

2. Existing engines may require overhaul

The engines in use at AOs have been in service for many years, even decades, and are heavily worn. A worn engine can burn oil, leak fluids, and run rough. For an uncontrolled engine, some of the effects of engine wear do not have a major effect on the engine's ability to do its job (e.g. pumping water). However, the operation of a catalytic emission control system requires that the engine be operated consistently smooth. An expensive major engine overhaul or rebuild would be necessary to ensure smooth engine operation prior to installing a catalytic emission control system. Many AOs do not have the resources (e.g., staff, experience, technical training, etc.) to complete an engine overhaul or rebuild without outside assistance. Meeting more stringent/lower emission standards increases the need for the engine to operate properly.

3. Existing engines cannot meet lower emissions levels due to narrower margin of compliance

As emission limits are lowered, there is a narrower margin of compliance and proper engine operation becomes more critical. AOs in the District have to constantly ensure that their engine is properly maintained and within all the appropriate specifications to ensure compliance with the current emission limit, more so than newer engines. The lower emissions levels will result in additional stresses on the engine and increased maintenance and monitoring efforts that result from operating a retrofitted engine. Even then, due to the age of the engine and based on engine not appropriately designed for additional add-on systems and the associated loads, engines will not be able to meet the lower limits.

4. Control systems must be custom designed

For proper control system design, the engine condition, make, model, power output, and exhaust gas flow rate and temperature must be considered. There are no universal, off-the-shelf, one size-fits-all systems available for purchase. Control system design also assumes that an engine is operating properly and smoothly per the engine manufacturer's specifications. To ensure proper operation of the control system, an engine may need to be overhauled or rebuilt prior to installation of the control system. A common problem with many retrofit emission control systems is installation of a system on an engine that is not operating smoothly or to engine manufacturer specifications. Installing a control system on a rough running engine will result in poor control system operation and eventually system and engine damage. Proper system design and engine operation is more important as emission limits are lowered since the margin of compliance will be much less.

5. Errors generated during control system installation

Site conditions like gas supply pressure can cause an existing engine to operate rough. If site issues are not addressed prior to installation of a control system, the control system will not operate correctly. An installer may attempt to correct rough engine

operation by making the combustion more fuel rich; however, this technique will not provide lasting results and will cause accelerated engine and control system wear and eventually failure. An emission control system that is designed to meet lower emission limits will require a larger catalyst element which will be more expensive to replace if permanently damaged.

6. Retrofit controls can damage an engine

For proper control of exhaust pollutants, a catalyst must be operated at a certain temperature range that is higher than normal exhaust temperatures. Additional fuel is often injected into the engine with the intent that the additional fuel will pass through the combustion chamber and ignite in the exhaust system prior to the catalyst (the high catalyst temperature ignites the fuel). This extra fuel results in higher engine operating temperatures since some of the extra fuel is combusted during normal engine combustion. The increased engine temperature leads to accelerated engine wear and reduced engine reliability. Due to wear and older design, increased combustion temperatures lead to engine failure and permanent engine damage.

7. Engine can damage a control system

An existing, worn engine can burn oil and run rough. Oil in the exhaust stream will foul/mask a catalyst which will result in reduced emission control efficiency and likely permanent damage to a catalyst element. The air-fuel ratio controller will attempt to adjust engine operation (e.g., injecting more fuel) to keep the control system operating within the specified parameters; however, adjusting engine operation will not correct a fouled catalyst. Continued operation with a damaged catalyst will lead to permanent catalyst damage. An emission control system that is designed to meet lower emission limits will require a larger catalyst element which will be more expensive to replace if permanently damaged and this cycle will be repeated further adding to the cost.

8. Compliance costs

Unlike many industries, AOs compete on an international basis and cannot pass increased production costs on to consumers. AOs must absorb the compliance costs associated with lower emission standards, for example: retrofit and replacement costs; additional maintenance costs; additional monitoring costs; and additional testing costs. These additional regulatory costs put them at an economic disadvantage to their competitors.

9. Engines operated in remote locations

AO spark-ignited engines are generally located in rural, hard to access areas with minimal oversight since AOs have limited resources and staffing. With seasonal labor and minimal year-round staffing, it is difficult for AOs to provide the frequent and complex maintenance required for retrofitted or new engines equipped with advanced emission controls. Lower emission limits are achieved only through well maintained engines and control systems. Lower emissions limits lead to increased maintenance

and monitoring efforts. The oil production industry is the only other major industry in the Valley that has IC engines located in remote locations; however, with the highly technical nature of oil production and refining as compared to agricultural production and additional economic resources, it is feasible for the oil and gas production industry to hire qualified staff dedicated to maintaining and operating IC engines and other equipment on-site.

Retrofitting AO engines with emission control systems to meet increasingly stringent emission limits poses unique challenges that are not applicable when replacing engines. Based on the challenges outlined above, meeting 25 ppm or even 11 ppmv with existing AO engines is not feasible. The additional maintenance, monitoring, and testing, along with the cost of rebuilding engines and the cost of the emission control system, may even be more costly than installing a replacement engine.

AO Lean-Burn Engine Replacement with SCR

When evaluating the ability to lower NOx emissions, an agricultural operator can install a new lean-burn engine with an SCR system. The cost-effectiveness analysis to lower emissions to 11 ppmv is as follows:

Table C-10 Annual Costs for Installing a New AO Lean-Burn Engine with SCR

Item	Assumptions/Methodology	Cost
Average Engine Power Rating	241 bhp	n/a
Annual Operation	2,500 hours (hr)	n/a
Capital Costs (Engine)		
New Engine Cost (without SCR)	Includes: engine, freight, installation, start-up, additional equipment (belt guards, fuel connection, etc.), and tax	$109,480
Annualized Engine Capital Costs (10 years, 10%)	0.163 x New Engine Cost	**$17,845**
SCR Equipment Costs		
SCR System	$73,000 per engine	$73,000
550 gallon double wall plastic urea tank and accessories	$5,270 per tank	$5,270
3 hp rotary screw air compressor with dryer and receiver tank	$5,875 per compressor package	$5,875
Total SCR Equipment Costs	Equipment costs x 20% profit/mark-up	$100,974
SCR Installation Costs		
Start-up and Commissioning Rate	$1,500/day; assume 1 day for each system	$1,500
Electrical upgrade to power compressor	$43.22/foot; avg. 1,020 feet to extend electrical line	$44,084
Total SCR Installation Costs		$45,584
Total SCR Capital Costs	SCR Equipment Costs + SCR Installation Costs	$146,558

Item	Assumptions/Methodology	Cost
Annualized SCR Capital Costs (10 years, 10%)	0.163 x Total SCR Capital Costs	**$23,889**
Annual Operating and Maintenance Costs (SCR)		
Annual Reagent (urea) Cost	$3 per gallon; 1 gallon/hr Cost = $3 x 2,500 hr	$7,500
Annual Increase in Fuel Cost (due to drop in fuel efficiency with SCR)	Fuel usage = 1,750.7 standard cubic feet per hour (scf/hr) Fuel cost (per 1,000 scf) = $7.36 Fuel cost (per hour) = (1,750.7 x $7.36) / 1,000 Fuel cost (per year) = hourly cost x 2,500 hr 2.5% drop in fuel efficiency Added Fuel Cost = Annual fuel cost x 2.5%	$805
Annual Electricity Cost (for compressor)	3 hp compressor = 2.24 kW power rating Electricity rate for AO = $0.136/kW-hr Hourly electricity cost = 2.24 kW x $0.136/kW-hr Annual electricity cost = hourly cost x 2,500 hr	$761
Annual Catalyst Cost	Life of catalyst = 5 years Cost per catalyst = $5,000 Catalyst costs for 10 years = $5,000 x 2 Annualized cost = $10,000 x 0.163	$1,630
Annual Maintenance Cost	Maintenance = $0.02 per bhp per hour of operation Annual cost = $0.02 x 241 bhp x 2,500 hr	$12,050
Annual Operating & Maintenance (O&M) Costs	Annual O&M = Annual Reagent Cost+ Annual Increased Fuel Cost + Annual Electricity Cost + Annual Catalyst Cost + Annual Maintenance Cost	**$22,746**
Annual Cost for New LB Engine with SCR	Annualized Engine Capital Cost + Annualized SCR Capital Cost + Annual O&M Cost	**$64,480**

*The values within this table are rounded.

The emissions reductions are calculated below:

BHP = 241 bhp
HR = 2,500 hours/year (hr/yr)
EF1 = 2.092 g-NOx/bhp-hr (equivalent to 150 ppmv)
EF2 = 0.132 g-NOx/bhp-hr (equivalent to 11 ppmv)
LF = 0.65
CF = 453.6 grams/pound (g/lb)

Current NOx = (BHP x HR x EF1 x LF) / (CF)
= (241 bhp x 2,500 hr/yr x 2.092 g-NOx/bhp-hr x 0.65) / (453.6 g/lb)
= 1,806 lb-NOx/year

Potential NOx = (BHP x HR x EF2 x LF) / (CF)
= (241 bhp x 2,500 hr/yr x 0.132 g-NOx/bhp-hr x 0.65) / 453.6
= 114 lb-NOx/year

Potential Emissions Reduction = Current NOx – Potential NOx
Potential Emissions Reduction = (1,806-114 lb) x (1 ton / 2,000 lb)
Potential Emissions Reduction = 0.85 tons/year

Cost Effectiveness: The cost effectiveness is the added cost, in dollars per year, of the control technology, divided by the emissions reductions achieved, in tons per year. Based on the calculations above, the cost effectiveness of replacing current AO lean-burn spark-ignited engines is as follow:

- New lean-burn engine with SCR: $75,859/ton of NOx reduced

As demonstrated in the analysis and summary above, it is not cost effective to replace existing AO lean-burn engines with newer engines equipped with SCR systems.

Since new lean-burn engines equipped with SCR systems are now all currently designed and sold to meet NOx emissions levels of 11 ppmv, there is not a more cost-effective option available to meet an intermediate emissions level of 25 ppmv through the purchase of new lean-burn engines equipped with SCR.

AO Lean-Burn Engine Replacement without SCR

When evaluating the ability to lower NOx emissions to 65 ppmv, an agricultural operator can replace the existing lean-burn IC engine with a new lean-burn engine certified to meet 65 ppmv without the need of an SCR system.

Table C-11 Annual Costs for Installing a New AO Lean-Burn Engine

Item	Assumptions/Methodology	Cost
Average Engine Power Rating	241 bhp	n/a
Annual Operation	2,500 hours (hr)	n/a
Capital Costs (Engine)		
New Engine Cost (without SCR)	Includes: engine, freight, installation, start-up, additional equipment (belt guards, fuel connection, etc.), and tax	$109,480
Annualized Engine Capital Costs (10 years, 10%)	0.163 x New Engine Cost	**$17,845**
Annual Operating and Maintenance Costs		
Annual Maintenance Cost	Maintenance = $0.01 per bhp per hour of operation Annual cost = $0.01 x 241 bhp x 2,500 hr	**$6,025**
Annual Cost for New LB Engine	Annualized Engine Capital Cost + Annual O&M Cost	**$23,870**

*The values within this table are rounded.

The emissions reductions are calculated below:

BHP = 241 bhp
HR = 2,500 hours/year (hr/yr)
EF1 = 2.092 g-NOx/bhp-hr (equivalent to 150 ppmv)
EF2 = 0.78 g-NOx/bhp-hr (equivalent to 65 ppmv)
LF = 0.65
CF = 453.6 grams/pound (g/lb)

Current NOx = (BHP x HR x EF1 x LF) / (CF)
= (241 bhp x 2,500 hr/yr x 2.092 g-NOx/bhp-hr x 0.65) / (453.6 g/lb)
= 1,806 lb-NOx/year

Potential NOx = (BHP x HR x EF2 x LF) / (CF)
= (241 bhp x 2,500 hr/yr x 0.78 g-NOx/bhp-hr x 0.65) / 453.6
= 673 lb-NOx/year

Potential Emissions Reduction = Current NOx – Potential NOx
Potential Emissions Reduction = (1,806-673 lb) x (1 ton / 2,000 lb)
Potential Emissions Reduction = 0.57 tons/year

Cost Effectiveness: The cost effectiveness is the added cost, in dollars per year, of the control technology, divided by the emissions reductions achieved, in tons per year. Based on the calculations above, the cost effectiveness of replacing current AO lean-burn spark-ignited engines is as follows:

- New lean-burn engine: $41,877/ton of NOx reduced

As demonstrated in the analysis and summary above, it is not cost effective to replace existing AO lean-burn engines with newer engines.

AO Rich-Burn Engine Replacement with 3-Way Catalyst Meeting 11 ppmv

When evaluating the ability to lower NOx emissions, an agricultural operator can install a new rich-burn engine with a 3-way catalyst. The cost-effectiveness is shown below:

Table C-12 Annual Cost for Installing a New AO Rich-Burn Engine with a 3-way Catalyst

Item	Assumptions/Methodology	Cost
Average Engine Power Rating	256 bhp	n/a
Annual Operation	2,500 hours (hr)	n/a
Total Capital Costs		
New Engine Cost	Includes: engine with 3-way catalyst, freight, installation, and tax	$95,000
Annualized Engine Capital Costs (10 years, 10%)	0.163 x New Engine Cost	**$15,485**
Annual Operating and Maintenance Costs (SCR)		
Annual Added Fuel Cost (due to drop in fuel efficiency with catalyst)	Fuel usage = 1,859.7 scf/hr Fuel cost (per 1,000 scf) = $7.36 Fuel cost (per hour) = (1,859.7 x $7.36) / 1,000 Fuel cost (per year) = hourly cost x 2,500 hr Assume 2.5% drop in fuel efficiency Added Fuel cost = Annual fuel cost x 2.5%	$855
Annual Catalyst Cost	Life of catalyst = 5 years Cost per catalyst = $5,000 Catalyst costs for 10 years = $5,000 x 2 Annualized Catalyst Cost = $10,000 x 0.163	$1,630
Annual Maintenance Cost	Maintenance = $0.02 per bhp per hour of operation Annual Maintenance Cost = $0.02 x 256 bhp x 2,500 hr	$12,800
Annual Operating & Maintenance (O&M) Costs	Annual O&M = Annual Added Fuel Cost + Annual Catalyst Cost + Annual Maintenance Cost	**$15,285**
Annual Cost for New RB Engine with 3-way	Annualized Engine Capital Cost + Annual O&M Cost	**$30,770**

*The values within the above table are rounded.

The emissions reductions are calculated below:

BHP = 256 bhp
HR = 2,500 hours/year
EF1 = 1.255 g-NOx/bhp-hr (equivalent to 90 ppmv)
EF2 = 0.132 g-NOx/bhp-hr (equivalent to 11 ppmv)
LF = 0.65
CF = 453.6 grams/pound

Current NOx = (BHP x HR x EF1 x LF) / (CF)
= (256 bhp x 2,500 hr/yr x 1.255 g-NOx/bhp-hr x 0.65) / 453.6
= 1,151 lb-NOx/year

Potential NOx = (BHP x HR x EF2 x LF) / (CF)
= (256 bhp x 2,500 hr/yr x 0.132 g-NOx/bhp-hr x 0.65) / 453.6
= 121 lb-NOx/year

Potential Emissions Reduction = Current NOx – Potential NOx
Potential Emissions Reduction = (1,151-121 lb) x (1 ton / 2,000 lb)
Potential Emissions Reduction = 0.52 tons/year

Cost Effectiveness: The cost effectiveness is the added cost, in dollars per year, of the control technology, divided by the emissions reductions achieved, in tons per year. Based on the calculations above, the cost effectiveness of replacing current AO rich-burn engines is as follows:

- New rich-burn engine with a 3-way catalyst to meet 11 ppmv: $59,173/ton of NOx reduced

As demonstrated in the analysis and summary above, it is not cost effective to replace existing spark-ignited engines with new rich-burn engines with 3-way catalysts meeting 11 ppmv.

AO Rich-Burn Engine Replacement with 3-Way Catalyst Meeting 25 ppmv

In order to meet 25 ppmv, an agricultural operator can install a new rich-burn engine with a slightly smaller catalyst compared to the catalyst needed to meet an 11 ppmv emission level.

Table C-13 Annual Cost for Installing a New AO Rich-Burn Engine with a 3-way Catalyst

Item	Assumptions/Methodology	Cost
Average Engine Power Rating	256 bhp	n/a
Annual Operation	2,500 hr	n/a
Total Capital Costs		
New Engine Cost	Includes: engine with 3-way catalyst, freight, installation, and tax	$95,000
Annualized Engine Capital Costs (10 years, 10%)	0.163 x New Engine Cost	**$15,485**
Annual Operating and Maintenance Costs (SCR)		
Annual Added Fuel Cost (due to drop in fuel efficiency with catalyst)	Fuel usage = 1,859.7 scf/hr Fuel cost (per 1,000 scf) = $7.36 Fuel cost (per hour) = (1,859.7 x $7.36) / 1,000 Fuel cost (per year) = hourly cost x 2,500 hr Assume 2.5% drop in fuel efficiency Added Fuel cost = Annual fuel cost x 2.5%	$855
Annual Catalyst Cost	Life of catalyst = 5 years Cost per catalyst = $4,000 Catalyst costs for 10 years = $4,000 x 2 Annualized Catalyst Cost = $8,000 x 0.163	$1,304
Annual Maintenance Cost	Maintenance = $0.02 per bhp per hour of operation Annual Maintenance Cost = $0.02 x 256 bhp x 2,500 hr	$12,800

Item	Assumptions/Methodology	Cost
Annual Operating & Maintenance (O&M) Costs	Annual O&M = Annual Added Fuel Cost + Annual Catalyst Cost + Annual Maintenance Cost	**$14,959**
Annual Cost for New RB Engine with 3-way	Annualized Engine Capital Cost + Annual O&M Cost	**$30,444**

*The values within the above table are rounded.

The emissions reductions are calculated below:

BHP = 256 bhp
HR = 2,500 hours/year
EF1 = 1.255 g-NOx/bhp-hr (equivalent to 90 ppmv)
EF2 = 0.30 g-NOx/bhp-hr (equivalent to 25 ppmv)
LF = 0.65
CF = 453.6 grams/pound

Current NOx = (BHP x HR x EF1 x LF) / (CF)
= (256 bhp x 2,500 hr/yr x 1.255 g-NOx/bhp-hr x 0.65) / 453.6
= 1,151 lb-NOx/year

Potential NOx = (BHP x HR x EF2 x LF) / (CF)
= (256 bhp x 2,500 hr/yr x 0.30 g-NOx/bhp-hr x 0.65) / 453.6
= 275 lb-NOx/year

Potential Emissions Reduction = Current NOx – Potential NOx
Potential Emissions Reduction = (1,151-275 lb) x (1 ton / 2,000 lb)
Potential Emissions Reduction = 0.44 tons/year

Cost Effectiveness: The cost effectiveness is the added cost, in dollars per year, of the control technology, divided by the emissions reductions achieved, in tons per year. Based on the calculations above, the cost effectiveness of replacing current AO rich-burn engines is as follows:

- New rich-burn engine with a 3-way catalyst to meet 25 ppmv: $69,191/ton of NOx reduced

As demonstrated in the analysis and summary above, it is not cost effective to replace existing spark-ignited engines with new rich-burn engines with 3-way catalysts meeting 25 ppmv.

Since new rich-burn engines equipped with 3-way catalysts are now all currently designed and sold to meet NOx emissions levels of 25 ppmv, there is not a more cost-effective option available to meet an intermediate emissions level of 65 ppmv through the purchase of new rich-burn engines.

C.56.7 Potential Emission Reduction Opportunities

As discussed above, there are no additional emission reduction opportunities at this time for Rule 4702.

C.56.8 Evaluation Findings

Rule 4702 currently has in place the most stringent measures feasible to implement in the Valley and therefore meets or exceeds federal RACT requirements for this source category. As the District continues to develop future attainment plans to address increasingly stringent federal air quality standards, this source category will be re-evaluated for additional potential opportunities to reduce emissions.

C.57 RULE 4703 STATIONARY GAS TURBINES

C.57.1 Emissions Inventory (Summer Average – Tons per day)

	2012	2015	2018	2021	2024	2027	2029	2030	2031
NOx	3.17	2.84	2.98	2.89	2.94	2.99	3.03	3.04	3.06
VOC	0.71	0.69	0.72	0.73	0.74	0.76	0.77	0.78	0.78

C.57.2 District Rule 4703 Description

The provisions of this rule are applicable to all stationary gas turbine systems, which are subject to District permitting requirements, and with electrical generation ratings equal to or greater than 0.3 megawatt (MW) or a maximum heat input rating of more than 3 million British Thermal Units per hour (MMBtu/hr), and that are used for the generation of electrical power. The purpose of this rule is to limit NOx emissions from these stationary gas turbines.

Rule 4703 was adopted on August 18, 1994. Since its adoption, the rule has been amended six times. The latest rule amendment in September 2007 strengthened the rule by establishing more stringent NOx limits for existing stationary gas turbines. EPA finalized approval for Rule 4703 on October 21, 2009 and deemed this rule as being at least as stringent as established RACT requirements. NOx emissions have been controlled by over 86% for this source category.

The requirements of Rule 4703 affect owners and operators of stationary gas turbine systems used to pump, compress, generate electricity, or perform other tasks. The four major industry groups are oil and gas production, utilities, manufacturing, and government.

In complying with the rule, all affected entities are required to control NOx and CO emissions by installing approved emissions control devices. Early in the rule development process, the District identified five different emissions control technologies that could be used to achieve proposed limits for stationary gas turbines. Of the five options, four mainly control NOx emissions, while the other one controls CO emissions. The four NOx control technologies are:

- Dilutant (water or steam) injection systems,
- Dry, low-NOx,
- Selective catalytic reduction, and
- SCONOx

Costs associated with different compliance options vary a great deal depending on technologies and available products. Depending on the size of the existing turbine systems, engine model and make, type of existing emissions control equipment, and many other factors, owners and operators of stationary gas turbine systems face different compliance costs. The impacts of Rule 4703 have been concentrated in the oil

and gas production sector and utilities sector of the Valley, as they own and operate the vast majority of stationary gas turbines subject to the rule.

C.57.3 How does District Rule 4703 compare with federal rules and regulations?

C.57.3.1 EPA – Control Technique Guidelines (CTG)

EPA CTG requirements are not applicable to this source category.

C.57.3.2 EPA – Alternative Control Technology (ACT)

C.57.3.2.1 EPA–435/R-93-007 (Alternative Control Techniques Document—NOx Emissions from Stationary Gas Turbines)

The requirements of Rule 4703 are as stringent as or more stringent than the requirements in the ACT.

C.57.3.3 Standards of Performance for New Stationary Sources (NSPS)

C.57.3.3.1 40 CFR 60 Subpart GG (Standards of Performance for Stationary Gas Turbines)

The requirements of Rule 4703 are as stringent as or more stringent than the requirements in the NSPS.

C.57.3.3.2 40 CFR 60 Subpart KKKK (Standards of Performance for Stationary Combustion Turbines)

The requirements of Rule 4703 are as stringent as or more stringent than the requirements in the NSPS.

C.57.3.4 National Emission Standards for Hazardous Air Pollutants (NESHAPs) and Maximum Achievable Control Technologies (MACTs)

C.57.3.4.1 40 CFR 63 Subpart YYYY (NESHAP for Stationary Combustion Turbines)

The requirements of Rule 4703 are as stringent as or more stringent than the requirements in the NESHAP.

C.57.4 How does District Rule 4703 compare with California State regulations?

There are no state regulations applicable to this source category.

C.57.5 How does District Rule 4703 compare to regulations from other air districts?

C.57.5.1 Bay Area AQMD

C.57.5.1.1 Regulation 9 Rule 9 (Nitrogen Oxides from Stationary Gas Turbines)

The requirements in Rule 4703 are as stringent as or more stringent than those in Rule 9-9.

C.57.5.2 Sacramento Metro AQMD

C.57.5.2.1 Rule 413 (Stationary Gas Turbines)

The requirements in Rule 4703 are as stringent as or more stringent than those in Rule 413.

C.57.5.3 South Coast AQMD

C.57.5.3.1 Rule 1134 (Emissions of Oxides of Nitrogen from Stationary Gas Turbines)

The requirements in Rule 4703 are as stringent as or more stringent than those in Rule 1134.

C.57.5.4 Ventura County APCD

C.57.5.4.1 Rule 74.23 (Stationary Gas Turbines)

The requirements in Rule 4703 are as stringent as or more stringent than those in Rule 74.23.

C.57.6 Potential Emission Reduction Opportunities

In its *2015 PM2.5 Plan* the District evaluated this source category to determine if there are any feasible emission reduction opportunities. The District found that Rule 4703 currently has in place the most stringent measures feasible to implement in the Valley.[93] The District re-evaluated the aforementioned options and has determined that no additional feasible opportunities have been developed in the last 12 months since the adoption of the *2015 PM2.5 Plan.* Therefore, there are no additional emission reduction opportunities at this time.

C.57.7 *Evaluation Findings*

Rule 4703 currently has in place the most stringent measures feasible to implement in the Valley and therefore meets or exceeds federal RACT requirements for this source category.

[93] SJVUAPCD. *2015 Plan for the 1997 PM2.5 Standard*. Appendix C Best Available Control Measures and Most Stringent Measures (2015, April 16). Retrieved from http://www.valleyair.org/Air_Quality_Plans/PM25Plans2015.htm

C.58 RULE 4902 RESIDENTIAL WATER HEATERS

C.58.1 Emissions Inventory (Summer Average – Tons per day)

	2012	2015	2018	2021	2024	2027	2029	2030	2031
NOx	1.48	1.44	1.39	1.34	1.28	1.29	1.31	1.32	1.32
VOC	0.10	0.10	0.11	0.11	0.11	0.11	0.11	0.12	0.12

C.58.2 District Rule 4902 Description

Adopted July 17, 1993, Rule 4902 is a point-of-sale rule that limits NOx emissions from natural gas-fired residential water heaters with heat input rates less than or equal to 75,000 Btu/hr. The original rule enforced a NOx emissions limit of 40 nanograms of NOx per Joule of heat output (ng/J). Amendments in March 2009 strengthened the rule by enforcing a limit of 10 ng/J for new or replacement water heaters and a limit of 14 ng/J for instantaneous water heaters. NOx emissions have been controlled by approximately 88% for this source category. EPA finalized approval for Rule 4902 on May 5, 2010.[94]

As a point-of-sale rule, Rule 4902 affects water heater manufacturers, plumbing wholesalers, retail home supply stores, plumbers and contractors, and homeowners. This source category encompasses several types of water heaters, including conventional storage water heaters, demand water heaters, heat pump water heaters, solar water heaters, and tankless coil and indirect water heaters. Water heater options also vary by fuel type which includes electricity, fuel oil, geothermal energy, natural gas, propane, and solar energy.

Conventional storage water heaters are the most common. They have an insulated tank sized from 20 to 80 gallons and natural gas fired units have a gas burner under the tank regulated by a thermostat. Demand water heaters, also known as instantaneous water heaters, heat water as it is required and do not use a storage tank. As soon as there is a demand for hot water, a gas burner heats cold water as it travels through a pipe in the unit. Natural gas-fired units generally provide hot water at a rate upwards of 5 gallons per minute.

A tankless coil water heater heats water flowing through a heat exchanger installed in a furnace or boiler. Similar to the tankless coil water heater an indirect water heater uses a furnace or boiler. Fluid heated by the furnace or boiler is circulated through a heat exchanger in a storage tank.

[94] EPA. *Revisions to the California State Implementation Plan, San Joaquin Valley Unified Air Pollution Control District;* Final Rule. 75 Fed. Reg. 86, pp. 24408 – 24409. (2010, May 5), (to be codified at 40 CFR 52) retrieved from: http://www.gpo.gov/fdsys/pkg/FR-2010-05-05/pdf/2010-10404.pdf

Manufacturers have focused on combustion modification to meet the lower NOx limit as required in other California air districts. Combustion modification systems are designed to reduce thermal NOx formation by changing the flame characteristics to reduce peak flame temperature. Combustion modification for residential water heaters is achieved by different burner designs such as low NOx and ultra-low NOx burners. Some of the design principles used in low NOx and ultra-low NOx burners include staged air burners, staged fuel burners, pre-mix burners, internal recirculation, and radiant burners.

C.58.3 How does District Rule 4902 compare with federal rules and regulations?

C.58.3.1 EPA – Control Technique Guidelines (CTG)

EPA CTG requirements are not applicable to this source category.

C.58.3.2 EPA – Alternative Control Technology (ACT)

EPA ACT requirements are not applicable to this source category.

C.58.3.3 Standards of Performance for New Stationary Sources (NSPS)

EPA NSPS requirements are not applicable to this source category.

C.58.3.4 National Emission Standards for Hazardous Air Pollutants (NESHAPs) and Maximum Achievable Control Technologies (MACTs)

EPA NESHAP and MACT requirements are not applicable to this source category.

C.58.4 How does District Rule 4902 compare with California State regulations?

There are no state regulations applicable to this source category.

C.58.5 How does District Rule 4902 compare to regulations from other air districts?

C.58.5.1 Bay Area AQMD

C.58.5.1.1 Regulation 9 Rule 6 (Nitrogen Oxides Emissions from Natural Gas-Fired Boilers and Water Heaters)

The requirements in Rule 4902 are as stringent as or more stringent than those in Rule 9-6.

C.58.5.2 Sacramento Metro AQMD

C.58.5.2.1 Rule 414 (Water Heaters, Boilers and Process Heaters Rated Less than 1,000,000 BTU per Hour)

The requirements in Rule 4902 are as stringent as or more stringent than those in Rule 414.

C.58.5.3 South Coast AQMD

C.58.5.3.1 Rule 1121 (Control of Nitrogen Oxides from Residential Type, Natural Gas-Fired Water Heaters)

The requirements in Rule 4902 are as stringent as or more stringent than those in Rule 1121.

C.58.5.4 Ventura County APCD

C.58.5.4.1 Rule 74.11 (Natural Gas-Fired Water Heaters)

The requirements in Rule 4902 are as stringent as or more stringent than those in Rule 74.11.

C.58.6 Potential Emission Reduction Opportunities

In its *2015 PM2.5 Plan* the District evaluated this source category to determine if there are any feasible emission reduction opportunities. The District found that Rule 4902 currently has in place the most stringent measures feasible to implement in the Valley.[95] The District re-evaluated the aforementioned options and has determined that no additional feasible opportunities have been developed in the last 12 months since the adoption of the *2015 PM2.5 Plan.* Therefore, there are no additional emission reduction opportunities at this time.

C.58.7 Evaluation Findings

According to the federal CAA §182(b)(2) and (f) this source category is not subject to federal RACT requirements because this source category has no sources subject to EPA CTGs and these sources are not “major sources” of VOCs and NOx, as confirmed by EPA in the Technical Support Document (TSD) for the partial approval of the Districts 2009 RACT SIP.[96] However, pursuant to the District’s No Stone Left Unturned philosophy, Rule 4902 was evaluated as a part of this plan development effort.

[95] SJVUAPCD. *2015 Plan for the 1997 PM2.5 Standard*. Appendix C Best Available Control Measures and Most Stringent Measures (2015, April 16). Retrieved from http://www.valleyair.org/Air_Quality_Plans/PM25Plans2015.htm

[96] U.S. EPA. Region IX Air Division. Technical Support Document for EPA’s Notice of Proposed Rulemaking for the California State Implementation Plan. Prepared by Stanley Tong. (2011, August 29). https://www.regulations.gov/#!documentDetail;D=EPA-R09-OAR-2011-0723-0006

Rule 4902 currently has in place the most stringent measures feasible to implement in the Valley and therefore would meet or exceed federal RACT requirements for this source category were they applicable. As the District continues to develop future attainment plans to address increasingly stringent federal air quality standards, this source category will be re-evaluated for additional potential opportunities to reduce emissions.

C.59 RULE 4905 NATURAL GAS-FIRED, FAN-TYPE CENTRAL FURNACES

C.59.1 Emissions Inventory (Summer Average – Tons per day)

	2012	2015	2018	2021	2024	2027	2029	2030	2031
NOx	2.62	2.68	2.78	2.87	2.93	2.95	2.99	3.01	3.03
VOC	0.21	0.21	0.21	0.22	0.23	0.23	0.23	0.23	0.24

C.59.2 District Rule 4905 Description

Rule 4905 is a point-of-sale rule applicable to any person who sells, offers for sale, installs or solicits the installation of natural-gas-fired, fan-type central furnaces, for use within the Valley with a rated heat input capacity of less than 175,000 Btu/hour, and for combination heating and cooling units with a rated cooling capacity of less than 65,000 Btu/hour. Affected parties include furnace manufacturers, residential heating wholesalers, supply stores, contractors and end-users. The point-of-sale approach has allowed the District to achieve NOx reductions without placing an undue financial burden on the residents, operators and businesses that sell these units in the Valley.

Rule 4905 was adopted on October 20, 2005 to establish NOx limits for residential central furnaces supplied, sold, or installed in the Valley. EPA finalized approval for Rule 4905 on May 30, 2007.[97] The District's Governing Board adopted amendments to Rule 4905 on January 22, 2015 making it the most stringent rule in the nation for this source category. The following is a summary of the amendments:

- Lower the NOx emission limit for residential units from 40 ng/J (0.093 lb/MMBtu) to 14 ng/J
- Expand the rule applicability to include non-residential units with a NOx emission limit of 14 ng/J and units installed in manufactured homes with a NOx limit of 40 ng/J, to be lowered to 14 ng/J in 2018
- Additional labeling requirements

Rule 4905 applies to furnaces fueled by natural gas that use forced air distribution, the most common type of heating system for residential and commercial buildings. Central furnaces are controlled by a thermostat, which sends signals to turn the device on or off when the building temperature does not match a chosen set point. A valve then opens to send natural gas to the burners, which combust the gas directly into the heat exchangers. A blower pulls air from outside the building through a filter, across the heat exchanger, and through a series of ducts and vents to different areas of the building. Exhaust from the combustion exits the building through a separate duct. Condensing units use an additional heat exchanger to extract the latent heat in the flue (exhaust)

[97] EPA. *Revisions to the California State Implementation Plan, San Joaquin Valley Unified Air Pollution Control District*; Direct Final Rule. 72 Fed. Reg. 103, pp. 29886 – 29889. (2007, May 30). (to be codified at 40 CFR Part 52), Retrieved from http://www.gpo.gov/fdsys/pkg/FR-2007-05-30/pdf/E7-10236.pdf

gas by cooling the combustion gasses to near ambient temperature and thereby increase the heating efficiency by up to 10%. The water vapor in the flue gas is condensed, collected, and drained.

Applicable units are used in approximately 71% of Valley residences and are not labeled for retail as "residential" or "commercial" furnaces. Units used in commercial buildings, which are subject to the requirements of Rule 4905 as of the January 2015 amendments, are essentially the same as residential units with the exception of possible differences in usage patterns and indoor/outdoor location. Research for the analyses in the January 2015 amendments estimated 1,252,190 residential and commercial units will be operating in the Valley in 2017. Replacement will occur gradually as these units reach the end of the 20-year useful life.

Units installed in manufactured homes utilize the same types of materials and operating principles as commercial and residential units; however, significant differences exist. Furnaces installed in manufactured homes use sealed combustion, meaning all of the combustion air is taken from outside the building. These units also pre-heat the air, typically to 50-60°F, using a concentric vent where the combustion air is drawn in through the outer ring, while exhaust gases are vented through the inside core of the vent pipe. The air is pre-heated because the cold outside air does not mix well with the fuel, while pre-heated air blends well and allows for quieter ignition and combustion. Furnaces installed in manufactured homes also have to comply with strict space restrictions.[98]

C.59.3 How does District Rule 4905 compare with federal rules and regulations?

C.59.3.1 EPA – Control Technique Guidelines (CTG)

EPA CTG requirements are not applicable to this source category.

C.59.3.2 EPA – Alternative Control Technology (ACT)

EPA ACT requirements are not applicable to this source category.

C.59.3.3 Standards of Performance for New Stationary Sources (NSPS)

EPA NSPS requirements are not applicable to this source category.

C.59.3.4 National Emission Standards for Hazardous Air Pollutants (NESHAPs) and Maximum Achievable Control Technologies (MACTs)

EPA NESHAP and MACT requirements are not applicable to this source category.

[98] U.S. Department of Energy. (2014, July 7). *Energy Conservation Program for Consumer Products: Energy Conservation Standards for Residential Furnace Fans.* Retrieved 9/23/14 from https://www.federalregister.gov/articles/2014/07/03/2014-15387/energy-conservation-program-for-consumer-products-energy-conservation-standards-for-residential.

C.59.4 How does District Rule 4905 compare with California State regulations?

There are no state regulations applicable to this source category.

C.59.5 How does District Rule 4905 compare to regulations from other air districts?

C.59.5.1 Bay Area AQMD

C.59.5.1.1 Regulation 9 Rule 4 (Nitrogen Oxides from Fan Type Residential Central Furnaces)

The requirements in Rule 4905 are as stringent as or more stringent than those in Rule 9-4.

C.59.5.2 Sacramento Metro AQMD

C.59.5.2.1 Rule 414 (Water Heaters, Boilers and Process Heaters Rated Less than 1,000,000 BTU per Hour)

The requirements in Rule 4905 are as stringent as or more stringent than those in Rule 414.

C.59.5.3 South Coast AQMD

C.59.5.3.1 Rule 1111 (Reduction of NOx Emissions from Natural Gas-Fired, Fan-Type Central Furnaces)

The requirements in Rule 4905 are as stringent as or more stringent than those in Rule 1111.

C.59.5.4 Ventura County APCD

C.59.5.4.1 Rule 74.22 (Natural Gas-Fired, Fan-Type Central Furnaces)

The requirements in Rule 4905 are as stringent as or more stringent than those in Rule 74.22.

C.59.6 Potential Emission Reduction Opportunities

No additional emissions reductions opportunities have been identified at this time.

C.59.7 Evaluation Findings

Pursuant to federal Clean Air Act §182(b)(2) and (f), this source category is not subject to federal RACT requirements, because this source category has no sources subject to EPA CTGs and these sources are not “major sources” of VOCs and NOx. However, Rule 4905 currently has in place the most stringent measures feasible to implement in the Valley and therefore would meet or exceed federal RACT requirements for this

source category were they applicable. As the District continues to develop future attainment plans to address increasingly stringent federal air quality standards, this source category will be re-evaluated for additional potential opportunities to reduce emissions.

C.60 EMISSION INVENTORY CODES

The following are the emission inventory codes used for the allocation of emissions as presented in this attainment plan.

Table 14 Emission Inventory Codes

Control Measure	Emission Inventory Codes
Rule 4103 (Open Burning)	670-660-0262-9842; 670-660-0262-9862; 670-660-0262-9874; 670-660-0262-9884; 670-660-0262-9888; 670-660-0262-9892; 670-662-0262-9878; 670-668-0200-9858; 670-668-0200-9872; 670-668-0200-9886; 670-995-0240-9848
Rule 4106 (Prescribed Burns)	670-666-0200-0000; 670-670-0200-0000
Rule 4301 (Fuel Burning Equipment)	None
Rule 4302 (Incinerator Burning)	130-130-0110-0000; 130-130-0130-0000; 130-130-0240-0000; 130-130-0324-0000; 130-130-0266-0000
Rule 4307 (Boilers, Steam Generators and Process Heaters 2 – 5 MMBtu/hr)	010-005-0110-0000; 010-005-0124-0000; 010-005-0130-0000; 010-005-0300-0000; 010-005-1220-0000; 020-005-0110-0000; 030-005-0110-0000; 030-005-0124-0000; 030-005-0130-0000; 030-005-1220-0000; 030-005-1530-0000; 030-010-0110-0000; 030-010-0130-0000; 030-010-1220-0000; 030-010-1600-0000; 030-015-0110-0000; 030-015-0130-0000; 040-005-0110-0000; 040-005-1530-0000; 040-010-0100-0000; 040-010-0110-0000; 040-010-0120-0000; 040-010-0130-0000; 040-010-1000-0000; 050-005-0110-0000; 050-005-0122-0000; 050-005-0124-0000; 050-005-0130-0000; 050-005-0320-0000; 050-005-1100-0000; 050-005-1220-0000; 050-005-1510-0000; 050-005-1520-0000; 050-005-3220-0000; 050-010-0110-0000; 050-010-0120-0000; 050-010-0320-0000; 050-010-1220-0000; 050-010-1500-0000; 052-005-0110-0000; 052-005-0124-0000; 052-005-1220-0000; 052-010-0110-0000; 052-010-0120-0000; 052-010-1224-0000; 060-005-0110-0000; 060-005-0122-0000; 060-005-0124-0000; 060-005-0130-0000; 060-005-0142-0000; 060-005-0144-0000; 060-005-0320-0000; 060-005-1220-0000; 060-005-1510-0000; 060-005-1520-0000; 060-010-0100-0000; 060-010-0110-0000; 060-010-0120-0000; 060-010-0142-0000 The EICs are the same for Rules 4306/4320, 4307, and 4308; the three rules share a combined emission inventory. Baseline emissions from the 2008 and 2009 rule amendments of these rules were used to determine the percentage of emissions for each rule. Those respective percentages are applied to the combined inventory to get the individual emission inventories.

Control Measure	Emission Inventory Codes
Rule 4308 (Boilers, Steam Generators and Process Heaters 0.075 to less than 2.0 MMBtu/hr)	The EICs are the same for Rules 4306/4320, 4307, and 4308; the three rules share a combined emission inventory. Baseline emissions from the 2008 and 2009 rule amendments of these rules were used to determine the percentage of emissions for each rule. Those respective percentages are applied to the combined inventory to get the individual emission inventories. See Rule 4307 for the EICs.
Rule 4309 (Dryers)	430-422-7078-0000; 430-424-7006-0000; 430-995-7000-0000; 499-995-0000-0000; 499-995-5630-0000
Rule 4311 (Flares)	110-132-0130-0000; 110-132-0146-0000; 120-132-0136-0000; 130-132-0110-0000; 130-132-0130-0000; 130-132-0136-0000; 310-320-0010-0000; 310-320-0110-0000; 310-320-0120-0000; 310-320-0130-0000; 310-320-0136-0000; 310-320-1600-0000; 320-320-0010-0000; 320-320-0110-0000; 320-320-0120-0000; 320-320-0130-0000
Rule 4313 (Lime Kilns)	Lime kilns are not included in the ARB emissions inventory. There are no lime kilns currently operating in the Valley.
Rule 4320 (AERO for Boilers, Steam Generators, and Process Heaters >5 MMBtu/hr)	The EICs are the same for Rules 4306/4320, 4307, and 4308; the three rules share a combined emission inventory. Baseline emissions from the 2008 and 2009 rule amendments of these rules were used to determine the percentage of emissions for each rule. Those respective percentages are applied to the combined inventory to get the individual emission inventories. See Rule 4307 for the EICs.
Rule 4352 (Solid Fuel Fired Boilers, Steam Generators, and Process Heaters)	010-005-0214-0000; 010-005-0218-0000; 010-005-0220-0000; 010-005-0240-0000; 010-005-0243-0000; 010-005-0254-0000; 020-005-0218-0000; 020-005-0230-0000; 030-005-0214-0000; 050-005-0214-0000; 050-005-0240-0000; 050-005-0254-0000; 052-005-0240-0000; 060-005-0240-0000; 060-005-0264-0000
Rule 4354 (Glass Melting Furnaces)	460-460-7037-0000; 460-460-7038-0000; 460-460-7039-0000
Rule 4401 (Steam-Enhanced Crude Oil Production Wells)	310-342-1600-0000; 310-344-1600-0000; 310-346-1600-0000; 310-348-1600-0000
Rule 4402 (Crude Oil Production Sumps)	310-300-1600-0000
Rule 4404 (Heavy Oil Test Station - Kern County)	310-350-1600-0000
Rule 4407 (In-Situ Combustion Well Vents)	The emissions from this source category are accounted for in Rule 4401.
Rule 4408 (Glycol Dehydration Systems)	The emissions from this source category are accounted for in Rule 4409.
Rule 4409 (Components at Light Crude Oil Production Facilities, Natural Gas Production Facilities, and Natural Gas Processing Facilities)	310-302-0110-0000; 310-302-1600-0000; 310-304-1600-0000; 310-306-1600-0000; 310-308-1600-0000; 310-308-0110-0000; 310-310-0110-0000; 310-310-1600-0000; 310-316-1600-0000; 310-352-0100-0000; 310-356-0110-0000

Control Measure	Emission Inventory Codes
Rule 4453 (Refinery Vacuum Producing Devices or Systems)	The emissions from this source category are accounted for in Rule 4409.
Rule 4454 (Refinery Process Unit Turnaround)	The emissions from this source category are accounted for in Rule 4409.
Rule 4455 (Components at Petroleum Refineries, Gas Liquids Processing Facilities, and Chemical Plants)	320-302-0010-0000; 320-304-0010-0000; 320-306-0010-0000; 320-316-0010-0000
Rule 4565 (Biosolids, Animal Manure, and Poultry Litter Operations)	199-170-0240-0000; 199-170-0260-0000; 199-190-0010-0000; 199-190-0110-0000; 199-190-0300-0000; 199-995-0000-0000; 199-995-0130-0000; 199-995-0240-0000; 199-995-0260-0000; 199-995-0300-0000; 199-995-0324-0000 The EICs are the same for Rules 4565 and 4566; the two rules share a combined emission inventory.
Rule 4566 (Organic Material Composting Operations)	The EICs are the same for Rules 4565 and 4566; the two rules share a combined emission inventory.
Rule 4570 (Confined Animal Facilities)	620-618-0262-0101; 620-618-0262-0102; 620-618-0262-0103; 620-618-0262-0104; 620-618-0262-0105; 620-618-0262-0106; 620-618-0262-0107; 620-618-0262-0108; 620-618-0262-0109; 620-618-0262-0110; 620-618-0263-0000
Rule 4601 (Architectural Coatings)	520-520-91XX-0000; 520-520-92XX-0000
Rule 4602 (Motor Vehicle Assembly Coatings)	The emissions from this source category are accounted for in Rule 4612.
Rule 4603 (Surface Coating of Metal Parts and Products, Plastic Parts and Products, and Pleasure Crafts)	230-226-9000-0000; 230-226-9100-0000; 230-226-9200-0000; 230-230-9020-0000; 230-230-9050-0000; 230-230-9052-0000; 230-230-9054-0000; 230-230-9100-0000; 230-230-9200-0000
Rule 4604 (Can and Coil Coating Operations)	230-228-9000-0000; 230-228-9020-0000; 230-228-9052-0000; 230-228-9057-0000; 230-228-9100-0000; 230-228-9200-0000
Rule 4605 (Aerospace Assembly and Component Coating Operations)	230-238-9000-0000, 230-238-9020-0000; 230-238-9100-0000, 230-238-9200-0000
Rule 4606 (Wood Products and Flat Wood Paneling Products Coating Operations)	230-232-9000-0000; 230-232-9020-0000; 230-232-9040-0000; 230-232-9052-0000; 230-232-9054-0000; 230-232-9100-0000; 230-232-9200-0000
Rule 4607 (Graphic Arts and Paper, Film, Foil, and Fabric Coatings)	230-222-9000-0000, 230-222-9100-0000, 230-224-9200-0000; 240-240-3202-0000; 240-240-3314-0000; 240-240-8302-0000; 240-260-8400-0000; 240-262-8400-0000; 240-264-8400-0000; 240-266-8350-0000; 240-266-8400-0000; 240-268-8400-0000; 240-995-8000-0000; 240-995-8400-0000
Rule 4610 (Glass Coating Operations)	The emissions from this source category are accounted for in Rule 4354.
Rule 4612 (Motor Vehicle and Mobile Equipment Coating Operations)	230-218-9000-0000; 230-218-9010-0000; 230-218-9020-0000; 230-218-9050-0000; 230-218-9054-0000; 230-218-9100-0000; 230-218-9200-0000

Control Measure	Emission Inventory Codes
Rule 4621 (Gasoline Transfer into Stationary Storage Containers, Delivery Vessels, and Bulk Plants)	330-395-1100-0000; 330-374-1100-0000; 330-330-1110-0000; 330-397-1100-0000; 330-390-1100-0000; 330-390-1400-0000; 330-396-1100-0000; 330-330-1000-0000; 330-376-1100-0000; 330-382-1100-0000; 330-384-1100-0000; 330-384-1110-0000; 330-382-1110-0000; 330-382-1120-0000; 330-384-1120-0000; 330-390-0010-0000
Rule 4622 (Gasoline Transfer into Motor Vehicle Fuel Tanks)	330-378-1100-0000; 330-380-1100-0000
Rule 4623 (Storage of Organic Liquids)	310-326-1600-0000; 310-328-1600-0000; 310-995-1600-0000; 320-326-1000-0000; 320-326-1214-0000; 320-326-1410-0000; 320-326-1610-0000; 320-328-1000-0000; 320-328-1110-0000; 320-328-1214-0000; 320-328-1410-0000; 320-328-1610-0000; 330-326-1110-0000; 330-326-1420-0000; 330-328-1000-0000; 330-328-1110-0000; 330-328-1600-0000; 330-328-1610-0000; 430-328-7006-0000
Rule 4624 (Transfer of Organic Liquid)	330-302-0010-0000; 330-995-0110-0000; 330-304-0010-0000; 330-995-0010-0000; 330-316-0010-0000; 330-318-0110-0000
Rule 4625 (Wastewater Separators)	320-340-0010-0000
Rule 4641 (Cutback, Slow Cure, and Emulsified Asphalt, Paving and Maintenance Operations)	540-560-0400-0000; 540-562-0400-0000; 540-564-0400-0000; 540-566-0400-0000
Rule 4642 (Solid Waste Disposal Sites)	120-120-0240-0000; 120-122-0242-0000
Rule 4651 (Soil Decontamination Operations)	140-995-0010-0000; 140-995-0110-0000; 140-995-0120-0000; 140-995-0240-0000; 330-995-0010-0000
Rule 4652 (Coatings and Ink Manufacturing)	410-995-8400-0000; 410-407-9000-0000
Rule 4653 (Adhesives and Sealants)	250-292-8200-0000; 250-292-8202-0000; 250-292-8250-0000
Rule 4661 (Organic Solvents)	The emissions from this source category are accounted for in Rules 4662 and 4663.
Rule 4662 (Organic Solvent Degreasing Operations)	220-204-0500-0000; 220-204-3008-0000; 220-204-3022-0000; 220-204-3083-0000; 220-204-3176-0000; 220-204-3204-0000; 220-204-3246-0000; 220-204-3333-0000; 220-204-3339-0000; 220-204-3344-0000; 220-204-8104-0000; 220-204-8106-0000; 220-206-3083-0000; 220-206-3107-0000; 220-206-3246-0000; 220-206-3300-0000; 220-206-3301-0000; 220-206-3328-0000; 220-206-3344-0000; 220-206-3346-0000; 220-206-8106-0000
Rule 4663 (Organic Solvent Cleaning, Storage, and Disposal)	220-208-0500-0000; 220-208-3022-0000; 220-208-3083-0000; 220-208-3176-0000; 220-208-3204-0000; 220-208-3246-0000; 220-208-3333-0000; 220-208-3339-0000; 220-208-3344-0000; 220-208-3346-0000; 220-208-8104-0000; 220-208-8106-0000; 230-216-8350-0000; 230-240-0500-0000; 230-240-3008-0000; 230-240-3060-0000; 230-240-3202-0000; 230-240-3232-0000; 230-240-3252-0000; 230-240-3372-0000; 230-240-8300-0000; 230-240-8302-0000; 230-240-8350

Control Measure	Emission Inventory Codes
Rule 4672 (Petroleum Solvent Dry Cleaning Operations)	210-200-3300-00000; 210-200-8102-0000; 210-200-8150-0000
Rule 4681 (Rubber Tire Manufacturing)	410-402-0248-0000
Rule 4682 (Polystyrene, Polyethylene, and Polypropylene Products Manufacturing)	410-404-5034-0000; 410-404-5036-0000; 410-404-5038-0000; 410-404-5044-0000; 410-404-5046-0000
Rule 4684 (Polyester Resin Operations)	410-403-5018-0000; 410-404-5016-0000; 410-404-5028-0000; 410-404-5030-0000
Rule 4691 (Vegetable Oil Processing Operations)	420-420-6030-0000
Rule 4692 (Commercial Charbroiling)	690-680-6000-0000
4693 (Bakery Ovens)	420-412-6012-0000; 420-412-6037-0000
Rule 4694 (Wine Fermentation and Storage Tanks)	420-408-6090-0000
Rule 4695 (Brandy Aging and Wine Aging Operations)	420-410-6090-0000
Rule 4702 (Internal Combustion Engines)	010-040-0110-0000; 010-040-1200-0000; 020-040-0110-0000; 020-040-1200-0000; 030-040-0110-0000; 030-040-0124-0000; 030-040-1200-0000; 030-040-1210-0000; 040-040-0110-0000; 050-040-0012-0000; 050-040-0110-0000; 050-040-0124-0000; 050-040-1200-0000; 052-040-0110-0000; 052-040-1200-0000; 052-042-0110-0000; 052-042-1200-0000; 052-042-1200-0010; 052-042-1200-0011; 060-040-0110-0000; 060-040-0124-0000; 060-040-0142-0000; 060-040-0146-0000; 060-040-1100-0000; 060-040-1200-0000; 060-040-1210-0000; 060-995-1220-0000; 099-040-1200-0000
Rule 4703 (Stationary Gas Turbines)	010-045-0110-0000; 010-045-1200-0000; 020-045-0110-0000; 030-045-0110-0000; 040-045-0134-0000; 050-045-1200-0000; 060-045-0110-0000; 060-045-1200-0000
Rule 4902 (Residential Water Heaters)	610-608-0110-0000
Rule 4905 (Natural Gas – Fired, Fan Type Residential Central Furnace)	610-606-0110-0000; 060-020-0110-0000

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Appendix D

Mobile Source Control Strategy

2016 PLAN FOR THE 2008 8-HOUR OZONE STANDARD

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Appendix D: Mobile Source Control Strategy

Mobile sources—on-road and off-road combined—account for over 85% of the San Joaquin Valley's total NOx emissions. According to the emissions inventory in Appendix B, mobile source emissions will decrease by nearly 42% from the 2012 baseline year to the 2031 attainment deadline due to already-adopted regulations and associated engine, fuel, and fleet improvements. However, the Valley's total vehicle miles traveled (VMT) are predicted to increase about 36% over the 2012-2031 timeframe, as the Valley remains a fast growing region and continues to serve as one of the state's major goods movement corridors. Additionally, as EPA promulgates increasingly stringent standards, and the District has already reduced over 80% of stationary source emissions within its jurisdiction, coming into attainment will continue to be difficult. Considering all of this in conjunction with the magnitude of the Valley's attainment challenges, it is clear that mobile source emissions reductions must be a key component of the District's strategies to attain EPA's health-based air quality standards.

Despite the need for mobile source control measures, the District does not have the authority to directly regulate the mobile source engines themselves. As discussed in *Chapter 5: Attainment Strategy*, the District has adopted innovative regulations such as Indirect Source Review (ISR) and Employer-based Trip Reduction (eTRIP) to reduce emissions from mobile sources, but only the state of California and the federal government can directly regulate tailpipe emissions from mobile sources. Additionally, land use decisions, such as building new roads, are controlled by the individual cities and eight counties that make up the District, despite the fact that these decisions can affect VMT (and therefore emissions). As such, the Air Resources Board (ARB) and Metropolitan Planning Organizations (MPOs) have adopted a number of comprehensive regulations and programs that have helped the District meet Valley air quality challenges. This appendix, provided by the California Air Resources Board, discusses these key mobile source strategies and demonstrates that these programs will cause a decrease in emissions despite an increase in VMT.

D.1 Key Statewide 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 ARB has implemented the most stringent mobile source emissions control program in the nation. ARB'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 pay for early adoption of the cleanest available 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 ARB'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, the ARB has consistently sought and obtained waivers and authorizations for its new motor vehicle regulations. ARB'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. A list of regulatory actions ARB has taken since 1985 is provided in Attachment A to highlight the scope of ARB's actions to reduce mobile source emissions.

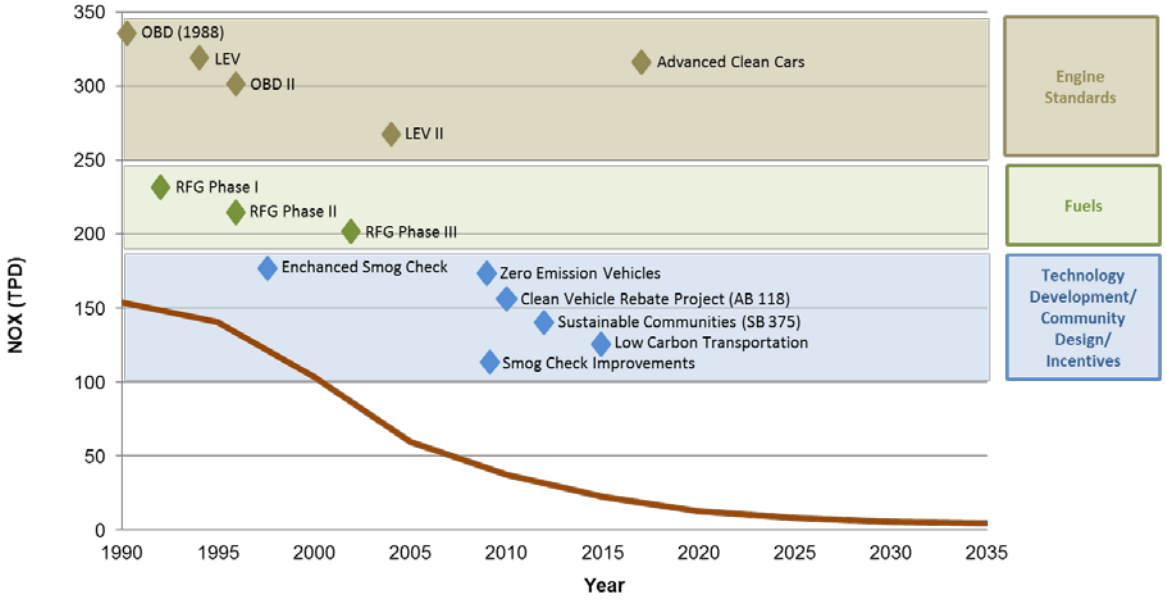
Recently, ARB adopted numerous regulations aimed at reducing exposure to diesel particulate matter and oxides of nitrogen, from freight transport sources like heavy duty diesel trucks, transportation sources like passenger cars and buses, and off-road sources like large construction equipment. Phased implementation of these regulations will produce increasing emission reduction benefits from now until 2031 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, ARB and San Joaquin Valley district staff work closely on identifying and distributing incentive funds to accelerate cleanup of engines. Key incentive programs include: the Carl Moyer Program; the Goods Movement Program; the Lower-Emission School Bus Program; and the Air Quality Improvement Program (AQIP). These incentive-based programs work in tandem with regulations to accelerate deployment of cleaner technology.

D.1.1 Light-Duty Vehicles

Figure D-1 illustrates the trend in NOx emissions from light-duty vehicles and key programs contributing to those reductions. As a result of these efforts, light-duty vehicle emissions in the San Joaquin Valley have been reduced significantly since 1990 and will continue to go down through 2031 due to the benefits of ARB's longstanding light-duty mobile source program. From today, light-duty vehicle NOx emissions are reduced by 70 percent in 2031. Key light-duty programs include Advanced Clean Cars, On-Board Diagnostics, Reformulated Gasoline, Incentive Programs, and the Enhanced Smog Check Program.

Figure D - 1 Key Programs to Reduce Light-Duty NOx Emissions



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 ARB regulations, today's new cars pollute 99 percent less than their predecessors did thirty years ago. In 1970, ARB 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 ARB 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.

D.1.1.1 Advanced Clean Cars

ARB's groundbreaking Advanced Clean Cars (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 these programs is evident: California is the world's largest market for Zero Emission Vehicles (ZEVs), with over 21 models available today, and a wide variety are now available at lower price points, attracting new consumers. As of January 2015, Californians drive 40 percent of all ZEVs on the road in the United States, while the U.S. makes up about half of the world market. This movement towards commercialization of advanced clean cars has occurred due to ARB's ZEV regulation, part of ACC, which affects passenger cars and light-duty trucks.

ARB'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 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 approved by ARB in January 2012 also included amendments affecting the current ZEV regulation 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 benefits will increase over time as new cleaner cars enter the fleet displacing older and dirtier vehicles.

D.1.1.2 On Board Diagnostics

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, ARB 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. 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. ARB subsequently strengthened OBD II requirements and added OBD II specific enforcement requirements for 2004 and subsequent model year passenger cars, light-duty trucks, and medium-duty vehicles and engines.

D.1.1.3 Reformulated Gasoline

Since 1996, ARB has been regulating the formulation of gasoline resulting 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 ARB. The specifications 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 vehicle to take full advantage of cleaner-burning gasoline properties.

D.1.1.4 Incentives

There are a number of different incentive programs focusing on light-duty vehicles that produce extra emission reductions beyond traditional regulations. The incentive programs work in two ways, encouraging the retirement of dirty older cars and encouraging the purchase of a cleaner vehicle.

Voluntary accelerated vehicle retirement or "car scrap" programs provide monetary incentives to vehicle owners to retire older, more polluting vehicles. The purpose of these programs is to reduce fleet emissions by accelerating the turnover of the existing fleet and subsequent replacement with newer, cleaner vehicles. Both State and local vehicle retirement programs are available.

California's voluntary vehicle retirement program is administered by the Bureau of Automotive Repair (BAR) and provides $1,000 per vehicle and $1,500 for low-income consumers for unwanted vehicles that have either failed or passed their last Smog Check Test and that meet certain eligibility guidelines. This program is referred to as the Consumer Assistance Program.

The Enhanced Fleet Modernization Program (EFMP) was approved by the AB 118 legislation to augment the State's existing vehicle retirement program. Approximately $30 million is available annually through 2015 to fund the EFMP via a $1 increase in vehicle registration fees. ARB developed the program in consultation with BAR. The program is jointly administered by both BAR for vehicle retirement, and local air districts for vehicle replacement.

Other programs, in addition to vehicle retirement programs, help to clean up the light-duty fleet. The AQIP, established by AB 118, is an ARB voluntary incentive program to fund clean vehicle and equipment projects. The Clean Vehicle Rebate Project (CVRP) is one of the current projects under AQIP. CVRP, started in 2009, is designed to accelerate widespread commercialization of zero-emission vehicles and plug-in hybrid electric vehicles by providing consumer rebates up to $2,500 to partially offset the higher cost of these advanced technologies. The CVRP is administered statewide by the California Center for Sustainable Energy. In Fiscal Years 2009-2012, $26.1 million, including $2 million provided by the California Energy Commission, funded approximately 8,000 rebates. In June 2012, the ARB allocated up to $15-21 million to the CVRP as outlined in the AQIP FY2012-2013 Funding Plan.

D.1.1.5 California Enhanced Smog Check Program

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 or 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:

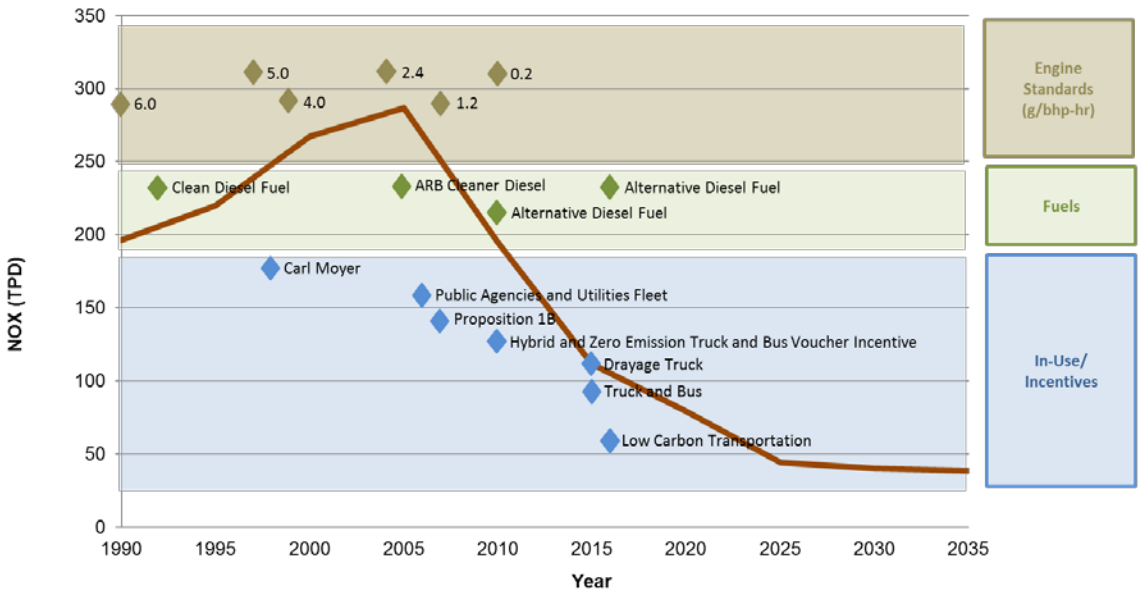
- Low pressure evaporative test;
- More stringent pass/fail cutpoints;
- Visible smoke test; and
- Inspection of light- and medium-duty diesel vehicles.

The next major change 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 sponsored by ARB and BAR, promised faster and less expensive Smog Check inspections by talking advantage of OBD software installed on all vehicles since 2000. 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.

D.1.2 Heavy-Duty Trucks

Figure D-2 illustrates the trend in NOx emissions from heavy-duty vehicles and key programs contributing to those reductions. As a result of these efforts, heavy-duty vehicle emissions in the San Joaquin Valley have been reduced significantly since 1990 and will continue to go down through 2031 due to the benefits of ARB's longstanding heavy-duty mobile source program. From today, heavy-duty NOx emissions are reduced by 60 percent in 2031. Key programs include Heavy-Duty Engine Standards, Clean Diesel Fuel, Truck and Bus Regulation and Incentive Programs.

Figure D - 2 Key Programs to Reduce Heavy-Duty Emissions



D.1.2.1 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 can 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 ARB to preferentially provide incentive funding to buyers of cleaner trucks, to encourage the development of cleaner engines.

D.1.2.2 Clean Diesel Fuel

Since 1993, ARB 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. In 2006, ARB 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 ARB formulation.

D.1.2.3 Cleaner In-Use Heavy-Duty Trucks (Truck and Bus Regulation)

The Truck and Bus Regulation was first adopted in December 2008. This rule represents a multi-year effort to turn over the legacy fleet of engines and replace them with the cleanest technology available. In December 2010, ARB 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 the truck and bus fleet over time, so that by 2023 nearly all older vehicles would need to 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 goats, 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.

ARB 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, an online reporting tool developed and maintained by ARB 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.***

ARB 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, ARB's approach to ensuring compliance is based on a comprehensive outreach and education effort.

D.1.2.4 Incentive Programs

There are a number of different incentive programs focusing on heavy-duty vehicles that produce extra emission reductions beyond traditional regulations. The incentive programs encourage the purchase of a cleaner truck

.
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. Since 1998, the Carl Moyer Program (Moyer Program) has provided funding for replacement, new purchase, repower and retrofit of trucks. Beginning in 2008, the Goods Movement Emission Reduction Program funded by Proposition 1B has funded cleaner trucks for the region's transportation corridors; the final increment of funds will implement projects in through 2018.

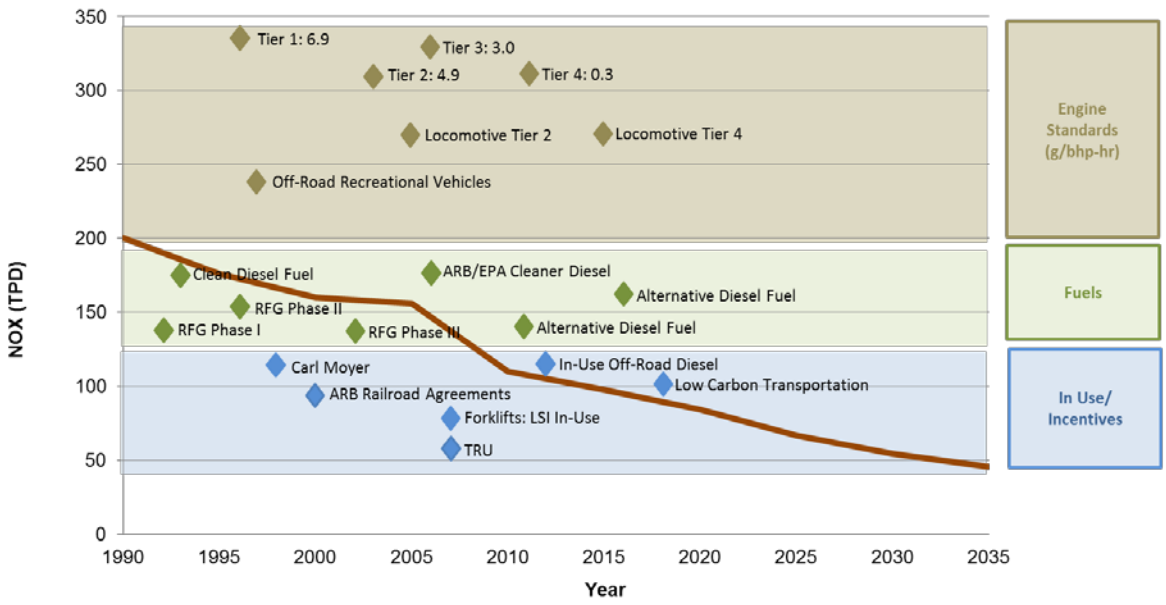
The Air Quality Improvement Program has funded the Hybrid and Zero-Emission Truck and Bus Voucher Incentive Project (HVIP) since 2010, and continued San Joaquin Valley participation is expected. ARB has also administered a Truck Loan Assistance Program since 2009.

D.1.3 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 D-3 illustrates the trend in NOx emissions from off-road equipment and key programs contributing to those reductions. As a result of these efforts, off-road emissions in the San Joaquin Valley have been reduced significantly since 1990 and will continue to go down through 2031 due to the benefits of ARB's and U.S. EPA longstanding programs. From today, off-road NOx emissions are reduced by 40 percent in 2031. Key programs include Off-Road Engine Standards, Locomotive Engine Standards, Clean Diesel Fuel, Cleaner In-Use Off-Road Regulation and In-Use LSI Fleet Regulation.

Figure D - 3 Key Programs to Reduce Off-Road Emissions



D.1.3.1 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.

The Board 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 and 2003. These regulations were implemented through three tiers of progressively more stringent exhaust emission standards that were phased in between 1995 and 2008.

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.

D.1.3.2 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.

D.1.3.3 Clean Diesel Fuel

Since 1993, ARB 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. In 2006, ARB 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 ARB formulation.

D.1.3.4 Cleaner In-Use Off-Road Equipment (Off-Road Regulation)

The Off-Road Regulation which was first approved in 2007 and subsequently amended in 2010 in light of the impacts of the economic recession. These off-road vehicles 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 ARB 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 will be 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 are 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 ARB staff.
- The Diesel Hotline (866-6DIESEL), which provides the regulated public with questions about the regulations and access to ARB staff. Staff is able to respond to questions in English, Spanish and Punjabi.
- The Off-road Listserv, providing equipment owners and dealerships with timely announcement of regulatory changes, regulatory assistance documents, and reminders for deadlines.

D.1.3.5 LSI In-Use Fleet Regulation

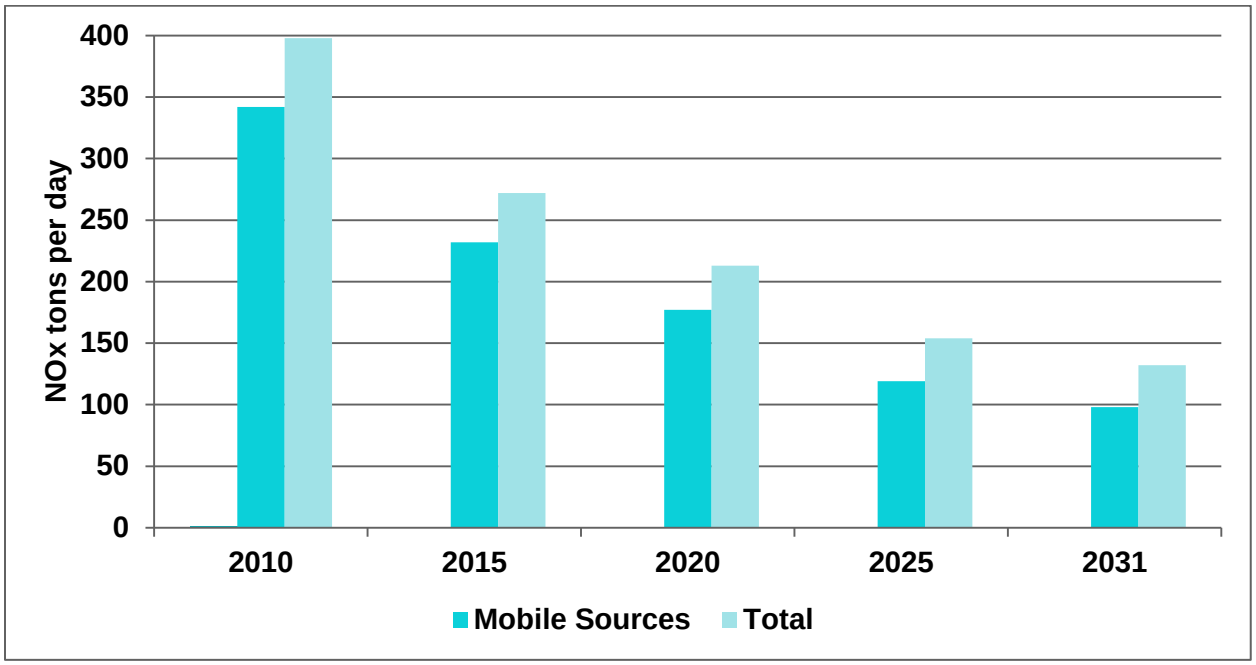
Forklift fleets can be subject to either the LSI fleet regulation, if fueled by gasoline or propane, or the off-road diesel fleet regulation. Both regulations require fleets to retire, repower, or replace higher-emitting equipment in order to maintain fleet average standards. The LSI fleet regulation was originally adopted in 2007 with requirements beginning in 2009. While the LSI fleet regulation applies to forklifts, tow tractors, sweeper/scrubbers, and airport ground support equipment, it maintains a separate fleet average requirement specifically for forklifts. The LSI fleet regulation requires fleets with four or more LSI forklifts to meet fleet average emission standards.

I. Emission Reduction Benefits of Existing Mobile Source Control Program

Air quality modeling has demonstrated that the substantial reductions from implementation of the existing mobile source control program will provide for attainment of both the 80 ppb ozone standard in 2023, and the 75 ppb ozone standard in 2031. As

shown in Figure D-4, these programs will reduce NOx emissions in the Valley by 140 tpd between 2015 and 2031.

Figure D - 4 San Joaquin Valley NOx Emission Reduction Trend



II. Air Resource Board Emission Reductions for the San Joaquin Valley

ARB staff has released the Proposed 2016 State Strategy for the State Implementation Plan (State SIP Strategy) to be considered by the Air Resources Board (Board) in September 2016. While the current control program provides the emission reductions necessary to meet the 75 ppb 8-hour ozone standard by 2031, the State SIP Strategy includes a discussion of the further NOx emission reduction benefits the proposed actions in the strategy would provide in the Valley in 2031. Those benefits include approximately 9 tpd of NOx emission reduction from measures under ARB's direct regulatory authority, which when coupled with strong action at the federal level, could achieve a total of 22 tpd of NOx reductions in 2031. After the State SIP Strategy is considered for approval by the Board later this year, ARB may propose an emissions reduction commitment for the San Joaquin Valley to the Board to be considered for approval for submittal to U.S. EPA.

D.2 TRANSPORTATION CONFORMITY

D.2.1 Transportation Conformity

Section 176(c) of the *Federal Clean Air Act* (CAA) establishes transportation conformity requirements which are intended to ensure that transportation activities do not interfere with air quality progress. The CAA requires that transportation plans, programs, and projects that obtain federal funds or approvals be consistent with, or *conform to* applicable state implementation plans (SIP) before being approved by a Metropolitan Planning Organization (MPO). Conformity to the SIP means that proposed transportation activities must not:

(1) Cause or contribute to any new violation of any standard,
(2) Increase the frequency or severity of any existing violation of any standard in any area, or
(3) Delay timely attainment of any standard or any required interim emission reductions or other milestones in any area.

A SIP analyzes the region's total emissions inventory from all sources necessary to demonstrate reasonable further progress (RFP), attainment, or maintenance of the National Ambient Air Quality Standards (NAAQS). The portion of the total emissions inventory from on-road highway and transit vehicles which provides RFP and attainment of the NAAQS in these analyses becomes the "motor vehicle emissions budget". [1] Motor vehicle emissions budgets are the mechanism for ensuring that transportation planning activities conform to the SIP. Budgets are set for each criteria pollutant or its precursors that the area does not attain and it is set for each RFP milestone year and the attainment year.

D.2.1.1 Requirements for Demonstrating Conformity

The eight metropolitan planning organizations (MPOs) in the Valley each prepare a long range regional transportation plan (RTP) at least every four years and a short range funding program, or regional transportation improvement program (RTIP) every two years. Content of both the RTP and RTIP are specified in federal transportation law found at Titles 23 and 49 of the federal code of regulations and applicable sections of state transportation planning law.

Before adopting the RTP/RTIP, the MPO prepares a regional emissions analysis using the proposed plan and program and compares those emissions to the emission budgets in the SIP. The MPO may determine RTP/RTIP conforms if the emissions from the proposed actions are less than the emissions budgets in the SIP. The conformity

[1] 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.

determination also signifies that the MPO has met other transportation conformity requirements such as interagency consultation and financial constraint.

D.2.1.2 Conformity Budgets

The emissions budgets presented in Attachment B use EMFAC2014 with MPO modeled VMT and speed distributions. The VMT and speed distribution data for each MPO are from the most recently amended 2015 Federal Transportation Improvement Program (FTIP) as of March 22, 2016. Air Resources Board (ARB) staff released a revised emission rate program, EMFAC2014, which updates the emission rates and planning assumptions used in calculating conformity budgets. EMFAC2014 was approved for use in SIPs and transportation conformity by U.S. EPA on December 14, 2015.

Section 93.124(e) of the federal conformity rule provides that nonattainment areas with more than one Metropolitan Planning Organization (MPO) may establish motor vehicle emission budgets for each MPO in the nonattainment area. This plan establishes county-level emission budgets for each MPO for the Rate of Progress (RFP) years of 2018, 2021, 2024, 2027 and 2030, and the attainment year of 2031 in the San Joaquin Valley.

Calculation Methodology

The budgets have been constructed in consultation with the eight Valley MPOs using emissions for a summer average day consistent with the attainment and progress demonstrations in this plan, using the following method:

1) Calculate the on road motor vehicle emissions totals for ROG and NOx from EMFAC2014 for each of the eight Valley MPOs;
2) Round each of the eight county MPO totals up to the nearest tenth ton for ROG and NOx.

The total of the eight Valley MPO budgets for ROG and NOx differ slightly from the total emissions of ROG and NOx in the San Joaquin Valley used in the RFP and attainment demonstrations due to the round up methodology and slight differences in motor vehicle activity in the most recent Valley RTPs. These differences however are less than one half of one percent (0.5%) of the Valley total of ROG and NOx in all progress years and the attainment year.

Table D- 1 San Joaquin Valley Transportation Conformity Budgets[1]

County Subarea	2018		2021		2024		2027		2030		2031	
	ROG	NOx	ROG	NOx	ROG	NOx	ROG	NOx	ROG	NOx	ROG	NOx
Fresno	8.0	27.7	6.4	22.2	5.4	14.1	4.9	13.2	4.5	12.6	4.3	12.5
Kern (SJV)	6.6	25.4	5.5	20.4	4.8	12.6	4.5	11.7	4.2	10.9	4.1	10.8
Kings	1.3	5.1	1.1	4.2	0.9	2.6	0.9	2.5	0.8	2.3	0.8	2.3
Madera	1.9	5.1	1.5	4.1	1.2	2.6	1.1	2.3	0.9	2.0	0.9	2.0
Merced	2.5	9.4	2.0	7.8	1.6	4.8	1.5	4.4	1.3	4.2	1.3	4.1
San Joaquin	5.9	13.0	4.9	10.3	4.2	6.9	3.8	6.2	3.5	5.7	3.3	5.5
Stanislaus	3.8	10.5	3.0	8.3	2.6	5.6	2.3	5.1	2.1	4.7	2.0	4.7
Tulare	3.7	9.5	2.9	7.2	2.4	4.7	2.2	4.1	1.9	3.8	1.9	3.7

[1] All emissions are expressed as summer tons/ day and were calculated using EMFAC2014 (December 14, 2015). VMT and speed distribution data for each MPO are from the most recently amended 2015 Federal Transportation Improvement Program (FTIP) as of March 22, 2016.

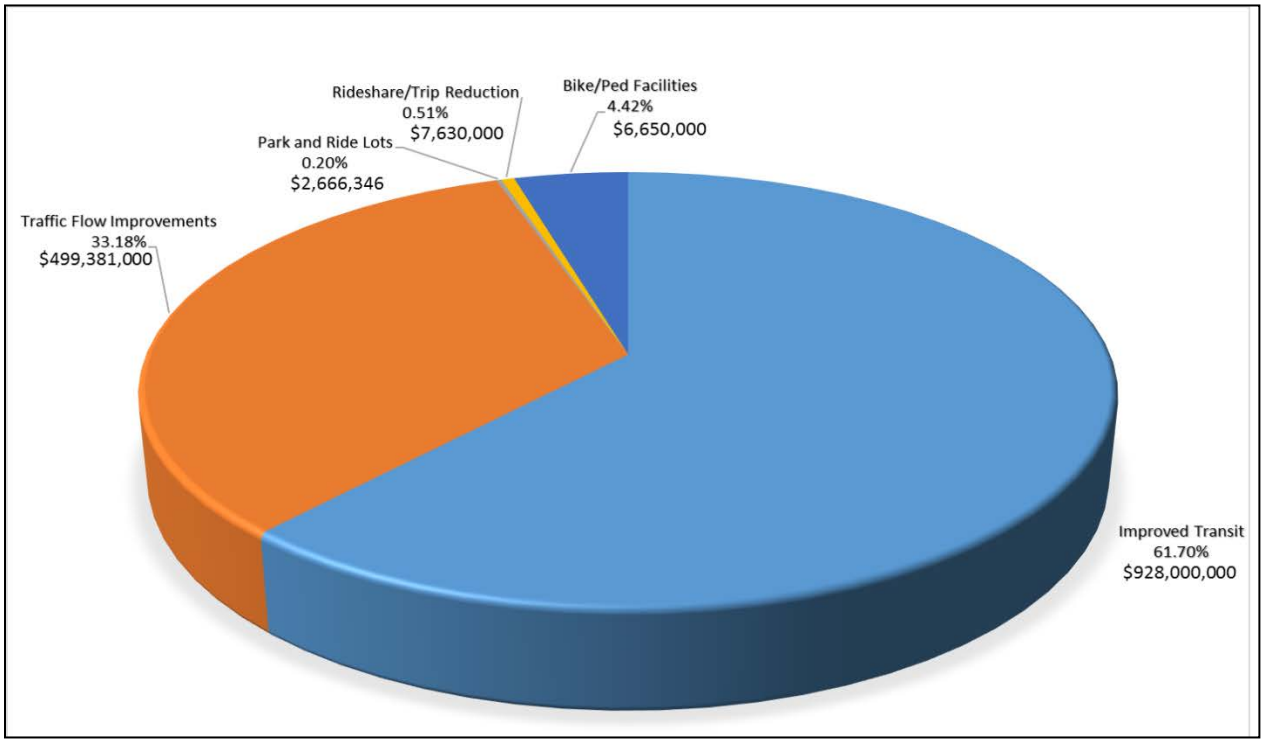
D.2.2 Local Reasonably Available Control Measures (RACM)

Transportation Control Measures (TCMs) in CAA §108(f) are currently being implemented by the Valley MPOs as part of the adopted Congestion Mitigation and Air Quality (CMAQ) cost effectiveness policy and in the development of each Regional Transportation Plan (RTP).

Valley MPOs continue to implement the adopted San Joaquin Valley CMAQ Policy, which was included in the District's *2007 Ozone Plan*, *2008 PM2.5 Plan, 2012 PM2.5 Plan*, *2015 PM2.5 Plan, and 2016 Ozone Plan*. The CMAQ policy includes a standardized process for distributing 20 percent of the CMAQ funds to projects that meet a minimum cost effectiveness beginning in fiscal year 2011. This policy focuses on achieving the most cost effective emissions reductions, while maintaining flexibility to meet local needs. The policy feasibility and minimum cost effectiveness standard was revisited in 2013 as part of the 2013 Federal Transportation Improvement Program (FTIP) development; the minimum cost effectiveness standard was also revisited in 2015 as part of the 2015 FTIP development.

Figure 6-2 provides an illustration of funding allocated valley-wide in the 2015 FTIPs for a sample of TCM categories: improved transit; high occupancy vehicle lanes; traffic flow improvements; park and ride lots; ridesharing/trip reduction programs; bicycle/pedestrian facilities. These tables demonstrate the eight SJV MPOs' commitment to the implementation of TCMs throughout the Valley. As the Valley MPOs implement TCMs through the current policies, all reasonable transportation control measures are being implemented.

Figure D - 5 Illustration of Valley MPO Funding for Sample TCM Categories



Each Valley MPO is required to update its RTP every four years. The RTP is a long-term regional transportation plan that provides a vision for transportation investments throughout the Valley. The 2014 RTPs integrate land use and transportation planning to achieve, where feasible, regional greenhouse gas (GHG) targets set by ARB pursuant to Senate Bill 375 (SB-375).

To further illustrate the eight SJV MPOs commitment to the implementation of TCMs throughout the Valley, the RTPs contains a host of improvements to every component of the regional multimodal transportation system including:

- ***Active transportation (non-motorized transportation, such as biking and walking)***
- ***Transportation demand management (TDM)***
- ***Transportation system management (TSM)***
- ***Transit***
- ***Passenger rail***
- ***Goods movement***
- ***Aviation and airport ground access***
- ***Highways***
- ***Arterials***
- ***Operations and maintenance***

Included within these transportation system improvements are TCM projects that reduce vehicle use or change traffic flow or congestion conditions. TCMs include the following categories of transportation improvement projects and programs:

- ***Improved Transit***
- ***High Occupancy Vehicle Lanes***
- ***Traffic Flow Improvements***
- ***Park and Ride Lots***
- ***Ridesharing/Trip Reduction Programs***
- ***Bicycle/Pedestrian Facilities***

As the San Joaquin Valley MPOs are implementing TCMs through the current policies, all reasonable transportation control measures are being implemented, as expressed in the *2016 Ozone Plan*, *2015 PM2.5 Plan, 2013 Plan for the Revoked 1-hour Ozone Standard,* and the *2012 PM2.5 Plan.* Therefore, there are no emissions reductions associated with unused regulatory control measures.

D.2.3 SB-375

The Sustainable Communities and Climate Protection Act of 2008 (Sustainable Communities, SB-375) enhances California's strategy to reduce GHG emissions through the coordination of transportation and land-use to reduce vehicle miles traveled per person through the development of a Sustainable Community Strategy. SB-375 identifies specific reduction goals for each of California's MPOs in 2020 and 2035 which the Sustainable Community Strategy must meet, if feasible. For the Valley, the SB-375 target reductions are a 5% per capita GHG emissions reductions from 2005 by 2020 and a 10% per capita GHG emissions reductions from 2005 by 2035. The strategies contained in the RTP/SCS produce benefits for the region far beyond simply reducing GHG emissions. The SCS integrates the transportation network and related strategies with an overall land use pattern that responds to projected growth, housing needs, changing demographics, and transportation demands. As a result, Sustainable Community Strategy development is anticipated to complement the reduction strategies outlined in the *2016 Ozone Plan*.

D.3 VMT OFFSETS

In 1979, U.S. EPA established a primary health-based national ambient air quality standard (NAAQS) for ozone at 0.12 parts per million (ppm) averaged over a 1-hour period. See 44 Fed.Reg. 8220 (February 9, 1979). The *Clean Air Act* (CAA), as amended in 1990, classified areas that had not yet attained the 1-hour standard, based on the severity of their ozone problem, ranging from Marginal to Extreme. Extreme areas were provided the most time to attain, until November 15, 2010, but were also subject to the most stringent requirements. In particular, Severe and Extreme areas were subject to CAA Section 182(d)(1)(A), which requires state implementation plans to adopt "specific enforceable transportation control strategies and transportation control measures to offset any growth in vehicle miles traveled or numbers of vehicle trips in such area…." U.S. EPA designated the San Joaquin Valley Air Basin as "Extreme" for the 1- hour standard on April 16, 2004 (69 Fed Reg 20550). Thus the San Joaquin Valley Air Basin was subject to this requirement under the 1-hour standard.

In 1997, U.S. EPA replaced the 1-hour ozone standard with an 8-hour standard of 0.08 ppm [62 Fed.Reg. 38856 (July 18, 1997)]. The U.S. EPA promulgated rules implementing the 8-hour standard with the "Phase 1" rule being was issued on April 30, 2004 (69 Fed.Reg. 23951), and the "Phase 2" rule, issued on November 29, 2005 (70 Fed. Reg. 71612). These implementation rules required that areas classified as Severe or Extreme under the 1997 8-hour standard would also be subject to the VMT offset requirement. U.S. EPA approved VMT offset demonstrations for the San Joaquin Valley for both the 1-hour and 8-hour ozone standards on April 5, 2015 (81 Fed Reg 19493).

D.3.1 2008 Ozone Standard

In 2008, U.S. EPA revised the 8-hour ozone NAAQS to a level of 0.075 parts per million. (73 Fed.Reg 16436, March 27, 2008). The San Joaquin Valley was subsequently designated non-attainment for the 2008 standard on May 21, 2012 and classified as an extreme non-attainment area (77 Fed.Reg 30087), making the San Joaquin Valley subject to the requirements of CAA Section 182(d)(1)(A) for the 2008 8-hour ozone NAAQS.

D.3.2 U.S. EPA Guidance on VMT Offset Requirement

In August 2012, U.S. EPA issued guidance titled "Implementing *Clean Air Act* Section 182(d)(1)(A): Transportation Control Measures and Transportation Control Strategies to Offset Growth in Emissions Due to Growth in Vehicle Miles Travelled". Among other things, U.S. EPA's guidance points out that subsequent court decisions regarding previous VMT offset demonstrations omitted any reference to "transportation control strategies" (TCS). TCSs, which are not defined in the CAA or U.S. EPA regulation, are eligible to offset growth in emissions due to growth in VMT. The U.S. EPA's new guidance indicates that technology improvements such as vehicle technology improvements, motor vehicle fuels, and other control strategies that are transportation-related could be used to offset increases in emissions due to VMT. U.S. EPA's revised

guidance sets forth a method of calculating the actual growth in emissions due to growth in VMT. Essentially, the state would compare projected attainment year emissions assuming no new control measures and no VMT growth with projected actual attainment year emissions (including new control measures and VMT growth). If the latter number is smaller than the former, no additional transportation control measures or strategies would be required. If additional transportation control measures and transportation control strategies are required, they should be clearly identified and distinguished from the measures included in the initial calculations for the base year and the three scenarios identified for the attainment year.

In addition, the guidance recommends that the base year used in the demonstration be the base year used in the attainment demonstration for the ozone standard. To address U.S. EPA's guidance, 2012 is used in this demonstration as the base year for the 2008 8-hour standard. Consistent with U.S. EPA guidance, emissions of VOC are used to determine compliance with the VMT offset requirement.

D.3.3 Transportation Control Strategies and Transportation Control Measures

By listing them separately, the *Clean Air Act* [CAA §182(d)(1)(A)] differentiates between transportation control strategies (TCS) and transportation control measures (TCM), and thus provides for a wide range of strategies and measures as options to offset growth in emissions from vehicle miles traveled (VMT) growth. In addition, the example TCMs listed in Section 108(f)(1)(A) of the CAA include measures that reduce emissions by reducing VMT, reducing tailpipe emissions, and removing dirtier vehicles from the fleet. California's motor vehicle control program includes a variety of strategies and measures including new engine standards and in-use programs (e.g., smog check, vehicle scrap, fleet rules, idling restrictions). TCMs developed by the eight San Joaquin Valley Metropolitan Planning Organizations (MPOs) provide additional reductions. In addition, the eight MPOs report every two years on the implementation status of TCMs in their jurisdiction.

Based on the provisions in Section 182(d)(1)(A) and the clarifications provided in the U.S. EPA guidance, any combination of transportation control strategies and TCMs may be used to meet the requirement to offset growth in emissions resulting from VMT growth. Since 1990 when this requirement was established, California has adopted more than sufficient enforceable transportation strategies and measures to meet the requirement to offset the growth in emissions from VMT growth. For the 2008 8-hour standard offset demonstration, 2012 controls are used as the base case control level since 2012 is the base year of the SIP

A list of the state's mobile source control program adopted since 1990 is provided in Attachment C. In addition, a list of TCMs implemented in the San Joaquin Valley Air Basin is provided in Attachment D.

D.3.4 Emissions Due To VMT Growth

As discussed above, U.S. EPA guidance does provide a recommended calculation methodology to determine if sufficient transportation control strategies and TCMs have been adopted and implemented to offset the growth in emissions due solely to growth in VMT. As such, any increase in emissions solely from VMT increases in the future attainment year from the base year (assuming that there are no further motor vehicle control programs implemented after the base year) would need to be offset. In addition, a calculation is needed to show the emissions levels if VMT had remained constant from the base year to the future attainment year. As discussed earlier, a comparison of the projected attainment year emissions assuming no new control measures and no VMT growth with projected actual attainment year emissions (including new control measures and VMT growth) would be made. If the latter number is smaller than the former, no additional transportation control measures or strategies would be required.

D.3.5 Methodology

The following calculations are based on the U.S. EPA guidance recommended calculation methodology. As shown for the 8-hour ozone standard, 2012 is the base year used for the attainment demonstration and 2031 is the attainment year.

Analysis Tool

This analysis uses California's approved motor vehicle emissions model, EMFAC. The EMFAC model estimates the emissions from two combustion processes: running exhaust and start exhaust, and four evaporative processes: hot soak, running losses, diurnal, and resting losses.

Emissions from running exhaust, start exhaust, hot soak, and running losses are a function of how much a vehicle is driven. Emissions from these processes are directly related to VMT, trips, and starts. These processes are included in the calculation of the emissions levels used in the VMT offset demonstration. Emissions from resting loss and diurnal loss processes are not related to VMT, trips or vehicle starts and are not included in the analysis because these emissions occur regardless if the vehicle makes a trip (i.e., a start) or not.

EMFAC combines trip-based VMT from the regional transportation planning agencies, starts data based on household travel surveys, and vehicle population data from the Department of Motor Vehicles with corresponding emission rates to calculate emissions. [1]

1 More information on data sources can be found in the EMFAC technical document which is located on the web at: http://www.arb.ca.gov/msei/emfac2011-technical-documentation-final-updated-0712-v03.pdf

With the EMFAC model, the calculation of emissions growth and whether it is offset is simplified to a comparison of future year emissions with "no growth" in VMT or new control strategies to future emissions with VMT growth and new control strategies. This follows U.S. EPA's 2012 guidance and is consistent with the court's interpretation of CAA section 182(d)(1)(A).

Analysis Using 2012 as the Base Year for the 2008 8-hour Ozone Standard with Attainment Year of 2031.

Step 1. Provide the emissions level for the base year.

Table D-2 shows the VOC emissions, VMT, starts, and vehicle population for calendar year 2012 from the EMFAC2014 model.

Table D-2 Summary of 2012 Baseline Year

	VMT (thousand miles/day)	Starts (thousands/day)	Vehicle Population (thousands)	VOC Emissions* (tons/day)
2012 Base Year	96,934	16,624	2,655	50

* Does not include diurnal or resting loss emissions.

Step 2. Calculate three emissions levels in the attainment year.

For the attainment year,

(1) Calculate emissions level with the motor vehicle control program frozen at 2012 levels and with projected VMT, starts, and vehicle population for the attainment year. This represents what the emissions in the attainment year would have been if transportation control strategies and TCMs had not been implemented after 2012;

(2) Calculate emissions level with the motor vehicle control program frozen at 2012 levels and assuming VMT, starts, and vehicle population do not increase from 2012 levels; and

(3) Calculate an emissions level that represents emissions with full implementation of all transportation control strategies and TCMs since 2002 and which represents the projected future year baseline emissions inventory using the VMT, starts, and vehicle population for the attainment year.

Calculation 1. ***Calculate the emissions in the attainment year assuming no new measures since the base year, and including growth in VMT, starts, and vehicle population.***

To perform this calculation, California Air Resources Board (CARB) staff identified the on-road motor vehicle control programs adopted since 2012 and adjusted EMFAC2014 to reflect the VOC emissions levels in 2031 without the benefits of the post-2012 control programs. The projected VOC emissions are 22 tons/day.

Calculation 2. Calculate the emissions with no growth in VMT, starts, or vehicle population.

In this calculation, the VOC emission levels in calendar year 2031 without benefit of the post 2012 control program are calculated. EMFAC2014 allows a user to input different VMT, starts, and vehicle population than default. For this calculation, EMFAC2014 was run without the benefit of the post 2012 control program for calendar year 2031 with the 2012 level of VMT of 96,934,216 miles per day, the 2012 level of starts at 16,623,711 per day, and the 2012 level of population at 2,665,304 vehicles. The VOC emissions associated with 2012 VMT, starts, and vehicle population in calendar year 2031 are 17 tons/day.

Calculation 3. Calculate emission reductions with full Implementation of Transportation Control Strategies & TCMs.

The VOC emission levels for 2031 assuming the benefits of the post-2012 motor vehicle control program and the projected VMT, starts, and vehicle population in 2031 are calculated using EMFAC2014. The projected VOC emissions level is 14 tons/day. VOC emissions for the three sets of calculations described above are summarized in table D-3.

Table D-3 Summary of 2031 Attainment Year Emissions Levels

	Description	VMT* (miles/day, thousands)	Starts (thousands/day)	Vehicle Population (thousands)	VOC Emissions** (tons/day)
(1)	**Emissions with Motor Vehicle Control Program Frozen at 2012 Levels.** (VMT, starts and vehicle population at 2031 levels.)	131,835	20,572	3,423	22
(2)	**Emissions with Motor Vehicle Control Program Frozen at 2012 Levels.** (VMT, starts, and vehicle population at 2012 levels)	96,934	16,624	2,655	17
(3)	**Emissions with Full Motor Vehicle Control Program in Place** (VMT, starts and vehicle population at 2031 levels)	131,835	20,572	3,423	14

* CY 2031 VMT based on 2015 FTIPs from the 8 San Joaquin Valley MPOs

** Does not include diurnal or resting loss emissions.

As provided in the U.S. EPA guidance, to determine compliance with the provisions of Section 182(d)(1)(A) of the federal *Clean Air Act*, the emissions levels calculated in Calculation 3 should be less than the emissions levels in Calculation 2:

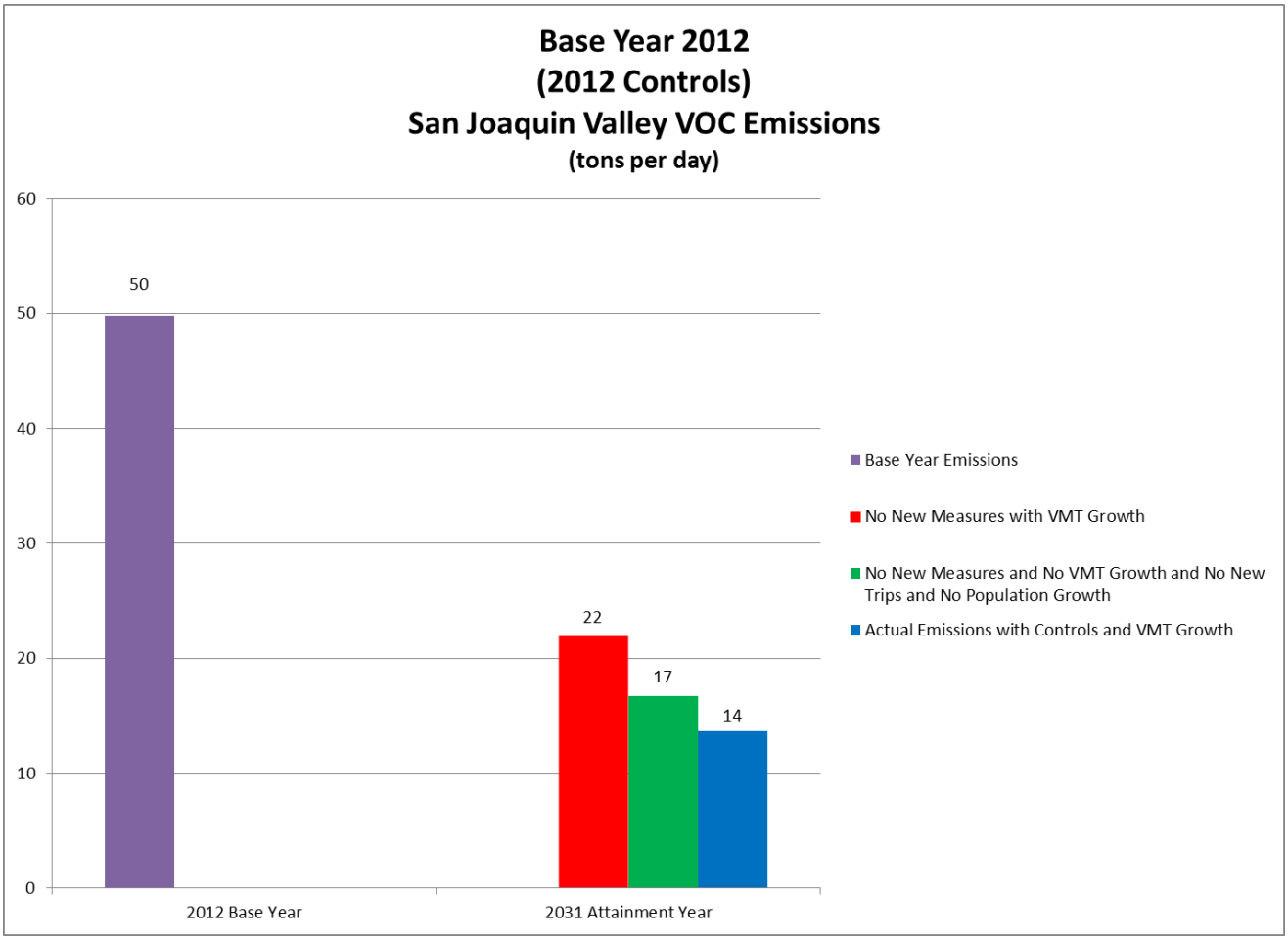
VOC: 14 < 17 tons/day

D.3.6 Summary

The previous sections provide an analysis to demonstrate compliance with the provisions of Section 182(d)(1)(A) of the federal Clean Air Act. To further illustrate the demonstration, Figure 1 below show graphically the emissions benefits of the motor vehicle control programs in offsetting VOC emissions due to increased VMT, starts, and vehicle population in the San Joaquin Valley Air Basin for the 2008 8-hour ozone standard (2012 base year). The left bar (in purple) shows the emissions in the base year with base year controls. The three bars on the right in each figure show the

emissions levels in the attainment year for the three calculations identified above: the red bar shows attainment year emissions with base year controls and attainment year VMT, starts, and vehicle population, the green bar shows attainment year emissions with base year controls, VMT, starts, and vehicle population, and the blue bar shows attainment year emissions with attainment year controls, VMT, starts, and vehicle population. Based on the U.S. EPA guidance, if the blue bar is lower than the green bar, then the identified transportation control strategies and TCMs are sufficient to offset the growth in emissions.

Figure D - 6 VOC Emissions* from On-Road Mobile Sources in the San Joaquin Valley Air Basin (2012 Base Year)



* Does not include resting or diurnal loss emissions

ATTACHMENT A: ARB'S MOBILE SOURCE REGULATORY ACTIONS SINCE 1985

Board Action	Hearing Date
Amendments to the Portable Fuel Container Regulation Amendments to the Portable Fuel Container (PFC) regulation, which include requiring certification fuel to contain 10 percent ethanol, harmonizing aspects of the Board's PFC certification and test procedures with those of the U.S. EPA, revising the ARB's certification process, and streamlining, clarifying, and increasing the robustness of ARB's certification and test procedures.	2/18/16
Technical Status and Proposed Revisions to On-Board Diagnostic System Requirements and Associated Enforcement Provisions for Passenger Cars, Light-Duty Trucks, and Medium-Duty Vehicles and Engines (OBD II) Amendments to the OBD II regulations that update requirements to account for LEV III applications and monitoring requirements for gasoline and diesel vehicles, and clarify and improve the regulation; also, updates to the associated OBD II enforcement regulation to align it with the proposed amendments to the OBD II regulations and a minor amendment to the definition of "emissions-related part" in title 13, CCR section 1900.	9/25/15
2015 Low Carbon Fuel Standard (LCFS) Amendments (2 of 2) Re-adoption of the Low Carbon Fuel Standard, which includes updates and revisions to the regulation now in effect. The proposed regulation was first presented to the Board at its February 2015 public hearing, at which the Board directed staff to make modifications to the proposal.	9/24/15
Proposed Regulation on the Commercialization of Alternative Diesel Fuels (2 of 2) Regulation governing the introduction of alternative diesel fuels into the California commercial market, including special provisions for biodiesel.	9/24/15
CA Cap on GHG Emissions and Market-Based Compliance Mechanisms (2 of 2) Amendments to the Cap and Trade Regulation to include a new Rice Cultivation Compliance Offset Protocol and an update to the United States Forest Compliance Offset Protocol that would include project eligibility in parts of Alaska.	6/25/15
Intermediate Volume Manufacturer Amendments to the Zero Emission Vehicle Regulation (2 of 2) Amendments regarding intermediate volume manufacturer compliance obligations under the Zero Emission Vehicle regulation.	5/21/15
2015 Amendments to Certification Procedures for Vapor Recovery Systems at Gasoline Dispensing Facilities—Aboveground Storage Tanks and Enhanced Conventional Nozzles Amendments would establish new performance standards and specifications for nozzles used at fleet facilities that exclusively refuel vehicles equipped with onboard vapor recovery systems, would provide regulatory relief for owners of certain existing aboveground storage tanks, and would ensure that mass-produced vapor recovery equipment matches the specifications of equipment evaluated during the ARB certification process.	4/23/15
Proposed Regulation for the Commercialization of Alternative Diesel Fuels (1 of 2) Regulation governing the introduction of alternative diesel fuels into the California commercial market, including special provisions for biodiesel. This is the first of two hearings on the item, and the Board will not take action to approve the proposed regulation.	2/19/15
Evaporative Emission Control Requirements for Spark-Ignition Marine Watercraft Regulation for controlling evaporative emissions from spark-ignition marine watercraft. The proposed regulation will harmonize, to the extent feasible, with similar federal requirements, while adding specific provisions needed to support California's air quality needs.	2/19/15
2015 Low Carbon Fuel Standard (LCFS) Amendments (1 of 2) Regulation for a Low Carbon Fuel Standard that includes re- adoption of the existing Low Carbon Fuel Standard with updates and revisions. This is the first of two hearings on the item, and the Board will not take action to approve the proposed regulation.	2/19/15
CA Cap on GHG Emissions and Market-Based Compliance Mechanisms to Add the Rice Cultivation Projects and Updated U.S. Forest Projects Protocols (1 of 2) Updates to the Cap and Trade Regulation to include a new Rice Cultivation Compliance Offset Protocol and an update to the United States Forest Compliance Offset Protocol that would include project eligibility in parts of Alaska.	12/18/14
2014 Amendments to ZEV Regulation Additional compliance flexibility to ZEV manufacturers working to bring advanced technologies to market.	10/23/14
LEV III Criteria Pollutant Requirements for Light- and Medium-Duty Vehicles the Hybrid Electric Vehicle Test Procedures, and the HD Otto-Cycle and HD Diesel Test Procedures Applies to the 2017 and subsequent model years.	10/23/14
Amendments to Mandatory Reporting Regulation for Greenhouse Gases Further align reporting methods with USEPA methods and factors, and modify reporting requirements to fully support implementation of California's Cap and Trade program.	9/19/14

Board Action	Hearing Date
Amendments to the California Cap on Greenhouse Gas Emissions and Market Based Compliance Mechanisms Technical revisions to Mandatory Reporting of Greenhouse Gas Emissions Regulation to further align reporting methods with U.S.EPA update methods and factors, and modify reporting requirements to fully support implementation of California's Cap and Trade program.	9/18/14
Amendments to the AB 32 Cost of Implementation Fee Regulation Amendments to the regulation to make it consistent with the revised mandatory reporting regulation, to add potential reporting requirements, and to incorporate requirements within the mandatory reporting regulation to streamline reporting.	9/18/14
Low Carbon Fuel Standard 2014 Update As a result of a California Court of Appeal decision, ARB will revisit the LCFS rulemaking process to meet certain procedural requirements of the APA and CEQA. Following incorporation of any modifications to the regulation, the Board will consider the proposed regulation for adoption at a second hearing held in the spring of 2015.	7/24/14
Revisions to the Carl Moyer Memorial Air Quality Standards Attainment Program Guidelines for On-Road Heavy-Duty Trucks Revisions to 1) reduce surplus emission reduction period, 2) reduce minimum CA usage requirement, 3) prioritize on-road funding to small fleets, 4) include light HD vehicles 14000-19500 libs, and 5) clarify program specifications.	7/24/14
Amendments to Enhanced Fleet Modernization (Car Scrap) Program Amendments consistent with SB 459 which requires ARB to increase benefits for low-income California residents, promote cleaner replacement vehicles, and enhance emissions reductions.	6/26/14
Proposed Approval of Amendments to CA Cap on GHG Emissions and Market-Based Compliance Mechanisms Second hearing of two, continued from October 2013.	4/24/14
Truck and Bus Rule Update Amendments to the Regulation to Reduce Emissions of Diesel Particulate Matter, Oxides of Nitrogen, and Other Criteria Pollutants From In-Use On-Road Diesel-Fueled Vehicles: increasing low-use vehicle thresholds, allowing owners to newly opt-in to existing flexibility provisions, adjusting "NOx exempt" vehicle provisions, and granting additional time for fleets in certain areas to meet PM filter requirements.	4/24/14
Heavy-Duty GHG Phase I: On-Road Heavy-Duty GHG Emissions Rule, Tractor-Trailer Rule, Commercial Motor Vehicle Idling Rule, Optional Reduced Emission Standards, Heavy-Duty Hybrid-Electric Vehicles Certification Procedure New GHG standards for MD and HD engines and vehicles identical to those adopted by the USEPA in 2011 for MYs 2014-18.	12/12/13
Agricultural equipment SIP credit rule Incentive-funded projects must be implemented using Carl Moyer Program Guidelines; must be surplus, quantifiable, enforceable, and permanent, and result in emission reductions that are eligible for SIP credit.	10/25/13
Mandatory Report of Greenhouse Gas Emissions Approved a regulation that establishes detailed specifications for emissions calculations, reporting, and verification of GHG emission estimates from significant sources.	10/25/13
CA Cap on Greenhouse Gas Emissions and Market-Based Compliance Mechanisms Technical revisions to the Mandatory Reporting of Greenhouse Gas Emissions Regulation to further align reporting methods with U.S.EPA, update factors, and modify definitions to maintain consistency with the Cap and Trade program.	10/25/13
Zero emission vehicle test procedures Existing certification test procedures for plug-in hybrid vehicles need to be updated to reflect technology developments. The ZEV regulation will require minor modifications to address clarity and implementation issues.	10/24/13
Consumer Products: Antiperspirants, Deodorants, Test Method 310, Aerosol Coatings, Proposed Repeal of Hairspray Credit) Amendments to require various consumer products to reformulate to reduce VOC or reactivity content to meet specified limits, and to clarify various regulatory provisions, improve enforcement, and add analytical procedures.	9/26/13
Alternative fuel certification procedures Amendments to current alternative fuel conversion certification procedures for motor vehicles and engines that will allow small volume conversion manufacturers to reduce the upfront demonstration requirements and allow systems to be sold sooner with lower certification costs than with the current process, beginning with MY 2018.	9/26/13

Board Action	Hearing Date
Vapor Recovery for Gasoline Dispensing Facilities Amendments to certification and test procedures for vapor recovery equipment used on cargo tanks and at gasoline dispensing facilities.	7/25/13
Off-highway recreational vehicle evaporative emission control Staff proposes to set evaporative emission standards to control hydrocarbon emissions from Off-Highway Recreational Vehicles. The running loss, hot soak, and diurnal performance standards can be met by using proven automobile type control technology.	7/25/13
Gasoline and diesel fuel test standards Adopted amendments to add test standards for the measurement of prohibited oxygenates at trace levels specified in existing regulations.	1/25/13
LEV III and ZEV Programs for Federal Compliance Option Adopted amendments to deem compliance with national GHG new vehicle standards in 2017-2025 as compliance with California GHG standards for the same model years.	11/15/12 12/6/12 EO
Consumer products (automotive windshield washing fluid) Adopted amendments to add portions of 14 California counties to the list of areas with freezing temperatures where 25% VOC content windshield washing fluid could be sold.	10/18/2012 EO 03/15/13
GHG mandatory reporting, Fee Regulation, and Cap and Trade 2012 Adopted amendments to eliminate emission verification for facilities emitting less than 25,000 MTCO2e and make minor changes in definitions and requirements.	9/20/12 11/2/12 EO
Amendments to Verification Procedure, Warranty and In-Use Compliance Requirements for In-Use Strategies to Control Emissions from Diesel Engines Approved amendments to the verification procedure used to evaluate diesel retrofits through emissions, durability, and field testing. Amendments will lower costs associated with required in-use compliance testing, streamline the in-use compliance process, and will extend time allowed to complete verifications.	8/23/2012 EO 07/02/13
Amendments to On-Board Diagnostics (OBD I and II) Regulations Approved amendments to the light- and medium-duty vehicle and heavy-duty engine OBD regulations.	8/23/2012 EO 06/26/13
Cap and Trade: Amendments to CA Cap on GHG Emissions and Market-Based Compliance Mechanisms, and Amendments Allowing Use of Compliance Instruments Issued by Linked Jurisdictions Amends Cap-and-Trade and compliance mechanisms to add security to the market system and to aid staff in implementation. Amendments include first auction rules, offset registry, market monitoring provisions, and information gathering necessary for the financial services operator.	6/28/12 7/31/12 EO
Vapor recovery defect list Adopted amendments to add defects and verification procedures for equipment approved since 2004, and make minor changes to provide clarity	6/11/12 EO
Tractor-Trailer GHG Regulation: Emergency Amendment Adopted emergency amendment to correct a drafting error and delay the registration date for participation in the phased compliance option	2/29/2012 2/29/12 EO
Advanced Clean Cars (ACC) Regulation: Low-Emission Vehicles and GHG Adopted more stringent criteria emission standards for MY 2015-2025 light and medium duty vehicles (LEV III), amended GHG emission standards for model year 2017-2025 light and medium duty vehicles (LEV GHG), amended ZEV Regulation to ensure the successful market penetration of ZEVs in commercial volumes, amended hydrogen fueling infrastructure mandate of the Clean Fuels Outlet regulation, and amended cert fuel for light duty vehicles from an MTBE-containing fuel to an E10 certification fuel.	1/26/12
Zero Emission Vehicle (ZEV) Adopted amendments to increase compliance flexibility, add two new vehicle categories for use in creating credits, increase credits for 300 mile FCVs, increase requirements for ZEVs and TZEVs, eliminate credit for PZEVs and AT PZEVs, expand applicability to smaller manufacturers, base ZEV credits on range, and make other minor changes in credit requirements	1/26/12
Amendments to Low Carbon Fuel Standard Regulation The amendments address several aspects of the regulation, including: reporting requirements, credit trading, regulated parties, opt-in and opt-out provisions, definitions, and other clarifying language.	12/16/11 10/10/12 EO

Board Action	Hearing Date
Amendments to Small Off-Road Engine and Tier 4 Off-Road Compression-Ignition Engine Regulations And Test Procedures; also "Recreational Marine" Spark-Ignition Marine Engine Amendments (Recreational Boats) adopted. Aligns California test procedures with U.S. EPA test procedures and requires off-road CI engine manufacturers to conduct in-use testing of their entire product lines to confirm compliance with previously established Not-To-Exceed emission thresholds.	12/16/2011 10/25/12 EO
Regulations and Certification Procedures for Engine Packages used in Light-Duty Specially Constructed Vehicles (Kit Cars) Ensures that certified engine packages, when placed into any Kit Car, would meet new vehicle emission standards, and be able to meet Smog Check requirements.	11/17/11 9/21/12 EO
Amendments to the California Reformulated Gasoline Regulations Corrects drafting errors in the predictive model, deletes outdated regulatory provisions, updates the notification requirements, and changes the restrictions on blending CARBOB with other liquids.	10/21/11 8/24/12 EO
Amendments to the In-Use Diesel Transport Refrigeration Units (TRU) ATCM Mechanisms to improve compliance rates and enforceability.	10/21/11 8/31/12 EO
Amendments to the AB 32 Cost of Implementation Fee Regulation Clarifies requirements and regulatory language, revises definitions.	10/20/11 8/21/12 EO
Cap on Greenhouse Gas Emissions and Market-Based Compliance Mechanisms Regulation, Including Compliance Offset Protocols Greenhouse Gas Emissions Cap-and-Trade Program, including compliance offset protocols and multiple pathways for compliance.	10/21/11 8/21/12 EO
Amendments to the Regulation for Cargo Handling Equipment (CHE) at Ports and Intermodal Rail Yards (Port Yard Trucks Regulation) Provides additional compliance flexibility, and maintains anticipated emissions reductions. As applicable to yard trucks and two-engine sweepers.	9/22/11 8/2/12 EO
Amendments to the Enhanced Vapor Recovery Regulation for Gasoline Dispensing Facilities New requirement for low permeation hoses at gasoline dispensing facilities.	9/22/11 7/26/12 EO
Amendments to Cleaner Main Ship Engines and Fuel for Ocean-Going Vessels Adjusts the offshore regulatory boundary. Aligns very low sulfur fuel implementation deadlines with new federal requirements.	6/23/11 9/13/12 EO
Particulate Matter Emissions Measurement Allowance For Heavy-Duty Diesel In-Use Compliance Regulation Emission measurement allowances provide for variability associated with the field testing required in the regulation.	6/23/11
Low Carbon Fuel Standard Carbon Intensity Lookup Table Amendments Adds new pathways for vegetation-based fuels	2/24/11
Amendments to Cleaner In-Use Heavy-Duty On-Road Diesel Trucks and LSI Fleets Regulations Amends five regulations to provide relief to fleets adversely affected by the economy, and take into account the fact that emissions are lower than previously predicted.	12/16/10 9/19/11 EO
Tractor-Trailer GHG Regulation Amendment Enacts administrative changes to increase compliance flexibility and reduce costs	12/16/10
Amendments to Cleaner In-Use Off-Road Diesel-Fueled Fleets Regulation Amendments provide relief to fleets adversely affected by the economy, and take into account the fact that emissions are lower than previously predicted.	12/16/10 10/28/11 EO
In-Use On-Road Diesel-Fueled Heavy-Duty Drayage Trucks at Ports and Rail Yard Facilities Amendments add flexibility to fleets' compliance schedules, mitigate the use of noncompliant trucks outside port and rail properties, and provide transition to the Truck and Bus regulation.	12/16/10 9/19/11 EO
Amendments to the Regulation for Mandatory Reporting of Greenhouse Gas Emissions Changes requirements to align with federal greenhouse gas reporting requirements adopted by US EPA.	12/16/10 10/28/11 EO
Cap on Greenhouse Gas Emissions and Market-Based Compliance Mechanisms Regulation Establishes framework and requirements for Greenhouse Gas Emissions Cap-and-Trade Program, including compliance offset protocols.	12/16/10 10/26/11 EO
Amendments to the Consumer Products Regulation Amendments set new or lower VOC limits for some categories, prohibit certain toxic air contaminants, high GWP compounds, and surfactants toxic to aquatic species. Also changes Method 310, used to determine aromatic content of certain products.	11/18/10 9/29/11 EO
Amendment of the ATCM for Diesel Transportation Refrigeration Units (TRU) Amendments expand the compliance options and clarify the operational life of various types of TRUs.	11/18/10 2/2/11 EO
Amendments to the ATCM for Stationary Compression Ignition Engines Approved amendments to closely align the emission limits for new emergency standby engines in the ATCM with the emission standards required by the federal Standards of Performance.	10/21/10 3/25/11 EO

Board Action	Hearing Date
Diesel Vehicle Periodic Smoke Inspection Program Adopted amendments to exempt medium duty diesel vehicles from smoke inspection requirements if complying with Smog Check requirements.	10/21/10 8/23/11 EO
Renewable Electricity Standard Regulation Approved a regulation that will require electricity providers to obtain at least 33% of their retail electricity sales from renewable energy resources by 2020.	9/23/10
Energy Efficiency at Industrial Facilities Adopted standards for the reporting of GHG emissions and the feasibility of emissions controls by the largest GHG-emitting stationary sources.	7/22/10 5/9/11 EO
Accelerated Introduction of Cleaner Line-Haul Locomotives Agreement with railroads sets prescribed reductions in diesel risk and target years through 2020 at four major railyards.	6/24/10
Amendments to Commercial Harbor Craft Regulation Approved amendments to require the use of cleaner engines in diesel-fueled crew and supply, barge, and dredge vessels.	6/24/10 4/11/11 EO
Amendments to New Passenger Motor Vehicle Greenhouse Gas Emission Standards Approved amendments deeming compliance with EPA's GHG standards as compliance with California's standards in 2012 through 2016 model years.	2/25/2010 03/29/10
Sulfur Hexafluoride (SF6) Regulation Regulation to reduce emissions of sulfur hexafluoride (SF6), a high-GWP GHG, from high-voltage gas-insulated electrical switchgear.	2/25/10 12/15/10 EO
Amendments to the Statewide Portable Equipment Registration Regulation and Portable Engine ATCM Approved amendments that extend the deadline for removal of certain uncertified portable engines for one year.	1/28/10 8/27/10 EO 12/8/10 EO
Diesel Engine Retrofit Control Verification, Warranty, and Compliance Regulation Amendments Approved amendments to require per-installation compatibility assessment, performance data collection, and reporting of additional information, and enhance enforceability.	1/28/10 12/6/10 EO
Stationary Equipment High-GWP Refrigerant Regulation Approved a regulation to reduce emissions of high-GWP refrigerants from stationary non-residential equipment.	12/1/09 9/14/10 EO
Amendments to Limit Ozone Emissions from Indoor Air Cleaning Devices Adopted amendments to delay the labeling compliance deadlines by one to two years and to make minor changes in testing protocols.	12/9/09
Emission Warranty Information Reporting Regulation Amendments Repealed the 2007 regulation and readopted the 1988 regulation with amendments to implement adverse court decision.	11/19/09 9/27/10 EO
Amendments to Maximum Incremental Reactivity Tables Added many new compounds and modified reactivity values for many existing compounds in the tables to reflect new research data.	11/3/09 7/23/10 EO
AB 32 Cost of Implementation Fee Regulation AB 32 authorizes ARB to adopt by regulation a schedule of fees to be paid by sources of greenhouse gas emissions regulated pursuant to AB 32. ARB staff will propose a fee regulation to support the administrative costs of AB 32 implementation.	9/24/2009 05/06/10 EO
Passenger Motor Vehicle Greenhouse Gas Limits Amendments Approved amendments granting credits to manufacturers for compliant vehicles sold in other states that have adopted California regulations.	9/24/09 2/22/10 EO
Consumer Products Amendments Approved amendments that set new VOC limits for multi-purpose solvent and paint thinner products and lower the existing VOC limit for double phase aerosol air fresheners.	9/24/09 8/6/10 EO
Amendments to In-Use Off-Road Diesel-Fueled Fleets Regulation Approved amendments to implement legislatively directed changes and provide additional incentives for early action.	7/23/09 12/2/09 EO 6/3/10 EO
Methane Emissions from Municipal Solid Waste Landfills Approved a regulation to require smaller and other uncontrolled landfills to install gas collection and control systems, and also requires existing and newly installed systems to operate optimally.	6/25/09 5/5/10 EO
Cool Car Standards Approved a regulation requiring the use of solar management window glass in vehicles up to 10,000 lb GVWR.	6/25/09

Board Action	Hearing Date
Enhanced Fleet Modernization (Car Scrap) Approved guidelines for a program to scrap up to 15,000 light duty vehicles statewide.	6/25/09 7/30/10 EO
Amendments to Heavy-Duty On-Board Diagnostics Regulations Approved amendments to the light and medium-duty vehicle and heavy duty engine OBD regulations.	5/28/2009 4/6/10 EO
Smog Check Improvements BAR adopted amendments to implement changes in state law and SIP commitments adopted by ARB between 1996 and 2007.	5/7/09 by BAR 6/9/09 EO
AB 118 Air Quality Improvement Program Guidelines The Air Quality Improvement Program provides for up to $50 million per year for seven years beginning in 2009-10 for vehicle and equipment projects that reduce criteria pollutants, air quality research, and advanced technology workforce training. The AQIP Guidelines describe minimum administrative, reporting, and oversight requirements for the program, and provide general criteria for how the program shall be implemented.	04/23/09 08/28/09 EO
Pesticide Element Reduce volatile organic compound (VOC) emissions from the application of agricultural field fumigants in the South Coast, Southeast Desert, Ventura County, San Joaquin Valley, and Sacramento Metro federal ozone nonattainment areas.	4/20/09 10/12/09 EO (2) 8/2/11 EO
Low Carbon Fuel Standard Approved new standards to lower the carbon content of fuels.	4/20/09 11/25/09 EO
Pesticide Element for San Joaquin Valley DPR Director approved pesticide ROG emission limit of 18.1 tpd and committed to implement restrictions on non-fumigant pesticide use by 2014 in the San Joaquin Valley.	4/7/09 DPR
Tire Pressure Inflation Regulation Approved a regulation requiring automotive service providers to perform tire pressure checks as part of every service.	3/26/09 2/4/10 EO
Sulfur Hexafluoride from Non-Utility and Non-Semiconductor Applications Approved a regulation to phase out use of Sulfur Hexafluoride over the next several years.	2/26/09 11/12/09 EO
Semiconductor Operations Approved a regulation to set standards to reduce fluorinated gas emissions from the semiconductor and related devices industry.	2/26/09 10/23/09 EO
Plug-In Hybrid Electric Vehicles Test Procedure Amendments Amends test procedures to address plug-in-hybrid electric vehicles.	1/23/09 12/2/09 EO
In-Use Off-Road Diesel-Fueled Fleets Amendments Makes administrative changes to recognize delays in the supply of retrofit control devices.	1/22/09
Small Containers of Automotive Refrigerant Approved a regulation to reduce leakage from small containers, adopt a container deposit and return program, and require additional container labeling and consumer education requirements.	1/22/09 1/5/10 EO
Aftermarket Critical Emission Parts on Highway Motorcycles Allows for the sale of certified critical emission parts by aftermarket manufacturers.	1/22/09 6/19/09 EO
Heavy-Duty Tractor-Trailer Greenhouse Gas (GHG) Reduction Approved a regulation to reduce greenhouse gas emissions by improving long haul tractor and trailer efficiency through use of aerodynamic fairings and low rolling resistance tires.	12/11/08 10/23/09 EO
Cleaner In-Use Heavy-Duty Diesel Trucks (Truck and Bus Regulation) Approved a regulation to reduce diesel particulate matter and oxides of nitrogen through fleet modernization and exhaust retrofits. Makes enforceability changes to public fleet, off-road equipment, and portable equipment regulations.	12/11/08 10/19/09 EO 10/23/09 EO
Large Spark-Ignition Engine Amendments Approved amendments to reduce evaporative, permeation, and exhaust emissions from large spark-ignition (LSI) engines equal to or below 1 liter in displacement.	11/1/08 3/12/09 EO
Small Off-Road Engine (SORE) Amendments Approved amendments to address the excessive accumulation of emission credits.	11/21/08 2/24/10 EO
Proposed AB 118 Air Quality Guidelines for the Air Quality Improvement Program and the Alternative and Renewable Fuel and Vehicle and Technology Program. The California Alternative and Renewable Fuel, Vehicle Technology, Clean Air, and Carbon Reduction Act of 2007 (AB 118) requires ARB to develop guidelines for both the Alternative and Renewable Fuel and Vehicle Technology Program and the Air Quality Improvement Program to ensure that both programs do not adversely impact air quality.	09/25/08 EO 05/20/09

Board Action	Hearing Date
Portable Outboard Marine Tanks and Components (part of Additional Evaporative Emission Standards) Approved a regulation that establishes permeation and emission standards for new portable outboard marine tanks and components.	9/25/08 7/20/09 EO
Cleaner Fuel in Ocean Going Vessels Approved a regulation that requires use of low sulfur fuel in ocean-going ship main engines, and auxiliary engines and boilers.	7/24/08 4/16/09 EO
Spark-Ignition Marine Engine and Boat Amendments Provides optional compliance path for > 500 hp sterndrive/inboard marine engines.	7/24/08 6/5/09 EO
Consumer Products Amendments Approved amendments that add volatile organic compound (VOC) limits for seven additional categories and lower limits for twelve previously regulated categories.	6/26/08 5/5/09 EO
Zero emission vehicles Updated California's ZEV requirements to provide greater flexibility with respect to fuels, technologies, and simplifying compliance pathways. Amendments give manufacturers increased flexibility to comply with ZEV requirements by giving credit to plug-in hybrid electric vehicles and establishing additional ZEV categories in recognition of new developments in fuel cell vehicles and battery electric vehicles.	3/27/08 12/17/08 EO
Amendments to the Verification Procedure, Warranty, and In-Use Compliance Requirements for In-Use Strategies to Control Emissions from Diesel Engines Adds verification requirements for control technologies that only reduce NOx emissions, new reduction classifications for NOx reducing technologies, new testing requirements, and conditional extensions for verified technologies.	1/24/08 12/4/08 EO
Mandatory Report of Greenhouse Gas Emissions Approved a regulation that establishes detailed specifications for emissions calculations, reporting, and verification of GHG emission estimates from significant sources.	12/6/07 10/12/08 EO
Gaseous Pollutant Measurement Allowances for In-Use Heavy-Duty Diesel Compliance Measurement accuracy margins are to be determined through an ongoing comprehensive testing program performed by an independent contractor. Amendments include these measurement accuracy margins into the regulation.	12/6/07 10/14/08 EO
Ocean-Going Vessels While at Berth (aka Ship Hoteling) - Auxiliary Engine Cold Ironing and Clean Technology Approved a regulation that reduces emissions from auxiliary engines on ocean-going ships while at-berth.	12/6/07 10/16/08 EO
In-Use On-Road Diesel-Fueled Heavy-Duty Drayage Trucks at Ports and Rail Yard Facilities Approved a regulation that establishes emission standards for in-use, heavy-duty diesel-fueled vehicles that transport cargo to and from California's ports and intermodal rail facilities.	12/6/07 10/12/08 EO
Commercial Harbor Craft Approved a regulation that establishes in-use and new engine emission limits for both auxiliary and propulsion diesel engines on ferries, excursion vessels, tugboats, and towboats.	11/15/07 9/2/08 EO
Suggested Control Measure for Architectural Coatings Amendments Approved amendments to reduce the recommended VOC content of 19 categories of architectural coatings.	10/26/07
Aftermarket Catalytic Converter Requirements Approved amendments that establish more stringent emission performance and durability requirements for used and new aftermarket catalytic converters offered for sale in California.	10/25/07 2/21/08 NOD
Limiting Ozone Emissions from Indoor Air Cleaning Devices Approved ozone emission limit of 0.050 ppm for portable indoor air cleaning devices in response to requirements of AB 2276 (2006).	9/27/07 8/7/08 EO
Pesticide Commitment for Ventura County in 1994 SIP Approved substitution of excess ROG emission reductions from state motor vehicle program for 1994 SIP reduction commitment from pesticide application in Ventura County.	9/27/07 11/30/07 EO
In-Use Off-Road Diesel Equipment Approved a regulation that requires off-road diesel fleet owners to modernize their fleets and install exhaust retrofits.	7/26/07 4/4/08 EO
Emission Control and Environmental Performance Label Regulations Approved amendments to add a Global Index Label and modify the formal of the Smog Index Label on new cars.	6/21/07 5/2/08 EO
Vapor Recovery from Aboveground Storage Tanks Approved a regulation to establish new performance standards and specifications for the vapor recovery systems and components used with aboveground storage tanks.	6/21/07 5/2/08 EO

Board Action	Hearing Date
CaRFG Phase 3 amendments Approved amendments to mitigate the increases in evaporative emissions from on-road motor vehicles resulting from the addition of ethanol to gasoline.	6/14/07 4/25/08 EO 8/7/08 EO
Formaldehyde from Composite Wood Products Approved an ATCM to limit formaldehyde emissions from hardwood plywood, particleboard, and medium density fiberboard to the maximum amount feasible.	4/26/07 3/5/08 EO
Portable equipment registration program (PERP) and airborne toxic control measure for diesel-fueled portable engines Approved amendments to allow permitting of Tier 0 portable equipment engines used in emergency or low use duty and to extend permitting of certain Tier 1 and 2 "resident" engines to 1/1/10.	3/22/07 7/31/07 EO
Perchloroethylene Control Measure Amendments Approved amendments to the Perchloroethylene ATCM to prohibit new Perc dry cleaning machines beginning 2008 and phase out all Perc machines by 2023.	1/25/07 11/7/07 EO
Amendments to Emission Warranty Information Reporting & Recall Regulations Approved amendments that tighten the provisions for recalling vehicles for emissions-related failures, helping ensure that corrective action is taken to vehicles with defective emission control devices or systems.	12/7/06 3/22/07 10/17/07 EO
Voluntary accelerated vehicle retirement regulations Approved amendments that authorize the use of remote sensing to identify light-duty high emitters and that establish protocols for quantifying emissions reductions from high emitters proposed for retirement.	12/7/06
Emergency regulation for portable equipment registration program (PERP), airborne toxic control measures for portable and stationary diesel-fueled engines	12/7/06
Amendments to the Hexavalent Chromium ATCM Approved amendments that require use of best available control technology on all chrome plating and anodizing facilities.	12/7/06
Consumer Products Regulation Amendments Approved amendments that set lower emission limits in 15 product categories.	11/17/06 9/25/07 EO
Requirements for Stationary Diesel In-Use Agricultural Engines Approved amendments to the stationary diesel engine ATCM which set emissions standards for in-use diesel agricultural engines.	11/16/06 7/3/07 NOD
Ships - Onboard Incineration Approved amendments to cruise ship incineration ATCM to include all oceangoing ships of 300 gross registered tons or more.	11/16/06 9/11/07 EO
Zero Emission Bus Approved amendments postponing the 15 percent purchase requirement three years for transit agencies in the diesel path and one to two years for transit agencies in the alternative fuel path, in order to keep pace with developments in zero emission bus technology, and adding an Advanced Demonstration requirement to offset emission losses.	10/19/06 8/27/07 EO
Distributed generation certification Approved amendments improving the emissions durability and testing requirements, adding waste gas emission standards, and eliminating a redundant PM standard in the current 2007 emission standards.	10/19/06 5/17/07 NOD
Heavy-Duty Diesel In-Use Compliance Regulation Approved amendments to the heavy-duty diesel engine regulations and test procedures to create a new in-use compliance program conducted by engine manufacturers. The amendments would help ensure compliance with applicable certification standards throughout an engine's useful life.	9/28/06 7/19/07 NOD
Revisions to OBD II and the Emission Warranty Regulations Approved amendments to the OBD II regulation to provide for improved emission control monitoring including air-fuel cylinder imbalance monitoring, oxygen sensor monitoring, catalyst monitoring, permanent fault codes for gasoline vehicles and new thresholds for diesel vehicles.	9/28/06 8/9/07 EO
Off-Highway Recreational Vehicle Amendments Approved amendments to the Off-Highway Recreational Vehicle Regulations including harmonizing evaporative emission standards with federal regulations, expanding the definition of ATVs, modifying labeling requirements, and adjusting riding seasons.	7/20/06 6/1/07 EO
Portable Equipment Registration Program (PERP) Amendments Approved amendments to the Statewide Portable Equipment Registration program that include installation of hour meters on equipment, and revisions to recordkeeping, reporting, and fees.	6/22/06 11/13/06 NOD
Heavy Duty Vehicle Service Information Approved amendments to the Service Information Rule to require manufacturers to make available diagnostic equipment and information for sale to the aftermarket.	6/22/06 5/3/07 EO

Board Action	Hearing Date
LEV II technical amendments Approved amendments to evaporative emission test procedures, four-wheel drive dynamometer provisions, and vehicle label requirements.	6/22/06 9/27/06 NOD
Dry Cleaning ATCM Amendments Approved amendments to the Dry Cleaning ATCM to limit siting of new dry cleaners, phase out use of Perc at co-residential facilities, phase out higher emitting Perc sources at other facilities, and require enhanced ventilation at existing and new Perc facilities.	5/25/06
Forklifts and other Large Spark Ignition (LSI) Equipment Adopted a regulation to reduce emissions from forklifts and other off-road spark-ignition equipment by establishing more stringent standards for new equipment, and requiring retrofits or engine replacement on existing equipment. Adopts EPA's standards for 2007; adopts more stringent standards for 2010.	5/25/06 3/2/07 EO
Enhanced Vapor Recovery Amendments Approved amendments to the vapor recovery system regulation and adopted revised test procedures.	5/25/06
Diesel Retrofit Technology Verification Procedure Approved amendments to the Diesel Emission In-use Control Strategy Verification Procedure to substitute a 30% increase limit in NOx concentration for an 80% reduction requirement from PM retrofit devices.	3/23/06 12/21/06 NOD
Heavy duty vehicle smoke inspection program amendments Approved amendments to impose a fine on trucks not displaying a current compliance certification sticker.	1/26/06 12/4/06 EO
Ocean-going Ship Auxiliary Engine Fuel Approved a regulation to require ships to use cleaner marine gas oil or diesel to power auxiliary engines within 24 nautical miles of the California coast.	12/8/05 10/20/06 EO
Diesel Cargo Handling Equipment Approved a regulation to require new and in-use cargo handling equipment at ports and intermodal rail yards to reduce emissions by utilizing best available control technology.	12/8/05 6/2/06 EO
Public and Utility Diesel Truck Fleets Approved a regulation to reduce diesel particulate matter emissions from heavy duty diesel trucks in government and private utility fleets.	12/8/05 10/4/06 EO
Cruise ships – Onboard Incineration Adopted an Air Toxic Control Measure to prohibit cruise ships from conducting onboard incineration within three nautical miles of the California coast.	11/17/05 2/1/06 NOD
Inboard Marine Engine Rule Amendments Approved amendments to the 2001 regulation to include additional compliance options for manufacturers.	11/17/05 9/26/06 EO
Heavy-Duty Diesel Truck Idling Technology Approved a regulation to limit sleeper truck idling to 5 minutes. Allows alternate technologies to provide cab heating/cooling and power.	10/20/05 9/1/06 EO
Automotive Coating Suggested Control Measure Approved an SCM for automotive coatings for adoption by air districts. The measure will reduce the VOC content of 11 categories of surface protective coatings.	10/20/05
2007-09 Model-year heavy duty urban bus engines and the fleet rule for transit agencies Adopted amendments to align urban bus emission limits with on-road heavy duty truck emission limits and allow for the purchase of non- complying buses under the condition that bus turnover increase to offset NOx increases.	10/20/05 10/27/05 7/28/06 EO
Portable fuel containers (part 2 of 2) Approved amendments to revise spout and automatic shutoff design.	9/15/05 7/28/06 EO
Portable Fuel Containers (part 1 of 2) Approved amendments to include kerosene containers in the definition of portable fuel containers.	9/15/05 11/9/05 NOD
2007-09 Model-year heavy duty urban bus engines and the fleet rule for transit agencies Adopted amendments to require all transit agencies in SCAQMD to purchase only alternate fuel versions of new buses.	9/15/05 Superceded by 10/20/05
Reid vapor pressure limit emergency rule Approved amendments to relax Reid vapor pressure limit to accelerate fuel production for Hurricane Katrina victims.	9/8/05 Operative for September and October 2005 only

Board Action	Hearing Date
Heavy-Duty Truck OBD Approved a regulation to require on-board diagnostic (OBD) systems for new gas and diesel trucks, similar to the systems on passenger cars.	7/21/05 12/28/05 EO
Definition of Large Confined Animal Facility Adopted a regulation to define the size of a large CAF for the purposes of air quality permitting and reduction of ROG emissions to the extent feasible.	6/23/05 4/13/06 EO
ATCM for stationary compression ignition engines Approved emergency amendments (3/17/05) and permanent amendments (5/26/05) to relax the diesel PM emission limits on new stationary diesel engines to current off-road engine standards to respond to the lack of availability of engines meeting the original ATCM standard.	3/17/05 5/26/05 7/29/05 EO
Transit Fleet Rule Approved amendments to add emission limits for non-urban bus transit agency vehicles, require lower bus and truck fleet-average NOx and PM emission limits, and clarify emission limits for CO, NMHC, and formaldehyde.	2/24/05 10/19/05 NOD
Thermal Spraying ATCM Approved a regulation to reduce emissions of hexavalent chromium and nickel from thermal spraying operations.	12/9/04 7/20/05 EO
Tier 4 Standards for Small Off-Road Diesel Engines (SORE) Approved new emission standards for off-road diesel engines to be phased in between 2008 and 2015.	12/9/04 10/21/05 EO
Emergency Regulatory Amendment Delaying the January 1, 2005 Implementation Date for the Diesel Fuel Lubricity Standard Adopted an emergency regulation delaying the lubricity standard compliance deadline by five months to respond to fuel pipeline contamination problems.	11/24/04 12/10/04 EO
Enhanced vapor recovery compliance extension Approved amendments to the EVR regulation to extend the compliance date for onboard refueling vapor recovery compatibility to the date of EVR compliance.	11/18/04 2/11/05 EO
CaRFG Phase 3 amendments Approved amendments correcting errors and streamlining requirements for compliance and enforcement of CaRFG Phase 3 regulations adopted in 1999.	11/18/04
Clean diesel fuel for harborcraft and intrastate locomotives Approved a regulation that required harborcraft and locomotives operating solely within California to use clean diesel fuel.	11/18/04 3/16/05 EO
Nonvehicular Source, Consumer Product, and Architectural Coating Fee Regulation Amendment Approved amendments to fee regulations to collect supplemental fees when authorized by the Legislature.	11/18/04
Greenhouse gas limits for motor vehicles Approved a regulation that sets the first ever greenhouse gas emission standards on light and medium duty vehicles starting with the 2009 model year.	9/24/04 8/4/05 EO
Gasoline vapor recovery system equipment defects list Approved the addition of defects to the VRED list for use by compliance inspectors.	8/24/04 6/22/05 EO
Unihose gasoline vapor recovery systems Approved an emergency regulation and an amendment to delay the compliance date for unihose installation to the date of dispenser replacement.	7/22/04 11/24/04 EO
General Idling Limits for Diesel Trucks Approved a regulation that limits idling of heavy-duty diesel trucks operating in California to five minutes, with exceptions for sleeper cabs.	7/22/04
Consumer Products Approved a regulation to reduce ROG emissions from 15 consumer products categories, prohibit the use of 3 toxic compounds in consumer products, ban the use of PDCB in certain products, allow for the use of Alternative Control Plans, and revise Test Method 310.	6/24/04 5/6/05 EO
Urban bus engines/fleet rule for transit agencies Approved amendments to allow for the purchase of hybrid diesel buses and revise the zero emission bus demonstration and purchase timelines.	6/24/04
Engine Manufacturer Diagnostics Approved a regulation that would require model year 2007 and later heavy duty truck engines to be equipped with engine diagnostic systems to detect malfunctions of the emission control system.	5/20/04

Board Action	Hearing Date
Chip Reflash Approved a voluntary program and a backstop regulation to reduce heavy duty truck NOx emissions through the installation of new software in the engine's electronic control module.	3/25/04 3/21/05 EO
Portable equipment registration program (PERP) Approved amendments to allow uncertified engines to be registered until December 31, 2005, to increase fees, and to modify administrative requirements.	2/26/04 1/7/05 EO 6/21/05 EO
Portable Diesel Engine ATCM Adopted a regulation to reduce diesel PM emissions from portable engines through a series of emission standards that increase in stringency through 2020.	2/26/04 1/4/05 EO
California motor vehicle service information rule Adopted amendments to allow for the purchase of heavy duty engine emission-related service information and diagnostic tools by independent service facilities and aftermarket parts manufacturers.	1/22/04 5/20/04
Transportation Refrigeration Unit ATCM Adopted a regulation to reduce diesel PM emissions from transport refrigeration units by establishing emission standards and facility reporting requirements to streamline inspections.	12/11/03 2/26/04 11/10/04 EO
Diesel engine verification procedures Approved amendments that reduced warranty coverage to the engine only, delayed the NOx reduction compliance date to 2007, added requirements for proof-of-concept testing for new technology, and harmonized durability requirements with those of U.S. EPA.	12/11/03 2/26/04 10/17/04
Chip Reflash Approved a voluntary program and a backstop regulation to reduce heavy duty truck NOx emissions through the installation of new software in the engine's electronic control module.	12/11/03 3/27/04 3/21/05 EO
Revised tables of maximum incremental reactivity values Approved the addition of 102 more chemicals with associated maximum incremental reactivity values to existing regulation allowing these chemicals to be used in aerosol coating formulations.	12/3/03
Stationary Diesel Engines ATCM Adopted a regulation to reduce diesel PM emissions from stationary diesel engines through the use of clean fuel, lower emission standards, operational practices.	11/20/03 12/11/03 2/26/2004 9/27/04 EO
Solid waste collection vehicles Adopted a regulation to reduce toxic diesel particulate emissions from solid waste collection vehicles by over 80 percent by 2010. This measure is part of ARB's plan to reduce the risk from a wide range of diesel engines throughout California.	9/25/03 5/17/04 EO
Small off-road engines (SORE) Adopted more stringent emission standards for the engines used in lawn and garden and industrial equipment, such as string trimmers, leaf blowers, walk-behind lawn mowers, generators, and lawn tractors.	9/25/03 7/26/04 EO
Off-highway recreational vehicles Changes to riding season restrictions.	7/24/03
Clean diesel fuel Adopted a regulation to reduce sulfur levels and set a minimum lubricity standard in diesel fuel used in vehicles and off-road equipment in California, beginning in 2006.	7/24/03 5/28/04 EO
Ozone Transport Mitigation Amendments Adopted amendments to require upwind districts to (1) have the same no-net-increase permitting thresholds as downwind districts, and (2) Adopt "all feasible measures."	5/22/03 10/2/03 NOD
Zero emission vehicles Updated California's ZEV requirements to support the fuel cell car development and expand sales of advanced technology partial ZEVs (like gasoline-electric hybrids) in the near-term, while retaining a role for battery electric vehicles.	3/27/03 12/19/03 EO
Heavy duty gasoline truck standards Aligned its existing rules with new, lower federal emission standards for gasoline-powered heavy-duty vehicles starting in 2008.	12/12/02 9/23/03 EO
Low emission vehicles II Minor administrative changes.	12/12/02 9/24/03 EO
Gasoline vapor recovery systems test procedures Approved amendments to add advanced vapor recovery technology certification and testing standards.	12/12/02 7/1/03 EO 10/21/03 EO
CaRFG Phase 3 amendments Approved amendments to allow for small residual levels of MTBE in gasoline while MTBE is being phased out and replaced by ethanol.	12/12/02 3/20/03 EO

Board Action	Hearing Date
School bus Idling Adopted a measure requiring school bus drivers to turn off the bus or vehicle engine upon arriving at a school and restart it no more than 30 seconds before departure in order to limit children's exposure to toxic diesel particulate exhaust.	12/12/02 5/15/03 EO
California Interim Certification Procedures for 2004 and Subsequent Model Year Hybrid-Electric Vehicles in the Urban Transit Bus and Heavy-Duty Vehicle Classes Regulation Amendment Adopted amendments to allow diesel-path transit agencies to purchase alternate fuel buses with higher NOx limits, establish certification procedures for hybrid buses, and require lower fleet-average PM emission limits.	10/24/02 9/2/03 EO
CaRFG Phase 3 amendments Approved amendments delaying removal of MTBE from gasoline by one year to 12/31/03.	7/25/02 11/8/02 EO
Diesel retrofit verification procedures, warranty, and in-use compliance requirements Adopted regulations to specify test procedures, warranty, and in-use compliance of diesel engine PM retrofit control devices.	5/16/02 3/28/03 EO
On-board diagnostics for cars Adopted changes to the On-Board Diagnostic Systems (OBD II) regulation to improve the effectiveness of OBD II systems in detecting motor vehicle emission-related problems.	4/25/02 3/7/03 EO
Voluntary accelerated light duty vehicle retirement regulations Establishes standards for a voluntary accelerated retirement program.	2/21/02 11/18/02 EO
Residential burning Adopted a measure to reduce emissions of toxic air contaminants from outdoor residential waste burning by eliminating the use of burn barrels and the outdoor burning of residential waste materials other than natural vegetation.	2/21/02 12/18/02 EO
California motor vehicle service information rule Adopted regulations to require light- and medium-duty vehicle manufacturers to offer for sale emission-related service information and diagnostic tools to independent service facilities and aftermarket parts manufacturers.	12/13/01 7/31/02 EO
Vapor recovery regulation amendments Adopted amendments to expand the list of specified defects requiring equipment to be removed from service.	11/15/01 9/27/02 EO
Distributed generation guidelines and regulations Adopted regulations requiring the permitting by ARB of distributed generation sources that are exempt from air district permitting and approved guidelines for use by air districts in permitting non-exempt units.	11/15/01 7/23/02 EO
Low emission vehicle regulations (LEV II) Approved amendments to apply PM emission limits to all new gasoline vehicles, extend gasoline PZEV emission limits to all fuel types, and streamline the manufacturer certification process.	11/15/01 8/6/02 EO
Gasoline vapor recovery systems test methods and compliance procedures Adopted amendments to add test methods for new technology components, streamline test methods for liquid removal equipment, and***.	10/25/01 7/9/02 EO
Heavy-duty diesel trucks Adopted amendments to emissions standards to harmonize with EPA regulations for 2007 and subsequent model year new heavy-duty diesel engines.	10/25/01
Automotive coatings Adopted Air Toxic Control Measure which prohibits the sale and use in California of automotive coatings that contain hexavalent chromium or cadmium.	9/20/01 9/2/02 EO
Inboard and sterndrive marine engines Lower emission standards for 2003 and subsequent model year inboard and sterndrive gasoline-powered engines in recreational marine vessels.	7/26/01 6/6/02 EO
Asbestos from construction, grading, quarrying, and surface mining Adopted an Airborne Toxic Control Measure for construction, grading, quarrying, and surface mining operations requiring dust mitigation for construction and grading operations, road construction and maintenance activities, and quarries and surface mines to minimize emissions of asbestos-laden dust.	7/26/01 6/7/02 EO
Zero emission vehicle infrastructure and standardization of electric vehicle charging equipment Adopted amendments to the ZEV regulation to alter the method of quantifying production volumes at joint-owned facilities and to add specifications for standardized charging equipment.	6/28/01 5/10/02 EO

Board Action	Hearing Date
Enhanced vapor recovery emergency regulation Adopted a four-year term for equipment certifications.	5/22/01 EO
Pollutant transport designation Adopted amendments to add two transport couples to the list of air basins in which upwind areas are required to adopt permitting thresholds no less stringent than those adopted in downwind areas.	4/26/01
Zero emission vehicle regulation amendments Adopted amendments to reduce the numbers of ZEVs required in future years, add a PZEV category and grant partial ZEV credit, modify the ZEV range credit, allow hybrid-electric vehicles partial ZEV credit, grant ZEV credit to advanced technology vehicles, and grant partial ZEV credit for several other minor new programs.	1/25/01 12/7/01 EO 4/12/02 EO
Heavy duty diesel engines supplemental test procedures Approved amendments to extend "Not-To-Exceed" and EURO III supplemental test procedure requirements through 2007 when federal requirements will include these tests.	12/7/00
Light and medium duty low emission vehicle alignment with federal standards Approved amendments that require light and medium duty vehicles sold in California to meet the more restrictive of state or federal emission standards.	12/7/00 12/27/00 EO
Exhaust emission standards for heavy duty gas engines Adopted amendments that establish 2005 emission limits for heavy duty gas engines that are equivalent to federal limits.	12/7/00 12/27/00 EO
CaRFG Phase 3 amendments Approved amendments to regulate the replacement of MTBE in gasoline with ethanol.	11/16/00 4/25/01 EO
CaRFG Phase 3 test methods Approved amendments to gasoline test procedures to quantify the olefin content and gasoline distillation temperatures.	11/16/00 7/11/01 EO 8/28/01 EO
Antiperspirant and deodorant regulations Adopted amendments to relax a 0% VOC limit to 40% VOC limit for aerosol antiperspirants.	10/26/00
Diesel risk reduction plan Adopted plan to reduce toxic particulate from diesel engines through retrofits on existing engines, tighter standards for new engines, and cleaner diesel fuel.	9/28/00
Conditional rice straw burning regulations Adopted regulations to limit rice straw burning to fields with demonstrated disease rates reducing production by more than 5 percent.	9/28/00
Asbestos from unpaved roads Tightened an existing Air Toxic Control Measure to prohibit the use of rock containing more than 0.25% asbestos on unsurfaced roads.	7/20/00
Aerosol Coatings Approved amendments to replace mass-based VOC limits with reactivity-based limits, add a table of Maximum Incremental Reactivity values, add limits for polyolefin adhesion promoters, prohibit use of certain toxic solvents, and make other minor changes.	6/22/00 5/1/01 EO
Consumer products aerosol adhesives Adopted amendments to delete a 25% VOC limit by 2002, add new VOC limits for six categories of adhesives, prohibit the use of toxic solvents, and add new labeling and reporting requirements.	5/25/00 3/14/01 EO
Automotive care products Approved an Air Toxic Control Measure to eliminate use of perchloroethylene, methylene chloride, and trichloroethylene in automotive products such as brake cleaners and degreasers.	4/27/00 2/28/01 EO
Enhanced vapor recovery Adopted amendments to require the addition of components to reduce spills and leakage, adapt to onboard vapor recovery systems, and continuously monitor system operation and report equipment leaks immediately.	3/23/00 7/25/01 EO
Agricultural burning smoke management Adopted amendments to add marginal burn day designations, require day-specific burn authorizations by districts, and smoke management plans for larger prescribed burn projects.	3/23/00 1/22/01 EO
Urban transit buses Adopted a public transit bus fleet rule and emissions standards for new urban buses that mandates a lower fleet-average NOx emission limit, PM retrofits, lower sulfur fuel use, and purchase of specified percentages of zero emission buses in future years.	1/27/00 2/24/00 11/22/00 EO 5/29/01 EO

Board Action	Hearing Date
Small Off-Road (diesel) Equipment (SORE) Adopted amendments to conform with new federal requirements for lower and engine power-specific emission limits, and for the averaging, banking, and trading of emissions among SORE manufacturers.	1/28/00
CaRFG Phase 3 MTBE phase out Adopted regulations to enable refiners to produce gasoline without MTBE while preserving the emissions benefits of Phase 2 cleaner burning gasoline.	12/9/99 6/16/00 EO
Consumer products – mid-term measures II Adopted a regulation which adds emission limits for 2 new categories and tightens emission limits for 15 categories of consumer products.	10/28/99
Portable fuel cans Adopted a regulation requiring that new portable fuel containers, used to refuel lawn and garden equipment, motorcycles, and watercraft, be spill-proof beginning in 2001.	9/23/99 7/6/00 EO
Clean fuels at service stations Adopted amendments rescinding requirements applicable to SCAB in 1994-1995, modifying the formula for triggering requirements, and allowing the Executive Officer to make adjustments to the numbers of service stations required to provide clean fuels.	7/22/99
Gasoline vapor recovery Adopted amendments to certification and test methods.	6/24/99
Reformulated gasoline oxygenate Adopted amendments rescinding the requirement for wintertime oxygenate in gasoline sold in the Lake Tahoe Air Basin and requiring the statewide labeling of pumps dispensing gasoline containing MTBE.	6/24/99
Marine pleasurecraft Adopted regulations to control emissions from spark-ignition marine engines, specifically, outboard marine engines and personal watercraft.	12/11/98 2/17/00 EO 6/14/00 EO
Voluntary accelerated light duty vehicle retirement Adopted regulation setting standards for voluntary accelerated retirement program.	12/10/98 10/22/99 EO
Off-highway recreational vehicles and engines Approved amendments to allow non-complying vehicles to operate in certain seasons and in certain ORV-designated areas.	12/10/98 10/22/99 EO
On-road motorcycles Amended on-road motorcycle regulations, to lower the tailpipe emission standards for ROG and NOx.	12/10/98
Portable equipment registration program (PERP) Approved amendments to exclude non-dredging equipment operating in OCS areas and equipment emitting hazardous pollutants, include NSPS Part OOO rock crushers, require SCR emission limits and onshore emission offsets from dredging equipment operating in OCS areas, set catalyst emission limits for gasoline engines, and relieve certain retrofitted engines from periodic source testing.	12/10/98
Liquid petroleum gas motor fuel specifications Approved amendment rescinding 5% propene limit and extending 10% limit indefinitely.	12/11/98
Reformulated gasoline Approved amendments to rescind the RVP exemption for fuel with 10% ethanol and allow for oxygen contents up to 3.7% if the Predictive Model weighted emissions to not exceed original standards.	12/11/98
Consumer products Adopted amendments to add new VOC test methods, to modify Method 310 to quantify low vapor pressure VOC (LVP-VOC) constituents, and to exempt LVP-VOC from VOC content limits	11/19/98
Consumer products Approved amendments to extend the 1999 VOC compliance deadline for several aerosol coatings, antiperspirants and deodorants, and other consumer products categories to 2002, to exempt methyl acetate from the VOC definition, and make other minor changes.	11/19/98
Low-emission vehicle program (LEV II) Adopted regulations adding exhaust emission standards for most sport utility vehicles, pick-up trucks and mini-vans, lowering tailpipe standards for cars, further reducing evaporative emission standards, and providing additional means for generating zero-emission vehicle credits.	11/5/98 9/17/99 EO
Off-road engine aftermarket parts Approved implementation of a new program to test and certify aftermarket parts in gasoline and diesel, light-duty through heavy duty, engines used in off-road vehicles and equipment.	11/19/98 10/1/99 EO 7/18/00 EO

Board Action	Hearing Date
Off-road spark ignition engines Adopted new emission standards for small and large spark ignition engines for off-road equipment, a new engine certification program, an in-use compliance testing program, and a three-year phase-in for large LSI.	10/22/98
Gasoline deposit control additives Adopted amendments to decertify pre-RFG additives, tighten the inlet valve deposit limits, add a combustion chamber deposit limit, and modify the test procedures to align with the characteristics of reformulated gasoline formulations.	9/24/98 4/5/99 EO
Stationary source test methods Adopted amendments to stationary source test methods to align better with federal methods.	8/27/98 7/2/99 EO
Locomotive MOA for South Coast Memorandum of agreement (MOA) signed by ARB, U.S. EPA and major railroads to concentrate cleaner locomotives in the South Coast by 2010 and fulfill 1994 ozone SIP commitment.	7/2/98
Reformulated gasoline Approved amendments to rescind the wintertime oxygenate requirement, allow for sulfur content averaging, and make other minor technical amendments.	8/27/98
Gasoline vapor recovery Adopted amendments to certification and test methods to add methods for onboard refueling vapor recovery, airport refuelers, and underground tank interconnections, and make minor changes to existing methods.	5/21/98 8/27/98
Ethylene oxide sterilizers Adopted amendments to the ATCM to streamline source testing requirements, add EtO limits in water effluent from control devices, and make other minor changes.	5/21/98
Chrome platers Adopted amendments to ATCM to harmonize with requirements of federal NESHAP standards for chrome plating and chromic acid anodizing facilities.	5/21/98
On-road heavy-duty vehicles Approved amendments to align on-road heavy duty vehicle engine emission standards with EPA's 2004 standards and align certification, testing, maintenance, and durability requirements with those of U.S. EPA.	4/23/98 2/26/99 EO
Small off-road engines (SORE) Approved amendments to grant a one-year delay in implementation, relaxation of emissions standards for non-handheld engines, emissions durability requirements, averaging/banking/trading, harmonization with the federal diesel engine regulation, and modifications to the production line testing requirements.	3/26/98
Heavy duty vehicle smoke inspection program Adopted amendments to require annual smoke testing, set opacity limits, and exempt new vehicles from testing for the first four years.	12/11/97 3/2/98 EO
Consumer products (hairspray credit program) Adopted standards for the granting of tradable emission reduction credits achieved by sales of hairspray products having VOC contents less than required limits.	11/13/97
Light-duty vehicle off-cycle emissions Adopted standards to control excess emissions from aggressive driving and air conditioner use in light duty vehicles and added two light duty vehicle test methods for certification of new vehicles under these standards.	7/24/97 3/19/98 EO
Consumer products Adopted amendments to add VOC limits to 18 categories of consumer products used in residential and industrial cleaning, automobile maintenance, and commercial poisons.	7/24/97
Enhanced evaporative emissions standards Adopted amendments extending the compliance date for ultra-small volume vehicle manufacturers by one year.	5/22/97
Emission reduction credit program Adopted standards for District establishment of ERC programs including certification, banking, use limitation, and reporting requirements.	5/22/97
Lead as a toxic air contaminant Adopted an amendment to designate inorganic lead as a toxic air contaminant.	4/24/97
Consumer products (hair spray) Adopted amendments to (1) delay a January 1, 1998, compliance deadline to June 1, 1999, (2) require progress plans from manufacturers, and (3) authorize the Executive Officer to require VOC mitigation when granting variances from the June 1, 1999 deadline.	3/27/97

Board Action	Hearing Date
Portable engine registration program (PERP) Adopted standards for (1) the permitting of portable engines by ARB and (2) District recognition and enforcement of permits.	3/27/97
Liquefied petroleum gas Adopted amendments to extend the compliance deadline from January 1, 1997, to January 1, 1999, for the 5% propene limit in liquefied petroleum gas used in motor vehicles.	3/27/97
Onboard diagnostics, phase II Adopted amendments to extend the phase-in of enhanced catalyst monitoring, modify misfire detection requirements, add PVC system and thermostat monitoring requirements, and require manufacturers to sell diagnostic tools and service information to repair shops.	12/12/96
Consumer products Adopted amendments to delay 25% VOC compliance date for aerosol adhesives, clarify portions of the regulation, exempt perchloroethylene from VOC definition, extend the sell-through time to three years, and add perchloroethylene reporting requirements.	11/21/96
Consumer products (test method) Adopted an amendment to add Method 310 for the testing of VOC content in consumer products.	11/21/96
Pollutant transport designation Adopted amendments to modify transport couples from the Broader Sacramento area and add couples to the newly formed Mojave Desert and Salton Sea Air Basins.	11/21/96
Diesel fuel certification test methods Approved amendments specifying the test methods used for quantifying the constituents of diesel fuel.	10/24/96 6/4/97 EO
Wintertime requirements for utility engines & off-highway vehicles Optional hydrocarbon and NOx standards for snow throwers and ice augers, raising CO standard for specialty vehicles under 25hp.	9/26/96
Large off-road diesel Statement of Principles National agreement between ARB, U.S. EPA, and engine manufacturers to reduce emissions from heavy-duty off-road diesel equipment four years earlier than expected in the 1994 SIP for ozone.	9/13/96
Regulatory improvement initiative Rescinded two regulations relating to fuel testing in response to Executive Order W-127-95.	5/30/96
Zero emission vehicles Adopted amendments to eliminate zero emission vehicle quotas between 1998 and 2002, and approved MOUs with seven automobile manufacturers to accelerate release of lower emission "49 state" vehicles.	3/28/96 7/24/96 EO
CaRFG variance requirements Approved amendments to add a per gallon fee on non-compliant gasoline covered by a variance and to made administrative changes in variance processing and extension.	1/25/96 2/5/96 EO 4/2/96 EO
Utility and lawn and garden equipment engines Adopted an amendment to relax the CO standard from 300 to 350 ppm for Class I and II utility engines.	1/25/96
National security exemption of military tactical vehicles Such vehicles would not be required to adhere to exhaust emission standards.	12/14/95
CaRFG regulation amendments Approved amendments to allow for downstream addition of oxygenates and expansion of compliance options for gasoline formulation.	12/14/95
Required additives in gasoline (deposit control additives) Terms, definitions, reporting requirements, and test procedures for compliance are to be clarified.	11/16/95
CaRFG test method amendments Approved amendments to designate new test methods for benzene, aromatic hydrocarbon, olefin, and sulfur content of gasoline.	10/26/95
Motor vehicle inspection and maintenance program Handled by BAR.	10/19/95 by BAR
Antiperspirants and deodorants, consumer products, and aerosol coating products Ethanol exemption for all products, modifications to aerosol special requirements, modifications for regulatory language consistency, modifications to VOC definition.	9/28/95
Low emission vehicle (LEV III) standards Reactivity adjustment factors, introduction of medium-duty ULEVs, window labels, and certification requirements and test procedures for LEVs.	9/28/95

Board Action	Hearing Date
Medium- and heavy-duty gasoline trucks Expedited introduction of ultra-low emission medium-duty vehicles and lower NOx emission standards for heavy-duty gasoline trucks to fulfill a 1994 ozone SIP commitment.	9/1/95
Retrofit emission standards: all vehicle classes to be included in the alternate durability test plan, kit manufacturers to be allowed two years to validate deterioration factors under the test plan, update retrofit procedures allowing manufacturers to disable specific OBDs if justified by law.	7/27/95
Gasoline vapor recovery systems Adopts revised certification and test procedures.	6/29/95
Onboard refueling vapor recovery standards 1998 and subsequent MY engine cars, LD trucks, and MD trucks less than 8500 GVWR.	6/29/1995 4/24/96 EO
Heavy duty vehicle exhaust emission standards for NOx Amendments to standards and test procedures for 1985 and subsequent MY HD engines, amendments to emission control labels, amendments to Useful Life definition and HD engines and in-use vehicle recalls.	6/29/95
Aerosol coatings regulation Adopted regulation to meet California Clean Air Act requirements and a 1994 ozone SIP commitment.	3/23/95
Periodic smoke inspection program Delays start of PSIP from 1995 to 1996.	12/8/94
Onboard diagnostics phase II Amendments to clarify regulation language, ensure maximum effectiveness, and address manufacturer concerns regarding implementation.	12/8/94
Alternative control plan (ACP) for consumer products A voluntary, market-based VOC emissions cap upon a grouping of consumer products, flexible by manufacturer that will minimize overall costs of emission reduction methods and programs.	9/22/94
Diesel fuel certification: new specifications for diesel engine certification fuel, amended oxygen specification for CNG certification fuel, and amended commercial motor vehicle liquefied petroleum gas regulations.	9/22/94
Utility and lawn and garden equipment (UGLE) engines Modification to emission test procedures, ECLs, defects warranty, quality-audit testing, and new engine compliance testing.	7/28/94
Evaporative emissions standards and test procedures Adopted evaporative emissions standards for medium-duty vehicles.	2/10/94
Off-road recreational vehicles Adopted emission control regulations for off-road motorcycles, all-terrain vehicles, go-karts, golf carts, and specialty vehicles.	1/1/94
Perchloroethylene from dry cleaners Adopted measure to control perchloroethylene emissions from dry cleaning operations.	10/1/93
Wintertime oxygenate program Amendments to the control time period for San Luis Obispo County, exemption for small retailers bordering Nevada, flexibility in gasoline delivery time, calibration of ethanol blending equipment, gasoline oxygen content test method.	9/9/93
Onboard diagnostic phase II	7/9/93
Urban transit buses Amended regulation to tighten state NOx and particulate matter (PM) standards for urban transit buses beyond federal standards beginning in 1996.	6/10/93
1-year implementation delay in emission standards for utility engines	4/8/93
Non-ferrous metal melting Adopted Air Toxic Control Measure for emissions of cadmium, arsenic, and nickel from non-ferrous metal melting operations.	1/1/93
Certifications requirements for low emission passenger cars, light-duty trucks & medium duty vehicles	1/14/93
Airborne toxic control measure for emissions of toxic metals from non-ferrous metal melting	12/10/92
Periodic self-inspection program Implemented state law establishing a periodic smoke self-inspection program for fleets operating heavy-duty diesel-powered vehicles.	12/10/92
Notice of general public interest for consumer products	11/30/92
Substitute fuel or clean fuel incorporated test procedures	11/12/92

Board Action	Hearing Date
New vehicle testing using CaRFG Phase 2 gasoline Approved amendments to require the use of CaRFG Phase 2 gasoline in the certification of exhaust emissions in new vehicle testing.	8/13/92
Standards and test procedures for alternative fuel retrofit systems	5/14/92
Alternative motor vehicle fuel certification fuel specification	3/12/92
Heavy-duty off-road diesel engines Adopted the first exhaust emission standards and test procedures for heavy-duty off-road diesel engines beginning in 1996.	1/9/92
Consumer Products - Tier II Adopted Tier II of regulations to reduce emissions from consumer products.	1/9/92
Wintertime oxygen content of gasoline Adopted regulation requiring the addition of oxygenates to gasoline during winter to satisfy federal Clean Air Act mandates for CO nonattainment areas.	12/1/91
CaRFG Phase 2 Adopted CaRFG phase 2 specifications including lowering vapor pressure, reducing the sulfur, olefin, aromatic, and benzene content, and requiring the year-round addition of oxygenates to achieve reductions in ROG, NOx, CO, oxides of sulfur (SOx) and toxics.	11/1/91
Low emissions vehicles amendments revising reactivity adjust factor (RAF) provisions and adopting a RAF for M85 transitional low emission vehicles	11/14/91
Onboard diagnostic, phase II	11/12/91
Onboard diagnostics for light-duty trucks and light & medium-duty motor vehicles	9/12/91
Utility and lawn & garden equipment Adopted first off-road mobile source controls under the California Clean Air Act regulating utility, lawn and garden equipment.	12/1/90
Control for abrasive blasting	11/8/90
Roadside smoke inspections of heavy-duty vehicles Adopted regulations implementing state law requiring a roadside smoke inspection program for heavy-duty vehicles.	11/8/90
Consumer Products Tier I Adopted Tier I of standards to reduce emissions from consumer products.	10/11/90
CaRFG Phase I Adopted CaRFG Phase I reformulated gasoline regulations to phase-out leaded gasoline, reduce vapor pressure, and require deposit control additives.	9/1/90
Low-emission vehicle (LEV) and clean fuels Adopted the landmark LEV/clean fuel regulations which called for the gradual introduction of cleaner cars in California. The regulations also provided a mechanism to ensure the availability of alternative fuels when a certain number of alternative fuel vehicles are sold.	9/1/90
Evaporative emissions from vehicles Modified test procedure to include high temperatures (up to 105 F) and ensure that evaporative emission control systems function properly on hot days.	8/9/90
Dioxins from medical waste incinerators Adopted Airborne Toxic Control Measure to reduce dioxin emissions from medical waste incinerators.	7/1/90
CA Clean Air Act guidance for permitting Approved California Clean Air Act permitting program guidance for new and modified stationary sources in nonattainment areas.	7/1/90
Consumer products BAAQMD	6/14/90
Medium duty vehicle emission standards Adopted three new categories of low emission MDVs, required minimum percentages of production, and established production credit and trading.	6/14/90
Medium-duty vehicles Amended test procedures for medium-duty vehicles to require whole-vehicle testing instead of engine testing. This modification allowed enforcement of medium-duty vehicle standards through testing and recall.	6/14/90
Ethylene oxide sterilizers Adopted Airborne Toxic Control Measure to reduce ethylene oxide emissions from sterilizers and aerators.	5/10/90
Asbestos in serpentine rock Adopted Airborne Toxic Control Measure for asbestos-containing serpentine rock in surfacing applications.	4/1/90

Board Action	Hearing Date
Certification procedure for aftermarket parts	2/8/90
Antiperspirants and deodorants Adopted first consumer products regulation, setting standards for antiperspirants and deodorants.	11/1/89
Residential woodstoves Approved suggested control measure for the control of emissions from residential wood combustion.	11/1/89
On-Board Diagnostic Systems II Adopted regulations to implement the second phase of on-board diagnostic requirements which alert drivers of cars, light-trucks and medium-duty vehicles when the emission control system is not functioning properly.	9/1/89
Cars and light-duty trucks Adopted regulations to reduce ROG and CO emissions from cars and light trucks by 35 percent.	6/1/89
Architectural coatings Approved a suggested control measure to reduce ROG emissions from architectural coatings.	5/1/89
Chrome from cooling towers Adopted Airborne Toxic Control Measure to reduce hexavalent chromium emissions from cooling towers.	3/1/89
Reformulated Diesel Fuel Adopted regulations requiring the use of clean diesel fuel with lower sulfur and aromatic hydrocarbons beginning in 1993.	11/1/88
Vehicle Recall Adopted regulations implementing a recall program which requires auto manufacturers to recall and fix vehicles with inadequate emission control systems (Vehicles are identified through in-use testing conducted by the ARB).	9/1/88
Suggested control measure for oil sumps Approved a suggested control measure to reduce emissions from sumps used in oil production operations.	8/1/88
Chrome platers Adopted Airborne Toxic Control Measure to reduce emissions of hexavalent chromium emissions from chrome plating and chromic acid anodizing facilities.	2/1/88
Suggested control measure for boilers Approved suggested control measure to reduce NOx emissions from industrial, institutional, and commercial boilers, steam generators and process heaters.	9/1/87
Benzene from service stations Adopted Airborne Toxic Control Measure to reduce benzene emissions from retail gasoline service stations (Also known as Phase II vapor recovery).	7/1/87
Agricultural burning guidelines Amended existing guidelines to add provisions addressing wildland vegetation management.	11/1/86
Heavy-duty vehicle certification Amended certification of heavy-duty diesel and gasoline-powered engines and vehicles to align with federal standards.	4/1/86
Cars and light-duty trucks Adopted regulations reducing NOx emissions from passenger cars and light-duty trucks by 40 percent.	4/1/86
Sulfur in diesel fuel Removed exemption for small volume diesel fuel refiners.	6/1/85
On-Board Diagnostics I Adopted regulations requiring the use of on-board diagnostic systems on gasoline-powered vehicles to alert the driver when the emission control system is not functioning properly.	4/1/85
Suggested control measure for wood coatings Approved a suggested control measure to reduce emissions from wood furniture and cabinet coating operations.	3/1/85
Suggested control measure for resin manufacturing Approved a suggested control measure to reduce ROG emissions from resin manufacturing.	1/1/85

ATTACHMENT B: SAN JOAQUIN VALLEY 8-HR OZONE MOTOR VEHICLE EMISSIONS BUDGETS

(Tons per summer average day, *established by conventional rounding)
Activity is the most recently amended 2015 FSTIP for each MPO as of March 22, 2016.

Table D- 4 2018 Motor Vehicle Emissions Budget

County	Fresno		Kern		Kings		Madera		Merced		San Joaquin		Stanislaus		Tulare		Valley Air Basin	
	ROG	NOx	ROG	NOx	ROG	NOx	ROG	NOx	ROG	NOx	ROG	NOx	ROG	NOx	ROG	NOx	ROG	NOx
EMFAC2014 V1.0.7	7.95	27.64	6.50	25.39	1.29	5.09	1.80	5.08	2.42	9.35	5.87	12.97	3.76	10.49	3.67	9.40		
Total	7.95	27.64	6.50	25.39	1.29	5.09	1.80	5.08	2.42	9.35	5.87	12.97	3.76	10.49	3.67	9.40	33.26	105.42
Rounded Total	8.000	27.700	6.600	25.400	1.300	5.100	1.900	5.100	2.500	9.400	5.900	13.000	3.800	10.500	3.700	9.500		
Budget*	8.0	27.7	6.6	25.4	1.3	5.1	1.9	5.1	2.5	9.4	5.9	13.0	3.8	10.5	3.7	9.5	33.7	105.7

Table D- 5 2021 Motor Vehicle Emissions Budgets

County	Fresno		Kern		Kings		Madera		Merced		San Joaquin		Stanislaus		Tulare		Valley Air Basin	
	ROG	NOx	ROG	NOx	ROG	NOx	ROG	NOx	ROG	NOx	ROG	NOx	ROG	NOx	ROG	NOx	ROG	NOx
EMFAC2014 V1.0.7	6.38	22.13	5.41	20.33	1.06	4.19	1.44	4.06	1.94	7.70	4.80	10.22	2.98	8.23	2.86	7.20		
Total	6.38	22.13	5.41	20.33	1.06	4.19	1.44	4.06	1.94	7.70	4.80	10.22	2.98	8.23	2.86	7.20	26.88	84.06
Rounded Total	6.400	22.200	5.500	20.400	1.100	4.200	1.500	4.100	2.000	7.800	4.900	10.300	3.000	8.300	2.900	7.200		
Budget*	6.4	22.2	5.5	20.4	1.1	4.2	1.5	4.1	2.0	7.8	4.9	10.3	3.0	8.3	2.9	7.2	27.3	84.5

Table D- 6 2024 Motor Vehicle Emissions Budgets

County	Fresno		Kern		Kings		Madera		Merced		San Joaquin		Stanislaus		Tulare		Valley Air Basin	
	ROG	NOx	ROG	NOx	ROG	NOx	ROG	NOx	ROG	NOx	ROG	NOx	ROG	NOx	ROG	NOx	ROG	NOx
EMFAC2014 V1.0.7	5.34	14.06	4.75	12.54	0.90	2.59	1.17	2.53	1.58	4.79	4.12	6.88	2.50	5.51	2.37	4.65		
Total	5.34	14.06	4.75	12.54	0.90	2.59	1.17	2.53	1.58	4.79	4.12	6.88	2.50	5.51	2.37	4.65	22.73	53.55
Rounded Total	5.400	14.100	4.800	12.600	0.900	2.600	1.200	2.600	1.600	4.800	4.200	6.900	2.600	5.600	2.400	4.700		
Budget*	**5.4**	**14.1**	**4.8**	**12.6**	**0.9**	**2.6**	**1.2**	**2.6**	**1.6**	**4.8**	**4.2**	**6.9**	**2.6**	**5.6**	**2.4**	**4.7**	**23.1**	**53.9**

Table D- 7 2027 Motor Vehicle Emissions Budgets

County	Fresno		Kern		Kings		Madera		Merced		San Joaquin		Stanislaus		Tulare		Valley Air Basin	
	ROG	NOx	ROG	NOx	ROG	NOx	ROG	NOx	ROG	NOx	ROG	NOx	ROG	NOx	ROG	NOx	ROG	NOx
EMFAC2014 V1.0.7	4.84	13.12	4.47	11.61	0.83	2.41	1.03	2.22	1.41	4.37	3.73	6.12	2.26	5.05	2.10	4.09		
Total	4.84	13.12	4.47	11.61	0.83	2.41	1.03	2.22	1.41	4.37	3.73	6.12	2.26	5.05	2.10	4.09	20.67	48.98
Rounded Total	4.900	13.200	4.500	11.700	0.900	2.500	1.100	2.300	1.500	4.400	3.800	6.200	2.300	5.100	2.200	4.100		
Budget*	**4.9**	**13.2**	**4.5**	**11.7**	**0.9**	**2.5**	**1.1**	**2.3**	**1.5**	**4.4**	**3.8**	**6.2**	**2.3**	**5.1**	**2.2**	**4.1**	**21.2**	**49.5**

Table D- 8 2030 Motor Vehicle Emissions Budgets

County	Fresno		Kern		Kings		Madera		Merced		San Joaquin		Stanislaus		Tulare		Valley Air Basin	
	ROG	NOx	ROG	NOx	ROG	NOx	ROG	NOx	ROG	NOx	ROG	NOx	ROG	NOx	ROG	NOx	ROG	NOx
EMFAC2014 V1.0.7	4.42	12.52	4.18	10.89	0.76	2.28	0.89	1.98	1.27	4.11	3.40	5.60	2.03	4.68	1.90	3.73		
Total	4.42	12.52	4.18	10.89	0.76	2.28	0.89	1.98	1.27	4.11	3.40	5.60	2.03	4.68	1.90	3.73	18.85	45.78
Rounded Total	**4.500**	**12.600**	**4.200**	**10.900**	**0.800**	**2.300**	**0.900**	**2.000**	**1.300**	**4.200**	**3.500**	**5.700**	**2.100**	**4.700**	**1.900**	**3.800**		
Budget*	**4.5**	**12.6**	**4.2**	**10.9**	**0.8**	**2.3**	**0.9**	**2.0**	**1.3**	**4.2**	**3.5**	**5.7**	**2.1**	**4.7**	**1.9**	**3.8**	**19.2**	**46.2**

Table D- 9 2031 Motor Vehicle Emissions Budgets

County	Fresno		Kern		Kings		Madera		Merced		San Joaquin		Stanislaus		Tulare		Valley Air Basin	
	ROG	NOx	ROG	NOx	ROG	NOx	ROG	NOx	ROG	NOx	ROG	NOx	ROG	NOx	ROG	NOx	ROG	NOx
EMFAC2014 V1.0.7	4.28	12.40	4.10	10.76	0.73	2.24	0.85	1.92	1.22	4.05	3.29	5.47	1.95	4.60	1.82	3.62		
Total	4.28	12.40	4.10	10.76	0.73	2.24	0.85	1.92	1.22	4.05	3.29	5.47	1.95	4.60	1.82	3.62	18.24	45.07
Rounded Total	**4.300**	**12.500**	**4.100**	**10.800**	**0.800**	**2.300**	**0.900**	**2.000**	**1.300**	**4.100**	**3.300**	**5.500**	**2.000**	**4.700**	**1.900**	**3.700**		
Budget*	**4.3**	**12.5**	**4.1**	**10.8**	**0.8**	**2.3**	**0.9**	**2.0**	**1.3**	**4.1**	**3.3**	**5.5**	**2.0**	**4.7**	**1.9**	**3.7**	**18.6**	**45.6**

ATTACHMENT C: STATE OF CALIFORNIA MOTOR VEHICLE CONTROL PROGRAM (1990-PRESENT) TRANSPORTATION CONTROL STRATEGIES ADOPTED BY THE CALIFORNIA AIR RESOURCES BOARD SINCE 1990

Measure	Hearing Date	Category
Emission Control System Warranty. T 13, CCR, 2035-2041, 1977	12/14/89	On-road
Certification Procedure for Aftermarket Parts. VC 27156 & 38391	02/08/90	On-road
Emission Standards for Medium Duty Vehicles. T 13, CCR, 1900, 1956.8, 1960.1, 1968.1, 2061, 2112, 2139	06/14/90	On-road
Wintertime Limits for Sulfur in Diesel Fuel. T 13, CCR, 2255	06/21/90	Fuels
Evaporative Emission Standards. T 13, CCR, 1976	08/09/90	On-road
California Reformulated Gasoline (CaRFG), Phase I. T 13, CCR, 2251.5	09/27/90	Fuels
Low Emission Vehicles and Clean Fuels. T 13, CCR, 1900, 1904, 1956.8, 1960.1, 1960.1.5, 1960.5 and 2111, 2112, 2125, and 2139, 2061.	09/28/90	On-road
Heavy Duty Diesel Smoke Emission Testing. T 13, CCR, 2180-2187	11/08/90	On-road
Limit on Aromatic Content of Diesel Fuel. T 13, CCR, 2256	12/13/90	Fuels
Onboard Diagnostics for Light-Duty Trucks and Light & Medium-Duty Motor Vehicles. T 13, CCR, 1977, 1968.1	09/12/91	On-road
Onboard Diagnostic, Phase II. T 13, CCR, 1968.1, 1977	11/12/91	On-road
Low Emission Vehicles amendments revising reactivity adjustment factor (RAF) provisions and adopting a RAF for M85 transitional low emission vehicles. T 13, CCR, 1960.1	11/14/91	On-road
California Reformulated Gasoline, Phase II. T 13, CCR, 2250, 2255.1, 2252, 2260 - 2272, 2295	11/21/91	Fuels
Wintertime Gasoline Program. T 13, CCR, 2258, 2298, 2251.5, 2296	11/21/91	Fuels
Specifications for Alternative Motor Vehicle Fuel. T 13, & 26, CCR, 2290, 2291, 2292.1, 2292.2, 2292.3, 2292.5, 2292.6, 2292.7, 1960.1(k), 1956.8(b), 1956.8(d)	12/12/91	Fuels
Specifications for Alternative Motor Vehicle Fuels. T 13, & 26, CCR, 2290-2292.7, 1960.1(k), 1956.8(b), 1956.8(d)	03/12/92	On-road
Standards and Test Procedures for Alternative Fuel Retrofit Systems. T 13, CCR, 2030, 2031	05/14/92	On-road
Phase 2 RFG certification fuel specifications. T 13, CCR, 1960.1, 1956.8(d)	08/13/92	On-road
Substitute Fuel or Clean Fuel Incorporated Test Procedures. T 13, CCR, 1960.1(k), 2317	11/12/92	On-road
Smoke Self Inspection Program for Heavy Duty Diesel & Gasoline Engines. T 13, CCR, 21902194, 2180-2187, 1956.8(b)	12/10/92	On-road

Measure	Hearing Date	Category
Certification Requirements for Low Emission Passenger Cars, Light-Duty Trucks & Medium Duty Vehicles. T 13, CCR, 1960.1, 1976, 2061, 1900	01/14/93	On-road
Urban Transit Buses. T 13, CCR, 1956.8, 1965, 2112	06/10/93	On-road
Onboard Diagnostic, Phase II. T 13, CCR, 1968.1	07/09/93	On-road
Wintertime Oxygenate Program. T 13, CCR, 2258, 2251.5, 2263(b), 2267, 2298, 2259, 2283, 2293.5	09/09/93	Fuels
Diesel Fuel Regulations -Emergency. T 13, CCR, 2281(h), 2282(1)	10/15/93	Fuels
Evaporative Emission Standards and Test Procedures. T 13, CCR, 1976	02/10/94	On-road
Predictive Model for Phase II CaRFG. T 13, CCR, 2261, 2262-2270	06/09/94	Fuels
Small Refiner Diesel. T 13, CCR, 2282(e)(1)	07/24/94	Fuels
Diesel Fuel Certification. T 13, CCR, 1956.8(b)&(d), 1960.1(k), 2292.6	09/22/94	Fuels
Self-Inspection Program for Heavy Duty Diesel & Gasoline Engines. T 13, CCR, 2190-2194, 21802187, 1956.8(b)	11/09/94	On-road
Onboard Diagnostics, Phase II. T 13, CCR,1963.1, & Certification Procedures	12/08/94	On-road
Periodic Smoke Inspection Program. T 13, CCR, 2190	12/08/94	On-road
Specification for Alternative Motor Vehicle Fuels (M100). T 13 CCR, 2292.1	12/08/94	Fuels
Heavy Duty Vehicle Exhaust Emission Standards. T 13, CCR, 1956.8 and incorporate test procedures.	06/29/95	On-road
Onboard Refueling Vapor Recovery Standards. T 13, CCR, 1976, 1978 and incorporate test procedures	06/29/95	On-road
Test Method for Oxygen in Gasoline. T 13, CCR, 2251.5(c), 2258(c), 2263(b)	06/29/95	Fuels
Retrofit Emission Standards. T 13, CCR, 1956.9, 2030, 2031, and incorporate test procedures	07/27/95	On-road
Low Emission Vehicle Standards 3 (LEV 3). T 13, CCR, 1956.8, 1960.1, 1965, 2101, 2061, 2062, and incorporate test procedures	09/28/95	On-road
Test Methods for CaRFG 13, CCR, 2263(b)	10/26/95	Fuels
Required Additives in Gasoline (Deposit Control Additives). T 13, CCR, 2257 and incorporates testing procedures.	11/16/95	Fuels
CaRFG Housekeeping & CARBOB. T 13, CCR, 2263.7, 2266.5, 2260, 2262.5, 2264, 2265, 2272	12/14/95	Fuels
Exemption of Military Tactical Vehicles. T 13, CCR, 1905, 2400, 2420	12/14/95	On Road/Off Road
CaRFG Variance Requirements. T 13, CCR, 2271 (Emergency)	01/25/96	Fuels
Postpone Zero Emission Vehicle Requirements. T 13, CCR, 1900, 1960.1, 1976	03/28/96	On-road

Measure	Hearing Date	Category
Regulation Improvements and Repeals (fuel additives). T 13, CCR, 2201, 2202	05/30/96	Fuels
Diesel Fuel Certification Test Methods . T 13, CCR, 1956.8(b), 1960.1(k), 2281(c), 2282(b), (c) and (g)	10/24/96	Fuels
Diesel Fuel Test Methods. T 13, CCR, 1956.8(b), 1960.1(k), 2281(c), 2282(b), (c) and (g)	10/24/96	Fuels
Onboard Diagnostics, Phase II, Technical Status. T 13, CCR, 1968.1, 2030, 2031	12/12/96	On-road
Liquefied Petroleum Gas Propane Limit Specification Delay. T 13, CCR, 2292.6	03/27/97	Fuels
Postpone Enhanced Evaporative Emission Requirements for Ultra-Small Volume Vehicle Manufacturers. T 13, CCR, 1976 and incorporate test procedures	05/22/97	On-road
Off-Cycle Emissions Supplemental Federal Test Procedures (SFTPs). T 13, CCR, 1960.1, 2101 and incorporate test procedures	07/24/97	On-road
Heavy Duty Vehicle Smoke Inspection Program/Periodic Smoke Inspection Program. T 13, CCR, 2180-2188 and 2190-2194	12/11/97	On-road
Heavy Duty Vehicle Regulations: 2004 Standards. T 13, CCR, 1956.8, 1965, 2036, 2112 and test procedures	04/23/98	On-road
Cleaner Burning Gasoline Model Flexibility. T 13, CCR, Sections 2260, 2262.1, 2262.3, 2262.4, 2262.5, 2262.6, 2262.7 and 2265	08/27/98	Fuels
Gasoline Vapor Recovery Systems. T 17, CCR, 94010-94015 and 94150, 94156, 94157, 94158, 94159, 94160, 94162	08/27/98	Vapor Recovery
Gasoline Deposit Control Additive Regulation. T 13, CCR, 2257, and incorporating test procedures	09/24/98	Fuels
Low Emission Vehicles Standards (LEV 2) and Compliance Assurance Program (CAP 2000). T 13, CCR,1961 & 1962 (both new); 1900, 1960.1, 1965, 1968.1, 1976, 1978, 2037, 2038, 2062, 2101, 2106, 2107, 2110, 2112, 2114, 2119, 2130, 2137-2140, 2143-2148	11/05/98	On-road
Exhaust Standards for (On-Road) Motorcycles. T 13, CCR, 1958	12/10/98	On-road
Voluntary Accelerated Light Duty Vehicle Retirement Regulations. T 13, CCR, 2600-2610	12/10/98	On-road
Cleaner Burning Gasoline (Increasing the Oxygen Content). T 13, CCR, sections 2262.5(b) and 2265(a)(2)	12/11/98	Fuels
Specifications for Liquid Petroleum Gas Used as a Motor Vehicle Fuel. T 13, CCR, 2292.6	12/11/98	Fuels
Cleaner Burning Gasoline, Oxygen Requirement for Wintertime In Lake Tahoe Area/Gas Pump Labeling for MTBE. T 13, CCR, 2262.5, and 2273	06/24/99	Fuels
Clean Fuels Regulation Requirements. T 13, CCR, sections 2300-2317, and 2303.5, 2311.5	07/22/99	On-road

Measure	Hearing Date	Category
CaRFG Phase 3 Amendments (Phase out of MTBE, standards, predictive model). T 13, CCR, 2260, 2261, 2262.1, 2262.5, 2263, 2264, 2264.2, 2265, 2266 etc…	12/09/99	Fuels
Transit Bus Standards. T 13, CCR, 1956.1, 1956.2, 1956.3, 1956.4, 1956.8, 1965	02/24/00	On-road
CaRFG Phase 3 Follow-up Amendments. T 13, CCR, sections 2260, 2261, 2262.3, 2262.5, 2263, 2264, 2265, 2266, 2266.5, 2270, 2272, 2273, 2282, 2296, 2297, 2262.9 and incorporated test procedures	11/16/00	Fuels
CaRFG Phase 3 Test Methods. T 13, CCR, sections 2263(b)	11/16/00	Fuels
Heavy Duty Diesel Engines "Not-to-Exceed (NTE)" Test Procedures. T 13 CCR, 1956.8, 2065	12/07/00	On-road
Light-and Medium Duty Low Emission Vehicle Alignment with Federal Standards. Exhaust Emission Standards for Heavy Duty Gas Engines. T 13, CCR, 1956.8 &1961	12/07/00	On-road
Zero Emission Vehicle Regulation Update. T 13, CCR, 1900, 1960.1(k), 1961, 1962 & incorporated Test Procedure	01/25/01	On-road
Zero Emission Vehicle Infrastructure and Standardization of Electric Vehicle Charging Equipment. T 13, CCR, 1900(b), 1962(b) 1962.1	06/28/01	On-road
Heavy Duty Diesel Engine Standards for 2007 and Later. T 13, CCR, 1956.8 and incorporated test procedures	10/25/01	On-road
Low Emission Vehicle Regulations. T 13, CCR, 1960.1,1960.5, 1961, 1962 and incorporate test procedures and guidelines	11/15/01	On-road
California Motor Vehicle Service Information Rule. T 13&17, CCR, 1969 & 60060.1 -60060.7	12/13/01	On-road
Voluntary Accelerated Light Duty Vehicle Retirement Regulations. T 13, CCR, 2601-2605, 2606 & appendices C & D, and 2607-2610	02/21/02	On-road
On-Board Diagnostic II Review Amendments. T 13, CCR, 1968.1, 1968.2, 1968.5	04/25/02	On-road
Diesel Retrofit Verification Procedure, Warranty and In-Use Compliance Requirements. T 13, CCR, 2700-2710	05/16/02	On-road
Revision to Transit Bus Regulations Amendments. T 13, CCR, 1956.1, 1956.2, 1956.4,1956.8, and 2112, & documents incorporated by reference	10/24/02	On-road
Airborne Toxic Control Measure for Diesel Particulate from School Bus Idling. T13, CCR, 2480	12/12/02	On-road
Low Emission Vehicles II. Align Heavy Duty Gas Engine Standards with Federal Standards; minor administrative changes. T 13, CCR, 1961, 1965, 1956.8, 1956.1, 1978, 2065 and documents incorporated by reference	12/12/02	On-road
Zero Emission Vehicle Amendments for 2003. T 13, CCR, 1960.1(k), 1961(a) and (d), 1900, 1962, and documents incorporated by reference	03/25/03	On-road

Measure	Hearing Date	Category
Solid Waste Collection Vehicles. T 13, CCR, 2020, 2021, 2021.1, 2021.2	09/24/03	On-road
Airborne Toxic Control Measure for Diesel Particulate for Transport Refrigeration Units. T 13, CCR, 2022 & 2477	12/11/03	On-road
Diesel Retrofit Verification Procedure, Warranty and In-Use Compliance Requirements (Amendments). T 13, CCR, 2701-2707 & 2709	12/11/03	On-road
CA Motor Vehicle Service Information Rule. T 13, CCR, 1969	01/22/04	On-road
Heavy Duty Diesel Engine-Chip Reflash. T 13, CCR, 2011, 2180.1, 2181, 2184, 2185, 2186, 2192, and 2194	03/27/04	On-road
Engine Manufacturer Diagnostic System Requirements for 2007 and Subsequent Model Heavy Duty Engines. T 13, CCR, 1971	05/20/04	On-road
Urban Bus Engines/Fleet Rule for Transit Agencies. T 13, CCR, 1956.1, 1956.2, 1956.3, and 1956.4,	06/24/04	On-road
Airborne Toxic Control Measure for Diesel Particulate from Diesel Fueled Commercial Vehicle Idling. T 13, CCR, 2485	07/22/04	On-road
Greenhouse Gas. T 13, CCR, 1961.1, 1900, 1961 and Incorporated Test Procedures	09/23/04	On-road
California Reformulated Gasoline, Phase 3. T 13, CCR, 2260, 2262, 2262.4, 2262.5, 2262.6, 2262.9, 2263, 2265 (and the incorporated "California Procedures"), and 2266.5	11/18/04	Fuels
Diesel Fuel Standards for Harborcraft & Locomotives. T 13, CCR, 2299, 2281, 2282, and 2284, and T 17, CCR, 93117	11/18/04	Fuels
Emergency Regulation for Temporary Delay of Diesel Fuel Lubricity Standard. T 13, CCR, 2284	11/24/04	Fuels
Transit Fleet Rule. T 13, CCR, 2023, 2023.1, 2023.2, 2023.3, 2023.4, 1956.1, 2020, 2021, repeal 1956.2, 1956.3, 1956.4	02/24/05	On-road
On-Board Diagnostic System Requirements for 2010 and Subsequent Model-Year Heavy-Duty Engines (HD OBD). T 13, CCR, 1971.1	07/21/05	On-road
2007-2009 Model-Year Heavy Duty Urban Bus Engines and the Fleet Rule for Transit Agencies. T 13, CCR, 1956.1, 1956.2, and 1956.8	09/15/05	On-road
Requirements to Reduce Idling Emissions from New and In-Use Trucks, Beginning in 2008. T 13, CCR section1956.8 and the incorporated document	10/20/05	On-road
Diesel Particulate Matter Control Measure for On-Road Heavy-Duty Diesel-Fueled Vehicles Owned or Operated by Public Agencies and Utilities. T 13, CCR, 2022 and 2022.1	12/08/05	On-road
AB1009 Heavy-Duty Vehicle Smoke Inspection Program. T 13, CCR, 2180, 2180.1, 2181, 2182, 2183, 2184, 2185, 2186, 2187, and 2188, 2189	01/26/06	On-road
Diesel Verification Procedure, Warranty & In-Use. T 13, CCR, 2702, 2703, 2704, 2706, 2707, and 2709.	03/23/06	On-road

Measure	Hearing Date	Category
Technical Amendments to Evaporative Exhaust and Evaporative Emissions Test Procedures. T 13, CCR, 1961,1976 and 1978.	05/25/06	On-road
California Motor Vehicle Service Information Rule. T 13, CCR, 1969 and incorporated documents	06/22/06	On-road
Heavy-Duty In-Use Compliance Regulation. T 13, CCR, 1956.1, 1956.8, and documents incorporated by reference	09/28/06	On-road
On-Board Diagnostic II. T 13, CCR, 1968.2, 1968.5, 2035, 2037 and 2038	09/28/06	On-road
Zero Emission Bus Regulation. T13, CCR, 2023.1, 2023.3, & 2023.4	10/19/06	On-road
Voluntary Accelerated Retirement Regulation. T 13, CCR, 2601-2610 and appendices A-D	12/07/06	On-road
Phase 3 Reformulated Gasoline (Ethanol Permeation) T 13, CCR, 2260, 2261, 2262, 2263, 2264, 2265, 2266, 2270, 2271, and 2273	06/14/07	On-road
Aftermarket Catalytic Converters and Used Catalytic Converters T 13, CCR, 2222	10/25/07	On-road
Port Truck Modernization T 13, CCR, 2027	12/07/07	On-road
Cleaner In-Use Heavy-Duty Trucks T 13, CCR, 2025	12/11/08	On-road
Enhanced Fleet Modernization Program (formerly “Expanded Vehicle Retirement Program”) T 13, CCR, 2620, 2621, 2622, 2623, 2624, 2625, 2626, 2627, 2628, 2629, and 2630	06/26/09	On-road
Vapor Recovery Equipment Defects List T 17, CCR, 94006	06/15/11	Vapor Recovery
Advanced Clean Cars T 13, CCR, 1900, 1956, 1960, 1961, 1962, 1965, 1968, 1976, 1978, 2037, 2038, 2062, 2112, 2139, 2140, 2145, 2147, 2235, 2300, 2302, 2303, 2304, 2306, 2307, 2308, 2309, 2310, 2311, 2312, 2313, 2314, 2315, 2316, 2317, and 2318	01/26/12	On-road
Zero Emission Vehicle Standards for 2009 through 2017 T 13, CCR, 1962.1, 1962.2, 1962.3	01/26/12	On-road
Emergency Regulatory Amendments to the Tractor-Trailer Greenhouse Gas Regulation T 17, CCR, 95307	02/29/12	On-Road
Amendments to On-Board Diagnostics (OBD I and II) Regulations T 13, CCR, 1968.2, 1971.1	08/23/12	On-road
Amendments to Verification Procedures, Warranty, and In-Use Compliance Requirements for In-Use Strategies to Control Emissions from Diesel Engines T13, CCR, 2700, 2701, 2702, 2703, 2704, 2705, 2706, 2707, 2708, 2709, 2710, 2711	08/23/12	On-road
Low Emission Vehicle III Greenhouse Gas and Zero Emission Vehicle Regulation Amendments for Federal Compliance Option T 13, CCR, 1900, 1956.8, 1960.1, 1961, 1961.2, 1961.3, 1962.1, 1962.2, 1976	11/15/12	On-road
Gasoline and Diesel Fuel Test Methods T13, CCR, 2262.9, 2263, 2282	01/25/13	Fuel
Off-Highway Recreational Vehicle Evaporative Emission Control T 13, CCR 2416, 2417, 2418, 2419, 2419.1, 2419.2, 2419.3, 2419.4	07/25/13	Vapor Recovery

Measure	Hearing Date	Category
Amendments to Vapor Recovery for Gasoline Dispensing Facilities T 17, CCR, 94014, 94016	07/25/13	Vapor Recovery
Alternative Fuel Certification Procedures T13, CCR, 2030, 2031	09/26/13	Fuel
Minor Modifications to the Zero Emission Vehicle Regulation T 13, CCR, 1962.1, 1962.2	10/24/13	On-road
Heavy-Duty Greenhouse Gas Phase 1: On-Road Heavy Duty Greenhouse Gas Emissions Rule, Tractor-Trailer Rule, Commercial Motor Vehicle Idling Rule, Optional Emission Standards, Heavy-Duty Hybrid-Electric Vehicle Certification Procedure T 13, CCR, 1900, 1956.8, 2036, 2037, 2112, 2139, 2140, 2147, 2485, T 17, CCR, 95300, 95301, 95302, 95303, 95305, 95660, 95661, 95662, 95663, 95664	12/12/13	On-road
Truck and Bus Rule Update T 13, CCR, 2025	04/24/14 11/20/14	On-road
Amendments to the Enhanced Fleet Modernization Program Regulation T13, CCR, 2620, 2621, 2622, 2623, 2624, 2625, 2626, 2627, 2628, 2629	06/26/14	On-road
2014 Amendments to Zero Emission Vehicle Regulation T 13, CCR, 1962.1, 1962.2	10/23/14 05/21/15	On-road
Amendments to Low Emission Vehicle III Criteria Pollutant Requirements for Light-and Medium-Duty Vehicles the Hybrid Electric Vehicle Test Procedures, and the Heavy-Duty Otto-Cycle and Heavy-Duty Diesel Test Procedures T 13, CCR, 1900, 1956.8, 1961.2, 1962.2, 1965, 1976, 1978	10/23/14	On-road
2015 Low Carbon Fuel Standard Amendments T 17, CCR, 95480, 95481, 95482, 95483, 95483.1, 95483.2, 95484, 95485, 95486, 95487, 95488, 95489, 95491, 95492, 95493, 95494, 95495, 95496, 95497	02/19/15 09/24/15	Fuel
Evaporative Emission Control Requirements for Spark-Ignition Marine Watercraft T13, CCR, 2850, 2851, 2852, 2853, 2854, 2855, 2856, 2857, 2858, 2859, 2860, 2861, 2862, 2863, 2864, 2865, 2866, 2867, 2868, 2869	02/19/15	Vapor Recovery
Commercialization of Alternative Diesel Fuels Regulation T13, CCR, 2290, 2291, 2293, 2293.1, 2293.2, 2293.3, 2293.4, 2293.5, 2293.6, 2293.7, 2293.8, 2293.9	02/19/15 09/24/15	Fuel
Amendments to Certification Procedures for Vapor Recovery Systems at Gasoline Dispensing Facilities: Aboveground Storage Tanks and Enhanced Conventional Nozzles T 17, CCR, 94010, 94011, 94016, 94017	04/23/15	Vapor Recovery
Revisions to On-Board Diagnostics System Requirements T 13, CCR, 1968.2, 1968.5, 1900	09/24/15	On-Road
Amendments to the Portable Fuel Container Regulation T 13, CCR, 2467, 2467.1, 2467.2, 2467.3, 2467.4, 2467.5, 2467.6,2467.7, 2467.8, 2467.9,	02/18/16	Vapor Recovery

ATTACHMENT D: ADOPTED TRANSPORTATION CONTROL MEASURES

The following tables represent each county's RACM commitment to implement TCMs as submitted for the *2002 Severe Area Ozone Plan* and approved by EPA.

Table D- 10 San Joaquin Council of Governments Summary of Commitments - 2002 Severe Area Ozone Plan

Number	Measure Title	SJCOG	Escalon	Lathrop	Lodi	Manteca	Ripon	Stockton	Tracy	County of San Joaquin	San Joaquin Regional Transit District
	Resolution Adopting Local Government Control Measures for the Severe Area Ozone Plan	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
											✓
SJC1.1	Regional Express Bus Program										✓
SJC1.2	Transit Access to Airports										✓
SJC1.3	Study Benefits of Bus Retrofit Program								✓		✓
SJC1.4	Mass Transit Alternatives										✓
SJC1.5	Expansion of Public Transportation Systems								✓		✓
SJC1.6	Transit Service Improvements in Combination with Park-and-Ride Lots and Parking Management								✓		✓
SJC1.7	Free (to the public) transit during special events								✓		✓
SJC1.9	Increase parking at transit centers or stops								✓		
SJC3.1	Commute Solutions	✓									
SJC3.2	Parking Cash-Out	✓									
SJC3.3	Employer Rideshare Program Incentives	✓									
SJC3.5	Preferential Parking for Carpools and Vanpools	✓									
SJC3.8	Purchase vans for vanpools	✓									
SJC3.9	Encourage merchants and employers to subsidize the cost of transit for employees	✓			✓				✓		
SJC13.16	Telecommuting	✓									
SJC5.1	Develop Intelligent Transportation Systems	✓							✓		
SJC5.2	Coordinate Traffic Signal Systems		✓	✓	✓	✓		✓	✓	✓	
SJC5.3	Reduce Traffic Congestion at Major Intersections		✓	✓	✓	✓		✓	✓	✓	

Table D- 10 San Joaquin Council of Governments Summary of Commitments - 2002 Severe Area Ozone Plan

Number	Measure Title	SJCOG	Escalon	Lathrop	Lodi	Manteca	Ripon	Stockton	Tracy	County of San Joaquin	San Joaquin Regional Transit District
SJC5.4	Site-Specific Transportation Control Measures		✓	✓	✓	✓		✓	✓	✓	
SJC5.6	Reversible Lanes				✓						
SJC5.7	One-Way Streets							✓	✓		
SJC5.8	On-Street Parking Restrictions			✓		✓		✓	✓	✓	
SJC5.9	Bus Pullouts in Curbs for Passenger Loading			✓				✓	✓		
SJC5.10	Additional Freeway Service Patrol										
SJC5.16	Adaptive traffic signals and signal timing		✓	✓	✓			✓	✓		
SJC5.17	Freeway bottleneck improvements (add lanes, construct shoulders, etc.)	✓									
SJC6.1	Park and Ride Lots	✓	✓						✓		
SJC6.2	Park and Ride lots serving perimeter counties	✓									
SJC7.3	Involve school districts to encourage walking/bicycling to school								✓		
SJC7.4	Adjust school hours so they do not coincide with peak traffic periods and Ozone seasons										
SJC7.11	Auto restricted zones								✓		
SJC8.1	Financial Incentives	✓									
SJC8.2	Internet ridematching services	✓									
SJC8.3	Preferential parking for carpoolers	✓									
SJC8.4	Credits and incentives for carpoolers	✓									
SJC8.5	Encourage employers to provide vehicles to carpoolers for running errands or emergencies	✓									
SJC8.6	Subscription Services										✓
SJC9.1	Establish Auto Free Zones and Pedestrian Malls		✓		✓			✓			
SJC9.2	Encouragement of Pedestrian Travel		✓	✓		✓		✓	✓	✓	
SJC9.3	Bicycle/Pedestrian Program		✓	✓	✓	✓		✓	✓	✓	
SJC9.4	Close certain roads for use by non-motorized traffic		✓	✓	✓	✓		✓	✓	✓	
SJC9.5	Encouragement of Bicycle Travel	✓	✓	✓					✓		

Table D- 10 San Joaquin Council of Governments Summary of Commitments - 2002 Severe Area Ozone Plan

Number	Measure Title	SJCOG	Escalon	Lathrop	Lodi	Manteca	Ripon	Stockton	Tracy	County of San Joaquin	San Joaquin Regional Transit District
SJC9.8	Close streets for special events for use by bikes and pedestrians when/where appropriate		✓	✓	✓	✓		✓	✓	✓	
SJC10.2	Bike Racks on Buses	✓							✓		✓
SJC10.4	Development of Bicycle Travel Facilities	✓	✓	✓	✓	✓		✓	✓	✓	
SJC13.1	Alternative Work Schedules	✓							✓		
SJC13.2	Modifications of Work Schedules	✓							✓		
SJC13.3	Telecommunications-Telecommuting	✓									
SJC13.4	Telecommunications-Teleconferencing	✓									
SJC14.3	Land Use/Development Alternatives		✓	✓	✓	✓		✓		✓	
SJC14.6	Transportation for Livable Communities (TLC)/Housing Incentive Program	✓							✓		
SJC15.1	Encouragement of Pedestrian Travel	✓							✓		
SJC15.2	Pedestrian and Bicycle Overpasses Where Safety Dictates		✓	✓	✓	✓		✓			
SJC17.1	Enforcement of Traffic, Parking, and Air Pollution Regulations		✓			✓		✓			
SJC17.6	Satellite campuses										
TCM1	Traffic Flow Improvements				✓	✓		✓	✓	✓	
TCM2	Public Transit								✓		✓
TCM3	Rideshare Programs	✓									
TCM4	Bicycle Programs	✓	✓	✓	✓	✓		✓	✓	✓	
TCM5	Alternative Fuels Program				✓			✓	✓	✓	
EPA	Commute Benefits	✓									
District	Heavy Duty Engine Emission Reduction Incentive Program										

Table D- 11 Stanislaus Council of Governments Summary of Commitments - 2002 Severe Area Ozone Plan

Number	Measure Title	StanCOG	Ceres	Hughson	Modesto	Newman	Oakdale	Patterson	Riverbank	Turlock	Waterford	Stanislaus County
	Resolution Adopting Local Government Control Measures for the Severe Area Ozone Plan	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
ST1.1	Regional Express Bus Program				✓							
ST1.2	Transit Access to Airports				✓							
ST1.4	Mass Transit Alternatives		✓				✓		✓	✓		
ST1.5	Expansion of Public Transportation Systems		✓		✓					✓		✓
ST1.7	Free transit during special events		✓		✓			✓				✓
ST3.1	Commute Solutions	✓										
ST3.5	Preferential Parking for Carpools and Vanpools				✓					✓		
ST3.9	Encourage merchants and employers to subsidize the cost of transit for employees						✓					
ST13.16	Telecommuting										✓	
ST5.1	Develop Intelligent Transportation Systems		✓		✓				✓			
ST5.2	Coordinate Traffic Signal Systems		✓		✓			✓		✓		
ST5.3	Reduce Traffic Congestion at Major Intersections		✓		✓		✓	✓		✓		✓
ST5.4	Site-Specific Transportation Control Measures		✓		✓					✓		
ST5.9	Bus Pullouts in Curbs for Passenger Loading		✓		✓		✓	✓	✓	✓		✓
ST5.13	Fewer stop signs		✓		✓			✓		✓		
ST5.15	Changeable lane assignments											
ST5.16	Adaptive traffic signals and signal timing											✓
ST7.14	Incentives for cities with good development practices											
ST7.15	Cash incentives to foster jobs/housing balance						✓	✓		✓		
ST7.16	Trip reduction oriented development				✓		✓			✓		
ST7.17	Transit oriented development						✓			✓		
ST7.18	Sustainable development				✓		✓			✓		
ST7.19	Establishment of Urban Growth Boundaries									✓		
ST8.1	Financial Incentives, Including Zero Bus Fares				✓							✓

Table D- 11 Stanislaus Council of Governments Summary of Commitments - 2002 Severe Area Ozone Plan

Number	Measure Title	StanCOG	Ceres	Hughson	Modesto	Newman	Oakdale	Patterson	Riverbank	Turlock	Waterford	Stanislaus County
ST8.2	Internet ride-matching services											
ST8.3	Preferential parking for carpoolers				✓					✓		
ST8.4	Credits and incentives for carpoolers				✓					✓		
ST9.2	Encouragement of Pedestrian Travel			✓			✓	✓		✓	✓	
ST9.3	Bicycle/Pedestrian Program	✓		✓			✓	✓	✓	✓	✓	✓
ST9.5	Encouragement of Bicycle Travel				✓	✓	✓	✓	✓	✓	✓	
ST9.11	Safe Routes to School		✓	✓	✓		✓	✓		✓		
ST10.2	Bike Racks on Buses				✓		✓		✓	✓		✓
ST11.8	Ban cruising during Ozone Alert Days				✓							
ST11.9	Discourage drive-thrus in new development				✓							
ST13.1	Alternative Work Schedules							✓	✓			
ST13.5	Internet commerce and education	✓		✓	✓	✓	✓	✓	✓	✓		✓
ST14.3	Land Use/Development Alternatives		✓		✓							
ST14.7	Incentives to increase density around transit centers											
ST14.8	Incentives for cities with good development practices											
ST15.1	Encouragement of Pedestrian Travel			✓			✓	✓			✓	
ST15.2	Pedestrian and Bicycle Overpasses Where Safety Dictates				✓		✓		✓	✓		
ST17.15	Encourage the purchase and use of alternative, cleaner vehicles								✓	✓		
STTCM1	Traffic Flow Improvements											
STTCM2	Public Transit											
STTCM3	Rideshare Programs											
STTCM4	Bicycle Programs											
STTCM5	Alternative Fuels Program											
ARB	Parking Cash-Out											

Table D- 11 Stanislaus Council of Governments Summary of Commitments - 2002 Severe Area Ozone Plan

Number	Measure Title	StanCOG	Ceres	Hughson	Modesto	Newman	Oakdale	Patterson	Riverbank	Turlock	Waterford	Stanislaus County
EPA	Commute Benefits											
District	Heavy Duty Engine Emission Reduction Incentive Program											
	ADDITIONAL COMMITMENTS FOR MEASURES NOT ON THE SUGGESTED LIST											
10.1	Region-wide Mandatory Bile Racks at Work Sites		✓									

Table D-12 Merced County Association of Governments Summary of Commitments - 2002 Severe Area Ozone Plan

Number	Measure Title	MCAG	Atwater	Dos Palos	Gustine	Livingston	Los Banos	Merced	County of Merced	Transit Joint Powers Authority for Merced County
	Resolution Adopting Local Government Control Measures for the Severe Area Ozone Plan	✓	✓	✓	✓	✓	✓	✓	✓	✓
ME1.5	Expansion of Public Transportation Systems									✓
ME1.10	Particulate Trap Retrofit									
ME3.1	Commute Solutions	✓								
ME3.3	Employer Rideshare Program Incentives									
ME3.9	Encourage merchants and employers to subsidize the cost of transit for employees									✓
ME5.3	Reduce Traffic Congestion at Major Intersections		✓	✓	✓	✓	✓	✓	✓	
ME5.7	One-Way Streets							✓		
ME5.9	Bus Pullouts in Curbs for Passenger Loading									✓
ME5.19	Internet provided road and route information									
ME8.2	Internet ride-matching services	✓								
ME9.2	Encouragement of Pedestrian Travel									
ME9.3	Bicycle/Pedestrian Program									
ME9.4	Close certain roads for use by non-motorized traffic		✓	✓	✓	✓	✓	✓	✓	
ME9.5	Encouragement of Bicycle Travel									
ME10.2	Bike Racks on Buses									
ME14.3	Land Use/Development Alternatives		✓	✓	✓	✓	✓	✓	✓	
ME14.5	Evaluation of the Air Quality Impacts of New development and Mitigation of Adverse Impacts		✓	✓	✓	✓	✓	✓	✓	
ME15.1	Encouragement of Pedestrian Travel									

Table D-12 Merced County Association of Governments Summary of Commitments - 2002 Severe Area Ozone Plan

Number	Measure Title	MCAG	Atwater	Dos Palos	Gustine	Livingston	Los Banos	Merced	County of Merced	Transit Joint Powers Authority for Merced County
ME17.12	Use scout troops, churches, public figures to carry message of air pollution problems									
TCM1	Traffic Flow Improvements		✓	✓	✓	✓	✓		✓	
TCM2	Public Transit							✓		
TCM3	Rideshare Programs	✓								
TCM4	Bicycle Programs									

Table D-13 Madera County Transportation Commission Summary of Commitments - 2002 Severe Area Ozone Plan

Number	Measure Title	MCTC	Chowchilla	Madera County	Madera
	Resolution Adopting Local Government Control Measures for the Sever Area Ozone Plan	✓	✓	✓	✓
MA1.5	Expansion of Public Transportation Systems		✓	✓	✓
MA1.7	Free transit during special events				✓
MA3.1	Commute Solutions	✓			
MA3.5	Preferential Parking for Carpools and Vanpools	✓			
MA3.9	Encourage merchants and employers to subsidize the cost of transit for employees	✓			
MA5.1	Develop Intelligent Transportation Systems		✓	✓	✓
MA5.2	Coordinate Traffic Signal Systems				✓
MA5.3	Reduce Traffic Congestion at Major Intersections			✓	✓
MA5.5	Removal of On-Street Parking				
MA5.9	Bus Pullouts in Curbs for Passenger Loading				✓
MA5.19	Internet provided road and route information		✓	✓	✓
MA7.3	Involve school districts to encourage walking to school				
MA9.2	Encouragement of Pedestrian Travel				
MA9.3	Bicycle/Pedestrian Program		✓	✓	✓
MA9.5	Encouragement of Bicycle Travel				
MA9.8	Close streets for special events for use by bikes and pedestrians			✓	✓
MA10.2	Bike Racks on Buses				
MA11.2	Encourage Limitations on Vehicle Idling	✓			
MA11.6	Promote use of Pony engines	✓			
MA13.3	Telecommunications-Telecommuting	✓			
MA13.4	Telecommunications-Teleconferencing	✓	✓	✓	✓
MA14.1	Area wide Public Awareness Programs	✓			

Table D-13 Madera County Transportation Commission Summary of Commitments - 2002 Severe Area Ozone Plan

Number	Measure Title	MCTC	Chowchilla	Madera County	Madera
MA14.5	Evaluation of the Air Quality Impacts of New development and Mitigation of Adverse Impacts		✓	✓	✓
MA15.1	Encouragement of Pedestrian Travel				
MA17.12	Use scout troops, churches, public figures to carry message of air pollution problems				
TCM1	Traffic Flow Improvements		✓	✓	✓
TCM2	Public Transit		✓	✓	✓
TCM3	Rideshare Programs	✓			
TCM4	Bicycle Programs				
TCM5	Alternative Fuels Program			✓	✓
EPA	Commute Benefits	*			
* MCTC has indicated that implementation of this measure is included in Measure 3.1 Commute Solutions, but was inadvertently omitted from the resolution package.					

Table D-14 Fresno Council of Governments Summary of Commitments - 2002 Severe Area Ozone Plan

Number	Measure Title	Fresno COG	Clovis/Clovis Transit	Coa-linga	Fire-baugh	Fowler	Fresno/Fresno Area Express	Huron	Kerman	Kings-burg	Men-dota	Orange Cove	Parlier	Reedley	Sanger	San Joaquin	Selma	Fresno County	Fresno County Rural Transit Agency
	Resolution Adopting Local Government Control Measures for the Severe Area Ozone Plan	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
FR1.1	Regional Express Bus Program		✓				✓												✓
FR1.2	Transit Access to Airports		✓				✓												
FR1.3	Study Benefits of Bus Retrofit Program		✓				✓												
FR1.4	Mass Transit Alternatives		✓				✓												✓
FR1.5	Expansion of Public Transportation Systems		✓				✓												✓
FR1.6	Transit Service Improvements in Combination with Park-and-Ride Lots and Parking Management																		
FR1.7	Free transit during special events		✓				✓												
FR1.9	Increase parking at transit centers or stops						✓												
FR2.3	Fixed Lanes for Buses and Carpools on Arterials																		
FR3.1	Commute Solutions	✓																	
FR3.2	Parking Cash-Out	✓																	
FR3.3	Employer Rideshare Program Incentives																		
FR3.5	Preferential Parking for Carpools and Vanpools	✓																	
FR3.6	Employee Parking Fees	✓																	
FR3.8	Purchase vans for vanpools																		
FR3.9	Encourage merchants and employers to subsidize the cost of transit for employees	✓																	
FR13.16	Telecommuting																		
FR5.1	Develop Intelligent Transportation Systems		✓				✓												
FR5.2	Coordinate Traffic Signal Systems		✓				✓	✓	✓				✓	✓	✓		✓	✓	
FR5.3	Reduce Traffic Congestion at Major Intersections		✓	✓		✓	✓	✓	✓	✓			✓	✓	✓	✓	✓	✓	
FR5.4	Site-Specific Transportation Control Measures		✓	✓		✓	✓	✓	✓	✓			✓	✓	✓	✓	✓	✓	

Table D-14 Fresno Council of Governments Summary of Commitments - 2002 Severe Area Ozone Plan

Number	Measure Title	Fresno COG	Clovis/Clovis Transit	Coa-linga	Fire-baugh	Fowler	Fresno/Fresno Area Express	Huron	Kerman	Kings-burg	Men-dota	Orange Cove	Parlier	Reedley	Sanger	San Joaquin	Selma	Fresno County	Fresno County Rural Transit Agency
FR5.5	Removal of On-Street Parking		✓	✓			✓	✓		✓		✓		✓	✓		✓	✓	
FR5.6	Reversible Lanes																		
FR5.7	One-Way Streets																✓		
FR5.8	On-Street Parking Restrictions		✓				✓											✓	
FR5.9	Bus Pullouts in Curbs for Passenger Loading		✓				✓											✓	
FR5.10	Additional Freeway Service Patrol	✓																	
FR5.11	Consider coordinating scheduling of arterial and highway maintenance to exclude ozone action days if the maintenance activities require lane reductions on heavily utilized arterials and highways		✓				✓											✓	
FR5.13	Fewer stop signs, remove unwarranted and "political" stop signs and signals		✓		✓		✓			✓				✓			✓	✓	
FR5.14	Ban left turns		✓				✓												
FR5.15	Changeable lane assignments																		
FR5.16	Adaptive traffic signals and signal timing		✓				✓											✓	
FR5.18	Minimize impact of construction on traveling public. Have contractors pay when lanes are closed as an incentive to keep lanes open		✓	✓		✓	✓	✓		✓	✓	✓	✓	✓	✓	✓	✓	✓	
FR6.1	Park and Ride Lots					✓		✓	✓	✓			✓	✓		✓	✓		
FR6.2	Park and Ride lots serving perimeter counties					✓		✓	✓	✓			✓	✓		✓	✓		
FR7.12	Incentives to increase density around transit centers		✓				✓												
FR8.1	Financial Incentives, Including Zero Bus Fares																		
FR8.2	Internet ride-matching services	✓																	
FR8.3	Preferential parking for carpoolers	✓																	
FR8.4	Credits and incentives for carpoolers	✓																	
FR8.5	Employers provide vehicles to carpoolers for running errands or emergencies	✓																	
FR8.6	Subscription Services																		✓

Table D-14 Fresno Council of Governments Summary of Commitments - 2002 Severe Area Ozone Plan

Number	Measure Title	Fresno COG	Clovis/Clovis Transit	Coa-linga	Fire-baugh	Fowler	Fresno/Fresno Area Express	Huron	Kerman	Kings-burg	Men-dota	Orange Cove	Parlier	Reedley	Sanger	San Joaquin	Selma	Fresno County	Fresno County Rural Transit Agency
FR9.1	Establish Auto Free Zones and Pedestrian Malls			✓			✓			✓									
FR9.2	Encouragement of Pedestrian Travel		✓	✓		✓	✓	✓	✓	✓		✓	✓	✓	✓	✓			
FR9.3	Bicycle/Pedestrian Program		✓	✓	✓	✓	✓	✓	✓		✓	✓	✓	✓	✓	✓	✓	✓	
FR9.4	Close certain roads for use by non-motorized traffic		✓	✓			✓			✓		✓		✓	✓		✓	✓	
FR9.5	Encouragement of Bicycle Travel		✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	
FR9.7	Cash Rebates for Bikes																		
FR9.8	Close streets for special events for use by bikes and pedestrians		✓	✓			✓			✓		✓		✓	✓		✓	✓	
FR9.10	Provide funding so volunteers do not have to pay the cost of trail creation and maintenance		✓		✓		✓							✓				✓	
FR10.2	Bike Racks on Buses		✓				✓												
FR10.4	Development of Bicycle Travel Facilities		✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	
FR10.5	Expedite Bicycle Projects from RTP		✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓		
FR10.6	Provide Bike/Pedestrian facilities safety patrols		✓		✓		✓	✓			✓			✓			✓		
FR10.7	Require inclusion of bicycle lanes on state or federally funded thoroughfare projects.		✓	✓		✓	✓		✓	✓		✓	✓	✓	✓	✓	✓		
FR11.3	Turn off engines while stalled in traffic																		
FR13.1	Alternative Work Schedules	✓																	
FR13.2	Modifications of Work Schedules	✓																	
FR13.3	Telecommunications-Telecommuting	✓																	
FR13.4	Telecommunications-Teleconferencing	✓																	
FR14.3	Land Use/Development Alternatives		✓			✓	✓		✓			✓	✓	✓	✓	✓	✓	✓	
FR14.5	Evaluation of the Air Quality Impacts of New Development and Mitigation of Adverse Impacts		✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	
FR14.7	Incentives to increase density around transit centers		✓				✓												
FR15.1	Encouragement of Pedestrian Travel	✓																	
FR15.2	Pedestrian and Bicycle Overpasses Where Safety Dictates		✓				✓											✓	

Table D-14 Fresno Council of Governments Summary of Commitments - 2002 Severe Area Ozone Plan

Number	Measure Title	Fresno COG	Clovis/Clovis Transit	Coa-linga	Fire-baugh	Fowler	Fresno/Fresno Area Express	Huron	Kerman	Kings-burg	Men-dota	Orange Cove	Parlier	Reedley	Sanger	San Joaquin	Selma	Fresno County	Fresno County Rural Transit Agency
FR17.1	Enforcement of Traffic, Parking, and Air Pollution Regulations		✓	✓	✓		✓	✓		✓					✓		✓		
FR17.6	Satellite campuses																		
FR-TCM1	Traffic Flow Improvements		✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	
FR-TCM2	Improved Public Transit						✓						✓						✓
FR-TCM3	Voluntary Rideshare Program and Employer Incentive Program	✓																	
FR-TCM4	Bicycle Lanes and Facilities		✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	
FR-TCM5	Alternative Fuels Program		✓		✓	✓	✓				✓			✓				✓	
FR-TCM6	Park and Ride Fringe Parking					✓		✓	✓	✓			✓	✓		✓	✓		
ARB	Parking Cash-Out	✓																	
EPA	Commute Benefits	✓																	
District	Heavy Duty Engine Emission Reduction Incentive Program																		
FR19.1	Regional Express Bus Program		✓				✓												✓
FR19.2	Expansion of Public Transportation Systems		✓				✓												✓
FR19.3	Consolidation of Public Transit Operators						✓												
FR19.4	Increase Parking at Transit Centers or Stops						✓			✓				✓					
FR19.5	Transit Stop Improvements		✓				✓												✓
FR19.6	Productivity Improvements		✓				✓												✓
FR19.7	Ridership Targets						✓												
FR19.18	Pedestrian facilities		✓	✓		✓	✓	✓		✓	✓	✓	✓	✓	✓	✓	✓	✓	
FR19.25	Optimize traffic signal timing		✓				✓	✓	✓				✓	✓	✓		✓	✓	
FR19.26	Encourage employers to provide money to employees for home computer purchase so employees can work from home.	✓																	

Table D-14 Fresno Council of Governments Summary of Commitments - 2002 Severe Area Ozone Plan

Number	Measure Title	Fresno COG	Clovis/Clovis Transit	Coa-linga	Fire-baugh	Fowler	Fresno/Fresno Area Express	Huron	Kerman	Kings-burg	Men-dota	Orange Cove	Parlier	Reedley	Sanger	San Joaquin	Selma	Fresno County	Fresno County Rural Transit Agency
	ADDITIONAL COMMITMENTS FOR MEASURES NOT ON THE SUGGESTED LIST																		
10.7A	Require Inclusion of Paved Shoulders Adequate for Bicycle Use on State or Federally Funded Reconstruction or Widening of Federal Major Collectors or Greater																	✓	

Table D-15 Tulare County Association of Governments Summary of Commitments - 2002 Severe Area Ozone Plan

Number	Measure Title	TCAG	Dinuba	Exeter	Farmersville	Lindsay	Porterville	Tulare	Woodlake	Visalia	County of Tulare
	Resolution Adopting Local Government Control Measures for the Severe Area Ozone Plan	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
TU1.1	Regional Express Bus Program							✓			✓
TU1.2	Transit Access to Airports						✓	✓		✓	
TU1.5	Expansion of Public Transportation Systems		✓	✓	✓	✓		✓	✓	✓	✓
TU1.6	Transit Service Improvements in Combination with Park-and-Ride Lots and Parking Management					✓	✓	✓			
TU1.7	Free transit during special events					✓	✓	✓		✓	
TU1.9	Increase parking at transit centers or stops						✓	✓			
											✓
TU3.1	Commute Solutions			✓	✓		✓	✓	✓		
TU3.2	Parking Cash-Out			✓			✓	✓	✓		✓
TU3.3	Employer Rideshare Program Incentives	✓					✓	✓		✓	
TU3.5	Preferential Parking for Carpools and Vanpools			✓	✓	✓	✓	✓	✓	✓	✓
TU3.8	Purchase vans for vanpools	✓									
TU3.9	Encourage merchants and employers to subsidize the cost of transit for employees	✓					✓	✓		✓	
TU5.1	Develop Intelligent Transportation Systems	✓				✓	✓	✓		✓	
TU5.2	Coordinate Traffic Signal Systems	✓					✓	✓		✓	
TU5.3	Reduce Traffic Congestion at Major Intersections	✓				✓	✓	✓		✓	
TU5.4	Site-Specific Transportation Control Measures	✓		✓	✓	✓	✓	✓	✓	✓	
TU5.5	Removal of On-Street Parking				✓	✓	✓	✓	✓	✓	✓
TU5.8	On-Street Parking Restrictions				✓	✓		✓	✓	✓	
TU5.9	Bus Pullouts in Curbs for Passenger Loading				✓		✓	✓	✓	✓	
TU5.16	Adaptive traffic signals and signal timing			✓	✓		✓	✓		✓	
TU5.19	Internet provided road and route information		✓	✓		✓		✓	✓	✓	
TU5.20	Regional route marking systems to encourage underutilized capacity	✓				✓		✓		✓	
TU6.1	Park and Ride Lots					✓	✓	✓			

Table D-15 Tulare County Association of Governments Summary of Commitments - 2002 Severe Area Ozone Plan

Number	Measure Title	TCAG	Dinuba	Exeter	Farmersville	Lindsay	Porterville	Tulare	Woodlake	Visalia	County of Tulare
TU7.3	Involve school districts to encourage walking to school		✓	✓	✓	✓	✓	✓	✓	✓	
TU7.12	Incentives to increase density around transit centers	✓					✓	✓			
TU7.13	Land use/air quality guidelines		✓	✓	✓	✓	✓	✓	✓	✓	
TU7.14	Incentives for cities with good development practices			✓	✓	✓	✓		✓		
TU7.17	Transit oriented development						✓	✓			
TU8.1	Financial Incentives, Including Zero Bus Fares										
TU8.2	Internet ride matching services										
TU8.3	Preferential parking for carpoolers		✓	✓	✓				✓	✓	✓
TU8.4	Credits and incentives for carpoolers		✓							✓	
TU8.5	Employers provide vehicles to carpoolers for running errands or emergencies	✓				✓					
TU8.6	Subscription Services										
TU9.1	Establish Auto Free Zones and Pedestrian Malls					✓		✓			
TU9.2	Encouragement of Pedestrian Travel					✓	✓	✓			
TU9.3	Bicycle/Pedestrian Program	✓				✓	✓	✓		✓	
TU9.4	Close certain roads for use by non-motorized traffic							✓			
TU9.5	Encouragement of Bicycle Travel	✓		✓		✓	✓	✓		✓	
TU9.8	Close streets for special events for use by bikes and pedestrians					✓	✓	✓			
TU9.9	Use condemned dirt roads for bike trails							✓			
TU10.1	Region-wide mandatory bike racks at work sites	✓						✓		✓	
TU10.2	Bike Racks on Buses						✓	✓	✓	✓	✓
TU11.6	Promote use of Pony engines	✓						✓			
TU13.1	Alternative Work Schedules	✓						✓			
TU13.2	Modifications of Work Schedules	✓						✓			
TU13.3	Telecommunications-Telecommuting	✓				✓					
TU13.4	Telecommunications-Teleconferencing	✓				✓		✓		✓	

Table D-15 Tulare County Association of Governments Summary of Commitments - 2002 Severe Area Ozone Plan

Number	Measure Title	TCAG	Dinuba	Exeter	Farmersville	Lindsay	Porterville	Tulare	Woodlake	Visalia	County of Tulare
TU14.1	Area-wide Public Awareness Programs		✓					✓			
TU14.2	Special Event Controls			✓	✓		✓		✓		
TU14.3	Land Use/Development Alternatives		✓	✓	✓	✓	✓	✓	✓	✓	✓
TU14.4	Voluntary No Drive Day Programs		✓					✓			
TU14.5	Evaluation of the Air Quality Impacts of New development and Mitigation of Adverse Impacts		✓	✓	✓	✓	✓	✓	✓	✓	✓
TU14.6	Transportation for Livable Communities (TLC)/Housing Incentive Program		✓	✓	✓	✓			✓		
TU14.7	Incentives to increase density around transit centers						✓	✓			
TU14.8	Incentives for cities with good development practices			✓	✓		✓		✓		
TU15.1	Encouragement of Pedestrian Travel									✓	
TU15.2	Pedestrian and Bicycle Overpasses Where Safety Dictates							✓			
TU17.6	Satellite campuses					✓					
TU17.12	Use scout troops, churches, public figures to carry message of air pollution problems	✓	✓	✓	✓		✓	✓	✓	✓	✓
TU17.14	Cool cities approach to reduce heat build-up					✓	✓	✓			
TCM1	Traffic Flow Improvements			✓	✓		✓		✓	✓	✓
TCM2	Public Transit		✓	✓	✓		✓			✓	✓
TCM3	Rideshare Programs						✓				
TCM4	Bicycle Programs	✓				✓		✓	✓	✓	
TCM5	Alternative Fuels Program	✓	✓				✓	✓		✓	✓
ARB	Parking Cash-Out										
EPA	Commute Benefits										
District	Heavy Duty Engine Emission Reduction Incentive Program										
	ADDITIONAL COMMITMENTS FOR MEASURES NOT ON THE SUGGESTED LIST										
TU1.8	Require that government employees use transit for home to work trips, expand transit, and encourage large businesses to promote transit use							✓			
TU3.14	Mandatory compressed work weeks					✓					
TU5.6	Reversible Lanes					☐		✓			
TU5.7	One-Way Streets					☐		✓		✓	

Table D-15 Tulare County Association of Governments Summary of Commitments - 2002 Severe Area Ozone Plan

Number	Measure Title	TCAG	Dinuba	Exeter	Farmersville	Lindsay	Porterville	Tulare	Woodlake	Visalia	County of Tulare
TU5.13	Fewer Stop Signs						✓	✓			
TU7.15	Cash incentives to foster jobs/housing balance					✓					
TU7.16	Trip reduction oriented development					✓		✓			
TU7.18	Sustainable development					✓		✓			
TU11.2	Encourage Limitations on Vehicle Idling					☐		✓			
TU17.1	Enforcement of Traffic, Parking, and Air Pollution Regulations					✓					
	Promote Use of Cleaner Lawn and Garden Equipment such as Lower-Emission Four-Stroke and Electric-Powered Equipment							✓			
	Defer Emissions Associated with Governmental Activities							✓			

Table D-16 Kings County Association of Governments Summary of Commitments - 2002 Severe Area Ozone Plan

Number	Measure Title	KCAG	Avenal	Corcoran	Hanford	Lemoore	County of Kings	Kings County Area Public Transit Agency
	Resolution Adopting Local Government Control measures for the Severe Area Ozone Plan	✓	✓	✓	✓	✓	✓	✓
KI1.5	Expansion of Public Transportation Systems		✓	✓				✓
KI1.6	Transit Service Improvements in Combination with Park-and-Ride Lots and Parking Management		✓	✓	✓			✓
KI1.7	Free transit during special events		✓	✓	✓			✓
KI3.1	Commute Solutions							
KI3.3	Employer Rideshare Program Incentives					✓		
KI3.5	Preferential Parking for Carpools and Vanpools						✓	
KI3.8	Purchase vans for vanpools		✓					✓
KI3.9	Encourage merchants and employers to subsidize the cost of transit for employees		✓	✓		✓		
KI6.1	Park and Ride Lots		✓		✓			
KI6.2	Park and Ride lots serving perimeter counties		✓		✓			
KI8.2	Internet ride-matching services							
KI8.3	Preferential parking for carpoolers						✓	
KI8.5	Employers provide vehicles to carpoolers for running errands or emergencies							
KI8.6	Subscription Services							
KI9.2	Encouragement of Pedestrian Travel		✓	✓	✓	✓	✓	
KI9.3	Bicycle/Pedestrian Program				✓			
KI9.4	Close certain roads for use by non-motorized traffic		✓	✓	✓	✓	✓	
KI9.5	Encouragement of Bicycle Travel		✓	✓	✓			
KI9.8	Close streets for special events for use by bikes and pedestrians		✓	✓	✓	✓	✓	
KI10.1	Region-wide mandatory bike racks at work sites				✓			
KI10.2	Bike Racks on Buses		✓	✓				✓
KI11.6	Promote use of Pony engines							

Table D-16 Kings County Association of Governments Summary of Commitments - 2002 Severe Area Ozone Plan

Number	Measure Title	KCAG	Avenal	Corcoran	Hanford	Lemoore	County of Kings	Kings County Area Public Transit Agency
KI13.1	Alternative Work Schedules				✓		✓	
KI13.2	Modifications of Work Schedules				✓	✓	✓	
KI13.4	Telecommunications-Teleconferencing		✓	✓	✓	✓	✓	
KI14.1	Area-wide Public Awareness Programs				✓			
KI14.3	Land Use/Development Alternatives				✓	✓	✓	
KI14.4	Voluntary No Drive Day Programs							
KI15.1	Encouragement of Pedestrian Travel		✓	✓	✓	✓	✓	
TCM1	Traffic Flow Improvements		✓	✓	✓		✓	
TCM2	Public Transit		✓	✓				✓
TCM3	Rideshare Programs	✓						
TCM4	Bicycle Programs		✓	✓	✓			
TCM5	Alternative Fuels Program				✓		✓	
EPA	Commute Benefits		✓	✓				
	ADDITIONAL COMMITMENTS FOR MEASURES NOT ON THE SUGGESTED LIST							
5.1	Develop Intelligent Transportation Systems				✓			
5.3	Reduce Traffic Congestion at Major Intersections		✓	✓	✓	✓	✓	
5.4	Site-Specific Transportation Control Measures		✓	✓	✓	✓	✓	
5.5	Removal of On-Street Parking		✓	✓	✓	✓	✓	
5.8	On-Street Parking Restrictions				✓		✓	
5.9	Bus Pullouts In Curbs for Passenger Loading				✓		✓	
5.22	Use Dynamic Message Signs to Direct/Smooth Speeds During Incidents						✓	
7.3	Involve School Districts to Encourage Walking to School				✓			
7.13	Land Use/Air Quality Guidelines				✓			
7.14	Incentives for Cities with Good Development Practices				✓			
17.6	Satellite Campuses				✓			

Table D-17 Kern Council of Governments Summary of Commitments - 2002 Severe Area Ozone Plan

Number	Measure Title	KCOG	Arvin	Bakersfield	California City*	County of Kern	Delano	Golden Empire Transit	Maricopa	McFarland	Ridgecrest*	Shafter	Taft	Tehachapi*	Wasco
	Resolution Adopting Local Government Control Measures for the Severe Area Ozone Plan	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
KE1.1	Regional Express Bus Program		✓			✓									
KE1.2	Transit Access to Airports														
KE1.4	Mass Transit Alternatives														
KE1.5	Expansion of Public Transportation Systems		✓			✓	✓					✓	✓	☐	
KE1.7	Free transit during special events					✓	✓					✓			✓
KE1.11	Make small dial-a-ride systems free														
KE1.12	Regional Express across county lines														
KE3.1	Commute Solutions														
KE3.2	Parking Cash-Out														
KE3.5	Preferential Parking for Carpools and Vanpools	✓													
KE3.9	Encourage merchants and employers to subsidize the cost of transit for employees						✓					✓			✓
KE3.15	Extend parking cash-out rule to more employers	**													
KE3.17	Promote Employer Rideshare Program Incentives														
KE3.18	Promote compressed work weeks														
KE3.19	Promote voluntary business closures on ozone action days														
KE5.1	Develop Intelligent Transportation Systems			✓									✓	☐	
KE5.2	Coordinate Traffic Signal Systems			✓		✓									
KE5.3	Reduce Traffic Congestion at Major Intersections			✓		✓								✓	✓
KE5.4	Site-Specific Transportation Control Measures			✓		✓									
KE5.5	Removal of On-Street Parking			✓	✓	✓					✓				✓
KE5.8	On-Street Parking Restrictions				✓										
KE5.9	Bus Pullouts in Curbs for Passenger Loading														
KE5.11	Consider coordinating scheduling of arterial and highway maintenance to exclude ozone			✓		✓									

Table D-17 Kern Council of Governments Summary of Commitments - 2002 Severe Area Ozone Plan

Number	Measure Title	KCOG	Arvin	Bakersfield	California City*	County of Kern	Delano	Golden Empire Transit	Maricopa	McFarland	Ridgecrest*	Shafter	Taft	Tehachapi*	Wasco
	action days if the maintenance activities require lane reductions on heavily utilized arterials and highways														
KE5.16	Adaptive traffic signals and signal timing			✓											
KE5.18	Minimize impact of construction on traveling public. Have contractors pay when lanes are closed as an incentive to keep lanes open			✓		✓									
KE5.19	Internet provided road and route information			✓		✓	✓					✓			
KE5.20	Regional route marking systems to encourage underutilized capacity			✓		✓	✓					✓			
KE5.22	Use dynamic message signs to direct/smooth speeds during incidents			✓											
KE5.27	Place vehicle sensors further away from intersections														
KE6.1	Park and Ride Lots														
KE7.3	Involve school districts to encourage walking to school														
KE7.4	Adjust school hours so they do not coincide with peak traffic periods and Ozone seasons														
KE7.12	Incentives to increase density around transit centers	✓		✓		✓									
KE7.13	Land use/air quality guidelines			✓		✓									
KE7.14	Incentives for cities with good development practices														
KE7.16	Trip reduction oriented development			✓		✓									
KE7.17	Transit oriented development		✓	✓		✓									✓
KE7.18	Sustainable development			✓		✓									
KE7.19	Shortened government work days during ozone alerts														
KE7.20	Distribute special parking passes for carpoolers														
KE7.21	Outreach program encouraging reduced trips during warmest part of the day														
KE8.2	Internet ride-matching services														
KE9.1	Establish Auto Free Zones and Pedestrian			✓		✓									✓

Table D-17 Kern Council of Governments Summary of Commitments - 2002 Severe Area Ozone Plan

Number	Measure Title	KCOG	Arvin	Bakersfield	California City*	County of Kern	Delano	Golden Empire Transit	Maricopa	McFarland	Ridgecrest*	Shafter	Taft	Tehachapi*	Wasco
	Malls														
KE9.2	Encouragement of Pedestrian Travel	✓				✓	✓					✓	✓	✓	
KE9.3	Bicycle/Pedestrian Program		✓			✓	✓				✓	✓	✓	☐	✓
KE9.5	Encouragement of Bicycle Travel	✓		✓	✓	✓	✓					✓	✓	✓	✓
KE9.8	Close streets for special events for use by bikes and pedestrians			✓			✓					✓			✓
KE9.10	Provide funding so volunteers do not have to pay the cost of trail creation and maintenance														
KE10.1	Region-wide mandatory bike racks at work sites			✓		✓	✓					✓			
KE10.2	Bike Racks on Buses		✓			✓	✓								
KE10.3	Regional Bike Parking Ordinance for all new construction			✓		✓							✓	☐	
KE13.2	Modifications of Work Schedules														
KE14.1	Area-wide Public Awareness Programs	✓													
KE14.2	Special Event Controls			✓		✓									
KE14.3	Land Use/Development Alternatives			✓		✓								✓	
KE14.4	Voluntary No Drive Day Programs	✓				✓									
KE14.5	Evaluation of the Air Quality Impacts of New development and Mitigation of Adverse Impacts						✓					✓		✓	✓
KE14.7	Incentives to increase density around transit centers	✓													
KE14.11	COG comments on land use planning decisions that affect transportation and air quality issues														
	Promote Telecommunications-Telecommuting														
	Promote Telecommunications-Teleconferencing														
	Promote voluntary business closures on ozone action days														
KE15.1	Encouragement of Pedestrian Travel	✓													

Table D-17 Kern Council of Governments Summary of Commitments - 2002 Severe Area Ozone Plan

Number	Measure Title	KCOG	Arvin	Bakersfield	California City*	County of Kern	Delano	Golden Empire Transit	Maricopa	McFarland	Ridgecrest*	Shafter	Taft	Tehachapi*	Wasco
KE15.2	Pedestrian and Bicycle Overpasses Where Safety Dictates			✓		✓									
KE17.6	Satellite campuses														
KE17.7	Charge more for higher emission fuels														
KE17.12	Use scout troops, churches, public figures to carry message of air pollution problems	✓													
KE17.14	Cool cities approach to reduce heat build-up														
KE17.16	Contact other areas that have been subject to EPA sanctions to determine best ways to implement new air quality measures														
KE17.17	Alternative fuel outreach program														
TCM1	Traffic Flow Improvements														
TCM2	Public Transit														
TCM3	Rideshare Programs														
TCM4	Bicycle Programs														
TCM5	Alternative Fuels Program	✓				✓									✓
ARB	Parking Cash-Out														
EPA	Commute Benefits	***													
District	Heavy Duty Engine Emission Reduction Incentive Program														
	ADDITIONAL COMMITMENTS FOR MEASURES NOT ON THE SUGGESTED LIST														
8.5	Shared LEV Vehicles at Work Sites			✓	✓										
14.9	Business, Industry and Governmental Outreach Program	✓													
14.1	Public Education Program	✓													
Local	Develop Programs that Encourage Good Movements by Rail											✓			
Local	Purchase Low Emission Vehicles (LEV) for Government Fleet Purposes													✓	

* These jurisdictions are located in the Mohave air basin, not the San Joaquin Valley air basin.
** KCOG has indicated that this measure is financially infeasible, but was inadvertently omitted from the reasoned justification documentation.
*** KCOG has indicated that implementation of this measure is included in Measure 14.9, but was inadvertently omitted from the resolution package.

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Appendix E

Incentives

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Appendix E: Incentives

The San Joaquin Valley Air Pollution Control District (District) has increasingly relied on its advocacy efforts to secure state and federal funding sources, and locally-generated funding to implement incentive programs that have become a crucial component of the District's overall strategy for achieving the emissions reductions necessary to bring the Valley into attainment. These programs provide an effective way to accelerate emissions reductions and encourage technology advancement, particularly from mobile sources, a sector not directly under the District's regulatory jurisdiction. Given that 85% of the NOx emissions in the Valley come from mobile sources, these successful voluntary incentive grant programs help the Valley achieve highly cost-effective emissions reductions that are surplus of the regulatory emissions reductions.

E.1 DISTRICT EXPERIENCE TO DATE IN ADMINISTERING AND IMPLEMENTING INCENTIVE PROGRAMS

The District operates one of the largest and most well-respected voluntary incentive programs in California. Through strong advocacy at the state and federal levels, the District has appropriated $136 million in incentive funding in the 2015-2016 District Budget.[1] Since the District's inception in 1992, considerable funding has been invested into thousands of clean-air projects throughout the Valley. These projects have achieved significant emissions reductions with corresponding air quality and health benefits.

The District typically requires match funding of 30% to 70% from grant recipients. To date, grant recipients have provided $692,200,000 in matching funds, with a combined District and grant recipient funding investment of more than $1.4 billion.

Table E-1 Summary of Grant Expenditures and Results

District Incentive Funding ($)	Grant Recipient Match Funding ($)	Emissions Reductions (tons)	Cost-Effectiveness ($/ton)
$756,300,000	$692,200,000	123,600	$6,118

[1] SJVAPCD. Recommended Budget 2015-2016. p.68. (2015, May 21) Retrieved from http://www.valleyair.org/Board_meetings/GB/agenda_minutes/Agenda/2015/May/BudgetHearing/final/03.pdf

E.2 SIP CREDITABILITY FOR INCENTIVE-BASED EMISSIONS REDUCTIONS

Historically, states and local air agencies have not been able to obtain credit in state implementation plans (SIPs) for incentive-based emissions reductions. When given SIP credit, incentive-based emissions reductions can be used alongside regulatory-based emissions reductions to meet federal Clean Air Act (CAA) requirements, such as demonstrating attainment with federal air quality standards at a future date or demonstrating that emissions reductions meet federal SIP reasonable further progress requirements. Given the substantial investment from the public and private sectors in replacing equipment under these voluntary incentives, establishing a general framework to receive SIP credit for these emissions reductions was critical. Recognizing the importance of this issue, the U.S. Environmental Protection Agency (EPA), California Air Resources Board (ARB), and the United States Department of Agriculture – Natural Resources Conservation Service (USDA-NRCS), worked together with the District and signed a Statement of Principles (MOU) in December 2010 that established a general framework for ensuring that reductions in air emissions resulting from voluntary incentives to replace off-road agricultural equipment received credit in the SIP. The MOU states that the District, NRCS, ARB and EPA would work collaboratively to develop a mechanism to provide SIP credit for emissions from incentive programs that are surplus, quantifiable, enforceable, and permanent. In continuing these efforts, in July 2012, EPA and USDA agreed to implement this concept to ensure that emissions reductions from incentive programs were given their proper credit in the SIP context.

As a result of these collaborative efforts, the District adopted Rule 9610 (State Implementation Plan Credit for Emission Reductions Generated Through Incentive Programs) on June 20, 2013. District Rule 9610 establishes the administrative mechanism through which SIP credit is quantified for emissions reduced in the Valley through incentives. EPA proposed a limited approval of Rule 9610 in May 2014[2] and finalized that approval on April 9, 2015.[3]

As with prohibitory rules, EPA guidance requires that emissions reductions achieved through voluntary incentive programs be demonstrated to be surplus, quantifiable, permanent, and enforceable in order for those reductions to receive SIP credit. Additionally, EPA guidance requires extensive documentation of emissions reductions proposed for SIP credit with ongoing follow-up and tracking of the emissions reductions.

District incentive programs are designed to meet the surplus-quantifiable-enforceable criteria. In order to be surplus, emissions reductions from voluntary incentive programs generally must not be required by any local, state, or federal regulations. Quantifiable emissions reductions are calculated using methodologies of state programs or other publically developed methodologies. To ensure enforceable and permanent emissions reductions, programs require mechanisms such as legally binding agreements with

[2] Revision to the California State Implementation Plan; San Joaquin Valley Unified Air Pollution Control District; Quantification of Emission Reductions from Incentives. 79 Fed. Reg. 96 pp. 25650-28658. (2014, May 19) (to be codified at 40 CFR Part 52). http://www.gpo.gov/fdsys/pkg/FR-2014-05-19/pdf/2014-11481.pdf

[3] Revision to the California State Implementation Plan; San Joaquin Valley Unified Air Pollution Control District; Quantification of Emission Reductions from Incentives. 80 Fed. Reg. 68 pp. 19020-19033. (2015, April 9) (to be codified at 40 CFR Part 52). http://www.gpo.gov/fdsys/pkg/FR-2015-04-09/pdf/2015-07972.pdf

program participants and physical inspections to verify the completion of projects. Furthermore, all criteria and reporting mechanisms are transparent to the public.

E.3 INCENTIVE FUNDING SOURCES

The District is engaged at every level of state and federal government to craft policy and funding targets that account for the Valley's unique challenges and need to accelerate emissions reductions, particularly from sources not under the District's regulatory authority. The District therefore, works closely with the Valley's legislative delegation to ensure that the Valley's needs are well represented in discussions of where to focus funding throughout the state and the region as a whole. In addition, the District is focused on how to effectively allocate the limited funding received for its incentive programs.

In addition to aggressively pursuing funding from state funding sources such as the Carl Moyer Program and Lower-Emission School Bus Program, the District has been very successful in securing grants from the highly-competitive federal Diesel Emissions reductions Act (DERA) and the state Assembly Bill (AB) 118 Air Quality Improvement Program (AQIP). Currently, the District is actively engaged with ARB, the California Energy Commission (CEC) and other state agencies to ensure that the Valley is well represented in project selections from the Greenhouse Gas (GHG) Reduction Fund totaling over $1 billion per year.

E.4 INCENTIVE STRATEGY

Each of the funding sources administered by the District includes different guidelines and statutory requirements for using the funds. Beyond the specific guidelines of each funding source, the District considers the following common factors when deciding how and where to spend incentive funds:

E.4.1 Cost Effectiveness

An important factor when considering where to invest District funds is determining which types of projects and programs will give the District the greatest return on its investment. This is typically represented in dollars per ton of emissions reduced. While cost-effectiveness is a primary factor, the District also considers projects that may not have the highest cost-effectiveness, but that provide other benefits, such as the advancement of new technology or community involvement.

E.4.2 Inventory of Available Projects

This factor is critical in all District incentive programs. To date, the District has been extremely successful in designing incentive programs that have broad appeal and applicability across multiple industries. Over the past 10 years, this level of interest has resulted in a substantial backlog of eligible projects waiting for funding. Unfortunately in most cases, many of those on waiting lists have since moved into a regulated class,

making them ineligible for funding. As a result, the District must continue to not only work within the existing regulations to find cost-effective, surplus project categories, but also to focus future funding in areas where a significant inventory of eligible projects still exists.

E.4.3 Required Expenditure Timeframes

Each funding source that the District administers generally requires obligation and expenditure by certain deadlines. These deadlines greatly impact funding priorities and choice of projects. The District may prioritize a funding category over others because of the timeframe associated with a particular funding source. For instance, priority may be given to certain projects that can reasonably be expected to finish prior to the deadline for that specific fund over other projects of equal relevance or cost-effectiveness, but with longer expected completion times. Again, the flexibility of this option works in concert with the dynamic nature of the incentive programs, projects, expenditure deadlines.

E.4.4 Upcoming Regulatory Deadlines

To ensure that incentive programs obtain the maximum SIP-creditable emissions reductions, the District performs a thorough analysis of all local, state, and federal regulations relating to the target categories. In addition, the District works proactively with the regulating agencies during the rule development process to understand the potential impacts of that rule on incentive projects and to ensure that opportunities for early incentive funding are maximized. These analyses determine which types of projects can be funded, for how long projects can be funded, which also impacts the potential cost-effectiveness of certain projects.

E.4.5 Health Benefits

In addition to emissions reductions needed to attain air quality standards, the District also seeks incentive projects that provide direct health benefits to Valley residents. For instance, the District's Lower-Emission School Bus Program is focused primarily on the localized toxic risk involved in children's exposure to diesel particulates. While not the largest source of regional particulate pollution, replacing or retrofitting aging school buses has an enormous impact on the toxic risk of school transportation.

E.4.6 Environmental Justice

The District places a strong emphasis in providing funding in a manner that benefits environmental justice communities. The District has worked cooperatively with the Environmental Justice Advisory Group to understand the Valley's environmental justice issues and to craft programs that reduce emissions in these areas.

E.4.7 Community Involvement and Benefits

The District develops and administers programs with an emphasis on community involvement. Some examples of these are the Clean-Green-Yard-Machine program,

Drive Clean! Rebate program, Burn Cleaner program, Transit Pass Subsidy program, and the Polluting-Automobile Scrap and Salvage program.

E.5 STATUTORY CONSTRAINTS ON INCENTIVE FUNDING

As previously mentioned, the District derives its current incentive funding comes from a range of local, state, and federal funding sources. These funding sources contain restrictions on the types of projects that may be funded, funding limitations, expenditure deadlines, and the administrative approach for funding distribution. These requirements vary significantly from one funding source to another, resulting in a complex matrix of funding categories and program requirements. Some key examples are summarized in Table E-2.

Table E-2 Statutory Constrains on Incentive Funding

Funding Source/ Category	Program Requirements
Proposition 1B Goods Movement	Funding must be dedicated to heavy duty trucks and locomotives. Program procedures require use of a Request-for-Proposals (RFP) process and priority be given to the most cost-effective projects.
Lower-Emission School Bus	Funding must be allocated to school bus replacements or retrofits. Retrofits are prioritized by oldest to newest buses.
Carl Moyer	Funding is primarily used on heavy-duty diesel equipment projects. Program has strict funding and cost-effectiveness requirements.
DMV Funds	Funding is used primarily for on-road and off-road mobile sources. Portions of funds must follow Carl Moyer and Lower-Emission School Bus guidelines.
Advanced Emission Reduction Option Funds	The District's Governing Board has discretion as to where to apply these funds through the District's annual budget process.
Indirect Source Review (ISR) Funds	Funding preference is given to emissions reductions opportunities near development projects.

E.6 DISTRICT INCENTIVE PROGRAMS

The District's incentive programs continue to be a model for other agencies throughout the state. Recent audits noted the District's efficient and effective use of incentive grant funds in reducing air pollution. The District has collaborated extensively with the U.S. Environmental Protection Agency (EPA), California Air Resources Board (ARB) and the United States Department of Agriculture – Natural Resources Conservation Service (USDA-NRCS) to develop the mechanism to take credit in state implementation plans (SIP) for emission reductions generated through incentive programs that satisfy the four federal criteria for SIP creditability – surplus, quantifiable, enforceable and permanent.

Historically, states and local air agencies have not been able to obtain SIP credit for incentive-based emissions reductions. When given SIP credit, incentive-based emissions reductions can be used alongside regulatory-based emissions reductions to meet federal CAA requirements, such as demonstrating attainment with federal air

quality standards at a future date or demonstrating that emissions reductions meet federal SIP reasonable further progress requirements. Given the heavy investment from the public and private sectors in replacing equipment under these voluntary incentives, establishing a general framework to receive SIP credit for these emissions reductions was critical for ensuring the continued success of these programs. Working together with EPA, ARB, and the USDA-NRCS, the District adopted Rule 9610 (State Implementation Credit for Emission Reductions Generated Through Incentive Programs) on June 20, 2013. District Rule 9610 establishes the administrative mechanism through which the District and ARB take SIP credit for emissions reduced through incentives. EPA proposed a limited approval of Rule 9610 in May 2014[4] and finalized that approval on April 9, 2015.[5]

E.6.1 2015-2016 Incentive Spending Priorities

The current incentive priorities are reflected in the 2015-2016 District Budget Incentive Spending Plan and are summarized in Table E-3.

Table E-3 District Incentive Priorities (2015-2016 Budget)

Community Incentives
Drive Clean Rebate (alternative-fueled passenger vehicles)
Polluting Automobile Scrape and Salvage (Tune In Tune Up, EFMP)
Burn Cleaner (residential wood burning)
Clean Green Yard Machines (residential lawn and garden)
REMOVE (transit subsidies, bike paths, etc.)
Vanpool Voucher Incentive Program
Charge Up (electric vehicle charging infrastructure)
Goods Movement
Proposition 1B Heavy Duty Trucks
Locomotives
Heavy Duty Equipment Programs
Agricultural Equipment Replacement
Agricultural Irrigation Pumps
Truck Voucher Program
Construction Equipment Replacement
Refuse Fleet Replacement
Advanced Transportation/Vehicles
Public Benefit Grants
EV Readiness Implementation
School Bus Replacement and Retrofit
School Bus Replacement and Retrofit
Statewide School Bus Replacement and Retrofit

[4] Revision to the California State Implementation Plan; San Joaquin Valley Unified Air Pollution Control District; Quantification of Emission Reductions from Incentives. 79 Fed. Reg. 96 pp. 25650-28658. (2014, May 19) (to be codified at 40 CFR Part 52). http://www.gpo.gov/fdsys/pkg/FR-2014-05-19/pdf/2014-11481.pdf

[5] Revision to the California State Implementation Plan; San Joaquin Valley Unified Air Pollution Control District; Quantification of Emission Reductions from Incentives. 80 Fed. Reg. 68 pp. 19020-19033. (2015, April 9) (to be codified at 40 CFR Part 52). http://www.gpo.gov/fdsys/pkg/FR-2015-04-09/pdf/2015-07972.pdf

Regional Assistance
Greenhouse Gas Mitigation Assistance
Technology Advancement
Technology Advancement Program
Zero-Emission Commercial Lawn and Garden

E.6.2 Heavy Duty Trucks

The District has administered numerous incentive programs targeted at on-road heavy-duty trucks, one of the biggest sources of NOx emissions in the Valley. Through the state's Proposition 1B Goods Movement Emission Reduction Program, Carl Moyer Voucher Incentive Program (VIP), and the District's-Truck Voucher Program (TVP) funded by grants from EPA and locally generated incentive funds, the District has replaced hundreds of older, high-polluting trucks with cleaner trucks certified to meet the latest EPA emission standards.

The District's Truck Voucher Program (TVP) was designed to provide an alternative source of incentive funding for heavy-duty truck operators that were unable to obtain funding through the proposition 1B program. The District contracts with Valley dealerships and makes the review and approval process efficient and streamlined to provide vouchers to truck owners. The District provides up to 35% of the cost of a new truck that meets or exceeds the 2010 emission standard for heavy-duty trucks. The District has funded the replacement of over 800 heavy-duty trucks, with more applications coming in every day. The program is very popular with Valley based heavy-duty truck dealers because the program operates very efficiently.

A typical TVP project can take as little as two weeks to complete, which is from the time the application is received by the District to the time the applicant is driving the new truck off of the lot. The program can operate at this pace because the contracted dealers that partner with the District reduce the voucher amount from the overall cost of the truck, which lowers the applicants' loan amount for the truck. After the truck is purchased the District validates the voucher with the dealer and mails a check to the dealer for the voucher amount.

The District's truck voucher programs have been designed to provide an alternative source of incentive funding for small businesses that do not qualify for funding under the Proposition 1B Program. The District contracts with Valley dealerships and makes the review and approval process efficient and streamlined to provide vouchers to truck operators.

E.6.3 Agricultural Pumping Engines

The District provides up to 85% funding for farmers looking to replace older, dirtier diesel engines with low-emission Tier 4 engines or zero-emission electric motors. Agriculture accounts for a majority of the local economy, and this program not only provides for significant emissions reductions from agricultural operations, but provides economic relief to Valley farmers, ranchers, and dairy operators. Eligible projects are funded with local, state, and federal sources, including but not limited to District Indirect

Source Review (ISR) mitigation fees, Carl Moyer Program funding, AB 923 funding, Federal Designated Funding, and Federal Diesel Air Shed Grant funding. In the past, collaboration with the California Public Utilities Commission (PUC) and local utilities has allowed for additional incentives on electric line extensions and special rate schedules, enhancing participation in the District's replacement program.

Over the past fifteen years, the District has funded the replacement of over 6,900 agricultural pump engines, with more projects currently in the queue. Over 2,500 of these replacements involved replacing older diesel engines with electric motors. The District has seen an increased demand for emissions-compliant diesel-engine repowers to electric motors in recent years. This option is ideal for both parties, since the District achieves the maximum emissions reductions with electric motor repowers and farmers lower their operating costs by switching to electricity, a more affordable fuel source. The District will consider pursuing a renewed public/private collaborative partnership similar to the previously mentioned partnership to provide further incentives for replacing remaining agricultural internal combustion engines with electric motors, potentially including assistance for line extensions for remotely located wells.

For a typical irrigation pump project, the District will verify that the old engine is operational and eligible. If so, the engine owner is offered the incentive and has the new engine or motor installed, making sure that the old engine is sufficiently disabled. The District conducts a post-inspection prior to payment to document the new engine or motor's specifications and to ensure the emissions reductions are accurate. Ongoing monitoring and reporting ensures the projects meet contracted emissions reductions targets.

E.6.4 Agricultural Equipment

Off-road agricultural equipment replacements and repowers play a crucial role in reducing emissions. These equipment units, including tractors, backhoes, wheel loaders, and other off-road farming vehicles are widely used in the Valley, and are essentially uncontrolled and unregulated. Eligible projects are funded with local, state, and federal sources, including but not limited to ISR, Carl Moyer funding, AB923 funding, Federal Designated funding, and Federal Diesel Air-Shed Grant.

The District has funded the repower and replacement of over 4,000 off-road agricultural vehicles, with a significant number of additional projects currently in the queue. Whether a farmer wishes to repower the current equipment with a cleaner engine or replace the equipment altogether, this program allows the District to achieve surplus emissions reductions while also facilitating the early equipment retirement and fleet turnover, both of which result in more efficient farming operations with less overall hours of operation.

In both repower and replacement projects, the farmer enters into an agreement with the District to replace the old, dirty engine or vehicle with newer, cleaner technology. The District first performs a pre-inspection to determine that the equipment and engine are operational. Then a final inspection is performed to verify the new equipment, as well

as witness the old equipment and engine's destruction at a District-approved recycling or scrapping facility, ensuring the old equipment and engine will never be put back into service. Ongoing monitoring and reporting ensure the expected emissions reductions and operation of the equipment meet the grant agreement requirements.

E.6.5 Locomotives

The emissions from goods movement are a significant source of diesel particulate matter (PM) in the Valley and the state, and many of the larger cities in the Valley are home to locomotive rail yards. Locomotives, in particular, present a considerable health risk from diesel PM emissions. Residential areas located close to rail yards have shown a significant increase in cancer risk and can equal or exceed the regional background or regional health risk levels.[6] The locomotive component of the Heavy-Duty Engine Program awards up to 85% grant funding for newer, cleaner diesel locomotive engines and locomotive replacements. Eligible projects are funded with local, state, and federal sources, including but not limited to the Carl Moyer Program, the Federal Diesel Air Shed Grant, and DERA funding.

The District has funded the repower or replacement of 41 locomotives, with more projects currently in the queue. One of the major benefits to the locomotive repower and replacement program is increased efficiency and longevity as a result of the revolutionary GenSet engine technology. The GenSet system uses multiple smaller off-road tier-4 emission level engines mounted on a single chassis. This system allows for each of the engines to be fired up individually so that in low-power demand situations only one of the engines can be used, helping to reduce unnecessary emissions. In addition, this system comes equipped with idle reduction technology that will shut down the engine during periods of inactivity.

The District funds locomotive repower or replacement projects through an RFP procurement process, and reviews and selects recipients based on established scoring criteria. During the pre-inspections, all necessary locomotive engine information is verified by District inspectors and documented in digital photographs. Upon verification of all information, the District enters into an agreement with the recipient for the project. Once the replacement switcher locomotive engine has been purchased and the original engine has been dismantled, the recipient will complete and return the claim-for-payment packet, and a post-inspection is performed, prior to payment, to verify the new information. Monitoring and reporting continue for the duration of the agreement to ensure the emissions reductions expected from the project occur.

E.6.6 Forklifts

The replacement and retrofit of forklifts are funded through the District's Large Spark-Ignited (LSI) forklift retrofit program and its Electric Forklift New-Purchase program. Operators can meet the proposed in-use fleet-average emission standards by purchasing low- and zero-emission equipment and by retrofitting uncontrolled

[6] ARB. Railyard Health Risk Assessment and Mitigation Measures. Conducted at the Stockton Railyard. (2009) Retrieved on 8/18/2015 from http://www.arb.ca.gov/railyard/hra/hra.htm.

equipment in their fleets. The use of new controlled engines and the retrofit of existing engines can reduce fuel use and improve engine life, thus creating cost savings that offset a portion of the additional equipment cost. Eligible projects are funded with federal, state, and local sources, including Carl Moyer Program funds and motor vehicle surcharge fees.

The District has funded 53 forklift projects. The installation of a LSI retrofit system improves engine operation and reduces fuel use. Closed-loop fuel systems generally improve the engine's overall efficiency. There is an estimated 10% to 20% reduction in fuel consumption with engines using closed-loop systems. An electric forklift has an obvious advantage as an emission-free vehicle, but can typically cost $1,500 to $5,000 more than a comparable LSI forklift. However, since an electric forklift has a longer useful life and reduced fuel and maintenance costs, the electric forklift can reduce life-cycle costs compared to a LSI forklift.

The forklift program is an over-the-counter program, in that applications are continually accepted on a first-come-first-served basis. Contrary to many of the off-road or agricultural components in the Heavy-Duty Engine Program, a pre-inspection is not required for the new electric forklift component (LSI retrofits are pre-inspected to ensure emissions are real and quantifiable). After contracts are awarded and the new equipment is purchased and installed, post-inspections are performed to ensure emissions reductions are accurately recorded and ongoing monitoring and reporting are required to ensure the emissions reductions occur.

E.6.7 School Bus Replacement and Retrofit

School bus replacements and retrofits play a vital role in reducing school children's exposure to both cancer-causing and smog-forming pollution. The School Bus Replacement and Retrofit programs provide grant funding for new, safer school buses and air pollution control equipment (retrofit devices) on buses that are already on the road. Public school districts in California that own their buses are eligible to receive funding. Eligible projects are funded with local, state, and federal funds including the Lower-Emission School Bus Program (Proposition 1B), DERA funding, and the American Reinvestment and Recovery Act (ARRA).

The District has provided funding to retrofit 2,254 school buses and replace 503 school buses. New buses purchased to replace older buses may be fueled with diesel or an alternative fuel, such as compressed natural gas (CNG), provided that the required emissions standards specified in the current guidelines for the Lower-Emission School Bus Program are met. Funds are also available for replacing on-board CNG tanks on older school buses and for updating deteriorating natural gas fueling infrastructure. Commercially available hybrid-electric school buses may be eligible for partial funding.

Eligible school buses are selected based on specific program requirements, including replacing the oldest models first. After determining eligibility, school districts are awarded contracts that provide a reasonable time period for project completion. A claim-for-payment form must also be submitted before funds can be awarded.

E.6.8 Alternative Fuel Infrastructure

At the District's 2015 Study Session in May 2015 the District discussed a multi-faceted action plan for promoting the deployment for near-zero emission natural gas (NG) vehicles and infrastructure in the Valley. One component of this action plan includes providing additional incentives for NG vehicles and infrastructure.

Providing incentives is an important component of promoting the use of natural gas vehicles due to the current lack of NG infrastructure and higher incremental costs for NG vehicles. The incremental cost of a NG truck can be as much as $60,000 more than a comparable diesel model. However, since the cost and maintenance of NG is less than diesel, there will eventually be a return on investment for the truck owner. Unfortunately, large fleets tend to turn their trucks over every 4-5 years, and the cost differential between NG and diesel is currently much lower than in the past based on lower diesel fuel costs. Truck owners therefore have little time to realize the cost benefits of NG vehicles. New incentives to reduce the incremental cost associated with NG vehicles would help overcome this market barrier and begin to create a larger market for NG vehicles in the Valley. As more NG vehicles are deployed, a secondary used truck market would also be created in the Valley that would further assist in increasing the overall deployment of NG vehicles. The District is taking incentive-based actions as summarized below.

E.6.8.1 Continue to fund new NG infrastructure through District's Public Benefit Grants Program

The District administers the Public Benefit Grants Program which was developed to bring direct benefits to Valley residents through local emission reduction projects implemented by local government agencies and public education institutions. Under the Alternative Fuel Infrastructure component of this program, public agencies can receive funding for the installation of new NG fueling infrastructure or expansion of existing infrastructure to support their vehicle deployment goals. One recent example of expanded fueling infrastructure under this program includes the construction a new public-access liquid NG fueling station in partnership with the City of Lathrop. Under the New Alternative Fuel Vehicle Purchase component, public agencies can receive funding for the purchase of new NG vehicles with a GVWR of 14,000 pounds or less. Public agencies purchase NG passenger vehicles to add to their existing fleets and supplant the duties of gasoline-powered vehicles.

E.6.8.2 Provide higher incentives for NG truck technologies that meet near-zero optional emissions standards

Under the District's Truck Voucher Program, the District currently provides up to 35% of the cost of a new 2010-certified truck, not to exceed $50,000. The District is exploring providing higher incentive levels for NG vehicles that meet the recently adopted near-zero optional emissions standards.

E.6.8.3 Provide new incentives for fleet expansions with new NG trucks

Truck funding is essentially limited to replacement projects where an older vehicle is scrapped and a new vehicle is purchased. The District supports NG vehicle fleet expansion in which incentives are provided for new vehicle purchases without the requirement to scrap an existing vehicle. As with the above, higher incentive levels would be explored and provided for NG truck technologies certified to the near zero option emissions standards.

E.6.8.4 Seek State AB 118 and Cap and Trade funding for the deployment of NG vehicles and installation of NG infrastructure

A portion of Cap and Trade revenues should be allocated to provide funding for the replacement of existing trucks with NG trucks and the installation of new fueling infrastructure that result in reductions of both criteria pollutants and GHG emissions. This is being pursued through both administrative and legislative means.

E.7 COMMUNITY BASED INCENTIVES

While all of the District's incentive programs are open to residents of the Valley, there are a number of programs, such as the Heavy-Duty Engine Program and the Proposition 1B Program, that are specifically designed for Valley businesses. These programs focus on replacing or retrofitting large diesel-powered equipment such as trucks, tractors, and agricultural irrigation pump engines. These programs are highly efficient and extremely cost-effective. Of equal importance, the District currently operates several incentive programs designed for the general public. These programs give the general public the opportunity to contribute to the goal of cleaner air for all Valley residents. The District's community incentives include a wide range of project types and source categories.

E.7.1 Burn Cleaner Program

The Burn Cleaner Program helps Valley residents upgrade their current high-polluting wood-burning devices and open hearth fireplaces to cleaner alternatives such as natural gas fired devices, and EPA certified wood and pellet stoves. Through this program residents are reducing directly emitted PM2.5 emissions in areas and times where those reductions are most needed. In 2014 the District updated the Burn Cleaner Program to make it more accessible and to increase the incentive amounts with great success. Through this program, the District offers a financial incentive to Valley residents with an increased incentive amount available to low-income qualified applicants through a streamlined voucher program that involves partnering with interested retailers. The program has upgraded over 9,730 wood-burning devices, and continues to receive a steady stream of applicants.

E.7.2 Polluting Automobile Scrap and Salvage (PASS)

Through the PASS program the District provides financial incentives to repair or replace eligible high emitting vehicles operating within the Valley. Weekend Tune In Tune Up (TITU) events are held throughout the Valley to provide emissions tests of vehicles to determine the likelihood of failing a smog test. Vehicles failing this test are provided vouchers that are redeemed at participating qualified smog shops for up to $650 in smog related repairs plus the cost of necessary smog checks and diagnostic time. In addition, opportunities exist through the weekend events to qualify for vehicle replacement incentive funding for 1995 vehicles whose owners meet program eligibility requirements including vehicle model year and household income. To date the PASS program has replaced 600 high emitting vehicles with new, cleaner vehicles, retired 504 additional vehicles, and repaired 15,249 vehicles. The PASS program has primarily been supported with locally generated incentive funds; however, a portion of the funding for vehicle repairs was funded through the Reformulated Gasoline Settlement Fund created as a result of an antitrust class action. In addition, funding for a portion of the vehicle replacement projects was provided by ARB through the Enhanced Fleet Modernization Program (EFMP) as well as the EFMP Plus Up program.

E.7.3 Clean Green Yard Machine

The Clean-Green-Yard-Machine (CGYM) program reduces emissions at the neighborhood level by providing incentives for residents to retire their old high-polluting gas mowers in favor of nonpolluting, electric mowers. The program has used locally generated incentive funds as well as funding from the State's AQIP. The CGYM program has successfully replaced over 4,090 gas lawn mowers with clean electric models.

E.7.4 Drive Clean! Rebate Program

This grant program encourages Valley residents to drive advanced clean vehicles, including electric and other alternative-fueled vehicles. Since the launch of the Drive Clean! Rebate Program in March 2012, the District has issued 2,493 rebates, totaling more than $6.8 million in grant funding.

E.7.5 Public Benefit Grants Program

The Public Benefit Grants Program is one of the District's newest incentive programs and provides funding to Valley cities, counties, and other public agencies for a wide variety of clean-air, public-benefit projects. Eligible applicants are cities, counties, special districts (e.g. water districts and irrigation districts), and public educational institutions (e.g. school districts, community colleges, and state universities) located within the Valley.

Currently, there are three components under the program:

- New Alternative Fuel Vehicle Purchase: $15.4 million has been awarded for the purchase of clean alternative fuel vehicles such as zero-emission motorcycles, and plug-in electric vehicles
- Enhanced Transportation Strategies: $3.7 million has been awarded to support local projects that incorporate advanced transit and transportation strategies that reduce emissions such as large-scale bicycle networks and bus rapid transit
- Alternative Fuel Infrastructure: $5 million has been awarded to support the installation of new NG fueling infrastructure or expansion of existing in-use stations to further the use of NG vehicles

E.7.6 REduce MOtor Vehicle Emissions (REMOVE)

The REMOVE program provides incentives for specific projects that will reduce the Valley's motor vehicle emissions, including e-mobility (video-telecommunications), bicycle infrastructure, alternative fuel vehicle mechanics training, and public transportation subsidies. The District has funded over 60 projects for over $3.4 million. Types of projects that have been funded include the construction of new Class I and II bikeways, subsidizing transit passes for new riders, and the installation of new electronic operating systems to allow the general public to pay bills and apply for permits and licenses online in lieu of driving to an office. The program allocates funds to cost-effective projects that have the greatest motor vehicle emissions reductions resulting in long-term impacts on air pollution problems in the Valley. All projects must have a direct air quality benefit in the Valley.

E.7.7 Vanpool Voucher Incentive Program

The Valley is an expansive region and many of its residents make long commutes for work on a daily basis. To offset some of these miles traveled, the Vanpool Voucher Incentive program provides incentives to Valley residents to participate in vanpools in lieu of using single occupant vehicle commutes to work. The program encourages commuter rideshare practices among frequent long distance riders (greater than 20 miles) in the Valley. The District has issued a total of 114,374 vouchers to Valley commuters for $4.3 million.

E.7.8 Charge Up! Program

To supplement the Drive Clean! Rebate Program, the District recently launched the Charge Up! Program which provides funding for the purchase and installation of publically accessible electric vehicle (EV) chargers. EV charging infrastructure is severely lacking in the Valley in comparison to other regions of the state, making it difficult for the technology to grow and sustain in the Valley as residents are hesitant to purchase EVs without the ability to easily refuel. The program aims to address these concerns of existing EV owners and promote the use of EVs with potentially new consumers. Since the launch of the program in June 2015, the District has awarded more than $1.4 million in incentives for the siting and installation of 140 level 2 and level 3 electric vehicle chargers.

Appendix F

Technology Advancement

2016 PLAN FOR THE 2008 8-HOUR OZONE STANDARD

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Appendix F: Technology Advancement

Despite major reductions in emissions and corresponding improvements in air quality, the San Joaquin Valley continues to face difficult challenges in meeting the federal ambient air quality standards. Achieving attainment of EPA's increasingly stringent ambient air quality standards will require the development and implementation of transformative zero/near-zero emissions technology over the coming decades.

On March 18, 2010, the District Governing Board approved the Technology Advancement Program, a strategic and comprehensive program to identify, solicit, and support technology advancement opportunities. The program's primary goal has been to advance technology and accelerate the deployment of innovative clean air technologies that can bring about emission reductions as rapidly as practicable. To date the District has undergone four rounds of Request for Proposals (RFPs) resulting in the successful demonstration of numerous innovative technologies.

The Technology Advancement Program (TAP) represents a significant step forward in the District's efforts to attain ever-tightening federal air quality standards and fulfill our public health mission. The Technology Advancement Program's primary goal is to advance technology and accelerate the deployment of innovative clean air technologies that can bring about emission reductions as rapidly as practicable. To address the Valley's needs with respect to both ozone and PM2.5, which are largely driven by NOx emissions, the Technology Advancement Program has placed a particular focus on NOx emissions reduction technologies. The Technology Advancement Program is implemented through a coordinated and collaborative process that engages technology developers and potential end-users through:

- Grant funding for technology advancement projects in the San Joaquin Valley through competitive processes
- Integration of technology advancement goals into existing grant programs
- Comprehensive outreach to identify potential technology and demonstration partners
- Ongoing review and feedback on new technologies
- Building partnerships with other agencies
- Building local capacity for research and development in the San Joaquin Valley

To date, the District has completed four Technology Advancement Program competitive funding RFPs, receiving over 130 proposals for clean technology demonstration projects through these RFPs. In total, the District has approved 34 of the proposed projects for total funding of over $11 million, with successful demonstrations of zero emissions yard trucks, electric composting, ultra-low NOx biogas engines, and other technologies.

F.1 TECHNOLOGY FOCUS AREAS

The District has structured the Technology Advancement Program to encourage participation within three focus areas. These focus areas represent the current needs of the Valley; they also reflect the types of proposals previously received by the District within this and other programs. Throughout implementation of this *2016 Plan for the 2008 8-Hour Ozone Standard (2016 Ozone Plan)* and future air quality plans, the District will continue to evaluate and, if necessary, update these technology focus areas to address the Valley's air quality challenges.

F.1.1 Renewable Energy

Renewable energy projects focus on overcoming the barriers that prevent the use or adoption of zero-emission renewable energy sources or reduce emissions from renewable energy systems to make them cleaner than comparable non-renewable alternatives.

F.1.2 Waste Solutions

Zero and near-zero emission technologies that minimize or eliminate emissions from waste management systems and processes, including waste-to-fuel systems, such as dairy digesters and other bio-fuel applications.

F.1.3 Mobile Sources

Zero and near-zero emission technologies with emphasis on goods and people movement, off-road equipment, and agricultural equipment.

F.2 DISTRICT ACTION TO PROMOTE THE USE OF NATURAL GAS TECHNOLOGY FOR GOODS MOVEMENT

Heavy-duty trucks are the largest source of NOx emissions in the Valley, and attaining the health-based ozone and particulate standards will require significant additional reductions in truck emissions through the development and implementation of advanced truck technology. Additionally, reducing emissions from heavy-duty trucks will provide significant health benefits for communities in the Valley and throughout the state, particularly those communities located near major freight corridors.

Much of the state's investment in recent technology development and demonstration efforts has focused on electrification. Although there have been significant advances in battery and fuel cell electric vehicle technologies, pursuing the advancement and deployment of clean natural gas heavy-duty vehicles and other more readily available and suitable near-zero emission technologies will help the Valley address our significant air quality challenges in a faster manner than solely relying on electrification technology due to current range limitations. Near-zero natural gas truck technology is already available commercially for limited applications and has the potential to reduce emissions. With additional advances in technology in the near term, near-zero

emissions natural gas truck technology could be expanded to more applications, serving as a vital component of the strategy to bring transformational change to the goods movement sector.

To address this gap, the District adopted its *Action Plan for Promoting the Use of Natural Gas Technology for Goods Movement in the San Joaquin Valley* (Action Plan)[1]. The Action Plan is a multifaceted plan for promoting the deployment of near-zero emissions natural gas vehicles and infrastructure in the San Joaquin Valley. The elements of the Action Plan are:

1. Support policy changes and legislation that help create a market for development, promotion, and deployment of near-zero emissions natural gas technology.

2. Increase outreach efforts to communicate benefits and encourage transition to natural gas technology by Valley fleet operators.

3. Provide additional incentives for natural gas vehicles and infrastructure.

4. Promote technology advancement for near-zero emissions natural gas technologies through the District's Technology Advancement Program.

5. Continue to evaluate and support, as appropriate, the development and deployment of hydrogen fuel cell technology in the heavy-duty truck sector.

F.3 FUTURE DEMONSTRATION PROJECTS

In 2016, the District expects to open its fifth competitive solicitation for proposals, with three million allocated towards this solicitation. In addition to directly funding demonstration projects, the District actively seeks opportunities to collaborate with technology innovators in seeking additional funding. As an example of this effort, the District is working with technology vendors and suitable end-users to form collaborative project proposals for active, and soon to be opened, funding opportunities from Cap-and-Trade Auction Proceeds[2]. The District is taking an active role to ensure the Valley receives its fair share of funds from this source.

Moving forward, District staff will continue to search for opportunities to support projects that build the air quality technology research and demonstration capacity of colleges and universities in the Valley. This emphasis will improve the ability of local institutions to engage in future clean-technology projects that are specifically suited to the Valley's needs. To accomplish this, staff has adapted the Technology Advancement Program

[1] San Joaquin Valley Air Pollution Control District. (2015, May 6). *Item Number 5: Review and Approve Action Plan for Promoting the Use of Natural Gas Technology for Goods Movement in the San Joaquin Valley.* http://www.valleyair.org/Board_meetings/GB/agenda_minutes/Agenda/2015/May/StudySession/final/05.pdf

[2] California Air Resources Board. (2015, July 28). *Cap-and-Trade Auction Proceeds.* Retrieved on August 19, 2015 from http://www.arb.ca.gov/cc/capandtrade/auctionproceeds/auctionproceeds.htm

scoring criteria so that projects that incorporate local colleges and universities will score additional points in the selection process, and has had ongoing outreach to local institutions to improve their understandings of the program's needs.

F.4 INTERAGENCY COLLABORATIVE EFFORTS

In addition to projects selected through the request-for-proposals process, the District has partnered with other air quality agencies in the state to demonstrate new and emerging technologies.

F.4.1 Restaurant Charbroiler Technology Partnership

Emission Control Device Manufacturers, Restaurants, and South Coast Air Quality Management District (South Coast)

Existing Rule 4692 achieves significant emissions reductions from chain-driven charbroilers. A variety of technologies for capturing emissions from under-fired charbroilers have been developed or improved in recent years. Under-fired charbroiler technologies are still un-tested in real-life applications and need further evaluation and demonstration at Valley restaurants before these technologies can be considered for amendments to Rule 4692. Technological feasibility issues and logistical issues such as the need to modify hoods and exhaust systems and reinforce roof supports in addition to the purchase, installation, maintenance, and labor costs must all be evaluated.

During the summer of 2015 the Governing Board approved $750,000 to fund the Restaurant Charbroiler Technology Partnership (RCTP) program which provides funding for restaurants to install particulate control systems for under-fired charbroilers as demonstration projects to assess their feasibility and effectiveness. This information will assist in evaluating potential amendments to Rule 4692. The first demonstration unit funded under the RCTP program started operation in September 2015. Several additional projects are expected to be funded in the near future.

F.4.2 Zero-Emission Commercial Lawn and Garden Equipment Demonstration

California Air Resources Board (ARB)

The Cordless Zero-Emission Commercial Lawn and Garden Equipment Demonstration Program, with funding support from ARB, provided eligible cordless zero-emission commercial lawn and garden equipment to commercial landscape professionals (participants) who conduct business within the Valley. The cordless zero-emission lawn and garden equipment was required to be designated commercial-grade and used by commercial landscape professionals to complete multiple small to large gardening tasks over an eight-hour workday period. Eligible equipment included, but was not limited to, lawn mowers, edgers, trimmers/brush cutters, hedge clippers, blowers/vacuums, sweepers, and chainsaws.

The District opened a Request for Applications on August 20, 2012. Participating equipment manufacturers/vendors (technology demonstrators) were responsible for providing the equipment; training to participants on the safe and efficient operation of the equipment and maintenance; and providing materials necessary for daily operation. The participants were to use the equipment in real-world settings to verify equipment durability and performance, battery capacity, and battery charge time. In addition, the participants were responsible for providing monthly data and feedback to the District and technology demonstrators and may have the opportunity to keep the equipment upon submittal of all required data and information for the program. The Cordless Zero-Emission Commercial Lawn and Garden Equipment Demonstration Program successfully ended in June 2013 with a total of 4 technology demonstrators, 60 participants and 445 pieces of equipment for in-use testing. The program demonstrated the performance and durability of electric equipment in non-residential applications to accelerate market acceptance and build upon the progress already made in the residential sector.

F.4.3 Natural Gas-Fired, Fan-Type Central Furnaces with Reduced NO_X Emissions

South Coast Air Quality Management District

South Coast conducted a demonstration project focused on prototype natural gas-fired fan-type central furnaces with reduced NO_X emissions. South Coast released a program opportunity notice for this demonstration project in February 2010, which solicited a number of proposals from furnace manufacturers and gas industry technology developers in partnership with furnace manufacturers. This technology assessment of reduced NO_X central furnaces was initiated with the November 2009 amendment of South Coast Rule 1111 (NOx Emissions from Natural Gas-fired, Fan type Central Furnaces). The District co-funded this technology assessment with the SCAQMD and Southern California Gas Company (SoCal Gas). The District provided $50,000, SCAQMD provided $1 million, and SoCal Gas provided $450,000 in funding. The technology assessment project was completed in the first quarter of 2014.

The goal of this technology assessment was to demonstrate reduced NO_X furnaces capable of meeting an emissions goal of 14 nanograms NO_X per joule of useful heat. Based on the results of the furnace demonstration project, the technology required to meet new NOx standards would be available by 2015. As a result of the study findings, the District amended Rule 4905 in January 2015 and incorporated more stringent NOx emissions limits for units subject to the rule and expanded applicability to include units installed on commercial buildings and on manufactured homes.

F.4.4 Vision for Clean Air: A Framework for Air Quality and Climate Planning

South Coast Air Quality Management District and California Air Resources Board

While the District's air quality challenges are significant, many aspects of those challenges are not unique, and they are not isolated to the boundaries of the Valley air basin. Strategies for reducing emissions in the Valley are enhanced through

partnerships and collaborations with other air districts and state agencies. The District seeks out opportunities for such collaborations to build strong relationships and even stronger attainment strategies.

In 2011, ARB, with the assistance of the District and South Coast AQMD, developed the *Vision for Clean Air: A Framework for Air Quality and Climate Planning*. The goal of this collaboration was to draft a common vision for mobile and stationary source strategies that integrate the need to meet federal air quality standards for PM2.5 and ozone, the need to reach California's greenhouse gas goals, and the need to reduce public exposure to toxics (e.g. diesel particulates). This collaborative effort took advantage of the efficiencies inherent in dealing with these three issues as inter-dependent problems with inter-dependent solutions.

Through the *Vision for Clean Air* effort, the three agencies have been evaluating pollutant reductions needed to meet overlapping air quality requirements for 2019, 2023, 2035, and 2050. These reductions depend on the integration of transformative measures and emerging technologies (including zero- and near-zero emission goods movement) with long-range planning and control strategies. Critical to the attainment of targets will be the evaluation of the potential policies, legislation, infrastructure, and efficiencies that will ensure that South Coast, the Valley, and California are prepared to meet the long-term goals.

Appendix G

Education and Public Outreach

2016 PLAN FOR THE 2008 8-HOUR OZONE STANDARD

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Appendix G: Public Education and Participation

The San Joaquin Valley Air Pollution Control District's (District) mission to protect public health by improving air quality in the San Joaquin Valley (Valley) relies on the public's awareness and understanding of the District's air-quality improvement programs. The Valley cannot meet these public health goals on the back of businesses alone. Valley businesses are subject to some of the most stringent air quality air quality regulations in the nation. As Valley businesses continue to be subject to additional rounds of prohibitory regulations, the role of the public becomes increasingly important in reaching federal standards.

Emissions from public behavior such as driving, residential wood burning and lawn-care maintenance continue to be a key factor in the Valley's emissions inventory. Consequently, public acceptance of concepts such as alternative commute options, as well as specific clean-air strategies, such as Check Before You Burn, the Air Alert program and Healthy Air Living (HAL), requires widespread lifestyle changes. To that end, the District Governing Board has placed a high priority on conducting an active and effective public education and outreach program.

The District's comprehensive public education and outreach program is composed of numerous elements that are designed to allow the District to leverage opportunities to advance the District's multiple strategic objectives, such as:

- Encourage and enlist the general public to do their part to reduce air pollution
- Empower and inform the public to protect themselves during episodes of poor air quality by providing them timely air quality information as well as scientific and comprehendible information on the health effects of air pollution
- Provide accurate and objective information about: Valley efforts to reduce air pollution; measurable results and achievements; and challenges that remain.

G.1 PUBLIC EDUCATION AND OUTREACH ACTIVITIES

Engaging the public in efforts to reduce emissions is a key element of the District's attainment strategy. Education increases public support for new and controversial regulations. The District's education and information program has expanded and evolved over the years. The following is a partial list of the District's Public Education and Outreach Activities:

- Executing successful outreach campaigns for District grant programs
    - Promoting and conducting eight years of Clean Green Yard Machines (CGYM) lawn mower-exchange programs
    - Promoting the Burn Cleaner Woodstove Change-out program
    - Developing and implementing the Tune In, Tune Up vehicle emissions check program

    - Developing Proposition 1B "Calling All Truckers" radio, print and billboard campaign
        - Working with Operation Clean Air (OCA), Coalition for Clean Air, and members of the goods movement Industry
        - Supporting the Drive Clean! vehicle program
- Developing seasonal, strong "Make One Change" messages in four languages(English, Spanish, Hmong & Punjabi) across the three distinct media markets of the Valley (Sacramento, Fresno, Bakersfield)
- Launching the Air Alert program
- Developing strong media relationship with reporters throughout the Valley and conducting hundreds of English and Spanish media interviews annually
- Regular meetings with Valley newspaper editorial boards and placement of op-eds in local papers
- Launching the amended Check Before You Burn residential wood-burning curtailment program
- Coordinating targeted outreach to foothill and mountain communities to solicit their participation and understanding in reducing particulate matter
- Producing the District's yearly "Annual Report to the Community"
- Developing the Real-time Air Advisory Network (RAAN) and the accompanying smart phone app
- Launching the Healthy Air Living Schools program, including developing branded program materials
    - Enrolling more than 1,000 schools in the program to follow RAAN
    - Engaging hundreds of Valley schools in the "Turn the Key Be Idle Free" no-idling campaign
    - Guiding schools to use the Real-Time Outdoor Activity Risk (ROAR) guidelines that provide health recommendations for outdoor exercise based on the duration of student's exposure, the intensity of their exercise and the air quality conditions
- Developing the Web-based Archived Air Quality (WAAQ) system to give the public historical air quality information
- Revising the "Blue Sky, Brown Sky … It's Up to You!" curriculum for elementary school teachers and students
- Improving the District's widely used 1-800-SMOG Info line that provides callers daily air quality forecasts and burn status information by county
- Developing the Healthy Air Living (HAL) Kids program to engage kids in air quality issues through partnerships with Valley PBS stations
- Launching HAL and creating understanding with the public through a variety of different outreach strategies and materials, including:
    - HAL logo development
    - Quick screen displays for events and District lobbies
    - HAL Website
    - HAL Partners program
- Assisting with public workshops

- Producing eTRIP handbook, correspondence letters and marketing class to engage businesses and help them understand and follow District Rule 9410 (Employer Based Trip Reduction)
- Creating and administering the annual HAL Kids Calendar featuring youth artwork
- Developing materials and crafting outreach targeted to the District's environmental justice areas
- Advertising through Cinemedia and movie lobby posters program during peak movie-going seasons (summer, holidays)
- Targeted District health video played in medical offices throughout the Valley
- Creating "Don't Burn Trash" messaging and placed in strategic areas in response to public needs and observations of the District's Compliance Department
- Valley Air District Air Quality Reports: Free media - branded daily air quality reports – Spanish- and English-language radio & TV
- Developing campaign targeting real estate brokers to ensure they are in compliance with the wood stove change-out program upon each home sale, included direct mail, internet ads, Eblasts, flyers and radio sponsorship on real estate shows
- Leveraging partnerships with bike coalition groups, asthma coalitions and local COGS to promote "Earth Day," "Bike to Work" and "Rideshare" weeks
- Developing "New Media" strategy for the District, which leverages the power of social media sites such as Facebook, Twitter and YouTube
- Utilizing video more aggressively to communicate key website information in a more exciting way and to provide District-focused footage to media outlets
- Producing outreach pieces on a wide variety of District programs including grants, asbestos, compliance, permitting, etc.
- Redeveloping the District's valleyair.org homepage to make it easier to navigate, including:
    - Major overhaul of the grants section to better serve potential applicants
    - Creation of a widget or digital tool to allow schools to place RAAN monitoring information directly on their homepage
- Conducting a series of successful symposiums, conferences, town hall meetings and community meetings
    - The 2015 Transboundary Ozone Conference
    - The 2012 PM and Lawn care Symposium
    - Multiple general air quality conferences
- Conducting hundreds of presentations throughout the Valley on air quality topics, and responding to tens of thousands of public calls and emails

G.2 PUBLIC EDUCATION AND OUTREACH PROGRAMS

Air Pollution levels can vary greatly during the day. While the District issues a daily air quality forecast for each county in the air basin, localized air quality often deviates from these generalized, county-wide, daily forecasts. Numerous pollutants and meteorological parameters are measured throughout the Valley on a daily basis using

an extensive air monitoring network managed by the District and ARB. The network measures pollutant concentrations necessary to show progress toward compliance with the national ambient air quality standards. The network also provides real-time air quality measurements used for daily air quality forecasts, residential wood-burning declarations, Air Alerts, and RAAN.

G.2.1 Air Alerts

The District developed the Air Alerts notification system to address potential exceedances of the 1-hour ozone standard. The Air Alert program is credited with being the critical component in the District's attainment of the 1-hour ozone health standard. Routinely implemented in August and September during back to school time, Air Alerts notify the public when conditions are conducive to the formation of elevated ozone levels, giving people ample advance notice to put emission-reducing practices into place. Notification is provided through the District's website, direct faxes, social media, and emails using targeted recipient lists, Valley media advisories, and press releases. Besides being an effective tool to communicate ozone trends, the Air Alerts notification system is also a way to educate Valley residents and businesses about the economic penalty for exceeding the standard.

G.2.2 Real – Time Air Advisory Network (RAAN)

The District launched the Real-time Air Advisory Network (RAAN) in 2010. This program is the first communication network in the nation to provide automated notification of poor or changing local air quality to the public throughout the air basin. While the District initially developed the program for schools as a tool to determine appropriate levels of outdoor activity for their students, the District expanded the program in 2011, and it is now available to all Valley residents.

The District combines local air quality information with specific, concentration-based health recommendations that allow RAAN subscribers to make informed decisions about when and for whom outdoor activities should be limited. The knowledge that exercise magnifies the health risks of PM2.5 exposure motivated the District to develop the RAAN program. Heavy breathing, as during exercise, allows air pollutants, especially the smallest particles (those less than 0.1 microns (PM0.1), also referred to as ultrafine particles), to more easily penetrate the alveolar region of the lungs. Particles that make it to this region are absorbed directly into the body's bloodstream. A 2003 study[1] found that during moderate exercise, 80% of inhaled PM0.1 were deposited in the lungs, compared to 60% lung retention while a person is at rest. However, because the volume of air exchanged per minute increased substantially during exercise, overall PM0.1 deposition increases by as much as 450%.

Anyone can subscribe to RAAN at no charge through the District's website (www.valleyair.org); all that is required is the subscriber's email address. Once

[1] Daigle, C.C., Chalupa, D.C., Gibb, F.R., Morrow, P.E., Oberdörster, G., Utell, M.J., and Frampton, M.W. (2003). Ultrafine Particle Deposition in Humans During Rest and Exercise. *Inhalation Toxicology*, 15, 539–552. DOI:10.1080/08958370390205065

subscribed, the District will send email notifications with a link to the real-time data of the closest monitoring station within the District's extensive monitoring network. The District sends automated notifications on an hourly basis when air quality deteriorates or improves.

G.2.3 Real-time Outdoor Activity Risk (ROAR)

To support the expanded RAAN program, the District developed the Real-time Outdoor Activity Risk (ROAR) scale. The levels of this scale provide specific recommendations and limitations for increasing levels of activity, from recess through competitive athletic events. This scale is based on the Air Quality Index system that is used for the daily air quality forecasts, but provides more detailed activity recommendations based on the latest health science. The ROAR system, when used in conjunction with RAAN notices and daily air quality forecasts, is part of a comprehensive set of tools available to schools and the public for effective health protection.

G.2.4 Web – Based Archived Air Quality (WAAQ) System

Providing accurate and up to date air quality information to Valley residents is a top priority for the District. This is especially important since there are times when the Valley's unique geography, topography, and meteorology overwhelm all clean air measures and lead to high pollution concentrations that may be unhealthy for Valley residents. High pollution concentrations also occur when exceptional events such as wildfires are experienced. Under these circumstances, the best course of action is to provide notifications to Valley residents so that sensitive individuals, in particular, can take precautions to minimize exposure.

Following-up on the success of the RAAN program, the District developed a system that provides air quality conditions on a neighborhood by neighborhood (4km x 4km) scale as opposed to being limited to only the readings from monitors. The District unveiled a state-of-the-art web tool for exploring historical air quality information at the neighborhood level. WAAQS allows anyone to compare air quality information over the past two decades in any Valley neighborhood. The District has now implemented WAAQS and it is available to the public on the District web at: http://www.valleyair.org/waaqs/

G.2.5 Check Before You Burn

The Check Before You Burn outreach program is critical to the implementation of District Rule 4901 (Wood Burning Fireplaces and Wood Burning Heaters). Rule 4901, along with the Check Before You Burn program, is credited with reducing levels of PM2.5 emissions during the winter season to historically low levels. The rule and outreach program was amended in 2008 and again in 2014 to reflect more stringent federal health-based standards, and together they have achieved the highest level of public recognition and compliance of any District program, with 80% of Valley residents

professing awareness based on a 2014 public survey.[2] According to the same survey, 59 percent of the respondents (Valley-wide) with wood-burning devices never use their devices. These statistics are a testament to heightened public awareness resulting from the District's multilingual, multimedia, targeted public outreach campaigns.

Annual Check Before You Burn outreach campaigns feature District Governing Board members in outdoor, radio, and video media speaking to the public about how to get involved in clean air activities. The District also uses extensive social media posts (Facebook and Twitter) to reach even more segments of the Valley's population. In addition, the District's toll-free information line and website receives thousands of "hits" during the wood-burning season, specifically to access wood-burning forecast information.

G.2.6 Healthy Air Living (HAL)

Most of the District's outreach activities and programs are covered by the HAL umbrella. As a year-round message, the HAL goal of "make one change" promotes and encourages Valley residents and businesses to implement voluntary measures to reduce emissions and improve air quality. Many of the emission-reduction recommendations address PM2.5 emissions, either directly emitted or as byproducts of other pollutants (e.g. reducing the number of miles traveled in a car reduces NOx and, therefore, particulates).

Components of the HAL message include: *Blue Sky, Brown Sky; It's Up To You,* kids activity kits aimed at elementary school students and their parents; the *Healthy Air Living Kids Calendar* for kindergarteners through high-school students; and *Healthy Air Living Schools program* which provides tools for educators to protect their students' health from the harmful effects of air pollution. In addition to these specific programs and others, the HAL logo and message are incorporated into the District's communications, collateral, incentive materials, and outreach efforts.

G.2.7 Healthy Air Living Partners

Through the HAL Partners program, adopted in 2009, the District provides participating businesses and entities with tools and educational materials to promote voluntary actions by employers and their employees to reduce emissions or shift emission-producing activities to non-peak periods. Despite significant effort by the District, to date only 203 partners have enrolled in the program. In response to this lack of enrollment, the District took an item to the District's Governing Board during the May 2015 Study Session to explore other avenues for increasing participation in the program, including: increasing the value of the program to businesses, and enlisting private-sector agencies, such as local chambers of commerce, to recruit partners.

[2] San Joaquin Valley Air Pollution Control District: Memorandum to SJVUAPCD Governing Board, District's Public Opinion Survey Relating to Residential Wood Burning and Other Habits of Valley Residents. Fresno, CA: Public Governing Board Meeting, March 20, 2014. Available at http://www.valleyair.org/Board_meetings/GB/agenda_minutes/Agenda/2014/march/final/09.pdf

G.2.7.1 Current HAL Partners Program

The program focuses on the importance of factoring in air quality when making everyday business and personal decisions. The District offers the following to HAL Partners:

- A webpage with tools and support for HAL Partners
- An email list serve to send out HAL Partner information and monthly Valley Air News E-blasts
- District staff conducts HAL trainings in person or via the internet upon request
- Facebook and Twitter HAL updates
- Materials and templates for employers to conduct outreach to their employees such as, but not limited to:
    - Registration form
    - HAL logos
    - Newsletters/Email blasts
    - Letters of support
    - Resolutions of commitment
    - Alternative Transportation Resource Book
    - Telecommuting Resource Book
    - Outreach posters
    - Small prizes and incentives
- District staff attends HAL Partner events (such as lunches, meetings, fairs) upon request
- District staff to answer questions and provide tools and support as needed and requested by HAL Partners

In exchange, every year HAL Partners are asked to commit to the following:

- Submit a HAL Partner annual registration form (available online)
- Have the Executive Director, President or similar top level employee (or Council/ Board), sign a HAL Resolution. The resolution can be generated internally or the organization can use the sample version created by the District
- Designate a HAL Coordinator or Team that will be responsible for facilitating the partnership
- Have the HAL Coordinator or Team watch the brief, introductory training video available on the HAL website
- Have the HAL Coordinator or Team watch the brief supplementary videos that will periodically be available on the HAL website
- Have the HAL Coordinator or Team follow the Valley Air District on facebook and twitter
- Sign up to receive HAL listserv emails
- Host one HAL event (such as a lunch, meeting, fair) for employees
- Distribute the semi-annual HAL newsletter twice during the year (winter and summer). This newsletter can be generated internally or the organization can use the sample versions created by the District

- Share the District's "Valley Air News" with all employees
- Distribute to employees District-generated brochures on a variety of topics including, but not limited to:
    - Healthy Air Living
    - Check Before You Burn
    - Clean-Air Yard Care
- Allow the District to post the organization logo and web address link on the HAL website as a Partner organization
- If possible, post the HAL logo and link on the organization's website
- Distribute a letter or email, under the signature of the CEO, encouraging employees to get involved in the HAL Program
- Distribute important air-quality information as requested during episodes of poor air quality
- Post a HAL Partner Certification in a visible location at the workplace

Current methods of outreach to recruit Valley businesses and municipalities include:

- Each year, the District conducts thousands of inspections, and at each inspection, District staff spends time with the facility representative to encourage potential enrollment
- All permit applications include a check-box allowing businesses to request information to become a HAL Partner
- Face-to-face meetings with management at all Valley cities and counties
- Distribution of HAL Partner program information and recruitment messaging at various public meetings and events
- Enlisted and funded the Stockton Chamber of Commerce to promote HAL Partnership as a part of their San Joaquin Green Team effort over the past three years
- Enlisted and funded Kern Green, a non-profit organization in Bakersfield, in 2012 to recruit HAL Partners
- Developed a HAL website to profile and promote HAL Partners, which allows Partners to create online marketing profiles to share with the public
- In 2009, under District Rule 9410 (Employer Based Trip Reduction), businesses were given credit toward compliance with the rule mandate in lieu of more costly compliance options provided under the rule

G.2.7.2 New Ideas to Increase Participation

Given the tremendous challenges the Valley faces in meeting the ever-tightening federal air quality standards, the District's hope when instituting this program was that thousands of businesses would sign up to be HAL Partners. The District believes that the failure to attract more entities to join the program can be attributed to the following:

- The bulk of the outreach effort to recruit potential partners has been done by District staff during compliance inspections and other interactions. Utilizing

representatives from other non-government entities to reach out to potential partners may bring a greater level of trust and buy-in
- When outside entities have been used in the past, partner recruitment has not been the primary focus but rather an add-on to other efforts
- Incentives for becoming a HAL Partner may not be sufficient
- Obligations imposed on HAL Partners may be excessive

The following changes were recommended to address the above challenges and enhance participation:

- Recruit non-governmental organizations such as chambers of commerce and non-profit organizations throughout the Valley to serve as ambassadors in recruiting HAL Partners
- Consider the following additional incentives:
    - Priority access to grant programs (when permissible by law)
    - Expedited permit processing for certain permitting actions
    - Community recognition
    - Reduced cost for attending District events and conferences
    - Waiver or discount on penalty fees
    - Provide District support letters and advice in obtaining air quality or energy-efficiency grants from other agencies
- Authorize the Executive Director/APCO to review obligations imposed on HAL Partners and eliminate unnecessary burden

G.2.7.3 Decision of the Governing Board

At the 2015 Study Session the Governing Board heard District suggestions for improving HAL Partner participations and discussed the potential options. Upon discussion by the Board there was a consensus that the commitments required for participation were perhaps too burdensome for many businesses. The Board directed staff to review the commitments and find ways to streamline them to encourage more active participation. In addition, the Board directed staff to convene separate focus groups representing industrial and municipal entities to garner feedback and suggestions regarding current barriers and potential incentives for increasing participation in the HAL Partner program.

G.3 PUBLIC PARTICIPATION

Non-regulatory strategies help accelerate attainment and have been an important part of the District's air quality attainment plans. The following strategies are supported by the District as alternative methods for the public to implement to reduce emissions in the Valley.

G.3.1 Green Purchasing and Contracting

Valley businesses and government agencies can get involved in air quality improvements by considering the environmental impacts when making purchasing and contracting decisions. Green purchasing and contracting is the selection of goods, services, and vehicles that have a reduced impact on human health and the environment when compared with other products that serve the same purpose. These efforts can reduce waste, energy consumption and the overall impact of day to day operations. When making purchasing decisions, preference should be given to environmentally responsible products, materials and supplies; fuel-efficient, low-emission and hybrid vehicles; energy-efficient and water-efficient appliances; and service providers who employ greener methods.

The District has created the *Green Purchasing and Contracting: A guide to reducing environmental impacts through the procurement process* guideline and made it available on the District webpage.[3] The District has also set an example for other agencies by adopting and implementing its own Green Procurement & Sustainable Practices Policy in January 2012. The District will continue to support Valley organizations in adopting policies and practices to make green purchasing and contracting a routine part of their operations.

G.3.2 Energy Efficiency and Conservation

California has been on the forefront of developing renewable energy sources and has implemented regulations to ensure cleaner non-renewable energy. The District's involvement in energy efficiency and renewable energy is guided by its Regional Energy Efficiency Strategy (REES), adopted in January 2010.[4] This policy identifies the District's commitment to fostering energy efficiency and clean energy alternatives as opportunities for emissions reductions. The District continues to work with stakeholders and state agencies to expand net metering and feed-in tariffs for use of solar and other renewable energy sources, promote energy efficiency programs for energy end users that will result in lower emissions and a more stable electrical distribution system, and develop measures that incentivize and encourage low-emission technologies for use of waste gas as an alternative to waste-gas venting or flaring.

Roadmap for Incorporating Energy Efficiency and Renewable Energy Policies and Programs into State Implementation Plans

On July 3, 2012, EPA released the first version of The Roadmap for incorporating Energy Efficiency/ Renewable Energy Policies and Programs into State and Tribal Implementation Plans which is part of EPA's effort to encourage state, tribal, and local

[3] SJVAPCD. *Green Purchasing and Contracting: A guide to reducing environmental impacts through the procurement process.* Available at http://www.valleyair.org/Programs/FastTrack/2011/GreenPurchasingReport4-6-11%20_2_.pdf.
[4] San Joaquin Valley Air Pollution Control District. (2010). *Approval of the District's Regional Energy Efficiency Strategy*. Memorandum to the SJVAPCD Governing Board. Public Hearing, January 21, 2010. http://www.valleyair.org/Board_meetings/GB/agenda_minutes/Agenda/2010/January/Agenda_Item_7_Jan_21_2010.pdf

agencies to consider incorporating energy efficiency and renewable energy policies and programs in their state and Tribal Implementation Plans (SIPs/TIPs). The initiative, available at http://www.epa.gov/airquality/eere/, includes a manual, training, tools, and technical assistance.

G.3.3 Eco-Driving

Finding ways, through education and outreach, to reduce emissions from mobile sources in the Valley is critical to attainment of federal air quality standards. One such program in development is Eco-Driving. Eco-Driving refers to everyday techniques that drivers can do to maximize the fuel economy of their vehicles. These include: observing good operating maintenance, such as proper tire pressure, wheel alignment, and oil viscosity; improving aerodynamics; traveling at efficient speeds; choosing the appropriate gear for manual transmissions; driving defensively to avoid unnecessary braking; accelerating at a constant pace; and other simple, yet often forgotten, driving techniques. As with other informational activities conducted by the District, an Eco-Driving program could be encompassed under the Healthy Air Living umbrella.

G.3.4 Alternative Energy Production

The District encourages cleaner ways of generating electricity and mechanical power, and moving vehicles, in addition to overall reductions in energy use. These alternative energy choices include renewable energy, waste-to-energy systems, and alternative fuels and vehicle technologies. The District also encourages the use of alternative energy sources that are clearly cleaner than industry standards in terms of criteria pollutants. The District's *Alternative Energy: On the Fast Track to Clean Air*[5], is a guideline for considering clean energy options in the Valley that discuss, and provide additional resources for, the District's current recommendations regarding the most advantageous and viable alternative energy systems. Alternative energy choices include solar energy, wind turbines, biomass, dairy digesters, and electric irrigation pumps, just to name a few.

G.3.5 Replacement of High-Polluting Devices

The residents of the Valley can reduce emissions through the replacement of high-polluting devices with cleaner technologies. Two examples include the replacement of open hearth fireplaces and higher polluting wood burning devices with natural gas or certified EPA wood burning devices and the replacement of gas powered lawnmowers with electric lawnmowers. The District supports these transitions by providing incentive funding to replace high polluting units with cleaner alternatives. The District also supports the efforts of Valley residents to replace and/or repair motor vehicles through additional incentive programs. Examples of District incentive programs aimed at residents of the Valley include (see Appendix E):

- Burn Cleaner

[5] SJVAPCD. *Alternative Energy: On the Fast Track to Clean Air. A Guide for Considering Clean Energy Options in the San Joaquin Valley.* Available at http://www.valleyair.org/Programs/FastTrack/2011/Alternative%20Energy.pdf

- Clean Green Yard Machine
- Polluting Automobile Scrap and Salvage (PASS)
- Vanpool Voucher
- Drive Clean

Additional details of these programs can be found on the District website at: http://valleyair.org/grants/

G.3.6 Employer-Based Trip Reduction

The goal of District Rule 9410 (Employer-Based Trip Reduction) (eTRIP Rule) is to reduce single-occupancy-vehicle work commutes. The eTRIP Rule requires the Valley's larger employers, representing a wide range of locales and sectors, to select and implement workplace measures that make it easier for their employees to choose ridesharing and alternative transportation. Because of the diversity of employers covered by the eTRIP Rule, the rule was built with a flexible, menu-based approach. Using the eTRIP Plan, employers choose from a list of measures, each contributing to a workplace that encourages employees to reduce their dependence on single-occupancy vehicles. Each eTRIP measure has a point value, and employer eTRIP plans must reach specified point targets for each strategy. The District has continually provided employer assistance through training, guidance materials, promotional information, and online reporting options.

Appendix H

Modeling Attainment Demonstration

2016 PLAN FOR THE 2008 8-HOUR OZONE STANDARD

Appendix H: Modeling Attainment Demonstration

[This Appendix is provided by the California Air Resources Board]

MODELING ATTAINMENT DEMONSTRATION

Photochemical Modeling for the 8-Hour Ozone State Implementation Plan in the San Joaquin Valley

Prepared by

California Air Resources Board
San Joaquin Valley Air Pollution Control District

Prepared for

United States Environmental Protection Agency Region IX

May 2, 2016

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ACRONYMS

ARB – Air Resources Board

BCs – Boundary Conditions

CMAQ Model – Community Multi-scale Air Quality Model

CSJV – Central San Joaquin Valley

DV – Design Value

GEOS -5 – Goddard Earth Observing System Model, Version 5

GMAO – Global Modeling and Assimilation Office

ICs – Initial Conditions

MOZART – Model for Ozone and Related chemical Tracers

MDA8 – Maximum Daily Average 8-hour Ozone

NASA – National Aeronautics and Space Administration

NARR - North American Regional Reanalysis

NCAR – National Center for Atmospheric Research

NOAA - National Oceanic and Atmospheric Administration

NSJV – Northern San Joaquin Valley

NO_x – Oxides of nitrogen

OFP - Ozone Forming Potential

ROG – Reactive Organic Gases

RH – Relative Humidity

RRF – Relative Response Factor

SAPRC – Statewide Air Pollution Research Center

SIP – State Implementation Plan

SJV – San Joaquin Valley

SJVAB – San Joaquin Valley Air Basin (SJVAB)

SJVAPCD – San Joaquin Valley Air Pollution Control District

SSJV – Southern San Joaquin Valley

U.S. EPA – United States Environmental Protection Agency

VOCs – Volatile Organic Compounds

WRF Model – Weather and Research Forecast Model

1. INTRODUCTION

The purpose of this document is to summarize the findings of the model attainment demonstration for the 0.075 ppm (or 75 ppb) 8-hour ozone standard in the San Joaquin Valley nonattainment area (SJV or the Valley), which forms the scientific basis for the SJV 2016 8-hour ozone SIP. The 75 ppb standard was promulgated by the U.S. EPA in 2008 and became effective in 2010. Currently, the Valley is designated as an extreme ozone nonattainment area for this standard and is mandated to demonstrate attainment of the standard by 2031.

Findings from the model attainment demonstration are summarized in terms of three sub-regions: 1) Northern SJV (San Joaquin, Stanislaus and Merced counties), 2) Central SJV (Madera, Fresno and King counties), and 3) Southern SJV (Tulare and Western Kern counties). These three sub-regions are characterized by distinct features in terms of geography, meteorology, and air quality. The general approach utilized in the attainment demonstration is described in Section 2, while the remaining sections discuss the meteorological modeling (Section 3), the emissions inventory (Section 4), and the photochemical modeling and results (Sections 5 and 6). A more detailed description of the modeling and development of the model-ready emissions inventory is presented in the Photochemical Modeling Protocol Appendix.

2. APPROACH

This section describes the Air Resources Board's (ARB's) procedures, based on U.S. EPA guidance (U.S. EPA, 2014[1]), for projecting ozone Design Values (DVs) to the future using model output and a Relative Response Factor (RRF) approach in order to show future year 2031 attainment of the 0.075 ppm 8-hour ozone standard.

2.1. METHODOLOGY

The U.S. EPA modeling guidance (U.S. EPA, 2014[1]) outlines the approach for utilizing models to predict future attainment of the 0.075 ppm 8-hour ozone standard. Consistent with the previous modeling guidance (U.S. EPA, 2007[2]), which was utilized in the 2007 SIP for the 0.08 ppm 8-hour ozone standard and informed the methodology used in the 2013 SIP for the 0.12 ppm 1-hour ozone standard, the current guidance recommends utilizing modeling in a relative sense. A brief summary of how models are

[1] U.S. EPA, 2014, Draft Modeling Guidance for Demonstrating Attainment of Air Quality Goals for Ozone, PM2.5 and Regional Haze, available at https://www.epa.gov/ttn/scram/guidance/guide/Draft_O3-PM-RH_Modeling_Guidance-2014.pdf

[2] U.S. EPA, 2007. Guidance on the Use of Models and Other Analyses for Demonstrating Attainment of Air Quality Goals for Ozone, $PM_{2.5}$, and Regional Haze. EPA-454/B07-002, 2007, available at. https://www.epa.gov/ttn/scram/guidance/guide/final-03-pm-rh-guidance.pdf

applied in the attainment demonstration, as prescribed by U.S. EPA modeling guidance (U.S. EPA, 2014[1]), is provided below. A more detailed description of the methodology in this and subsequent sections is provided in the Photochemical Modeling Protocol Appendix.

2.2. MODELING PERIOD

Based on analysis of the conduciveness of recent years' meteorological conditions leading to elevated ozone, as well as the availability of the most detailed emissions inventory, the year 2012 was selected for both baseline modeling and design value calculation in the model attainment test. These baseline design value mixing ratios serve as the anchor point for estimating future year projected design values.
The extreme nonattainment designation for the SJV requires that attainment of the 2008 8-hour ozone standard be demonstrated by 2031. Therefore, 2031 was the future year modeled in this attainment demonstration.

The revised U.S. EPA modeling guidance requires the model attainment demonstration to utilize the top ten modeled days when projecting design values to the future. Peak ozone mixing ratios for a given year at any monitor within the Valley generally occur between June and September. Therefore, the entire ozone season (May – September) was modeled for 2012 and 2031 to ensure that all of the top ozone days were simulated.

2.3. BASELINE DESIGN VALUES

Specifying the baseline design value is a key consideration in the model attainment test, since this value is projected forward and used to test for future attainment at each site. The starting point for the attainment demonstration is with the observational based design value (DV), which represents the three-year average of the annual 4th highest 8-hour ozone mixing ratio observed at a specific monitor for the year in consideration. For example, a DV for 2012 would represent the average of the 4th highest 8-hour ozone mixing ratio from 2010, 2011, and 2012.

The U.S. EPA recommends using an average of three DVs that straddle the baseline year in order to better account for the year-to-year variability inherent in meteorology. Since 2012 was chosen as the base year for projecting DVs to the future, site-specific DVs were calculated for the three three-year periods ending in 2012, 2013, and 2014 and then these three DVs were averaged. This average DV is called a weighted DV (in

[1] U.S. EPA, 2014, Draft Modeling Guidance for Demonstrating Attainment of Air Quality Goals for Ozone, PM2.5 and Regional Haze, available at https://www.epa.gov/ttn/scram/guidance/guide/Draft_O3-PM-RH_Modeling_Guidance-2014.pdf

the context of this SIP, the weighted DV will also be referred to as the reference year DV or DV_R). Table 1 illustrates the observational data from each year that goes into the average DV is calculated.

Table 1. Illustrates the data from each year that are utilized in the Design Value calculation for a specific year (DV Year), and the yearly weighting of data for the average Design Value calculation (or DV_R).

DV Year	Years Averaged for the Design Value (4th highest observed 8-hr O_3)				
2012	2010	2011	2012		
2013		2011	2012	2013	
2014			2012	2013	2014
Yearly Weightings for the Average Design Value Calculation					
2012-2014 Average	$DV_R = \frac{8hrO3_{2010} + (2)8hrO3_{2011} + (3)8hrO3_{2012} + (2)8hrO3_{2013} + 8hrO3_{2014}}{9}$				

Table 2 lists the design values for the sites within the three major sub regions of the Valley that are used in the model attainment demonstration. Note that the DVs are listed in descending order for sites within each subregion. The Clovis monitoring site (highlighted in yellow), and located in Fresno county within the Central SJV, is the Valley's design site (i.e. site with the highest average DV in the SJV non-attainment area) with an average DV of 95.7 ppb. All remaining sites, excluding the Stockton-Hazelton monitor in the Northern SJV, have average DVs that exceed the 75 ppb standard.

Table 2. Year-specific 8-hr ozone design values for 2012, 2013, and 2014, and the average baseline design value (represented as the average of the three year-specific design values) for the monitoring sites located in the SJV.

County	Monitoring Site	8-hr Ozone Design Value (ppb)			
		2012	2013	2014	2012-2014 Average
Northern SJV					
Stanislaus	***Turlock-S Minaret Street***	***88***	***86***	***84***	***86.0***
Merced	Merced-S Coffee Avenue	83	81	81	81.7
San Joaquin	Tracy-Airport	80	79	79	79.3
Stanislaus	Modesto-14th Street	75	75	78	76.0
San Joaquin	Stockton-Hazelton Street	69	67	69	68.3
Central SJV					
Fresno	***Clovis-N Villa Avenue***	***98***	***94***	***95***	***95.7***
Fresno	Fresno-Drummond Street	95	94	88	92.3
Fresno	Parlier	92	92	92	92.0
Fresno	Fresno-Garland	94	89	89	90.7
Fresno	Fresno-Sierra Skypark #2	92	88	87	89.0
Kings	Hanford-S Irwin Street	90	84	84	86.0
Madera	Madera-28261 Avenue 14	86	84	84	84.7
Madera	Madera-Pump Yard	78	79	81	79.3
Fresno	Tranquility	77	77	75	76.3
Southern SJV					
Tulare	***Sequoia and Kings Canyon Natl Park***	***95***	***93***	***91***	***93.0***
Kern	Arvin-Di Giorgio	91	89	88	89.3
Kern	Edison	93	86	84	87.7
Kern	Bakersfield-5558 California Avenue	89	86	85	86.7
Tulare	Porterville-1839 Newcomb Street	90	88	81	86.3
Kern	Oildale-3311 Manor Street	89	84	81	84.7
Tulare	Sequoia Natl Park-Lower Kaweah	81	85	86	84.0
Kern	Maricopa-Stanislaus Street	87	84	79	83.3
Kern	Shafter-Walker Street	86	82	81	83.0
Tulare	Visalia-N Church Street	87	80	80	82.3

2.4. BASE, REFERENCE, AND FUTURE YEARS

The model attainment demonstration consists of the following three primary model simulations, which all utilized the same model inputs, including meteorology, chemical boundary conditions, and biogenic emissions. The only difference between the simulations was in the year represented by the anthropogenic emissions (2012 or 2031) and certain day-specific emissions.

1. Base Year (or Base Case) Simulation

The base year simulation for 2012 was used to assess model performance and includes as much day-specific detail as possible in the emissions inventory such as hourly adjustments to the motor vehicle and biogenic inventories based on observed local meteorological conditions, known wildfire and agricultural burning events, and exceptional events like the Chevron refinery fire in the Bay Area, which occurred over 6 days from August 19-24, 2012.

2. Reference (or Baseline) Year Simulation

The reference year simulation was identical to the base year simulation, except that certain emissions events which are either random and/or cannot be projected to the future were removed from the emissions inventory. For the 2012 reference year modeling there are two categories/emissions sources that were excluded: 1) wildfires, which are difficult to predict in the future and can influence the model response to anthropogenic emissions reductions in regions with large fires, and 2) the Chevron refinery fire mentioned above.

3. Future Year Simulation

The future year simulation is identical to the reference year simulation, except that projected future year (2031) anthropogenic emission levels were used rather than the 2012 emission levels. All other model inputs (e.g., meteorology, chemical boundary conditions, biogenic emissions, and calendar for day-of-week specifications in the inventory) are the same as those used in the reference year simulation.

To summarize (Table 3), the base year 2012 simulation was used for evaluating model performance, while the reference (or baseline) 2012 and future year 2031 simulations were used to project the average DVs to the future as described in the Photochemical Modeling Protocol Appendix and in subsequent sections of this document.

Table 3. Description of CMAQ model simulations.

Simulation	Anthropogenic Emissions	Biogenic Emissions	Meteorology	Chemical Boundary Conditions
Base year (2012)	2012 w/ wildfires and Chevron refinery fire	2012 MEGAN	2012 WRF	2012 MOZART
Reference year (2012)	2012 w/o wildfires and w/o Chevron refinery fire	2012 MEGAN	2012 WRF	2012 MOZART
Future year (2031)	2031 w/o wildfires and w/o Chevron refinery fire	2012 MEGAN	2012 WRF	2012 MOZART

2.5. RELATIVE RESPONSE FACTORS

As part of the model attainment demonstration, the fractional changes in ozone mixing ratios between the model future year and model reference year were calculated at each of the monitors. These ratios, called "relative response factors" (RRFs), were calculated based on the ratio of future year modeled maximum daily average 8-hour (MDA8) ozone to modeled reference year MDA8 ozone (Equation 1).

$$\mathrm{RRF} = \frac{\text{average MDA8 ozone}_{\text{future}}}{\text{average MDA8 ozone}_{\text{reference}}} \quad (1)$$

The MDA8 values, used in calculating the RRF, were based on the maximum simulated ozone within a 3x3 array of cells with the grid cells containing the monitor located at the center of the array (U.S. EPA, 2014). The future and reference year ozone values used in the RRF calculations were paired in space and time (i.e., using the future year MDA8 ozone for the same modeled day and at the same grid cell where the MDA8 ozone for the reference year is located within the 3x3 array of cells).

The modeled days utilized in the RRF calculation were selected based on the following U.S. EPA recommended criteria (U.S EPA, 2014).

- Begin with days that have simulated baseline MDA8 >= 60 ppb and calculate RRFs based on the top 10 high ozone days.

- If there are fewer than 10 days with MDA8 >= 60 ppb then all days >= 60 ppb are used in the RRF calculation, as long as there are at least 5 days used in the calculation.
- If there are fewer than 5 days >= 60 ppb, an RRF is not calculated at that monitor.
- Restrict the simulated days used in the RRF calculation by only including days with reference MDA8 within +/- 20% of the observed value at the monitor. This ensures that only modeled days which are consistent with the observed ozone levels are used in the RRF calculation.

2.6. FUTURE YEAR DESIGN VALUE CALCULATION

Future year design values for each site were calculated by multiplying the corresponding baseline design value (Table 2) by the site-specific RRF (Equation 2).

$$\mathrm{DV_F} = \mathrm{DV_R} \times \mathrm{RRF} \quad (2)$$

where,

DV_F = the future year design value,
DV_R = the reference year design value (from Table 2), and
RRF = the site specific RRF from Equation 1

Future year design values from the model attainment demonstration are discussed in Section 5.3.

3. METEOROLOGICAL MODELING

California's proximity to the ocean, complex terrain, and diverse climate represent a unique challenge for developing meteorological fields that adequately represent the synoptic and mesoscale features of the regional meteorology. In summertime, the majority of the storm tracks are far away to the north of the state and a semi-permanent Pacific high typically sits off the California coast. Interactions between this eastern Pacific subtropical high pressure system and the thermal low pressure further inland over Central Valley or South Coast lead to conditions conducive to pollution buildup (Fosberg and Schroeder, 1966[1]; Bao et al., 2008[2]).

[1] Fosberg, M.A., Schroeder, M.J., Marine air penetration in Central California, Journal of Applied Meteorology, 5, 573-589, 1966.

[2] Bao, J.W., Michelson, S.A., Persson, P.O.G., Djalalova, I.V., Wilczak, J.M., Observed and WRF-simulated low-level winds in a high-ozone episode during the Central California ozone study, Journal of Applied Meteorology and Climatology, 47, 2372-2394, 2008.

In the past, the ARB has utilized both prognostic and diagnostic meteorological models, as well as hybrid approaches in an effort to develop meteorological fields for use in air quality modeling that most accurately represent the meteorological processes that are important to air quality (e.g., Jackson et al., 2006[1]). In this work, the state-of-the-science Weather and Research Forecasting (WRF) prognostic model (Skamarock et al., 2005[2]) version 3.6 was utilized to develop the meteorological fields used in the subsequent photochemical model simulations.

3.1. WRF MODEL SETUP

The WRF meteorological modeling domain consisted of three nested Lambert projection grids of 36-km (D01), 12-km (D02), and 4-km (D03) uniform horizontal grid spacing (Figure 1). WRF was run simultaneously for the three nested domains with two-way feedback between the parent and the nest grids. The D01 and D02 grids were used to resolve the larger scale synoptic weather systems, while the D03 grid resolved the finer details of the atmospheric conditions and was used to drive the air quality model simulations. All three domains utilized 30 vertical sigma layers (defined in Table 4), with the major physics options for each domain listed in Table 5.

Initial and boundary conditions (IC/BCs) for the WRF modeling were based on the 32-km horizontal resolution North American Regional Reanalysis (NARR) data that are archived at the National Center for Atmospheric Research (NCAR). Boundary conditions to WRF were updated at 6-hour intervals for the 36-km grid (D01). In addition, surface and upper air observations obtained from NCAR were used to further refine the analysis data that were used to generate the IC/BCs. Analysis nudging was employed in the outer 36-km grid (D01) to ensure that the simulated meteorological fields were constrained and did not deviate from the observed meteorology. No nudging was used on the two inner domains to allow model physics to work fully without externally imposed forcing (Rogers et al., 2013[3]).

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[1] Jackson, B.S., Chau, D., Gurer, K., Kaduwela, A.: Comparison of ozone simulations using MM5 and CALMET/MM5 hybrid meteorological fields for the July/August 2000 CCOS episode, *Atmos. Environ.*, 40, 2812-2822, 2006.

[2] Skamarock, W. C., J. B. Klemp, J. Dudhia, D. O. Gill, D. M. Barker, W. Wang, and J. G. Powers, 2005: A description of the Advanced Research WRF Version 2. NCAR Tech Notes-468+STR

[3] Rogers, R.E., Deng, A., Stauffer, D. Gaudet, B.J., Jia, Y., Soong, S.-T., Tanrikulu, S., Application of the Weather Research and Forecasting model for air quality modeling in the San Francisco Bay area, Journal of Applied Meteorology and Climatology, 52, 1953-1973, 2013.

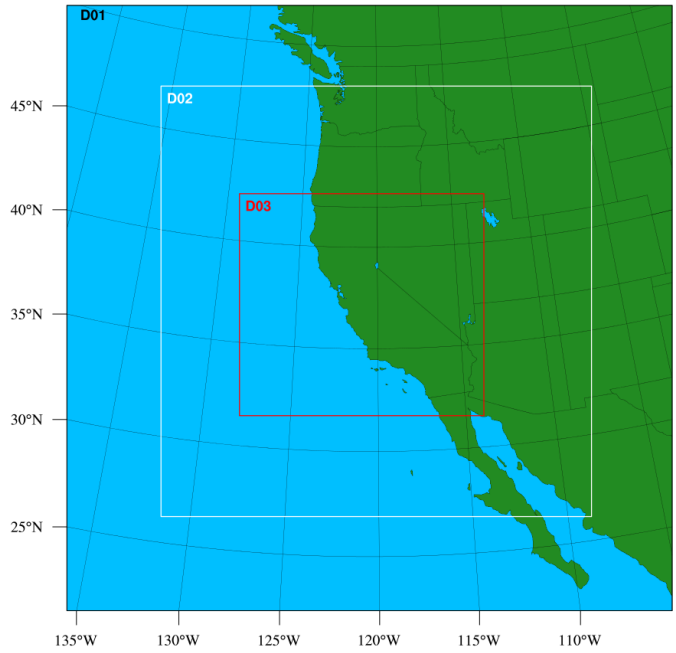


Figure 1. WRF modeling domains (D01 36km; D02 12km; and D03 4km).

Table 4. WRF vertical layer structure.

Layer Number	Height (m)	Layer Thickness (m)	Layer Number	Height (m)	Layer Thickness (m)
30	16082	1192	14	1859	334
29	14890	1134	13	1525	279
28	13756	1081	12	1246	233
27	12675	1032	11	1013	194
26	11643	996	10	819	162
25	10647	970	9	657	135
24	9677	959	8	522	113
23	8719	961	7	409	94
22	7757	978	6	315	79
21	6779	993	5	236	66
20	5786	967	4	170	55
19	4819	815	3	115	46
18	4004	685	2	69	38
17	3319	575	1	31	31
16	2744	482	0	0	0
15	2262	403			

Note: Shaded layers denote the subset of vertical layers used in the CMAQ photochemical model simulations.

Table 5. WRF Physics Options.

Physics Option	Domain		
	D01 (36 km)	D02 (12 km)	D03 (4 km)
Microphysics	WSM 6-class graupel scheme	WSM 6-class graupel scheme	WSM 6-class graupel scheme
Longwave radiation	RRTM	RRTM	RRTM
Shortwave radiation	Dudhia scheme	Dudhia scheme	Dudhia scheme
Surface layer	Revised MM5 Monin-Obukhov	Revised MM5 Monin-Obukhov	Revised MM5 Monin-Obukhov
Land surface	Pleim-Xiu LSM	Pleim-Xiu LSM	Pleim-Xiu LSM
Planetary Boundary Layer	YSU	YSU	YSU
Cumulus Parameterization	Kain-Fritsch scheme	Kain-Fritsch scheme	None

3.2. WRF MODEL RESULTS AND EVALUATION

Simulated surface wind speed, temperature, and relative humidity from the 4 km domain were validated against hourly observations at 55 surface stations in the SJV. Observational data for the surface stations were obtained from the ARB archived meteorological database (http://www.arb.ca.gov/aqmis2/aqmis2.php). Table 6 lists the monitoring stations and which parameters are measured at each station, including wind speed and direction (wind), temperature (T) and relative humidity (RH). The location of each of these sites is shown in Figure 2. Several quantitative performance metrics were used to compare hourly surface observations and modeled estimates: mean bias (MB), mean error (ME) and index of agreement (IOA) based on recommendations from Simon et al. (2012)[1]. A summary of these statistics by performance region is shown in Table 6. The distribution of hourly mean bias and mean error are shown in Figure 3. The spatial distributions of the mean bias and mean error of modeled surface wind, temperature and relatively humidity are shown in Figure 4, while observed vs. modeled scatter plots are shown in Figure 5.

[1] Simon, H., Baker, K. R., and Phillips, S.: Compilation and interpretation of photochemical model performance statistics published between 2006 and 2012, *Atmospheric Environment*, 61, 124-139, 2012.

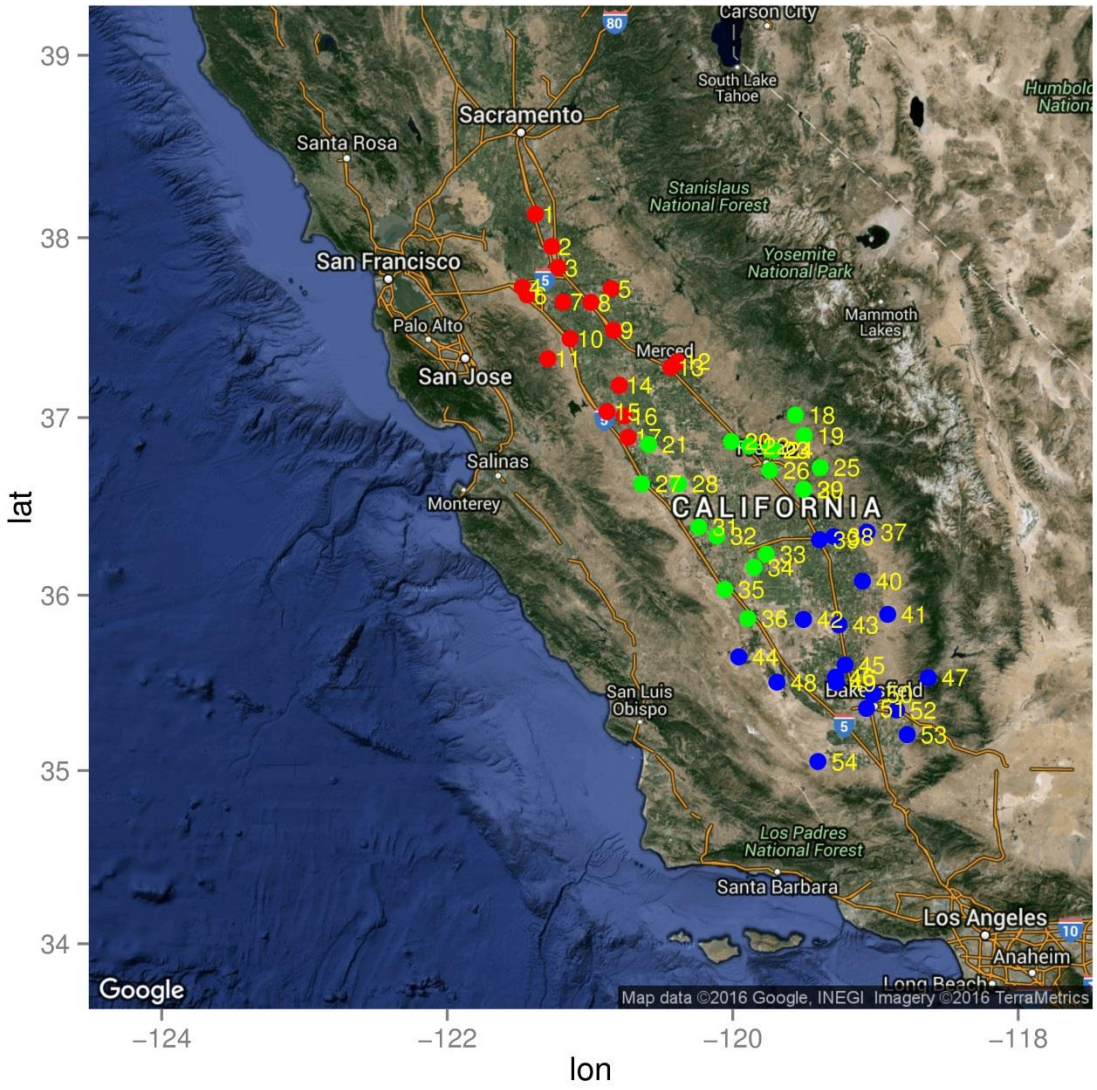


Figure 2. Meteorological monitoring sites in the San Joaquin Valley: red markers represent sites in the Northern SJV; green markers represent sites in the Central SJV, while blue markers represent sites in the Southern SJV. Refer to Table 6 for addition information on sites.

Table 6. Meteorological site location and parameter measured

Site	Site ID	Site Name	Region	Parameter observed
1	5809	Lodi West	NSJV	T, RH
2	2094	Stockton-Hazelton Street	NSJV	Wind, T, RH
3	5736	Manteca	NSJV	T, RH
4	5810	Tracy	NSJV	T, RH
5	5831	Oakdale #2	NSJV	T, RH
6	3696	Tracy-Airport	NSJV	Wind, T
7	5737	Modesto #3	NSJV	T, RH
8	2833	Modesto-14th Street	NSJV	Wind, T
9	2996	Turlock-S Minaret Street	NSJV	Wind, T
10	5805	Patterson #2	NSJV	T, RH
11	3526	Diablo Grande	NSJV	Wind, T, RH
12	5793	Merced	NSJV	T, RH
13	3022	Merced-S Coffee Avenue	NSJV	Wind, T
14	3647	San Luis National Wildlife Refuge	NSJV	Wind, T, RH
15	5752	Kesterson	NSJV	T, RH
16	5730	Los Banos #2	NSJV	T, RH
17	5770	Panoche	NSJV	T, RH
18	3522	Hurley 1	CSJV	T, RH
19	3346	Fancher Creek	CSJV	T, RH
20	3211	Madera-Pump Yard	CSJV	Wind, T, RH
21	5711	Firebaugh - Telles	CSJV	T, RH
22	2844	Fresno-Sierra Skypark #2	CSJV	Wind, T
23	5741	Fresno State #2	CSJV	T, RH
24	3026	Clovis-N Villa Avenue	CSJV	Wind, T, RH
25	5787	Orange Cove	CSJV	T, RH
26	2013	Fresno-Drummond Street	CSJV	Wind, T
27	3309	Panoche Road	CSJV	T, RH
28	5757	Westlands	CSJV	T, RH
29	5723	Parlier #2	CSJV	T, RH
30	2114	Parlier	CSJV	Wind, T, RH
31	5828	Five Points SW	CSJV	T, RH
32	5708	Five Points #2	CSJV	T, RH
33	3712	Santa Rosa Rancheria-17225 Jersey	CSJV	T
34	5715	Stratford #2	CSJV	T, RH
35	3330	Kettleman Hills	CSJV	T, RH
36	5717	Kettleman	CSJV	T, RH
37	5746	Lindcove	SSJV	T, RH
38	2032	Visalia-N Church Street	SSJV	Wind, T
39	3250	Visalia-Airport	SSJV	Wind, T, RH
40	5812	Porterville #3	SSJV	T, RH
41	3350	Fountain Springs	SSJV	Wind, T, RH
42	6813	Alpaugh	SSJV	T, RH
43	5823	Delano #2	SSJV	T, RH
44	5729	Blackwells Corner	SSJV	T, RH
45	5783	Famoso	SSJV	T, RH
46	5709	Shafter - USDA	SSJV	T, RH
47	5879	Democrat #2	SSJV	Wind, T, RH
48	5791	Belridge	SSJV	T, RH
49	2981	Shafter-Walker Street	SSJV	Wind, T, RH
50	2772	Oildale-3311 Manor Street	SSJV	Wind, T
51	3146	Bakersfield-5558 California Avenue	SSJV	Wind, T, RH
52	2312	Edison	SSJV	Wind, T
53	5771	Arvin-Edison	SSJV	T, RH
54	2919	Maricopa-Stanislaus Street	SSJV	Wind, T

Wind Speed biases are positive in each of the three regions, with the smallest bias occurring in Southern SJV (SSJV) (0.49 m/s) and the largest bias occurring in the Central SJV (CSJV) (0.65 m/s). Temperature bias is relatively small in the SSJV and Northern SJV (NSJV), -0.87 ˚K and -0.41 ˚K, respectively, and higher in the NSJV (0.41 ˚K). Temperature generally shows very good agreement between the observations and simulation in all regions with IOA values above 0.90. Relative humidity biases range from -3.87% to 12.99%, with the largest bias occurring in the SSJV. These results are comparable to other recent WRF modeling efforts in California investigating ozone formation in Central California (e.g., Hu et al., 2012[1]) and modeling analysis for the CalNex and CARES field studies (e.g., Fast et al., 2014[2]; Baker et al., 2013[3]; Kelly et al., 2014[4]; Angevine et al., 2012[5]). Detailed hourly time-series of surface temperature, relative humidity, wind speed, and wind direction for each sub-region can be found in the supplementary material.

[1] Hu, J., Howard, C. J., Mitloehner, F., Green, P. G., and Kleeman, M. J.: Mobile Source and Livestock Feed Contributions to Regional Ozone Formation in Central California, *Environmental Science & Technology*, 46, 2781-2789, 2012.

[2]Fast, J. D., Gustafson Jr, W. I., Berg, L. K., Shaw, W. J., Pekour, M., Shrivastava, M., Barnard, J. C., Ferrare, R. A., Hostetler, C. A., Hair, J. A., Erickson, M., Jobson, B. T., Flowers, B., Dubey, M. K., Springston, S., Pierce, R. B., Dolislager, L., Pederson, J., and Zaveri, R. A.: Transport and mixing patterns over Central California during the carbonaceous aerosol and radiative effects study (CARES), *Atmos. Chem. Phys.,* 12, 1759-1783, 2012, doi:10.5194/acp-12-1759-2012.

[3]Baker, K. R., Misenis, C., Obland, M. D., Ferrare, R. A., Scarino, A. J., and Kelly, J. T.: Evaluation of surface and upper air fine scale WRF meteorological modeling of the May and June 2010 CalNex period in California, *Atmos. Environ.*, 80, 299-309, 2013.

[4] Kelly, J. T., Baker, K. R., Nowak, J. B., Murphy, J. G., Milos, Z. M., VandenBoer, T. C., Ellis, R. A., Neuman, J. A., Weber, R. J., Roberts, J. M., Veres, P. R., de Gouw, J. A., Beaver, M. R., Newman, S., and Misenis, C.: Fine-scale simulation of ammonium and nitrate over the South Coast Air Basin and San Joaquin Valley of California during CalNex-2010, *J. Geophysical Research,* 119, 3600-3614, doi:10.1002/2013JD021290.

[5] Angevine, W. M., Eddington, L., Durkee, K., Fairall, C., Bianco, L., Brioude, J.: Meteorological model evaluation for CalNex 2010, *Monthly Weather Review*, 140, 3885-3906, 2012.

Table 7. Hourly surface wind speed, temperature and relative humidity statistics by region for May-September 2012.

Region	Observed Mean	Modeled Mean	Mean Bias	Mean Error	IOA
		Wind Speed (m/s)			
SSJV	1.87	2.36	0.49	0.99	0.64
CSJV	2.06	2.70	0.65	1.06	0.68
NSJV	2.42	3.05	0.64	1.24	0.71
		Temperature (˚K)			
SSJV	298.40	297.53	-0.87	2.91	0.90
CSJV	297.99	297.34	-0.65	2.78	0.91
NSJV	295.57	295.97	0.41	2.41	0.94
		Relative Humidity (%)			
SSJV	41.95	54.95	12.99	17.99	0.63
CSJV	39.63	49.80	10.17	16.85	0.60
NSJV	50.36	46.49	-3.86	12.35	0.79

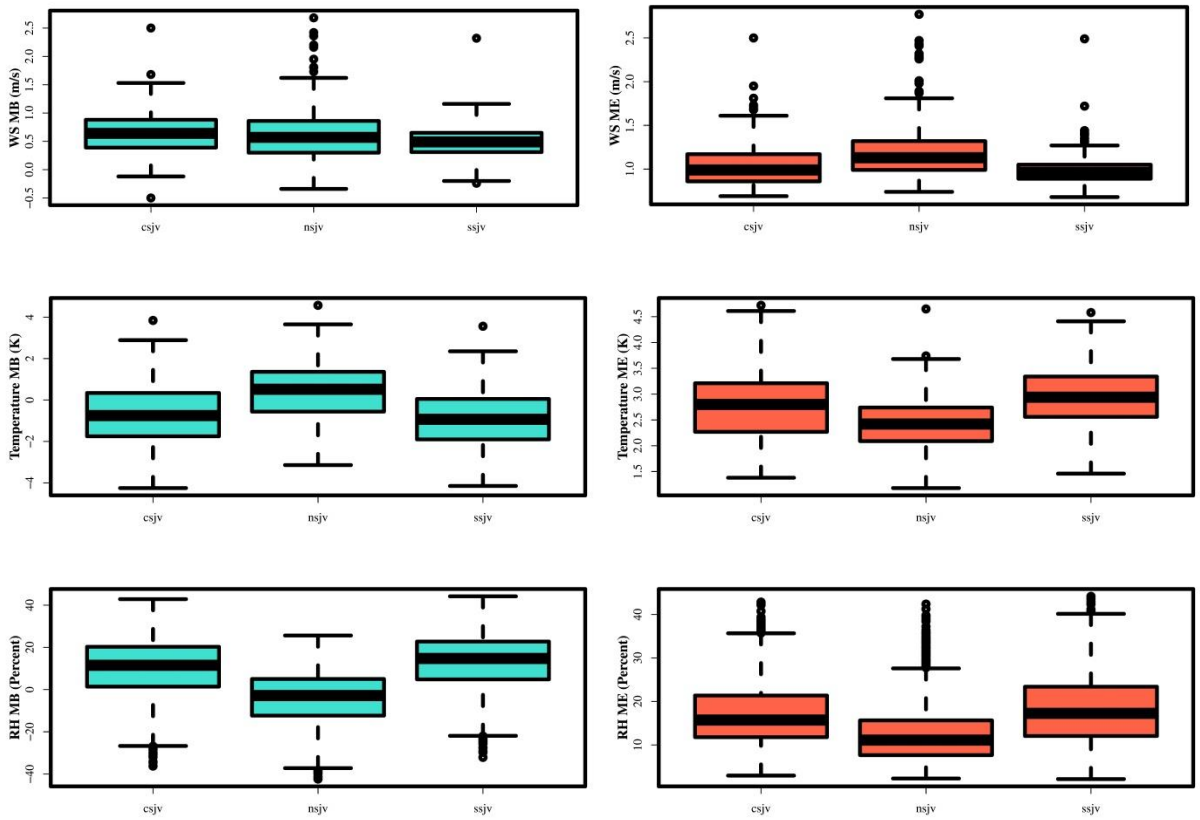


Figure 3. Distribution of hourly mean bias (left) and mean error (right) for May-September 2012. Results are shown for wind speed (top), temperature (middle), and Relative Humidity (bottom).

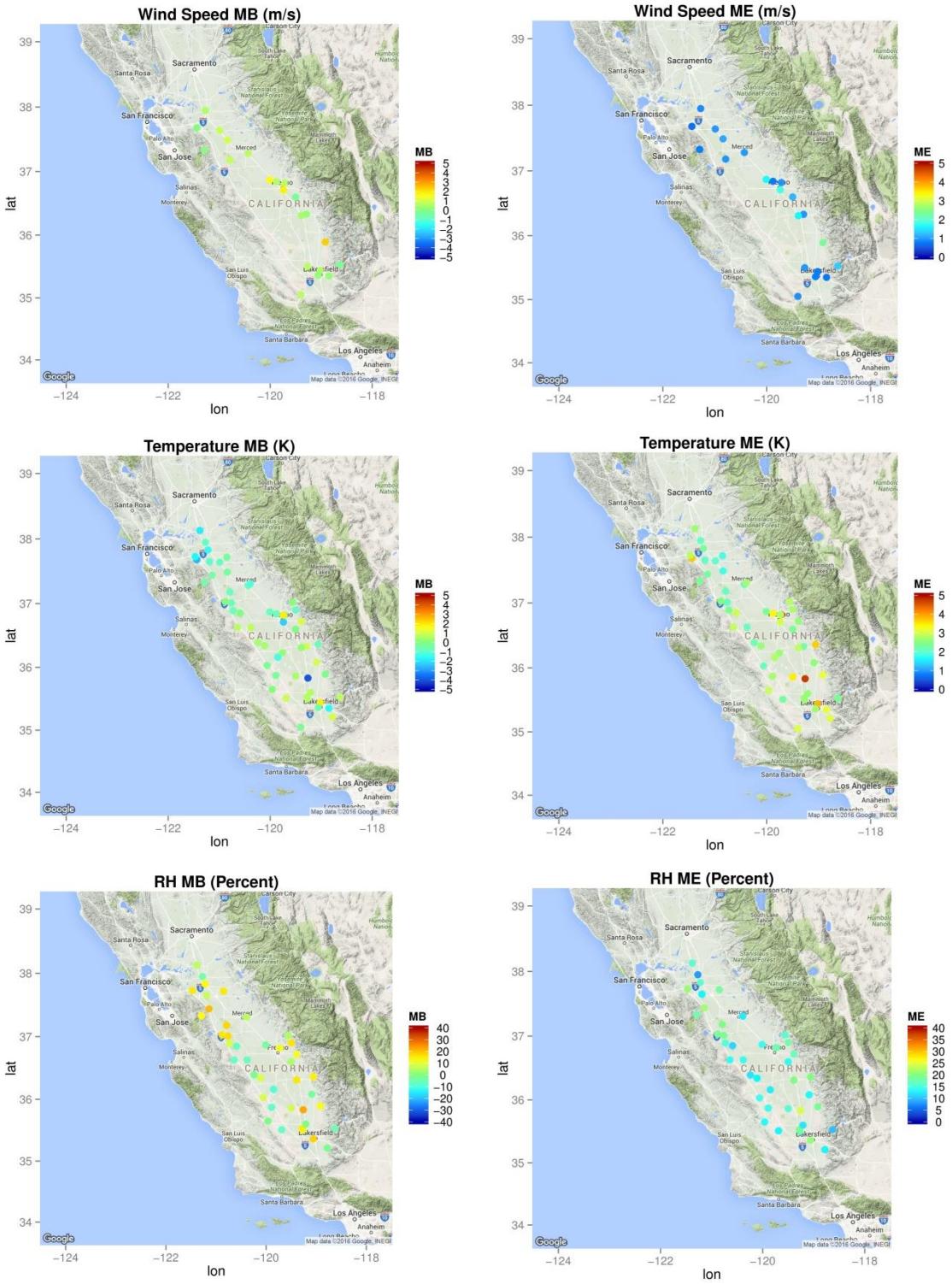


Figure 4. Spatial distribution of mean bias (left) and mean error (right) for May-September 2012. Results are shown for wind speed (top), temperature (middle), and Relative Humidity (bottom).

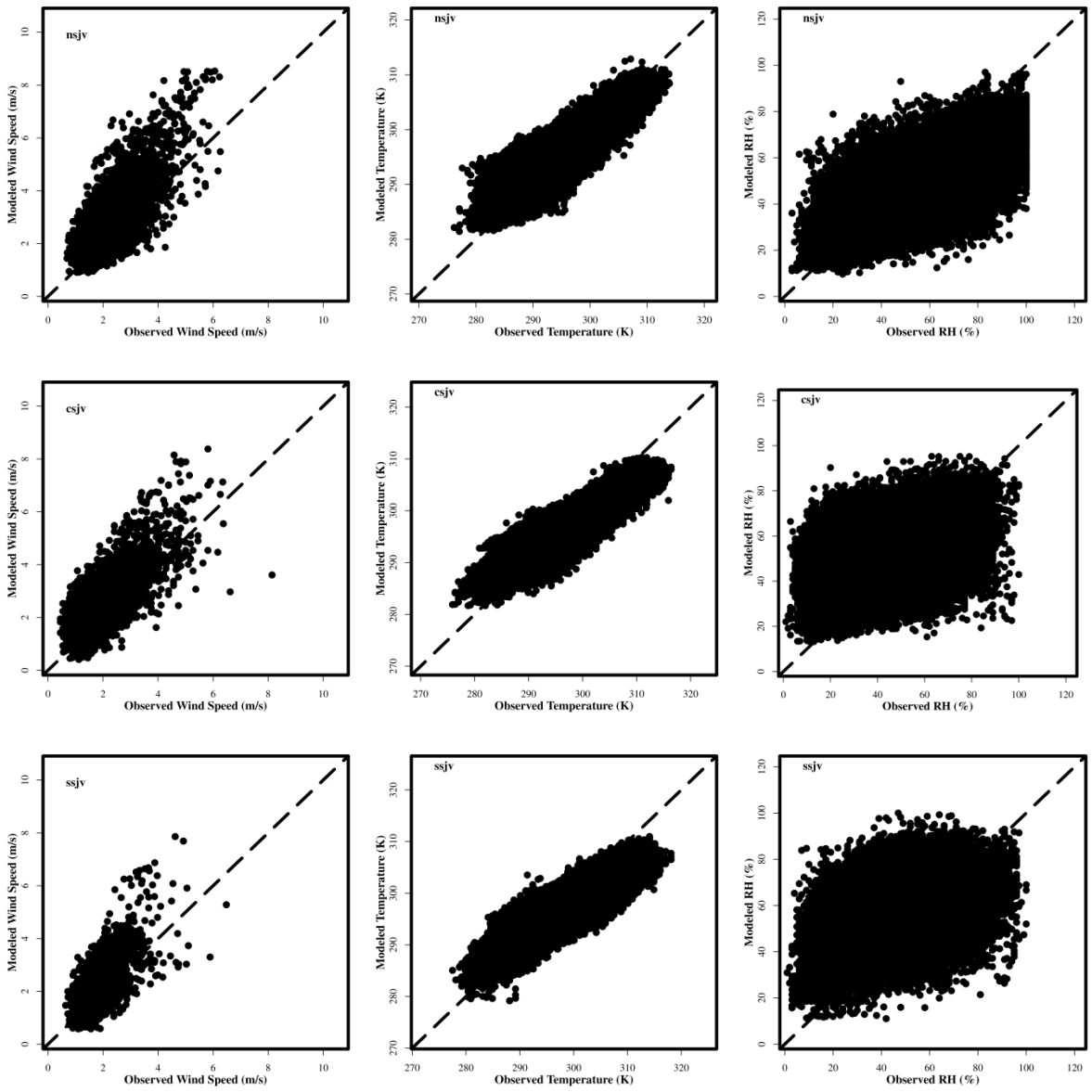


Figure 5. Comparison of modeled and observed hourly wind speed (left column), 2-meter temperature (middle column), and relative humidity (right column). Results for the Northern SJV are shown in the top row, Central SJV in the middle row, and Southern SJV in the bottom row.

3.2.1 PHENOMENOLOGICAL EVALUATION

Conducting a detailed phenomenological evaluation for all modeled days can be resource intensive given that the entire ozone season was modeled. However, some insight and confidence that the model is able to reproduce the meteorological conditions leading to elevated ozone can be gained by investigating the meteorological conditions during a period of peak ozone within the Valley in more detail. The highest-ozone-conducive meteorological conditions in the Valley occurred on or around July 10, 2012. Surface weather analysis shows the SJV was in between a high pressure center off the California coast and a large high pressure system over the areas spanning from the Rockies to the Midwest. The surface wind distributions (Figure 6, 7, 8) indicate the model was able to capture many of the important features of the meteorological fields in the SJV. The winds in the area of the San Joaquin delta split into flows going up towards the Sacramento Valley and down towards SJV. The westerly winds also penetrated into SJV via Pacheco pass. However, wind direction over Tehachapi pass varies, depending on the relative strength of the valley floor winds and the slope winds over the Tehachapi Mountains. The up-slope (Figure 7) and down-slope wind (Figure 8) changes are well reproduced in the model, both over the eastern slope of the Coastal Ranges and western slope of the Sierra.

4. EMISSIONS

The emissions inventory used in this modeling was based on the most recent inventory submitted to the U.S. EPA, with base year 2012 (http://www.arb.ca.gov/planning/sip/2012iv/2012iv.htm). For a detailed description of the emissions inventory, updates to the inventory, and how it was processed from the planning totals to a gridded inventory for modeling, see Modeling Emissions Inventory Appendix.

4.1 EMISSIONS SUMMARIES

Table 7 summarizes the 2012 and 2031 SJV anthropogenic emissions used in this work. Overall, anthropogenic NO_x was projected to decrease by ~60% between 2012 and 2031 from 339.5 tpd to 131.9 tpd. In contrast, anthropogenic ROG was projected to decrease by ~12% from 337.2 tpd to 296.7 tpd. Monthly biogenic ROG totals for 2012 within the Valley are shown in Figure 9 (note that the same biogenic emissions were used in 2012 and 2031 modeling). Throughout the summer, biogenic ROG emission ranged from ~800 tpd in September to nearly 1600 tpd in July and August, with the difference in emissions primarily due to differences in temperature and leaf area from month-to-month.

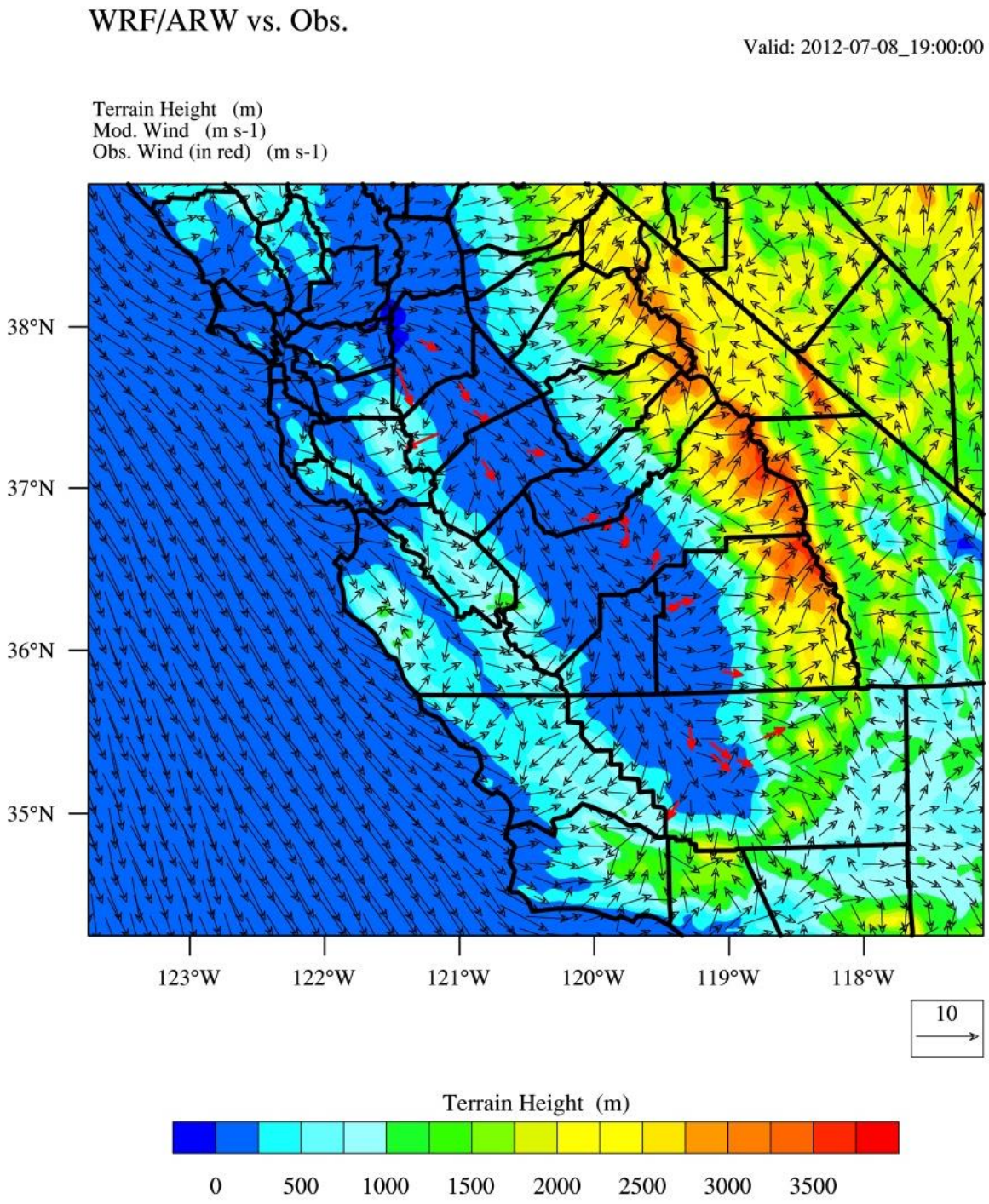


Figure 6. Surface wind field at 11:00 PST July 08, 2012.

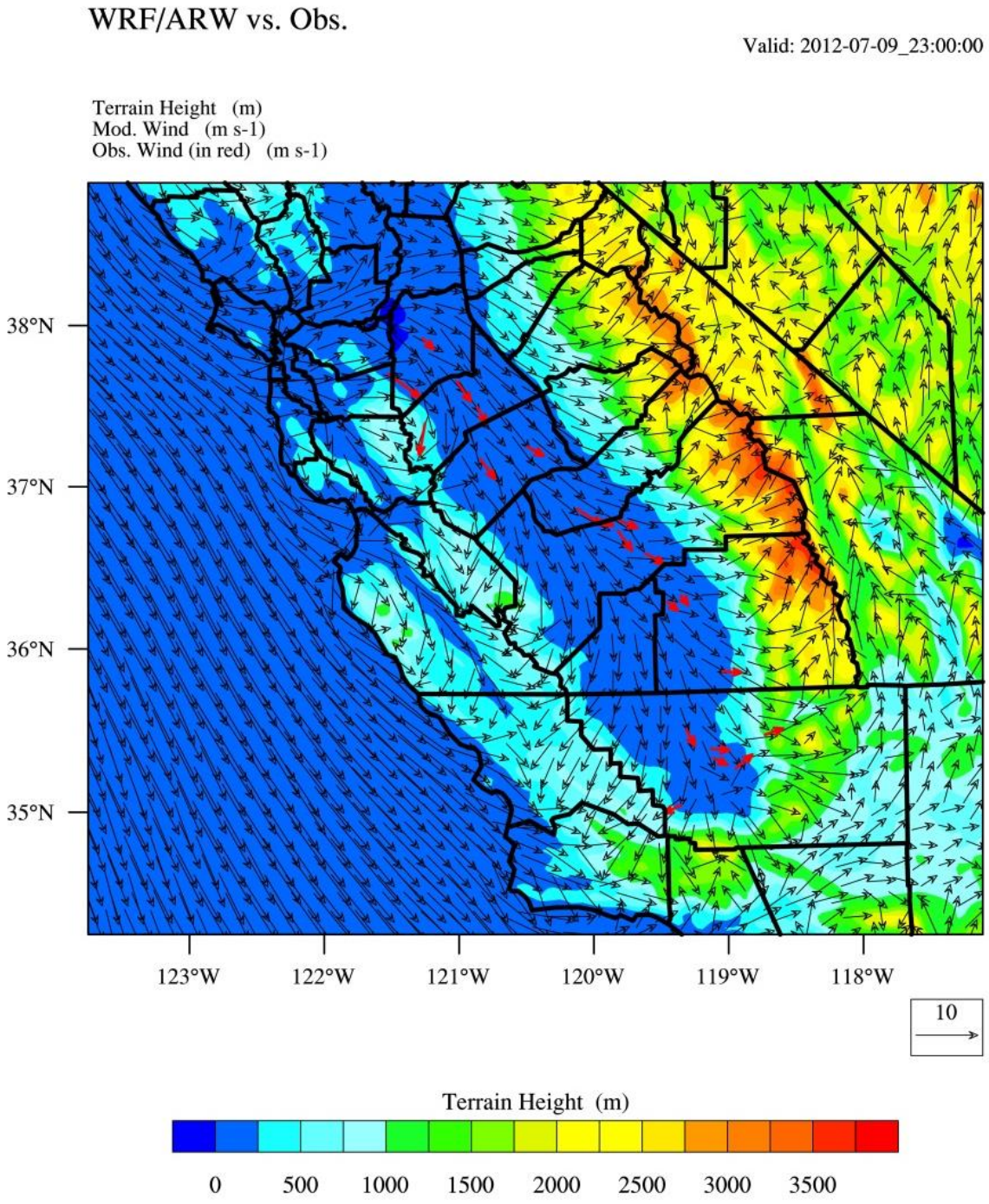


Figure 7. Surface wind field at 15:00 PST July 09, 2012.

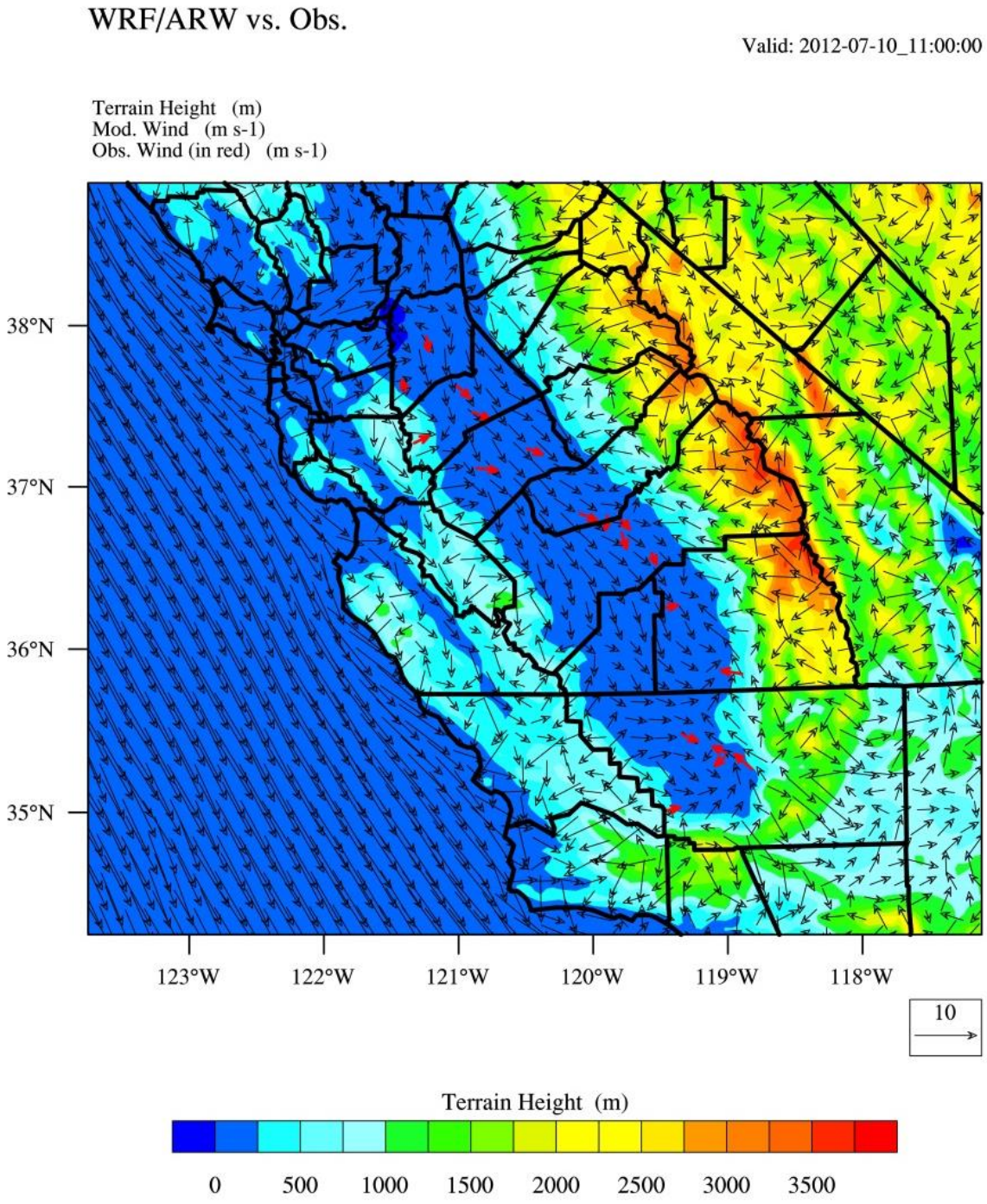


Figure 8. Surface wind field at 03:00 PST July 10, 2012.

Table 8. SJV Summer Planning Emissions for 2012 and 2031 (tons/day).

Source Category	2012		2031	
	NO_x [tons/day]	ROG [tons/day]	NO_x [tons/day]	ROG [tons/day]
Stationary	42.4	85.3	29.5	100.0
Area	4.7	147.0	4.9	152.7
On-Road Mobile	187.7	60.4	45.1	18.3
Other Mobile	104.7	44.5	52.4	25.7
Total	339.5	337.2	131.9	296.7

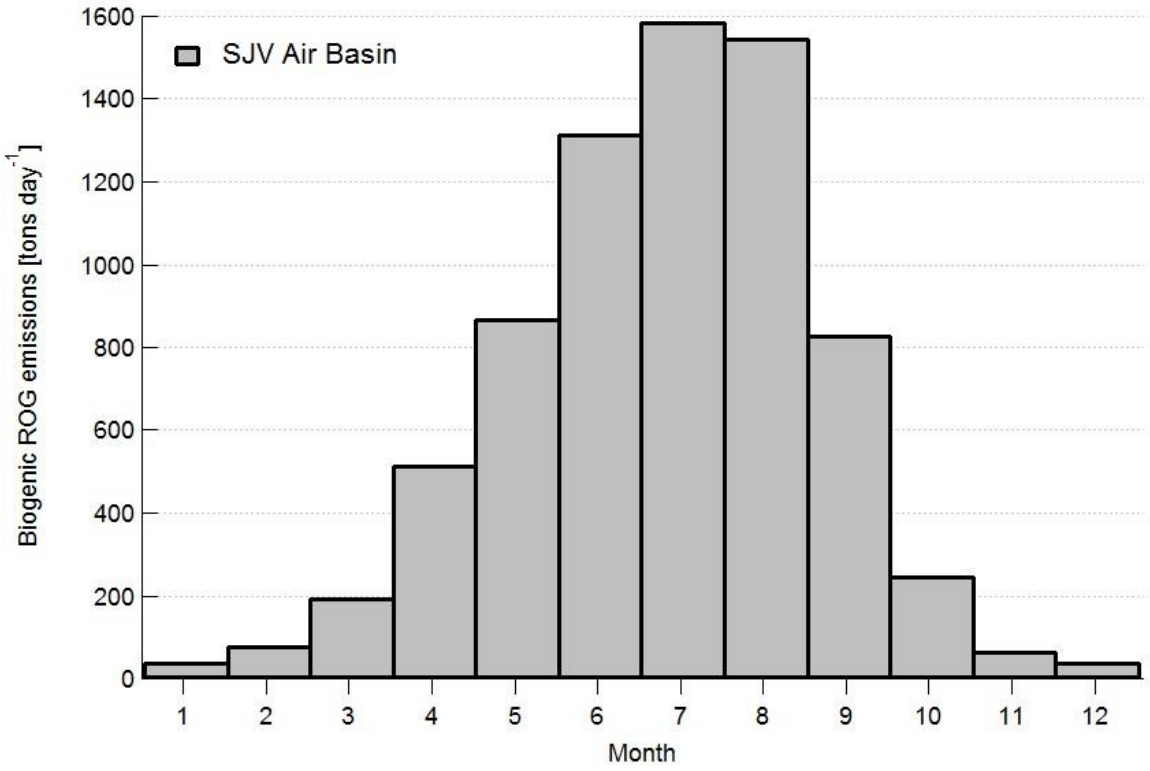


Figure 9. Monthly average biogenic ROG emissions for 2012.

5. OZONE MODELING

5.1. CMAQ MODEL SETUP

Figure 10 shows the CMAQ modeling domains used in this work. The larger domain covering all of California has a horizontal grid size resolution of 12 km with 107x97 lateral grid cells for each vertical layer and extends from the Pacific Ocean in the west to Eastern Nevada in the east and runs from the U.S.-Mexico border in the south to the California-Oregon border in the north. The smaller nested domain covering the SJV region has a finer scale 4km grid resolution and includes 192x192 lateral grid cells. The 12km and 4km domains are based on a Lambert Conformal Conic projection with reference longitude at -120.5°W, reference latitude at 37°N, and two standard parallels at 30°N and 60°N, which is consistent with WRF domain settings. The 30 vertical layers from WRF were mapped onto 18 vertical layers for CMAQ extending from the surface to 100 mb such that majority of the vertical layers fall within the planetary boundary layer. This vertical layer structure is based on the WRF sigma-pressure coordinates and the exact layer structure used can be found in Table 4.

The photochemical modeling for this attainment demonstration utilized CMAQ version 5.0.2, released by the U.S. EPA (https://www.cmascenter.org/cmaq/) in May 2014. The SAPRC07 mechanism was selected as the photochemical mechanism for the CMAQ simulations. Further details of the CMAQ configuration used in this work are summarized in Table 9 and in the Photochemical Modeling Protocol Appendix. The same configuration has been used for all simulations including the base, reference, and future years. CMAQ was compiled using the Intel FORTRAN compiler version 12.

The entire ozone season (May – September 2012) was simulated through parallel individual monthly simulations. For each month, the CMAQ simulations included a seven day spin-up period (i.e., the last seven days of the previous month) for the outer 12 km domain where initial conditions for the beginning day were set to the default initial conditions included with the CMAQ release. The 4 km inner domain simulations utilized a three day spin-up period, where the initial conditions for the starting day were based on output from the corresponding day of the 12 km domain simulation.

Chemical boundary conditions for the outer 12 km domain were extracted from the global chemical transport Model for Ozone and Related chemical Tracers, version 4 (MOZART-4; Emmons et al., 2010[1]). The MOZART-4 data for 2012 was obtained from the National Center for Atmospheric Research (NCAR; http://www.acom.ucar.edu/wrf-chem/mozart.shtml) for the simulations driven by meteorological fields from the NASA GMAO GEOS-5 model. The same MOZART derived BCs for the 12 km outer domain, were used for all simulations (e.g., Base, Reference, Future, and any sensitivity simulation). The inner 4 km domain simulations utilized BCs that were based on the output from the corresponding day of the 12 km domain simulation.

[1] Emmons, L. K., Walters, S., Hess, P. G., Lamarque, J.-F., Pfister, G. G., Fillmore, D., Granier, C., Guenther, A., Kinnison, D., Laepple, T., Orlando, J., Tie, X., Tyndall, G., Wiedinmyer, C., Baughcum, S. L., and Kloster, S.: Description and evaluation of the Model for Ozone and Related chemical Tracers, version 4 (MOZART-4), Geosci. Model Dev., 3, 43-67, doi:10.5194/gmd-3-43-2010, 2010.

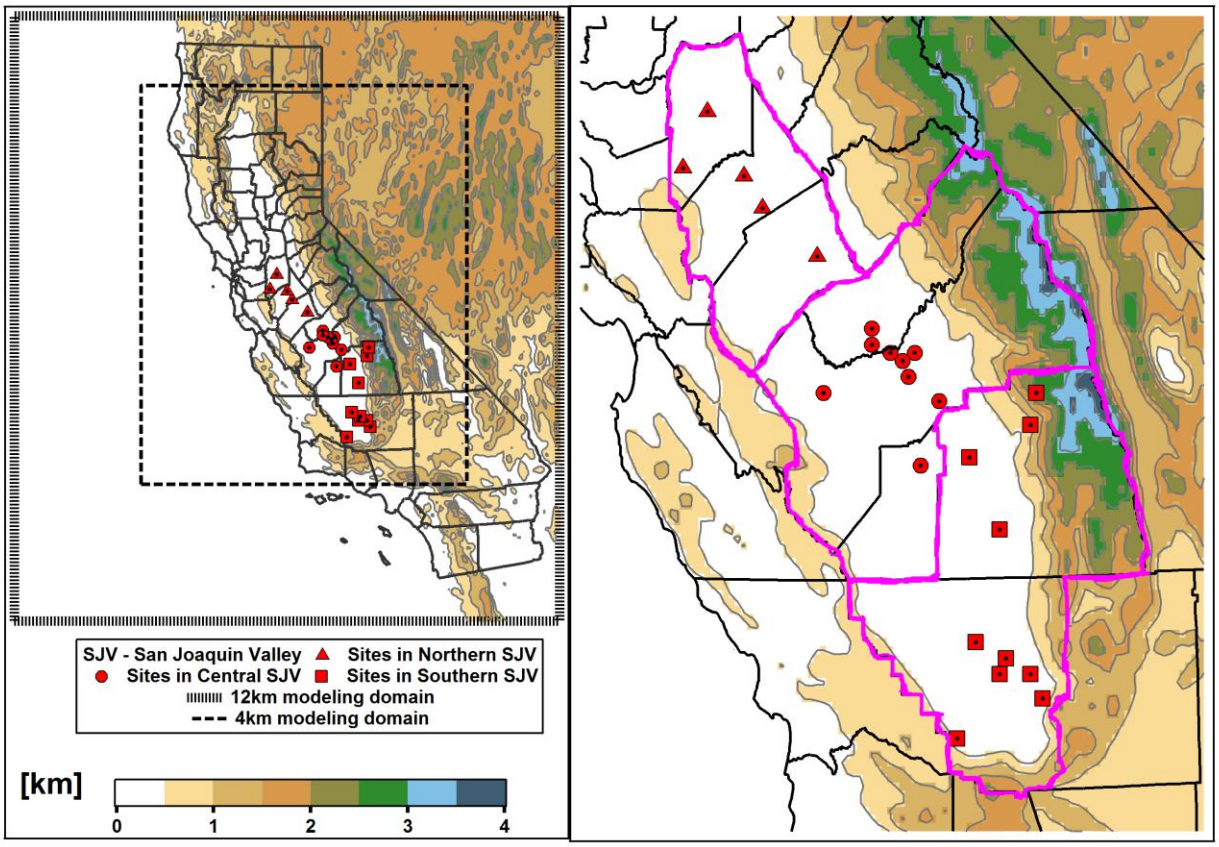


Figure 10. The CMAQ modeling domains used in this SIP modeling. The outer box of the left panel is the California statewide 12 km modeling domain, while the inner box shows the 4km modeling domain covering Central California. The shaded and gray line contours denote the gradients in topography (km). The insert on the right shows the zoomed-in view of the spatial extent (magenta lines) and the location of sites in the Northern (red triangle markers), Central (red circle makers) and Southern (red square markers) sub regions in the Valley that have been used in evaluating model performance for ozone. (Figure adapted from Kulkarni et al., 2014[1])

[1] Kulkarni, S., Kaduwela, A. P., Avise, J. C., DaMassa, J. A., and Chau, D.: An extended approach to calculate the ozone relative response factors used in the attainment demonstration for the National Ambient Air Quality Standards, *J. Air & Waste Management Association,* 64(10), 1204-1213, 2014, doi:10.1080/10962247.2014.936984.

Table 9. CMAQ configuration and settings.

Process	Scheme
Horizontal advection	Yamo (Yamartino scheme for mass-conserving advection)
Vertical advection	WRF-based scheme for mass-conserving advection
Horizontal diffusion	Multi-scale
Vertical diffusion	ACM2 (Asymmetric Convective Model version 2)
Gas-phase chemical mechanism	SAPRC-07 gas-phase mechanism with version “C” toluene updates
Chemical solver	EBI (Euler Backward Iterative solver)
Aerosol module	Aero6 (the sixth-generation CMAQ aerosol mechanism with extensions for sea salt emissions and thermodynamics; includes a new formulation for secondary organic aerosol yields)
Cloud module	ACM_AE6 (ACM cloud processor that uses the ACM methodology to compute convective mixing with heterogeneous chemistry for AERO6)
Photolysis rate	phot_inline (calculate photolysis rates in-line using simulated aerosols and ozone concentrations)

5.2. CMAQ MODEL EVALUATION

Observed ozone data from the Air Quality and Meteorological Information System (AQMIS) database (www.arb.ca.gov/airqualitytoday/) was used to evaluate the accuracy of the 4 km CMAQ modeling for all ozone monitors listed in Table 2 and Figure 10. The U.S. EPA modeling guidance (U.S. EPA, 2014[1]) recommends using the grid cell value where the monitor is located, to pair observations with simulated values in operational evaluation of model predictions. However, the future year design value calculations (discussed in Sections 2.5 and 2.6) are based on simulated values > 60ppb near the monitor (i.e. the maximum simulated ozone within a 3x3 array of cells with the grid cell containing the monitor located at the center of the array). Hence, model performance was evaluated at each monitor by comparing observations against the simulated values using only data above the 60 ppb threshold at the monitored grid cell as well as the peak grid cell within the 3x3 grid array centered on the monitor (i.e., the 3x3 maximum). Model performance is further summarized separately for the three sub-regions in the Valley due to their distinct geographical, meteorological and air quality patterns.

As recommended by U.S. EPA, a number of statistical metrics have been used to evaluate the model performance for ozone. These metrics include mean bias (MB), mean error (ME), mean fractional bias (MFB), mean fractional error (MFE), normalized mean bias (NMB), normalized mean error (NME), root mean square error (RMSE), and correlation coefficient (R^2). In addition, the following plots were used in evaluating the modeling: time-series plots comparing the predictions and observations, scatter plots for comparing the magnitude of the simulated and observed mixing ratios, box plots to summarize the time series data across different regions and averaging times, as well as frequency distributions.

The model performance evaluation is presented for the entire SJV region and also disaggregated for the three sub regions. Performance statistics for data above 60 ppb are reported separately for different ozone metrics including 8-hour daily maximum ozone, 1-hour daily maximum ozone, and hourly ozone (all hours of the day) for the monitored grid cell as well as the 3x3 maximum.

Performance statistics for Maximum Daily Average 8-hour ozone (MDA8) are shown in Table 10. Overall, when simulated data extracted at the grid cell is used for comparison with observations, the model shows a slight negative bias in MDA8 ozone greater than

[1] U.S. EPA, 2014, Draft Modeling Guidance for Demonstrating Attainment of Air Quality Goals for Ozone, PM2.5 and Regional Haze, available at https://www.epa.gov/ttn/scram/guidance/guide/Draft_O3-PM-RH_Modeling_Guidance-2014.pdf

60 ppb in all regions, with the smallest bias occurring in the Southern SJV (-4.3 ppb) and the largest bias occurring in the Central SJV (-6.9 ppb). However, when the 3x3 maximum is used instead, the bias reduces to -2.1 ppb in Southern SJV and to -5 ppb in the Central SJV. Mean error shows a consistent trend with the error getting smaller from 7.9 ppb to 7.2 ppb for the entire SJV when the 3x3 maximum is considered. Similar statistics for daily maximum 1-hour ozone and hourly ozone can be found in Table 11 and Table 12, respectively.

Model performance statistics within the range of values shown in Tables 10, 11 and 12 are consistent with previous studies in the SJV and studies elsewhere in the U.S. Hu et al. (2012)[1], simulated an ozone episode in the SJV (July 27 – August 2, 2000) using a different chemical mechanisms and found that modeled bias ranged from -0.5 to -12.6 ppb for daily maximum 8-hour ozone (compared to -5.2 and -3.2 ppb for the entire SJV in this work) and -0.2 to -15.3 ppb for daily maximum 1-hour ozone in the SJV (compared to -7.5 and -4.7 ppb in this work). Similarly, Shearer et al. (2012)[2] compared model performance in Central California during two episodes in 2000 (July 24 – 26 and July 31 – August 2) for two different chemical mechanisms and found that normalized bias for daily maximum 8-hour ozone ranged from -7% to -14% with hourly peak ozone showing a slightly larger range from -7% to -18%. These are also consistent with the statistics found in this work, which were calculated as -4.3 % (8-hour) and -5.9 % (1-hour). Jin et al. (2010)[3] conducted a longer term simulation over Central California (summer 2000) and found a RMSE for daily maximum 8-hour ozone of 13 ppb, which is greater than the 9.2 ppb found in this work, but Jin et al. (2010) also showed a smaller overall bias of -1 ppb, compared to -3.2 ppb in this work.

[1] Hu, J., Howard, C. J., Mitloehner, F., Green, P. G., and Kleeman, M. J.: Mobile Source and Livestock Feed Contributions to Regional Ozone Formation in Central California, *Environmental Science & Technology*, 46, 2781-2789, 2012.

[2] Shearer, S. M., Harley, R. A., Jin, L., and Brown, N. J.: Comparison of SAPRC99 and SAPRC07 mechanisms in photochemical modeling for central California, *Atmos. Environ.*, 46, 205-216, 2012.

[3] Jin, L., Brown, N. J., Harley, R. A., Bao, J.-W., Michelson, S. A., and Wilczak, J. M.: Seasonal versus episodic performance evaluation for an Eulerian photochemical air quality model, *J. Geophys. Res.*, 115, D09302, doi:10.1029/2009JD012680, 2010.

Table 10. Daily maximum 8-hour ozone performance statistics by modeling subregions and entire SJV region for May-September 2012.

Daily Maximum 8-hour ozone > 60 ppb with simulated data extracted at grid cell where the monitor is located				
Parameter	**NSJV**	**CSJV**	**SSJV**	**Entire SJV**
Number of data points	172	494	944	1610
Mean obs (ppb)	72.4	75.6	75.8	75.4
Standard Deviation obs (ppb)	8.8	9.5	8	8.7
Mean Bias (ppb)	-5.2	-6.9	-4.3	-5.2
Mean Error (ppb)	7.1	8.4	7.8	7.9
RMSE (ppb)	9.6	10.7	9.6	10
Normalized Mean Bias (%)	-7.2	-9.1	-5.7	-6.9
Normal Mean Error (%)	9.9	11.1	10.3	10.5
R-squared	0.18	0.28	0.19	0.21
Index of Agreement	0.58	0.63	0.64	0.64

Daily Maximum 8-hour ozone > 60 ppb with simulated data extracted from the 3x3 grid cell array maximum centered at the monitor				
Parameter	**NSJV**	**CSJV**	**SSJV**	**Entire SJV**
Number of data points	197	557	1009	1763
Mean obs (ppb)	71.9	75.1	75.4	74.9
Standard Deviation obs (ppb)	8.6	9.4	8.1	8.7
Mean Bias (ppb)	-3.7	-5	-2.1	-3.2
Mean Error (ppb)	6.7	7.6	7.1	7.2
RMSE (ppb)	9	9.6	8.9	9.2
Normalized Mean Bias (%)	-5.2	-6.6	-2.8	-4.3
Normal Mean Error (%)	9.4	10.1	9.5	9.6
R-squared	0.18	0.31	0.22	0.24
Index of Agreement	0.62	0.69	0.68	0.69

Table 11. Daily maximum 1-hour ozone performance statistics by modeling subregions and entire SJV region for May-September 2012.

Daily Maximum 1-hour ozone > 60 ppb with simulated data extracted at grid cell where the monitor is located				
Parameter	**NSJV**	**CSJV**	**SSJV**	**Entire SJV**
Number of data points	310	714	1094	2118
Mean obs (ppb)	76.1	81.3	82.1	81
Standard Deviation obs (ppb)	11.1	13.3	10.5	11.8
Mean Bias (ppb)	-4.9	-9.9	-6.7	-7.5
Mean Error (ppb)	8.4	11.5	10.3	10.4
RMSE (ppb)	10.9	14.7	12.6	13.1
Normalized Mean Bias (%)	-6.4	-12.2	-8.2	-9.3
Normal Mean Error (%)	11	14.1	12.6	12.9
R-squared	0.25	0.35	0.24	0.27
Index of Agreement	0.65	0.65	0.65	0.66

Daily Maximum 1-hour ozone > 60 ppb with simulated data extracted from the 3x3 grid cell array maximum centered at the monitor				
Parameter	**NSJV**	**CSJV**	**SSJV**	**Entire SJV**
Number of data points	333	789	1164	2286
Mean obs (ppb)	75.5	80.5	81.5	80.3
Standard Deviation obs (ppb)	11	13.1	10.6	11.8
Mean Bias (ppb)	-2.9	-6.8	-3.8	-4.7
Mean Error (ppb)	7.6	9.6	9.1	9.1
RMSE (ppb)	10	12.4	11.4	11.5
Normalized Mean Bias (%)	-3.8	-8.5	-4.6	-5.9
Normal Mean Error (%)	10.1	12	11.2	11.3
R-squared	0.28	0.42	0.29	0.34
Index of Agreement	0.7	0.74	0.71	0.73

Table 12. Hourly ozone performance statistics by modeling subregions and entire SJV region for May-September 2012. Note that only statistics for the grid cell in which the monitor is located were calculated for hourly ozone.

Hourly ozone > 60 ppb with simulated data extracted at grid cell where the monitor is located				
Parameter	**NSJV**	**CSJV**	**SSJV**	**Entire SJV**
Number of data points	1421	3999	8180	13600
Mean obs (ppb)	74.3	77.1	75.9	76.1
Standard Deviation obs (ppb)	9.8	11	9.6	10.1
Mean Bias (ppb)	-5	-7.7	-4.2	-5.3
Mean Error (ppb)	8	9.8	8.3	8.8
RMSE (ppb)	10.6	12.8	10.6	11.3
Normalized Mean Bias (%)	-6.7	-10	-5.5	-7
Normal Mean Error (%)	10.8	12.8	11	11.5
R-squared	0.16	0.2	0.2	0.18
Index of Agreement	0.59	0.59	0.65	0.62

Simon et al. (2012)[1] conducted a review of photochemical model performance statistics published between 2006 and 2012 for North America (from 69 peer-reviewed articles). In Figure 11, the statistical evaluation of this model attainment demonstration is compared to the model performance summary presented in Simon et al. (2012) by overlaying the various summary statistics from the attainment demonstration onto the Simon et al. (2012) model performance summary. Note that the box-whisker plot (colored in gray) shown in Figure 11 is reproduced using data from Figure 4 of Simon et al. (2012). The blue and red colored horizontal line markers in each of the panels of Figure 11 denote the model performance statistics calculated using simulated data at the grid cell and the 3x3 maximum from the current modeling work. Figure 11 clearly shows that the modeling performance statistical metrics for hourly, daily maximum 8-hr and daily maximum 1-hr ozone from this work are consistent with and fall within the range of values reported by other studies in the literature. In particular, the Simon et. al. (2012) study found that mean bias for daily maximum 8-hour ozone ranged from approximately -7 ppb to 13 ppb, while mean error ranged from around 4 ppb to 22 ppb, and RMSE ranged from approximately 8 ppb to 23 ppb; all of which are similar in magnitude to the statistics presented in Table 10. Time series, scatter plots, box plots of mean bias (grouped into 10 ppb bins based on observed values) and frequency distributions of the hourly, 1-hr daily maximum and 8-hour daily maximum ozone data used to generate Tables 10, 11 and 12 can be found in the supplementary material.

[1] Simon, H., Baker, K. R., and Phillips, S.: Compilation and interpretation of photochemical model performance statistics published between 2006 and 2012, *Atmospheric Environment*, 61, 124-139, 2012.

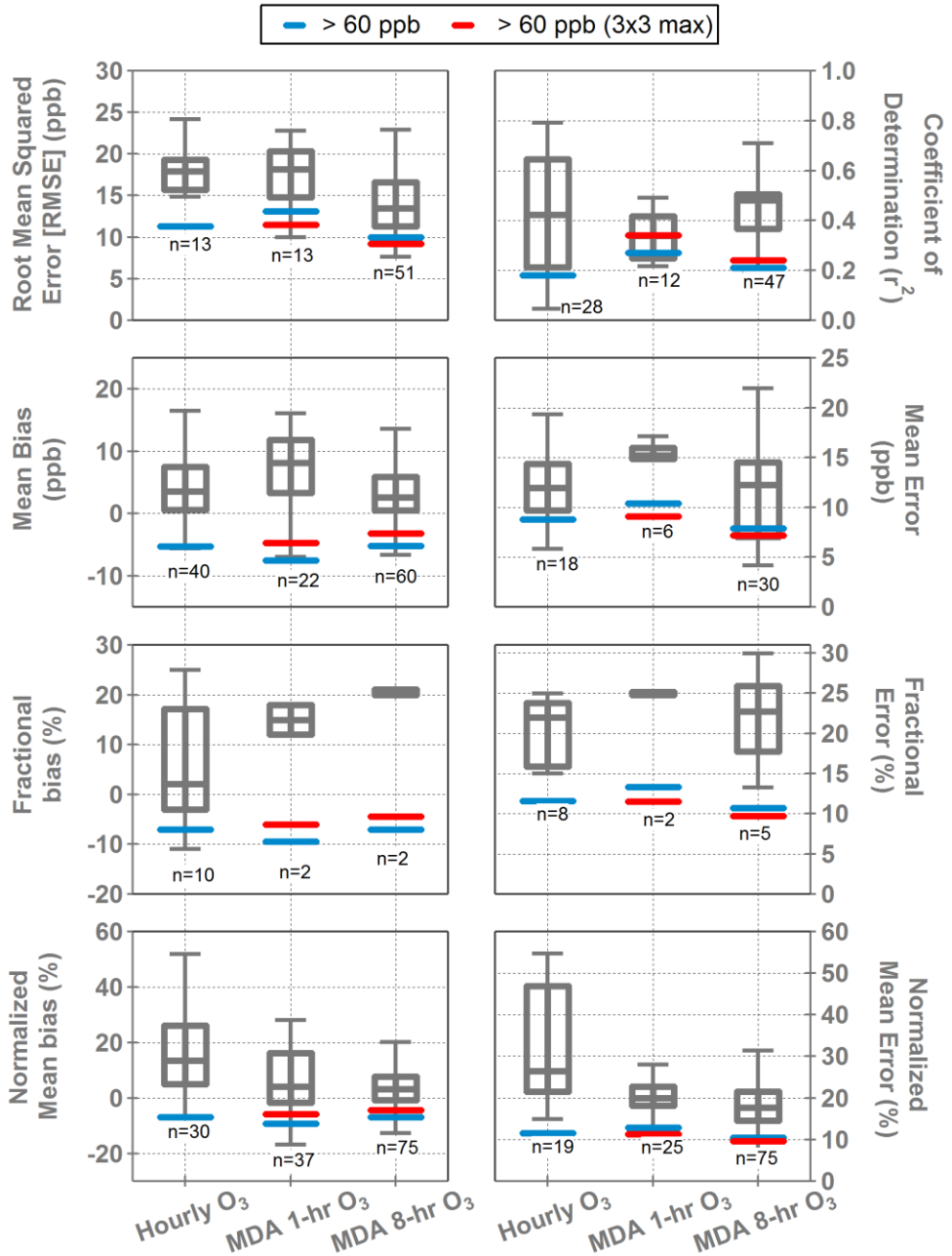


Figure 11. Comparison of various statistical metrics from the model attainment demonstration modeling to the range of statistics from the 69 peer-reviewed studies summarized in Simon et al. (2012)[1]. (MDA denotes Maximum Daily Average)

[1] Simon, H., Baker, K. R., and Phillips, S.: Compilation and interpretation of photochemical model performance statistics published between 2006 and 2012, *Atmospheric Environment*, 61, 124-139, 2012.

5.2.1 DIAGNOSITC EVALUATION

In addition to the statistical evaluation presented above, since the modeling is utilized in a relative sense, it is also useful to consider whether the model is able to reproduce observable relationships between changes in emissions and ozone. One approach to this would be to conduct a retrospective analysis where additional years are modeled (e.g., 2000 or 2005) and the ability of the modeling system to reproduce the observed change in ozone over time is investigated. However, this approach is extremely time consuming. Another approach to investigating the ozone response to changes in emissions is through the so called "weekend effect".

The weekend effect is a well-known phenomenon in some major urbanized areas where emissions of NO_x are substantially lower on weekends than on weekdays, but measured levels of ozone are higher on weekends than on weekdays. This is due to the complex and non-linear relationship between NO_x and ROG precursors and ozone (Swamy et al., 2012)[1]. Ozone formation exhibits a nonlinear dependence to NO_x and ROG precursors in the atmosphere. In general terms, under ambient conditions of high-NO_x and low-ROG (NO_x-disbenefit region in Figure 12), ozone formation tends to exhibit a disbenefit to reductions in NO_x emissions (i.e., ozone increases with decreases in NO_x) and a benefit to reductions in ROG emissions (i.e., ozone decreases with decreases in ROG). In contrast, under ambient conditions of low-NO_x and high-ROG (NO_x-limited region in Figure 12), ozone formation shows a benefit to reductions in NO_x emissions, while changes in ROG emissions result in only minor decreases in ozone. These two distinct "ozone chemical regimes" are illustrated in Figure 12 along with a transitional regime that can exhibit characteristics of both the NO_x-disbenefit and NOx-limited regimes. Note that Figure 12 is shown for illustrative purposes only, and does not represent the actual ozone sensitivity within the SJV for a given combination of NO_x and VOC (ROG) emissions.

In this context, the prevalence of weekend effect in a region suggests that the region is in a NO_x-disbenefit regime (Heuss et al., 2003)[2]. A lack of a weekend effect (i.e., no pronounced high O_3 occurrences during weekends) would suggest that the region is in a transition regime and moving between being NO_x-limited and exhibiting a NO_x-

[1] Swamy, Y.V., Venkanna, R.,Nikhil, G.N., Chitanya, D.N.S.K., Sinha, P.R., Ramakrishna, M., and Rao, A.G., 2012. Impact of Nitrogen Oxides, Volatile Organic Compounds and Black Carbon on
Atmospheric Ozone Levels at a Semi Arid Urban Site in Hyderabad. Aerosol and Air Quality Research 12, 662–671.

[2] Heuss, J.M., Kahlbaum, D.F., and Wolff, G.T., 2003. Weekday/weekend ozone differences: What can we learn from them? Journal of the Air & Waste Management Association 53(7), 772-788

disbenefit. A reversed weekend effect (i.e., lower O_3 during weekends) would suggest that the region is NO_x-limited.

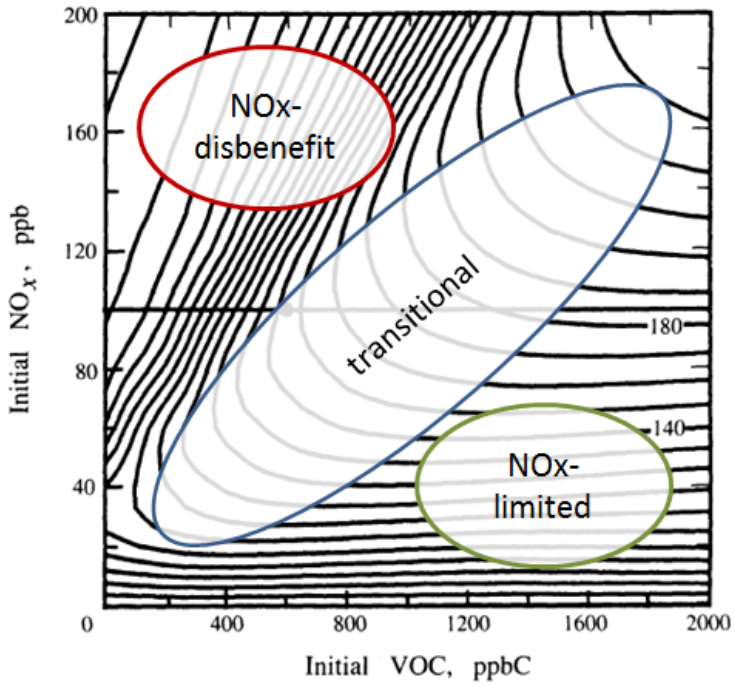


Figure 12. Illustrates a typical ozone isopleth plot, where each line represents ozone mixing ratio, in 10 ppb increments, as a function of initial NO_x and VOC (or ROG) mixing ratio (adapted from Seinfeld and Pandis, 1998[1], Figure 5.15). General chemical regimes for ozone formation are shown as NO_x-disbenefit (red circle), transitional (blue circle), and NO_x-limited (green circle).

Investigating the "weekend effect" and how it has changed over time is a useful real world metric for evaluating the ozone chemistry regime in the SJV and how well it is represented in the modeling. The trend in day-of-week dependence of the Valley's sub-regional observed ozone levels between 2000 and 2014 is shown in Figure 13. The three-panel scatter plot compares the average site-specific weekday (Wednesday and Thursday) and weekend (Sunday) observed summertime (June through September) daily maximum 8-hr ozone value by year (2000 to 2014) and separated into three sub-regions: Northern SJV (top), Central SJV (middle), and Southern SJV (bottom). The light grey triangle and dark gray square markers denote the predicted baseline (2012) and future (2031) average site-specific weekday and weekend ozone values from the attainment demonstration modeling. (Different definitions of weekday and weekend

[1] Seinfeld J. H. and Pandis S. N. (1998) Atmospheric Chemistry and Physics: From Air Pollution to Climate Change, 1st edition, J. Wiley, New York.

days were also investigated and did not show appreciable differences from the Wednesday/Thursday and Sunday definitions.)

From Figure 13 it can be seen that ozone levels are highest in the Southern (i.e. Bakersfield area) and Central (i.e. Fresno area) SJV regions, with the lowest levels seen in the Northern SJV region. A key observation in Figure 13 is that the summertime average weekday and weekend ozone levels have steadily declined between 2000 and 2014.

Along with the declining ozone, there is a pattern shift in the weekday and weekend ozone between 2000 and 2014. In the early 2000's, the central and southern regions of the SJV exhibited roughly an equal number of sites with weekend ozone greater and less than weekday ozone, which suggests that the regions may have been in the transitional chemical regime for ozone formation. By the mid-2000's, the majority of the sites were showing weekday ozone greater than weekend ozone, which is consistent with a shift into complete NO_x-limited chemistry. By 2014, however, some of the sites had shifted back towards a more equal distribution between weekday and weekend ozone, likely due to variability in the biogenic emissions and meteorology. In contrast to the central and southern portions of the SJV, the northern region clearly experienced a greater NO_x-disbenefit in the early 2000's and then moved into a transitional chemical regime in the mid-2000's and is yet to move fully into the NO_x-limited regime.

The simulated baseline 2012 weekday/weekend values (light gray triangle markers) fall above the 1:1 dashed line for central and southern portions, while the values in the northern fall close to the 1:1 dashed line. These predicted values are consistent with observed findings that show a shift into NO_x limited chemistry in the Central and Southern SJV regions and prevalence of transitional chemical regime in Northern SJV.

These findings are consistent with an independent analysis by UC Berkeley researchers on the observed response of ozone from 1995 to 2010 in the SJV to emission reductions in NO_x and VOC reactivity (Pusede et al., 2012[1]). The Pusede et al. study concluded that NO_x emission reductions have been effective at reducing ozone levels and have successfully transitioned the southern and central portions of the SJV into a NO_x-limited chemistry regime, while the northern portion of the SJV is currently in the process of transitioning to the same chemical regime.

[1] Pusede, S. E., and R. C. Cohen, 2012, On the observed response of ozone to NOx and VOC reactivity reductions in San Joaquin Valley California 1995–present, *Atmos. Chem. Phys.*, *12*, 8323–8339.

The predicted future 2031 values (dark gray square markers) clearly show that weekday and weekend ozone decline significantly (all values are below 60 ppb) and all three sub regions show a shift to a NO_x-limited regime with all values falling above the 1:1 dashed line. This modeling-based finding of 2031 NO_x limitation has been corroborated by a study from the UC Berkeley researchers that analyzed the impacts of future emissions controls using an analytical model constrained by CalNex 2010 measurements in the Valley (Pusede et. al., 2014[1]) and concluded that the NO_x controls will be immediately and incrementally more effective than the corresponding ROG controls in lowering the Valley's ozone levels.

[1] Pusede, S. E., Gentner, D. R., Wooldridge, P. J., Browne, E. C., Rollins, A. W., Min, K.-E., Russell, A. R., Thomas, J., Zhang, L., Brune, W. H., Henry, S. B., DiGangi, J. P., Keutsch, F. N., Harrold, S. A., Thornton, J. A., Beaver, M. R., St. Clair, J. M., Wennberg, P. O., Sanders, J., Ren, X., VandenBoer, T. C., Markovic, M. Z., Guha, A., Weber, R., Goldstein, A. H., and Cohen, R. C.: On the temperature dependence of organic reactivity, nitrogen oxides, ozone production, and the impact of emission controls in San Joaquin Valley, California, Atmos. Chem. Phys., 14, 3373-3395, doi:10.5194/acp-14-3373-2014, 2014.

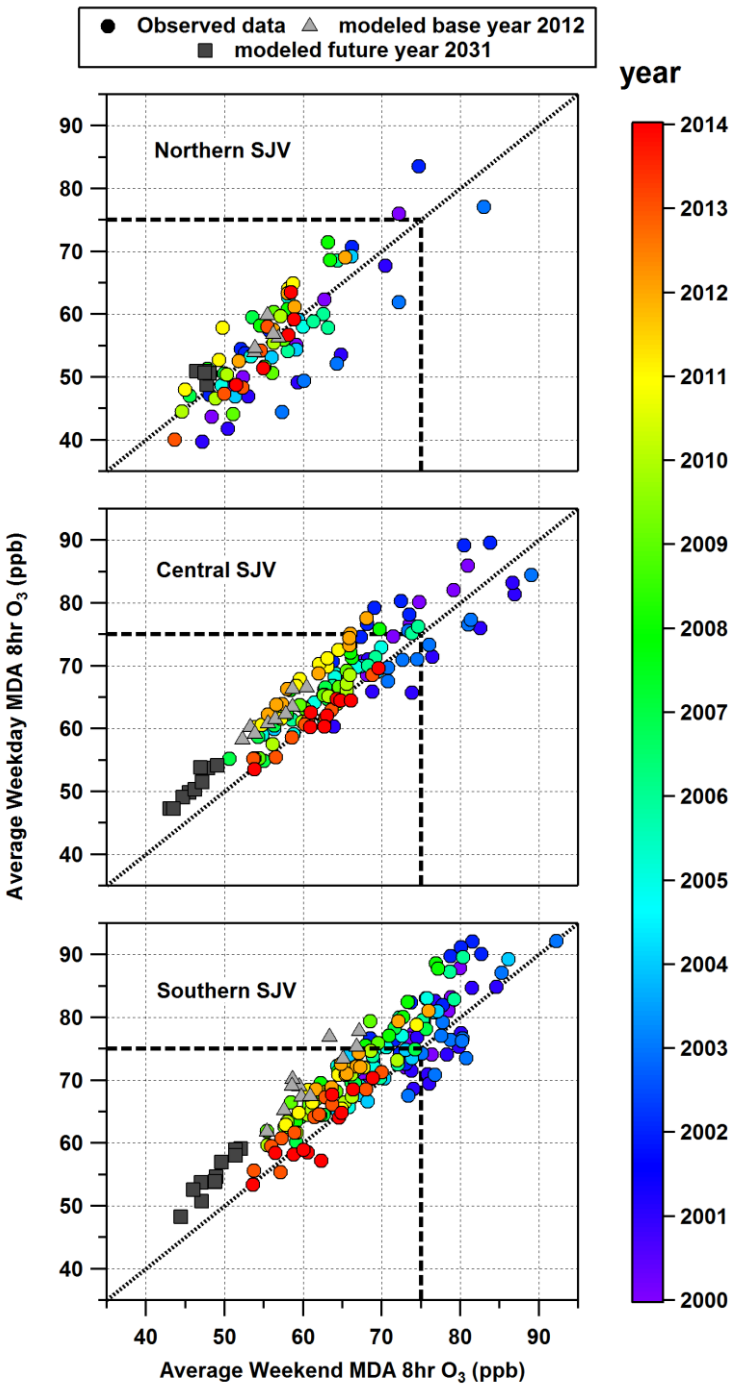


Figure 13. Site-specific average weekday and weekend maximum daily average 8-hour ozone for each year from 2000 to 2014 for the Northern SJV (top), Central SJV (middle), and Southern SJV (bottom). The colored circle markers denote observed values while the light gray triangle and dark gray square markers denote the simulated baseline 2012 and future 2031 values. Points falling below the 1:1 dashed line represent a NO_x-disbenefit regime, those on the 1:1 dashed line represent a transitional regime, and those above the 1:1 dashed line represent a NO_x-limited regime.

5.3. RELATIVE RESPONSE FACTORS AND FUTURE YEAR DESIGN VALUES

The RRFs (Section 2.5) and the future 2031 design values (Section 2.6) for the representative sites in the northern, central and southern regions of the Valley were calculated using the procedures outlined in the corresponding sections, respectively, and are summarized in Table 13. Note that the results shown in Table 13 are ordered by each sub region in descending order of the average reference year 2012 DVs.

The results in Table 13 show that all monitoring sites in the Valley have a future DV less than 75 ppb based on the 2031 emissions inventory, with the Clovis monitor in Central SJV having the highest predicted future design of 74 ppb in 2031 (Note that Clovis is also the valley's design site for base year 2012). Therefore, the air quality simulations predict that the entire Valley will attain the 75 ppb 8-hour O_3 standard by 2031.

The three sub regions show varied response to emission controls as evident from the RRF values shown in Table 13. The Southern SJV shows the greatest response followed by Central SJV as seen from the low values of the site-specific RRF and the 2031 DVs, which is consistent with the prevalence of NO_x-limited ozone formation regimes (Section 5.2) in those regions. The Northern SJV shows the lowest response (relatively higher RRF values), which is expected as this region is still transitioning to the NO_x-limited chemical regime (section 5.2).

Table 13. Summary of key parameters related to the future year 2031 design value (DV) calculation.

County	Site	Average Reference Year 2012 DV (ppb)	RRF	Average Future Year 2031 DV (ppb)
Northern SJV				
Stanislaus	***Turlock-S Minaret Street***	***86.0***	***0.8019***	***69***
Merced	Merced-S Coffee Avenue	81.7	0.8009	65
San Joaquin	Tracy-Airport	79.3	0.8428	66
Stanislaus	Modesto-14th Street	76.0	0.8100	61
San Joaquin	Stockton-Hazelton Street	68.3	0.8444	57
Central SJV				
Fresno	***Clovis-N Villa Avenue***	***95.7***	***0.7729***	***74***
Fresno	Fresno-Drummond Street	92.3	0.7712	71
Fresno	Parlier	92.0	0.7513	69
Fresno	Fresno-Garland	90.7	0.7812	70
Fresno	Fresno-Sierra Skypark #2	89.0	0.7684	68
Kings	Hanford-S Irwin Street	86.0	0.7537	64
Madera	Madera-28261 Avenue 14	84.7	0.7746	65
Madera	Madera-Pump Yard	79.3	0.7789	61
Fresno	Tranquility	76.3	0.7943	60
Southern SJV				
Tulare	***Sequoia and Kings Canyon Natl Park***	***93.0***	***0.7037***	***65***
Kern	Arvin-Di Giorgio	89.3	0.7242	64
Kern	Edison	87.7	0.7397	64
Kern	Bakersfield-5558 California Avenue	86.7	0.7573	65
Tulare	Porterville-1839 Newcomb Street	86.3	0.7327	63
Kern	Oildale-3311 Manor Street	84.7	0.7772	65
Tulare	Sequoia Natl Park-Lower Kaweah	84.0	0.7302	61
Kern	Maricopa-Stanislaus Street	83.3	0.7561	63
Kern	Shafter-Walker Street	83.0	0.7556	62
Tulare	Visalia-N Church Street	82.3	0.7391	60

5.4. UNMONITORED AREA ANALYSIS

The unmonitored area analysis is used to ensure that there are no regions outside of the existing monitoring network that would exceed the NAAQS if a monitor was present (U.S. EPA, 2014[1]). U.S. EPA recommends combining spatially interpolated design value fields with modeled ozone gradients and grid-specific RRFs in order to generate gridded future year gradient adjusted design values. This analysis can be done using the Model Attainment Test Software (MATS) (Abt , 2014[2]). However, this software is not open source and comes as a precompiled software package. To maintain transparency and flexibility in the analysis, in-house R codes (https://www.r-project.org/) developed at ARB, were utilized in this analysis.

The unmonitored area analysis was conducted using the 8-hr O_3 weighted DVs from all the available sites that fall within the 4km inner modeling domain along with the reference year 2012 and future year 2031 4 km CMAQ model output. The steps followed in the unmonitored area analysis are as follows:

Step 1: For each grid cell, calculate the average of the top-10 modeled maximum daily average 8-hour ozone concentrations from the reference year simulation.

Step 2: Interpolate the monitor-specific weighted base-year DVs to an unmonitored grid cell using normalized inverse distance squared weightings for all monitors within a grid cell's Voronoi Region (calculated with the R tripack library; https://cran.r-project.org/web/packages/tripack/README), and adjusted based on the ozone gradient between the grid cell and the corresponding monitor from Step 1. Interpolation is done only within the geographic region constrained by the monitoring network, since extrapolating to outside of the monitoring network is inherently uncertain.

Step 3: For each grid cell, calculate an RRF based on the reference- and future-year modeling following the same approach outlined in Section 2.5, except that the +/- 20% limitation on the simulated and observed maximum daily average 8-

[1] U.S. EPA, 2014, Draft Modeling Guidance for Demonstrating Attainment of Air Quality Goals for Ozone, PM2.5 and Regional Haze, available at https://www.epa.gov/ttn/scram/guidance/guide/Draft_O3-PM-RH_Modeling_Guidance-2014.pdf

[2] Abt, 2014. Modeled Attainment Test Software: User's Manual. MATS available at: http://www.epa.gov/scram001/modelingapps_mats.htm

hour ozone is not applicable because observed data do not exist for grid cells in unmonitored areas.

Step 4: Multiply the gradient-adjusted interpolated DVs from Step 2 by the gridded RRFs from Step 3 to calculated future-year gridded DVs.

Step 5: Examine the future-year gridded DVs to determine if there are peak values higher than those at the monitors, which could cause violations of the 8-hour ozone NAAQS.

Figure 14 shows the spatial distribution of gridded DVs for the SJV non-attainment area based on the unmonitored area analysis (described above). The black colored triangle markers denote the monitoring sites, which had valid reference year 2012 DVs and were used in the analysis. The entire valley shows gridded DVs that are below the 75 ppb standard. The gridded DVs falling between 71 and 75 ppb can be found near the Tracy monitoring site in the northern region and to the east of Fresno in the Central region, but are below the 75 ppb standard. Therefore, the unmonitored area analysis predicts that all unmonitored regions within the Valley will attain the 75 ppb 8-hour O_3 standard by 2031.

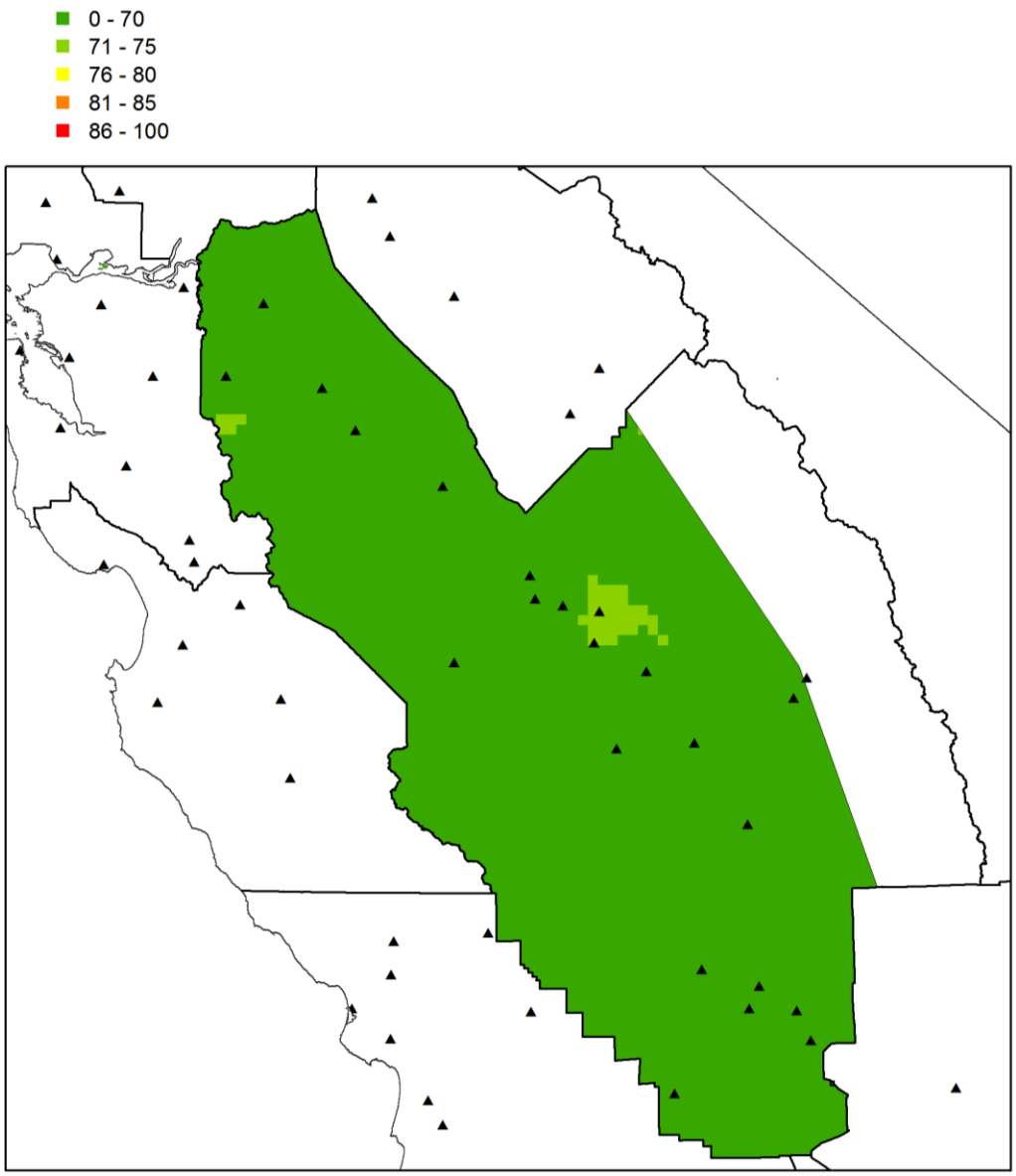


Figure 14. Spatial distribution of the future 2031 DVs based on the unmonitored area analysis in the Valley. Color scale is in ppb of ozone.

5.5. "BANDED" RELATIVE RESPONSE FACTORS AND FUTURE YEAR DESIGN VALUES

The "Band-RRF" approach expands upon the standard "Single-RRF" (Section 5.3) approach to account for differences in model response to emissions controls at varying ozone levels. The most recent U.S. EPA modeling guidance (U. S. EPA 2014[1]) accounts for some of these differences by focusing on the top ten modeled days, but even the top ten days may contain a significant range of ozone mixing ratios. The Band-RRF approach accounts for these differences more explicitly by grouping the simulated ozone into bands of lower, medium, and higher ozone mixing ratios.

In this work, the banded RRFs were calculated to project the future year 2031 DVs. The inherent data used for this analysis is consistent with the data used in the single RRF calculations (Sections 2.5 and 5.3). The various steps involved in the calculation of banded RRFs are as follows:

1. MDA 8-hour ozone mixing ratios for all days that are above 60 ppb and that fall within +/- 20% of observations are stratified into 5 ppb increments in the 60 -100 ppb range. (All days above 100 ppb are grouped into a single bin)

2. A separate RRF is calculated for each ozone band following a similar approach as the standard Single-RRF. A linear regression is then fit to the data resulting in an equation relating RRF to ozone band as long as there are at least 3 bands (without missing data). The band RRF calculations were not available for sites that had fewer than 3 bands of valid RRFs. Similar to the Single-RRF; this equation is unique to each monitor/location.

3. The top ten days for each monitor, based on observed 8-hour ozone for each year of the 5 years that is utilized in the design value calculation (see Table 1), are then projected to the future using the appropriate RRF for the corresponding ozone band.

4. The top ten future days for each individual year are then re-sorted, the fourth highest 8-hour ozone is selected, and the future year design value is calculated

[1] U.S. EPA, 2014, Draft Modeling Guidance for Demonstrating Attainment of Air Quality Goals for Ozone, PM2.5 and Regional Haze, available at https://www.epa.gov/ttn/scram/guidance/guide/Draft_O3-PM-RH_Modeling_Guidance-2014.pdf

in a manner consistent with the base/reference year design value calculation.

5. The future Design Values was then compared with the 75 ppb 8-hour O_3 standard to determine the attainment status for each monitor.

More detailed information on the Band-RRF approach can be found in Kulkarni et al. (2014)[1] and the SJV 2013 1-Hour Ozone SIP[2].

The banded RRFs and the corresponding future 2031 design values for the representative sites in the northern, central and southern regions of the Valley were calculated using the procedure outlined above, and are summarized in Table 14. Note that the results shown in Table 14 are ordered by each sub region in the descending order of average reference year 2012 DVs.

The results in Table 14 show that all the monitoring sites in the Valley have a future DV less than 75 ppb, with the Clovis monitoring site in Central SJV having the highest predicted future design with an estimated future design value of 72 ppb in 2031, which is 2 ppb lower than the corresponding single-RRF value (Table 13). (Note that Clovis is also the valley's design site for base year 2012).

[1] Kulkarni, S., Kaduwela, A. P., Avise, J. C., DaMassa, J. A., and Chau, D.: An extended approach to calculate the ozone relative response factors used in the attainment demonstration for the National Ambient Air Quality Standards, *J. Air & Waste Management Association,* 64(10), 1204-1213, 2014, doi:10.1080/10962247.2014.936984.

[2] http://www.valleyair.org/Air_Quality_Plans/Ozone-OneHourPlan-2013.htm

Table 14. Summary of banded RRF calculation along with the future year 2031 design values projected from the average reference year 2012 design value

County	Site	Average Reference Year 2012 Design Value (ppb)	Average Future Year 2031 Design Value using banded "RRF"(ppb)
Northern SJV			
Stanislaus	***Turlock-S Minaret Street***	***86.0***	65
Merced	Merced-S Coffee Avenue	81.7	64
San Joaquin	Tracy-Airport	79.3	66
Stanislaus	Modesto-14th Street	76.0	61
San Joaquin	Stockton-Hazelton Street	68.3	--
Central SJV			
Fresno	***Clovis-N Villa Avenue***	***95.7***	72
Fresno	Fresno-Drummond Street	92.3	67
Fresno	Parlier	92.0	66
Fresno	Fresno-Garland	90.7	--
Fresno	Fresno-Sierra Skypark #2	89.0	63
Kings	Hanford-S Irwin Street	86.0	--
Madera	Madera-28261 Avenue 14	84.7	62
Madera	Madera-Pump Yard	79.3	60
Fresno	Tranquility	76.3	--
Southern SJV			
Tulare	***Sequoia and Kings Canyon Natl Park***	***93.0***	65
Kern	Arvin-Di Giorgio	89.3	65
Kern	Edison	87.7	66
Kern	Bakersfield-5558 California Avenue	86.7	65
Tulare	Porterville-1839 Newcomb Street	86.3	62
Kern	Oildale-3311 Manor Street	84.7	65
Tulare	Sequoia Natl Park-Lower Kaweah	84.0	62
Kern	Maricopa-Stanislaus Street	83.3	61
Kern	Shafter-Walker Street	83.0	60
Tulare	Visalia-N Church Street	82.3	61

6. OZONE ISOPLETHS

Since the entire Valley is projected to be in attainment for 2008 75 ppb 8-hour O_3 standard, no additional emission reductions beyond what is currently being implemented through the current control program will be necessary. However, the U.S. EPA revised the 8-hr O_3 standard to a level of 0.070 ppm (70 ppb) on October 1, 2015 (80 FR 65292), for which the final designations are due in late 2017.

Hence, it is important to know the precursor limitation in the future to assess the level of emissions controls needed to attain the 2015 8-hr O_3 standard of 0.070 ppm (70 ppb) and ensure that emissions controls that could be needed for other standards (e.g., 1-hour O_3, 24-hour $PM_{2.5}$, annual $PM_{2.5}$, and 1-hour NO_x) support attainment of the revised standard. Looking at the future DVs in Table 13, it can be seen that the majority of sites in the Valley are predicted to attain the 70 ppb standard by 2031, with exception of the Clovis and Fresno Drummond monitoring sites.

In order to identify what combinations of precursor emissions reductions (including which precursors are most effective at reducing ozone as well as the magnitude of reductions needed) might lead to attainment, modeling sensitivity simulations with varying degrees of precursor reductions from anthropogenic sources are typically performed. The results of these sensitivity simulations are plotted on ozone isopleth diagrams, which are also referred to as carrying capacity diagrams (see Figure 12 for isopleth example). The isopleths provide an estimate of the level of emissions needed to demonstrate attainment and thereby inform the development of a corresponding control strategy.

To examine the future ozone sensitivity within the SJV for different combinations of NO_x and VOC (ROG) emissions in the Valley, modeling sensitivity simulations were conducted to generate the 8-hr ozone isopleths. These sensitivity simulations are identical to the future year 2031 simulation discussed earlier in Section 2.4 and Table 3, except that domain-wide fractional reductions were applied to future year 2031 anthropogenic NO_x and ROG emission levels. Each sensitivity simulation was run for the entire ozone season (May – September 2012) and included statewide 12 km simulations nested down to 4 km. The inner 4 km domain sensitivity simulations utilized BCs based on output from the corresponding 12 km sensitivity simulation, while the 12 km simulations all utilized the same MOZART derived BCs. The RRF methodology described in Section 2.5 was then applied to the inner 4 km domain output of each fractional ROG and NO_x sensitivity simulation to calculate the future DV (for that specific NO_x-ROG combination) at each monitoring site in the Valley.

Figures 15 and 16 show the 2031 8-hour ozone isopleths for the Clovis and Fresno Drummond monitoring sites (isopleths for other sites are not shown since their projected DVs are below 70 ppb). In each figure, the bottom and top axes represent the domain-wide fractional ROG emissions and the corresponding SJV basin emission totals (tons per day) in 2031, respectively. Likewise, the left and right axes represent the domain-wide fractional NO_x emissions and the corresponding SJV basin emission totals (tons per day) in 2031, respectively. The top right point on each diagram represents the projected DV for the attainment demonstration (listed in Table 13).

The shape of the ozone isopleths shown in Figures 15 and 16 indicates that they fall in the bottom right corner of the Figure 12, where the NO_x-limited regime is prevalent. It is evident from these diagrams that the future O_3 mixing ratios throughout the San Joaquin Valley are predicted to be in the NO_x-limited regime and that the sensitivity to ROG emissions controls will be much lower when compared to NO_x. Since NO_x is the limiting precursor, modest additional NO_x reductions are needed to attain the 70 ppb standard in the Valley.

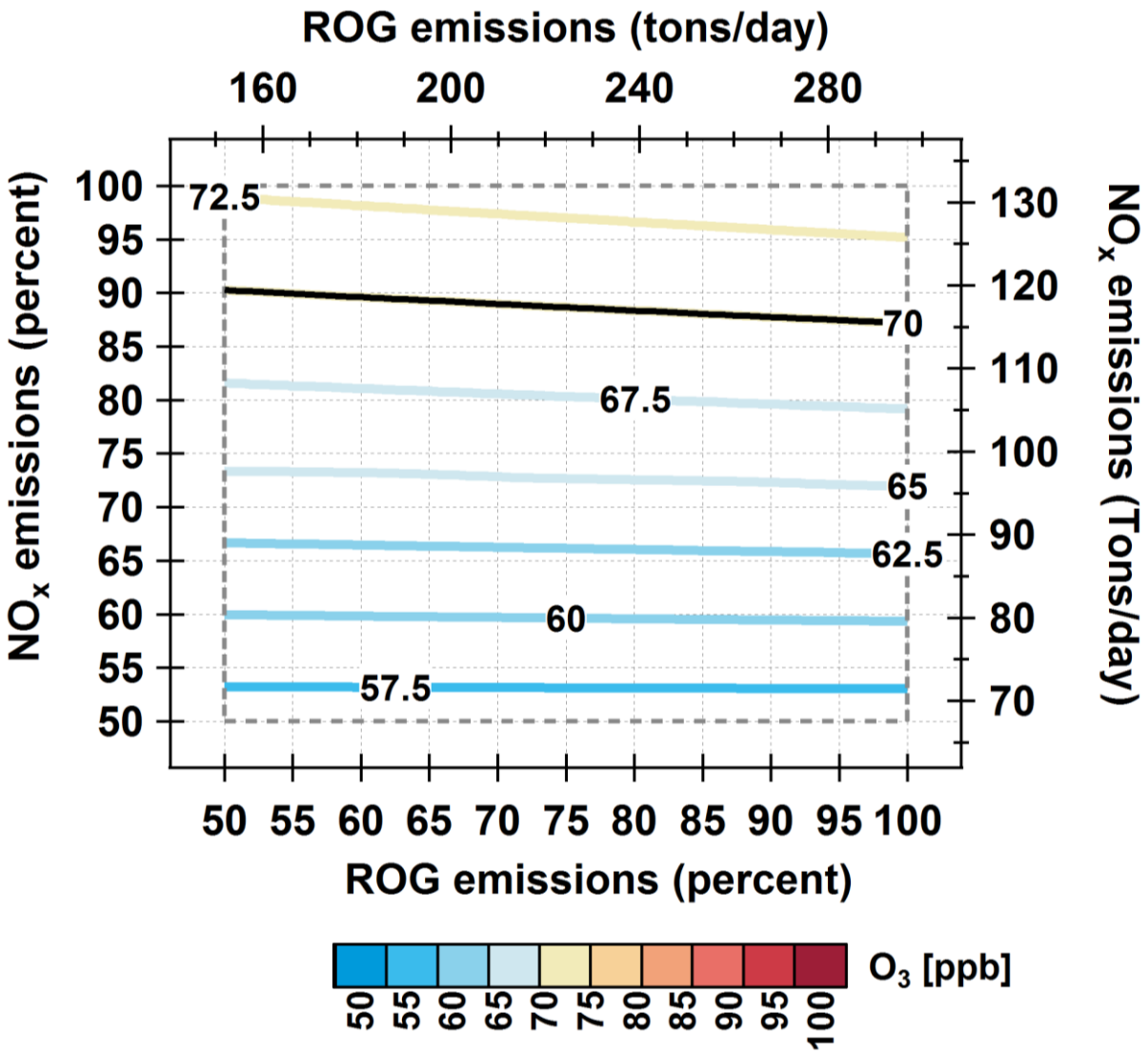


Figure 15. The 8-hr ozone isopleth based on 2031 emission levels at the Clovis site located in Central SJV.

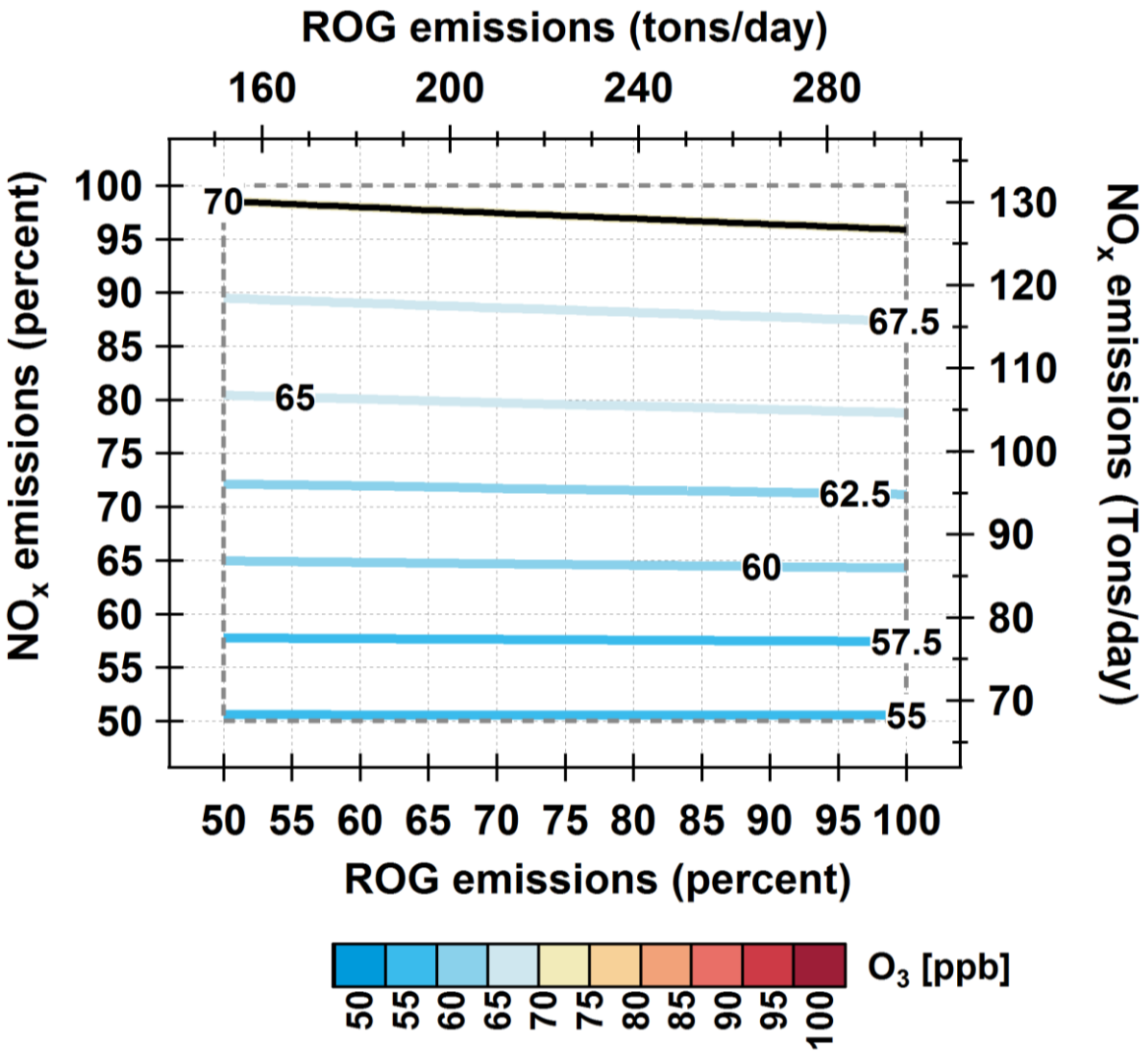


Figure 16. The 8-hr ozone isopleth based on 2031 emission levels at the Fresno Drummond site located in Central SJV.

SUPPLEMENTAL MATERIALS

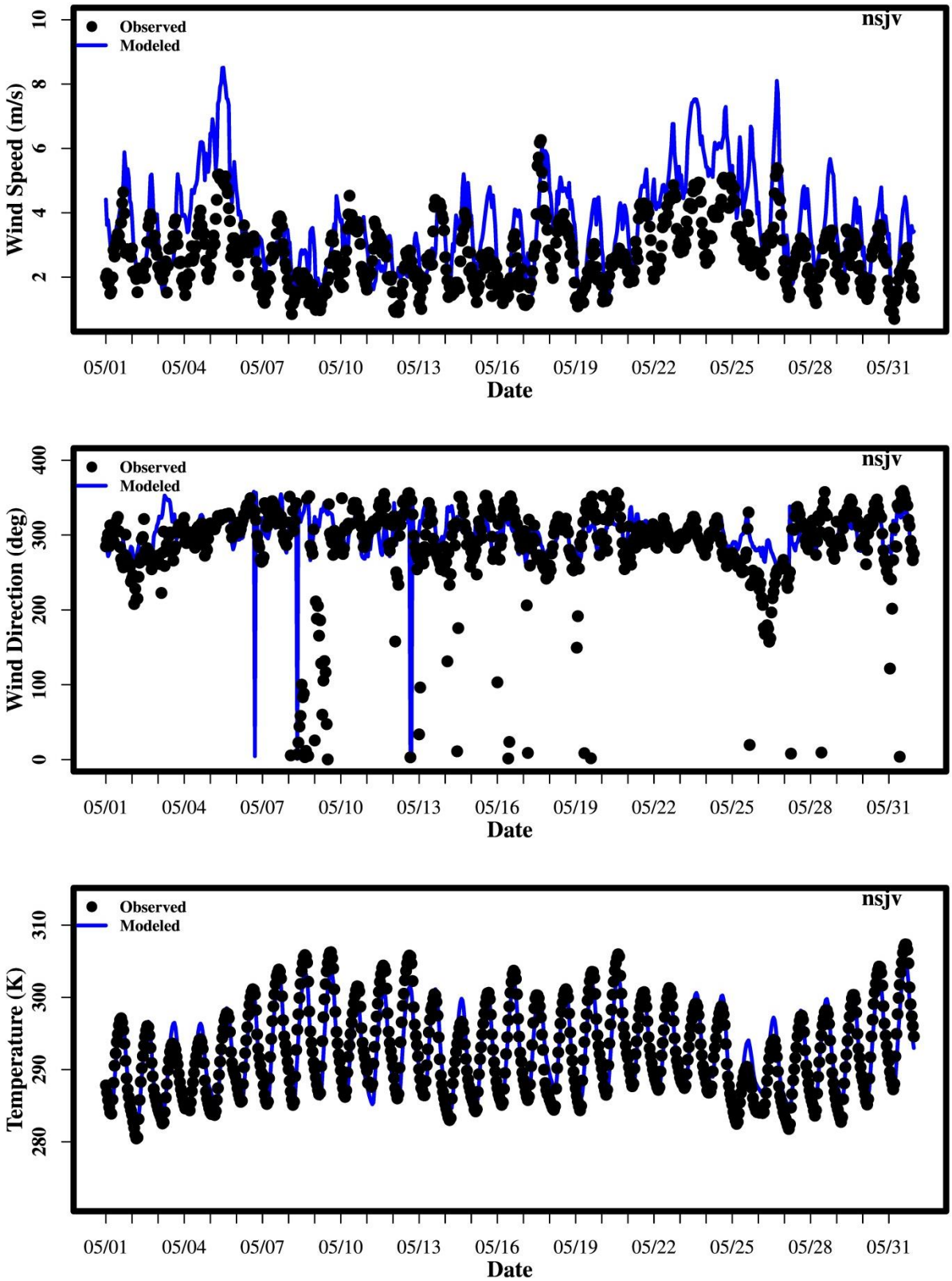


Figure S. 1 Time series of wind speed, direction, and temperature for the Northern San Joaquin Valley in May 2012.

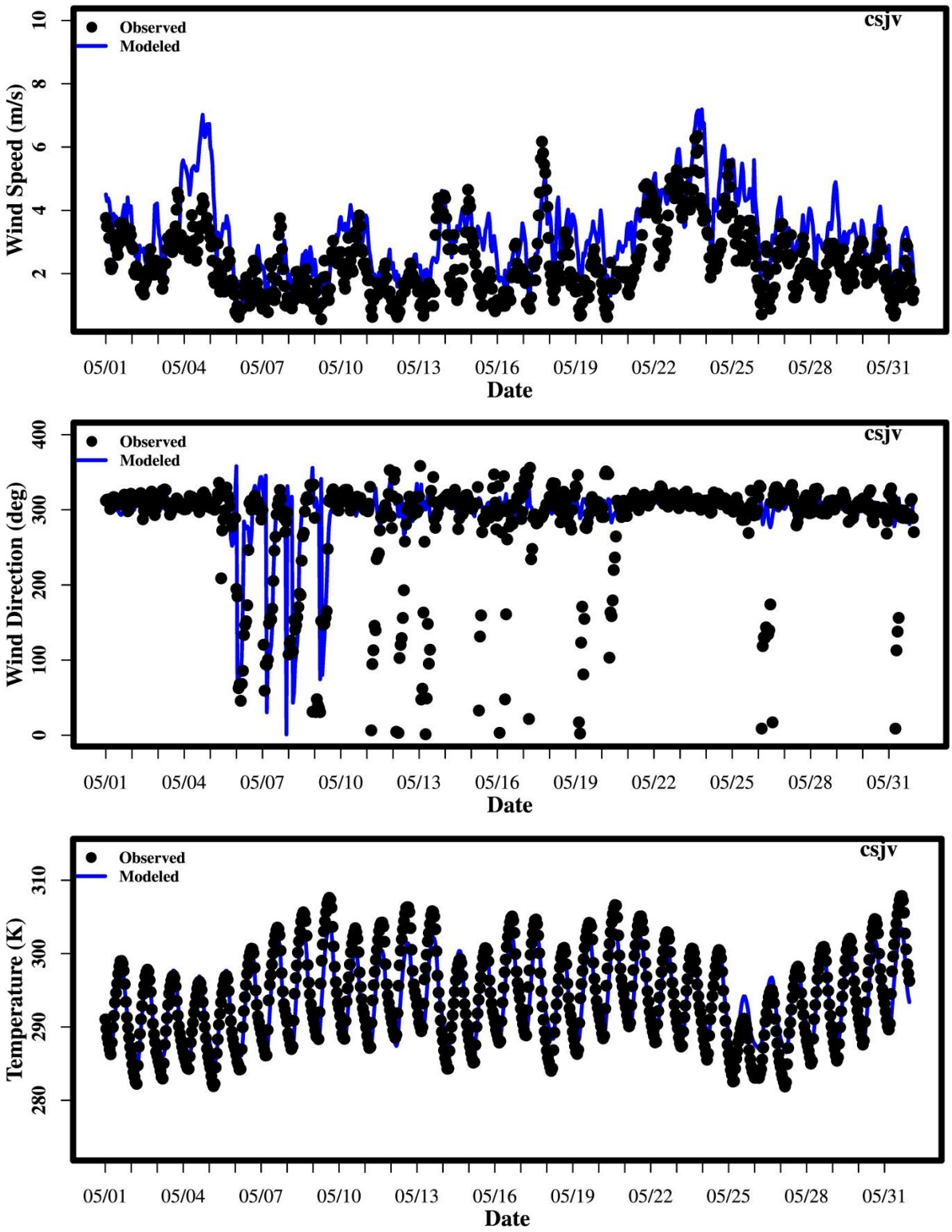


Figure S. 2 Time series of wind speed, direction, and temperature for the Central San Joaquin Valley in May 2012.

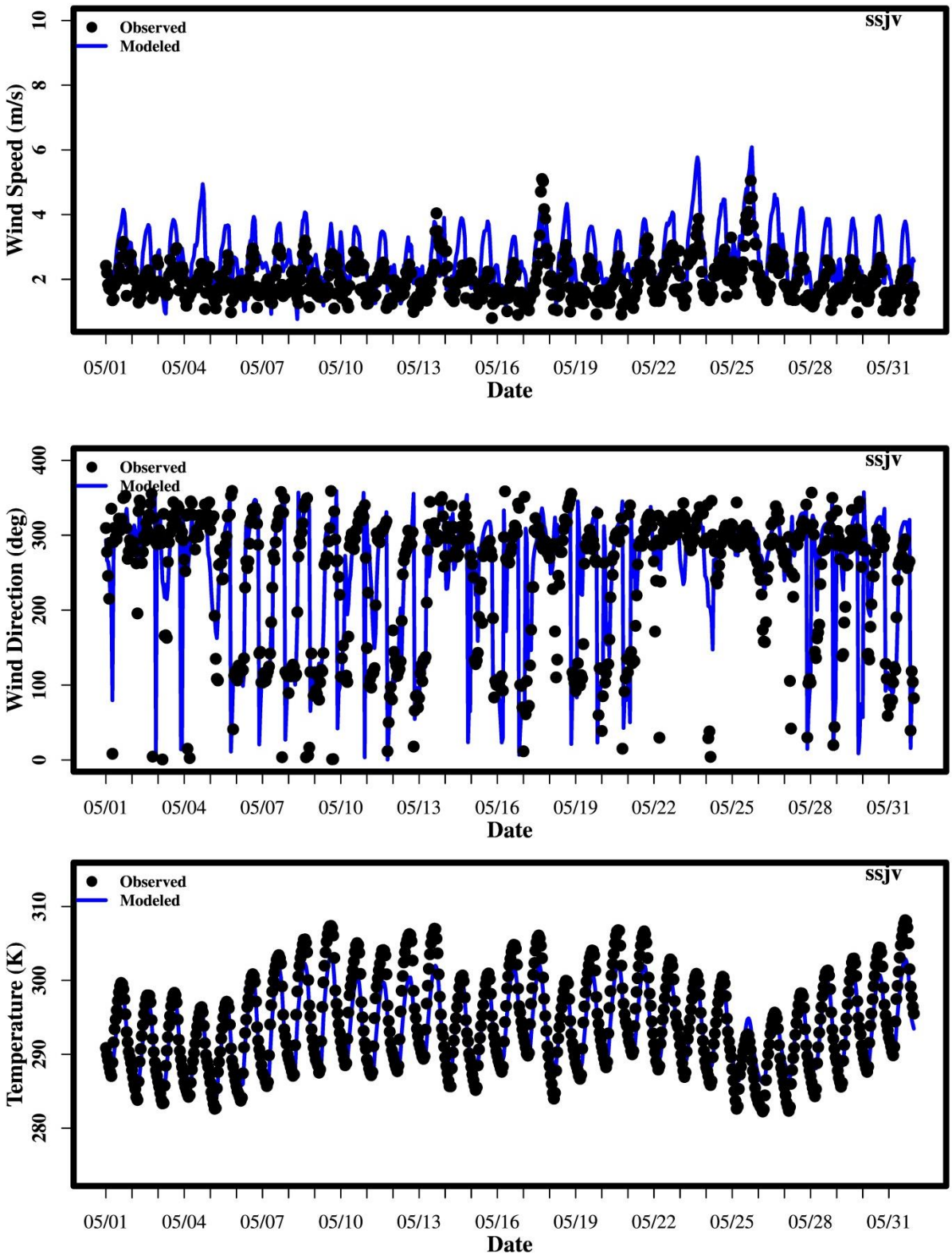


Figure S. 3 Time series of wind speed, direction, and temperature for the Southern San Joaquin Valley in May 2012.

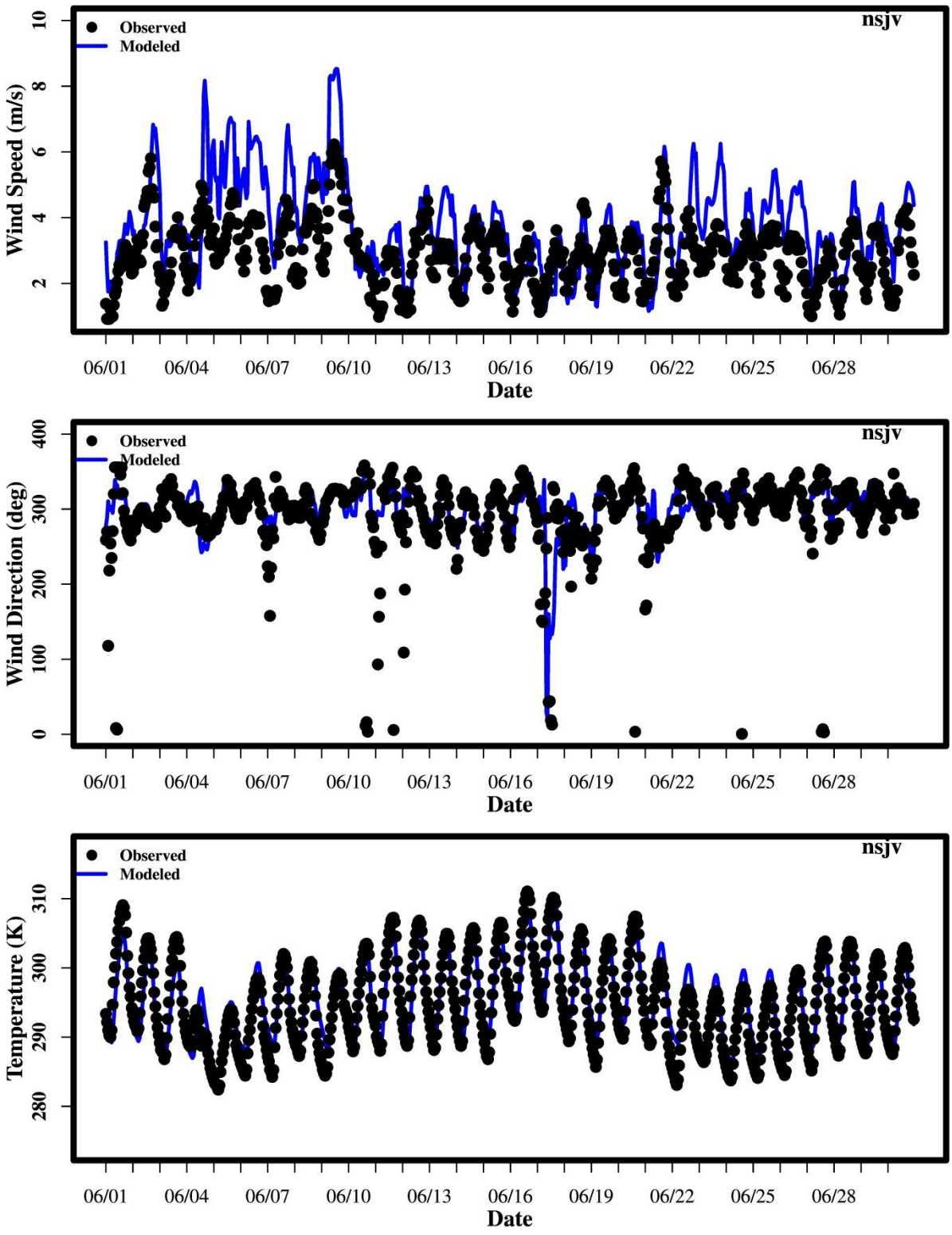


Figure S. 4 Time series of wind speed, direction, and temperature for the Northern San Joaquin Valley in June 2012.

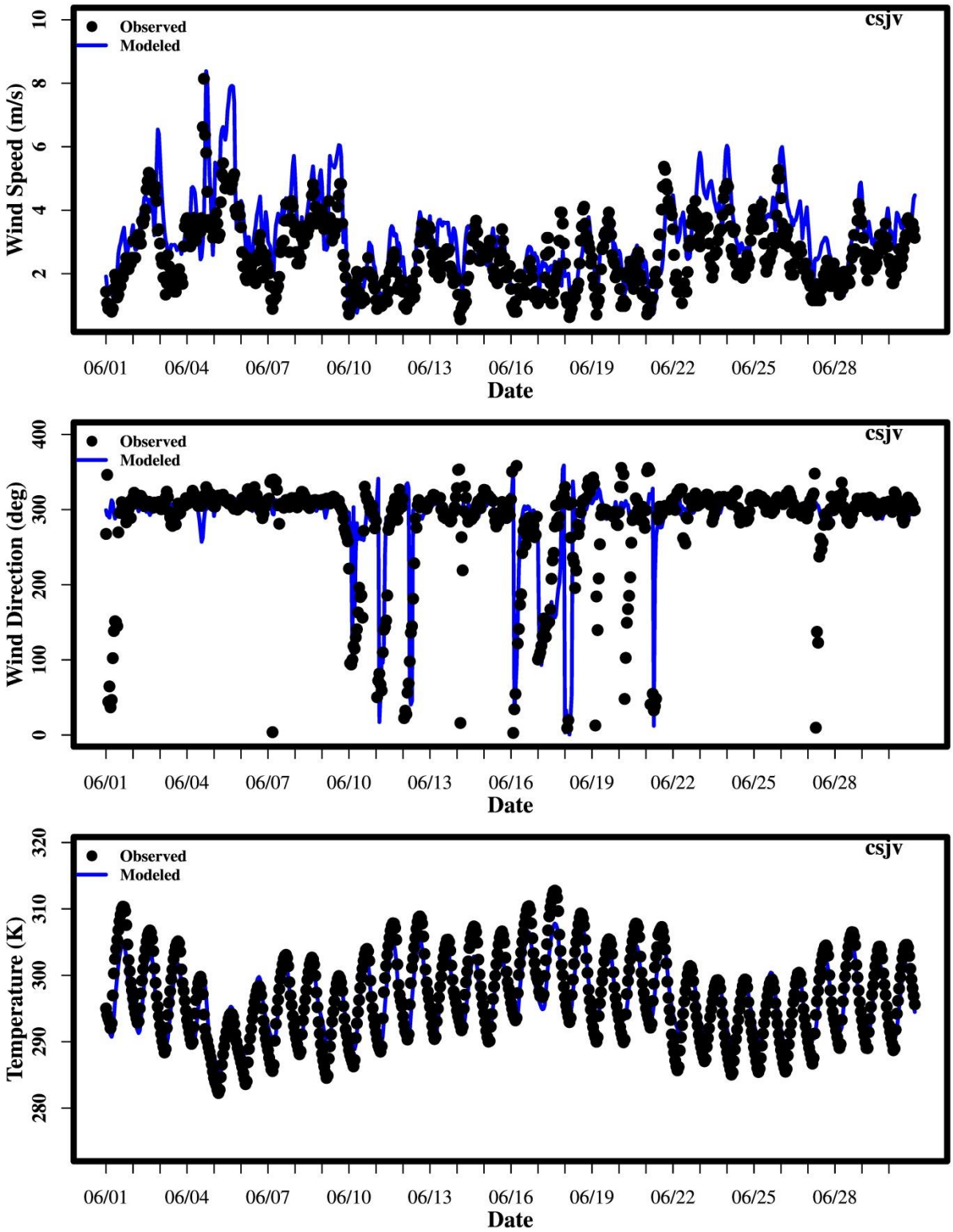


Figure S. 5 Time series of wind speed, direction, and temperature for the Central San Joaquin Valley in June 2012.

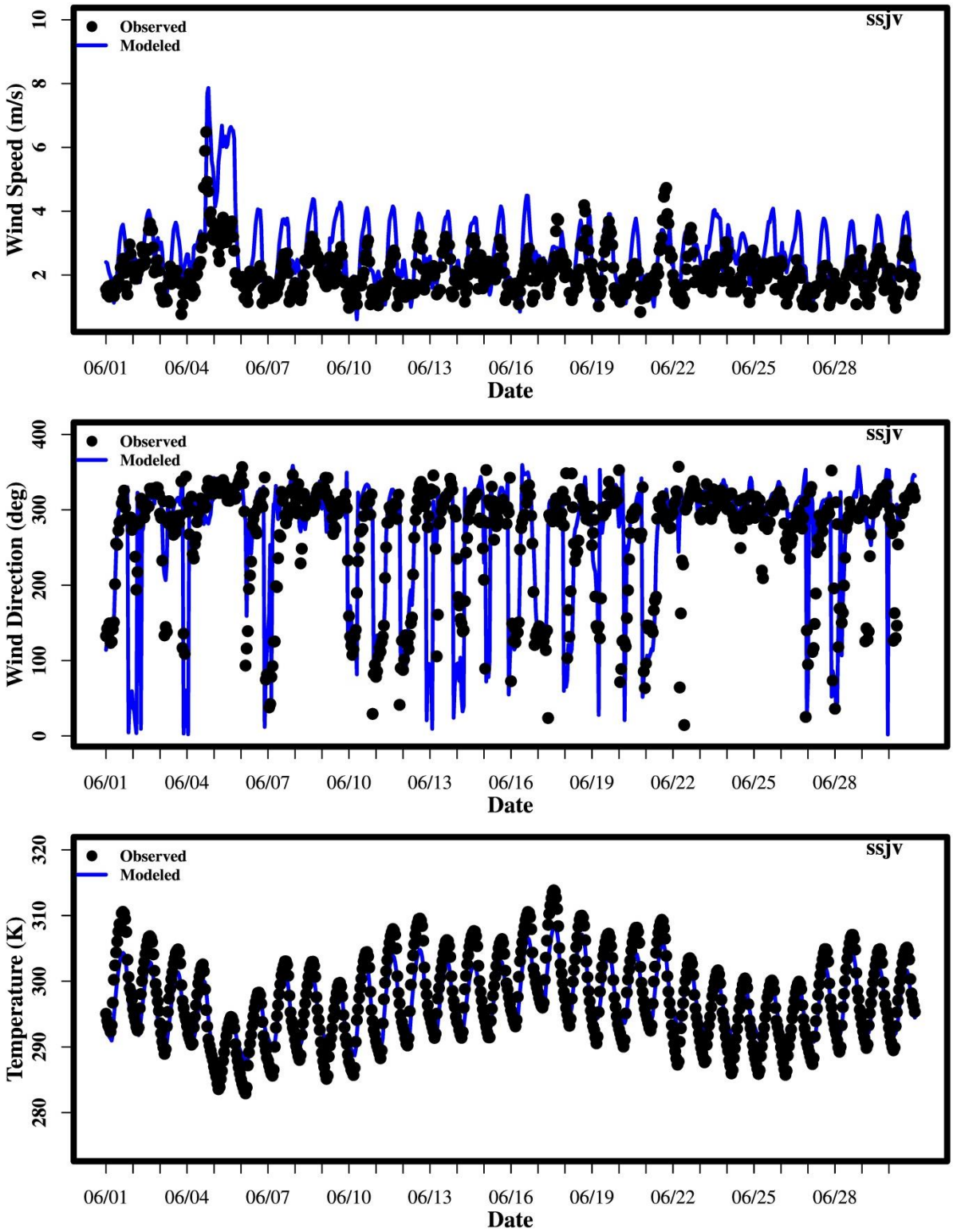


Figure S. 6 Time series of wind speed, direction, and temperature for the Southern San Joaquin Valley in June 2012.

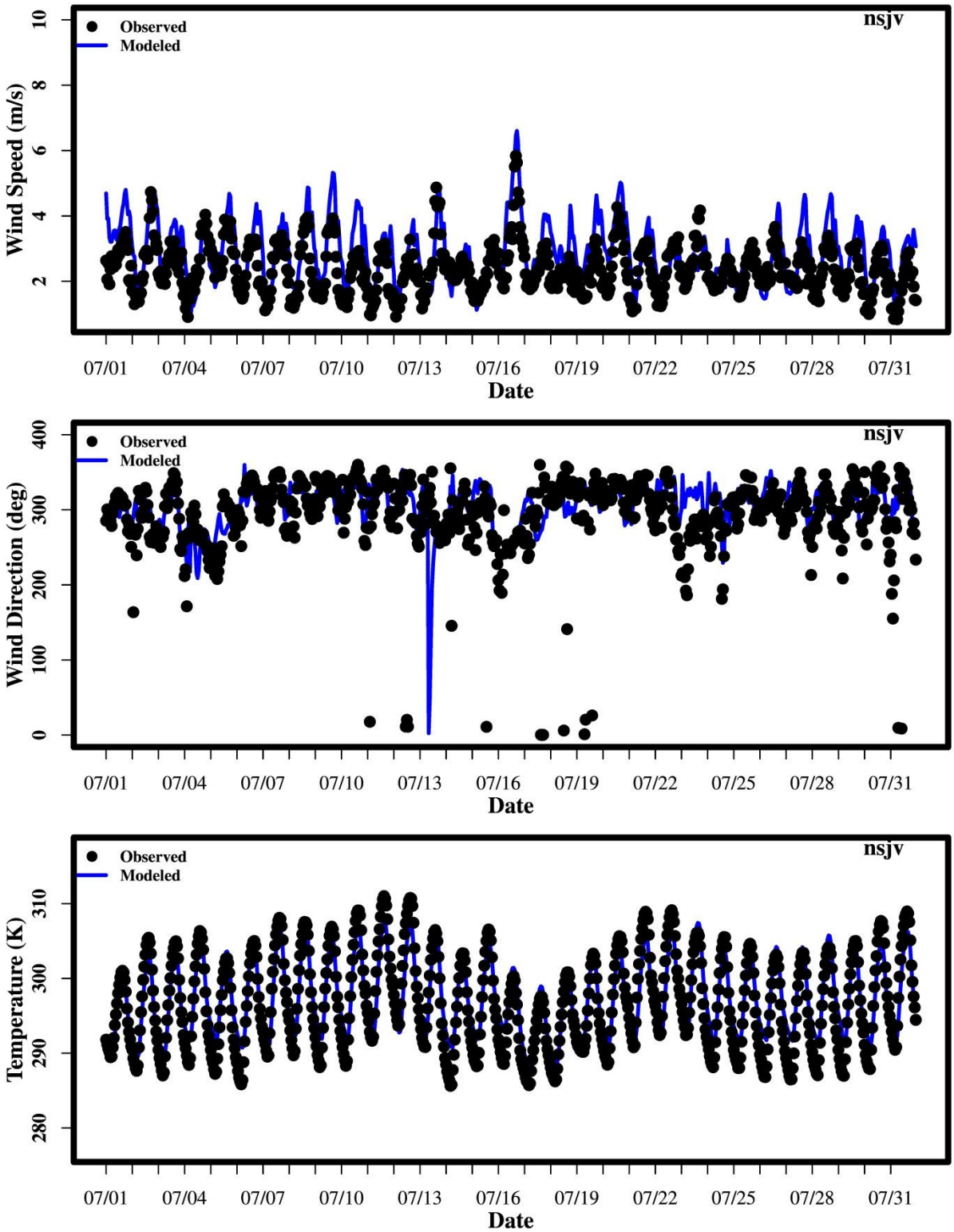


Figure S. 7 Time series of wind speed, direction, and temperature for the Northern San Joaquin Valley in July 2012.

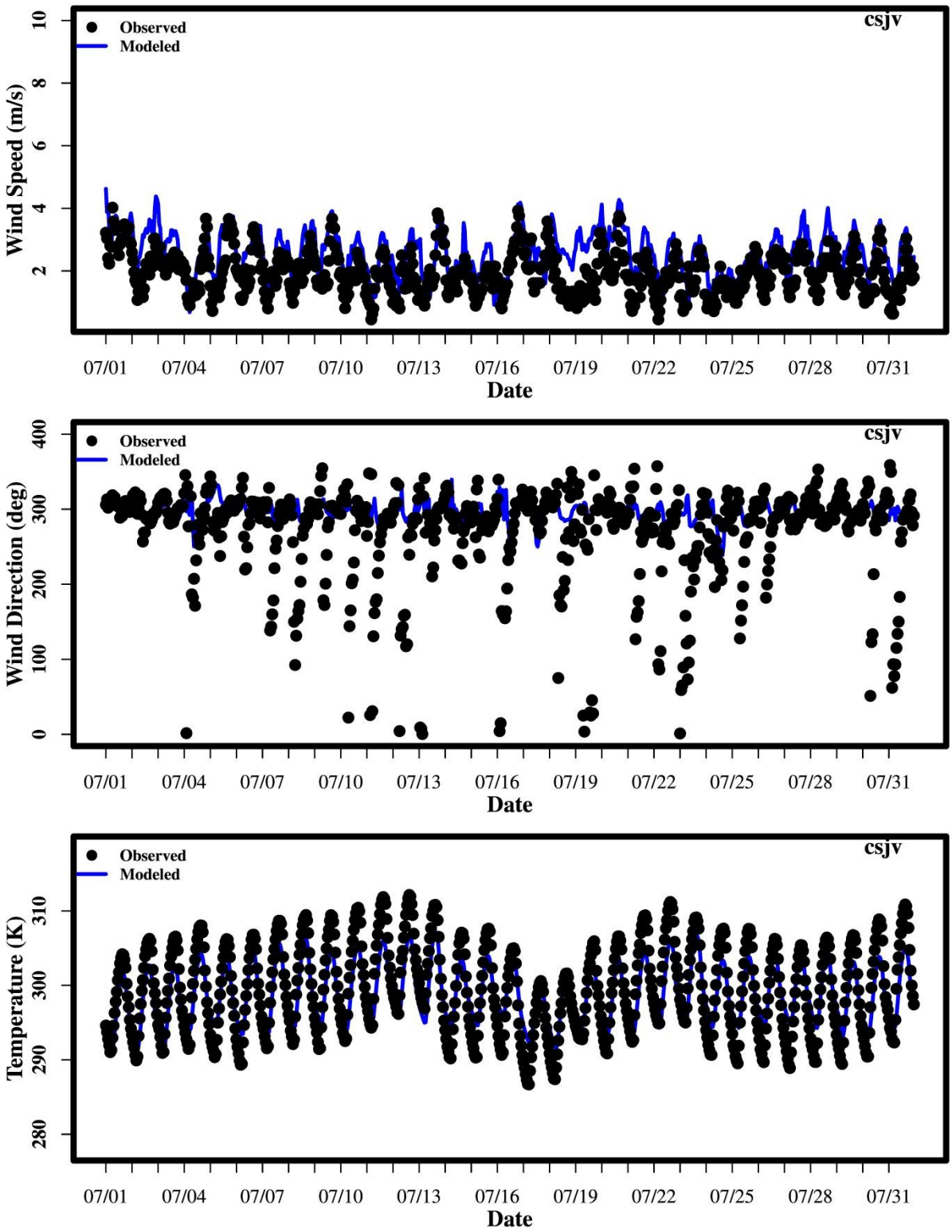


Figure S. 8 Time series of wind speed, direction, and temperature for the Central San Joaquin Valley in July 2012.

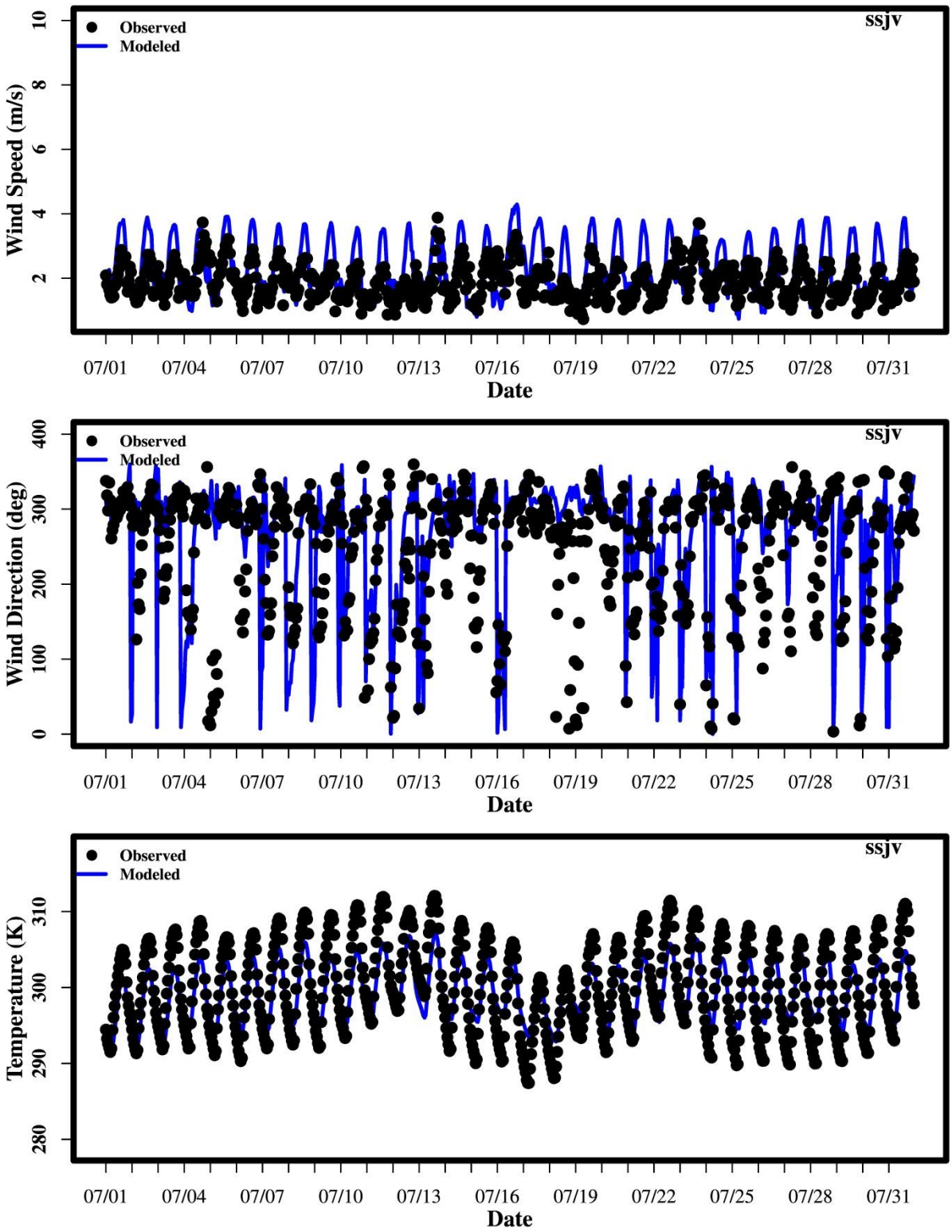


Figure S. 9 Time series of wind speed, direction, and temperature for the Southern San Joaquin Valley in July 2012.

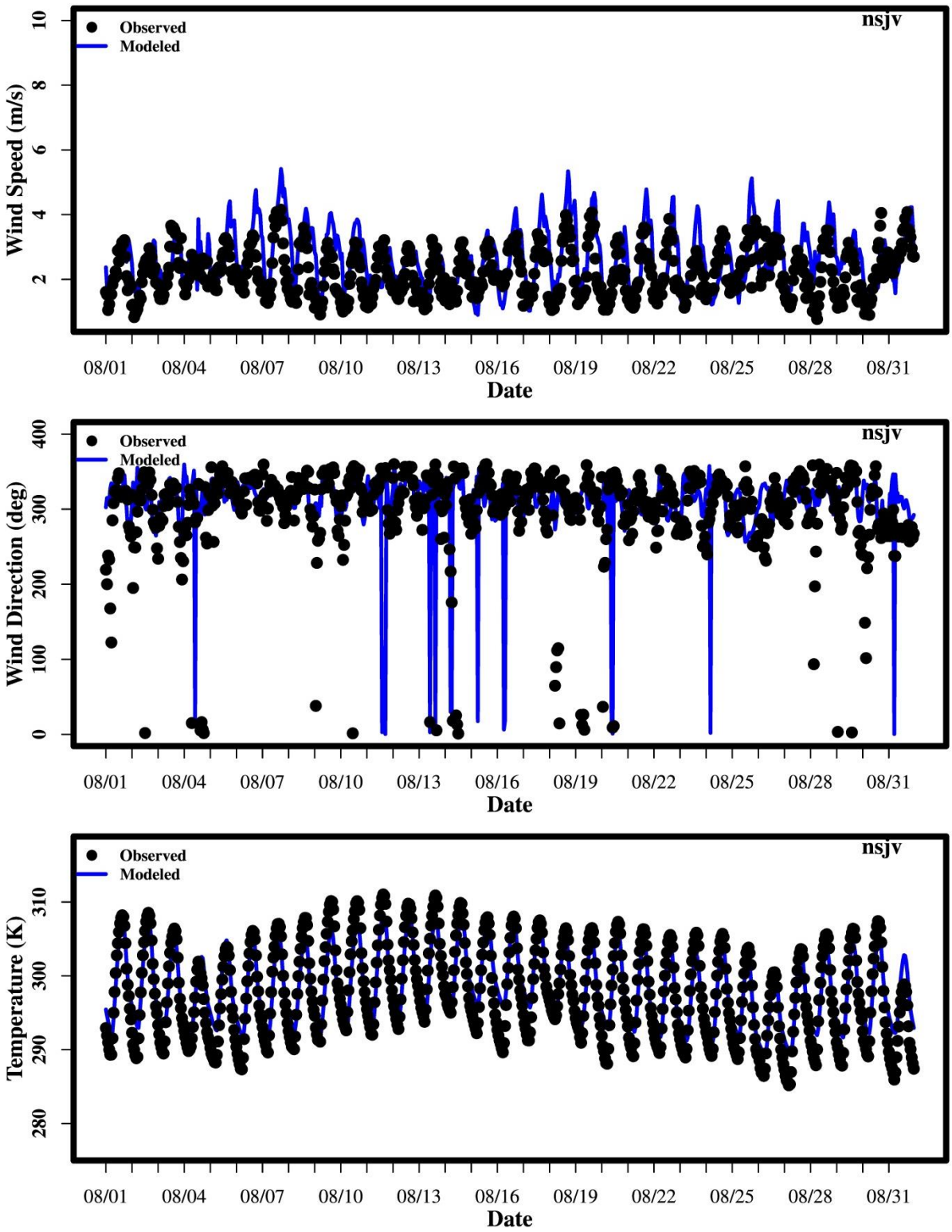


Figure S. 10 Time series of wind speed, direction, and temperature for the Northern San Joaquin Valley in August 2012.

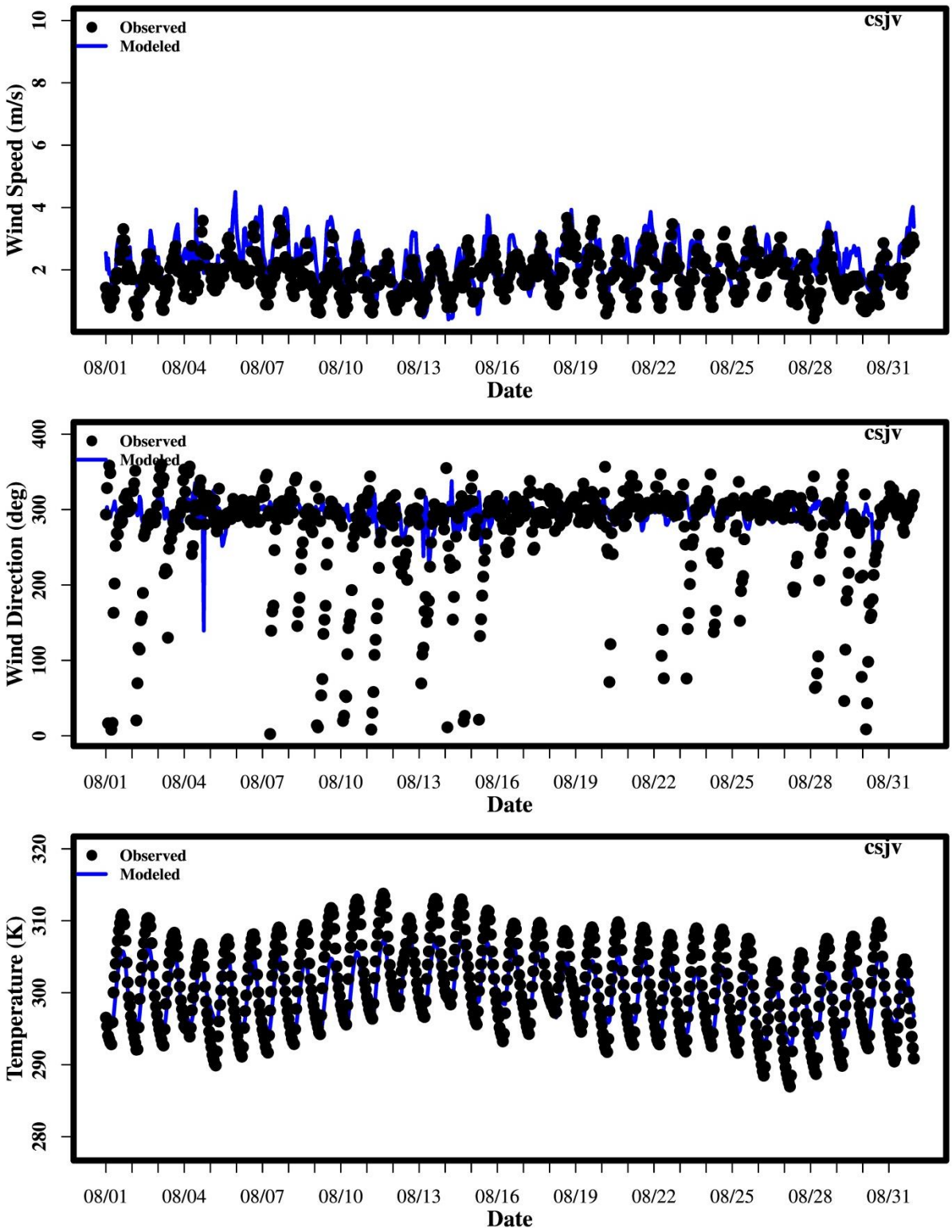


Figure S. 11 Time series of wind speed, direction, and temperature for the Central San Joaquin Valley in August 2012.

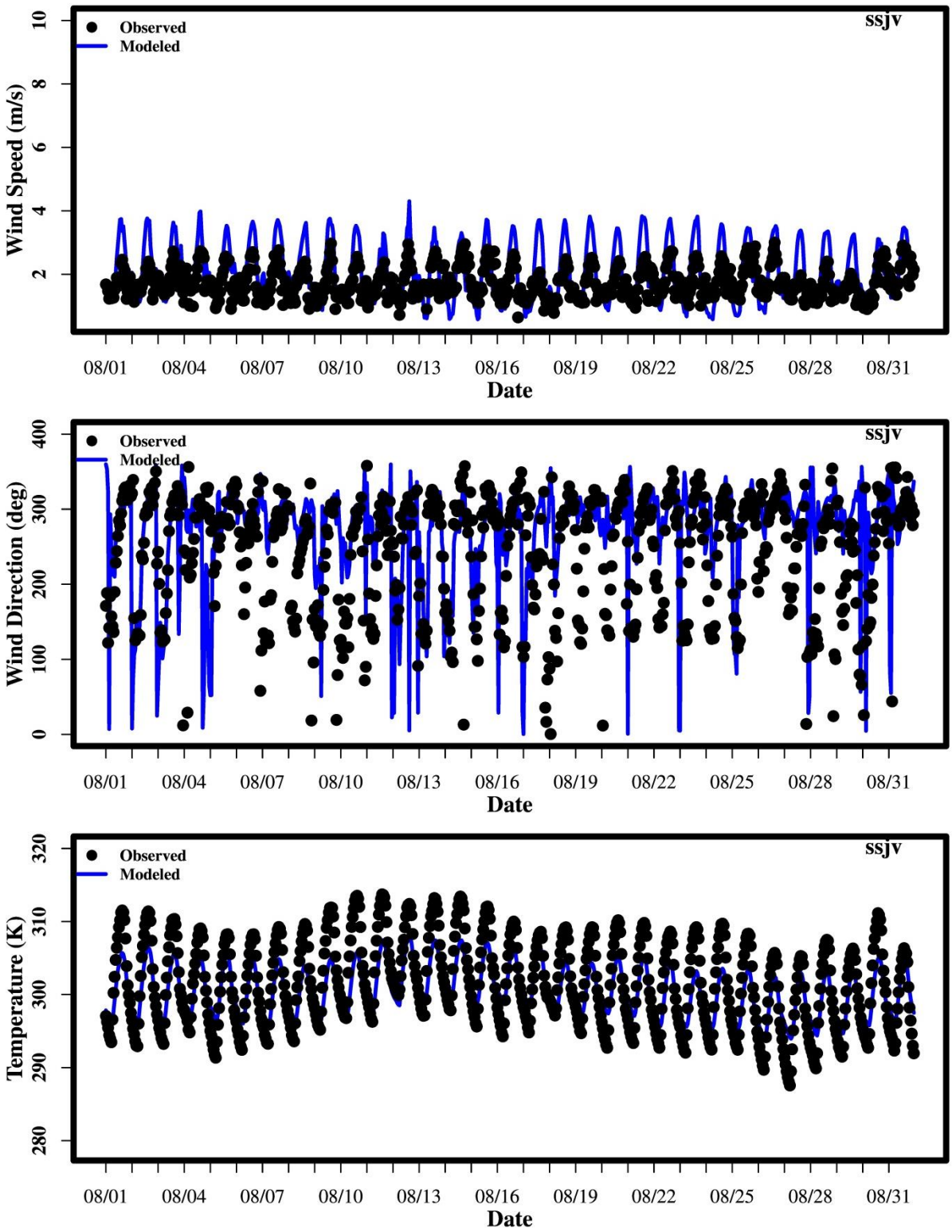


Figure S. 12 Time series of wind speed, direction, and temperature for the Southern San Joaquin Valley in August 2012.

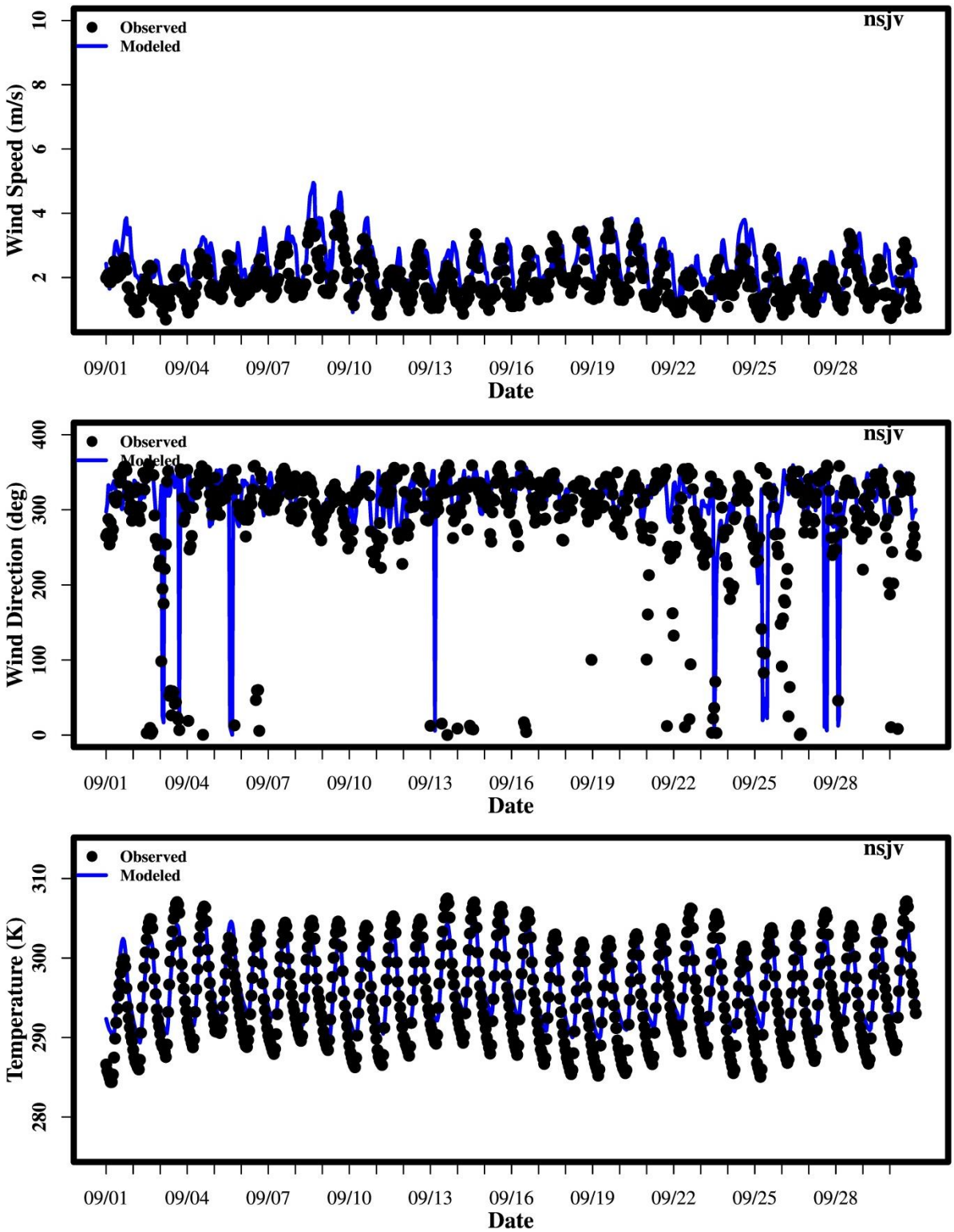


Figure S. 13 Time series of wind speed, direction, and temperature for the Northern San Joaquin Valley in September 2012.

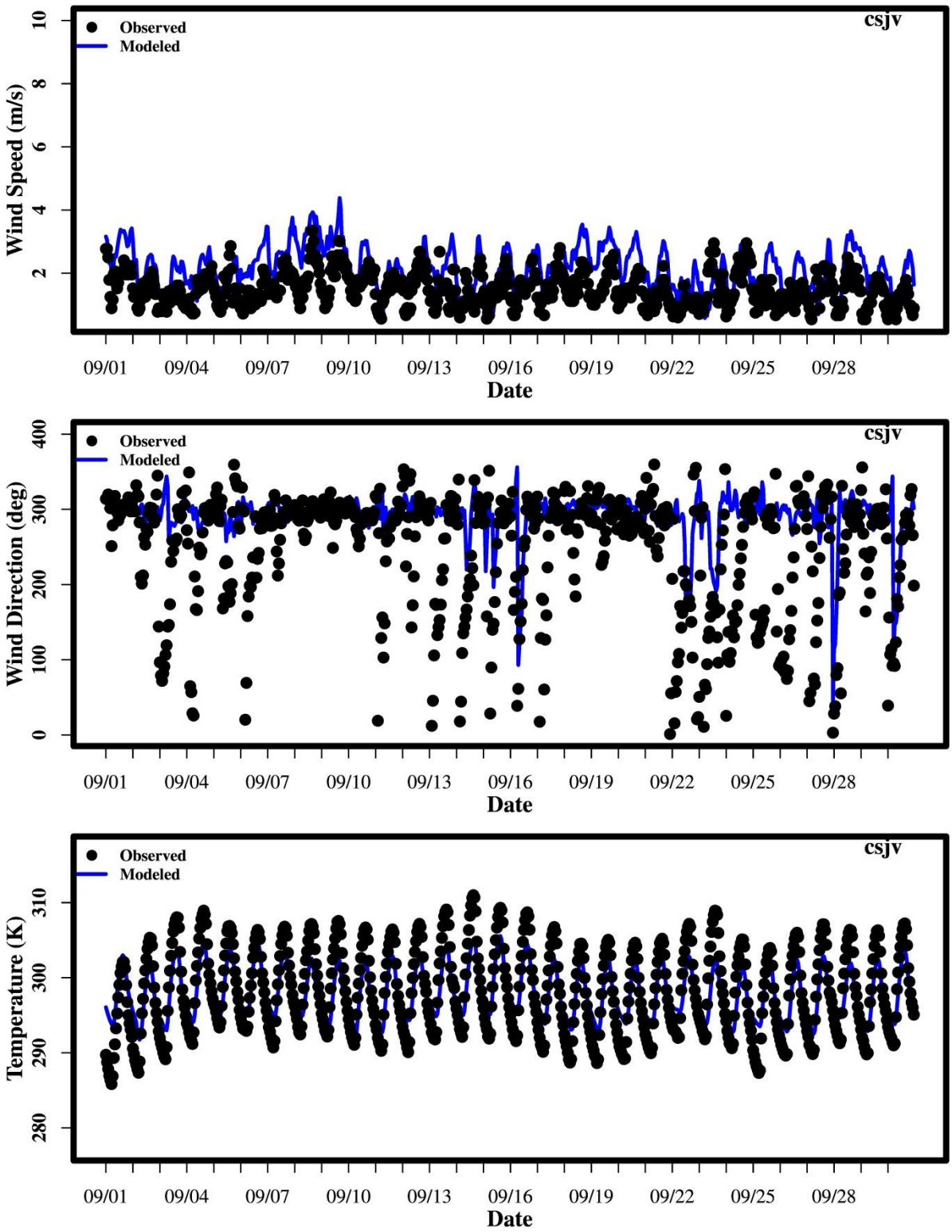


Figure S. 14 Time series of wind speed, direction, and temperature for the Central San Joaquin Valley in September 2012.

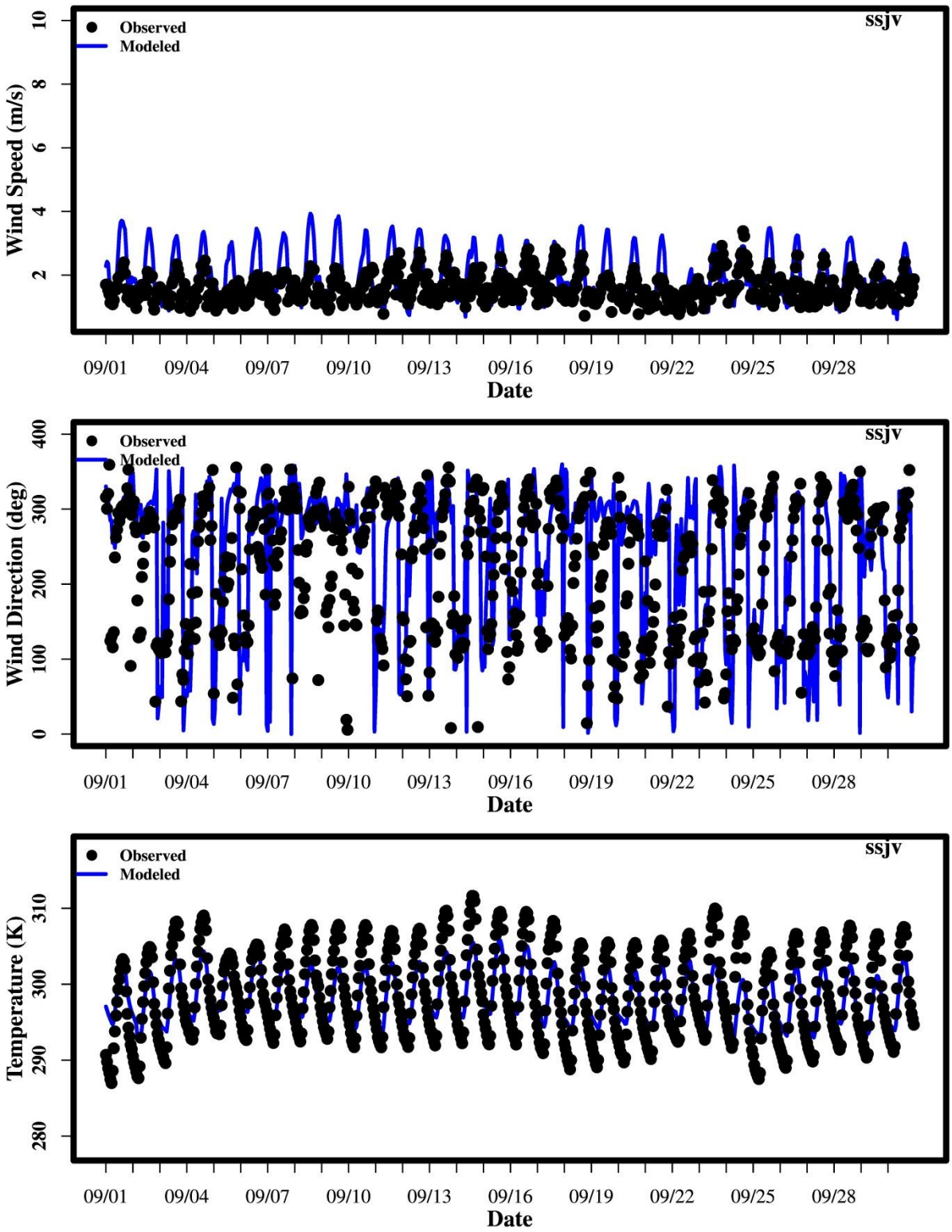


Figure S. 15 Time series of wind speed, direction, and temperature for the Southern San Joaquin Valley in September 2012.

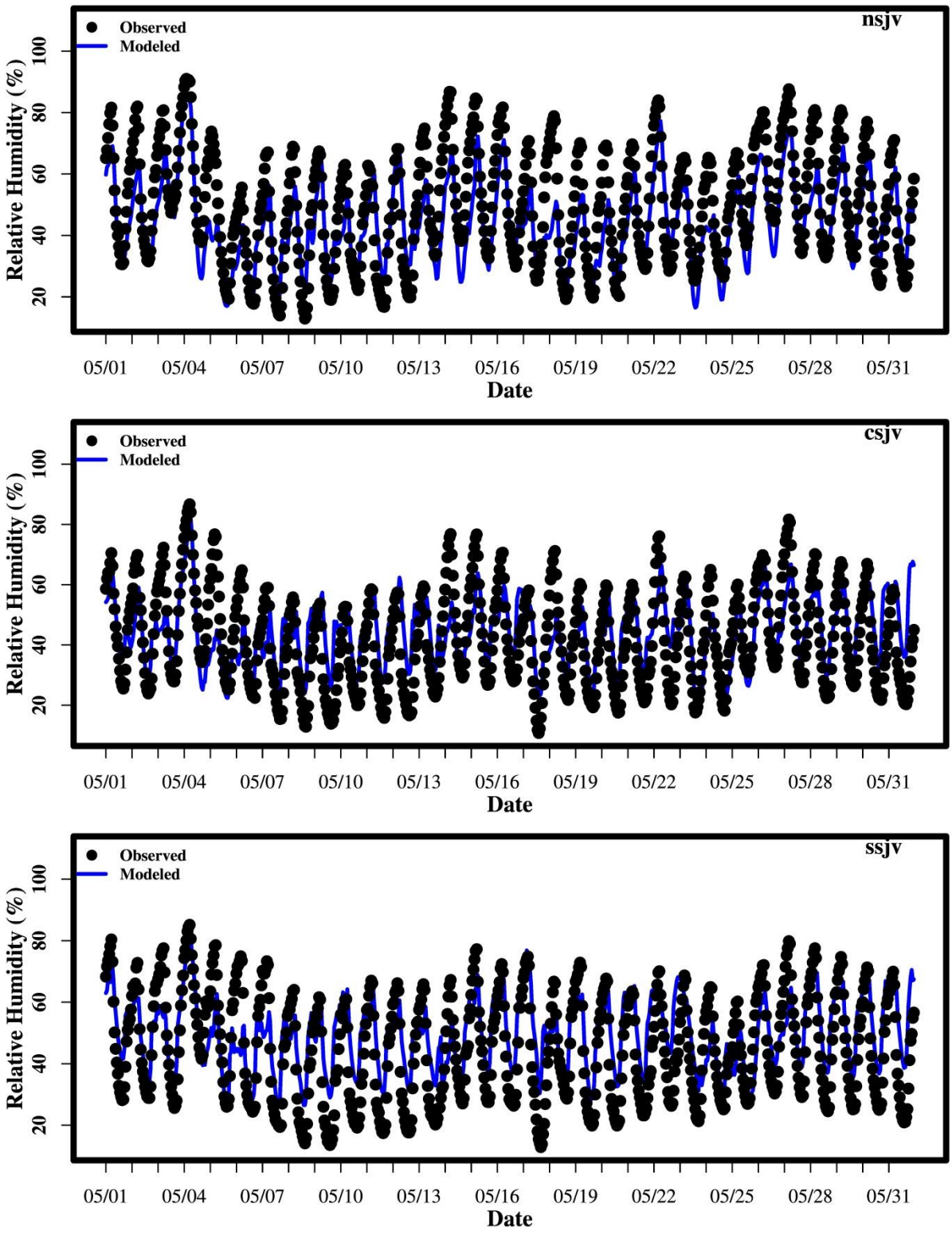


Figure S. 16 Time series of relative humidity for the (top) Northern SJV, (middle) Central SJV, and (bottom) Southern SJV in May 2012.

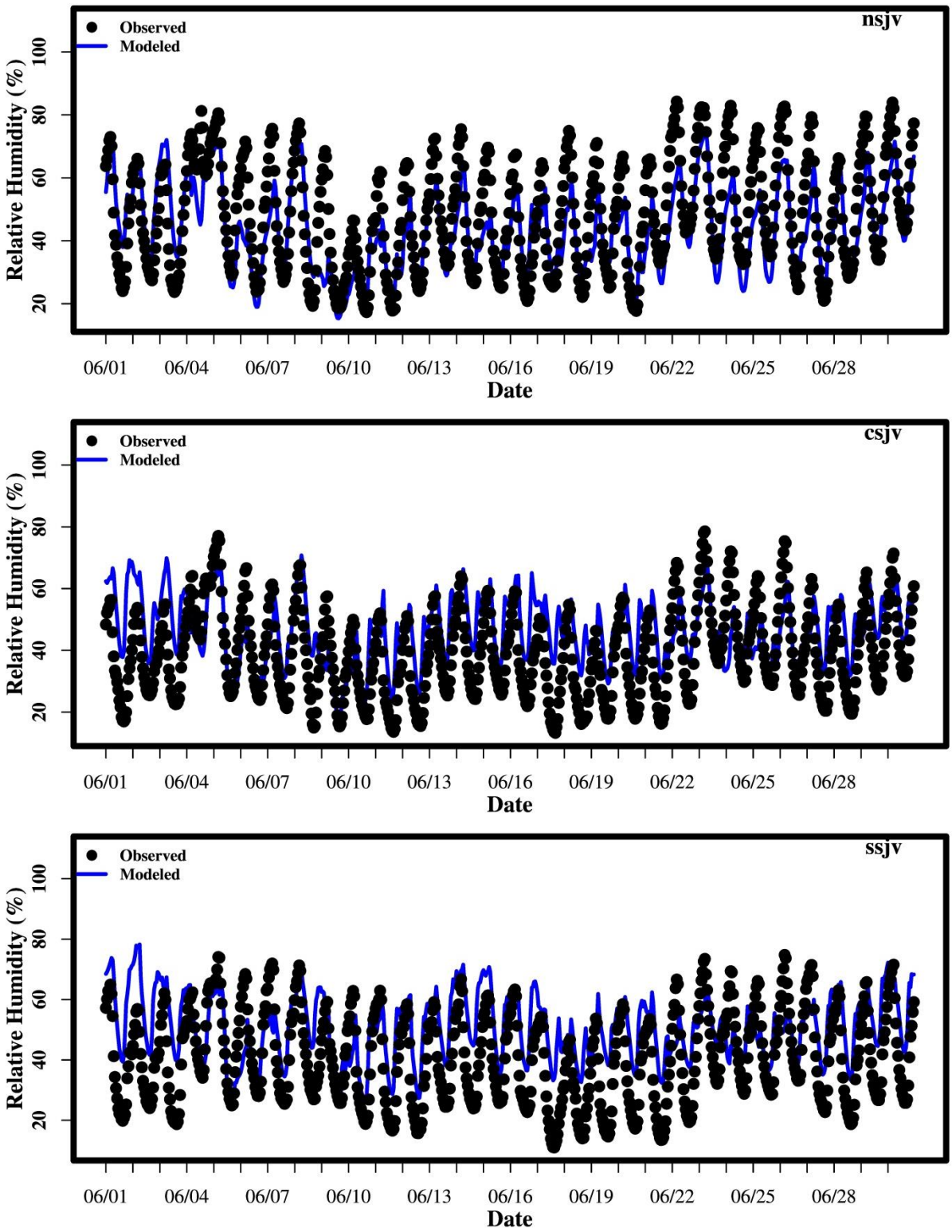


Figure S. 17 Time series of relative humidity for the (top) Northern SJV, (middle) Central SJV, and (bottom) Southern SJV in June 2012.

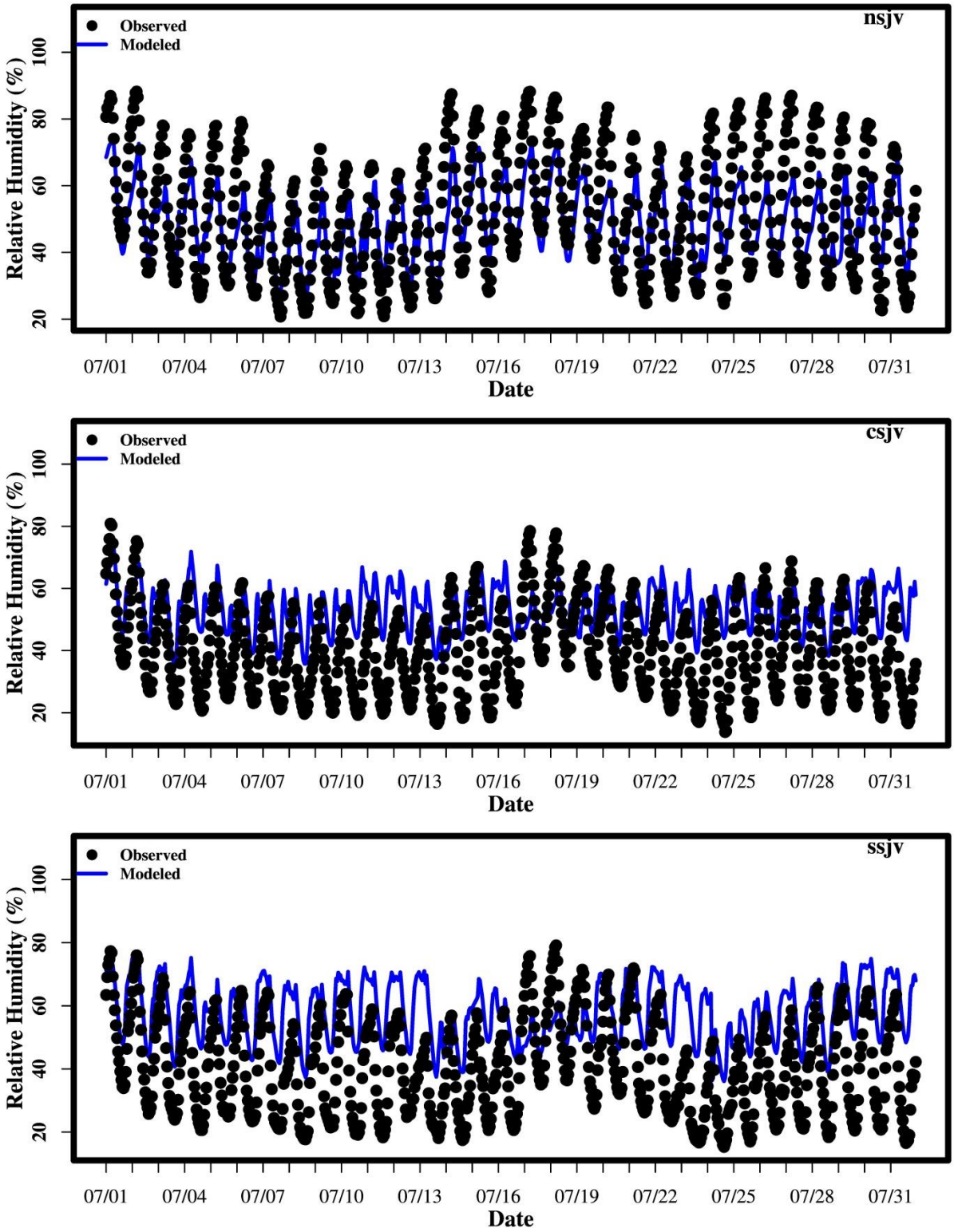


Figure S. 18 Time series of relative humidity for the (top) Northern SJV, (middle) Central SJV, and (bottom) Southern SJV in July 2012.

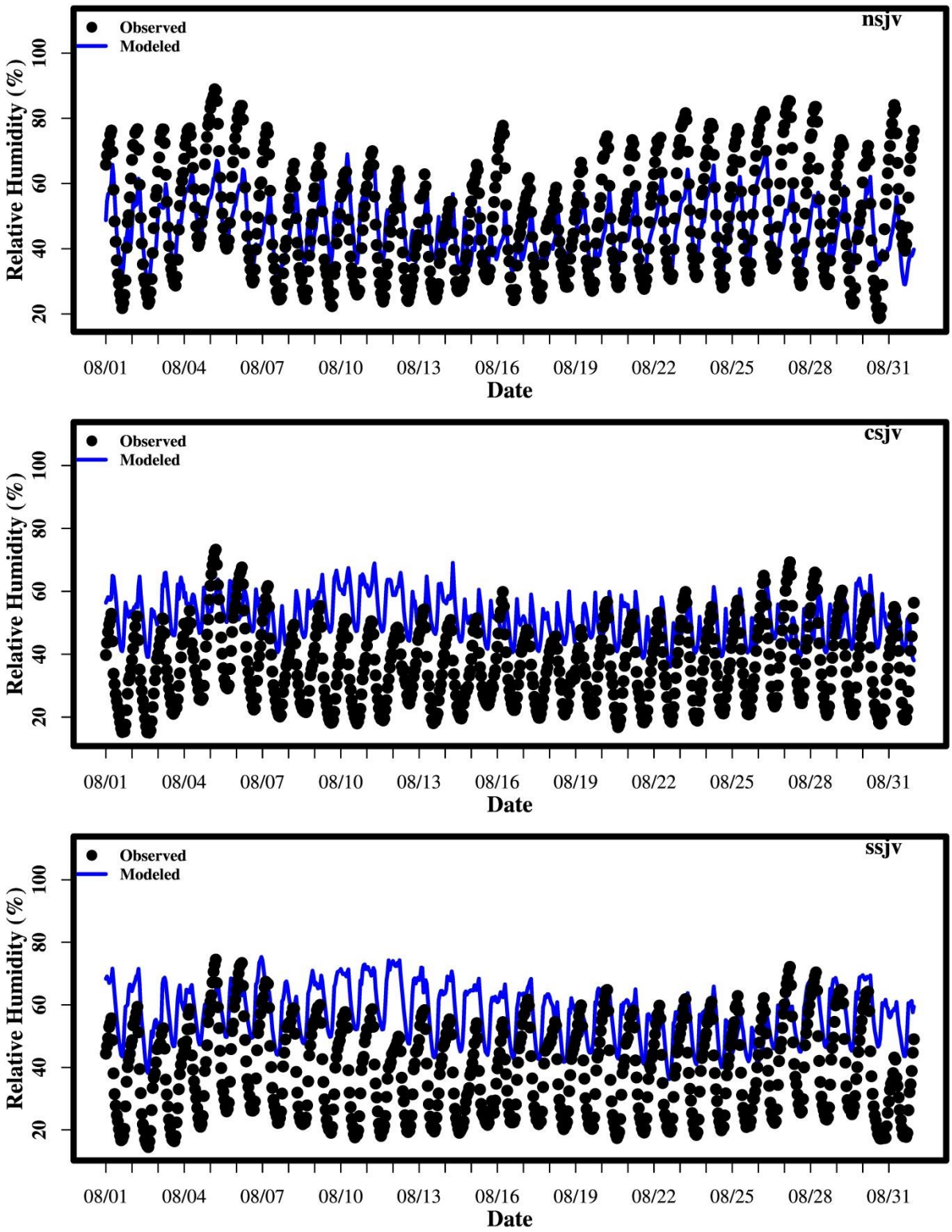


Figure S. 19 Time series of relative humidity for the (top) Northern SJV, (middle) Central SJV, and (bottom) Southern SJV in August 2012.

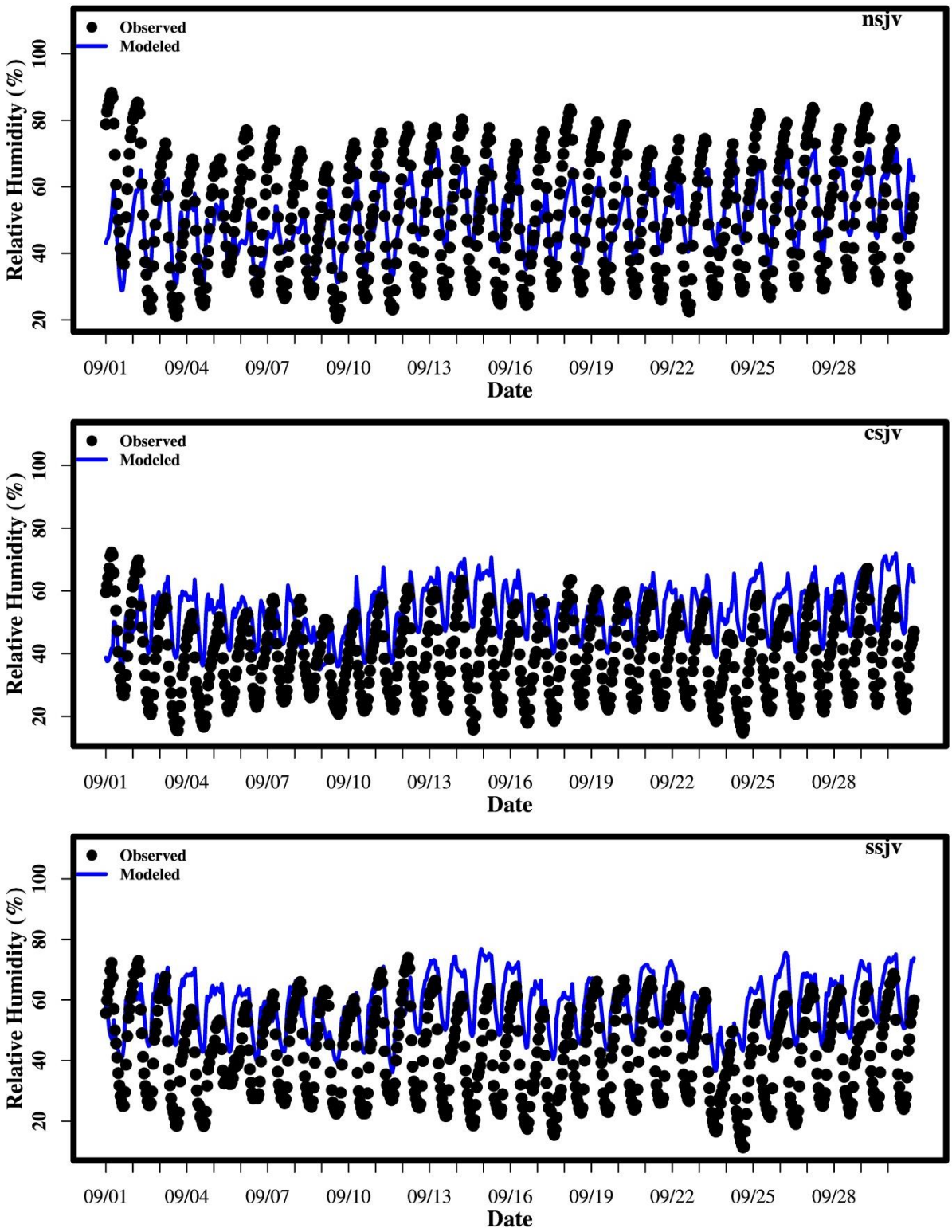


Figure S. 20 Time series of relative humidity for the (top) Northern SJV, (middle) Central SJV, and (bottom) Southern SJV in September 2012.

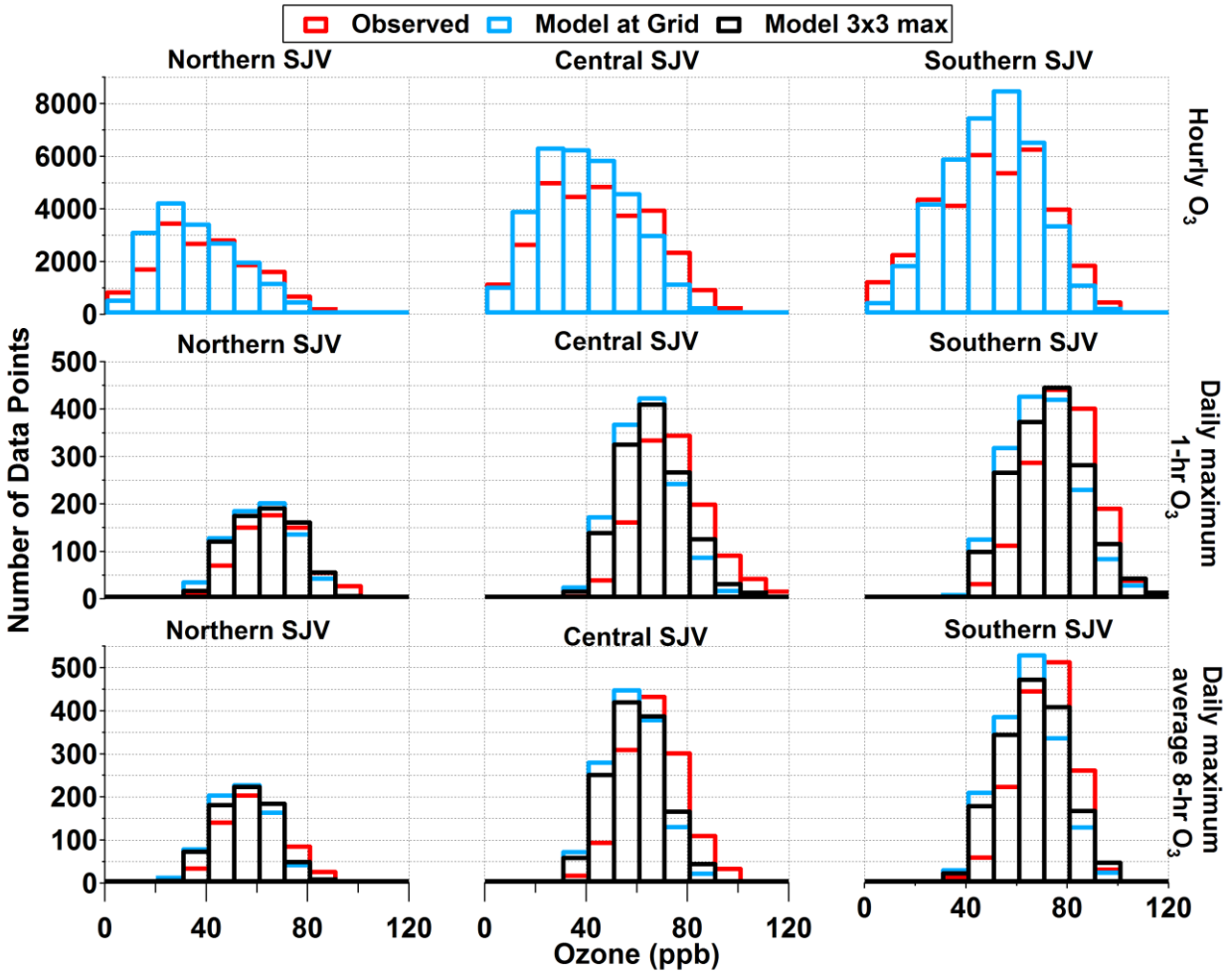


Figure S. 21 Observed and modeled ozone frequency distribution for the ozone season (May – September 2012)

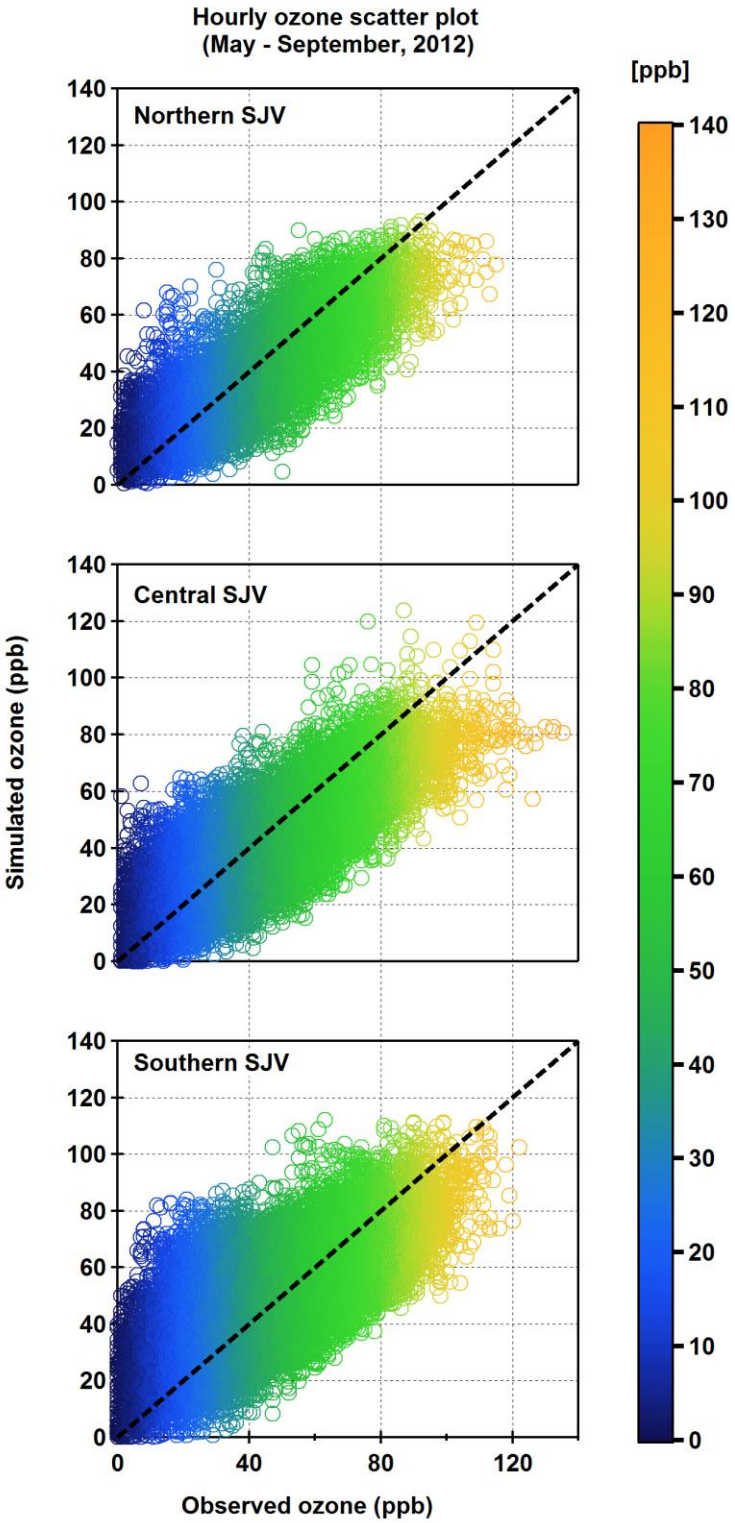


Figure S. 22 Scatter plot of hourly ozone for the ozone season (May – September 2012)

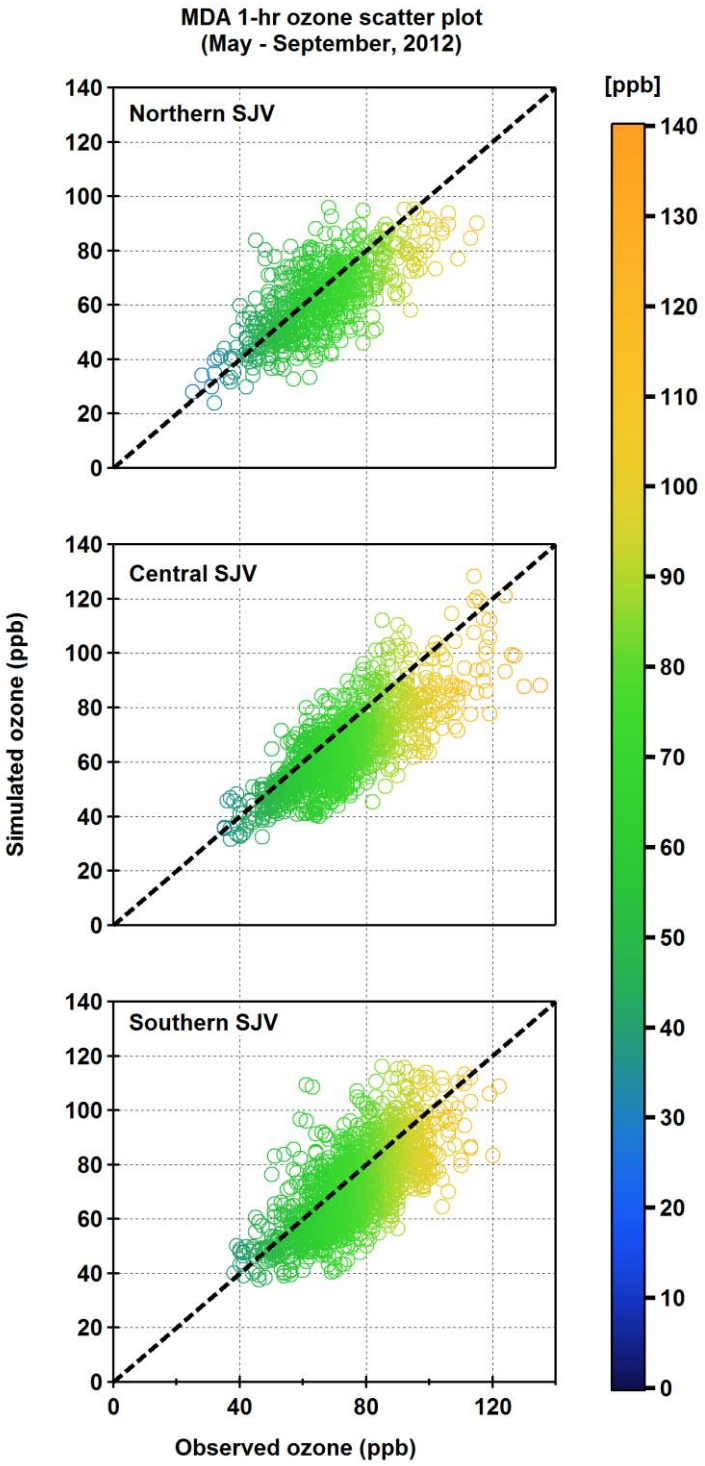


Figure S. 23 Scatter plot of daily maximum 1-hour ozone for the ozone season (May – September 2012)

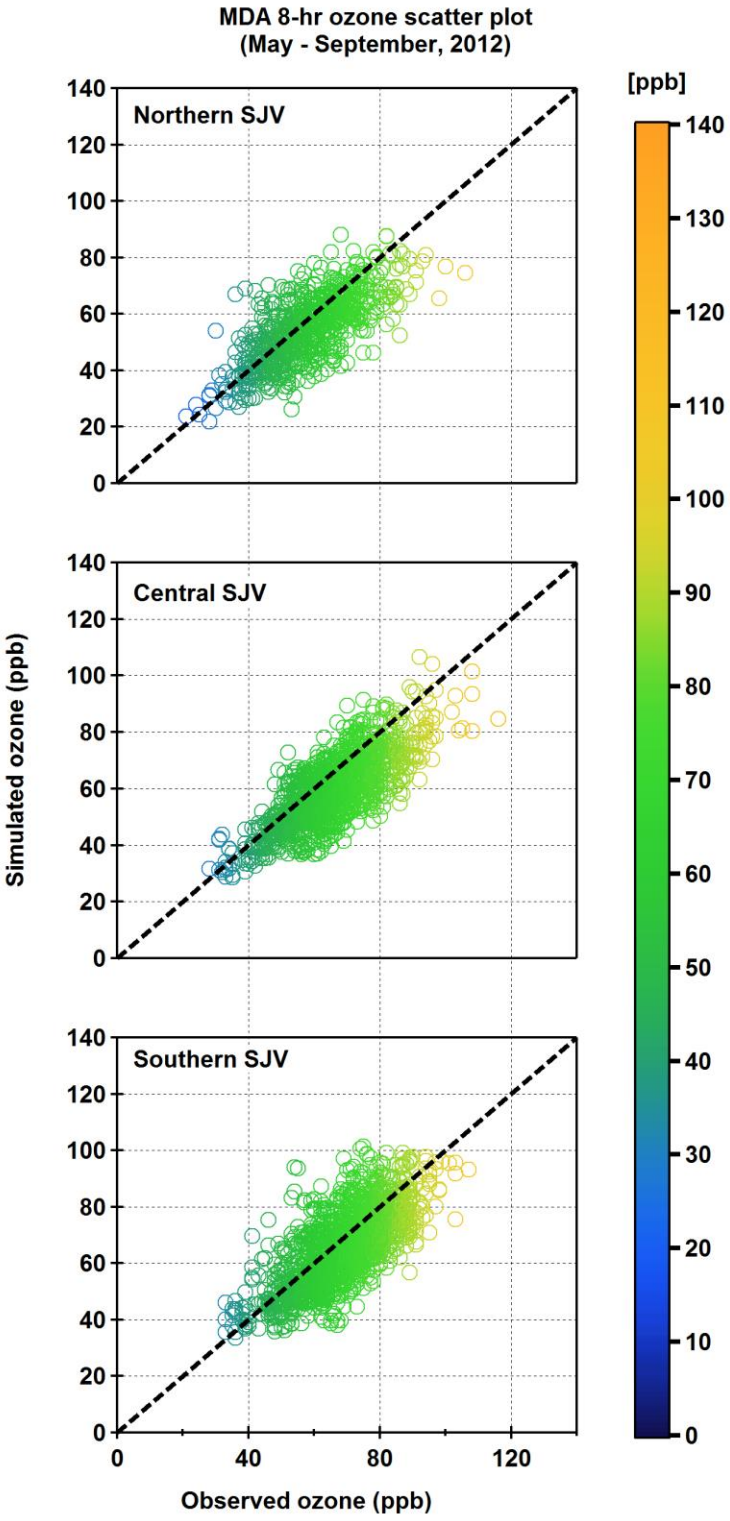


Figure S. 24 Scatter plot of daily maximum 8-hour ozone for the ozone season (May – September 2012)

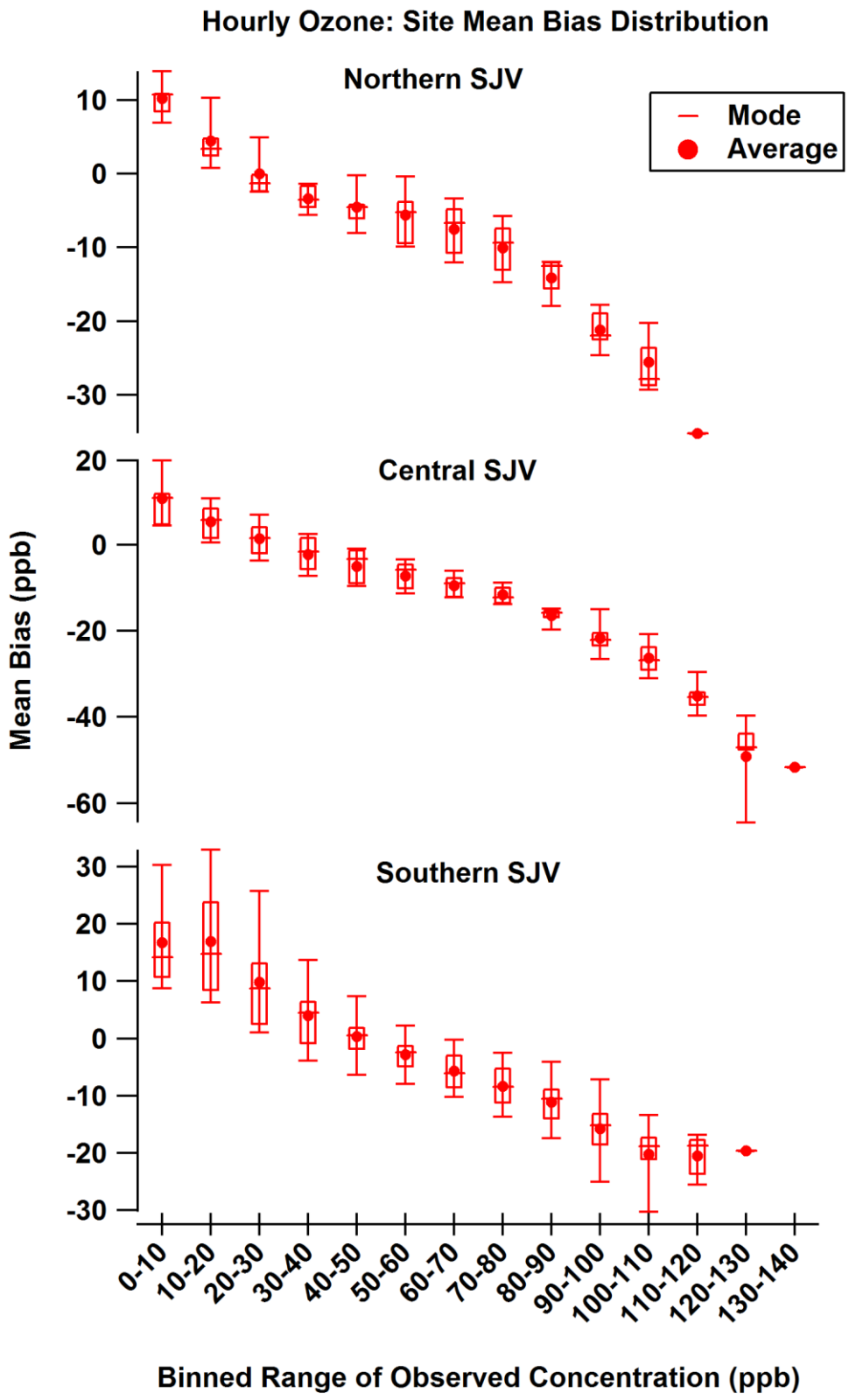


Figure S. 25 Hourly Ozone Site Mean Bias Distribution for the ozone season (May – September 2012)

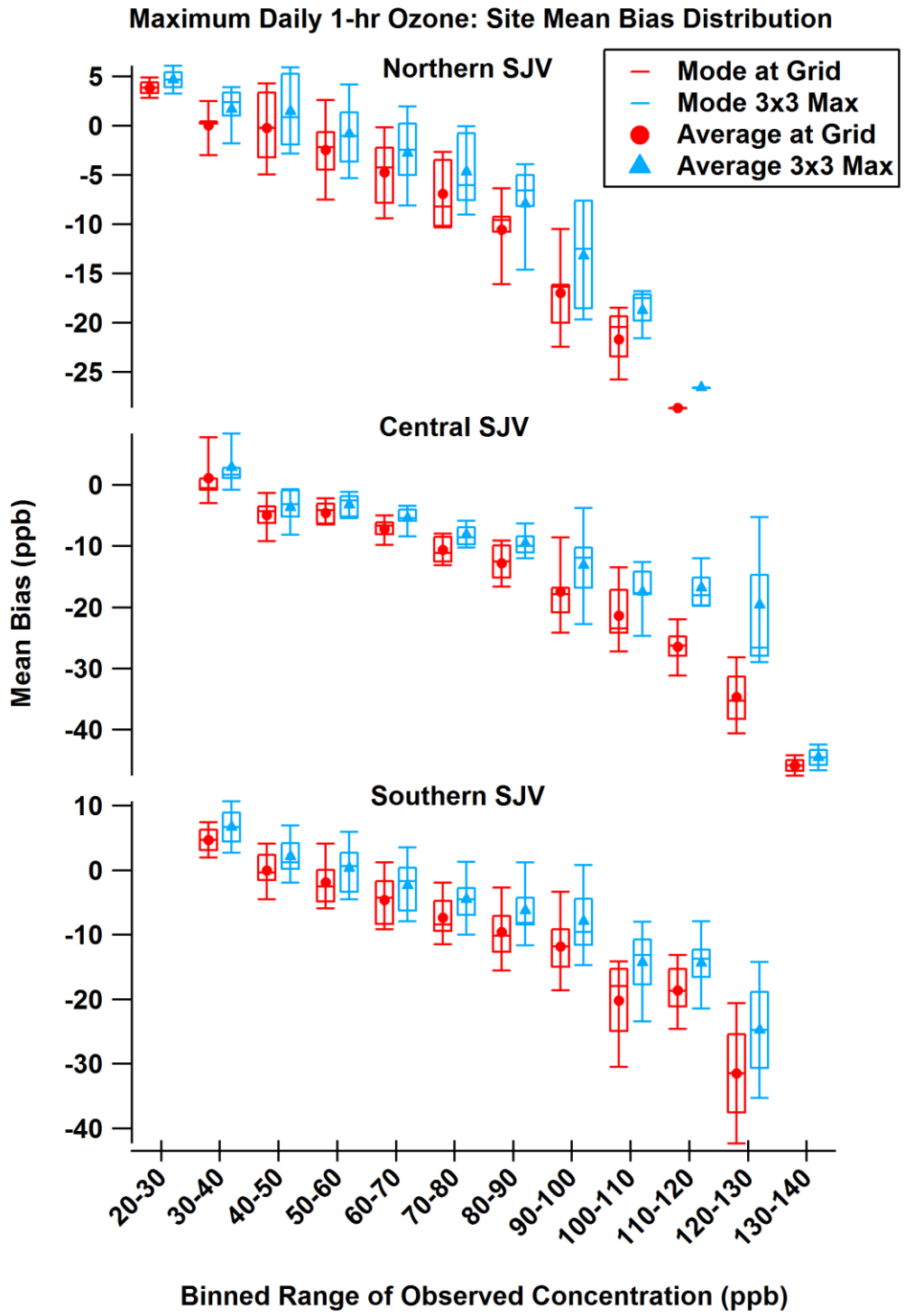


Figure S. 26 Daily Maximum 1-hour Ozone Site Mean Bias Distribution for the ozone season (May – September 2012)

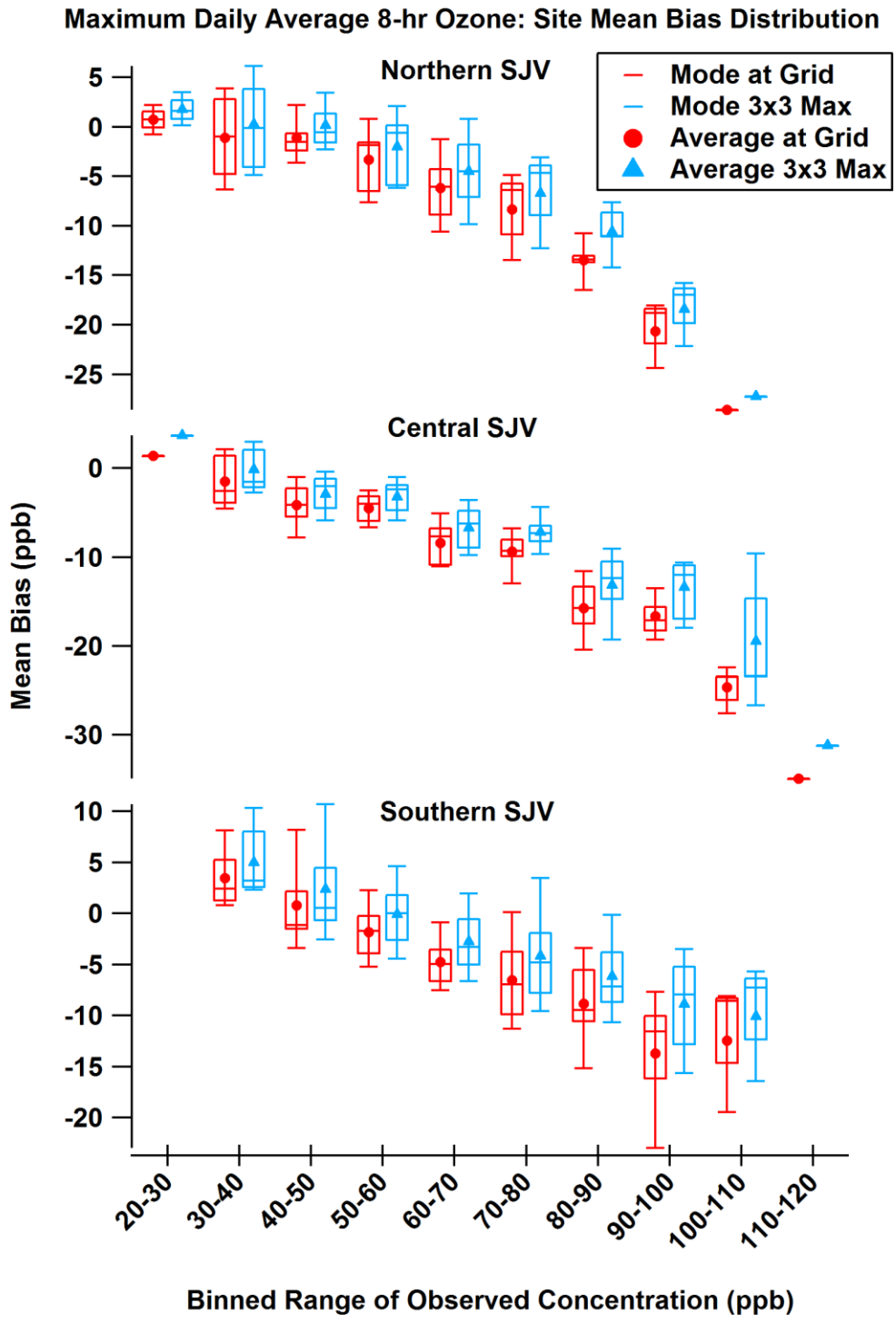


Figure S. 27 Daily Maximum Average 8-hour Ozone Site Mean Bias Distribution for the ozone season (May – September 2012)

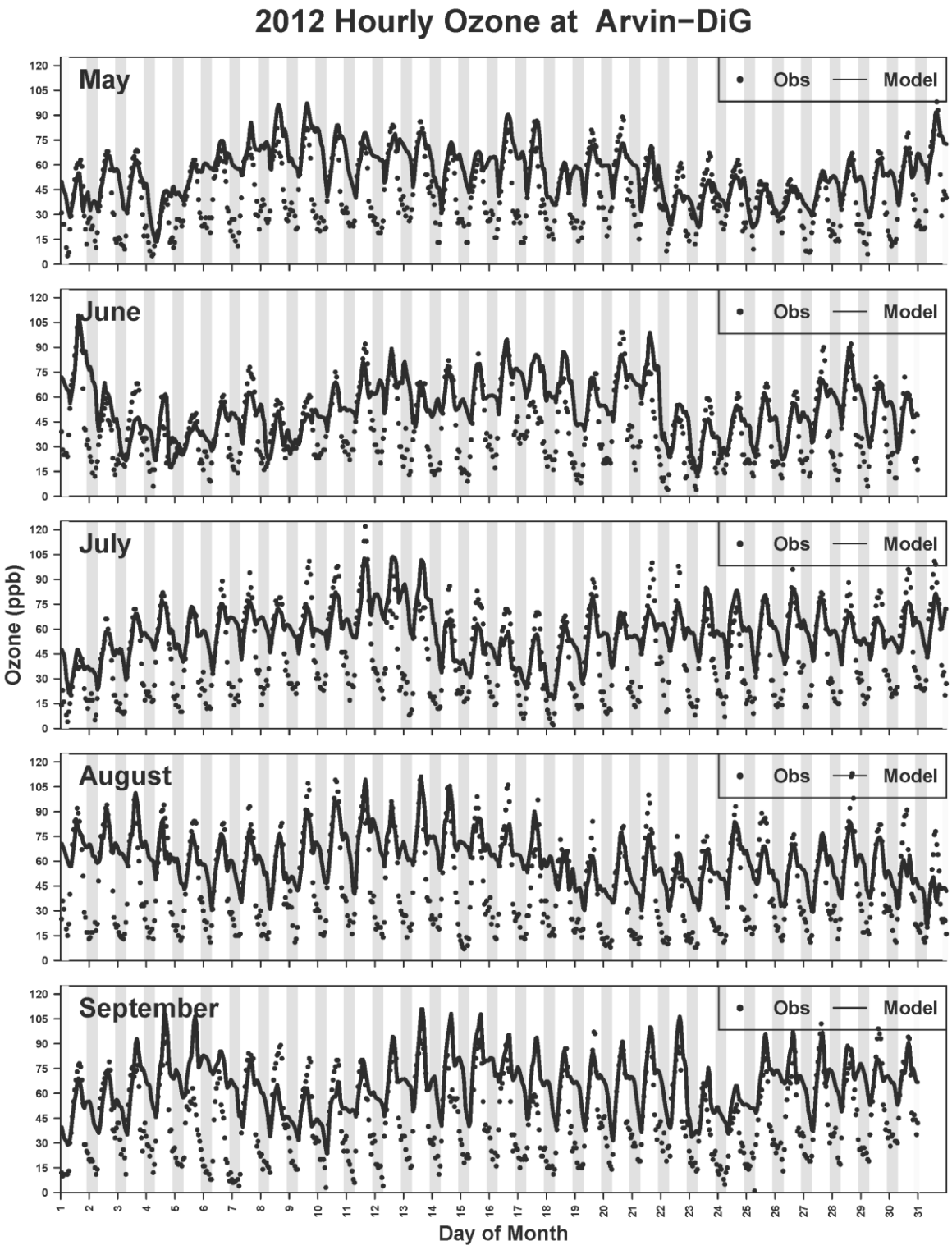


Figure S. 28 Time-series of hourly ozone at Arvin-Di Giorgio.

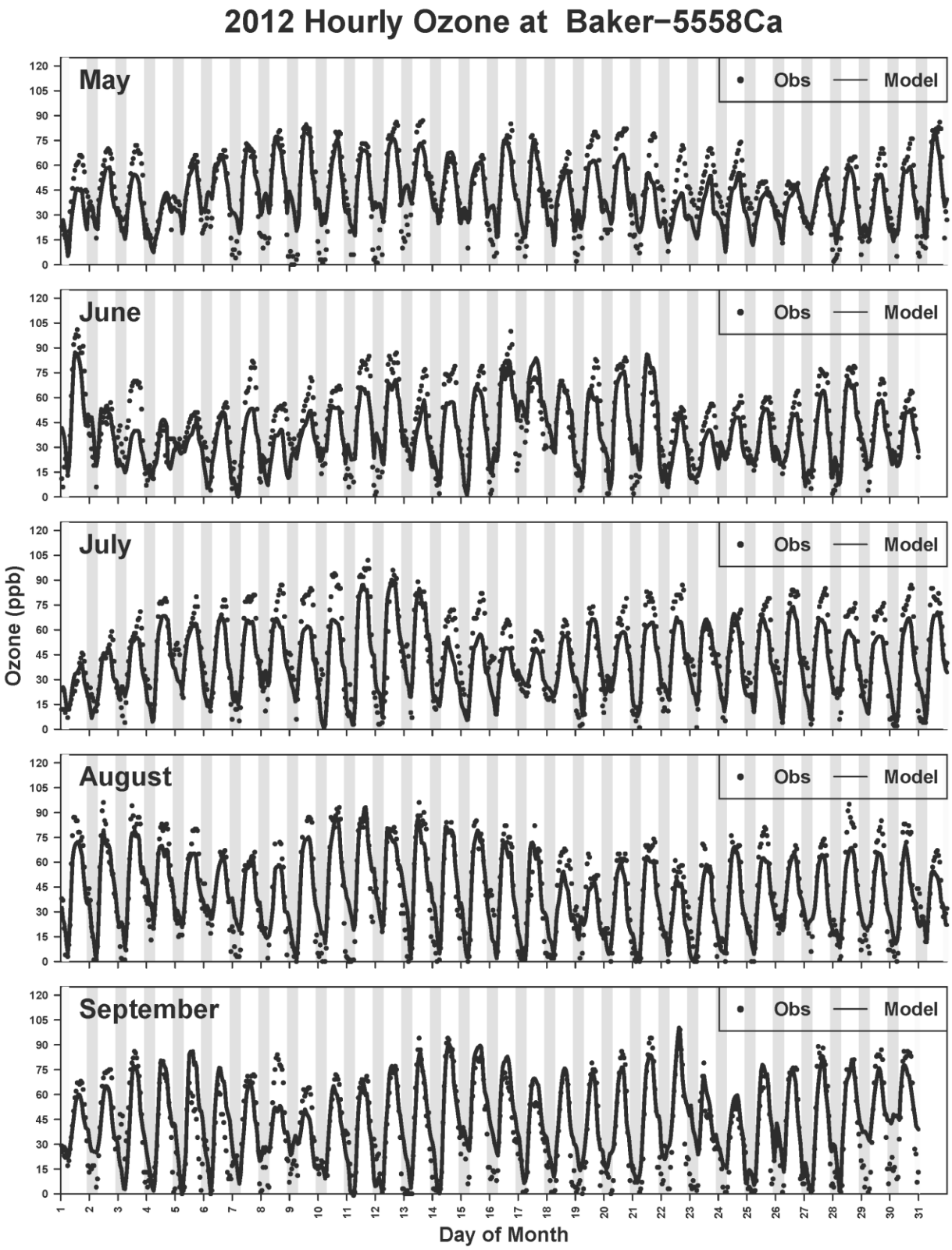


Figure S. 29 Time-series of hourly ozone at Bakersfield-5558 California Avenue.

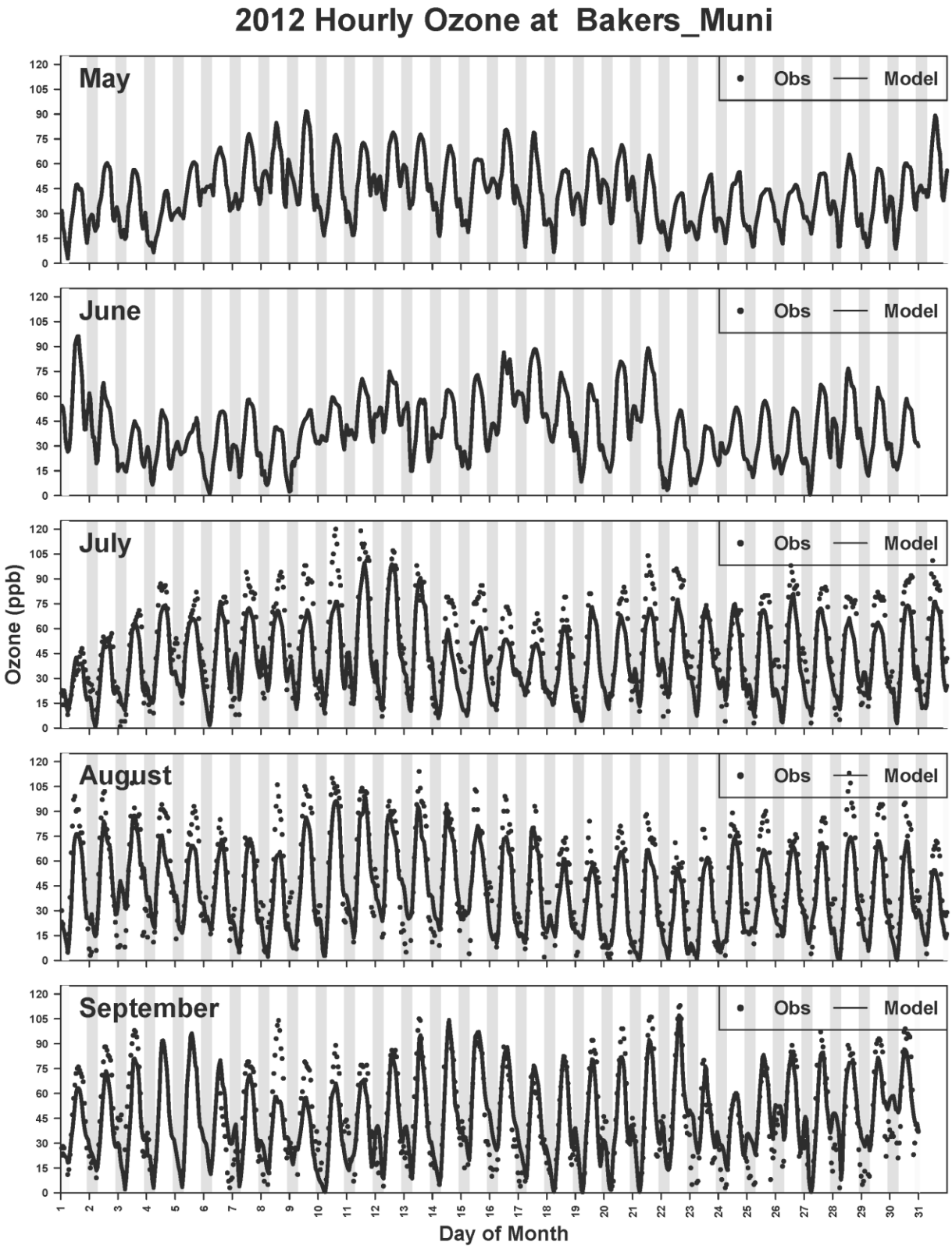


Figure S. 30 Time-series of hourly ozone at Bakersfield Municipal Airport

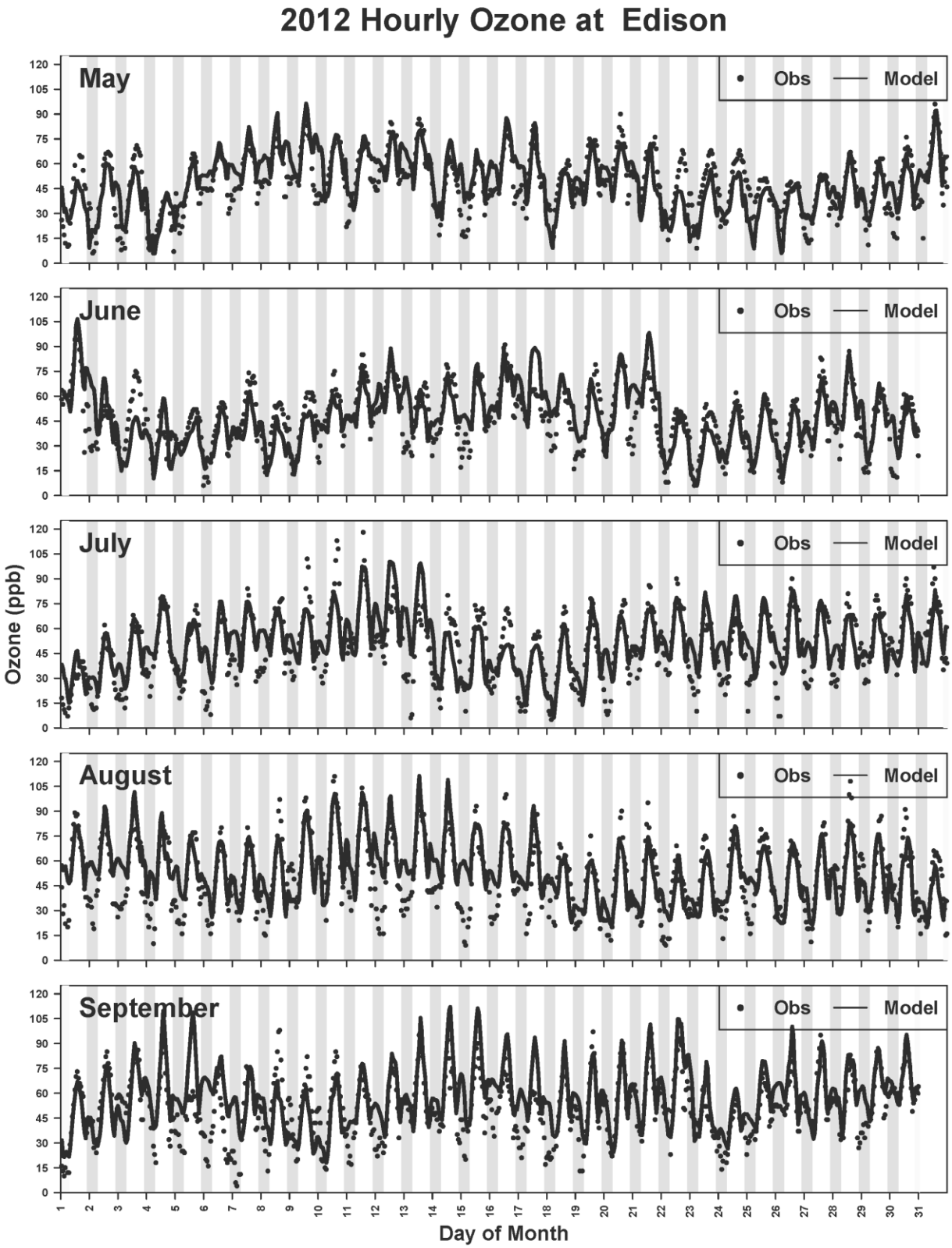


Figure S. 31 Time-series of hourly ozone at Edison

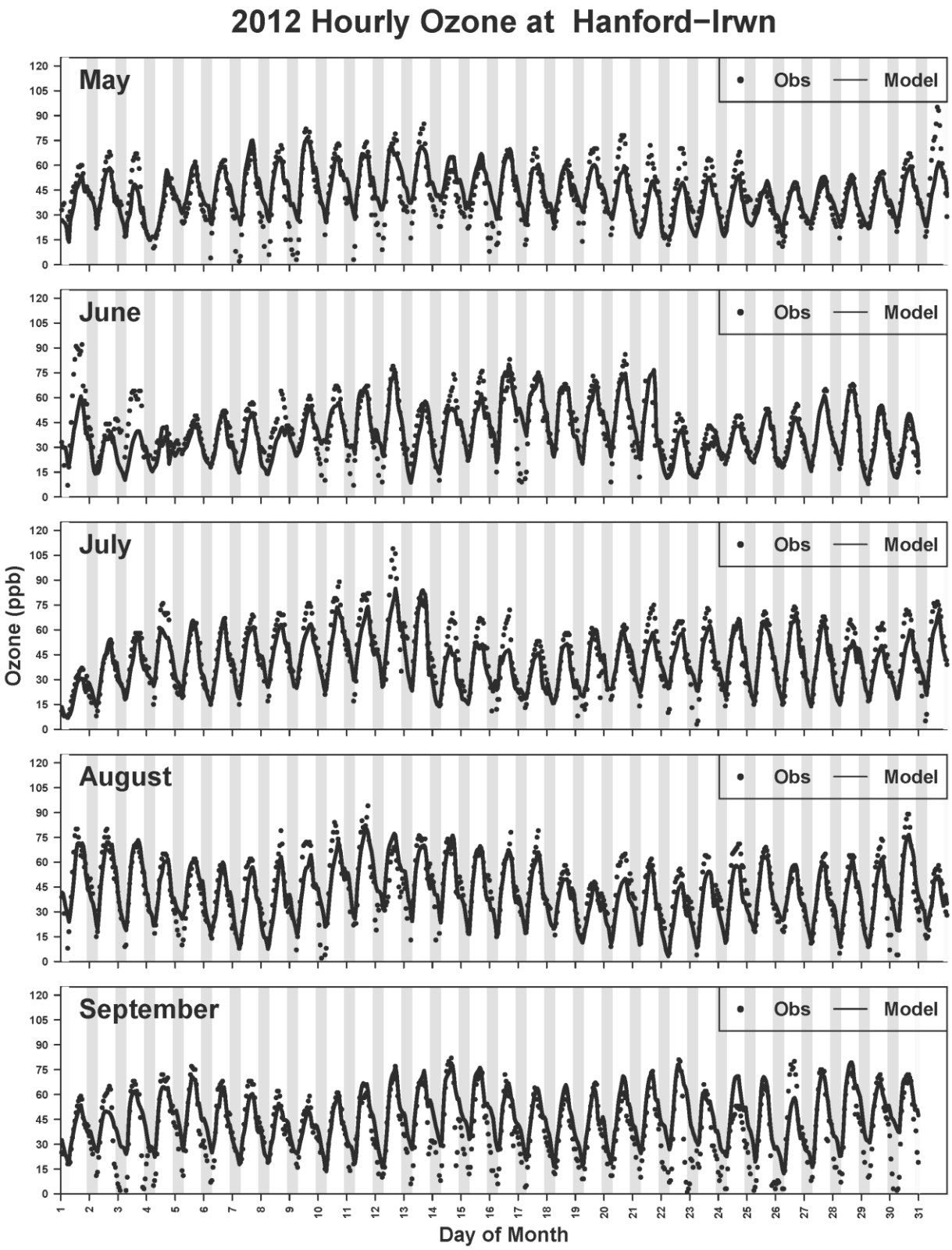


Figure S. 32 Time-series of hourly ozone at Hanford-S Irwin Street

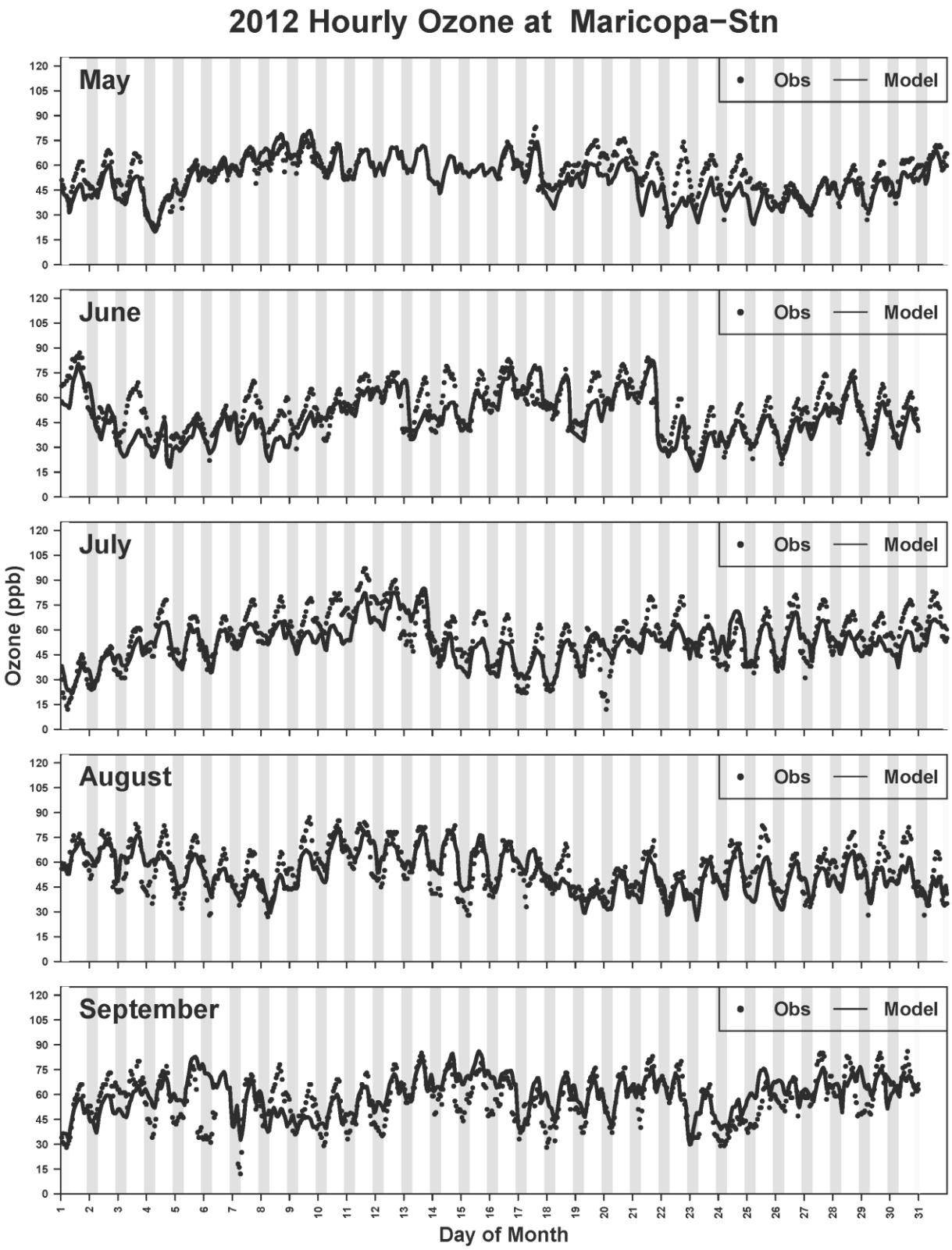


Figure S. 33 Time-series of hourly ozone at Maricopa Stanislaus Street

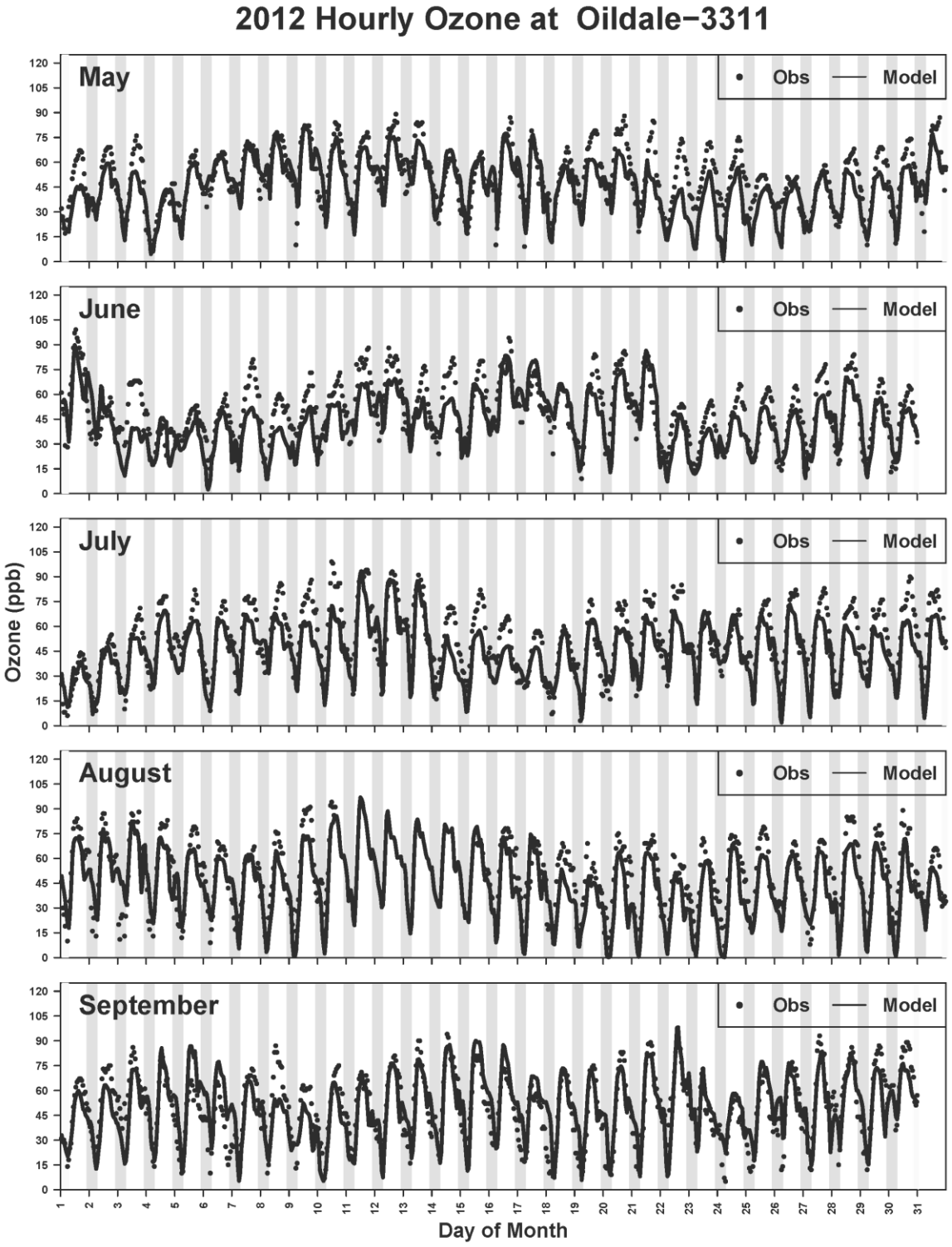


Figure S. 34 Time-series of hourly ozone at Oildale-3311 Manor Street

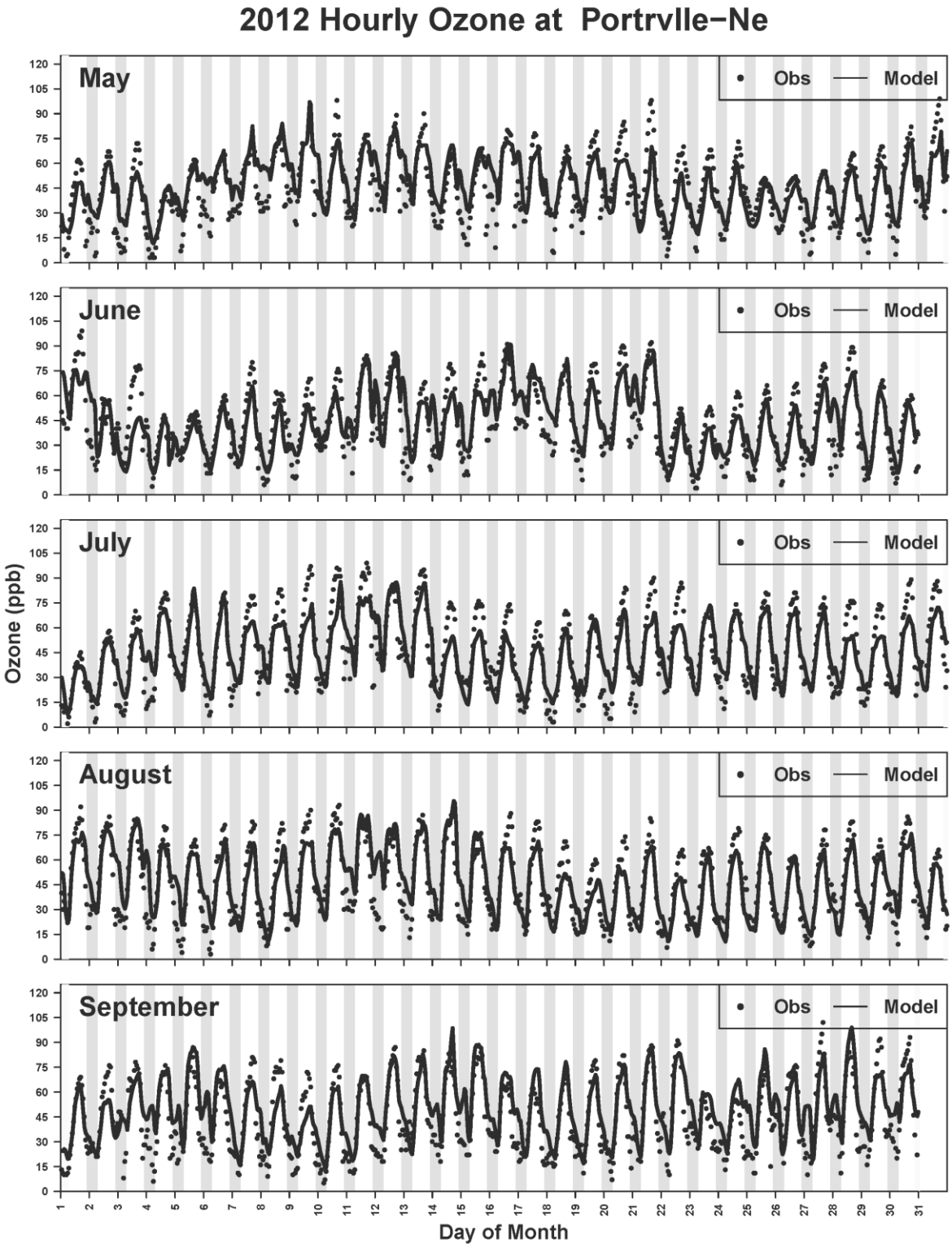


Figure S. 35 Time-series of hourly ozone at Porterville 1839 Newcomb Street

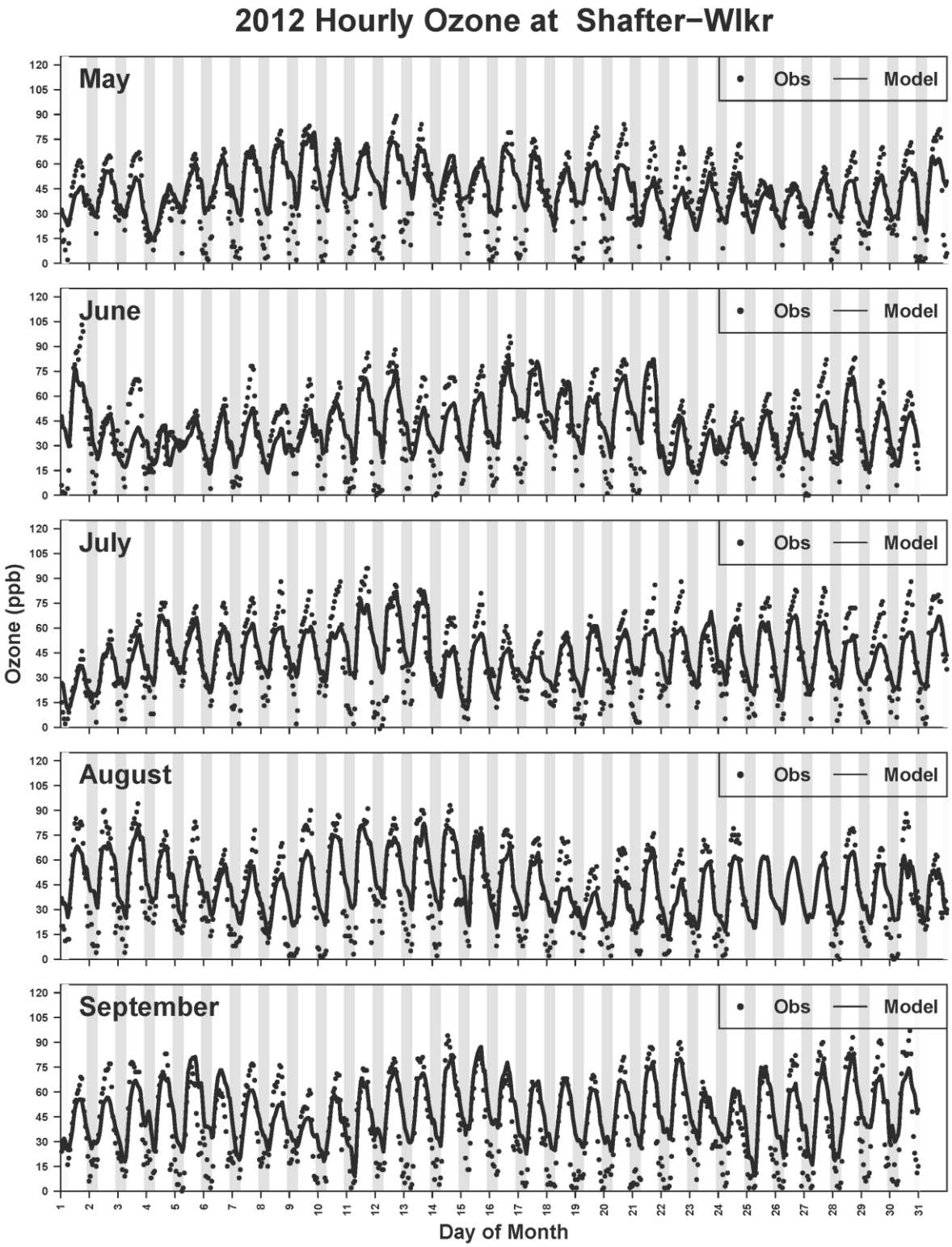


Figure S. 36 Time-series of hourly ozone at Shafter Walker Street

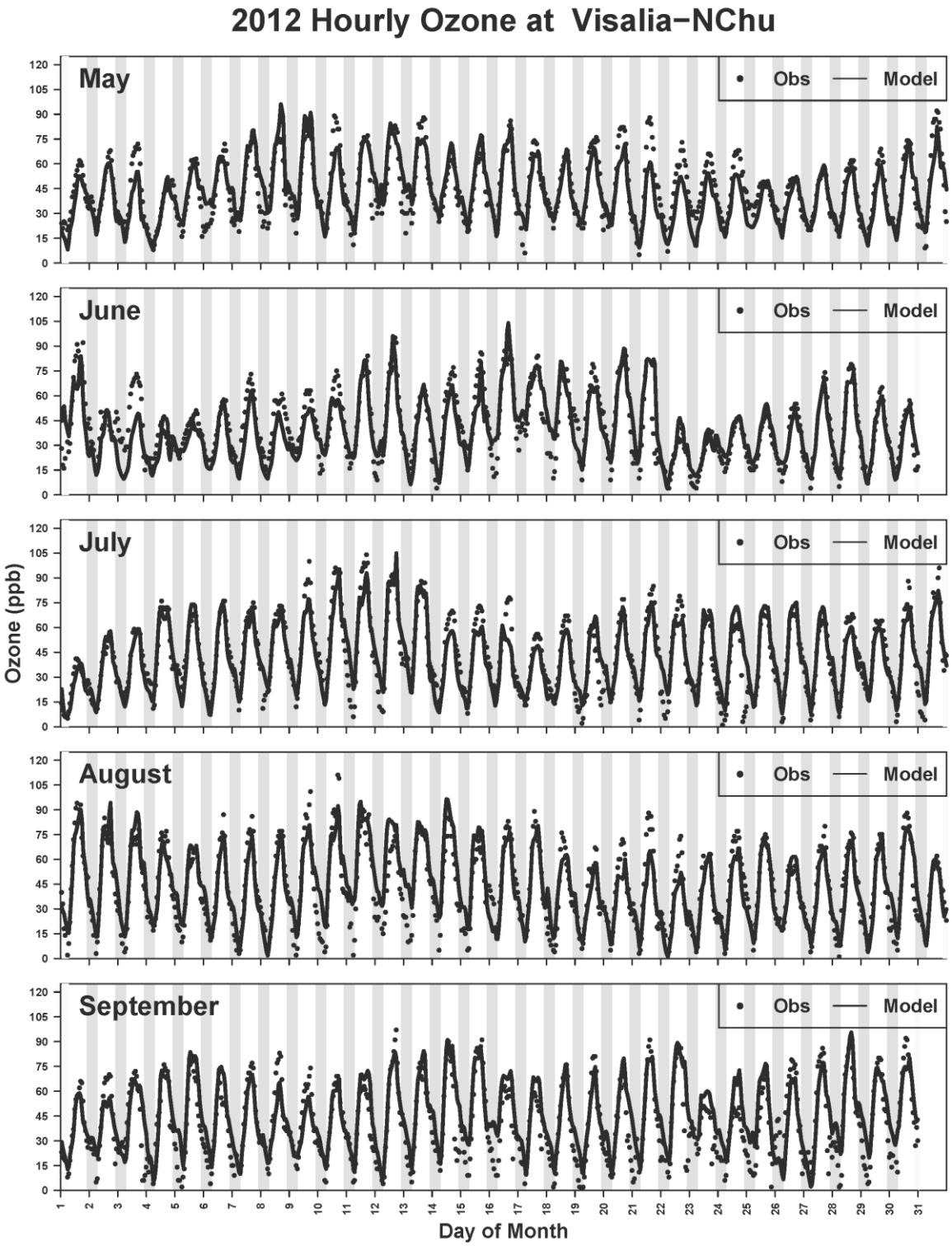


Figure S. 37 Time-series of hourly ozone at Visalia N. Church Street

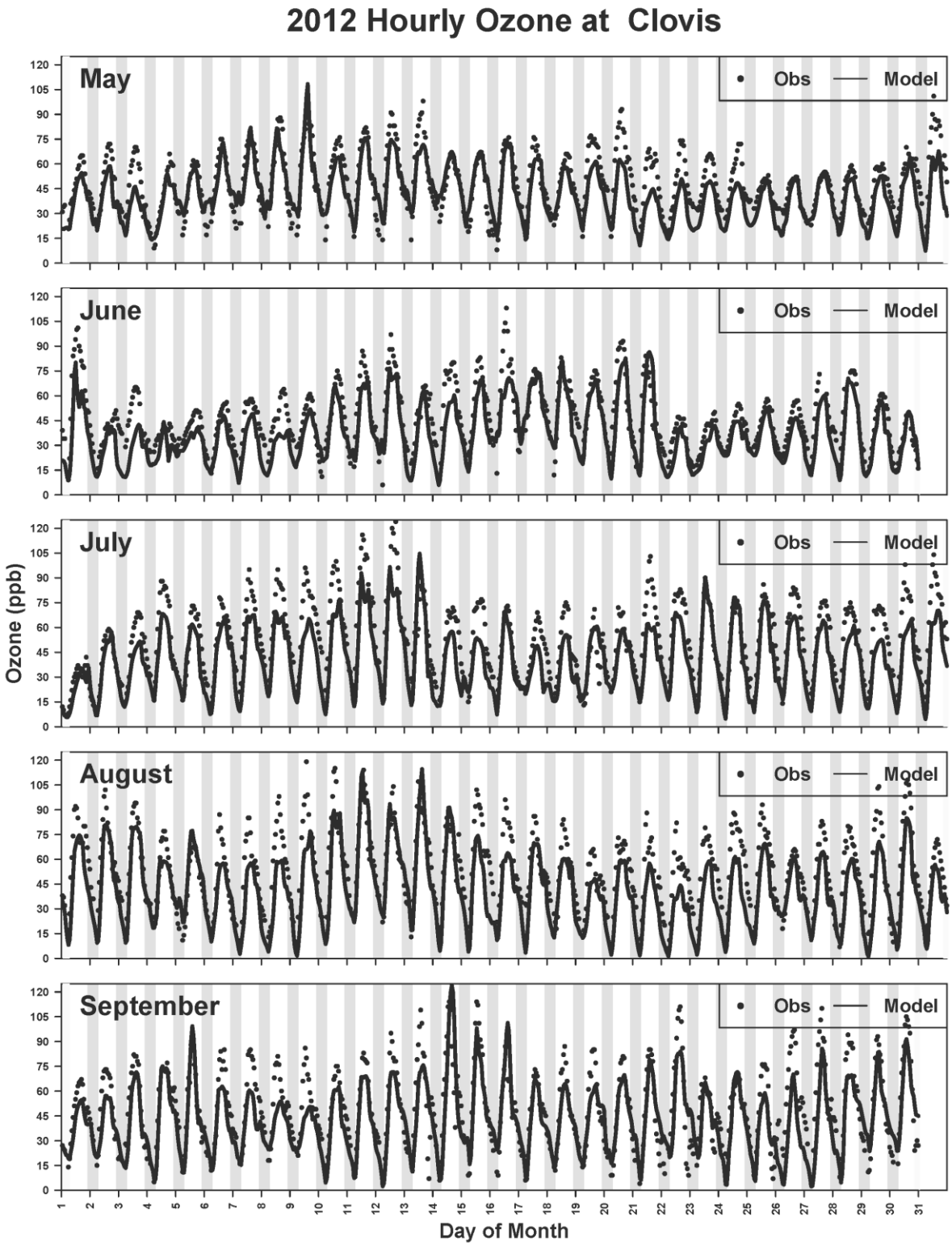


Figure S. 38 Time-series of hourly ozone at Clovis N. Villa Avenue

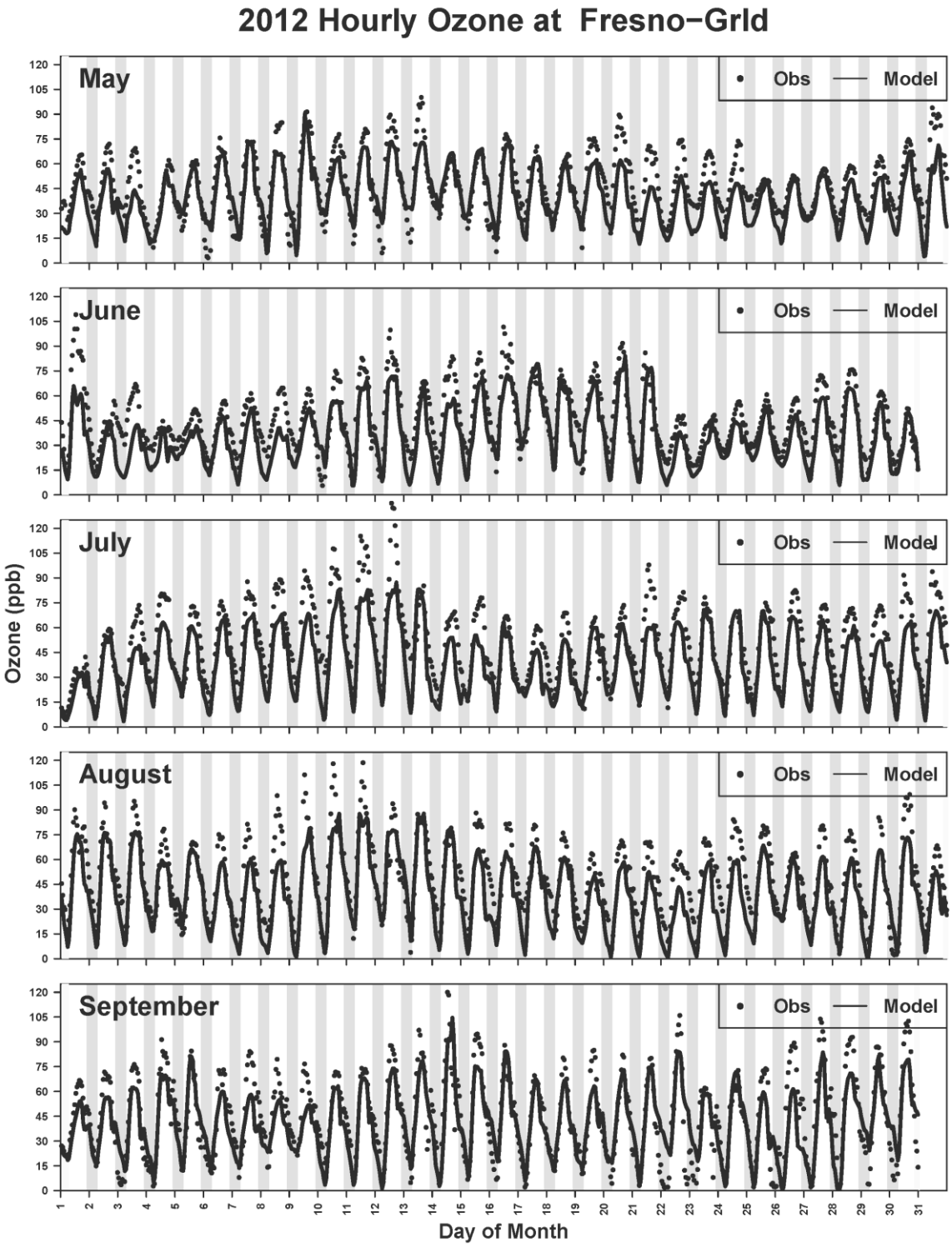


Figure S. 39 Time-series of hourly ozone at Fresno-Garland

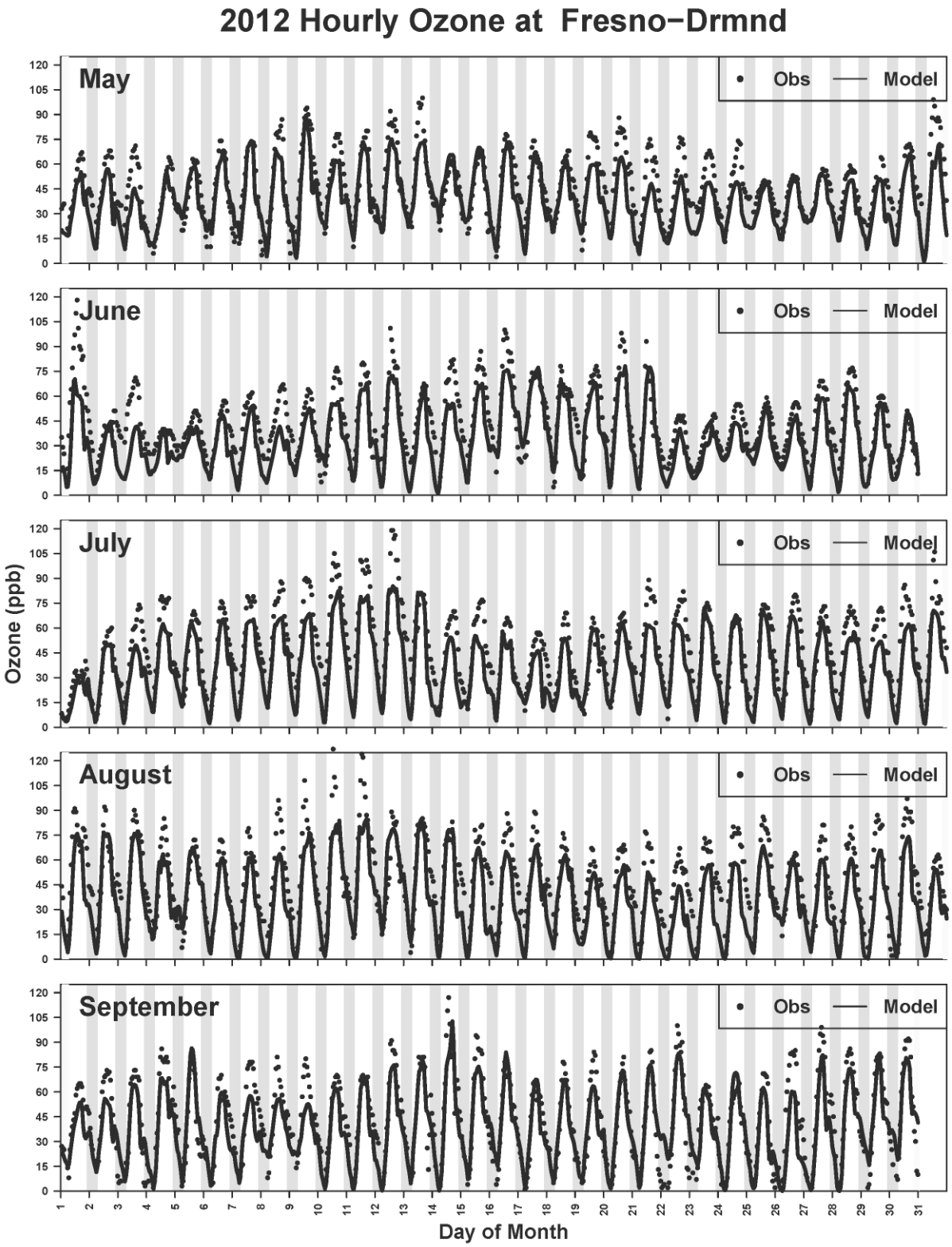


Figure S. 40 Time-series of hourly ozone at Fresno Drummond

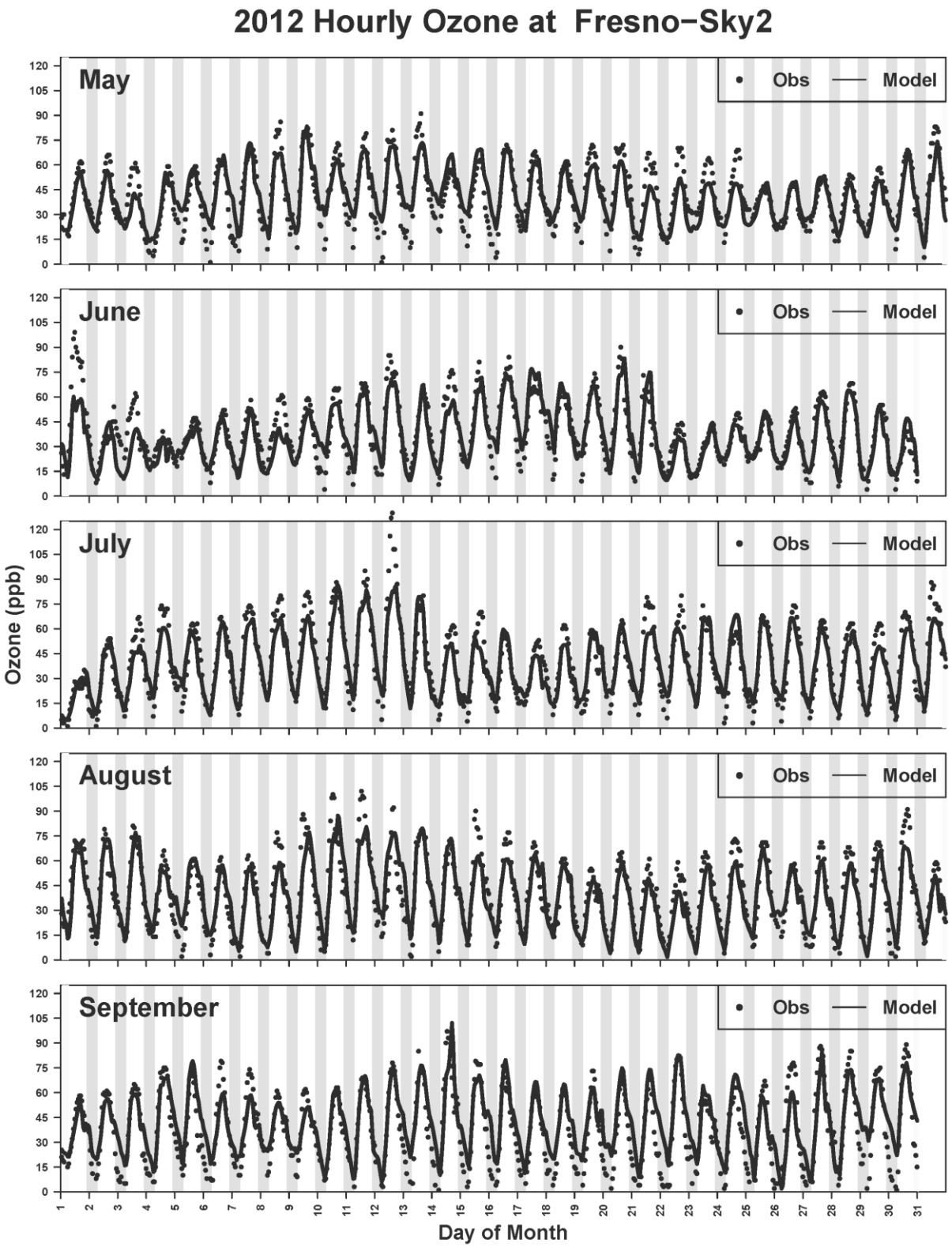


Figure S. 41 Time-series of hourly ozone at Fresno-Sierra Skypark#2

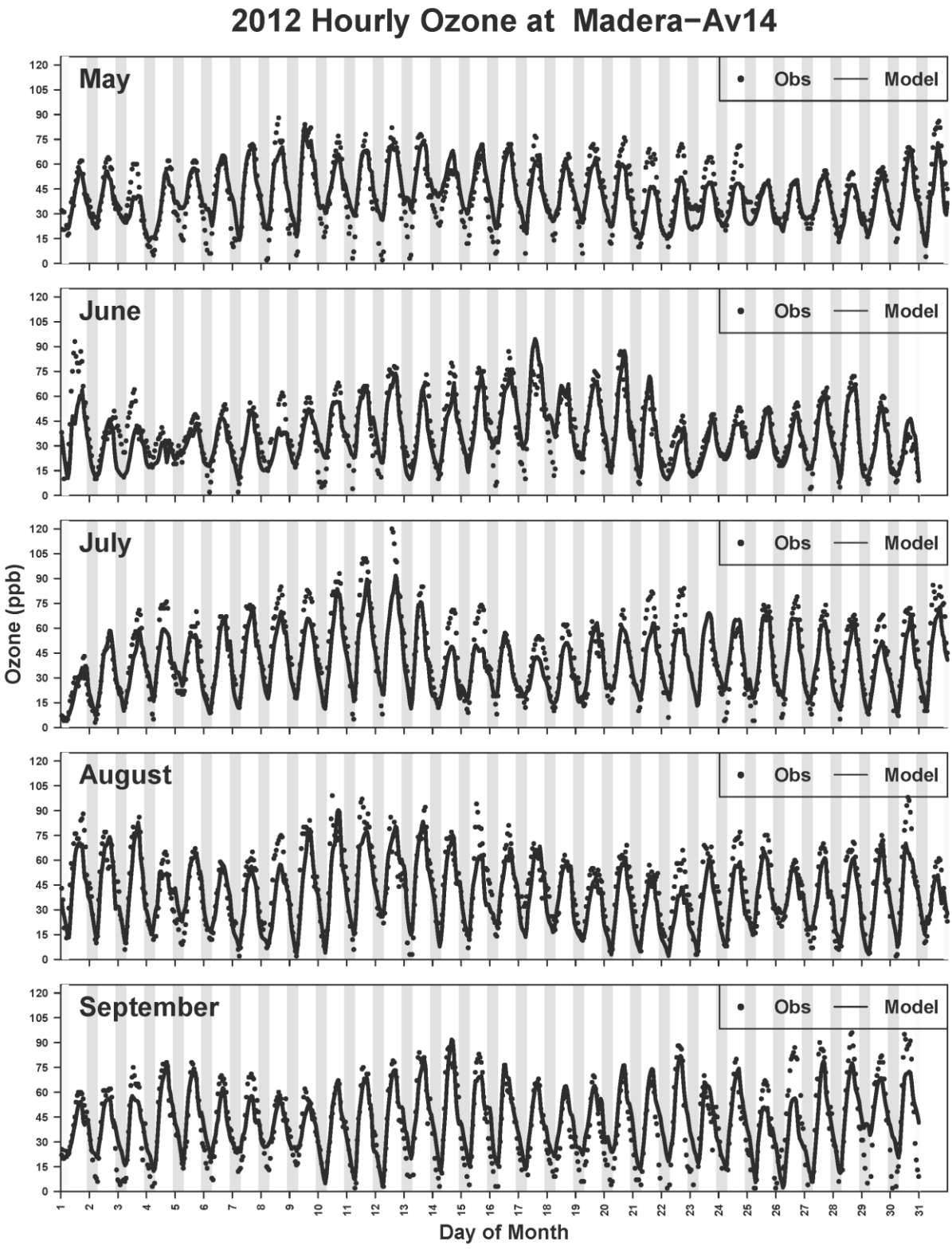


Figure S. 42 Time-series of hourly ozone at Madera-28621 Avenue 14

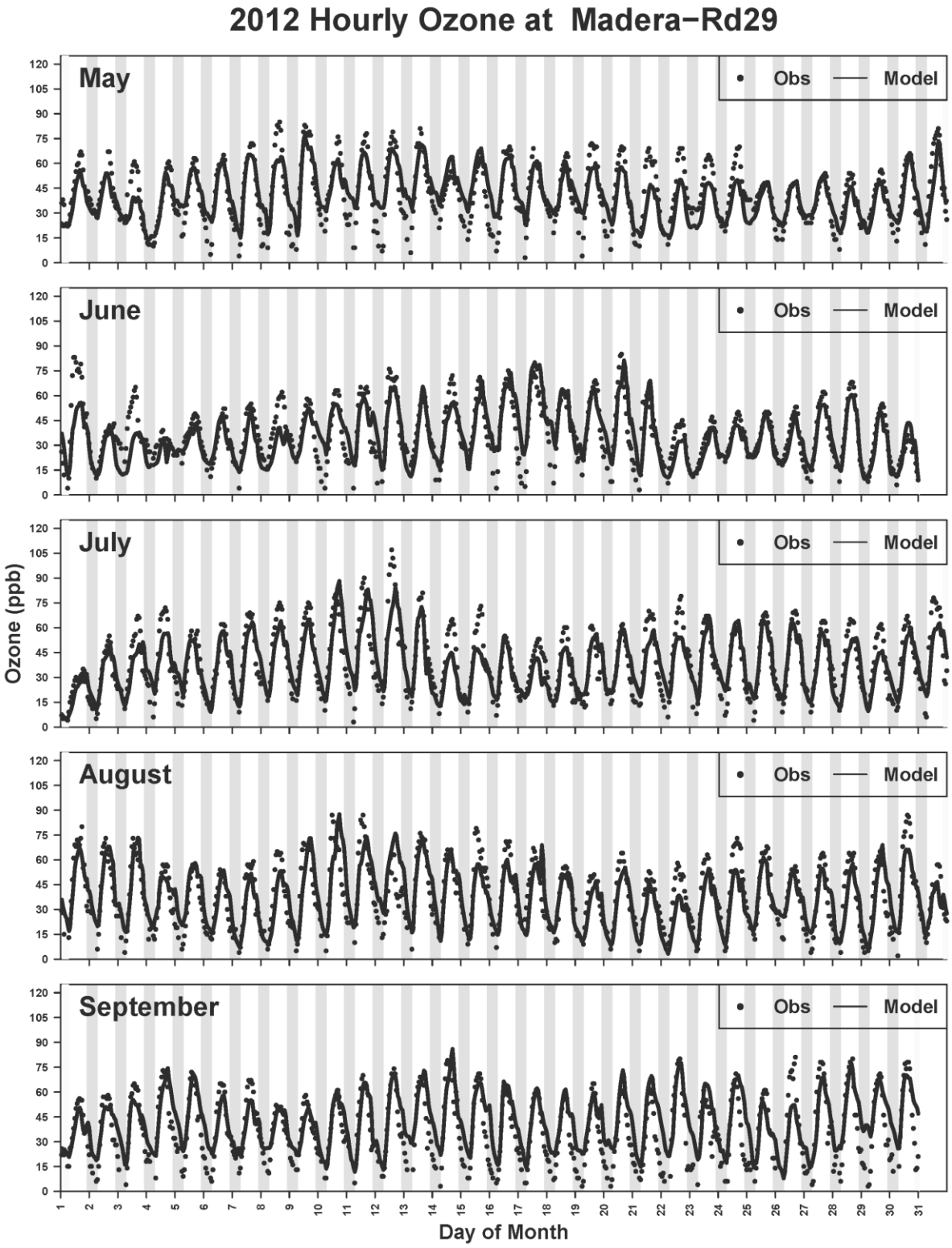


Figure S. 43 Time-series of hourly ozone at Madera-Pump Yard

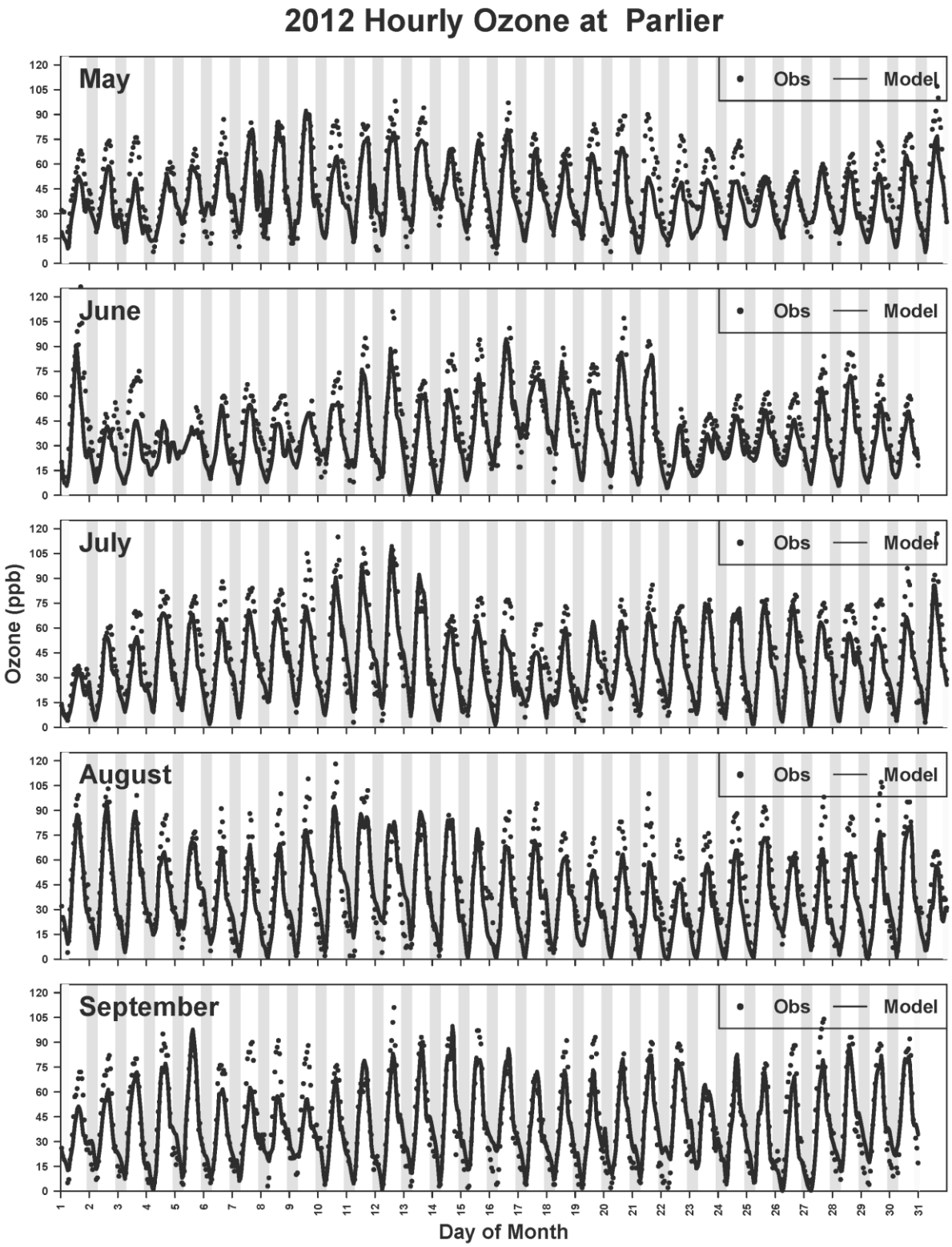


Figure S. 44 Time-series of hourly ozone at Parlier

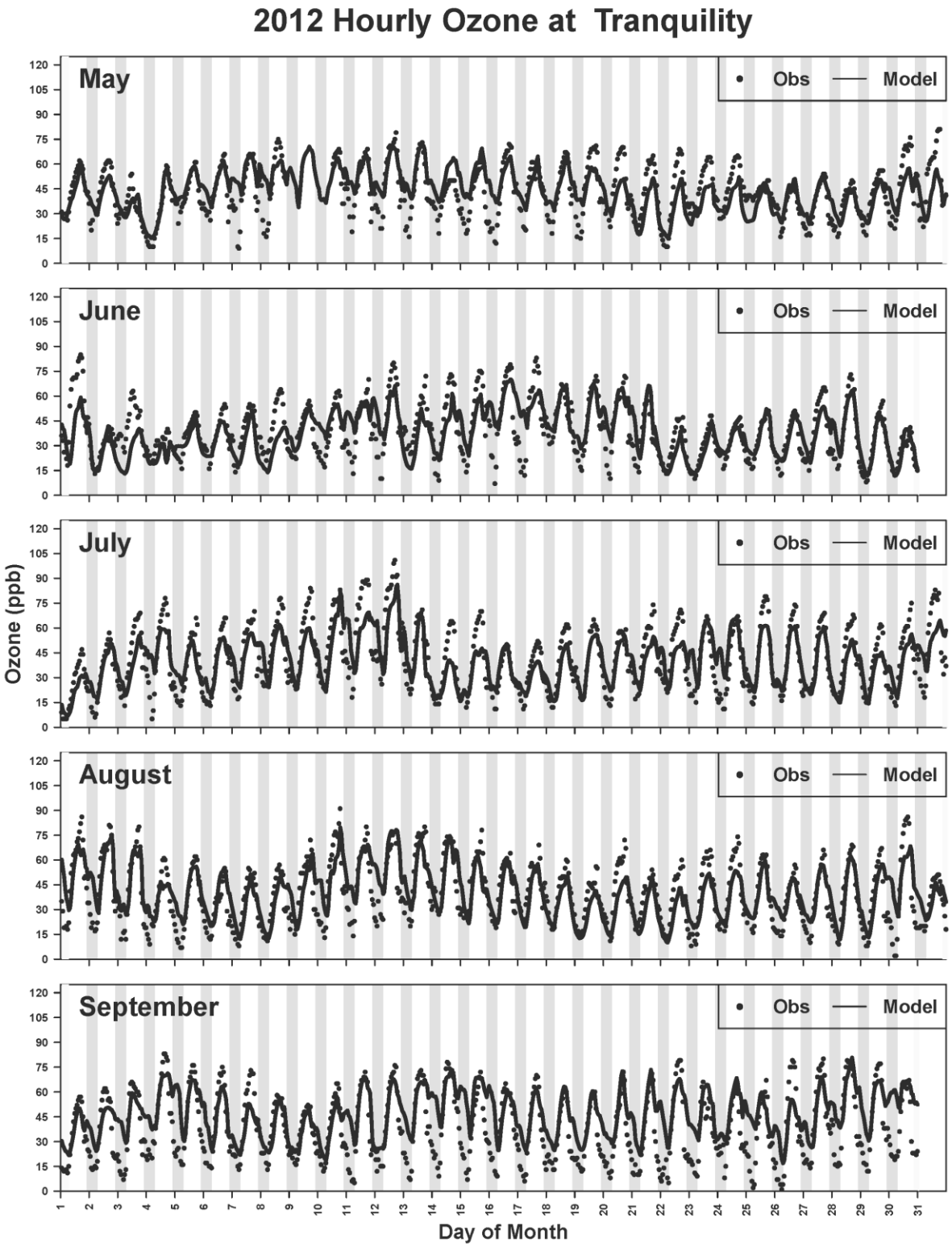


Figure S. 45 Time-series of hourly ozone at Tranquility-32650 West Adams Avenue

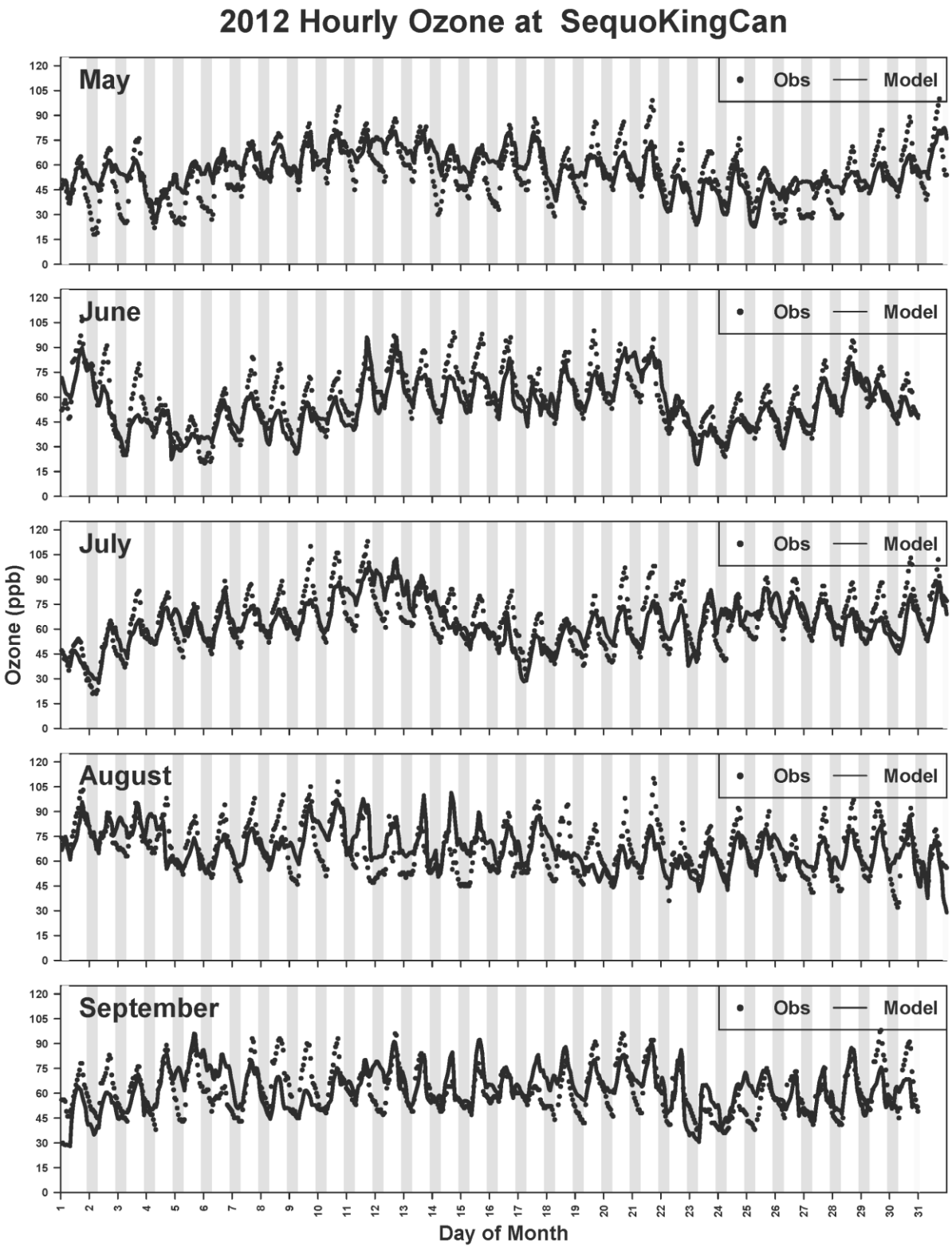


Figure S. 46 Time-series of hourly ozone at Sequoia and Kings Canyon Natl Park

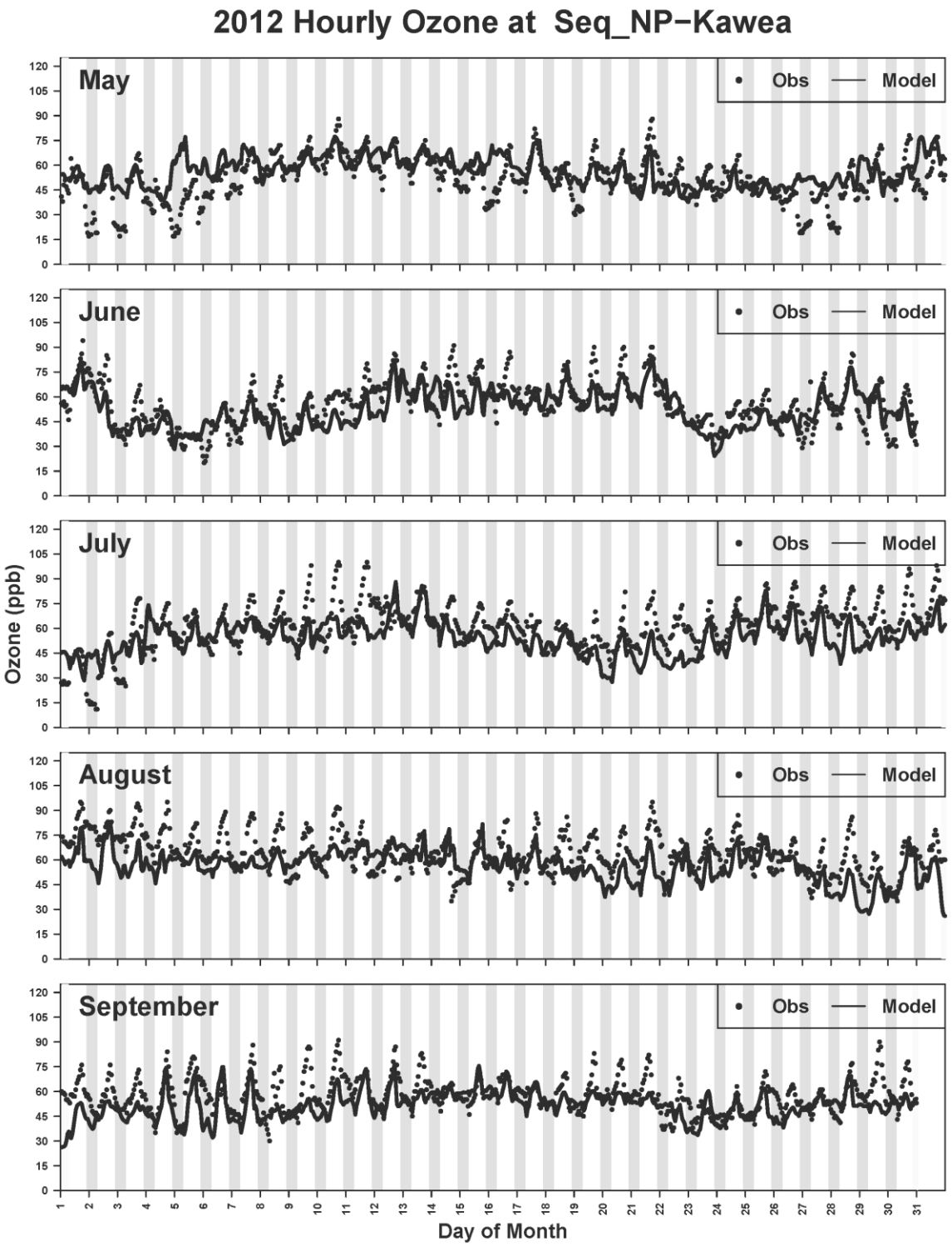


Figure S. 47 Time-series of hourly ozone at Sequoia Natl Park-Lower Kaweah

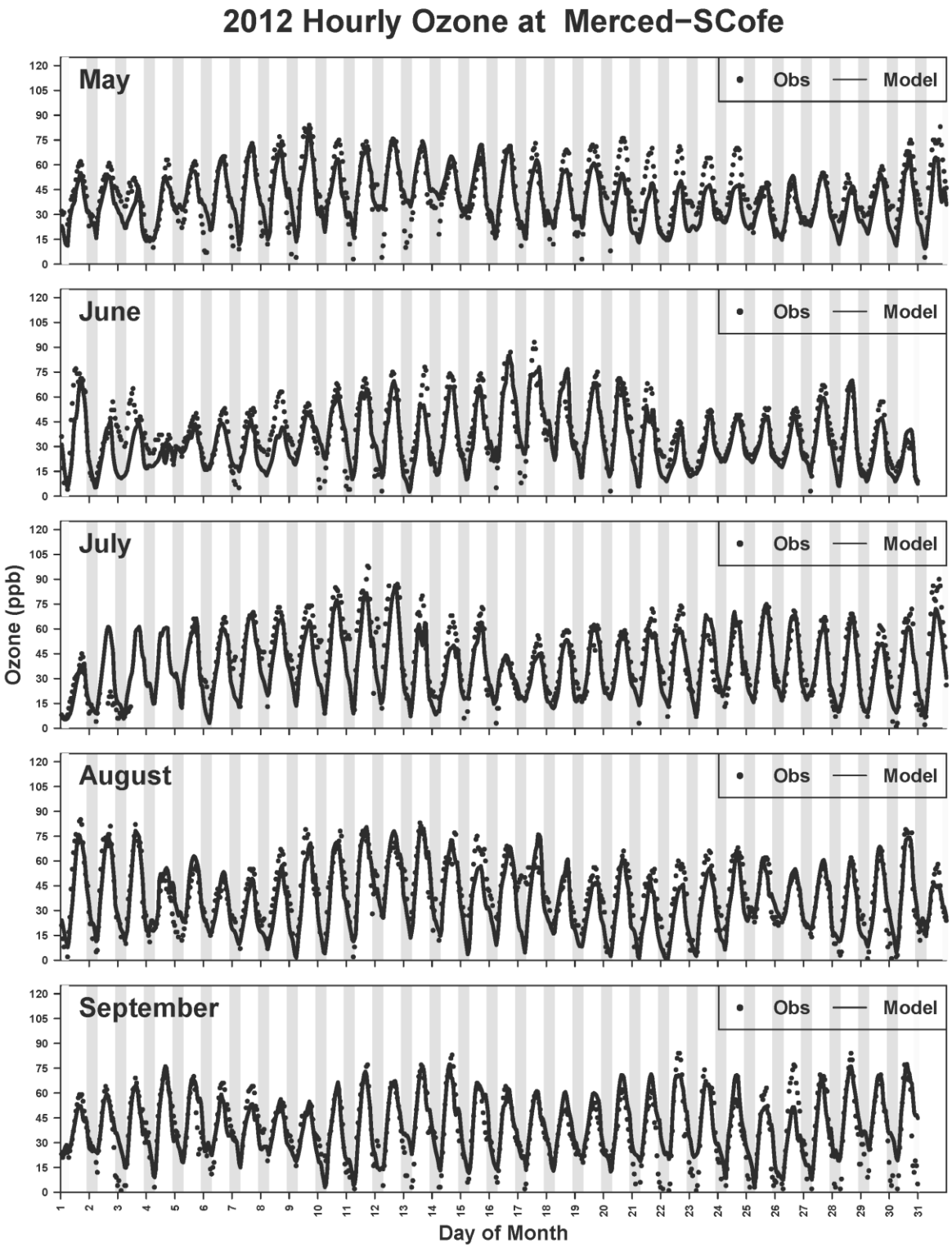


Figure S. 48 Time-series of hourly ozone at Merced-S Coffee Avenue

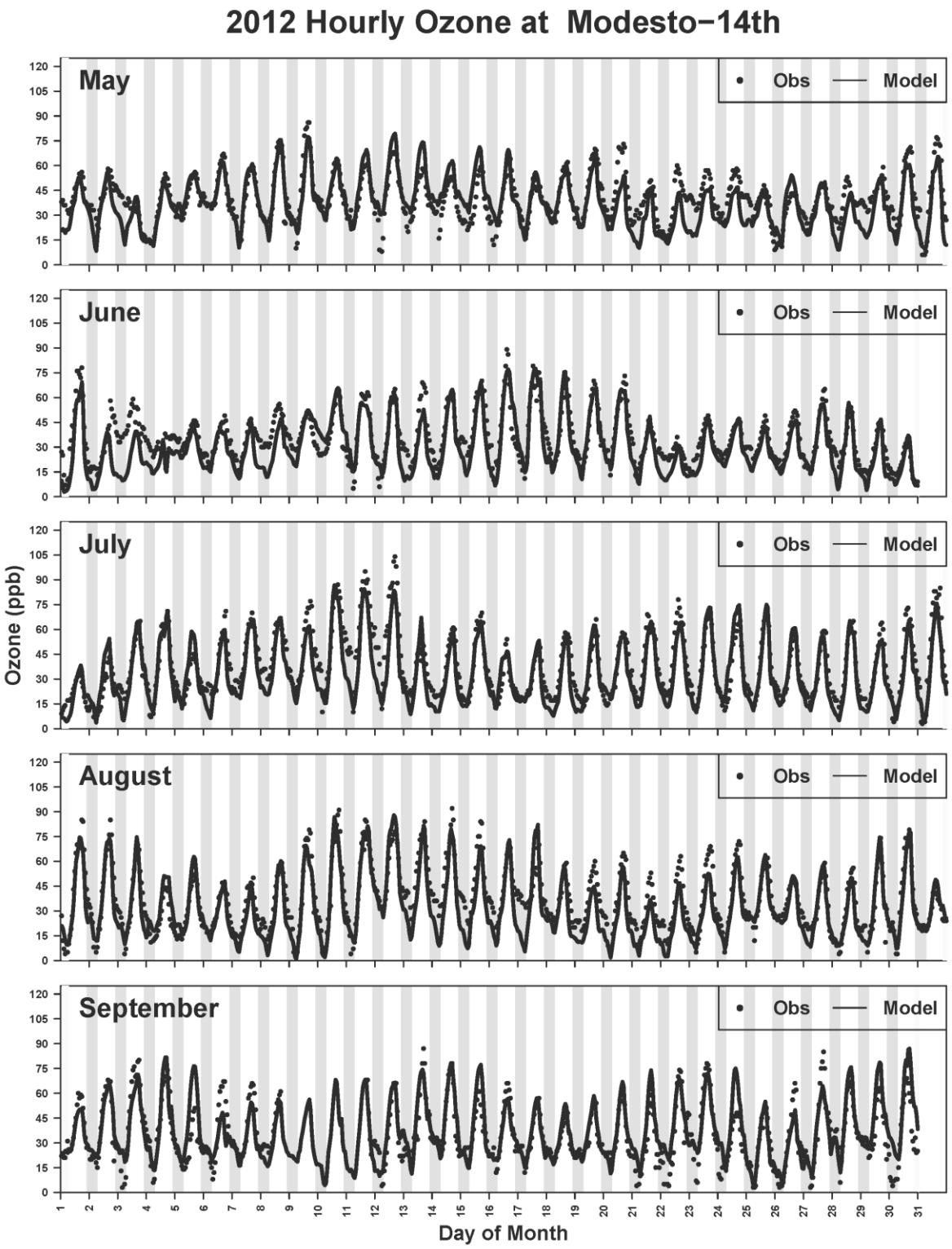


Figure S. 49 Time-series of hourly ozone at Modesto-14th Street

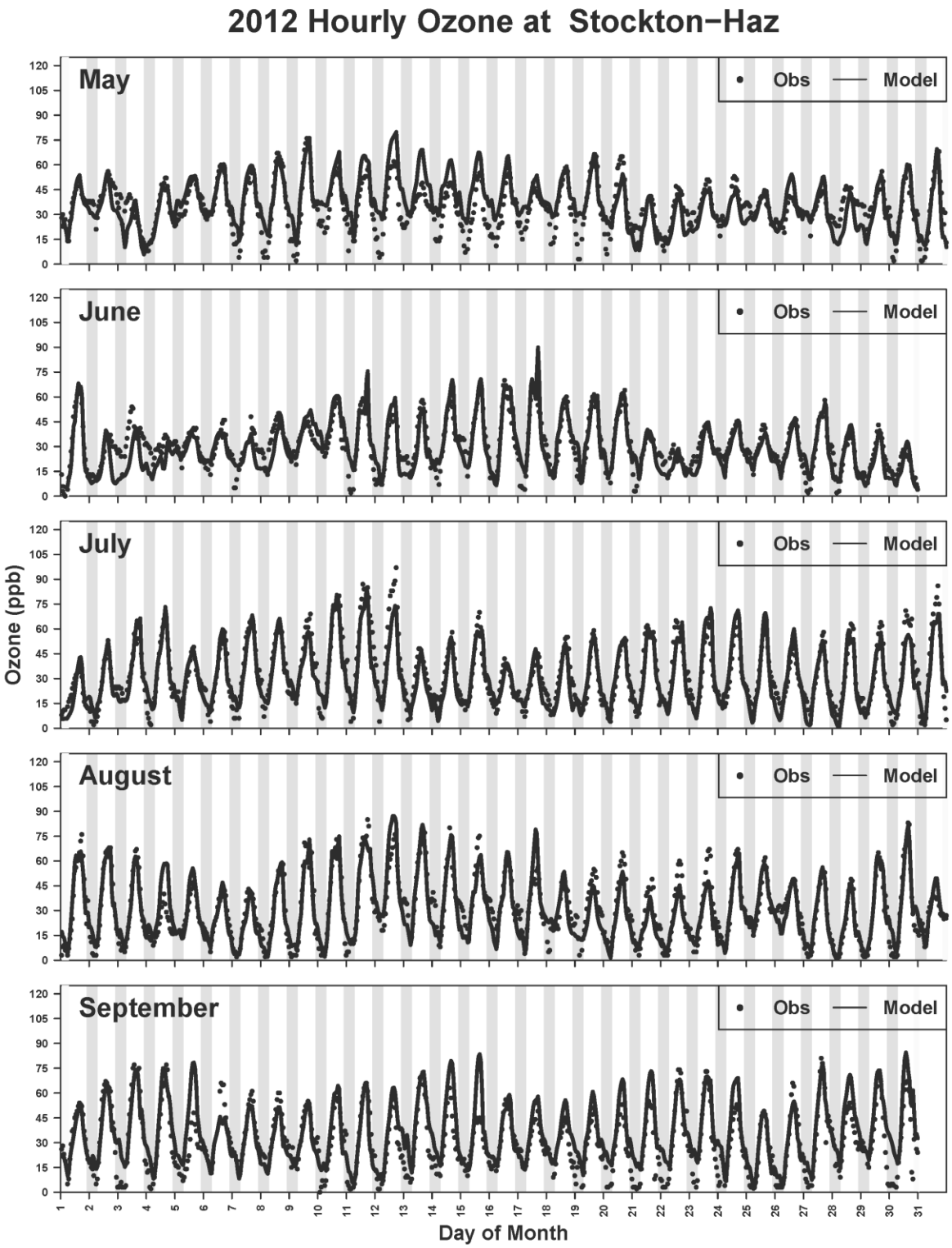


Figure S. 50 Time-series of hourly ozone at Stockton-Hazelton Street

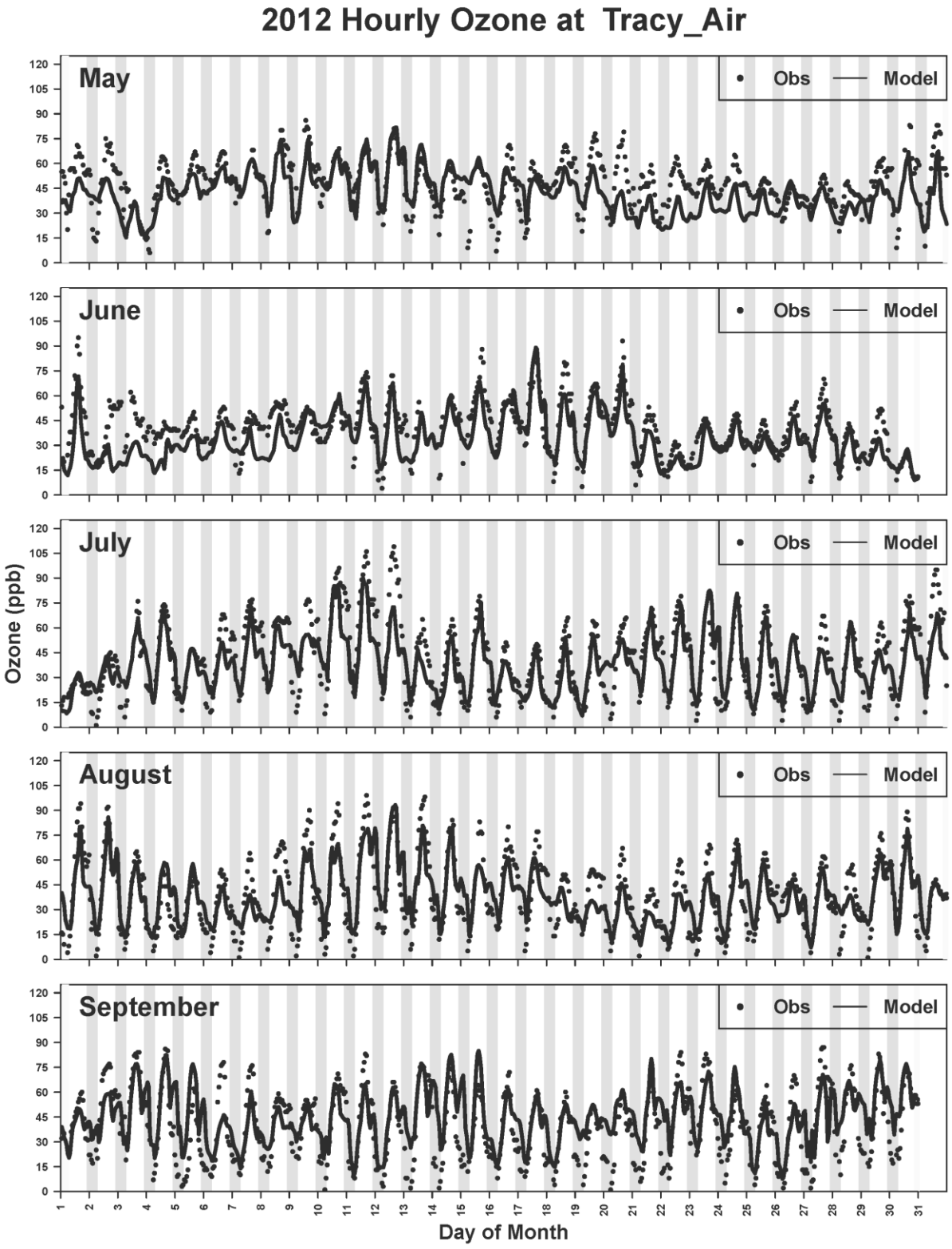


Figure S. 51 Time-series of hourly ozone at Tracy-Airport

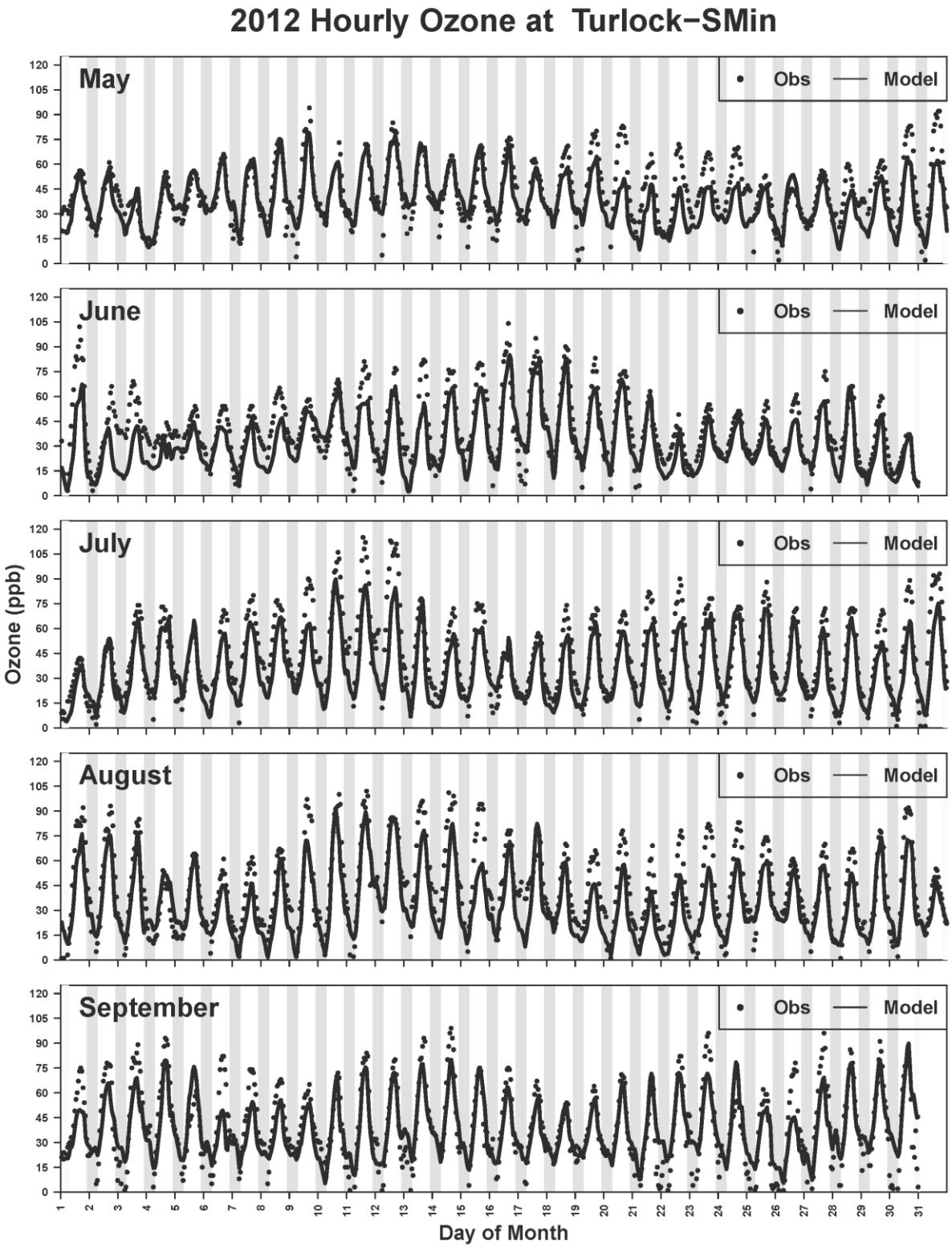


Figure S. 52 Time-series of hourly ozone at Turlock-S Minaret Street

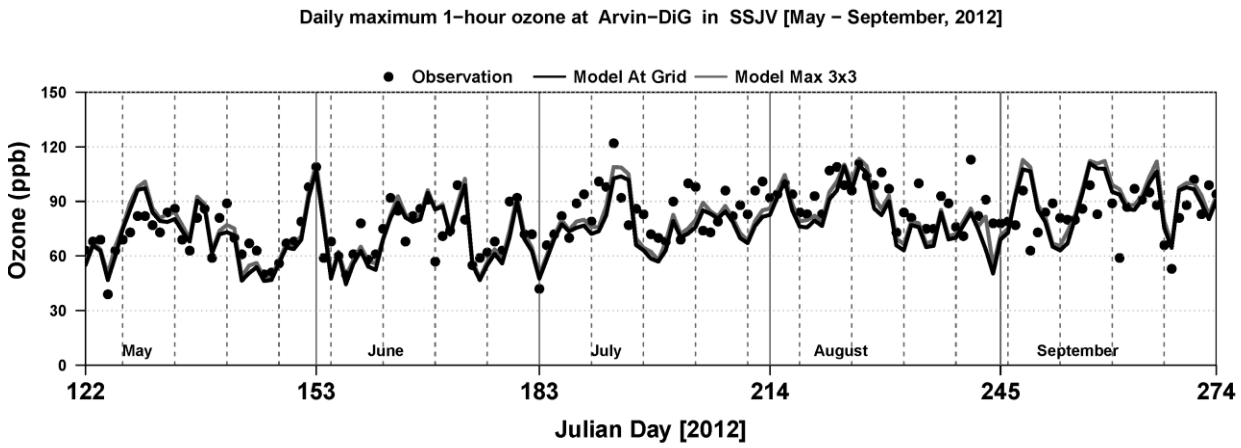


Figure S. 53 Time-series of daily maximum 1-hr ozone at Arvin-Di Giorgio

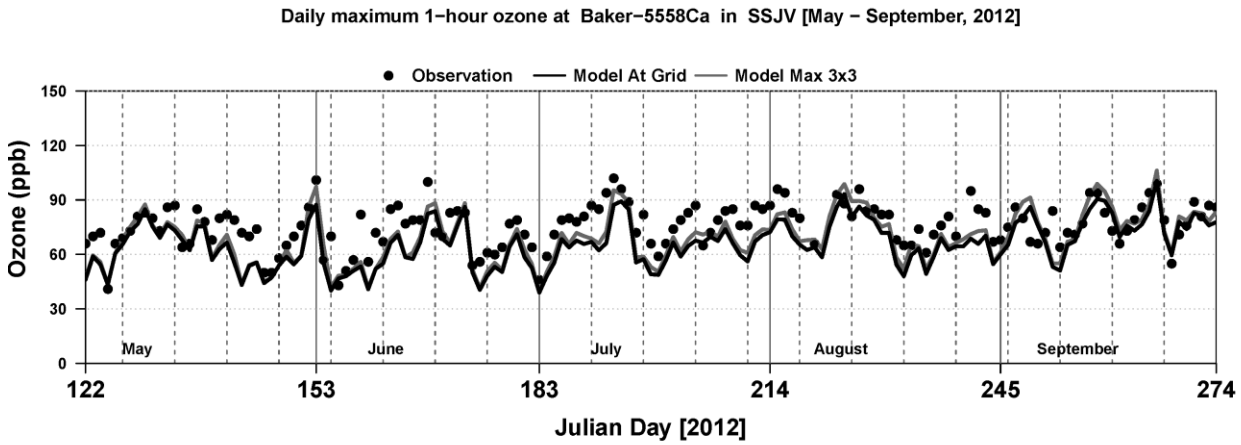


Figure S. 54 Time-series of daily maximum 1-hr ozone at Bakersfield-5558 California Avenue

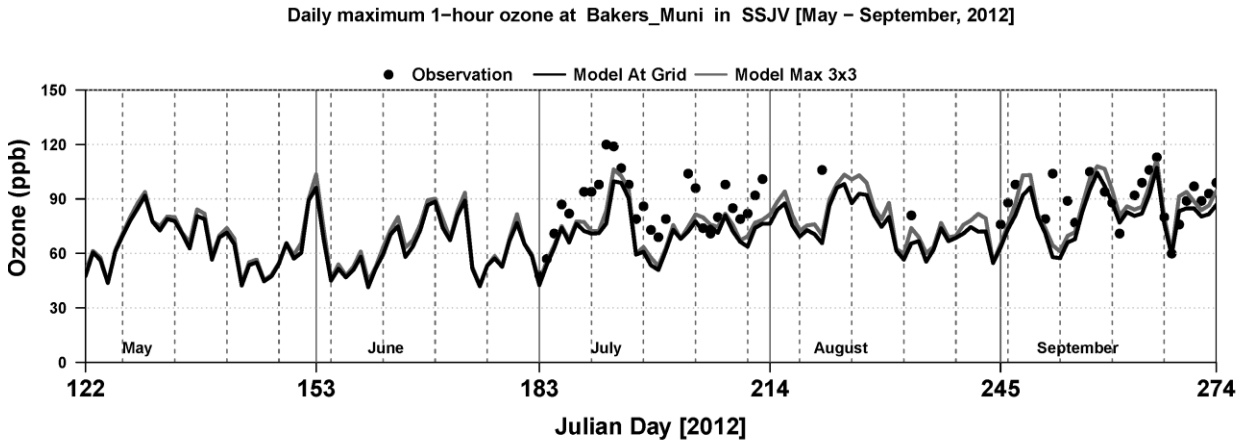


Figure S. 55 Time-series of daily maximum 1-hr ozone at Bakersfield-Municipal Airport

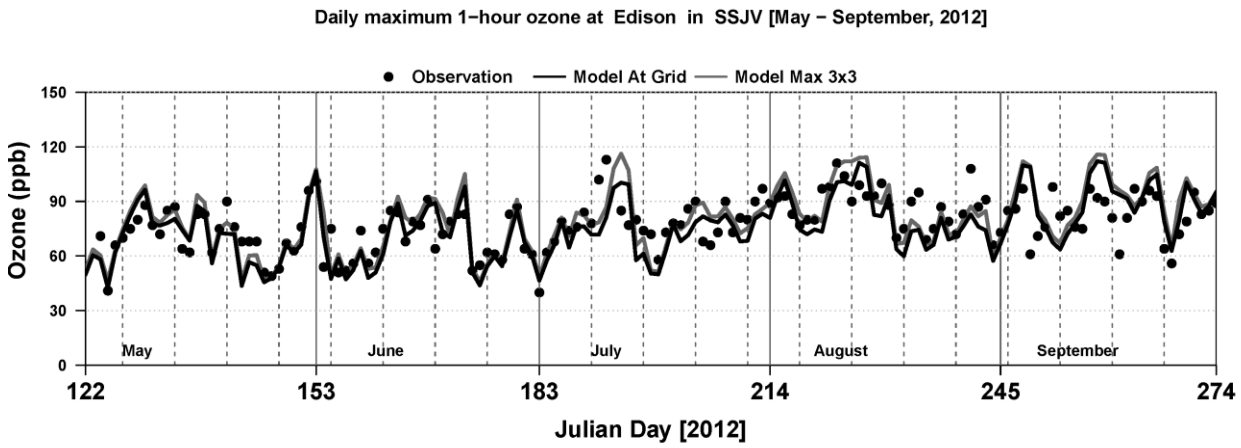


Figure S. 56 Time-series of daily maximum 1-hr ozone at Edison

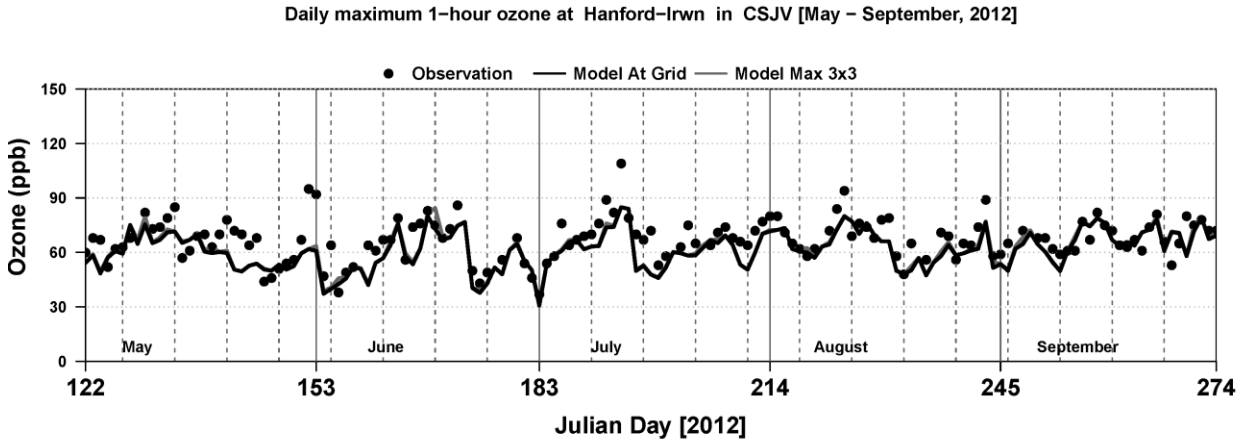


Figure S. 57 Time-series of daily maximum 1-hr ozone at Hanford-S Irwin Street

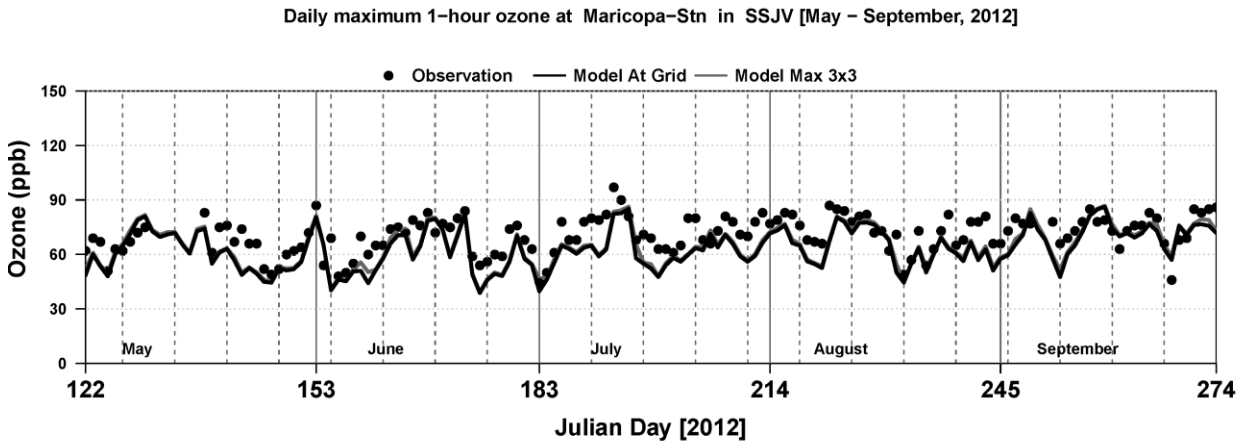


Figure S. 58 Time-series of daily maximum 1-hr ozone at Maricopa-Stanislaus Street

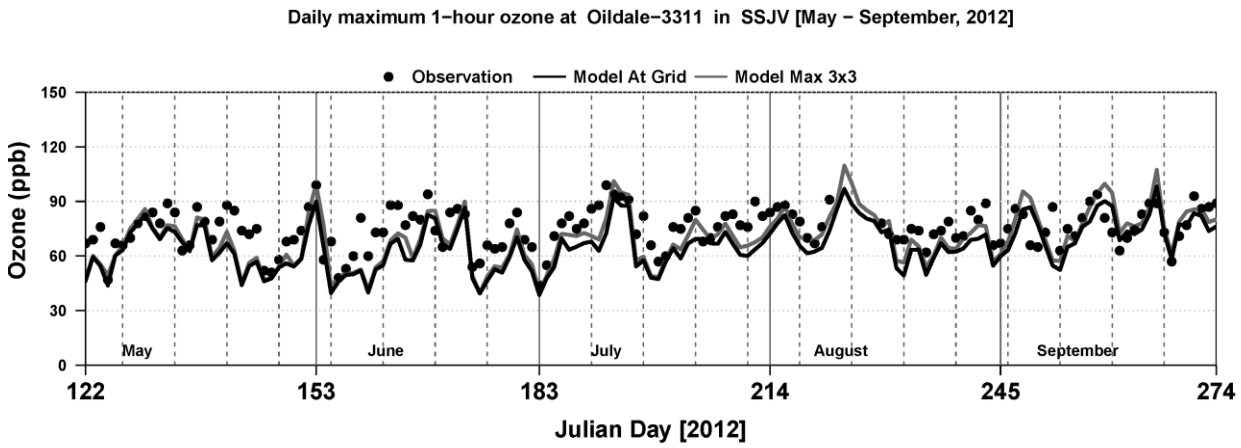


Figure S. 59 Time-series of daily maximum 1-hr ozone at Oildale-3311 Manor Street

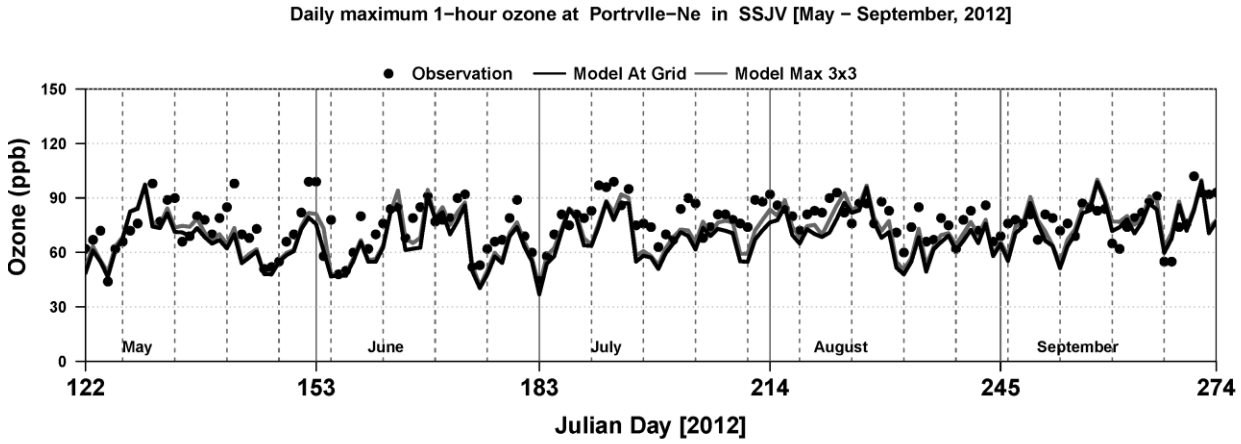


Figure S. 60 Time-series of daily maximum 1-hr ozone at Porterville-1839 Newcomb Street

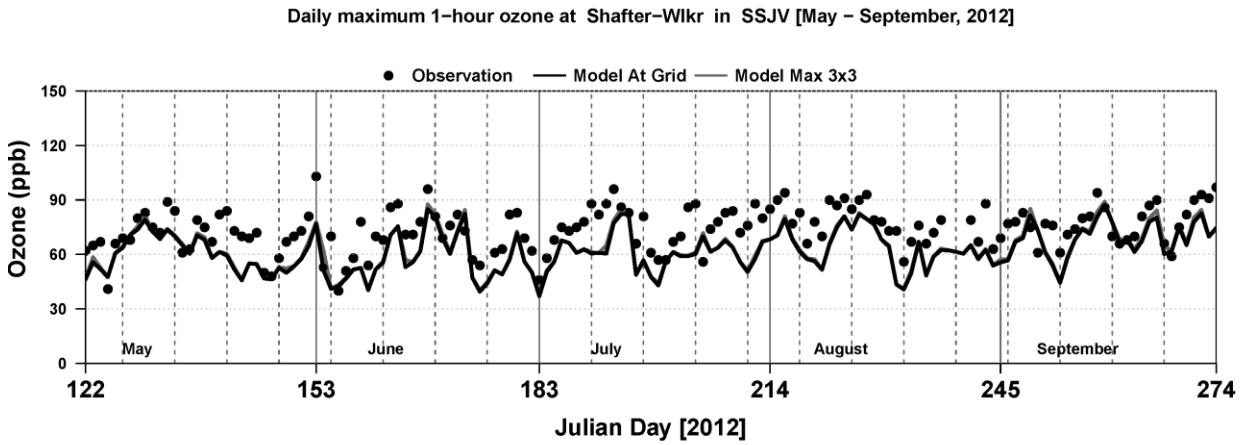


Figure S. 61 Time-series of daily maximum 1-hr ozone at Shafter-Walker Street

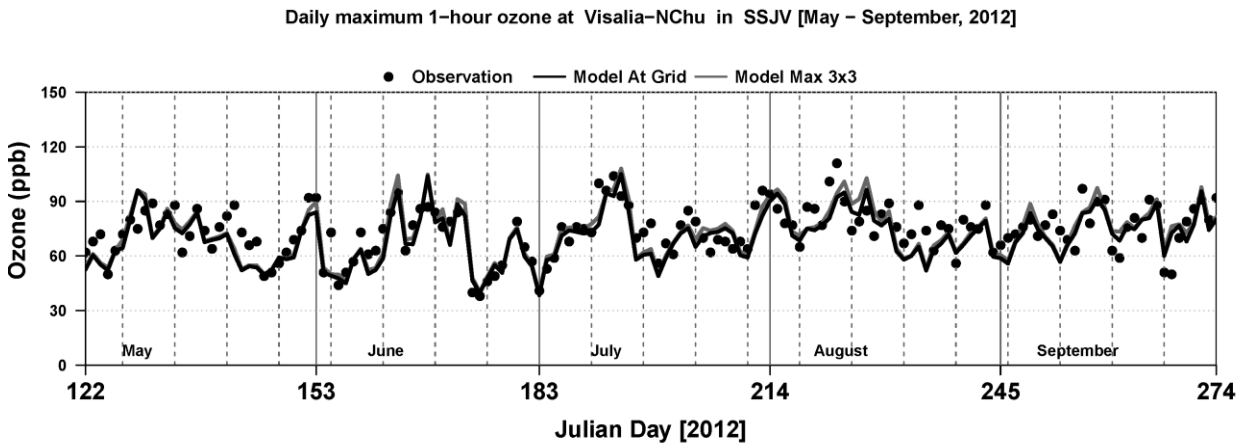


Figure S. 62 Time-series of daily maximum 1-hr ozone at Visalia-N Church Street

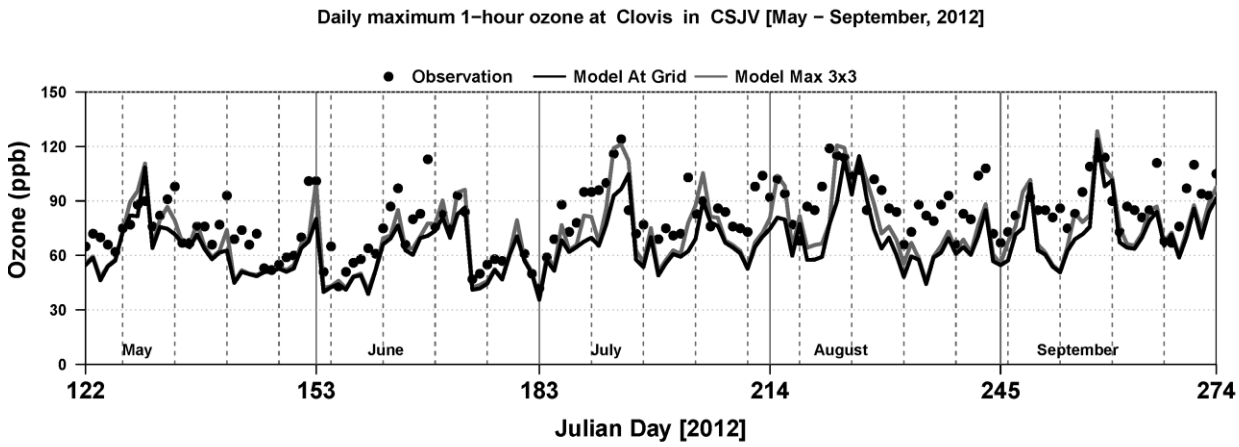


Figure S. 63 Time-series of daily maximum 1-hr ozone at Clovis-N Villa Avenue

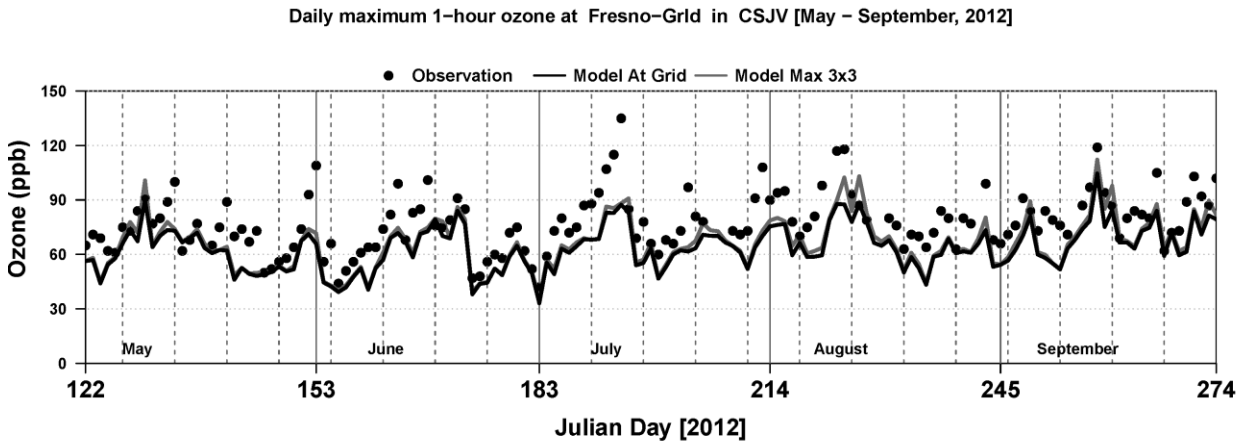


Figure S. 64 Time-series of daily maximum 1-hr ozone at Fresno-Garland

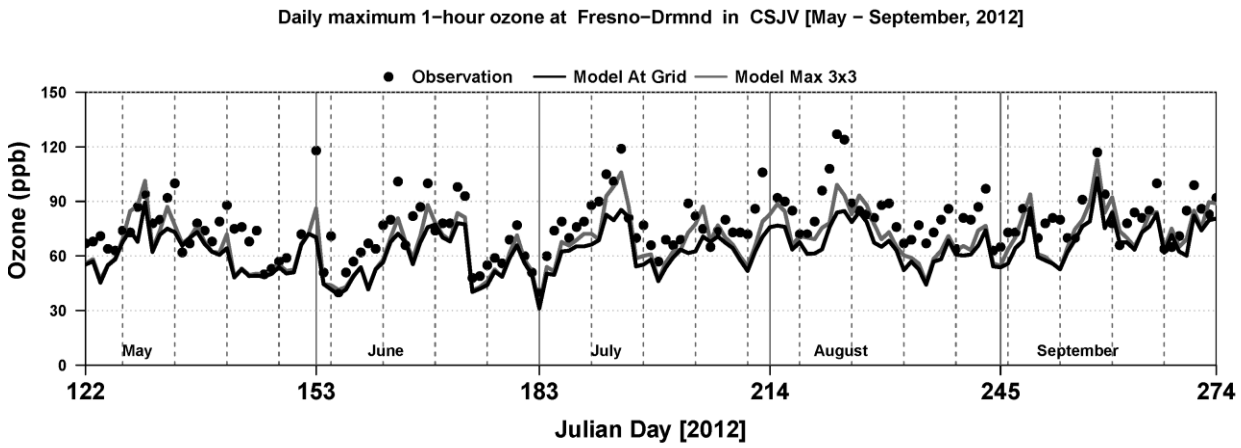


Figure S. 65 Time-series of daily maximum 1-hr ozone at Fresno-Drummond Street

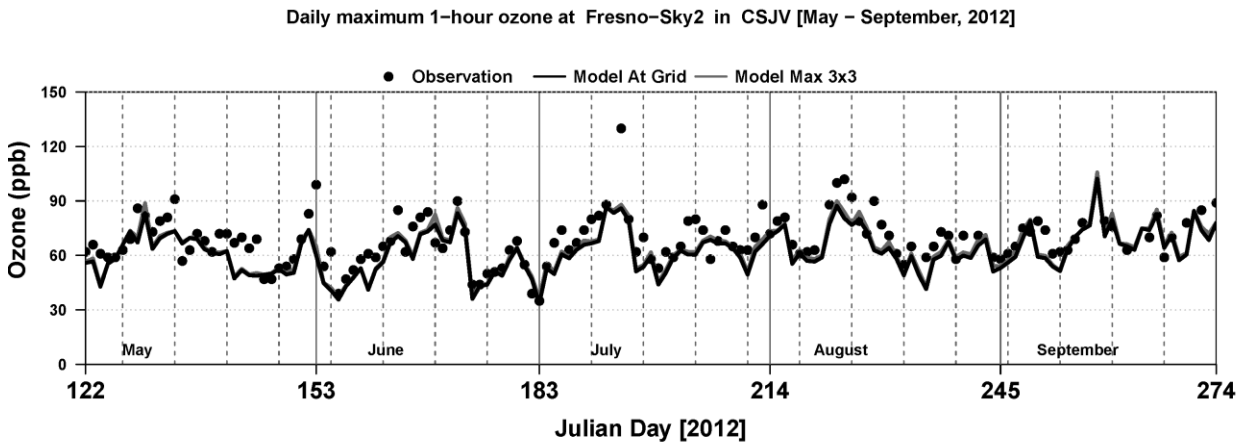


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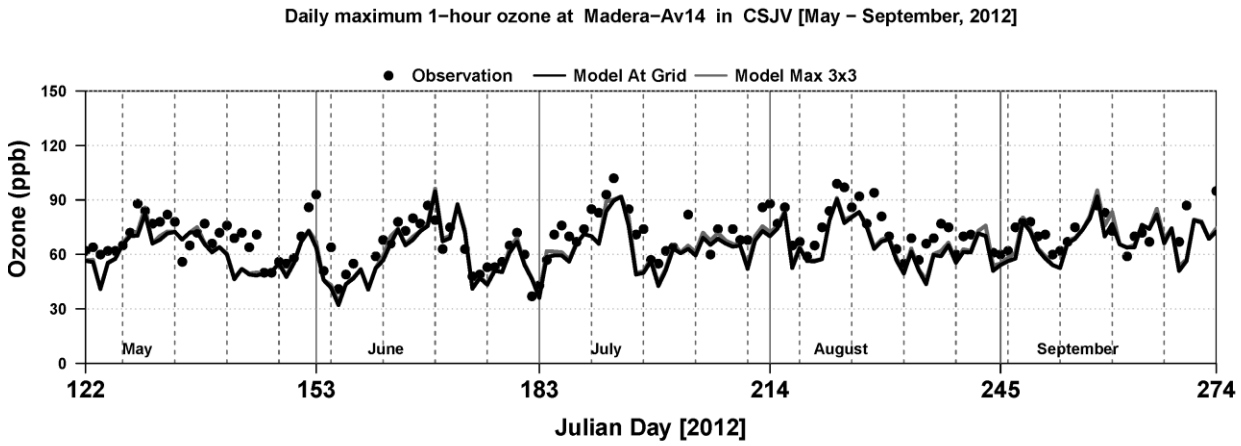


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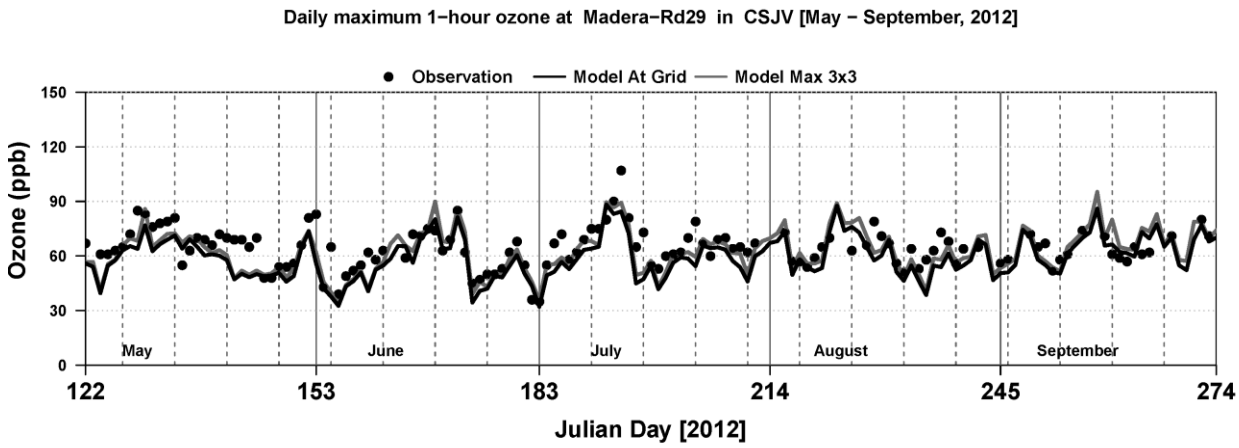


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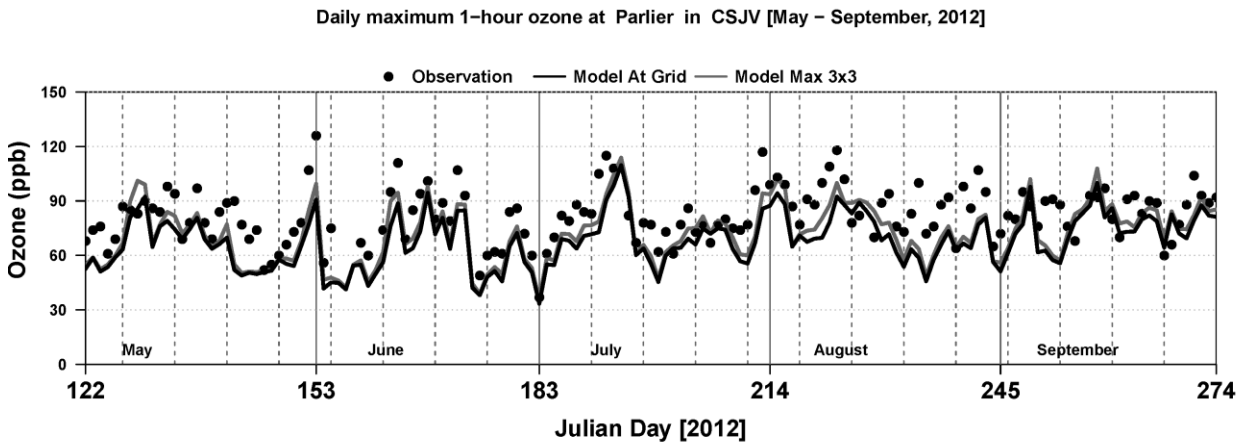


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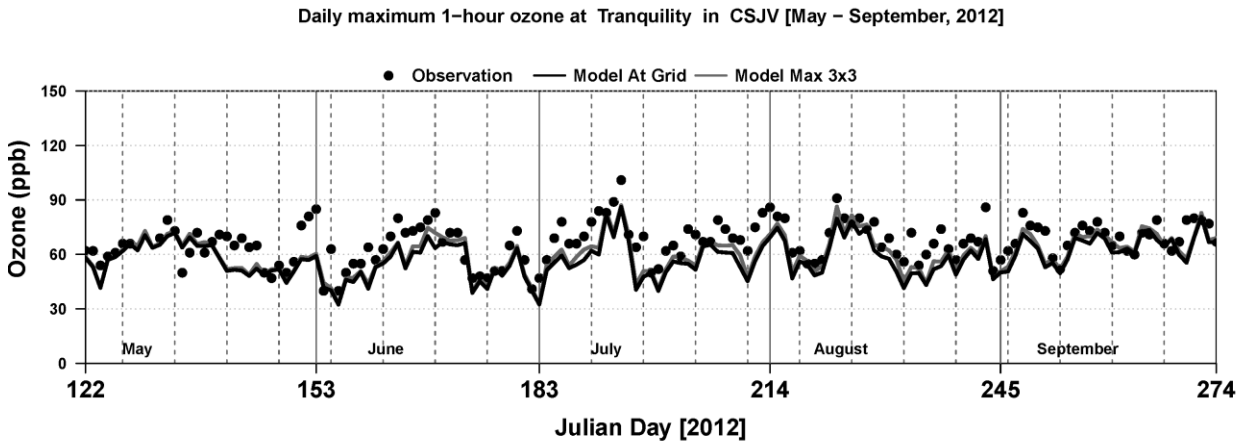


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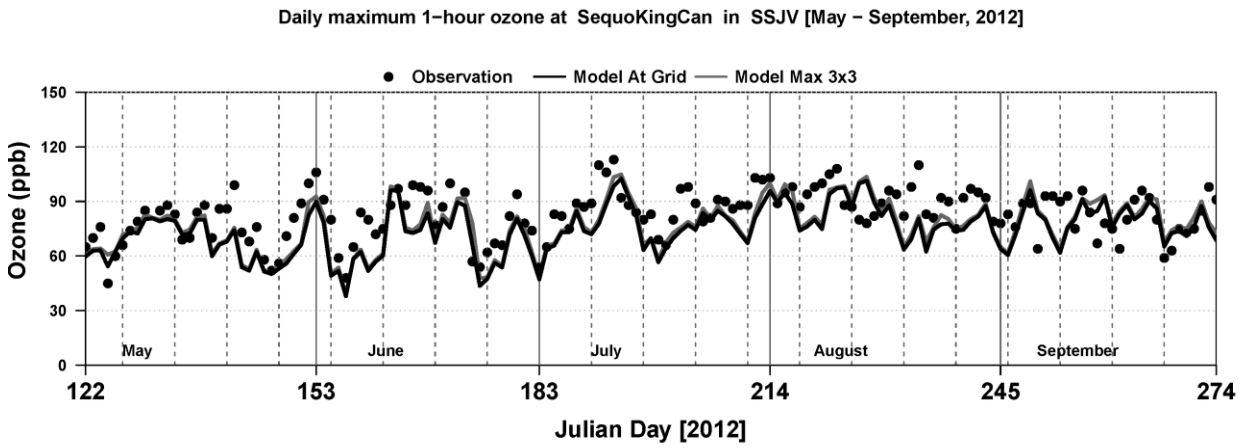


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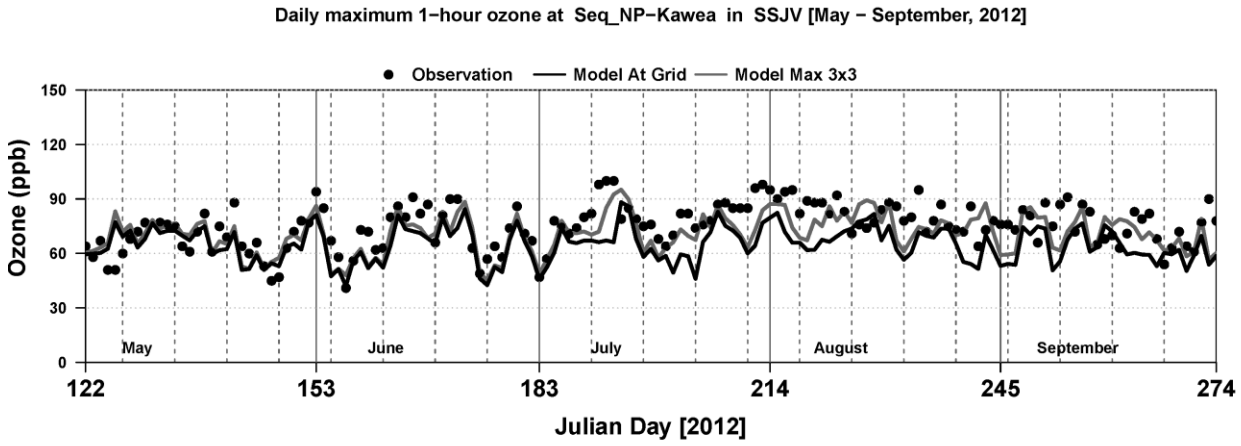


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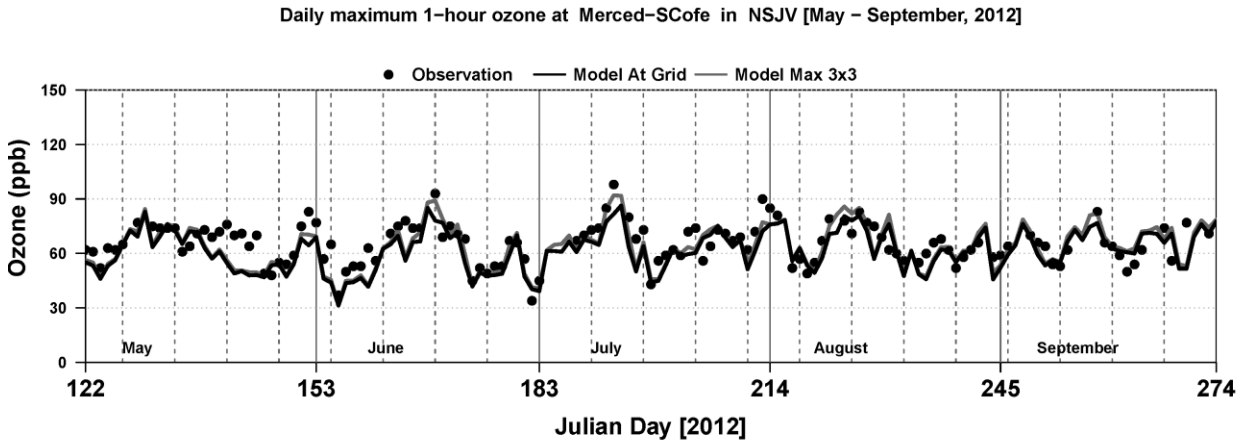


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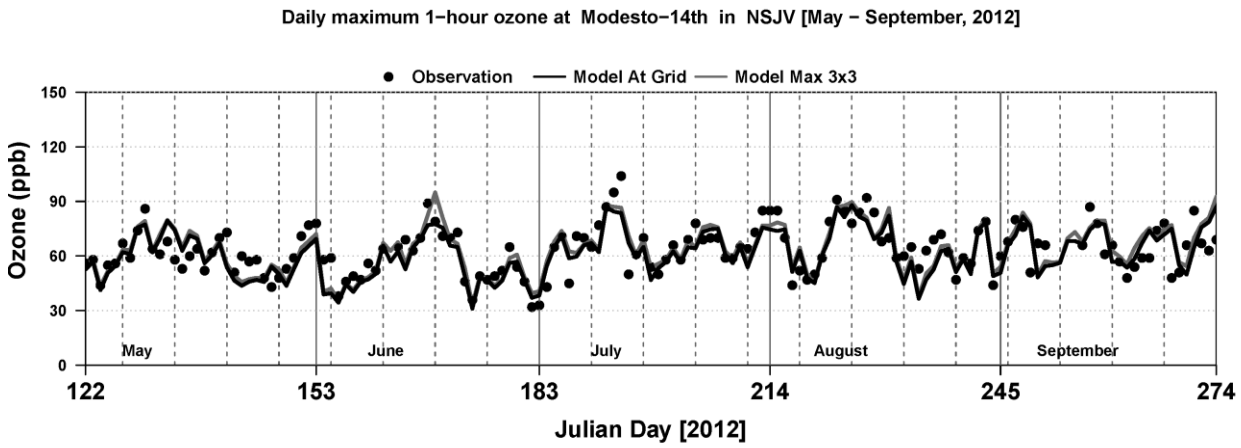


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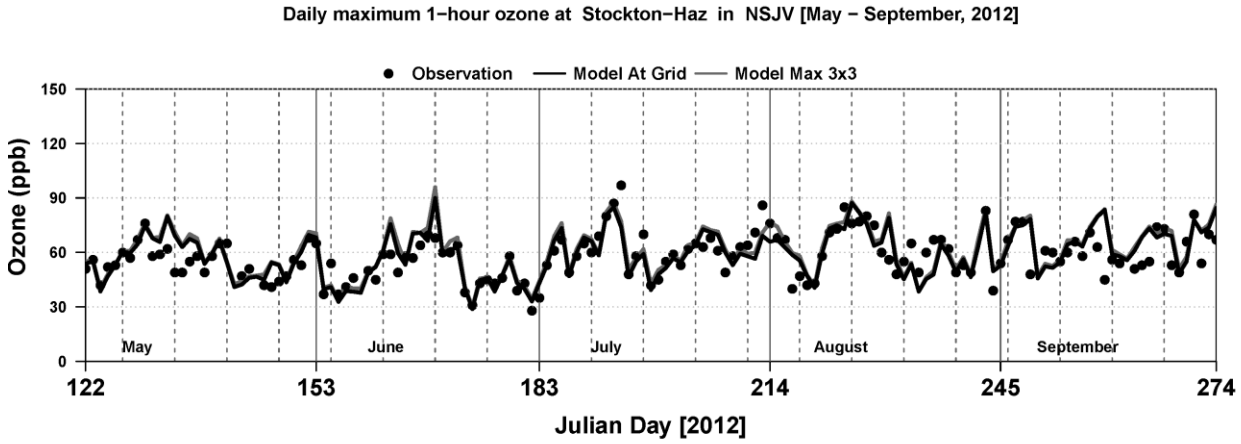


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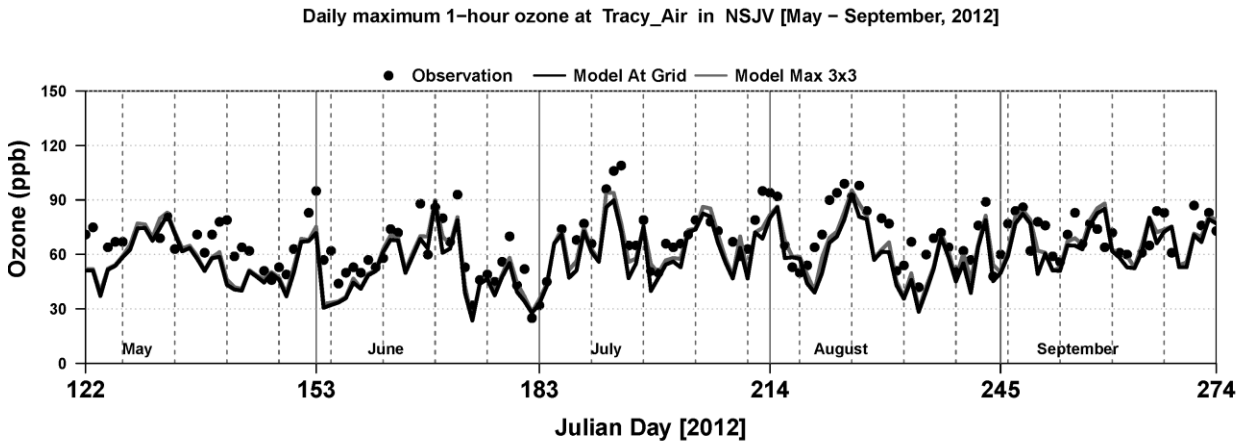


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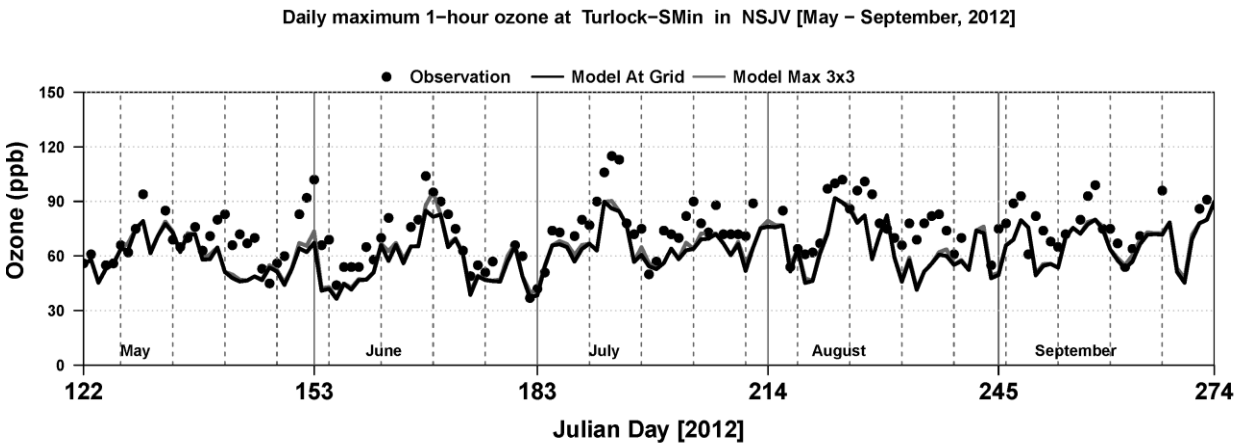


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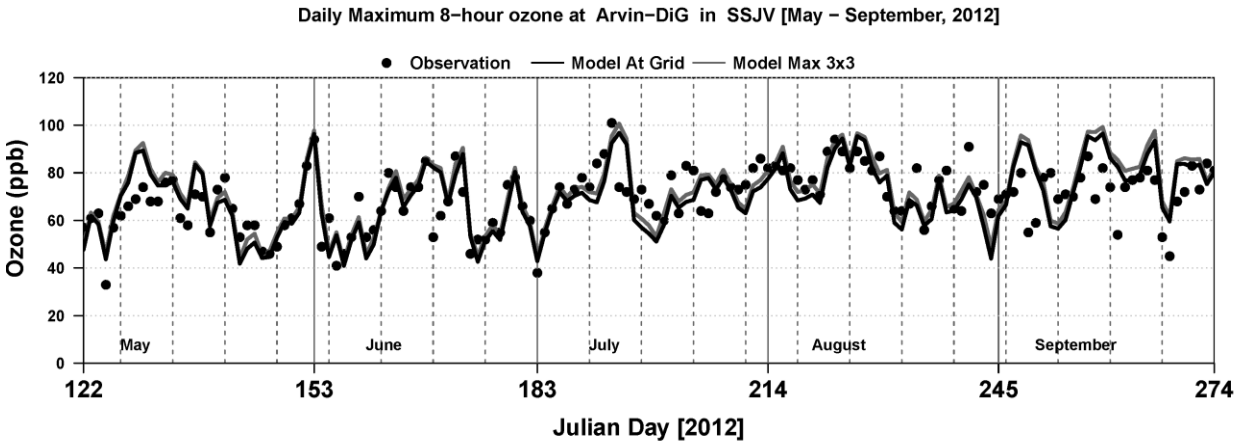


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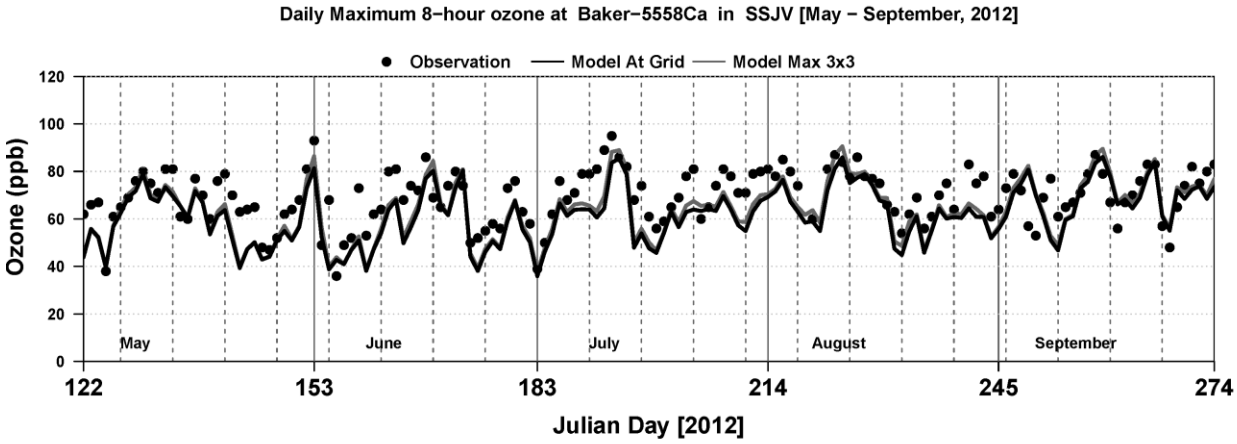


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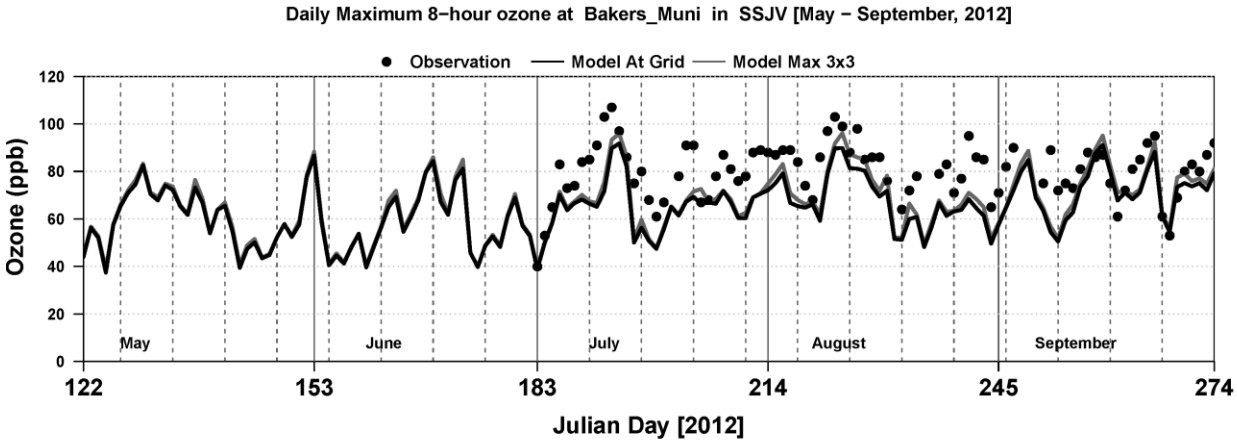


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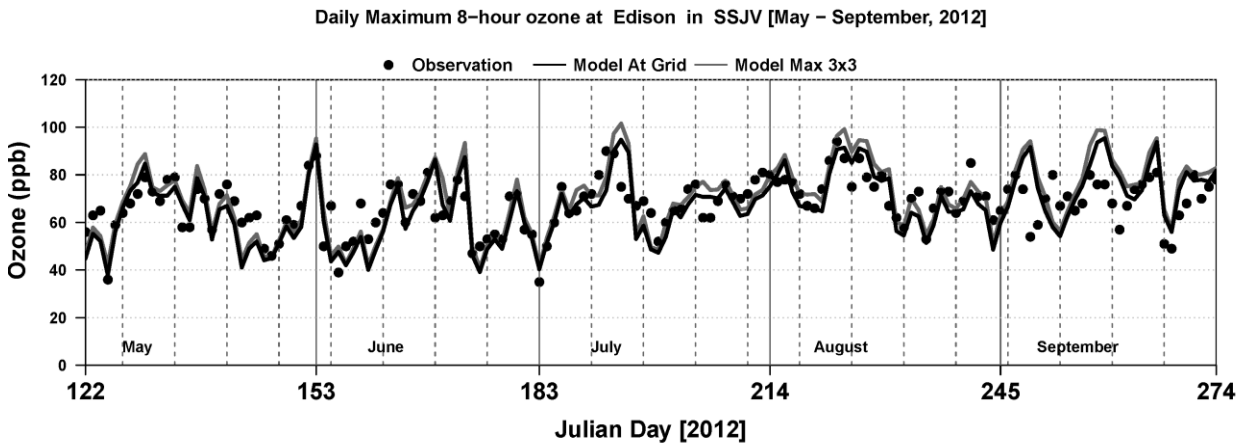


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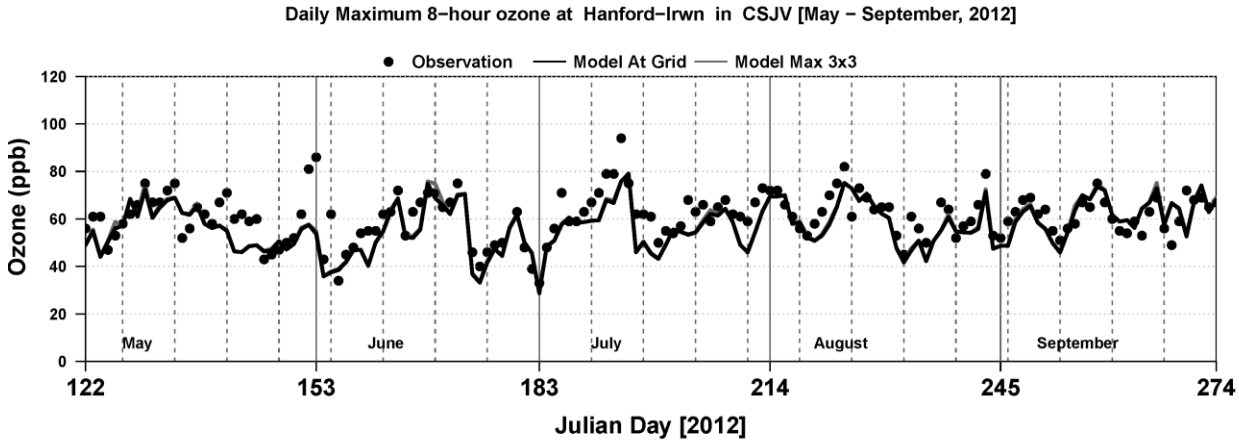


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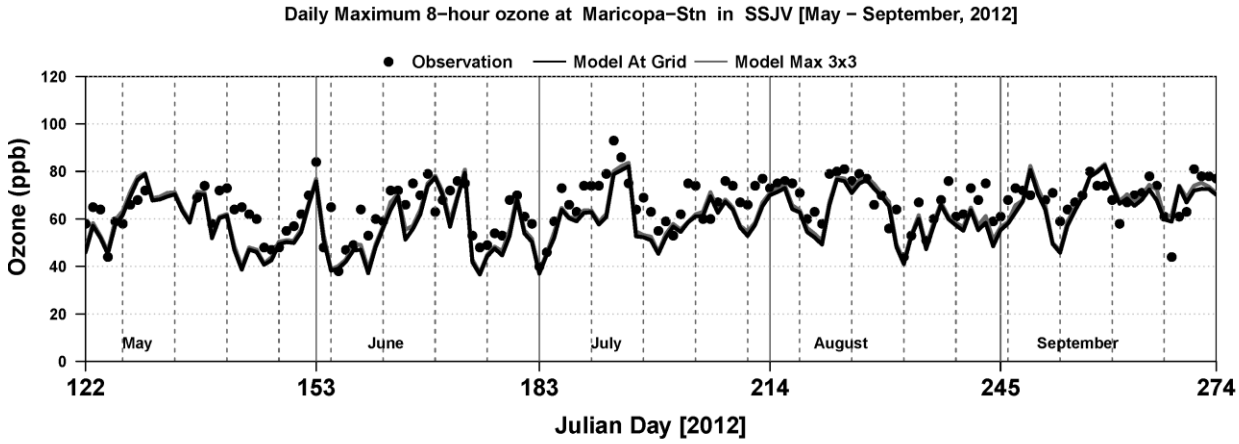


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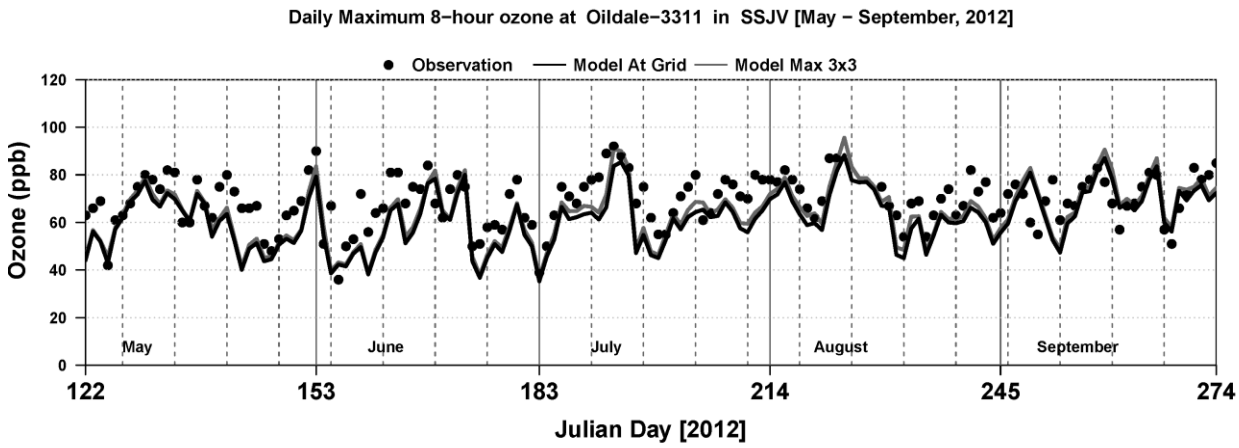


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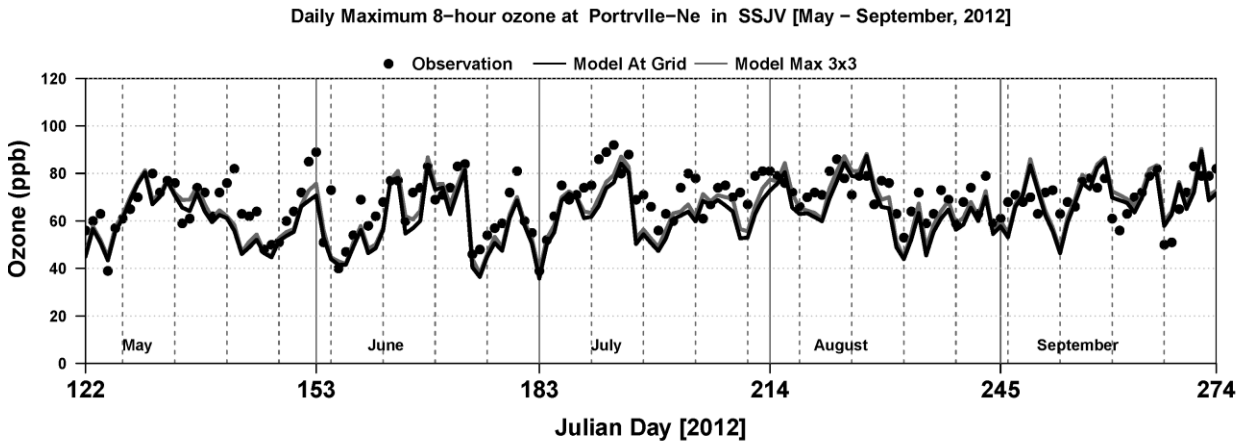


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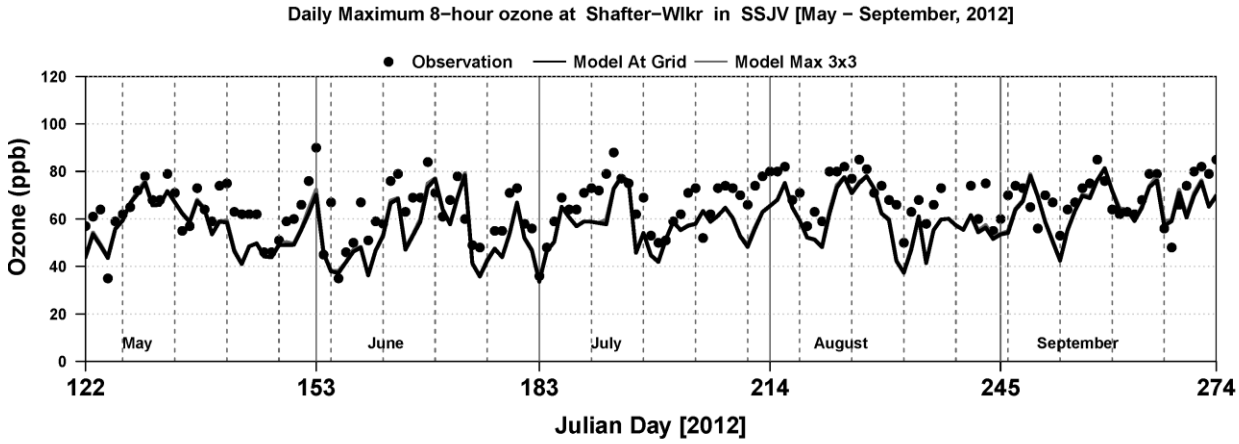


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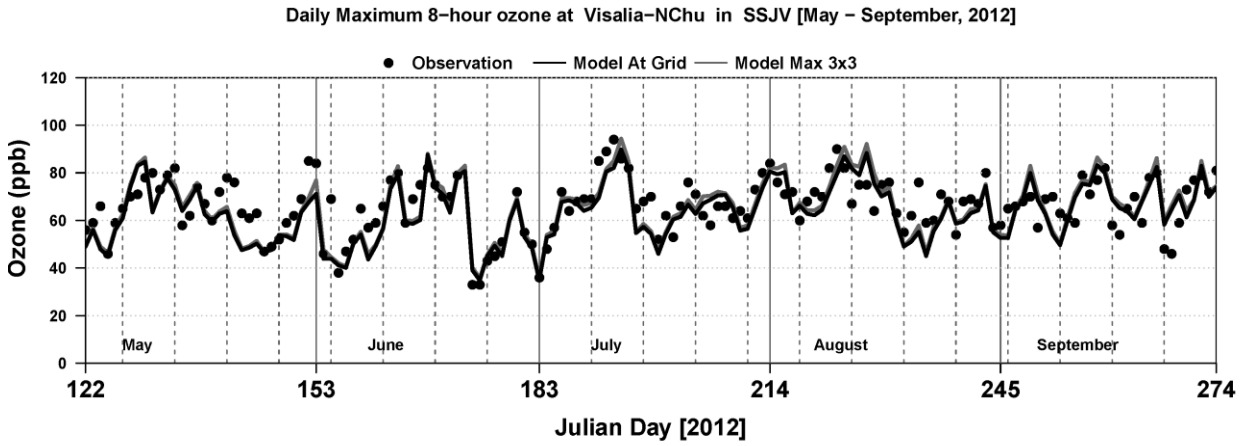


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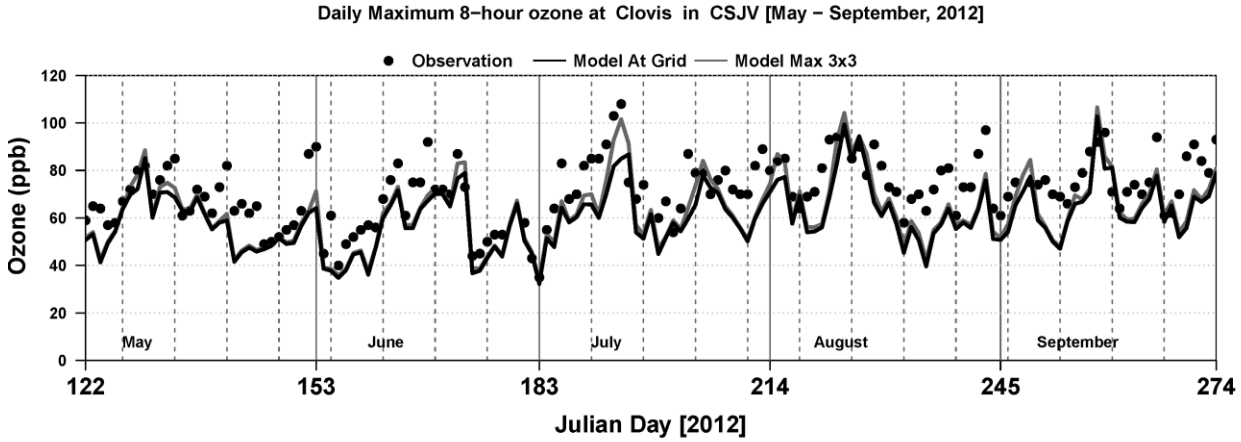


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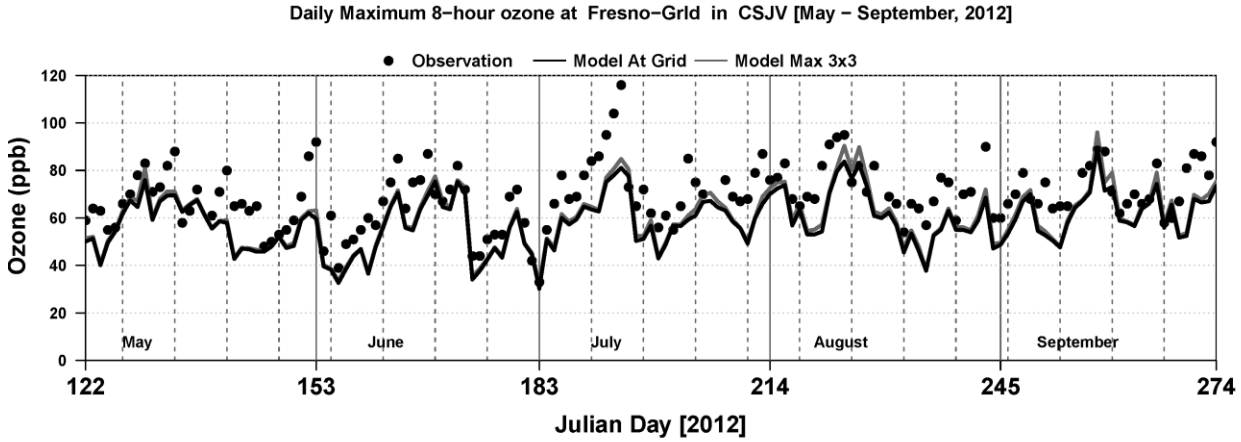


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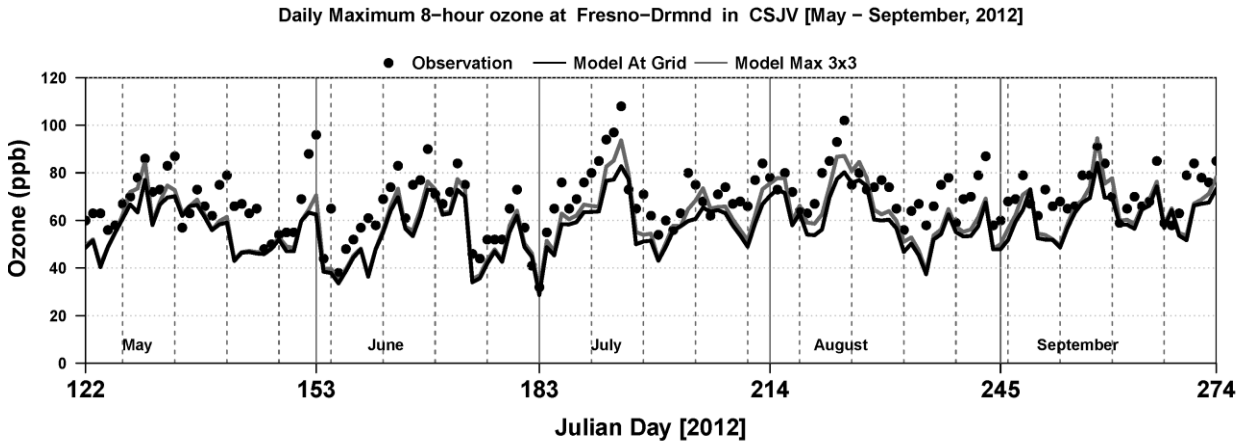


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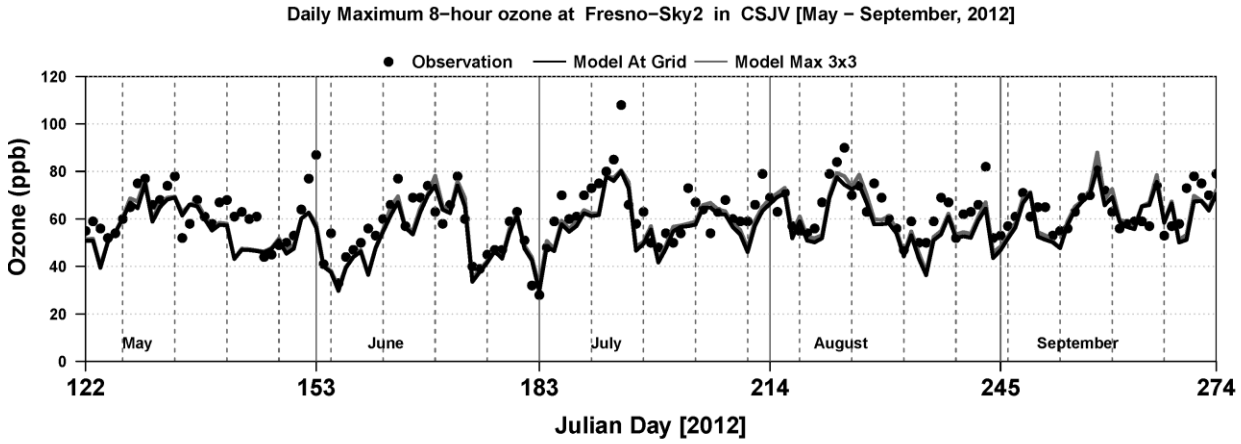


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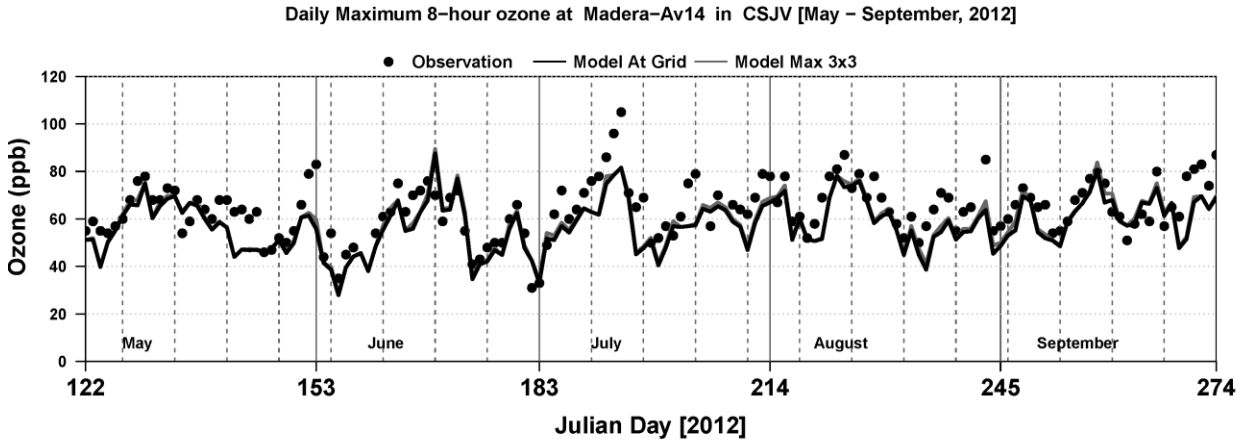


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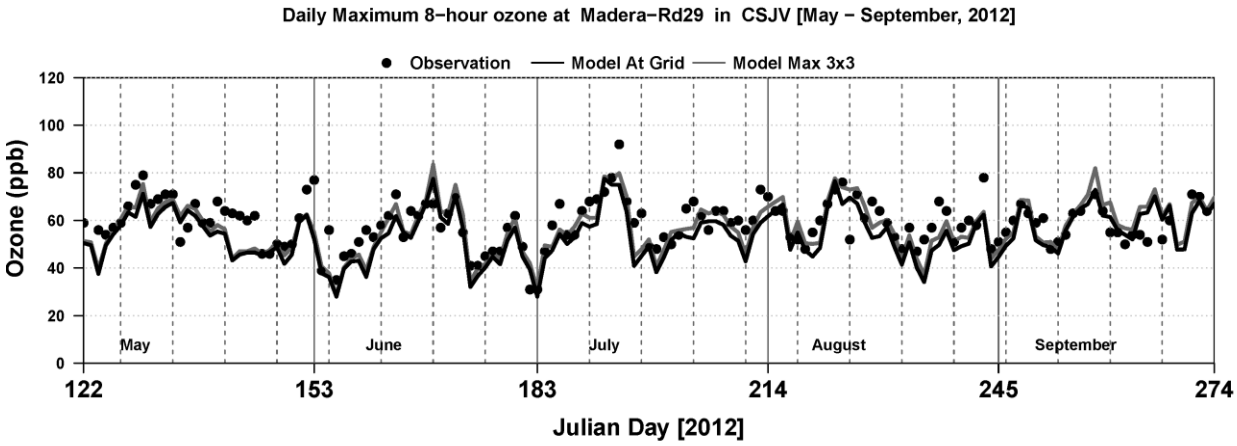


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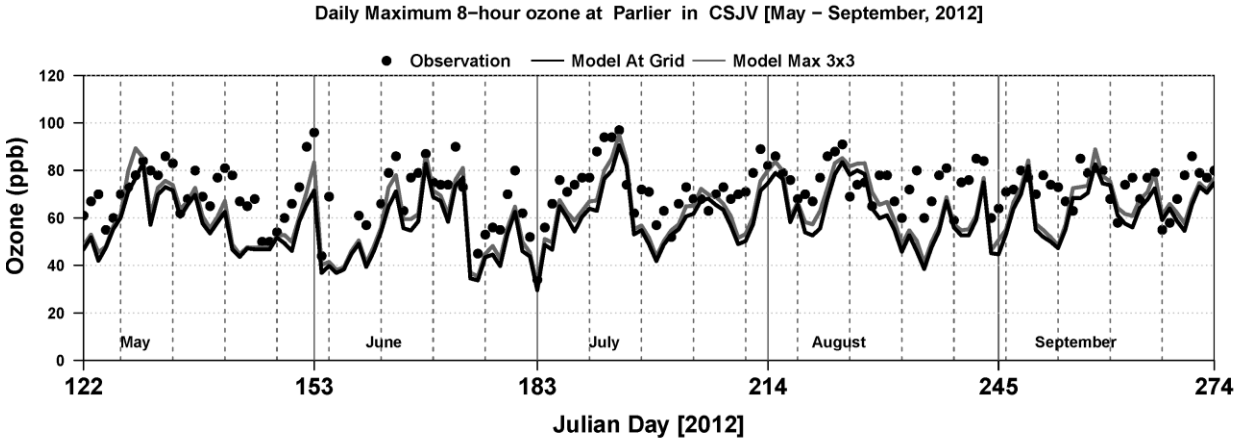


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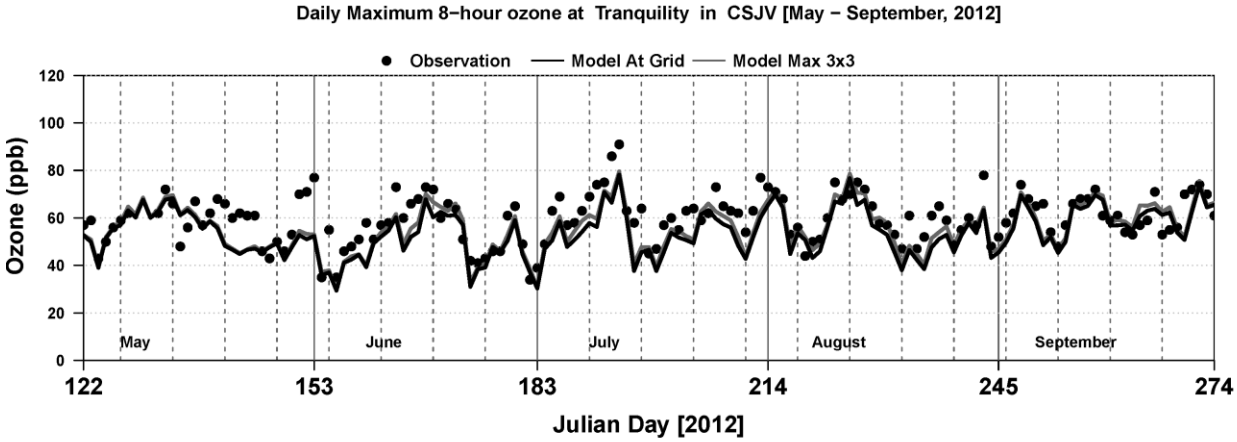


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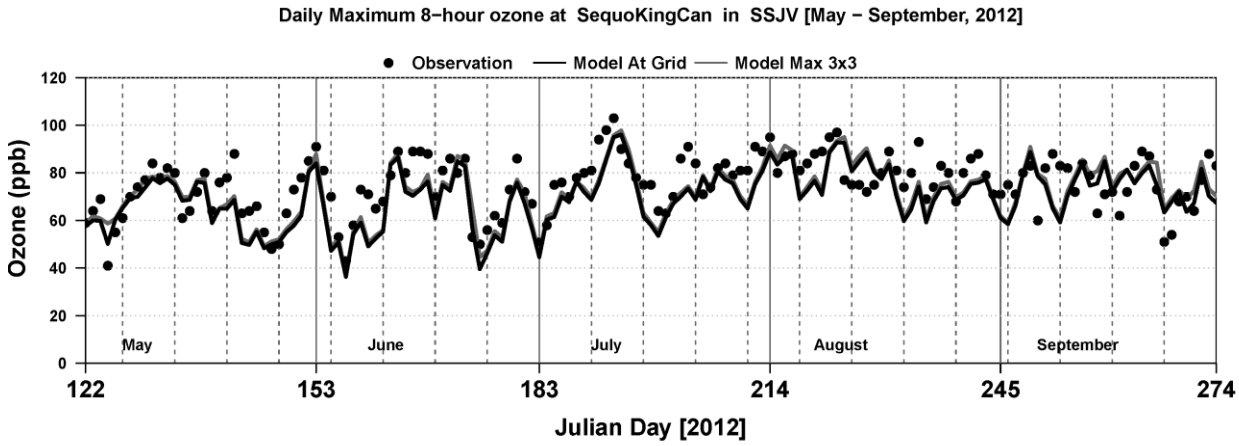


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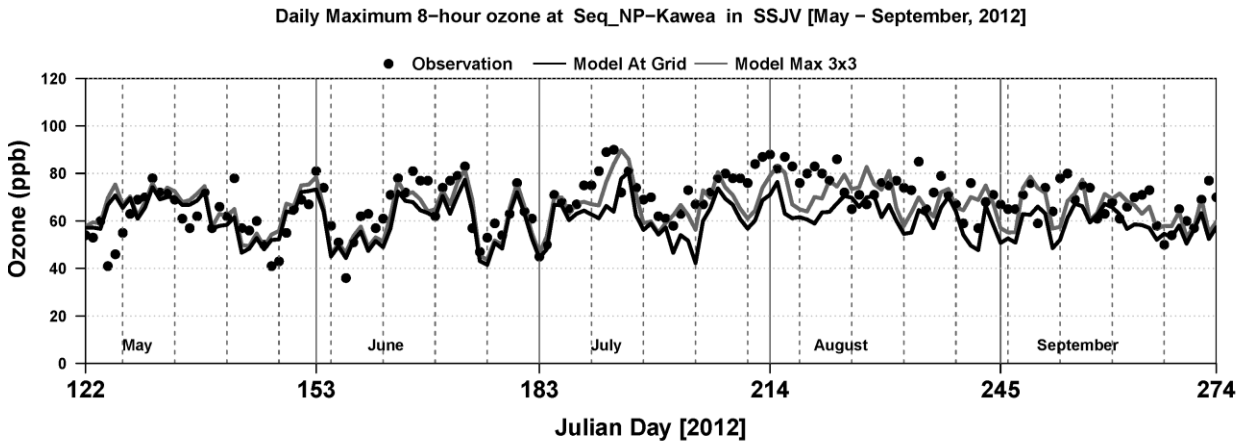


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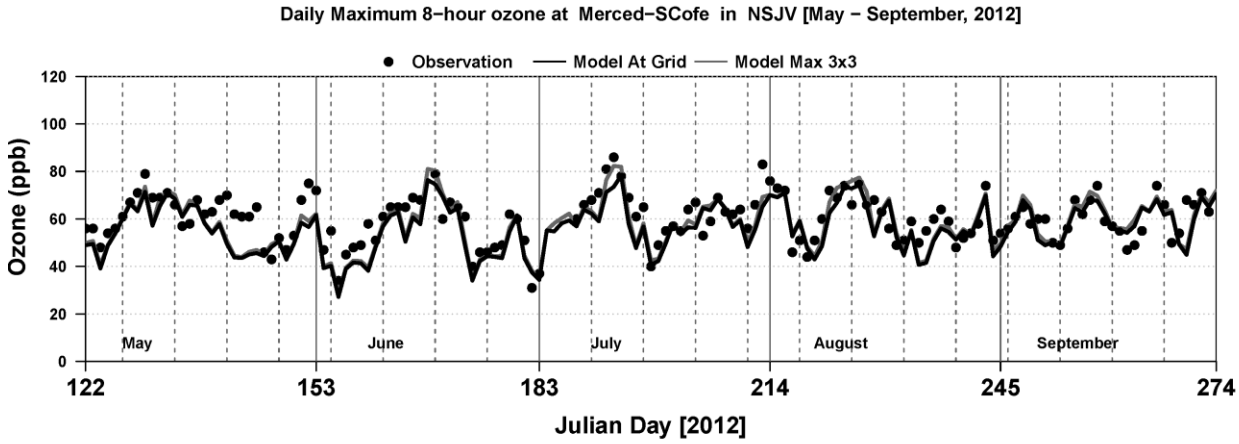


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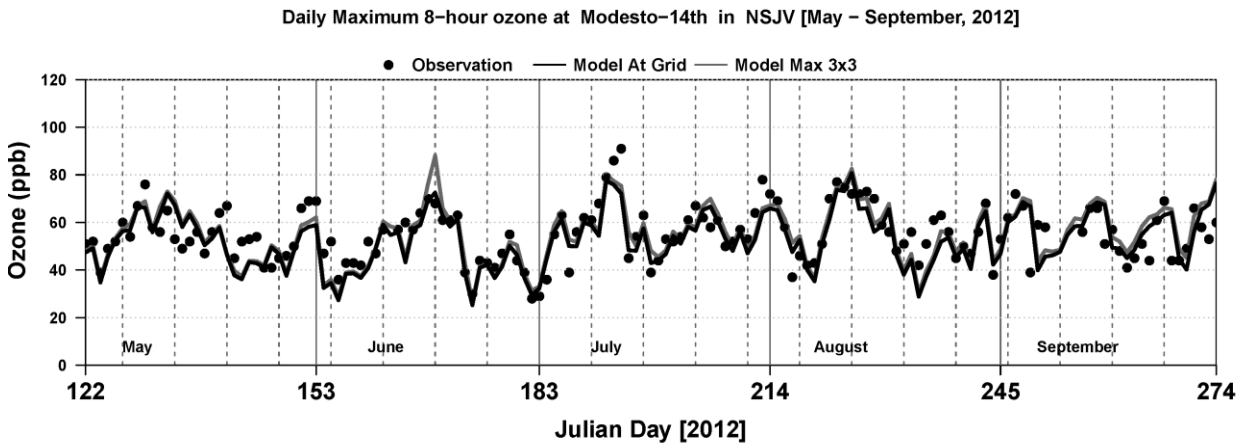


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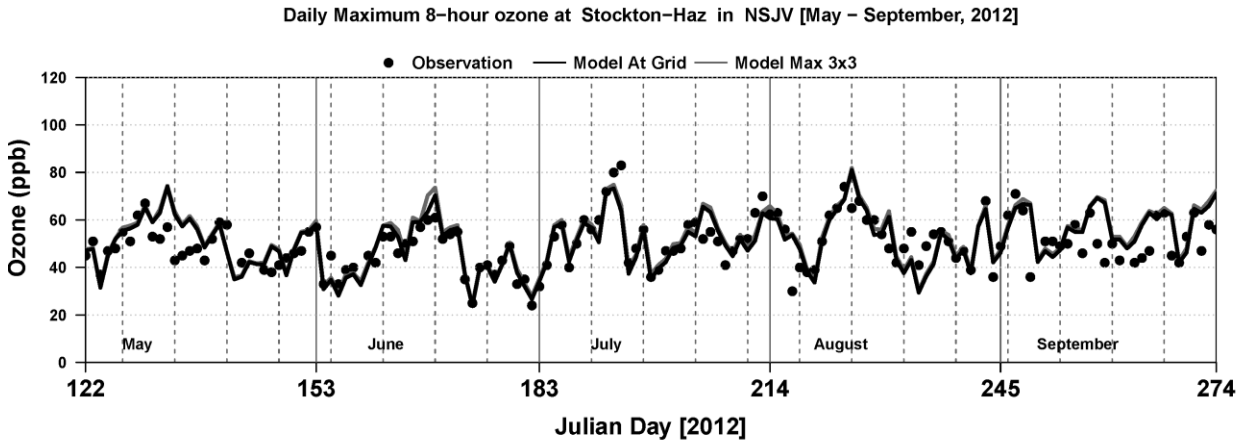


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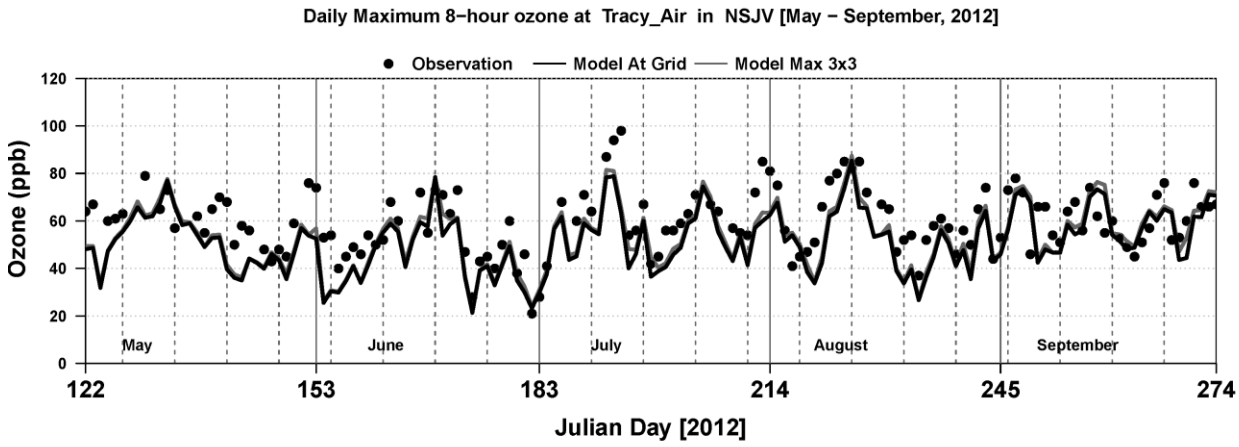


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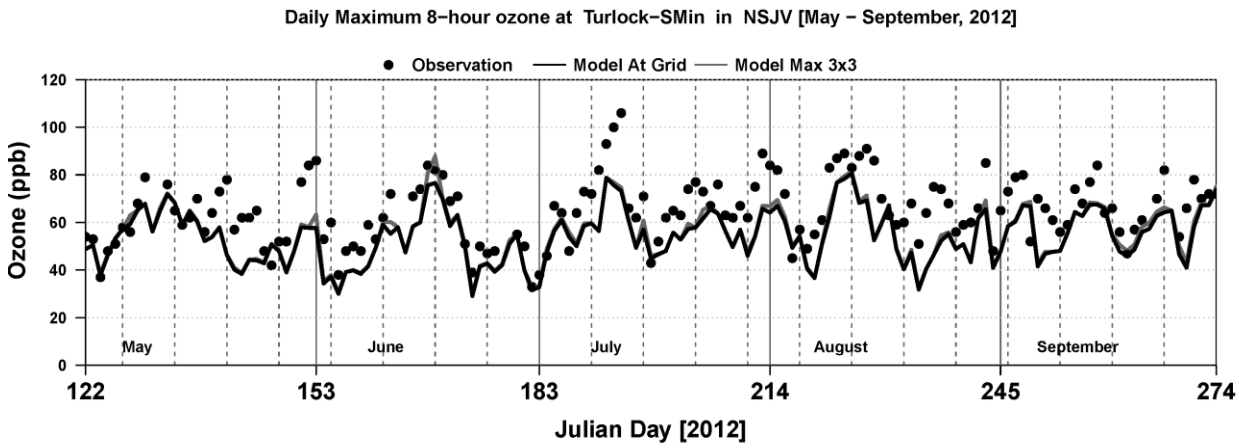


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Appendix I

Modeling Protocol

Appendix I: Modeling Protocol

[This Appendix is provided by the California Air Resources Board]

PHOTOCHEMICAL MODELING PROTOCOL

Photochemical Modeling for the 8-Hour Ozone State Implementation Plan in the San Joaquin Valley

Prepared by

California Air Resources Board
San Joaquin Valley Air Pollution Control District

Prepared for

United States Environmental Protection Agency Region IX

May 2, 2016

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ACRONYMS

ARB – Air Resources Board

ARCTAS-CARB – California portion of the Arctic Research of the Composition of the Troposphere from Aircraft and Satellites conducted in 2008

BEARPEX – Biosphere Effects on Aerosols and Photochemistry Experiment in 2007 and 2009

BCs – Boundary Conditions

CABERNET – California Airborne BVOC Emission Research in Natural Ecosystem Transects in 2011

CalNex – Research at the Nexus of Air Quality and Climate Change conducted in 2010

CARES – Carbonaceous Aerosols and Radiative Effects Study in 2010

CCOS - Central California Ozone Study

CMAQ Model – Community Multi-scale Air Quality Model

CIT – California Institute of Technology

CRPAQS – California Regional $PM_{10}/PM_{2.5}$ Air Quality Study

CSJV – Central San Joaquin Valley

DISCOVER-AQ - Deriving Information on Surface Conditions from Column and Vertically Resolved Observations Relevant to Air Quality

DV – Design Value

FDDA – Four-Dimensional Data Assimilation

HNO_3 – Nitric Acid

ICs – Initial Conditions

IMS-95 – Integrated Monitoring Study of 1995

LIDAR – Light Detection And Ranging

MDA – Maximum Daily Average

MM5 – Mesoscale Meteorological Model Version 5

MOZART – Model for Ozone and Related chemical Tracers

NASA – National Aeronautics and Space Administration

NCAR – National Center for Atmospheric Research

NCEP – National Centers for Environmental Prediction

NARR - North American Regional Reanalysis

NOAA - National Oceanic and Atmospheric Administration

NO_x – Oxides of nitrogen

NSJV – Northern San Joaquin Valley

OFP - Ozone Forming Potential

PAMS – Photochemical Assessment Monitoring Stations

PAN – Peroxy Acetyl Nitrate

$PM_{2.5}$ – Particulate Matter with aerodynamic diameter less than 2.5 micrometers

PM_{10} – Particulate Matter with aerodynamic diameter less than 10 micrometers

RH – Relative Humidity

ROG – Reactive Organic Gases

RRF – Relative Response Factor

RSAC – Reactivity Scientific Advisory Committee

SAPRC – Statewide Air Pollution Research Center

SARMAP – SJVAQS/AUSPEX Regional Modeling Adaptation Project

SIP – State Implementation Plan

SJV – San Joaquin Valley

SJVAB – San Joaquin Valley Air Basin (SJVAB)

SJVAPCD – San Joaquin Valley Air Pollution Control District

SJVAQS/AUSPEX – San Joaquin Valley Air Quality Study/Atmospheric Utilities Signatures Predictions and Experiments

SLAMS – State and Local Air Monitoring Stations

SOA – Secondary Organic Aerosol

SoCAB – Southern California Air Basin

SSJV – Southern San Joaquin Valley

UCD – University of California at Davis

U.S. EPA – United States Environmental Protection Agency

VOC – Volatile Organic Compounds

WRF Model – Weather and Research Forecast Model

1. INTRODUCTION

The purpose of this modeling protocol is to detail and formalize the procedures for conducting the photochemical modeling that forms the basis of the attainment demonstration in the 8-hr Ozone State Implementation Plan (SIP) for the San Joaquin Valley (SJV). The protocol is intended to communicate up front how the modeling attainment test will be performed. In addition, this protocol discusses additional analyses that are intended to help corroborate the modeled attainment test.

1.1 Recent History of Ozone SIPs in SJV and the Need for the Current 8-hr Ozone SIP

Over the past decade, the San Joaquin Valley Air Pollution Control District (SJVAPCD or District) has adopted State Implementation Plans (SIPs or Plans) that set forth State and local emission reduction strategies to bring the San Joaquin Valley (SJV) into attainment of federal ozone (O_3) and particulate matter (PM) air quality standards by specified dates.

In 1997, the U.S. EPA adopted the first 8-hour ozone standard of 0.08 ppm, which became effective in June 2004. In April 2007, the District adopted its first 8-hour Ozone Plan to address the 0.08 ppm standard. The 2007 Plan predicted attainment of the 0.08 ppm standard by 2023 with a NO_x carrying capacity (the level of emissions that needs to be achieved to meet the standard) of ~160 tons per day valley-wide, which was approved by U.S. EPA on March 1, 2012 (76 FR 57846). In 2008, the U.S. EPA adopted a more stringent 8-hour ozone standard of 0.075 ppm, which became effective in 2010. This protocol addresses the modeling to be used in the attainment demonstration for the SJV 0.075 ppm 8-hour ozone SIP.

1.2 Modeling roles for the current SIP

The Clean Air Act (Act) establishes the planning requirements for those areas that routinely exceed the health-based air quality standards. These nonattainment areas must adopt and implement a SIP that demonstrates how they will attain the standards by specified dates. Air quality modeling is an important technical component of the SIP, as it is used in combination with other technical information to project the attainment status of an area and to develop appropriate emission control strategies to achieve attainment.

For the current SIP, the SJVAPCD and ARB will jointly develop the emission inventories which are an integral part of the modeling. Working closely with the district, the ARB will perform the meteorological and air quality modeling. The SJVAPCD will then develop and adopt their local air quality plan. Upon approval by the ARB, the SIP will be submitted to U.S.EPA for approval.

1.3 Stakeholder participation

Public participation constitutes an integral part of the SIP development. It is equally important in all technical aspects of SIP development, including the modeling. As the SIP is developed, SJVAPCD and ARB will hold public workshops on the modeling and other SIP elements. Representatives from the private sector, environmental interest groups, academia, and the federal, state, and local public sectors are invited to attend and provide comments. In addition, Draft Plan documents will be available for public review and comment at various stages of plan development and at least 30 days before Plan consideration by the SJVAPCD's Governing Board and subsequently by the ARB Board. These documents will include descriptions of the technical aspects of the SIP. Stakeholders have the choice to provide written and in-person comments at any of the Plan workshops and public Board hearings. The agencies take the comments into consideration when finalizing the Plan.

1.4 Involvement of external scientific/technical experts and their input on the photochemical modeling

During the development of the modeling protocol for the 2012 SJV 24-hour $PM_{2.5}$ SIP, ARB and the SJVAPCD engaged a group of experts on prognostic meteorological modeling and photochemical/aerosol modeling to help prepare the modeling protocol document.

The structure of the technical expert group was as follows:

Conveners: John DaMassa – ARB
Samir Sheikh – SJVAPCD
Members: Scott Bohning – U.S. EPA Region 9
Ajith Kaduwela – ARB
James Kelly – U.S. EPA Office of Air Quality Planning and Standards
Michael Kleeman – University of California at Davis
Jonathan Pleim – U.S. EPA Office of Research and Development
Anthony Wexler – University of California at Davis

The technical consultant group provided technical consultations/guidance to the staff at ARB and SJVAPCD during the development of the protocol. Specifically, the group provided technical expertise on the following components of the protocol (only those comments specifically related to ozone modeling are shown):

- Selection of the physics and chemistry options for the prognostic meteorological and photochemical air quality models
- Selection of methods to prepare initial and boundary conditions for the air quality model
- Performance evaluations of both prognostic meteorological and photochemical air quality models. This includes statistical, diagnostic, and phenomenological evaluations of simulated results.
- Preparation of Technical Support Documents.

The current approach to regional air quality modeling has not changed significantly since the 2012 SJV 24-hour $PM_{2.5}$ SIP, so the expertise provided on the above components to the protocol remain highly relevant. In addition, since regional air quality modeling simulates ozone chemistry and PM chemistry/formation simultaneously, there is generally no difference in how the models are configured and simulations conducted for ozone vs. PM. Therefore, development of the current ozone modeling protocol will rely heavily on the recommendations made by this group of technical experts, as well as recently published work in peer-review journals related to regional air quality modeling for ozone.

1.5 Schedule for completion of the Plan

Final area designations kick-off the three year SIP development process. For the first two years, efforts center on updates and improvements to the Plan's technical and scientific underpinnings. These include the development of emission inventories, selection of modeling periods, model selection, model input preparation, model performance evaluation and supplemental analyses. During the last year, modeling, further supplemental analyses and control strategy development proceed in an iterative manner and the public participation process gets under way. After thorough review the District Board and subsequently the ARB Board consider the Plan. The Plan is then submitted to U.S. EPA. The table below summarizes the overall anticipated schedule for Plan completion:

Table 1-1. Timeline for Completion of the Plan

Timeline	Action
Fall 2015	Emission Inventory Completed
Winter 2015/Spring 2016	Modeling Completed
Winter 2015/Spring 2016	Public Workshop(s) on the Draft Plan
June 2016	San Joaquin Valley Governing Board Hearing to consider the Draft Plan
July 2016	ARB Board Hearing to consider the SJV Adopted Plan
July 16, 2016	Plan is due to U.S. EPA

2. DESCRIPTION OF THE CONCEPTUAL MODEL FOR THE NONATTAINMENT AREA

2.1 History of Field Studies in the Region

The San Joaquin Valley (SJV) air basin is perhaps the second most studied air basin in the world, in terms of the number of publications in peer-reviewed international scientific/technical journals and other major reports, with the Los Angeles air basin being the first. Major field studies that have taken place in the SJV and surrounding areas are listed in Table 2-1.

The first major air quality study in the SJV, dubbed Project Lo-Jet, took place in 1970 and resulted in the identification of the Fresno Eddy (Lin and Jao, 1995 and references therein). The first Valley-wide study that formed the foundation for a SIP was the San Joaquin Valley Air Quality Study/Atmospheric Utilities Signatures Predictions and Experiments (SJVAQS/AUSPEX) study, also known as SARMAP (SJVAQS/AUSPEX Regional Modeling Adaptation Project). A 1-hour Extreme Ozone Attainment Demonstration Plan based on the SARMAP Study was submitted to the U.S. EPA in 2004 and was approved in 2009 (74 FR 33933; 75 FR 10420). The next major study was the Integrated Monitoring Study in 1995 (IMS-95), which was the pilot study for the subsequent California Regional PM10/PM2.5 Air Quality Study (CRPAQS) in 2000 (Solomon and Magliano, 1998). IMS-95 formed the technical basis for the 2003 PM10 SIP which was approved by the U.S. EPA in 2006 (71 FR 63642). The area was re-designated as attainment in 2008 (73 FR 66759). The first annual field campaign in the SJV was CRPAQS, and embedded in it was the Central California Ozone Study (CCOS) that took place during the summer of 2000 (Fujita et al., 2001). CRPAQS was a component of the technical foundation for the 2008 annual $PM_{2.5}$ SIP which was approved by the U.S. EPA in 2011 (76 FR 41338; 76 FR 69896), and CCOS was part of the technical basis for the 2007 8-hour O_3 SIP (76 FR 57846). While CCOS is still very relevant to the current 8-hr O_3 SIP, there are five subsequent studies with relevance to ozone formation in the Valley and surrounding regions: 1) ARCTAS-CARB 2008, 2) CalNex 2010, 3) CARES 2010, 4) BEARPEX 2007 & 2009, 5) CABERNET 2011. Each of these studies has contributed significantly to our understanding of various atmospheric processes in the Valley.

The ARCTAS-CARB aircraft field campaign was a joint research effort by NASA and CARB and took place from June 18 to 24, 2008. During the study, DC-8 aircraft performed two flights over southern California on June 18 and 24 with a focus on the Southern California Air Basin (SoCAB), one flight over northern California with a focus on the San Joaquin Valley Air Basin (SJVAB) on June 20, and one flight off shore on

June 22 to quantify the pollutant levels in the air masses entering California from the Pacific Ocean. During the campaign, large wildfires occurred in California, particularly in the north. The DC-8 aircraft encountered many of the fire plumes, which allowed for the study of fire emissions and their chemical composition, as well as evaluation of the simulated fire impacts. The ARCTAS-CARB campaign provided a unique dataset for evaluating the impacts of wildfires on ozone levels through photochemical modeling studies and for evaluating the distribution of reactive nitrogen species in California (Huang et al., 2011; Cai et al., 2016).

The CalNex May-July 2010 field campaign was organized by NOAA (NOAA, 2014) and CARB. The focus of this field study included airborne measurements using the NOAA WP-3D aircraft and the Twin Otter Remote Sensing aircraft, and surface measurements using the R/V *Atlantis* mobile platform as well as two stationary ground supersites, one of which was located in Bakersfield. Analysis of the data collected during CalNex has shown that photochemical ozone production in the southern and central portions of the Valley is transitioning to a NO_x-limited chemistry regime, where further NO_x reductions are expected to lead to a more rapid reduction in ozone than what was observed over the past decade or more (Pusede and Cohen, 2012). Studies have also shown that there is evidence for an unidentified temperature-dependent VOC emissions source on the hottest days (Pusede and Cohen, 2012; Pusede et al., 2014) and large sources of hydrocarbon compounds from petroleum extraction/processing, dairy (and other cattle) operations, and agricultural crops in SJV (Gentner et al., 2014a,b).

The CARES field campaign took place in the central California region, to the northeast of Sacramento in June 2010. Comprehensive data sets of trace gases and aerosols were taken from the daily evolving Sacramento urban plume under relatively well-defined and regular meteorological conditions using multiple suites of ground-based and airborne instruments onboard the Gulfstream (G-1) research aircraft. The ground-based measurements were conducted at two sites: one within the Sacramento urban source area and the other in a downwind area about 70 km to the northeast in Cool, CA. A combination of measurement and model data during CARES (Fast et al., 2012) shows that emissions from the San Francisco Bay area transported by intrusions of marine air contributed a large fraction of the carbon monoxide in the vicinity of Sacramento. The study also showed that mountain venting processes contributed to aged pollutants aloft in the valley atmosphere that are then entrained into the growing boundary layer the following day. Although the CARES study did not take place within the SJV itself, it remains relevant to the SJV for two reasons: 1) CARES took place within the delta region north of the SJV, which can influence air quality in the northern SJV (see Section 2.4), and 2) the improved scientific understanding of the interaction between urban

emissions and downwind biogenic emissions gained during CARES is applicable to the SJV, which experiences a similar confluence of anthropogenic and biogenic emissions.

BEARPEX was conducted at the University of California's Blodgett Forest Research Station during June-July 2007 and September-October 2009. Blodgett Forest is located 65 miles northeast of Sacramento. The project was designed to study chemistry downwind of urban areas where there is high VOC reactivity (due to biogenic emissions sources) and low NO_x, to understand the full oxidation sequence and subsequent fate of biogenic VOC and the processes leading to formation and removal of biogenic secondary organic aerosol (SOA) and the associated chemical and optical properties of SOA. A study by Bouvier-Brown et al., (2009) suggests that reactive and semi-volatile compounds, especially sesquiterpenes, significantly impact the gas- and particle-phase chemistry of the atmosphere at Blodgett Forest. An analysis of absolute PANs mixing ratios by Lafranchi et al. (2009) reveals a missing PANs sink that can be resolved by increasing the peroxy acetyl radicals + RO2 rate constant by a factor of 3. At the BEARPEX field site, the sum of the individual biogenically derived nitrates account for two-thirds of the organic nitrate, confirming the importance of biogenic nitrates to the NO_y budget (Beaver et al., 2012).

The CABERNET field campaign was conducted in June 2011 in California. The objectives were to develop and evaluate new approaches for regional scale measurements of biogenic VOC emissions, quantify the response of biogenic VOC emissions to land cover change, investigate the vertical transport of isoprene and oxidation products, and evaluate biogenic emission models. Isoprene fluxes were measured on board the Center for Interdisciplinary Remotely-Piloted Aircraft Studies (CIRPAS) Twin Otter (http://www.cirpas.org/twinOtter.html) using the virtual disjunct eddy covariance method (Karl et al. 2012). Isoprene flux measurements from CABERNET have formed the basis for evaluating the biogenic emissions inventory used in California's SIP modeling (Misztal et al., 2016).

Table 2-1. Major Field Studies in Central California and surrounding areas.

Year	Study	Significance
1970	Project Lo-Jet	Identified summertime low-level jet and Fresno eddy
1972	Aerosol Characterization Experiment (ACHEX)	First TSP chemical composition and size distributions
1979-1980	Inhalable Particulate Network	First long-term PM2.5 and PM10 mass and elemental

		measurements in Bay Area, Five Points
1978	Central California Aerosol and Meteorological Study	Seasonal TSP elemental composition, seasonal transport patterns
1979-1982	Westside Operators	First TSP sulfate and nitrate compositions in western Kern County
1984	Southern SJV Ozone Study	First major characterization of O3 and meteorology in Kern County
1986-1988	California Source Characterization Study	Quantified chemical composition of source emissions
1988-1989	Valley Air Quality Study	First spatially diverse, chemical characterized, annual and 24-hour PM2.5 and PM10
Summer 1990	San Joaquin Valley Air Quality Study/Atmospheric Utilities Signatures Predictions and Experiments (SJVAQS/AUSPEX) – Also known as SARMAP (SJVAQS/AUSPEX Regional Modeling Adaptation Project)	First central California regional study of O3 and PM2.5
July and August 1991	California Ozone Deposition Experiment	Measurements of dry deposition velocities of O3 using the eddy correlation technique made over a cotton field and senescent grass near Fresno
Winter 1995	Integrated Monitoring Study (IMS-95, the CRPAQS Pilot Study)	First sub-regional winter study
December 1999 – February 2001	California Regional PM10/PM2.5 Air Quality Study (CRPAQS) and Central California Ozone Study	First year-long, regional-scale effort to measure both O_3 and $PM_{2.5}$
December 1999 to present	Fresno Supersite	First multi-year experiment with advanced monitoring technology

July 2003	NASA high-resolution lidar flights	First high-resolution airborne lidar application in SJV in the summer
February 2007	U.S. EPA Advanced Monitoring Initiative	First high-resolution airborne lidar application in SJV in the winter
August-October 2007; June-July 2009	BEARPEX (Biosphere Effects on Aerosols and Photochemistry Experiment)	Research-grade measurements to study the interaction of the Sacramento urban plume with downwind biogenic emissions
June 2008	ARCTAS - CARB	First measurement of high-time resolution (1-10s) measurements of organics and free radicals in SJV
May-July 2010	CalNex 2010 (Research at the Nexus of Air Quality and Climate Change)	Expansion of ARCTAS-CARB type research-grade measurements to multi-platform and expanded geographical area including the ocean.
June 2010	CARES (Carbonaceous Aerosols and Radiative Effects Study)	Research-grade measurements of trace gases and aerosols within the Sacramento urban plume to investigate SOA formation
June 2011	CABERNET (California Airborne BVOC Emission Research in Natural Ecosystem Transects)	Provided the first ever airborne flux measurements of isoprene in California
January-February 2013	DISCOVER-AQ (Deriving Information of Surface Conditions from Column and Vertically Resolved Observations Relevant to Air Quality)	Research-grade measurements of trace gases and aerosols during two $PM_{2.5}$ pollution episodes in the SJV

2.2 Description of the Ambient Monitoring Network

The San Joaquin Valley covers an area of 23,490 square miles and is home to approximately 4 million residents. The Valley is bordered on the west by the coastal mountain ranges and on the east by the Sierra Nevada range. These ranges converge at the southern end of the basin at the Tehachapi Mountains. The majority of the population is centered in the large urban areas of Bakersfield, Fresno, Modesto, and Stockton. The nonattainment area includes seven full counties (San Joaquin, Stanislaus, Merced, Madera, Fresno, Kings, and Tulare) and one partial county Kern (only the western portion of Kern County, which lies in the jurisdiction of the SJVAPCD is included).

The Valley can be divided into three regions that are characterized by distinct geography, meteorology, and air quality: 1) northern SJV (San Joaquin, Stanislaus, and Merced counties), 2) central SJV (Madera, Fresno, and King counties), and 3) southern SJV (Tulare and Western Kern counties). A third of the Valley population lives in the northern SJV. This lowland area is bordered by the Sacramento Valley and Delta lowland to the north, the central portion of the SJV to the south, and mountain ranges to the east and west. Because of the marine influence, which extends into this area through gaps in the coastal mountains to the west, the northern SJV experiences a more temperate climate than the rest of the Basin. These cooler temperatures and the predominant air flow patterns generally favor better air quality. Similar to the northern SJV, the central and southern SJV are also low lying areas, flanked by mountains on their west and east sides. The worst air quality within the Valley occurs in these two regions, where the population is primarily clustered around the Fresno and Bakersfield urban areas. In these regions the interaction between geography, climate, and a mix of natural (biogenic) and anthropogenic emissions pose significant challenges to air quality progress. The southern SJV represents the terminus of the Valley and is flanked by mountains on the south, as well. The surrounding mountains in both areas act as barriers to air flow, and combined with recirculation patterns and stable air to trap emissions and pollutants near the valley floor. The higher temperatures and more stagnant conditions in these two regions lead to a build-up of ozone and overall poorer air quality. In addition to the urban air quality problems, emissions and pollutants from these areas are transported downwind, resulting in poor air quality in downwind areas.

As discussed above, the Valley's diverse area includes several major metropolitan areas, vast expanses of agricultural land, industrial sources, and highways, all of which pose many issues to air quality. The San Joaquin Valley Air Pollution Control District (SJVAPCD or District), the California Air Resources Board (CARB), and the National Park Service work together and operate an extensive network of air quality monitors throughout the Valley to help improve and protect public health. The data collected from

the Valley air monitoring network is used to generate daily air quality forecasts, issue health advisories as needed, support compliance with various ambient air quality standards and serves as the basis for developing long-term attainment strategies and tracking progress towards health-based air quality standards.

Figure 2-1 shows the spatial distribution of the ozone, NO_x, and PAMS (Photochemical Assessment Monitoring Stations) monitors in the Valley (see Table 2-2 for longitude/latitude information for each monitor). The monitors are located throughout the Valley floor, higher elevation locations, and within higher population density urban areas, and have been shown to sufficiently capture the highest ozone mixing ratios and the corresponding precursors under various weather conditions and in all major population centers. A detailed discussion about the monitoring network and its adequacy can be found in the Valley's 2015 Air Monitoring Network Plan (http://www.valleyair.org/aqinfo/Docs/2015-Air-Monitoring-Network-Plan.pdf) and 2014 California Infrastructure SIP (http://www.arb.ca.gov/planning/sip/infrasip/docs/i-sip.pdf).

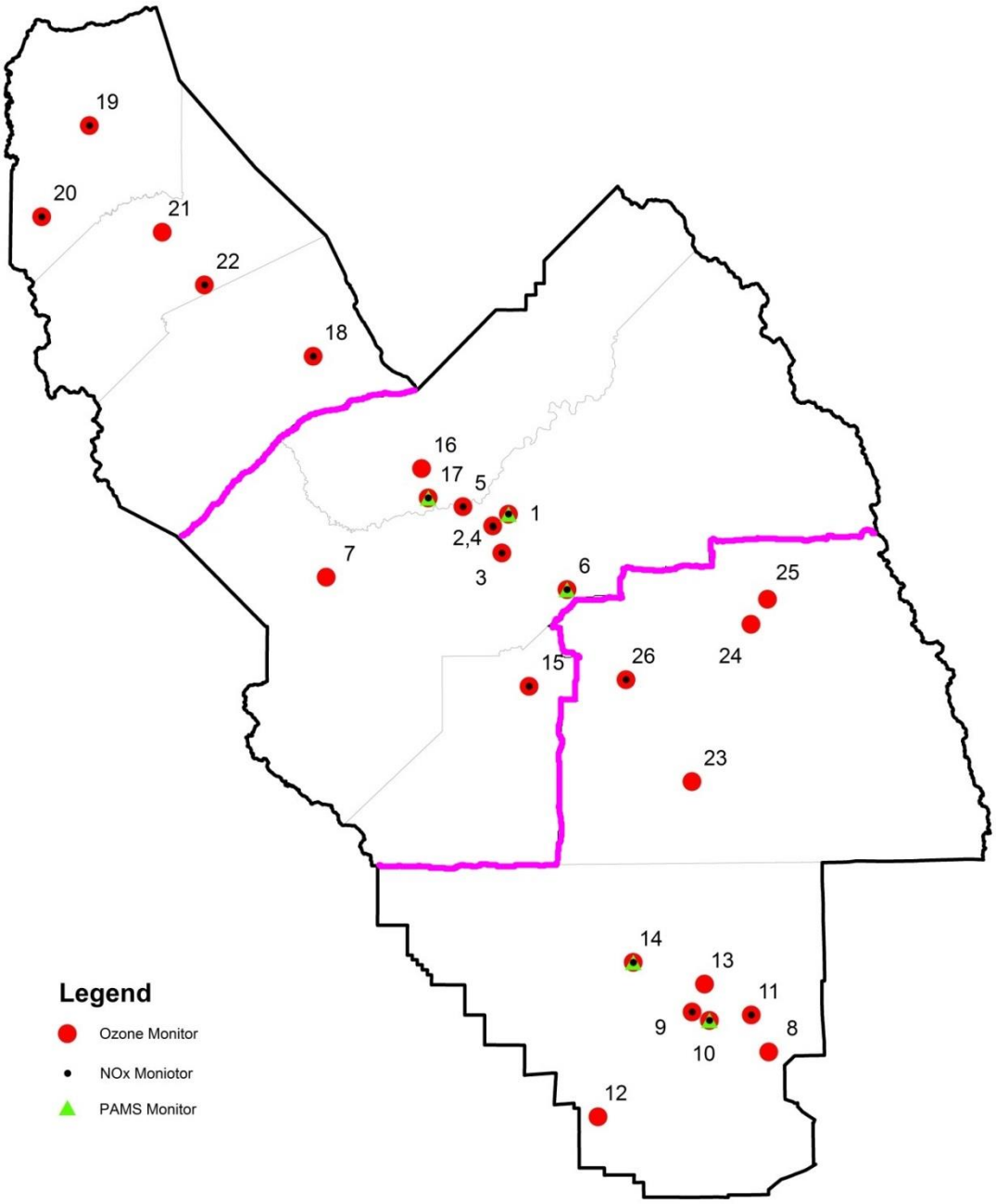


Figure 2-1. Map of the Monitoring Sites in the San Joaquin Valley. The red and black circle markers denote the location of ozone and NO_x monitors while the green triangle markers denote the PAMS monitors. The magenta lines denote the regional boundaries of the northern, central and southern SJV sub-regions that are used for evaluating the meteorological and photochemical modeling performance.

Table 2-2. 2012-2015 San Joaquin Valley Ozone, NO_x, and PAMS Sites

#	County	Sub Region	Site	NO_x	Ozone	PAMS	Latitude	Longitude
1	Fresno	Central SJV	Clovis-N Villa Avenue	X	X	X	36.8194	-119.7164
2	Fresno	Central SJV	Fresno-1st Street	X	X		36.7819	-119.7731
3	Fresno	Central SJV	Fresno-Drummond Street	X	X		36.7053	-119.7413
4	Fresno	Central SJV	Fresno-Garland	X	X		36.7853	-119.7742
5	Fresno	Central SJV	Fresno-Sierra Skypark #2	X	X		36.8417	-119.8828
6	Fresno	Central SJV	Parlier	X	X	X	36.5974	-119.5039
7	Fresno	Central SJV	Tranquility-32650 West Adams Avenue		X		36.6342	-120.3823
8	Kern	Southern SJV	Arvin-Di Giorgio		X		35.2367	-118.7894
9	Kern	Southern SJV	Bakersfield-5558 California Avenue	X	X		35.3567	-119.0628
10*	Kern	Southern SJV	Bakersfield-Municipal Airport	X	X	X	35.3313	-119.001
11	Kern	Southern SJV	Edison	X	X		35.3458	-118.8506
12	Kern	Southern SJV	Maricopa-Stanislaus Street		X		35.0514	-119.4028
13	Kern	Southern SJV	Oildale-3311 Manor Street		X		35.4381	-119.0167
14	Kern	Southern SJV	Shafter-Walker Street	X	X	X	35.5033	-119.2728
15	Kings	Central SJV	Hanford-S Irwin Street	X	X		36.3147	-119.6436
16	Madera	Central SJV	Madera-28261		X		36.9533	-120.0342

			Avenue 14					
17	Madera	Central SJV	Madera-Pump Yard	X	X	X	36.8672	-120.01
18	Merced	Northern SJV	Merced-S Coffee Avenue	X	X		37.2817	-120.4336
19	San Joaquin	Northern SJV	Stockton-Hazelton Street	X	X		37.9517	-121.2689
20	San Joaquin	Northern SJV	Tracy-Airport	X	X		37.6825	-121.4406
21	Stanislaus	Northern SJV	Modesto-14th Street		X		37.6419	-120.9942
22	Stanislaus	Northern SJV	Turlock-S Minaret Street	X	X		37.4882	-120.8359
23	Tulare	Southern SJV	Porterville-1839 Newcomb Street		X		36.0318	-119.055
24	Tulare	Southern SJV	Sequoia and Kings Canyon Natl Park		X		36.4911	-118.8342
25	Tulare	Southern SJV	Sequoia Natl Park-Lower Kaweah		X		36.564	-118.773
26	Tulare	Southern SJV	Visalia-N Church Street	X	X		36.3325	-119.2908

*As the Bakersfield municipal airport site in Kern County became operational in June 2012, the measurements were not available for calculating 8-hr ozone design values in 2012 and 2013. Hence this site was excluded from the current SIP attainment demonstration.

2.3 Ozone Trends and Sensitivity to Emissions Reductions

The San Joaquin Valley is one of the most severely polluted air basins in the U.S., and is designated as an extreme ozone nonattainment area for the U.S. EPA 2008 0.075 ppm 8-hour ozone standard. Anthropogenic sources of the oxides of nitrogen (NO_x) and reactive organic gases (ROG) are the major precursors that lead to ozone formation in the valley. Biogenic hydrocarbons are also important contributors to ozone precursors in the region, and are projected to play an even more important role in the future as emission controls reduce anthropogenic ROG. Since the 1980's, the Valley's

emission control programs have substantially reduced the amounts of both anthropogenic NO_x and ROG throughout the valley. As these control programs have led to changes in the relative levels of NO_x and ROG in the valley over time, the control programs have also adapted so as to reduce ozone levels as rapidly as possible. This adaptation within the control programs is necessary because ozone formation responds differently to NO_x and ROG controls as the relative levels of NO_x and ROG in the atmosphere change.

Specifically, ozone formation exhibits a nonlinear dependence to NO_x and ROG precursors in the atmosphere. In general terms, under ambient conditions of high-NO_x and low-ROG (NO_x-disbenefit region in Figure 2-2), ozone formation tends to exhibit a disbenefit to reductions in NO_x emissions (i.e., ozone increases with decreases in NO_x) and a benefit to reductions in ROG emissions (i.e., ozone decreases with decreases in ROG). In contrast, under ambient conditions of low-NO_x and high-ROG (NO_x-limited region in Figure 2-2), ozone formation shows a benefit to reductions in NOx emissions, while changes in ROG emissions result in only minor decreases in ozone. These two distinct "ozone chemical regimes" are illustrated in Figure 2-2 along with a transitional regime that can exhibit characteristics of both the NO_x-disbenefit and NO_x-limited regimes. Note that Figure 2-2 is shown for illustrative purposes only, and does not represent the actual ozone sensitivity within the SJV for a given combination of NO_x and VOC (ROG) emissions.

During the 1980's in the SJV, when NO_x emissions were high relative to ROG and the region exhibited a NOx-disbenefit towards ozone formation, ROG emission controls outpaced NO_x controls. During the 1990's, emission controls slowly shifted to a more balanced approach between ROG and NO_x, and by the 2000's NO_x reductions began to outpace ROG reductions. For much of the 1980's through the mid-2000's, the Valley was in a NO_x-disbenefit or transitional chemical regime and it's only been within the past decade (mid- to late-2000's) where the Valley began transitioning to a NO_x-limited chemical regime. This transition from a NO_x -disbenefit to a NO_x -limited chemical regime can be analyzed through the year-to-year variability in biogenic ROG emissions, which during the summer ozone season can be many times greater than anthropogenic ROG emissions in the Valley, as well as through the so called "weekend effect" which shows an increase in ozone on the weekend under NO_x -disbenefit conditions (and a decrease under NO_x -limited conditions).

Basin-wide summer emission trends from 2000 to 2014 for the SJV are shown in Figure 2-3 (top) for anthropogenic NO_x and ROG, as well as biogenic ROG (biogenic trends are for 2001 to 2014). Figure 2-3 clearly shows large decrease in both anthropogenic NO_x (from 627 tpd to 340 tpd) and ROG (from 503 tpd to 337 tpd) emissions from 2000

to 2012. Over the same time period, biogenic ROG emissions exhibited large year-to-year variability, ranging from ~1000 tpd in 2005 to ~2000 tpd in 2006 and 2010. However, even at its lowest levels, biogenic ROG is estimated to be three times as high as the anthropogenic ROG inventory in 2012 and upwards of seven times as high during peak biogenic years.

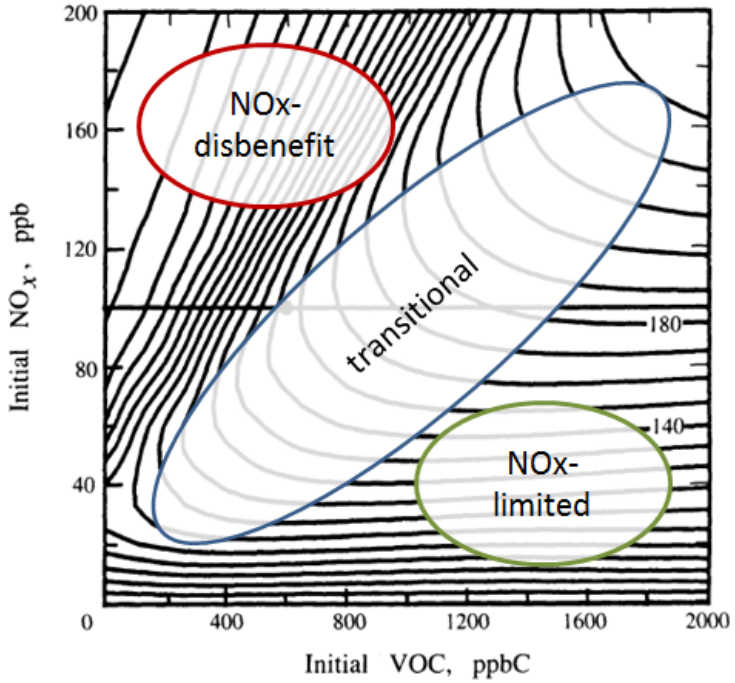


Figure 2-2. Illustrates a typical ozone isopleth plot, where each line represents ozone mixing ratio, in 10 ppb increments, as a function of initial NO_x and VOC (or ROG) mixing ratio (adapted from Seinfeld and Pandis, 1998, Figure 5.15). General chemical regimes for ozone formation are shown as NO_x-disbenefit (red circle), transitional (blue circle), and NO_x-limited (green circle).

Over the same 2000 to 2014 time period, the ozone design value and days above the ozone standard (exceedance days) within the SJV declined steadily (Figure 2-3 middle and bottom, respectively), but did also exhibit a fair amount of variability due to year-to-year variability in meteorology and the associated changes in biogenic emissions. Overall, the basin-wide design values have declined from 111 ppb in 2000 to 95 ppb in 2014. However, these DVs are still substantially higher than the current 75 ppb standard.

Since the basin-wide DV is focused on the highest ozone values and the location of these peaks can change from year-to-year, the exceedance days, a measure of overall

air quality and the frequency of ozone exposure, may be a better metric for evaluating changes in ozone chemistry when viewed in the context of changing biogenic ROG emissions. Exceedance days in the Valley have substantially decreased over time from 144 in 2000 to 86 in 2014 (40% lower with respect to 2000) indicating significant improvements in ozone air quality across the entire valley. The decline in weekend exceedance days was slightly higher (44% decrease from 43 to 24) than the corresponding decline in weekday exceedance days (~38% decrease from 101 to 62) between the years 2000 and 2014. Comparing the year-to-year variability in exceedance days to similar variability in the biogenic ROG emissions, shows that from 2001-2007 the two were strongly correlated (i.e., when biogenic ROG emissions increased, so did the number of exceedance days). This is consistent with valley being primarily in a NO_x-disbenefit regime, where increases in ROG emissions result in enhanced ozone formation. From 2008 onwards, this correlation no longer exists and the two are actually anti-correlated for all years except 2009. Although other factors beyond chemistry, such as meteorology, play a large role in the year-to-year variability in ozone, this suggests a shift from a NO_x-disbenefit regime to a transitional or NO_x-limited regime around the 2008 timeframe.

Investigating the “weekend effect” and how it has changed over time is also a useful metric for evaluating the ozone chemistry regime in the SJV. The weekend effect is a well-known phenomenon in some major urbanized areas where emissions of ozone precursors are substantially lower on weekends than on weekdays, but measured levels of ozone are higher on weekends than on weekdays. There are several hypotheses to explain the higher frequency of elevated O_3 on weekends but the reduced NO_x emissions during weekends is a key contributor (Swamy et al., 2012). The basic premise here is that a strong weekend effect would be an indication of a NO_x disbenefit regime (Heuss et al., 2003). The excess NO_x in this regime not only titrates the O_3 but also mutes the VOC reactivity by using peroxy radicals to terminate NO_2 as NO_3 radicals and subsequently HNO_3. The reduction of NO_x during the weekend (mainly due to the reduced motor vehicle and diesel truck activity) would lessen the titration and increase the VOC reactivity. The final result is elevated O_3 mixing ratios occurring disproportionally on weekends. A lack of a weekend effect (i.e., no pronounced high O_3 occurrences during weekends) would suggest that the region is in a transition regime. The reversed weekend effect (i.e., lower O_3 during weekends) would suggest that the region is in a NO_x-limited regime.

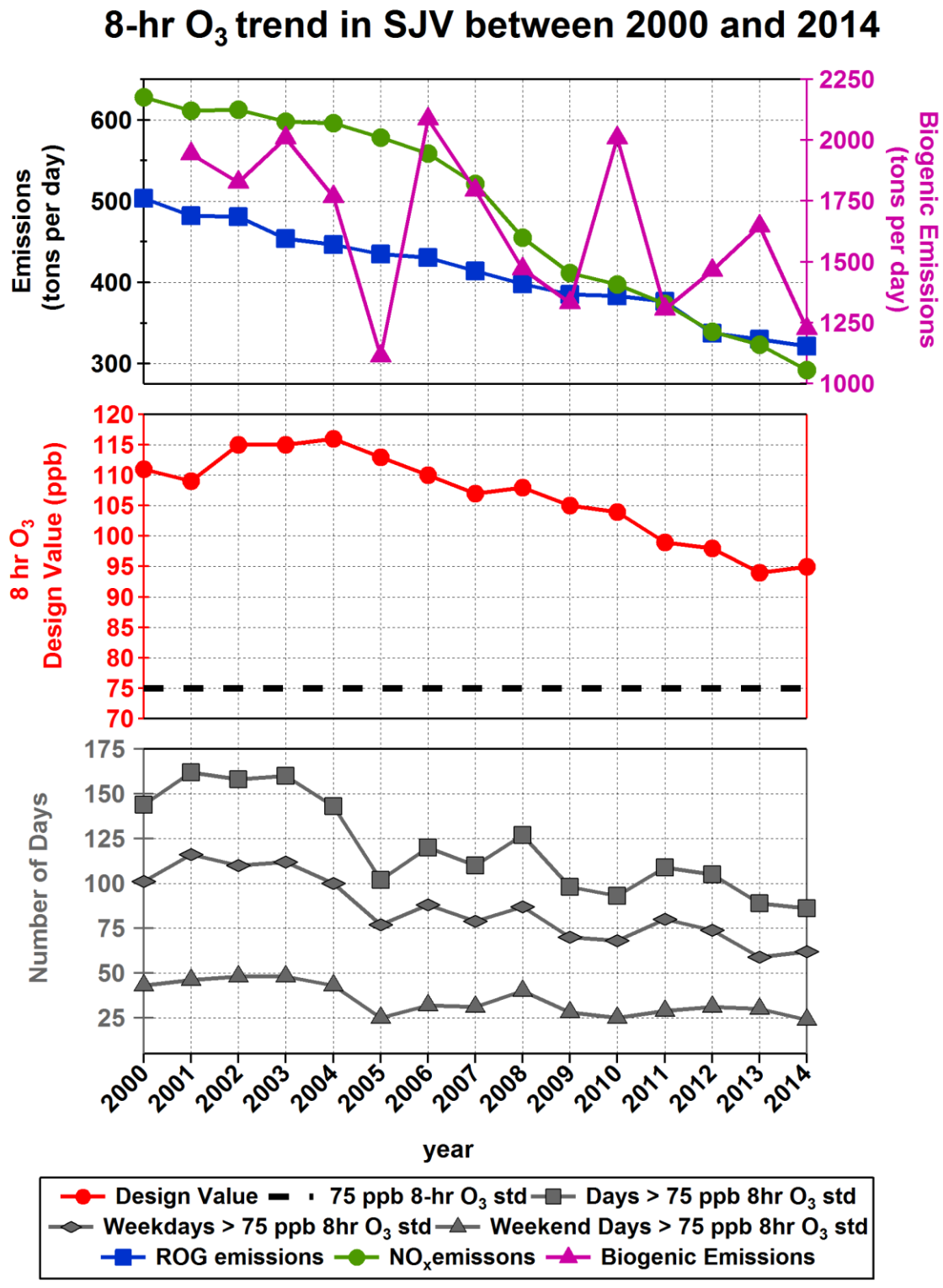


Figure 2-3. Trends in SJV air basin emissions (top), 8-hour ozone design value (middle), and number of days above the 8-hour ozone standard.

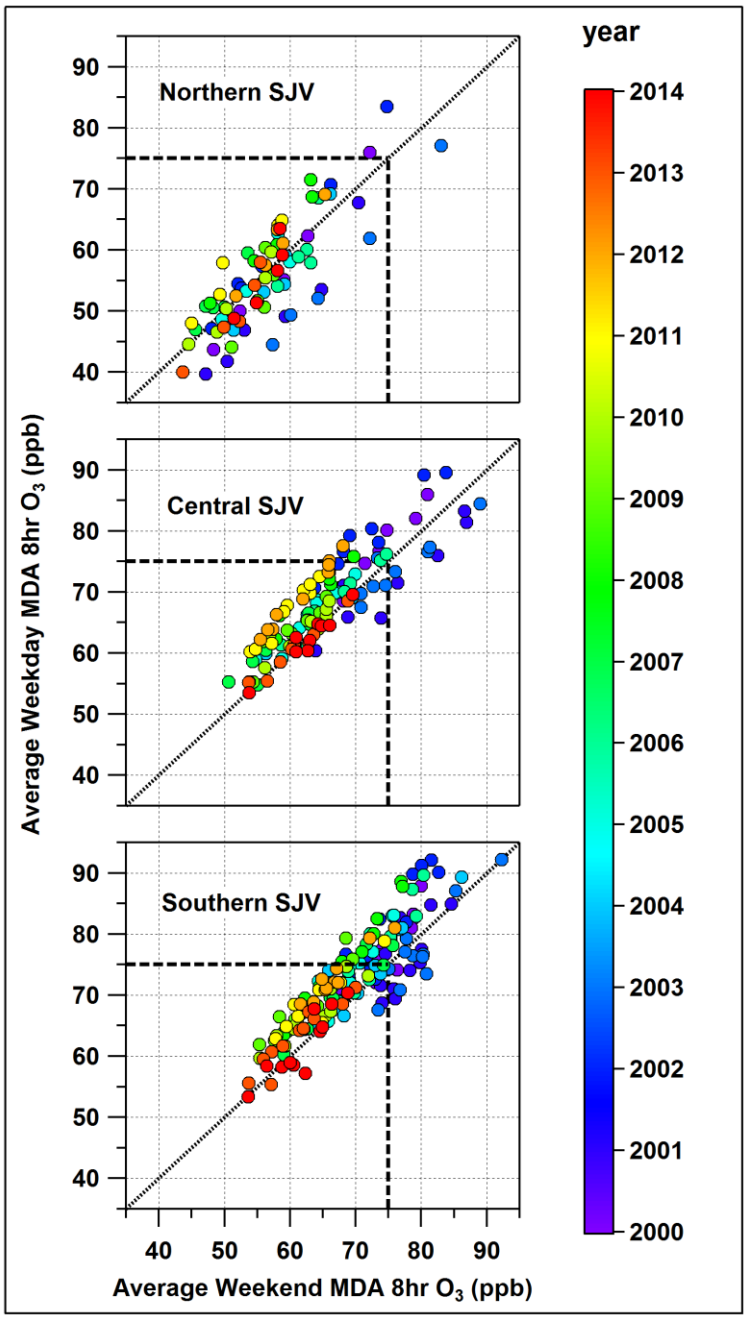


Figure 2-4. Site-specific average weekday and weekend maximum daily average 8-hour ozone for each year from 2000 to 2014 for the Northern SJV (top), Central SJV (middle), and Southern SJV (bottom). Points falling below the 1:1 dashed line represent a NO_x-disbenefit regime, those on the 1:1 dashed line represent a transitional regime, and those above the 1:1 dashed line represent a NO_x-limited regime.

The trend in day-of-week dependence of the Valley's sub-regional observed ozone levels between 2000 and 2014 is shown in Figure 2-4. The three-panel scatter plot shown in Figure 2-4 compares the average site-specific weekday (Wednesday and Thursday) and weekend (Sunday) observed summertime (June through September) maximum daily average (MDA) 8-hr ozone value by year (2000 to 2014), separated into three sub-regions: Northern SJV (top), Central SJV (middle), and Southern SJV (bottom). Different definitions of weekday and weekend days were also investigated and did not show appreciable differences from the Wednesday/Thursday and Sunday definitions.

From Figure 2-4 it can be seen that ozone levels are highest in the southern (i.e. Bakersfield area) and central (i.e. Fresno area) SJV regions, with the lowest levels seen in the northern SJV region. A key observation in Figure 2-4 is that the summertime average weekday and weekend ozone levels have steadily declined between 2000 and 2014, consistent with the decline in the basin-wide DV and exceedance days shown in Figure 2-3. Along with the declining ozone, there is a pattern shift in the weekday and weekend ozone between 2000 and 2014. In the early 2000's, the central and southern regions of the SJV exhibited roughly the same number of sites with weekend ozone greater than weekday ozone as sites with weekday ozone greater than weekend ozone, which suggests that the regions may have been in the transitional chemical regime for ozone formation. By the mid-2000's, the majority of the sites were showing weekday ozone greater than weekend ozone, which is consistent with a shift into complete NO_x-limited chemistry. By 2014, however, some of the sites had shifted back towards a more equal distribution between weekday and weekend ozone. This shift though, is expected due to the relatively low level of biogenic emissions in 2014 (Figure 2-3), which could cause a shift from a NO_x-limited environment to a more transitional chemistry environment (Figure 2-2). In contrast to the central and southern portions of the SJV, the northern region clearly experienced a greater NO_x-disbenefit in the early 2000's and then moved into a transitional chemical regime in the mid-2000's and has yet to move fully into the NO_x-limited regime.

These findings are consistent with an independent analysis by UC Berkeley researchers on the observed response of ozone from 1995 to 2010 in the SJV to emission reductions in NO_x and VOC reactivity. This study concluded that NO_x emission reductions have been effective at reducing ozone levels and have successfully transitioned the southern and central portions of the SJV into a NO_x-limited chemistry regime, while the northern portion of the SJV is currently in the process of transitioning to the same chemical regime (Pusede et al. 2012).

2.4 Meteorological Conditions Leading to Ozone Exceedances

Figure 2-5 illustrates the topography, air basin and county boundaries in California. The San Joaquin Valley (highlighted in pink) is a region of highly complex terrain, and is surrounded by the Sierra Nevada Mountains on the east, coastal mountain ranges to the west, and the Tehachapi Mountains to the south. Weather conditions during much of the summer ozone season are dominated by an area of high pressure, known as the East Pacific Ridge, which creates a broad region of warm, descending air over Central California. Weather conditions and summertime ozone levels in Central California have been shown to be strongly influenced by the strength and positioning of this ridge (Lehrman et al., 2004; Pun et al., 2008).



Figure 2-5. California topography, air basins, and counties.

Synoptic forcing under the East Pacific Ridge is typically weak, with wind flows above the planetary boundary layer from the northwest, resulting in wind flows in Central California that are primarily thermally driven and strongly influenced by orographic effects (Zhong et al., 2004). Thermal gradients between the eastern Pacific Ocean and inland in the Valley result in a strong daytime sea breeze which follows the terrain and can extend well inland through the Carquinez Straight and to a lesser extent the

Altamont, Pacheco, and Cholame Passes. When meteorological conditions are favorable, polluted air masses from the Bay Area traveling through the Carquinez Straight bifurcate over the Delta region, with one branch flowing to the northeast into the southern Sacramento Valley and the other branch flowing southeast into the northern San Joaquin Valley (Figure 2-6).

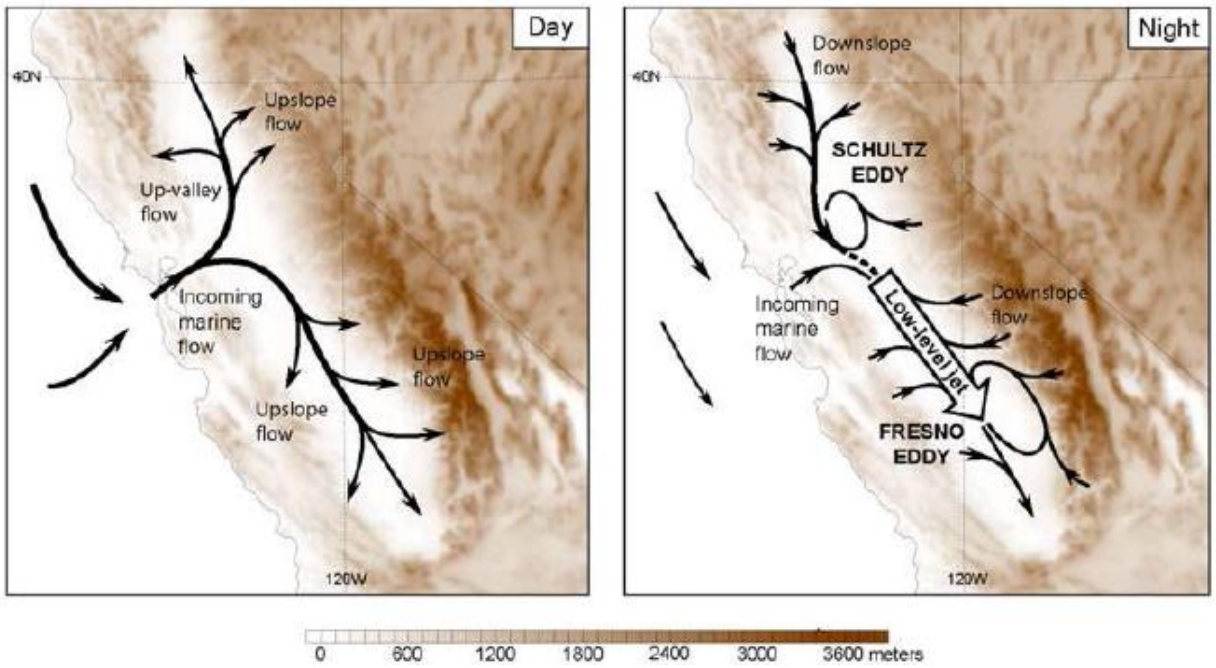


Figure 2-6. Conceptual low-level wind patterns in Central California during the day (left panel) and night (right panel) for typical ozone episode conditions (adapted from Bao et al., 2006).

At night, the sea breeze gradually weakens and can even reverse in some cases, but up-valley flow off of the Delta usually persists. Nighttime surface wind flow in the Central Valley is dominated by downslope flows off of the mountain ranges on all sides (Figure 2-6) and when combined with the continued up-valley flows from the Delta, result in low-level eddies such as the Schultz eddy in the southern Sacramento Valley and the Fresno eddy in the SJV (Lehrman et al., 2004). At night, winds aloft become decoupled from the surface and can form a low-level nocturnal jet (Zhong et al., 2004), which has been shown to be an important nighttime pollutant transport mechanism within the Valley (Lehrman et al., 2001). The conditions that promote the formation of this nocturnal jet within the Valley may also limit ventilation of the Valley, resulting in a buildup of pollution over multiple days.

Clustering and classification techniques have been utilized on both observed meteorology (Lehrman et al., 2001; Blanchard et al., 2008; Beaver and Palazoglu, 2009) and observed and modeled ozone (Fujita et al., 1999; Jin et al., 2011) in the Valley and the surrounding region to better understand the relationship between meteorology and elevated ozone. These various studies reveal that the position and strength of the Pacific High has a dominant influence on ozone levels throughout the Central Valley, along with the height of the marine inversion and strength of the low-level on-shore flow. Synoptic flows that weaken or break down the Pacific High result in lower ozone throughout the Central Valley, while a strong sea breeze with a deep marine boundary layer results in lower ozone levels within the Bay Area, but also an enhanced transport of polluted air masses into the Delta region. Under such conditions, elevated ozone can occur in the Sacramento and San Joaquin Valleys if the synoptic forcing is sufficiently weak so that vertical mixing is reduced and recirculation is enhanced. The highest ozone levels in the Valley occur as the thermal gradient between off-shore and inland weakens and the high pressure system strengthens, resulting in reduced transport of polluted air masses from the Bay Area inland to the Delta, which is accompanied by a rise in temperatures inland. As the sea breeze weakens even further, conditions stagnate within the Valley and ozone levels peak. Ozone levels will remain elevated until a synoptic system moves through the area and breaks down the Pacific High.

3. SELECTION OF MODELING PERIODS

3.1 Reference Year Selection and Justification

From an air quality and emissions perspective, ARB and the District have selected 2012 as the base year for design value calculation and for the modeled attainment test. These baseline values will serve as the anchor point for estimating future year projected design values.

The selection of 2012 is based on the following two considerations:

- Most complete and up to date emissions inventory, which reduces the uncertainty associated with future emissions projections.
- Analysis of the ozone forming potential (OFP) for recent years, as well as the frequency of meteorological conditions that are known to be associated with ozone exceedance events.

Details on these analyses can be found in the Weight of Evidence Appendix to this SIP.

3.2 Future Year Selection and Justification

The future year modeled is determined by the year for which attainment must be demonstrated. The extreme nonattainment designation for the SJV requires that attainment of the 2008 8-hour ozone standard be demonstrated by 2031. Therefore, 2031 will be the future year modeled in this attainment demonstration.

3.3 Justification for Seasonal Modeling Rather than Episodic Modeling

Recent ozone based studies, which focused on model performance evaluation for regulatory assessment, have recommended the use of modeling results covering the full synoptic cycles and full ozone seasons (Hogrefe et al., 2000; Vizuete et al., 2011). This enables a more complete assessment of ozone response to emission controls under a wide range of meteorological conditions.

The four highest ozone mixing ratios for a given year at any monitor within the Valley generally occur between June and September. This is important because it's the 4th highest ozone mixing ratio that is used in the Design Value (DV) calculation. In some cases, these top four days may all come from a single episode, but it is more likely that they occur during different episodes throughout the ozone season. Furthermore, based on the work of Foley et al. (2015), the revised U.S. EPA modeling guidance requires the model attainment demonstration to utilize the top ten modeled days when projecting Design Values (DVs) to the future. Rather than modeling many different episodes in an attempt to capture the top ten modeled days over the 2012 ozone season, we propose to model the entire ozone season (May – September) to ensure that all of the top days are modeled.

4. DEVELOPMENT OF EMISSION INVENTORIES

For a detailed description of the emissions inventory, updates to the inventory, and how it was processed from the planning totals to a gridded inventory for modeling, see the Modeling Emissions Inventory Appendix.

5. MODELS AND INPUTS

5.1 Meteorological Model

Meteorological model selection is based on a need to accurately simulate the synoptic and mesoscale meteorological features observed during the selected modeling period. The main difficulties in accomplishing this are California's extremely complex terrain and its diverse climate. It is desirable that atmospheric modeling adequately represent essential meteorological fields such as wind flows, ambient temperature variation, evolution of the boundary layer, and atmospheric moisture content to properly characterize the meteorological component of photochemical modeling.

In the past, the ARB has applied prognostic, diagnostic, and hybrid models to prepare meteorological fields for photochemical modeling. There are various numerical models that are used by the scientific community to study the meteorological characteristics of an air pollution episode. For this SIP, we will use the Weather and Research Forecasting (WRF) model (Skaramock et al, 2005) to develop the meteorological fields that drive the photochemical modeling. The U.S. EPA (2014) recommends the use of a well-supported grid-based mesoscale meteorological model for generating meteorological inputs. The WRF model is a community-based mesoscale prediction model, which represents the state-of-the-science and has a large community of model users and developers who frequently update the model as new science becomes available. In recent years, WRF has been applied in California to generate meteorological fields for numerous air quality studies (e.g., Angevine, et al., 2012; Baker et al., 2015; Ensberg et al., 2013; Fast et al., 2014; Hu et al., 2014a, 2014b; Huang et al., 2010; Kelly et al., 2014; Lu et al., 2012; Mahmud et al., 2010), and has been shown to reasonably reproduce the observed meteorology in California.

5.1.1 Meteorological Modeling Domain

The WRF meteorological modeling domain consists of three nested grids of 36 km, 12 km and 4 km uniform horizontal grid spacing (illustrated in Figure 5-1). The purpose of the coarse, 36 km grid (D01) is to provide synoptic-scale conditions to all three grids, while the 12 km grid (D02) is used to provide finer resolution data that feeds into the 4 km grid (D03). The D01 grid is centered at 37 ˚N and 120.5 ˚W and was chosen so that the inner two grids, D02 and D03, would nest inside of D03 and be sufficiently far away from the boundaries to minimize boundary influences. The D01 grid consists of 90 x 90 grid cells, while the D02 and D03 grids encompass 192 x 192 and 327 x 297 grid cells, respectively, with an origin at -696 km x -576 km (Lambert Conformal projection). WRF

will be run for the three nested domains simultaneously with two-way feedback between the parent and the nest grids. The D01 and D02 grids are meant to resolve the larger scale synoptic weather systems, while the D03 grid is intended to resolve the finer details of the atmospheric conditions and will be used to drive the air quality model simulations. All three domains will utilize 30 vertical sigma layers (defined in Table 5-1), as well as the various physics options listed in Table 5-2 for each domain.

The initial and boundary conditions (IC/BCs) for WRF will be prepared based on 3-D North American Regional Reanalysis (NARR) data that are archived at the National Center for Atmospheric Research (NCAR). These data have a 32km horizontal resolution. Boundary conditions to WRF are updated at 6-hour intervals for the 36km grid (D01). In addition, surface and upper air observations obtained from NCAR will be used to further refine the analysis data that are used to generate the IC/BCs. Analysis nudging will be employed in the outer 36km grid (D01) to ensure that the simulated meteorological fields are constrained and do not deviate from the observed meteorology.

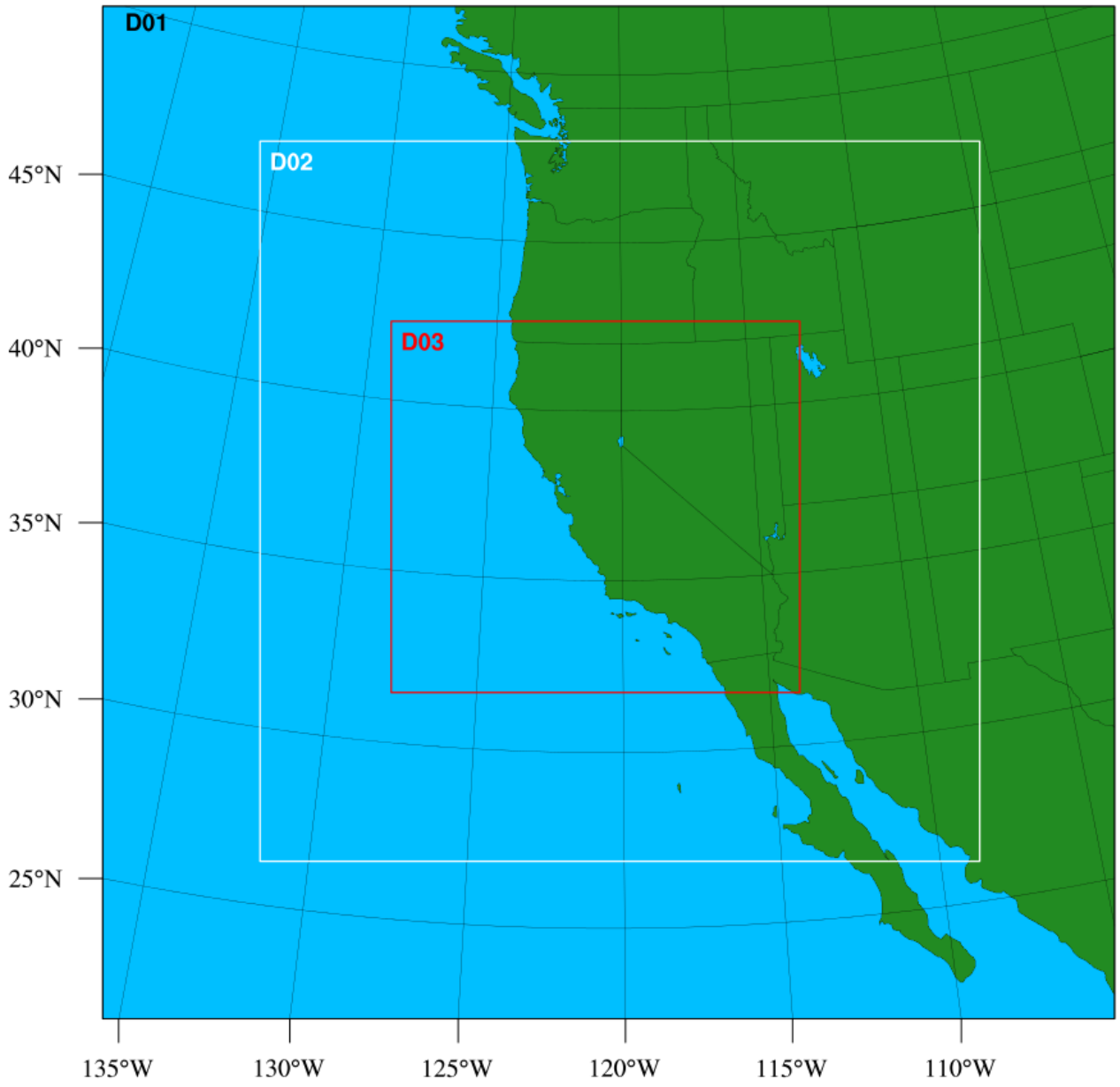


Figure 5-1. The three nested grids for the WRF model (D01 36km; D02 12km; and D03 4km).

Table 5-1. Proposed WRF vertical layer structure.

Layer Number	Height (m)	Layer Thickness (m)	Layer Number	Height (m)	Layer Thickness (m)
30	16082	1192	14	1859	334
29	14890	1134	13	1525	279
28	13756	1081	12	1246	233
27	12675	1032	11	1013	194
26	11643	996	10	819	162
25	10647	970	9	657	135
24	9677	959	8	522	113
23	8719	961	7	409	94
22	7757	978	6	315	79
21	6779	993	5	236	66
20	5786	967	4	170	55
19	4819	815	3	115	46
18	4004	685	2	69	38
17	3319	575	1	31	31
16	2744	482	0	0	0
15	2262	403			

Note: Shaded layers denote the subset of vertical layers to be used in the CMAQ photochemical model simulations. Further details on the CMAQ model configuration and settings can be found in subsequent sections.

Table 5-2. WRF Physics Options.

Physics Option	Domain		
	D01 (36 km)	D02 (12 km)	D03 (4 km)
Microphysics	WSM 6-class graupel scheme	WSM 6-class graupel scheme	WSM 6-class graupel scheme
Longwave radiation	RRTM	RRTM	RRTM
Shortwave radiation	Dudhia scheme	Dudhia scheme	Dudhia scheme
Surface layer	Revised MM5 Monin-Obukhov	Revised MM5 Monin-Obukhov	Revised MM5 Monin-Obukhov
Land surface	Pleim-Xiu LSM	Pleim-Xiu LSM	Pleim-Xiu LSM
Planetary Boundary Layer	YSU	YSU	YSU
Cumulus Parameterization	Kain-Fritsch scheme	Kain-Fritsch scheme	None

5.2 Photochemical Model

U.S. EPA guidance (U.S. EPA, 2014) requires several factors to be considered as criteria for choosing a qualifying air quality model to support the attainment demonstration. These criteria include: (1) It should have received a scientific peer review; (2) It should be appropriate for the specific application on a theoretical basis; (3) It should be used with databases which are available and adequate to support its application; (4) It should be shown to have performed well in past modeling applications; and (5). It should be applied consistently with an established protocol on methods and procedures (U.S. EPA, 2014). In addition, it should be well documented with a user's guide as well as technical descriptions. For the ozone modeled attainment test, a grid-based photochemical model is necessary to offer the best available representation of important atmospheric processes and the ability to analyze the impacts of proposed emission controls on ozone mixing ratios. The Community Multiscale Air Quality (CMAQ) Modeling System has been selected for modeling ozone in the SJV.

The CMAQ model, a state-of-the-science "one-atmosphere" modeling system developed by U.S. EPA, was designed for applications ranging from regulatory and policy analysis to investigating the atmospheric chemistry and physics that contribute to air pollution. CMAQ is a three-dimensional Eulerian modeling system that simulates ozone, particulate matter, toxic air pollutants, visibility, and acidic pollutant species throughout the troposphere (UNC, 2010). The model has undergone peer review every few years and represents the state-of-the-science (Brown et al., 2011). The CMAQ

model is regularly updated to incorporate new chemical and aerosol mechanisms, algorithms, and data as they become available in the scientific literature (e.g., Appel et al., 2013; Foley, et al., 2010; Pye and Pouliot, 2012;). In addition, the CMAQ model is well documented in terms of its underlying scientific algorithms as well as guidance on operational uses (e.g., Appel et al., 2013; Binkowski and Roselle, 2003; Byun and Ching, 1999; Byun and Schere, 2006; Carlton et al., 2010; Foley et al., 2010; Kelly, et al., 2010a; Pye and Pouliot, 2012; UNC, 2010).

The CMAQ model was the regional air quality model used for the 2008 SJV annual $PM_{2.5}$ SIP, the 2012 SJV 24-hour $PM_{2.5}$ SIP and the 2013 1-hr ozone SIP for the SJV. A number of previous studies have also used the CMAQ model to study ozone and $PM_{2.5}$ formation in the SJV (e.g., Jin et al., 2008, 2010b; Kelly et al., 2010b; Liang and Kaduwela, 2005; Livingstone, et al., 2009; Pun et al, 2009; Tonse et al., 2008; Vijayaraghavan et al., 2006; Zhang et al., 2010). The CMAQ model has also been used for regulatory analysis for many of U.S. EPA's rules, such as the Clean Air Interstate Rule (U.S. EPA, 2005) and Light-duty and Heavy-duty Greenhouse Gas Emissions Standards (U.S. EPA, 2010, 2011a). There have been numerous applications of the CMAQ model within the U.S. and abroad (e.g., Appel, et al., 2007, 2008; Civerolo et al., 2010; Eder and Yu, 2006; Hogrefe et al., 2004; Lin et al., 2008, 2009; Marmur et al., 2006; O'Neill, et al., 2006; Philips and Finkelstein, 2006; Sokhi et al., 2006; Smyth et al., 2006; Tong et al., 2006; Wilczak et al., 2009; Zhang et al., 2004, 2006), which have shown it to be suitable as a regulatory and scientific tool for investigating air quality. Staff at the CARB has developed expertise in applying the CMAQ model, since it has been used at CARB for over a decade. In addition, technical support for the CMAQ model is readily available from the Community Modeling and Analysis System (CMAS) Center (http://www.cmascenter.org/) established by the U.S. EPA.

Version 5.0.2 of the CMAQ model, released in May 2014, will be used in this SIP (http://www.airqualitymodeling.org/cmaqwiki/index.php?title=CMAQ_version_5.0.2_%28April_2014_release%29_Technical_Documentation). Compared to the previous version CMAQv4.7.1, which was used for the 2013 1-hour SIP, CMAQ version 5 and above incorporated substantial new features and enhancements to topics such as gas-phase chemistry, aerosol algorithms, and structure of the numerical code (http://www.airqualitymodeling.org/cmaqwiki/index.php?title=CMAQ_version_5.0_%28February_2012_release%29_Technical_Documentation#RELEASE_NOTES_for_CMAQv5.0_-.C2.A0February_2012).

5.2.1 Photochemical Modeling Domain

Figure 5-2 shows the photochemical modeling domains used by ARB for this work. The larger domain, covering all of California, has a horizontal grid resolution of 12 km and extends from the Pacific Ocean in the west to Eastern Nevada in the east and runs from south of the U.S.-Mexico border in the south to north of the California-Oregon border in the north. The smaller domain nested within the outer 12 km domain covers most of northern and central California and incorporates a finer scale 4 km grid resolution to better reflect the finer scale details of meteorology, topography, and emissions. Consistent with the WRF modeling, the 12 km and 4 km CMAQ domains are based on a Lambert Conformal Conic projection with reference longitude at -120.5°W, reference latitude at 37°N, and two standard parallels at 30°N and 60°N. The 30 vertical layers from WRF were mapped onto 18 vertical layers for CMAQ, extending from the surface to 100 mb such that the majority of the vertical layers fall within the planetary boundary layer. This vertical layer structure is based on the WRF sigma-pressure coordinates and the exact layer structure used can be found in Table 5-1.

For the coarse portions of nested regional grids, U.S. EPA guidance suggests a grid cell size of 12 km if feasible but not larger than 36 km. For the fine scale portions of nested regional grids, it is desirable to use a grid cell size of ~4 km (U.S. EPA, 2014). Our selection of modeling domains and grid resolution is consistent with this guidance. U.S. EPA guidance does not require a minimum number of vertical layers for an attainment demonstration, although typical applications of “one- atmosphere” models (with the model top at 50 mb) are anywhere from 14 to 35 vertical layers. For the present SIP, 18 vertical layers will be used in the CMAQ model. The vertical structure is based on the sigma-pressure coordinate, with the layers separated at 1.0, 0.9958, 0.9907, 0.9846, 0.9774, 0.9688, 0.9585, 0.9463, 0.9319, 0.9148, 0.8946, 0.8709, 0.8431, 0.8107, 0.7733, 0.6254, 0.293, 0.0788, and 0.0. As previously noted, this also ensures that the majority of the layers are in the planetary boundary layer.

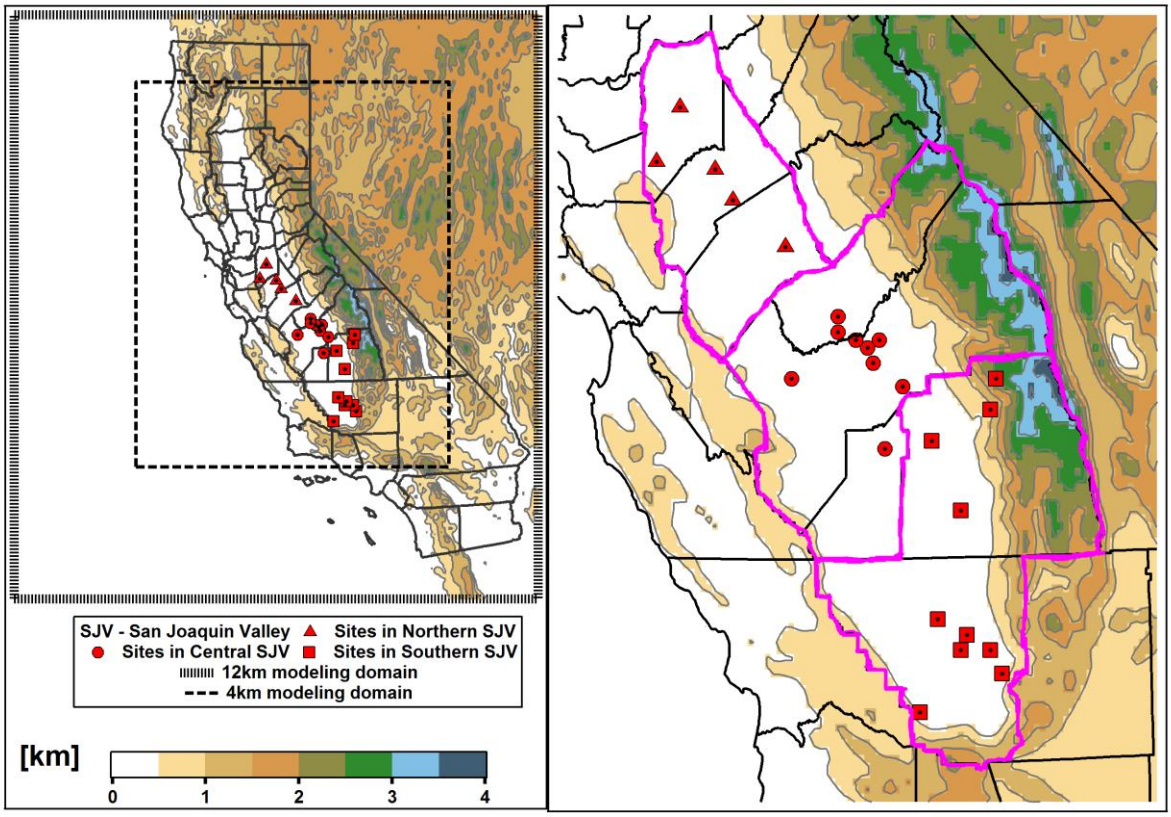


Figure 5-2. The CMAQ modeling domains used in this SIP modeling. The outer box of the left panel is the California statewide 12 km modeling domain, while the inner box shows the 4km modeling domain covering Central California. The shaded and gray line contours denote the gradients in topography (km). The insert on the right shows the zoomed-in view of the spatial extent (magenta lines) and the location of sites in the Northern (red triangle markers), Central (red circle makers) and Southern (red square markers) sub regions in the Valley that have been used in evaluating model performance for ozone. (Figure adapted from Kulkarni et al., 2014)

5.2.2 CMAQ Model Options

Table 5-3 shows the CMAQv5.0.2 configuration that will be used to model ozone in the SJV. The same configuration will be used for all simulations for the base case, reference, and future years. CMAQv5.0.2 was compiled using the Intel FORTRAN compiler version 12.

Table 5-3. CMAQ v5.0.2 configuration and settings.

Process	Scheme
Horizontal advection	Yamo (Yamartino scheme for mass-conserving advection)
Vertical advection	WRF-based scheme for mass-conserving advection
Horizontal diffusion	Multi-scale
Vertical diffusion	ACM2 (Asymmetric Convective Model version 2)
Gas-phase chemical mechanism	SAPRC-07 gas-phase mechanism with version "C" toluene updates
Chemical solver	EBI (Euler Backward Iterative solver)
Aerosol module	Aero6 (the sixth-generation CMAQ aerosol mechanism with extensions for sea salt emissions and thermodynamics; includes a new formulation for secondary organic aerosol yields)
Cloud module	ACM_AE6 (ACM cloud processor that uses the ACM methodology to compute convective mixing with heterogeneous chemistry for AERO6)
Photolysis rate	phot_inline (calculate photolysis rates in-line using simulated aerosols and ozone)

5.2.3 Photochemical Mechanism

The SAPRC07 mechanism will be utilized as the photochemical mechanism for the CMAQ simulations. SAPRC07, developed by Dr. William Carter at the University of California, Riverside, is a detailed mechanism describing the gas-phase reactions of volatile organic compounds (VOCs) and oxides of nitrogen (NO_x) (Carter, 2010a, 2010b). It represents a complete update to the SAPRC99 mechanism, which has been used for previous ozone SIP plans in the SJV. The well-known SAPRC family of mechanisms have been used widely in California and the U.S. (e.g., Baker, et al., 2015; Cai et al., 2011; Chen et al., 2014a; Dennis et al., 2008; Ensberg, et al., 2013; Hakami, et al., 2004a, 2004b; Hu et al., 2012, 2014a, 2014b; Jackson, et al., 2006; Jin et al., 2008, 2010b; Kelly, et al., 2010b; Lane et al., 2008; Liang and Kaduwela, 2005; Livingstone et al., 2009; Lin et al., 2005; Napelenok, 2006; Pun et al., 2009; Tonse et al., 2008; Ying et al., 2008a, 2008b; Zhang et al., 2010; Zhang and Ying, 2011).

The SAPRC07 mechanism has been fully reviewed by four experts in the field through a ARB funded contract. These reviews can be found at http://www.arb.ca.gov/research/reactivity/rsac.htm. Dr. Derwent's (2010) review compared ozone impacts of 121 organic compounds calculated using SAPRC07 and the Master Chemical Mechanism (MCM) v 3.1 and concluded that the ozone impacts using the two mechanisms were consistent for most compounds. Dr. Azzi (2010) used SAPRC07 to simulate ozone formation from isoprene, toluene, m-xylene, and evaporated fuel in environmental chambers performed in Australia and found that SAPRC07 performed reasonably well for these data. Dr. Harley discussed implementing the SAPRC07 mechanism into 3-D air quality models and brought up the importance of the rate constant of NO_2 + OH. This rate constant in the SAPRC07 mechanism in CMAQv5.0.2 has been updated based on new research (Mollner et al., 2010). Dr. Stockwell (2009) compared individual reactions and rate constants in SAPRC07 to two other mechanisms (CB05 and RADM2) and concluded that SAPRC07 represented a state-of-the-science treatment of atmospheric chemistry.

5.2.4 CMAQ Initial and Boundary Conditions (IC/BC) and Spin-Up period

Air quality model initial conditions define the mixing ratio (or concentration) of chemical and aerosol species within the modeling domain at the beginning of the model simulation. Boundary conditions define the chemical species mixing ratio (or concentration) within the air entering or leaving the modeling domain. This section discusses the initial and boundary conditions used by the ARB in air quality modeling that will support developing the 8-hour ozone SIP.

U.S. EPA guidance recommends using a model "spin-up" period by beginning a simulation 3-10 days prior to the period of interest (U.S. EPA, 2014). This "spin-up" period allows the initial conditions to be "washed out" of the system, so that the actual initial conditions have little to no impact on the modeling over the time period of interest, as well as giving sufficient time for the modeled species to come to chemical equilibrium. When simulating an entire ozone season, it is more computationally efficient to simulate each month in parallel rather than the entire season sequentially. For each month, the CMAQ simulations will include a seven day spin-up period (i.e., the last seven days of the previous month) for the outer 12 km domain to ensure that the initial conditions are "washed out" of the system. Initial conditions at the beginning of the seven day spin-up period will be based on the default initial conditions that are included with the CMAQ release. The 4 km inner domain simulations will utilize a three

day spin-up period, where the initial conditions will be based on output from the corresponding day of the 12 km domain simulation.

In recent years, the use of global chemical transport model (CTM) outputs as boundary conditions (BCs) in regional CTM applications has become increasingly common (Chen et al., 2008; Hogrefe et al., 2011; Lin et al., 2010; Lam and Fu, 2009; Lee et al., 2011), and has been shown to improve model performance in many cases (Appel et al., 2007; Borge et al., 2010; Tang et al., 2007, 2009; Tong and Mauzerall, 2006;). The advantage of using global CTM model outputs as opposed to fixed climatological-average BCs is that the global CTM derived BCs capture spatial, diurnal, and seasonal variability, as well as provide a set of chemically consistent pollutant mixing ratios. In the modeling for this SIP, the Model for Ozone And Related chemical Tracers (MOZART; Emmons et al., 2010a) will be used to define the boundary conditions for the outer 12 km CMAQ domain, while boundary conditions for the 4 km domain will be derived from the 12 km output. MOZART is a comprehensive global model for simulating atmospheric composition including both gases and bulk aerosols (Emmons et al., 2010a). It was developed by the National Center for Atmospheric Research (NCAR), the Max-Planck-Institute for Meteorology (in Germany), and the Geophysical Fluid Dynamics Laboratory (GFDL) of the National Oceanic and Atmospheric Administration (NOAA), and is widely used in the scientific community. In addition to inorganic gases and VOCs, BCs were extracted for aerosol species including elemental carbon, organic matter, sulfate, soil and nitrate. MOZART has been extensively peer-reviewed and applied in a range of studies that utilize its output in defining BCs for regional modeling studies within California and other regions of the U.S. (e.g., Avise et al., 2008; Chen et al., 2008, 2009a, 2009b; Fast et al., 2014; Jathar et al., 2015).

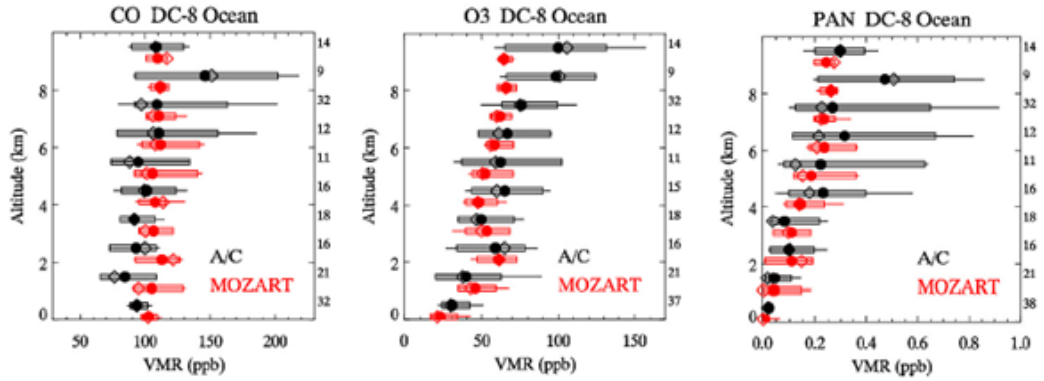


Figure 5-3. Comparison of MOZART (red) simulated CO (left), ozone (center), and PAN (right) to observations (black) along the DC-8 flight track. Shown are mean (filled symbol), median (open symbols), 10th and 90th percentiles (bars) and extremes (lines). The number of data points per 1-km wide altitude bin is shown next to the graphs. Adapted from Figure 2 in Pfister et al. (2011).

In particular, MOZART version 4 (MOZART-4) was recently used in a study characterizing summertime air masses entering California from the Pacific Ocean (Pfister et al., 2011). In their work, Pfister et al. (2011) compared MOZART-4 simulation results to measurements of CO, ozone, and PAN made off the California coast during the ARCTAS-CARB airborne field campaign (Jacob et al., 2010) and showed good agreement between the observations and model results (see Figure 5-3).
The specific MOZART simulations to be utilized in this SIP are the MOZART4-GEOS5 simulations by Louisa Emmons (NCAR) for the year 2012, which are available for download at http://www.acom.ucar.edu/wrf-chem/mozart.shtml. These simulations are similar to those of Emmons et al. (2010a), but with updated meteorological fields. Boundary condition data will be extracted from the MOZART-4 output and processed to CMAQ model ready format using the "mozart2camx" code developed by the Rambol-Environ Corporation (available at http://www.camx.com/download/support-software.aspx). The final BCs represent day-specific mixing ratios, which vary in both space (horizontal and vertical) and time (every six hours).

Per U.S. EPA guidance, the same MOZART derived BCs for the 12 km outer domain will be used for all simulations (e.g., Base Case, Reference, Future, and any sensitivity simulation).

5.3 Quality Assurance of Model Inputs

In developing the IC/BCs and Four Dimensional Data Assimilation (FDDA) datasets for WRF, quality control is performed on all associated meteorological data. Generally, all surface and upper air meteorological data are plotted in space and time to identify extreme values that are suspected to be "outliers". Data points are also compared to other, similar surrounding data points to determine whether there are any large relative discrepancies. If a scientifically plausible reason for the occurrence of suspected outliers is not known, the outlier data points are flagged as invalid and may not be used in the modeling analyses.

In addition, the model-ready emissions files used in CMAQ will be evaluated and compared against the planning inventory totals. Although deviations between the model-ready and planning inventories are expected due to temporal adjustments (e.g., month-of-year and day-of-week) and adjustments based on meteorology (e.g., evaporative emissions from motor vehicles and biogenic sources), any excessive deviation will be investigated to ensure the accuracy of the temporal and meteorology based adjustments. If determined to be scientifically implausible, then the adjustments

which led to the deviation will be investigated and updated based on the best available science.

Similar to the quality control of the modeling emissions inventory, the chemical boundary conditions derived from the global CTM model will be evaluated to ensure that no errors were introduced during the processing of the data (e.g., during vertical interpolation of the global model data to the regional model vertical structure or mapping of the chemical species). Any possible errors will be evaluated and addressed if they are determined to be actual errors and not an artifact of the spatial and temporal dynamics inherent in the boundary conditions themselves.

6. METEOROLOGICAL MODEL PERFORMANCE

The complex interactions between the ocean-land interface, orographic induced flows from the mountain-valley topography, and the extreme temperature gradients between the ocean, delta region, valley floor, and mountain ranges surrounding the valley, make the SJV one of the most challenging areas in the country to simulate using prognostic meteorological models. Although there is a long history of prognostic meteorological model applications in the SJV (e.g., Seaman, Stauffer, and Lario-Gibbs, 1995; Stauffer et al., 2000; Tanrikulu et al., 2000; Jackson et al., 2006; Bao et al., 2008; Livingstone et al., 2009; Michelson et al., 2010; Jin et al., 2010a, 2010b; Hu at al., 2010), there is no single model configuration that works equally well for all years and/or seasons, which makes evaluation of the simulated meteorological fields critical for ensuring that the fields reasonably reproduce the observed meteorology for any given time period.

6.1 Ambient Data Base and Quality of Data

Observed meteorological data used to evaluate the WRF model simulations will be obtained from the Air Quality and Meteorological Information System (AQMIS) database, which is a web-based source for real-time and official air quality and meteorological data (www.arb.ca.gov/airqualitytoday/). This database contains surface meteorological observations from 1969-2016, with the data through 2013 having been fully quality assured and deemed official. In addition ARB also has quality-assured upper-air meteorological data obtained using balloons, aircraft, and profilers.

6.2 Statistical Evaluation

Statistical analyses will be performed to evaluate how well the WRF model captured the overall structure of the observed atmosphere within the SJV during the five-month simulation period, using wind speed, wind direction, temperature, and humidity.
The performance of the WRF model against observations will be evaluated using the METSTAT analysis tool (Emery et al, 2001) and supplemented using statistical software tools developed at ARB. The model output and observations for all five months in 2012 will be read, and data points at each observational site for wind speed, wind direction, temperature, and moisture data will be extracted. The following values will be calculated: Mean Obs, Mean Model, Mean Bias (MB), Mean (Gross) Error (ME/MGE), Normalized Mean Bias (NMB), Root Mean Squared error (RMSE), and the Index Of Agreement (IOA) when applicable.

The mathematical expressions for these quantities are:

$$\mathrm{MB} = \frac{1}{\mathrm{N}} \sum_{1}^{\mathrm{N}} (\mathrm{Model} - \mathrm{Obs}) \tag{6-1}$$

$$\mathrm{ME} = \frac{1}{\mathrm{N}} \sum_{1}^{\mathrm{N}} |\mathrm{Model} - \mathrm{Obs}| \tag{6-2}$$

$$\mathrm{NMB} = \frac{\sum_{1}^{\mathrm{N}} (\mathrm{Model} - \mathrm{Obs})}{\sum_{1}^{\mathrm{N}} \mathrm{Obs}} \times 100\%, \tag{6-3}$$

$$\mathrm{RSME} = \sqrt{\frac{\sum_{1}^{\mathrm{N}} (\mathrm{Model} - \mathrm{Obs})^2}{\mathrm{N}}} \tag{6-4}$$

$$IOA = 1 - \frac{\sum_{1}^{N} (Model - Obs)^2}{\sum_{1}^{N} \left[(Model - Obs) + (Model + Obs) \right]^2}, \tag{6-5}$$

where, "*Model*" is the simulated values, "*Obs*" is the observed value, and *N* is the number of observations. These values will be tabulated and plotted for all monitoring sites within the SJV and summarized for three subregions: Northern SJV, Central SJV, and Southern SJV. Statistics may be compared to other prognostic model applications in the SJV to place the current model performance within the context of previous studies. In addition to the statistics above, model performance may also be evaluated through metrics such as frequency distributions, time-series analysis, and wind-rose plots. Based on previous experience with meteorological simulations in California, it is expected that the analysis will show wind speed to be overestimated at some stations with a smaller difference at others. The diurnal variations of temperature and wind direction at most stations are likely to be captured reasonably well. However, the model will likely underestimate the larger magnitudes of temperature during the day and smaller magnitudes at night.

6.3 Phenomenological Evaluation

In addition to the statistical evaluation described above, a phenomenological based evaluation can provide additional insights as to the accuracy of the meteorological model. A phenomenological evaluation may include analysis such as determining the relationship between observed air quality and key meteorological parameters (e.g., conceptual model) and then evaluating whether the simulated meteorology and air quality is able to reproduce those relationships. Another possible approach would be to generate geopotential height charts at 500 and 850 mb using the simulated results and compare those to the standard geopotential height charts. This would reveal if the large-scale weather systems at those pressure levels were adequately simulated by the regional prognostic meteorology model. Another similar approach is to identify the larger-scale meteorological conditions associated with air quality events using the National Centers for Environmental Prediction (NCEP) Reanalysis dataset. These can then be visually compared to the simulated meteorological fields to determine whether those large-scale meteorological conditions were accurately simulated and whether the same relationships observed in the NCEP reanalysis are present in the simulated data.

7. PHOTOCHEMICAL MODEL PERFORMANCE

7.1 Ambient Data

Observed air quality data used to evaluate the CMAQ model simulations will be obtained from the Air Quality and Meteorological Information System (AQMIS) database, which is a web-based source for real-time and official air quality and meteorological data (www.arb.ca.gov/airqualitytoday/). This database contains surface air quality observations from 1980-2016, with the data through 2014 having been fully quality assured and deemed official.

7.2 Statistical Evaluation

As recommended by U.S. EPA, a number of statistical metrics will be used to evaluate the model performance for ozone. These metrics include mean bias (MB), mean error (ME), mean fractional bias (MFB), mean fractional error (MFE), normalized mean bias (NMB), normalized mean error (NME), root mean square error (RMSE), and correlation coefficient (R^2). The formulae for estimating these metrics are given below.

$$\mathrm{MB} = \frac{1}{\mathrm{N}}\sum_{1}^{\mathrm{N}}(\mathrm{Model} - \mathrm{Obs}) \tag{7-1}$$

$$\mathrm{ME} = \frac{1}{\mathrm{N}}\sum_{1}^{\mathrm{N}}\left|\mathrm{Model} - \mathrm{Obs}\right| \tag{7-2}$$

$$\mathrm{MFB} = \frac{2}{\mathrm{N}}\sum_{1}^{\mathrm{N}}\left(\frac{\mathrm{Model} - \mathrm{Obs}}{\mathrm{Model} + \mathrm{Obs}}\right) \times 100\%, \tag{7-3}$$

$$\mathrm{MFE} = \frac{2}{\mathrm{N}}\sum_{1}^{\mathrm{N}}\left(\frac{\left|\mathrm{Model} - \mathrm{Obs}\right|}{\mathrm{Model} + \mathrm{Obs}}\right) \times 100\%, \tag{7-4}$$

$$\mathrm{NMB} = \frac{\sum_{1}^{\mathrm{N}}(\mathrm{Model} - \mathrm{Obs})}{\sum_{1}^{\mathrm{N}}\mathrm{Obs}} \times 100\%, \tag{7-5}$$

$$NME = \frac{\sum_{1}^{N} | Model - Obs |}{\sum_{1}^{N} Obs} \times 100\%, \quad (7\text{-}6)$$

$$RSME = \sqrt{\frac{\sum_{1}^{N} (Model - Obs)^2}{N}} \quad (7\text{-}7)$$

$$R^2 = \left(\frac{\sum_{1}^{N} ((Model - \overline{Model}) \times (Obs - \overline{Obs}))}{\sqrt{\sum_{1}^{N} (Model - \overline{Model})^2 \sum_{1}^{N} (Obs - \overline{Obs})^2}}\right)^2 \quad (7\text{-}8)$$

where, "Model" is the simulated mixing ratio, "$\overline{Model}$" is the simulated mean mixing ratio, "Obs" is the observed value, "$\overline{Obs}$" is the mean observed value, and "N" is the number of observations.

In addition, for evaluating summertime O_3, we will also use mean normalized bias (MNB) and mean normalized gross error (MNGE). Definitions for these quantities are given below.

$$MNB = \frac{1}{N} \sum_{1}^{N} \left(\frac{Model - Obs}{Obs} \right) \times 100\%, \quad (7\text{-}9)$$

$$MNGE = \frac{1}{N} \sum_{1}^{N} \left(\frac{|Model - Obs|}{Obs} \right) \times 100\%. \quad (7\text{-}10)$$

In addition to the above statistics, various forms of graphics will also be created to visually examine and compare the model predictions to observations. These will include time-series plots comparing the predictions and observations, scatter plots for comparing the magnitude of the simulated and observed mixing ratios, box plots to summarize the time series data across different regions and averaging times, as well as frequency distributions. These plots will be created for paired observations and

predictions over time scales dictated by the averaging frequencies of observations (i.e., hourly, daily, monthly, seasonally) for the species of interest. Together, they will provide a comprehensive view of model performance during different time periods, in different sub-regions, and over different mixing ratio levels.

7.3 Comparison to Previous Modeling Studies

Previous U.S. EPA modeling guidance (U.S. EPA, 1991) utilized “bright line” criteria for the performance statistics that distinguished between adequate and inadequate model performance. In the latest modeling guidance from U.S. EPA (U.S EPA, 2014) it is now recommended that model performance be evaluated in the context of similar modeling studies to ensure that the model performance approximates the quality of other studies. The work of Simon et al. (2012) summarized photochemical model performance for studies published in the peer-reviewed literature between 2006 and 2012. and this work will form the basis for evaluating the modeling utilized in this attainment demonstration.

7.4 Diagnostic Evaluation

Diagnostic evaluations are useful for investigating whether the physical and chemical processes that control ozone formation are correctly represented in the modeling. These evaluations can take many forms, such as utilizing model probing tools like process analysis, which tracks and apportions ozone mixing ratios in the model to various chemical and physical processes, or source apportionment tools that utilize model tracers to attribute ozone formation to various emissions source sectors and/or geographic regions. Sensitivity studies (either “brute-force” or the numerical Direct Decoupled Method) can also provide useful information as to the response exhibited in the modeling to changes in various input parameters, such as changes to the emissions inventory or boundary conditions. Due to the nature of this type of analysis, diagnostic evaluations can be very resource intensive and the U.S. EPA modeling guidance acknowledges that air agencies may have limited resources and time to perform such analysis under the constraints of a typical SIP modeling application. To the extent possible, some level of diagnostic evaluation will be included in the model attainment demonstration for this SIP.

8. ATTAINMENT DEMONSTRATION

The U.S. EPA modeling guidance (U.S. EPA, 2014) outlines the approach for utilizing models to predict future attainment of the 0.075 ppm 8-hour ozone standard. Consistent with the previous modeling guidance (U.S. EPA, 2007) utilized in the 2007 SIP for the 0.08 ppm 8-hour ozone standard and the 2013 SIP for the 0.12 ppm 1-hour ozone standard, the current guidance recommends utilizing modeling in a relative sense. A detailed description of how models are applied in the attainment demonstration, as prescribed by U.S. EPA modeling guidance, is provided below.

8.1 Base Year Design Values

The starting point for the attainment demonstration is with the observational based design value (DV), which is used to determine compliance with the standard at any given monitor. The DV for a specific monitor and year represents the three-year average of the annual 4th highest 8-hour ozone mixing ratio observed at the monitor. For example, a DV for 2012 would represent the average of the 4th highest 8-hour ozone mixing ratio from 2010, 2011, and 2012. The U.S. EPA recommends using an average of three DVs to better account for the year-to-year variability inherent in meteorology. Since 2012 has been chosen as the base year for projecting DVs to the future, site-specific DVs will be calculated for the three three-year periods ending in 2012, 2013, and 2014 and then these three DVs will be averaged. This average DV is called a weighted DV (in the context of this SIP, the weighted DV will also be referred to as the reference year DV or DV_R). Table 8-1 illustrates how the weighted DV is calculated.

Table 8-1. Illustrates the data from each year that are utilized in the Design Value calculation for a specific year (DV Year), and the yearly weighting of data for the weighted Design Value calculation (or DVR).

DV Year	Years Averaged for the Design Value (4th highest observed 8-hr O_3)				
2012	2010	2011	2012		
2013		2011	2012	2013	
2014			2012	2013	2014
Yearly Weightings for the Weighted Design Value Calculation					
2012-2014 Average	$\mathrm{DV_R} = \frac{8\mathrm{hrO3}_{2010} + (2)8\mathrm{hrO3}_{2011} + (3)8\mathrm{hrO3}_{2012} + (2)8\mathrm{hrO3}_{2013} + 8\mathrm{hrO3}_{2014}}{9}$				

8.2 Base, Reference, and Future Year Simulations

Projecting the weighted DVs to the future requires three photochemical model simulations described below:

1. Base Year Simulation

The base year simulation for 2012 is used to assess model performance (i.e., to ensure that the model is reasonably able to reproduce the observed ozone mixing ratios). Since this simulation will be used to assess model performance, it is essential to include as much day-specific detail as possible in the emissions inventory, including, but not limited to hourly adjustments to the motor vehicle and biogenic inventories based on observed local meteorological conditions, known wildfire and agricultural burning events, and exceptional events such as the Chevron refinery fire.

2. Reference Year Simulation

The reference year simulation is identical to the base year simulation, except that certain emissions events which are either random and/or cannot be projected to the future are removed from the emissions inventory. These include wildfires and events such as the Chevron refinery fire.

3. Future Year Simulation

The future year simulation is identical to the reference year simulation, except that projected future year (2031) anthropogenic emission levels are used rather than the 2012 emission levels. All other model inputs (e.g., meteorology, chemical boundary conditions, biogenic emissions, and calendar for day-of-week specifications in the inventory) are the same as those used in the reference year simulation.

The base year simulation is solely used for evaluating model performance, while the reference and future year simulations are used to project the weighted DV to the future as described in subsequent sections of this document.

8.3 Relative Response Factors

As part of the model attainment demonstration, the fractional change in air pollutant mixing ratios between the model future year and model reference year are calculated for each monitor location. These ratios, called “relative response factors” or RRF, are calculated based on the ratio of modeled future year maximum daily average 8-hour (MDA8) ozone to modeled baseline year MDA8 (Equation 8-1).

$$RRF = \frac{\text{average MDA8 ozone}_{\text{future}}}{\text{average MDA8 ozone}_{\text{reference}}} \quad (8\text{-}1)$$

The MDA8 values used in calculating the RRF are based on the maximum simulated ozone within a 3x3 array of cells surrounding the monitor (Figure 8-1). The future and base year ozone values used in RRF calculations are paired in space (i.e., using the future year MDA8 ozone value at the same grid cell where the MDA8 value for the base year is located within the 3x3 array of cells). The days used to calculate the average MDA8 for the reference and future years are inherently consistent, since the same meteorology is used to drive both simulations.

Not all modeled days are used to calculate the average MDA8 ozone from the reference and future year simulations. The form of the 8-hour ozone NAAQS is such that it is geared toward the days with the highest mixing ratios of any ozone season (i.e., the 4th highest MDA8 ozone). Therefore, the modeled days used in the RRF calculation should also reflect days with the highest ozone levels. As a result, the current U.S. EPA guidance suggests using the top 10 modeled days when calculating the RRF. Since the relative sensitivity to emissions changes (in both the model and real world) can vary from day-to-day due to meteorology and emissions (e.g., temperature dependent emissions or day-of-week variability) using the top 10 days ensures that the calculated RRF is robust and stable (i.e., not overly sensitive to any single day used in the calculation).

When choosing the top 10 days, the U.S. EPA recommends beginning with all days in which the simulated reference MDA8 is >= 60 ppb and then calculating RRFs based on the top 10 high ozone days. If there are fewer than 10 days with MDA8 ozone >= 60 ppb then all days >= 60 ppb are used in the RRF calculation, as long as there are at least 5 days used in the calculation. If there are fewer than 5 days >= 60 ppb, an RRF cannot be calculated for that monitor. To ensure that only modeled days which are consistent with the observed ozone levels are used in the RRF calculation, the modeled days are further restricted to days in which the reference MDA8 ozone is within +/- 20% of the observed value at the monitor location.

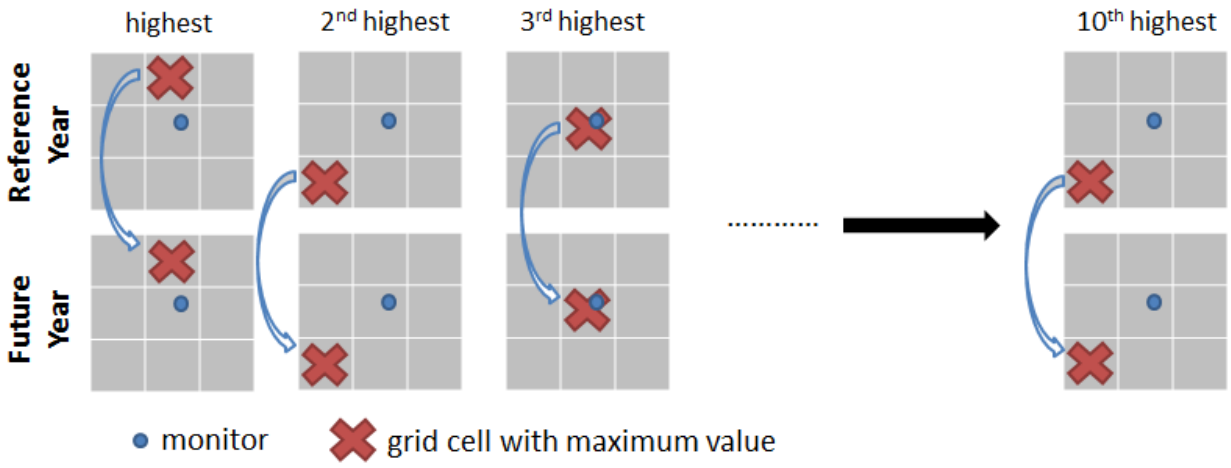


Figure 8-1. Example showing how the location of the MDA8 ozone for the top ten days in the reference and future years are chosen.

8.4 Future Year Design Value Calculation

A future year DV for each monitor is calculated by multiplying the corresponding reference year DV by the site-specific RRF from Equation 8-1 (Equation 8-2).

$$DV_F = DV_R \times RRF \quad (8\text{-}2)$$

where,
DV_F = future year design value,
DV_R = reference year design value, and
RRF = the site specific RRF from Equation 8-1

The resulting future year DVs are then compared to the 8-hour ozone NAAQS (75 ppb) to demonstrate whether attainment will be reached under the future emissions scenario utilized in the future year modeling. A monitor is considered to be in attainment of the 75 ppb ozone standard if the estimated future design value does not exceed the level of the standard.

8.5 Unmonitored Area Analysis

The unmonitored area analysis is used to ensure that there are no regions outside of the existing monitoring network that would exceed the NAAQS if a monitor was present (U.S. EPA, 2014). U.S. EPA recommends combining spatially interpolated design value fields with modeled ozone gradients and grid-specific RRFs in order to generate gridded future year gradient adjusted design values. This analysis can be done using the Model

Attainment Test Software (MATS) (Abt, 2014); however this software is not open source and comes as a precompiled software package. To maintain transparency and flexibility in the analysis, in-house R codes (https://www.r-project.org/) developed at ARB will be utilized in this analysis.

The steps followed in the unmonitored area analysis are as follows:

Step 1: For each grid cell, calculate the average of the top-10 modeled maximum daily average 8-hour ozone mixing ratios from the reference year simulation.

Step 2: Interpolate the monitor-specific weighted base-year DVs to an unmonitored grid cell using normalized inverse distance squared weightings for all monitors within a grid cell's Voronoi Region (calculated with the R tripack library; https://cran.r-project.org/web/packages/tripack/README), and adjusted based on the ozone gradient between the grid cell and the corresponding monitor from Step 1. Interpolation is done only within the geographic region constrained by the monitoring network, since extrapolating to outside of the monitoring network is inherently uncertain.

Step 3: For each grid cell, calculate an RRF based on the reference- and future-year modeling following the same approach outlined in Section 8.3, except that the +/- 20% limitation on the simulated and observed maximum daily average 8-hour ozone is not applicable because observed data do not exist for grid cells in unmonitored areas.

Step 4: Multiply the gradient-adjusted interpolated DVs from Step 2 by the gridded RRFs from Step 3 to calculated future-year gridded DVs.

Step 5: Examine the future-year gridded DVs to determine if there are peak values higher than those at the monitors, which could cause violations of the 8-hour ozone NAAQS.

The R codes used in this analysis will be made available upon request.

8.6 Banded Relative Response Factors

The “Band-RRF” approach expands upon the standard “Single-RRF” approach to account for differences in model response to emissions controls at varying ozone levels. The most recent U.S. EPA modeling guidance (U. S. EPA, 2014) accounts for some of these differences by focusing on the top ten modeled days, but even the top ten days may contain a significant range of ozone mixing ratios. The Band-RRF approach accounts for these differences more explicitly by grouping the simulated ozone into bands of lower, medium, and higher ozone mixing ratios. Specifically, daily peak 8-hour ozone mixing ratios for all days meeting model performance criteria (+/- 20% with the observations) can be stratified into 5 ppb increments from 60 ppb upwards (bin size and mixing ratio range may vary under different applications). A separate RRF is calculated for each ozone band following a similar approach as the standard Single-RRF. A linear regression is then fit to the data resulting in an equation relating RRF to ozone band. Similar to the Single-RRF, this equation is unique to each monitor/location.

The top ten days for each monitor, based on observed 8-hour ozone, for each year that is utilized in the design value calculation (see Table 8-1) is then projected to the future using the appropriate RRF for the corresponding ozone band. The top ten future days for each year are then re-sorted, the fourth highest 8-hour ozone is selected, and the future year design value is calculated in a manner consistent with the base/reference year design value calculation. More detailed information on the Band-RRF approach can be found in Kulkarni et al. (2014) and the SJV 2013 1-Hour Ozone SIP.

9. PROCEDURAL REQUIREMENTS

9.1 How Modeling and other Analyses will be Archived, Documented, and Disseminated

The air quality modeling system covers the central portion of California with 4x4 km^2 grids. In total there are over half a million grid cells in each simulation (192 x 192 cells in the lateral direction and 18 vertical layers). The meteorological modeling system has roughly double the number of grid cells since it has 30 vertical layers. Archiving of all the inputs and outputs takes several terabytes (TB) of computer disk space (for comparison, one single-layer DVD can hold roughly 5 gigabytes (GB) of data, and it would require ~200 DVDs to hold one TB). Please note that this estimate is for simulated surface-level pollutant output only. If three-dimensional pollutant data are needed, it would add a few more TB to this total. Therefore, transferring the modeling inputs/outputs over the internet using file transfer protocol (FTP) is not practical.

Interested parties may send a request for model inputs/outputs to Mr. John DaMassa, Chief of the Modeling and Meteorology Branch at the following address.

John DaMassa, Chief
Modeling and Meteorology Branch
Air Quality Planning and Science Division
Air Resources Board
California Environmental Protection Agency
P.O. Box 2815
Sacramento, CA 95814, USA

The requesting party will need to send an external disk drive(s) to facilitate the data transfer. The requesting party should also specify what input/output files are requested so that ARB can determine the capacity of the external disk drive(s) that the requester should send.

9.2 Specific Deliverables to U.S. EPA

The following is a list of modeling-related documents that will be provided to the U.S. EPA.

- The modeling protocol
- Emissions preparation and results
- Meteorology
    - Preparation of model inputs
    - Model performance evaluation
- Air Quality
    - Preparation of model inputs
    - Model performance evaluation
- Documentation of corroborative and weight-of-evidence analyses
- Predicted future year 8-hour ozone Design Values
- Access to input data and simulation results

REFERENCES

Abt, 2014. Modeled Attainment Test Software: User's Manual. MATS available at: http://www.epa.gov/scram001/modelingapps_mats.htm

Angevine, W.M., Eddington, L., Durkee, K., Fairall, C., Bianco, L., and Brioude, J., 2012, Meteorological model evaluation for CalNex 2010, Monthly Weather Review, 140, 3885-3906.

Appel, K. W., Pouliot, G. A., Simon, H., Sarwar, G., Pye, H. O. T., Napelenok, S. L., Akhtar, F., and Roselle, S. J., 2013, Evaluation of dust and trace metal estimates from the Community Multiscale Air Quality (CMAQ) model version 5.0, Geoscientific Model Development, 6, 883-899, doi:10.5194/gmd-6-883-2013, 2013.

Appel, W. K., Gilliland, A.B., Sarwar, G., and Gilliam, R.C., 2007, Evaluation of the Community Multiscale Air Quality (CMAQ) model version 4.5: Sensitivities impacting model performance: Part I – Ozone, Atmospheric Environment, 41, 9603-9615.

Appel, W.K., Bhave, P.V., Gilliland, A.B., Sarwar, G., and Roselle, S.J., 2008, Evaluation of the Community Multiscale Air Quality (CMAQ) model version 4.5: Sensitivities impacting model performance; Part II – Particulate Matter, Atmospheric Environment, 42, 6057-6066.

Avise, J., Chen, J., Lamb, B., Wiedinmyer, C., Guenther, A., Salathe, E., and Mass, C., 2009, Attribution of projected changes in summertime US ozone and $PM_{2.5}$ concentrations to global changes, Atmospheric Chemistry and Physics, 9, 1111-1124.

Azzi, M., White, S.J., Angove, D.E., Jamie, I. M., and Kaduwela, A., 2010, Evaluation of the SAPRC-07 mechanism against CSIRO smog chamber data, Atmospheric Environment, 44, 1707-1713.

Baker, K. R., Carlton, A. G., Kleindienst, T. E., Offenberg, J. H., Beaver, M. R., Gentner, D. R., Goldstein, A. H., Hayes, P. L., Jimenez, J. L., Gilman, J. B., de Gouw, J. A., Woody, M. C., Pye, H. O. T., Kelly, J. T., Lewandowski, M., Jaoui, M., Stevens, P. S., Brune, W. H., Lin, Y.-H., Rubitschun, C. L., and Surratt, J. D.: Gas and aerosol carbon in California: comparison of measurements and model predictions in Pasadena and Bakersfield, Atmos. Chem. Phys., 15, 5243-5258, doi:10.5194/acp-15-5243-2015, 2015.

Bao, J.W., Michelson, S.A., Persson, P.O.G., Djalalova, I.V., and Wilczak, J.M., 2008, Observed and WRF-simulated low-level winds in a high-ozone episode during the Central California Ozone Study, Journal of Applied Meteorology and Climatology, 47(9), 2372-2394.

Bao, Jian-Wen Bao, Sara A. Michelson, Ola Persson, Laura Bianco, Irina Djalalova, David E. White, and James M. Wilczak (2006); NOAA Contributions to the Central California Ozone Study and Ongoing Meteorological Monitoring; NOAA/Earth Systems

Research Laboratory, Boulder, Colorado; Draft Final Report to San Joaquin Valleywide Air Pollution Study Agency and California Air Resources Board.

Beaver, M.R. et al., 2012 Importance of biogenic precursors to the budget of organic nitrates: observations of multifunctional organic nitrates by CIMS and TD-LIF during BEARPEX 2009, Atmos. Chem. Phys., 12, 5773-5785.

Beaver, S.; Palazoglu, A. 2009. Influence of synoptic and mesoscale meteorology on ozone pollution potential for San Joaquin Valley of California. Atmos. Environ. 43: 1779–1788.

Binkowski, F.S. and Roselle, S.J., 2003, Models-3 Community Multiscale Air Quality (CMAQ) model aerosol component, 2. Model description, Journal of Geophysical Research, 108, D6, doi:10.1029/2001jd001409.

Blanchard, C.L.; Tanenbaum, S.; Fujita, E.M.; Campbell, D.; Wilkinson, J. August 2008. Understanding Relationships between Changes in Ambient Ozone and Precursor Concentrations and Changes in VOC and NOx Emissions from 1990 to 2004 in Central California. Report prepared for the California Air Resources Board.

Borge, R., Lopez, J., Lumbreras, J., Narros, A., and Rodriguez, E., 2010, Influence of boundary conditions on CMAQ simulations over the Iberian Peninsula, Atmospheric Environment, 44, 2681-2695 (doi:10.1016/j.atmosenv.2010.04.044).

Bouvier-Brown, N.C., Goldstein, A.H., Gilman, J.B., Kuster, W.C., and de Gouw, J.A., 2009, Atmos. Chem. Phys., 9, 5505-5518.

Brown, N., Allen,D.T., Amar, P., Kallos, G., McNider, R., Russell, A.G., and Stockwell, W.R., 2011, Final report: Fourth peer review of the CMAQ model, Submitted to Community Modeling and Analysis System Center, The University of North Carolina at Chapel Hill.

Byun, D.W. and Ching, J.K.S., 1999, Science Algorithms of the EPA Models-3 Community Multiscale Air Quality (CMAQ) Modeling System, EPA/600/R-99/030, available at http://www.epa.gov/AMD/CMAQ/CMAQscienceDoc.html

Byun, D.W. and Schere, K.L., 2006, Review of the governing equations, computational algorithms, and other components of the Models-3 Community Multiscale Air Quality (CMAQ) modeling system, Applied Mechanics Review, 59, 51-77.

Cai C. et al., 2016 Simulating reactive nitrogen, carbon monoxide, and ozone in California during ARCTAS-CARB 2008 with high wildfire activity, Atmos. Environ. 128, 28-44.

Cai, C., Kelly, J.T., Avise, J.C., Kaduwela, A.P., and Stockwell, W.R., 2011, Photochemical modeling in California with two chemical mechanisms: Model

intercomparison and response to emission reductions, Journal of the Air & Waste Management Association, 61, 559-572.

Carlton, A.G., Bhave, P., Napelenok, S.L., Edney, E.O., Sarwar, G., Pinder, R.W., Pouliot, G.A., and Houyoux, M., 2010, Model representation of secondary organic aerosol in CMAQv4.7, Environmental Science Technology, 44, 8553-8560.

Carter, W.P.L., 2010a, Development of the SAPRC-07 chemical mechanism, Atmospheric Environment, 44(40), 5324-5335.

Carter, W.P.L., 2010b, Development of a condensed SAPRC-07 chemical mechanism, Atmospheric Environment, 44(40), 5336-5345.

Chen, J., Vaughan, J., Avise, J., O'Neill, S., and Lamb, B., 2008, Enhancement and evaluation of the AIRPACT ozone and $PM_{2.5}$ forecast system for the Pacific Northwest, Journal of Geophysical Research, 113, D14305, doi:10.1029/2007JD009554.

Chen, J., Lu, J., Avise, J.C., DaMassa, J.A., Kleeman, M.J., and Kaduwela, A.P., 2014a, Seasonal modeling of PM2.5 in California's San Joaquin Valley, Atmospheric Environment, 92, 182-190.

Chen, J., Zhan, Z., Cai, C., Avise, J., DaMassa, J., Kaduwela, A., 2014b, Modeling air quality in the San Joaquin Valley during the 2013 DISCOVER-AQ field campaign, 2014 American Geophysical Union Fall Meeting, San Francisco, CA.

Civerolo, K., Hogrefe, C., Zalewsky, E., Hao, W., Sistla, G., Lynn, B., Rosenzweig, C., and Kinney, P., 2010, Evaluation of an 18-year CMAQ simulation: Seasonal variations and long-term temporal changes in sulfate and nitrate, Atmospheric Environment, 44, 3745-3752.

Derwent, R. G., M. E. Jenkin, M. J. Pilling, W.P.L. Carter, and A. Kaduwela, 2010, Reactivity scales as comparative tools for chemical mechanisms, Journal of the Air & Waste Management Association, 60, 914-924.

Eder, B., Yu, S., 2006, A performance evaluation of the 2004 release of Models-3 CMAQ, Atmospheric Environment, 40, 4811-4824.

Emery, C., Tai, E., and Yarwood, G., 2001, Enhanced Meteorological Modeling and Performance Evaluation for Two Texas Ozone Episodes, Final report submitted to the Texas Natural Resources Conservation Commission.

Emmons, L.K., Walters, S., Hess, P.G., Lamarque, J.F., Pfister, G.G., Fillmore, D., Granier, C., Guenther, A., Kinnison, D., Laepple, T., Orlando, J., Tie, X., Tyndall, G., Wiedinmyer, C., Baughcum, S.L., and Kloster, S., 2010a, Description and evaluation of the Model for Ozone and Related chemical Tracers, Version 4 (MOZART-4), Geoscientific Model Development, 3, 43-67.

Emmons, L. K., Apel, E.C., Lamarque, J.F., Hess, P.G., Avery, M., Blake, D., Brune, W., Campos, T., Crawford, J., DeCarlo, P.F., Hall, S., Heikes, B., Holloway, J., Jimenez, J.L., Knapp, D.J., Kok, G., Mena-Carrasco, M., Olson, J., O'Sullivan, D., Sachse, G., Walega, J., Weibring, P., Weinheimer, A., and Wiedinmyer, C., 2010b, Impact of Mexico City emissions on regional air quality from MOZART-4 simulations, Atmospheric Chemistry and Physics, 10, 6195-6212

Ensberg, J. J., et al., 2013, Inorganic and black carbon aerosols in the Los Angeles Basin during CalNex, Journal of Geophysical Research - Atmosphere, 118, 1777–1803, doi:10.1029/2012JD018136.

Fast JD, WI Gustafson, Jr, LK Berg, WJ Shaw, MS Pekour, MKB Shrivastava, JC Barnard, R Ferrare, CA Hostetler, J Hair, MH Erickson, T Jobson, B Flowers, MK Dubey, PhD, SR Springston, BR Pirce, L Dolislager, JR Pederson, and RA Zaveri. 2012. "Transport and Mixing Patterns over Central California during the Carbonaceous Aerosol and Radiative Effects Study (CARES)." Atmospheric Chemistry and Physics 12(4):1759-1783. doi:10.5194/acp-12-1759-2012

Fast, J.D., et al., 2014, Modeling regional aerosol and aerosol precursor variability over California and its sensitivity to emissions and long-range transport during the 2010 CalNex and CARES campaigns, Atmospheric Chemistry Physics, 14, 10013-10060.

Federal Register, 2006, Approval and Promulgation of Implementation Plans; Designation of Areas for Air Quality Planning Purposes; State of California; PM-10; Determination of Attainment for the San Joaquin Valley Nonattainment Area; Determination Regarding Applicability of Certain Clean Air Act Requirements, Final Rule, October 30th, 63642-63664.

Federal Register, 2009, Approval and Promulgation of Implementation Plans: 1-Hour Ozone Extreme Area Plan for San Joaquin Valley, CA, Proposed Rule, July 14th, 33933-33947.

Federal Register, 2010, Approval and Promulgation of Implementation Plans; Designation of Areas for Air Quality Planning Purposes; State of California; PM-10; Revision of Designation; Redesignation of the San Joaquin Valley Air Basin PM-10 Nonattainment Area to Attainment; Approval of PM-10 Maintenance Plan for the San Joaquin Valley Air Basin; Approval of Commitments for the East Kern PM-10 Nonattainment Area, Final Rule, November 12th, 66759-66775.

Federal Register, 2010, Approval and Promulgation of Implementation Plans: 1-Hour Ozone Extreme Area Plan for San Joaquin Valley, CA, March 8th, 10420-10438.

Federal Register, 2011, Approval and Promulgation of Implementation Plans; California; 2008 San Joaquin Valley PM2.5 Plan and 2007 State Strategy, Proposed Rule, July 13th, 41338-41363.

Federal Register, 2011, Approval and Promulgation of Implementation Plans; California; 2008 San Joaquin Valley PM2.5 Plan and 2007 State Strategy, Final Rule, November 9th, 69896-69926.

Federal Register, 2011, Approval of Air Quality Implementation Plans; California; San Joaquin Valley; Attainment Plan for 1997 8-Hour Ozone Standard, Proposed Rule, September 16th, 57846-57869.

Federal Register, 2016, Clean Air Plans; 1-Hour and 1997 8-Hour Ozone Nonattainment Area Requirements; San Joaquin Valley, California, Final Rule, April 5th, 19492 -19495.

Foley, K.M., Roselle, S.J., Appel, K.W., Bhave, P.V., Pleim, J.E., Otte, T.L., Mathur, R., Sarwar, G., Young, J.O., Gilliam, R.C., Nolte, C.G., Kelly, J.T., Gilliland, A.B., and Bash, J.O., 2010, Incremental testing of the Community Multiscale Air Quality (CMAQ) modeling system version 4.7, Geoscientific Model Development, 3, 205-226.

Foley. K., P. Dolwick, C. Hogrefe, H. Simon, B. Timin, and N. Possiel, (2015), Dynamic evaluation of CMAQ part II: Evaluation of relative response factor metrics for ozone attainment demonstrations, Atmospheric Environment , 103: 188–195, doi:10.1016/j.atmosenv.2014.12.039

Fujita, E., D. Campbell, R. Keisler, J. Brown, S. Tanrikulu, and A. J. Ranzieri, 2001, Central California Ozone Study (CCOS)-Final report, volume III:Summary of field operations, Technical Report, California Air Resources Board, Sacramento.

Fujita, E., Keislar, R., Stockwell, W., Moosuller, H., DuBois, D., Koracin, D. and Zielinska, B. Central California Ozone Study-Volume I, Field Study Plan.Division of Atmospheric Science Desert Research Institue, 2215 Raggio Parkway, Reno, NV. 1999

Gentner, D.R. et al., 2014a, Emissions of organic carbon and methane from petroleum and dairy operations in California's San Joaquin Valley Atmos. Chem. Phys., 14, 4955-4978.

Gentner, D.R., Ormeño, Fares, E.S., Ford, T.B., Weber, R., Park, J.-H., Brioude, J., Angevine, W.M., Karlik, J.F., and Goldstein, A.H., 2014b, Emissions of terpenoids, benzenoids, and other biogenic gas-phase organic compounds from agricultural crops and their potential implications for air quality Atmos. Chem. Phys., 14, 5393–5413.

Hakami, A., Bergin, M.S., and Russell, A.G., 2004a, Ozone formation potential of organic compounds in the eastern United States: A comparison of episodes, inventories, and domain, Environmental Science & Technology, 38, 6748-6759.

Hakami, A., Harley, R.A., Milford, J.B., Odman, M.T., and Russell, A.G., 2004b, Regional, three-dimensional assessment of the ozone formation potential of organic compounds, Atmospheric Environment, 38, 121-134.

Heuss, J.M., Kahlbaum, D.F., and Wolff, G.T., 2003. Weekday/weekend ozone differences: What can we learn from them? Journal of the Air & Waste Management Association 53(7), 772-788.

Hogrefe, C., Hao, W., Zalewsky, E.E., Ku, J.Y., Lynn, B., Rosenzweig, C., Schultz, M.G., Rast, S., Newchurch, M.J., Wang, L., Kinney, P.L., and Sistla, G., 2011, An analysis of long-term regional-scale ozone simulations over the Northeastern United States: variability and trends, Atmospheric Chemistry and Physics, 11, 567-582.

Hogrefe, C., S. T. Rao, I. G. Zurbenko, and P. S. Porter, 2000 *Interpreting Information in Time Series of Ozone Observations and Model Predictions Relevant to Regulatory Policies in the Eastern United States*. Bull. Amer. Met. Soc., 81, 2083 – 2106

Hogrefe,C., Biswas, J., Lynn, B., Civerolo, K., Ku, J.Y., Rosenthal, J. , Rosenweig, C., Goldberg, R., and Kinney, P.L., 2004, Simulating regional-scale ozone climatology over the eastern United States: model evaluation results, Atmospheric Environment, 38, 2627-2638.

Hu, J., Howard, C.J., Mitloehner, F., Green, P.G., and Kleeman, M.J., 2012, Mobile source and livestock feed contributions to regional ozone formation in Central California, Environmental Science & Technology, 46, 2781-2789.

Hu, J., Ying, Q., Chen, J., Mahmud, A., Zhao, Z., Chen, S.H., and Kleeman, M.J., 2010, Particulate air quality model predictions using prognostic vs. diagnostic meteorology in central California, Atmospheric Environment, 44, 215-226.

Hu, J., Zhang, H., Ying, Q., Chen, S.-H., Vandenberghe, F., and Kleeman, M. J., 2014b, Long-term particulate matter modeling for health effects studies in California – Part 1: Model performance on temporal and spatial variations, Atmospheric Chemistry Physics Discussion, 14, 20997-21036.

Hu,J., Zhang, H., Chen, S. , Ying, Q., Wiedinmyer, C., Vandenberghe, F., and Kleeman, M.J., 2014a, Identifying PM2.5 and PM0.1 sources for epidemiological studies in California, Environmental Sciences & Technology, 48, 4980-4990.

Huang, M., Carmichael, G.R., Adhikary, B., Spak, S.N., Kulkarni, S., Cheng, Y.F., Wei, C., Tang, Y., Parrish, D.D., Oltmans, S.J., D'Allura, A., Kaduwela, A., Cai, C., Weinheimer, A.J., Wong, M., Pierce, R.B., Al-Saadi, J.A. Streets, D.G., and Zhang, Q., 2010, Impacts of transported background ozone on California air quality during the ARCTAS-CARB period - a multi-scale modeling study, Atmospheric Chemistry and Physics, 10(14), 6947-6968.

Huang, M., Carmichael, G.R., Spak, S.N., Adhikary, B., Kulkarni, S., Cheng, Y.,Wei, C., Tang, Y., D'Allura, A., Wennberg, P.O., Huey, G.L., Dibb, J.E., Jimenez, J.L., Cubison, M.J., Weinheimer, A.J., Kaduwela, A., Cai, C., Wong, M., Bradley, P.R., Al-Saadi, J.A., Streets, D.G., and Zhang, Q., 2011, Multi-scale modeling study of the source

contributions to near-surface ozone and sulfur oxides levels over California during the ARCTAS-CARB period, Atmospheric Chemistry and Physics, 11(7), 3173-3194.

Jackson, B., Chau, D., Gürer, K., and Kaduwela, A, 2006, Comparison of ozone simulations using MM5 and CALMET/MM5 hybrid meteorological fields for the July/August 2000 CCOS episode, Atmospheric Environment, 40, 2812-2822.

Jacob, D.J., Crawford, J.H., Maring, H., Clarke, A.D., Dibb, J.E., Emmons, L.K., Ferrare, R.A., Hostetler, C.A., Russell, P.B., Singh, H.B., Thompson, A.M., Shaw, G.E., McCauley, E., Pederson, J.R., and Fisher, J.A., 2010, The Arctic Research of the Composition of the Troposphere from Aircraft and Satellites (ARCTAS) Mission: Design, Execution, and First Results, Atmospheric Chemistry and Physics, 10(11), 5191-5212.

Jathar, S. H., Cappa, C. D., Wexler, A. S., Seinfeld, J. H., and Kleeman, M. J.: Multi-generational oxidation model to simulate secondary organic aerosol in a 3-D air quality model, Geosci. Model Dev., 8, 2553-2567, doi:10.5194/gmd-8-2553-2015, 2015.

Jin L., Brown, N.J., Harley, R.A., Bao, J.W., Michelson, S.A., and Wilczak, J.M., 2010b, Seasonal versus episodic performance evaluation for an Eulerian photochemical air quality model, Journal of Geophysical Research, 115, D09302, doi:10.1029/2009JD012680.

Jin, L. Brown, N. and Harley, R.A. A Seasonal Perspective on Regional Air Quality in Central California, Draft Final Report, Lawrence Berkeley National Laboratory, Berkeley, CA, January, 2010a.

Jin, L., Harley, R.A., and Brown, N.J., 2011, Ozone pollution regimes modeled for a summer season in California's San Joaquin Valley: A cluster analysis, Atmospheric Environment, 45, 4707-4719.

Jin, L., Tonse, S., Cohan, D.S., Mao, X., Harley, R.A., and Brown, N.J., 2008, Sensitivity analysis of ozone formation and transport for a central California air pollution episode, Environmental Science Technology, 42, 3683-3689.

Karl, T, Misztal, P.K., Jonsson, H.H., Shertz, S., Goldstein, A.H., and Guenther, A.B., 2013, Airborne Flux Measurements of BVOCs above Californian Oak Forests: Experimental Investigation of Surface and Entrainment Fluxes, OH Densities, and Damköhler Numbers, JOURNAL OF THE ATMOSPHERIC SCIENCES, 70, 3277-3287

Kelly, J. T., et al., 2014, Fine-scale simulation of ammonium and nitrate over the South Coast Air Basin and San Joaquin Valley of California during CalNex-2010, Journal of Geophysical Research - Atmosphere, 119, 3600–3614, doi:10.1002/2013JD021290.

Kelly, J.T., Avise, J., Cai, C., and Kaduwela, A., 2010b, Simulating particle size distributions over California and impact on lung deposition fraction, Aerosol Science & Technology, 45, 148-162.

Kelly, J.T., Bhave, P., Nolte, C.G., Shankar, U., and Foley, K.M., 2010a, Simulating emission and chemical evolution of coarse sea-salt particles in the Community Multiscale Air Quality (CMAQ) model, Geoscientific Model Development, 3, 257-273.

Kulkarni, S., Kaduwela, A.P., Avise, J.C., DaMassa, J.A., and Chau, D. , 2014, An extended approach to calculate the ozone relative response factors used in the attainment demonstration for the National Ambient Air Quality Standards, Journal of the Air & Waste Management Association, 64, 1204-1213.

LaFranchi, B.W. et al., 2009, Closing the peroxy acetyl nitrate budget: observations of acyl peroxy nitrates (PAN, PPN, and MPAN) during BEARPEX 2007, Atmos. Chem. Phys., 9, 7623–7641.

Lam, Y.F. and Fu, J.S., 2009, A novel downscaling technique for the linkage of global and regional air quality modeling, Atmospheric Chemistry and Physics, 9, 9169-9185.

Lane, T.E., Donahue, N.M., and Pandis, S.N., 2008, Simulating secondary organic aerosol formation using the volatility basis-set approach in a chemical transport model, Atmospheric Environment, 42, 7439-7451.

Lee, S. H., Kim, S.W., Trainer, M., Frost, G.J., McKeen, S.A., Cooper, O.R., Flocke, F., Holloway, J.S., Neuman, J.A., Ryerson, T., Senff, C.J., Swanson, A.L., and Thompson, A.M., 2011, Modeling ozone plumes observed downwind of New York City over the North Atlantic Ocean during the ICARTT field campaign, Atmospheric Chemistry and Physics, 11, 7375-7397, doi:10.5194/acp-11-7375-2011.

Lehrman, D., B.Knuth and D.Fairley, 2001. Characterization of the 2000 Measurement Period, Interim Report, Contract No. 01-2CCOS, Technical and Business Systems, Inc., November.

Lehrman, D., Bush, D., Knuth, B., Fairley, D., Blanchard, C., 2004. Characterization of the CCOS 2000 measurement period. Final report, California Air Resources Board, Sacramento, CA, available at http://www.arb.ca.gov/airways/ccos/ccos.htm (item II-8).

Liang, J. and Kaduwela, A., 2005, Micro-development of CMAQ for California Regional Particulate Matter Air Quality Study, Proceedings of the 4th Annual CMAQ Models-3 User's Conference, Chapel Hill, NC.

Lin, C. J., Ho, T. C., Chu, H. W.,, Yang, H., Chandru, S., Krishnarajanagar, N., Chiou, P., Hopper J. R., June 2005,Sensitivity analysis of ground-level ozone concentration to emission changes in two urban regions of southeast Texas, Journal of Environ. Manage., 75 315-323, http://dx.doi.org/10.1016/j.jenvman.2004.09.012.

Lin, M., Holloway, T., Carmichael, G.R., and Fiore, A.M., 2010, Quantifying pollution inflow and outflow over East Asia in spring with regional and global models, Atmospheric Chemistry and Physics, 10, 4221-4239, doi:10.5194/acp-10-4221-2010.

Lin, M., Holloway, T., Oki, T., Streets, D. G., and Richter, A., 2009, Multi-scale model analysis of boundary layer ozone over East Asia, Atmospheric Chemistry Physics, 9, 3277-3301, 2009.

Lin, M., Oki, T., Holloway, T., Streets, D.G., Bengtsson, M., and Kanae, S., 2008, Long-range transport of acidifying substances in East Asia - Part I: Model evaluation and sensitivity studies, Atmospheric Environment, 42, 5939-5955.

Lin, Y.L., and Jao, I.C., 1995, A Numerical Study of Flow Circulations in the Central Valley of California and Formation Mechanisms of the Fresno Eddy, Monthly Weather Review, 123(11), 3227-3239.

Livingstone, P.L., Magliano, K.,Guerer, K., Allen, P.D., Zhang, K.M., Ying, Q., Jackson, B.S., Kaduwela, A., Kleeman, M., Woodhouse, L.F., Turkiewicz, K., Horowitz, L.W., Scott, K., Johnson, D., Taylor, C., O'Brien, G., DaMassa, J., Croes, B.E., Binkowski, F., and Byun, D., 2009, Simulating PM concentration during a winter episode in a subtropical valley: Sensitivity simulations and evaluation methods, Atmospheric Environment, 43, 5971-5977.

Lu, W., Zhong, S., Charney, J.J., Bian, X., and Liu, S., 2012, WRF simulation over complex terrain during a southern California wildfire event, Climate and Dynamics, 117, D05125, doi:10.1029/2011JD017004.

Mahmud, A., Hixson, M., Hu, J., Zhao, Z., Chen, S.H., and Kleeman, M.J., 2010, Climate impact on airborne particulate matter concentrations in California using seven year analysis periods, Atmospheric Chemistry Physics, 10, 11097-11114.

Marmur, A., Park, S.K., Mulholland, J.A., Tolbert, P.E., and Russell, A.G., 2006, Source apportionment of PM2.5 in the southeastern United States using receptor and emissions-based models: Conceptual differences and implications for time-series health studies, Atmospheric Environment, 40, 2533-2551.

Michelson, S.A.,Djalalova, I.V.,and Bao, J.W., 2010, Evaluation of the Summertime Low-Level Winds Simulated by MM5 in the Central Valley of California, Journal of Applied Meteorology and Climatology, 49(11), 2230-2245.

Misztal, P. K., Avise, J. C., Karl, T., Scott, K., Jonsson, H. H., Guenther, A. B., and Goldstein, A. H., 2016, Evaluation of regional isoprene emission factors and modeled fluxes in California, Atmos. Chem. Phys. Discuss., doi:10.5194/acp-2016-130, in review.

Mollner, A.K., Valluvadasan, S., Feng, L., Sprague, M.K., Okumura, M., Milligan, D.B., Bloss, W.J., Sander, S.P., Martien, P.T., Harley, R.A., McCoy, A.B., and Carter, W.P.L.,

2010, Rate of Gas Phase Association of Hydroxyl Radical and Nitrogen Dioxide, Sciences, 330, 646-649.

Napelenok, S.L., Cohan, D.S., Hu, Y., and Russell, A.G., 2006, Decoupled direct 3D sensitivity analysis for particulate matter (DDM-3D/PM), Atmospheric Environment, 40, 6112-6121.

NOAA (2014), Synthesis of Policy Relevant Findings from the CalNex 2010 Field Study, Final report to the California Air Resources Board, available at http://www.esrl.noaa.gov/csd/projects/calnex/synthesisreport.pdf

O'Neill, S.M., Lamb, B.K., Chen, J., Claiborn, C., Finn, D., Otterson, S., Figueroa, C., Bowman, C., Boyer, M., Wilson, R., Arnold, J., Aalbers, S., Stocum, J., Swab, C., Stoll, M., Dubois, M., and Anderson, M., 2006, Modeling ozone and aerosol formation and transport in the Pacific Northwest with the Community Multi-Scale Air Quality (CMAQ) Modeling System, Environmental Science Technology, 40, 1286 – 1299.

Pfister, G.G., Parrish, D.D., Worden, H., Emmons, L.K., Edwards, D.P., Wiedinmyer, C., Diskin, G.S., Huey, G., Oltmans, S.J., Thouret, V., Weinheimer, A., and Wisthaler, A., 2011a, Characterizing summertime chemical boundary conditions for airmasses entering the US West Coast, Atmospheric Chemistry and Physics, 11(4), 1769-1790.

Philips, S.B., Finkelstein, P.L., 2006, Comparison of spatial patterns of pollutant distribution with CMAQ predictions, Atmospheric Environment, 40, 4999-5009.

Pun, B.K., Balmori, R.T.F., Seigneur, C., 2009, Modeling wintertime particulate matter formation in central California, Atmospheric Environment, 43, 402-409.

Pun, B.K., J.F. Louis and C. Seigneur, 2008. A conceptual model of ozone formation in the San Joaquin Valley. Doc. No. CP049-1-98. Atmospheric and Environmental Research Inc., San Ramon, CA, 15 December.

Pusede, S. E., and R. C. Cohen, 2012, On the observed response of ozone to NOx and VOC reactivity reductions in San Joaquin Valley California 1995–present, Atmos. Chem. Phys., 12, 8323–8339.

Pusede, S. E., Gentner, D. R., Wooldridge, P. J., Browne, E. C., Rollins, A. W., Min, K.-E., Russell, A. R., Thomas, J., Zhang, L., Brune, W. H., Henry, S. B., DiGangi, J. P., Keutsch, F. N., Harrold, S. A., Thornton, J. A., Beaver, M. R., St. Clair, J. M., Wennberg, P. O., Sanders, J., Ren, X., VandenBoer, T. C., Markovic, M. Z., Guha, A., Weber, R., Goldstein, A. H., and Cohen, R. C.: On the temperature dependence of organic reactivity, nitrogen oxides, ozone production, and the impact of emission controls in San Joaquin Valley, California, Atmos. Chem. Phys., 14, 3373-3395, doi:10.5194/acp-14-3373-2014, 2014.

Pye, H.O.T. and Pouliot, G.A., 2012, Modeling the role of alkanes, polycyclic aromatic hydrocarbons, and their oligomers in secondary organic aerosol formation, Environmental Science & Technology, 46, 6041-6047.

Seaman, N.L., Stauffer, D.R., and Lario-Gibbs, A.M., 1995, A Multiscale Four-Dimensional Data Assimilation System Applied in the San Joaquin Valley during SARMAP. Part I: Modeling Design and Basic Performance Characteristics, Journal of Applied Meteorology 34(8), 1739-1761.

Seinfeld J. H. and Pandis S. N. (1998) Atmospheric Chemistry and Physics: From Air Pollution to Climate Change, 1st edition, J. Wiley, New York.

Simon, H., Baker, K.R., and Phillips, S., 2012, Compilation and interpretation of photochemical model performance statistics published between 2006 and 2012, Atmospheric Environment, 61, 124-139.

Smyth, S.C., Jiang, W., Yin, D., Roth, H., and Giroux, E., 2006, Evaluation of CMAQ O3 and PM2.5 performance using Pacific 2001 measurement data, Atmospheric Environment, 40, 2735-2749.

Sokhi, R.S., Jose, R.S., Kitwiroon, N., Fragkoua, E., Perez, J.L., and Middleton, D.R., 2006, Prediction of ozone levels in London using the MM5–CMAQ modeling system. Environmental Modeling & Software, 21, 566–576.

Solomon, P.A. and Magliano, K.L., 1998, The 1995-Integrated Monitoring Study (IMS95) of the California Regional PM10/PM2.5 air quality study (CRPAQS): Study overview, Atmospheric Environment, 33(29), 4747-4756.

Stauffer, D.R., Seaman, N.L. Hunter, G.K., Leidner, S.M., Lario-Gibbs, A., and Tanrikulu, S., 2000, A field-coherence technique for meteorological field-program design for air quality studies. Part I: Description and interpretation, Journal of Applied Meteorology,39(3), 297-316.

Stockwell, W. R., 2009, Peer review of the SAPRC-07 chemical mechanism of Dr. William Carter, Report to the California Air Resources Board, March 9.

Swamy, Y.V., Venkanna, R.,Nikhil, G.N., Chitanya, D.N.S.K., Sinha, P.R., Ramakrishna, M., and Rao, A.G., 2012. Impact of Nitrogen Oxides, Volatile Organic Compounds and Black Carbon onAtmospheric Ozone Levels at a Semi Arid Urban Site in Hyderabad. Aerosol and Air Quality Research 12, 662–671.

Tang, Y., Carmichael, G.R., Thongboonchoo, N., Chai, T.F., Horowitz, L.W., Pierce, R.B., Al-Saadi, J.A., Pfister, G., Vukovich, J.M., Avery, M.A., Sachse, G.W., Ryerson, T.B., Holloway, J.S., Atlas, E.L., Flocke, F.M., Weber, R.J., Huey, L.G., Dibb, J.E., Streets, D.G., and Brune, W.H., 2007, Influence of lateral and top boundary conditions on regional air quality prediction: A multiscale study coupling regional and global

chemical transport models, Journal of Geophysical Research 112, D10S18, doi:10.1029/2006JD007515.

Tang, Y.H., Lee, P., Tsidulko, M., Huang, H.C., McQueen, J.T., DiMego, G.J., Emmons, L.K., Pierce, R.B., Thompson, A.M., Lin, H.M., Kang, D.W., Tong, D., Yu, S.C., Mathur, R., Pleim, J.E., Otte, T.L., Pouliot, G., Young, J.O., Schere, K.L., Davidson, P.M., and Stajner, I., 2009, The impact of chemical lateral boundary conditions on CMAQ predictions of tropospheric ozone over the continental United States, Environmental Fluid Mechanics, 9, 43-58, doi:10.1007/s10652-008-9092-5.

Tanrikulu, S., Stauffer, D.R., Seaman, N.L., and Ranzieri, A.J., 2000, A Field-Coherence Technique for Meteorological Field-Program Design for Air Quality Studies. Part II: Evaluation in the San Joaquin Valley, Journal of Applied Meteorology, 39(3), 317-334.

Tong, D.Q., and Mauzerall, D.L., 2006, Spatial variability of summertime tropospheric ozone over the continental United States: Implications of an evaluation of the CMAQ model, Atmospheric Environment, 40, 3041-3056.

Tonse, S.R., Brown, N.J., Harley, R.A., and Jin, L. 2008, A process-analysis based study of the ozone weekend effect, Atmospheric Environment, 42, 7728-7736.

U.S. EPA, 2005, Technical Support Document for the Final Clean Air Interstate Rule, Air Quality Modeling, prepared by the U.S. EPA Office of Air Quality Planning and Standards, RTP, NC.

U.S. EPA, 2007, Guidance on the Use of Models and Other Analyses for Demonstrating Attainment of Air Quality Goals for Ozone, PM2.5, and Regional Haze, EPA-454/B07-002.

U.S. EPA, 2010, Air Quality Modeling Technical Support Document: Light-Duty Vehicle Greenhouse Gas Emission Standards Final Rule, EPA Report 454/4-10-003.

U.S. EPA, 2014, Draft Modeling Guidance for Demonstrating Attainment of Air Quality Goals for Ozone, PM2.5 and Regional Haze, available at http://www.epa.gov/scram001/guidance/guide/Draft_O3-PM-RH_Modeling_Guidance-2014.pdf

U.S. EPA. 1991. Guideline for Regulatory Application of the Urban Airshed Model. EPA-450/4-91-013. Found at http://www.epa.gov/ttn/scram/guidance_sip.htm

UNC, 2010, Operational Guidance for the Community Multiscale Air Quality (CMAQ) Modeling System Version 4.7.1., available at http://www.cmascenter.org/help/model_docs/cmaq/4.7.1/CMAQ_4.7.1_OGD_28june10.pdf.

Vijayaraghavan, K., Karamchadania, P., and Seigneur, C., 2006, Plume-in-grid modeling of summer air pollution in Central California, Atmospheric Environment, 40, 5097-5109.

Vizuete, W., Jeffries, H.E., Tesche, T.W., Olaguer, E., Couzo, E., 2011. Issues with Ozone Attainment Methodology for Houston, TX. Journal of the Air and Waste Management Association 61 (3), 238-253.

Wilczak, J. M., Djalalova, I., McKeen, S., Bianco, L., Bao, J., Grell, G, Peckham, S., Mathur, R., McQueen, J., and Lee, P., 2009, Analysis of regional meteorology and surface ozone during the TexAQS II field program and an evaluation of the NMM-CMAQ and WRF-Chem air quality models, Journal of Geophysical Research, 114, D00F14, doi:10.1029/2008JD011675.

Ying, Q., Lu, J., Allen, P., Livingstone, P., Kaduwela, A., and Kleeman, M., 2008a, Modeling air quality during the California Regional $PM_{10}/PM_{2.5}$ Air Quality Study (CRPAQS) using the UCD/CIT source-oriented air quality model – Part I. Base case model results, Atmospheric Environment, 42, 8954-8966.

Ying, Q., Lu, J., Kaduwela, A., and Kleeman, M., 2008b, Modeling air quality during the California Regional $PM_{10}/PM_{2.5}$ Air Quality Study (CPRAQS) using the UCD/CIT Source Oriented Air Quality Model - Part II. Regional source apportionment of primary airborne particulate matter, Atmospheric Environment, 42(39), 8967-8978.

Zhang, H., and Ying, Q., 2011, Secondary organic aerosol formation and source apportionment in Southeast Texas, Atmospheric Environment, 45, 3217-3227.

Zhang, Y., Liu, P., Liu, X., Pun, B., Seigneur, C., Jacobson, M.Z., and Wang, W., 2010, Fine scale modeling of wintertime aerosol mass, number, and size distributions in Central California, Journal of Geophysical Research, 115, D15207, doi:10.1029/2009JD012950.

Zhang, Y., Liu, P., Queen, A., Misenis, C., Pun, B., Seigneur, C., and Wu, S.Y., 2006, A Comprehensive performance evaluation of MM5-CMAQ for the summer 1999 Southern Oxidants Study Episode, Part-II. Gas and aerosol predictions, Atmospheric Environment, 40, 4839-4855.

Zhang, Y., Pun, B., Wu, S.Y., Vijayaraghavan, K., and Seigneur, C., 2004, Application and Evaluation of Two Air Quality Models for Particulate Matter for a Southeastern U.S. Episode, Journal of Air & Waste Management Association, 54, 1478-1493.

Zhong, Shiyuan, C. David Whiteman, Xindi Bian, 2004: Diurnal Evolution of Three-Dimensional Wind and Temperature Structure in California's Central Valley. J. Appl. Meteor., 43, 1679–1699.

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Appendix J

Modeling Emission Inventory

2016 PLAN FOR THE 2008 8-HOUR OZONE STANDARD

Appendix J: Modeling Emission Inventory

[This Appendix is provided by the California Air Resources Board]

Modeling Emission Inventory for the 8-Hour Ozone State Implementation Plan in the San Joaquin Valley

Prepared by

California Air Resources Board

San Joaquin Valley Air Pollution Control District

Prepared for

United States Environmental Protection Agency Region IX

May 5, 2016

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1. Development of Ozone Emissions Inventories

Emission inputs for air quality modeling (commonly and interchangeably referred to as 'modeling inventories' or 'gridded inventories') have been developed by ARB and district staff. These inventories support the different SIPs across California to meet various federal ozone standards. ARB maintains an electronic database of emissions and other useful information to generate aggregate emission estimates at the county, air basin and district level. This database is called the California Emission Inventory Development and Reporting System (CEIDARS). CEIDARS provides a foundation for the development of a more refined (hourly, grid-cell specific) set of emission inputs that are required by air quality models. The CEIDARS base year inventory is a primary input to the state's emission forecasting system, known as the California Emission Projection Analysis Model (CEPAM). CEPAM produces the projected emissions that are then gridded and serve as the emission input for the photochemical models.

The following sections of this document describe how base and future year emissions inventory estimates are prepared.

1.1. Inventory Coordination

The Air Resources Board convened the SIP Inventory Working Group (SIPIWG) to provide an opportunity and means for interested parties (ARB, districts, etc.) to discuss issues pertaining to the development and review of base year, future year, planning and gridded inventories to be used in SIP modeling. The group has met every four to six weeks since March 2013. Group participants included district staff from Bay Area, Butte, Eastern Kern, El Dorado, Feather River, Imperial, Northern Sierra, Placer, Sacramento, San Diego, San Joaquin, San Luis Obispo, South Coast, Ventura and Yolo-Solano.

Additionally, ARB established the SIPIWG Spatial Surrogate Sub-committee, which focused on improving input data to spatially disaggregate emissions at a more refined level needed for air quality modeling. Local air districts that participated included San

Joaquin Valley APCD, South Coast AQMD, Ventura County APCD and Sacramento Metropolitan AQMD.

In addition to the two coordination groups described above, a great deal of work preceded this modeling effort through the Central California Air Quality Studies (CCAQS). CCAQS consisted of two studies: 1) the Central California Ozone Study (CCOS); and 2) the California Regional PM_{10}/$PM_{2.5}$ Air Quality Study (CRPAQS).

1.2. Background

California's emission inventory is an estimate of the amounts and types of pollutants emitted from thousands of industrial facilities, millions of motor vehicles and a myriad of emission sources such as consumer products and fireplaces. The development and maintenance of the emission inventory involves several agencies. This multi-agency effort includes: ARB, 35 local air pollution control and air quality management districts (Districts), regional transportation planning agencies (RTPAs), and California Department of Transportation (Caltrans). The ARB is responsible for the compilation of the final statewide emission inventory, and for maintaining this information in CEIDARS. The final emission inventory reflects the best information available at the time.

The basic principle for estimating county-wide regulatory emissions is to multiply an estimated, per-unit emission factor by an estimate of typical usage or activity. For example, on-road motor vehicle emission factors are estimated for a specific vehicle type and applied to all applicable vehicles. The estimates are based on dynamometer tests of a small sample for a vehicle type. The activity for any given vehicle type is based on an estimate of typical driving patterns, number of vehicle starts, and typical miles driven. Assumptions are also made regarding typical usage; it is assumed that all vehicles of certain vehicle type are driven under similar conditions in each region of the state.

Developing emission estimates for stationary sources involves the use of per unit emission factors and activity levels. Under ideal conditions, facility-specific emission factors are determined from emission tests for a particular process at a facility. More commonly, a generic emission factor is developed by averaging the results of emission

tests from similar processes at several different facilities. This generic factor is then used to estimate emissions from similar types of processes when a facility-specific emission factor is not available. Activity levels from stationary sources are measured in terms such as the amount of product produced, solvent used, or fuel used.

The district reported or ARB estimated emissions totals are stored in the CEIDARS database for any given pollutant. Both criteria and toxic air pollutant emission inventories are stored in this complex database. These are typically annual average emissions for each county, air basin, and district. Modeling inventories for reactive organic gases (ROG) are estimated from total organic gases (TOG). Similarly, the modeling inventories for total particulate matter 10µ in diameter and smaller (PM_{10}) and total particulate matter 2.5µ in diameter and smaller ($PM_{2.5}$) are estimated from total particulate matter (PM). Details about chemical and size resolved speciation of emissions for modeling can be found in section 2.4. Additional information on ARB emission inventories can be found at: http://www.arb.ca.gov/ei/ei.htm.

1.3. Inventory Years

The emission inventory scenarios used for air quality modeling must be consistent with U.S. EPA's Modeling guidance (U.S. EPA, 2014). Since changes in the emissions inventory can affect the calculation of the relative response factor (RRF), the terms used in the preparation of the emission inventory scenarios must be clearly defined. In this document the following inventory definitions will be used:

1.3.1. Base Case Modeling Inventory (2012): Base case modeling is intended to demonstrate confidence in the modeling system used for the modeled attainment test. The base case modeling inventory is not used as part of the modeled attainment test itself. Model performance is assessed relative to how well model-simulated concentrations match actual measured concentrations. The modeling inputs are developed to represent (as best as possible) actual, day-specific conditions. Therefore, the base case modeling inventory for 2012 includes day-specific emissions for certain sectors. This includes, for instance, actual district-reported point source emissions information for 2012,

as well as other available day-specific activities and emission adjustments. The year 2012 was selected to coincide with the year selected for baseline design values (described below). The U.S. EPA modeling guidance states that once the model has been shown to perform adequately, the use of day-specific emissions is no longer needed. In preparation for SIP development, both ARB and the local air districts began a comprehensive review and update of the emission inventory several years ago resulting in the most up-to-date emissions inventory for 2012.

1.3.2. Reference Year (or Baseline) Modeling Inventory (2012): The baseline or reference year inventory is intended to be a representation of emission patterns occurring through the baseline design value period and the emission patterns expected in the future year. U.S. EPA modeling guidance describes the reference year modeling inventory as "a common starting point" that represents average or "typical" conditions that are consistent with the baseline design value period. U.S. EPA guidance also states "using a 'typical' or average reference year inventory provides an appropriate platform for comparisons between baseline and future years." The 2012 reference year inventory represents typical average conditions and emission patterns through the 2012 design value period. This reference emissions inventory is not developed to capture day-specific emission characteristics. However, this baseline inventory includes temperature, relative humidity and solar insolation effects, and district-reported point source emissions for 2012.

1.3.3. Future Year Modeling Inventory (2031): Future year modeling inventories, along with the reference year modeling inventory, are used in the model-derived RRF calculation. These inventories maintain the "typical", average patterns of the 2012 reference year modeling inventory. The 2031 inventory will include temperature, relative humidity, and solar insolation effects from reference year (2012) meteorology. Future year point, area and

mobile source emissions are projected from the 2012 baseline emissions used in the 2012 reference year modeling inventory.

In summary and based on the definitions above, the following modeling emission inventories were developed:

1.3.4. 2012 Base Case Modeling Inventory: This day-specific inventory is used for the model performance evaluation.

1.3.5. 2012 Reference Year (Baseline) Modeling Inventory: This 2012 reference year inventory is used to determine site-specific RRFs in the modeled attainment test. It is not a day-specific inventory. Rather, the 2012 reference year modeling inventory represents typical, average conditions and emission patterns over the baseline design value period, excluding day-specific information other than 2012 meteorological effects.

1.3.6. 2031 Future Year Modeling Inventories: These typical, average-day inventories are used to determine site-specific RRFs in the modeled attainment test. Consistent with the 2012 reference year modeling inventory, the 2031 inventory is projected from the 2012 baseline inventory and includes 2012 meteorological effects.

1.4. Spatial Extent of Emission Inventories

The emissions model-ready files that are prepared for use as an input for the air quality model conform to the definition and extent of the grid shown in Figure 1.

The domain uses a Lambert projection and assumes a spherical Earth. The emissions inventory grid uses a Lambert Conical Projection with two parallels. The parallels are at 30° and 60° N latitude, with a central meridian at 120.5° W longitude. The coordinate system origin is offset to 37° N latitude. The emissions inventory uses a grid with a spatial resolution of 4 km x 4 km. The state modeling domain (ST4K) extends entirely over California and 100 nautical miles west over the Pacific Ocean. A smaller

subdomain (CCOS) is used for the San Joaquin Valley. It has the same grid definitions and resolution as the main domain, but has a smaller area offset to cover central and northern California. The specifications of the emissions inventory domain and CCOS subdomain are summarized in Table 1.

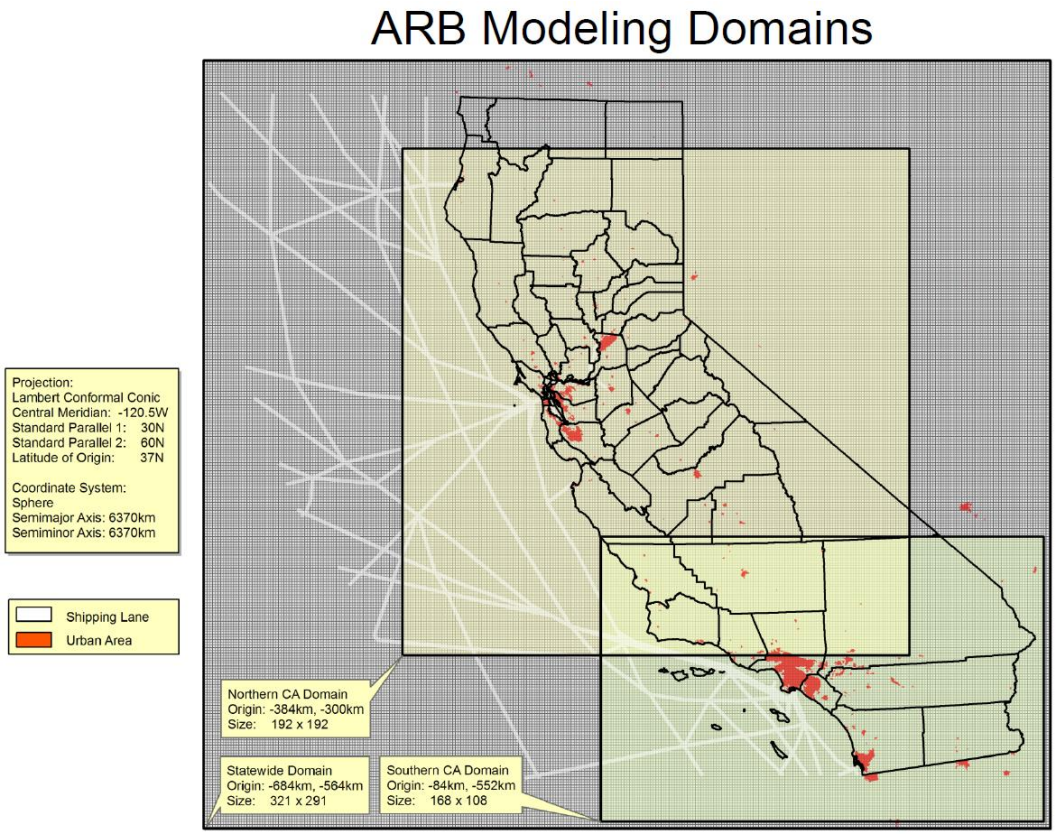


Figure 1 Spatial coverage and parameter summary of modeling domains

Table 1 Modeling domain parameters

Parameter	Statewide domain (ST4K)	Subdomain (CCOS)
Map Projection	Lambert Conformal Conic	Lambert Conformal Conic
Datum	None (Clarke 1866 spheroid)	None (Clarke 1866 spheroid)
1st Standard Parallel	30.0° N	30.0° N
2nd Standard Parallel	60.0° N	60.0° N
Central Meridian	-120.5° W	-120.5° W
Latitude of projection origin	37.0° N	37.0° N
COORDINATE SYSTEM		
Units	Meters	Meters
Semi-major axis	6370 km	6370 km
Semi-minor axis	6370 km	6370 km
DEFINITION OF GRID		
Grid size	4km x 4km	4km x 4km
Number of cells	321 x 291 cells	192 x 192 cells
Lambert origin	(-684,000 m, -564,000 m)	(-384,000 m, -300,000 m)
Geographic center	-120.5° Lat and 37.0° Lon	-120.5° Lat and 37.0° Lon

2. Estimation of Base Year Modeling Inventory

As mentioned in section 1.3, base case modeling is intended to demonstrate confidence in the modeling system used for the modeled attainment test. The following sections describe the temporal and spatial distribution of emissions and how the different sectors of this baseline year modeling inventory are prepared.

2.1. Terminology

The terms “point sources” and “area sources” are often confused. Traditionally, these terms have had different meanings to the developers of emissions inventories and the developers of modeling inventories. Table 2 summarizes the difference in the terms. Both sets of terms are used in this document. In modeling terminology, “point sources” traditionally refer to elevated emission sources that exit from a stack and have a plume rise. While the current inventory includes emissions from stacks, all emission sources

reported by the SJVAPCD associated with a facility are treated as potential elevated sources. The emissions processor calculates plume rise if appropriate; non-elevated sources are treated as ground-level sources. Examples of non-elevated emissions sources include gas dispensing facilities and storage piles. “Area sources” refers collectively to area-wide sources, stationary-aggregated sources, and other mobile sources (including aircraft, trains, ships, and all off-road vehicles and equipment). That is, “area sources” are low-level sources from a modeling perspective.

Table 2 Inventory terms for emission source types

Modeling Term	Emission Inventory Term	Examples
Point	Stationary – Point Facilities	Stacks at Individual Facilities
Area	Off-Road Mobile	Construction Equipment, Farm Equipment, Trains, Recreational Boats
Area	Area-wide	Residential Fuel Combustion, Livestock Waste, Consumer Products, Architectural Coatings
Area	Stationary - Aggregated	Industrial Fuel Use
On-Road Motor Vehicles	On-Road Mobile	Cars and Trucks
Biogenic	Biogenic	Trees

The following sections describe in more detail the temporal, spatial and chemical disaggregation of the emissions inventory for point sources and area sources.

2.2. Temporal Distribution of Emissions

Emission inventories that are temporally and spatially resolved are needed for modeling purposes, for both the baseline year and future years. The temporal distribution of on-road emissions and biogenic emissions are discussed in sections 3.4 and 3.5, respectively. How emissions are temporally distributed for the remaining sources (point, area and off-road mobile sources) are discussed below.

Emissions are adjusted temporally to represent variations by month, day of week and hour of day. Temporal data are stored in ARB's emission inventory database. Each local air district assigns temporal data for all processes at each facility in their district to represent when emissions at each process occur. For example, emissions from degreasing may operate differently than a boiler. ARB or district staff also assigns temporal data for each area source category by county/air basin/district.

2.2.1. Monthly Variation: Emissions are adjusted temporally to represent variations by month. Some emission sources operate the same over a year. For example, a process heater at a refinery or a line haul locomotive likely operates the same month to month. Other emission categories, such as a tomato processing plant or use of recreational boats, vary significantly by season. ARB's emission inventory database stores the relative monthly activity for each process, the sum of which is 100. Therefore, to apportion refinery heaters or line haul locomotive emissions, a monthly fraction is calculated as 100/12 = 8.33. This is considered a flat monthly profile. To apply monthly variations to create a gridded inventory, the annual average day's emissions (yearly emissions divided by 365) is multiplied by the ratio of a specific month's activity to the flat monthly profile. For example, if there is no monthly variation (i.e. the flat monthly profile is 8.33 for each month), then the emissions for a day in each month of the year remain unchanged. On the other hand, a typical monthly throughput in July for recreational boats is 15. The emissions for a typical day in July would be about 1.8 times higher than an annual average day (ratio of 15 / 8.33).

2.2.2. Weekly Variation: Emissions are adjusted temporally to represent variations by day of week. Some operations are the same over a week, such as a utility boiler or a landfill. Many businesses operate only 5 days per week. Other emissions sources are similar on weekdays, but may operate differently on weekend days, such as architectural coatings or off-road motorcycles. To accommodate variations in days of the week, each process or emission category is assigned a days per week code or DPWK. Table 3 below shows

the current DPWK codes, and Table 11 on Appendix D shows additional DPWK codes used for agricultural related emissions

Table 3 Day of week variation factors

Code	WEEKLY CYCLE CODE DESCRIPTION	M	T	W	TH	F	S	S
1	One day per week	1	1	1	1	1	0	0
2	Two days per week	1	1	1	1	1	0	0
3	Three days per week	1	1	1	1	1	0	0
4	Four days per week	1	1	1	1	1	0	0
5	Five days per week - Uniform activity on week days; non on Saturday and Sunday	1	1	1	1	1	0	0
6	Six days per week - Uniform activity on week days; non on Saturday and Sunday	1	1	1	1	1	1	0
7	Seven days per week – Uniform activity every day Of the week	1	1	1	1	1	1	1
20	Uniform activity on Saturday and Sunday; No activity the remainder of the week	0	0	0	0	0	1	1
21	Uniform activity on Saturday and Sunday; No activity the remainder of the week	5	5	5	5	5	10	10
22	Uniform activity on week days; Reduced activity on weekends	10	10	10	10	10	7	4
23	Uniform activity on week days; Reduced activity on weekends (For onroad motor vehicles)	10	10	10	10	10	8	8
24	Uniform activity on week days; half as much activity on Saturday. Little activity on Sunday	10	10	10	10	10	5	1
25	Uniform activity on week days; one third as much on Saturday; little on Sunday	10	10	10	10	10	3	1
26	Uniform activity on week days; little activity on Saturday; no activity on Sunday	10	10	10	10	10	3	0
27	Uniform activity on week days; half as much activity on weekends	10	10	10	10	10	5	5
28	Uniform activity on week days; Five times as much activity on weekends	2	2	2	2	2	10	10
29	Uniform activity on Monday through Thursday; increased activity on Friday, Saturday, Sunday	8	8	8	8	10	10	10

2.2.3. Daily Variation: Emissions are adjusted temporally to represent variations by hour of day. Many emission sources occur 24 hours per day, such as livestock waste or sewage treatment plant. Many businesses operate 8 hours per day. Other emissions sources vary significantly over a day, such as residential space heating or pesticide application. Each process or emission category is assigned an hours per day code or HPDY. Table 4 below shows the daily variation factors or current HPDY codes. Table 12 on Appendix D shows additional DPWK codes used for agricultural related emissions.

Table 4 Daily variation factors

Code	CODE DESCRIPTION	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23
1	1 HOUR PER DAY	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0
2	2 HOURS PER DAY	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0
3	3 HOURS PER DAY	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0
4	4 HOURS PER DAY	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0
5	5 HOURS PER DAY	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0
6	6 HOURS PER DAY	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0
7	7 HOURS PER DAY	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0
8	8 HOURS PER DAY - UNIFORM ACTIVITY FROM 8 A.M. TO 4 P.M. (NORMAL WORKING SHIFT)	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0
9	9 HOURS PER DAY	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1	1	0	0	0	0	0	0	0
10	10 HOURS PER DAY	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1	1	1	0	0	0	0	0	0	0
11	11 HOURS PER DAY	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1	1	1	1	0	0	0	0	0	0
12	12 HOURS PER DAY	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1	1	1	1	1	0	0	0	0	0
13	13 HOURS PER DAY	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1	1	1	1	1	1	0	0	0
14	14 HOURS PER DAY	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0	0
15	15 HOURS PER DAY	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0
16	16 HOURS PER DAY - UNIFORM ACTIVITY FROM 8 A.M. TO MIDNIGHT (2 WORKING SHIFTS)	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
17	17 HOURS PER DAY	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
18	18 HOURS PER DAY	0	0	0	0	0	0	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
19	19 HOURS PER DAY	0	0	0	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0	0
20	20 HOURS PER DAY	0	0	0	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0
21	21 HOURS PER DAY	0	0	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0
22	22 HOURS PER DAY	0	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0
23	23 HOURS PER DAY	0	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
24	24 HOURS PER DAY - UNIFORM ACTIVITY DURING THE DAY	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
31	MAJOR ACTIVITY 5-9 P.M., AVERAGE DURING DAY, MINIMAL IN EARLY A.M.(GAS STATIONS)	3	1	1	1	1	1	1	5	5	5	5	5	5	5	5	5	5	10	10	10	10	7	7	3
33	MAX ACTIVITY 7-9 A.M. & 7-11 P.M.,AVERAGE DURING DAY, LOW AT NIGHT (RESIDENTIAL FUEL COMBUSTION)	2	2	2	2	2	2	2	10	10	6	6	5	5	5	5	5	5	5	5	10	10	10	10	2
34	ACTIVITY 1 TO 9 A.M.; NO ACTIVITY REMAINDER OF DAY (i.e. ORCHARD HEATERS)	0	8	8	8	8	10	10	10	10	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
35	MAX ACTIVITY 7 A.M. TO 1 A.M., REMAINDER IS LOW (i.e. COMMERCIAL AIRCRAFT)	10	1	1	1	1	1	1	8	8	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10
37	ACTIVITY DURING DAYLIGHT HOURS; LESS CHANCE IN EARLY MORNING AND LATE EVENING	0	0	0	0	0	1	3	6	9	10	10	10	10	10	10	10	10	9	6	3	1	0	0	0
38	ACTIVITY DURING MEAL TIME HOURS (i.e. RESIDENTIAL COOKING)	0	0	0	0	0	2	6	6	2	2	1	2	4	4	2	1	1	3	10	8	7	6	1	0
50	PEAK ACTIVITY AT 7 A.M. & 4 P.M.; AVERAGE DURING DAY (ON-ROAD MOTOR VEHICLES)	1	1	1	1	1	1	6	10	6	5	5	5	5	5	5	6	10	8	6	4	1	1	1	1
51	ACTIVITY FROM 6 A.M. TO 12 P.M. (PETROLEUM DRY CLEANING)	0	0	0	0	0	0	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0
52	MAJOR ACTIVITY FROM 6 A.M.-12 P.M., LESS FROM 12-7 P.M. (PESTICIDES)	0	0	0	0	0	1	6	10	10	10	10	10	6	3	3	3	3	4	4	0	0	0	0	0
53	ACTIVITY FROM 7 A.M. TO 12 P.M. (AGRICULTURAL AIRCRAFT)	0	0	0	0	0	0	0	2	2	2	2	2	1	0	0	0	0	0	0	0	0	0	0	0
54	UNIFORM ACTIVITY FROM 7 A.M. TO 9 P.M. (DAYTIME BIOGENICS)	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0	0	0
55	UNIFORM ACTIVITY FROM 9 P.M. TO 7 A.M. (NIGHTIME BIOGENICS)	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1
56	MAX ACTIVITY 8 A.M. TO 5 P.M, MINIMAL AT NIGHT & EARLY MORNING(CAN&COIL/METAL PARTS COATINGS)	0	0	0	0	1	1	2	3	10	10	10	10	10	10	10	10	9	1	1	1	1	1	1	1
57	MAX ACTIVITY 7 A.M. TO 2 P.M., MINIMAL AT EVENING AND MORNING HOURS (CONSTRUCTION EQUIPMENT ON HOT	0	0	0	0	0	1	6	10	10	10	10	10	10	9	8	4	2	1	1	0	0	0	0	0
58	MAX ACTIVITY 7 A.M. TO NOON.;REDUCED ACTIVITY NOON TO 6 P.M. (AUTO REFINISHING)	0	0	0	0	0	0	0	10	10	10	10	10	8	8	8	8	8	8	0	0	0	0	0	0
59	MAXIMUM ACTIVITY FROM 7:00 AM TO 3:00 PM; REDUCED ACTIVITY FROM 3:00 TO 6:00 PM.(CONSTRUCTION	0	0	0	0	0	0	2	10	10	10	10	10	10	10	10	7	3	1	1	0	0	0	0	0
60	MAXIMUM ACTIVITY FROM NOON TO 7:00 PM; REDUCED ACTIVITY EVENING AND MORNING HOURS (RECREATIONAL	0	0	0	0	0	0	0	2	4	6	7	9	10	10	10	10	10	10	10	7	5	3	1	0
81	MAX ACTIVITY 9 AM TO 3 PM; HALF THE ACTIVITY REMAINING HOURS (WASTE FROM DAIRY CATTLE)	7	6	6	5	4	4	4	5	7	8	9	10	10	10	7	3	3	3	4	4	5	6	7	7
82	ACTIVITY FROM 10 AM TO 9 PM RISING TO PEAK AT 3; NO ACTIVITY REMAINDER OF DAY (WASTE FROM POULTRY)	0	0	0	0	0	0	0	0	0	3	3	7	7	7	10	10	7	3	3	3	3	0	0	0
83	ACTIVITY FROM 9 AM TO 12 AM RISING TO PEAK AT 3; MINIMUM ACTIVITY REMAINDER OF DAY (WASTE FROM SWINE)	0	0	0	0	0	0	0	1	1	2	4	6	8	8	9	10	8	4	3	3	2	1	1	1
84	MAJOR ACTIVITY FROM 11AM TO 6PM; REDUCED OTHER HOURS (EVAP-COASTAL COUNTIES)	7	7	6	6	6	6	6	7	8	8	9	9	10	10	10	10	9	9	8	8	7	7	7	7
85	MAJOR ACTIVITY FROM 11AM TO 6PM; REDUCED OTHER HOURS (EVAP-NON-COASTAL COUNTIES)	5	5	5	5	4	4	5	5	6	7	8	9	9	10	10	10	9	9	8	7	6	6	6	5

2.3. Spatial Allocation

Once the base year or future year inventories are developed, the next step of modeling inventory development is to spatially allocate the emissions. Air quality modeling attempts to replicate the physical and chemical processes that occur in an inventory domain. Therefore, it is important that the physical location of emissions be specified as accurately as possible. Ideally, the actual location of all emissions would be known exactly. In reality, however, some categories of emissions would be virtually impossible to determine – for example, the actual amount and location of consumer products (e.g. deodorant) used every day. To the extent possible, the spatial allocation of emissions in a modeling inventory approximates as closely as possible the actual location of emissions.

Spatial allocation is typically accomplished by using spatial surrogates. These spatial surrogates are processed into spatial allocation factors in order to geographically distribute county-wide area source emissions to individual grid cells. Spatial surrogates are developed based on demographic, land cover and other data that exhibit patterns which vary geographically. The spatial surrogates have been updated over the years mainly by Sonoma Technology, Inc. (STI) (Funk, et al., 2001) who created a 2000 base year and various future years. Later, STI updated the underlying spatial data and developed new surrogates (Reid, et al., 2006) completing the project in 2008.

Three basic types of surrogate data were used to develop the spatial allocation factors: land use and land cover; facility location; and demographic and socioeconomic data. Land use and land cover data are associated with specific land uses, such as agricultural harvesting or recreational boats. Facility locations are used for sources such as gas stations and dry cleaners. Demographic and socioeconomic data, such as population and housing, are associated with residential, industrial, and commercial activity (e.g. residential fuel combustion). To develop spatial allocation factors of high quality and resolution, local socioeconomic and demographic data were used where available for both baseline and future years. These data were available from local Metropolitan Planning Organizations (MPO) or Regional Transportation Planning Agencies (RTPA), where they are used as inputs for travel demand models. In rural

regions for which local data were not available, data from Caltrans' Statewide Transportation Model were used.

Since 2008, ARB staff have continued to search for more recent or improved sources of data, since the underlying data used by STI were pre-recession. ARB staff have updated many of the spatial surrogates and added many new ones.

- Updates to land use categories were made using the National Land Cover Database 2011 (Homer, et al., 2015).
- Many surrogates were updated using the locations from Dun & Bradstreet's Market Insight Database (Dun and Bradstreet, 2015). The types of sources were defined by SIC. Fourteen new surrogates were developed for industrial-related sources using SIC and whether manufacturing occurred at the facility.
- U.S. Census American Community Survey (FactFinder, 2011) data by census block were used to update residential fuel use.
- Sierra Research developed nine new surrogates related to agricultural activities (Anderson, et al., 2012) , some of which incorporated crop-specific factors.
- Seven new surrogates were developed using vessel traffic data, or Automatic Identification System (AIS) data, collected by the U.S. Coast Guard.
- A new surrogate was created to represent the location of construction equipment. The distribution is a combination of two sets of data: 90% change in "imperviousness" between 2006 and 2011 from NLCD 2011 and 10% road network. Impervious surfaces are mainly artificial structures such as pavements (roads, sidewalks, driveways and parking lots) that are covered by materials impenetrable to a satellite such as asphalt, concrete, brick, stone and rooftops.
- A new surrogate was compiled to distribute emissions from transport refrigeration units (TRU) from three sources: 65% distribution centers, 34% road network and 1% grocery stores / food processing facilities. Information on distribution centers were retrieved from ARBER, the ARB Equipment Registration software for the Transport Refrigeration Unit (TRU) ATCM and the Drayage Truck Regulation.

In all, a total of 99 unique surrogates are available for use. A summary of the spatial surrogates for which spatial allocation factors were developed is shown below in Table 5.

Table 5 Spatial Surrogates

Surrogate Name	Surrogate Definition
AEROSPACE	Spatial distribution of businesses involved in aerospace
Airports	Spatial locations of all airports
All_PavedRds	Spatial distribution of road network (all paved roads)
AutobodyShops	Locations of autobody repair and refinishing shops
CAFO	Spatial distribution of concentrated animal feeding operations
CANCOIL	Spatial distribution of businesses involved in can and coil operations
Cemeteries	Spatial locations of cemeteries
Comm_Airports	Spatial locations of commercial airports
COMPOST	Spatial distribution of composting
CONSTRUCTION_EQUIP	Spatial distribution of where construction equipment is used
Devplnd_HiDensity	Spatial distribution of developed land - low density, medium density and high density
Devplnd_LoDensity	Spatial distribution of developed land - open space (lowest density)
DREDGE	Locations of dredging
Drycleaners	Locations of dry cleaning facilities
DryLakeBeds	Locations of dry lake beds
Elev5000ft	Topological contours – areas above 5000 feet
Employ_Roads	Spatial distribution of total employment and road density (all paved roads)
FABRIC	Spatial distribution of businesses involved in fabric manufacturing
FERRIES	Locations of ferry ports and routes
FISHING_COMM	Locations of commercial fishing
Forestland	Spatial distribution of forest land
Fugitive_Dust	Spatial distribution of barren land
GAS_DISTRIBUTION	Location of gas pipelines
GAS_SEEP	Location of natural-occurring gas seeps
GasStations	Locations of gasoline service stations
GASWELL	Locations of gas wells
GolfCourses	Spatial locations of golf courses
HE_Sqft	Computed surrogate based on housing and employment (est. ft2 / person)
Hospitals	Spatial locations of hospitals
Housing	Spatial distribution of total housing
Housing_Autobody	Spatial distribution of housing and autobody refinishing shops
Housing_Com_Emp	Spatial distribution of total housing and commercial employment
Housing_Restaurants	Spatial distribution of total housing and restaurants/bakeries
Surrogate Name	Surrogate Definition
INDUSTRIAL	Spatial distribution of industrial businesses where manufacturing occurs (SIC<4000)
Industrial_Emp	Spatial distribution of industrial employment
InlandShippingLanes	Spatial distribution of major shipping lanes within bays and inland areas
Irr_Cropland	Spatial location of agricultural cropland
Lakes_Coastline	Locations of lakes, reservoirs, and coastline
LAKES_RIVERS_RECBOAT	Locations of lakes, rivers and reservoirs where recreational boats are used
LANDFILLS	Locations of landfills
LANDPREP	Spatial distribution of dust from land preparation operations (e.g. tilling)
LINEHAUL	Spatial distribution of Class I rail network
LiveStock	Spatial distribution of cattle ranches, feedlots, dairies, and poultry farms
MARINE	Spatial distribution of businesses involved in marine
METALFURN	Spatial distribution of businesses involved in metal furniture
METALPARTS	Spatial distribution of businesses involved in metal parts and products
Metrolink_Lines	Spatial distribution of metrolink network
MILITARY_AIRCRAFT	Locations of landing strips on military bases
MILITARY_SHIPS	Locations of military ship activity
MILITARY_TACTICAL	Military bases where tactical equipment are used
MiltaryBases	Locations of military bases

Surrogate Name	Surrogate Definition
NON_PASTURE_AG	Spatial distribution of farmland
NonIrr_Pastureland	Spatial location of pasture land
NonRes_Chg	Computed surrogate based on spatial distribution of non-residential areas
OCEAN_RECBOAT	Locations of recreational boat activity that can occur on the ocean and SF Bay
OIL_SEEP	Location of naturally-occurring oil seeps
OILWELL	Locations of oil wells (both onshore and offshore)
OTHERCOAT	Spatial distribution of businesses with SIC<4000 not included in another category
PAPER	Spatial distribution of businesses involved in paper
PASTURE	Spatial distribution of grazing land
PEST_ME_BR	Spatial distribution of methyl bromide pesticides
PEST_NO_ME_BR	Spatial distribution of non-methyl bromide pesticides
PLASTIC	Spatial distribution of businesses involved in plastic
Pop_ComEmp_Hos	Spatial distribution of hospitals, population and commercial employment
Population	Spatial distribution of population
Ports	Locations of shipping ports
POTWs	Coordinate locations of POTWs
PrimaryRoads	Spatial distribution of road network (primary roads)
PRINT	Spatial distribution of print businesses
Raillines	Spatial distribution of railroad network
RailYards	Locations of rail yards
Rds_HE	Calculated surrogate based on road densities and housing/employment (est. ft2 / person)
RefinieriesTankFarms	Coordinate locations of refineries and tank farms
Res_NonRes_Chg	Computed surrogate based on spatial distribution of residential and non-residential areas
ResGasHeating	Spatial distribution of homes using gas supplied by a utility as primary source of heating
Residential_Chg	Computed surrogate based on spatial distribution of residential areas
ResLPGHeat	Spatial distribution of homes using gas (bottled, tank or LP) as primary source of heating
ResNonResChg_IndEmp	Spatial distribution of industrial employment and residential/non-residential change
ResOilHeat	Spatial distribution of homes using fuel oil or kerosene as primary source of heating
Restaurants	Locations of restaurants
ResWoodHeating	Spatial distribution of homes using wood as primary source of heating
Surrogate Name	Surrogate Definition
SandandGravelMines	Locations of sand/gravel excavation and mining
Schools	Spatial locations of schools
SecondaryPavedRds	Spatial distribution of road network (secondary roads)
SEMICONDUCT	Spatial distribution of businesses involved in semiconductors
Ser_ComEmp_Sch_GolfC_Cem	Spatial distribution of service and commercial employment, schools, cemeteries, olf courses
Service_Com_Emp	Spatial distribution of service and commercial employment
Shiplanes	Spatial distribution of major shipping lanes
SILAGE	Spatial distribution of silage operations
SingleHousingUnits	Spatial distribution of single dwelling units
TRU	Spatial distribution of transport refrigeration units
TUG_TOW	Spatial distribution of tug and tow boats
UnpavedRds	Spatial distribution of road network (unpaved roads)
Wineries	Locations of wineries
WOOD	Spatial distribution of businesses using wood
WOODFURN	Spatial distribution of businesses involved in wood furniture

The following sections describe in more detail the type of spatial disaggregation used for each sector of the emissions inventory.

2.3.1. Spatial Allocation of Area Sources: Each area source category is assigned a spatial surrogate that is used to allocate emissions to a grid cell in

ARB's 4km statewide modeling domain. Examples of surrogates include population, land use, and other data with known geographic distributions for allocating emissions to grid cells, as described above.

2.3.2. Spatial Allocation of Point Sources: Each point source is allocated to grid cells using the latitude and longitude reported for each stack. If there are no stack latitude and longitude, the facility coordinates are used. There are two types of point sources: elevated and non-elevated sources. Vertical distribution of elevated sources is allocated using the plume rise algorithm in the emissions processor, SMOKE (see section 3.3), while non-elevated are allocated to the first layer. Most stationary point sources with existing stacks are regarded as elevated sources. Those without physical stacks that provide only latitude/longitude, such as airports or landfills, are considered non-elevated.

2.3.3. Spatial Allocation of Wildfires, Prescribed Burns and Wildland Fire Use: Emissions from these sources are event and location-based. A fire event can last a few hours or span multiple days. Each fire is spatially allocated to grid cells using the extent of each fire event, while the temporal distribution also reflects the actual duration of the fire.

2.3.4. Spatial Allocation of Ocean going vessels (OGV): Ship emissions are allocated to the grids corresponding to the vessel traffic lanes in ARB's OGV model (ARB-PTSD, 2011) These traffic lanes were estimated from three different sources:

a. National Waterway Network
b. The Ship Traffic, Energy and Environment Model
c. Automated instrumentation system (AIS) telemetry data collected in 2007

2.3.5. Spatial Allocation of On-road Motor Vehicles: The spatial allocation of on-road motor vehicles is based on DTIM as described in section 3.4.

2.3.6. Spatial Allocation of Biogenic Emissions: As described in section 3.5, the spatial allocation of biogenic emissions is accomplished using the Model of Emissions of Gases and Aerosols from Nature (MEGAN). More details can be found at: http://lar.wsu.edu/megan/. Driving variables in MEGAN include land cover, weather, and atmospheric chemical composition. MEGAN is set up to create 2D gridded emissions files at a resolution that matches the statewide 4k modeling domain.

2.4. Speciation Profiles

ARB's emission inventory lists the amount of pollutants discharged into the atmosphere by source in a certain geographical area during a given time period. It currently contains estimates for CO, NH_3, NOx, SOx, total organic gases (TOG) and particulate matter (PM). CO and NH3 are single species; NOx emissions are composed of NO, NO_2 and HONO; and SOx emissions are composed of SO_2 and SO_3. Emissions of TOG and PM for many sources can actually contain over hundreds of different chemical species, and speciation is the process of disaggregating these inventory pollutants into individual chemical species components or group of species. ARB maintains and updates such species profiles for organic gases (OG) and PM for a variety of source categories.

Photochemical models simulate the physical and chemical processes in the lower atmosphere, and include all emissions of the important classes of chemicals involved in photochemistry. Organic gases emitted to the atmosphere are referred to as Total Organic Gas or TOG. TOG includes all organic compounds that can become airborne (through evaporation, sublimation, as aerosols, etc.), excluding carbon monoxide, carbon dioxide, carbonic acid, metallic carbides or carbonates and ammonium carbonate. TOG emissions reported in the ARB's emission inventory are the basis for deriving the Reactive Organic Gas (ROG) emission components, which are also reported in the inventory. ROG is defined as TOG minus ARB's exempt compounds (e.g., methane, ethane, various chlorinated fluorocarbons, acetone, perchloroethylene, volatile methyl siloxanes, etc.). ROG is nearly identical to U.S. EPA's Volatile Organic

Compounds (VOC), which is based on EPA's exempt list. For all practical purposes, use of the term ROG and VOC are interchangeable. Also, various regulatory uses of the term VOC, such as that for consumer products exclude specific, additional compounds from particular control requirements.

The OG speciation profiles are applied to estimate the amounts of various organic compounds that make up TOG emissions. A speciation profile contains a list of organic compounds and the weight fraction that each compound comprises of the TOG emissions from a particular source type. In addition to the chemical name for each chemical constituent, the file also shows the chemical code (a 5-digit ARB internal identifier). The speciation profiles are applied to TOG to develop both the photochemical model inputs and the emission inventory for ROG. It should be noted that districts are allowed to report their own reactive fraction of TOG that is used to calculate ROG rather than use the information from the assigned organic gas speciation profiles. These district-reported fractions are not used in developing modeling inventories because the information needed to calculate the amount of each organic compound is not available.

The PM emissions are size fractionated by using PM size profiles, which contain the total weight fraction for $PM_{2.5}$ and PM_{10} out of total PM. The fine and coarse PM chemical compositions are characterized by applying the PM chemical speciation profiles for each source type, which contain the weight fractions of each chemical species for $PM_{2.5}$, PM_{10} and total PM. PM chemical speciation profiles may also vary for different PM size fractions even for the same emission source. PM size profiles and speciation profiles are typically generated based on source testing data. In most previous source testing studies aimed at determining PM chemical composition, filter-based sampling techniques were used to collect PM samples for chemical analyses.

The organic gas profiles and PM profiles used in the emission inventory are available for download from the ARB's web site at: http://www.arb.ca.gov/ei/speciate/speciate.htm

Each process or product category is keyed to one of the OG profiles and one of the PM profiles. Also available for download from ARB's web site is a cross-reference file that indicates which OG profile and PM profile are assigned to each category in the inventory. The inventory source categories are represented by an 8-digit source classification code (SCC) for point sources, or a 14-digit emission inventory code (EIC) for area and mobile sources. Some of the organic gas profiles and PM profiles related to motor vehicles, ocean going vessels, and fuel evaporative sources vary by the inventory year of interest, due to changes in fuel composition and vehicle fleet composition over time.

Research studies are conducted regularly to improve ARB's speciation profiles. These profiles support ozone and PM modeling studies but are also designed to be used for aerosol and regional toxics modeling. The profiles are also used to support other health or welfare related modeling studies where the compounds of interest cannot always be anticipated. Therefore, speciation profiles should be as complete and accurate as possible. ARB has an ongoing effort to update speciation profiles as data become available, such as through testing of emission sources or surveys of product formulations. New speciation data generally undergo technical and peer review, and updating of the profiles is coordinated with users of the data. The recent addition to ARB's speciation profiles include:

(1) Organic gas profile
- Consumer products
- Architectural coating
- Gasoline fuel and headspace vapor
- Gasoline vehicle hot soak and diurnal evaporation
- Gasoline vehicle start and running exhaust
- Silage
- Aircraft exhaust
- Compressed Natural Gas (CNG) bus running exhaust

(2) PM profile
- Gasoline vehicle exhaust
- On-road diesel exhaust

- Off-road diesel exhaust
- Ocean going vessel exhaust
- Aircraft exhaust
- Concrete batching
- Commercial cooking
- Residential fuel combustion-natural gas
- Coating/painting
- Cotton ginning
- Stationary combustion

3. Methodology for Developing Baseline Year Emissions Inventory

As mentioned in section 1, the baseline inventory includes temperature, humidity and solar insolation effects for some emission categories; development of these data is described in sections 3.1 and 3.2. The remaining sections of Chapter 3 detail how the baseline year inventory is created for different sectors of the inventory such as point, area, on-road motor vehicles, biogenic and other day-specific sources.

3.1. Surface Temperature and Relative Humidity Fields

The calculation of gridded emissions for some categories of the emissions inventory is dependent on meteorological variables. More specifically, biogenic emissions are sensitive to air temperatures and solar radiation while emissions from on-road mobile sources are sensitive to air temperature and relative humidity. As a result, estimates of air temperature (T), relative humidity (RH), and solar radiation are needed for each grid cell in the modeling domain in order to take into account the effects of these meteorological variables.

Gridded temperature, humidity, and radiation fields are readily available from prognostic meteorological models such as the Weather Research and Forecasting model (WRF) model (http://www.wrf-model.org/index.php), which is used to prepare meteorological inputs for the air quality model. However, it is widely recognized that diagnostic (i.e. observation-based) models provide more accurate local-scale estimates of ground

surface temperature and humidity. As a result, the CALMET(http://www.src.com/) diagnostic meteorological model is used to generate a gridded temperature field and an objective analysis scheme is used to generate a gridded humidity field. The solar radiation fields needed for biogenic emission inventory calculations were taken from the WRF prognostic model, which is also used to generate meteorology for the air quality model. The principal steps involved in generating a gridded, surface-level temperature field using CALMET include the following:

1. Compute the relative weights of each surface observation station to each grid cell (the weight is inversely proportional to the distance between the surface observation station and grid cell center).
2. Adjust all surface temperatures to sea level. In this step, a lapse rate of -0.0049 ^{o}C/m is used (this lapse rate is based on private communication with Gary Moore of Earth Tech, Inc., Concord, MA). This lapse rate (=2.7 F/1000 feet) is based on observational data.
3. Use the weights to compute a spatially-averaged sea-level temperature in each grid cell.
4. Correct all sea-level temperatures back to 10 m height above ground level (i.e. the standard height of surface temperature measurement) using the lapse rate of -0.0049 ^{o}C/m again.
5. The current version of CALMET does not generate estimates of relative humidity. As a result, a post-processing program was used to produce gridded, hourly relative humidity estimates from observed relative humidity data. The major steps needed to generate gridded, surface-level relative humidity are described as follows:
    a. Calculate actual vapor pressure from observed relative humidity and temperature at all meteorological stations. The (Mc. Rae, 1980) method is used to calculate the saturated vapor pressure from temperature;
    b. Compute the relative weights of each surface observation station to each grid in question, exactly as done by CALMET to compute the temperature field;

c. Use the weights from step 2 to compute a spatially-averaged estimate of actual vapor pressure in each grid cell;
d. For each grid cell, calculate relative humidity from values for actual vapor pressure and temperature for the same grid cell.

3.2. Insolation Effects

Insolation data was used in the estimation of the gridded emissions inventory and provided by the WRF meteorological fields as mentioned in Section 3.5.

3.3. Estimation of Gridded Area and Point sources

Emissions inventories that are temporally, chemically, and spatially resolved are needed as inputs for the photochemical air quality model. Point sources and area sources (area-wide, off-road mobile and aggregated stationary) are processed into emissions inventories for photochemical modeling using the SMOKE (Sparse Matrix Operator Kernel Emissions) modeling system (https://www.cmascenter.org/smoke/). Improvements to SMOKE were recently implemented under ARB contract for version 4.0 of SMOKE (Baek, 2015).

Inputs for SMOKE are annual emissions totals from CEPAM and information for allocating to temporal, chemical, and spatial resolutions. Temporal inputs for SMOKE are screened for missing or invalid temporal codes as discussed in section 4.1. Temporal allocation of emissions using SMOKE involves the disaggregation of annual emissions totals into monthly, day of week, and hour of day emissions totals. The temporal codes from Table 3 and Table 4 are reformatted into an input-ready format as explained in the SMOKE user's manual. Chemical speciation profiles, as described in section 2.4, and emissions source cross-reference files used as inputs for SMOKE are developed by ARB staff. SMOKE uses the files for the chemical speciation of NOx, SOx, TOG and PM to species needed by photochemical air quality models.

Emissions for area sources are allocated to grid cells as defined by the modeling grid domain defined in section 1.4. Emissions are spatially disaggregated by the use of

spatial surrogates as described in section 2.3. These spatial surrogates are converted to a SMOKE-ready format as described in the SMOKE user's manual. Emissions for point sources are allocated to grid cells by SMOKE using the latitude and longitude coordinates reported for each stack.

3.4. Estimation of On-road Motor Vehicle Emissions

The EMFAC emissions model is used by ARB to assess emissions from on-road vehicles including cars, trucks, and buses in California, and to support air quality planning efforts to meet the Federal Highway Administration's transportation planning requirements. EMFAC is designed to produce county-level, average-day estimates. As a result, these estimates must be disaggregated spatially and temporally into gridded, hourly estimates for air quality modeling.

The general methodology used to disaggregate EMFAC emission estimates is a two-step approach. The first step uses the Direct Travel Impact Model (DTIM4) (Systems Applications Inc., 2001) to produce gridded, hourly emission estimates. The second step distributes EMFAC emissions according to the spatiotemporal output from DTIM. This methodology has been peer reviewed by the Institute of Transportation Studies at the University of California, Irvine, under CCOS contract 11-4CCOS.

The spatiotemporal allocation of emissions from DTIM does not vary dramatically with small changes in meteorological data (T/RH), resulting in a negligible monthly variation of the spatial surrogate. However, differences in DTIM's winter versus summer spatiotemporal allocation are slightly appreciable. Therefore, spatial surrogates are created for a winter and a summer day.

The most recent version of EMFAC, EMFAC2014, has three separate modules that are relevant for the preparation of the on-road emissions gridded inventory: one that estimates emissions, one that estimates emission rates, and one that estimates activity data. The emissions module is run for every county and every day of the modeled year using day-specific temperature and relative humidity. On a less granular level, the emissions rates module is run for every county for a summer day and a winter day.

Lastly, the activity module is run once to estimates vehicle miles traveled (VMT), number of vehicle trips, fuel consumption, and the number of vehicles in use.

3.4.1. General Methodology: Mobile source emissions are sensitive to ambient temperature and humidity. Both EMFAC and DTIM account for meteorological effects using day-specific inputs. For EMFAC, hourly gridded temperature and humidity fields are averaged by county using a gridded VMT weighted average (i.e. weighted proportional to the VMT per grid cell in a county). DTIM accepts gridded, hourly data directly (CALMET formatted data). See section 3.1 for more information.

EMFAC provides vehicle-class-specific emissions estimates for: exhaust, evaporative, tire wear, and brake wear emissions. EMFAC also produces estimates of: VMT, number of vehicle trips, fuel consumption, and the number of vehicles in use. More information on EMFAC can be found at (ARB-MSEI, 2015) . The vehicle activity is the most important input for spatiotemporal distribution of emissions. DTIM uses hourly vehicle miles traveled on each highway link and each of the vehicle trips in the modeling domain. The detailed vehicle activity data is obtained from ARB's Integrated Transportation Network (dtiv3) database.

The overall processing of on-road emissions to create the gridded emissions inventory can be seen in Figure 2. Activity data from the ITN (see section 3.4.2) is developed for the thirteen EMFAC 2007 vehicle types, but activity is split for gas and diesel, resulting in a total of 26 vehicle types as shown in the block diagram. The forecasted on-road modeling inventories are developed using the same methodology as the baseline year, where future year emissions are based on running EMFAC 2014 in Emissions Mode for the associated future year.

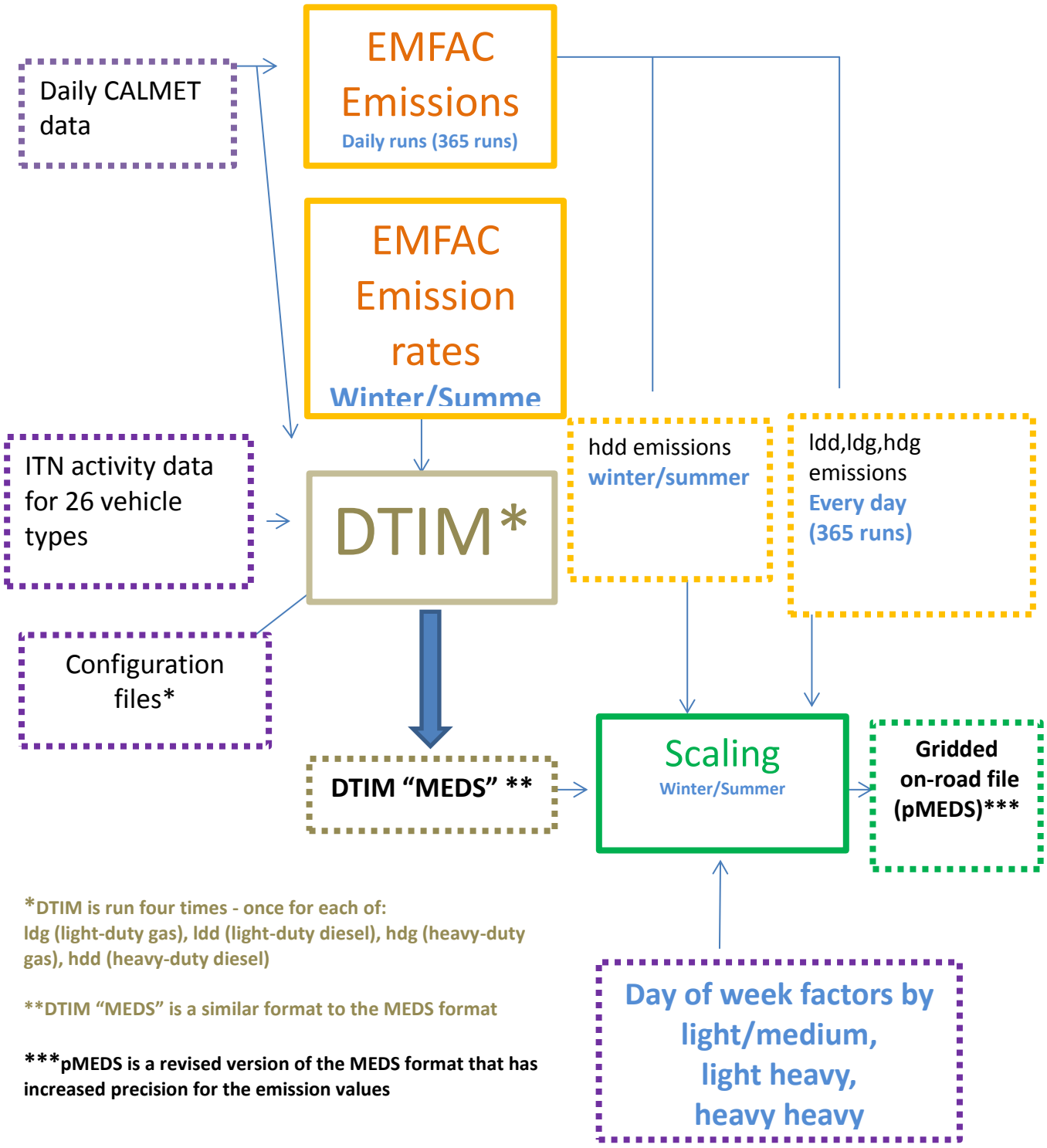


Figure 2 Block diagram for on-road processing

3.4.2. ITN Activity Data: The ITN is a database which is populated with link-based and Traffic Analysis Zone (TAZ)-based travel activity from travel demand models provided by different metropolitan planning organizations (MPOs), California Department of Transportation (Caltrans) and other California regional transportation planning agencies. The vintage and types of data used in the current version of the ITN are shown in Table 6. Different types of quality control parameters like vehicle mix, hourly distributions and post-mile coverage are obtained from default EMFAC and Caltrans databases. After these various pieces of data are imported to the database, the data can be examined for quality assurance. These input data sets are later moved into consolidated and geographically referenced master tables of link and TAZ activity data. Finally, these master tables are processed to produce hourly tables and hourly activity data input files for DTIM.

Table 6 Vintage of travel demand models for link based and traffic analysis zone

Metropolitan Planning Organizations	TDM Version Base year	Data types received	Data received on
AMBAG	2010	Links, Trips	06/15/2015
BCAG	2010	Links, Trips	05/13/2015
FCOG	2008	Links†	06/11/2015
CALTRANS	2010	Links, Trips	12/09/2014
KCOG	2010	Links†	06/11/2015
KCAG	2010	Links†	06/11/2015
MTC	2010	Links, Trips	03/23/2015
MCTC	2010	Links†	06/11/2015
MCAG	2010	Links, Trips	06/11/2015
SACOG	2010	Links, Trips	05/08/2014
SANDAG	2008	Links, Trips	12/09/2014
SBCAG	2010	Links, Trips	04/06/2015
SCAG	2008	Links, Trips	01/23/2014
SJCOG	2010	Links, Trips	06/11/2015
SLOCOG	2010	Links, Trips	12/19/2014
StanCOG	2010	Links, Trips	06/11/2015
SCRTPA	2010	Links, Trips	07/13/2015
TCAG	2010	Links†	06/11/2015
TMPO	2010	Links, Trips	04/02/2015

† Trips data from Caltrans Statewide Travel Demand model were used

3.4.3. Spatial Adjustment: The spatial allocation of county-wide EMFAC emissions is accomplished using gridded, hourly emission estimates from DTIM normalized by county. DTIM uses emission rates from EMFAC along with activity data, digitized roadway segments (links) and traffic analysis zone centroids to calculate gridded, hourly emissions for travel and trip ends. DTIM considers fewer vehicle categories than EMFAC outputs; therefore a mapping between EMFAC and DTIM vehicle categories is necessary. Categories of emissions after running DTIM are presented in Table 7. The categories are represented by the listed source classification codes (SCC) developed by ARB and depend on vehicle type, technology, and whether the vehicle is catalyst, non-catalyst, or diesel. Light- and medium-duty vehicles are separated from heavy-duty vehicles to allow for separate reporting and control strategy applications.

Table 7 DTIM Emission Categories

SCC for light and medium duty gas vehicles	SCC for heavy-duty gas vehicles	SCC for light-duty and medium-duty diesel vehicles	SCC for heavy-duty diesel vehicles	Description
202	302			Catalyst Start Exhaust
203	303			Catalyst Running Exhaust
204	304			Non-catalyst Start
205	305			Non-catalyst Running
206	306			Hot Soak
207	307			Diurnal Evaporatives
		808	408, 508	Diesel Exhaust
209	309			Running Evaporatives
210	310			Resting Evaporatives
211	311			Multi-Day Resting
212	312			Multi-Day Diurnal
213	313	813	413, 513, 613,	PM Tire Wear
214	314	814	414, 514, 614,	PM Brake Wear
215	315			Catalyst Buses
216	316			Non-catalyst Buses
		817	617, 717	Diesel Bus
218	318			Catalyst Idle
219	319			Non-catalyst Idle
		820	420, 520, 620,	Diesel Idle
221	321			PM Road Dust

DTIM and EMFAC2014 are both run using the 13 vehicle types shown in Table 8. In order to obtain better resolved spatiotemporal surrogates, the DTIM runs are split by light-duty (LDA, LDT1, LDT2, MDV, LHDT1, LHDT2, Urban Bus, MH, MCY) and heavy-duty (T6/T7 HHDT, SBUS, Other BUS) vehicle classes, and also by fuel type (gas, diesel). Each DTIM run outputs emissions for categories from 1-13; therefore, the mapping from Table 8 is used to preserve the spatial surrogates for each of the four DTIM runs. These codes depend on vehicle type, technology, and whether the vehicle is catalyst, non-catalyst, or diesel.

Table 8 Vehicle classification and type of adjustment

DTIM Category	Vehicle type	Type of adjustment
1	LDA	LD
2	LDT1	LD
3	LDT2	LD
4	MDV	LD
5	LHDT1	LM
6	LHDT2	LM
7	T6	LM
8	T7 HHDT	HHDT
9	Other Bus	LM
10	School Bus	Unadjusted on weekdays, zeroed on weekends
11	Urban Bus	LD
12	Motorhomes	LD
13	Motorcycles	LD

3.4.4. Temporal Adjustment (Day-of-Week adjustments to EMFAC daily totals): EMFAC2014 produces average day-of-week (DOW) estimates that represent Tuesday, Wednesday, and Thursday. In order to more accurately represent daily emissions, DOW adjustments are made to all emissions estimated on a Friday, Saturday, Sunday or Monday,. The DOW adjustment factors were developed using CalVAD data. The California Vehicle Activity Database (CalVAD), developed by UC Irvine for ARB, is a system that fuses available data sources to produce a “best estimate” of vehicle activity by class. The CalVAD data set includes actual daily measurements of VMT on

the road network for 43 of the 58 counties in California. For various reasons, it was determined that only 34 of these counties had useful data. In order to fill the missing 24 counties' data to cover all of California, a county which is nearby and similar in geography is selected for each of the missing counties. The CalVAD fractions were developed for three categories of vehicles: passenger cars (LD), light- and medium-duty trucks (LM), and heavy-heavy duty trucks (HHDT). Table 8 also shows the corresponding assignment to each vehicle type. Furthermore, the CalVAD fractions are scaled so that a typical workday (Tuesday, Wednesday, or Thursday) gets a scaling factor of 1.0. All other days of the week receive a scaling factor where their VMT is related back to the typical work day. This means there are a total of five weekday scaling factors. Lastly, the CalVAD data was used to create a typical holiday, because the traffic patterns for holidays are quite different than a typical week day. Thus, in the end, there are six daily fractions for each of the three vehicle classes, for all 58 counties. The DOW factors and vehicle type can be found in Appendix A: Day of week redistribution factors by vehicle type and county.

3.4.5. Temporal Adjustment (Hour-of-Day re-distribution of hourly travel network volumes): The travel networks provided by local transportation agencies and used with DTIM represent an hourly distribution for an average day. As for EMFAC, it is assumed that these average day-of-week hourly distributions represent hourly mid-week activities (i.e. for Tuesday, Wednesday, and Thursday). As such, they lack the temporal variations that are known to occur on other days of the week. To rectify this, the CalVAD data were used to develop hour-of-day profiles for Friday through Monday and a typical holiday. In a similar manner as the DOW factors, these hour-of-day profiles are used to re-allocate the hourly travel network distributions used in DTIM to Friday through Monday and a typical holiday. The hour-of-day profiles can be found in Appendix B: Hour of Day Profiles by vehicle type and county.

3.4.6. Summary of On-road Emissions Processing Steps: Eight general steps are used to spatially and temporally allocate EMFAC emissions by hour and grid cell:

1. Activity Data
   a. EMFAC is run in default mode for a single day to generate hourly activity data for each vehicle type and county: VMT, vehicle population, and number of vehicle trips. This is a single day's run, as EMFAC2014 yields the same hourly activity data for every day of the year.
   b. The activity data are used to generate various input files for ITN and DTIM. The general goal being to determine how much each activity belongs to each vehicle type through the day.

2. Road Network
   a. Pull a full copy of the California road network from the ITN database, using MPO inputs.
   b. Convert the ITN results to a form readable by DTIM.
   c. Apply travel network volumes by county hourly DOW fractions.

3. Meteorological Input Data
   a. Gridded, hourly temperature (T) and relative humidity (RH) are modeled using CALMET. Section 3.1 describes the development of these meteorological (met) data in more detail.
   b. Daily met files are prepared in formats readable by both EMFAC2014 and DTIM4.

4. EMFAC Emission Rates
   a. EMFAC is run in emissions rates mode (using monthly-average T and RH) to generate a look-up table of on-road mobile source emission rates by

speed, temperature, and relative humidity for each county. These results are created on a monthly-average basis to save processing time.

b. The emissions rates are pulled from the EMFAC database and reformatted in the DTIM-ready IRS file format.

5. EMFAC Emissions
   a. EMFAC is run in emissions mode (using days-specific T and RH) to provide county-wide on-road mobile source emission estimates by day and hour for EMFAC categories.
   b. These results are saved for later use.

6. DTIM
   a. DTIM is run for one week (five representative days since Tuesday, Wednesday and Thursday are treated as a single day) in the summer and in the winter.
   b. Convert the DTIM output results into MEDS format for further processing.

More details on the DTIM and scaling processing can be found in the Appendix C.

7. Scale EMFAC Emissions Using DTIM
   a. For each day of EMFAC emissions, the closest day-of-week matching DTIM file is chosen for scaling.
   b. The daily, county-wide EMFAC emissions are distributed spatially and temporally using the DTIM MEDS files as surrogates, as shown in the equation:

$$E_{P,ij,hr,cat} = \frac{EF_{P,cat} \times DTIM_{P,ij,hr,cat}}{DTIM_{P,daily,cat,cnty}}$$

where:

E = grid cell emissions
EF = EMFAC emissions
DTIM = DTIM emissions

p = pollutant
i,j = grid cell
hr = hourly emissions
cat = emission category
daily = daily emissions
cnty = county

c. Finally, the Caltrans day-of-week factors are applied to the gridded, hourly emissions to better match traffic patterns.

8. Final Formatting
   a. The final step of on-road emissions processing is to convert the gridded, hourly emissions data to a NetCDF file usable by the CMAQ photochemical model.

3.5. Estimation of Gridded Biogenic Emissions

Biogenic emissions were estimated using the Model of Emissions of Gases and Aerosols from Nature (MEGAN) version 2.04 (Guenther, et al., 2006). MEGAN estimates biogenic emissions as a function of normalized emission rates (i.e. emission rates at standard conditions), which are adjusted to reflect variations in temperature, light, leaf area index (LAI), and leaf age (estimated from changes in LAI). The default MEGAN input databases for emission factors (EFs), plant functional types (PFTs), and LAI are not used in the application of MEGAN in California. Instead, California-specific emission factor and PFT databases were translated from those used in the Biogenic Emission Inventory GIS (BEIGIS) system (Scott & Benjamin, 2003) to improve emission estimates and to maintain consistency with previous California biogenic emission inventories. LAI data were derived from the MODIS 8-day LAI satellite product. Hourly surface temperatures were from observations gridded with the CALMET meteorological model and insolation data was provided by the WRF meteorological fields, as discussed in section 3.1. Emissions of isoprene, monoterpenes, and methylbutenol were estimated from California-specific gridded emission factor data, while emissions of sesquiterpenes, methanol, and other volatile organic compounds were estimated from California-specific PFT data and PFT-derived emission rates.

MEGAN emissions estimates for California were evaluated during the California Airborne BVOC Emission Research in Natural Ecosystems Transects (CABERNET) field campaign in 2011 (Karl, et al., 2013), (Misztal, et al., 2014) and were shown to agree to within +/-20% of the measured fluxes (Misztal, et al., 2015), which is well within the stated model uncertainty of 50%.

3.6. Estimation of Other Day-Specific Sources

Day-specific data were used for preparing base case inventories when data were available. ARB and district staffs were able to gather hourly/daily emission information for 1) wildfires and prescribed burns 2) paved and unpaved road dust 3) agricultural burns in six districts and 4) a refinery fire. Additionally, emissions in future years were removed for facilities that have closed beyond the baseline year.

For the reference and future year inventories, which are used to calculate Relative Response Factors (RRF), day-specific emissions for wildfires, prescribed burns, wildland fires use (WFU) and the Chevron fire are left out of the inventory. All other day-specific data are included in both reference and future year modeling inventories.

3.6.1. Wildfires and Prescribed Burns: Day-specific, base case estimates of emissions from wildfires and prescribed fires were developed in a two part process. The first part consisted of estimating micro-scale, fire-specific emissions (i.e. at the fire polygon scale, which can be at a smaller spatial scale than the grid cells used in air quality modeling). The second part consisted of several steps of post-processing fire polygon emission estimates into gridded, hourly emission estimates that were formatted for use in air quality modeling.

Fire event-specific emissions were estimated using a combination of geospatial databases and a federal wildland fire emission model, first described in (Clinton, et al., 2006). A series of pre-processing steps were performed using a Geographic Information System (GIS) to develop fuel

loading and fuel moisture inputs to the First Order Fire Effects (FOFEM) fire emission model (Lutes, et al., 2012). Polygons from a statewide interagency fire perimeters geodatabase (fire12_1.gdb, downloaded June 4, 2013) maintained by the Fire and Resource Assessment Program (FRAP) of the California Department of Forestry and Fire Protection (CALFIRE) provided georeferenced information on the location, size (area), spatial shape, and timing of wildfires and prescribed burns. (Under interagency Memorandums of Understanding, federal, state, and local agencies report California wildfire and prescribed burning activity data to FRAP.) Using GIS software, fire polygons were overlaid upon a vegetation fuels raster dataset called the Fuel Characteristic Classification System (FCCS) (Ottmar, et al., 2007). The FCCS maps vegetation fuels at a 30 meter spatial resolution, and is maintained and distributed by LANDFIRE.GOV, a state and federal consortium of wildland fire and natural resource management agencies. With spatial overlay of fire polygons upon the FCCS raster, fuel model codes were retrieved and component areas within each fire footprint tabulated. For each fuel code, loadings (tons/acre) for fuel categories were retrieved from a FOFEM look-up table. Fuel categories included dead woody fuel size classes, overstory live tree crown, understory trees, shrubs, herbaceous vegetation, litter and duff. Fuel moisture values for each fire were estimated by overlaying fire polygons on year- and month-specific 1 km spatial resolution fuel moisture raster files generated from the national Wildland Fire Assessment System (WFAS.net) and retrieving moisture values from fire polygon centroids. Fire event-specific fuel loads and fuel moisture values were compiled and formatted to a batch input file and run through FOFEM.

A series of post-processing steps were performed on the FOFEM batch output to include emission estimates (pounds/acre) for three supplemental pollutant species (NH_3, TNMHC and N_2O) in addition to the seven species native to FOFEM (CO, CO_2, $PM_{2.5}$, PM_{10}, CH_4, NO_x, SO_2), and to calculate total emissions (tons) by pollutant species for each fire. Emission estimates

for NH_3, TNMHC and N_2O were based on mass ratios to emitted CO and CO_2 (Gong, et al., 2003)

Fire polygon emissions were apportioned to CMAQ model grid cells using area fractions, developed using GIS software, by intersecting fire polygons to the grid domain.

Another set of post-processing steps were applied to allocate fire polygon emissions by date and hour of the day. Fire polygon emissions were allocated evenly between fire start and end dates, taken from the fire perimeters geodatabase. Daily emissions were then allocated to hour of day and to the model grid cells and distributed vertically using method developed by the Western Regional Air Partnership (WRAP), which specifies a pre-defined diurnal temporal profile, plume bottom and plume top for each fire. (WRAP, 2005)

3.6.2. Paved Road Dust: Statewide emissions from paved road dust were adjusted for each day of the baseline year. The adjustment reduced emissions by 25% from paved road dust on days when precipitation occurred. Paved road dust emissions are calculated using the AP-42 method described in (U.S. EPA, 2011).

This methodology includes equations that adjust emissions based on average precipitation in a month; these precipitation-adjusted emissions were placed in the CEIDARS and CEPAM databases. Since daily precipitation totals are readily available, ARB and district staff agreed that paved road dust emissions should be estimated for each day rather than by month as described in the AP-42 methodology. The emissions from CEIDARS were replaced with day-specific data. A description of the steps used to calculate day-specific emissions is as follows:

Daily uncontrolled emissions for each county/air basin are estimated from the AP-42 methodology [Equation (1) on page 13.2.1-4]. No monthly precipitation adjustments are incorporated into the equation to estimate emissions.

To adjust for precipitation, daily precipitation data for 2012 were provided by an in-house database maintained by ARB staff that stores collected meteorology data from outside sources. The specific data sources for these data include: Remote Automated Weather Stations (RAWS), Atmospheric Infrared Sounder (AIRS), California Irrigation Management Information System (CIMIS) networks, SFBMET, and Federal Aviation Administration (FAA). FAA data provides precipitation data collected from airports in California.

If the precipitation is greater than or equal to 0.01 inches (measured anywhere in a county or county/air basin piece on a particular day), then the uncontrolled emissions are reduced by 25% for that day only. This reduction of emissions follows the recommendation in AP-42 as referenced above.

Replace the annual average emissions with day-specific emissions for every day in the corresponding emission inventory dataset.

3.6.3. Unpaved Road Dust: Statewide emissions from unpaved road dust were adjusted for rainfall suppression for each day of the year. The adjustment reduced county-wide emissions by 100% (total suppression) from unpaved road dust on days when precipitation greater than 0.01” occurred in a county/air basin. Dust emissions from unpaved roads were calculated using an emission factor derived from tests conducted by the University of California, Davis, and the Desert Research Institute (DRI). Unpaved road vehicle miles traveled (VMT) were based on county-specific road mileage estimates.

Emissions were assumed to be suppressed for each day with rainfall of 0.01 inch or greater using equation (2) from the method described in (U.S. EPA, 2011). The equation adjusts emissions based on annual precipitation; these precipitation-adjusted emissions were placed in the CEIDARS database. Similar to paved road dust, ARB and district staff agreed that unpaved road dust emissions should be estimated for each day. The emissions from CEIDARS were replaced with day-specific data for the appropriate years. Following is a description of the steps that were taken to calculate day-specific emissions.

a) Start with the daily uncontrolled emissions for each county/air basin as estimated from ARB's methodology. In other words, no precipitation adjustments have been incorporated in the emission estimates.
b) Use the same daily precipitation data as for paved road dust (see above)
c) If the precipitation is greater than or equal to 0.01 inches measured anywhere in a county or county/air basin portion on a particular day, then the emissions are removed for that day only.
d) Replace the annual average emissions with day-specific emissions for every day.

3.6.4. Agricultural Burning: Agricultural burning day-specific emission estimations were incorporated into the inventory for the following areas:

San Joaquin Valley

The San Joaquin Valley Air Pollution Control District estimated emissions for each day of 2012 when agricultural burning occurred. Emissions were estimated for the burning of prunings, field crops, weed abatement and other solid fuels. Information needed to estimate emissions came from the district's Smoke Management System, which stores information on burn permits issued by the district. In order to obtain a daily burn authorization, the person requesting the burn provides information to the district, including the acres and type of material to be burned, the specific location of the burn and the

date of the burn. Acres are converted to tons of fuel burned using a fuel loading factor based on the specific crop to be burned. Emissions are calculated by multiplying the tons of fuel burned by a crop-specific emission factor. More information can be found in (ARB-Miscellaneous Methodologies, 2013).

To determine the location of the burn, district staff created spatial allocation factors for each 4 kilometer grid cell used in modeling. These factors were developed for “burn zones” in the San Joaquin Valley based on the agricultural land coverage. Daily emissions in each “agricultural burn zone” were then distributed across the zone/grid cell combinations using the spatial allocation factors. Emissions were summarized by grid cell and day.

Burning was assumed to occur over three hours from 10:00 a.m. to 1:00 p.m., except for two categories. Orchard removals were assumed to burn over eight hours from 10:00 a.m. to 6:00 p.m. Vineyard removals were assumed to burn over five hours from 10:00 a.m. to 3:00 p.m.

Sacramento

Sacramento Metropolitan Air Quality Management District provided information needed to calculate emissions in Sacramento County from agricultural burning for each day of 2012 when agricultural burning occurred. Using the same methodology as San Joaquin Valley, emissions were estimated for the burning of prunings, field crops, weed abatement and other solid fuels. Information needed to estimate emissions came from burn permits issued by the district. In order to obtain a burn permit, the person requesting the burn provides information to the district, including the acres to be burned, the specific location of the burn and the date of the burn. Acres are converted to tons of fuel burned using a fuel loading factor based on the specific crop to be burned. Emissions are calculated by multiplying the tons of fuel burned by a crop-specific emission factor. The location of the burn was converted to

latitude/longitude based on the address or description of location provided by the burn permit holder, then ultimately to grid cell. Burning was assumed to occur over eight hours from 10:00 a.m. to 6:00 p.m.

Yolo-Solano

Yolo-Solano Air Quality Management District provided information needed to calculate emissions from agricultural burning for each day of 2012 when agricultural burning occurred. Data were provided for their region: all of Yolo County and the Sacramento Valley portion of Solano County. Using the same methodology as San Joaquin Valley, emissions were estimated for the burning of prunings, field crops, weed abatement and range improvement. The location of the burn was converted to latitude/longitude based on the address or description of location provided by the burn permit holder, then ultimately to grid cell. Burning was assumed to occur over five hours from 11:00 a.m. to 4:00 p.m.

Feather River

Feather River Air Quality Management District provided information needed to calculate emissions from agricultural and prescribed burning for each day of 2012 when agricultural burning occurred. Data were provided for Sutter and Yuba Counties. Using the same methodology as San Joaquin Valley, emissions were estimated for the burning of prunings, field crops, weed abatement, other solid waste and prescribed burns not included in the wildfires / prescribed burns discussed on page 38. The location of each burn was converted to latitude/longitude based on the address or description of location provided by the burn permit holder, then ultimately to grid cell. Orchard prunings were assumed to occur from 9:00 a.m. to 4:00 p.m. The burning of field crops, rice, weeds and ditch banks were assumed to occur from 10:00 a.m. to 5:00 p.m. from March 1 through August 31 and from 10:00

a.m. to 4:00 p.m. from September 1 through February 29. Prescribed burns over 10 acres were assumed to occur from 9:00 a.m. to 12:00 a.m. while prescribed burns less than 10 acres were assumed to occur from 9:00 a.m. to 6:00 p.m.

Ventura

Ventura County Air Pollution Control District provided emissions in Ventura County from agricultural burning for each day of 2012 when agricultural burning occurred. Using the same methodology as San Joaquin Valley, emissions were estimated for the burning of prunings, field crops, weed abatement, range improvement and prescribed burns not included in the wildfires / prescribed burns discussed on page 38. Information needed to estimate emissions came from burn permits issued by the district. In order to obtain a burn permit, the person requesting the burn provides information to the district, including the acres to be burned, the specific location of the burn and the date of the burn. Acres are converted to tons of fuel burned using a fuel loading factor based on the specific crop to be burned. Emissions are calculated by multiplying the tons of fuel burned by a crop-specific emission factor. The location of the burn was converted to latitude/longitude based on the address or description of location provided by the burn permit holder, then ultimately to grid cell. Burning was assumed to occur over three hours from 9:00 a.m. to 12:00 p.m.

3.6.5. Refinery Fire: On August 6, 2012, the Chevron U.S.A Inc. refinery in Richmond experienced a catastrophic pipe rupture. The flammable, high temperature gas oil flowing through the pipe ignited shortly after the release and burned for approximately 5 hours. Flaring also occurred for four days from August 6 through August 10. Bay Area Air Quality Management District (BAAQMD) staff estimated NOx and SOx emissions from both the fire and flaring; TOG emissions from flaring were also estimated. The emissions were spread evenly across the hours they occurred.

Additionally, stack data were estimated by the BAAQMD. Based on physical observation of the plume height, the first two hours of the fire were estimated to have the highest gas flow rate used in the calculation of plume rise. The gas flow rate was reduced for the latter three hours of the fire.

3.6.6. Closed Facilities: Emissions in future years were removed for facilities that have closed beyond the baseline year. In other words, the emissions were removed from future year inventories for a facility that was included in the 2012 inventory but stopped operating after 2012. Local air district staffs provided the list of facilities.

4. Quality Assurance of Modeling Inventories

As mentioned in section 1.3, base case modeling is intended to demonstrate confidence in the modeling system. Quality assurance of the data is fundamental in order to detect any possible outliers and potential problems with emission estimates. The most important quality assurance checks of the modeling emissions inventory are summarized in the following sections.

4.1. Area and Point Sources

Before utilizing SMOKE to process the annual emissions totals into temporally, chemically, and spatially-resolved emissions inventories for photochemical modeling, all SMOKE inputs are subject to extensive quality assurance procedures performed by ARB staff. Annual and forecasted emissions are carefully reviewed before input into SMOKE. ARB and district staff review data used to calculate emissions along with other associated data, such as the location of facilities and assignment of SCC to each process. Growth and control information are reviewed and updated as needed.

The next check is to compare annual average emissions from CEPAM with planning inventory totals to ensure data integrity. The planning and modeling inventories start with the same annual average emissions. The planning inventory is developed for an average summer day and an average winter day, whereas the modeling inventory is

developed by month. Both inventory types use the same temporal data described in section 2.2. The summer planning inventory uses the monthly throughputs from May through October. Similarly, the winter planning inventory uses the monthly throughputs from November through April. The modeling inventory produces emissions for a weekday, Saturday and Sunday for each month.

Annual emissions totals are plotted using the same gridding inputs as used in SMOKE in order to visually inspect and analyze the spatial allocation of emissions independent of temporal allocation and chemical speciation. Spatial plots by source category like the one shown in Figure 3 are carefully screened for proper spatial distribution of emissions.

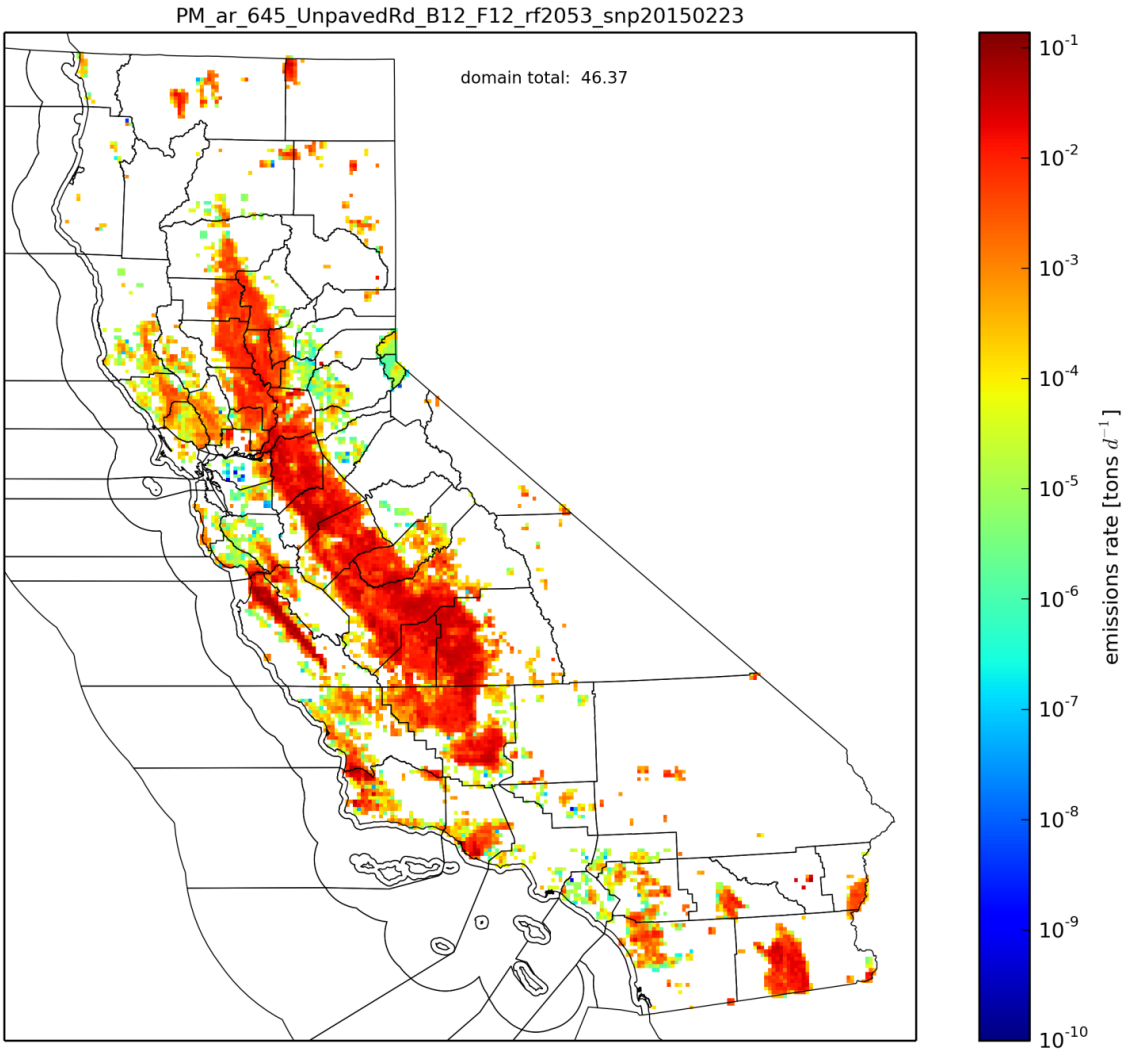


Figure 3 Example of a spatial plot by source category

Before air quality model-ready emissions files are generated by SMOKE, the run configurations and parameters set within the SMOKE environment are checked for consistency for both the reference and future years.

To aid in the quality assurance process, SMOKE is configured to generate inventory reports of temporally, chemically, and spatially-resolved emissions inventories. ARB staff utilize the SMOKE reports by checking emissions totals by source category and region, creating and analyzing time series plots, and comparing aggregated emissions totals with the pre-SMOKE emissions totals obtained from CEPAM. A screenshot capture of a portion of such report can be seen in Figure 4.

```
# Processed as Area sources
# Base inventory year      2012
# No gridding matrix applied
# No speciation matrix applied
# Temporal factors applied for episode from
#      Wednesday Aug. 8, 2012   at 080000 to
#      Thursday Aug. 9, 2012   at 080000
# Annual total data basis in report
#          ,          ,                    , [tons/day]    , [tons/day]    , [tons/day]    , [tons/day]    , [tons/day]    , [tons/day]
#Date      , Region      , SCC                , CO           , NOX          , TOG          , NH3          , SOX          , PM
 08/09/2012, 0LC006017LAK, 00000005204212000010,    0.19098E-01,   0.46288E-01,   0.44956E-02,   0.00000E+00,   0.16055E-03,   0.16051E-02
 08/09/2012, 0LC006017LAK, 00000005204212000011,    0.94908E-02,   0.21052E-01,   0.30532E-02,   0.00000E+00,   0.00000E+00,   0.11252E-02
 08/09/2012, 0LC006017LAK, 00000011011003000000,    0.00000E+00,   0.00000E+00,   0.00000E+00,   0.63987E-03,   0.00000E+00,   0.00000E+00
 08/09/2012, 0LC006017LAK, 00000012012202420000,    0.00000E+00,   0.00000E+00,   0.00000E+00,   0.29915E-01,   0.00000E+00,   0.00000E+00
 08/09/2012, 0LC006017LAK, 00000019917002400000,    0.00000E+00,   0.00000E+00,   0.00000E+00,   0.13904E-01,   0.00000E+00,   0.00000E+00
 08/09/2012, 0LC006017LAK, 00000021020033000000,    0.00000E+00,   0.00000E+00,   0.13736E-01,   0.00000E+00,   0.00000E+00,   0.00000E+00
 08/09/2012, 0LC006017LAK, 00000021020081500000,    0.00000E+00,   0.00000E+00,   0.31439E-02,   0.00000E+00,   0.00000E+00,   0.00000E+00
 08/09/2012, 0LC006017LAK, 00000022020405000000,    0.00000E+00,   0.00000E+00,   0.31245E-01,   0.00000E+00,   0.00000E+00,   0.00000E+00
 08/09/2012, 0LC006017LAK, 00000022020430220000,    0.00000E+00,   0.00000E+00,   0.72951E-03,   0.00000E+00,   0.00000E+00,   0.00000E+00
 08/09/2012, 0LC006017LAK, 00000022020430830000,    0.00000E+00,   0.00000E+00,   0.36475E-03,   0.00000E+00,   0.00000E+00,   0.00000E+00
 08/09/2012, 0LC006017LAK, 00000022020432040000,    0.00000E+00,   0.00000E+00,   0.36475E-03,   0.00000E+00,   0.00000E+00,   0.00000E+00
```

Figure 4 Screen capture of a SMOKE-generated QA report

4.1.1. Area and Point Sources Temporal Profiles: Checks for missing or invalid temporal assignments are conducted to ensure accurate temporal allocation of emissions. Special attention is paid to checking monthly throughputs and appropriate monthly temporal distribution of emissions for each source category. In addition, checks for time-invariant temporal assignments are done for certain source categories and suitable alternate temporal assignments are determined and applied. For the agricultural source sector (e.g. agricultural pesticides/fertilizers, farming operations, fugitive windblown dust, managed burning and disposal, and farm equipment), replacement temporal assignments are extracted from the

Agricultural Emissions Temporal and Spatial Allocation Tool (AgTool). (Anderson, et al., 2012). The AgTool is a database management system capable of temporally and spatially allocating emissions from the agricultural source sector. It was developed by Sierra Research, Inc. and its subcontractor Alpine Geophysics, LLC along with collaboration from ARB and the San Joaquin Valley Air Pollution Control District (SJVAPCD). Temporal allocation data outputs from the AgTool, were compiled using input data provided by the UC Cooperative Extension, U.S. Department of Agriculture (USDA), and the CA Department of Pesticide Regulation (DPR).

Further improvements to temporal profiles used in the allocation of area source emissions are performed using suitable alternate temporal assignments determined by ARB staff. Select sources from manufacturing and industrial, degreasing, petroleum marketing, mineral processes, consumer products, residential fuel combustion, farming operations, aircraft, and commercial harbor craft sectors are among the source categories included in the application of adjustments to temporal allocation.

4.2. On-road Emissions

There are several processes to conduct quality assurance of the on-road mobile source modeling inventory at various stages of the inventory processing. The specific steps taken are described below:

1. Generate an ITN spatial plot to check if there were any missing network activities.
2. Generate a time series plot for each county to check the diurnal pattern of network activities.
3. Generate time series plots for the DTIM output files by county and by SCC to check the diurnal pattern.

4. Generate time series plots for the on-road mobile source files after scaling to EMFAC 2014 emissions (MEDS files) by county and SCC to check the diurnal pattern.
5. Compare the statewide daily total emissions for the MEDS files and the EMFAC 2014 emissions files to ensure that the emissions are the same.
6. Generate the spatial plot for the MEDS file to check if there were any missing emissions.
7. Generate time series and spatial plots again to check the final MEDS files.

4.3. Day-specific Sources

4.3.1. Wildfires and Prescribed Burns: To check for potential wildfire activity data gaps in the CALFIRE interagency fire perimeters geodatabase, staff examined geospatial fire activity data reported in the national Geospatial Multi-Agency Coordination (www.geomac.gov) wildland fire geodatabase. California wildfires reported to GeoMAC were accounted for in the CALFIRE geodatabase.

Prescribed burns are performed by land and fire management agencies primarily to reduce wildfire risk to local communities associated with high loads of vegetation fuels in adjacent wildlands. Vegetation is burned during winter, in-situ or in piles following mechanical treatment. Public land management agencies also perform prescribed burning to restore the natural role of fire in selected ecosystems. To check for potential prescribed burn activity data gaps in the CALFIRE interagency fire perimeters geodatabase, staff queried data for calendar year 2012 reported to ARB's Prescribed Fire Information Reporting System (PFIRS) (https://ssl.arb.ca.gov/pfirs/index.php). Staff discovered that CALFIRE data accounted for 38 prescribed burn projects, while PFIRS reported 453 projects. Only one burn project was accounted for in both datasets. Burn project area for CALFIRE data totaled approximately 3,780 acres, while burned acres reported to PFIRS totaled

9,097 acres. Burn projects reported to PFIRS were located in the Sierra Nevada Mountains and northern Coast Range.

Records for 651 prescribed wildland burn events reported for 2012 were downloaded from PFIRS and imported to a geodatabase. Data fields included event ("Unit") name, burned area, latitude/longitude, start and end dates. A series of geoprocessing steps were used to map and overlay prescribed burns as points on the statewide vegetation fuels (FCCS) and moisture raster datasets, to retrieve associated fuel loadings and moisture values for use as input to FOFEM. Prescribed burn points were also overlayed on the statewide 4-km modeling grid to assign grid cell IDs to each burn. Emission estimates for each prescribed burn event were generated by FOFEM and summarized in an Access database.

4.3.2. Paved Road Dust: The average daily emissions inventory was adjusted with day-specific precipitation data to produce a day-specific emissions inventory. Total emissions by county before the adjustment were compared to CEPAM for a reasonable match. After the adjustment, the day-specific total emission by county was compared to CEPAM using time series plots. These plots were verified to confirm that there were only two values for every county/air basin/district: high values and low values. The high values are emissions that were not affected by rain adjustment, while the low values are emissions that were affected by the 25% rain adjustment reduction. Additionally the day-specific total was also compared to other inventory years to verify the expected growth trend.

4.3.3. Unpaved Road Dust: Unpaved road dust followed the same quality assurance process as paved road dust.

4.3.4. Agricultural Burning: Checks were done to verify the quality of the agricultural burn data. The day-specific emissions from agricultural burning

were compared to the emissions from CEPAM for each county to check for reasonableness. Time series plots were reviewed for each county to see that days when burning occurred matched the days provided by the local air district. For each county, a few individual fires were calculated by hand starting from the raw data through all the steps to the final MEDS files to make sure the calculations were done correctly. Spatial plots were made to double check the locations of each burn.

4.3.5. Chevron Refinery Fire: The calculations in the MEDS files were verified by hand to make sure the emissions and stack data matched what was provided by the BAAQMD.

4.4. Additional QA

In addition to the QA described above, comparisons are made between annual average inventories from CEPAM and modeling inventories. The modeling inventory shows emissions by month and subsequently calculates the annual average for comparison with CEPAM emissions. Annual average inventories and modeling inventories can be different, but differences should be well understood. For example, modeling inventories are adjusted to reflect different days of the week for on-road motor vehicles as detailed in section 3.4; since weekend travel is generally less than weekday travel, modeling inventory emissions are usually lower when compared to annual average inventories from CEPAM. Figure 5 provides a screen capture of a report that summarizes different emission categories for San Luis Obispo County. Please note that this table is only an example since emissions have been updated from what is displayed here.

County:*40* Spec:*NOx*

EIC	Description	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual	CEPAM	Difference
10	electric utilities	0.12	0.11	0.1	0.06	0.09	0.13	0.13	0.16	0.14	0.16	0.14	0.13	0.12	0.12	0.00
20	cogeneration	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.00
30	oil and gas production (combustion)	0.13	0.13	0.13	0.13	0.13	0.13	0.13	0.13	0.13	0.13	0.13	0.13	0.13	0.13	0.00
40	petroleum refining (combustion)	0.3	0.3	0.26	0.3	0.33	0.33	0.33	0.33	0.33	0.33	0.33	0.26	0.31	0.31	0.00
50	manufacturing and industrial	0.06	0.06	0.06	0.06	0.07	0.06	0.07	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.00
52	food and agricultural processing	0.19	0.19	0.19	0.34	0.34	0.34	0.38	0.38	0.38	0.18	0.18	0.18	0.27	0.27	0.00
60	service and commercial	0.91	0.92	0.92	0.92	0.92	0.9	0.9	0.91	0.91	0.91	0.92	0.91	0.91	0.91	0.00
99	other (fuel combustion)	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.00
110	sewage treatment	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00
120	landfills	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00
130	incinerators	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00
140	soil remediation	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00
199	other (waste disposal)	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00
210	laundering	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00
220	degreasing	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00
230	coatings and related process solvents	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00
240	printing	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00
250	adhesives and sealants	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00
299	other (cleaning and surface coatings)	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00
310	oil and gas production	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00
320	petroleum refining	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.00
330	petroleum marketing	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00
399	other (petroleum production and marketing)	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00
410	chemical	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00
420	food and agriculture	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00
430	mineral processes	0.03	0.03	0.03	0.03	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.03	0.04	0.04	0.00
440	metal processes	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00
450	wood and paper	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00
460	glass and related products	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00
470	electronics	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00
499	other (industrial processes)	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00
510	consumer products	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00
520	architectural coatings and related process sol	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00
530	pesticides/fertilizers	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00
540	asphalt paving / roofing	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00
610	residential fuel combustion	0.73	0.73	0.68	0.65	0.57	0.57	0.57	0.57	0.57	0.65	0.7	0.73	0.64	0.64	0.00
620	farming operations	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00
630	construction and demolition	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00
640	paved road dust	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00
645	unpaved road dust	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00
650	fugitive windblown dust	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00
660	fires	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00
670	managed burning and disposal	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.00
690	cooking	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00
699	other (miscellaneous processes)	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00
700	on-road vehicles	9.34	9.32	9.36	9.17	9.06	8.81	8.69	8.77	8.63	8.79	9.3	9.23	9.04	9.60	0.56
810	aircraft	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.00
820	trains	0.19	0.19	0.19	0.19	0.19	0.19	0.19	0.19	0.19	0.19	0.19	0.19	0.19	0.93	0.74
830	ships and commercial boats	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00
833	ocean going vessels	11.23	11.23	11.23	11.23	11.23	11.23	11.23	11.23	11.23	11.23	11.23	11.23	11.23	11.52	0.29
835	commercial harbor craft	1.12	1.12	1.12	1.12	1.12	1.12	1.12	1.12	1.12	1.12	1.12	1.12	1.12	0.83	-0.29
840	recreational boats	0.05	0.05	0.17	0.18	0.16	0.47	0.46	0.43	0.12	0.11	0.11	0.06	0.2	0.20	0.00
850	off-road recreational vehicles	0.03	0.03	0.03	0.03	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.03	0.04	0.04	0.00
860	off-road equipment	1.08	1.24	1.21	1.24	1.25	1.28	1.25	1.25	1.28	1.21	1.19	1.12	1.21	1.21	0.00
870	farm equipment	1.08	1.22	1.72	1.77	2.21	2.21	2.16	2.21	2.17	1.52	1.14	1.06	1.71	1.71	0.00
890	fuel storage and handling	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00
920	geogenic sources	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00
***	Total	26.78	27.05	27.59	27.61	27.93	28.05	27.88	28.01	27.55	26.87	27.01	26.67	27.42	28.73	1.31

Notes:
CEPAM refers to annual average emissions from 2016 SIP Baseline Emission Inventory Tool with external adjustments: http://outapp.arb.ca.gov/cefs/2016oz
Monthly gridded emissions comes from GeoVAST mo-yr/avg tabular summary - gid 319

On-road vehicles: The modeling inventory adjusts on-road by day of week as well as day-specific temperatures and relative humidity - Fridays are higher wit
time series plots shows weekdays are ~9-10 tpd
Trains: The modeling inventory reflects the revised locomotive emissions; the planning inventory reflects the previous emission estimates
OGV model produces gridded OGV emissions, which can vary from planning inventory (these emissions include OC1 and OC2 offshore air basins)
CHC The modeling inventory reflects the revised commercial harbor craft emissions; the planning inventory reflects the previous emission estimates

Figure 5 Screenshot of comparison of inventories report

Staff also review how modeling emissions vary over a year. Figure 6 provides an example of a modeling inventory time series plot for San Luis Obispo County for area-wide sources, on-road sources and off-road sources. Again, this figure is only an example.

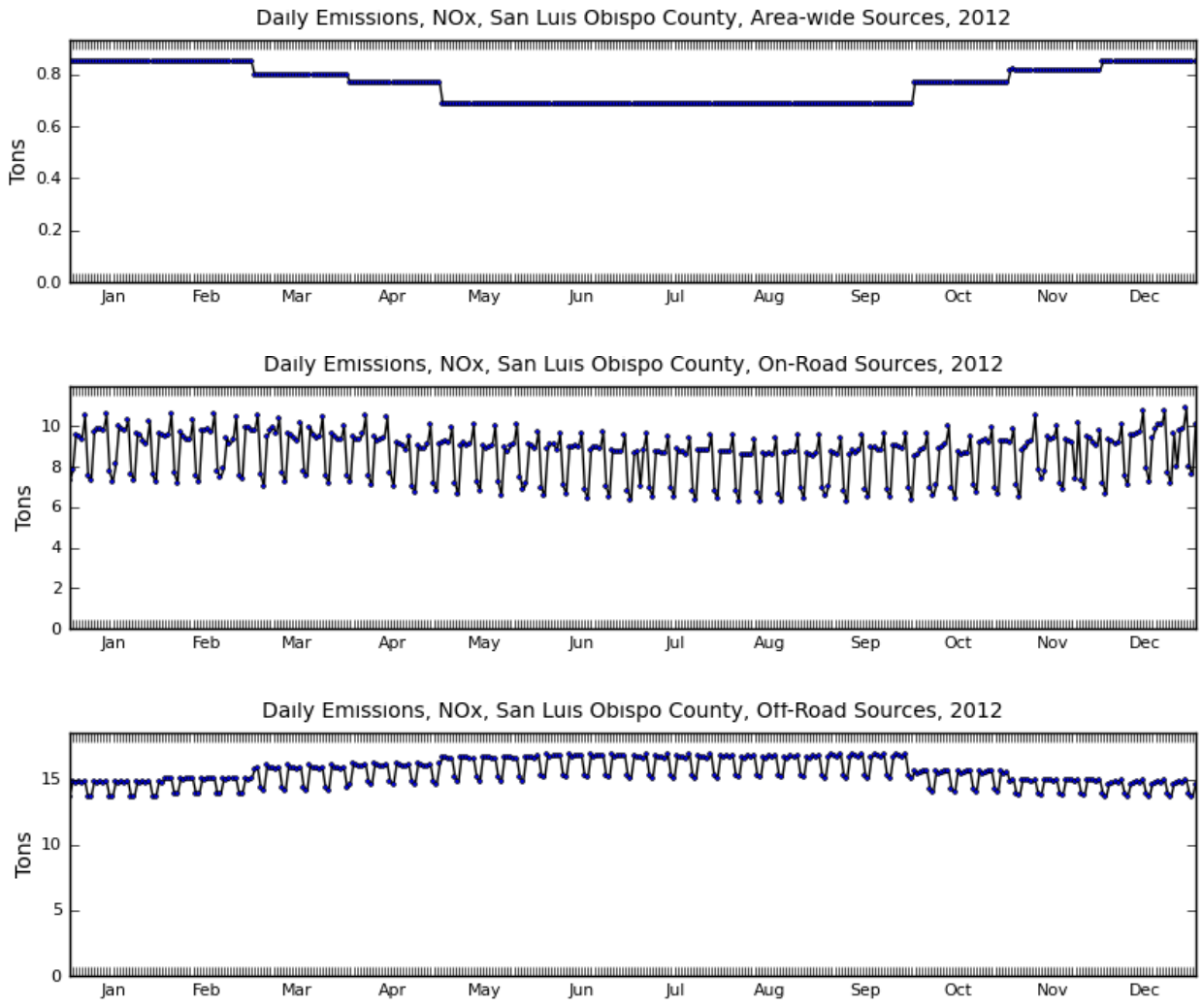


Figure 6 Daily variation of NOx emissions for mobile sources for San Luis Obispo

4.5. Model ready files QA

Prior to developing the modeling inventory emissions files used in the photochemical models, the same model-ready emissions files developed for the individual source categories (e.g. on-road, area, point, day-specific sources) are checked for quality assurance. Extensive quality assurance procedures are already performed by ARB staff on the intermediate emissions files (e.g. MEDS, SMOKE-generated reports), however, further checks are needed to ensure data integrity is preserved when the model-ready emissions files are generated from those intermediate emissions files.

Comparisons of the totals for both the intermediate and model-ready emissions files are made. Emissions totals are aggregated spatially, temporally, and chemically to single-layer, statewide, daily values by inventory pollutant. Spatial plots are also generated for both the intermediate and model-ready emissions files using the same graphical utilities and aggregated to the same spatial, temporal, and chemical resolution to allow equal comparison of emissions. Any discrepancies in the emissions totals are reconciled before proceeding with the development of the model-ready inventory emissions files.

Before combining the model-ready emissions files of the individual source category inventories into a single model-ready inventory, they are checked for completeness. Day-specific source inventories (when necessary) should have emissions for every day in the modeling period. Likewise, source inventories with emissions files that use averaged temporal allocation (e.g. day-of-week, weekday/weekend, monthly) should have model-ready emissions files to represent every day in the modeling period. In particular, it is important that during these checks source inventories with missing files are identified and resolved. Once all constituent source inventories are complete, they are used to develop the model-ready inventory used in photochemical modeling. When the modeling inventory files are generated, log files are also generated documenting what each daily model-ready emissions file is comprised of as an additional means of verifying that each daily model-ready inventory is complete.

Bibliography

Anderson, C., Carlson, T., Dulla, R. & Wilkinson, J., 2012. *AGTOOL Agricultural sector emissions allocation model – Data development. CCOS_11-2,* Sacramento, CA: Sierra Research Inc.

ARB-Miscellaneous Methodologies, 2013. *District Miscellaneous Processes Methodologies - Managed Burning and Disposal.* [Online]
Available at: http://www.arb.ca.gov/ei/areasrc/distmiscprocwstburndis.htm
[Accessed 10 7 2015].

ARB-MSEI, 2015. *Mobile Source Emissions Inventory -- Categories.* [Online]
Available at: http://www.arb.ca.gov/msei/categories.htm#emfac2014
[Accessed 10 07 2015].

ARB-PTSD, 2011. *Appendix D: Emissions estimation methodology for Ocean-going vessels.* [Online]
Available at: http://www.arb.ca.gov/regact/2011/ogv11/ogv11appd.pdf
[Accessed 10 7 2015].

Baek, B. a. S. C., 2015. *Final Summary Report: Development of SMOKE version 4.0. Under contract ITS:12-764,* Sacramento, CA: s.n.

Clinton, N., Gong, P. & Scott, K. 2., 2006. Quantification of pollutants emitted from very large wildland fires in Southern California. *Atmospheric Environment,* Volume 40, pp. 3686-3695.

Dun and Bradstreet, 2015. *Market insight database..* [Online]
Available at: http://www.dnb.com
[Accessed 15 June 2015].

FactFinder, U. C. B. /. A., 2011. *"B25040: House heating fue. 2013 ACS 5-year estimatesl".* [Online]
Available at: http://factfinder2.census.gov
[Accessed March 2015].

Funk, t., Stiefer, P. & Chinkin, L., 2001. *Development of gridded spatial allocation factors for the state of California.,* Sacramento: STI.

Gong, P., Clinton, N. & Pu, R. T. Y. a. S. J., 2003. *Extension and input refinement to the ARB wildland fire emissions estimation model. Final report, contract number 00-729,* Sacramento, CA.: Air Resources Board.

Guenther, A. et al., 2006. Estimates of global terrestrial isoprene emissions using MEGAN (Model of Emissions of Gases and Aerosols from Nature. *Chem. Phys.,* 6(11), pp. 3181-3210.

Homer, C. et al., 2015. Completion of the 2011 National Land Cover Database for the conterminous United States-Representing a decade of land cover change information. *Photogrammetric Engineering and Remote Sensing,* 81(5), pp. 345-354.

Karl, T. et al., 2013. Airborne flux measurements of BVOCs above Californian oak forests: experimental investigation of surface and entrainment fluxes, OH densities and Dahmkohler numbers. *J. Atmos. Sci.,* 70(10), pp. 3277-3287.

Lutes, D., Keane, R. & Reinhardt, E. 2., 2012. *FOFEM 6 User Guide. USDA Forest Service, Rocky Mountain Research Station, Missoula Fire Sciences Laboratory,* Missoula, MT 59808: s.n.

Mc. Rae, G. J., 1980. A simple procedure for calculating atmospheric water vapor concentration. *J. Air Pollution Control Association,* Volume 30, p. 384.

Misztal, P. et al., 2015. Evaluation of regional isoprene emission estimates in California based on direct airborne flux measurements. *Submitted to Atmos. Chem. Phys..*

Misztal, P. K. et al., 2014. Airborne flux measurements of biogenic volatile organic compounds over California. *Atmos. Chem. Phys.,* Volume 14, pp. 10631-10647.

Ottmar, R., Sandberg, D. & Riccardi, C. a. P. S., 2007. An overview of the Fuel Characteristic Classification System – Quantifying, classifying, and creating fuelbeds for resource planning.. *Canadian Journal of Forest Research,* 37(12), pp. 2383-2393.

Reid, S., Penfold, B. & Chinkin, L., 2006. *Emission inventory for the Central California Ozone Study (CCOS) review of spatial variations of area, non-road mobile, and point sources of emissions,* Petaluma, CA: STI.

Scott, K. & Benjamin, M., 2003. Development of a biogenic volatile organic compounds emission inventory for the SCOS97-NARSTO domain. *Atmos. Environ.,* Volume 37, Supplement 2, pp. 39-49.

Systems Applications Inc., 2001. *DTIM 4 User's Guide. Prepared for the California Department of Transportation,* Sacramento: Systems Applications, Inc..

U.S. EPA, 2011. AP 42, Compilation of Air Pollutant Emission Factors. In: *Volume 1. Chapter 13: Miscellaneous Sources. Section 13.2.1 (Paved Road).* Fifth ed. s.l.:U.S. EPA.

U.S. EPA, 2014. *Draft Modeling Guidance for Demonstrating Attainment of Air Quality Goals for Ozone, PM2.5, and RegionalHaze,* North Carollina: U.S. EPA.

WRAP, 2005. *2002 Fire Emission Inventory for the WRAP Region Phase I – Essential Documentation.* [Online]
Available at:
http://www.wrapair.org/forums/fejf/documents/emissions/WRAP_2002%20EI%20Report_20050107.pdf
[Accessed 28 4 2016].

Appendix A: Day of week redistribution factors by vehicle type and county

The factors shown in Table 9 represent the “day of week” factors for each county for a broad vehicle class: LD is Light Duty, LM is Light and Medium Duty Trucks, and HH is Heavy- Heavy Duty Trucks.

Table 9 Day of week adjustment by vehicle class and county

County	Day of Week	LD	LM	HH
Alameda	Sunday	0.797	0.496	0.324
Alameda	Monday	0.948	0.919	0.893
Alameda	Tues/Wed/Thurs	1	1	1
Alameda	Friday	1.051	1.014	0.959
Alameda	Saturday	0.929	0.618	0.369
Alameda	Holiday	0.797	0.866	0.829
Alpine	Sunday	1.201	0.821	0.415
Alpine	Monday	1.007	0.945	0.908
Alpine	Tues/Wed/Thurs	1	1	1
Alpine	Friday	1.247	1.082	1.007
Alpine	Saturday	1.219	0.803	0.442
Alpine	Holiday	1.118	0.935	0.832
Amador	Sunday	1.201	0.821	0.415
Amador	Monday	1.007	0.945	0.908
Amador	Tues/Wed/Thurs	1	1	1
Amador	Friday	1.247	1.082	1.007
Amador	Saturday	1.219	0.803	0.442
Amador	Holiday	1.118	0.935	0.832
Butte	Sunday	0.651	0.442	0.41
Butte	Monday	0.964	0.96	0.871
Butte	Tues/Wed/Thurs	1	1	1
Butte	Friday	1.008	1.015	0.962
Butte	Saturday	0.771	0.604	0.503
Butte	Holiday	0.73	0.657	0.606
Calaveras	Sunday	1.201	0.821	0.415
Calaveras	Monday	1.007	0.945	0.908
Calaveras	Tues/Wed/Thurs	1	1	1
Calaveras	Friday	1.247	1.082	1.007
Calaveras	Saturday	1.219	0.803	0.442
Calaveras	Holiday	1.118	0.935	0.832
Colusa	Sunday	0.651	0.442	0.41
Colusa	Monday	0.964	0.96	0.871
Colusa	Tues/Wed/Thurs	1	1	1
Colusa	Friday	1.008	1.015	0.962
Colusa	Saturday	0.771	0.604	0.503
Colusa	Holiday	0.73	0.657	0.606
Contra Costa	Sunday	0.779	0.519	0.376
Contra Costa	Monday	0.943	0.927	0.873
Contra Costa	Tues/Wed/Thurs	1	1	1
Contra Costa	Friday	1.048	1.023	0.982
Contra Costa	Saturday	0.924	0.665	0.471
Contra Costa	Holiday	0.788	0.827	0.799
Del Norte	Sunday	0.85	0.493	0.326
Del Norte	Monday	0.961	0.95	0.915
Del Norte	Tues/Wed/Thurs	1	1	1
Del Norte	Friday	1.031	1.004	0.932
Del Norte	Saturday	0.924	0.619	0.376
Del Norte	Holiday	0.77	0.619	0.527
El Dorado	Sunday	0.972	0.668	0.602
El Dorado	Monday	0.988	0.977	0.943
El Dorado	Tues/Wed/Thurs	1	1	1
El Dorado	Friday	1.178	1.101	0.963
El Dorado	Saturday	1.037	0.786	0.575
El Dorado	Holiday	0.971	0.933	0.921
Fresno	Sunday	0.851	0.443	0.396
Fresno	Monday	1.016	0.934	0.878
Fresno	Tues/Wed/Thurs	1	1	1
Fresno	Friday	1.155	1.026	0.927
Fresno	Saturday	0.946	0.563	0.478
Fresno	Holiday	0.799	0.774	0.784
Glenn	Sunday	0.651	0.442	0.41

County	Day of Week	LD	LM	HH
Glenn	Monday	0.964	0.96	0.871
Glenn	Tues/Wed/Thurs	1	1	1
Glenn	Friday	1.008	1.015	0.962
Glenn	Saturday	0.771	0.604	0.503
Glenn	Holiday	0.73	0.657	0.606
Humboldt	Sunday	0.85	0.493	0.326
Humboldt	Monday	0.961	0.95	0.915
Humboldt	Tues/Wed/Thurs	1	1	1
Humboldt	Friday	1.031	1.004	0.932
Humboldt	Saturday	0.924	0.619	0.376
Humboldt	Holiday	0.77	0.619	0.527
Imperial	Sunday	1.082	0.608	0.396
Imperial	Monday	1.004	0.931	0.948
Imperial	Tues/Wed/Thurs	1	1	1
Imperial	Friday	1.109	1.161	0.983
Imperial	Saturday	1.065	0.687	0.522
Imperial	Holiday	1.024	0.814	0.673
Inyo	Sunday	1.201	0.821	0.415
Inyo	Monday	1.007	0.945	0.908
Inyo	Tues/Wed/Thurs	1	1	1
Inyo	Friday	1.247	1.082	1.007
Inyo	Saturday	1.219	0.803	0.442
Inyo	Holiday	1.118	0.935	0.832
Kern	Sunday	1.114	0.63	0.416
Kern	Monday	1.061	0.942	0.849
Kern	Tues/Wed/Thurs	1	1	1
Kern	Friday	1.253	1.044	0.9
Kern	Saturday	1.1	0.734	0.535
Kern	Holiday	0.986	0.911	0.837
Kings	Sunday	0.663	0.358	0.355
Kings	Monday	0.961	0.909	0.89
Kings	Tues/Wed/Thurs	1	1	1
Kings	Friday	1.045	0.982	0.947
Kings	Saturday	0.807	0.52	0.454
Kings	Holiday	0.669	0.665	0.758
Lake	Sunday	0.85	0.493	0.326
Lake	Monday	0.961	0.95	0.915
Lake	Tues/Wed/Thurs	1	1	1
Lake	Friday	1.031	1.004	0.932
Lake	Saturday	0.924	0.619	0.376
Lake	Holiday	0.77	0.619	0.527
Lassen	Sunday	0.941	0.703	0.587
Lassen	Monday	0.993	0.942	0.798
Lassen	Tues/Wed/Thurs	1	1	1
Lassen	Friday	1.094	1.07	0.882
Lassen	Saturday	0.962	0.766	0.658
Lassen	Holiday	0.968	0.744	0.608
Los Angeles	Sunday	0.858	0.489	0.398
Los Angeles	Monday	0.973	0.936	0.878
Los Angeles	Tues/Wed/Thurs	1	1	1
Los Angeles	Friday	1.047	1.005	0.918
Los Angeles	Saturday	0.979	0.641	0.509
Los Angeles	Holiday	0.863	0.808	0.801
Madera	Sunday	1.017	0.478	0.4
Madera	Monday	1.024	0.942	0.902
Madera	Tues/Wed/Thurs	1	1	1
Madera	Friday	1.176	1.022	0.96
Madera	Saturday	1.105	0.602	0.476
Madera	Holiday	0.866	0.833	0.832
Marin	Sunday	0.779	0.519	0.376
Marin	Monday	0.943	0.927	0.873
Marin	Tues/Wed/Thurs	1	1	1
Marin	Friday	1.048	1.023	0.982
Marin	Saturday	0.924	0.665	0.471
Marin	Holiday	0.788	0.827	0.799
Mariposa	Sunday	1.201	0.821	0.415
Mariposa	Monday	1.007	0.945	0.908
Mariposa	Tues/Wed/Thurs	1	1	1
Mariposa	Friday	1.247	1.082	1.007
Mariposa	Saturday	1.219	0.803	0.442
Mariposa	Holiday	1.118	0.935	0.832
Mendocino	Sunday	0.85	0.493	0.326
Mendocino	Monday	0.961	0.95	0.915
Mendocino	Tues/Wed/Thurs	1	1	1

County	Day of Week	LD	LM	HH
Mendocino	Friday	1.031	1.004	0.932
Mendocino	Saturday	0.924	0.619	0.376
Mendocino	Holiday	0.77	0.619	0.527
Merced	Sunday	1.002	0.593	0.421
Merced	Monday	1.009	0.958	0.904
Merced	Tues/Wed/Thurs	1	1	1
Merced	Friday	1.185	1.103	0.97
Merced	Saturday	1.055	0.713	0.477
Merced	Holiday	0.977	0.897	0.797
Modoc	Sunday	1.133	0.801	0.638
Modoc	Monday	1.159	0.961	0.634
Modoc	Tues/Wed/Thurs	1	1	1
Modoc	Friday	1.202	1.109	0.767
Modoc	Saturday	1.041	0.819	0.745
Modoc	Holiday	1.087	0.992	0.704
Mono	Sunday	1.201	0.821	0.415
Mono	Monday	1.007	0.945	0.908
Mono	Tues/Wed/Thurs	1	1	1
Mono	Friday	1.247	1.082	1.007
Mono	Saturday	1.219	0.803	0.442
Mono	Holiday	1.118	0.935	0.832
Monterey	Sunday	1.2	0.603	0.342
Monterey	Monday	1.106	0.988	0.876
Monterey	Tues/Wed/Thurs	1	1	1
Monterey	Friday	1.116	1.093	0.995
Monterey	Saturday	1.023	0.724	0.7
Monterey	Holiday	1.083	0.755	0.607
Napa	Sunday	1.028	0.624	0.392
Napa	Monday	0.989	0.95	0.895
Napa	Tues/Wed/Thurs	1	1	1
Napa	Friday	1.126	1.041	0.988
Napa	Saturday	1.118	0.743	0.44
Napa	Holiday	0.952	0.905	0.847
Nevada	Sunday	0.972	0.668	0.602
Nevada	Monday	0.988	0.977	0.943
Nevada	Tues/Wed/Thurs	1	1	1
Nevada	Friday	1.178	1.101	0.963
Nevada	Saturday	1.037	0.786	0.575
Nevada	Holiday	0.971	0.933	0.921
Orange	Sunday	0.808	0.415	0.327
Orange	Monday	0.962	0.92	0.891
Orange	Tues/Wed/Thurs	1	1	1
Orange	Friday	1.038	1.025	0.988
Orange	Saturday	0.94	0.587	0.433
Orange	Holiday	0.831	0.774	0.796
Placer	Sunday	0.972	0.668	0.602
Placer	Monday	0.988	0.977	0.943
Placer	Tues/Wed/Thurs	1	1	1
Placer	Friday	1.178	1.101	0.963
Placer	Saturday	1.037	0.786	0.575
Placer	Holiday	0.971	0.933	0.921
Plumas	Sunday	0.651	0.442	0.41
Plumas	Monday	0.964	0.96	0.871
Plumas	Tues/Wed/Thurs	1	1	1
Plumas	Friday	1.008	1.015	0.962
Plumas	Saturday	0.771	0.604	0.503
Plumas	Holiday	0.73	0.657	0.606
Riverside	Sunday	0.894	0.489	0.383
Riverside	Monday	0.974	0.941	0.887
Riverside	Tues/Wed/Thurs	1	1	1
Riverside	Friday	1.085	1.028	0.977
Riverside	Saturday	1.011	0.629	0.491
Riverside	Holiday	0.933	0.848	0.844
Sacramento	Sunday	0.774	0.49	0.431
Sacramento	Monday	0.963	0.954	0.913
Sacramento	Tues/Wed/Thurs	1	1	1
Sacramento	Friday	1.065	1.039	0.973
Sacramento	Saturday	0.884	0.622	0.502
Sacramento	Holiday	0.809	0.832	0.852
San Benito	Sunday	1.2	0.603	0.342
San Benito	Monday	1.106	0.988	0.876
San Benito	Tues/Wed/Thurs	1	1	1
San Benito	Friday	1.116	1.093	0.995
San Benito	Saturday	1.023	0.724	0.7

County	Day of Week	LD	LM	HH
San Benito	Holiday	1.083	0.755	0.607
San Bernardino	Sunday	0.89	0.56	0.532
San Bernardino	Monday	0.988	0.931	0.913
San Bernardino	Tues/Wed/Thurs	1	1	1
San Bernardino	Friday	1.094	1.069	1.012
San Bernardino	Saturday	0.97	0.743	0.634
San Bernardino	Holiday	0.942	0.818	0.831
San Diego	Sunday	0.796	0.532	0.341
San Diego	Monday	0.963	0.928	0.882
San Diego	Tues/Wed/Thurs	1	1	1
San Diego	Friday	1.067	1.022	0.982
San Diego	Saturday	0.928	0.665	0.446
San Diego	Holiday	0.808	0.785	0.785
San Francisco	Sunday	0.852	0.522	0.39
San Francisco	Monday	0.928	0.897	0.888
San Francisco	Tues/Wed/Thurs	1	1	1
San Francisco	Friday	1.05	1.002	0.98
San Francisco	Saturday	0.957	0.639	0.452
San Francisco	Holiday	0.783	0.811	0.84
San Joaquin	Sunday	0.933	0.5	0.393
San Joaquin	Monday	0.984	0.918	0.908
San Joaquin	Tues/Wed/Thurs	1	1	1
San Joaquin	Friday	1.128	1.086	0.976
San Joaquin	Saturday	1.035	0.657	0.466
San Joaquin	Holiday	0.907	0.77	0.757
San Luis Obispo	Sunday	1.038	0.629	0.413
San Luis Obispo	Monday	1.064	0.97	0.935
San Luis Obispo	Tues/Wed/Thurs	1	1	1
San Luis Obispo	Friday	1.113	1.094	1.047
San Luis Obispo	Saturday	0.99	0.725	0.563
San Luis Obispo	Holiday	0.967	0.714	0.669
San Mateo	Sunday	0.714	0.439	0.324
San Mateo	Monday	0.926	0.89	0.887
San Mateo	Tues/Wed/Thurs	1	1	1
San Mateo	Friday	1.02	0.983	0.978
San Mateo	Saturday	0.835	0.55	0.402
San Mateo	Holiday	0.78	0.742	0.767
Santa Barbara	Sunday	0.81	0.388	0.301
Santa Barbara	Monday	1.044	0.952	0.912
Santa Barbara	Tues/Wed/Thurs	1	1	1
Santa Barbara	Friday	1.08	1.011	0.996
Santa Barbara	Saturday	0.829	0.542	0.562
Santa Barbara	Holiday	0.811	0.535	0.545
Santa Clara	Sunday	0.734	0.489	0.343
Santa Clara	Monday	0.954	0.909	0.906
Santa Clara	Tues/Wed/Thurs	1	1	1
Santa Clara	Friday	1.042	1.004	0.953
Santa Clara	Saturday	0.853	0.614	0.4
Santa Clara	Holiday	0.765	0.834	0.807
Santa Cruz	Sunday	0.846	0.526	0.468
Santa Cruz	Monday	0.935	0.923	0.947
Santa Cruz	Tues/Wed/Thurs	1	1	1
Santa Cruz	Friday	1.027	1.012	1.036
Santa Cruz	Saturday	0.935	0.652	0.541
Santa Cruz	Holiday	0.9	0.896	0.875
Shasta	Sunday	1.076	0.823	0.627
Shasta	Monday	0.939	1.007	0.66
Shasta	Tues/Wed/Thurs	1	1	1
Shasta	Friday	1.078	1.156	0.774
Shasta	Saturday	1.117	0.863	0.719
Shasta	Holiday	0.902	0.837	0.602
Sierra	Sunday	0.972	0.668	0.602
Sierra	Monday	0.988	0.977	0.943
Sierra	Tues/Wed/Thurs	1	1	1
Sierra	Friday	1.178	1.101	0.963
Sierra	Saturday	1.037	0.786	0.575
Sierra	Holiday	0.971	0.933	0.921
Siskiyou	Sunday	1.133	0.801	0.638
Siskiyou	Monday	1.159	0.961	0.634
Siskiyou	Tues/Wed/Thurs	1	1	1
Siskiyou	Friday	1.202	1.109	0.767
Siskiyou	Saturday	1.041	0.819	0.745
Siskiyou	Holiday	1.087	0.992	0.704
Solano	Sunday	1.008	0.589	0.36

County	Day of Week	LD	LM	HH
Solano	Monday	0.979	0.948	0.887
Solano	Tues/Wed/Thurs	1	1	1
Solano	Friday	1.13	1.033	0.969
Solano	Saturday	1.091	0.719	0.416
Solano	Holiday	0.909	0.896	0.844
Sonoma	Sunday	0.779	0.519	0.376
Sonoma	Monday	0.943	0.927	0.873
Sonoma	Tues/Wed/Thurs	1	1	1
Sonoma	Friday	1.048	1.023	0.982
Sonoma	Saturday	0.924	0.665	0.471
Sonoma	Holiday	0.788	0.827	0.799
Stanislaus	Sunday	1.002	0.593	0.421
Stanislaus	Monday	1.009	0.958	0.904
Stanislaus	Tues/Wed/Thurs	1	1	1
Stanislaus	Friday	1.185	1.103	0.97
Stanislaus	Saturday	1.055	0.713	0.477
Stanislaus	Holiday	0.977	0.897	0.797
Sutter	Sunday	0.972	0.668	0.602
Sutter	Monday	0.988	0.977	0.943
Sutter	Tues/Wed/Thurs	1	1	1
Sutter	Friday	1.178	1.101	0.963
Sutter	Saturday	1.037	0.786	0.575
Sutter	Holiday	0.971	0.933	0.921
Tehama	Sunday	1.076	0.823	0.627
Tehama	Monday	0.939	1.007	0.66
Tehama	Tues/Wed/Thurs	1	1	1
Tehama	Friday	1.078	1.156	0.774
Tehama	Saturday	1.117	0.863	0.719
Tehama	Holiday	0.902	0.837	0.602
Trinity	Sunday	1.133	0.801	0.638
Trinity	Monday	1.159	0.961	0.634
Trinity	Tues/Wed/Thurs	1	1	1
Trinity	Friday	1.202	1.109	0.767
Trinity	Saturday	1.041	0.819	0.745
Trinity	Holiday	1.087	0.992	0.704
Tulare	Sunday	1.029	0.429	0.185
Tulare	Monday	1.052	0.936	0.912
Tulare	Tues/Wed/Thurs	1	1	1
Tulare	Friday	1.099	1.02	0.97
Tulare	Saturday	0.993	0.67	0.503
Tulare	Holiday	0.942	0.585	0.567
Tuolumne	Sunday	1.201	0.821	0.415
Tuolumne	Monday	1.007	0.945	0.908
Tuolumne	Tues/Wed/Thurs	1	1	1
Tuolumne	Friday	1.247	1.082	1.007
Tuolumne	Saturday	1.219	0.803	0.442
Tuolumne	Holiday	1.118	0.935	0.832
Ventura	Sunday	0.772	0.406	0.491
Ventura	Monday	0.956	0.924	0.932
Ventura	Tues/Wed/Thurs	1	1	1
Ventura	Friday	1.036	0.992	1.004
Ventura	Saturday	0.888	0.554	0.637
Ventura	Holiday	0.817	0.785	0.863
Yolo	Sunday	0.902	0.563	0.357
Yolo	Monday	0.972	0.954	0.932
Yolo	Tues/Wed/Thurs	1	1	1
Yolo	Friday	1.099	1.045	0.973
Yolo	Saturday	0.992	0.669	0.426
Yolo	Holiday	0.895	0.883	0.861
Yuba	Sunday	0.972	0.668	0.602
Yuba	Monday	0.988	0.977	0.943
Yuba	Tues/Wed/Thurs	1	1	1
Yuba	Friday	1.178	1.101	0.963
Yuba	Saturday	1.037	0.786	0.575
Yuba	Holiday	0.971	0.933	0.921

Appendix B: Hour of Day Profiles by vehicle type and county

The factors shown in Table 10 represent the "day of week" factors for each county for a broad vehicle class: LD is Light Duty, LM is Light and Medium Duty Trucks, and HH is Heavy- Heavy Duty Trucks.

Table 10 Hour of Day Profiles by vehicle type and county

		Alameda			Alpine			Amador			Butte			Calaveras			Colusa			Contra Costa		
Day of Week	Hour	LD	LM	HH	LD	LM	HH	LD	LM	HH	LD	LM	HH	LD	LM	HH	LD	LM	HH	LD	LM	HH
Sunday	0	0.020	0.041	0.061	0.010	0.014	0.032	0.010	0.014	0.032	0.015	0.010	0.015	0.010	0.014	0.032	0.015	0.010	0.015	0.019	0.038	0.053
Sunday	1	0.013	0.039	0.056	0.007	0.011	0.024	0.007	0.011	0.024	0.010	0.006	0.011	0.007	0.011	0.024	0.010	0.006	0.011	0.012	0.034	0.047
Sunday	2	0.010	0.039	0.052	0.005	0.011	0.022	0.005	0.011	0.022	0.007	0.004	0.012	0.005	0.011	0.022	0.007	0.004	0.012	0.008	0.031	0.043
Sunday	3	0.007	0.038	0.049	0.004	0.010	0.021	0.004	0.010	0.021	0.006	0.004	0.012	0.004	0.010	0.021	0.006	0.004	0.012	0.006	0.030	0.040
Sunday	4	0.007	0.037	0.046	0.004	0.010	0.020	0.004	0.010	0.020	0.006	0.005	0.017	0.004	0.010	0.020	0.006	0.005	0.017	0.006	0.029	0.038
Sunday	5	0.010	0.038	0.044	0.007	0.013	0.021	0.007	0.013	0.021	0.010	0.011	0.029	0.007	0.013	0.021	0.010	0.011	0.029	0.010	0.031	0.038
Sunday	6	0.016	0.038	0.043	0.012	0.019	0.026	0.012	0.019	0.026	0.016	0.017	0.037	0.012	0.019	0.026	0.016	0.017	0.037	0.016	0.033	0.039
Sunday	7	0.022	0.039	0.042	0.019	0.023	0.029	0.019	0.023	0.029	0.023	0.029	0.051	0.019	0.023	0.029	0.023	0.029	0.051	0.023	0.036	0.040
Sunday	8	0.032	0.040	0.041	0.032	0.035	0.038	0.032	0.035	0.038	0.033	0.043	0.071	0.032	0.035	0.038	0.033	0.043	0.071	0.033	0.040	0.042
Sunday	9	0.046	0.043	0.041	0.051	0.051	0.053	0.051	0.051	0.053	0.047	0.063	0.091	0.051	0.051	0.053	0.047	0.063	0.091	0.048	0.046	0.044
Sunday	10	0.059	0.046	0.041	0.067	0.067	0.071	0.067	0.067	0.071	0.057	0.075	0.084	0.067	0.067	0.071	0.057	0.075	0.084	0.062	0.051	0.045
Sunday	11	0.065	0.047	0.039	0.080	0.081	0.085	0.080	0.081	0.085	0.067	0.083	0.079	0.080	0.081	0.085	0.067	0.083	0.079	0.067	0.053	0.046
Sunday	12	0.069	0.048	0.038	0.083	0.081	0.076	0.083	0.081	0.076	0.074	0.090	0.070	0.083	0.081	0.076	0.074	0.090	0.070	0.070	0.054	0.046
Sunday	13	0.071	0.049	0.036	0.085	0.082	0.074	0.085	0.082	0.074	0.078	0.089	0.061	0.085	0.082	0.074	0.078	0.089	0.061	0.073	0.055	0.050
Sunday	14	0.072	0.049	0.035	0.085	0.083	0.069	0.085	0.083	0.069	0.079	0.081	0.057	0.085	0.083	0.069	0.079	0.081	0.057	0.073	0.055	0.047
Sunday	15	0.071	0.049	0.034	0.084	0.081	0.066	0.084	0.081	0.066	0.080	0.079	0.053	0.084	0.081	0.066	0.080	0.079	0.053	0.073	0.053	0.041
Sunday	16	0.070	0.048	0.033	0.082	0.079	0.060	0.082	0.079	0.060	0.079	0.075	0.045	0.082	0.079	0.060	0.079	0.075	0.045	0.072	0.052	0.039
Sunday	17	0.069	0.048	0.034	0.076	0.070	0.053	0.076	0.070	0.053	0.075	0.066	0.043	0.076	0.070	0.053	0.075	0.066	0.043	0.070	0.050	0.038
Sunday	18	0.063	0.045	0.033	0.064	0.056	0.043	0.064	0.056	0.043	0.066	0.054	0.039	0.064	0.056	0.043	0.066	0.054	0.039	0.063	0.047	0.036
Sunday	19	0.057	0.043	0.035	0.049	0.043	0.035	0.049	0.043	0.035	0.055	0.042	0.037	0.049	0.043	0.035	0.055	0.042	0.037	0.056	0.044	0.035
Sunday	20	0.052	0.041	0.036	0.038	0.033	0.024	0.038	0.033	0.024	0.045	0.031	0.030	0.038	0.033	0.024	0.045	0.031	0.030	0.051	0.041	0.036
Sunday	21	0.045	0.037	0.039	0.026	0.022	0.020	0.026	0.022	0.020	0.035	0.022	0.024	0.026	0.022	0.020	0.035	0.022	0.024	0.042	0.038	0.037
Sunday	22	0.033	0.032	0.043	0.017	0.014	0.017	0.017	0.014	0.017	0.023	0.013	0.018	0.017	0.014	0.017	0.023	0.013	0.018	0.030	0.032	0.039
Sunday	23	0.021	0.027	0.049	0.010	0.010	0.020	0.010	0.010	0.020	0.014	0.008	0.015	0.010	0.010	0.020	0.014	0.008	0.015	0.019	0.027	0.043
Monday	0	0.009	0.026	0.032	0.006	0.010	0.017	0.006	0.010	0.017	0.006	0.002	0.006	0.006	0.010	0.017	0.006	0.002	0.006	0.007	0.023	0.029
Monday	1	0.004	0.027	0.032	0.004	0.009	0.016	0.004	0.009	0.016	0.004	0.002	0.007	0.004	0.009	0.016	0.004	0.002	0.007	0.003	0.022	0.028
Monday	2	0.003	0.028	0.033	0.003	0.009	0.016	0.003	0.009	0.016	0.003	0.002	0.010	0.003	0.009	0.016	0.003	0.002	0.010	0.002	0.022	0.029
Monday	3	0.005	0.030	0.035	0.005	0.011	0.019	0.005	0.011	0.019	0.003	0.004	0.012	0.005	0.011	0.019	0.003	0.004	0.012	0.003	0.023	0.030
Monday	4	0.014	0.033	0.039	0.008	0.017	0.024	0.008	0.017	0.024	0.007	0.009	0.021	0.008	0.017	0.024	0.007	0.009	0.021	0.012	0.028	0.035
Monday	5	0.034	0.039	0.044	0.019	0.028	0.036	0.019	0.028	0.036	0.018	0.024	0.037	0.019	0.028	0.036	0.018	0.024	0.037	0.033	0.041	0.042
Monday	6	0.051	0.046	0.048	0.036	0.041	0.050	0.036	0.041	0.050	0.041	0.051	0.055	0.036	0.041	0.050	0.041	0.051	0.055	0.054	0.051	0.048
Monday	7	0.064	0.053	0.052	0.051	0.044	0.065	0.051	0.044	0.065	0.078	0.069	0.066	0.051	0.044	0.065	0.078	0.069	0.066	0.066	0.058	0.053
Monday	8	0.064	0.055	0.053	0.053	0.056	0.068	0.053	0.056	0.068	0.067	0.077	0.077	0.053	0.056	0.068	0.067	0.077	0.077	0.062	0.060	0.055
Monday	9	0.058	0.054	0.054	0.059	0.065	0.080	0.059	0.065	0.080	0.057	0.071	0.080	0.059	0.065	0.080	0.057	0.071	0.080	0.055	0.056	0.054
Monday	10	0.053	0.053	0.054	0.067	0.074	0.087	0.067	0.074	0.087	0.057	0.071	0.077	0.067	0.074	0.087	0.057	0.071	0.077	0.052	0.054	0.053
Monday	11	0.051	0.054	0.054	0.071	0.075	0.082	0.071	0.075	0.082	0.060	0.074	0.073	0.071	0.075	0.082	0.060	0.074	0.073	0.053	0.055	0.054
Monday	12	0.052	0.056	0.054	0.074	0.074	0.080	0.074	0.074	0.080	0.063	0.072	0.071	0.074	0.074	0.080	0.063	0.072	0.071	0.054	0.056	0.054

		Alameda			Alpine			Amador			Butte			Calaveras			Colusa			Contra Costa		
Day of Week	Hour	LD	LM	HH	LD	LM	HH	LD	LM	HH	LD	LM	HH	LD	LM	HH	LD	LM	HH	LD	LM	HH
Monday	13	0.054	0.057	0.054	0.074	0.075	0.075	0.074	0.075	0.075	0.063	0.072	0.068	0.074	0.075	0.075	0.063	0.072	0.068	0.056	0.056	0.054
Monday	14	0.061	0.059	0.053	0.077	0.076	0.065	0.077	0.076	0.065	0.067	0.077	0.064	0.077	0.076	0.065	0.067	0.077	0.064	0.063	0.059	0.056
Monday	15	0.066	0.059	0.051	0.082	0.076	0.058	0.082	0.076	0.058	0.078	0.080	0.056	0.082	0.076	0.058	0.078	0.080	0.056	0.069	0.063	0.058
Monday	16	0.069	0.057	0.048	0.081	0.073	0.045	0.081	0.073	0.045	0.086	0.077	0.049	0.081	0.073	0.045	0.086	0.077	0.049	0.072	0.060	0.052
Monday	17	0.070	0.053	0.044	0.071	0.059	0.035	0.071	0.059	0.035	0.087	0.062	0.041	0.071	0.059	0.035	0.087	0.062	0.041	0.073	0.056	0.047
Monday	18	0.062	0.045	0.037	0.052	0.042	0.023	0.052	0.042	0.023	0.051	0.038	0.030	0.052	0.042	0.023	0.051	0.038	0.030	0.061	0.045	0.039
Monday	19	0.048	0.035	0.031	0.037	0.030	0.017	0.037	0.030	0.017	0.036	0.024	0.024	0.037	0.030	0.017	0.036	0.024	0.024	0.045	0.033	0.031
Monday	20	0.036	0.028	0.026	0.027	0.022	0.013	0.027	0.022	0.013	0.026	0.018	0.023	0.027	0.022	0.013	0.026	0.018	0.023	0.035	0.026	0.026
Monday	21	0.031	0.022	0.023	0.020	0.016	0.010	0.020	0.016	0.010	0.020	0.012	0.021	0.020	0.016	0.010	0.020	0.012	0.021	0.031	0.022	0.024
Monday	22	0.024	0.018	0.023	0.015	0.012	0.009	0.015	0.012	0.009	0.013	0.007	0.017	0.015	0.012	0.009	0.013	0.007	0.017	0.023	0.017	0.023
Monday	23	0.016	0.015	0.025	0.009	0.007	0.010	0.009	0.007	0.010	0.008	0.004	0.015	0.009	0.007	0.010	0.008	0.004	0.015	0.014	0.014	0.025
Tues/Wed/Thurs	0	0.008	0.026	0.034	0.005	0.009	0.017	0.005	0.009	0.017	0.006	0.003	0.010	0.005	0.009	0.017	0.006	0.003	0.010	0.006	0.022	0.031
Tues/Wed/Thurs	1	0.004	0.027	0.034	0.003	0.008	0.017	0.003	0.008	0.017	0.003	0.002	0.011	0.003	0.008	0.017	0.003	0.002	0.011	0.003	0.021	0.030
Tues/Wed/Thurs	2	0.003	0.028	0.035	0.002	0.009	0.017	0.002	0.009	0.017	0.003	0.002	0.013	0.002	0.009	0.017	0.003	0.002	0.013	0.002	0.021	0.030
Tues/Wed/Thurs	3	0.005	0.030	0.037	0.003	0.010	0.022	0.003	0.010	0.022	0.003	0.003	0.015	0.003	0.010	0.022	0.003	0.003	0.015	0.003	0.023	0.031
Tues/Wed/Thurs	4	0.014	0.034	0.041	0.006	0.014	0.025	0.006	0.014	0.025	0.006	0.008	0.022	0.006	0.014	0.025	0.006	0.008	0.022	0.011	0.028	0.036
Tues/Wed/Thurs	5	0.035	0.040	0.046	0.018	0.027	0.039	0.018	0.027	0.039	0.017	0.024	0.037	0.018	0.027	0.039	0.017	0.024	0.037	0.034	0.040	0.044
Tues/Wed/Thurs	6	0.055	0.047	0.050	0.037	0.042	0.052	0.037	0.042	0.052	0.041	0.053	0.054	0.037	0.042	0.052	0.041	0.053	0.054	0.056	0.052	0.049
Tues/Wed/Thurs	7	0.067	0.054	0.053	0.053	0.047	0.064	0.053	0.047	0.064	0.077	0.069	0.066	0.053	0.047	0.064	0.077	0.069	0.066	0.068	0.059	0.054
Tues/Wed/Thurs	8	0.064	0.056	0.054	0.054	0.056	0.070	0.054	0.056	0.070	0.066	0.077	0.077	0.054	0.056	0.070	0.066	0.077	0.077	0.063	0.060	0.056
Tues/Wed/Thurs	9	0.057	0.054	0.055	0.059	0.068	0.083	0.059	0.068	0.083	0.057	0.071	0.080	0.059	0.068	0.083	0.057	0.071	0.080	0.055	0.055	0.053
Tues/Wed/Thurs	10	0.051	0.053	0.054	0.064	0.069	0.081	0.064	0.069	0.081	0.056	0.071	0.077	0.064	0.069	0.081	0.056	0.071	0.077	0.051	0.053	0.052
Tues/Wed/Thurs	11	0.049	0.054	0.054	0.068	0.069	0.077	0.068	0.069	0.077	0.058	0.071	0.074	0.068	0.069	0.077	0.058	0.071	0.074	0.050	0.054	0.052
Tues/Wed/Thurs	12	0.050	0.055	0.054	0.069	0.071	0.074	0.069	0.071	0.074	0.062	0.070	0.069	0.069	0.071	0.074	0.062	0.070	0.069	0.052	0.055	0.053
Tues/Wed/Thurs	13	0.053	0.056	0.053	0.072	0.073	0.074	0.072	0.073	0.074	0.063	0.073	0.067	0.072	0.073	0.074	0.063	0.073	0.067	0.054	0.056	0.054
Tues/Wed/Thurs	14	0.060	0.058	0.052	0.077	0.076	0.067	0.077	0.076	0.067	0.066	0.076	0.063	0.077	0.076	0.067	0.066	0.076	0.063	0.062	0.059	0.054
Tues/Wed/Thurs	15	0.064	0.058	0.050	0.084	0.078	0.058	0.084	0.078	0.058	0.079	0.080	0.056	0.084	0.078	0.058	0.079	0.080	0.056	0.067	0.063	0.056
Tues/Wed/Thurs	16	0.067	0.056	0.047	0.082	0.074	0.048	0.082	0.074	0.048	0.087	0.076	0.045	0.082	0.074	0.048	0.087	0.076	0.045	0.070	0.060	0.051
Tues/Wed/Thurs	17	0.067	0.052	0.042	0.074	0.061	0.036	0.074	0.061	0.036	0.088	0.062	0.040	0.074	0.061	0.036	0.088	0.062	0.040	0.071	0.057	0.046
Tues/Wed/Thurs	18	0.061	0.044	0.036	0.053	0.044	0.023	0.053	0.044	0.023	0.054	0.039	0.031	0.053	0.044	0.023	0.054	0.039	0.031	0.062	0.047	0.039
Tues/Wed/Thurs	19	0.050	0.035	0.030	0.038	0.031	0.016	0.038	0.031	0.016	0.036	0.026	0.023	0.038	0.031	0.016	0.036	0.026	0.023	0.048	0.035	0.031
Tues/Wed/Thurs	20	0.038	0.027	0.025	0.030	0.025	0.012	0.030	0.025	0.012	0.028	0.019	0.021	0.030	0.025	0.012	0.028	0.019	0.021	0.038	0.027	0.026
Tues/Wed/Thurs	21	0.033	0.022	0.022	0.023	0.018	0.010	0.023	0.018	0.010	0.021	0.013	0.020	0.023	0.018	0.010	0.021	0.013	0.020	0.033	0.022	0.024
Tues/Wed/Thurs	22	0.026	0.017	0.022	0.017	0.013	0.010	0.017	0.013	0.010	0.014	0.007	0.016	0.017	0.013	0.010	0.014	0.007	0.016	0.024	0.017	0.022
Tues/Wed/Thurs	23	0.016	0.014	0.023	0.010	0.008	0.010	0.010	0.008	0.010	0.009	0.004	0.013	0.010	0.008	0.010	0.009	0.004	0.013	0.015	0.013	0.024
Friday	0	0.009	0.027	0.036	0.005	0.009	0.019	0.005	0.009	0.019	0.007	0.003	0.011	0.005	0.009	0.019	0.007	0.003	0.011	0.008	0.022	0.033
Friday	1	0.005	0.028	0.037	0.003	0.008	0.019	0.003	0.008	0.019	0.004	0.003	0.012	0.003	0.008	0.019	0.004	0.003	0.012	0.004	0.021	0.031
Friday	2	0.004	0.029	0.038	0.002	0.008	0.019	0.002	0.008	0.019	0.004	0.003	0.015	0.002	0.008	0.019	0.004	0.003	0.015	0.003	0.022	0.032
Friday	3	0.005	0.031	0.039	0.002	0.008	0.021	0.002	0.008	0.021	0.004	0.004	0.017	0.002	0.008	0.021	0.004	0.004	0.017	0.004	0.023	0.033
Friday	4	0.013	0.034	0.043	0.005	0.013	0.024	0.005	0.013	0.024	0.006	0.007	0.024	0.005	0.013	0.024	0.006	0.007	0.024	0.010	0.028	0.036
Friday	5	0.032	0.040	0.048	0.013	0.023	0.037	0.013	0.023	0.037	0.015	0.022	0.039	0.013	0.023	0.037	0.015	0.022	0.039	0.030	0.039	0.044
Friday	6	0.049	0.046	0.052	0.026	0.035	0.049	0.026	0.035	0.049	0.035	0.045	0.055	0.026	0.035	0.049	0.035	0.045	0.055	0.050	0.049	0.050
Friday	7	0.060	0.052	0.055	0.039	0.040	0.060	0.039	0.040	0.060	0.063	0.063	0.064	0.039	0.040	0.060	0.063	0.063	0.064	0.063	0.057	0.055
Friday	8	0.059	0.054	0.056	0.043	0.049	0.068	0.043	0.049	0.068	0.058	0.072	0.074	0.043	0.049	0.068	0.058	0.072	0.074	0.059	0.057	0.056
Friday	9	0.054	0.053	0.056	0.049	0.057	0.073	0.049	0.057	0.073	0.052	0.068	0.075	0.049	0.057	0.073	0.052	0.068	0.075	0.053	0.054	0.054
Friday	10	0.051	0.053	0.056	0.058	0.063	0.078	0.058	0.063	0.078	0.055	0.071	0.074	0.058	0.063	0.078	0.055	0.071	0.074	0.051	0.053	0.053
Friday	11	0.052	0.055	0.055	0.064	0.069	0.077	0.064	0.069	0.077	0.060	0.074	0.074	0.064	0.069	0.077	0.060	0.074	0.074	0.053	0.055	0.054
Friday	12	0.054	0.056	0.055	0.066	0.071	0.076	0.066	0.071	0.076	0.063	0.072	0.069	0.066	0.071	0.076	0.063	0.072	0.069	0.056	0.057	0.055
Friday	13	0.056	0.057	0.054	0.071	0.074	0.077	0.071	0.074	0.077	0.065	0.076	0.069	0.071	0.074	0.077	0.065	0.076	0.069	0.058	0.058	0.056
Friday	14	0.061	0.058	0.052	0.076	0.077	0.070	0.076	0.077	0.070	0.069	0.078	0.063	0.076	0.077	0.070	0.069	0.078	0.063	0.064	0.059	0.056
Friday	15	0.063	0.058	0.049	0.083	0.079	0.060	0.083	0.079	0.060	0.078	0.080	0.055	0.083	0.079	0.060	0.078	0.080	0.055	0.066	0.062	0.056
Friday	16	0.064	0.055	0.045	0.083	0.077	0.050	0.083	0.077	0.050	0.085	0.075	0.047	0.083	0.077	0.050	0.085	0.075	0.047	0.067	0.059	0.050

		Alameda			Alpine			Amador			Butte			Calaveras			Colusa			Contra Costa		
Day of Week	Hour	LD	LM	HH	LD	LM	HH	LD	LM	HH	LD	LM	HH	LD	LM	HH	LD	LM	HH	LD	LM	HH
Friday	17	0.064	0.051	0.040	0.075	0.064	0.038	0.075	0.064	0.038	0.082	0.061	0.039	0.075	0.064	0.038	0.082	0.061	0.039	0.067	0.055	0.046
Friday	18	0.059	0.044	0.034	0.062	0.051	0.025	0.062	0.051	0.025	0.059	0.041	0.029	0.062	0.051	0.025	0.059	0.041	0.029	0.060	0.047	0.039
Friday	19	0.052	0.035	0.027	0.050	0.039	0.018	0.050	0.039	0.018	0.042	0.028	0.024	0.050	0.039	0.018	0.042	0.028	0.024	0.049	0.036	0.030
Friday	20	0.042	0.028	0.022	0.041	0.030	0.013	0.041	0.030	0.013	0.032	0.021	0.021	0.041	0.030	0.013	0.032	0.021	0.021	0.040	0.029	0.023
Friday	21	0.036	0.023	0.019	0.036	0.025	0.010	0.036	0.025	0.010	0.027	0.015	0.020	0.036	0.025	0.010	0.027	0.015	0.020	0.035	0.023	0.020
Friday	22	0.032	0.019	0.017	0.030	0.019	0.011	0.030	0.019	0.011	0.021	0.011	0.016	0.030	0.019	0.011	0.021	0.011	0.016	0.030	0.019	0.019
Friday	23	0.023	0.015	0.018	0.018	0.012	0.009	0.018	0.012	0.009	0.014	0.007	0.015	0.018	0.012	0.009	0.014	0.007	0.015	0.022	0.015	0.020
Saturday	0	0.016	0.033	0.052	0.010	0.015	0.027	0.010	0.015	0.027	0.012	0.007	0.021	0.010	0.015	0.027	0.012	0.007	0.021	0.015	0.030	0.044
Saturday	1	0.010	0.033	0.051	0.007	0.012	0.023	0.007	0.012	0.023	0.008	0.005	0.016	0.007	0.012	0.023	0.008	0.005	0.016	0.009	0.027	0.040
Saturday	2	0.008	0.033	0.049	0.005	0.011	0.022	0.005	0.011	0.022	0.006	0.004	0.020	0.005	0.011	0.022	0.006	0.004	0.020	0.006	0.026	0.039
Saturday	3	0.006	0.034	0.048	0.004	0.010	0.025	0.004	0.010	0.025	0.005	0.004	0.022	0.004	0.010	0.025	0.005	0.004	0.022	0.005	0.025	0.037
Saturday	4	0.008	0.035	0.048	0.005	0.013	0.028	0.005	0.013	0.028	0.006	0.008	0.024	0.005	0.013	0.028	0.006	0.008	0.024	0.006	0.027	0.037
Saturday	5	0.014	0.037	0.049	0.010	0.021	0.034	0.010	0.021	0.034	0.012	0.017	0.039	0.010	0.021	0.034	0.012	0.017	0.039	0.013	0.030	0.040
Saturday	6	0.023	0.039	0.050	0.017	0.028	0.039	0.017	0.028	0.039	0.021	0.028	0.049	0.017	0.028	0.039	0.021	0.028	0.049	0.023	0.035	0.042
Saturday	7	0.033	0.041	0.051	0.029	0.036	0.053	0.029	0.036	0.053	0.034	0.041	0.058	0.029	0.036	0.053	0.034	0.041	0.058	0.034	0.041	0.047
Saturday	8	0.045	0.044	0.052	0.044	0.045	0.060	0.044	0.045	0.060	0.045	0.057	0.067	0.044	0.045	0.060	0.045	0.057	0.067	0.046	0.047	0.049
Saturday	9	0.054	0.047	0.052	0.059	0.061	0.071	0.059	0.061	0.071	0.054	0.068	0.074	0.059	0.061	0.071	0.054	0.068	0.074	0.055	0.051	0.050
Saturday	10	0.060	0.050	0.051	0.073	0.074	0.078	0.073	0.074	0.078	0.063	0.080	0.073	0.073	0.074	0.078	0.063	0.080	0.073	0.061	0.054	0.051
Saturday	11	0.064	0.052	0.050	0.081	0.077	0.083	0.081	0.077	0.083	0.068	0.082	0.071	0.081	0.077	0.083	0.068	0.082	0.071	0.065	0.056	0.052
Saturday	12	0.066	0.053	0.048	0.078	0.077	0.075	0.078	0.077	0.075	0.074	0.083	0.068	0.078	0.077	0.075	0.074	0.083	0.068	0.066	0.058	0.055
Saturday	13	0.066	0.053	0.045	0.075	0.072	0.060	0.075	0.072	0.060	0.074	0.079	0.062	0.075	0.072	0.060	0.074	0.079	0.062	0.067	0.059	0.058
Saturday	14	0.066	0.053	0.042	0.075	0.068	0.055	0.075	0.068	0.055	0.074	0.076	0.057	0.075	0.068	0.055	0.074	0.076	0.057	0.067	0.058	0.057
Saturday	15	0.066	0.053	0.040	0.075	0.068	0.052	0.075	0.068	0.052	0.073	0.074	0.052	0.075	0.068	0.052	0.073	0.074	0.052	0.068	0.057	0.051
Saturday	16	0.065	0.051	0.037	0.072	0.070	0.047	0.072	0.070	0.047	0.073	0.067	0.045	0.072	0.070	0.047	0.073	0.067	0.045	0.068	0.056	0.047
Saturday	17	0.065	0.050	0.034	0.066	0.063	0.040	0.066	0.063	0.040	0.069	0.058	0.039	0.066	0.063	0.040	0.069	0.058	0.039	0.067	0.054	0.044
Saturday	18	0.060	0.046	0.031	0.058	0.052	0.031	0.058	0.052	0.031	0.058	0.047	0.034	0.058	0.052	0.031	0.058	0.047	0.034	0.060	0.048	0.036
Saturday	19	0.050	0.041	0.028	0.047	0.041	0.026	0.047	0.041	0.026	0.046	0.036	0.029	0.047	0.041	0.026	0.046	0.036	0.029	0.049	0.041	0.029
Saturday	20	0.043	0.036	0.025	0.038	0.031	0.020	0.038	0.031	0.020	0.040	0.028	0.024	0.038	0.031	0.020	0.040	0.028	0.024	0.043	0.036	0.025
Saturday	21	0.042	0.033	0.024	0.031	0.025	0.016	0.031	0.025	0.016	0.036	0.022	0.023	0.031	0.025	0.016	0.036	0.022	0.023	0.041	0.033	0.024
Saturday	22	0.039	0.029	0.023	0.025	0.020	0.018	0.025	0.020	0.018	0.029	0.016	0.017	0.025	0.020	0.018	0.029	0.016	0.017	0.037	0.029	0.023
Saturday	23	0.029	0.025	0.023	0.016	0.013	0.018	0.016	0.013	0.018	0.020	0.011	0.017	0.016	0.013	0.018	0.020	0.011	0.017	0.028	0.024	0.022
Holiday	0	0.015	0.028	0.035	0.008	0.011	0.020	0.008	0.011	0.020	0.010	0.004	0.012	0.008	0.011	0.020	0.010	0.004	0.012	0.013	0.027	0.034
Holiday	1	0.008	0.029	0.035	0.005	0.009	0.018	0.005	0.009	0.018	0.006	0.004	0.011	0.005	0.009	0.018	0.006	0.004	0.011	0.007	0.026	0.033
Holiday	2	0.006	0.031	0.036	0.003	0.010	0.018	0.003	0.010	0.018	0.004	0.003	0.012	0.003	0.010	0.018	0.004	0.003	0.012	0.004	0.025	0.033
Holiday	3	0.005	0.032	0.037	0.004	0.010	0.021	0.004	0.010	0.021	0.004	0.005	0.015	0.004	0.010	0.021	0.004	0.005	0.015	0.003	0.025	0.033
Holiday	4	0.009	0.035	0.040	0.005	0.012	0.020	0.005	0.012	0.020	0.007	0.009	0.024	0.005	0.012	0.020	0.007	0.009	0.024	0.007	0.029	0.035
Holiday	5	0.019	0.037	0.043	0.009	0.018	0.031	0.009	0.018	0.031	0.014	0.020	0.037	0.009	0.018	0.031	0.014	0.020	0.037	0.017	0.034	0.039
Holiday	6	0.029	0.042	0.045	0.018	0.023	0.038	0.018	0.023	0.038	0.030	0.036	0.047	0.018	0.023	0.038	0.030	0.036	0.047	0.029	0.040	0.044
Holiday	7	0.038	0.046	0.048	0.029	0.031	0.043	0.029	0.031	0.043	0.044	0.052	0.061	0.029	0.031	0.043	0.044	0.052	0.061	0.038	0.045	0.047
Holiday	8	0.046	0.049	0.051	0.041	0.044	0.056	0.041	0.044	0.056	0.052	0.066	0.075	0.041	0.044	0.056	0.052	0.066	0.075	0.045	0.050	0.051
Holiday	9	0.049	0.050	0.052	0.058	0.057	0.075	0.058	0.057	0.075	0.053	0.071	0.081	0.058	0.057	0.075	0.053	0.071	0.081	0.049	0.053	0.052
Holiday	10	0.055	0.053	0.053	0.076	0.083	0.087	0.076	0.083	0.087	0.059	0.076	0.081	0.076	0.083	0.087	0.059	0.076	0.081	0.056	0.056	0.053
Holiday	11	0.060	0.056	0.054	0.084	0.086	0.088	0.084	0.086	0.088	0.066	0.076	0.071	0.084	0.086	0.088	0.066	0.076	0.071	0.062	0.059	0.055
Holiday	12	0.064	0.058	0.055	0.085	0.087	0.089	0.085	0.087	0.089	0.071	0.078	0.074	0.085	0.087	0.089	0.071	0.078	0.074	0.067	0.061	0.056
Holiday	13	0.066	0.059	0.054	0.083	0.081	0.078	0.083	0.081	0.078	0.071	0.076	0.065	0.083	0.081	0.078	0.071	0.076	0.065	0.070	0.062	0.056
Holiday	14	0.069	0.060	0.053	0.080	0.074	0.068	0.080	0.074	0.068	0.070	0.078	0.060	0.080	0.074	0.068	0.070	0.078	0.060	0.073	0.062	0.057
Holiday	15	0.069	0.058	0.051	0.078	0.074	0.060	0.078	0.074	0.060	0.075	0.075	0.053	0.078	0.074	0.060	0.075	0.075	0.053	0.071	0.061	0.054
Holiday	16	0.068	0.056	0.047	0.078	0.072	0.049	0.078	0.072	0.049	0.079	0.070	0.044	0.078	0.072	0.049	0.079	0.070	0.044	0.070	0.057	0.050
Holiday	17	0.066	0.051	0.043	0.071	0.066	0.041	0.071	0.066	0.041	0.074	0.064	0.041	0.071	0.066	0.041	0.074	0.064	0.041	0.067	0.053	0.044
Holiday	18	0.060	0.044	0.037	0.057	0.049	0.033	0.057	0.049	0.033	0.058	0.044	0.034	0.057	0.049	0.033	0.058	0.044	0.034	0.059	0.045	0.038
Holiday	19	0.052	0.036	0.031	0.043	0.040	0.022	0.043	0.040	0.022	0.047	0.033	0.026	0.043	0.040	0.022	0.047	0.033	0.026	0.051	0.036	0.031
Holiday	20	0.046	0.030	0.027	0.033	0.026	0.013	0.033	0.026	0.013	0.038	0.025	0.025	0.033	0.026	0.013	0.038	0.025	0.025	0.046	0.031	0.028

		Alameda			Alpine			Amador			Butte			Calaveras			Colusa			Contra Costa		
Day of Week	**Hour**	**LD**	**LM**	**HH**	**LD**	**LM**	**HH**	**LD**	**LM**	**HH**	**LD**	**LM**	**HH**	**LD**	**LM**	**HH**	**LD**	**LM**	**HH**	**LD**	**LM**	**HH**
Holiday	21	0.042	0.025	0.024	0.024	0.018	0.011	0.024	0.018	0.011	0.030	0.018	0.021	0.024	0.018	0.011	0.030	0.018	0.021	0.041	0.026	0.026
Holiday	22	0.035	0.020	0.024	0.017	0.012	0.009	0.017	0.012	0.009	0.024	0.011	0.017	0.017	0.012	0.009	0.024	0.011	0.017	0.033	0.021	0.025
Holiday	23	0.024	0.016	0.026	0.010	0.008	0.010	0.010	0.008	0.010	0.014	0.007	0.014	0.010	0.008	0.010	0.014	0.007	0.014	0.021	0.017	0.026

		Del Norte			El Dorado			Fresno			Glenn			Humboldt			Imperial			Inyo		
Day of Week	**Hour**	**LD**	**LM**	**HH**	**LD**	**LM**	**HH**	**LD**	**LM**	**HH**	**LD**	**LM**	**HH**	**LD**	**LM**	**HH**	**LD**	**LM**	**HH**	**LD**	**LM**	**HH**
Sunday	0	0.013	0.011	0.008	0.013	0.020	0.031	0.015	0.033	0.043	0.015	0.010	0.015	0.013	0.011	0.008	0.026	0.015	0.017	0.010	0.014	0.032
Sunday	1	0.013	0.008	0.010	0.008	0.016	0.028	0.010	0.030	0.040	0.010	0.006	0.011	0.013	0.008	0.010	0.026	0.013	0.016	0.007	0.011	0.024
Sunday	2	0.012	0.006	0.008	0.006	0.013	0.026	0.008	0.027	0.037	0.007	0.004	0.012	0.012	0.006	0.008	0.025	0.009	0.014	0.005	0.011	0.022
Sunday	3	0.014	0.005	0.007	0.005	0.012	0.025	0.005	0.025	0.034	0.006	0.004	0.012	0.014	0.005	0.007	0.025	0.008	0.015	0.004	0.010	0.021
Sunday	4	0.014	0.004	0.011	0.005	0.012	0.025	0.006	0.024	0.034	0.006	0.005	0.017	0.014	0.004	0.011	0.027	0.010	0.015	0.004	0.010	0.020
Sunday	5	0.017	0.009	0.019	0.008	0.015	0.027	0.010	0.026	0.034	0.010	0.011	0.029	0.017	0.009	0.019	0.030	0.015	0.017	0.007	0.013	0.021
Sunday	6	0.021	0.014	0.028	0.013	0.020	0.030	0.017	0.029	0.036	0.016	0.017	0.037	0.021	0.014	0.028	0.032	0.019	0.021	0.012	0.019	0.026
Sunday	7	0.026	0.020	0.036	0.022	0.028	0.034	0.022	0.032	0.037	0.023	0.029	0.051	0.026	0.020	0.036	0.033	0.026	0.029	0.019	0.023	0.029
Sunday	8	0.031	0.032	0.043	0.034	0.041	0.040	0.032	0.038	0.040	0.033	0.043	0.071	0.031	0.032	0.043	0.037	0.039	0.035	0.032	0.035	0.038
Sunday	9	0.040	0.050	0.054	0.048	0.055	0.046	0.044	0.046	0.044	0.047	0.063	0.091	0.040	0.050	0.054	0.040	0.053	0.047	0.051	0.051	0.053
Sunday	10	0.047	0.064	0.067	0.064	0.068	0.052	0.055	0.052	0.046	0.057	0.075	0.084	0.047	0.064	0.067	0.043	0.063	0.057	0.067	0.067	0.071
Sunday	11	0.055	0.079	0.062	0.075	0.075	0.055	0.063	0.057	0.047	0.067	0.083	0.079	0.055	0.079	0.062	0.046	0.071	0.065	0.080	0.081	0.085
Sunday	12	0.061	0.087	0.065	0.082	0.079	0.058	0.071	0.062	0.049	0.074	0.090	0.070	0.061	0.087	0.065	0.048	0.075	0.068	0.083	0.081	0.076
Sunday	13	0.065	0.092	0.064	0.084	0.079	0.058	0.076	0.064	0.049	0.078	0.089	0.061	0.065	0.092	0.064	0.052	0.078	0.068	0.085	0.082	0.074
Sunday	14	0.067	0.087	0.065	0.084	0.077	0.057	0.077	0.063	0.048	0.079	0.081	0.057	0.067	0.087	0.065	0.053	0.074	0.065	0.085	0.083	0.069
Sunday	15	0.072	0.086	0.067	0.082	0.073	0.057	0.077	0.061	0.047	0.080	0.079	0.053	0.072	0.086	0.067	0.056	0.071	0.061	0.084	0.081	0.066
Sunday	16	0.077	0.086	0.072	0.079	0.068	0.055	0.075	0.059	0.046	0.079	0.075	0.045	0.077	0.086	0.072	0.056	0.068	0.058	0.082	0.079	0.060
Sunday	17	0.070	0.075	0.058	0.072	0.062	0.053	0.073	0.056	0.045	0.075	0.066	0.043	0.070	0.075	0.058	0.059	0.067	0.055	0.076	0.070	0.053
Sunday	18	0.067	0.059	0.054	0.060	0.052	0.049	0.066	0.050	0.044	0.066	0.054	0.039	0.067	0.059	0.054	0.059	0.062	0.055	0.064	0.056	0.043
Sunday	19	0.062	0.045	0.050	0.050	0.043	0.045	0.057	0.044	0.042	0.055	0.042	0.037	0.062	0.045	0.050	0.057	0.051	0.051	0.049	0.043	0.035
Sunday	20	0.054	0.035	0.047	0.041	0.035	0.042	0.050	0.038	0.041	0.045	0.031	0.030	0.054	0.035	0.047	0.052	0.041	0.049	0.038	0.033	0.024
Sunday	21	0.045	0.024	0.039	0.031	0.026	0.039	0.040	0.033	0.040	0.035	0.022	0.024	0.045	0.024	0.039	0.047	0.032	0.044	0.026	0.022	0.020
Sunday	22	0.033	0.015	0.033	0.021	0.019	0.036	0.030	0.028	0.040	0.023	0.013	0.018	0.033	0.015	0.033	0.039	0.023	0.042	0.017	0.014	0.017
Sunday	23	0.022	0.009	0.032	0.013	0.015	0.033	0.020	0.023	0.039	0.014	0.008	0.015	0.022	0.009	0.032	0.031	0.018	0.038	0.010	0.010	0.020
Monday	0	0.010	0.003	0.007	0.008	0.014	0.027	0.009	0.019	0.024	0.006	0.002	0.006	0.010	0.003	0.007	0.025	0.010	0.016	0.006	0.010	0.017
Monday	1	0.009	0.002	0.007	0.005	0.012	0.025	0.005	0.018	0.023	0.004	0.002	0.007	0.009	0.002	0.007	0.025	0.008	0.016	0.004	0.009	0.016
Monday	2	0.010	0.003	0.010	0.004	0.012	0.025	0.004	0.018	0.023	0.003	0.002	0.010	0.010	0.003	0.010	0.024	0.008	0.017	0.003	0.009	0.016
Monday	3	0.012	0.006	0.012	0.006	0.014	0.027	0.005	0.020	0.025	0.003	0.004	0.012	0.012	0.006	0.012	0.030	0.014	0.019	0.005	0.011	0.019
Monday	4	0.014	0.009	0.013	0.011	0.019	0.030	0.011	0.023	0.027	0.007	0.009	0.021	0.014	0.009	0.013	0.030	0.022	0.025	0.008	0.017	0.024
Monday	5	0.022	0.022	0.026	0.023	0.030	0.036	0.024	0.034	0.033	0.018	0.024	0.037	0.022	0.022	0.026	0.034	0.036	0.031	0.019	0.028	0.036
Monday	6	0.037	0.047	0.044	0.042	0.047	0.043	0.044	0.047	0.041	0.041	0.051	0.055	0.037	0.047	0.044	0.036	0.043	0.034	0.036	0.041	0.050
Monday	7	0.045	0.058	0.058	0.060	0.061	0.048	0.069	0.064	0.048	0.078	0.069	0.066	0.045	0.058	0.058	0.040	0.056	0.039	0.051	0.044	0.065
Monday	8	0.047	0.062	0.067	0.059	0.062	0.050	0.063	0.062	0.049	0.067	0.077	0.077	0.047	0.062	0.067	0.041	0.065	0.045	0.053	0.056	0.068
Monday	9	0.050	0.065	0.078	0.056	0.061	0.050	0.055	0.056	0.047	0.057	0.071	0.080	0.050	0.065	0.078	0.043	0.064	0.051	0.059	0.065	0.080
Monday	10	0.051	0.065	0.080	0.058	0.064	0.051	0.055	0.056	0.048	0.057	0.071	0.077	0.051	0.065	0.080	0.044	0.069	0.058	0.067	0.074	0.087
Monday	11	0.056	0.067	0.083	0.062	0.066	0.053	0.057	0.059	0.050	0.060	0.074	0.073	0.056	0.067	0.083	0.047	0.071	0.066	0.071	0.075	0.082
Monday	12	0.058	0.069	0.081	0.066	0.068	0.054	0.061	0.061	0.052	0.063	0.072	0.071	0.058	0.069	0.081	0.048	0.068	0.067	0.074	0.074	0.080
Monday	13	0.063	0.074	0.076	0.067	0.067	0.054	0.063	0.062	0.054	0.063	0.072	0.068	0.063	0.074	0.076	0.050	0.070	0.067	0.074	0.075	0.075
Monday	14	0.067	0.076	0.074	0.070	0.069	0.055	0.069	0.065	0.056	0.067	0.077	0.064	0.067	0.076	0.074	0.051	0.069	0.066	0.077	0.076	0.065
Monday	15	0.073	0.087	0.062	0.073	0.069	0.055	0.074	0.068	0.058	0.078	0.080	0.056	0.073	0.087	0.062	0.057	0.072	0.062	0.082	0.076	0.058
Monday	16	0.076	0.084	0.053	0.075	0.067	0.054	0.079	0.068	0.059	0.086	0.077	0.049	0.076	0.084	0.053	0.054	0.063	0.061	0.081	0.073	0.045
Monday	17	0.075	0.075	0.040	0.073	0.061	0.052	0.076	0.062	0.057	0.087	0.062	0.041	0.075	0.075	0.040	0.057	0.054	0.055	0.071	0.059	0.035

		Del Norte			El Dorado			Fresno			Glenn			Humboldt			Imperial			Inyo		
Day of Week	Hour	LD	LM	HH	LD	LM	HH	LD	LM	HH	LD	LM	HH	LD	LM	HH	LD	LM	HH	LD	LM	HH
Monday	18	0.057	0.047	0.032	0.056	0.046	0.045	0.053	0.043	0.050	0.051	0.038	0.030	0.057	0.047	0.032	0.054	0.040	0.047	0.052	0.042	0.023
Monday	19	0.050	0.031	0.029	0.040	0.031	0.039	0.037	0.030	0.043	0.036	0.024	0.024	0.050	0.031	0.029	0.052	0.032	0.041	0.037	0.030	0.017
Monday	20	0.043	0.020	0.021	0.031	0.022	0.035	0.030	0.023	0.039	0.026	0.018	0.023	0.043	0.020	0.021	0.047	0.022	0.037	0.027	0.022	0.013
Monday	21	0.035	0.015	0.020	0.025	0.017	0.032	0.024	0.018	0.035	0.020	0.012	0.021	0.035	0.015	0.020	0.045	0.018	0.031	0.020	0.016	0.010
Monday	22	0.025	0.009	0.014	0.017	0.012	0.030	0.018	0.013	0.032	0.013	0.007	0.017	0.025	0.009	0.014	0.038	0.013	0.026	0.015	0.012	0.009
Monday	23	0.016	0.005	0.013	0.012	0.009	0.030	0.012	0.010	0.029	0.008	0.004	0.015	0.016	0.005	0.013	0.030	0.014	0.025	0.009	0.007	0.010
Tues/Wed/Thurs	0	0.010	0.004	0.008	0.008	0.014	0.029	0.007	0.018	0.027	0.006	0.003	0.010	0.010	0.004	0.008	0.024	0.011	0.023	0.005	0.009	0.017
Tues/Wed/Thurs	1	0.009	0.003	0.008	0.004	0.011	0.027	0.004	0.017	0.027	0.003	0.002	0.011	0.009	0.003	0.008	0.025	0.009	0.020	0.003	0.008	0.017
Tues/Wed/Thurs	2	0.010	0.002	0.012	0.004	0.011	0.027	0.003	0.017	0.027	0.003	0.002	0.013	0.010	0.002	0.012	0.026	0.008	0.020	0.002	0.009	0.017
Tues/Wed/Thurs	3	0.011	0.005	0.014	0.005	0.013	0.029	0.004	0.019	0.028	0.003	0.003	0.015	0.011	0.005	0.014	0.027	0.012	0.022	0.003	0.010	0.022
Tues/Wed/Thurs	4	0.015	0.010	0.021	0.010	0.018	0.031	0.009	0.023	0.031	0.006	0.008	0.022	0.015	0.010	0.021	0.029	0.018	0.025	0.006	0.014	0.025
Tues/Wed/Thurs	5	0.024	0.024	0.035	0.022	0.029	0.037	0.024	0.032	0.036	0.017	0.024	0.037	0.024	0.024	0.035	0.034	0.036	0.032	0.018	0.027	0.039
Tues/Wed/Thurs	6	0.037	0.048	0.048	0.042	0.047	0.044	0.044	0.047	0.044	0.041	0.053	0.054	0.037	0.048	0.048	0.036	0.046	0.039	0.037	0.042	0.052
Tues/Wed/Thurs	7	0.045	0.059	0.065	0.060	0.061	0.050	0.070	0.064	0.051	0.077	0.069	0.066	0.045	0.059	0.065	0.040	0.057	0.044	0.053	0.047	0.064
Tues/Wed/Thurs	8	0.047	0.063	0.069	0.060	0.062	0.051	0.065	0.063	0.051	0.066	0.077	0.077	0.047	0.063	0.069	0.041	0.065	0.048	0.054	0.056	0.070
Tues/Wed/Thurs	9	0.050	0.064	0.074	0.055	0.060	0.050	0.055	0.057	0.049	0.057	0.071	0.080	0.050	0.064	0.074	0.041	0.062	0.053	0.059	0.068	0.083
Tues/Wed/Thurs	10	0.051	0.065	0.075	0.056	0.061	0.051	0.054	0.056	0.050	0.056	0.071	0.077	0.051	0.065	0.075	0.044	0.066	0.057	0.064	0.069	0.081
Tues/Wed/Thurs	11	0.055	0.065	0.076	0.059	0.064	0.052	0.055	0.058	0.051	0.058	0.071	0.074	0.055	0.065	0.076	0.046	0.067	0.061	0.068	0.069	0.077
Tues/Wed/Thurs	12	0.057	0.068	0.076	0.061	0.065	0.053	0.058	0.060	0.051	0.062	0.070	0.069	0.057	0.068	0.076	0.048	0.067	0.064	0.069	0.071	0.074
Tues/Wed/Thurs	13	0.061	0.070	0.071	0.064	0.066	0.053	0.061	0.062	0.053	0.063	0.073	0.067	0.061	0.070	0.071	0.049	0.069	0.063	0.072	0.073	0.074
Tues/Wed/Thurs	14	0.066	0.074	0.068	0.068	0.068	0.053	0.068	0.065	0.054	0.066	0.076	0.063	0.066	0.074	0.068	0.052	0.069	0.061	0.077	0.076	0.067
Tues/Wed/Thurs	15	0.073	0.084	0.062	0.073	0.069	0.053	0.074	0.067	0.056	0.079	0.080	0.056	0.073	0.084	0.062	0.055	0.071	0.057	0.084	0.078	0.058
Tues/Wed/Thurs	16	0.078	0.086	0.053	0.075	0.067	0.052	0.080	0.067	0.056	0.087	0.076	0.045	0.078	0.086	0.053	0.057	0.065	0.056	0.082	0.074	0.048
Tues/Wed/Thurs	17	0.077	0.078	0.041	0.074	0.063	0.050	0.078	0.063	0.054	0.088	0.062	0.040	0.077	0.078	0.041	0.056	0.054	0.051	0.074	0.061	0.036
Tues/Wed/Thurs	18	0.059	0.047	0.030	0.059	0.048	0.044	0.055	0.045	0.047	0.054	0.039	0.031	0.059	0.047	0.030	0.053	0.041	0.045	0.053	0.044	0.023
Tues/Wed/Thurs	19	0.048	0.031	0.027	0.043	0.034	0.038	0.039	0.032	0.040	0.036	0.026	0.023	0.048	0.031	0.027	0.052	0.032	0.039	0.038	0.031	0.016
Tues/Wed/Thurs	20	0.041	0.021	0.020	0.035	0.025	0.034	0.032	0.024	0.035	0.028	0.019	0.021	0.041	0.021	0.020	0.050	0.024	0.036	0.030	0.025	0.012
Tues/Wed/Thurs	21	0.036	0.017	0.020	0.029	0.019	0.031	0.027	0.019	0.032	0.021	0.013	0.020	0.036	0.017	0.020	0.045	0.021	0.030	0.023	0.018	0.010
Tues/Wed/Thurs	22	0.025	0.009	0.014	0.020	0.013	0.029	0.020	0.014	0.028	0.014	0.007	0.016	0.025	0.009	0.014	0.039	0.016	0.027	0.017	0.013	0.010
Tues/Wed/Thurs	23	0.017	0.005	0.012	0.013	0.009	0.028	0.013	0.010	0.025	0.009	0.004	0.013	0.017	0.005	0.012	0.031	0.013	0.025	0.010	0.008	0.010
Friday	0	0.009	0.004	0.008	0.007	0.014	0.032	0.007	0.019	0.030	0.007	0.003	0.011	0.009	0.004	0.008	0.023	0.009	0.025	0.005	0.009	0.019
Friday	1	0.009	0.003	0.009	0.005	0.011	0.030	0.004	0.018	0.030	0.004	0.003	0.012	0.009	0.003	0.009	0.024	0.009	0.022	0.003	0.008	0.019
Friday	2	0.009	0.003	0.011	0.004	0.011	0.030	0.003	0.017	0.029	0.004	0.003	0.015	0.009	0.003	0.011	0.024	0.009	0.021	0.002	0.008	0.019
Friday	3	0.011	0.005	0.016	0.005	0.012	0.030	0.004	0.019	0.031	0.004	0.004	0.017	0.011	0.005	0.016	0.026	0.011	0.023	0.002	0.008	0.021
Friday	4	0.013	0.009	0.022	0.008	0.016	0.033	0.009	0.023	0.034	0.006	0.007	0.024	0.013	0.009	0.022	0.028	0.017	0.027	0.005	0.013	0.024
Friday	5	0.021	0.021	0.039	0.017	0.026	0.038	0.020	0.032	0.039	0.015	0.022	0.039	0.021	0.021	0.039	0.032	0.031	0.034	0.013	0.023	0.037
Friday	6	0.033	0.041	0.054	0.033	0.040	0.045	0.037	0.044	0.046	0.035	0.045	0.055	0.033	0.041	0.054	0.034	0.040	0.040	0.026	0.035	0.049
Friday	7	0.039	0.052	0.065	0.049	0.054	0.050	0.059	0.060	0.053	0.063	0.063	0.064	0.039	0.052	0.065	0.036	0.052	0.049	0.039	0.040	0.060
Friday	8	0.044	0.059	0.074	0.051	0.057	0.052	0.057	0.059	0.053	0.058	0.072	0.074	0.044	0.059	0.074	0.039	0.058	0.051	0.043	0.049	0.068
Friday	9	0.047	0.060	0.078	0.050	0.057	0.052	0.052	0.056	0.052	0.052	0.068	0.075	0.047	0.060	0.078	0.040	0.059	0.056	0.049	0.057	0.073
Friday	10	0.048	0.067	0.075	0.054	0.061	0.054	0.053	0.057	0.052	0.055	0.071	0.074	0.048	0.067	0.075	0.043	0.063	0.060	0.058	0.063	0.078
Friday	11	0.054	0.068	0.077	0.060	0.066	0.055	0.056	0.059	0.053	0.060	0.074	0.074	0.054	0.068	0.077	0.045	0.066	0.064	0.064	0.069	0.077
Friday	12	0.060	0.072	0.079	0.063	0.067	0.055	0.059	0.061	0.053	0.063	0.072	0.069	0.060	0.072	0.079	0.046	0.063	0.065	0.066	0.071	0.076
Friday	13	0.063	0.075	0.072	0.066	0.068	0.054	0.062	0.063	0.054	0.065	0.076	0.069	0.063	0.075	0.072	0.049	0.066	0.063	0.071	0.074	0.077
Friday	14	0.068	0.078	0.067	0.070	0.070	0.054	0.068	0.066	0.055	0.069	0.078	0.063	0.068	0.078	0.067	0.051	0.067	0.059	0.076	0.077	0.070
Friday	15	0.073	0.083	0.060	0.073	0.070	0.052	0.073	0.067	0.055	0.078	0.080	0.055	0.073	0.083	0.060	0.054	0.069	0.057	0.083	0.079	0.060
Friday	16	0.076	0.082	0.049	0.074	0.067	0.050	0.077	0.067	0.053	0.085	0.075	0.047	0.076	0.082	0.049	0.056	0.067	0.053	0.083	0.077	0.050
Friday	17	0.074	0.072	0.038	0.072	0.063	0.047	0.074	0.061	0.050	0.082	0.061	0.039	0.074	0.072	0.038	0.058	0.060	0.048	0.075	0.064	0.038
Friday	18	0.060	0.050	0.026	0.063	0.051	0.042	0.060	0.047	0.043	0.059	0.041	0.029	0.060	0.050	0.026	0.057	0.051	0.042	0.062	0.051	0.025
Friday	19	0.052	0.034	0.024	0.050	0.039	0.035	0.046	0.034	0.036	0.042	0.028	0.024	0.052	0.034	0.024	0.057	0.043	0.038	0.050	0.039	0.018
Friday	20	0.043	0.022	0.017	0.041	0.029	0.030	0.038	0.026	0.030	0.032	0.021	0.021	0.043	0.022	0.017	0.053	0.033	0.033	0.041	0.030	0.013
Friday	21	0.040	0.018	0.016	0.037	0.023	0.028	0.034	0.020	0.026	0.027	0.015	0.020	0.040	0.018	0.016	0.049	0.025	0.027	0.036	0.025	0.010

		Del Norte			El Dorado			Fresno			Glenn			Humboldt			Imperial			Inyo		
Day of Week	Hour	LD	LM	HH	LD	LM	HH	LD	LM	HH	LD	LM	HH	LD	LM	HH	LD	LM	HH	LD	LM	HH
Friday	22	0.031	0.012	0.011	0.030	0.017	0.026	0.028	0.015	0.023	0.021	0.011	0.016	0.031	0.012	0.011	0.042	0.017	0.023	0.030	0.019	0.011
Friday	23	0.022	0.007	0.012	0.019	0.011	0.024	0.020	0.011	0.020	0.014	0.007	0.015	0.022	0.007	0.012	0.034	0.014	0.020	0.018	0.012	0.009
Saturday	0	0.012	0.008	0.014	0.013	0.019	0.038	0.015	0.028	0.041	0.012	0.007	0.021	0.012	0.008	0.014	0.025	0.018	0.036	0.010	0.015	0.027
Saturday	1	0.013	0.006	0.014	0.008	0.015	0.034	0.010	0.025	0.038	0.008	0.005	0.016	0.013	0.006	0.014	0.027	0.015	0.030	0.007	0.012	0.023
Saturday	2	0.013	0.004	0.011	0.006	0.014	0.032	0.008	0.024	0.037	0.006	0.004	0.020	0.013	0.004	0.011	0.027	0.012	0.024	0.005	0.011	0.022
Saturday	3	0.012	0.004	0.014	0.006	0.013	0.031	0.006	0.023	0.036	0.005	0.004	0.022	0.012	0.004	0.014	0.028	0.015	0.027	0.004	0.010	0.025
Saturday	4	0.014	0.008	0.020	0.007	0.014	0.032	0.009	0.024	0.037	0.006	0.008	0.024	0.014	0.008	0.020	0.031	0.019	0.030	0.005	0.013	0.028
Saturday	5	0.020	0.016	0.034	0.011	0.018	0.034	0.016	0.029	0.040	0.012	0.017	0.039	0.020	0.016	0.034	0.034	0.035	0.037	0.010	0.021	0.034
Saturday	6	0.025	0.025	0.043	0.019	0.026	0.039	0.026	0.036	0.045	0.021	0.028	0.049	0.025	0.025	0.043	0.035	0.038	0.043	0.017	0.028	0.039
Saturday	7	0.030	0.031	0.058	0.032	0.038	0.046	0.036	0.043	0.049	0.034	0.041	0.058	0.030	0.031	0.058	0.038	0.050	0.050	0.029	0.036	0.053
Saturday	8	0.036	0.041	0.070	0.045	0.051	0.052	0.045	0.050	0.052	0.045	0.057	0.067	0.036	0.041	0.070	0.040	0.057	0.055	0.044	0.045	0.060
Saturday	9	0.043	0.053	0.079	0.057	0.062	0.056	0.053	0.055	0.054	0.054	0.068	0.074	0.043	0.053	0.079	0.043	0.064	0.058	0.059	0.061	0.071
Saturday	10	0.052	0.069	0.082	0.067	0.071	0.060	0.060	0.061	0.056	0.063	0.080	0.073	0.052	0.069	0.082	0.044	0.066	0.064	0.073	0.074	0.078
Saturday	11	0.054	0.076	0.075	0.074	0.076	0.061	0.066	0.064	0.056	0.068	0.082	0.071	0.054	0.076	0.075	0.045	0.064	0.069	0.081	0.077	0.083
Saturday	12	0.061	0.080	0.070	0.075	0.075	0.060	0.069	0.065	0.056	0.074	0.083	0.068	0.061	0.080	0.070	0.046	0.063	0.066	0.078	0.077	0.075
Saturday	13	0.063	0.082	0.064	0.075	0.074	0.057	0.069	0.063	0.054	0.074	0.079	0.062	0.063	0.082	0.064	0.049	0.063	0.063	0.075	0.072	0.060
Saturday	14	0.065	0.081	0.062	0.074	0.071	0.055	0.070	0.063	0.053	0.074	0.076	0.057	0.065	0.081	0.062	0.051	0.062	0.059	0.075	0.068	0.055
Saturday	15	0.067	0.080	0.054	0.072	0.068	0.051	0.069	0.060	0.049	0.073	0.074	0.052	0.067	0.080	0.054	0.053	0.062	0.053	0.075	0.068	0.052
Saturday	16	0.071	0.081	0.051	0.070	0.064	0.048	0.067	0.057	0.046	0.073	0.067	0.045	0.071	0.081	0.051	0.053	0.057	0.047	0.072	0.070	0.047
Saturday	17	0.068	0.072	0.037	0.066	0.057	0.044	0.063	0.051	0.042	0.069	0.058	0.039	0.068	0.072	0.037	0.054	0.054	0.039	0.066	0.063	0.040
Saturday	18	0.062	0.053	0.032	0.056	0.047	0.038	0.056	0.044	0.036	0.058	0.047	0.034	0.062	0.053	0.032	0.055	0.048	0.034	0.058	0.052	0.031
Saturday	19	0.059	0.040	0.029	0.046	0.037	0.033	0.047	0.036	0.031	0.046	0.036	0.029	0.059	0.040	0.029	0.052	0.040	0.030	0.047	0.041	0.026
Saturday	20	0.051	0.032	0.021	0.040	0.030	0.028	0.041	0.031	0.027	0.040	0.028	0.024	0.051	0.032	0.021	0.049	0.032	0.026	0.038	0.031	0.020
Saturday	21	0.047	0.026	0.023	0.035	0.025	0.025	0.038	0.027	0.023	0.036	0.022	0.023	0.047	0.026	0.023	0.045	0.025	0.023	0.031	0.025	0.016
Saturday	22	0.037	0.019	0.020	0.028	0.019	0.023	0.034	0.024	0.021	0.029	0.016	0.017	0.037	0.019	0.020	0.040	0.020	0.020	0.025	0.020	0.018
Saturday	23	0.028	0.014	0.021	0.020	0.014	0.021	0.024	0.019	0.019	0.020	0.011	0.017	0.028	0.014	0.021	0.036	0.018	0.016	0.016	0.013	0.018
Holiday	0	0.010	0.004	0.009	0.010	0.016	0.028	0.013	0.023	0.029	0.010	0.004	0.012	0.010	0.004	0.009	0.027	0.013	0.019	0.008	0.011	0.020
Holiday	1	0.014	0.004	0.008	0.006	0.013	0.027	0.007	0.022	0.027	0.006	0.004	0.011	0.014	0.004	0.008	0.028	0.009	0.017	0.005	0.009	0.018
Holiday	2	0.010	0.003	0.014	0.004	0.012	0.026	0.005	0.022	0.027	0.004	0.003	0.012	0.010	0.003	0.014	0.026	0.008	0.018	0.003	0.010	0.018
Holiday	3	0.014	0.005	0.012	0.005	0.013	0.027	0.004	0.021	0.028	0.004	0.005	0.015	0.014	0.005	0.012	0.027	0.010	0.018	0.004	0.010	0.021
Holiday	4	0.014	0.006	0.017	0.008	0.016	0.029	0.008	0.024	0.030	0.007	0.009	0.024	0.014	0.006	0.017	0.030	0.016	0.022	0.005	0.012	0.020
Holiday	5	0.019	0.018	0.028	0.014	0.023	0.032	0.016	0.031	0.034	0.014	0.020	0.037	0.019	0.018	0.028	0.030	0.026	0.029	0.009	0.018	0.031
Holiday	6	0.028	0.034	0.042	0.025	0.033	0.036	0.028	0.039	0.038	0.030	0.036	0.047	0.028	0.034	0.042	0.032	0.032	0.031	0.018	0.023	0.038
Holiday	7	0.039	0.045	0.052	0.036	0.044	0.042	0.040	0.046	0.041	0.044	0.052	0.061	0.039	0.045	0.052	0.036	0.042	0.037	0.029	0.031	0.043
Holiday	8	0.041	0.051	0.059	0.046	0.053	0.048	0.045	0.049	0.043	0.052	0.066	0.075	0.041	0.051	0.059	0.040	0.055	0.044	0.041	0.044	0.056
Holiday	9	0.044	0.057	0.066	0.054	0.059	0.050	0.049	0.052	0.047	0.053	0.071	0.081	0.044	0.057	0.066	0.042	0.061	0.054	0.058	0.057	0.075
Holiday	10	0.050	0.069	0.075	0.065	0.069	0.053	0.057	0.059	0.049	0.059	0.076	0.081	0.050	0.069	0.075	0.045	0.067	0.060	0.076	0.083	0.087
Holiday	11	0.056	0.072	0.077	0.074	0.074	0.057	0.065	0.063	0.051	0.066	0.076	0.071	0.056	0.072	0.077	0.047	0.070	0.068	0.084	0.086	0.088
Holiday	12	0.058	0.080	0.078	0.077	0.074	0.056	0.070	0.067	0.054	0.071	0.078	0.074	0.058	0.080	0.078	0.046	0.069	0.070	0.085	0.087	0.089
Holiday	13	0.063	0.077	0.069	0.076	0.074	0.058	0.072	0.067	0.056	0.071	0.076	0.065	0.063	0.077	0.069	0.053	0.080	0.070	0.083	0.081	0.078
Holiday	14	0.068	0.083	0.067	0.075	0.073	0.056	0.074	0.066	0.055	0.070	0.078	0.060	0.068	0.083	0.067	0.051	0.075	0.068	0.080	0.074	0.068
Holiday	15	0.071	0.082	0.064	0.074	0.070	0.055	0.076	0.067	0.056	0.075	0.075	0.053	0.071	0.082	0.064	0.054	0.067	0.062	0.078	0.074	0.060
Holiday	16	0.075	0.083	0.061	0.072	0.066	0.054	0.076	0.064	0.055	0.079	0.070	0.044	0.075	0.083	0.061	0.056	0.066	0.057	0.078	0.072	0.049
Holiday	17	0.072	0.076	0.044	0.068	0.059	0.051	0.072	0.058	0.052	0.074	0.064	0.041	0.072	0.076	0.044	0.056	0.061	0.054	0.071	0.066	0.041
Holiday	18	0.054	0.048	0.040	0.057	0.049	0.045	0.058	0.046	0.049	0.058	0.044	0.034	0.054	0.048	0.040	0.052	0.047	0.045	0.057	0.049	0.033
Holiday	19	0.056	0.036	0.029	0.047	0.036	0.041	0.047	0.035	0.043	0.047	0.033	0.026	0.056	0.036	0.029	0.053	0.039	0.040	0.043	0.040	0.022
Holiday	20	0.049	0.025	0.029	0.039	0.029	0.037	0.039	0.028	0.040	0.038	0.025	0.025	0.049	0.025	0.029	0.049	0.029	0.035	0.033	0.026	0.013
Holiday	21	0.040	0.019	0.023	0.030	0.020	0.033	0.032	0.022	0.036	0.030	0.018	0.021	0.040	0.019	0.023	0.046	0.022	0.030	0.024	0.018	0.011
Holiday	22	0.029	0.012	0.018	0.023	0.015	0.031	0.026	0.017	0.032	0.024	0.011	0.017	0.029	0.012	0.018	0.042	0.020	0.027	0.017	0.012	0.009
Holiday	23	0.025	0.010	0.019	0.015	0.010	0.029	0.018	0.013	0.029	0.014	0.007	0.014	0.025	0.010	0.019	0.032	0.019	0.025	0.010	0.008	0.010

		Kern			Kings			Lake			Lassen			Los Angeles			Madera			Marin		
Day of Week	Hour	LD	LM	HH	LD	LM	HH	LD	LM	HH	LD	LM	HH	LD	LM	HH	LD	LM	HH	LD	LM	HH
Sunday	0	0.014	0.028	0.041	0.016	0.031	0.042	0.013	0.011	0.008	0.020	0.007	0.015	0.025	0.043	0.051	0.014	0.037	0.044	0.019	0.038	0.053
Sunday	1	0.010	0.024	0.038	0.010	0.025	0.038	0.013	0.008	0.010	0.020	0.005	0.014	0.018	0.033	0.044	0.008	0.032	0.040	0.012	0.034	0.047
Sunday	2	0.007	0.022	0.034	0.007	0.026	0.036	0.012	0.006	0.008	0.020	0.003	0.012	0.014	0.028	0.040	0.005	0.028	0.037	0.008	0.031	0.043
Sunday	3	0.006	0.020	0.033	0.005	0.022	0.031	0.014	0.005	0.007	0.021	0.004	0.011	0.009	0.022	0.035	0.004	0.026	0.035	0.006	0.030	0.040
Sunday	4	0.007	0.021	0.033	0.004	0.020	0.031	0.014	0.004	0.011	0.024	0.007	0.011	0.008	0.021	0.034	0.004	0.025	0.034	0.006	0.029	0.038
Sunday	5	0.012	0.024	0.033	0.008	0.023	0.031	0.017	0.009	0.019	0.028	0.012	0.015	0.012	0.024	0.035	0.009	0.027	0.034	0.010	0.031	0.038
Sunday	6	0.016	0.027	0.034	0.018	0.029	0.036	0.021	0.014	0.028	0.030	0.017	0.026	0.018	0.029	0.037	0.016	0.030	0.036	0.016	0.033	0.039
Sunday	7	0.024	0.032	0.035	0.023	0.030	0.035	0.026	0.020	0.036	0.034	0.032	0.037	0.025	0.034	0.039	0.022	0.033	0.036	0.023	0.036	0.040
Sunday	8	0.032	0.039	0.038	0.034	0.040	0.040	0.031	0.032	0.043	0.037	0.045	0.053	0.035	0.040	0.042	0.033	0.039	0.040	0.033	0.040	0.042
Sunday	9	0.042	0.045	0.040	0.048	0.049	0.046	0.040	0.050	0.054	0.044	0.064	0.064	0.047	0.050	0.045	0.046	0.047	0.044	0.048	0.046	0.044
Sunday	10	0.051	0.051	0.042	0.059	0.057	0.049	0.047	0.064	0.067	0.046	0.076	0.072	0.057	0.056	0.047	0.056	0.052	0.046	0.062	0.051	0.045
Sunday	11	0.059	0.056	0.045	0.071	0.064	0.052	0.055	0.079	0.062	0.050	0.083	0.079	0.062	0.059	0.047	0.065	0.057	0.048	0.067	0.053	0.046
Sunday	12	0.066	0.060	0.046	0.084	0.077	0.057	0.061	0.087	0.065	0.053	0.088	0.075	0.065	0.060	0.047	0.071	0.059	0.049	0.070	0.054	0.046
Sunday	13	0.071	0.063	0.047	0.083	0.077	0.056	0.065	0.092	0.064	0.054	0.082	0.069	0.068	0.060	0.046	0.073	0.059	0.049	0.073	0.055	0.050
Sunday	14	0.075	0.065	0.047	0.080	0.072	0.055	0.067	0.087	0.065	0.059	0.075	0.067	0.068	0.058	0.044	0.076	0.059	0.048	0.073	0.055	0.047
Sunday	15	0.078	0.064	0.048	0.076	0.065	0.052	0.072	0.086	0.067	0.060	0.076	0.064	0.067	0.055	0.043	0.076	0.058	0.047	0.073	0.053	0.041
Sunday	16	0.077	0.063	0.048	0.074	0.062	0.050	0.077	0.086	0.072	0.063	0.074	0.058	0.065	0.052	0.042	0.077	0.058	0.047	0.072	0.052	0.039
Sunday	17	0.074	0.060	0.047	0.068	0.056	0.046	0.070	0.075	0.058	0.063	0.063	0.058	0.063	0.049	0.040	0.074	0.055	0.046	0.070	0.050	0.038
Sunday	18	0.069	0.055	0.046	0.059	0.044	0.042	0.067	0.059	0.054	0.061	0.053	0.050	0.059	0.045	0.040	0.068	0.048	0.043	0.063	0.047	0.036
Sunday	19	0.061	0.049	0.046	0.050	0.037	0.037	0.062	0.045	0.050	0.059	0.051	0.041	0.056	0.042	0.039	0.060	0.043	0.041	0.056	0.044	0.035
Sunday	20	0.053	0.042	0.045	0.043	0.032	0.037	0.054	0.035	0.047	0.051	0.034	0.036	0.052	0.040	0.040	0.052	0.039	0.040	0.051	0.041	0.036
Sunday	21	0.042	0.035	0.044	0.036	0.028	0.035	0.045	0.024	0.039	0.044	0.025	0.031	0.047	0.038	0.041	0.042	0.034	0.039	0.042	0.038	0.037
Sunday	22	0.032	0.030	0.045	0.028	0.022	0.034	0.033	0.015	0.033	0.035	0.016	0.024	0.036	0.034	0.042	0.031	0.028	0.038	0.030	0.032	0.039
Sunday	23	0.021	0.025	0.046	0.015	0.015	0.033	0.022	0.009	0.032	0.024	0.009	0.018	0.024	0.029	0.042	0.018	0.023	0.037	0.019	0.027	0.043
Monday	0	0.013	0.022	0.025	0.005	0.013	0.019	0.010	0.003	0.007	0.020	0.005	0.012	0.012	0.018	0.025	0.007	0.021	0.024	0.007	0.023	0.029
Monday	1	0.009	0.019	0.024	0.002	0.012	0.019	0.009	0.002	0.007	0.021	0.003	0.010	0.007	0.015	0.023	0.003	0.020	0.024	0.003	0.022	0.028
Monday	2	0.008	0.019	0.024	0.001	0.014	0.020	0.010	0.003	0.010	0.022	0.003	0.012	0.006	0.015	0.023	0.002	0.020	0.024	0.002	0.022	0.029
Monday	3	0.011	0.022	0.026	0.001	0.012	0.019	0.012	0.006	0.012	0.023	0.004	0.012	0.007	0.017	0.024	0.004	0.023	0.026	0.003	0.023	0.030
Monday	4	0.021	0.029	0.028	0.003	0.015	0.021	0.014	0.009	0.013	0.026	0.011	0.013	0.016	0.024	0.030	0.012	0.028	0.029	0.012	0.028	0.035
Monday	5	0.040	0.041	0.033	0.012	0.021	0.027	0.022	0.022	0.026	0.037	0.047	0.021	0.038	0.042	0.038	0.029	0.039	0.036	0.033	0.041	0.042
Monday	6	0.047	0.046	0.034	0.034	0.040	0.038	0.037	0.047	0.044	0.038	0.049	0.030	0.054	0.056	0.044	0.050	0.051	0.044	0.054	0.051	0.048
Monday	7	0.056	0.054	0.038	0.070	0.071	0.056	0.045	0.058	0.058	0.041	0.051	0.035	0.061	0.062	0.049	0.072	0.063	0.051	0.066	0.058	0.053
Monday	8	0.050	0.052	0.038	0.073	0.071	0.056	0.047	0.062	0.067	0.043	0.058	0.047	0.059	0.061	0.049	0.063	0.059	0.049	0.062	0.060	0.055
Monday	9	0.049	0.052	0.039	0.061	0.062	0.053	0.050	0.065	0.078	0.045	0.073	0.058	0.054	0.058	0.049	0.058	0.056	0.049	0.055	0.056	0.054
Monday	10	0.052	0.053	0.042	0.059	0.062	0.054	0.051	0.065	0.080	0.047	0.076	0.068	0.052	0.057	0.050	0.057	0.057	0.051	0.052	0.054	0.053
Monday	11	0.057	0.056	0.044	0.059	0.063	0.056	0.056	0.067	0.083	0.052	0.073	0.077	0.052	0.058	0.051	0.059	0.059	0.053	0.053	0.055	0.054
Monday	12	0.061	0.059	0.046	0.062	0.064	0.056	0.058	0.069	0.081	0.053	0.068	0.073	0.054	0.058	0.052	0.060	0.062	0.055	0.054	0.056	0.054
Monday	13	0.064	0.060	0.049	0.064	0.067	0.058	0.063	0.074	0.076	0.056	0.065	0.066	0.055	0.058	0.052	0.061	0.061	0.054	0.056	0.056	0.054
Monday	14	0.068	0.063	0.052	0.073	0.071	0.064	0.067	0.076	0.074	0.058	0.072	0.066	0.059	0.060	0.052	0.066	0.062	0.057	0.063	0.059	0.056
Monday	15	0.074	0.067	0.057	0.078	0.072	0.064	0.073	0.087	0.062	0.059	0.079	0.061	0.062	0.060	0.052	0.071	0.064	0.058	0.069	0.063	0.058
Monday	16	0.073	0.065	0.058	0.086	0.073	0.062	0.076	0.084	0.053	0.061	0.069	0.053	0.063	0.058	0.051	0.075	0.062	0.057	0.072	0.060	0.052
Monday	17	0.067	0.058	0.057	0.087	0.070	0.062	0.075	0.075	0.040	0.059	0.067	0.054	0.064	0.055	0.050	0.074	0.058	0.055	0.073	0.056	0.047
Monday	18	0.050	0.044	0.053	0.056	0.046	0.053	0.057	0.047	0.032	0.056	0.043	0.048	0.059	0.047	0.047	0.052	0.041	0.047	0.061	0.045	0.039
Monday	19	0.037	0.034	0.049	0.037	0.028	0.038	0.050	0.031	0.029	0.050	0.030	0.044	0.049	0.036	0.042	0.037	0.030	0.039	0.045	0.033	0.031
Monday	20	0.032	0.028	0.048	0.029	0.021	0.033	0.043	0.020	0.021	0.043	0.021	0.036	0.039	0.028	0.038	0.030	0.022	0.034	0.035	0.026	0.026
Monday	21	0.026	0.023	0.048	0.023	0.015	0.029	0.035	0.015	0.020	0.040	0.016	0.037	0.034	0.023	0.037	0.025	0.017	0.031	0.031	0.022	0.024
Monday	22	0.021	0.018	0.044	0.016	0.010	0.024	0.025	0.009	0.014	0.030	0.009	0.035	0.027	0.020	0.036	0.019	0.014	0.027	0.023	0.017	0.023
Monday	23	0.014	0.015	0.042	0.009	0.007	0.021	0.016	0.005	0.013	0.022	0.006	0.030	0.017	0.016	0.035	0.012	0.011	0.024	0.014	0.014	0.025

		Kern			Kings			Lake			Lassen			Los Angeles			Madera			Marin		
Day of Week	Hour	LD	LM	HH	LD	LM	HH	LD	LM	HH	LD	LM	HH	LD	LM	HH	LD	LM	HH	LD	LM	HH
Tues/Wed/Thurs	0	0.010	0.021	0.032	0.004	0.013	0.022	0.010	0.004	0.008	0.022	0.004	0.024	0.011	0.019	0.029	0.005	0.020	0.027	0.006	0.022	0.031
Tues/Wed/Thurs	1	0.006	0.019	0.031	0.002	0.012	0.021	0.009	0.003	0.008	0.022	0.004	0.016	0.006	0.016	0.028	0.001	0.019	0.026	0.003	0.021	0.030
Tues/Wed/Thurs	2	0.006	0.019	0.031	0.000	0.011	0.021	0.010	0.002	0.012	0.024	0.003	0.012	0.005	0.016	0.027	0.001	0.019	0.027	0.002	0.021	0.030
Tues/Wed/Thurs	3	0.009	0.022	0.031	0.000	0.012	0.021	0.011	0.005	0.014	0.025	0.005	0.016	0.007	0.017	0.028	0.002	0.022	0.028	0.003	0.023	0.031
Tues/Wed/Thurs	4	0.019	0.029	0.034	0.003	0.014	0.023	0.015	0.010	0.021	0.028	0.011	0.025	0.015	0.025	0.033	0.010	0.027	0.032	0.011	0.028	0.036
Tues/Wed/Thurs	5	0.039	0.041	0.037	0.012	0.021	0.029	0.024	0.024	0.035	0.039	0.045	0.028	0.037	0.042	0.041	0.027	0.037	0.039	0.034	0.040	0.044
Tues/Wed/Thurs	6	0.048	0.046	0.039	0.035	0.040	0.042	0.037	0.048	0.048	0.041	0.045	0.035	0.054	0.056	0.047	0.050	0.050	0.047	0.056	0.052	0.049
Tues/Wed/Thurs	7	0.058	0.053	0.042	0.070	0.066	0.055	0.045	0.059	0.065	0.041	0.054	0.046	0.061	0.062	0.051	0.074	0.063	0.054	0.068	0.059	0.054
Tues/Wed/Thurs	8	0.052	0.052	0.042	0.073	0.071	0.058	0.047	0.063	0.069	0.044	0.061	0.053	0.059	0.062	0.051	0.065	0.059	0.052	0.063	0.060	0.056
Tues/Wed/Thurs	9	0.049	0.050	0.041	0.060	0.062	0.054	0.050	0.064	0.074	0.046	0.067	0.059	0.054	0.058	0.050	0.057	0.057	0.051	0.055	0.055	0.053
Tues/Wed/Thurs	10	0.050	0.051	0.042	0.057	0.060	0.054	0.051	0.065	0.075	0.048	0.069	0.067	0.052	0.057	0.051	0.055	0.057	0.052	0.051	0.053	0.052
Tues/Wed/Thurs	11	0.054	0.054	0.044	0.058	0.063	0.056	0.055	0.065	0.076	0.049	0.069	0.074	0.052	0.057	0.051	0.056	0.058	0.052	0.050	0.054	0.052
Tues/Wed/Thurs	12	0.059	0.056	0.046	0.060	0.064	0.056	0.057	0.068	0.076	0.051	0.069	0.070	0.053	0.057	0.051	0.057	0.059	0.053	0.052	0.055	0.053
Tues/Wed/Thurs	13	0.062	0.058	0.047	0.061	0.064	0.057	0.061	0.070	0.071	0.054	0.071	0.064	0.055	0.058	0.050	0.059	0.060	0.054	0.054	0.056	0.054
Tues/Wed/Thurs	14	0.068	0.062	0.050	0.071	0.070	0.059	0.066	0.074	0.068	0.056	0.072	0.062	0.059	0.059	0.050	0.065	0.063	0.055	0.062	0.059	0.054
Tues/Wed/Thurs	15	0.075	0.067	0.053	0.077	0.072	0.062	0.073	0.084	0.062	0.058	0.073	0.059	0.060	0.058	0.049	0.072	0.064	0.056	0.067	0.063	0.056
Tues/Wed/Thurs	16	0.075	0.066	0.054	0.086	0.073	0.060	0.078	0.086	0.053	0.058	0.070	0.053	0.062	0.056	0.048	0.078	0.064	0.055	0.070	0.060	0.051
Tues/Wed/Thurs	17	0.070	0.060	0.053	0.087	0.072	0.060	0.077	0.078	0.041	0.060	0.071	0.048	0.062	0.053	0.046	0.079	0.061	0.053	0.071	0.057	0.046
Tues/Wed/Thurs	18	0.052	0.046	0.048	0.059	0.051	0.051	0.059	0.047	0.030	0.053	0.043	0.043	0.058	0.046	0.043	0.055	0.043	0.044	0.062	0.047	0.039
Tues/Wed/Thurs	19	0.039	0.036	0.044	0.039	0.032	0.038	0.048	0.031	0.027	0.049	0.034	0.038	0.051	0.036	0.039	0.040	0.031	0.036	0.048	0.035	0.031
Tues/Wed/Thurs	20	0.033	0.030	0.042	0.032	0.023	0.032	0.041	0.021	0.020	0.044	0.025	0.030	0.042	0.028	0.036	0.033	0.024	0.032	0.038	0.027	0.026
Tues/Wed/Thurs	21	0.029	0.025	0.041	0.026	0.017	0.028	0.036	0.017	0.020	0.038	0.018	0.029	0.037	0.024	0.034	0.028	0.019	0.028	0.033	0.022	0.024
Tues/Wed/Thurs	22	0.023	0.020	0.039	0.018	0.011	0.023	0.025	0.009	0.014	0.029	0.011	0.026	0.030	0.020	0.033	0.021	0.014	0.025	0.024	0.017	0.022
Tues/Wed/Thurs	23	0.015	0.017	0.038	0.010	0.007	0.019	0.017	0.005	0.012	0.022	0.006	0.024	0.019	0.016	0.032	0.013	0.011	0.023	0.015	0.013	0.024
Friday	0	0.009	0.021	0.035	0.006	0.014	0.024	0.009	0.004	0.008	0.021	0.005	0.023	0.012	0.021	0.032	0.005	0.020	0.029	0.008	0.022	0.033
Friday	1	0.007	0.019	0.034	0.002	0.012	0.024	0.009	0.003	0.009	0.022	0.004	0.015	0.008	0.017	0.030	0.002	0.019	0.029	0.004	0.021	0.031
Friday	2	0.006	0.019	0.034	0.001	0.011	0.022	0.009	0.003	0.011	0.023	0.003	0.011	0.007	0.017	0.030	0.001	0.019	0.029	0.003	0.022	0.032
Friday	3	0.008	0.021	0.035	0.001	0.013	0.024	0.011	0.005	0.016	0.024	0.004	0.016	0.007	0.018	0.031	0.003	0.021	0.030	0.004	0.023	0.033
Friday	4	0.015	0.027	0.037	0.002	0.015	0.025	0.013	0.009	0.022	0.025	0.007	0.025	0.014	0.025	0.035	0.008	0.026	0.034	0.010	0.028	0.036
Friday	5	0.031	0.037	0.040	0.011	0.021	0.031	0.021	0.021	0.039	0.033	0.027	0.029	0.033	0.040	0.044	0.022	0.036	0.040	0.030	0.039	0.044
Friday	6	0.039	0.043	0.043	0.031	0.039	0.043	0.033	0.041	0.054	0.035	0.034	0.035	0.049	0.054	0.050	0.039	0.047	0.048	0.050	0.049	0.050
Friday	7	0.048	0.050	0.045	0.063	0.064	0.057	0.039	0.052	0.065	0.040	0.046	0.049	0.057	0.060	0.053	0.059	0.058	0.054	0.063	0.057	0.055
Friday	8	0.045	0.050	0.045	0.067	0.069	0.059	0.044	0.059	0.074	0.044	0.061	0.056	0.056	0.060	0.054	0.054	0.058	0.054	0.059	0.057	0.056
Friday	9	0.045	0.049	0.046	0.057	0.062	0.057	0.047	0.060	0.078	0.047	0.068	0.060	0.052	0.058	0.054	0.051	0.056	0.054	0.053	0.054	0.054
Friday	10	0.049	0.053	0.047	0.057	0.063	0.056	0.048	0.067	0.075	0.046	0.068	0.071	0.052	0.058	0.054	0.052	0.057	0.054	0.051	0.053	0.053
Friday	11	0.054	0.055	0.048	0.059	0.065	0.058	0.054	0.068	0.077	0.049	0.075	0.077	0.053	0.059	0.054	0.054	0.059	0.054	0.053	0.055	0.054
Friday	12	0.058	0.057	0.049	0.061	0.064	0.058	0.060	0.072	0.079	0.051	0.071	0.070	0.054	0.059	0.054	0.056	0.060	0.055	0.056	0.057	0.055
Friday	13	0.063	0.060	0.050	0.062	0.066	0.058	0.063	0.075	0.072	0.056	0.074	0.065	0.056	0.059	0.052	0.059	0.062	0.055	0.058	0.058	0.056
Friday	14	0.068	0.063	0.051	0.070	0.069	0.058	0.068	0.078	0.067	0.056	0.074	0.060	0.057	0.059	0.051	0.065	0.063	0.055	0.064	0.059	0.056
Friday	15	0.072	0.067	0.053	0.073	0.069	0.060	0.073	0.083	0.060	0.059	0.074	0.055	0.058	0.057	0.049	0.071	0.064	0.056	0.066	0.062	0.056
Friday	16	0.073	0.064	0.052	0.079	0.073	0.060	0.076	0.082	0.049	0.061	0.072	0.054	0.059	0.055	0.046	0.077	0.062	0.053	0.067	0.059	0.050
Friday	17	0.070	0.059	0.050	0.079	0.065	0.055	0.074	0.072	0.038	0.058	0.066	0.046	0.059	0.051	0.044	0.076	0.057	0.049	0.067	0.055	0.046
Friday	18	0.060	0.048	0.044	0.061	0.050	0.047	0.060	0.050	0.026	0.056	0.051	0.043	0.057	0.045	0.040	0.063	0.046	0.042	0.060	0.047	0.039
Friday	19	0.049	0.039	0.039	0.045	0.034	0.036	0.052	0.034	0.024	0.052	0.043	0.036	0.051	0.037	0.035	0.050	0.035	0.035	0.049	0.036	0.030
Friday	20	0.042	0.032	0.035	0.036	0.023	0.028	0.043	0.022	0.017	0.046	0.032	0.028	0.045	0.029	0.030	0.042	0.026	0.029	0.040	0.029	0.023
Friday	21	0.037	0.027	0.032	0.031	0.017	0.024	0.040	0.018	0.016	0.041	0.021	0.026	0.040	0.024	0.027	0.037	0.021	0.025	0.035	0.023	0.020
Friday	22	0.031	0.023	0.029	0.028	0.013	0.019	0.031	0.012	0.011	0.032	0.013	0.026	0.036	0.021	0.026	0.030	0.015	0.020	0.030	0.019	0.019
Friday	23	0.021	0.018	0.027	0.017	0.008	0.016	0.022	0.007	0.012	0.023	0.008	0.024	0.027	0.017	0.024	0.021	0.012	0.018	0.022	0.015	0.020
Saturday	0	0.016	0.028	0.043	0.013	0.022	0.035	0.012	0.008	0.014	0.024	0.009	0.025	0.020	0.031	0.046	0.012	0.031	0.042	0.015	0.030	0.044
Saturday	1	0.011	0.023	0.041	0.008	0.019	0.032	0.013	0.006	0.014	0.026	0.007	0.015	0.013	0.025	0.041	0.008	0.027	0.039	0.009	0.027	0.040
Saturday	2	0.009	0.022	0.040	0.005	0.017	0.031	0.013	0.004	0.011	0.025	0.004	0.013	0.011	0.023	0.039	0.006	0.025	0.038	0.006	0.026	0.039
Saturday	3	0.009	0.021	0.040	0.003	0.016	0.030	0.012	0.004	0.014	0.026	0.004	0.017	0.008	0.020	0.037	0.005	0.024	0.036	0.005	0.025	0.037

		Kern			Kings			Lake			Lassen			Los Angeles			Madera			Marin		
Day of Week	**Hour**	**LD**	**LM**	**HH**	**LD**	**LM**	**HH**	**LD**	**LM**	**HH**	**LD**	**LM**	**HH**	**LD**	**LM**	**HH**	**LD**	**LM**	**HH**	**LD**	**LM**	**HH**
Saturday	4	0.014	0.025	0.041	0.004	0.016	0.031	0.014	0.008	0.020	0.029	0.007	0.025	0.010	0.022	0.038	0.008	0.027	0.037	0.006	0.027	0.037
Saturday	5	0.027	0.034	0.044	0.010	0.022	0.033	0.020	0.016	0.034	0.035	0.022	0.023	0.017	0.028	0.042	0.017	0.032	0.041	0.013	0.030	0.040
Saturday	6	0.034	0.038	0.045	0.023	0.031	0.041	0.025	0.025	0.043	0.039	0.035	0.033	0.027	0.036	0.046	0.026	0.039	0.046	0.023	0.035	0.042
Saturday	7	0.042	0.045	0.047	0.036	0.041	0.048	0.030	0.031	0.058	0.039	0.041	0.050	0.037	0.046	0.051	0.036	0.045	0.050	0.034	0.041	0.047
Saturday	8	0.050	0.052	0.050	0.045	0.049	0.053	0.036	0.041	0.070	0.044	0.057	0.053	0.046	0.052	0.054	0.047	0.052	0.054	0.046	0.047	0.049
Saturday	9	0.056	0.056	0.052	0.053	0.054	0.057	0.043	0.053	0.079	0.047	0.074	0.065	0.053	0.057	0.056	0.055	0.057	0.056	0.055	0.051	0.050
Saturday	10	0.060	0.057	0.053	0.061	0.063	0.059	0.052	0.069	0.082	0.050	0.080	0.075	0.057	0.060	0.056	0.062	0.062	0.060	0.061	0.054	0.051
Saturday	11	0.063	0.059	0.053	0.067	0.072	0.062	0.054	0.076	0.075	0.050	0.078	0.073	0.060	0.062	0.056	0.067	0.063	0.058	0.065	0.056	0.052
Saturday	12	0.065	0.061	0.052	0.071	0.072	0.064	0.061	0.080	0.070	0.053	0.075	0.066	0.062	0.062	0.054	0.068	0.062	0.056	0.066	0.058	0.055
Saturday	13	0.066	0.061	0.050	0.071	0.069	0.060	0.063	0.082	0.064	0.055	0.070	0.064	0.062	0.060	0.051	0.068	0.059	0.054	0.067	0.059	0.058
Saturday	14	0.067	0.060	0.049	0.071	0.070	0.060	0.065	0.081	0.062	0.053	0.068	0.063	0.062	0.058	0.048	0.068	0.059	0.051	0.067	0.058	0.057
Saturday	15	0.067	0.060	0.048	0.070	0.067	0.055	0.067	0.080	0.054	0.054	0.063	0.059	0.062	0.056	0.045	0.068	0.056	0.049	0.068	0.057	0.051
Saturday	16	0.064	0.056	0.044	0.070	0.061	0.049	0.071	0.081	0.051	0.057	0.064	0.055	0.062	0.053	0.042	0.068	0.054	0.046	0.068	0.056	0.047
Saturday	17	0.058	0.052	0.041	0.066	0.056	0.046	0.068	0.072	0.037	0.055	0.064	0.051	0.060	0.049	0.038	0.064	0.050	0.041	0.067	0.054	0.044
Saturday	18	0.051	0.046	0.036	0.059	0.048	0.038	0.062	0.053	0.032	0.052	0.049	0.044	0.057	0.044	0.034	0.057	0.042	0.035	0.060	0.048	0.036
Saturday	19	0.044	0.037	0.032	0.049	0.036	0.030	0.059	0.040	0.029	0.048	0.039	0.039	0.051	0.037	0.029	0.049	0.034	0.029	0.049	0.041	0.029
Saturday	20	0.039	0.033	0.028	0.043	0.032	0.027	0.051	0.032	0.021	0.046	0.034	0.030	0.046	0.033	0.026	0.043	0.030	0.025	0.043	0.036	0.025
Saturday	21	0.035	0.029	0.026	0.040	0.027	0.022	0.047	0.026	0.023	0.039	0.026	0.026	0.043	0.030	0.024	0.039	0.027	0.022	0.041	0.033	0.024
Saturday	22	0.030	0.024	0.024	0.037	0.024	0.020	0.037	0.019	0.020	0.031	0.020	0.020	0.042	0.029	0.024	0.035	0.024	0.019	0.037	0.029	0.023
Saturday	23	0.023	0.020	0.020	0.024	0.017	0.017	0.028	0.014	0.021	0.023	0.010	0.017	0.033	0.026	0.022	0.025	0.020	0.018	0.028	0.024	0.022
Holiday	0	0.015	0.023	0.028	0.011	0.017	0.026	0.010	0.004	0.009	0.020	0.007	0.015	0.017	0.024	0.031	0.010	0.023	0.027	0.013	0.027	0.034
Holiday	1	0.009	0.021	0.028	0.006	0.018	0.023	0.014	0.004	0.008	0.020	0.003	0.012	0.011	0.020	0.028	0.004	0.024	0.028	0.007	0.026	0.033
Holiday	2	0.007	0.020	0.028	0.002	0.018	0.027	0.010	0.003	0.014	0.025	0.003	0.011	0.009	0.019	0.027	0.002	0.022	0.027	0.004	0.025	0.033
Holiday	3	0.008	0.021	0.028	0.001	0.019	0.027	0.014	0.005	0.012	0.022	0.002	0.016	0.007	0.019	0.028	0.001	0.023	0.028	0.003	0.025	0.033
Holiday	4	0.013	0.024	0.028	0.002	0.015	0.027	0.014	0.006	0.017	0.024	0.004	0.015	0.012	0.023	0.030	0.006	0.026	0.030	0.007	0.029	0.035
Holiday	5	0.027	0.032	0.032	0.010	0.021	0.027	0.019	0.018	0.028	0.031	0.020	0.021	0.024	0.033	0.036	0.016	0.033	0.035	0.017	0.034	0.039
Holiday	6	0.033	0.037	0.033	0.026	0.034	0.037	0.028	0.034	0.042	0.033	0.025	0.028	0.034	0.041	0.040	0.028	0.040	0.039	0.029	0.040	0.044
Holiday	7	0.039	0.043	0.036	0.043	0.046	0.041	0.039	0.045	0.052	0.038	0.036	0.044	0.042	0.047	0.043	0.037	0.045	0.042	0.038	0.045	0.047
Holiday	8	0.043	0.047	0.037	0.050	0.052	0.042	0.041	0.051	0.059	0.044	0.054	0.043	0.045	0.050	0.045	0.044	0.051	0.045	0.045	0.050	0.051
Holiday	9	0.050	0.050	0.040	0.051	0.052	0.050	0.044	0.057	0.066	0.046	0.071	0.064	0.048	0.053	0.047	0.051	0.053	0.048	0.049	0.053	0.052
Holiday	10	0.055	0.055	0.042	0.060	0.067	0.052	0.050	0.069	0.075	0.051	0.088	0.073	0.054	0.058	0.050	0.060	0.060	0.053	0.056	0.056	0.053
Holiday	11	0.064	0.060	0.047	0.067	0.070	0.059	0.056	0.072	0.077	0.053	0.082	0.075	0.058	0.061	0.051	0.068	0.064	0.055	0.062	0.059	0.055
Holiday	12	0.068	0.061	0.050	0.073	0.077	0.064	0.058	0.080	0.078	0.055	0.082	0.072	0.061	0.063	0.053	0.072	0.066	0.056	0.067	0.061	0.056
Holiday	13	0.071	0.066	0.051	0.075	0.072	0.057	0.063	0.077	0.069	0.054	0.078	0.063	0.063	0.064	0.053	0.071	0.067	0.058	0.070	0.062	0.056
Holiday	14	0.073	0.064	0.052	0.076	0.070	0.062	0.068	0.083	0.067	0.060	0.077	0.067	0.064	0.064	0.053	0.073	0.064	0.058	0.073	0.062	0.057
Holiday	15	0.075	0.067	0.055	0.072	0.073	0.063	0.071	0.082	0.064	0.054	0.081	0.062	0.065	0.061	0.051	0.075	0.062	0.054	0.071	0.061	0.054
Holiday	16	0.072	0.064	0.055	0.075	0.066	0.057	0.075	0.083	0.061	0.062	0.077	0.063	0.064	0.057	0.050	0.076	0.060	0.054	0.070	0.057	0.050
Holiday	17	0.066	0.059	0.054	0.071	0.059	0.053	0.072	0.076	0.044	0.061	0.066	0.050	0.063	0.053	0.048	0.073	0.056	0.053	0.067	0.053	0.044
Holiday	18	0.056	0.046	0.049	0.059	0.046	0.048	0.054	0.048	0.040	0.057	0.043	0.042	0.058	0.046	0.045	0.061	0.044	0.046	0.059	0.045	0.038
Holiday	19	0.047	0.042	0.050	0.047	0.032	0.038	0.056	0.036	0.029	0.052	0.035	0.041	0.052	0.038	0.042	0.050	0.035	0.040	0.051	0.036	0.031
Holiday	20	0.039	0.033	0.046	0.040	0.029	0.033	0.049	0.025	0.029	0.043	0.022	0.034	0.047	0.032	0.039	0.043	0.029	0.037	0.046	0.031	0.028
Holiday	21	0.031	0.027	0.046	0.034	0.024	0.033	0.040	0.019	0.023	0.041	0.024	0.036	0.042	0.028	0.038	0.035	0.022	0.032	0.041	0.026	0.026
Holiday	22	0.025	0.021	0.043	0.030	0.015	0.031	0.029	0.012	0.018	0.031	0.011	0.026	0.037	0.025	0.037	0.028	0.018	0.029	0.033	0.021	0.025
Holiday	23	0.016	0.018	0.041	0.018	0.009	0.022	0.025	0.010	0.019	0.022	0.009	0.026	0.025	0.020	0.036	0.018	0.014	0.026	0.021	0.017	0.026

		Mariposa			Mendocino			Merced			Modoc			Mono			Monterey			Napa		
Day of Week	Hour	LD	LM	HH	LD	LM	HH	LD	LM	HH	LD	LM	HH	LD	LM	HH	LD	LM	HH	LD	LM	HH
Sunday	0	0.010	0.014	0.032	0.013	0.011	0.008	0.014	0.025	0.037	0.019	0.009	0.017	0.010	0.014	0.032	0.019	0.010	0.029	0.017	0.035	0.054
Sunday	1	0.007	0.011	0.024	0.013	0.008	0.010	0.009	0.019	0.032	0.021	0.007	0.014	0.007	0.011	0.024	0.020	0.008	0.023	0.011	0.030	0.047
Sunday	2	0.005	0.011	0.022	0.012	0.006	0.008	0.007	0.016	0.029	0.022	0.006	0.013	0.005	0.011	0.022	0.020	0.007	0.021	0.007	0.028	0.044
Sunday	3	0.004	0.010	0.021	0.014	0.005	0.007	0.005	0.015	0.028	0.022	0.005	0.013	0.004	0.010	0.021	0.020	0.007	0.019	0.006	0.026	0.043
Sunday	4	0.004	0.010	0.020	0.014	0.004	0.011	0.006	0.016	0.028	0.023	0.006	0.013	0.004	0.010	0.020	0.024	0.012	0.019	0.006	0.025	0.038
Sunday	5	0.007	0.013	0.021	0.017	0.009	0.019	0.010	0.019	0.029	0.025	0.008	0.016	0.007	0.013	0.021	0.026	0.017	0.021	0.009	0.027	0.038
Sunday	6	0.012	0.019	0.026	0.021	0.014	0.028	0.015	0.023	0.031	0.028	0.014	0.024	0.012	0.019	0.026	0.029	0.024	0.026	0.014	0.030	0.038
Sunday	7	0.019	0.023	0.029	0.026	0.020	0.036	0.021	0.029	0.035	0.030	0.022	0.034	0.019	0.023	0.029	0.031	0.030	0.034	0.020	0.033	0.039
Sunday	8	0.032	0.035	0.038	0.031	0.032	0.043	0.031	0.038	0.040	0.033	0.036	0.048	0.032	0.035	0.038	0.035	0.038	0.040	0.031	0.038	0.042
Sunday	9	0.051	0.051	0.053	0.040	0.050	0.054	0.043	0.050	0.047	0.036	0.052	0.062	0.051	0.051	0.053	0.038	0.049	0.049	0.047	0.047	0.046
Sunday	10	0.067	0.067	0.071	0.047	0.064	0.067	0.055	0.060	0.051	0.040	0.071	0.075	0.067	0.067	0.071	0.041	0.057	0.057	0.060	0.054	0.046
Sunday	11	0.080	0.081	0.085	0.055	0.079	0.062	0.063	0.065	0.054	0.044	0.082	0.086	0.080	0.081	0.085	0.047	0.068	0.061	0.066	0.056	0.047
Sunday	12	0.083	0.081	0.076	0.061	0.087	0.065	0.070	0.070	0.055	0.049	0.089	0.088	0.083	0.081	0.076	0.051	0.074	0.063	0.067	0.056	0.045
Sunday	13	0.085	0.082	0.074	0.065	0.092	0.064	0.075	0.071	0.056	0.054	0.090	0.080	0.085	0.082	0.074	0.053	0.073	0.065	0.070	0.056	0.042
Sunday	14	0.085	0.083	0.069	0.067	0.087	0.065	0.077	0.069	0.055	0.058	0.089	0.072	0.085	0.083	0.069	0.059	0.078	0.065	0.071	0.057	0.038
Sunday	15	0.084	0.081	0.066	0.072	0.086	0.067	0.078	0.070	0.053	0.063	0.087	0.069	0.084	0.081	0.066	0.061	0.078	0.066	0.071	0.052	0.037
Sunday	16	0.082	0.079	0.060	0.077	0.086	0.072	0.077	0.067	0.052	0.064	0.081	0.059	0.082	0.079	0.060	0.064	0.074	0.060	0.072	0.055	0.036
Sunday	17	0.076	0.070	0.053	0.070	0.075	0.058	0.075	0.062	0.049	0.065	0.066	0.051	0.076	0.070	0.053	0.063	0.068	0.053	0.071	0.052	0.035
Sunday	18	0.064	0.056	0.043	0.067	0.059	0.054	0.068	0.055	0.046	0.065	0.055	0.044	0.064	0.056	0.043	0.064	0.060	0.049	0.068	0.051	0.036
Sunday	19	0.049	0.043	0.035	0.062	0.045	0.050	0.061	0.047	0.042	0.062	0.043	0.036	0.049	0.043	0.035	0.060	0.052	0.046	0.062	0.048	0.037
Sunday	20	0.038	0.033	0.024	0.054	0.035	0.047	0.051	0.039	0.040	0.057	0.032	0.028	0.038	0.033	0.024	0.055	0.043	0.041	0.056	0.046	0.038
Sunday	21	0.026	0.022	0.020	0.045	0.024	0.039	0.041	0.031	0.038	0.049	0.022	0.023	0.026	0.022	0.020	0.050	0.034	0.037	0.046	0.038	0.038
Sunday	22	0.017	0.014	0.017	0.033	0.015	0.033	0.029	0.024	0.036	0.041	0.015	0.019	0.017	0.014	0.017	0.039	0.022	0.031	0.033	0.032	0.043
Sunday	23	0.010	0.010	0.020	0.022	0.009	0.032	0.019	0.019	0.037	0.028	0.012	0.016	0.010	0.010	0.020	0.030	0.016	0.025	0.020	0.027	0.050
Monday	0	0.006	0.010	0.017	0.010	0.003	0.007	0.011	0.017	0.023	0.023	0.007	0.013	0.006	0.010	0.017	0.023	0.006	0.009	0.010	0.024	0.031
Monday	1	0.004	0.009	0.016	0.009	0.002	0.007	0.007	0.015	0.022	0.023	0.006	0.011	0.004	0.009	0.016	0.024	0.007	0.009	0.005	0.023	0.031
Monday	2	0.003	0.009	0.016	0.010	0.003	0.010	0.006	0.015	0.022	0.025	0.007	0.011	0.003	0.009	0.016	0.025	0.009	0.010	0.004	0.022	0.030
Monday	3	0.005	0.011	0.019	0.012	0.006	0.012	0.009	0.018	0.025	0.027	0.010	0.011	0.005	0.011	0.019	0.025	0.011	0.014	0.005	0.023	0.032
Monday	4	0.008	0.017	0.024	0.014	0.009	0.013	0.018	0.027	0.032	0.030	0.015	0.012	0.008	0.017	0.024	0.033	0.023	0.019	0.014	0.030	0.037
Monday	5	0.019	0.028	0.036	0.022	0.022	0.026	0.030	0.039	0.039	0.033	0.022	0.018	0.019	0.028	0.036	0.039	0.042	0.024	0.039	0.041	0.044
Monday	6	0.036	0.041	0.050	0.037	0.047	0.044	0.044	0.051	0.045	0.036	0.034	0.024	0.036	0.041	0.050	0.044	0.060	0.031	0.050	0.049	0.051
Monday	7	0.051	0.044	0.065	0.045	0.058	0.058	0.058	0.058	0.050	0.040	0.043	0.030	0.051	0.044	0.065	0.041	0.056	0.038	0.059	0.058	0.056
Monday	8	0.053	0.056	0.068	0.047	0.062	0.067	0.053	0.058	0.051	0.043	0.054	0.039	0.053	0.056	0.068	0.043	0.058	0.045	0.055	0.056	0.055
Monday	9	0.059	0.065	0.080	0.050	0.065	0.078	0.051	0.059	0.053	0.045	0.067	0.048	0.059	0.065	0.080	0.045	0.063	0.053	0.053	0.057	0.058
Monday	10	0.067	0.074	0.087	0.051	0.065	0.080	0.054	0.062	0.056	0.050	0.074	0.054	0.067	0.074	0.087	0.046	0.065	0.059	0.055	0.060	0.058
Monday	11	0.071	0.075	0.082	0.056	0.067	0.083	0.057	0.064	0.057	0.052	0.075	0.059	0.071	0.075	0.082	0.050	0.066	0.061	0.057	0.058	0.058
Monday	12	0.074	0.074	0.080	0.058	0.069	0.081	0.060	0.064	0.058	0.055	0.078	0.059	0.074	0.074	0.080	0.052	0.068	0.065	0.058	0.060	0.059
Monday	13	0.074	0.075	0.075	0.063	0.074	0.076	0.061	0.064	0.058	0.057	0.081	0.060	0.074	0.075	0.075	0.056	0.069	0.063	0.059	0.059	0.055
Monday	14	0.077	0.076	0.065	0.067	0.076	0.074	0.067	0.066	0.058	0.057	0.081	0.065	0.077	0.076	0.065	0.057	0.070	0.065	0.064	0.058	0.053
Monday	15	0.082	0.076	0.058	0.073	0.087	0.062	0.072	0.065	0.057	0.059	0.080	0.063	0.082	0.076	0.058	0.058	0.070	0.066	0.068	0.058	0.050
Monday	16	0.081	0.073	0.045	0.076	0.084	0.053	0.075	0.063	0.055	0.060	0.072	0.064	0.081	0.073	0.045	0.059	0.067	0.060	0.071	0.058	0.046
Monday	17	0.071	0.059	0.035	0.075	0.075	0.040	0.074	0.055	0.051	0.057	0.059	0.066	0.071	0.059	0.035	0.058	0.062	0.057	0.070	0.054	0.042
Monday	18	0.052	0.042	0.023	0.057	0.047	0.032	0.055	0.042	0.042	0.053	0.045	0.063	0.052	0.042	0.023	0.055	0.043	0.053	0.055	0.041	0.035
Monday	19	0.037	0.030	0.017	0.050	0.031	0.029	0.042	0.031	0.036	0.048	0.032	0.060	0.037	0.030	0.017	0.045	0.029	0.048	0.043	0.032	0.028
Monday	20	0.027	0.022	0.013	0.043	0.020	0.021	0.034	0.023	0.031	0.042	0.022	0.054	0.027	0.022	0.013	0.041	0.022	0.045	0.035	0.026	0.024
Monday	21	0.020	0.016	0.010	0.035	0.015	0.020	0.027	0.018	0.028	0.036	0.016	0.046	0.020	0.016	0.010	0.035	0.017	0.039	0.030	0.022	0.021
Monday	22	0.015	0.012	0.009	0.025	0.009	0.014	0.020	0.014	0.027	0.029	0.012	0.039	0.015	0.012	0.009	0.026	0.011	0.035	0.023	0.018	0.022
Monday	23	0.009	0.007	0.010	0.016	0.005	0.013	0.014	0.011	0.025	0.020	0.008	0.031	0.009	0.007	0.010	0.020	0.007	0.033	0.016	0.015	0.025
Tues/Wed/Thurs	0	0.005	0.009	0.017	0.010	0.004	0.008	0.008	0.016	0.025	0.023	0.007	0.018	0.005	0.009	0.017	0.020	0.006	0.023	0.009	0.023	0.033
Tues/Wed/Thurs	1	0.003	0.008	0.017	0.009	0.003	0.008	0.005	0.014	0.024	0.025	0.006	0.015	0.003	0.008	0.017	0.022	0.007	0.021	0.005	0.021	0.031
Tues/Wed/Thurs	2	0.002	0.009	0.017	0.010	0.002	0.012	0.005	0.014	0.025	0.027	0.006	0.013	0.002	0.009	0.017	0.023	0.007	0.021	0.004	0.021	0.031
Tues/Wed/Thurs	3	0.003	0.010	0.022	0.011	0.005	0.014	0.008	0.018	0.028	0.029	0.009	0.013	0.003	0.010	0.022	0.025	0.010	0.022	0.005	0.022	0.032

		Mariposa			Mendocino			Merced			Modoc			Mono			Monterey			Napa		
Day of Week	Hour	LD	LM	HH	LD	LM	HH	LD	LM	HH	LD	LM	HH	LD	LM	HH	LD	LM	HH	LD	LM	HH
Tues/Wed/Thurs	4	0.006	0.014	0.025	0.015	0.010	0.021	0.017	0.026	0.034	0.032	0.014	0.016	0.006	0.014	0.025	0.030	0.019	0.024	0.013	0.028	0.039
Tues/Wed/Thurs	5	0.018	0.027	0.039	0.024	0.024	0.035	0.030	0.039	0.042	0.035	0.021	0.020	0.018	0.027	0.039	0.037	0.037	0.029	0.036	0.040	0.046
Tues/Wed/Thurs	6	0.037	0.042	0.052	0.037	0.048	0.048	0.044	0.050	0.047	0.038	0.033	0.027	0.037	0.042	0.052	0.043	0.057	0.038	0.048	0.048	0.051
Tues/Wed/Thurs	7	0.053	0.047	0.064	0.045	0.059	0.065	0.059	0.059	0.052	0.040	0.046	0.036	0.053	0.047	0.064	0.042	0.057	0.046	0.059	0.056	0.056
Tues/Wed/Thurs	8	0.054	0.056	0.070	0.047	0.063	0.069	0.055	0.058	0.052	0.042	0.056	0.046	0.054	0.056	0.070	0.045	0.062	0.050	0.056	0.057	0.057
Tues/Wed/Thurs	9	0.059	0.068	0.083	0.050	0.064	0.074	0.051	0.059	0.054	0.044	0.066	0.057	0.059	0.068	0.083	0.046	0.063	0.055	0.052	0.055	0.056
Tues/Wed/Thurs	10	0.064	0.069	0.081	0.051	0.065	0.075	0.052	0.060	0.056	0.045	0.071	0.065	0.064	0.069	0.081	0.047	0.061	0.058	0.053	0.057	0.057
Tues/Wed/Thurs	11	0.068	0.069	0.077	0.055	0.065	0.076	0.054	0.061	0.057	0.047	0.076	0.070	0.068	0.069	0.077	0.049	0.065	0.060	0.053	0.058	0.057
Tues/Wed/Thurs	12	0.069	0.071	0.074	0.057	0.068	0.076	0.057	0.062	0.057	0.050	0.076	0.070	0.069	0.071	0.074	0.051	0.066	0.060	0.055	0.058	0.056
Tues/Wed/Thurs	13	0.072	0.073	0.074	0.061	0.070	0.071	0.060	0.063	0.056	0.052	0.077	0.069	0.072	0.073	0.074	0.054	0.069	0.059	0.057	0.060	0.055
Tues/Wed/Thurs	14	0.077	0.076	0.067	0.066	0.074	0.068	0.066	0.065	0.056	0.057	0.081	0.067	0.077	0.076	0.067	0.058	0.072	0.059	0.064	0.061	0.053
Tues/Wed/Thurs	15	0.084	0.078	0.058	0.073	0.084	0.062	0.073	0.066	0.055	0.058	0.078	0.064	0.084	0.078	0.058	0.059	0.072	0.057	0.069	0.061	0.050
Tues/Wed/Thurs	16	0.082	0.074	0.048	0.078	0.086	0.053	0.077	0.064	0.053	0.057	0.072	0.061	0.082	0.074	0.048	0.060	0.070	0.053	0.072	0.058	0.046
Tues/Wed/Thurs	17	0.074	0.061	0.036	0.077	0.078	0.041	0.076	0.057	0.049	0.056	0.060	0.057	0.074	0.061	0.036	0.058	0.063	0.051	0.072	0.055	0.041
Tues/Wed/Thurs	18	0.053	0.044	0.023	0.059	0.047	0.030	0.058	0.044	0.041	0.053	0.046	0.053	0.053	0.044	0.023	0.052	0.044	0.046	0.058	0.044	0.035
Tues/Wed/Thurs	19	0.038	0.031	0.016	0.048	0.031	0.027	0.044	0.032	0.034	0.048	0.033	0.044	0.038	0.031	0.016	0.049	0.032	0.041	0.047	0.035	0.028
Tues/Wed/Thurs	20	0.030	0.025	0.012	0.041	0.021	0.020	0.036	0.025	0.030	0.045	0.025	0.038	0.030	0.025	0.012	0.043	0.024	0.037	0.039	0.029	0.024
Tues/Wed/Thurs	21	0.023	0.018	0.010	0.036	0.017	0.020	0.028	0.019	0.026	0.038	0.018	0.032	0.023	0.018	0.010	0.038	0.018	0.034	0.033	0.022	0.021
Tues/Wed/Thurs	22	0.017	0.013	0.010	0.025	0.009	0.014	0.021	0.014	0.025	0.032	0.014	0.026	0.017	0.013	0.010	0.029	0.011	0.030	0.025	0.018	0.022
Tues/Wed/Thurs	23	0.010	0.008	0.010	0.017	0.005	0.012	0.015	0.012	0.023	0.025	0.010	0.021	0.010	0.008	0.010	0.022	0.008	0.026	0.017	0.015	0.025
Friday	0	0.005	0.009	0.019	0.009	0.004	0.008	0.008	0.016	0.027	0.021	0.007	0.019	0.005	0.009	0.019	0.020	0.006	0.022	0.009	0.022	0.034
Friday	1	0.003	0.008	0.019	0.009	0.003	0.009	0.006	0.014	0.025	0.023	0.006	0.017	0.003	0.008	0.019	0.020	0.006	0.021	0.005	0.022	0.032
Friday	2	0.002	0.008	0.019	0.009	0.003	0.011	0.005	0.014	0.026	0.024	0.007	0.016	0.002	0.008	0.019	0.022	0.007	0.021	0.004	0.021	0.034
Friday	3	0.002	0.008	0.021	0.011	0.005	0.016	0.008	0.017	0.029	0.026	0.009	0.016	0.002	0.008	0.021	0.024	0.009	0.022	0.005	0.022	0.034
Friday	4	0.005	0.013	0.024	0.013	0.009	0.022	0.014	0.024	0.035	0.029	0.013	0.019	0.005	0.013	0.024	0.028	0.018	0.024	0.011	0.026	0.039
Friday	5	0.013	0.023	0.037	0.021	0.021	0.039	0.024	0.035	0.042	0.032	0.018	0.023	0.013	0.023	0.037	0.035	0.033	0.029	0.029	0.038	0.046
Friday	6	0.026	0.035	0.049	0.033	0.041	0.054	0.036	0.045	0.047	0.033	0.030	0.032	0.026	0.035	0.049	0.041	0.050	0.038	0.039	0.045	0.052
Friday	7	0.039	0.040	0.060	0.039	0.052	0.065	0.049	0.053	0.052	0.037	0.039	0.039	0.039	0.040	0.060	0.039	0.049	0.046	0.048	0.051	0.057
Friday	8	0.043	0.049	0.068	0.044	0.059	0.074	0.047	0.054	0.053	0.040	0.051	0.049	0.043	0.049	0.068	0.041	0.056	0.050	0.047	0.051	0.057
Friday	9	0.049	0.057	0.073	0.047	0.060	0.078	0.047	0.056	0.055	0.045	0.063	0.054	0.049	0.057	0.073	0.045	0.058	0.055	0.047	0.055	0.058
Friday	10	0.058	0.063	0.078	0.048	0.067	0.075	0.051	0.060	0.058	0.048	0.069	0.060	0.058	0.063	0.078	0.047	0.062	0.059	0.052	0.057	0.059
Friday	11	0.064	0.069	0.077	0.054	0.068	0.077	0.054	0.062	0.060	0.049	0.072	0.063	0.064	0.069	0.077	0.050	0.067	0.060	0.055	0.058	0.059
Friday	12	0.066	0.071	0.076	0.060	0.072	0.079	0.057	0.063	0.060	0.052	0.074	0.063	0.066	0.071	0.076	0.051	0.067	0.060	0.059	0.060	0.058
Friday	13	0.071	0.074	0.077	0.063	0.075	0.072	0.061	0.065	0.059	0.055	0.077	0.062	0.071	0.074	0.077	0.056	0.071	0.062	0.064	0.061	0.052
Friday	14	0.076	0.077	0.070	0.068	0.078	0.067	0.068	0.067	0.058	0.059	0.080	0.063	0.076	0.077	0.070	0.060	0.075	0.059	0.067	0.061	0.051
Friday	15	0.083	0.079	0.060	0.073	0.083	0.060	0.074	0.067	0.056	0.063	0.081	0.061	0.083	0.079	0.060	0.060	0.074	0.060	0.069	0.061	0.048
Friday	16	0.083	0.077	0.050	0.076	0.082	0.049	0.076	0.064	0.053	0.058	0.075	0.059	0.083	0.077	0.050	0.060	0.070	0.055	0.069	0.058	0.045
Friday	17	0.075	0.064	0.038	0.074	0.072	0.038	0.075	0.058	0.048	0.059	0.063	0.055	0.075	0.064	0.038	0.060	0.064	0.049	0.068	0.051	0.040
Friday	18	0.062	0.051	0.025	0.060	0.050	0.026	0.064	0.048	0.040	0.054	0.052	0.051	0.062	0.051	0.025	0.054	0.049	0.044	0.060	0.046	0.034
Friday	19	0.050	0.039	0.018	0.052	0.034	0.024	0.052	0.037	0.032	0.050	0.036	0.046	0.050	0.039	0.018	0.050	0.036	0.040	0.054	0.039	0.027
Friday	20	0.041	0.030	0.013	0.043	0.022	0.017	0.043	0.029	0.026	0.046	0.030	0.041	0.041	0.030	0.013	0.045	0.028	0.037	0.048	0.033	0.023
Friday	21	0.036	0.025	0.010	0.040	0.018	0.016	0.035	0.022	0.022	0.040	0.022	0.036	0.036	0.025	0.010	0.038	0.021	0.032	0.039	0.026	0.019
Friday	22	0.030	0.019	0.011	0.031	0.012	0.011	0.027	0.016	0.020	0.031	0.016	0.031	0.030	0.019	0.011	0.031	0.015	0.029	0.031	0.020	0.020
Friday	23	0.018	0.012	0.009	0.022	0.007	0.012	0.020	0.012	0.018	0.025	0.012	0.025	0.018	0.012	0.009	0.023	0.010	0.026	0.022	0.016	0.021
Saturday	0	0.010	0.015	0.027	0.012	0.008	0.014	0.015	0.026	0.040	0.026	0.013	0.020	0.010	0.015	0.027	0.023	0.011	0.030	0.014	0.029	0.051
Saturday	1	0.007	0.012	0.023	0.013	0.006	0.014	0.010	0.020	0.035	0.026	0.008	0.016	0.007	0.012	0.023	0.025	0.010	0.027	0.009	0.024	0.044
Saturday	2	0.005	0.011	0.022	0.013	0.004	0.011	0.008	0.018	0.032	0.027	0.007	0.015	0.005	0.011	0.022	0.025	0.009	0.026	0.007	0.022	0.041
Saturday	3	0.004	0.010	0.025	0.012	0.004	0.014	0.008	0.019	0.032	0.030	0.007	0.014	0.004	0.010	0.025	0.027	0.011	0.024	0.006	0.023	0.040
Saturday	4	0.005	0.013	0.028	0.014	0.008	0.020	0.011	0.021	0.035	0.029	0.009	0.016	0.005	0.013	0.028	0.031	0.020	0.025	0.007	0.023	0.041
Saturday	5	0.010	0.021	0.034	0.020	0.016	0.034	0.017	0.028	0.039	0.033	0.015	0.019	0.010	0.021	0.034	0.038	0.034	0.030	0.013	0.029	0.045
Saturday	6	0.017	0.028	0.039	0.025	0.025	0.043	0.025	0.036	0.045	0.036	0.023	0.025	0.017	0.028	0.039	0.038	0.047	0.040	0.021	0.033	0.047
Saturday	7	0.029	0.036	0.053	0.030	0.031	0.058	0.034	0.044	0.050	0.038	0.033	0.036	0.029	0.036	0.053	0.042	0.047	0.046	0.030	0.038	0.053

		Mariposa			Mendocino			Merced			Modoc			Mono			Monterey			Napa		
Day of Week	Hour	LD	LM	HH	LD	LM	HH	LD	LM	HH	LD	LM	HH	LD	LM	HH	LD	LM	HH	LD	LM	HH
Saturday	8	0.044	0.045	0.060	0.036	0.041	0.070	0.044	0.053	0.055	0.041	0.047	0.047	0.044	0.045	0.060	0.043	0.055	0.050	0.042	0.046	0.052
Saturday	9	0.059	0.061	0.071	0.043	0.053	0.079	0.054	0.061	0.060	0.045	0.063	0.059	0.059	0.061	0.071	0.047	0.062	0.055	0.054	0.054	0.058
Saturday	10	0.073	0.074	0.078	0.052	0.069	0.082	0.062	0.068	0.063	0.049	0.075	0.067	0.073	0.074	0.078	0.047	0.067	0.062	0.063	0.058	0.055
Saturday	11	0.081	0.077	0.083	0.054	0.076	0.075	0.067	0.071	0.064	0.050	0.084	0.073	0.081	0.077	0.083	0.049	0.068	0.063	0.068	0.060	0.052
Saturday	12	0.078	0.077	0.075	0.061	0.080	0.070	0.069	0.070	0.062	0.053	0.083	0.071	0.078	0.077	0.075	0.055	0.071	0.060	0.069	0.060	0.052
Saturday	13	0.075	0.072	0.060	0.063	0.082	0.064	0.070	0.067	0.058	0.055	0.081	0.069	0.075	0.072	0.060	0.054	0.070	0.059	0.067	0.057	0.047
Saturday	14	0.075	0.068	0.055	0.065	0.081	0.062	0.070	0.064	0.054	0.057	0.076	0.065	0.075	0.068	0.055	0.055	0.066	0.058	0.067	0.057	0.045
Saturday	15	0.075	0.068	0.052	0.067	0.080	0.054	0.069	0.061	0.049	0.060	0.074	0.062	0.075	0.068	0.052	0.055	0.065	0.056	0.067	0.057	0.044
Saturday	16	0.072	0.070	0.047	0.071	0.081	0.051	0.068	0.057	0.045	0.056	0.070	0.058	0.072	0.070	0.047	0.057	0.065	0.052	0.068	0.054	0.038
Saturday	17	0.066	0.063	0.040	0.068	0.072	0.037	0.064	0.051	0.040	0.055	0.061	0.057	0.066	0.063	0.040	0.056	0.053	0.047	0.066	0.054	0.035
Saturday	18	0.058	0.052	0.031	0.062	0.053	0.032	0.056	0.042	0.033	0.051	0.049	0.052	0.058	0.052	0.031	0.052	0.044	0.042	0.060	0.049	0.032
Saturday	19	0.047	0.041	0.026	0.059	0.040	0.029	0.048	0.034	0.027	0.049	0.038	0.045	0.047	0.041	0.026	0.049	0.039	0.039	0.052	0.044	0.030
Saturday	20	0.038	0.031	0.020	0.051	0.032	0.021	0.041	0.029	0.024	0.042	0.031	0.038	0.038	0.031	0.020	0.043	0.031	0.035	0.046	0.040	0.028
Saturday	21	0.031	0.025	0.016	0.047	0.026	0.023	0.037	0.024	0.021	0.037	0.023	0.031	0.031	0.025	0.016	0.038	0.025	0.029	0.042	0.035	0.025
Saturday	22	0.025	0.020	0.018	0.037	0.019	0.020	0.031	0.020	0.019	0.031	0.017	0.026	0.025	0.020	0.018	0.030	0.017	0.026	0.036	0.030	0.023
Saturday	23	0.016	0.013	0.018	0.028	0.014	0.021	0.023	0.016	0.017	0.023	0.012	0.019	0.016	0.013	0.018	0.023	0.011	0.020	0.026	0.024	0.024
Holiday	0	0.008	0.011	0.020	0.010	0.004	0.009	0.013	0.020	0.027	0.024	0.008	0.015	0.008	0.011	0.020	0.024	0.008	0.016	0.014	0.028	0.038
Holiday	1	0.005	0.009	0.018	0.014	0.004	0.008	0.009	0.017	0.025	0.027	0.008	0.012	0.005	0.009	0.018	0.022	0.009	0.015	0.008	0.024	0.033
Holiday	2	0.003	0.010	0.018	0.010	0.003	0.014	0.007	0.015	0.024	0.024	0.008	0.012	0.003	0.010	0.018	0.024	0.007	0.015	0.005	0.026	0.033
Holiday	3	0.004	0.010	0.021	0.014	0.005	0.012	0.007	0.016	0.026	0.029	0.010	0.013	0.004	0.010	0.021	0.024	0.009	0.017	0.004	0.025	0.034
Holiday	4	0.005	0.012	0.020	0.014	0.006	0.017	0.011	0.020	0.029	0.029	0.012	0.014	0.005	0.012	0.020	0.031	0.019	0.019	0.008	0.025	0.035
Holiday	5	0.009	0.018	0.031	0.019	0.018	0.028	0.019	0.028	0.033	0.031	0.016	0.017	0.009	0.018	0.031	0.033	0.029	0.024	0.017	0.030	0.040
Holiday	6	0.018	0.023	0.038	0.028	0.034	0.042	0.027	0.035	0.038	0.037	0.025	0.023	0.018	0.023	0.038	0.038	0.042	0.030	0.024	0.036	0.044
Holiday	7	0.029	0.031	0.043	0.039	0.045	0.052	0.035	0.042	0.042	0.038	0.033	0.031	0.029	0.031	0.043	0.040	0.044	0.037	0.030	0.042	0.049
Holiday	8	0.041	0.044	0.056	0.041	0.051	0.059	0.040	0.048	0.046	0.040	0.049	0.040	0.041	0.044	0.056	0.037	0.050	0.041	0.039	0.047	0.049
Holiday	9	0.058	0.057	0.075	0.044	0.057	0.066	0.048	0.055	0.050	0.043	0.062	0.054	0.058	0.057	0.075	0.046	0.057	0.048	0.048	0.055	0.057
Holiday	10	0.076	0.083	0.087	0.050	0.069	0.075	0.059	0.064	0.055	0.050	0.076	0.060	0.076	0.083	0.087	0.048	0.066	0.056	0.060	0.060	0.056
Holiday	11	0.084	0.086	0.088	0.056	0.072	0.077	0.065	0.070	0.060	0.047	0.084	0.068	0.084	0.086	0.088	0.055	0.077	0.063	0.066	0.064	0.055
Holiday	12	0.085	0.087	0.089	0.058	0.080	0.078	0.069	0.072	0.061	0.053	0.083	0.070	0.085	0.087	0.089	0.052	0.074	0.065	0.068	0.063	0.060
Holiday	13	0.083	0.081	0.078	0.063	0.077	0.069	0.071	0.071	0.061	0.062	0.091	0.067	0.083	0.081	0.078	0.055	0.071	0.069	0.069	0.062	0.055
Holiday	14	0.080	0.074	0.068	0.068	0.083	0.067	0.072	0.069	0.059	0.059	0.087	0.069	0.080	0.074	0.068	0.050	0.071	0.067	0.071	0.060	0.055
Holiday	15	0.078	0.074	0.060	0.071	0.082	0.064	0.073	0.068	0.058	0.057	0.079	0.065	0.078	0.074	0.060	0.061	0.068	0.068	0.071	0.064	0.054
Holiday	16	0.078	0.072	0.049	0.075	0.083	0.061	0.073	0.065	0.055	0.056	0.072	0.062	0.078	0.072	0.049	0.062	0.069	0.058	0.068	0.057	0.046
Holiday	17	0.071	0.066	0.041	0.072	0.076	0.044	0.070	0.057	0.050	0.056	0.058	0.060	0.071	0.066	0.041	0.058	0.062	0.058	0.067	0.055	0.041
Holiday	18	0.057	0.049	0.033	0.054	0.048	0.040	0.060	0.046	0.044	0.053	0.044	0.058	0.057	0.049	0.033	0.054	0.050	0.049	0.061	0.042	0.038
Holiday	19	0.043	0.040	0.022	0.056	0.036	0.029	0.050	0.036	0.039	0.048	0.029	0.049	0.043	0.040	0.022	0.049	0.037	0.047	0.053	0.037	0.029
Holiday	20	0.033	0.026	0.013	0.049	0.025	0.029	0.042	0.029	0.034	0.044	0.024	0.045	0.033	0.026	0.013	0.046	0.032	0.043	0.049	0.029	0.024
Holiday	21	0.024	0.018	0.011	0.040	0.019	0.023	0.034	0.023	0.030	0.040	0.019	0.040	0.024	0.018	0.011	0.040	0.025	0.038	0.042	0.028	0.024
Holiday	22	0.017	0.012	0.009	0.029	0.012	0.018	0.027	0.017	0.028	0.031	0.014	0.030	0.017	0.012	0.009	0.031	0.016	0.032	0.035	0.022	0.025
Holiday	23	0.010	0.008	0.010	0.025	0.010	0.019	0.018	0.014	0.026	0.024	0.009	0.024	0.010	0.008	0.010	0.020	0.008	0.028	0.023	0.018	0.026

		Nevada			Orange			Placer			Plumas			Riverside			Sacramento			San Benito		
Day of Week	Hour	LD	LM	HH	LD	LM	HH	LD	LM	HH	LD	LM	HH	LD	LM	HH	LD	LM	HH	LD	LM	HH
Sunday	0	0.013	0.020	0.031	0.023	0.045	0.061	0.013	0.020	0.031	0.015	0.010	0.015	0.022	0.036	0.050	0.019	0.031	0.044	0.019	0.010	0.029
Sunday	1	0.008	0.016	0.028	0.015	0.032	0.049	0.008	0.016	0.028	0.010	0.006	0.011	0.015	0.028	0.044	0.013	0.025	0.039	0.020	0.008	0.023
Sunday	2	0.006	0.013	0.026	0.011	0.025	0.041	0.006	0.013	0.026	0.007	0.004	0.012	0.011	0.023	0.040	0.009	0.021	0.036	0.020	0.007	0.021
Sunday	3	0.005	0.012	0.025	0.007	0.019	0.034	0.005	0.012	0.025	0.006	0.004	0.012	0.009	0.020	0.036	0.007	0.019	0.034	0.020	0.007	0.019
Sunday	4	0.005	0.012	0.025	0.007	0.018	0.031	0.005	0.012	0.025	0.006	0.005	0.017	0.009	0.020	0.035	0.008	0.020	0.034	0.024	0.012	0.019
Sunday	5	0.008	0.015	0.027	0.011	0.022	0.034	0.008	0.015	0.027	0.010	0.011	0.029	0.012	0.023	0.036	0.011	0.023	0.034	0.026	0.017	0.021
Sunday	6	0.013	0.020	0.030	0.018	0.029	0.038	0.013	0.020	0.030	0.016	0.017	0.037	0.019	0.029	0.039	0.017	0.027	0.037	0.029	0.024	0.026
Sunday	7	0.022	0.028	0.034	0.026	0.036	0.041	0.022	0.028	0.034	0.023	0.029	0.051	0.026	0.035	0.041	0.025	0.033	0.039	0.031	0.030	0.034
Sunday	8	0.034	0.041	0.040	0.037	0.046	0.046	0.034	0.041	0.040	0.033	0.043	0.071	0.036	0.045	0.044	0.035	0.042	0.043	0.035	0.038	0.040
Sunday	9	0.048	0.055	0.046	0.050	0.058	0.051	0.048	0.055	0.046	0.047	0.063	0.091	0.049	0.054	0.047	0.049	0.052	0.047	0.038	0.049	0.049
Sunday	10	0.064	0.068	0.052	0.059	0.065	0.052	0.064	0.068	0.052	0.057	0.075	0.084	0.057	0.061	0.047	0.060	0.060	0.049	0.041	0.057	0.057
Sunday	11	0.075	0.075	0.055	0.065	0.067	0.052	0.075	0.075	0.055	0.067	0.083	0.079	0.064	0.065	0.048	0.066	0.063	0.049	0.047	0.068	0.061
Sunday	12	0.082	0.079	0.058	0.068	0.066	0.049	0.082	0.079	0.058	0.074	0.090	0.070	0.067	0.066	0.047	0.072	0.066	0.049	0.051	0.074	0.063
Sunday	13	0.084	0.079	0.058	0.069	0.064	0.046	0.084	0.079	0.058	0.078	0.089	0.061	0.069	0.065	0.045	0.074	0.067	0.049	0.053	0.073	0.065
Sunday	14	0.084	0.077	0.057	0.068	0.059	0.043	0.084	0.077	0.057	0.079	0.081	0.057	0.069	0.063	0.044	0.074	0.064	0.047	0.059	0.078	0.065
Sunday	15	0.082	0.073	0.057	0.068	0.055	0.040	0.082	0.073	0.057	0.080	0.079	0.053	0.068	0.060	0.042	0.072	0.061	0.046	0.061	0.078	0.066
Sunday	16	0.079	0.068	0.055	0.067	0.051	0.038	0.079	0.068	0.055	0.079	0.075	0.045	0.067	0.056	0.041	0.071	0.059	0.045	0.064	0.074	0.060
Sunday	17	0.072	0.062	0.053	0.064	0.047	0.036	0.072	0.062	0.053	0.075	0.066	0.043	0.064	0.052	0.040	0.068	0.056	0.043	0.063	0.068	0.053
Sunday	18	0.060	0.052	0.049	0.060	0.041	0.034	0.060	0.052	0.049	0.066	0.054	0.039	0.061	0.047	0.039	0.061	0.049	0.041	0.064	0.060	0.049
Sunday	19	0.050	0.043	0.045	0.055	0.036	0.033	0.050	0.043	0.045	0.055	0.042	0.037	0.057	0.042	0.039	0.053	0.042	0.040	0.060	0.052	0.046
Sunday	20	0.041	0.035	0.042	0.052	0.034	0.034	0.041	0.035	0.042	0.045	0.031	0.030	0.053	0.037	0.039	0.048	0.038	0.039	0.055	0.043	0.041
Sunday	21	0.031	0.026	0.039	0.045	0.032	0.036	0.031	0.026	0.039	0.035	0.022	0.024	0.044	0.031	0.039	0.040	0.032	0.039	0.050	0.034	0.037
Sunday	22	0.021	0.019	0.036	0.034	0.028	0.038	0.021	0.019	0.036	0.023	0.013	0.018	0.032	0.024	0.038	0.029	0.027	0.038	0.039	0.022	0.031
Sunday	23	0.013	0.015	0.033	0.022	0.024	0.042	0.013	0.015	0.033	0.014	0.008	0.015	0.021	0.018	0.038	0.019	0.023	0.039	0.030	0.016	0.025
Monday	0	0.008	0.014	0.027	0.010	0.016	0.024	0.008	0.014	0.027	0.006	0.002	0.006	0.011	0.018	0.027	0.009	0.018	0.028	0.023	0.006	0.009
Monday	1	0.005	0.012	0.025	0.006	0.012	0.021	0.005	0.012	0.025	0.004	0.002	0.007	0.008	0.016	0.026	0.005	0.015	0.026	0.024	0.007	0.009
Monday	2	0.004	0.012	0.025	0.005	0.012	0.021	0.004	0.012	0.025	0.003	0.002	0.010	0.007	0.016	0.027	0.004	0.015	0.026	0.025	0.009	0.010
Monday	3	0.006	0.014	0.027	0.006	0.013	0.022	0.006	0.014	0.027	0.003	0.004	0.012	0.011	0.020	0.030	0.006	0.018	0.028	0.025	0.011	0.014
Monday	4	0.011	0.019	0.030	0.015	0.022	0.029	0.011	0.019	0.030	0.007	0.009	0.021	0.024	0.033	0.038	0.013	0.026	0.033	0.033	0.023	0.019
Monday	5	0.023	0.030	0.036	0.034	0.041	0.043	0.023	0.030	0.036	0.018	0.024	0.037	0.040	0.049	0.045	0.029	0.040	0.040	0.039	0.042	0.024
Monday	6	0.042	0.047	0.043	0.054	0.060	0.054	0.042	0.047	0.043	0.041	0.051	0.055	0.053	0.059	0.049	0.052	0.057	0.048	0.044	0.060	0.031
Monday	7	0.060	0.061	0.048	0.066	0.073	0.060	0.060	0.061	0.048	0.078	0.069	0.066	0.059	0.064	0.051	0.071	0.066	0.051	0.041	0.056	0.038
Monday	8	0.059	0.062	0.050	0.064	0.073	0.061	0.059	0.062	0.050	0.067	0.077	0.077	0.056	0.062	0.052	0.066	0.064	0.052	0.043	0.058	0.045
Monday	9	0.056	0.061	0.050	0.056	0.065	0.058	0.056	0.061	0.050	0.057	0.071	0.080	0.053	0.059	0.051	0.056	0.059	0.052	0.045	0.063	0.053
Monday	10	0.058	0.064	0.051	0.052	0.061	0.055	0.058	0.064	0.051	0.057	0.071	0.077	0.052	0.058	0.051	0.052	0.057	0.052	0.046	0.065	0.059
Monday	11	0.062	0.066	0.053	0.052	0.060	0.055	0.062	0.066	0.053	0.060	0.074	0.073	0.053	0.058	0.052	0.053	0.058	0.053	0.050	0.066	0.061
Monday	12	0.066	0.068	0.054	0.053	0.060	0.054	0.066	0.068	0.054	0.063	0.072	0.071	0.055	0.058	0.051	0.056	0.059	0.053	0.052	0.068	0.065
Monday	13	0.067	0.067	0.054	0.055	0.059	0.053	0.067	0.067	0.054	0.063	0.072	0.068	0.057	0.059	0.051	0.057	0.059	0.053	0.056	0.069	0.063
Monday	14	0.070	0.069	0.055	0.060	0.061	0.054	0.070	0.069	0.055	0.067	0.077	0.064	0.061	0.060	0.051	0.062	0.060	0.053	0.057	0.070	0.065
Monday	15	0.073	0.069	0.055	0.064	0.061	0.053	0.073	0.069	0.055	0.078	0.080	0.056	0.065	0.061	0.050	0.070	0.064	0.052	0.058	0.070	0.066
Monday	16	0.075	0.067	0.054	0.067	0.060	0.052	0.075	0.067	0.054	0.086	0.077	0.049	0.067	0.059	0.049	0.076	0.063	0.051	0.059	0.067	0.060
Monday	17	0.073	0.061	0.052	0.068	0.057	0.050	0.073	0.061	0.052	0.087	0.062	0.041	0.066	0.054	0.047	0.073	0.057	0.048	0.058	0.062	0.057
Monday	18	0.056	0.046	0.045	0.060	0.044	0.042	0.056	0.046	0.045	0.051	0.038	0.030	0.056	0.043	0.042	0.056	0.044	0.043	0.055	0.043	0.053
Monday	19	0.040	0.031	0.039	0.047	0.029	0.034	0.040	0.031	0.039	0.036	0.024	0.024	0.044	0.031	0.037	0.040	0.031	0.037	0.045	0.029	0.048
Monday	20	0.031	0.022	0.035	0.037	0.020	0.028	0.031	0.022	0.035	0.026	0.018	0.023	0.035	0.023	0.033	0.032	0.024	0.033	0.041	0.022	0.045
Monday	21	0.025	0.017	0.032	0.032	0.017	0.026	0.025	0.017	0.032	0.020	0.012	0.021	0.030	0.017	0.031	0.028	0.019	0.030	0.035	0.017	0.039
Monday	22	0.017	0.012	0.030	0.024	0.013	0.025	0.017	0.012	0.030	0.013	0.007	0.017	0.023	0.012	0.029	0.021	0.015	0.028	0.026	0.011	0.035
Monday	23	0.012	0.009	0.030	0.015	0.010	0.026	0.012	0.009	0.030	0.008	0.004	0.015	0.016	0.009	0.028	0.014	0.011	0.027	0.020	0.007	0.033
Tues/Wed/Thurs	0	0.008	0.014	0.029	0.009	0.015	0.026	0.008	0.014	0.029	0.006	0.003	0.010	0.010	0.017	0.030	0.008	0.018	0.031	0.020	0.006	0.023
Tues/Wed/Thurs	1	0.004	0.011	0.027	0.005	0.012	0.024	0.004	0.011	0.027	0.003	0.002	0.011	0.007	0.015	0.029	0.005	0.015	0.030	0.022	0.007	0.021
Tues/Wed/Thurs	2	0.004	0.011	0.027	0.004	0.012	0.023	0.004	0.011	0.027	0.003	0.002	0.013	0.006	0.015	0.029	0.004	0.015	0.029	0.023	0.007	0.021
Tues/Wed/Thurs	3	0.005	0.013	0.029	0.005	0.013	0.025	0.005	0.013	0.029	0.003	0.003	0.015	0.010	0.019	0.032	0.006	0.017	0.031	0.025	0.010	0.022

		Nevada			Orange			Placer			Plumas			Riverside			Sacramento			San Benito		
Day of Week	Hour	LD	LM	HH	LD	LM	HH	LD	LM	HH	LD	LM	HH	LD	LM	HH	LD	LM	HH	LD	LM	HH
Tues/Wed/Thurs	4	0.010	0.018	0.031	0.013	0.022	0.031	0.010	0.018	0.031	0.006	0.008	0.022	0.022	0.032	0.040	0.012	0.024	0.036	0.030	0.019	0.024
Tues/Wed/Thurs	5	0.022	0.029	0.037	0.033	0.040	0.045	0.022	0.029	0.037	0.017	0.024	0.037	0.039	0.048	0.047	0.027	0.038	0.043	0.037	0.037	0.029
Tues/Wed/Thurs	6	0.042	0.047	0.044	0.054	0.061	0.057	0.042	0.047	0.044	0.041	0.053	0.054	0.053	0.060	0.051	0.052	0.057	0.050	0.043	0.057	0.038
Tues/Wed/Thurs	7	0.060	0.061	0.050	0.065	0.073	0.062	0.060	0.061	0.050	0.077	0.069	0.066	0.059	0.064	0.053	0.071	0.066	0.053	0.042	0.057	0.046
Tues/Wed/Thurs	8	0.060	0.062	0.051	0.063	0.073	0.062	0.060	0.062	0.051	0.066	0.077	0.077	0.056	0.062	0.053	0.066	0.063	0.053	0.045	0.062	0.050
Tues/Wed/Thurs	9	0.055	0.060	0.050	0.057	0.066	0.059	0.055	0.060	0.050	0.057	0.071	0.080	0.052	0.059	0.052	0.056	0.059	0.053	0.046	0.063	0.055
Tues/Wed/Thurs	10	0.056	0.061	0.051	0.052	0.061	0.056	0.056	0.061	0.051	0.056	0.071	0.077	0.051	0.058	0.052	0.051	0.057	0.053	0.047	0.061	0.058
Tues/Wed/Thurs	11	0.059	0.064	0.052	0.052	0.061	0.054	0.059	0.064	0.052	0.058	0.071	0.074	0.051	0.058	0.051	0.052	0.057	0.053	0.049	0.065	0.060
Tues/Wed/Thurs	12	0.061	0.065	0.053	0.053	0.060	0.053	0.061	0.065	0.053	0.062	0.070	0.069	0.053	0.058	0.051	0.054	0.058	0.053	0.051	0.066	0.060
Tues/Wed/Thurs	13	0.064	0.066	0.053	0.055	0.060	0.052	0.064	0.066	0.053	0.063	0.073	0.067	0.056	0.059	0.051	0.056	0.059	0.052	0.054	0.069	0.059
Tues/Wed/Thurs	14	0.068	0.068	0.053	0.059	0.061	0.052	0.068	0.068	0.053	0.066	0.076	0.063	0.060	0.061	0.050	0.061	0.061	0.051	0.058	0.072	0.059
Tues/Wed/Thurs	15	0.073	0.069	0.053	0.063	0.061	0.051	0.073	0.069	0.053	0.079	0.080	0.056	0.064	0.061	0.048	0.070	0.064	0.050	0.059	0.072	0.057
Tues/Wed/Thurs	16	0.075	0.067	0.052	0.065	0.059	0.049	0.075	0.067	0.052	0.087	0.076	0.045	0.066	0.060	0.047	0.075	0.063	0.048	0.060	0.070	0.053
Tues/Wed/Thurs	17	0.074	0.063	0.050	0.066	0.055	0.046	0.074	0.063	0.050	0.088	0.062	0.040	0.066	0.055	0.044	0.073	0.057	0.044	0.058	0.063	0.051
Tues/Wed/Thurs	18	0.059	0.048	0.044	0.060	0.044	0.040	0.059	0.048	0.044	0.054	0.039	0.031	0.058	0.045	0.040	0.059	0.046	0.041	0.052	0.044	0.046
Tues/Wed/Thurs	19	0.043	0.034	0.038	0.049	0.030	0.032	0.043	0.034	0.038	0.036	0.026	0.023	0.046	0.032	0.035	0.041	0.033	0.035	0.049	0.032	0.041
Tues/Wed/Thurs	20	0.035	0.025	0.034	0.040	0.021	0.027	0.035	0.025	0.034	0.028	0.019	0.021	0.038	0.024	0.032	0.034	0.026	0.031	0.043	0.024	0.037
Tues/Wed/Thurs	21	0.029	0.019	0.031	0.035	0.017	0.025	0.029	0.019	0.031	0.021	0.013	0.020	0.033	0.018	0.029	0.030	0.021	0.029	0.038	0.018	0.034
Tues/Wed/Thurs	22	0.020	0.013	0.029	0.026	0.013	0.024	0.020	0.013	0.029	0.014	0.007	0.016	0.025	0.012	0.027	0.022	0.016	0.027	0.029	0.011	0.030
Tues/Wed/Thurs	23	0.013	0.009	0.028	0.016	0.010	0.025	0.013	0.009	0.028	0.009	0.004	0.013	0.017	0.008	0.026	0.015	0.012	0.027	0.022	0.008	0.026
Friday	0	0.007	0.014	0.032	0.010	0.017	0.029	0.007	0.014	0.032	0.007	0.003	0.011	0.011	0.018	0.031	0.009	0.019	0.034	0.020	0.006	0.022
Friday	1	0.005	0.011	0.030	0.006	0.014	0.026	0.005	0.011	0.030	0.004	0.003	0.012	0.007	0.015	0.030	0.005	0.016	0.032	0.020	0.006	0.021
Friday	2	0.004	0.011	0.030	0.005	0.013	0.025	0.004	0.011	0.030	0.004	0.003	0.015	0.007	0.016	0.030	0.004	0.016	0.031	0.022	0.007	0.021
Friday	3	0.005	0.012	0.030	0.006	0.014	0.026	0.005	0.012	0.030	0.004	0.004	0.017	0.009	0.019	0.033	0.006	0.017	0.033	0.024	0.009	0.022
Friday	4	0.008	0.016	0.033	0.013	0.021	0.032	0.008	0.016	0.033	0.006	0.007	0.024	0.020	0.030	0.041	0.011	0.024	0.037	0.028	0.018	0.024
Friday	5	0.017	0.026	0.038	0.029	0.038	0.045	0.017	0.026	0.038	0.015	0.022	0.039	0.034	0.045	0.048	0.024	0.036	0.044	0.035	0.033	0.029
Friday	6	0.033	0.040	0.045	0.048	0.057	0.057	0.033	0.040	0.045	0.035	0.045	0.055	0.046	0.055	0.052	0.045	0.053	0.051	0.041	0.050	0.038
Friday	7	0.049	0.054	0.050	0.061	0.070	0.063	0.049	0.054	0.050	0.063	0.063	0.064	0.053	0.061	0.054	0.063	0.063	0.054	0.039	0.049	0.046
Friday	8	0.051	0.057	0.052	0.059	0.070	0.063	0.051	0.057	0.052	0.058	0.072	0.074	0.051	0.059	0.054	0.059	0.061	0.055	0.041	0.056	0.050
Friday	9	0.050	0.057	0.052	0.054	0.064	0.060	0.050	0.057	0.052	0.052	0.068	0.075	0.050	0.058	0.053	0.052	0.058	0.054	0.045	0.058	0.055
Friday	10	0.054	0.061	0.054	0.052	0.062	0.058	0.054	0.061	0.054	0.055	0.071	0.074	0.051	0.059	0.053	0.050	0.057	0.054	0.047	0.062	0.059
Friday	11	0.060	0.066	0.055	0.054	0.062	0.057	0.060	0.066	0.055	0.060	0.074	0.074	0.053	0.060	0.053	0.053	0.059	0.054	0.050	0.067	0.060
Friday	12	0.063	0.067	0.055	0.055	0.062	0.056	0.063	0.067	0.055	0.063	0.072	0.069	0.055	0.061	0.053	0.056	0.060	0.053	0.051	0.067	0.060
Friday	13	0.066	0.068	0.054	0.057	0.062	0.055	0.066	0.068	0.054	0.065	0.076	0.069	0.058	0.061	0.052	0.058	0.060	0.052	0.056	0.071	0.062
Friday	14	0.070	0.070	0.054	0.060	0.062	0.053	0.070	0.070	0.054	0.069	0.078	0.063	0.061	0.062	0.050	0.063	0.062	0.051	0.060	0.075	0.059
Friday	15	0.073	0.070	0.052	0.061	0.060	0.051	0.073	0.070	0.052	0.078	0.080	0.055	0.062	0.061	0.048	0.070	0.063	0.049	0.060	0.074	0.060
Friday	16	0.074	0.067	0.050	0.063	0.057	0.048	0.074	0.067	0.050	0.085	0.075	0.047	0.063	0.058	0.046	0.072	0.060	0.046	0.060	0.070	0.055
Friday	17	0.072	0.063	0.047	0.063	0.053	0.044	0.072	0.063	0.047	0.082	0.061	0.039	0.062	0.053	0.043	0.069	0.055	0.043	0.060	0.064	0.049
Friday	18	0.063	0.051	0.042	0.058	0.042	0.036	0.063	0.051	0.042	0.059	0.041	0.029	0.058	0.045	0.039	0.060	0.046	0.039	0.054	0.049	0.044
Friday	19	0.050	0.039	0.035	0.050	0.031	0.030	0.050	0.039	0.035	0.042	0.028	0.024	0.050	0.035	0.034	0.046	0.035	0.033	0.050	0.036	0.040
Friday	20	0.041	0.029	0.030	0.042	0.023	0.024	0.041	0.029	0.030	0.032	0.021	0.021	0.043	0.026	0.030	0.038	0.026	0.028	0.045	0.028	0.037
Friday	21	0.037	0.023	0.028	0.038	0.018	0.022	0.037	0.023	0.028	0.027	0.015	0.020	0.039	0.020	0.027	0.035	0.022	0.026	0.038	0.021	0.032
Friday	22	0.030	0.017	0.026	0.033	0.015	0.021	0.030	0.017	0.026	0.021	0.011	0.016	0.032	0.014	0.024	0.029	0.018	0.024	0.031	0.015	0.029
Friday	23	0.019	0.011	0.024	0.024	0.012	0.021	0.019	0.011	0.024	0.014	0.007	0.015	0.023	0.009	0.021	0.020	0.013	0.023	0.023	0.010	0.026
Saturday	0	0.013	0.019	0.038	0.017	0.030	0.049	0.013	0.019	0.038	0.012	0.007	0.021	0.017	0.027	0.047	0.016	0.027	0.046	0.023	0.011	0.030
Saturday	1	0.008	0.015	0.034	0.011	0.022	0.041	0.008	0.015	0.034	0.008	0.005	0.016	0.012	0.021	0.042	0.011	0.022	0.042	0.025	0.010	0.027
Saturday	2	0.006	0.014	0.032	0.009	0.019	0.037	0.006	0.014	0.032	0.006	0.004	0.020	0.010	0.019	0.040	0.008	0.020	0.039	0.025	0.009	0.026
Saturday	3	0.006	0.013	0.031	0.007	0.016	0.034	0.006	0.013	0.031	0.005	0.004	0.022	0.009	0.019	0.039	0.007	0.019	0.038	0.027	0.011	0.024
Saturday	4	0.007	0.014	0.032	0.009	0.018	0.036	0.007	0.014	0.032	0.006	0.008	0.024	0.012	0.021	0.041	0.009	0.022	0.039	0.031	0.020	0.025
Saturday	5	0.011	0.018	0.034	0.015	0.026	0.042	0.011	0.018	0.034	0.012	0.017	0.039	0.018	0.029	0.045	0.014	0.027	0.042	0.038	0.034	0.030
Saturday	6	0.019	0.026	0.039	0.026	0.037	0.050	0.019	0.026	0.039	0.021	0.028	0.049	0.028	0.039	0.050	0.023	0.035	0.046	0.038	0.047	0.040
Saturday	7	0.032	0.038	0.046	0.037	0.049	0.058	0.032	0.038	0.046	0.034	0.041	0.058	0.039	0.048	0.055	0.034	0.044	0.050	0.042	0.047	0.046

		Nevada			Orange			Placer			Plumas			Riverside			Sacramento			San Benito		
Day of Week	Hour	LD	LM	HH	LD	LM	HH	LD	LM	HH	LD	LM	HH	LD	LM	HH	LD	LM	HH	LD	LM	HH
Saturday	8	0.045	0.051	0.052	0.048	0.060	0.064	0.045	0.051	0.052	0.045	0.057	0.067	0.047	0.056	0.056	0.045	0.052	0.053	0.043	0.055	0.050
Saturday	9	0.057	0.062	0.056	0.055	0.065	0.065	0.057	0.062	0.056	0.054	0.068	0.074	0.054	0.062	0.057	0.054	0.059	0.055	0.047	0.062	0.055
Saturday	10	0.067	0.071	0.060	0.059	0.068	0.064	0.067	0.071	0.060	0.063	0.080	0.073	0.058	0.064	0.056	0.061	0.063	0.055	0.047	0.067	0.062
Saturday	11	0.074	0.076	0.061	0.062	0.069	0.062	0.074	0.076	0.061	0.068	0.082	0.071	0.062	0.066	0.054	0.066	0.065	0.055	0.049	0.068	0.063
Saturday	12	0.075	0.075	0.060	0.064	0.068	0.058	0.075	0.075	0.060	0.074	0.083	0.068	0.063	0.065	0.052	0.068	0.065	0.053	0.055	0.071	0.060
Saturday	13	0.075	0.074	0.057	0.064	0.064	0.053	0.075	0.074	0.057	0.074	0.079	0.062	0.064	0.064	0.050	0.068	0.064	0.051	0.054	0.070	0.059
Saturday	14	0.074	0.071	0.055	0.064	0.061	0.048	0.074	0.071	0.055	0.074	0.076	0.057	0.064	0.062	0.047	0.068	0.061	0.048	0.055	0.066	0.058
Saturday	15	0.072	0.068	0.051	0.064	0.057	0.044	0.072	0.068	0.051	0.073	0.074	0.052	0.064	0.059	0.044	0.067	0.059	0.045	0.055	0.065	0.056
Saturday	16	0.070	0.064	0.048	0.064	0.053	0.039	0.070	0.064	0.048	0.073	0.067	0.045	0.063	0.056	0.041	0.067	0.056	0.042	0.057	0.065	0.052
Saturday	17	0.066	0.057	0.044	0.062	0.048	0.034	0.066	0.057	0.044	0.069	0.058	0.039	0.061	0.051	0.037	0.064	0.052	0.039	0.056	0.053	0.047
Saturday	18	0.056	0.047	0.038	0.057	0.041	0.028	0.056	0.047	0.038	0.058	0.047	0.034	0.056	0.043	0.033	0.057	0.045	0.034	0.052	0.044	0.042
Saturday	19	0.046	0.037	0.033	0.050	0.032	0.022	0.046	0.037	0.033	0.046	0.036	0.029	0.049	0.035	0.028	0.048	0.037	0.030	0.049	0.039	0.039
Saturday	20	0.040	0.030	0.028	0.044	0.027	0.018	0.040	0.030	0.028	0.040	0.028	0.024	0.044	0.030	0.024	0.042	0.031	0.027	0.043	0.031	0.035
Saturday	21	0.035	0.025	0.025	0.042	0.026	0.018	0.035	0.025	0.025	0.036	0.022	0.023	0.042	0.026	0.022	0.040	0.029	0.025	0.038	0.025	0.029
Saturday	22	0.028	0.019	0.023	0.040	0.025	0.018	0.028	0.019	0.023	0.029	0.016	0.017	0.037	0.022	0.020	0.036	0.026	0.024	0.030	0.017	0.026
Saturday	23	0.020	0.014	0.021	0.030	0.021	0.019	0.020	0.014	0.021	0.020	0.011	0.017	0.029	0.017	0.018	0.026	0.020	0.022	0.023	0.011	0.020
Holiday	0	0.010	0.016	0.028	0.015	0.023	0.030	0.010	0.016	0.028	0.010	0.004	0.012	0.015	0.023	0.032	0.013	0.023	0.032	0.024	0.008	0.016
Holiday	1	0.006	0.013	0.027	0.009	0.018	0.027	0.006	0.013	0.027	0.006	0.004	0.011	0.010	0.018	0.030	0.008	0.019	0.030	0.022	0.009	0.015
Holiday	2	0.004	0.012	0.026	0.007	0.015	0.025	0.004	0.012	0.026	0.004	0.003	0.012	0.008	0.018	0.029	0.006	0.018	0.030	0.024	0.007	0.015
Holiday	3	0.005	0.013	0.027	0.006	0.015	0.025	0.005	0.013	0.027	0.004	0.005	0.015	0.009	0.020	0.031	0.006	0.019	0.030	0.024	0.009	0.017
Holiday	4	0.008	0.016	0.029	0.010	0.019	0.029	0.008	0.016	0.029	0.007	0.009	0.024	0.016	0.027	0.035	0.010	0.023	0.033	0.031	0.019	0.019
Holiday	5	0.014	0.023	0.032	0.023	0.032	0.038	0.014	0.023	0.032	0.014	0.020	0.037	0.026	0.036	0.041	0.019	0.032	0.037	0.033	0.029	0.024
Holiday	6	0.025	0.033	0.036	0.038	0.047	0.047	0.025	0.033	0.036	0.030	0.036	0.047	0.035	0.044	0.044	0.031	0.041	0.043	0.038	0.042	0.030
Holiday	7	0.036	0.044	0.042	0.047	0.057	0.053	0.036	0.044	0.042	0.044	0.052	0.061	0.041	0.049	0.046	0.042	0.049	0.046	0.040	0.044	0.037
Holiday	8	0.046	0.053	0.048	0.047	0.058	0.053	0.046	0.053	0.048	0.052	0.066	0.075	0.046	0.054	0.049	0.048	0.054	0.049	0.037	0.050	0.041
Holiday	9	0.054	0.059	0.050	0.050	0.060	0.054	0.054	0.059	0.050	0.053	0.071	0.081	0.051	0.057	0.050	0.052	0.057	0.051	0.046	0.057	0.048
Holiday	10	0.065	0.069	0.053	0.055	0.064	0.056	0.065	0.069	0.053	0.059	0.076	0.081	0.056	0.061	0.051	0.057	0.060	0.052	0.048	0.066	0.056
Holiday	11	0.074	0.074	0.057	0.059	0.067	0.058	0.074	0.074	0.057	0.066	0.076	0.071	0.061	0.065	0.053	0.063	0.065	0.054	0.055	0.077	0.063
Holiday	12	0.077	0.074	0.056	0.061	0.068	0.057	0.077	0.074	0.056	0.071	0.078	0.074	0.063	0.066	0.053	0.067	0.065	0.054	0.052	0.074	0.065
Holiday	13	0.076	0.074	0.058	0.062	0.067	0.057	0.076	0.074	0.058	0.071	0.076	0.065	0.064	0.066	0.053	0.068	0.066	0.055	0.055	0.071	0.069
Holiday	14	0.075	0.073	0.056	0.064	0.066	0.055	0.075	0.073	0.056	0.070	0.078	0.060	0.064	0.064	0.052	0.069	0.065	0.053	0.050	0.071	0.067
Holiday	15	0.074	0.070	0.055	0.065	0.062	0.052	0.074	0.070	0.055	0.075	0.075	0.053	0.064	0.061	0.050	0.070	0.063	0.052	0.061	0.068	0.068
Holiday	16	0.072	0.066	0.054	0.064	0.057	0.049	0.072	0.066	0.054	0.079	0.070	0.044	0.064	0.058	0.048	0.069	0.060	0.049	0.062	0.069	0.058
Holiday	17	0.068	0.059	0.051	0.064	0.051	0.045	0.068	0.059	0.051	0.074	0.064	0.041	0.064	0.053	0.045	0.066	0.054	0.046	0.058	0.062	0.058
Holiday	18	0.057	0.049	0.045	0.058	0.042	0.040	0.057	0.049	0.045	0.058	0.044	0.034	0.059	0.046	0.043	0.058	0.046	0.042	0.054	0.050	0.049
Holiday	19	0.047	0.036	0.041	0.052	0.032	0.034	0.047	0.036	0.041	0.047	0.033	0.026	0.052	0.036	0.038	0.049	0.036	0.037	0.049	0.037	0.047
Holiday	20	0.039	0.029	0.037	0.046	0.025	0.030	0.039	0.029	0.037	0.038	0.025	0.025	0.045	0.029	0.036	0.043	0.030	0.034	0.046	0.032	0.043
Holiday	21	0.030	0.020	0.033	0.041	0.021	0.029	0.030	0.020	0.033	0.030	0.018	0.021	0.039	0.022	0.032	0.037	0.024	0.031	0.040	0.025	0.038
Holiday	22	0.023	0.015	0.031	0.035	0.018	0.029	0.023	0.015	0.031	0.024	0.011	0.017	0.029	0.016	0.030	0.029	0.019	0.029	0.031	0.016	0.032
Holiday	23	0.015	0.010	0.029	0.023	0.014	0.030	0.015	0.010	0.029	0.014	0.007	0.014	0.021	0.011	0.028	0.020	0.014	0.029	0.020	0.008	0.028

		San Bernardino			San Diego			San Francisco			San Joaquin			San Luis Obispo			San Mateo			Santa Barbara		
Day of Week	Hour	LD	LM	HH	LD	LM	HH	LD	LM	HH	LD	LM	HH	LD	LM	HH	LD	LM	HH	LD	LM	HH
Sunday	0	0.024	0.030	0.035	0.019	0.033	0.051	0.026	0.032	0.056	0.016	0.024	0.039	0.017	0.009	0.017	0.021	0.029	0.049	0.020	0.017	0.032
Sunday	1	0.017	0.025	0.031	0.012	0.029	0.044	0.019	0.030	0.050	0.010	0.017	0.034	0.017	0.006	0.012	0.013	0.029	0.047	0.021	0.015	0.026
Sunday	2	0.014	0.022	0.028	0.009	0.026	0.040	0.017	0.030	0.048	0.007	0.015	0.031	0.018	0.005	0.009	0.010	0.028	0.045	0.020	0.012	0.022
Sunday	3	0.011	0.020	0.027	0.007	0.023	0.036	0.011	0.028	0.042	0.006	0.014	0.030	0.018	0.004	0.011	0.006	0.029	0.043	0.019	0.010	0.022
Sunday	4	0.012	0.020	0.027	0.007	0.023	0.034	0.009	0.028	0.040	0.008	0.015	0.030	0.019	0.005	0.009	0.007	0.029	0.041	0.023	0.014	0.023
Sunday	5	0.015	0.022	0.028	0.011	0.026	0.035	0.011	0.029	0.039	0.011	0.018	0.031	0.022	0.009	0.012	0.010	0.030	0.040	0.023	0.017	0.029
Sunday	6	0.021	0.026	0.030	0.018	0.030	0.037	0.018	0.032	0.040	0.017	0.022	0.033	0.026	0.015	0.017	0.015	0.031	0.039	0.029	0.024	0.031
Sunday	7	0.027	0.031	0.033	0.026	0.035	0.040	0.024	0.032	0.039	0.023	0.027	0.036	0.030	0.024	0.025	0.022	0.033	0.038	0.031	0.029	0.031
Sunday	8	0.036	0.038	0.037	0.037	0.041	0.043	0.033	0.036	0.040	0.032	0.036	0.040	0.037	0.037	0.039	0.032	0.036	0.038	0.036	0.042	0.037
Sunday	9	0.046	0.046	0.041	0.050	0.048	0.047	0.047	0.042	0.043	0.045	0.048	0.046	0.043	0.056	0.050	0.047	0.040	0.039	0.042	0.054	0.047
Sunday	10	0.055	0.055	0.047	0.062	0.055	0.050	0.060	0.049	0.044	0.056	0.059	0.050	0.051	0.072	0.068	0.062	0.046	0.042	0.046	0.065	0.055
Sunday	11	0.060	0.060	0.050	0.068	0.059	0.050	0.065	0.053	0.045	0.063	0.067	0.054	0.054	0.079	0.080	0.069	0.052	0.042	0.049	0.072	0.059
Sunday	12	0.064	0.066	0.053	0.072	0.061	0.051	0.067	0.056	0.043	0.068	0.071	0.056	0.058	0.089	0.088	0.072	0.056	0.043	0.055	0.078	0.062
Sunday	13	0.067	0.067	0.054	0.072	0.062	0.049	0.067	0.056	0.041	0.071	0.074	0.055	0.059	0.085	0.081	0.073	0.057	0.042	0.057	0.074	0.057
Sunday	14	0.068	0.066	0.054	0.071	0.059	0.046	0.067	0.056	0.040	0.073	0.073	0.054	0.062	0.085	0.075	0.072	0.058	0.041	0.060	0.072	0.051
Sunday	15	0.066	0.063	0.053	0.071	0.057	0.043	0.066	0.056	0.039	0.073	0.071	0.053	0.065	0.081	0.066	0.070	0.059	0.041	0.061	0.070	0.051
Sunday	16	0.065	0.060	0.052	0.070	0.056	0.042	0.065	0.057	0.038	0.073	0.068	0.050	0.067	0.076	0.063	0.070	0.060	0.041	0.063	0.066	0.049
Sunday	17	0.063	0.056	0.051	0.067	0.053	0.040	0.063	0.057	0.038	0.072	0.063	0.049	0.065	0.070	0.064	0.068	0.060	0.043	0.064	0.059	0.049
Sunday	18	0.060	0.051	0.049	0.061	0.048	0.038	0.058	0.054	0.038	0.067	0.055	0.044	0.063	0.058	0.055	0.059	0.055	0.041	0.061	0.054	0.046
Sunday	19	0.056	0.045	0.047	0.054	0.043	0.036	0.053	0.048	0.037	0.061	0.047	0.041	0.057	0.046	0.044	0.052	0.049	0.040	0.059	0.046	0.043
Sunday	20	0.052	0.042	0.047	0.047	0.039	0.036	0.049	0.044	0.038	0.054	0.040	0.039	0.053	0.037	0.035	0.049	0.045	0.041	0.053	0.040	0.043
Sunday	21	0.044	0.036	0.045	0.039	0.035	0.036	0.045	0.038	0.039	0.044	0.031	0.036	0.045	0.026	0.032	0.045	0.039	0.041	0.045	0.031	0.046
Sunday	22	0.034	0.030	0.042	0.029	0.030	0.037	0.037	0.032	0.041	0.031	0.024	0.035	0.034	0.016	0.025	0.034	0.030	0.040	0.035	0.023	0.045
Sunday	23	0.023	0.025	0.041	0.019	0.027	0.040	0.025	0.025	0.044	0.019	0.019	0.036	0.023	0.010	0.024	0.021	0.022	0.040	0.026	0.017	0.042
Monday	0	0.015	0.017	0.023	0.009	0.018	0.023	0.012	0.020	0.031	0.010	0.012	0.022	0.018	0.004	0.008	0.009	0.016	0.025	0.016	0.005	0.012
Monday	1	0.011	0.015	0.022	0.005	0.017	0.022	0.007	0.021	0.030	0.006	0.010	0.021	0.017	0.003	0.008	0.004	0.018	0.026	0.015	0.004	0.014
Monday	2	0.010	0.015	0.022	0.004	0.017	0.023	0.005	0.021	0.031	0.006	0.010	0.022	0.018	0.003	0.010	0.003	0.019	0.028	0.016	0.005	0.016
Monday	3	0.014	0.018	0.024	0.005	0.018	0.024	0.005	0.022	0.031	0.011	0.015	0.025	0.020	0.006	0.014	0.003	0.020	0.029	0.018	0.007	0.019
Monday	4	0.025	0.028	0.029	0.012	0.022	0.028	0.010	0.025	0.035	0.029	0.028	0.033	0.024	0.011	0.019	0.007	0.022	0.031	0.020	0.013	0.028
Monday	5	0.041	0.044	0.038	0.031	0.034	0.037	0.023	0.031	0.040	0.043	0.043	0.042	0.031	0.027	0.029	0.020	0.026	0.034	0.028	0.025	0.038
Monday	6	0.052	0.053	0.044	0.055	0.050	0.047	0.045	0.040	0.046	0.053	0.052	0.048	0.040	0.048	0.041	0.044	0.035	0.041	0.037	0.048	0.045
Monday	7	0.061	0.065	0.052	0.068	0.066	0.057	0.064	0.057	0.055	0.061	0.059	0.053	0.046	0.065	0.053	0.071	0.058	0.057	0.048	0.071	0.046
Monday	8	0.056	0.056	0.047	0.063	0.062	0.058	0.064	0.064	0.057	0.055	0.057	0.053	0.049	0.066	0.057	0.071	0.070	0.064	0.054	0.083	0.052
Monday	9	0.051	0.051	0.045	0.055	0.056	0.054	0.059	0.054	0.054	0.051	0.056	0.055	0.051	0.069	0.064	0.065	0.059	0.058	0.054	0.078	0.055
Monday	10	0.050	0.050	0.045	0.051	0.055	0.054	0.055	0.053	0.054	0.051	0.058	0.056	0.051	0.070	0.073	0.057	0.052	0.053	0.053	0.069	0.060
Monday	11	0.052	0.052	0.046	0.052	0.056	0.055	0.053	0.053	0.055	0.052	0.060	0.058	0.054	0.070	0.074	0.052	0.050	0.051	0.056	0.072	0.066
Monday	12	0.054	0.054	0.049	0.054	0.058	0.057	0.053	0.054	0.053	0.054	0.061	0.058	0.055	0.070	0.070	0.051	0.053	0.051	0.060	0.073	0.069
Monday	13	0.055	0.057	0.051	0.056	0.059	0.057	0.053	0.056	0.053	0.056	0.063	0.057	0.058	0.071	0.070	0.052	0.055	0.051	0.062	0.072	0.064
Monday	14	0.059	0.062	0.055	0.063	0.062	0.057	0.059	0.059	0.052	0.063	0.068	0.058	0.064	0.076	0.067	0.056	0.059	0.052	0.065	0.075	0.062
Monday	15	0.063	0.065	0.058	0.072	0.065	0.057	0.063	0.061	0.051	0.069	0.072	0.059	0.068	0.083	0.061	0.063	0.065	0.055	0.070	0.077	0.060
Monday	16	0.064	0.066	0.060	0.075	0.065	0.057	0.065	0.061	0.049	0.072	0.071	0.056	0.068	0.079	0.053	0.070	0.070	0.057	0.067	0.067	0.052
Monday	17	0.064	0.065	0.060	0.073	0.062	0.055	0.067	0.068	0.049	0.070	0.065	0.052	0.064	0.065	0.047	0.074	0.077	0.059	0.058	0.046	0.041
Monday	18	0.054	0.050	0.052	0.058	0.046	0.044	0.062	0.056	0.042	0.055	0.045	0.041	0.051	0.041	0.040	0.067	0.059	0.048	0.050	0.034	0.037
Monday	19	0.042	0.035	0.043	0.041	0.033	0.034	0.050	0.039	0.033	0.041	0.031	0.033	0.043	0.026	0.036	0.051	0.039	0.035	0.045	0.025	0.035
Monday	20	0.035	0.028	0.038	0.033	0.026	0.029	0.039	0.030	0.027	0.033	0.023	0.028	0.037	0.018	0.030	0.037	0.029	0.028	0.036	0.017	0.033
Monday	21	0.031	0.023	0.036	0.028	0.022	0.025	0.036	0.024	0.024	0.027	0.017	0.026	0.031	0.014	0.027	0.033	0.022	0.024	0.030	0.013	0.034
Monday	22	0.025	0.018	0.033	0.020	0.017	0.023	0.031	0.018	0.023	0.021	0.013	0.023	0.024	0.009	0.026	0.025	0.016	0.022	0.024	0.010	0.032
Monday	23	0.018	0.013	0.030	0.013	0.015	0.022	0.021	0.013	0.025	0.014	0.010	0.022	0.017	0.005	0.021	0.015	0.011	0.020	0.016	0.007	0.030
Tues/Wed/Thurs	0	0.013	0.016	0.024	0.007	0.017	0.025	0.012	0.019	0.032	0.009	0.011	0.024	0.016	0.004	0.017	0.008	0.016	0.026	0.016	0.005	0.022
Tues/Wed/Thurs	1	0.010	0.014	0.023	0.004	0.016	0.024	0.007	0.019	0.031	0.006	0.010	0.023	0.016	0.003	0.014	0.003	0.017	0.027	0.015	0.004	0.022
Tues/Wed/Thurs	2	0.010	0.015	0.024	0.003	0.016	0.024	0.005	0.020	0.032	0.005	0.010	0.023	0.016	0.003	0.014	0.002	0.018	0.028	0.015	0.004	0.021
Tues/Wed/Thurs	3	0.013	0.018	0.025	0.004	0.017	0.026	0.005	0.021	0.032	0.010	0.014	0.026	0.018	0.004	0.017	0.003	0.019	0.029	0.017	0.006	0.024

		San Bernardino			San Diego			San Francisco			San Joaquin			San Luis Obispo			San Mateo			Santa Barbara		
Day of Week	Hour	LD	LM	HH	LD	LM	HH	LD	LM	HH	LD	LM	HH	LD	LM	HH	LD	LM	HH	LD	LM	HH
Tues/Wed/Thurs	4	0.024	0.027	0.031	0.010	0.022	0.029	0.009	0.024	0.036	0.027	0.026	0.034	0.021	0.009	0.022	0.007	0.021	0.031	0.019	0.012	0.033
Tues/Wed/Thurs	5	0.041	0.044	0.040	0.029	0.033	0.038	0.024	0.029	0.041	0.043	0.041	0.042	0.030	0.023	0.032	0.020	0.025	0.034	0.026	0.025	0.045
Tues/Wed/Thurs	6	0.053	0.053	0.046	0.055	0.050	0.049	0.047	0.040	0.049	0.054	0.051	0.049	0.041	0.049	0.046	0.046	0.035	0.042	0.039	0.051	0.052
Tues/Wed/Thurs	7	0.062	0.065	0.054	0.068	0.067	0.059	0.065	0.058	0.057	0.062	0.059	0.054	0.048	0.066	0.057	0.073	0.059	0.058	0.051	0.072	0.052
Tues/Wed/Thurs	8	0.056	0.057	0.050	0.063	0.064	0.059	0.064	0.067	0.059	0.056	0.057	0.054	0.049	0.067	0.060	0.071	0.072	0.066	0.056	0.083	0.056
Tues/Wed/Thurs	9	0.050	0.051	0.046	0.055	0.056	0.055	0.058	0.054	0.055	0.051	0.055	0.055	0.050	0.066	0.065	0.064	0.058	0.058	0.056	0.079	0.057
Tues/Wed/Thurs	10	0.049	0.049	0.046	0.050	0.054	0.054	0.053	0.051	0.053	0.049	0.056	0.056	0.052	0.066	0.067	0.054	0.050	0.052	0.054	0.070	0.060
Tues/Wed/Thurs	11	0.050	0.051	0.047	0.051	0.056	0.055	0.051	0.052	0.054	0.050	0.058	0.056	0.053	0.067	0.071	0.050	0.049	0.050	0.057	0.072	0.064
Tues/Wed/Thurs	12	0.052	0.053	0.049	0.053	0.058	0.056	0.051	0.053	0.053	0.052	0.059	0.056	0.056	0.069	0.067	0.049	0.051	0.050	0.060	0.071	0.062
Tues/Wed/Thurs	13	0.054	0.056	0.051	0.055	0.059	0.055	0.052	0.055	0.052	0.055	0.062	0.056	0.060	0.071	0.065	0.050	0.054	0.051	0.063	0.072	0.060
Tues/Wed/Thurs	14	0.058	0.062	0.054	0.063	0.062	0.056	0.058	0.059	0.051	0.062	0.068	0.057	0.063	0.076	0.064	0.056	0.058	0.052	0.064	0.075	0.058
Tues/Wed/Thurs	15	0.062	0.065	0.057	0.072	0.065	0.055	0.060	0.061	0.050	0.069	0.074	0.058	0.069	0.084	0.058	0.062	0.065	0.054	0.067	0.076	0.052
Tues/Wed/Thurs	16	0.064	0.067	0.059	0.074	0.065	0.055	0.064	0.062	0.047	0.072	0.074	0.057	0.070	0.081	0.050	0.070	0.071	0.056	0.064	0.065	0.044
Tues/Wed/Thurs	17	0.064	0.066	0.058	0.073	0.063	0.054	0.065	0.070	0.047	0.070	0.067	0.053	0.063	0.067	0.045	0.072	0.081	0.061	0.056	0.045	0.036
Tues/Wed/Thurs	18	0.055	0.052	0.050	0.061	0.047	0.043	0.062	0.059	0.041	0.056	0.048	0.041	0.053	0.044	0.039	0.067	0.065	0.051	0.050	0.036	0.034
Tues/Wed/Thurs	19	0.044	0.037	0.041	0.044	0.033	0.033	0.052	0.041	0.032	0.043	0.033	0.033	0.044	0.029	0.034	0.053	0.041	0.036	0.044	0.026	0.031
Tues/Wed/Thurs	20	0.038	0.029	0.037	0.036	0.026	0.028	0.042	0.031	0.026	0.034	0.025	0.028	0.038	0.021	0.028	0.039	0.029	0.027	0.037	0.019	0.029
Tues/Wed/Thurs	21	0.033	0.023	0.033	0.031	0.021	0.025	0.039	0.024	0.024	0.028	0.019	0.025	0.032	0.016	0.026	0.035	0.022	0.023	0.031	0.015	0.031
Tues/Wed/Thurs	22	0.027	0.017	0.029	0.022	0.017	0.022	0.034	0.018	0.023	0.021	0.014	0.022	0.025	0.010	0.023	0.027	0.015	0.019	0.025	0.011	0.027
Tues/Wed/Thurs	23	0.020	0.012	0.025	0.014	0.014	0.021	0.023	0.012	0.024	0.015	0.010	0.021	0.018	0.006	0.019	0.017	0.010	0.017	0.018	0.008	0.026
Friday	0	0.014	0.016	0.025	0.008	0.018	0.027	0.014	0.020	0.034	0.008	0.012	0.025	0.016	0.004	0.016	0.009	0.016	0.027	0.016	0.006	0.024
Friday	1	0.011	0.014	0.024	0.005	0.017	0.026	0.008	0.020	0.033	0.006	0.010	0.024	0.016	0.003	0.014	0.005	0.017	0.029	0.016	0.005	0.022
Friday	2	0.010	0.014	0.024	0.004	0.017	0.027	0.007	0.020	0.033	0.005	0.010	0.024	0.016	0.003	0.014	0.003	0.018	0.029	0.016	0.005	0.021
Friday	3	0.013	0.017	0.026	0.005	0.018	0.028	0.006	0.022	0.034	0.009	0.013	0.027	0.017	0.004	0.017	0.003	0.020	0.031	0.016	0.006	0.025
Friday	4	0.021	0.024	0.030	0.009	0.021	0.031	0.009	0.024	0.036	0.022	0.023	0.034	0.020	0.007	0.022	0.007	0.021	0.032	0.020	0.011	0.033
Friday	5	0.035	0.037	0.038	0.026	0.032	0.040	0.022	0.029	0.042	0.036	0.036	0.042	0.027	0.018	0.031	0.019	0.025	0.035	0.025	0.022	0.043
Friday	6	0.046	0.046	0.044	0.048	0.047	0.050	0.043	0.039	0.048	0.046	0.045	0.048	0.038	0.042	0.045	0.042	0.034	0.042	0.038	0.046	0.050
Friday	7	0.055	0.056	0.050	0.061	0.060	0.058	0.060	0.053	0.056	0.053	0.052	0.053	0.044	0.058	0.054	0.067	0.053	0.056	0.046	0.068	0.051
Friday	8	0.052	0.052	0.048	0.057	0.058	0.058	0.060	0.059	0.058	0.049	0.051	0.054	0.048	0.061	0.059	0.068	0.060	0.061	0.053	0.079	0.056
Friday	9	0.049	0.048	0.046	0.052	0.055	0.056	0.055	0.052	0.056	0.046	0.052	0.055	0.049	0.064	0.065	0.061	0.054	0.056	0.054	0.079	0.062
Friday	10	0.050	0.050	0.047	0.051	0.055	0.056	0.052	0.052	0.056	0.048	0.055	0.057	0.052	0.068	0.070	0.054	0.050	0.052	0.053	0.071	0.063
Friday	11	0.052	0.053	0.050	0.054	0.058	0.058	0.052	0.055	0.056	0.050	0.058	0.059	0.054	0.070	0.072	0.053	0.051	0.052	0.058	0.074	0.066
Friday	12	0.054	0.055	0.051	0.056	0.060	0.058	0.053	0.055	0.054	0.054	0.061	0.058	0.056	0.072	0.070	0.052	0.054	0.052	0.059	0.073	0.061
Friday	13	0.056	0.058	0.053	0.059	0.061	0.057	0.054	0.057	0.053	0.058	0.065	0.058	0.060	0.074	0.068	0.053	0.057	0.053	0.064	0.073	0.058
Friday	14	0.059	0.063	0.056	0.066	0.063	0.056	0.058	0.060	0.052	0.065	0.070	0.059	0.064	0.079	0.066	0.059	0.062	0.055	0.066	0.073	0.056
Friday	15	0.060	0.066	0.058	0.071	0.065	0.055	0.060	0.063	0.050	0.069	0.075	0.059	0.067	0.083	0.058	0.064	0.070	0.057	0.067	0.074	0.052
Friday	16	0.061	0.066	0.058	0.070	0.064	0.054	0.062	0.064	0.047	0.071	0.073	0.057	0.068	0.078	0.051	0.069	0.073	0.058	0.064	0.062	0.045
Friday	17	0.060	0.064	0.056	0.068	0.060	0.050	0.062	0.067	0.046	0.069	0.069	0.053	0.062	0.064	0.047	0.069	0.079	0.059	0.057	0.046	0.038
Friday	18	0.055	0.053	0.050	0.060	0.048	0.041	0.059	0.056	0.039	0.061	0.052	0.041	0.056	0.048	0.039	0.064	0.063	0.049	0.050	0.036	0.035
Friday	19	0.048	0.043	0.043	0.048	0.035	0.031	0.052	0.043	0.031	0.050	0.038	0.031	0.047	0.033	0.032	0.052	0.043	0.035	0.046	0.028	0.031
Friday	20	0.043	0.035	0.038	0.039	0.027	0.025	0.042	0.032	0.025	0.042	0.029	0.026	0.042	0.025	0.028	0.039	0.031	0.026	0.038	0.022	0.029
Friday	21	0.039	0.029	0.034	0.035	0.023	0.021	0.039	0.025	0.021	0.035	0.022	0.022	0.036	0.019	0.024	0.034	0.023	0.021	0.032	0.017	0.029
Friday	22	0.033	0.022	0.029	0.029	0.020	0.019	0.039	0.020	0.020	0.028	0.017	0.019	0.028	0.014	0.021	0.031	0.017	0.017	0.027	0.014	0.026
Friday	23	0.025	0.016	0.024	0.020	0.016	0.017	0.031	0.014	0.020	0.020	0.012	0.017	0.021	0.009	0.017	0.023	0.011	0.014	0.019	0.010	0.024
Saturday	0	0.020	0.024	0.034	0.015	0.026	0.043	0.022	0.026	0.048	0.014	0.021	0.037	0.018	0.007	0.027	0.017	0.024	0.042	0.022	0.013	0.039
Saturday	1	0.015	0.020	0.031	0.010	0.023	0.039	0.015	0.025	0.045	0.009	0.016	0.032	0.020	0.006	0.022	0.010	0.024	0.041	0.021	0.010	0.032
Saturday	2	0.013	0.019	0.029	0.007	0.022	0.037	0.013	0.025	0.043	0.007	0.014	0.031	0.020	0.005	0.020	0.008	0.024	0.041	0.022	0.009	0.030
Saturday	3	0.013	0.018	0.029	0.006	0.020	0.035	0.009	0.025	0.041	0.007	0.015	0.031	0.021	0.005	0.021	0.006	0.025	0.041	0.022	0.010	0.032
Saturday	4	0.015	0.020	0.030	0.007	0.022	0.036	0.008	0.026	0.039	0.011	0.018	0.033	0.022	0.007	0.023	0.007	0.026	0.041	0.024	0.014	0.040
Saturday	5	0.021	0.025	0.033	0.014	0.026	0.039	0.013	0.028	0.041	0.018	0.025	0.037	0.025	0.013	0.031	0.011	0.028	0.042	0.028	0.021	0.046
Saturday	6	0.030	0.032	0.038	0.024	0.032	0.045	0.021	0.031	0.044	0.027	0.033	0.042	0.032	0.024	0.039	0.019	0.031	0.043	0.035	0.035	0.053
Saturday	7	0.039	0.040	0.043	0.036	0.040	0.051	0.031	0.036	0.047	0.036	0.042	0.048	0.038	0.041	0.051	0.031	0.035	0.044	0.040	0.048	0.054

		San Bernardino			San Diego			San Francisco			San Joaquin			San Luis Obispo			San Mateo			Santa Barbara		
Day of Week	**Hour**	**LD**	**LM**	**HH**	**LD**	**LM**	**HH**	**LD**	**LM**	**HH**	**LD**	**LM**	**HH**	**LD**	**LM**	**HH**	**LD**	**LM**	**HH**	**LD**	**LM**	**HH**
Saturday	8	0.046	0.047	0.048	0.048	0.048	0.056	0.043	0.041	0.051	0.045	0.050	0.054	0.047	0.053	0.055	0.043	0.039	0.046	0.046	0.059	0.057
Saturday	9	0.052	0.052	0.050	0.056	0.054	0.059	0.052	0.046	0.052	0.054	0.059	0.058	0.050	0.067	0.062	0.054	0.045	0.048	0.050	0.068	0.060
Saturday	10	0.056	0.056	0.053	0.062	0.058	0.060	0.059	0.051	0.053	0.061	0.067	0.062	0.054	0.078	0.069	0.062	0.050	0.051	0.053	0.070	0.059
Saturday	11	0.059	0.060	0.055	0.066	0.061	0.060	0.062	0.055	0.052	0.065	0.071	0.063	0.059	0.084	0.078	0.067	0.056	0.053	0.057	0.073	0.059
Saturday	12	0.061	0.063	0.057	0.068	0.063	0.058	0.063	0.057	0.051	0.067	0.072	0.062	0.060	0.082	0.070	0.068	0.059	0.051	0.059	0.074	0.056
Saturday	13	0.062	0.063	0.055	0.068	0.062	0.055	0.062	0.058	0.048	0.067	0.070	0.059	0.061	0.079	0.064	0.067	0.060	0.050	0.061	0.070	0.051
Saturday	14	0.062	0.063	0.055	0.068	0.061	0.051	0.062	0.059	0.046	0.067	0.068	0.056	0.060	0.074	0.061	0.067	0.061	0.049	0.061	0.068	0.048
Saturday	15	0.062	0.062	0.054	0.068	0.059	0.047	0.063	0.059	0.043	0.067	0.065	0.052	0.062	0.072	0.053	0.067	0.062	0.048	0.061	0.061	0.045
Saturday	16	0.061	0.060	0.052	0.067	0.057	0.043	0.063	0.059	0.042	0.066	0.061	0.048	0.061	0.066	0.050	0.067	0.062	0.046	0.059	0.059	0.041
Saturday	17	0.059	0.057	0.049	0.064	0.054	0.039	0.061	0.059	0.039	0.063	0.055	0.043	0.059	0.059	0.044	0.067	0.061	0.044	0.057	0.053	0.036
Saturday	18	0.055	0.051	0.044	0.057	0.047	0.033	0.058	0.056	0.036	0.057	0.045	0.036	0.053	0.050	0.037	0.061	0.055	0.040	0.052	0.046	0.033
Saturday	19	0.048	0.042	0.039	0.048	0.040	0.027	0.051	0.047	0.031	0.049	0.036	0.030	0.048	0.038	0.031	0.049	0.046	0.034	0.045	0.036	0.029
Saturday	20	0.043	0.037	0.035	0.042	0.035	0.023	0.044	0.040	0.028	0.043	0.030	0.026	0.043	0.032	0.029	0.042	0.039	0.030	0.041	0.031	0.029
Saturday	21	0.041	0.034	0.033	0.039	0.033	0.022	0.044	0.034	0.026	0.040	0.026	0.023	0.037	0.027	0.025	0.042	0.035	0.028	0.035	0.027	0.024
Saturday	22	0.037	0.029	0.030	0.034	0.031	0.021	0.045	0.032	0.027	0.035	0.023	0.021	0.028	0.018	0.021	0.040	0.030	0.025	0.029	0.023	0.023
Saturday	23	0.030	0.023	0.026	0.025	0.027	0.020	0.036	0.025	0.026	0.025	0.017	0.019	0.021	0.013	0.017	0.029	0.022	0.022	0.023	0.019	0.021
Holiday	0	0.018	0.020	0.026	0.013	0.023	0.029	0.021	0.023	0.035	0.012	0.015	0.027	0.018	0.006	0.012	0.014	0.020	0.030	0.020	0.010	0.020
Holiday	1	0.014	0.018	0.024	0.008	0.021	0.027	0.013	0.022	0.033	0.008	0.013	0.025	0.019	0.004	0.009	0.008	0.021	0.031	0.021	0.008	0.020
Holiday	2	0.012	0.017	0.024	0.006	0.020	0.027	0.010	0.024	0.033	0.006	0.012	0.025	0.019	0.003	0.011	0.005	0.022	0.031	0.019	0.006	0.018
Holiday	3	0.013	0.018	0.026	0.005	0.020	0.027	0.007	0.025	0.033	0.008	0.014	0.026	0.022	0.005	0.013	0.004	0.024	0.033	0.021	0.008	0.023
Holiday	4	0.019	0.024	0.029	0.008	0.023	0.030	0.008	0.028	0.035	0.015	0.020	0.030	0.022	0.008	0.015	0.006	0.025	0.034	0.022	0.012	0.028
Holiday	5	0.029	0.032	0.034	0.019	0.029	0.034	0.016	0.031	0.039	0.023	0.028	0.035	0.028	0.017	0.021	0.014	0.029	0.037	0.027	0.023	0.037
Holiday	6	0.036	0.038	0.037	0.035	0.040	0.042	0.028	0.036	0.044	0.031	0.035	0.039	0.034	0.030	0.031	0.027	0.035	0.041	0.031	0.034	0.042
Holiday	7	0.043	0.045	0.041	0.046	0.048	0.049	0.039	0.042	0.047	0.036	0.040	0.043	0.041	0.044	0.040	0.044	0.043	0.046	0.042	0.060	0.045
Holiday	8	0.047	0.048	0.043	0.048	0.050	0.050	0.046	0.049	0.050	0.041	0.045	0.047	0.046	0.055	0.046	0.053	0.048	0.050	0.048	0.073	0.051
Holiday	9	0.049	0.050	0.045	0.052	0.053	0.053	0.051	0.049	0.053	0.047	0.051	0.050	0.050	0.065	0.062	0.055	0.050	0.050	0.051	0.075	0.059
Holiday	10	0.053	0.053	0.047	0.057	0.058	0.056	0.057	0.054	0.054	0.055	0.061	0.056	0.052	0.076	0.072	0.058	0.052	0.052	0.053	0.071	0.058
Holiday	11	0.057	0.059	0.052	0.062	0.063	0.059	0.061	0.057	0.056	0.063	0.069	0.061	0.052	0.082	0.088	0.062	0.056	0.053	0.057	0.076	0.066
Holiday	12	0.060	0.063	0.053	0.065	0.065	0.060	0.063	0.059	0.055	0.066	0.072	0.062	0.058	0.086	0.085	0.062	0.060	0.055	0.059	0.079	0.070
Holiday	13	0.062	0.064	0.055	0.066	0.066	0.059	0.065	0.062	0.057	0.068	0.074	0.062	0.061	0.081	0.082	0.065	0.062	0.055	0.061	0.072	0.056
Holiday	14	0.063	0.066	0.056	0.068	0.065	0.058	0.067	0.063	0.055	0.070	0.073	0.060	0.059	0.076	0.075	0.067	0.066	0.056	0.060	0.073	0.060
Holiday	15	0.062	0.066	0.057	0.070	0.064	0.057	0.065	0.064	0.053	0.071	0.072	0.058	0.064	0.077	0.065	0.068	0.067	0.054	0.064	0.072	0.055
Holiday	16	0.062	0.063	0.057	0.069	0.060	0.053	0.063	0.062	0.048	0.071	0.068	0.054	0.068	0.072	0.057	0.069	0.067	0.055	0.060	0.061	0.050
Holiday	17	0.062	0.061	0.056	0.066	0.055	0.048	0.061	0.058	0.045	0.068	0.061	0.050	0.062	0.063	0.046	0.069	0.063	0.051	0.059	0.047	0.037
Holiday	18	0.056	0.053	0.052	0.058	0.045	0.042	0.057	0.052	0.040	0.060	0.050	0.042	0.053	0.044	0.039	0.060	0.053	0.044	0.053	0.038	0.036
Holiday	19	0.048	0.043	0.046	0.049	0.037	0.035	0.049	0.042	0.032	0.051	0.040	0.037	0.047	0.035	0.037	0.050	0.044	0.037	0.049	0.029	0.036
Holiday	20	0.043	0.034	0.041	0.043	0.030	0.030	0.044	0.034	0.029	0.044	0.031	0.032	0.041	0.027	0.028	0.045	0.033	0.032	0.040	0.024	0.032
Holiday	21	0.037	0.027	0.037	0.037	0.025	0.027	0.042	0.028	0.024	0.037	0.025	0.029	0.035	0.019	0.023	0.042	0.027	0.028	0.036	0.020	0.038
Holiday	22	0.031	0.021	0.033	0.030	0.022	0.025	0.040	0.021	0.025	0.029	0.019	0.026	0.027	0.014	0.022	0.033	0.020	0.025	0.028	0.017	0.034
Holiday	23	0.023	0.015	0.030	0.020	0.018	0.024	0.028	0.016	0.026	0.020	0.013	0.024	0.021	0.010	0.020	0.023	0.014	0.022	0.021	0.013	0.031

		Santa Clara			Santa Cruz			Shasta			Sierra			Siskiyou			Solano			Sonoma		
Day of Week	Hour	LD	LM	HH	LD	LM	HH	LD	LM	HH	LD	LM	HH	LD	LM	HH	LD	LM	HH	LD	LM	HH
Sunday	0	0.018	0.036	0.052	0.011	0.032	0.036	0.013	0.008	0.016	0.013	0.020	0.031	0.019	0.009	0.017	0.017	0.037	0.059	0.019	0.038	0.053
Sunday	1	0.011	0.034	0.046	0.006	0.031	0.036	0.013	0.006	0.013	0.008	0.016	0.028	0.021	0.007	0.014	0.011	0.032	0.052	0.012	0.034	0.047
Sunday	2	0.008	0.032	0.042	0.003	0.030	0.037	0.012	0.006	0.011	0.006	0.013	0.026	0.022	0.006	0.013	0.009	0.030	0.048	0.008	0.031	0.043
Sunday	3	0.005	0.032	0.039	0.002	0.034	0.035	0.012	0.005	0.011	0.005	0.012	0.025	0.022	0.005	0.013	0.007	0.027	0.044	0.006	0.030	0.040
Sunday	4	0.005	0.032	0.037	0.003	0.035	0.038	0.015	0.007	0.013	0.005	0.012	0.025	0.023	0.006	0.013	0.007	0.028	0.042	0.006	0.029	0.038
Sunday	5	0.008	0.033	0.036	0.006	0.035	0.035	0.018	0.012	0.018	0.008	0.015	0.027	0.025	0.008	0.016	0.010	0.029	0.042	0.010	0.031	0.038
Sunday	6	0.014	0.035	0.037	0.013	0.036	0.036	0.021	0.019	0.026	0.013	0.020	0.030	0.028	0.014	0.024	0.016	0.032	0.042	0.016	0.033	0.039
Sunday	7	0.021	0.037	0.039	0.022	0.038	0.039	0.029	0.030	0.039	0.022	0.028	0.034	0.030	0.022	0.034	0.021	0.035	0.043	0.023	0.036	0.040
Sunday	8	0.032	0.040	0.040	0.034	0.036	0.040	0.037	0.043	0.053	0.034	0.041	0.040	0.033	0.036	0.048	0.031	0.041	0.045	0.033	0.040	0.042
Sunday	9	0.047	0.046	0.044	0.051	0.043	0.043	0.043	0.055	0.067	0.048	0.055	0.046	0.036	0.052	0.062	0.046	0.048	0.046	0.048	0.046	0.044
Sunday	10	0.061	0.051	0.047	0.064	0.044	0.047	0.053	0.071	0.079	0.064	0.068	0.052	0.040	0.071	0.075	0.059	0.053	0.045	0.062	0.051	0.045
Sunday	11	0.068	0.053	0.047	0.071	0.047	0.046	0.060	0.077	0.080	0.075	0.075	0.055	0.044	0.082	0.086	0.067	0.055	0.044	0.067	0.053	0.046
Sunday	12	0.073	0.054	0.046	0.073	0.046	0.043	0.064	0.084	0.077	0.082	0.079	0.058	0.049	0.089	0.088	0.069	0.055	0.041	0.070	0.054	0.046
Sunday	13	0.075	0.055	0.045	0.076	0.047	0.041	0.066	0.083	0.070	0.084	0.079	0.058	0.054	0.090	0.080	0.070	0.055	0.038	0.073	0.055	0.050
Sunday	14	0.075	0.055	0.044	0.078	0.052	0.047	0.067	0.085	0.065	0.084	0.077	0.057	0.058	0.089	0.072	0.071	0.053	0.036	0.073	0.055	0.047
Sunday	15	0.075	0.054	0.042	0.081	0.054	0.051	0.072	0.083	0.061	0.082	0.073	0.057	0.063	0.087	0.069	0.071	0.052	0.035	0.073	0.053	0.041
Sunday	16	0.073	0.053	0.041	0.082	0.055	0.051	0.073	0.080	0.058	0.079	0.068	0.055	0.064	0.081	0.059	0.071	0.051	0.033	0.072	0.052	0.039
Sunday	17	0.071	0.051	0.040	0.080	0.058	0.052	0.068	0.066	0.056	0.072	0.062	0.053	0.065	0.066	0.051	0.070	0.051	0.033	0.070	0.050	0.038
Sunday	18	0.064	0.047	0.039	0.069	0.051	0.048	0.065	0.056	0.049	0.060	0.052	0.049	0.065	0.055	0.044	0.066	0.048	0.033	0.063	0.047	0.036
Sunday	19	0.057	0.044	0.038	0.058	0.051	0.047	0.058	0.043	0.041	0.050	0.043	0.045	0.062	0.043	0.036	0.060	0.046	0.034	0.056	0.044	0.035
Sunday	20	0.050	0.040	0.037	0.048	0.047	0.044	0.048	0.031	0.032	0.041	0.035	0.042	0.057	0.032	0.028	0.055	0.043	0.035	0.051	0.041	0.036
Sunday	21	0.041	0.034	0.038	0.036	0.039	0.039	0.041	0.023	0.026	0.031	0.026	0.039	0.049	0.022	0.023	0.045	0.039	0.039	0.042	0.038	0.037
Sunday	22	0.029	0.029	0.040	0.022	0.033	0.036	0.031	0.016	0.021	0.021	0.019	0.036	0.041	0.015	0.019	0.032	0.033	0.043	0.030	0.032	0.039
Sunday	23	0.018	0.024	0.044	0.011	0.028	0.032	0.020	0.012	0.017	0.013	0.015	0.033	0.028	0.012	0.016	0.020	0.028	0.049	0.019	0.027	0.043
Monday	0	0.007	0.022	0.028	0.004	0.024	0.033	0.013	0.006	0.012	0.008	0.014	0.027	0.023	0.007	0.013	0.010	0.026	0.035	0.007	0.023	0.029
Monday	1	0.003	0.022	0.027	0.001	0.025	0.031	0.012	0.006	0.011	0.005	0.012	0.025	0.023	0.006	0.011	0.006	0.025	0.034	0.003	0.022	0.028
Monday	2	0.002	0.023	0.028	0.001	0.025	0.034	0.013	0.006	0.011	0.004	0.012	0.025	0.025	0.007	0.011	0.005	0.024	0.034	0.002	0.022	0.029
Monday	3	0.003	0.025	0.030	0.002	0.025	0.034	0.015	0.010	0.012	0.006	0.014	0.027	0.027	0.010	0.011	0.006	0.026	0.035	0.003	0.023	0.030
Monday	4	0.007	0.029	0.033	0.007	0.031	0.038	0.019	0.019	0.015	0.011	0.019	0.030	0.030	0.015	0.012	0.015	0.032	0.040	0.012	0.028	0.035
Monday	5	0.024	0.035	0.040	0.026	0.034	0.038	0.025	0.030	0.021	0.023	0.030	0.036	0.033	0.022	0.018	0.037	0.043	0.046	0.033	0.041	0.042
Monday	6	0.047	0.046	0.049	0.061	0.043	0.049	0.032	0.041	0.024	0.042	0.047	0.043	0.036	0.034	0.024	0.050	0.051	0.050	0.054	0.051	0.048
Monday	7	0.065	0.054	0.057	0.082	0.053	0.056	0.034	0.048	0.032	0.060	0.061	0.048	0.040	0.043	0.030	0.061	0.058	0.053	0.066	0.058	0.053
Monday	8	0.068	0.057	0.060	0.079	0.054	0.059	0.039	0.059	0.039	0.059	0.062	0.050	0.043	0.054	0.039	0.056	0.057	0.055	0.062	0.060	0.055
Monday	9	0.065	0.055	0.055	0.073	0.053	0.053	0.047	0.065	0.046	0.056	0.061	0.050	0.045	0.067	0.048	0.054	0.056	0.055	0.055	0.056	0.054
Monday	10	0.056	0.053	0.054	0.064	0.050	0.052	0.050	0.070	0.053	0.058	0.064	0.051	0.050	0.074	0.054	0.055	0.058	0.056	0.052	0.054	0.053
Monday	11	0.052	0.054	0.054	0.059	0.055	0.054	0.056	0.072	0.055	0.062	0.066	0.053	0.052	0.075	0.059	0.056	0.057	0.055	0.053	0.055	0.054
Monday	12	0.053	0.055	0.054	0.055	0.060	0.059	0.059	0.073	0.055	0.066	0.068	0.054	0.055	0.078	0.059	0.057	0.058	0.054	0.054	0.056	0.054
Monday	13	0.054	0.056	0.053	0.056	0.054	0.052	0.060	0.076	0.058	0.067	0.067	0.054	0.057	0.081	0.060	0.058	0.057	0.052	0.056	0.056	0.054
Monday	14	0.062	0.060	0.054	0.059	0.061	0.057	0.065	0.079	0.059	0.070	0.069	0.055	0.057	0.081	0.065	0.064	0.057	0.051	0.063	0.059	0.056
Monday	15	0.068	0.063	0.055	0.063	0.060	0.051	0.071	0.081	0.062	0.073	0.069	0.055	0.059	0.080	0.063	0.069	0.056	0.048	0.069	0.063	0.058
Monday	16	0.071	0.063	0.054	0.067	0.059	0.051	0.070	0.070	0.063	0.075	0.067	0.054	0.060	0.072	0.064	0.071	0.054	0.044	0.072	0.060	0.052
Monday	17	0.074	0.062	0.052	0.069	0.058	0.047	0.065	0.057	0.066	0.073	0.061	0.052	0.057	0.059	0.066	0.070	0.050	0.040	0.073	0.056	0.047
Monday	18	0.065	0.050	0.042	0.057	0.051	0.040	0.058	0.042	0.064	0.056	0.046	0.045	0.053	0.045	0.063	0.054	0.041	0.035	0.061	0.045	0.039
Monday	19	0.052	0.037	0.031	0.040	0.042	0.034	0.054	0.031	0.059	0.040	0.031	0.039	0.048	0.032	0.060	0.042	0.032	0.028	0.045	0.033	0.031
Monday	20	0.036	0.028	0.025	0.028	0.030	0.025	0.050	0.022	0.054	0.031	0.022	0.035	0.042	0.022	0.054	0.035	0.026	0.025	0.035	0.026	0.026
Monday	21	0.030	0.022	0.022	0.023	0.024	0.020	0.041	0.017	0.051	0.025	0.017	0.032	0.036	0.016	0.046	0.029	0.022	0.023	0.031	0.022	0.024
Monday	22	0.022	0.016	0.020	0.015	0.018	0.017	0.030	0.011	0.043	0.017	0.012	0.030	0.029	0.012	0.039	0.023	0.018	0.024	0.023	0.017	0.023
Monday	23	0.014	0.012	0.022	0.009	0.013	0.017	0.022	0.008	0.034	0.012	0.009	0.030	0.020	0.008	0.031	0.016	0.016	0.028	0.014	0.014	0.025
Tues/Wed/Thurs	0	0.006	0.022	0.029	0.004	0.023	0.029	0.012	0.006	0.017	0.008	0.014	0.029	0.023	0.007	0.018	0.009	0.025	0.037	0.006	0.022	0.031
Tues/Wed/Thurs	1	0.003	0.022	0.029	0.001	0.024	0.032	0.012	0.005	0.015	0.004	0.011	0.027	0.025	0.006	0.015	0.005	0.023	0.036	0.003	0.021	0.030
Tues/Wed/Thurs	2	0.002	0.023	0.029	0.001	0.025	0.032	0.013	0.006	0.014	0.004	0.011	0.027	0.027	0.006	0.013	0.004	0.023	0.036	0.002	0.021	0.030
Tues/Wed/Thurs	3	0.003	0.025	0.031	0.001	0.027	0.034	0.014	0.009	0.015	0.005	0.013	0.029	0.029	0.009	0.013	0.005	0.025	0.037	0.003	0.023	0.031

		Santa Clara			Santa Cruz			Shasta			Sierra			Siskiyou			Solano			Sonoma		
Day of Week	Hour	LD	LM	HH	LD	LM	HH	LD	LM	HH	LD	LM	HH	LD	LM	HH	LD	LM	HH	LD	LM	HH
Tues/Wed/Thurs	4	0.007	0.028	0.034	0.006	0.029	0.036	0.018	0.017	0.017	0.010	0.018	0.031	0.032	0.014	0.016	0.013	0.030	0.041	0.011	0.028	0.036
Tues/Wed/Thurs	5	0.025	0.036	0.042	0.026	0.032	0.038	0.023	0.026	0.022	0.022	0.029	0.037	0.035	0.021	0.020	0.035	0.042	0.048	0.034	0.040	0.044
Tues/Wed/Thurs	6	0.050	0.047	0.052	0.065	0.040	0.045	0.030	0.042	0.030	0.042	0.047	0.044	0.038	0.033	0.027	0.050	0.050	0.052	0.056	0.052	0.049
Tues/Wed/Thurs	7	0.067	0.055	0.059	0.084	0.055	0.056	0.038	0.051	0.039	0.060	0.061	0.050	0.040	0.046	0.036	0.061	0.057	0.054	0.068	0.059	0.054
Tues/Wed/Thurs	8	0.069	0.058	0.061	0.080	0.055	0.055	0.042	0.061	0.048	0.060	0.062	0.051	0.042	0.056	0.046	0.056	0.056	0.055	0.063	0.060	0.056
Tues/Wed/Thurs	9	0.065	0.055	0.055	0.074	0.054	0.056	0.047	0.064	0.058	0.055	0.060	0.050	0.044	0.066	0.057	0.053	0.056	0.055	0.055	0.055	0.053
Tues/Wed/Thurs	10	0.055	0.053	0.054	0.062	0.052	0.053	0.051	0.067	0.066	0.056	0.061	0.051	0.045	0.071	0.065	0.052	0.057	0.055	0.051	0.053	0.052
Tues/Wed/Thurs	11	0.051	0.053	0.053	0.057	0.053	0.055	0.054	0.070	0.069	0.059	0.064	0.052	0.047	0.076	0.070	0.052	0.057	0.054	0.050	0.054	0.052
Tues/Wed/Thurs	12	0.051	0.055	0.053	0.054	0.057	0.055	0.058	0.072	0.067	0.061	0.065	0.053	0.050	0.076	0.070	0.054	0.057	0.053	0.052	0.055	0.053
Tues/Wed/Thurs	13	0.054	0.056	0.052	0.054	0.058	0.054	0.061	0.074	0.066	0.064	0.066	0.053	0.052	0.077	0.069	0.057	0.057	0.051	0.054	0.056	0.054
Tues/Wed/Thurs	14	0.061	0.059	0.052	0.058	0.061	0.056	0.065	0.077	0.063	0.068	0.068	0.053	0.057	0.081	0.067	0.064	0.058	0.049	0.062	0.059	0.054
Tues/Wed/Thurs	15	0.067	0.063	0.054	0.062	0.061	0.055	0.070	0.080	0.061	0.073	0.069	0.053	0.058	0.078	0.064	0.070	0.058	0.046	0.067	0.063	0.056
Tues/Wed/Thurs	16	0.070	0.064	0.053	0.065	0.060	0.053	0.072	0.072	0.058	0.075	0.067	0.052	0.057	0.072	0.061	0.073	0.056	0.043	0.070	0.060	0.051
Tues/Wed/Thurs	17	0.072	0.062	0.051	0.067	0.057	0.047	0.065	0.057	0.056	0.074	0.063	0.050	0.056	0.060	0.057	0.072	0.052	0.039	0.071	0.057	0.046
Tues/Wed/Thurs	18	0.065	0.052	0.042	0.058	0.050	0.043	0.060	0.044	0.052	0.059	0.048	0.044	0.053	0.046	0.053	0.058	0.043	0.033	0.062	0.047	0.039
Tues/Wed/Thurs	19	0.053	0.037	0.030	0.041	0.041	0.034	0.053	0.032	0.045	0.043	0.034	0.038	0.048	0.033	0.044	0.046	0.034	0.028	0.048	0.035	0.031
Tues/Wed/Thurs	20	0.038	0.027	0.024	0.029	0.032	0.028	0.047	0.024	0.039	0.035	0.025	0.034	0.045	0.025	0.038	0.038	0.028	0.024	0.038	0.027	0.026
Tues/Wed/Thurs	21	0.032	0.021	0.021	0.024	0.024	0.021	0.042	0.021	0.034	0.029	0.019	0.031	0.038	0.018	0.032	0.032	0.023	0.022	0.033	0.022	0.024
Tues/Wed/Thurs	22	0.023	0.016	0.019	0.017	0.018	0.019	0.031	0.013	0.028	0.020	0.013	0.029	0.032	0.014	0.026	0.025	0.018	0.023	0.024	0.017	0.022
Tues/Wed/Thurs	23	0.014	0.011	0.020	0.009	0.012	0.015	0.022	0.010	0.022	0.013	0.009	0.028	0.025	0.010	0.021	0.016	0.015	0.028	0.015	0.013	0.024
Friday	0	0.007	0.022	0.032	0.005	0.023	0.030	0.013	0.007	0.021	0.007	0.014	0.032	0.021	0.007	0.019	0.009	0.025	0.040	0.008	0.022	0.033
Friday	1	0.004	0.023	0.031	0.002	0.022	0.031	0.012	0.005	0.018	0.005	0.011	0.030	0.023	0.006	0.017	0.006	0.024	0.039	0.004	0.021	0.031
Friday	2	0.003	0.024	0.032	0.001	0.024	0.032	0.012	0.006	0.018	0.004	0.011	0.030	0.024	0.007	0.016	0.005	0.024	0.039	0.003	0.022	0.032
Friday	3	0.003	0.025	0.033	0.002	0.027	0.034	0.014	0.008	0.018	0.005	0.012	0.030	0.026	0.009	0.016	0.005	0.025	0.040	0.004	0.023	0.033
Friday	4	0.007	0.029	0.036	0.005	0.030	0.038	0.016	0.015	0.021	0.008	0.016	0.033	0.029	0.013	0.019	0.011	0.030	0.044	0.010	0.028	0.036
Friday	5	0.022	0.035	0.044	0.022	0.033	0.041	0.023	0.023	0.026	0.017	0.026	0.038	0.032	0.018	0.023	0.027	0.040	0.050	0.030	0.039	0.044
Friday	6	0.044	0.045	0.053	0.054	0.040	0.046	0.029	0.035	0.033	0.033	0.040	0.045	0.033	0.030	0.032	0.039	0.047	0.053	0.050	0.049	0.050
Friday	7	0.060	0.052	0.058	0.075	0.049	0.055	0.034	0.044	0.041	0.049	0.054	0.050	0.037	0.039	0.039	0.050	0.053	0.056	0.063	0.057	0.055
Friday	8	0.063	0.054	0.060	0.071	0.047	0.050	0.039	0.055	0.049	0.051	0.057	0.052	0.040	0.051	0.049	0.048	0.054	0.057	0.059	0.057	0.056
Friday	9	0.060	0.054	0.057	0.068	0.049	0.051	0.042	0.060	0.055	0.050	0.057	0.052	0.045	0.063	0.054	0.048	0.055	0.057	0.053	0.054	0.054
Friday	10	0.054	0.053	0.056	0.061	0.051	0.053	0.049	0.063	0.058	0.054	0.061	0.054	0.048	0.069	0.060	0.052	0.056	0.056	0.051	0.053	0.053
Friday	11	0.053	0.055	0.056	0.061	0.056	0.054	0.052	0.069	0.061	0.060	0.066	0.055	0.049	0.072	0.063	0.056	0.058	0.055	0.053	0.055	0.054
Friday	12	0.055	0.057	0.056	0.058	0.056	0.053	0.057	0.070	0.061	0.063	0.067	0.055	0.052	0.074	0.063	0.059	0.058	0.053	0.056	0.057	0.055
Friday	13	0.058	0.058	0.054	0.060	0.059	0.058	0.057	0.075	0.061	0.066	0.068	0.054	0.055	0.077	0.062	0.063	0.058	0.051	0.058	0.058	0.056
Friday	14	0.064	0.061	0.053	0.064	0.062	0.056	0.065	0.080	0.060	0.070	0.070	0.054	0.059	0.080	0.063	0.067	0.058	0.048	0.064	0.059	0.056
Friday	15	0.067	0.063	0.054	0.065	0.061	0.055	0.070	0.082	0.059	0.073	0.070	0.052	0.063	0.081	0.061	0.069	0.057	0.045	0.066	0.062	0.056
Friday	16	0.069	0.062	0.051	0.065	0.062	0.054	0.072	0.073	0.057	0.074	0.067	0.050	0.058	0.075	0.059	0.070	0.054	0.041	0.067	0.059	0.050
Friday	17	0.069	0.060	0.048	0.064	0.059	0.049	0.065	0.062	0.055	0.072	0.063	0.047	0.059	0.063	0.055	0.067	0.050	0.037	0.067	0.055	0.046
Friday	18	0.063	0.049	0.038	0.056	0.053	0.046	0.061	0.047	0.051	0.063	0.051	0.042	0.054	0.052	0.051	0.061	0.044	0.031	0.060	0.047	0.039
Friday	19	0.053	0.037	0.028	0.044	0.043	0.035	0.059	0.039	0.046	0.050	0.039	0.035	0.050	0.036	0.046	0.054	0.037	0.026	0.049	0.036	0.030
Friday	20	0.039	0.028	0.021	0.032	0.034	0.027	0.051	0.028	0.040	0.041	0.029	0.030	0.046	0.030	0.041	0.047	0.031	0.022	0.040	0.029	0.023
Friday	21	0.033	0.022	0.018	0.027	0.027	0.022	0.045	0.022	0.035	0.037	0.023	0.028	0.040	0.022	0.036	0.039	0.025	0.020	0.035	0.023	0.020
Friday	22	0.028	0.017	0.016	0.023	0.019	0.016	0.037	0.018	0.031	0.030	0.017	0.026	0.031	0.016	0.031	0.030	0.020	0.020	0.030	0.019	0.019
Friday	23	0.021	0.013	0.016	0.015	0.014	0.013	0.026	0.012	0.025	0.019	0.011	0.024	0.025	0.012	0.025	0.021	0.016	0.022	0.022	0.015	0.020
Saturday	0	0.015	0.029	0.046	0.009	0.028	0.038	0.015	0.011	0.021	0.013	0.019	0.038	0.026	0.013	0.020	0.014	0.031	0.057	0.015	0.030	0.044
Saturday	1	0.009	0.028	0.042	0.005	0.028	0.038	0.014	0.008	0.018	0.008	0.015	0.034	0.026	0.008	0.016	0.009	0.028	0.052	0.009	0.027	0.040
Saturday	2	0.007	0.028	0.040	0.003	0.029	0.042	0.014	0.008	0.016	0.006	0.014	0.032	0.027	0.007	0.015	0.007	0.027	0.049	0.006	0.026	0.039
Saturday	3	0.005	0.029	0.038	0.002	0.032	0.042	0.014	0.007	0.016	0.006	0.013	0.031	0.030	0.007	0.014	0.006	0.026	0.046	0.005	0.025	0.037
Saturday	4	0.006	0.030	0.039	0.003	0.032	0.042	0.017	0.014	0.017	0.007	0.014	0.032	0.029	0.009	0.016	0.008	0.028	0.047	0.006	0.027	0.037
Saturday	5	0.011	0.033	0.042	0.009	0.035	0.041	0.021	0.018	0.021	0.011	0.018	0.034	0.033	0.015	0.019	0.014	0.031	0.049	0.013	0.030	0.040
Saturday	6	0.020	0.037	0.046	0.019	0.034	0.043	0.025	0.027	0.028	0.019	0.026	0.039	0.036	0.023	0.025	0.022	0.037	0.052	0.023	0.035	0.042
Saturday	7	0.032	0.041	0.050	0.033	0.038	0.041	0.032	0.038	0.039	0.032	0.038	0.046	0.038	0.033	0.036	0.032	0.042	0.054	0.034	0.041	0.047

		Santa Clara			Santa Cruz			Shasta			Sierra			Siskiyou			Solano			Sonoma		
Day of Week	**Hour**	**LD**	**LM**	**HH**	**LD**	**LM**	**HH**	**LD**	**LM**	**HH**	**LD**	**LM**	**HH**	**LD**	**LM**	**HH**	**LD**	**LM**	**HH**	**LD**	**LM**	**HH**
Saturday	8	0.045	0.046	0.053	0.049	0.041	0.046	0.040	0.055	0.051	0.045	0.051	0.052	0.041	0.047	0.047	0.044	0.049	0.056	0.046	0.047	0.049
Saturday	9	0.055	0.051	0.056	0.059	0.046	0.046	0.044	0.064	0.061	0.057	0.062	0.056	0.045	0.063	0.059	0.056	0.054	0.055	0.055	0.051	0.050
Saturday	10	0.062	0.054	0.056	0.066	0.047	0.047	0.051	0.071	0.067	0.067	0.071	0.060	0.049	0.075	0.067	0.065	0.057	0.052	0.061	0.054	0.051
Saturday	11	0.067	0.057	0.056	0.068	0.052	0.052	0.058	0.077	0.068	0.074	0.076	0.061	0.050	0.084	0.073	0.068	0.058	0.050	0.065	0.056	0.052
Saturday	12	0.069	0.057	0.054	0.067	0.053	0.050	0.060	0.076	0.067	0.075	0.075	0.060	0.053	0.083	0.071	0.067	0.057	0.047	0.066	0.058	0.055
Saturday	13	0.069	0.057	0.051	0.067	0.055	0.049	0.059	0.073	0.066	0.075	0.074	0.057	0.055	0.081	0.069	0.066	0.056	0.044	0.067	0.059	0.058
Saturday	14	0.069	0.057	0.049	0.069	0.053	0.049	0.065	0.076	0.066	0.074	0.071	0.055	0.057	0.076	0.065	0.066	0.055	0.041	0.067	0.058	0.057
Saturday	15	0.069	0.057	0.045	0.072	0.056	0.049	0.067	0.073	0.064	0.072	0.068	0.051	0.060	0.074	0.062	0.066	0.054	0.038	0.068	0.057	0.051
Saturday	16	0.068	0.055	0.043	0.074	0.055	0.048	0.065	0.069	0.059	0.070	0.064	0.048	0.056	0.070	0.058	0.066	0.053	0.034	0.068	0.056	0.047
Saturday	17	0.067	0.052	0.038	0.074	0.055	0.046	0.064	0.062	0.055	0.066	0.057	0.044	0.055	0.061	0.057	0.065	0.050	0.031	0.067	0.054	0.044
Saturday	18	0.061	0.047	0.034	0.066	0.052	0.040	0.061	0.048	0.050	0.056	0.047	0.038	0.051	0.049	0.052	0.058	0.046	0.029	0.060	0.048	0.036
Saturday	19	0.050	0.040	0.029	0.054	0.045	0.035	0.059	0.041	0.044	0.046	0.037	0.033	0.049	0.038	0.045	0.050	0.040	0.026	0.049	0.041	0.029
Saturday	20	0.042	0.035	0.025	0.044	0.041	0.033	0.050	0.031	0.036	0.040	0.030	0.028	0.042	0.031	0.038	0.045	0.036	0.023	0.043	0.036	0.025
Saturday	21	0.040	0.031	0.023	0.039	0.037	0.032	0.044	0.023	0.030	0.035	0.025	0.025	0.037	0.023	0.031	0.041	0.033	0.023	0.041	0.033	0.024
Saturday	22	0.036	0.027	0.023	0.032	0.031	0.028	0.034	0.017	0.024	0.028	0.019	0.023	0.031	0.017	0.026	0.035	0.029	0.023	0.037	0.029	0.023
Saturday	23	0.026	0.022	0.022	0.020	0.025	0.025	0.026	0.013	0.019	0.020	0.014	0.021	0.023	0.012	0.019	0.026	0.023	0.023	0.028	0.024	0.022
Holiday	0	0.012	0.025	0.032	0.008	0.024	0.031	0.014	0.008	0.015	0.010	0.016	0.028	0.024	0.008	0.015	0.013	0.029	0.038	0.013	0.027	0.034
Holiday	1	0.007	0.025	0.031	0.003	0.025	0.034	0.013	0.007	0.013	0.006	0.013	0.027	0.027	0.008	0.012	0.008	0.027	0.038	0.007	0.026	0.033
Holiday	2	0.004	0.026	0.032	0.002	0.025	0.034	0.013	0.006	0.012	0.004	0.012	0.026	0.024	0.008	0.012	0.005	0.025	0.037	0.004	0.025	0.033
Holiday	3	0.003	0.027	0.032	0.001	0.024	0.029	0.013	0.006	0.012	0.005	0.013	0.027	0.029	0.010	0.013	0.005	0.026	0.037	0.003	0.025	0.033
Holiday	4	0.005	0.029	0.034	0.004	0.030	0.034	0.016	0.013	0.014	0.008	0.016	0.029	0.029	0.012	0.014	0.008	0.028	0.039	0.007	0.029	0.035
Holiday	5	0.014	0.034	0.038	0.012	0.033	0.041	0.020	0.017	0.020	0.014	0.023	0.032	0.031	0.016	0.017	0.018	0.034	0.043	0.017	0.034	0.039
Holiday	6	0.027	0.039	0.044	0.028	0.037	0.045	0.025	0.028	0.026	0.025	0.033	0.036	0.037	0.025	0.023	0.025	0.040	0.046	0.029	0.040	0.044
Holiday	7	0.039	0.043	0.048	0.043	0.035	0.038	0.030	0.037	0.036	0.036	0.044	0.042	0.038	0.033	0.031	0.032	0.045	0.050	0.038	0.045	0.047
Holiday	8	0.050	0.048	0.052	0.052	0.048	0.053	0.036	0.051	0.046	0.046	0.053	0.048	0.040	0.049	0.040	0.041	0.050	0.053	0.045	0.050	0.051
Holiday	9	0.054	0.052	0.054	0.058	0.051	0.053	0.047	0.068	0.056	0.054	0.059	0.050	0.043	0.062	0.054	0.051	0.055	0.055	0.049	0.053	0.052
Holiday	10	0.058	0.055	0.056	0.064	0.049	0.054	0.051	0.068	0.064	0.065	0.069	0.053	0.050	0.076	0.060	0.062	0.060	0.055	0.056	0.056	0.053
Holiday	11	0.061	0.058	0.057	0.069	0.055	0.050	0.059	0.083	0.069	0.074	0.074	0.057	0.047	0.084	0.068	0.068	0.063	0.056	0.062	0.059	0.055
Holiday	12	0.063	0.060	0.057	0.067	0.057	0.059	0.066	0.081	0.071	0.077	0.074	0.056	0.053	0.083	0.070	0.070	0.061	0.054	0.067	0.061	0.056
Holiday	13	0.066	0.062	0.057	0.068	0.069	0.064	0.062	0.084	0.068	0.076	0.074	0.058	0.062	0.091	0.067	0.071	0.062	0.052	0.070	0.062	0.056
Holiday	14	0.069	0.062	0.056	0.073	0.058	0.060	0.069	0.076	0.064	0.075	0.073	0.056	0.059	0.087	0.069	0.072	0.060	0.051	0.073	0.062	0.057
Holiday	15	0.071	0.062	0.054	0.072	0.070	0.056	0.065	0.081	0.061	0.074	0.070	0.055	0.057	0.079	0.065	0.068	0.056	0.046	0.071	0.061	0.054
Holiday	16	0.072	0.060	0.051	0.071	0.059	0.052	0.070	0.068	0.061	0.072	0.066	0.054	0.056	0.072	0.062	0.066	0.054	0.044	0.070	0.057	0.050
Holiday	17	0.071	0.057	0.047	0.070	0.058	0.048	0.068	0.063	0.060	0.068	0.059	0.051	0.056	0.058	0.060	0.064	0.050	0.040	0.067	0.053	0.044
Holiday	18	0.064	0.048	0.039	0.063	0.054	0.045	0.063	0.047	0.055	0.057	0.049	0.045	0.053	0.044	0.058	0.058	0.042	0.034	0.059	0.045	0.038
Holiday	19	0.054	0.038	0.032	0.052	0.035	0.029	0.056	0.035	0.048	0.047	0.036	0.041	0.048	0.029	0.049	0.051	0.037	0.029	0.051	0.036	0.031
Holiday	20	0.045	0.031	0.026	0.043	0.035	0.027	0.050	0.028	0.041	0.039	0.029	0.037	0.044	0.024	0.045	0.047	0.031	0.025	0.046	0.031	0.028
Holiday	21	0.039	0.025	0.024	0.036	0.029	0.026	0.045	0.021	0.035	0.030	0.020	0.033	0.040	0.019	0.040	0.042	0.026	0.024	0.041	0.026	0.026
Holiday	22	0.031	0.019	0.022	0.024	0.021	0.022	0.027	0.013	0.029	0.023	0.015	0.031	0.031	0.014	0.030	0.033	0.022	0.025	0.033	0.021	0.025
Holiday	23	0.020	0.014	0.024	0.015	0.016	0.015	0.022	0.010	0.023	0.015	0.010	0.029	0.024	0.009	0.024	0.022	0.018	0.029	0.021	0.017	0.026

		Stanislaus			Sutter			Tehama			Trinity			Tulare			Tuolumne			Ventura		
Day of Week	Hour	LD	LM	HH	LD	LM	HH	LD	LM	HH	LD	LM	HH	LD	LM	HH	LD	LM	HH	LD	LM	HH
Sunday	0	0.014	0.025	0.037	0.013	0.020	0.031	0.013	0.008	0.016	0.019	0.009	0.017	0.022	0.015	0.017	0.010	0.014	0.032	0.014	0.036	0.048
Sunday	1	0.009	0.019	0.032	0.008	0.016	0.028	0.013	0.006	0.013	0.021	0.007	0.014	0.024	0.015	0.009	0.007	0.011	0.024	0.009	0.026	0.042
Sunday	2	0.007	0.016	0.029	0.006	0.013	0.026	0.012	0.006	0.011	0.022	0.006	0.013	0.023	0.011	0.008	0.005	0.011	0.022	0.006	0.021	0.038
Sunday	3	0.005	0.015	0.028	0.005	0.012	0.025	0.012	0.005	0.011	0.022	0.005	0.013	0.023	0.009	0.010	0.004	0.010	0.021	0.004	0.018	0.036
Sunday	4	0.006	0.016	0.028	0.005	0.012	0.025	0.015	0.007	0.013	0.023	0.006	0.013	0.024	0.010	0.018	0.004	0.010	0.020	0.004	0.018	0.035
Sunday	5	0.010	0.019	0.029	0.008	0.015	0.027	0.018	0.012	0.018	0.025	0.008	0.016	0.026	0.018	0.025	0.007	0.013	0.021	0.008	0.021	0.036
Sunday	6	0.015	0.023	0.031	0.013	0.020	0.030	0.021	0.019	0.026	0.028	0.014	0.024	0.030	0.031	0.042	0.012	0.019	0.026	0.014	0.027	0.038
Sunday	7	0.021	0.029	0.035	0.022	0.028	0.034	0.029	0.030	0.039	0.030	0.022	0.034	0.034	0.035	0.050	0.019	0.023	0.029	0.022	0.034	0.041
Sunday	8	0.031	0.038	0.040	0.034	0.041	0.040	0.037	0.043	0.053	0.033	0.036	0.048	0.035	0.042	0.052	0.032	0.035	0.038	0.034	0.044	0.044
Sunday	9	0.043	0.050	0.047	0.048	0.055	0.046	0.043	0.055	0.067	0.036	0.052	0.062	0.040	0.057	0.047	0.051	0.051	0.053	0.049	0.057	0.047
Sunday	10	0.055	0.060	0.051	0.064	0.068	0.052	0.053	0.071	0.079	0.040	0.071	0.075	0.044	0.066	0.054	0.067	0.067	0.071	0.065	0.070	0.050
Sunday	11	0.063	0.065	0.054	0.075	0.075	0.055	0.060	0.077	0.080	0.044	0.082	0.086	0.047	0.070	0.055	0.080	0.081	0.085	0.074	0.076	0.051
Sunday	12	0.070	0.070	0.055	0.082	0.079	0.058	0.064	0.084	0.077	0.049	0.089	0.088	0.051	0.076	0.058	0.083	0.081	0.076	0.078	0.077	0.051
Sunday	13	0.075	0.071	0.056	0.084	0.079	0.058	0.066	0.083	0.070	0.054	0.090	0.080	0.054	0.073	0.070	0.085	0.082	0.074	0.080	0.074	0.049
Sunday	14	0.077	0.069	0.055	0.084	0.077	0.057	0.067	0.085	0.065	0.058	0.089	0.072	0.056	0.071	0.068	0.085	0.083	0.069	0.079	0.068	0.047
Sunday	15	0.078	0.070	0.053	0.082	0.073	0.057	0.072	0.083	0.061	0.063	0.087	0.069	0.059	0.071	0.067	0.084	0.081	0.066	0.077	0.062	0.045
Sunday	16	0.077	0.067	0.052	0.079	0.068	0.055	0.073	0.080	0.058	0.064	0.081	0.059	0.060	0.066	0.066	0.082	0.079	0.060	0.075	0.057	0.043
Sunday	17	0.075	0.062	0.049	0.072	0.062	0.053	0.068	0.066	0.056	0.065	0.066	0.051	0.061	0.063	0.064	0.076	0.070	0.053	0.070	0.050	0.041
Sunday	18	0.068	0.055	0.046	0.060	0.052	0.049	0.065	0.056	0.049	0.065	0.055	0.044	0.060	0.052	0.056	0.064	0.056	0.043	0.062	0.040	0.038
Sunday	19	0.061	0.047	0.042	0.050	0.043	0.045	0.058	0.043	0.041	0.062	0.043	0.036	0.059	0.050	0.051	0.049	0.043	0.035	0.055	0.034	0.037
Sunday	20	0.051	0.039	0.040	0.041	0.035	0.042	0.048	0.031	0.032	0.057	0.032	0.028	0.055	0.037	0.040	0.038	0.033	0.024	0.046	0.028	0.036
Sunday	21	0.041	0.031	0.038	0.031	0.026	0.039	0.041	0.023	0.026	0.049	0.022	0.023	0.048	0.029	0.028	0.026	0.022	0.020	0.037	0.024	0.036
Sunday	22	0.029	0.024	0.036	0.021	0.019	0.036	0.031	0.016	0.021	0.041	0.015	0.019	0.038	0.018	0.029	0.017	0.014	0.017	0.026	0.020	0.035
Sunday	23	0.019	0.019	0.037	0.013	0.015	0.033	0.020	0.012	0.017	0.028	0.012	0.016	0.028	0.014	0.019	0.010	0.010	0.020	0.015	0.018	0.037
Monday	0	0.011	0.017	0.023	0.008	0.014	0.027	0.013	0.006	0.012	0.023	0.007	0.013	0.022	0.004	0.006	0.006	0.010	0.017	0.006	0.015	0.027
Monday	1	0.007	0.015	0.022	0.005	0.012	0.025	0.012	0.006	0.011	0.023	0.006	0.011	0.023	0.004	0.004	0.004	0.009	0.016	0.003	0.012	0.026
Monday	2	0.006	0.015	0.022	0.004	0.012	0.025	0.013	0.006	0.011	0.025	0.007	0.011	0.023	0.004	0.005	0.003	0.009	0.016	0.002	0.012	0.026
Monday	3	0.009	0.018	0.025	0.006	0.014	0.027	0.015	0.010	0.012	0.027	0.010	0.011	0.024	0.006	0.011	0.005	0.011	0.019	0.003	0.013	0.028
Monday	4	0.018	0.027	0.032	0.011	0.019	0.030	0.019	0.019	0.015	0.030	0.015	0.012	0.027	0.015	0.020	0.008	0.017	0.024	0.008	0.019	0.032
Monday	5	0.030	0.039	0.039	0.023	0.030	0.036	0.025	0.030	0.021	0.033	0.022	0.018	0.035	0.035	0.032	0.019	0.028	0.036	0.024	0.034	0.039
Monday	6	0.044	0.051	0.045	0.042	0.047	0.043	0.032	0.041	0.024	0.036	0.034	0.024	0.040	0.056	0.050	0.036	0.041	0.050	0.049	0.055	0.045
Monday	7	0.058	0.058	0.050	0.060	0.061	0.048	0.034	0.048	0.032	0.040	0.043	0.030	0.044	0.063	0.057	0.051	0.044	0.065	0.075	0.072	0.050
Monday	8	0.053	0.058	0.051	0.059	0.062	0.050	0.039	0.059	0.039	0.043	0.054	0.039	0.046	0.071	0.059	0.053	0.056	0.068	0.071	0.071	0.052
Monday	9	0.051	0.059	0.053	0.056	0.061	0.050	0.047	0.065	0.046	0.045	0.067	0.048	0.046	0.066	0.060	0.059	0.065	0.080	0.057	0.064	0.052
Monday	10	0.054	0.062	0.056	0.058	0.064	0.051	0.050	0.070	0.053	0.050	0.074	0.054	0.049	0.070	0.066	0.067	0.074	0.087	0.053	0.062	0.053
Monday	11	0.057	0.064	0.057	0.062	0.066	0.053	0.056	0.072	0.055	0.052	0.075	0.059	0.051	0.070	0.065	0.071	0.075	0.082	0.056	0.063	0.054
Monday	12	0.060	0.064	0.058	0.066	0.068	0.054	0.059	0.073	0.055	0.055	0.078	0.059	0.056	0.072	0.066	0.074	0.074	0.080	0.058	0.064	0.054
Monday	13	0.061	0.064	0.058	0.067	0.067	0.054	0.060	0.076	0.058	0.057	0.081	0.060	0.055	0.073	0.071	0.074	0.075	0.075	0.058	0.061	0.053
Monday	14	0.067	0.066	0.058	0.070	0.069	0.055	0.065	0.079	0.059	0.057	0.081	0.065	0.058	0.073	0.070	0.077	0.076	0.065	0.063	0.063	0.053
Monday	15	0.072	0.065	0.057	0.073	0.069	0.055	0.071	0.081	0.062	0.059	0.080	0.063	0.061	0.077	0.074	0.082	0.076	0.058	0.072	0.065	0.052
Monday	16	0.075	0.063	0.055	0.075	0.067	0.054	0.070	0.070	0.063	0.060	0.072	0.064	0.061	0.073	0.064	0.081	0.073	0.045	0.078	0.064	0.050
Monday	17	0.074	0.055	0.051	0.073	0.061	0.052	0.065	0.057	0.066	0.057	0.059	0.066	0.059	0.059	0.057	0.071	0.059	0.035	0.080	0.060	0.049
Monday	18	0.055	0.042	0.042	0.056	0.046	0.045	0.058	0.042	0.064	0.053	0.045	0.063	0.050	0.037	0.047	0.052	0.042	0.023	0.063	0.046	0.043
Monday	19	0.042	0.031	0.036	0.040	0.031	0.039	0.054	0.031	0.059	0.048	0.032	0.060	0.045	0.024	0.036	0.037	0.030	0.017	0.042	0.029	0.038
Monday	20	0.034	0.023	0.031	0.031	0.022	0.035	0.050	0.022	0.054	0.042	0.022	0.054	0.040	0.017	0.031	0.027	0.022	0.013	0.031	0.020	0.033
Monday	21	0.027	0.018	0.028	0.025	0.017	0.032	0.041	0.017	0.051	0.036	0.016	0.046	0.035	0.013	0.023	0.020	0.016	0.010	0.025	0.015	0.032
Monday	22	0.020	0.014	0.027	0.017	0.012	0.030	0.030	0.011	0.043	0.029	0.012	0.039	0.029	0.010	0.017	0.015	0.012	0.009	0.016	0.010	0.030
Monday	23	0.014	0.011	0.025	0.012	0.009	0.030	0.022	0.008	0.034	0.020	0.008	0.031	0.022	0.006	0.011	0.009	0.007	0.010	0.009	0.008	0.030
Tues/Wed/Thurs	0	0.008	0.016	0.025	0.008	0.014	0.029	0.012	0.006	0.017	0.023	0.007	0.018	0.021	0.004	0.009	0.005	0.009	0.017	0.005	0.015	0.032
Tues/Wed/Thurs	1	0.005	0.014	0.024	0.004	0.011	0.027	0.012	0.005	0.015	0.025	0.006	0.015	0.021	0.004	0.007	0.003	0.008	0.017	0.002	0.012	0.030
Tues/Wed/Thurs	2	0.005	0.014	0.025	0.004	0.011	0.027	0.013	0.006	0.014	0.027	0.006	0.013	0.022	0.004	0.009	0.002	0.009	0.017	0.001	0.012	0.030
Tues/Wed/Thurs	3	0.008	0.018	0.028	0.005	0.013	0.029	0.014	0.009	0.015	0.029	0.009	0.013	0.024	0.005	0.012	0.003	0.010	0.022	0.002	0.013	0.031

		Stanislaus			Sutter			Tehama			Trinity			Tulare			Tuolumne			Ventura		
Day of Week	Hour	LD	LM	HH	LD	LM	HH	LD	LM	HH	LD	LM	HH	LD	LM	HH	LD	LM	HH	LD	LM	HH
Tues/Wed/Thurs	4	0.017	0.026	0.034	0.010	0.018	0.031	0.018	0.017	0.017	0.032	0.014	0.016	0.028	0.014	0.018	0.006	0.014	0.025	0.007	0.019	0.035
Tues/Wed/Thurs	5	0.030	0.039	0.042	0.022	0.029	0.037	0.023	0.026	0.022	0.035	0.021	0.020	0.035	0.033	0.032	0.018	0.027	0.039	0.022	0.034	0.043
Tues/Wed/Thurs	6	0.044	0.050	0.047	0.042	0.047	0.044	0.030	0.042	0.030	0.038	0.033	0.027	0.041	0.056	0.052	0.037	0.042	0.052	0.049	0.055	0.049
Tues/Wed/Thurs	7	0.059	0.059	0.052	0.060	0.061	0.050	0.038	0.051	0.039	0.040	0.046	0.036	0.044	0.067	0.060	0.053	0.047	0.064	0.075	0.072	0.052
Tues/Wed/Thurs	8	0.055	0.058	0.052	0.060	0.062	0.051	0.042	0.061	0.048	0.042	0.056	0.046	0.046	0.071	0.063	0.054	0.056	0.070	0.071	0.071	0.054
Tues/Wed/Thurs	9	0.051	0.059	0.054	0.055	0.060	0.050	0.047	0.064	0.058	0.044	0.066	0.057	0.047	0.067	0.065	0.059	0.068	0.083	0.057	0.064	0.053
Tues/Wed/Thurs	10	0.052	0.060	0.056	0.056	0.061	0.051	0.051	0.067	0.066	0.045	0.071	0.065	0.049	0.069	0.065	0.064	0.069	0.081	0.052	0.061	0.053
Tues/Wed/Thurs	11	0.054	0.061	0.057	0.059	0.064	0.052	0.054	0.070	0.069	0.047	0.076	0.070	0.052	0.071	0.062	0.068	0.069	0.077	0.054	0.062	0.053
Tues/Wed/Thurs	12	0.057	0.062	0.057	0.061	0.065	0.053	0.058	0.072	0.067	0.050	0.076	0.070	0.054	0.069	0.065	0.069	0.071	0.074	0.056	0.063	0.053
Tues/Wed/Thurs	13	0.060	0.063	0.056	0.064	0.066	0.053	0.061	0.074	0.066	0.052	0.077	0.069	0.056	0.072	0.067	0.072	0.073	0.074	0.057	0.061	0.051
Tues/Wed/Thurs	14	0.066	0.065	0.056	0.068	0.068	0.053	0.065	0.077	0.063	0.057	0.081	0.067	0.059	0.074	0.070	0.077	0.076	0.067	0.063	0.063	0.050
Tues/Wed/Thurs	15	0.073	0.066	0.055	0.073	0.069	0.053	0.070	0.080	0.061	0.058	0.078	0.064	0.061	0.080	0.071	0.084	0.078	0.058	0.071	0.065	0.049
Tues/Wed/Thurs	16	0.077	0.064	0.053	0.075	0.067	0.052	0.072	0.072	0.058	0.057	0.072	0.061	0.060	0.072	0.063	0.082	0.074	0.048	0.078	0.063	0.046
Tues/Wed/Thurs	17	0.076	0.057	0.049	0.074	0.063	0.050	0.065	0.057	0.056	0.056	0.060	0.057	0.057	0.059	0.054	0.074	0.061	0.036	0.079	0.060	0.044
Tues/Wed/Thurs	18	0.058	0.044	0.041	0.059	0.048	0.044	0.060	0.044	0.052	0.053	0.046	0.053	0.051	0.037	0.043	0.053	0.044	0.023	0.065	0.047	0.040
Tues/Wed/Thurs	19	0.044	0.032	0.034	0.043	0.034	0.038	0.053	0.032	0.045	0.048	0.033	0.044	0.045	0.025	0.036	0.038	0.031	0.016	0.044	0.031	0.034
Tues/Wed/Thurs	20	0.036	0.025	0.030	0.035	0.025	0.034	0.047	0.024	0.039	0.045	0.025	0.038	0.041	0.019	0.027	0.030	0.025	0.012	0.034	0.021	0.030
Tues/Wed/Thurs	21	0.028	0.019	0.026	0.029	0.019	0.031	0.042	0.021	0.034	0.038	0.018	0.032	0.035	0.014	0.021	0.023	0.018	0.010	0.028	0.016	0.029
Tues/Wed/Thurs	22	0.021	0.014	0.025	0.020	0.013	0.029	0.031	0.013	0.028	0.032	0.014	0.026	0.029	0.010	0.015	0.017	0.013	0.010	0.018	0.011	0.028
Tues/Wed/Thurs	23	0.015	0.012	0.023	0.013	0.009	0.028	0.022	0.010	0.022	0.025	0.010	0.021	0.022	0.006	0.011	0.010	0.008	0.010	0.010	0.008	0.030
Friday	0	0.008	0.016	0.027	0.007	0.014	0.032	0.013	0.007	0.021	0.021	0.007	0.019	0.020	0.004	0.010	0.005	0.009	0.019	0.006	0.016	0.033
Friday	1	0.006	0.014	0.025	0.005	0.011	0.030	0.012	0.005	0.018	0.023	0.006	0.017	0.021	0.003	0.007	0.003	0.008	0.019	0.003	0.013	0.031
Friday	2	0.005	0.014	0.026	0.004	0.011	0.030	0.012	0.006	0.018	0.024	0.007	0.016	0.023	0.004	0.008	0.002	0.008	0.019	0.002	0.012	0.031
Friday	3	0.008	0.017	0.029	0.005	0.012	0.030	0.014	0.008	0.018	0.026	0.009	0.016	0.022	0.005	0.013	0.002	0.008	0.021	0.003	0.014	0.032
Friday	4	0.014	0.024	0.035	0.008	0.016	0.033	0.016	0.015	0.021	0.029	0.013	0.019	0.027	0.013	0.020	0.005	0.013	0.024	0.007	0.019	0.036
Friday	5	0.024	0.035	0.042	0.017	0.026	0.038	0.023	0.023	0.026	0.032	0.018	0.023	0.034	0.032	0.033	0.013	0.023	0.037	0.020	0.032	0.042
Friday	6	0.036	0.045	0.047	0.033	0.040	0.045	0.029	0.035	0.033	0.033	0.030	0.032	0.038	0.051	0.057	0.026	0.035	0.049	0.043	0.052	0.049
Friday	7	0.049	0.053	0.052	0.049	0.054	0.050	0.034	0.044	0.041	0.037	0.039	0.039	0.042	0.062	0.063	0.039	0.040	0.060	0.067	0.068	0.052
Friday	8	0.047	0.054	0.053	0.051	0.057	0.052	0.039	0.055	0.049	0.040	0.051	0.049	0.046	0.070	0.063	0.043	0.049	0.068	0.064	0.069	0.054
Friday	9	0.047	0.056	0.055	0.050	0.057	0.052	0.042	0.060	0.055	0.045	0.063	0.054	0.047	0.066	0.063	0.049	0.057	0.073	0.054	0.062	0.053
Friday	10	0.051	0.060	0.058	0.054	0.061	0.054	0.049	0.063	0.058	0.048	0.069	0.060	0.050	0.070	0.066	0.058	0.063	0.078	0.053	0.061	0.054
Friday	11	0.054	0.062	0.060	0.060	0.066	0.055	0.052	0.069	0.061	0.049	0.072	0.063	0.052	0.071	0.063	0.064	0.069	0.077	0.057	0.064	0.054
Friday	12	0.057	0.063	0.060	0.063	0.067	0.055	0.057	0.070	0.061	0.052	0.074	0.063	0.054	0.070	0.067	0.066	0.071	0.076	0.059	0.064	0.053
Friday	13	0.061	0.065	0.059	0.066	0.068	0.054	0.057	0.075	0.061	0.055	0.077	0.062	0.056	0.072	0.067	0.071	0.074	0.077	0.061	0.065	0.052
Friday	14	0.068	0.067	0.058	0.070	0.070	0.054	0.065	0.080	0.060	0.059	0.080	0.063	0.058	0.074	0.070	0.076	0.077	0.070	0.065	0.065	0.050
Friday	15	0.074	0.067	0.056	0.073	0.070	0.052	0.070	0.082	0.059	0.063	0.081	0.061	0.059	0.075	0.068	0.083	0.079	0.060	0.071	0.065	0.049
Friday	16	0.076	0.064	0.053	0.074	0.067	0.050	0.072	0.073	0.057	0.058	0.075	0.059	0.059	0.070	0.059	0.083	0.077	0.050	0.075	0.063	0.046
Friday	17	0.075	0.058	0.048	0.072	0.063	0.047	0.065	0.062	0.055	0.059	0.063	0.055	0.055	0.057	0.055	0.075	0.064	0.038	0.074	0.059	0.043
Friday	18	0.064	0.048	0.040	0.063	0.051	0.042	0.061	0.047	0.051	0.054	0.052	0.051	0.053	0.041	0.043	0.062	0.051	0.025	0.064	0.046	0.040
Friday	19	0.052	0.037	0.032	0.050	0.039	0.035	0.059	0.039	0.046	0.050	0.036	0.046	0.045	0.027	0.036	0.050	0.039	0.018	0.048	0.032	0.034
Friday	20	0.043	0.029	0.026	0.041	0.029	0.030	0.051	0.028	0.040	0.046	0.030	0.041	0.042	0.020	0.026	0.041	0.030	0.013	0.037	0.022	0.029
Friday	21	0.035	0.022	0.022	0.037	0.023	0.028	0.045	0.022	0.035	0.040	0.022	0.036	0.039	0.017	0.019	0.036	0.025	0.010	0.032	0.017	0.027
Friday	22	0.027	0.016	0.020	0.030	0.017	0.026	0.037	0.018	0.031	0.031	0.016	0.031	0.032	0.014	0.015	0.030	0.019	0.011	0.024	0.012	0.027
Friday	23	0.020	0.012	0.018	0.019	0.011	0.024	0.026	0.012	0.025	0.025	0.012	0.025	0.026	0.011	0.010	0.018	0.012	0.009	0.016	0.009	0.027
Saturday	0	0.015	0.026	0.040	0.013	0.019	0.038	0.015	0.011	0.021	0.026	0.013	0.020	0.025	0.010	0.013	0.010	0.015	0.027	0.011	0.024	0.043
Saturday	1	0.010	0.020	0.035	0.008	0.015	0.034	0.014	0.008	0.018	0.026	0.008	0.016	0.025	0.007	0.010	0.007	0.012	0.023	0.006	0.018	0.040
Saturday	2	0.008	0.018	0.032	0.006	0.014	0.032	0.014	0.008	0.016	0.027	0.007	0.015	0.026	0.007	0.011	0.005	0.011	0.022	0.004	0.016	0.038
Saturday	3	0.008	0.019	0.032	0.006	0.013	0.031	0.014	0.007	0.016	0.030	0.007	0.014	0.027	0.009	0.013	0.004	0.010	0.025	0.003	0.015	0.037
Saturday	4	0.011	0.021	0.035	0.007	0.014	0.032	0.017	0.014	0.017	0.029	0.009	0.016	0.029	0.014	0.024	0.005	0.013	0.028	0.005	0.017	0.038
Saturday	5	0.017	0.028	0.039	0.011	0.018	0.034	0.021	0.018	0.021	0.033	0.015	0.019	0.036	0.033	0.032	0.010	0.021	0.034	0.011	0.023	0.041
Saturday	6	0.025	0.036	0.045	0.019	0.026	0.039	0.025	0.027	0.028	0.036	0.023	0.025	0.042	0.056	0.054	0.017	0.028	0.039	0.021	0.033	0.045
Saturday	7	0.034	0.044	0.050	0.032	0.038	0.046	0.032	0.038	0.039	0.038	0.033	0.036	0.041	0.055	0.068	0.029	0.036	0.053	0.034	0.046	0.050

		Stanislaus			Sutter			Tehama			Trinity			Tulare			Tuolumne			Ventura		
Day of Week	Hour	LD	LM	HH	LD	LM	HH	LD	LM	HH	LD	LM	HH	LD	LM	HH	LD	LM	HH	LD	LM	HH
Saturday	8	0.044	0.053	0.055	0.045	0.051	0.052	0.040	0.055	0.051	0.041	0.047	0.047	0.043	0.057	0.069	0.044	0.045	0.060	0.046	0.057	0.053
Saturday	9	0.054	0.061	0.060	0.057	0.062	0.056	0.044	0.064	0.061	0.045	0.063	0.059	0.045	0.061	0.069	0.059	0.061	0.071	0.057	0.065	0.055
Saturday	10	0.062	0.068	0.063	0.067	0.071	0.060	0.051	0.071	0.067	0.049	0.075	0.067	0.048	0.066	0.068	0.073	0.074	0.078	0.065	0.071	0.056
Saturday	11	0.067	0.071	0.064	0.074	0.076	0.061	0.058	0.077	0.068	0.050	0.084	0.073	0.050	0.067	0.068	0.081	0.077	0.083	0.070	0.076	0.056
Saturday	12	0.069	0.070	0.062	0.075	0.075	0.060	0.060	0.076	0.067	0.053	0.083	0.071	0.052	0.068	0.065	0.078	0.077	0.075	0.072	0.074	0.054
Saturday	13	0.070	0.067	0.058	0.075	0.074	0.057	0.059	0.073	0.066	0.055	0.081	0.069	0.053	0.067	0.068	0.075	0.072	0.060	0.072	0.071	0.053
Saturday	14	0.070	0.064	0.054	0.074	0.071	0.055	0.065	0.076	0.066	0.057	0.076	0.065	0.055	0.070	0.070	0.075	0.068	0.055	0.072	0.068	0.050
Saturday	15	0.069	0.061	0.049	0.072	0.068	0.051	0.067	0.073	0.064	0.060	0.074	0.062	0.058	0.077	0.065	0.075	0.068	0.052	0.072	0.063	0.047
Saturday	16	0.068	0.057	0.045	0.070	0.064	0.048	0.065	0.069	0.059	0.056	0.070	0.058	0.057	0.066	0.055	0.072	0.070	0.047	0.072	0.059	0.044
Saturday	17	0.064	0.051	0.040	0.066	0.057	0.044	0.064	0.062	0.055	0.055	0.061	0.057	0.054	0.053	0.050	0.066	0.063	0.040	0.068	0.051	0.040
Saturday	18	0.056	0.042	0.033	0.056	0.047	0.038	0.061	0.048	0.050	0.051	0.049	0.052	0.052	0.040	0.039	0.058	0.052	0.031	0.059	0.041	0.035
Saturday	19	0.048	0.034	0.027	0.046	0.037	0.033	0.059	0.041	0.044	0.049	0.038	0.045	0.046	0.034	0.030	0.047	0.041	0.026	0.048	0.031	0.030
Saturday	20	0.041	0.029	0.024	0.040	0.030	0.028	0.050	0.031	0.036	0.042	0.031	0.038	0.042	0.027	0.021	0.038	0.031	0.020	0.040	0.024	0.027
Saturday	21	0.037	0.024	0.021	0.035	0.025	0.025	0.044	0.023	0.030	0.037	0.023	0.031	0.038	0.023	0.018	0.031	0.025	0.016	0.037	0.022	0.024
Saturday	22	0.031	0.020	0.019	0.028	0.019	0.023	0.034	0.017	0.024	0.031	0.017	0.026	0.032	0.019	0.011	0.025	0.020	0.018	0.031	0.019	0.023
Saturday	23	0.023	0.016	0.017	0.020	0.014	0.021	0.026	0.013	0.019	0.023	0.012	0.019	0.025	0.014	0.008	0.016	0.013	0.018	0.022	0.016	0.022
Holiday	0	0.013	0.020	0.027	0.010	0.016	0.028	0.014	0.008	0.015	0.024	0.008	0.015	0.024	0.008	0.009	0.008	0.011	0.020	0.009	0.019	0.032
Holiday	1	0.009	0.017	0.025	0.006	0.013	0.027	0.013	0.007	0.013	0.027	0.008	0.012	0.024	0.007	0.010	0.005	0.009	0.018	0.005	0.016	0.030
Holiday	2	0.007	0.015	0.024	0.004	0.012	0.026	0.013	0.006	0.012	0.024	0.008	0.012	0.023	0.006	0.007	0.003	0.010	0.018	0.003	0.014	0.029
Holiday	3	0.007	0.016	0.026	0.005	0.013	0.027	0.013	0.006	0.012	0.029	0.010	0.013	0.023	0.007	0.011	0.004	0.010	0.021	0.003	0.015	0.031
Holiday	4	0.011	0.020	0.029	0.008	0.016	0.029	0.016	0.013	0.014	0.029	0.012	0.014	0.027	0.016	0.017	0.005	0.012	0.020	0.007	0.018	0.032
Holiday	5	0.019	0.028	0.033	0.014	0.023	0.032	0.020	0.017	0.020	0.031	0.016	0.017	0.033	0.030	0.032	0.009	0.018	0.031	0.016	0.029	0.038
Holiday	6	0.027	0.035	0.038	0.025	0.033	0.036	0.025	0.028	0.026	0.037	0.025	0.023	0.035	0.045	0.052	0.018	0.023	0.038	0.031	0.042	0.043
Holiday	7	0.035	0.042	0.042	0.036	0.044	0.042	0.030	0.037	0.036	0.038	0.033	0.031	0.040	0.052	0.064	0.029	0.031	0.043	0.047	0.056	0.047
Holiday	8	0.040	0.048	0.046	0.046	0.053	0.048	0.036	0.051	0.046	0.040	0.049	0.040	0.043	0.065	0.066	0.041	0.044	0.056	0.051	0.059	0.049
Holiday	9	0.048	0.055	0.050	0.054	0.059	0.050	0.047	0.068	0.056	0.043	0.062	0.054	0.045	0.061	0.058	0.058	0.057	0.075	0.052	0.061	0.051
Holiday	10	0.059	0.064	0.055	0.065	0.069	0.053	0.051	0.068	0.064	0.050	0.076	0.060	0.050	0.075	0.055	0.076	0.083	0.087	0.059	0.066	0.053
Holiday	11	0.065	0.070	0.060	0.074	0.074	0.057	0.059	0.083	0.069	0.047	0.084	0.068	0.049	0.076	0.055	0.084	0.086	0.088	0.066	0.069	0.054
Holiday	12	0.069	0.072	0.061	0.077	0.074	0.056	0.066	0.081	0.071	0.053	0.083	0.070	0.058	0.075	0.060	0.085	0.087	0.089	0.068	0.072	0.055
Holiday	13	0.071	0.071	0.061	0.076	0.074	0.058	0.062	0.084	0.068	0.062	0.091	0.067	0.052	0.069	0.068	0.083	0.081	0.078	0.070	0.070	0.053
Holiday	14	0.072	0.069	0.059	0.075	0.073	0.056	0.069	0.076	0.064	0.059	0.087	0.069	0.055	0.069	0.070	0.080	0.074	0.068	0.071	0.068	0.053
Holiday	15	0.073	0.068	0.058	0.074	0.070	0.055	0.065	0.081	0.061	0.057	0.079	0.065	0.062	0.070	0.078	0.078	0.074	0.060	0.073	0.064	0.050
Holiday	16	0.073	0.065	0.055	0.072	0.066	0.054	0.070	0.068	0.061	0.056	0.072	0.062	0.065	0.074	0.069	0.078	0.072	0.049	0.073	0.061	0.049
Holiday	17	0.070	0.057	0.050	0.068	0.059	0.051	0.068	0.063	0.060	0.056	0.058	0.060	0.053	0.057	0.062	0.071	0.066	0.041	0.071	0.056	0.046
Holiday	18	0.060	0.046	0.044	0.057	0.049	0.045	0.063	0.047	0.055	0.053	0.044	0.058	0.051	0.040	0.046	0.057	0.049	0.033	0.061	0.045	0.041
Holiday	19	0.050	0.036	0.039	0.047	0.036	0.041	0.056	0.035	0.048	0.048	0.029	0.049	0.047	0.031	0.041	0.043	0.040	0.022	0.049	0.032	0.036
Holiday	20	0.042	0.029	0.034	0.039	0.029	0.037	0.050	0.028	0.041	0.044	0.024	0.045	0.046	0.027	0.026	0.033	0.026	0.013	0.041	0.024	0.033
Holiday	21	0.034	0.023	0.030	0.030	0.020	0.033	0.045	0.021	0.035	0.040	0.019	0.040	0.040	0.019	0.021	0.024	0.018	0.011	0.034	0.019	0.032
Holiday	22	0.027	0.017	0.028	0.023	0.015	0.031	0.027	0.013	0.029	0.031	0.014	0.030	0.034	0.014	0.014	0.017	0.012	0.009	0.025	0.014	0.031
Holiday	23	0.018	0.014	0.026	0.015	0.010	0.029	0.022	0.010	0.023	0.024	0.009	0.024	0.024	0.011	0.011	0.010	0.008	0.010	0.016	0.012	0.032

		Yolo			Yuba		
Day of Week	Hour	LD	LM	HH	LD	LM	HH
Sunday	0	0.016	0.026	0.044	0.013	0.020	0.031
Sunday	1	0.011	0.019	0.036	0.008	0.016	0.028
Sunday	2	0.008	0.017	0.033	0.006	0.013	0.026
Sunday	3	0.006	0.015	0.030	0.005	0.012	0.025
Sunday	4	0.007	0.016	0.029	0.005	0.012	0.025
Sunday	5	0.011	0.020	0.032	0.008	0.015	0.027
Sunday	6	0.016	0.025	0.034	0.013	0.020	0.030
Sunday	7	0.023	0.031	0.040	0.022	0.028	0.034
Sunday	8	0.034	0.041	0.046	0.034	0.041	0.040
Sunday	9	0.048	0.054	0.051	0.048	0.055	0.046
Sunday	10	0.060	0.063	0.054	0.064	0.068	0.052
Sunday	11	0.067	0.067	0.054	0.075	0.075	0.055
Sunday	12	0.071	0.070	0.053	0.082	0.079	0.058
Sunday	13	0.072	0.070	0.052	0.084	0.079	0.058
Sunday	14	0.073	0.069	0.050	0.084	0.077	0.057
Sunday	15	0.073	0.067	0.047	0.082	0.073	0.057
Sunday	16	0.072	0.063	0.045	0.079	0.068	0.055
Sunday	17	0.070	0.059	0.043	0.072	0.062	0.053
Sunday	18	0.063	0.051	0.041	0.060	0.052	0.049
Sunday	19	0.057	0.044	0.038	0.050	0.043	0.045
Sunday	20	0.051	0.038	0.036	0.041	0.035	0.042
Sunday	21	0.042	0.032	0.037	0.031	0.026	0.039
Sunday	22	0.030	0.025	0.037	0.021	0.019	0.036
Sunday	23	0.019	0.020	0.040	0.013	0.015	0.033
Monday	0	0.010	0.018	0.028	0.008	0.014	0.027
Monday	1	0.006	0.015	0.026	0.005	0.012	0.025
Monday	2	0.005	0.014	0.026	0.004	0.012	0.025
Monday	3	0.007	0.016	0.028	0.006	0.014	0.027
Monday	4	0.016	0.025	0.034	0.011	0.019	0.030
Monday	5	0.032	0.040	0.043	0.023	0.030	0.036
Monday	6	0.048	0.052	0.050	0.042	0.047	0.043
Monday	7	0.066	0.065	0.056	0.060	0.061	0.048
Monday	8	0.064	0.064	0.057	0.059	0.062	0.050
Monday	9	0.057	0.062	0.056	0.056	0.061	0.050
Monday	10	0.055	0.061	0.057	0.058	0.064	0.051
Monday	11	0.056	0.062	0.056	0.062	0.066	0.053
Monday	12	0.058	0.062	0.056	0.066	0.068	0.054
Monday	13	0.059	0.061	0.055	0.067	0.067	0.054
Monday	14	0.062	0.062	0.054	0.070	0.069	0.055
Monday	15	0.068	0.063	0.053	0.073	0.069	0.055
Monday	16	0.073	0.062	0.051	0.075	0.067	0.054
Monday	17	0.072	0.057	0.046	0.073	0.061	0.052
Monday	18	0.053	0.043	0.039	0.056	0.046	0.045
Monday	19	0.039	0.030	0.031	0.040	0.031	0.039
Monday	20	0.032	0.023	0.026	0.031	0.022	0.035
Monday	21	0.027	0.018	0.024	0.025	0.017	0.032
Monday	22	0.021	0.014	0.023	0.017	0.012	0.030
Monday	23	0.014	0.011	0.025	0.012	0.009	0.030
Tues/Wed/Thurs	0	0.009	0.017	0.031	0.008	0.014	0.029
Tues/Wed/Thurs	1	0.006	0.014	0.028	0.004	0.011	0.027
Tues/Wed/Thurs	2	0.005	0.014	0.028	0.004	0.011	0.027
Tues/Wed/Thurs	3	0.006	0.016	0.030	0.005	0.013	0.029

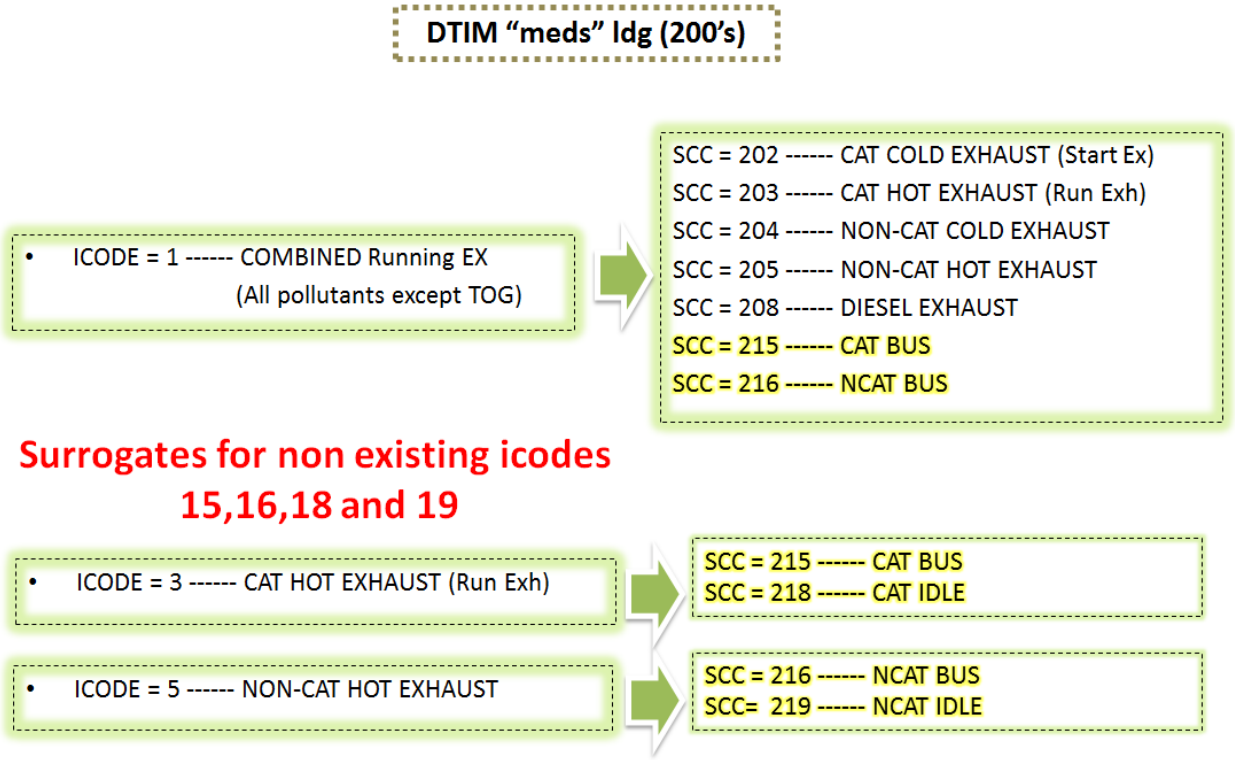
		Yolo			Yuba		
Day of Week	Hour	LD	LM	HH	LD	LM	HH
Tues/Wed/Thurs	4	0.014	0.023	0.036	0.010	0.018	0.031
Tues/Wed/Thurs	5	0.029	0.037	0.044	0.022	0.029	0.037
Tues/Wed/Thurs	6	0.046	0.051	0.052	0.042	0.047	0.044
Tues/Wed/Thurs	7	0.066	0.065	0.057	0.060	0.061	0.050
Tues/Wed/Thurs	8	0.065	0.064	0.057	0.060	0.062	0.051
Tues/Wed/Thurs	9	0.057	0.062	0.057	0.055	0.060	0.050
Tues/Wed/Thurs	10	0.053	0.061	0.057	0.056	0.061	0.051
Tues/Wed/Thurs	11	0.054	0.061	0.057	0.059	0.064	0.052
Tues/Wed/Thurs	12	0.056	0.061	0.056	0.061	0.065	0.053
Tues/Wed/Thurs	13	0.058	0.061	0.055	0.064	0.066	0.053
Tues/Wed/Thurs	14	0.062	0.062	0.053	0.068	0.068	0.053
Tues/Wed/Thurs	15	0.069	0.063	0.051	0.073	0.069	0.053
Tues/Wed/Thurs	16	0.074	0.062	0.048	0.075	0.067	0.052
Tues/Wed/Thurs	17	0.073	0.058	0.044	0.074	0.063	0.050
Tues/Wed/Thurs	18	0.056	0.045	0.037	0.059	0.048	0.044
Tues/Wed/Thurs	19	0.041	0.032	0.030	0.043	0.034	0.038
Tues/Wed/Thurs	20	0.034	0.025	0.025	0.035	0.025	0.034
Tues/Wed/Thurs	21	0.029	0.020	0.023	0.029	0.019	0.031
Tues/Wed/Thurs	22	0.022	0.015	0.022	0.020	0.013	0.029
Tues/Wed/Thurs	23	0.015	0.011	0.023	0.013	0.009	0.028
Friday	0	0.009	0.017	0.032	0.007	0.014	0.032
Friday	1	0.006	0.014	0.030	0.005	0.011	0.030
Friday	2	0.005	0.014	0.030	0.004	0.011	0.030
Friday	3	0.006	0.015	0.032	0.005	0.012	0.030
Friday	4	0.012	0.022	0.037	0.008	0.016	0.033
Friday	5	0.024	0.034	0.044	0.017	0.026	0.038
Friday	6	0.038	0.047	0.052	0.033	0.040	0.045
Friday	7	0.054	0.059	0.058	0.049	0.054	0.050
Friday	8	0.055	0.059	0.059	0.051	0.057	0.052
Friday	9	0.051	0.059	0.058	0.050	0.057	0.052
Friday	10	0.052	0.060	0.058	0.054	0.061	0.054
Friday	11	0.056	0.062	0.058	0.060	0.066	0.055
Friday	12	0.059	0.063	0.056	0.063	0.067	0.055
Friday	13	0.062	0.064	0.055	0.066	0.068	0.054
Friday	14	0.066	0.064	0.053	0.070	0.070	0.054
Friday	15	0.070	0.063	0.050	0.073	0.070	0.052
Friday	16	0.071	0.061	0.046	0.074	0.067	0.050
Friday	17	0.069	0.057	0.041	0.072	0.063	0.047
Friday	18	0.060	0.047	0.037	0.063	0.051	0.042
Friday	19	0.049	0.036	0.029	0.050	0.039	0.035
Friday	20	0.041	0.028	0.024	0.041	0.029	0.030
Friday	21	0.036	0.023	0.021	0.037	0.023	0.028
Friday	22	0.029	0.018	0.019	0.030	0.017	0.026
Friday	23	0.019	0.013	0.019	0.019	0.011	0.024
Saturday	0	0.014	0.024	0.050	0.013	0.019	0.038
Saturday	1	0.009	0.019	0.042	0.008	0.015	0.034
Saturday	2	0.008	0.017	0.039	0.006	0.014	0.032
Saturday	3	0.007	0.016	0.037	0.006	0.013	0.031
Saturday	4	0.009	0.019	0.038	0.007	0.014	0.032
Saturday	5	0.014	0.025	0.043	0.011	0.018	0.034
Saturday	6	0.023	0.033	0.049	0.019	0.026	0.039
Saturday	7	0.034	0.044	0.055	0.032	0.038	0.046

		Yolo			Yuba		
Day of Week	Hour	LD	LM	HH	LD	LM	HH
Saturday	8	0.046	0.055	0.059	0.045	0.051	0.052
Saturday	9	0.057	0.064	0.061	0.057	0.062	0.056
Saturday	10	0.065	0.070	0.063	0.067	0.071	0.060
Saturday	11	0.069	0.071	0.059	0.074	0.076	0.061
Saturday	12	0.069	0.068	0.056	0.075	0.075	0.060
Saturday	13	0.069	0.065	0.052	0.075	0.074	0.057
Saturday	14	0.068	0.063	0.047	0.074	0.071	0.055
Saturday	15	0.067	0.060	0.043	0.072	0.068	0.051
Saturday	16	0.066	0.056	0.039	0.070	0.064	0.048
Saturday	17	0.063	0.052	0.035	0.066	0.057	0.044
Saturday	18	0.057	0.045	0.029	0.056	0.047	0.038
Saturday	19	0.048	0.035	0.025	0.046	0.037	0.033
Saturday	20	0.042	0.030	0.021	0.040	0.030	0.028
Saturday	21	0.039	0.027	0.020	0.035	0.025	0.025
Saturday	22	0.034	0.023	0.020	0.028	0.019	0.023
Saturday	23	0.024	0.018	0.019	0.020	0.014	0.021
Holiday	0	0.012	0.022	0.032	0.010	0.016	0.028
Holiday	1	0.008	0.017	0.029	0.006	0.013	0.027
Holiday	2	0.006	0.015	0.029	0.004	0.012	0.026
Holiday	3	0.006	0.017	0.029	0.005	0.013	0.027
Holiday	4	0.011	0.021	0.032	0.008	0.016	0.029
Holiday	5	0.019	0.030	0.038	0.014	0.023	0.032
Holiday	6	0.027	0.038	0.044	0.025	0.033	0.036
Holiday	7	0.037	0.046	0.050	0.036	0.044	0.042
Holiday	8	0.046	0.054	0.053	0.046	0.053	0.048
Holiday	9	0.053	0.059	0.056	0.054	0.059	0.050
Holiday	10	0.061	0.065	0.058	0.065	0.069	0.053
Holiday	11	0.067	0.069	0.060	0.074	0.074	0.057
Holiday	12	0.069	0.068	0.059	0.077	0.074	0.056
Holiday	13	0.069	0.068	0.057	0.076	0.074	0.058
Holiday	14	0.070	0.066	0.055	0.075	0.073	0.056
Holiday	15	0.069	0.065	0.052	0.074	0.070	0.055
Holiday	16	0.067	0.060	0.049	0.072	0.066	0.054
Holiday	17	0.064	0.055	0.044	0.068	0.059	0.051
Holiday	18	0.057	0.046	0.039	0.057	0.049	0.045
Holiday	19	0.050	0.036	0.033	0.047	0.036	0.041
Holiday	20	0.044	0.029	0.028	0.039	0.029	0.037
Holiday	21	0.039	0.023	0.025	0.030	0.020	0.033
Holiday	22	0.030	0.018	0.024	0.023	0.015	0.031
Holiday	23	0.020	0.014	0.026	0.015	0.010	0.029

Appendix C: Scaling procedures after DTIM processing

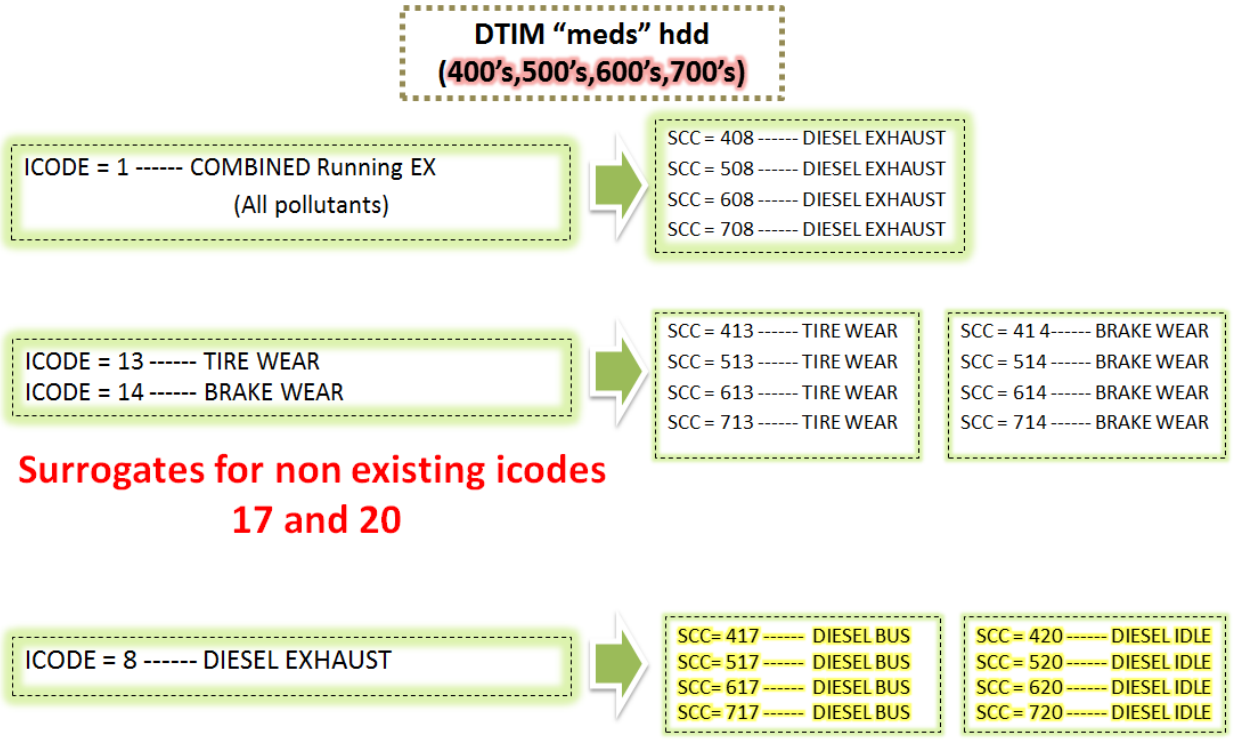
C1. Block Diagram of Scaling Process: ldg (gas: heavy- and light-duty; diesel: light-duty)

DTIM has 1 to 12 Source Classification Codes (SCC) that vary by species. For CO, NOx, SOx and PM species, DTIM only uses SCC=1 for the running exhaust emissions regardless of the fuel type and process. However, distribution of the running exhaust emissions according to the fuel type and process is needed. The following diagram explains how to distribute the running exhaust emissions for the light-duty gas. The running exhaust emissions are distributed to the catalyst cold exhaust, catalyst hot exhaust, non-catalyst cold exhaust, non-catalyst hot exhaust, catalyst bus and non-catalyst bus by using the corresponding emissions from EMFAC. Since there are no idle emissions in DTIM, surrogates are needed for the catalyst idle and non-catalyst idle. The surrogates for the catalyst idle and non-catalyst idle are catalyst hot exhaust, and non-catalyst hot exhaust, respectively.



C2. Block Diagram of Scaling Process: hdd (heavy-duty diesel)

The following diagram explains how to distribute the running exhaust emissions for heavy-duty diesel. The running exhaust emissions are distributed to the diesel exhaust or diesel bus exhaust depending on the vehicle type by using the corresponding emissions from EMFAC. Since there are no idle emissions in DTIM, a surrogate is used. The surrogate for the diesel idle emissions is diesel exhaust or diesel bus exhaust, depending on the vehicle type.



Appendix D: Additional temporal profiles

Temporal profiles developed from the AGTOOL are applied as potential replacements when processing the emissions inventories for modeling using the SMOKE processor. This would apply for agriculturally related emissions with time-invariant temporal distributions, which includes the following emission source categories: food and agricultural processing, pesticides and fertilizers, farming operations, unpaved road dust, fugitive windblown dust, managed burning and disposal, and farming equipment

Table 11 Day of week temporal profiles from the Agricultural Emissions Temporal and Spatial Allocation Tool (AgTool)

Code	M	T	W	TH	F	S	S
201	1	174	248	182	203	97	95
202	1	2	1	0	2	1	993
203	1	117	192	190	229	222	48
204	2	16	13	13	10	928	17
205	3	342	597	25	4	5	24
206	4	100	33	241	105	455	62
207	5	50	284	126	125	315	95
208	6	94	41	40	348	358	112
209	7	203	111	236	340	0	102
210	8	221	225	123	117	80	225
211	9	37	63	667	111	37	77
212	11	2	881	41	40	18	8
213	12	96	105	153	201	425	8
214	13	370	306	90	47	101	73
215	13	368	72	498	2	41	6
216	19	562	125	102	47	39	107
217	22	348	74	115	125	215	102
218	22	292	63	229	65	104	224
219	22	482	41	111	167	93	83
220	25	184	100	136	223	152	182
221	25	192	107	223	278	75	101
222	27	40	51	99	310	58	415
223	29	51	237	127	172	308	77
224	30	219	195	158	222	112	64
225	30	185	151	125	186	120	203
226	35	131	195	172	151	201	114
227	35	146	162	175	157	180	143
228	36	179	200	93	188	186	117
229	37	82	363	208	2	73	235
230	40	211	162	182	160	165	81
231	40	468	0	420	0	72	0
232	41	269	293	118	95	121	62
233	44	56	399	13	268	61	160
234	45	335	72	82	210	180	77
235	46	124	139	148	199	168	177
236	46	207	54	453	54	134	52
237	48	310	346	83	84	91	38
238	52	201	140	196	121	160	132
239	53	134	123	144	206	192	149
240	53	108	150	163	171	207	148
241	57	156	183	117	92	220	175
242	63	105	176	154	148	195	160
243	63	186	136	175	187	134	120

Code	M	T	W	TH	F	S	S
244	64	230	173	136	83	251	63
245	66	249	149	127	105	185	120
246	67	222	278	236	65	129	2
247	70	120	192	168	188	145	116
248	74	95	170	197	157	144	162
249	74	190	108	126	246	116	138
250	77	295	104	187	155	88	93
251	79	135	291	129	86	182	97
252	80	360	9	19	424	79	29
253	81	133	132	125	226	167	135
254	82	136	151	118	160	196	157
255	82	92	125	207	177	153	164
256	85	133	152	145	188	173	124
257	87	295	16	111	47	244	201
258	96	128	104	169	161	224	119
259	104	196	118	155	202	132	94
260	104	111	196	121	181	127	162
261	107	161	70	90	227	243	102
262	107	145	115	203	187	147	95
263	111	171	137	0	297	202	81
264	112	121	144	165	155	172	131
265	113	199	97	132	218	147	94
266	113	167	15	156	399	70	80
267	115	150	128	153	192	139	122
268	115	103	120	138	117	251	156
269	119	125	119	87	144	158	248
270	120	145	130	137	155	166	147
271	125	155	141	108	179	149	142
272	130	140	137	170	93	139	192
273	135	222	191	83	169	110	90
274	136	160	156	162	144	156	86
275	138	109	107	137	227	147	137
276	139	101	117	171	167	171	134
277	143	143	143	143	143	143	143
278	150	230	118	72	144	170	116
279	163	118	106	135	185	112	181
280	199	136	81	163	143	180	99
281	218	8	2	14	6	525	226
282	250	35	290	130	50	109	137
283	255	116	82	103	128	63	252
284	278	182	148	36	105	112	139
285	326	168	189	0	105	0	211
286	0	212	165	131	202	128	161
287	0	289	0	0	356	222	133
288	0	321	93	208	109	81	188
289	0	431	4	160	246	15	144
290	0	515	122	111	48	128	76
291	0	0	0	916	84	0	0
292	0	0	0	0	148	0	852
294	0	0	0	0	1000	0	0

Table 12 Daily temporal profiles from the Agricultural Emissions Temporal and Spatial Allocation Tool (AgTool)

Code	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23
201	0	0	0	0	0	10	102	2	26	358	259	134	65	1	26	10	3	2	1	0	0	0	0	0
202	0	0	0	5	3	2	5	59	44	38	28	640	19	21	48	34	21	22	10	1	0	1	0	0
203	1	0	0	0	10	162	64	51	139	270	115	46	61	3	15	16	16	4	12	6	3	1	3	2
204	1	0	0	0	0	1	139	405	79	126	69	54	33	31	13	20	14	14	2	0	0	0	0	0
205	1	3	6	2	3	8	1	2	5	29	73	112	125	115	101	164	46	49	65	68	3	10	5	2
206	2	5	0	4	22	5	6	8	26	31	88	90	66	397	38	28	43	100	34	5	0	0	0	0
207	2	3	0	0	37	177	45	57	167	203	123	102	23	15	8	6	22	6	1	0	0	0	0	1
208	2	0	0	0	0	20	1	498	9	15	28	8	42	6	358	2	2	0	9	0	0	0	0	0
209	2	0	0	12	54	3	41	471	18	105	94	31	7	9	68	33	43	7	0	0	0	0	0	0
210	2	4	2	4	4	3	17	40	60	137	87	178	42	67	82	198	60	6	3	1	1	1	1	1
211	3	2	3	2	0	2	6	12	43	75	220	413	2	199	2	5	4	7	0	0	0	0	0	0
212	4	5	0	0	6	220	16	73	212	321	135	6	0	0	0	0	0	0	3	0	0	0	0	0
213	4	159	11	187	7	0	0	16	71	536	0	1	0	0	0	0	0	0	7	0	0	0	0	0
214	5	5	5	7	6	13	6	91	50	29	237	161	11	37	123	78	76	1	51	1	1	1	1	2
215	8	5	19	15	44	48	35	44	88	109	96	100	58	112	62	44	30	52	13	3	3	3	3	6
216	9	0	0	0	0	10	19	157	83	105	65	92	15	19	73	308	32	6	2	4	1	0	1	0
217	9	9	6	7	10	84	13	35	113	187	138	63	57	58	25	40	44	45	30	4	5	4	3	13
218	10	3	6	5	7	11	17	61	30	44	61	73	88	56	119	265	18	3	108	3	1	3	3	6
219	0	0	0	0	0	393	374	26	0	139	0	4	11	1	2	15	33	2	0	0	0	0	0	0
220	11	11	8	2	25	16	144	131	173	251	106	55	56	4	1	4	1	0	0	0	0	0	0	0
221	13	13	15	25	32	11	8	12	8	123	19	135	6	47	157	65	26	96	154	7	6	6	6	8
222	9	9	2	19	3	19	7	16	76	20	39	156	44	277	29	52	176	37	2	2	2	1	1	2
223	5	5	3	4	13	23	108	64	68	61	92	278	59	38	56	34	38	22	14	5	1	1	2	5
224	1	1	10	4	8	32	50	118	64	72	75	123	130	51	72	63	61	24	8	2	16	2	11	1
225	4	4	8	12	25	22	33	74	62	76	86	114	72	84	86	92	80	33	12	7	3	4	3	4
226	4	4	8	11	12	26	26	46	37	85	114	231	83	67	71	91	57	12	4	4	1	2	3	2
227	7	7	9	10	19	39	25	45	61	92	97	102	73	120	66	66	72	45	19	7	5	5	5	5
228	4	4	8	9	28	20	30	24	34	58	53	180	122	60	128	104	67	29	22	3	2	4	4	3
229	10	10	15	14	18	171	37	47	47	41	38	40	45	22	27	57	13	3	305	4	6	5	5	20
230	19	19	40	29	38	80	48	119	50	39	31	35	75	49	84	80	64	27	22	21	12	10	9	1
231	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42
232	0	0	0	0	0	2	20	24	22	21	37	146	32	41	17	219	406	5	4	4	0	1	0	0
233	0	0	0	0	0	0	0	0	512	0	0	0	0	0	488	0	0	0	0	0	0	0	0	0
234	9	9	7	5	9	32	20	58	39	80	110	105	136	66	131	41	89	12	16	9	9	0	7	1
235	2	2	2	5	6	31	48	95	72	51	41	460	48	29	19	20	34	17	9	8	1	0	0	0
236	11	11	23	12	20	28	23	22	28	64	96	55	75	53	105	105	146	58	13	11	8	10	14	9
237	18	18	12	10	15	7	11	24	20	49	77	80	54	38	59	177	120	20	10	35	38	44	39	26
238	1	1	1	4	1	20	52	86	79	118	93	120	71	56	132	73	42	27	8	4	2	3	3	1
239	2	2	1	3	2	42	31	82	79	79	87	78	85	78	76	67	142	38	15	4	1	2	2	1
240	0	0	0	19	27	55	26	23	26	51	112	162	192	112	85	60	22	8	1	12	6	0	0	1
241	3	3	7	34	3	37	32	238	35	45	66	70	64	43	166	68	52	16	4	5	1	1	4	0
242	3	3	2	35	6	40	47	69	76	97	85	95	80	78	105	42	48	56	12	4	1	15	2	0
243	0	0	0	2	18	6	70	47	130	146	115	21	62	64	247	42	22	4	2	0	0	0	1	0
244	22	22	18	16	38	65	86	87	74	83	68	64	61	34	32	51	105	25	17	10	2	2	6	12
245	6	6	5	7	16	30	26	53	78	126	75	74	33	44	63	118	131	12	8	2	68	8	8	4
246	0	0	0	1	7	426	80	147	29	25	23	109	2	29	53	6	45	0	0	0	0	17	0	0
247	0	0	5	175	1	6	0	37	49	13	4	11	250	0	1	0	439	0	0	9	0	0	0	0
248	4	4	12	8	64	229	105	285	61	59	32	42	10	71	3	4	8	0	0	0	0	0	0	0

Code	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23
249	0	0	0	0	1	6	51	4	11	34	153	492	8	40	7	15	167	8	0	1	0	0	0	0
250	8	8	8	1	1	4	4	4	368	389	188	12	1	1	1	1	1	0	0	0	0	0	0	0
251	17	17	7	68	22	64	11	227	26	299	87	17	4	4	60	15	0	0	0	1	2	25	15	12
252	0	0	0	0	0	3	2	1	2	2	958	9	3	3	2	3	3	8	2	0	0	0	0	0
253	0	2	0	0	0	2	60	212	153	137	76	138	58	47	61	25	13	7	9	1	0	0	0	0
254	0	6	0	0	151	178	73	63	226	62	12	58	9	7	39	21	80	15	0	0	0	0	0	0
255	0	17	356	0	0	149	0	213	0	2	258	0	0	0	0	0	0	0	4	0	0	0	0	0
256	0	0	0	1	0	244	44	98	70	1	0	538	2	0	0	0	0	2	0	0	0	0	0	0
257	0	0	0	0	0	0	11	38	8	77	89	690	18	14	14	10	21	2	8	0	0	0	0	0
258	0	0	0	0	1	217	54	47	60	119	118	231	0	82	0	54	17	0	0	0	0	0	0	0
259	0	0	0	0	8	312	108	95	177	227	73	0	0	0	0	0	0	0	0	0	0	0	0	0
260	0	0	0	0	77	0	1	18	74	134	241	243	121	48	8	11	0	23	0	1	0	0	0	0
261	0	0	0	0	0	1	10	58	48	373	106	114	34	70	38	15	0	0	0	0	0	58	0	76
262	0	0	0	0	0	3	2	20	7	113	26	792	4	5	9	4	10	5	0	0	0	0	0	0
263	0	0	0	0	0	72	919	0	0	9	0	0	0	0	0	0	0	0	0	0	0	0	0	0
264	0	0	0	0	0	75	0	618	307	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
265	0	0	0	0	0	89	14	0	0	0	0	897	0	0	0	0	0	0	0	0	0	0	0	0
266	0	0	0	0	0	92	0	263	71	187	123	70	50	6	19	4	10	85	19	0	0	0	0	0
267	0	0	0	0	0	377	95	0	0	32	0	495	0	0	0	0	0	0	0	0	0	0	0	0
268	0	0	0	0	0	772	22	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	206
269	0	0	0	0	0	795	121	7	1	16	9	22	5	3	7	8	4	0	0	0	0	0	0	0
270	0	0	0	0	0	0	67	0	9	371	397	127	26	3	1	0	0	0	0	0	1	0	0	0
271	0	0	0	0	0	0	495	0	31	269	0	0	0	144	0	61	0	0	0	0	0	0	0	0
272	0	0	0	0	0	0	929	34	0	0	0	37	0	0	0	0	0	0	0	0	0	0	0	0
273	0	0	0	0	0	0	0	1	0	0	0	997	0	1	0	0	0	0	0	0	0	0	0	0
274	0	0	0	0	0	0	0	6	24	368	49	198	25	32	42	95	45	58	56	1	0	0	0	0
275	0	0	0	0	0	0	0	46	483	33	11	12	7	17	50	4	336	0	0	0	0	0	0	0
276	0	0	0	0	0	0	0	864	0	0	0	0	136	0	0	0	0	0	0	0	0	0	0	0
277	0	0	0	0	0	0	0	0	42	75	167	483	0	233	0	0	0	0	0	0	0	0	0	0
278	0	0	0	0	0	0	0	0	0	84	93	823	0	0	0	0	0	0	0	0	0	0	0	0
279	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
280	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1000	0	0	0	0	0	0	0
281	0	0	0	0	0	0	0	0	0	0	0	1000	0	0	0	0	0	0	0	0	0	0	0	0
282	0	0	0	0	0	0	0	1000	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
283	0	0	0	0	0	0	1000	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
284	0	0	0	0	0	1000	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Appendix K

Weight of Evidence

2016 PLAN FOR THE 2008 8-HOUR OZONE STANDARD

Appendix K Weight of Evidence

[This Appendix is provided by the California Air Resources Board]

Weight of Evidence

San Joaquin Valley

Attainment Plan for the National 0.075 ppm 8-Hour Ozone SIP

May 2016

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1 Introduction

This weight-of-evidence (WOE) document provides support for the modeled attainment demonstration that projects the San Joaquin Valley (Valley or SJV) air basin will attain the National Ambient Air Quality Standard (NAAQS or standard) of 0.075 parts per million (ppm) for 8-hour ozone by 2031.

This introduction includes a brief description of the elements of a WOE analysis, a physical context for the processes that lead to ozone formation in the Valley, and an assessment of current ozone air quality in the Valley. The remainder of the document provides a broad foundation of information that corroborates the modeled attainment demonstration.

1.1 Elements Commonly Included in an Attainment Demonstration

The attainment demonstration portion of a State Implementation Plan (SIP) consists of the analyses used to determine whether the current control strategy provides the reductions necessary to meet the standard by the specified attainment year. This attainment demonstration includes photochemical modeling which predicts that projected controls on ozone-forming emissions will result in an 8-hour design value for the Valley that is below the level of the national standard of 0.075 ppm by 2031.

Because of the inherent uncertainties in photochemical modeling, the U.S. Environmental Protection Agency (EPA) requires states to supplement the modeling results with a WOE assessment. The WOE assessment provides a set of analyses that complement the photochemical modeling. In this document, these analyses include consideration of measured air quality, emissions inventories, and meteorological data. All analysis methods have innate strengths and weaknesses, so examining an air quality problem in a variety of ways can help to offset the limitations and uncertainties inherent to individual methods. This approach also provides a better understanding of the overall problem, as well as insight about the level and mix of emissions controls needed for attainment.

The scope of the WOE analysis is different for each nonattainment area, with the level of appropriate detail dependent upon the complexity of the air quality problem, how far into the future the attainment deadline is, and the amount of data and modeling available. In this case, the Valley is moving towards attainment of the 8-hour ozone standard, and the projected attainment date (2031) is based on multiple methods to evaluate the modeling results. This document summarizes the analyses that provide a WOE assessment that complement the model results.

1.2 Physical Context

Ozone forms in the lower atmosphere through a complex set of processes that are initiated by sunlight; therefore, ozone is called a photochemical pollutant. The sun's energy also drives meteorological processes through diurnal cycles from day to day and through seasonal cycles from year to year. As a result of these photochemical and meteorological processes, the "ozone season" with relatively high ambient ozone levels in California's San Joaquin Valley is considered, for this document, as May through October.

The San Joaquin Valley is located in the Central Valley of California, in a semi-arid climate with long, hot, dry summers, and mild winters. The Valley is also situated between three mountain ranges which meet in the south of the Valley near Bakersfield. On the west side of the Valley is the Coastal mountain range, on the east side is the Sierra Nevada mountain range, and on the south side are the Tehachapis. During the summer season, a high pressure system builds up over the eastern Pacific Ocean and a thermal low pressure system forms over the desert in the southwestern United States; this produces hot, dry conditions that cause thermally driven wind flow patterns across the Valley. These meteorological conditions cause poor dispersion and stagnation which are conducive to the formation of elevated ozone concentrations.

Wind speed plays a significant role in the dispersion of air pollutants. Figure 1 depicts the typical daytime and nighttime wind flow patterns during the ozone season in the Valley. The dominant wind flow pattern during the daytime in the Valley is from the northwest to the southeast. Surface winds enter the Valley from the northwest through the delta and through passes in the Coastal Range. The airflow generally moves from Stockton to Bakersfield, carrying ozone and the precursor emissions that contribute to ozone formation from both the San Francisco Bay area and the Sacramento Valley.

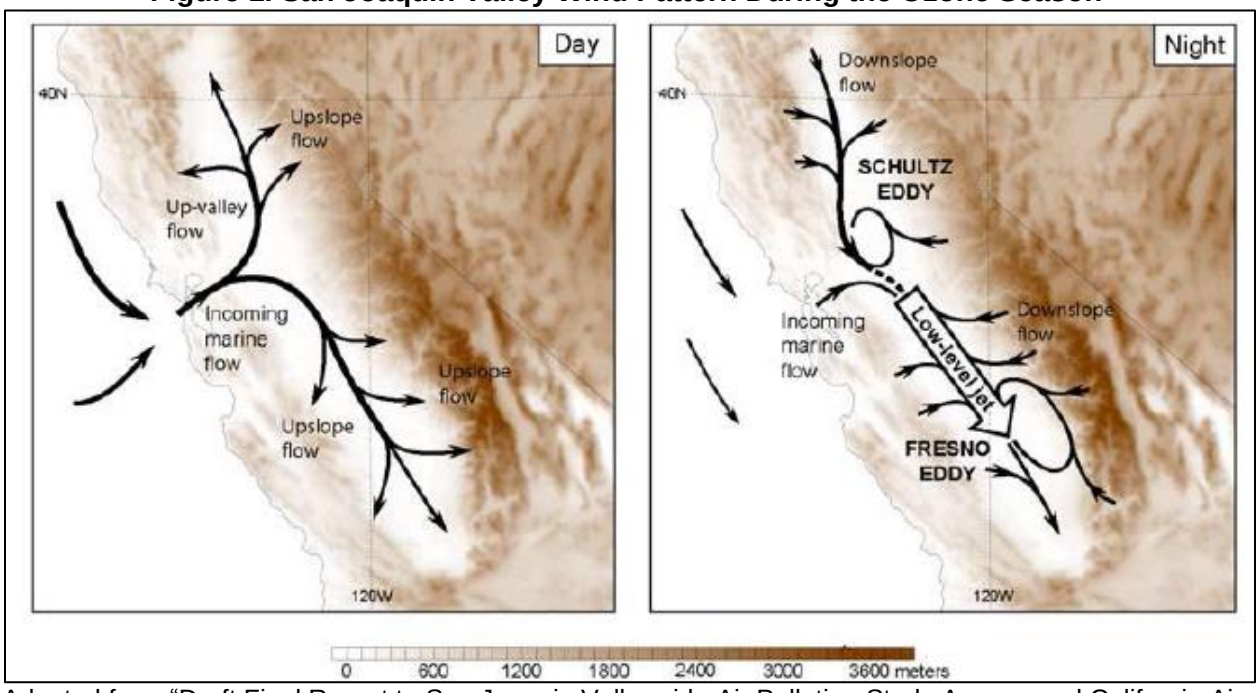
The effect of transport is seen in the accumulation of ozone in the central and southern portions of the Valley. Historically, the cities of Clovis and Parlier (downwind of Fresno), and the communities of Edison and Arvin (downwind of Bakersfield) have often experienced the highest ozone levels in the Valley. High ozone levels can also occur closer to emission sources. In recent years, the highest ozone levels have occurred in the cities of Clovis and Fresno. In the Valley, high ozone has a large component that is due to local emission production, as the ozone is generally lowest for each city at the upwind site, increases in the city, and is highest at downwind locations.

At night, the general northwest to southeast surface wind flow pattern continues along the western portion of the Valley; however, some nighttime wind circulation changes also occur when:

1) The airflow is no longer able to exit the southern end of the Valley because it encounters cooler drainage winds from the surrounding mountains.

2) A nocturnal jet stream approximately 1,000 feet above the surface flows at speeds up to 33 miles per hour (mph), transporting air rapidly into the southern portion of the Valley; however, the mountains surrounding the southern end of the Valley cause the air to turn counterclockwise and flow back toward the north along the eastern edge of the Valley. This flow, referred to as the Fresno eddy, circulates the pollution plume back toward Fresno, where it encounters more ozone precursors.
3) Pollutants carried in the upslope mountain flow during the day via daytime heating are carried back downslope toward the Valley floor via drainage flows caused by nocturnal surface cooling.

Figure 1. San Joaquin Valley Wind Pattern During the Ozone Season



Adapted from "Draft Final Report to San Joaquin Valleywide Air Pollution Study Agency and California Air Resources Board" by J.W. Bao, S.A. Michelson, O. Persson, L. Bianco, I. Djalalova, D.E. White, and J.M. Wilczak, 2006, *NOAA Contributions to the Central California Ozone Study and Ongoing Meteorological Monitoring; NOAA/Earth Systems Research Laboratory, Boulder, Colorado*.

A third of the basin population lives in the northern Valley. This lowland area is bordered by the Sacramento Valley and Delta lowland to the north, the central portion of the San Joaquin Valley to the south, and by mountains on the other two sides. Because of the marine influence, which extends into this area through gaps in the Coastal Range to the west, the northern Valley experiences a more temperate climate than the rest of the basin. These cooler temperatures and the predominant air flow patterns generally favor better ozone air quality.

In contrast to the northern Valley, most of the Valley population lives in the central and southern portions of the basin, in and around the Fresno and Bakersfield urban areas. Sites in the central and southern areas exceed the national standard by the greatest

margin, and geography, emissions, and climate pose significant challenges to air quality progress. Similar to the northern Valley, the central and southern Valley are also low lying areas, flanked by mountains on their west and east sides. The southern Valley represents the terminus of the Valley and is flanked by mountains to the south, as well. The surrounding mountains in both areas act as barriers to air flow, and combined with recirculation patterns and stable air, trap emissions and pollutants. The higher temperatures and more stagnant conditions in these two regions lead to a build-up of ozone and overall poorer air quality.

1.3 Recent Air Quality

The San Joaquin Valley has one of the most challenging ozone problems in the nation, and is one of only two nonattainment areas classified as extreme. Currently only two sites attain the national 0.075 ppm 8-hour ozone standard. However, recent trends are showing that ozone has become increasingly more responsive to emissions reductions, and the Valley's highest ozone levels today are much lower than they were just 10 years ago.

The design value (DV), U.S. EPA's compliance metric, is the average of the fourth highest daily maximum 8-hour concentration in each year measured over a consecutive three-year period. A site meets the standard when its design value is less than or equal to 0.075 ppm, the effective level of the standard. Table 1 shows the current operational sites in the Valley and their most recent design values. The scope of this document includes official data submitted through 2014. A preliminary look at 2015 using available official data, supplemented with preliminary data, is evaluated at the end of this document.

The northern region has the lowest values in the Valley. Stockton-Hazelton Street and Tranquility-32650 West Adams Avenue are the only sites that meet the current standard of 0.075 ppm with 2014 design values of 0.069 ppm and 0.075 ppm, respectively. The highest site in the northern region is Turlock-S Minaret Street with a design value of 0.084 ppm. Peak sites in the central region are Clovis-N Villa Avenue (0.095 ppm) and Parlier (0.092 ppm), which have the highest design values in the Valley. Finally, the highest sites in the southern region are Bakersfield-Municipal Airport and Sequoia and Kings Canyon National Park with design values of 0.091 ppm in 2014.

Table 1. Recent Design Values for Sites Currently Operating in the SJV (ppm)

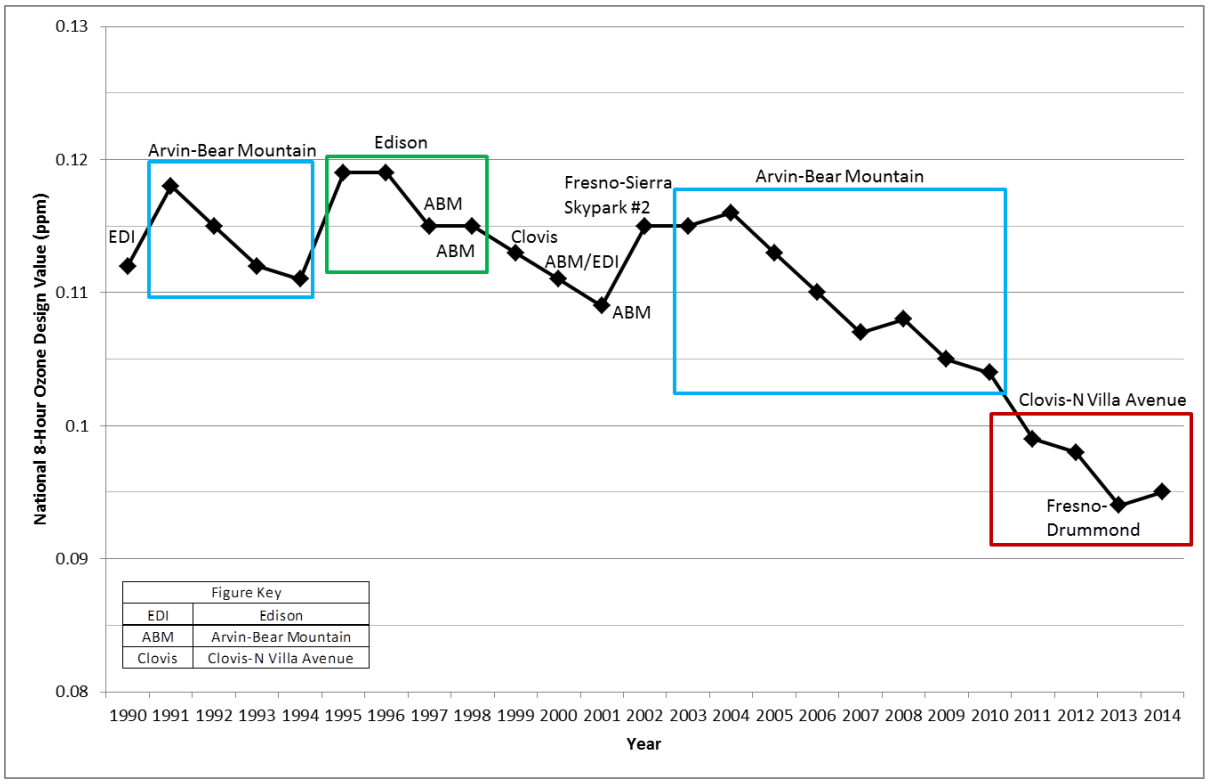
	County	Site	2012	2013	2014
Northern	Merced	Merced-S Coffee Avenue	0.083	0.081	0.081
	San Joaquin	Stockton-Hazelton Street	0.069	0.067	0.069
	San Joaquin	Tracy-Airport	0.080	0.079	0.079
	Stanislaus	Modesto-14th Street	0.075	0.075	0.078
	Stanislaus	Turlock-S Minaret Street	0.088	0.086	0.084
Central	Fresno	Clovis-N Villa Avenue	0.098	0.094	0.095
	Fresno	Fresno-1st Street/Fresno-Garland*	0.094	0.089	0.089
	Fresno	Fresno-Drummond Street	0.095	0.094	0.088
	Fresno	Fresno-Sierra Skypark #2	0.092	0.088	0.087
	Fresno	Parlier	0.092	0.092	0.092
	Fresno	Tranquility-32650 West Adams Avenue	0.077	0.077	0.075
	Kings	Hanford-S Irwin Street	0.090	0.084	0.084
	Madera	Madera-28261 Avenue 14	0.086	0.084	0.084
	Madera	Madera-Pump Yard	0.078	0.079	0.081
Southern	Kern	Arvin-Bear Mountain/Arvin-Di Giorgio*	0.094	0.089	0.088
	Kern	Bakersfield-5558 California Avenue	0.089	0.086	0.085
	Kern	Bakersfield-Municipal Airport	N/A	N/A	0.091
	Kern	Edison	0.093	0.086	0.084
	Kern	Maricopa-Stanislaus Street	0.087	0.084	0.079
	Kern	Oildale-3311 Manor Street	0.089	0.084	0.081
	Kern	Shafter-Walker Street	0.086	0.082	0.081
	Tulare	Porterville-1839 Newcomb Street	0.090	0.088	0.081
	Tulare	Sequoia and Kings Canyon Natl Park	0.095	0.093	0.091
	Tulare	Sequoia Natl Park-Lower Kaweah	0.081	0.085	0.086
	Tulare	Visalia-N Church Street	0.087	0.080	0.080

*U.S. EPA has approved the relocation requests from Fresno-1st to Fresno-Garland and Arvin-Bear Mountain to Arvin-Di Giorgio. U.S. EPA has stipulated that for the purposes of design value calculation, data from the original and replacement sites be combined to form one continuous data record.

2 Assessment of Valleywide Air Quality Progress

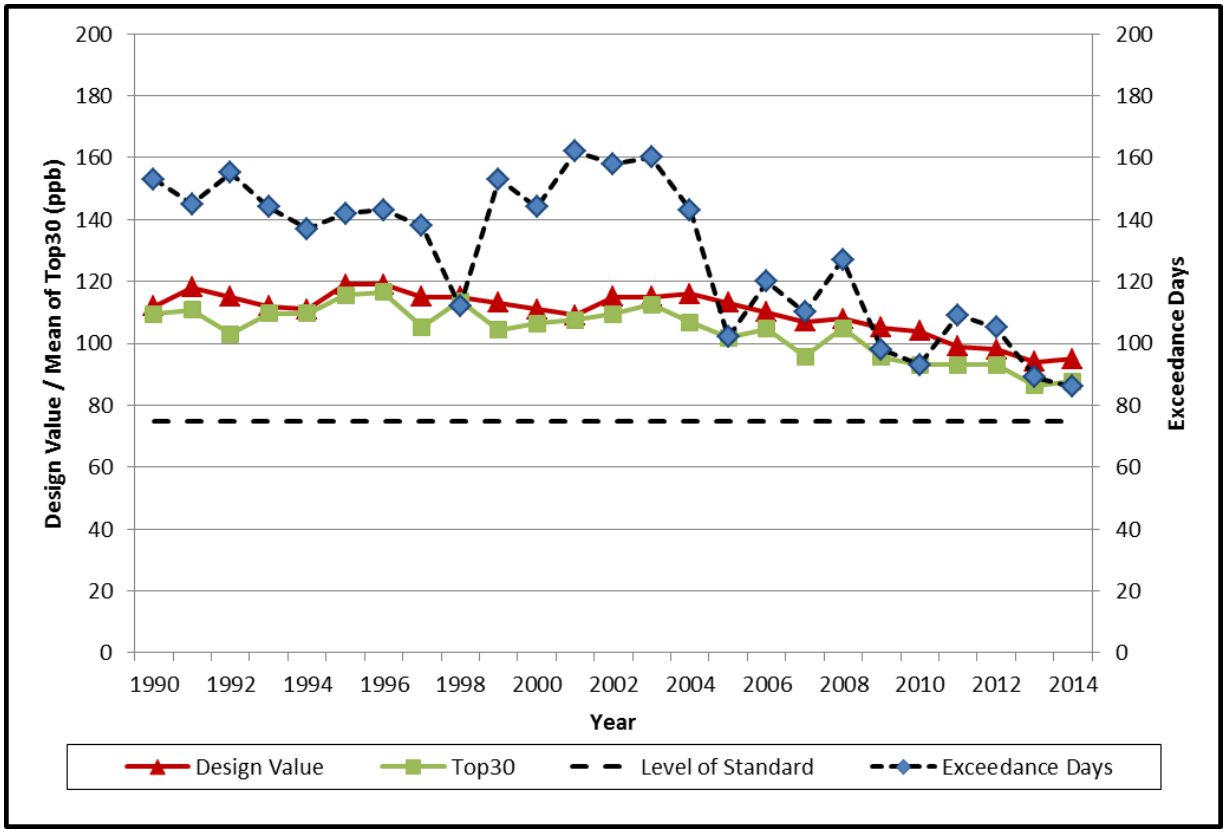
Figure 2 shows the basinwide design value trend from 1990 to 2014. Over the last 20 years, the design site has alternated between the central region (Clovis-N Villa Avenue, Fresno-Drummond, or Fresno-Sierra Skypark #2) and the southern region (Edison and/or Arvin-Bear Mountain). The Valley experienced modest progress between the 1990s and early 2000s, but since 2004, there has been a consistent and substantial trend towards lower ozone levels. Figure 2 shows that in the most recent years, from 2011-2014, Clovis-N Villa Avenue has consistently been the design site. In 2013, Clovis-N Villa and Fresno-Drummond shared a design value of 0.094 ppm, and therefore were both design sites for the basin.

Figure 2. Design Value Trend for the San Joaquin Valley Air Basin



Trends for three air quality indicators – design value, exceedance days, and mean of top 30 – are provided for the air basin from 1990-2014 in Figure 3. These three indicators address different aspects of ozone air quality, and together provide information to evaluate overall progress in reducing ozone exposure as well as attaining the standard. As mentioned earlier, the design value is U.S. EPA's compliance metric. The mean of top 30 is a stable and responsive measure of progress as it represents the trend in the upper 8 percent of daily maximum 8-hour ozone levels during the year. Finally, the exceedance day metric shows how many days in a year the 8-hour ozone was above the standard. Due to the nature of this metric, exceedance days will generally show the most year-to-year variability. However, it is still an important metric to consider, as it does provide a measure of the frequency of exposure. Similar to the design value, the mean of top 30 and exceedance days have shown the most progress since 2004. Although there is some year-to-year variability such as the 2008 ozone season which was heavily impacted by wildfires, every metric has shown considerable progress over the past decade.

Figure 3. Ozone Trends (1990-2014) in the San Joaquin Valley Air Basin



3 Recent Trends (2004-2014)

In the early 2000s, almost the entire Valley exceeded the 8-hour ozone standard, and the standard was exceeded somewhere in the Valley approximately 150 days during the ozone season each year. However, ozone air quality has improved throughout the region, with the basinwide design value (highest design value at any site in the basin) declining by 18 percent between 2004 and 2014, and basinwide exceedance days declining by 40 percent.

3.1 Basinwide Perspective

As shown in Figure 4, which is a magnified version of Figure 3 for years 2004-2014, there is a steady decline of the two more stable metrics, the design value and the mean of the top 30, as well as the number of exceedance days.

Figure 4. Recent Ozone Trends (2004-2014) in the San Joaquin Valley Air Basin

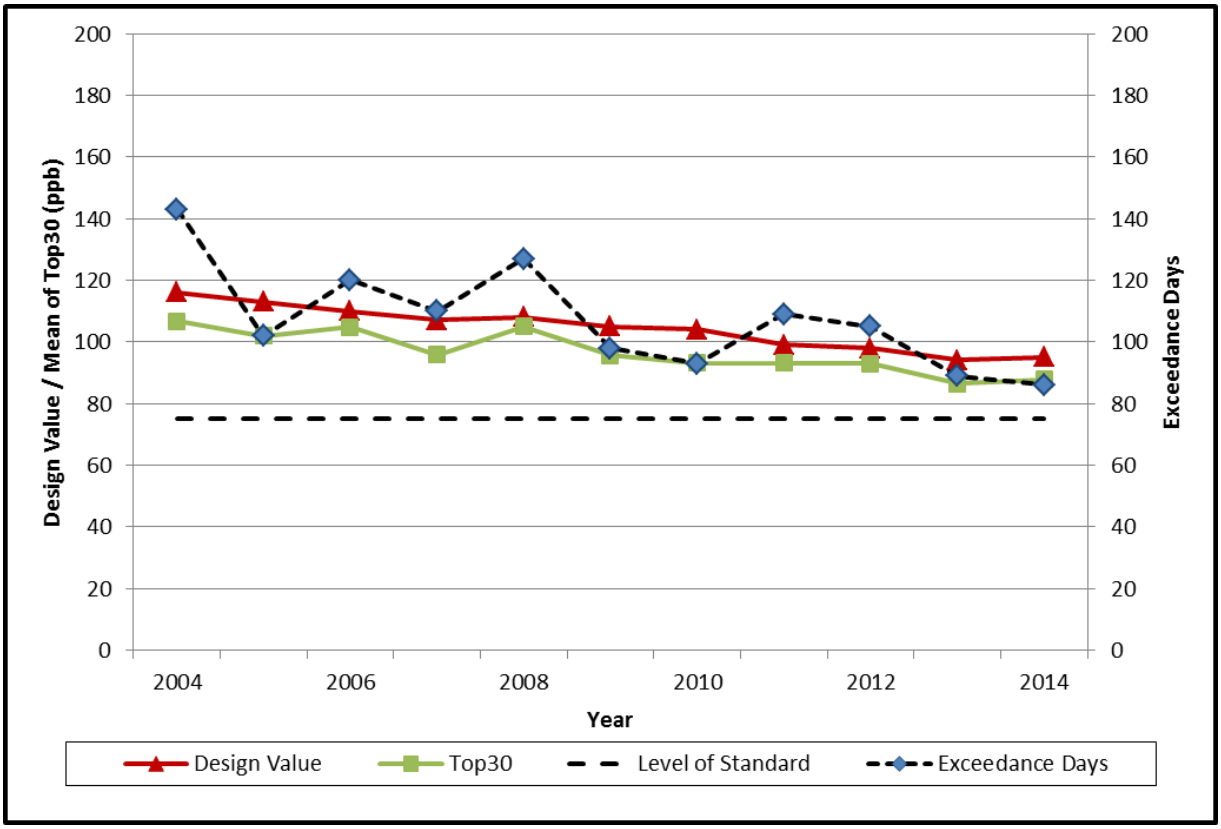
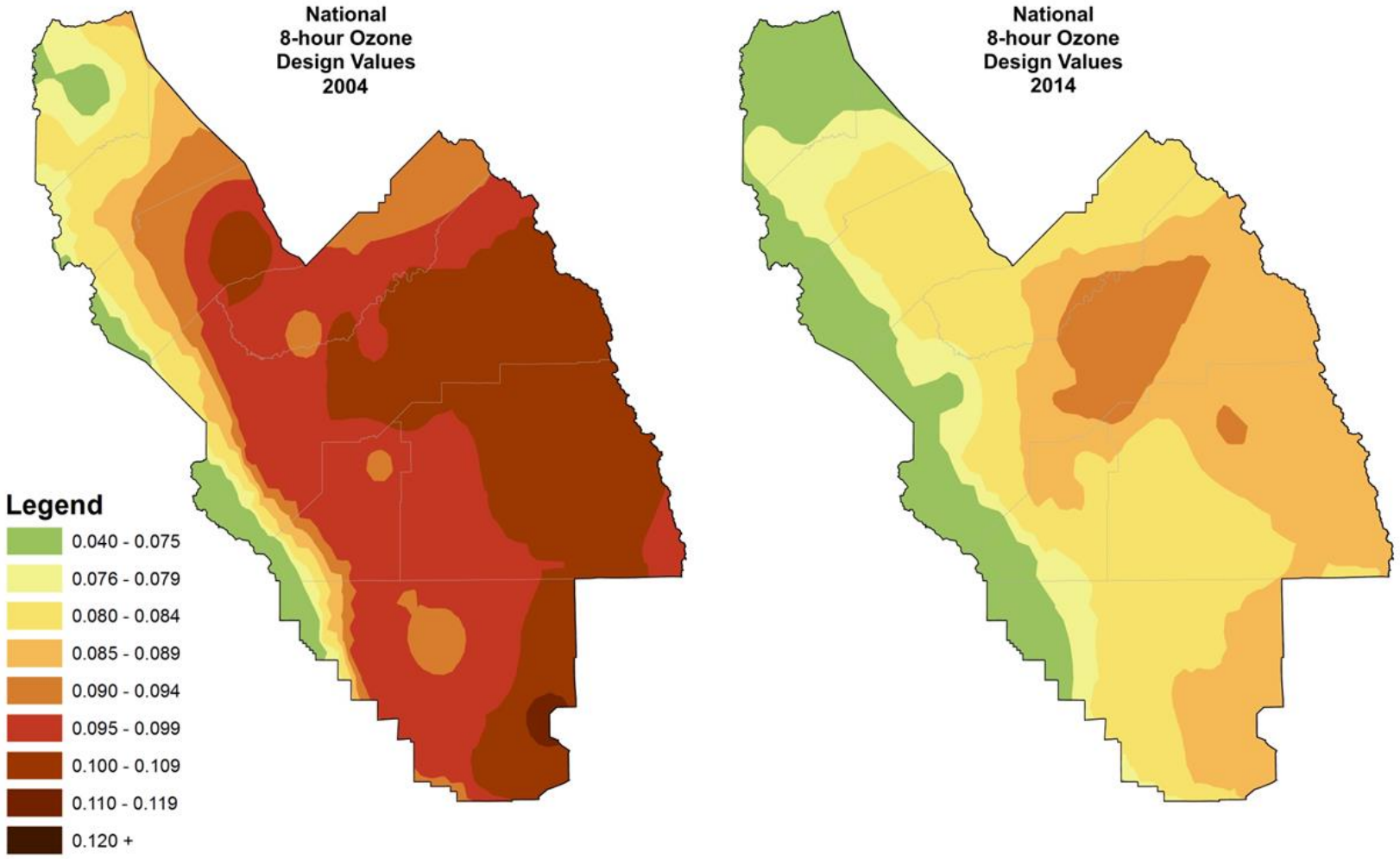


Figure 5 illustrates the progress that has been made in reducing the spatial extent of design values in the Valley. In 2002-2004, most of the Valley was far above the 0.075 ppm ozone standard. Today, a larger portion of the Valley is in attainment, all of the regions are significantly closer to the level of the standard, and the extent of the ozone problem is diminishing.

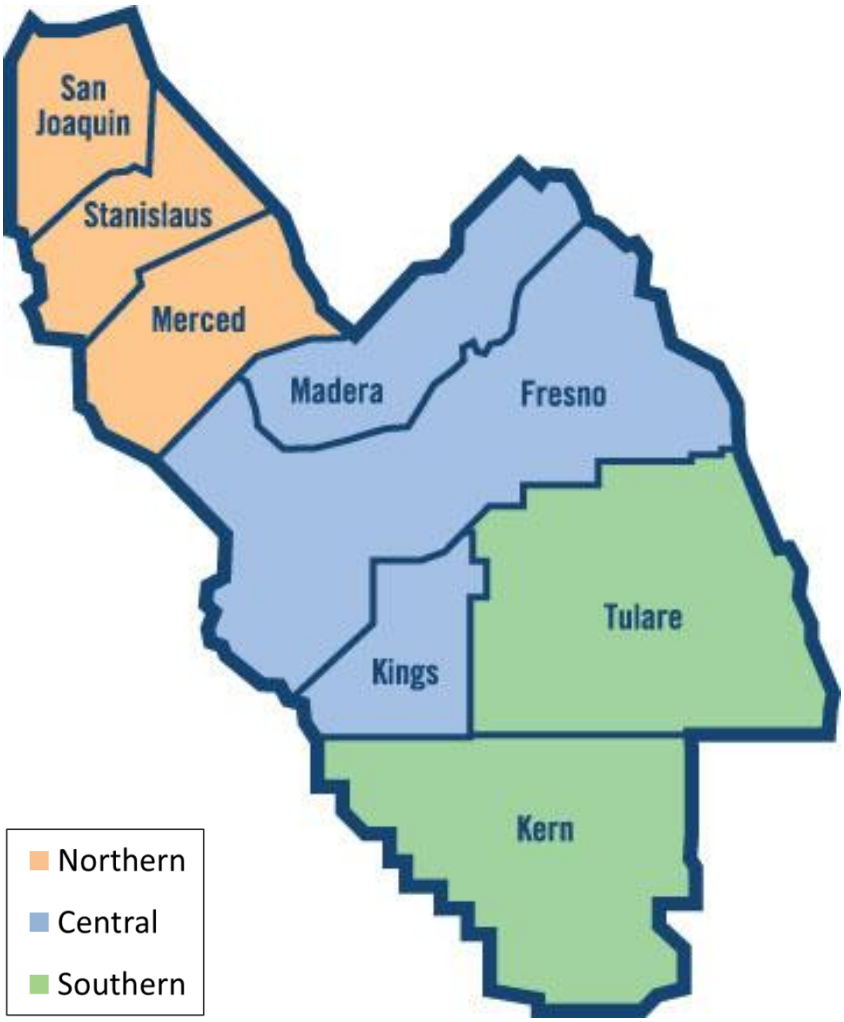
Figure 5. Reductions in Levels and Spatial Extent of Elevated Design Values in the San Joaquin Valley Air Basin



3.2 Regional Trends

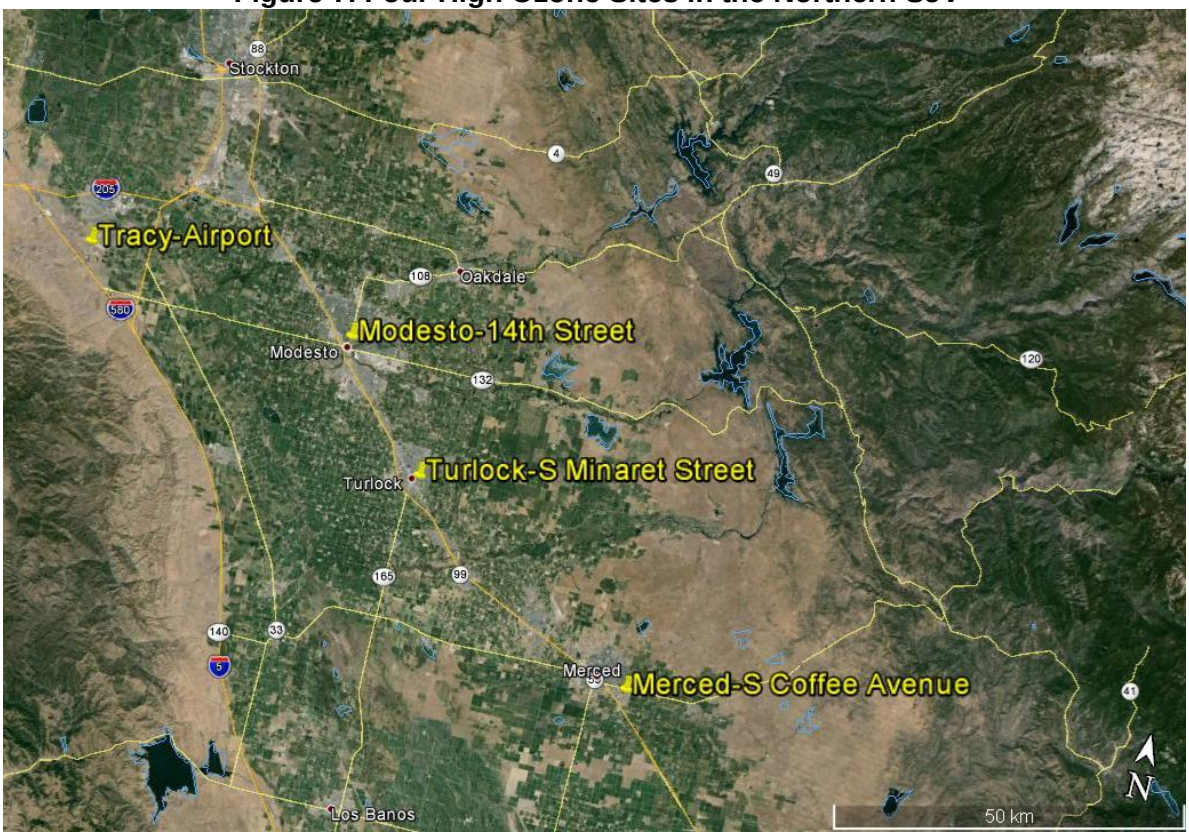
For the purpose of this analysis, the Valley is split up into three different regions: northern, central, and southern. Figure 6 shows a map of the Valley and each county, split into the three regions. The following section shows trends for the highest sites in each region from 2004 through 2014. A map of the locations of these monitoring sites in each region is shown in Figures 7, 12, 17, and 22.

Figure 6. Counties and Regions in the San Joaquin Valley



Source: https://www.valleyair.org/General_info/aboutdist.htm

Figure 7. Four High Ozone Sites in the Northern SJV



Figures 8-11 show trends of selected sites in the northern region over the past decade. All of the sites are very close to the standard. The highest site in 2004, Merced-S Coffee Avenue, had over a 20 percent decrease in design value (from 0.102 to 0.081 ppm), and a 53 percent decrease in exceedance days (from 47 to 22). Design values at Modesto-14th Street decreased by 6 percent and the site is now nearing the level of the standard (from 0.083 to 0.078 ppm). The northern region also demonstrates how local ozone production is a large contributor for the highest ozone values. Stockton-Hazelton Street, an upwind site, is the only site in the region in attainment of the standard, at 0.069 ppm (from Table 1). Moving southeastward along the predominant wind flow direction, ozone levels increase at Modesto-14th Street (0.078 ppm), and are highest at the downwind sites of Turlock-S Minaret Street and Merced-S Coffee Avenue (0.084 and 0.081 ppm, respectively).

Figure 8. Ozone Trends for Merced-S Coffee Ave

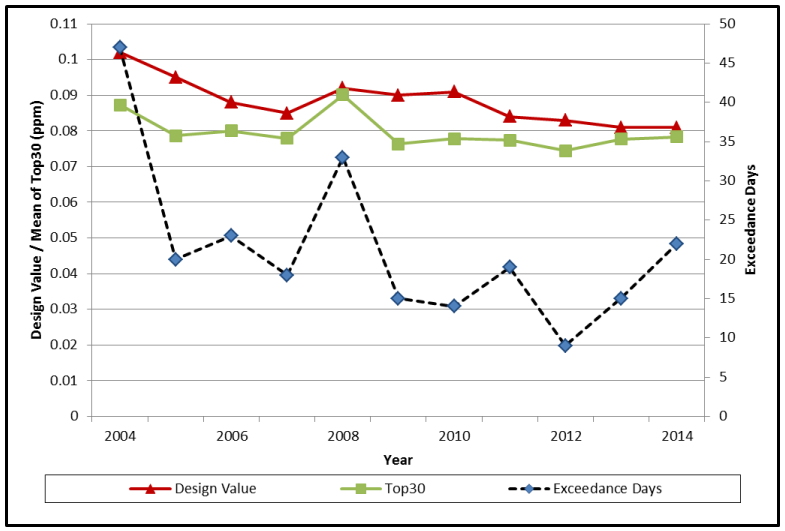


Figure 9. Ozone Trends for Turlock-S Minaret St

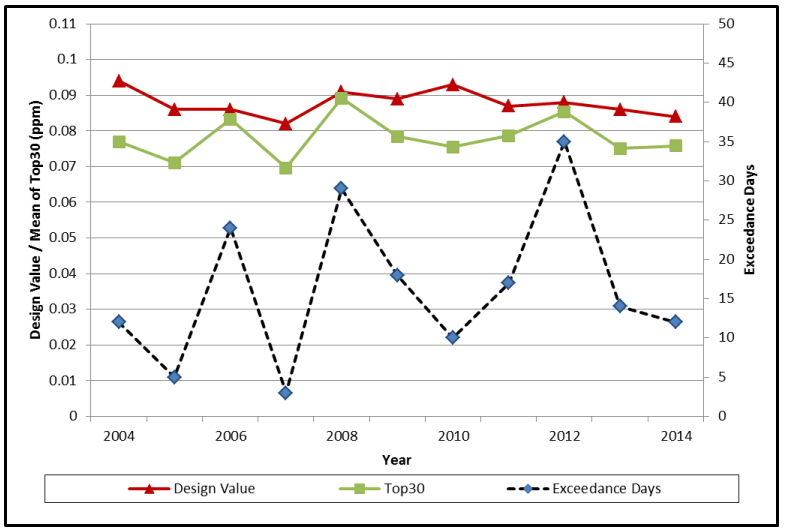


Figure 10. Ozone Trends for Tracy-Airport

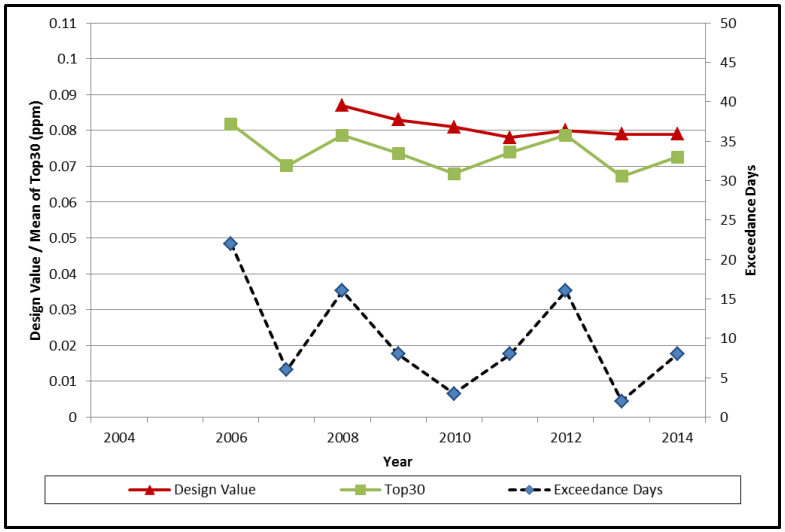


Figure 11. Ozone Trends for Modesto-14th St

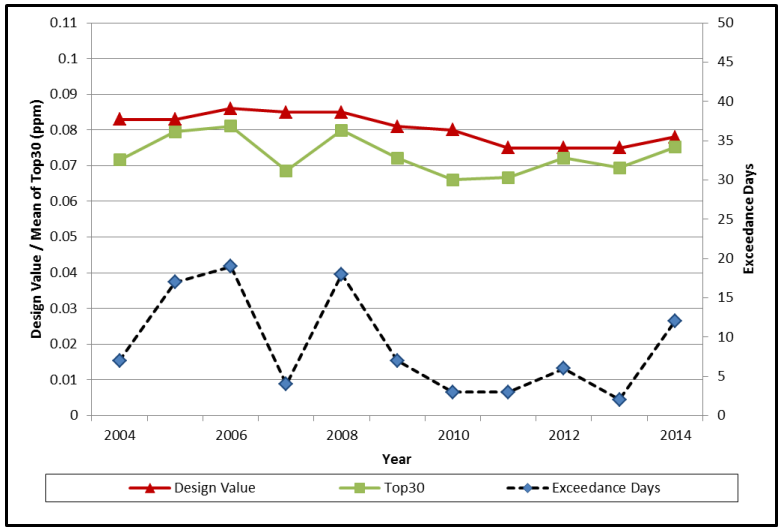
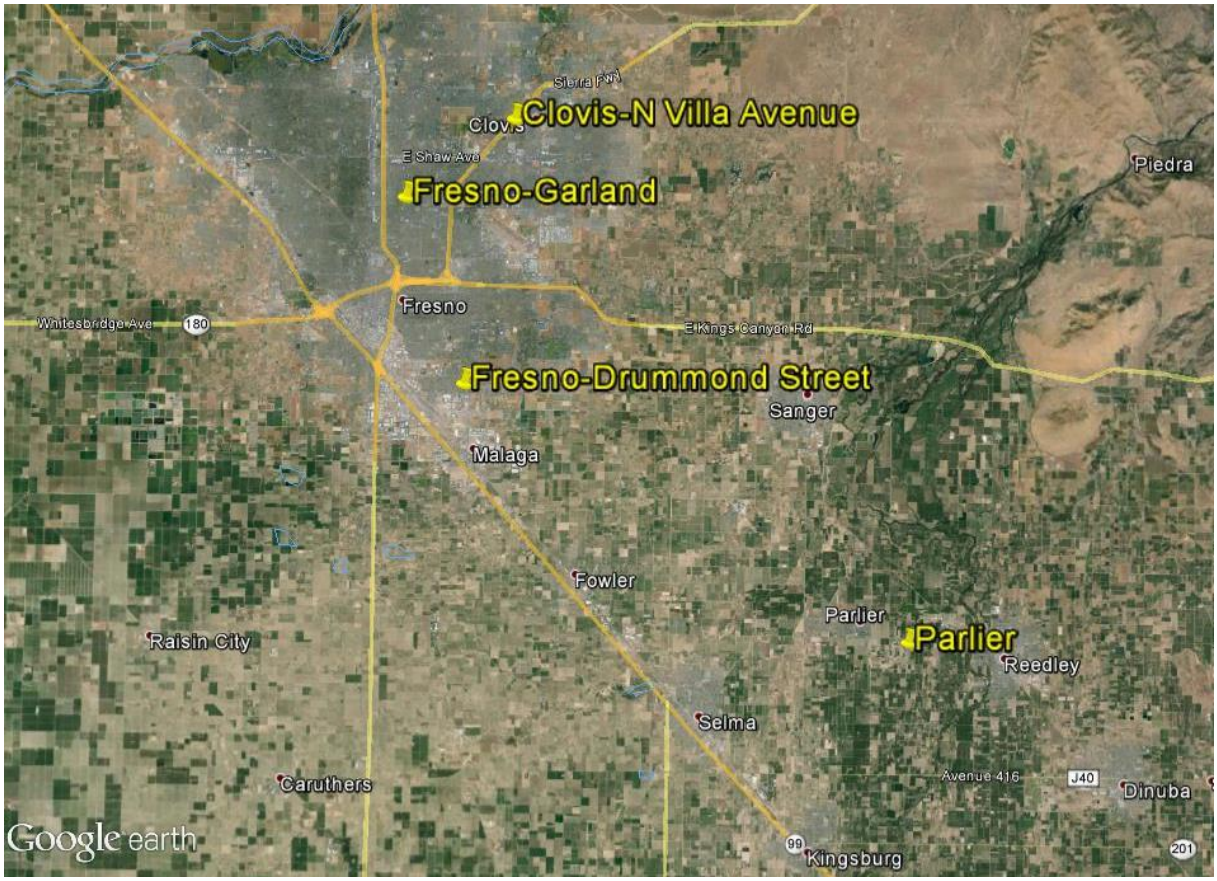


Figure 12. Four High Ozone Sites in the Central SJV



Figures 13-16 show trends for selected sites in the central region. This region currently records the highest ozone values in the Valley. The more northern sites in this region, such as Madera-Pump Yard and Fresno-Sierra Skypark #2 (not depicted) now have the lowest design values. In this time period, these sites had decreases in design value of 9 percent (0.089 to 0.081 ppm) and 16 percent (0.104 to 0.087 ppm), respectively. Fresno-Drummond had a 13 percent drop in design value (0.101 to 0.088 ppm), Parlier had a 12 percent drop (0.104 to 0.092 ppm), and Fresno-1st Street/Garland had a 13 percent drop (0.102 to 0.089 ppm). Clovis-N Villa Avenue showed similar levels for design value in 2014 compared to 2004, but has been steadily decreasing since 2010. The other two metrics show greater year-to-year variability for each site, with modest progress for the top 30 and exceedance days at worst sites Additional discussion of trends in the central region is provided in subsequent sections.

Figure 13. Ozone Trends for Clovis-N Villa Ave

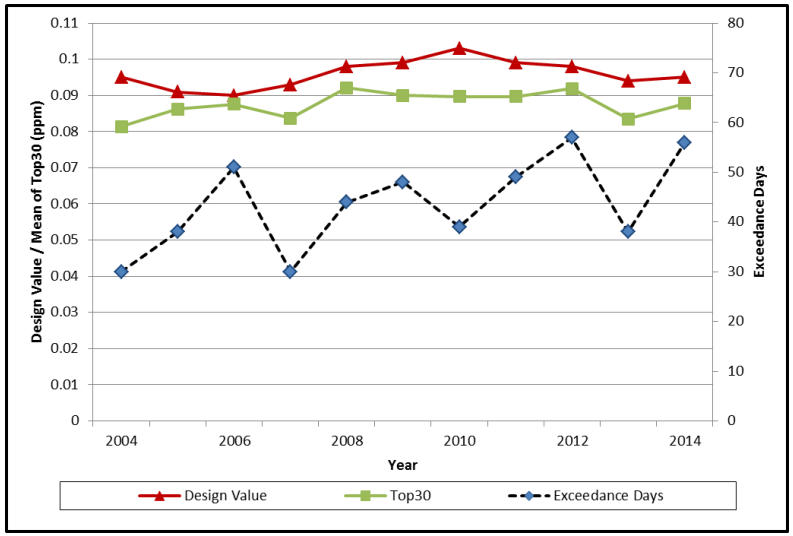


Figure 14. Ozone Trends Fresno-Drummond

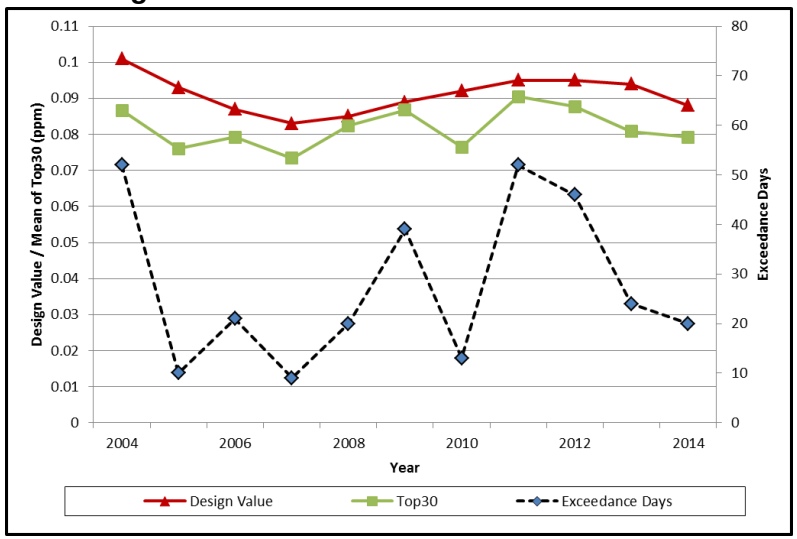


Figure 15. Ozone Trends for Parlier

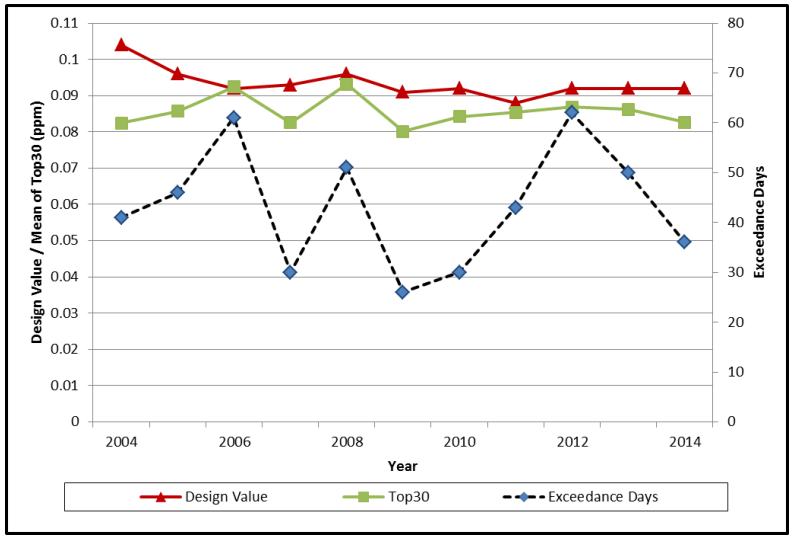


Figure 16. Ozone Trends for Fresno-1st St/Garland

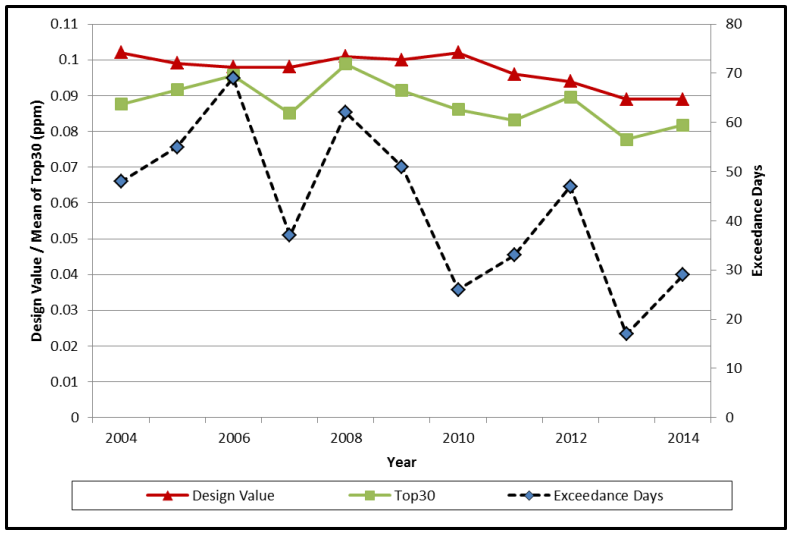
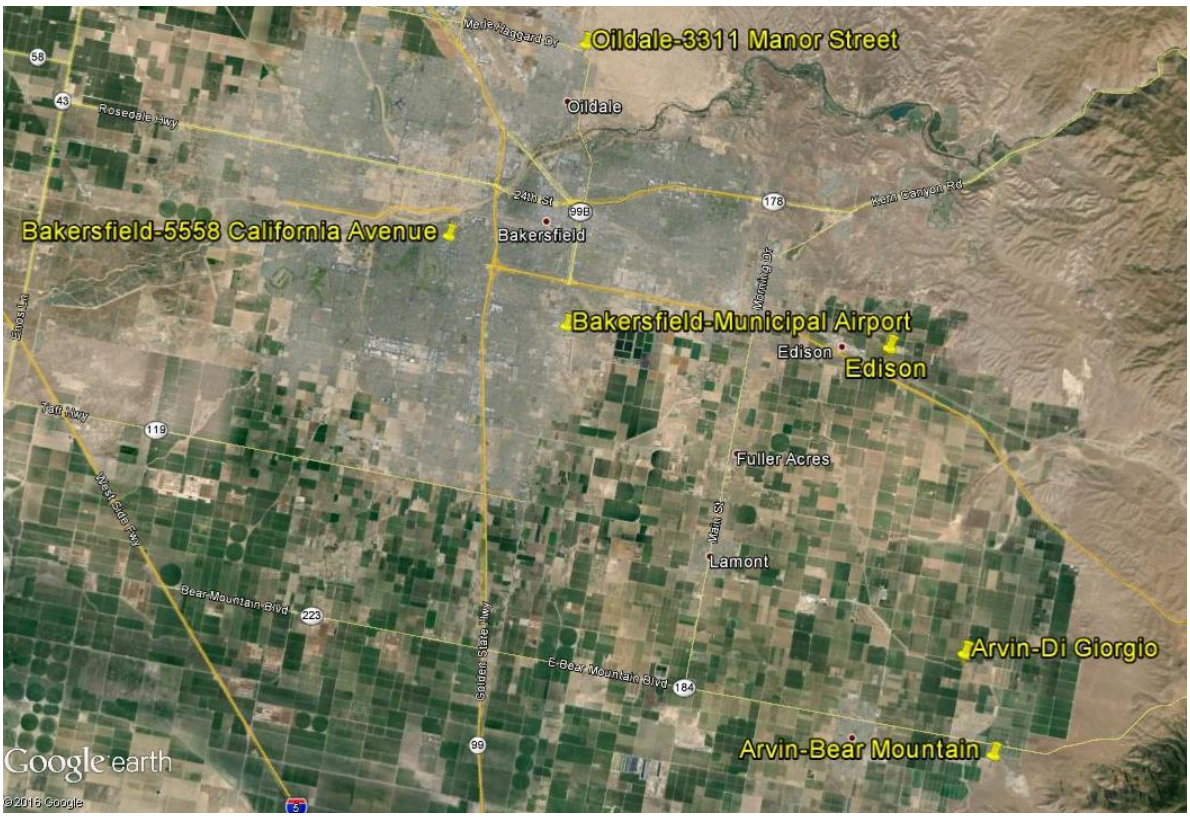


Figure 17. Six High Ozone Sites in the Southern SJV



Figures 18-21 show trends for the selected sites in the southern region. In the past, the Valley's highest 8-hour concentrations occurred in the southern region. However, all of the sites in this region have shown considerable progress since 2004, with the most substantial progress since 2010. Edison, Oildale, and Bakersfield-California Ave had modest improvements in design values from 2004 to 2010. Since 2004, Edison has shown a 17 percent decrease in design value (0.101 to 0.084 ppm), Oildale has shown a 17 percent decrease (0.098 to 0.081 ppm), and Bakersfield has shown a 12 percent decrease (0.097 to 0.085 ppm). Similar to the design value, the top 30 and exceedance day metrics are showing steady declines, especially since 2010, but with a bit more year-to-year variability. Arvin-Di Giorgio was established in 2010 as a replacement site for Arvin-Bear Mountain, which was shut down after the 2010 ozone season when the lease for that site was terminated. The Arvin sites show significant decreases in ozone over the last ten years. Bakersfield-Municipal Airport is a new site, established in July 2012. As previously shown in Table 1, this site has only had one design value since its inception, 0.091 ppm in 2014. As a recently established site, there is insufficient history to present a meaningful trend alongside the trends shown for the other sites.

Figure 18. Ozone Trends for Arvin-Bear Mountain/Di Giorgio

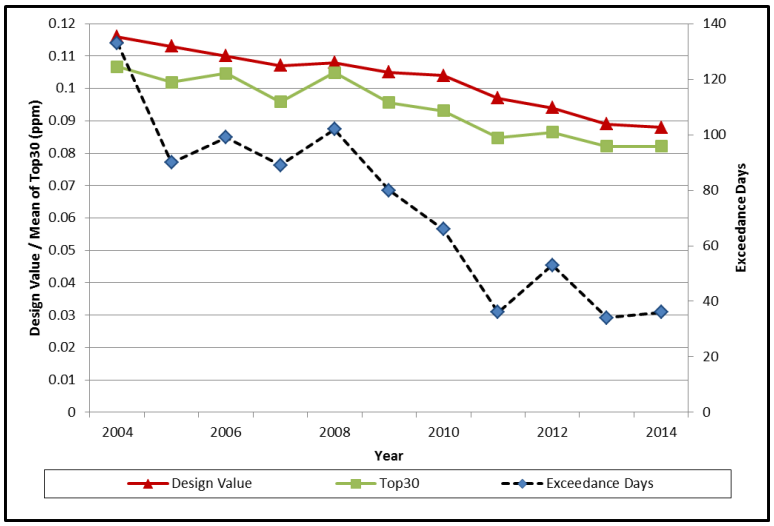


Figure 19. Ozone Trends for Edison

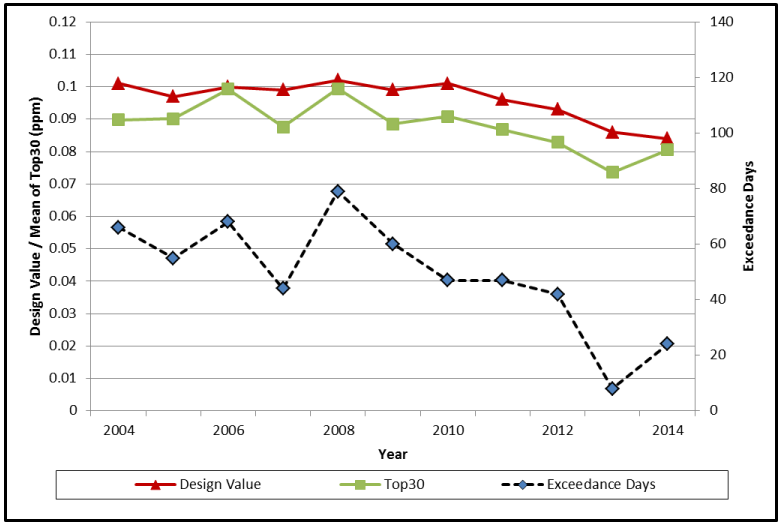


Figure 20. Ozone Trends for Oildale-3311 Manor Street

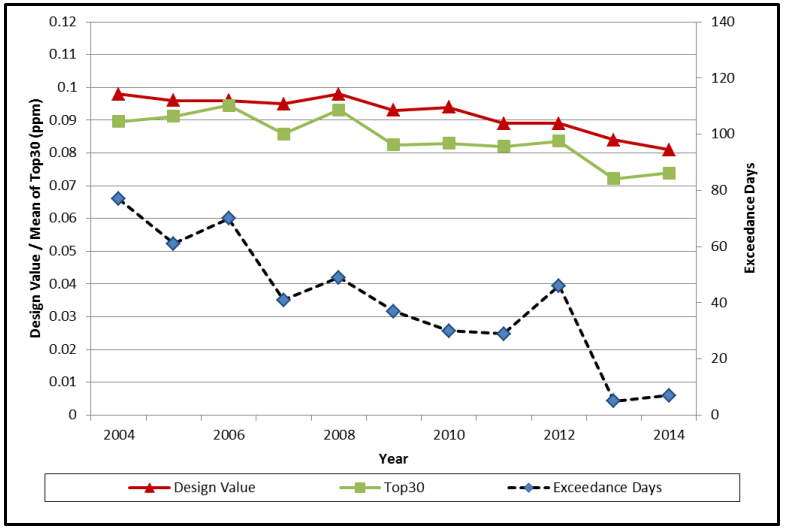


Figure 21. Ozone Trends for Bakersfield-5558 Ca Ave

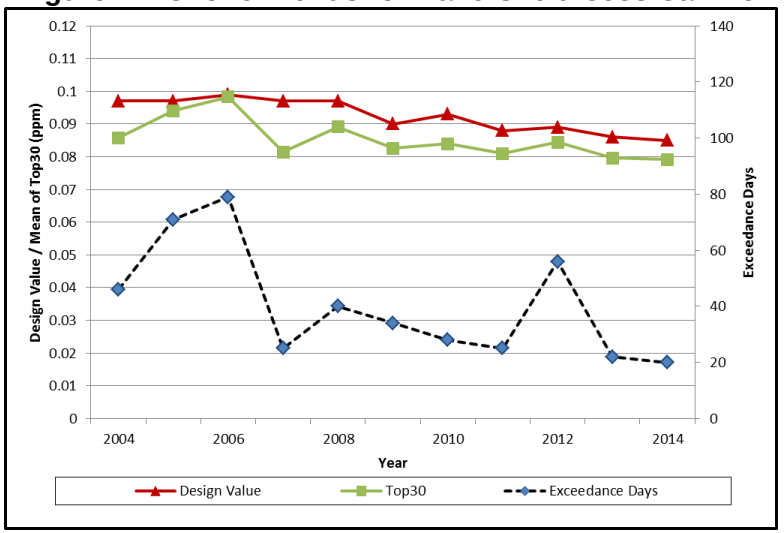


Figure 22. Two High Ozone Sites in Sequoia National Park



Figures 23 and 24 show trends at the two sites in Sequoia National Park within Tulare County. These sites have unique dynamics, as they are elevated, downwind sites, far away from any urban center. In addition, as oxides of nitrogen (NOx) emissions and ozone reach these sites, the remaining NOx may react with large amount of biogenic emissions in these areas to form ozone. Sequoia and Kings Canyon National Park has shown a 13 percent decrease in design value (0.105 to 0.091 ppm), an 11 percent decrease in top 30 (0.094 to 0.084 ppm), and a 46 percent decrease in exceedance days (94 to 51). Sequoia National Park-Lower Kaweah has shown a 15 percent decrease in design value (0.101 to 0.086 ppm), a 9 percent decrease in top 30 (0.088 to 0.080 ppm), and a 35 percent decrease in exceedance days (49 to 32).

Figure 23. Ozone Trends for Sequoia and Kings Canyon National Park

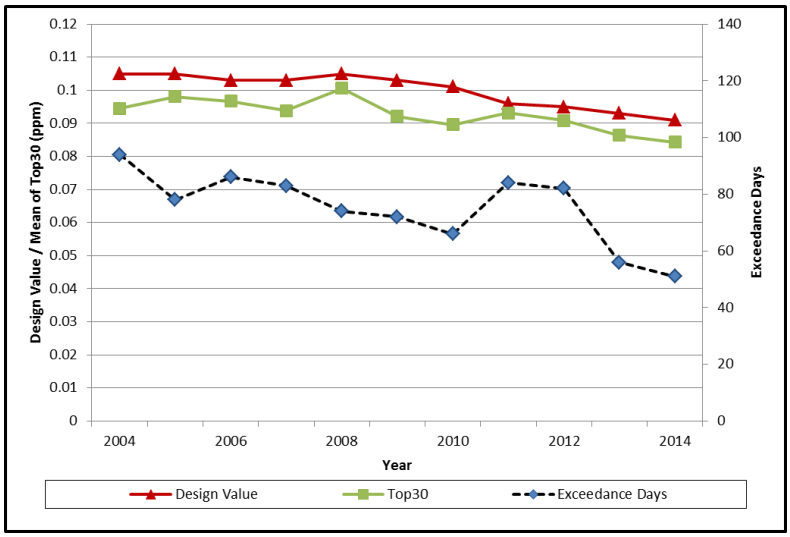
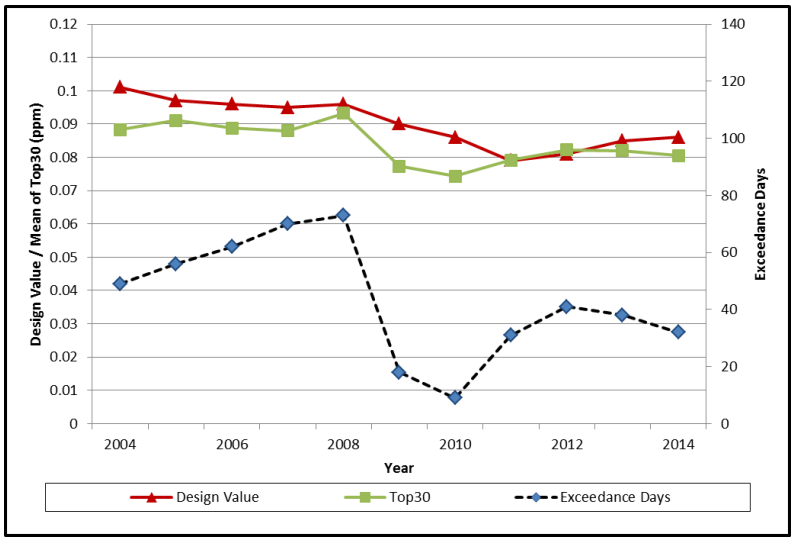


Figure 24. Ozone Trends for Sequoia National Park-Lower Kaweah



4 Meteorology and Air Quality Trends

The meteorological and photochemical processes leading to ozone formation are complex involving interactions both at the surface and in the upper air. The previous trends discussion looked at air quality as measured at ambient monitoring sites, without any consideration of or adjustment for meteorological variability.

The following discussions characterize the general meteorological conditions to evaluate the aptness of using 2012 as a base year for modeling, as well as analyzing long-term ozone trends having been "adjusted" for meteorological variability. These analyses are an effort to better understand the impact of meteorology on air quality and thereby track improvements attributable to emissions reductions.

4.1 Suitability of 2012 as a Base Year for Modeling

Two analyses of meteorological conditions during recent ozone seasons are presented below. The first is a statistical analysis of annual ozone-forming potential (OFP) using data mining software, and the second is a simple tabular comparison of the frequencies of relevant meteorological conditions by month and year.

4.1.1 Ozone-Forming Potential

Within an ozone season, day-to-day differences in meteorological conditions strongly affect the daily maximum levels of ambient ozone, thus days differ in their OFP. Ozone levels are affected by factors in addition to meteorology, such as variations in emissions, but for this discussion OFP is limited to meteorological effects represented by the meteorological data used in this analysis.

Annual OFP is an aggregate summary of daily OFP values within each year. Annual OFP differs from year to year because meteorological conditions that favor higher or lower daily OFP differ in their frequencies from year to year.

In April 2007, U.S. EPA expanded the scope of photochemical modeling required for ozone attainment demonstrations. Previously, attainment modeling was based on a few multi-day episodes when ozone levels were unusually high, especially at the design site(s). Now, however, attainment modeling must address a wider range of conditions and locations when and where ozone levels exceed the 8-hour standard for ozone.

The U.S. EPA's current draft modeling guidance released in 2014[1] includes the following: (1) "it is recommended to use a recent base year period" and (2) the base year period should include "time periods in which observed concentrations are close to

[1] Modeling Guidance for Demonstrating Attainment of Air Quality Goals for Ozone, PM2.5, and Regional Haze - December 2014 DRAFT (https://www.epa.gov/ttn/scram/guidance/guide/Draft_O3-PM-RH_Modeling_Guidance-2014.pdf).

the appropriate base year design value … and ensure there are a sufficient number of days so that the modeled attainment test applied at each monitor violating the NAAQS is based on multiple days." The first guideline concerning "recent years" focused attention on evaluating the years 2010 to 2013. The second guideline concerning "sufficient days" to support for the modeled attainment test led to an OFP summary based on the 40 days with the highest meteorologically-based OFP.

Each ozone season from 2000 through 2013 was summarized based on daily OFP values within the season. Three different summaries – a whole season view, a Top 40 view, and a Top 8 view – were considered. The whole season includes a mixture of high and low OFP values. The Top 8 view includes the highest OFP conditions but lacks the additional breadth that the U.S. EPA guidance recommends. Therefore, the Top 40 view was selected as a practical approach with respect to the new scope for attainment modeling. The average of the 40 highest daily OFP values is used to rank each year with respect to the other years.

For the central region of the Valley, the overall relationship between daily OFP (predicted daily max 8-hour ozone based on meteorology) and the observed daily max 8-hour ozone for 2005-2007, the selected baseline period for this analysis, is shown in Figure 25, which exhibits an excellent linear fit (R^2=0.87). The relationship for the southern region is shown in Figure 26, which also exhibits an excellent linear fit (R^2=0.83).

This document shows the results of the most recent annual OFP analysis for the central and southern regions of the San Joaquin Valley air basin. The analysis was done with TreeNet[2]. Table 2 shows the annual rankings with respect to OFP based on the top 40 days each year. A separate ranking is given to the two important regions, the central region and the southern region. An overall basin ranking is then based on the average of the two regional ranks. Based on the OFP values in Table 2 for the most recent four years, 2012 ranks highest overall and for both regions. In addition, when compared to the 14 years from 2000 to 2013, 2012 has the fourth highest overall ranking.

[2] TreeNet, a commercial product of Salford Systems, implements the principle of "stochastic gradient boosting" in the context of CART (classification and regression trees) modeling. The developer's website has freely available materials that explain these products (https://www.salford-systems.com/).

Figure 25. OFP vs Observed Daily Max 8-Hour Ozone in Central SJV

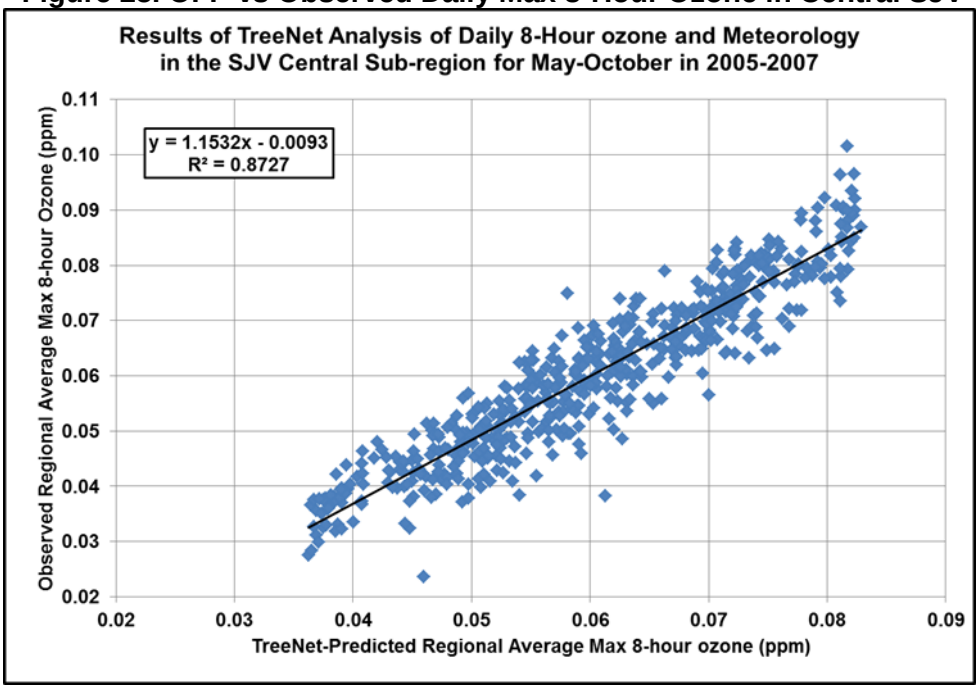


Figure 26. OFP vs Observed Daily Max 8-Hour Ozone in Southern SJV

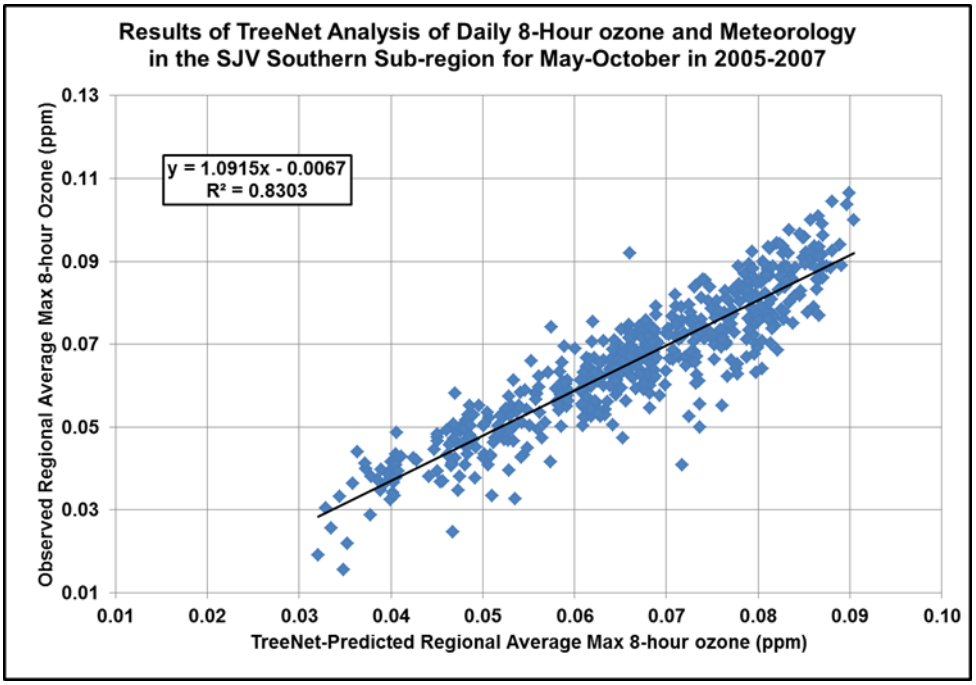


Table 2. OFP Ranking by Year

Annual rank for Ozone-Forming Potential (highest = 1) Based on the Average of the Top 40 OFP Values in Each Year			
Year	Basin Rank	Central SJV	Southern SJV
2000	10.5	11	10
2001	6	7	5
2002	6.5	5	8
2003	2	2	2
2004	12.5	12	13
2005	6.5	4	9
2006	1	1	1
2007	14	14	14
2008	10.5	10	11
2009	3	3	3
2010	12.5	13	12
2011	8	9	7
2012	5	6	4
2013	7	8	6

4.1.2 Ozone-related Meteorological Conditions by Month and Year

Relationships between meteorological conditions and ozone have been studied for more than three decades. Though many different statistical methods have been used to study ozone and meteorology, several categories of meteorological variables have repeatedly provided predictive power.[3] High ozone levels typically occur on days with strong sunlight, high temperatures, trapping inversions, and light recirculating winds. Ozone seasons in which these types of conditions occur frequently are most suitable for use as a base-case in SIP modeling needed to demonstrate future attainment of an ozone standard.

Tables 3-8 offer a broad view of the frequencies of meteorological conditions in the Valley that favor different ozone levels from lowest to highest. Each table addresses one meteorological variable for 1996 to 2013 by month (May-October).

Clear, sunny conditions are present on almost all days from May to October in the Valley. Surface temperature is represented by the midday (10 a.m.- 4 p.m.) average temperature in the central region (Table 3) and the southern region (Table 4). Trapping inversions are represented in two tables: one for the temperature aloft at the 850 mb pressure height (Table 5) and one for the difference between temperature aloft and

[3] Thompson, M. L., Reynolds, J., Cox, L. H., Guttorp, P., Sampson, P. D., 2001. A review of statistical methods for the meteorological adjustment of tropospheric ozone. Atmospheric Environment 35, 617-630.

surface temperature, an indicator of atmospheric stability (Table 6). Winds are represented by the midday (10 a.m.- 4 p.m.) average wind speed in the central region (Table 7) and the southern region (Table 8).

In each table, monthly quintiles are used. All of the observed values in a month for all of the years together were used to determine that month's quintiles, the 20th, 40th, 60th, 80th, and 100th percentiles. So, each row in a table represents 20 percent of observed values within that month over all the years. This allows the distribution of values for one year to be compared to the distributions for all the other years.

For example, the value "12" in the first row and third column of Table 2 means that 12 days in May 1996 had midday average temperatures up to 24.0^{o}C in the central region. The "13" below the "12" means that 13 days that month had temperatures higher than 24.0^{o}C and up to 27.9^{o}C. The cut-points are the same for all months and all years and were chosen so each category accounts for 20 percent or 1/5th of the data (hence, "quintiles") through all of the years. The 21 days in the highest quintile in August 2012 indicates that month had more days in that high-temperature category than any other August. The row of data below the table is the total number of days each year from May-October in the highest category for surface temperature. And, 2012 had more of such days (45) than any other year during 2010 through 2013.

In each table, the 2012 column is highlighted to facilitate comparisons to the other years. In addition, one or two rows below the table show the sum across months of the days with conditions most conducive to high ozone levels. Where two rows are given the row that is desirable is identified.

With respect to surface temperature, shown in Tables 3 and 4, 2012 had the most days in the highest quintile among the most recent four years. Table 5 presents the distributions for temperatures aloft (T850) and shows that 2012 had the most days in the highest quintile among the most recent four years. These results are important because the surface temperature and the temperature aloft are the meteorological variables most closely associated with high OFP.

With respect to atmospheric stability (Table 6) and wind speed (Tables 7 and 8), 2012 was ranked neither highest nor lowest. In the statistical modeling results, wind speed was the second most important variable for some months in the central region of the Valley, though it always ranked below the temperature variables in the southern region.

Table 3. Quintiles for Midday (10 a.m. to 4 p.m.) Average Surface Temperature in the Central SJV

month	SJVC st (°C)	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013
5	24.0	12	5	27	17	12	1	12	16	14	14	10	6	15	4	22	20	**8**	9
5	27.9	13	8	4	9	9	11	11	6	8	11	10	14	9	11	6	9	**9**	11
5	30.7	3	13		3	5	4	6	3	5	3	5	8	1	9	3	1	**9**	7
5	33.3	3	5		2	2	6		3	3	3	5	3	2	5		1	**5**	3
5	41.2					3	9	2	3	1		1		4	2				1
6	24.0	3	3	9	5	3		1	2	2	6	2	3	1	7	2	9	**5**	
6	27.9	5	9	12	5	3	6	7	9	6	14	4	1	7	12	8	4	**6**	7
6	30.7	10	10	5	8	6	9	12	7	13	6	10	15	5	1	10	9	**8**	8
6	33.3	3	5	4	8	9	3	5	5	8	3	2	6	10	4	6	5	**6**	8
6	41.2	9	3		4	9	12	5	7	1	1	12	5	7	6	4	3	**5**	7
7	24.0																		
7	27.9		1	5	5	7	4			1				1			6	**2**	
7	30.7	4	10	4	14	8	10	4	2	4	3	2	9	3	4	8	4	**5**	3
7	33.3	5	14	8	4	10	8	16	7	14	6	9	10	14	10	12	11	**13**	9
7	41.2	22	6	14	8	6	9	11	22	12	22	20	12	13	17	11	10	**11**	19
8	24.0				1											2			
8	27.9	2	2	2	7	3	3	3	2	4	1	4	2	1	2	2			2
8	30.7	8	13	4	10	8	6	12	11	7	5	8	6	4	7	7	6	**3**	8
8	33.3	4	9	9	7	8	8	7	12	9	7	15	11	11	11	14	19	**7**	14
8	41.2	17	7	16	6	12	14	9	6	11	18	4	12	15	11	6	6	**21**	7
9	24.0	2		9		5		6		7	5	4	8	1	3	3	1		4
9	27.9	8	10	6	5	7	9	5	6	4	12	6	7	7	4	6	4	**1**	9
9	30.7	12	7	4	15	11	8	4	9	6	8	11	11	5	4	10	5	**7**	7
9	33.3	7	8	4	9	4	10	6	7	7	5	5	1	12	8	4	13	**17**	6
9	41.2	1	5	7	1	3	3	9	8	6		4	3	5	11	7	7	**5**	4
10	24.0	18	21	23	9	20	14	21	4	19	20	23	23	13	24	19	16	**14**	14
10	27.9	7	7	7	15	8	10	6	18	9	9	8	7	16	7	4	12	**12**	16
10	30.7	2	2	1	4	1	4	4	9	3	2		1	1		5	3	**1**	1
10	33.3	3	1		3	2	2							1		3		**1**	
10	41.2	1					1											**3**	
	Top 20% total =	50	21	37	19	33	48	36	46	31	41	41	32	44	47	28	26	**45**	38

* Surface Temperature quintile (20th, 40th, 60th, 80th, and 100th percentiles for mid-day average surface temperatrue across the ozone seasons for 2000-2013)

Table 4. Quintiles for Midday (10 a.m. to 4 p.m.) Average Surface Temperature in the Southern SJV

month	SJVS st (°C)	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013
5	24.7	9	5	29	17	11	1	12	15	15	15	9	6	14	3	22	18	**7**	11
5	28.7	15	8	2	9	11	9	11	7	7	8	8	13	10	13	5	11	**10**	9
5	31.6	4	12		2	3	6	6	4	6	5	8	8	1	9	4		**7**	6
5	34.0	3	5		3	3	7		2	2	3	5	4	2	3		2	**7**	4
5	41.4		1			3	8	2	3	1		1		4	3				1
6	24.7	3	3	9	5	3		1		2	6	1	2	2	6	2	8	**6**	1
6	28.7	5	14	11	6	4	5	5	10	8	13	3	2	6	11	7	5	**5**	5
6	31.6	11	6	7	7	5	10	14	4	13	7	10	15	4	4	11	7	**7**	10
6	34.0	3	5	3	7	5	4	5	9	6	2	4	7	13	3	6	5	**6**	7
6	41.4	8	2		5	13	11	5	7	1	2	12	4	5	6	4	5	**6**	7
7	24.7																		
7	28.7		2	5	4	7	3			1			1				5	**2**	
7	31.6	5	9	4	13	10	10	5	1	5	4	2	12	7	5	7	6	**5**	1
7	34.0	6	15	12	8	8	7	14	11	15	4	8	6	13	7	12	10	**12**	7
7	41.4	20	5	10	6	6	11	12	19	10	23	21	12	11	19	12	10	**12**	23
8	24.7				2											1			
8	28.7	3	8	4	8	3	2	4	4	4	1	1	3	2	2	3			
8	31.6	8	9	5	8	6	7	8	11	9	5	8	9	3	7	7	5	**3**	10
8	34.0	6	9	6	7	13	8	10	8	9	7	17	7	11	10	13	20	**6**	14
8	41.4	14	5	16	6	9	14	9	8	9	18	5	12	15	12	7	6	**22**	7
9	24.7	3	3	11		8		6		7	6	2	9	1	2	3			4
9	28.7	9	10	6	6	6	7	5	6	5	11	6	8	6	5	7	5	**1**	7
9	31.6	9	7	3	15	10	5	1	9	6	9	10	9	8	4	9	5	**7**	9
9	34.0	8	7	5	9	3	15	10	6	7	4	6	1	10	6	4	12	**16**	6
9	41.4	1	3	5		3	3	8	9	5		6	3	5	13	7	8	**6**	4
10	24.7	19	21	23	9	19	11	21	5	18	20	23	23	13	23	21	16	**16**	15
10	28.7	6	7	7	15	9	13	5	16	10	7	7	7	15	8	3	12	**10**	16
10	31.6	3	2	1	4	1	3	3	10	2	3	1	1	2		5	3	**1**	
10	34.0	1	1		3	2	1	2		1	1			1		2		**1**	
10	41.4	2					3											**3**	
Top 20% total =		45	16	31	17	34	50	36	46	26	43	45	31	40	53	30	29	**49**	42

* Surface Temperature quintile (20th, 40th, 60th, 80th, and 100th percentiles for mid-day average surface temperatrue across the ozone seasons for 2000-2013)

Table 5. Quintiles for T850; Average of 4 a.m. and 4 p.m. Temperatures at 850 mb Height (~1500 m) at Oakland, CA

month	T850* (°C)	_1996	_1997	_1998	_1999	_2000	_2001	_2002	_2003	_2004	_2005	_2006	_2007	_2008	_2009	_2010	_2011	_2012	_2013
5	11.7	17	6	31	16	15	2	16	14	18	19	12	7	17	6	23	22	**10**	14
5	16.0	10	14		8	8	8	12	8	8	5	9	13	6	11	8	6	**10**	8
5	18.8	2	7		2	3	8	1	4	3	4	5	11	3	7		3	**9**	7
5	21.4	2	4		5	2	9	2	3	2	3	4		1	4			**2**	2
5	29.4					3	4		2			1		4	3				
6	11.7	4	5	11	6	4	2	1		3	11	2	3	2	12	7	9	**8**	3
6	16.0	4	11	11	8	4	11	5	9	3	13	7	5	7	8	8	6	**7**	8
6	18.8	9	7	7	7	5	6	12	8	12	4	6	13	3	2	10	10	**6**	6
6	21.4	5	5	1	6	6	7	9	4	10	2	6	7	14	4	2	3	**6**	5
6	29.4	8	2		3	11	4	3	9	2		9	2	4	4	3	2	**3**	8
7	11.7		1			1							2				3	**1**	
7	16.0	1	1	2	8	7	6			2	1		1		4		5	**3**	
7	18.8	3	11	10	11	10	8	2	3	4	1	6	7	4	3	5	3	**8**	1
7	21.4	6	15	8	3	8	5	13	7	14	5	7	8	14	3	12	9	**13**	11
7	29.4	21	3	11	9	5	12	16	21	11	24	18	13	13	21	14	11	**6**	19
8	11.7		1		4			3	3				1		1	3	2		
8	16.0		9	3	8	2	2	3	5	6		1	2	2	3	3			6
8	18.8	8	9	4	6	9	7	4	8	9	4	11	9	5	8	5	6	**3**	12
8	21.4	5	6	9	6	10	7	9	11	5	13	17	6	11	8	15	18	**8**	9
8	29.4	18	6	15	7	10	15	12	4	11	14	2	13	13	11	5	5	**20**	4
9	11.7	4	1	6		7	1	5		4	7	2	11	2	3	3	1		6
9	16.0	6	9	11	3	6	4	5	5	4	9	3	8	3	4	9	3	**1**	9
9	18.8	11	10	2	4	9	14	4	3	7	9	11	2	9	4	7	3	**3**	7
9	21.4	8	9	5	15	3	9	6	6	9	5	7	6	10	6	3	10	**22**	2
9	29.4	1	1	6	8	5	2	10	16	6		7	3	6	13	8	13	**4**	6
10	11.7	16	15	18	3	17	5	9	3	16	13	12	20	8	11	17	11	**11**	10
10	16.0	5	10	13	9	8	10	15	4	4	12	14	7	7	13	4	8	**9**	15
10	18.8	3	4		12	1	9	4	16	8	6	5	2	14	7	4	6	**5**	6
10	21.4	3	2		7	4	3	2	2	2			2	2		4	6	**1**	
10	29.4	4				1	4	1	6	1						2		**5**	
Top 20% total =		52	12	32	27	35	41	42	58	31	38	37	31	40	52	32	31	**38**	37

* T850 quintile (20th, 40th, 60th, 80th, and 100th percentiles for T850 across the ozone seasons for 2000-2013)

Table 6. Quintiles for Atmospheric Stability* in the Southern SJV

month	sjvs_stability (°C)	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013
5	-14.6	16	12	21	5	14	9	20	9	15	12	12	13	8	8	17	19	12	17
5	-13.4	6	11	4	8	9	8	8	7	7	10	9	6	8	8	5	6	12	7
5	-12.4	5	6	2	8	4	8	1	6	3	7	4	5	8	6	5	5	4	5
5	-11.1	2	2	1	4	4	4	1	6	5	1	3	6	5	5	3	1	1	2
5	-2.0	2		3	6		2	1	3	1	1	3	1	2	4	1		2	
6	-14.6	4	9	8	10	5	18	5	3	3	14	9	10	5	8	18	12	18	9
6	-13.4	11	9	8	9	5	10	10	9	2	11	8	8	11	12	8	8	5	9
6	-12.4	9	5	4	7	9	2	5	7	8	5	6	8	9	5	2	8	4	4
6	-11.1	4	4	8	3	8		7	4	8		3	3	4	5	2	2	3	2
6	-2.0	2	3	2	1	3		3	7	9		4	1	1					6
7	-14.6	1	2	6	5	6	3		3	1	2	6	4		7		9	7	6
7	-13.4	5	7	5	5	8	13	7	3	6	3	7	3	2	5	7	11	12	8
7	-12.4	8	9	4	6	9	5	11	8	12	7	6	7	13	7	7	5	6	6
7	-11.1	11	10	12	13	5	4	5	10	11	15	10	11	7	5	15	3	5	7
7	-2.0	6	3	4	2	3	6	8	7	1	4	2	6	9	7	2	3	1	4
8	-14.6		7	2	7	3	5	1	6	1	2	2	4	5	7	6	2	1	10
8	-13.4	6	4	4	6	5	5	4	10	5	8	11	4	7	8	7	10	5	11
8	-12.4	6	10	8	10	9	8	7	9	15	8	10	11	7	5	6	8	10	8
8	-11.1	7	9	11	6	12	7	5	4	8	10	8	7	11	6	8	9	11	1
8	-2.0	12	1	6	2	2	6	14	2	2	3		5	1	5	4	2	4	1
9	-14.6	4	8	3	1	7	3	5	1	2	5	6	7	3	3	2	1	4	9
9	-13.4	6	6	6	2	6	8	5	4	3	5	2	8	4	4	8		3	5
9	-12.4	8	9	4	1	4	3	5	7	8	6	5	4	8	7	8	6	7	7
9	-11.1	8	3	6	11	4	12	11	7	12	3	8	4	9	12	4	14	9	5
9	-2.0	4	4	11	15	9	4	4	11	5	11	9	7	6	4	8	9	7	4
10	-14.6	1	5	1	1	3	2				4	4	6	2		3	3	5	
10	-13.4	2	1	3	2	4	1		2	3	2	1	4	3	6	4	2	3	3
10	-12.4	2	4	5	3	3	2	8	1	3	5	2	3	6	3	1	2	2	8
10	-11.1	5	5	8	4	6	5	3	6	5	5	5	4	3	4	6	4	6	9
10	-2.0	21	16	14	21	16	21	20	22	20	15	19	14	17	18	17	20	15	11
	Top 20% total =	47	27	40	47	33	39	50	52	38	34	37	34	36	38	32	34	29	26

* Stability quintile (20th, 40th, 60th, 80th, and 100th percentiles for daily average stability across the ozone seasons for 2000-2013). Stability is Temperature Aloft (at 850 mb ht) minus mid-day average (10 a.m. - 4 p.m.) in the southern region.

Table 7. Quintiles for Midday (10 a.m. to 4 p.m.) Average Wind Speed in the Central SJV

month	sjvc wss (m/s)	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013
5	2.0	0	0	2	1	3	9	2	6	0	3	2	1	6	4	3	4	**3**	2
5	2.2	3	3	4	5	4	8	5	5	7	5	5	8	7	5	7	3	**11**	5
5	2.5	2	5	5	5	4	2	5	8	5	9	7	5	4	5	4	6	**5**	3
5	2.8	8	6	8	6	5	4	6	6	10	3	5	8	5	6	4	3	**1**	5
5	8.5	18	17	12	14	15	8	13	6	9	11	12	9	9	11	13	15	**11**	16
6	2.0	1	0	6	0	3	2	0	2	0	2	2	0	2	1	0	3	**2**	1
6	2.2	3	0	7	5	7	2	6	10	4	8	5	2	6	5	3	7	**4**	4
6	2.5	5	6	6	4	5	9	4	7	5	7	6	10	9	8	3	7	**3**	3
6	2.8	12	10	5	10	10	7	11	8	11	4	12	12	3	13	8	7	**8**	8
6	8.5	9	14	6	11	5	10	9	3	10	9	5	6	10	3	16	6	**13**	14
7	2.0	0	0	0	0	0	3	2	1	0	0	0	3	3	2	2	1	**3**	4
7	2.2	4	4	5	5	8	3	4	7	6	7	8	6	6	2	8	10	**8**	8
7	2.5	12	6	16	10	10	13	15	11	7	7	7	5	4	12	6	12	**6**	6
7	2.8	9	11	6	10	8	11	7	6	13	11	10	12	10	6	11	7	**10**	12
7	8.5	6	10	4	6	5	1	3	6	5	6	6	5	8	9	4	1	**4**	1
8	2.0	1	1	3	2	6	3	2	3	2	2	1	3	3	4	5	6	**3**	3
8	2.2	7	4	11	3	8	6	12	8	11	3	13	10	11	5	12	12	**7**	10
8	2.5	9	11	10	8	8	14	9	10	7	12	12	11	8	8	7	8	**7**	6
8	2.8	10	8	7	10	4	5	6	8	7	11	5	3	6	11	5	4	**14**	6
8	8.5	4	7	0	8	5	3	2	2	4	3	0	4	3	3	2	1	**0**	6
9	2.0	3	8	5	5	12	9	8	14	8	6	10	10	15	10	9	8	**17**	8
9	2.2	9	12	13	2	7	6	6	6	9	7	12	4	6	8	9	10	**6**	5
9	2.5	8	4	3	13	4	8	8	5	4	10	2	4	4	2	8	8	**3**	6
9	2.8	7	2	5	8	3	3	3	3	2	3	3	5	4	5	2	2	**3**	3
9	8.5	3	4	4	2	4	4	5	2	7	4	3	7	1	5	2	2	**1**	8
10	2.0	13	17	15	22	18	17	23	23	19	16	20	17	22	16	21	23	**19**	22
10	2.2	6	5	5	3	2	7	6	2	3	5	6	2	2	5	3	4	**5**	4
10	2.5	3	2	3	2	2	3	0	2	1	4	2	1	1	1	2	1	**1**	1
10	2.8	3	3	1	2	5	3	1	1	2	3	2	2	2	3	1	1	**2**	1
10	8.5	6	4	7	2	4	1	1	3	6	3	1	9	4	6	4	2	**4**	3
(desireable)	Low 40% total =	50	54	76	53	78	75	76	87	69	64	84	66	89	67	82	91	**88**	76
(undesireable)	Top 20% total =	46	56	33	43	38	27	33	22	41	36	27	40	35	37	41	27	**33**	48

* Surface wind speed quintile (20th, 40th, 60th, 80th, and 100th percentiles for mid-day average wind speed across the ozone seasons for 2000-2013)

Table 8. Quintiles for Midday (10 a.m. to 4 p.m.) Average Wind Speed in the Southern SJV

month	sjvc wss (m/s)	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013
5	3.2	2	1	17	3	7	2	0	6	0	11	3	2	6	1	6	4	**5**	4
5	3.7	7	6	4	11	6	8	8	9	3	6	4	5	9	6	6	8	**8**	7
5	4.2	12	7	4	9	6	7	6	5	10	6	10	6	4	10	5	7	**5**	6
5	4.8	5	12	5	4	5	7	11	5	11	5	7	10	7	8	6	7	**8**	8
5	11.2	5	5	1	4	7	7	6	6	7	3	7	8	5	6	8	5	**5**	6
6	3.2	9	2	2	4	2	2	1	1	0	6	1	3	3	3	1	4	**4**	0
6	3.7	3	1	13	2	8	8	1	4	2	1	2	4	1	7	3	3	**2**	5
6	4.2	5	4	6	6	2	3	8	4	4	5	3	7	9	10	8	4	**5**	11
6	4.8	4	7	5	9	9	7	8	11	13	10	13	5	6	5	6	12	**9**	7
6	11.2	9	16	4	9	9	10	12	10	11	8	11	11	11	5	12	7	**10**	7
7	3.2	0	3	2	1	0	1	1	2	0	0	2	5	2	3	1	2	**5**	6
7	3.7	2	1	8	9	8	6	3	5	6	0	2	7	2	6	5	3	**4**	3
7	4.2	9	3	8	8	8	9	3	3	3	1	3	9	8	6	8	6	**6**	6
7	4.8	7	8	10	8	10	9	7	8	8	10	8	6	8	10	10	12	**8**	8
7	11.2	13	16	3	5	5	6	17	13	14	20	16	4	11	6	7	8	**8**	8
8	3.2	3	11	3	4	3	0	1	7	1	2	1	7	2	5	1	3	**2**	3
8	3.7	6	8	7	7	8	3	7	6	3	1	4	10	8	6	8	10	**6**	9
8	4.2	11	4	9	7	9	10	5	4	7	4	8	5	13	11	5	12	**8**	11
8	4.8	6	5	7	6	6	7	11	10	14	9	8	4	4	6	7	5	**5**	6
8	11.2	5	3	5	7	5	11	7	4	6	15	10	5	4	3	10	1	**10**	2
9	3.2	5	12	11	8	12	8	4	6	5	3	4	9	6	11	9	6	**6**	17
9	3.7	12	8	7	6	9	7	6	6	8	5	8	12	12	9	7	10	**13**	6
9	4.2	10	4	6	8	2	9	12	5	5	8	6	7	10	5	6	7	**10**	3
9	4.8	3	5	2	4	5	5	2	5	9	7	7	0	2	1	6	5	**1**	3
9	11.2	0	1	4	4	2	1	6	8	3	7	5	2	0	4	2	2	**0**	1
10	3.2	22	22	15	18	16	17	16	16	15	19	17	18	15	21	21	25	**15**	17
10	3.7	4	4	9	7	11	6	6	6	10	3	9	4	9	6	3	2	**8**	9
10	4.2	3	2	5	2	2	6	6	6	2	5	1	0	3	0	2	1	**6**	2
10	4.8	0	0	0	3	0	1	1	1	1	3	2	1	0	2	1	3	**1**	0
10	11.2	2	3	2	1	2	1	2	2	3	1	2	8	4	2	4	0	**1**	3
(desireable)	Low 40% total =	75	79	98	80	90	68	54	74	53	57	57	86	75	84	71	80	**78**	86
(undesireable)	Top 20% total =	34	44	19	30	30	36	50	43	44	54	51	38	35	26	43	23	**34**	27

* Surface wind speed quintile (20th, 40th, 60th, 80th, and 100th percentiles for mid-day average wind speed across the ozone seasons for 2000-2013)

The combined picture from Tables 3-8 indicates that the meteorological conditions present in the 2012 ozone season make the best choice among recent years (2010-2013) as a base-case for SIP modeling of ozone in the San Joaquin Valley. This conclusion is based on two different evaluations of meteorological conditions in the Valley during the ozone seasons of 2000-2013.

4.2 Meteorology-adjusted Ozone Trends – Seasonal Averages by Region

In addition to an evaluation of trends in OFP and variations in meteorological variables, when observed trends are adjusted to compensate for periods of atypical meteorology, the "meteorology-adjusted" trends reveal more clearly the impact of emissions reductions.

This section presents observed and meteorology-adjusted trends for the season (May-October) average of daily maximum 8-hour ozone in three regions of the Valley from 2007-2014. Although these trends do not relate directly to attainment of the national 8-hour ozone standard, they do offer a broad-based perspective on the response of ambient ozone levels to strategic reductions in emissions of NOx and volatile organic compounds (VOC).

4.2.1 Meteorology and Ozone

Large variations in daily maximum 8-hour ozone concentrations are normally observed within an ozone season (May-October). These variations are due to differences in meteorology, emissions, and other factors, all of which affect ambient ozone levels. Years differ in the frequencies of low-ozone versus high-ozone meteorological conditions, and the year-to-year fluctuations in these frequencies can sometimes mask the extent to which the ozone air quality trends represent changes in emissions.

Datasets containing daily maximum 8-hour ozone and a variety of meteorological variables were prepared for the northern, central, and southern regions of the Valley. Each data set included the variables shown in Table 9.

Table 9. List of Observed (upper-air and surface) and Derived Variables Used in CART

Variables	Description	Unit
Surface		
Wind Speed	Midday 6 hour (10 a.m.- 4 p.m.) average	m/s
Temperature	Midday 6 hour (10 a.m.- 4 p.m.) average, daily average	°C
Dew Point	Midday 6 hour (10 a.m.- 4 p.m.) average	°C
Relative Humidity	Midday 6 hour (10 a.m.- 4 p.m.) average	%
Upper-air (500, 700, 850 mb)		
Temperature	a.m., p.m., average	°C
Geopotential Height	a.m., p.m., average	m
Transport		
Distance (vector)	24-hour back trajectory	km
Total Distance	24-hour back trajectory	km
Direction	Aerial direction from North	Degree
Sector	Total 8 sectors (1-8)	Unitless
Stability		
AM Stability	Upper-air temperature at 5 a.m. minus surface daily maximum temperature	°C
Average Stability	Upper-air daily average temperature minus surface daily average temperature	°C
Mixing Height	Depth of lower mixing atmosphere	m

The data for 2009, 2010, and 2011 were used as a "calibration period" with which to establish a baseline for 8-hour ozone in relation to meteorology. The daily maximum 8-hour ozone data and the daily meteorological data in the calibration period were used to develop rules for classifying days into meteorological groups in such a way that the total variability of 8-hour ozone within the groups is as small as possible. This was done using a data mining tool, called Classification and Regression Trees (CART),[4] which automatically selects the most effective meteorological variables for this purpose. The classification rules were based on the data for the three-year period 2009-2011 with the reasonable assumption that emissions were relatively stable during this period and together the years included a wide range of meteorological conditions. Once the classification rules were developed, they were used to classify the remaining days in the 2007-2014 ozone seasons.

The frequencies of days in the meteorological classes fluctuated from year to year. For each year, the class frequencies were linked to the class averages for the calibration period to produce a "predicted seasonal average". The difference between the predicted seasonal average and the calibration period's baseline average was

[4] The developer's web site has freely available information regarding CART (www.salford-systems.com)

used to “meteorology-adjust” the observed seasonal average. The resulting meteorology-adjusted trends are shown alongside the observed trends in Figures 27-29.

4.2.2 Meteorology-adjusted Trends for Season Average Daily-Max 8-hour Ozone

In this analysis, each daily maximum 8-hour ozone value was averaged over the ozone season, within each region, from 2007-2014. These season average trends may differ from trends for other indicators, such as design values, that highlight changes in the higher end of the distribution of ozone concentrations.

Figures 27-29 show observed and meteorology-adjusted data with a linear trend fitted to the adjusted data. The linear trend represents the best available general assessment of the response of season-average 8-hour ozone to emissions of NOx and VOC. Note that season-average trends are expected to improve at a slower rate compared to trends in “peak” indicators (such as design value and mean of top 30).

- For the northern region, the linear fit to the meteorology-adjusted data in Figure 27 shows a mild downward trend.

- For the central region, the linear fit to the meteorology-adjusted data in Figure 28 shows a flat trend.

- For the southern region, the linear fit to the meteorology-adjusted data in Figure 29 shows a substantial overall decline of almost 1.5 ppb per year.

These season average trends are generally similar to the patterns observed in the other metrics. Additional discussion on how these relate to the response to emission reductions based on the ozone chemistry of the region is provided in subsequent sections.

Figure 27. Meteorology-adjusted Season Average of Daily Maximum 8-Hour Ozone Concentrations for Northern SJV

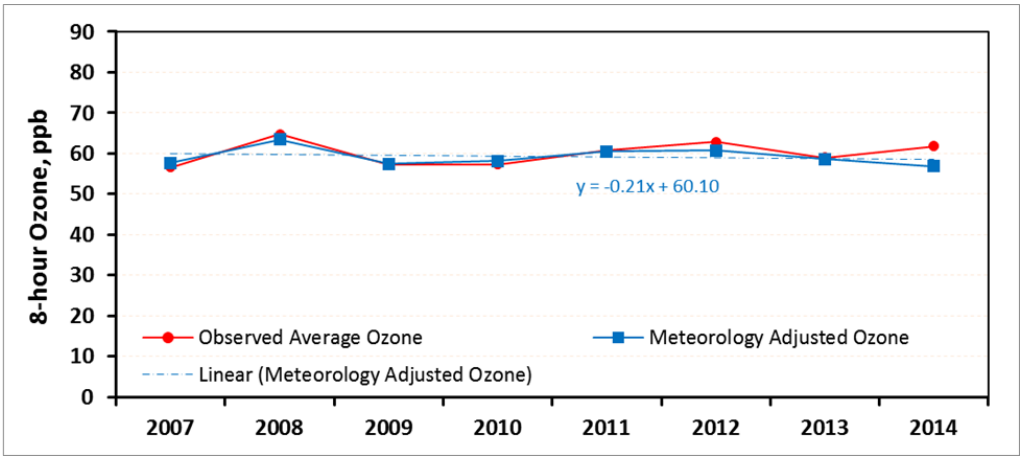


Figure 28. Meteorology-adjusted Season Average of Daily Maximum 8-hour Ozone Concentrations for Central SJV

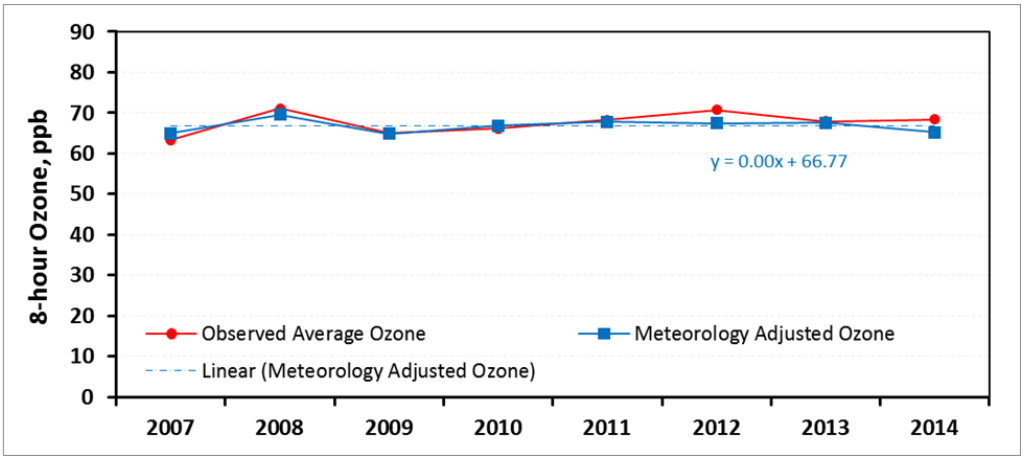
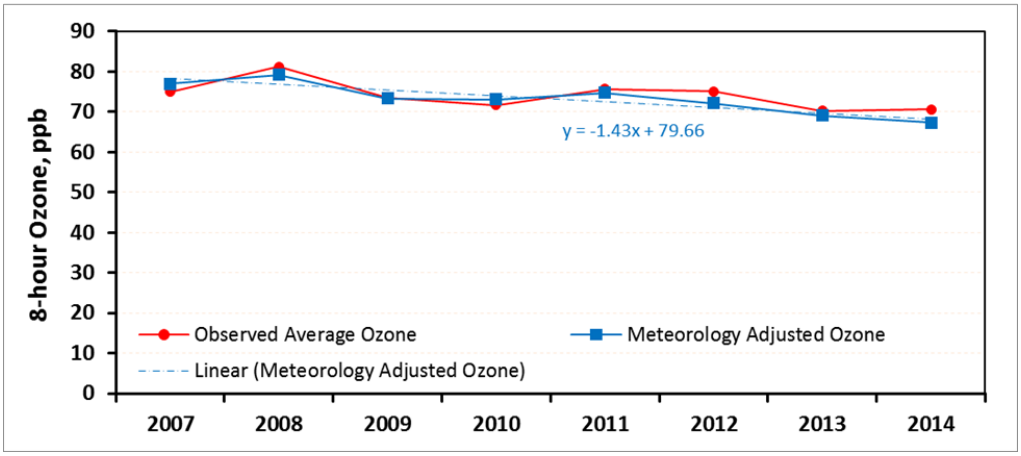


Figure 29. Meteorology-adjusted Season Average of Daily Maximum 8-hour Ozone Concentrations for Southern SJV

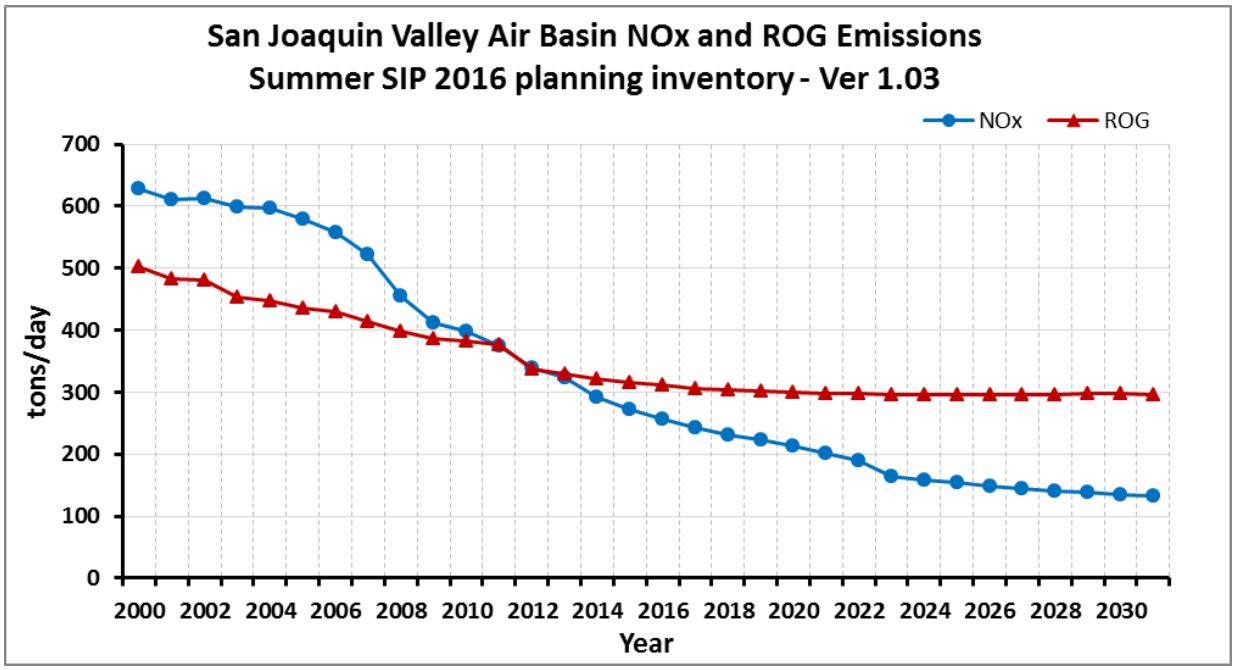


5 Trends in Precursor Emissions

Tropospheric ozone is a secondary pollutant that is formed by NOx and VOCs (also referred to as reactive organic gases, or ROG) through complex non-linear photochemical reactions. Anthropogenic emissions from mobile sources, industrial facilities and electric utilities, gasoline vapors, and chemical solvents are some of the major sources of NOx and ROG. Vegetation is also a major source of ROG emissions.

Emissions control programs have substantially reduced the amounts of both NOx and ROG emitted by various sources throughout the Valley. Emissions trends, excluding emissions from natural sources, for NOx and ROG in the Valley as a whole are shown in Figure 30. All emission inventory values are based on the California Air Resources Board's (ARB) California Emission Projection Analysis Model (CEPAM) for the 2016 Ozone SIP version 1.03 with external adjustments, using 2012 as the base year. The figure shows that from 2000-2031, anthropogenic NOx is forecasted to decrease by 79 percent and ROG by 41 percent.

Figure 30. Overall Anthropogenic NOx and ROG Emissions Trends for the SJV



The relative amount of ROG emissions compared to NOx, or ROG/NOx ratio, is an important consideration when planning emissions reduction strategies. For higher ROG/NOx ratios, ROG emissions reductions will generally be less effective in lowering ozone while NOx emissions reductions will be more effective. This is known as a NOx-limited regime. A ROG-limited regime occurs when the ROG/NOx ratios are lower, indicating higher NOx emissions. In this regime, ROG emissions reductions will be more effective than NOx emissions in reducing ozone concentrations.

Looking forward from 2012, the 2031 emissions represent approximately a 60 percent decrease in NOx and a 12 percent decrease in ROG. Accordingly, the ROG/NOx ratio for anthropogenic emissions in 2031 is expected to be over twice the ratio that prevailed in 2012. The ratio of ambient ROG to ambient NOx would be greater than the ROG/NOx ratio based upon anthropogenic emissions. This is because biogenic ROG is the majority of the total ROG inventory in the Valley for most of the ozone season, while biogenic NOx is a tiny fraction of the total NOx inventory. The trend towards higher ROG/NOx ratios in the Valley indicates that the area will become more NOx-limited, thus NOx controls will become increasingly more effective for lowering ozone concentrations.

Trends in summer emissions of anthropogenic NOx and ROG for the central region are shown in Figure 31 and for the southern region in Figure 32. These trends show similarities that reflect the valleywide implementation of significant control programs for both NOx and ROG. Similar to the Valley as a whole, in the central and southern regions of the Valley, the inventory shows greater reductions in NOx (an average of 47 percent in the two regions) than ROG (an average of 35 percent in those regions) from 2000-2012, with that pattern continuing through 2031. The key feature of these trends is that the southern region, with a higher ROG/NOx ratio than the central region, appears to have transitioned to a NOx-sensitive regime first.

Figure 31. Anthropogenic NOx and ROG Emissions Trends for the Central SJV

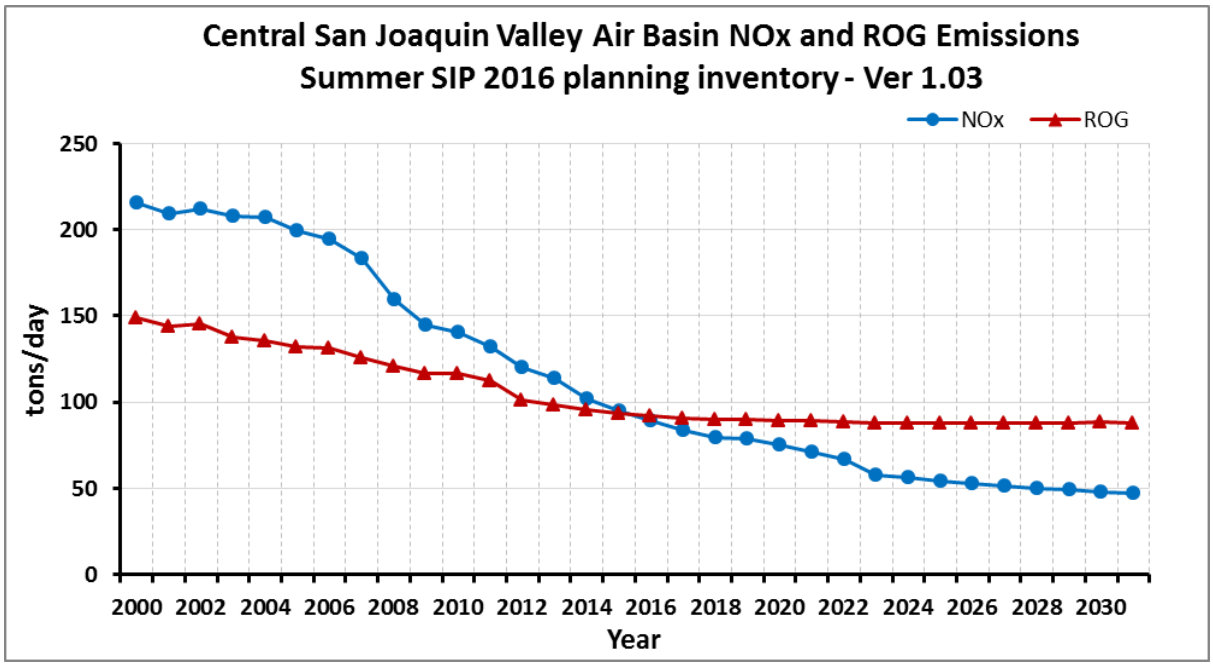
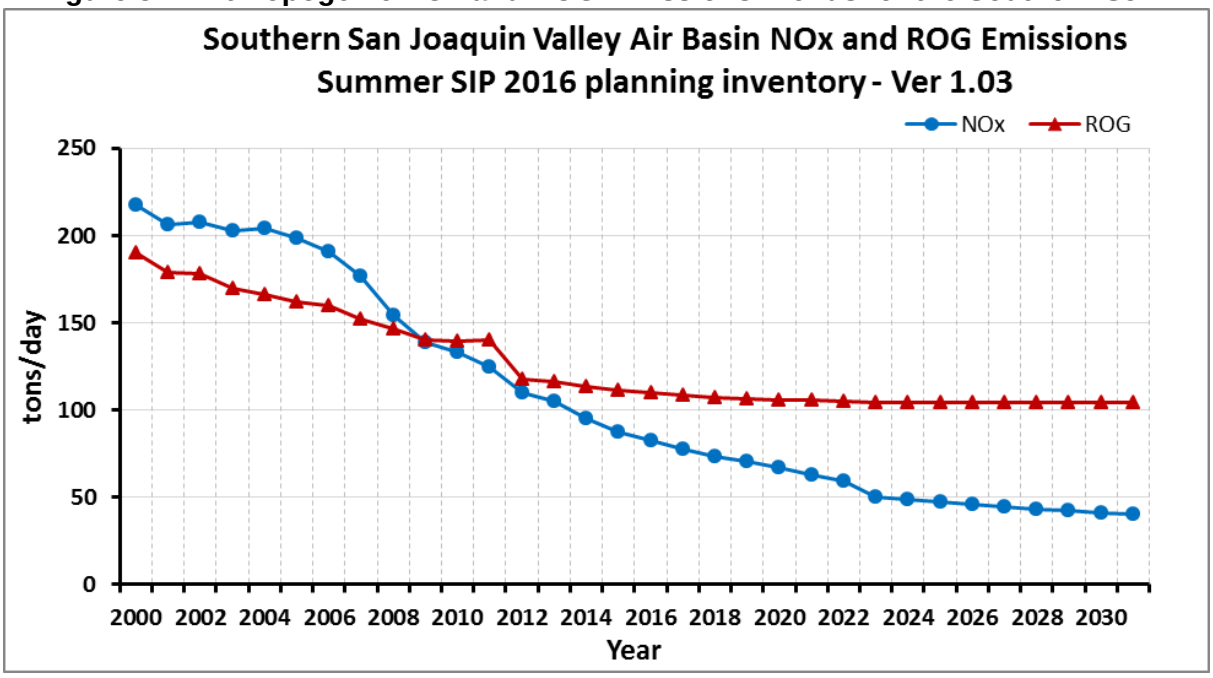


Figure 32. Anthropogenic NOx and ROG Emissions Trends for the Southern SJV



The county-by-county trends in Figures 33 and 34 have largely similar shapes but differ in the magnitude of the emissions, with the highest NOx and ROG emissions in Kern and Fresno counties. Note that Fresno County has higher NOx emissions, and Kern County has higher ROG emissions.

Figure 33. Summer NOx Emissions by County

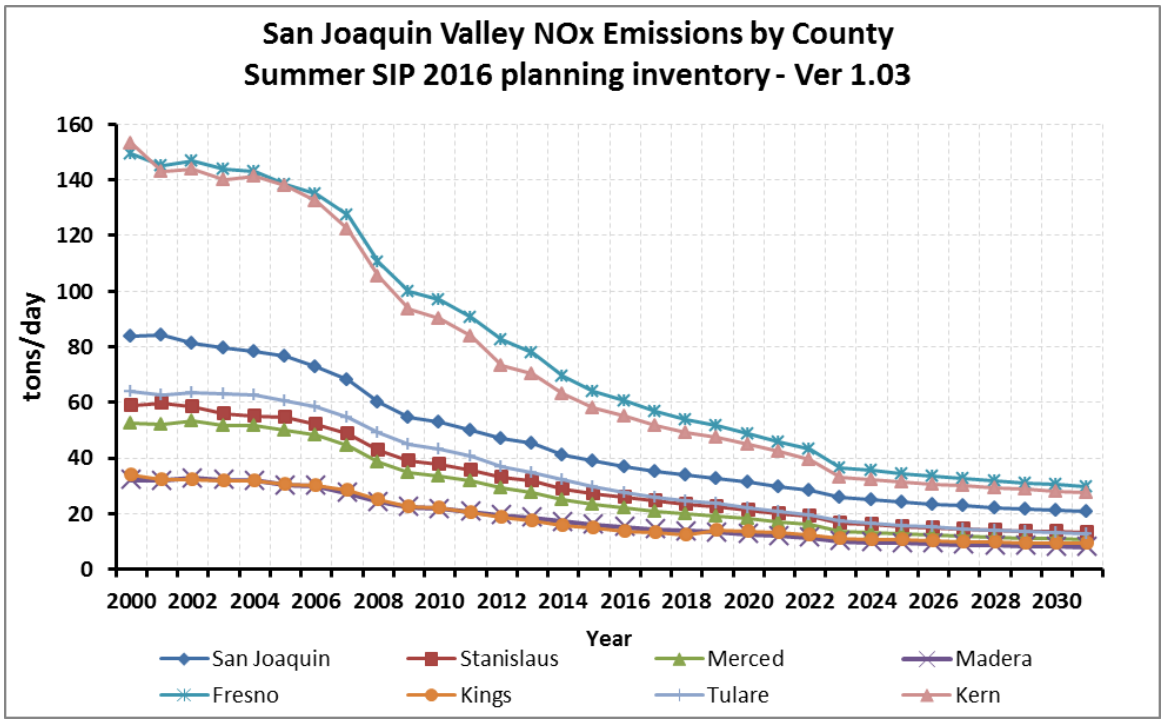
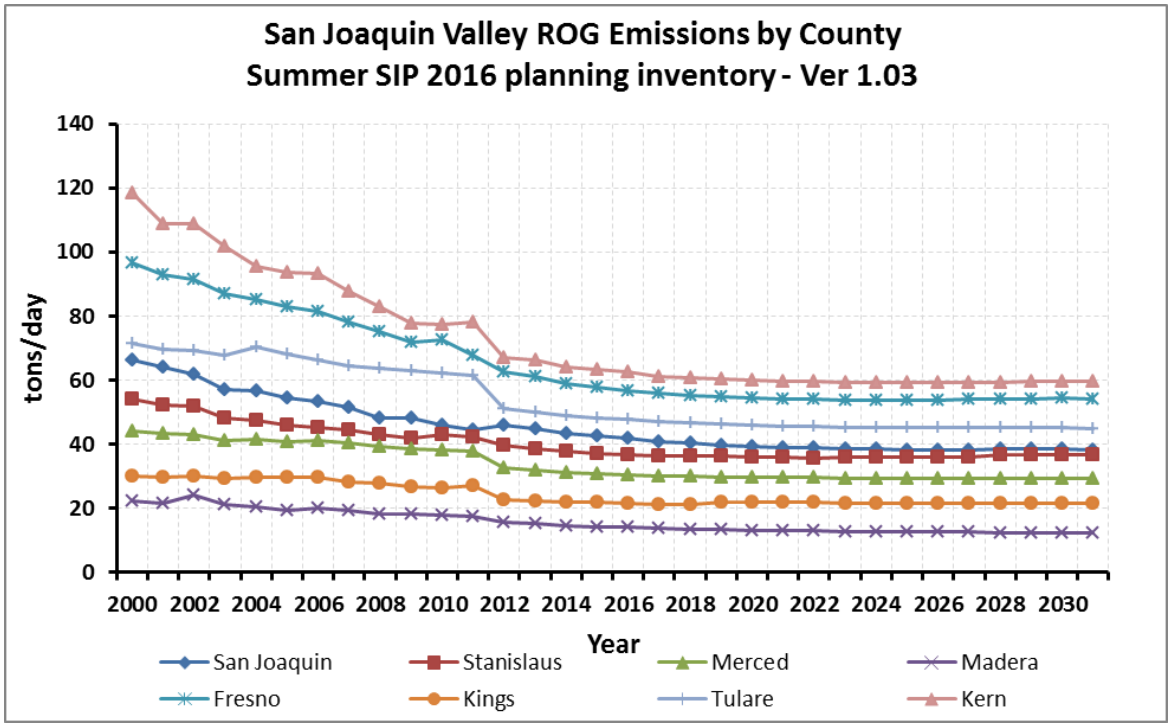


Figure 34. Summer ROG Emissions by County



6 Trends for Ozone Precursor Concentrations

This section presents trends in the primary ozone precursors, NOx and VOC. The data are from a special-purpose network of Photochemical Assessment Monitoring Stations (PAMS) where both NOx and VOC are measured side-by-side. The PAMS network operates during the summer ozone season and collects VOC samples that represent different parts of the day. The work done for this WOE was patterned after previous WOE analyses that focused on the morning hours between 5:00 a.m. and 8:00 a.m. in July and August, when the ambient concentrations of ozone precursor emissions are highest, during the morning commute hours.

The VOC data discussed here are the sum of 55 chemical species, sometimes called Non-Methane Organic Compounds (NMOC), a subset of VOC. These data are known to be lower than total VOC by percentages that differ by location.

The PAMS reactivity metric quantifies the relative impacts of each species on ozone formation. Using the maximum incremental reactivity (MIR) scale, this reactivity-weighted metric is a more meaningful measurement for how ambient VOC plays a role in forming ozone.

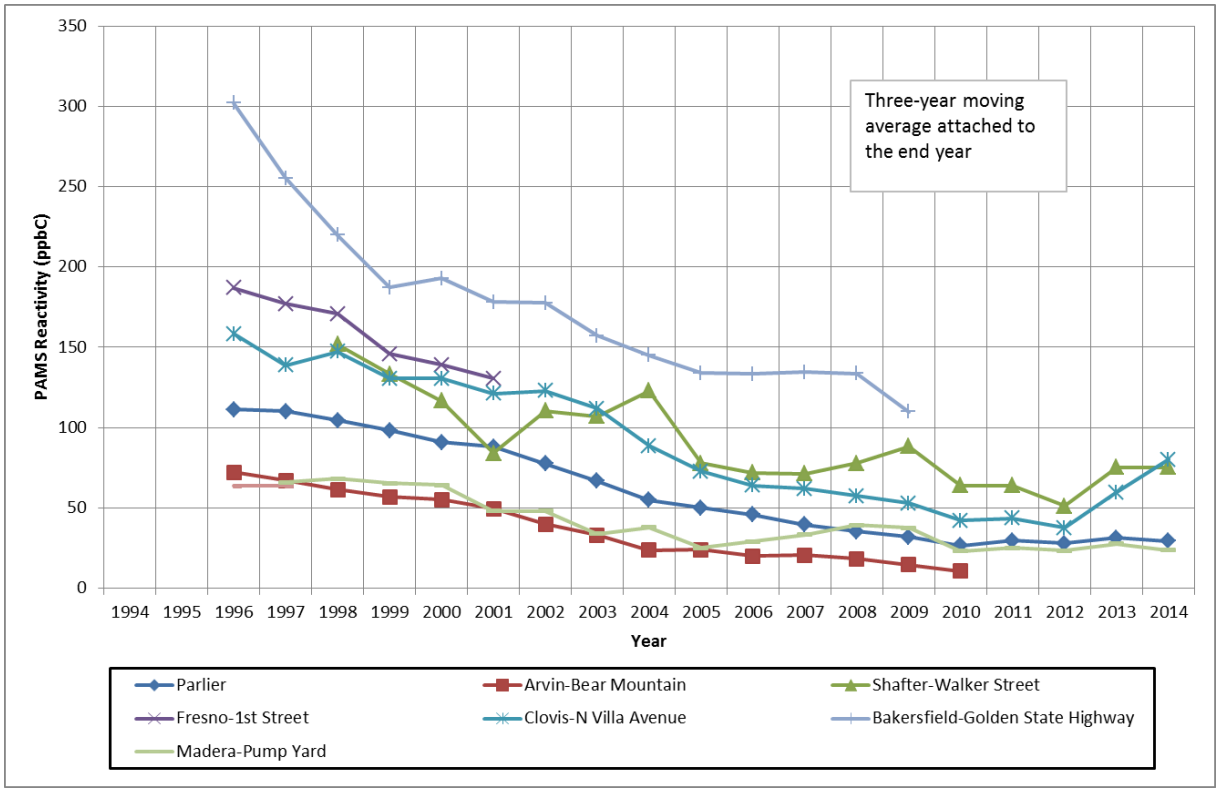
VOC is not measured at many of the monitors in the routine ambient network. The routine network of NOx monitors, however, is extensive, and is discussed in a subsequent section.

6.1 Analysis of PAMS Data

The data were collected and filtered for the months of July and August because these two months tend to be during the peak of the ozone season. In addition, NMOC data were not consistently available for other months in the PAMS network. PAMS data is measured and collected periodically throughout the day, and most observations tend to represent a three hour period. As such, it was important also to filter for a certain time period of the day. Data from the 5:00 a.m.- 7:00 a.m. Pacific Daylight Time (PDT) and 6:00 a.m.- 8:00 a.m. PDT periods were selected. This time period was chosen because it represents the hours before photochemistry (and therefore ozone formation) is triggered, and at a time when ozone precursor are at higher levels.

From 1994 to 2014, ambient VOC concentrations decreased significantly throughout the Valley. Trends for each site shown in Figure 35 show a long term downward trend towards lower VOC levels in every region. The ambient VOC levels are consistent with the emissions inventory trends, with the southern region (Bakersfield-Golden State Highway and Shafter-Walker Street) having higher levels than the central region (Fresno-1st Street, Clovis-N Villa Avenue, and Parlier). Because the sites in the southern region have higher VOC levels, it would take comparatively fewer NOx reductions in order for that region to transition to a NOx-limited regime, and ultimately show a response with lower ozone levels.

Figure 35. July-August Means at all SJV PAMS Stations (5-7 a.m./6-8 a.m.)*



*3-hour NMOC/PAMS samples from 5-7 a.m. or 6-8 a.m. for a standard set of 55 compounds. Some samples with extreme mixing ratios for one or more compounds were identified and excluded. Data for 2008 and 2012 were not available for this area during the chosen months and hours.

6.2 Analysis of Routine Ambient NOx Data

The trends in the previous section represent ambient ROG and NOx at sites in the limited PAMS network during July and August for the hours between 5:00 a.m. and 8:00 a.m. This section will focus on all sites in the Valley that measure NOx, providing a broader basis for assessing trends. These concentrations are averages measured over the May-October season for all hours in the day, from 1990-2014.

Figures 36, 37, and 38 show NOx trends for each site in the northern, central, and southern regions, respectively. All figures use three-year averages attached to the end year to show a trend less sensitive to year-to-year variation. Ambient NOx in each of the regions is on a steady decline. All sites, especially the ones with the highest concentration, show substantial NOx decreases over the past 20 years. On average, the sites in the central region and southern regions had a decrease of about 40 percent from 2000-2012. The overall trend in ambient NOx measurements is consistent with the emissions inventory data.

Figure 36. Northern SJV Trends for Ambient 24-hour NOx from May-October

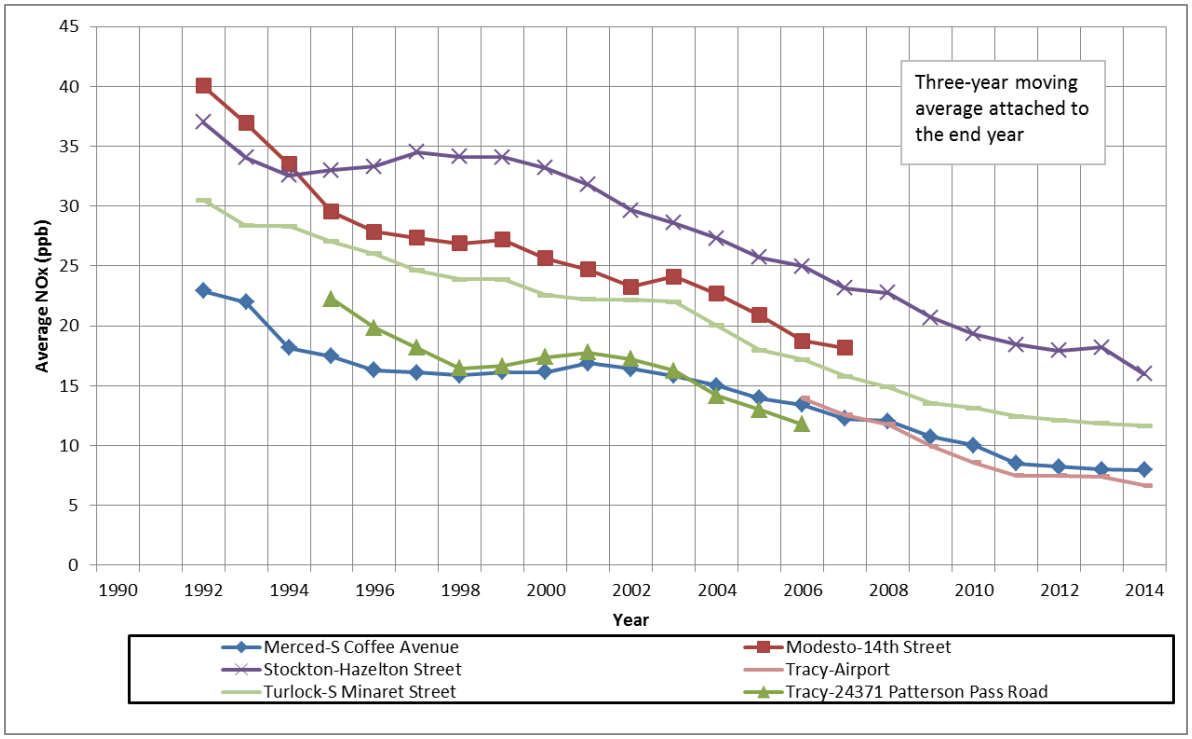


Figure 37. Central SJV Trends for Ambient 24-hour NOx from May-October

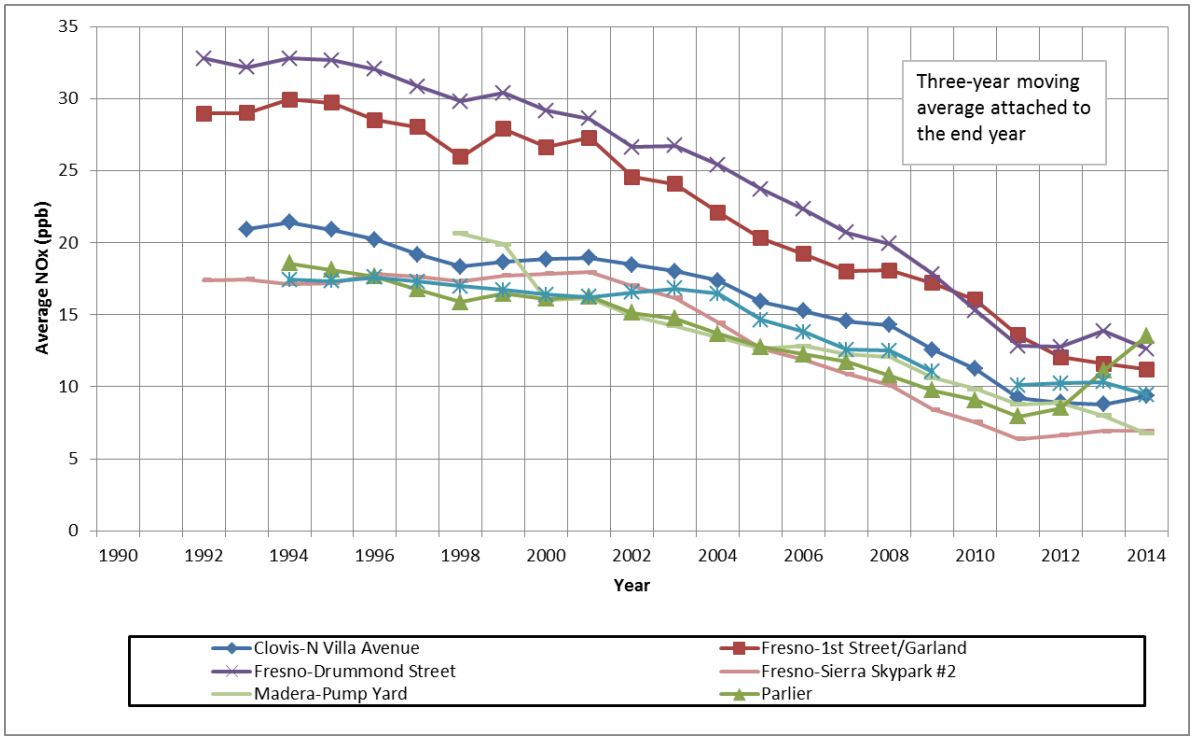
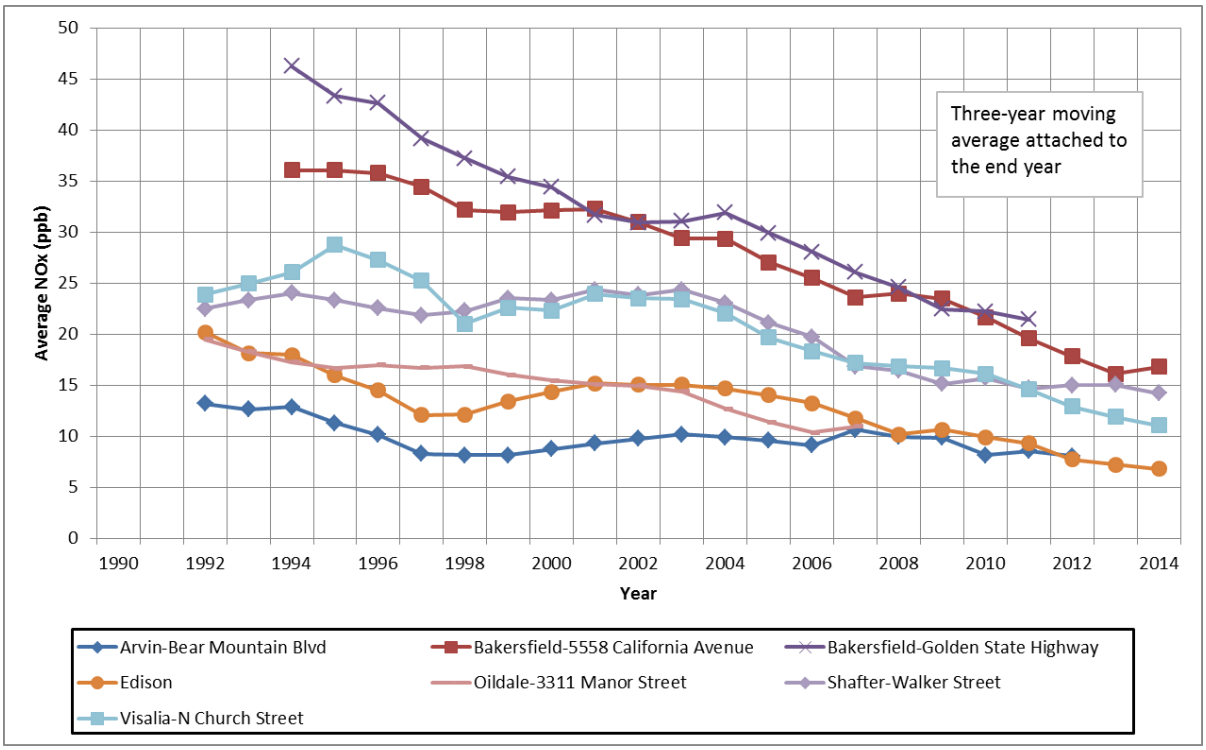


Figure 38. Southern SJV Trends for Ambient 24-hour NOx from May-October



7 Weekend Effect in the San Joaquin Valley

The ozone "weekend effect" (WE) is a well-known phenomenon in many urbanized areas where emissions of ozone precursors decrease substantially on weekends while the measured levels of ozone increase on weekends.

The WE is not uniformly present in California's urban areas. For example, in the five year period from 2005 through 2009, the WE was approximately 33 percent (the average 8-hour maximum ozone averaged 33 percent higher on weekends than on weekdays) at San Bernardino in the South Coast Air Basin, but the WE was only 3 percent at Clovis in the San Joaquin Valley.

Weekend effect values for the northern, central, and southern regions of the Valley are shown in Table 10 on a site-by-site basis and a regional average basis. A widely held view of the WE is that high WE values are consistent with a VOC-sensitive regime, while low (especially negative) WE values are consistent with a NOx-sensitive regime. In a VOC-sensitive regime, reductions in NOx emissions may have a counterproductive effect. In a NOx-sensitive regime, reductions in NOx emissions are expected to reduce ambient ozone levels. These varying effects of NOx reductions are due to the non-linear chemistry of ozone formation involving NOx and VOC.

In many places, NOx emissions are substantially lower on weekends compared to weekdays.[5] In some cases, a strong WE is present, while in others, a reverse WE is present, with weekend ozone being lower than weekday ozone. The WE values shown in Table 10 may indicate that regions of the San Joaquin Valley differ in their sensitivity to NOx and VOC emissions.

In the northern region of the Valley, the average WE decreased from 8.4 percent in 2000-2004 to 2.5 percent in 2010-2014. These values are consistent with scientific and modeling assessments indicating the northern region was in a VOC-sensitive regime, is now in a period of transition, and will soon be in a NOx-sensitive regime.

In the central region of the Valley, the average WE decreased from 2.8 and 2.9 percent in 2000-2004 and 2005-2009 down to 0.0 percent in 2010-2014. These values are consistent with scientific and modeling assessments indicating the central region was in a transition period from VOC-sensitivity to NOx-sensitivity, but has become NOx-sensitive.

In the southern region of the Valley, the average WE decreased from 2.0 and 2.6 percent in 2000-2004 and 2005-2009 to -0.8 percent in 2010-2014. These values are consistent with scientific and modeling assessments indicating the southern region transitioned from a VOC-sensitive regime and has been in a NOx-sensitive regime in recent years. The ozone weekday-weekend analyses corroborate that the central and southern regions are currently in a NOx-limited regime and the northern region will soon be transitioning into one.

In addition to the results in Table 10, the ozone weekend effect was evaluated for three sites in Tulare County: Visalia, and elevated downwind sites, Sequoia-Kings Canyon and Sequoia-Lower Kaweah. Visalia is nearer to Fresno and Hanford than to Bakersfield and has WE trends more closely aligned with central region sites. The WE values for Visalia were 6.9 percent in 2000-2004, 7.8 percent in 2005-2009, and 2.1 percent in 2010-2014. At Sequoia-Kings Canyon, the WE values were 0.1 percent in 2000-2004, -1.7 percent in 2005-2009, and -2.5 percent in 2010-2014. At Sequoia-Lower Kaweah, the WE values were -0.5 percent in 2000-2004, -1.8 percent in 2005-2009, and -2.7 percent in 2010-2014. These results indicate that reductions in anthropogenic NOx emissions in the heavily populated regions of the Valley are expected to reduce ozone at elevated downwind sites, consistent with both recent air quality trends and modeling results.

[5] http://www.arb.ca.gov/research/weekendeffect/arb-final/wee_tsd_ch5_3.pdf

Table 10. Average Weekend Effect (percent)*

Sub-region and Site	2000 to 2004	2005 to 2009	2010 to 2014
SJV - Northern			
Merced – South Coffee	1.1	0.1	-1.5
Modesto – 14th Street	11.3	9.9	4.0
Stockton – Hazelton	14.8	11.8	5.9
Turlock – South Minaret	6.2	5.3	1.7
Average	**8.4**	**6.8**	**2.5**
SJV - Central			
Clovis	4.0	3.0	1.0
Fresno – Drummond	6.2	6.1	2.4
Fresno – First Street & Garland	2.2	4.1	0.5
Fresno – Sierra Sky Park #2	1.4	3.6	-0.4
Hanford – South Irwin	1.2	0.6	-0.5
Madera – Pump Yard	1.4	1.3	-2.3
Parlier	3.2	1.3	-0.7
Average	**2.8**	**2.9**	**0.0**
SJV – Southern			
Arvin – Bear Mtn. Rd. & Di Giorgio	0.6	1.4	-3.5
Bakersfield – CA Avenue	3.1	3.7	0.4
Edison	2.9	3.5	-1.1
Maricopa	0.5	1.5	-1.0
Oildale	1.8	2.9	1.0
Shafter	1.8	2.6	-0.7
Average	**2.0**	**2.6**	**-0.8**

* [(WE-WD) / WD] x100%. A positive value means the average Weekend ozone was the indicated percent higher with respect to the average Weekday ozone.

8 Modeled Attainment Projections

Regional photochemical modeling assessment was performed by ARB following U.S. EPA's modeling guidance. Multiple modeling metrics were evaluated to determine whether the Valley would attain by 2031. These metrics are briefly described below and in more detail in the modeling appendix in this *2016 Plan for the 0.075 ppm 8-hour Ozone Standard*.

Previously, modeling results were used in a direct or deterministic sense, mainly because computing resources were sufficient to simulate very few episodes (one in most cases). From those simulations, a limited number of days were used to determine future year attainment. However, current modeling guidance recommends using the model results in a relative sense (using relative response factors or RRFs) in the context of the 8-hour ozone standard. A model attainment demonstration must utilize the top ten modeled days at each monitoring site when projecting design values into the future. Overall, the modeling shows a strong response to lower NOx emissions based on inventory projections with current emission reductions programs.

8.1 Single RRF Approach

The first approach was to use the model in a relative sense following the procedure in the 8-hour ozone modeling guidance. Accordingly, a single average RRF was calculated for each site in Table 11, and each reference year design value was multiplied by the corresponding RRF. This approach is used to predict future ozone levels in the Valley's attainment demonstration.

The design values based on the single average RRF approach are shown in the fourth column (2031 DV single RRF) in Table 11. These future design values are projected at levels below the standard for all stations, with Clovis-N Villa Avenue predicted to be the highest site at 74 parts per billion (ppb), or 0.074 ppm. Therefore, based on a single RRF approach for each site, the 0.075 ppm 8-hour ozone standard will be met at all sites in the San Joaquin Valley in 2031.

8.2 Comparison of Single vs. Band RRF

The second metric is based on the recognition that higher ozone concentrations are generally more responsive than lower ozone concentrations to the control of precursors. Results of the band RRF approach are included here as they further inform the attainment outlook for the Valley.

The band RRF method accounts for differences in model response to emissions controls at varying ozone levels by grouping the simulated ozone into bands of lower, medium, and higher ozone mixing ratios. A separate RRF is calculated for each ozone band following a similar approach to the single RRF.

The fifth column of Table 11 lists the 2031 design values calculated using banded RRFs. As was the case with the single RRF method, these modeling results suggest that Clovis-N Villa Avenue will be the high site in the future, with a 2031 design value of 72 ppb. Similar to the single RRF approach, the modeling indicates that all sites in the San Joaquin Valley will meet the standard by 2031.

Table 11. Modeled Design Value Projections (ppb)

	County	Site Name	Weighted 2012 Design Value	2031 DV (single RRF)	2031 DV (band RRF)
Northern	Merced	Merced-S Coffee Avenue	81.7	65	64
	San Joaquin	Stockton-Hazelton Street	68.3	57	--
	San Joaquin	Tracy-Airport	79.3	66	66
	Stanislaus	Modesto-14th Street	76.0	61	61
	Stanislaus	Turlock-S Minaret Street	86.0	69	65
Central	Fresno	Clovis-N Villa Avenue	95.7	74	72
	Fresno	Fresno-1st Street/Fresno-Garland	90.7	70	--
	Fresno	Fresno-Drummond Street	92.3	71	67
	Fresno	Fresno-Sierra Skypark #2	89.0	68	63
	Fresno	Parlier	92.0	69	66
	Fresno	Tranquility-32650 West Adams Avenue	76.3	60	--
	Kings	Hanford-S Irwin Street	86.0	64	--
	Madera	Madera-28261 Avenue 14	84.7	65	62
	Madera	Madera-Pump Yard	79.3	61	60
Southern	Kern	Arvin-Di Giorgio	89.3	64	65
	Kern	Bakersfield-5558 California Avenue	86.7	65	65
	Kern	Edison	87.7	64	66
	Kern	Maricopa-Stanislaus Street	83.3	63	61
	Kern	Oildale-3311 Manor Street	84.7	65	65
	Kern	Shafter-Walker Street	83.0	62	60
	Tulare	Porterville-1839 Newcomb Street	86.3	63	62
	Tulare	Sequoia and Kings Canyon Natl Park	93.0	65	65
	Tulare	Sequoia Natl Park-Lower Kaweah	84.0	61	62
	Tulare	Visalia-N Church Street	82.3	60	61

9 Corroborating Studies

The design value trends, emissions inventory, and ambient precursor concentrations are all consistent with the conclusions presented in recent work by Pusede and Cohen,[6] who studied the effects of temperature, NOx, and reactivity-weighted VOC (analogous to PAMS reactivity) on the frequency of high ozone days in the San Joaquin Valley. The study included observed data from 1995 to 2010. Monitoring sites for which data were evaluated were chosen based on location upwind, within, and downwind of three cities. The authors classified the Valley into northern, central, and southern regions. The assessment was done to estimate the probability of exceeding the California 8-hour average ozone standard of 0.070 ppm, which is also relevant to the new national ozone standard set in 2015. The manuscript described changes in the frequency of high ozone days based on routine observed data as mentioned above to provide direct insight into the probabilistic response of ozone to emissions reductions.

The authors inferred from the study results that chemical production and not meteorology dominated the statistics of State standard ozone exceedances in the Valley. Results also indicate that local ozone production plays a larger role as the number of exceedance days increased from upwind to downwind sites which underscores the importance of controlling local sources of emissions in the Valley. Over the study period, decreases in reactive VOC were shown to dramatically reduce the frequency of exceedance days for the State 8-hour ozone standard, particularly at moderate temperatures (28-33°C). While the publication addressed ozone production over a range of temperatures, the interactions of ozone precursors at higher temperatures (34-45°C) are most significant with respect to highest ozone concentrations and attainment of the national 0.075 ppm 8-hour ozone standard. At these higher temperatures, ozone production in the southern region of the Valley became NOx-sensitive in the 2007-2010 timeframe. The study noted that with NOx reductions projected to occur in the post 2010 timeframe on the basis of local, State and national rulemakings, the Valley was poised to experience improved ozone air quality. Indeed, as emissions have continued to decrease since 2010, ozone levels have responded as predicted in this study.

The study concluded that in the northern region, the downwind site at Merced is already in a NOx-limited regime. The other sites will show a more delayed response to NOx reductions, after the transition to a NOx-limited regime occurs. No completely consistent and reliable thresholds are available to separate VOC-limited conditions from NOx-limited conditions in all regions. Nevertheless, the southern and central regions of the Valley typically have very high VOC/NOx ratios in the ambient air during the peak months of the ozone season. A key cause of the VOC/NOx ratios during these months is high levels of biogenic VOC emissions, which may be three to seven

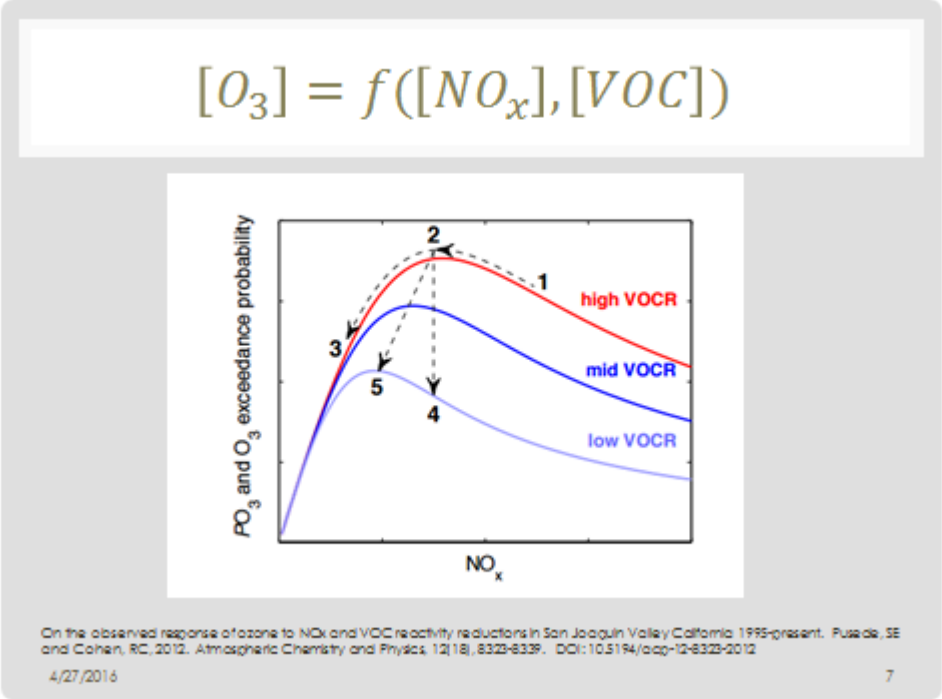
[6] S. E. Pusede and R. C. Cohen, On the observed response of ozone to NOx and VOC reactivity reductions in San Joaquin Valley California 1995–present, Atmos. Chem. Phys., 12, 8323-8339, 2012.

times the anthropogenic VOC emissions. The biogenic VOC emissions also tend to include many "reactive" compounds which enhance the effective VOC/NOx ratio. Accordingly, the VOC/NOx ratios in the Valley's ambient air that represents emissions from biogenic sources as well as human activities are much greater than the VOC/NOx ratios from an emissions inventory that represents only human activities.

In the following figure taken from Pusede and Cohen, the Valley air would be represented by the top (red) curve. The WOE now indicates that the southern and central regions of the Valley are now on the downhill path (from the 2 to the 3), where NOx emissions reductions should rapidly reduce levels of ozone in the ambient air.

Pusede and Cohen also showed that the ozone chemistry in the central region in 2007-2010 was nearer to peak ozone production than in the southern region. Therefore, while NOx emission reductions were expected to result in lower peak ozone concentrations, progress in the central region would be outpaced by progress in the southern region.

Figure 39. Response of Ozone to NOx and VOC Reactivity Reductions



This evidence corroborates results of the modeling analyses, which indicate that NOx reductions will be relatively more effective than VOC reductions in reducing ozone concentrations in the Valley.

10 Preliminary Look: 2015 Ozone Data

While this WOE focuses on official ozone data submitted through 2014, most of the data from 2015 are already submitted. For the data that have not been submitted yet, staff used the Air Quality and Meteorological Information System (AQMIS) for preliminary data. Using these two data sets, it is possible to look at preliminary numbers for trends continuing through 2015.

As pointed out earlier, Clovis-N Villa Avenue and Parlier are the sites that currently have the highest ozone concentrations in the Valley. The 2015 data for these two sites show a decrease in the design value. Clovis-N Villa Avenue had a 2 ppb decrease in design value, while Parlier's design value decreased by 1 ppb. As Table 12 shows below, almost all sites in the Valley show a decrease in design value, with the exception of a few sites with lower design values that showed a small increase of 1 ppb.

Table 12. Preliminary Look: 2014-2015 Design Values (ppm)*

	County	Site	2014	2015
Northern	Merced	Merced-S Coffee Avenue	0.081	0.082
	San Joaquin	Stockton-Hazelton Street	0.069	0.068
	San Joaquin	Tracy-Airport	0.079	0.076
	Stanislaus	Modesto-14th Street	0.078	0.079
	Stanislaus	Turlock-S Minaret Street	0.084	0.082
Central	Fresno	Clovis-N Villa Avenue	0.095	0.093
	Fresno	Fresno-1st Street/Fresno-Garland	0.089	0.087
	Fresno	Fresno-Drummond Street	0.088	0.086
	Fresno	Fresno-Sierra Skypark #2	0.087	0.087
	Fresno	Parlier	0.092	0.091
	Fresno	Tranquility-32650 West Adams Avenue	0.075	0.075
	Kings	Hanford-S Irwin Street	0.084	0.085
	Madera	Madera-28261 Avenue 14	0.084	0.083
	Madera	Madera-Pump Yard	0.081	0.082
Southern	Kern	Arvin-Bear Mountain/Arvin-Di Giorgio	0.088	0.087
	Kern	Bakersfield-5558 California Avenue	0.085	0.085
	Kern	Bakersfield-Municipal Airport	0.091	0.090
	Kern	Edison	0.084	0.084
	Kern	Maricopa-Stanislaus Street	0.079	0.079
	Kern	Oildale-3311 Manor Street	0.081	0.079
	Kern	Shafter-Walker Street	0.081	0.080
	Tulare	Porterville-1839 Newcomb Street	0.081	0.082
	Tulare	Sequoia and Kings Canyon Natl Park	0.091	0.089
	Tulare	Sequoia Natl Park-Lower Kaweah	0.086	0.085
	Tulare	Visalia-N Church Street	0.080	0.079

*Data extracted from ARB's AQMIS (http://www.arb.ca.gov/aqmis2/aqmis2.php).

The preliminary 2015 data are consistent with the conclusions of the WOE assessment demonstrating that the Valley continues to show a trend toward lower ozone.

11 Summary

Photochemical modeling performed in support of the Valley's 8-hour ozone attainment plan shows that with current emissions reductions programs, the San Joaquin Valley will attain the 0.075 ppm 8-hour ozone standard by 2031. This is consistent with additional analyses using observed ozone levels, meteorology, and precursor emissions. While the southern portion of the Valley transitioned to a NOx-sensitive regime first, other regions are now undergoing the same transition.

This WOE package comprises a set of complementary analyses that supplement the SIP-required modeling, providing additional support for the attainment demonstration based on the following factors:

- Trends for multiple indicators of ozone air quality have shown progress in the Valley, with a decrease in basinwide design value of 20 percent from 1990 to 2014 (22 percent when including 2015 data), with an 18 percent reduction in design value since 2004.

- Exceedance days have decreased by 40 percent in the past decade, and the severity of ozone has significantly decreased throughout the Valley.

- Sites in the northern region are already close to the level of the standard. The highest site in 2014, Turlock-S Minaret Street, has shown a decrease in design value of 0.010 ppm (0.094 to 0.084 ppm) since 2004, and is now within 11 percent of the standard.

- The central region has exhibited progress at most sites, with a declining trend in design values over the past decade, especially in recent years. The design site, Clovis-N Villa Avenue, showed limited progress prior to 2010; however, since then ozone concentrations have been decreasing. The other high sites in the central region on average have seen a 14 percent drop in design value and approximately 27 percent drop in exceedance days in the past decade.

- Sites in the southern region have shown the most progress, with the highest design value in the region decreasing by 22 percent (0.116 to 0.091 ppm) since 2004, and exceedance days decreasing by 73 percent.

- Accounting for meteorological variability, season average ozone levels declined from 2007-2014 in the southern and northern regions of the Valley. Similarly adjusted design value trends could be expected to show a greater response to emission reductions and decline at a faster rate throughout the Valley.

- From 2000-2012, ambient NOx concentrations have decreased in the central and southern regions by an average of 40 percent.

- From the emission inventory, there has been a basinwide reduction of 46 percent (288 tons/day) in NOx and a reduction of 33 percent (166 tons/day) in VOC from 2000 to 2012. These reductions have driven the VOC/NOx ratio in the Valley towards and into the NOx-limited regime. Within that time frame, the central and southern regions had on average a 47 percent reduction in NOx, corroborated by the 40 percent decrease in ambient NOx concentrations in those regions.

- The ozone weekday-weekend analysis supports that the central and southern regions are already in a NOx-limited regime and the northern region will soon be transitioning into one.

- Recent studies conducted by researchers at UC Berkeley have analyzed the effects of NOx and VOCs on high ozone days in the Valley. They concluded that the northern region has not yet transitioned to a NOx-limited regime. However, as of 2010, NOx reductions were already effective or poised to become so in the southern region and central regions.

- Based on all available ambient precursor trends, emissions inventory, weekday-weekend analyses, and field-based studies, it is expected that the Valley will be increasingly responsive to NOx reductions.

- Between 2012 and 2031, current control programs are expected to reduce NOx emissions by approximately 60 percent (around 200 tons/day).

- The modeled ozone reductions in the Valley also demonstrate increasing responsiveness to NOx reductions. The substantial NOx reductions that will occur though ongoing implementation of current control programs are consistent with the demonstration that the Valley will attain the 0.075 ppm ozone standard in 2031.

Taken together, all of these factors indicate that all sites in the San Joaquin Valley can be expected to attain the national 0.075 ppm 8-hour ozone standard by 2031 with current ARB and District control programs.

Appendix L

Emission Reduction Credits

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Appendix L: Emission Reduction Credits

L.1 INTRODUCTION

The District requires most new and modified stationary sources that increase emissions in amounts in excess of specific emission offset thresholds to obtain emission reduction credits (ERCs) to offset the growth in emissions. District Rule 2201 (New and Modified Stationary Source Review or "NSR" Rule) contains the offset requirements. Offsets represent either on-site reductions or the use of banked ERCs. The District expects that some pre-baseline credits (pre-2007 for this ozone plan) will be used to mitigate growth from permitted stationary sources during the period of this plan. This Appendix discusses the use of such ERCs for the Valley.

L.1.1 Pre-Baseline Emission Reduction Credits

The General Preamble to the Federal Clean Air Act (57 FR 13498) states that the pre-baseline ERCs must be reflected as growth and included in the attainment demonstration "*to the extent that the State expects that such credits will be used as offsets or netting prior to attainment of the ambient standards.*" The August 26, 1994 memorandum from John Seitz, EPA's Director of Office of Air Quality Planning and Standards, to David Howekamp of EPA Region IX, provides two ways for inclusion of these ERCs as growth by stating that "*A state may choose to show that the magnitude of the pre-1990* (pre-baseline) *ERCs (in absolute tonnage) was included in the growth factor, or the state may choose to show that it was not included in the growth factor, but in addition to anticipated general growth.*"

By including the pre-baseline ERCs in the growth factor, the District has selected the first methodology provided in Seitz's memorandum. However, in either case, the purpose is to show that this plan, by including pre-baseline ERCs as a part of expected growth, will result in a projected inventory adequate to attain the NAAQS and achieve any applicable rate of progress:

projected inventory = baseline inventory + growth + ERCs(pre-baseline) - offsets - reductions

where: growth = non-permitted growth + permitted growth

offsets = ERCs(post-baseline) + ERCs(pre-baseline)

reductions = reductions required by the measures in the Plan

Growth Estimates: The emissions trends and growth estimates in this plan were generated using the reports from the California Emissions Projection Analysis Model (CEPAM). The emissions inventory and associated emissions projections are based on ARB's latest SIP Planning Projections (2016 SIP Ver. 1.03, as of April 30, 2016). CEPAM's computer tools were used to develop projections and emission estimates based on the most current available growth and control data available at the time of the

forecast runs. CEPAM was first developed in the 1990s (called CEFS at the time) to assist in developing air quality plans, determining how and where air pollution can be reduced, tracking progress towards meeting plans goals and mandates, and constructing emission trends, and has been updated regularly since then.

A key component of CEPAM is the growth data. The growth estimates generated by CEPAM include growth in emissions requiring offsets under the New Source Review Rule as well as that which can be accommodated without triggering offsets. Tables J-1 and J-2 show total projected growth rates of 5.40 tons/day of NOx and 12.66 tons/day of VOCs for the period 2012 to 2031. The CEPAM inventory shows negative growth for some segments of the economy, representing a shrinking emissions inventory even before considering reductions required by District plans. However, for the purposes of this ERC-use analysis, the District did not include these negative growth numbers (by setting negative growth to zero), as only positive growth requires offsetting with ERCs.

The projected inventory for 2031 incorporates the projected growth as well as the expected controls from the measures contained in prior plans. Notwithstanding slight rounding errors, the projected 2031 inventory equals the baseline inventory plus the projected growth minus the expected reductions from the controls contained in previously adopted plans. Reductions due to this ozone plan are not incorporated in these projections, but do not affect the amount of offsets estimated to mitigate the projected growth.

Emission Offsetting Requirements: Under the District's Rule 2201, new sources with NOx or VOC emissions exceeding 20,000 lb/year must offset their emissions. Additionally, existing facilities with emissions meeting or exceeding these levels must offset any increase in emissions.

Use of Interpollutant Offsets: Under the District's New Source Review Rule 2201, offsetting emissions increases with reductions in precursor pollutants is allowed, within some specified limitations, and interpollutant offsetting between NOx and VOC is specifically allowed.

As discussed in Chapter 4 of this plan, photochemical modeling for this plan has clearly demonstrated that the Valley continues to be a NOx-limited regime, with NOx a significantly more important driver to the formation of ozone than VOC. For that reason, the District will continue to accept NOx ERCs as valid mitigation of VOC emissions increases, at a very conservative and protective 1-to-1 ratio, but will not accept VOC ERCs as mitigation of NOx increases, unless and until EPA approves into the SIP a specific VOC-for-NOx interpollutant offsetting ratio for the San Joaquin Valley. The District does not anticipate proposing such a ratio, but will review any such proposals presented by interested parties and will forward to EPA for their approval upon District concurrence of the adequacy of the proposed ratio.

Pre-Baseline Offset Usage Estimate: The amount of offsets expected to be consumed during this plan's period was estimated by establishing the percentage of permitting

actions for each source category that would be subject to offset requirements under Rule 2201. For each source category, this percentage was established based on past permitting history, the fraction of sources in the category with emissions at or above the offset trigger levels, and the historical permitting activity for the source category. The following factors were used in estimating the potential need for offsets:

- All increases from modifications to existing sources with potential emissions at or above the above offset thresholds would require offsets (District Rule 2201).
- New sources with emissions exceeding the above offset thresholds would require offsets (District Rule 2201).
- The percentage of sources that meet any of the above criteria was estimated by examining past permitting history and by projecting future permitting based on the estimated growth. For instance, the majority of permitting actions with increases in emissions from oil production facilities come from sources with potential emissions in excess of the above offset thresholds. Therefore, for that source category, it was assumed that 80-100% of increases in overall emissions would require offsets.

The quantity of required offsets was then established by multiplying the expected growth in emissions for each source category by this percentage and the expected offset ratio. District Rule 2201 establishes offset ratios ranging from 1.0:1 to 1.5:1 based on the distance from the source of ERCs to the source with increase in emissions. An offset ratio of 1.5:1 applies to all transactions where the distance is greater than 15 miles. For 2012 through April 19, 2016, the average offset ratio for all permitting actions requiring offsets was 1.47:1 for NOx and 1.49:1 for VOC. A conservative average offset ratio of 1.5:1 was used for this plan's calculations for both pollutants. Tables J-1 and J-2 contain the expected growth, percentage of activities subject to offset requirements, and the expected quantity of offsets for each pollutant.

Although some offsets are expected to come from post-baseline reductions, this plan conservatively assumes that all offsets will be pre-baseline. See Table J-3 for a current list of District-issued ERCs, as of April 19, 2016. The expected offset usage for 2012 through 2031, as shown in Tables J-1 and J-2, has been estimated in this plan as follows:

	Expected ERC Use (tpd)	**Growth (tpd)**
NOx	5.27	5.28
VOC	12.66	23.57

As shown above, the quantity of pre-baseline offsets that are expected to be used between 2012 and 2031 is less than the plan's estimated growth in emissions for each pollutant. Therefore, if growth in new and modified sources occurs at the rate estimated in this plan, the use of offsets as required in Rule 2201 will ensure that permitted increases in emissions will not interfere with progress toward attainment of federal 8-hour ozone standards. As discussed in Chapter 6, the District also satisfies the

requirement for reasonable further progress with the above-mentioned projected inventories, without taking credit for the ERCs required of and provided by new and modified stationary sources permitted during this period. Finally, because all projected annual use of ERCs is included in the plan's estimated growth, this ERC use is surplus of all plan requirements.

Safeguards to assure plan integrity despite the use of pre-baseline credits: In order to assure that the use of pre-baseline ERCs does not interfere with attainment effort and the applicable rate of progress, this plan incorporates the following safeguards:

- The District will place a cap on the amount of pre-baseline credits that can be used. Although the District has relied on a number of conservative assumptions in estimating the usage quantity of pre-baseline credits, some degree of uncertainty exists. For instance, unexpected growth or irregular permitting activity may occur for one or more source categories. The cap on the use of pre-baseline ERCs will be enforced by tracking the permitted growth in emissions and disallowing the use of such credits in permitting actions when the above-specified growth levels are reached. A review of the emissions changes for 2012 through 2015 show that the District's permitting actions have resulted in annual decreases in emissions of both NOx and VOC. Therefore, the District does not anticipate that the above-specified growth levels will be exceeded.

- Although some ERCs will come from post-baseline reductions, this plan conservatively assumes that all offsets will come from pre-baseline reductions. As discussed earlier, federal law only requires the pre-baseline ERCs to be included in the growth and the attainment demonstration. This plan assumes that all ERCs used to offset emission increases will be pre-baseline ERCs and, therefore, includes them all within the projected inventory as growth. Using this projected inventory leads to conservative conclusions relating to the attainment and rate of progress demonstrations.

- Although permissible, this plan does not take credit for reductions and mitigations required under the District's New and Modified Source Review Rule. In particular, this plan does not reduce future years' emissions by taking credit for the amount of ERCs provided through permitting actions. This conservative approach further assures that the attainment demonstration is not affected by the use of pre-baseline ERCs.

Table J-1 Estimated NOx Growth, Control, and Estimated Offset Use

SUMMARY CATEGORY NAME	2012 Emissions Tons/day	Growth Factor (%)	Estimated Growth (tons/day)	Control Factor (%)	Reductions (tons/day)	2031 Emissions Tons/day	Percent Requiring Offsets	Estimated Offsets (tons/day)
FUEL COMBUSTION								
ELECTRIC UTILITIES	4.47	11.39	0.51	-0.59	-0.03	4.96	100%	0.76
COGENERATION	1.68	42.60	0.72	-0.01	0.00	2.40	100%	1.07
OIL AND GAS PRODUCTION (COMBUSTION)	3.22	-34.49	0.00	-20.84	-0.67	1.67	100%	0.00
PETROLEUM REFINING (COMBUSTION)	0.19	0.00	0.00	-25.98	-0.05	0.14	100%	0.00
MANUFACTURING AND INDUSTRIAL	5.20	5.66	0.29	-1.72	-0.09	5.41	40%	0.18
FOOD AND AGRICULTURAL PROCESSING	15.49	8.45	1.31	-74.01	-11.47	3.86	25%	0.49
SERVICE AND COMMERCIAL	4.22	9.44	0.40	-3.55	-0.15	4.49	25%	0.15
OTHER (FUEL COMBUSTION)	0.70	15.91	0.11	-34.33	-0.24	0.47	25%	0.04
TOTAL NOx: FUEL COMBUSTION	**35.19**		**3.34**		**-12.69**	**23.39**		**2.70**
WASTE DISPOSAL								
SEWAGE TREATMENT	0.03	34.24%	0.01	0.00%	0.00	0.04	0%	0.00
LANDFILLS	0.17	34.82%	0.06	0.00%	0.00	0.23	30%	0.03
INCINERATORS	0.04	25.92%	0.01	0.00%	0.00	0.05	90%	0.01
SOIL REMEDIATION	0.01	26.92%	0.00	0.00%	0.00	0.01	0%	0.00

SUMMARY CATEGORY NAME	2012 Emissions Tons/day	Growth Factor (%)	Estimated Growth (tons/day)	Control Factor (%)	Reductions (tons/day)	2031 Emissions Tons/day	Percent Requiring Offsets	Estimated Offsets (tons/day)
OTHER (WASTE DISPOSAL)	0.00	33.33%	0.00	0.00%	0.00	0.00	0%	0.00
TOTAL NOx: WASTE DISPOSAL	**0.25**		**0.08**		**0.00**	**0.33**		**0.04**
CLEANING AND SURFACE COATINGS								
LAUNDERING	0.00	0.00%	0.00	0.00%	0.00	0.00	0%	0.00
DEGREASING	0.00	0.00%	0.00	0.00%	0.00	0.00	0%	0.00
COATINGS AND RELATED PROCESS SOLVENTS	0.00	0.00%	0.00	0.00%	0.00	0.00	0%	0.00
PRINTING	0.00	0.00%	0.00	0.00%	0.00	0.00	0%	0.00
ADHESIVES AND SEALANTS	0.00	0.00%	0.00	0.00%	0.00	0.00	0%	0.00
OTHER (CLEANING AND SURFACE COATINGS)	0.00	0.00%	0.00	0.00%	0.00	0.00	0%	0.00
TOTAL NOx: CLEANING AND SURFACE COATINGS	**0.00**		**0.00**		**0.00**	**0.00**		**0.00**
PETROLEUM PRODUCTION AND MARKETING								
OIL AND GAS PRODUCTION	0.37	-34.40%	0.00	0.08%	0.00	0.24	100%	0.00
PETROLEUM REFINING	0.01	0.00%	0.00	0.00%	0.00	0.01	100%	0.00
PETROLEUM MARKETING	0.04	46.89%	0.02	0.00%	0.00	0.06	20%	0.01

SUMMARY CATEGORY NAME	2012 Emissions Tons/day	Growth Factor (%)	Estimated Growth (tons/day)	Control Factor (%)	Reductions (tons/day)	2031 Emissions Tons/day	Percent Requiring Offsets	Estimated Offsets (tons/day)
OTHER (PETROLEUM PRODUCTION AND MARKETING)	0.00	0.00%	0.00	0.00%	0.00	0.00	0%	0.00
TOTAL NOx: PETROLEUM PRODUCTION AND MARKETING	**0.42**		**0.02**		**0.00**	**0.31**		**0.01**
INDUSTRIAL PROCESSES								
CHEMICAL	0.30	45.77%	0.14	0.03%	0.00	0.44	50%	0.10
FOOD AND AGRICULTURE	0.00	0.00%	0.00	0.00%	0.00	0.00	10%	0.00
MINERAL PROCESSES	0.22	51.32%	0.11	0.00%	0.00	0.34	25%	0.04
METAL PROCESSES	0.00	0.00%	0.00	0.00%	0.00	0.00	10%	0.00
WOOD AND PAPER	0.00	0.00%	0.00	0.00%	0.00	0.00	0%	0.00
GLASS AND RELATED PRODUCTS	6.04	26.32%	1.59	-37.20%	-2.25	4.69	100%	2.38
ELECTRONICS	0.00	0.00%	0.00	0.00%	0.00	0.00	0%	0.00
OTHER (INDUSTRIAL PROCESSES)	0.00	33.33%	0.00	0.00%	0.00	0.00	25%	0.00
TOTAL NOx: INDUSTRIAL PROCESSES	**6.57**		**1.84**		**-3.05**	**5.47**		**2.53**
TOTAL NOx: STATIONARY SOURCES	**42.42**		**5.28**		**-27.45**	**29.50**		**5.40**

Table J-2 Estimated VOC Growth, Control, and Estimated Offset Use

SUMMARY CATEGORY NAME	2012 Emissions (tons/day)	Growth Factor (%)	Estimated Growth (tons/day)	Control Factor (%)	Reductions (tons/day)	2031 Emissions (tons/day)	Percent Requiring Offsets	Estimated Offsets (tons/day)
FUEL COMBUSTION								
ELECTRIC UTILITIES	0.22	-4.04%	0.00	0.00%	0.00	0.21	100%	0.00
COGENERATION	0.49	28.61%	0.14	0.00%	0.00	0.63	90%	0.19
OIL AND GAS PRODUCTION (COMBUSTION)	1.18	-34.49%	0.00	0.04%	0.00	0.77	95%	0.00
PETROLEUM REFINING (COMBUSTION)	0.10	0.00%	0.00	0.00%	0.00	0.10	100%	0.00
MANUFACTURING AND INDUSTRIAL	0.18	6.49%	0.01	0.00%	0.00	0.19	25%	0.00
FOOD AND AGRICULTURAL PROCESSING	1.31	23.28%	0.30	-56.72%	-0.74	0.52	10%	0.05
SERVICE AND COMMERCIAL	0.54	13.26%	0.07	-0.02%	0.00	0.61	25%	0.03
OTHER (FUEL COMBUSTION)	0.05	20.34%	0.01	-41.45%	-0.02	0.03	10%	0.00
TOTAL VOC: FUEL COMBUSTION	**4.06**		**0.54**		**-0.76**	**3.06**		**0.27**
WASTE DISPOSAL								
SEWAGE TREATMENT	0.03	34.16%	0.01	0.00%	0.00	0.04	25%	0.00
LANDFILLS	1.52	32.72%	0.50	0.00%	0.00	2.01	50%	0.37
INCINERATORS	0.01	25.45%	0.00	0.00%	0.00	0.01	0%	0.00
SOIL REMEDIATION	0.11	31.66%	0.03	0.00%	0.00	0.14	10%	0.01

SUMMARY CATEGORY NAME	2012 Emissions (tons/day)	Growth Factor (%)	Estimated Growth (tons/day)	Control Factor (%)	Reductions (tons/day)	2031 Emissions (tons/day)	Percent Requiring Offsets	Estimated Offsets (tons/day)
OTHER (WASTE DISPOSAL)	21.36	36.26%	7.75	-3.74%	-0.80	28.02	25%	2.90
TOTAL VOC: WASTE DISPOSAL	**23.03**		**8.29**		**-0.80**	**30.23**		**3.29**
CLEANING AND SURFACE COATINGS								
LAUNDERING	0.09	28.83%	0.03	0.00%	0.00	0.12	0%	0.00
DEGREASING	1.53	14.05%	0.21	-0.01%	0.00	1.74	10%	0.03
COATINGS AND RELATED PROCESS SOLVENTS	7.84	38.26%	3.00	-0.72%	-0.06	10.79	50%	2.25
PRINTING	4.85	35.14%	1.71	0.00%	0.00	6.56	25%	0.64
ADHESIVES AND SEALANTS	0.56	-15.91%	0.00	-0.05%	0.00	0.47	25%	0.00
OTHER (CLEANING AND SURFACE COATINGS)	6.16	41.44%	2.55	-0.02%	0.00	8.72	50%	1.92
TOTAL VOC: CLEANING AND SURFACE COAT	**21.05**		**7.50**		**-0.06**	**28.40**		**4.84**
PETROLEUM PRODUCTION AND MARKETING								
OIL AND GAS PRODUCTION	13.07	-34.47%	0.00	0.00%	0.00	8.56	80%	0.00
PETROLEUM REFINING	0.79	0.00%	0.00	0.00%	0.00	0.79	90%	0.00
PETROLEUM MARKETING	6.09	18.97%	1.16	-20.96%	-1.28	5.70	40%	0.69
OTHER (PETROLEUM PRODUCTION AND MARKETING)	0.02	21.95%	0.00	-1.22%	0.00	0.02	80%	0.00

SUMMARY CATEGORY NAME	2012 Emissions (tons/day)	Growth Factor (%)	Estimated Growth (tons/day)	Control Factor (%)	Reductions (tons/day)	2031 Emissions (tons/day)	Percent Requiring Offsets	Estimated Offsets (tons/day)
TOTAL VOC: PETROLEUM PRODUCTION AND MARKETING	**19.97**		**1.16**		**-1.28**	**15.08**		**0.70**
INDUSTRIAL PROCESSES								
CHEMICAL	4.80	45.73%	2.19	0.00%	0.00	6.99	25%	0.82
FOOD AND AGRICULTURE	11.18	30.65%	3.43	0.00%	0.00	14.61	50%	2.57
MINERAL PROCESSES	0.25	51.14%	0.13	0.00%	0.00	0.38	25%	0.05
METAL PROCESSES	0.16	5.88%	0.01	0.00%	0.00	0.17	25%	0.00
WOOD AND PAPER	0.01	3.09%	0.00	0.00%	0.00	0.01	25%	0.00
GLASS AND RELATED PRODUCTS	0.02	21.50%	0.00	0.00%	0.00	0.02	100%	0.01
ELECTRONICS	0.00	0.00%	0.00	0.00%	0.00	0.00	0%	0.00
OTHER (INDUSTRIAL PROCESSES)	0.78	40.78%	0.32	0.00%	0.00	1.09	25%	0.12
TOTAL VOC: INDUSTRIAL PROCESSES	**17.20**		**6.08**		**0.00**	**23.28**		**3.57**
TOTAL VOC: STATIONARY SOURCES	**85.29**		**23.57**		**-2.90**	**100.05**		**12.66**

Emission inventory used: 2016 Ozone SIP Ver 1.03
Offset ratios used: *1.5 for NOx and ROG*

L.2 LIST OF ERCS

Table J-3 Current List of NOx and VOC Emission Reduction Credits, 4/19/2016

Current ERC Certificate Holder	Certificate Number			Pollutant	Emissions (lb/qtr)			
					1st qtr	2nd qtr	3rd qtr	4th qtr
AERA ENERGY LLC	S	2774	2	NOx	5817	4899	4757	8181
AERA ENERGY LLC	S	2782	2	NOx	329	323	318	341
AERA ENERGY LLC	S	135	2	NOx	5032	1152	0	0
AERA ENERGY LLC	S	137	2	NOx	5115	6792	5437	9206
AERA ENERGY LLC	S	1061	2	NOx	8071	8777	10695	9555
AERA ENERGY LLC	S	1062	2	NOx	8530	9784	10046	9903
AERA ENERGY LLC	S	1063	2	NOx	9423	10057	12159	9776
AERA ENERGY LLC	S	1064	2	NOx	5126	5705	5881	6709
AERA ENERGY LLC	S	1065	2	NOx	10366	10483	11017	8841
AERA ENERGY LLC	S	1066	2	NOx	5542	7367	5038	6117
AERA ENERGY LLC	S	1067	2	NOx	1255	893	2650	4592
AERA ENERGY LLC	S	1068	2	NOx	7648	9620	6968	8415
AERA ENERGY LLC	S	1069	2	NOx	4713	5029	4352	2082
AERA ENERGY LLC	S	1070	2	NOx	495	4228	2744	99
AERA ENERGY LLC	S	1821	2	NOx	5974	7291	7466	4158
AERA ENERGY LLC	S	3267	2	NOx	5519	3439	0	2156
AERA ENERGY LLC	S	3312	2	NOx	2432	4568	1346	162
AERA ENERGY LLC	S	3831	2	NOx	8498	5583	30	1326
AERA ENERGY LLC	C	219	2	NOx	1738	1923	2100	1931
AERA ENERGY LLC	C	681	2	NOx	26900	26900	26900	26900
AERA ENERGY LLC	S	1851	2	NOx	914	455	0	1154
AERA ENERGY LLC	S	139	2	NOx	11686	11816	11946	11946
AERA ENERGY LLC	S	140	2	NOx	36695	46397	47292	36806
AERA ENERGY LLC	S	158	2	NOx	38057	29690	32405	43791
AERA ENERGY LLC	S	162	2	NOx	128454	152970	128743	130786
AERA ENERGY LLC	S	163	2	NOx	96698	107197	101158	78678
AERA ENERGY LLC	S	470	2	NOx	3478	4930	5390	5212
AERA ENERGY LLC	S	662	2	NOx	9433	18919	3766	817
AERA ENERGY LLC	S	784	2	NOx	7140	3993	228	0
AERA ENERGY LLC	S	838	2	NOx	442	218	338	338
AERA ENERGY LLC	S	865	2	NOx	6713	6788	6863	6863
AERA ENERGY LLC	S	883	2	NOx	632	160	2073	2061
AERA ENERGY LLC	S	1270	2	NOx	4586	4637	4688	4688
AERA ENERGY LLC	S	1437	2	NOx	42372	49588	46800	43954
AERA ENERGY LLC	S	1476	2	NOx	1242	0	0	350

Current ERC Certificate Holder	Certificate Number			Pollutant	Emissions (lb/qtr)			
					1st qtr	2nd qtr	3rd qtr	4th qtr
AERA ENERGY LLC	S	1477	2	NOx	2153	0	0	607
AERA ENERGY LLC	S	1935	2	NOx	474	508	543	543
AERA ENERGY LLC	S	2361	2	NOx	30	4	0	12
AERA ENERGY LLC	S	3689	2	NOx	76465	88497	87135	83102
AERA ENERGY LLC	S	4063	2	NOx	573	515	438	663
AERA ENERGY LLC	S	4064	2	NOx	359	564	674	586
AERA ENERGY LLC	S	4284	2	NOx	90667	81037	29972	74455
AERA ENERGY LLC	S	4422	2	NOx	6370	2050	2897	6316
AERA ENERGY LLC	S	1092	2	NOx	348	242	246	236
AERA ENERGY LLC	S	2023	2	NOx	1108	636	737	993
AGRI-CEL INC	S	3631	2	NOx	54	67	63	8
ALON BAKERSFIELD REFINING	S	3460	2	NOx	4645	5658	5190	4325
ALON BAKERSFIELD REFINING	S	3461	2	NOx	1425	1689	1612	1776
ALON BAKERSFIELD REFINING	S	4334	2	NOx	95700	98089	100530	100530
ANDERSON CLAYTON CORP/IDRIA #1	C	1279	2	NOx	0	0	0	754
AVENAL POWER CENTER, LLC	S	2814	2	NOx	6121	13869	18914	11461
AVENAL POWER CENTER, LLC	S	2955	2	NOx	51000	51000	51000	51000
AVENAL POWER CENTER, LLC	C	899	2	NOx	2243	2243	2243	2243
AVENAL POWER CENTER, LLC	C	902	2	NOx	13879	6131	1086	8539
AVENAL POWER CENTER, LLC	N	720	2	NOx	0	9	1255	437
AVENAL POWER CENTER, LLC	N	722	2	NOx	0	1166	88317	1422
AVENAL POWER CENTER, LLC	N	726	2	NOx	0	0	4728	0
AVENAL POWER CENTER, LLC	N	728	2	NOx	10542	3731	2487	5171
BAKER COMMODITIES INC	N	482	2	NOx	1194	1194	1196	1194
BAKERSFIELD CITY WOOD SITE	S	2969	2	NOx	1564	2135	2265	1857
BREITBURN OPERATING LP	S	4057	2	NOx	7	9	7	6
BRITZ AG FINANCE CO., INC.	C	557	2	NOx	0	0	0	232
BRITZ GIN PARTNERSHIP II	C	871	2	NOx	0	0	0	585
BRITZ INCORPORATED	C	586	2	NOx	0	0	0	381
BROWN SAND INC	N	46	2	NOx	90	98	46	83
BRUCE CARTER INDUSTRIES, INC.	S	4038	2	NOx	25	31	29	4
BUILDING MATERIALS MFG. CORP. (DBA GAF)	S	1662	2	NOx	5832	5840	5848	5848
BUTTONWILLOW GINNING CO	S	4634	2	NOx	0	0	0	520
CALAVERAS MATERIALS INC	C	89	2	NOx	284	257	294	236
CALAVERAS MATERIALS INC.	C	233	2	NOx	1265	3371	3913	2469
CALIFORNIA DAIRIES	N	1341	2	NOx	1486	265	264	264
CALIFORNIA DAIRIES, INC	S	2731	2	NOx	50	0	24	1282

Current ERC Certificate Holder	Certificate Number			Pollutant	Emissions (lb/qtr)			
					1st qtr	2nd qtr	3rd qtr	4th qtr
CALIFORNIA DAIRIES, INC.	C	658	2	NOx	0	0	102	75
CALIFORNIA DAIRIES, INC.	C	1364	2	NOx	450	126	356	79
CALIFORNIA DAIRIES, INC.	S	2293	2	NOx	32	33	32	32
CALIFORNIA DAIRIES, INC.	C	635	2	NOx	22	22	22	22
CALIFORNIA DAIRIES, INC.	N	707	2	NOx	0	1270	1363	226
CALIFORNIA HEAVY OIL, INC.	N	1219	2	NOx	0	162	162	0
CALIFORNIA HEAVY OIL, INC.	N	1233	2	NOx	0	87	131	0
CALIFORNIA RESOURCES ELK HILLS, LLC	S	3249	2	NOx	89	208	73	157
CALIFORNIA RESOURCES ELK HILLS, LLC	S	4436	2	NOx	1735	332	662	1082
CALIFORNIA RESOURCES ELK HILLS, LLC	S	4645	2	NOx	13505	14239	14978	14976
CALIFORNIA RESOURCES ELK HILLS, LLC	S	4142	2	NOx	17881	18426	18973	18974
CALIFORNIA RESOURCES ELK HILLS, LLC	S	4196	2	NOx	109	69	138	148
CALIFORNIA RESOURCES ELK HILLS, LLC	S	4211	2	NOx	13364	14303	18022	17508
CALIFORNIA RESOURCES ELK HILLS, LLC	S	4390	2	NOx	6684	5862	4959	6369
CALIFORNIA RESOURCES PRODUCTION CORP	N	1165	2	NOx	456	465	456	456
CALIFORNIA RESOURCES PRODUCTION CORP	S	3586	2	NOx	0	1512	6228	0
CALIFORNIA RESOURCES PRODUCTION CORP	S	3588	2	NOx	1847	0	0	0
CALIFORNIA RESOURCES PRODUCTION CORP	S	4093	2	NOx	159	0	0	0
CALIFORNIA RESOURCES PRODUCTION CORP	S	4434	2	NOx	0	5255	2832	6776
CALIFORNIA RESOURCES PRODUCTION CORP	S	4088	2	NOx	80	80	80	80
CALIFORNIA RESOURCES PRODUCTION CORP	S	4361	2	NOx	1476	1476	1476	1476
CALIFORNIA RESOURCES PRODUCTION CORP	S	4484	2	NOx	860	860	860	861
CALIFORNIA RESOURCES PRODUCTION CORP	N	1235	2	NOx	3614	0	0	0
CALIFORNIA RESOURCES PRODUCTION CORP	N	1245	2	NOx	1219	0	0	0
CALIFORNIA RESOURCES PRODUCTION CORP.	C	1231	2	NOx	186	186	186	186
CALIFORNIA RESOURCES PRODUCTION CORP.	C	1329	2	NOx	428	428	428	428
CALIFORNIA RESOURCES PRODUCTION CORP.	C	1335	2	NOx	456	456	456	456
CALIFORNIA RESOURCES PRODUCTION CORP.	C	1343	2	NOx	4973	4972	4973	4738
CALIFORNIA STATE PRISON - CORCORAN	S	3112	2	NOx	135	137	137	138
CALMAT CO.	C	50	2	NOx	104	111	154	159
CALMAT OF FRESNO	C	40	2	NOx	74	355	163	547

Current ERC Certificate Holder	Certificate Number			Pollutant	Emissions (lb/qtr)			
					1st qtr	2nd qtr	3rd qtr	4th qtr
CALNEV PIPE LINE LLC	S	2553	2	NOx	1886	1886	1886	1886
CALPINE CORPORATION	S	3298	2	NOx	2103	9681	19140	9076
CALPINE CORPORATION	S	3541	2	NOx	0	242	0	0
CALPINE ENERGY SERVICES, L.P.	S	3138	2	NOx	0	0	0	760
CALPINE ENERGY SERVICES, L.P.	S	3277	2	NOx	6400	0	3870	1876
CALPINE ENERGY SERVICES, L.P.	C	1014	2	NOx	302	0	0	852
CALPINE ENERGY SERVICES, L.P.	C	1040	2	NOx	0	0	0	684
CALPINE ENERGY SERVICES, L.P.	N	845	2	NOx	4089	4089	4089	3093
CALPINE ENERGY SERVICES, L.P.	N	846	2	NOx	4429	4429	4429	3353
CALPINE ENERGY SERVICES, L.P.	N	903	2	NOx	5833	5834	5834	5833
CAMPBELL SOUP COMPANY	N	127	2	NOx	1515	454	409	924
CANANDAIGUA WINE COMPANY INC	C	1203	2	NOx	354	358	380	334
CANDLEWICK YARNS	C	507	2	NOx	90	77	63	58
CASTLE AIRPORT AVIATION & DEVELOP CENTER	N	109	2	NOx	38954	39386	39819	39819
CHEMICAL WASTE MANAGEMENT, INC	N	687	2	NOx	7	7	6	6
CHEVRON U S A INC	S	1325	2	NOx	260	118	276	211
CHEVRON U S A INC	S	4304	2	NOx	1983	2317	2340	2807
CHEVRON U S A INC	S	629	2	NOx	2316	2041	2088	1975
CHEVRON U S A INC	S	1428	2	NOx	1968	1990	2011	2011
CHEVRON U.S.A. INC.	N	1051	2	NOx	15566	8173	19366	19259
CHEVRON U.S.A. INC.	N	1052	2	NOx	0	0	8139	0
CHEVRON U.S.A. INC.	N	1053	2	NOx	0	0	9120	180
CHEVRON U.S.A. INC.	N	1054	2	NOx	500	500	500	500
CHEVRON USA INC	S	436	2	NOx	12891	9861	9530	10101
CHEVRON USA INC	S	3819	2	NOx	6000	6000	6000	6000
CHEVRON USA INC	S	1605	2	NOx	5672	7143	7028	6447
CHEVRON USA INC	S	4551	2	NOx	132708	132708	132708	132708
CHEVRON USA INC	S	20410281	2	NOx	3806	3765	3765	3848
CHEVRON USA INC	C	221	2	NOx	2311	2557	2792	2567
CHEVRON USA INC	C	331	2	NOx	23739	23739	23740	23740
CHEVRON USA INC	C	364	2	NOx	30130	29673	29217	29217
CHEVRON USA INC	C	1158	2	NOx	0	0	0	132
CHEVRON USA INC	C	1159	2	NOx	0	0	0	137
CHEVRON USA INC	C	1160	2	NOx	175	0	0	1230
CHEVRON USA INC	C	1161	2	NOx	0	0	0	846

Current ERC Certificate Holder	Certificate Number			Pollutant	Emissions (lb/qtr)			
					1st qtr	2nd qtr	3rd qtr	4th qtr
CHEVRON USA INC	C	966	2	NOx	2	2	2	2
CHEVRON USA INC	S	909	2	NOx	3990	3412	3474	3072
CHEVRON USA INC	S	1487	2	NOx	11663	11793	11923	11923
CHEVRON USA INC	S	2456	2	NOx	32003	32799	31884	32561
CHEVRON USA INC	S	3784	2	NOx	47002	47880	48758	48758
CHEVRON USA INC	S	3817	2	NOx	0	0	9568	154
CHEVRON USA INC	S	3818	2	NOx	0	6312	0	5064
CHEVRON USA INC	S	4666	2	NOx	39135	39676	40218	40218
CHEVRON USA INC	S	1100	2	NOx	62167	62857	63548	63548
CHEVRON USA INC	S	1102	2	NOx	57160	57795	58430	58430
CHEVRON USA INC	S	1106	2	NOx	11814	11942	12075	12075
CHEVRON USA INC	S	1256	2	NOx	45238	45741	46244	46244
CHEVRON USA INC	S	1419	2	NOx	4875	4928	4983	4983
CHEVRON USA INC	S	1445	2	NOx	17602	20114	20328	15867
CHEVRON USA INC	S	2111	2	NOx	7823	15506	21032	12182
CHEVRON USA INC	S	3156	2	NOx	12415	12563	12710	12710
CHEVRON USA INC	S	3544	2	NOx	3027	3303	2542	2691
CHEVRON USA INC	S	3604	2	NOx	1948	3037	3398	2243
CHEVRON USA INC	S	4652	2	NOx	19428	12602	13035	11552
CHEVRON USA INC	S	496	2	NOx	5160	233	1734	4212
CHEVRON USA INC	S	1967	2	NOx	973	955	855	984
CHEVRON USA INC	S	2031	2	NOx	5694	4723	4406	0
CHEVRON USA INC	S	77	2	NOx	2038	1840	1733	2274
CHEVRON USA INC	S	40410441	2	NOx	20385	20612	20838	20838
CHEVRON USA INC (REFINERY)	S	4573	2	NOx	24199	24787	25374	25374
CHEVRON USA INC LOST HILLS GP	S	704	2	NOx	5564	5626	5687	5687
CHEVRON USA INC LOST HILLS GP	S	1470	2	NOx	780	789	797	797
CHEVRON USA PRODUCTION INC	S	674	2	NOx	507	781	226	485
CHEVRON USA PRODUCTION INC	S	3228	2	NOx	139	161	275	104
CHEVRON USA PRODUCTION INC	S	3533	2	NOx	181	188	224	219
CHEVRON USA, INC.	C	1147	2	NOx	56	57	39	53
CHEVRON USA, INC.	C	1372	2	NOx	27	70	23	17
CITY OF TULARE	S	3398	2	NOx	501	0	0	0
CITY OF TULARE	N	902	2	NOx	0	436	436	471
CITY OF VISALIA	N	317	2	NOx	0	0	7160	0
CLARK BROTHERS-DERRICK GIN	C	511	2	NOx	0	0	0	43

Current ERC Certificate Holder	Certificate Number			Pollutant	Emissions (lb/qtr)			
					1st qtr	2nd qtr	3rd qtr	4th qtr
CLIMECO CORPORATION	N	1324	2	NOx	525	525	525	525
CON AGRA FOOD INGREDIENTS, CO	S	2201	2	NOx	6	6	5	5
CONAGRA CONSUMER FROZEN FOODS	N	487	2	NOx	356	163	243	300
CONAGRA CONSUMER FROZEN FOODS	N	856	2	NOx	0	0	1749	0
CORCORAN IRRIGATION DISTRICT	C	560	2	NOx	352	356	321	209
COTTON ASSOCIATES, INC	S	25	2	NOx	0	0	0	157
CRAYCROFT BRICK COMPANY	C	71	2	NOx	417	336	328	332
CRESTWOOD WEST COAST LLC	S	4236	2	NOx	47	137	86	23
CRESTWOOD WEST COAST LLC	S	4240	2	NOx	125	125	125	125
CRESTWOOD WEST COAST LLC	S	4242	2	NOx	14	14	14	14
CRIMSON RESOURCE MANAGEMENT	S	3441	2	NOx	5	4	4	5
CRIMSON RESOURCE MANAGEMENT	S	3388	2	NOx	4704	3393	3449	2696
CRIMSON RESOURCE MANAGEMENT	S	3389	2	NOx	95	299	319	166
CRIMSON RESOURCE MANAGEMENT	S	2251	2	NOx	316	272	186	375
DAIRY FARMERS OF AMERICA, INC.	C	689	2	NOx	0	0	253	0
DARLING INGREDIENTS INC	C	1298	2	NOx	0	0	0	270
DARLING INGREDIENTS INC.	S	4346	2	NOx	911	860	804	641
DARLING INGREDIENTS INC.	N	1225	2	NOx	0	51	107	0
DIAMOND FOODS INCORPORATED	N	573	2	NOx	1	1	0	0
DIAMOND FOODS INCORPORATED	N	826	2	NOx	4443	2607	2618	0
E & J GALLO WINERY	C	1071	2	NOx	612	605	563	535
E & J GALLO WINERY	N	1272	2	NOx	0	0	0	953
E & J GALLO WINERY	N	849	2	NOx	0	14	111	0
E & J GALLO WINERY	N	1011	2	NOx	625	625	625	625
E & J GALLO WINERY	N	1012	2	NOx	545	545	545	545
E & J GALLO WINERY	N	1221	2	NOx	9542	9542	10501	9541
E & J GALLO WINERY	N	1270	2	NOx	1276	909	1275	1275
E & J GALLO WINERY	N	1380	2	NOx	1224	1225	1225	1225
E&B NATURAL RESOURCES	S	4408	2	NOx	76	95	96	87
E&B NATURAL RESOURCES MGMT	S	4609	2	NOx	1086	0	0	0
E&B NATURAL RESOURCES MGMT	S	4612	2	NOx	0	1049	919	1379
E&B NATURAL RESOURCES MGMT	S	4627	2	NOx	2500	2500	2500	2500
EAGLE VALLEY GINNING LLC	N	847	2	NOx	0	0	0	427

Current ERC Certificate Holder	Certificate Number			Pollutant	Emissions (lb/qtr)			
					1st qtr	2nd qtr	3rd qtr	4th qtr
ECKERT FROZEN FOODS	N	133	2	NOx	146	545	2047	395
ELBOW ENTERPRISES INC	S	2535	2	NOx	0	0	0	1168
ELK HILLS POWER LLC	S	1622	2	NOx	1373	1389	1404	1404
ELK HILLS POWER LLC	S	1994	2	NOx	12485	12624	12762	12762
EVOLUTION MARKETS INC.	S	2738	2	NOx	1696	3526	1536	1221
EVOLUTION MARKETS INC.	S	2740	2	NOx	0	27355	0	0
EVOLUTION MARKETS INC.	S	2896	2	NOx	130	131	132	132
EVOLUTION MARKETS INC.	S	2899	2	NOx	1313	1378	1443	1443
EVOLUTION MARKETS INC.	S	2908	2	NOx	1500	1500	1500	1500
EVOLUTION MARKETS INC.	C	944	2	NOx	0	298	1590	300
EVOLUTION MARKETS INC.	C	945	2	NOx	0	286	1530	289
EVOLUTION MARKETS INC.	N	776	2	NOx	875	927	771	876
EXXONMOBIL CORPORATION	S	4544	2	NOx	5175	5197	5494	4871
EXXONMOBIL CORPORATION	S	4545	2	NOx	3010	2818	2052	3565
EXXONMOBIL CORPORATION	S	4546	2	NOx	1648	1666	1685	1685
FARMERS COOPERATIVE GIN INC	S	2533	2	NOx	0	0	0	598
FORWARD INC LANDFILL	N	1328	2	NOx	131	130	131	130
FREEPORT-MC MORAN OIL & GAS	S	4098	2	NOx	13229	10050	6765	15163
FREEPORT-MC MORAN OIL & GAS	S	4099	2	NOx	10010	10691	10155	6716
FREEPORT-MC MORAN OIL & GAS	S	4100	2	NOx	1411	73	1449	2071
FREEPORT-MC MORAN OIL & GAS	S	4366	2	NOx	148	148	148	148
FREEPORT-MC MORAN OIL & GAS	S	4495	2	NOx	4630	4632	4633	4632
FRESNO/CLOVIS REGIONAL WWTP	C	1211	2	NOx	65	65	65	65
FRITO-LAY, INC.	S	3763	2	NOx	287	442	182	53
FRITO-LAY, INC.	S	3765	2	NOx	7432	7619	7790	7789
G.I.C. FINANCIAL SERVICES, INC.	C	1391	2	NOx	19830	19688	19996	19903
GALLO GLASS COMPANY	N	768	2	NOx	14634	12268	15814	10504
GALLO GLASS COMPANY	N	900	2	NOx	63691	64821	66246	61340
GALLO GLASS COMPANY	N	966	2	NOx	63525	46849	57176	61929
GENERAL MILLS OPERATIONS, INC	N	610	2	NOx	52	3	0	100
GENERAL MILLS, INC	S	3217	2	NOx	0	0	0	30
GLOBAL AMPERSAND LLC	S	2976	2	NOx	239	239	239	239
GROWERS COOP	S	88	2	NOx	0	0	22	406
GUARDIAN INDUSTRIES CORP	C	1378	2	NOx	11898	11898	11898	11897
H. J. HEINZ COMPANY	N	534	2	NOx	0	360	3207	0
H. J. HEINZ COMPANY	N	694	2	NOx	0	43	2570	0

Current ERC Certificate Holder	Certificate Number			Pollutant	Emissions (lb/qtr)			
					1st qtr	2nd qtr	3rd qtr	4th qtr
H. J. HEINZ COMPANY	N	1085	2	NOx	69	70	60	30
H. J. HEINZ COMPANY, L.P.	N	21	2	NOx	0	1026	3112	1060
HANSEN BROTHERS	C	249	2	NOx	0	0	0	256
HERSHEY CHOCOLATE & CONF. CORP	N	952	2	NOx	114	106	125	125
HILMAR CHEESE COMPANY	S	2138	2	NOx	0	0	0	1070
HOLMES WESTERN OIL CORPORATION	S	3377	2	NOx	1633	1632	1632	1632
HYDROGEN ENERGY CA LLC	C	1058	2	NOx	10100	10100	10100	10100
HYDROGEN ENERGY CALIFORNIA, LLC	S	3273	2	NOx	120500	120500	120500	120500
INGREDION INCORPORATED	N	1278	2	NOx	35860	23235	31589	34804
J.G. BOSWELL CO. (EL RICO)	C	135	2	NOx	14	4	0	40
JOHN T HOPPER	C	712	2	NOx	0	55	295	56
KAWEAH DELTA DISTRICT HOSPITAL	S	2657	2	NOx	100	441	536	667
KERN DELTA CO LLC	S	4315	2	NOx	0	0	0	622
KERN LAKE COOP GIN	S	2074	2	NOx	0	0	0	309
KERN OIL & REFINING CO.	S	2653	2	NOx	94	277	91	215
KERN OIL & REFINING COMPANY	C	1243	2	NOx	3081	4129	2703	716
KERN OIL & REFINING COMPANY	N	878	2	NOx	24	19	32	24
KERN OIL & REFINING COMPANY	N	879	2	NOx	156	188	224	202
KERN RIVER HOLDINGS, INC.	C	1368	2	NOx	1038	1037	1037	1037
KRAFT FOODS INC	C	149	2	NOx	284	284	284	284
KRAFT FOODS INC	C	386	2	NOx	9774	9883	9992	9992
KRAFT FOODS INC	C	387	2	NOx	5	5	4	4
KRAFT FOODS INC	C	1138	2	NOx	0	0	0	1632
KRAFT HEINZ FOODS COMPANY	S	4027	2	NOx	0	0	3425	1107
KRAFT HEINZ FOODS COMPANY	S	4028	2	NOx	2070	0	0	94
KRAFT HEINZ FOODS COMPANY	S	4035	2	NOx	0	0	0	24
KRAFT HEINZ FOODS COMPANY	S	4036	2	NOx	0	0	165	0
KRAFT HEINZ FOODS COMPANY	S	4037	2	NOx	1227	3443	0	733
LA PALOMA GENERATING COMPANY	N	1291	2	NOx	0	9612	22455	0
LAND O' LAKES, INC.	S	3326	2	NOx	214	166	214	214
LAND O' LAKES, INC.	S	3625	2	NOx	618	473	646	602
LAND O' LAKES, INC.	C	1393	2	NOx	2070	2212	1904	1997
LAND O' LAKES, INC.	N	1371	2	NOx	136	223	238	198
LAND O' LAKES, INC.	N	1377	2	NOx	364	328	400	391

Current ERC Certificate Holder	Certificate Number			Pollutant	Emissions (lb/qtr)			
					1st qtr	2nd qtr	3rd qtr	4th qtr
LAWRENCE LIVERMORE NATL. LAB	N	464	2	NOx	83	31	0	61
LEPRINO FOODS	N	108	2	NOx	2335	2529	2412	2143
LEPRINO FOODS COMPANY	C	60	2	NOx	7878	7985	7810	7898
LIBERTY COMPOSTING INC	S	3855	2	NOx	925	925	925	925
LIDESTRI FOODS, INC	N	391	2	NOx	0	0	1527	0
LINN OPERATING, INC	S	4514	2	NOx	4332	1450	4332	1569
LINN OPERATING, INC	S	4515	2	NOx	11433	0	0	0
LINN OPERATING, INC	S	4516	2	NOx	239	239	239	239
LINN OPERATING, INC	S	4530	2	NOx	0	0	5400	1920
LINN OPERATING, INC	N	1302	2	NOx	0	0	2915	0
LINN OPERATING, INC	N	1349	2	NOx	112	112	112	112
LINN OPERATING, INC	N	1370	2	NOx	2234	2234	2234	2234
LINN OPERATING, INC.	N	1332	2	NOx	0	400	0	4000
LOCKHEED MARTIN	S	2990	2	NOx	3000	3000	3000	3000
LOCKHEED MARTIN	S	3079	2	NOx	1160	1840	1500	1500
LOS BANOS GRAVEL GROUP, ASPHLT	N	125	2	NOx	23	113	359	120
LOS GATOS TOMATO PRODUCTS	C	1021	2	NOx	0	4	0	0
LOVELACE & SONS FARMING	C	807	2	NOx	0	0	0	257
M CARATAN INC	S	2516	2	NOx	0	0	189	46
MACPHERSON OIL COMPANY	S	4132	2	NOx	145	145	145	145
MACPHERSON OIL COMPANY	C	1195	2	NOx	73	73	73	73
MACPHERSON OIL COMPANY	N	1339	2	NOx	1368	1367	1368	1368
MALAGA POWER, LLC	C	1355	2	NOx	0	0	1029	0
MARTIN ANDERSON	C	1051	2	NOx	52	77	45	3
MEMORIAL MEDICAL CENTER	S	2268	2	NOx	2550	2550	2550	2550
MEYERS FARMING LLC	C	1112	2	NOx	0	3701	5023	2200
MIDWAY PEAKING LLC	S	4234	2	NOx	283	283	496	354
MODESTO IRRIGATION DISTRICT	N	430	2	NOx	0	0	273	0
MODESTO IRRIGATION DISTRICT	C	1111	2	NOx	0	0	74	5923
MONTEREY RESOURCES, INC.	S	432	2	NOx	2053	2081	1707	1898
NAS LEMOORE	C	1048	2	NOx	26	26	25	25
NORTHERN CALIFORNIA POWER AGENCY	S	2854	2	NOx	0	1437	0	0
NORTHERN CALIFORNIA POWER AGENCY	S	2857	2	NOx	0	0	0	1031
NORTHERN CALIFORNIA POWER AGENCY	S	2895	2	NOx	0	0	0	3406
NORTHERN CALIFORNIA POWER AGENCY	S	4180	2	NOx	0	0	0	1865
NORTHERN CALIFORNIA	C	1132	2	NOx	0	137	122	117

Current ERC Certificate Holder	Certificate Number			Pollutant	Emissions (lb/qtr)			
					1st qtr	2nd qtr	3rd qtr	4th qtr
POWER AGENCY								
NORTHERN CALIFORNIA POWER AGENCY	C	1268	2	NOx	0	0	2196	1831
NORTHERN CALIFORNIA POWER AGENCY	N	751	2	NOx	0	0	10015	0
NORTHERN CALIFORNIA POWER AGENCY	N	752	2	NOx	0	791	835	0
NORTHERN CALIFORNIA POWER AGENCY	N	1028	2	NOx	0	274	790	147
NORTHROP GRUMMAN CORPORATION	N	992	2	NOx	2000	2000	2000	2000
OAKWOOD LAKE RESORT	N	601	2	NOx	0	117	188	0
OLAM	N	1359	2	NOx	1780	5324	10542	5665
OLDUVAI GORGE, LLC	S	2802	2	NOx	3233	0	0	5000
OLDUVAI GORGE, LLC	S	4641	2	NOx	14283	649	2200	4032
OLDUVAI GORGE, LLC	C	998	2	NOx	0	0	0	815
OLDUVAI GORGE, LLC	N	782	2	NOx	1085	1097	1109	1109
OLDUVAI GORGE, LLC	N	1174	2	NOx	61177	57625	59600	61400
OLDUVAI GORGE, LLC	N	1184	2	NOx	2154	287	335	1351
OLDUVAI GORGE, LLC	N	1257	2	NOx	837	923	1010	1010
OXY USA, INC	N	1196	2	NOx	0	396	665	0
PACIFIC COAST PRODUCERS	N	753	2	NOx	195	605	3088	312
PACIFIC GAS & ELECTRIC COMPANY	S	4404	2	NOx	30	16	55	63
PACIFIC PIPELINE SYSTEM, LLC	S	1099	2	NOx	0	13703	12649	0
PACIFIC PIPELINE SYSTEM, LLC	S	2286	2	NOx	1278	2194	2438	2438
PACIFIC PIPELINE SYSTEM, LLC	S	575	2	NOx	0	4693	10418	3569
PACTIV, LLC	S	3863	2	NOx	233	199	51	109
PARAMOUNT FARMS	N	1325	2	NOx	14475	14475	14475	14475
PARAMOUNT FARMS, INC	N	284	2	NOx	3670	3580	3488	3488
PARAMOUNT FARMS, INC.	C	1035	2	NOx	0	0	155	334
PARAMOUNT FARMS, INC.	C	1327	2	NOx	0	930	2965	1965
PASTORIA ENERGY FACILITY, LLC	S	1543	2	NOx	10354	8381	11018	11467
PASTORIA ENERGY FACILITY, LLC	S	4163	2	NOx	164079	166154	168230	169711
PASTORIA ENERGY LLC	C	755	2	NOx	2525	1011	0	2038
PHILLIPS 66 PIPELINE LLC	C	1163	2	NOx	0	0	17	0
PILKINGTON NORTH AMERICA, INC	N	410	2	NOx	272	4	43	275
PILKINGTON NORTH AMERICA, INC	N	1333	2	NOx	76237	75102	82677	79027
PLAINS LPG SERVICES, L.P.	C	717	2	NOx	1024	1024	1023	1023
R F MACDONALD	C	579	2	NOx	0	8	0	0

Current ERC Certificate Holder	Certificate Number			Pollutant	Emissions (lb/qtr)			
					1st qtr	2nd qtr	3rd qtr	4th qtr
R M WADE & COMPANY	C	152	2	NOx	326	373	379	370
RIO BRAVO JASMIN	S	4620	2	NOx	62026	50075	62747	63660
RIO BRAVO POSO	S	4617	2	NOx	29596	45246	57418	38786
SAN JOAQUIN REFINING COMPANY	S	4452	2	NOx	0	1	1	0
SAN JOAQUIN REFINING COMPANY	C	1341	2	NOx	616	8	41	283
SAN JOAQUIN VALLEY CONCENTRATES	C	1209	2	NOx	13	13	12	15
SAPUTO CHEESE USA INC.	N	834	2	NOx	1810	1810	1810	1810
SENECA RESOURCES	S	1427	2	NOx	88	57	76	98
SENECA RESOURCES	S	3718	2	NOx	0	118	0	0
SENECA RESOURCES	S	4327	2	NOx	1750	1750	1750	1750
SENECA RESOURCES	S	4640	2	NOx	1730	1730	1730	1730
SENECA RESOURCES	S	4578	2	NOx	18	18	18	18
SENECA RESOURCES	N	906	2	NOx	183	517	517	517
SENECA RESOURCES	N	1338	2	NOx	587	588	587	587
SHAFTER-WASCO GINNING COMPANY	S	3268	2	NOx	0	0	0	232
SIERRA POWER CORPORATION	S	4628	2	NOx	20309	17668	17217	18721
SIERRA POWER CORPORATION	S	2910001	2	NOx	2115	2138	2162	2162
SOUTH VALLEY GINS INC	S	4635	2	NOx	77	0	0	752
SOUTH VALLEY GINS INC	S	3554	2	NOx	0	0	0	192
SOUTHERN CALIF GAS CO	S	1016	2	NOx	283	288	289	289
SOUTHERN CALIFORNIA GAS CORPORATION	N	299	2	NOx	0	1311	1415	0
STOCKTON EAST WATER DISTRICT	N	763	2	NOx	2654	3705	3750	3359
STRATAS FOODS LLC	C	1020	2	NOx	0	0	0	108
SUN GARDEN-GANGI CANNING CO LL	N	222	2	NOx	0	0	12886	540
TAUBER OIL COMPANY	S	4356	2	NOx	1500	1500	1500	1500
TAUBER OIL COMPANY	S	4369	2	NOx	1479	2396	1701	1445
TAUBER OIL COMPANY	N	1267	2	NOx	500	500	500	500
TAUBER OIL COMPANY	N	1277	2	NOx	2500	2500	2500	2500
TEXACO EXPLOR & PROD INC	S	20250361	2	NOx	7037	7356	6314	6778
THE BEVERAGE SOURCE	N	92	2	NOx	220	800	520	900
THE NESTLE COMPANY INC	N	508	2	NOx	2975	2444	1853	3352
TKV CONTAINERS, INC.	C	1015	2	NOx	0	13	14	0
TRIANGLE PACIFIC CORPORATION	N	18	2	NOx	187	54	54	161
TRI-CITY GROWERS INC	S	4392	2	NOx	54	0	0	229
TURLOCK IRRIGATION DISTRICT	S	3707	2	NOx	3442	2862	2277	2277

Current ERC Certificate Holder	Certificate Number			Pollutant	Emissions (lb/qtr)			
					1st qtr	2nd qtr	3rd qtr	4th qtr
UNITED STATES GYPSUM COMPANY	S	2543	2	NOx	0	0	0	311
UNITED STATES GYPSUM COMPANY	S	2815	2	NOx	39560	6703	27282	33352
UNITED STATES GYPSUM COMPANY	C	818	2	NOx	0	0	0	734
UNITED STATES GYPSUM COMPANY	N	662	2	NOx	308	36838	15649	308
VALLEY AIR CONDITIONING & REPAIR INC	C	693	2	NOx	0	0	108	0
VECTOR ENVIRONMENTAL, INC.	S	4039	2	NOx	102	125	117	15
VINTAGE PETROLEUM	N	346	2	NOx	0	165	1432	14
VINTAGE PRODUCTION CALIFORNIA LLC	N	1211	2	NOx	443	443	443	435
WELLHEAD POWER PANOCHE, LLC.	C	874	2	NOx	0	3	3	0
WESTERN STONE PRODUCTS, INC.	N	17	2	NOx	543	543	619	619
WESTLAKE FARMS INC	C	645	2	NOx	0	0	0	498
WESTSIDE FARMERS COOP #2 & #3	C	1038	2	NOx	109	0	0	1122
WONDERFUL PISTACHIOS & ALMONDS	C	1270	2	NOx	770	770	770	770
WONDERFUL PISTACHIOS & ALMONDS	C	1313	2	NOx	10770	10770	10770	10770
AERA ENERGY LLC	C	219	1	VOC	268	297	324	298
AERA ENERGY LLC	C	679	1	VOC	11014	11468	11508	11211
AERA ENERGY LLC	S	663	1	VOC	544	495	483	454
AERA ENERGY LLC	S	868	1	VOC	724	735	729	672
AERA ENERGY LLC	S	1058	1	VOC	8179	8280	8354	8353
AERA ENERGY LLC	S	1138	1	VOC	162	233	2	25
AERA ENERGY LLC	S	1142	1	VOC	39631	39976	40411	40489
AERA ENERGY LLC	S	1162	1	VOC	713	719	730	730
AERA ENERGY LLC	S	1476	1	VOC	190	0	0	54
AERA ENERGY LLC	S	1477	1	VOC	329	0	0	93
AERA ENERGY LLC	S	1587	1	VOC	26	28	26	26
AERA ENERGY LLC	S	1681	1	VOC	10	10	10	10
AERA ENERGY LLC	S	1874	1	VOC	40	10	1	22
AERA ENERGY LLC	S	1880	1	VOC	360	591	251	0
AERA ENERGY LLC	S	2136	1	VOC	3772	3393	3836	3913
AERA ENERGY LLC	S	2237	1	VOC	5394	5463	5539	5539
AERA ENERGY LLC	S	2361	1	VOC	27	4	0	11
AERA ENERGY LLC	S	2725	1	VOC	65082	65830	66578	66578
AERA ENERGY LLC	S	2774	1	VOC	8176	5745	5185	3973

Current ERC Certificate Holder	Certificate Number			Pollutant	Emissions (lb/qtr)			
					1st qtr	2nd qtr	3rd qtr	4th qtr
AERA ENERGY LLC	S	2782	1	VOC	44	43	42	46
AERA ENERGY LLC	S	2939	1	VOC	6264	3536	3647	6483
AERA ENERGY LLC	S	3110	1	VOC	21914	22310	22708	22708
AERA ENERGY LLC	S	3223	1	VOC	16	16	16	17
AERA ENERGY LLC	S	3272	1	VOC	2642	2701	2759	2759
AERA ENERGY LLC	S	3308	1	VOC	2266	1066	1090	2320
AERA ENERGY LLC	S	3451	1	VOC	20480	438	2608	1572
AERA ENERGY LLC	S	3687	1	VOC	17245	18573	17870	17768
AERA ENERGY LLC	S	3919	1	VOC	178503	181091	183734	183787
AERA ENERGY LLC	S	4063	1	VOC	157	140	120	181
AERA ENERGY LLC	S	4064	1	VOC	98	154	184	160
AERA ENERGY LLC	S	4444	1	VOC	118983	120436	121890	121890
AERA ENERGY LLC	S	4489	1	VOC	9052	10114	11697	8982
AERA ENERGY LLC	S	4624	1	VOC	50080	50508	51652	52619
AGRI-CEL INC	S	3631	1	VOC	21495	26078	24122	2902
ALON BAKERSFIELD REFINING	S	3663	1	VOC	38947	38947	38947	38948
ALON BAKERSFIELD REFINING	S	4330	1	VOC	34595	35394	35803	35711
ANDERSEN RACK SYSTEMS, INC	N	950	1	VOC	7335	7335	7335	7335
ANDERSON CLAYTON CORP	C	903	1	VOC	0	0	0	4
ANDERSON CLAYTON CORP	S	314	1	VOC	0	0	1	18
ANDERSON CLAYTON CORP	S	471	1	VOC	0	0	0	9
ANDERSON CLAYTON CORP	S	1045	1	VOC	0	0	0	22
ANDERSON CLAYTON CORP	S	1171	1	VOC	3	0	0	24
ANDERSON CLAYTON CORP	S	1262	1	VOC	1	0	0	19
ANDERSON CLAYTON CORP	S	1263	1	VOC	9	0	0	24
ANDERSON CLAYTON CORP.	N	181	1	VOC	0	0	0	6
ANDERSON CLAYTON CORP.	N	499	1	VOC	0	0	0	15
ANDERSON CLAYTON CORP/BURREL	C	806	1	VOC	14	0	0	42
ANDERSON CLAYTON CORP/BUTTE	C	699	1	VOC	0	0	0	19
ANDERSON CLAYTON CORP/CORCORAN	C	81	1	VOC	0	0	0	15
ANDERSON CLAYTON CORP/DAIRYLAN	C	332	1	VOC	0	0	0	7
ANDERSON CLAYTON CORP/DAIRYLND	C	472	1	VOC	0	0	0	13
ANDERSON CLAYTON CORP/EL DORAD	C	427	1	VOC	1	0	0	17
ANDERSON CLAYTON CORP/FIVE PTS	C	78	1	VOC	0	0	0	8
ANDERSON CLAYTON CORP/HANFORD	C	74	1	VOC	0	0	0	5

Current ERC Certificate Holder	Certificate Number			Pollutant	Emissions (lb/qtr)			
					1st qtr	2nd qtr	3rd qtr	4th qtr
ANDERSON CLAYTON CORP/HANFORD	C	863	1	VOC	0	0	0	36
ANDERSON CLAYTON CORP/IDRIA #1	C	959	1	VOC	0	0	0	76
ANDERSON CLAYTON CORP/IDRIA #2	C	250	1	VOC	0	0	0	9
ANDERSON CLAYTON CORP/KEARNY	C	75	1	VOC	0	0	0	7
ANDERSON CLAYTON CORP/KERMAN	C	428	1	VOC	0	0	0	11
ANDERSON CLAYTON CORP/KINGSRIV	C	460	1	VOC	2	0	0	31
ANDERSON CLAYTON CORP/MURIT #1	C	334	1	VOC	0	0	0	7
ANDERSON CLAYTON CORP/MURIT #2	C	336	1	VOC	0	0	0	7
ANDERSON CLAYTON CORP/MURRAY	C	234	1	VOC	0	0	0	12
ANDERSON CLAYTON CORP/NAPA GIN	C	335	1	VOC	0	0	0	5
ANDERSON CLAYTON CORP/PLSNT VA	C	326	1	VOC	0	0	0	18
ANDERSON CLAYTON CORP/SAN JOAQ	C	79	1	VOC	0	0	0	5
ANDERSON CLAYTON CORP/SETTER	C	76	1	VOC	0	0	0	7
ANDERSON CLAYTON CORP/STRATFOR	C	56	1	VOC	0	0	0	4
ANDERSON CLAYTON CORP/SUNSET	C	333	1	VOC	0	0	0	5
ANDERSON CLAYTON CORP/TRANQLTY	C	80	1	VOC	0	0	0	12
ANDERSON CLAYTON CORPORATION	N	135	1	VOC	0	0	0	5
ANDERSON CLAYTON CORPORATION	N	737	1	VOC	1	0	0	16
ANDERSON CLAYTON-MARICOPA GIN	S	697	1	VOC	0	0	0	25
APTCO LLC	C	663	1	VOC	0	147	788	148
APTCO LLC	C	664	1	VOC	0	149	796	150
APTCO LLC	C	665	1	VOC	0	141	758	143
APTCO LLC	C	684	1	VOC	0	138	241	139
APTCO LLC	N	390	1	VOC	1370	1266	1618	948
APTCO LLC	N	397	1	VOC	12104	11748	9416	0
APTCO LLC	N	540	1	VOC	5000	5000	5000	5000
APTCO LLC	N	854	1	VOC	3141	4397	2894	0
APTCO LLC	S	872	1	VOC	9	8	9	9
APTCO LLC	S	1990	1	VOC	1306	1709	1829	1157
ARCO PIPELINE FACILITY	C	271	1	VOC	419	417	417	417
ARDAGH GLASS INC	C	1344	1	VOC	0	0	0	7
ARDAGH GLASS INC	N	1292	1	VOC	0	0	0	135

Current ERC Certificate Holder	Certificate Number			Pollutant	Emissions (lb/qtr)			
					1st qtr	2nd qtr	3rd qtr	4th qtr
ARDAGH GLASS INC	S	4497	1	VOC	0	0	0	34
ASV WINES	C	1395	1	VOC	0	0	379	0
ASV WINES, INC.	N	892	1	VOC	0	0	189	0
AVENAL POWER CENTER, LLC	C	897	1	VOC	45	45	45	45
AVENAL POWER CENTER, LLC	C	898	1	VOC	5480	6496	4696	6616
AVENAL POWER CENTER, LLC	N	724	1	VOC	0	0	241	0
AVENAL POWER CENTER, LLC	N	725	1	VOC	0	0	709	0
AVENAL POWER CENTER, LLC	S	2951	1	VOC	12500	12500	12500	12500
AVENAL POWER CENTER, LLC	S	2988	1	VOC	0	69	0	0
BAKERSFIELD CITY WOOD SITE	S	2969	1	VOC	46	59	61	52
BAKERSFIELD CRUDE TERMINAL, LLC	S	4189	1	VOC	3821	3819	9800	5042
BAKERSFIELD CRUDE TERMINAL, LLC	S	4190	1	VOC	877	878	30	0
BAKERSFIELD CRUDE TERMINAL, LLC	S	4191	1	VOC	8302	8303	3170	7958
BAR 20 PARTNERS LTD	S	2593	1	VOC	0	9	345	350
BAR 20 PARTNERS LTD	S	2594	1	VOC	7	15	38	38
BAR 20 PARTNERS LTD	S	2595	1	VOC	873	882	892	892
BAR 20 PARTNERS LTD	S	2915	1	VOC	445	419	50	45
BREA OIL COMPANY, INC.	S	3355	1	VOC	149	391	193	112
BREITBURN OPERATING LP	S	4059	1	VOC	15	19	16	13
BRITZ AG FINANCE CO., INC.	C	557	1	VOC	0	0	0	8
BRITZ GIN PARTNERSHIP II	C	871	1	VOC	0	0	0	32
BRITZ INCORPORATED	C	586	1	VOC	0	0	0	21
BRONCO WINE COMPANY	S	3732	1	VOC	125	125	125	125
BROWN SAND INC	N	46	1	VOC	2	2	1	2
BRUCE CARTER INDUSTRIES, INC.	S	4038	1	VOC	10031	12170	11257	1354
BUILDERS CONCRETE, INC.	C	41	1	VOC	35	35	35	35
BUTTONWILLOW GINNING CO	S	2937	1	VOC	0	0	0	40
BUTTONWILLOW GINNING CO	S	4634	1	VOC	0	0	0	105
CALAVERAS MATERIALS INC	C	89	1	VOC	92	83	95	76
CALAVERAS MATERIALS INC.	C	233	1	VOC	148	410	483	300
CALIFORNIA DAIRIES	N	497	1	VOC	33	33	33	33
CALIFORNIA DAIRIES, INC.	C	683	1	VOC	0	0	454	0
CALIFORNIA RESOURCES ELK HILLS, LLC	S	829	1	VOC	57	60	72	58
CALIFORNIA RESOURCES ELK HILLS, LLC	S	1593	1	VOC	3128	3163	3197	3197
CALIFORNIA RESOURCES ELK HILLS, LLC	S	1703	1	VOC	394	1333	1998	1038
CALIFORNIA RESOURCES ELK HILLS, LLC	S	1706	1	VOC	2314	5505	6449	2760

Current ERC Certificate Holder	Certificate Number			Pollutant	Emissions (lb/qtr)			
					1st qtr	2nd qtr	3rd qtr	4th qtr
CALIFORNIA RESOURCES ELK HILLS, LLC	S	1708	1	VOC	1664	3970	4474	1890
CALIFORNIA RESOURCES ELK HILLS, LLC	S	1713	1	VOC	1093	2620	3078	1181
CALIFORNIA RESOURCES ELK HILLS, LLC	S	1714	1	VOC	1290	3038	3527	1472
CALIFORNIA RESOURCES ELK HILLS, LLC	S	1717	1	VOC	1239	3804	4274	1639
CALIFORNIA RESOURCES ELK HILLS, LLC	S	1719	1	VOC	928	1948	2037	1118
CALIFORNIA RESOURCES ELK HILLS, LLC	S	1722	1	VOC	1132	2723	3230	1359
CALIFORNIA RESOURCES ELK HILLS, LLC	S	1723	1	VOC	1723	4185	4934	2003
CALIFORNIA RESOURCES ELK HILLS, LLC	S	1725	1	VOC	1169	2764	3251	1348
CALIFORNIA RESOURCES ELK HILLS, LLC	S	1726	1	VOC	1603	3911	4662	1932
CALIFORNIA RESOURCES ELK HILLS, LLC	S	1727	1	VOC	1061	2580	3064	1240
CALIFORNIA RESOURCES ELK HILLS, LLC	S	1728	1	VOC	1692	4025	4596	2098
CALIFORNIA RESOURCES ELK HILLS, LLC	S	1754	1	VOC	0	653	619	0
CALIFORNIA RESOURCES ELK HILLS, LLC	S	1773	1	VOC	379	0	0	468
CALIFORNIA RESOURCES ELK HILLS, LLC	S	1775	1	VOC	604	591	0	577
CALIFORNIA RESOURCES ELK HILLS, LLC	S	1777	1	VOC	419	454	0	0
CALIFORNIA RESOURCES ELK HILLS, LLC	S	1778	1	VOC	0	1021	0	0
CALIFORNIA RESOURCES ELK HILLS, LLC	S	1779	1	VOC	0	656	559	0
CALIFORNIA RESOURCES ELK HILLS, LLC	S	1780	1	VOC	0	1678	0	0
CALIFORNIA RESOURCES ELK HILLS, LLC	S	1782	1	VOC	454	464	398	0
CALIFORNIA RESOURCES ELK HILLS, LLC	S	1783	1	VOC	587	2	35	4
CALIFORNIA RESOURCES ELK HILLS, LLC	S	2120	1	VOC	55	794	1411	55
CALIFORNIA RESOURCES ELK HILLS, LLC	S	2301	1	VOC	55	1046	1416	172
CALIFORNIA RESOURCES ELK HILLS, LLC	S	2488	1	VOC	9	4650	5387	2519
CALIFORNIA RESOURCES ELK HILLS, LLC	S	2490	1	VOC	0	2806	3570	1534
CALIFORNIA RESOURCES ELK HILLS, LLC	S	2623	1	VOC	0	895	988	68
CALIFORNIA RESOURCES ELK HILLS, LLC	S	2625	1	VOC	22	110	96	68
CALIFORNIA RESOURCES ELK HILLS, LLC	S	2627	1	VOC	52	52	52	52
CALIFORNIA RESOURCES ELK HILLS, LLC	S	3053	1	VOC	137	139	140	140
CALIFORNIA RESOURCES ELK	S	3077	1	VOC	121	123	124	124

Current ERC Certificate Holder	Certificate Number			Pollutant	Emissions (lb/qtr)			
					1st qtr	2nd qtr	3rd qtr	4th qtr
HILLS, LLC								
CALIFORNIA RESOURCES ELK HILLS, LLC	S	3078	1	VOC	81	82	83	83
CALIFORNIA RESOURCES ELK HILLS, LLC	S	3166	1	VOC	842	2545	2372	659
CALIFORNIA RESOURCES ELK HILLS, LLC	S	3169	1	VOC	193	2665	3573	520
CALIFORNIA RESOURCES ELK HILLS, LLC	S	3225	1	VOC	648	1755	1926	805
CALIFORNIA RESOURCES ELK HILLS, LLC	S	3327	1	VOC	24	24	24	24
CALIFORNIA RESOURCES ELK HILLS, LLC	S	3379	1	VOC	386	6020	8655	1509
CALIFORNIA RESOURCES ELK HILLS, LLC	S	3536	1	VOC	44	2319	3256	356
CALIFORNIA RESOURCES ELK HILLS, LLC	S	3538	1	VOC	0	2333	3325	626
CALIFORNIA RESOURCES ELK HILLS, LLC	S	3627	1	VOC	3730	3448	3015	3510
CALIFORNIA RESOURCES ELK HILLS, LLC	S	3947	1	VOC	83	2429	3196	464
CALIFORNIA RESOURCES ELK HILLS, LLC	S	3951	1	VOC	75129	76311	77494	77493
CALIFORNIA RESOURCES ELK HILLS, LLC	S	4140	1	VOC	19	2065	2847	12
CALIFORNIA RESOURCES ELK HILLS, LLC	S	4196	1	VOC	74	74	74	74
CALIFORNIA RESOURCES ELK HILLS, LLC	S	4211	1	VOC	10584	10957	14277	13713
CALIFORNIA RESOURCES ELK HILLS, LLC	S	4228	1	VOC	443	456	316	463
CALIFORNIA RESOURCES ELK HILLS, LLC	S	4470	1	VOC	55150	63829	66405	61718
CALIFORNIA RESOURCES ELK HILLS, LLC	S	4643	1	VOC	435	2800	3881	892
CALIFORNIA RESOURCES PRODUCTION CORP	N	1125	1	VOC	179	179	179	179
CALIFORNIA RESOURCES PRODUCTION CORP	N	1153	1	VOC	885	885	885	885
CALIFORNIA RESOURCES PRODUCTION CORP	N	1193	1	VOC	1604	1604	1604	1604
CALIFORNIA RESOURCES PRODUCTION CORP	S	3574	1	VOC	145	2915	4020	260
CALIFORNIA RESOURCES PRODUCTION CORP	S	4049	1	VOC	32	796	1783	481
CALIFORNIA RESOURCES PRODUCTION CORP	S	4062	1	VOC	26	178	115	66
CALIFORNIA RESOURCES PRODUCTION CORP	S	4080	1	VOC	0	255	0	0
CALIFORNIA RESOURCES PRODUCTION CORP	S	4256	1	VOC	87	19	0	4
CALIFORNIA RESOURCES PRODUCTION CORP	S	4258	1	VOC	0	1513	676	0
CALIFORNIA RESOURCES PRODUCTION CORP	S	4297	1	VOC	0	2124	2849	0
CALIFORNIA RESOURCES PRODUCTION CORP	S	4348	1	VOC	0	2138	3271	7

Current ERC Certificate Holder	Certificate Number			Pollutant	Emissions (lb/qtr)			
					1st qtr	2nd qtr	3rd qtr	4th qtr
CALIFORNIA RESOURCES PRODUCTION CORP	S	4350	1	VOC	738	4013	5529	908
CALIFORNIA RESOURCES PRODUCTION CORP	S	4388	1	VOC	846	4119	5670	1044
CALIFORNIA RESOURCES PRODUCTION CORP	S	4432	1	VOC	0	116	741	0
CALIFORNIA RESOURCES PRODUCTION CORP	S	4440	1	VOC	74	74	74	74
CALIFORNIA RESOURCES PRODUCTION CORP	S	4454	1	VOC	170	170	170	170
CALIFORNIA RESOURCES PRODUCTION CORP	S	4482	1	VOC	0	325	774	0
CALIFORNIA RESOURCES PRODUCTION CORP	S	4487	1	VOC	8711	8711	8711	8711
CALIFORNIA RESOURCES PRODUCTION CORP	S	4630	1	VOC	70	138	199	152
CALIFORNIA-WASHINGTON CAN CO.	N	77	1	VOC	2664	0	0	1583
CALMAT CO.	C	50	1	VOC	2	2	3	3
CALMAT OF FRESNO	C	40	1	VOC	2	11	5	17
CALPINE CORPORATION	C	1080	1	VOC	2235	2037	1988	2251
CALPINE CORPORATION	S	1666	1	VOC	0	0	0	9
CALPINE CORPORATION	S	3116	1	VOC	1440	1546	1621	1621
CALPINE ENERGY SERVICES, L.P.	N	927	1	VOC	10503	10981	11573	11536
CALPINE ENERGY SERVICES, L.P.	S	3261	1	VOC	4454	4972	3890	4155
CALPINE ENERGY SERVICES, L.P.	S	3283	1	VOC	0	150	171	0
CALPINE ENERGY SERVICES, L.P.	S	3292	1	VOC	4804	6146	6632	3338
CALPINE ENERGY SERVICES, L.P.	S	3300	1	VOC	4636	4705	4774	4771
CALPINE ENERGY SERVICES, L.P.	S	3368	1	VOC	1500	1500	1500	1500
CALPINE ENERGY SERVICES, L.P.	S	3503	1	VOC	5500	5500	5500	5500
CALPINE ENERGY SERVICES, L.P.	S	3504	1	VOC	1000	1000	1000	1000
CALPINE ENERGY SERVICES, L.P.	S	3555	1	VOC	5000	5000	5000	5000
CAMPBELL SOUP COMPANY	N	127	1	VOC	84	58	52	61
CANANDAIGUA WINE COMPANY INC	C	1085	1	VOC	21	17	30	15
CANDLEWICK YARNS	C	507	1	VOC	23	20	16	14
CANTUA COOPERATIVE GIN, INC.	C	760	1	VOC	0	0	0	38
CASTLE AIRPORT AVIATION & DEVELOP CENTER	N	523	1	VOC	31801	32175	32549	32549
CENTRAL CALIFORNIA SHEETS, LLC	S	4675	1	VOC	3298	3298	3298	3298
CHEMICAL WASTE MANAGEMENT, INC	N	1284	1	VOC	5785	0	0	10355
CHEMICAL WASTE	S	2645	1	VOC	1513	2602	2033	2038

Current ERC Certificate Holder	Certificate Number			Pollutant	Emissions (lb/qtr)			
					1st qtr	2nd qtr	3rd qtr	4th qtr
MANAGEMENT, INC.								
CHEVRON U S A INC	S	629	1	VOC	48	42	43	41
CHEVRON U S A INC	S	3404	1	VOC	171	202	232	232
CHEVRON U S A INC	S	4304	1	VOC	226	264	267	320
CHEVRON USA INC	C	221	1	VOC	357	395	431	396
CHEVRON USA INC	C	277	1	VOC	2209	2209	2209	2209
CHEVRON USA INC	C	331	1	VOC	1220	1220	1221	1221
CHEVRON USA INC	C	966	1	VOC	6	6	6	6
CHEVRON USA INC	S	77	1	VOC	42	38	36	47
CHEVRON USA INC	S	165	1	VOC	2970	3003	3036	3036
CHEVRON USA INC	S	410	1	VOC	5	7	11	15
CHEVRON USA INC	S	647	1	VOC	235	699	540	95
CHEVRON USA INC	S	703	1	VOC	2084	2107	2130	2130
CHEVRON USA INC	S	1049	1	VOC	3461	0	0	0
CHEVRON USA INC	S	1793	1	VOC	1420	1443	1335	1334
CHEVRON USA INC	S	1878	1	VOC	230	136	143	82
CHEVRON USA INC	S	1912	1	VOC	225	238	250	250
CHEVRON USA INC	S	2107	1	VOC	651	638	666	666
CHEVRON USA INC	S	2373	1	VOC	11698	11110	8970	9796
CHEVRON USA INC	S	2430	1	VOC	2459	2142	1336	1543
CHEVRON USA INC	S	2674	1	VOC	1848	1848	1848	1848
CHEVRON USA INC	S	2675	1	VOC	1835	1835	1835	1835
CHEVRON USA INC	S	2708	1	VOC	1605	1634	1664	1664
CHEVRON USA INC	S	3148	1	VOC	181	163	274	216
CHEVRON USA INC	S	3518	1	VOC	1780	1780	1780	1780
CHEVRON USA INC	S	3544	1	VOC	346	378	292	308
CHEVRON USA INC	S	3604	1	VOC	223	345	388	256
CHEVRON USA INC	S	3701	1	VOC	25142	25559	25976	25976
CHEVRON USA INC	S	3811	1	VOC	3947	4032	4121	4125
CHEVRON USA INC	S	4004	1	VOC	460	466	471	470
CHEVRON USA INC	S	4066	1	VOC	1281	1477	1673	1673
CHEVRON USA INC	S	4068	1	VOC	522	567	615	615
CHEVRON USA INC	S	4110	1	VOC	90	93	83	66
CHEVRON USA INC	S	4198	1	VOC	37461	38412	39324	39358
CHEVRON USA INC	S	4355	1	VOC	6428	6428	6428	6428
CHEVRON USA INC	S	4379	1	VOC	4124	4209	4295	3637
CHEVRON USA INC	S	4549	1	VOC	0	184	257	706
CHEVRON USA INC	S	4553	1	VOC	341	364	388	388
CHEVRON USA INC	S	4558	1	VOC	39502	40427	41352	41348

Current ERC Certificate Holder	Certificate Number			Pollutant	Emissions (lb/qtr)			
					1st qtr	2nd qtr	3rd qtr	4th qtr
CHEVRON USA INC	S	4576	1	VOC	99488	100764	102130	102151
CHEVRON USA INC	S	4657	1	VOC	5038	5134	5229	5228
CHEVRON USA INC	S	4670	1	VOC	116015	117519	119022	119022
CHEVRON USA INC (REFINERY)	S	657	1	VOC	35011	35399	35788	35788
CHEVRON USA INC LOST HILLS GP	S	1847	1	VOC	2764	2793	2825	2825
CHEVRON USA PRODUCTION INC	S	674	1	VOC	5779	5851	5903	5902
CHEVRON USA PRODUCTION INC	S	3533	1	VOC	6	4	9	8
CHEVRON USA, INC.	C	1147	1	VOC	77	79	54	74
CHEVRON USA, INC.	C	1372	1	VOC	14	36	12	9
CILION INC.	S	3373	1	VOC	2978	2979	2979	2978
CILION, INC.	S	3132	1	VOC	13000	13000	13000	13000
CITY OF TULARE	C	1063	1	VOC	0	107	678	109
CLARK BROTHERS-DERRICK GIN	C	511	1	VOC	0	0	0	2
CLEAN HARBORS BUTTONWILLOW, LLC	S	685	1	VOC	31195	31541	31888	31888
COALINGA FARMERS CO-OP GIN	C	537	1	VOC	0	0	0	8
COIT RANCH	C	532	1	VOC	0	0	0	8
CONAGRA CONSUMER FROZEN FOODS	N	858	1	VOC	5	0	0	8
CONOCOPHILLIPS COMPANY	N	1276	1	VOC	1445	766	67	0
CORCORAN IRRIGATION DISTRICT	C	560	1	VOC	154	163	159	90
COTTON ASSOCIATES, INC	S	25	1	VOC	0	0	0	8
CRAYCROFT BRICK COMPANY	C	71	1	VOC	24	20	19	19
CRESTWOOD WEST COAST LLC	S	4237	1	VOC	7	22	14	4
CRESTWOOD WEST COAST LLC	S	4239	1	VOC	197	24	0	1
CRESTWOOD WEST COAST LLC	S	4293	1	VOC	1079	1108	1139	1137
CRIMSON RESOURCE MANAGEMENT	S	2161	1	VOC	54	49	31	63
CRIMSON RESOURCE MANAGEMENT	S	3386	1	VOC	67	138	142	94
CRIMSON RESOURCE MANAGEMENT	S	3387	1	VOC	23009	20107	19072	13925
CRIMSON RESOURCE MANAGEMENT	S	3441	1	VOC	13	4	13	22
DART CONTAINER CORPORATION	C	555	1	VOC	30481	26626	14213	50680
DEL MONTE FOODS MODESTO PLANT 1	N	1238	1	VOC	82	71	116	28
DELTA TRADING L P	S	4619	1	VOC	2067	2164	2257	2261
DIAMOND FOODS INCORPORATED	N	572	1	VOC	126	45	138	120

Current ERC Certificate Holder	Certificate Number			Pollutant	Emissions (lb/qtr)			
					1st qtr	2nd qtr	3rd qtr	4th qtr
DIAMOND FOODS INCORPORATED	N	645	1	VOC	1695	1419	1451	783
DIAMOND FOODS INCORPORATED	N	828	1	VOC	1495	671	1063	1914
DOLE PACKAGED FOODS LLC	N	520	1	VOC	3	11	41	8
DTE STOCKTON, LLC	S	3715	1	VOC	1450	1450	1450	1450
DTE STOCKTON, LLC	S	4485	1	VOC	725	725	725	725
DUNCAN ENTERPRISES	C	33	1	VOC	26	26	27	18
E & J GALLO WINERY	C	1071	1	VOC	23	22	21	20
E & J GALLO WINERY	C	1229	1	VOC	8075	8075	8041	8040
E & J GALLO WINERY	N	2	1	VOC	9	9	26	28
E & J GALLO WINERY	S	4354	1	VOC	16065	16065	16065	16065
E & J GALLO WINERY	S	4381	1	VOC	827	771	816	805
E & J GALLO WINERY	S	4414	1	VOC	2761	2761	2783	2783
E & J GALLO WINERY	S	4442	1	VOC	7039	7032	7025	7013
E & J GALLO WINERY	S	4480	1	VOC	16946	16904	16875	16857
E & J GALLO WINERY	S	4601	1	VOC	2107	2106	1527	1407
E & J GALLO WINERY	S	4664	1	VOC	48500	48500	48500	48500
E&B NATURAL RESOURCES	S	4408	1	VOC	9	11	11	10
E&B NATURAL RESOURCES MGMT	S	2773	1	VOC	7	12	5	9
E&B NATURAL RESOURCES MGMT	S	3791	1	VOC	7500	7500	7500	7500
EAGLE VALLEY GINNING LLC	N	847	1	VOC	0	0	0	23
ECKERT FROZEN FOODS	N	133	1	VOC	3	11	41	8
ELBOW ENTERPRISES INC	S	2535	1	VOC	0	0	0	70
ELEMENT MARKETS LLC	S	3370	1	VOC	5	4	4	4
ENRON OIL & GAS COMPANY	S	1044	1	VOC	5516	5576	5638	5638
EQUILON ENTERPRISES LLC	N	1167	1	VOC	23	3	20	19
EVERGREEN BEVERAGE PACKAGING	S	4412	1	VOC	5	6	4	5
EXXONMOBIL CORPORATION	S	4547	1	VOC	128	130	131	131
FARMERS COOPERATIVE GIN INC	S	2533	1	VOC	0	0	0	39
FARMERS FIREBAUGH GINNING CO.	C	956	1	VOC	16	0	0	47
FIBREBOARD CORP.	N	209	1	VOC	41	34	16	45
FJ MANAGEMENT INC.	S	4676	1	VOC	570904	563128	587574	592334
FOSTER FOOD PRODUCTS	S	1501	1	VOC	432	437	442	442
FOSTER FOOD PRODUCTS	S	1502	1	VOC	68	63	58	58
FREEPORT-MC MORAN OIL & GAS	S	4106	1	VOC	821	821	822	822
FREEPORT-MC MORAN OIL & GAS	S	4107	1	VOC	840	840	840	840
FREEPORT-MC MORAN OIL &	S	4364	1	VOC	24	24	24	24

Current ERC Certificate Holder	Certificate Number			Pollutant	Emissions (lb/qtr)			
					1st qtr	2nd qtr	3rd qtr	4th qtr
GAS								
FREEPORT-MCMORAN OIL & GAS, LLC	C	1241	1	VOC	892	0	1736	2684
FREEPORT-MCMORAN OIL & GAS, LLC	C	1272	1	VOC	2299	2271	2242	2243
FRESNO/CLOVIS REGIONAL WWTP	C	1211	1	VOC	6	6	5	5
FRITO-LAY, INC.	S	3411	1	VOC	4018	6573	9128	9128
FRITO-LAY, INC.	S	3426	1	VOC	380	474	377	337
FRITO-LAY, INC.	S	3429	1	VOC	55	57	58	58
FRITO-LAY, INC.	S	3430	1	VOC	76	96	74	72
G3 ENTERPRISES	S	4076	1	VOC	183	183	182	182
G3 ENTERPRISES	S	4371	1	VOC	137	137	137	136
G3 ENTERPRISES	S	4663	1	VOC	1500	1500	1500	1500
GENERAL MILLS OPERATIONS, INC	N	139	1	VOC	16	13	13	19
GROWERS COOP	S	88	1	VOC	0	0	1	15
GUARDIAN INDUSTRIES CORP	S	4651	1	VOC	1461	1549	1353	1378
H. J. HEINZ COMPANY	N	60	1	VOC	0	23	129	0
H. J. HEINZ COMPANY	N	694	1	VOC	0	0	701	0
H. J. HEINZ COMPANY	N	1085	1	VOC	52	53	45	23
H. J. HEINZ COMPANY, L.P.	N	21	1	VOC	0	60	180	60
HANSEN BROTHERS	C	249	1	VOC	0	0	0	13
HECK CELLARS	S	4053	1	VOC	9715	9715	9715	9715
HERSHEY CHOCOLATE & CONF. CORP	N	42	1	VOC	1	1	1	1
HERSHEY CHOCOLATE & CONF. CORP	N	373	1	VOC	9	11	13	11
HERSHEY CHOCOLATE & CONF. CORP	N	952	1	VOC	5	5	6	6
HOLMES WESTERN OIL CORPORATION	C	823	1	VOC	0	0	0	10
HOLMES WESTERN OIL CORPORATION	N	652	1	VOC	324	326	311	301
HOLMES WESTERN OIL CORPORATION	N	653	1	VOC	30	30	25	24
HOLMES WESTERN OIL CORPORATION	N	1259	1	VOC	1209	1208	1208	1208
HOLMES WESTERN OIL CORPORATION	S	4032	1	VOC	216	562	641	200
HUNTER EDISON OIL DEVELOPMENT	S	3723	1	VOC	2186	2256	2234	2282
HYDROGEN ENERGY CALIFORNIA, LLC	S	3305	1	VOC	14625	14625	14625	14625
HYDROGEN ENERGY CALIFORNIA, LLC	S	3557	1	VOC	11437	11438	11438	11437
HYDROGEN ENERGY CALIFORNIA, LLC	S	3605	1	VOC	7937	7938	7938	7937
INGREDION INCORPORATED	S	4428	1	VOC	2000	2000	2000	2000

Current ERC Certificate Holder	Certificate Number			Pollutant	Emissions (lb/qtr)			
					1st qtr	2nd qtr	3rd qtr	4th qtr
INGREDION INCORPORATED	S	4660	1	VOC	500	500	500	500
INTERNATIONAL PAPER COMPANY	S	2995	1	VOC	875	875	875	875
J.G. BOSWELL CO. (EL RICO)	C	135	1	VOC	1	0	0	1
KAWEAH DELTA DISTRICT HOSPITAL	S	2656	1	VOC	460	738	828	938
KERMAN CO-OP GIN & WAREHOUSE 1	C	1002	1	VOC	0	0	0	13
KERN DELTA CO LLC	S	4311	1	VOC	0	0	0	17
KERN DELTA CO LLC	S	4314	1	VOC	0	0	0	38
KERN LAKE COOP GIN	S	2074	1	VOC	0	0	0	134
KERN OIL & REFINING CO.	S	3693	1	VOC	952	966	951	1099
KERN OIL & REFINING CO.	S	4295	1	VOC	126	126	126	126
KERN OIL & REFINING CO.	S	4394	1	VOC	808	808	808	808
KERN OIL & REFINING CO.	S	4649	1	VOC	29	29	29	29
KERN RIVER HOLDINGS, INC.	S	4598	1	VOC	54	54	54	53
LAND O' LAKES, INC.	C	1044	1	VOC	258	0	0	683
LAND O' LAKES, INC.	N	1373	1	VOC	40	53	55	49
LAND O' LAKES, INC.	N	1376	1	VOC	184	165	202	196
LAND O' LAKES, INC.	S	3284	1	VOC	527	893	642	0
LAND O' LAKES, INC.	S	3625	1	VOC	57	43	59	55
LAND O' LAKES, INC.	S	4658	1	VOC	164	76	272	247
LATON CO-OP GIN, INC.	C	746	1	VOC	0	0	0	8
LAWRENCE LIVERMORE NATL. LAB	N	464	1	VOC	2	1	0	1
LEPRINO FOODS COMPANY	C	60	1	VOC	137	139	136	138
LIDESTRI FOODS, INC	N	391	1	VOC	0	0	389	0
LINN OPERATING, INC	N	1202	1	VOC	66	66	66	66
LINN OPERATING, INC	N	1295	1	VOC	157	144	137	134
LINN OPERATING, INC	N	1296	1	VOC	0	0	20	0
LINN OPERATING, INC	N	1297	1	VOC	0	1027	0	0
LINN OPERATING, INC	S	4500	1	VOC	8	1433	8	8
LINN OPERATING, INC	S	4501	1	VOC	9428	9428	9428	9428
LINN OPERATING, INC	S	4502	1	VOC	1307	1307	1307	1308
LINN OPERATING, INC	S	4504	1	VOC	284	0	0	0
LINN OPERATING, INC	S	4537	1	VOC	2415	1551	0	1322
LINN OPERATING, INC	S	4593	1	VOC	22190	22190	22190	22189
LINN OPERATING, INC	S	4622	1	VOC	1334	6262	4415	645
LINN OPERATING, INC	S	4653	1	VOC	1536	1536	1536	1536
LIVE OAK LIMITED	S	3	1	VOC	198	200	202	202
LOS ANGELES CNTY SANITATION DIST NO.2	N	472	1	VOC	5953	6019	6086	6086

Current ERC Certificate Holder	Certificate Number			Pollutant	Emissions (lb/qtr)			
					1st qtr	2nd qtr	3rd qtr	4th qtr
LOS ANGELES CNTY SANITATION DIST NO.2	N	1068	1	VOC	269	1452	271	426
LOS ANGELES COUNTY SANITATION DISTRICT 2	S	2147	1	VOC	12500	12500	12500	12500
LOS BANOS GRAVEL GROUP, ASPHLT	N	125	1	VOC	16	81	258	86
LOS GATOS TOMATO PRODUCTS	C	1021	1	VOC	0	3	0	0
M CARATAN INC	S	2516	1	VOC	0	0	26	6
MACPHERSON OIL COMPANY	N	1254	1	VOC	0	0	0	493
MACPHERSON OIL COMPANY	N	1337	1	VOC	1428	1428	1428	935
MACPHERSON OIL COMPANY	S	4419	1	VOC	2	2	2	2
MADERA CO-OP GIN, INC.	C	943	1	VOC	0	0	0	11
MALIBU BOATS LLC	N	942	1	VOC	13753	22879	14803	14093
MALIBU BOATS LLC	S	2555	1	VOC	5000	5000	5000	5000
MARTIN ANDERSON	C	1051	1	VOC	8699	12348	6585	90
MESA VERDE TRADING CO., INC	S	4307	1	VOC	4	0	0	1
MEYERS FARMING LLC	C	1112	1	VOC	0	767	1032	454
MID VALLEY DISPOSAL, INC.	S	4492	1	VOC	6681	6681	6681	6681
MID-VALLEY COTTON GROWERS INC	S	317	1	VOC	0	0	0	6
MID-VALLEY COTTON GROWERS INC	S	2989	1	VOC	0	0	0	16
MIDWAY PEAKING LLC	S	4233	1	VOC	0	0	0	10
MINTURN CO-OP GIN	N	441	1	VOC	0	0	0	20
MODESTO IRRIGATION DISTRICT	C	1109	1	VOC	4342	4331	4373	4371
MODESTO IRRIGATION DISTRICT	N	479	1	VOC	0	0	305	0
MODESTO IRRIGATION DISTRICT	N	739	1	VOC	0	0	27	0
MONTEREY RESOURCES, INC.	S	1983	1	VOC	708	720	557	640
NAS LEMOORE	C	1046	1	VOC	1607	453	1066	59
NORTHERN CALIFORNIA POWER AGENCY	S	3744	1	VOC	240	103	0	0
NUSTAR ENERGY LP	S	3299	1	VOC	1000	1000	1000	1000
OAKWOOD LAKE RESORT	N	601	1	VOC	0	72	115	0
OILDALE ENERGY LLC	S	1096	1	VOC	100	100	100	100
OLAM	N	920	1	VOC	0	0	3	0
OLAM	N	1359	1	VOC	118	338	652	425
OLDUVAI GORGE, LLC	N	1364	1	VOC	9103	0	786	0
OLDUVAI GORGE, LLC	N	1366	1	VOC	89	0	0	0
O'NEILL VINTNERS & DISTILLERS	S	3886	1	VOC	404	404	404	404
PACIFIC ETHANOL VISALIA	S	4438	1	VOC	2273	2271	2270	2264
PACIFIC GAS & ELECTRIC CO.	N	1382	1	VOC	393	5292	4501	81

Current ERC Certificate Holder	Certificate Number			Pollutant	Emissions (lb/qtr)			
					1st qtr	2nd qtr	3rd qtr	4th qtr
PACIFIC PIPELINE SYSTEM, LLC	S	776	1	VOC	28	67	77	34
PACTIV CORPORATION	N	1062	1	VOC	27192	27192	27192	27192
PACTIV, LLC	C	1182	1	VOC	9986	9206	9494	9041
PACTIV, LLC	C	1183	1	VOC	2001	1688	2462	1110
PACTIV, LLC	C	1184	1	VOC	47518	2227	0	17129
PACTIV, LLC	C	1185	1	VOC	51342	0	0	0
PACTIV, LLC	N	1241	1	VOC	23529	14812	15264	14520
PACTIV, LLC	S	3862	1	VOC	1513	1972	1571	1510
PANOCHE GINNING CO	C	904	1	VOC	0	0	0	49
PARAMOUNT FARMS, INC.	C	291	1	VOC	0	0	63	12
PELCO INC A DELAWARE CORPORATION	C	1121	1	VOC	374	374	349	349
PELCO INC A DELAWARE CORPORATION	C	1122	1	VOC	1842	2601	2219	1756
PHOENIX BIO INDUSTRIES LLC	C	824	1	VOC	500	500	500	500
PILKINGTON NORTH AMERICA, INC	N	1198	1	VOC	79	78	99	93
PLAINS LPG SERVICES LP	S	3793	1	VOC	583	583	583	583
PLAINS LPG SERVICES LP	S	4561	1	VOC	0	972	1020	381
RIO BRAVO JASMIN	S	4620	1	VOC	237	187	242	247
RIO BRAVO POSO	S	4617	1	VOC	191	330	414	274
SAN JOAQUIN FACILITIES MGMT	S	3210	1	VOC	33767	28482	32565	37850
SAN JOAQUIN FACILITIES MGMT	S	3801	1	VOC	228	225	223	223
SAN JOAQUIN FACILITIES MGMT	S	4446	1	VOC	0	0	13	8
SAN JOAQUIN FACILITIES MGMT	S	4448	1	VOC	34	8	34	39
SC JOHNSON HOME STORAGE INC	C	1173	1	VOC	1055	1415	1403	1447
SEALED AIR CORPORATION	C	851	1	VOC	19000	19000	19000	19000
SEMI TROPIC COOP GIN	S	426	1	VOC	1	0	1	28
SENECA RESOURCES	N	1336	1	VOC	108	108	108	108
SENECA RESOURCES	N	1363	1	VOC	0	0	695	0
SENECA RESOURCES	N	1365	1	VOC	1500	287	2514	1004
SENECA RESOURCES	S	3440	1	VOC	0	0	0	339
SENECA RESOURCES	S	4323	1	VOC	1500	1500	1500	1500
SEQUOIA FOREST INDUSTRIES	C	67	1	VOC	2	9	0	6
SEQUOIA FOREST INDUSTRIES	C	72	1	VOC	7	0	1	1
SFPP, L.P.	S	4188	1	VOC	2374	2374	2372	2372
SHAFTER-WASCO GINNING COMPANY	S	3268	1	VOC	0	0	0	13

Current ERC Certificate Holder	Certificate Number			Pollutant	Emissions (lb/qtr)			
					1st qtr	2nd qtr	3rd qtr	4th qtr
SHELL CALIFORNIA PIPELINE COMPANY LLC	C	467	1	VOC	185	0	0	0
SHELL OIL PRODUCTS US	S	4223	1	VOC	0	20	3	3
SHELL OIL PRODUCTS US	S	4251	1	VOC	431	460	493	492
SHELL OIL PRODUCTS US	S	4336	1	VOC	61	33	0	0
SHELL PIPELINE COMPANY LP	S	2303	1	VOC	0	658	431	0
SILGAN CONTAINERS LODI MFG CORP	N	431	1	VOC	5103	3464	3573	3865
SILGAN CONTAINERS MANUFAC CORP	C	1208	1	VOC	4279	3921	3042	3166
SOUTH KERN INDUSTRIAL CENTER LLC	S	3006	1	VOC	0	190	382	0
SOUTH VALLEY GINS INC	S	3554	1	VOC	0	0	0	10
SOUTH VALLEY GINS INC	S	4635	1	VOC	4	0	0	42
SOUTHERN CALIF GAS CO	S	671	1	VOC	570	576	583	583
SOUTHERN CALIF GAS CO	S	1739	1	VOC	1322	1337	1354	1352
STOCKTON EAST WATER DISTRICT	N	763	1	VOC	1627	2271	2299	2059
SYNAGRO WEST, INC DBA CENTRL VLY COMPOST	N	1357	1	VOC	3450	995	2495	0
TAUBER OIL COMPANY	N	1239	1	VOC	234	203	211	182
TAUBER OIL COMPANY	S	4398	1	VOC	2918	2992	3083	3093
TAUBER OIL COMPANY	S	4662	1	VOC	2000	2000	2000	2000
TESORO LOGISTICS OPERATIONS LLC	N	1078	1	VOC	1539	1539	1539	1537
TEXACO EXPLOR & PROD INC	S	904	1	VOC	492	551	403	459
THE DOW CHEMICAL COMPANY	N	799	1	VOC	218	212	236	224
THE NESTLE COMPANY INC	N	93	1	VOC	997	1820	1874	1007
THE WINE GROUP LLC	S	4147	1	VOC	250	250	249	249
THE WINE GROUP LLC	S	4661	1	VOC	500	500	500	500
TKV CONTAINERS, INC.	C	1015	1	VOC	0	83	83	0
TRC CYPRESS GROUP LLC	S	2292	1	VOC	1412	1412	1412	1412
TRC OPERATION COMPANY, INC.	S	767	1	VOC	394	399	403	403
TRI-CITY GROWERS INC	S	4392	1	VOC	3	0	0	14
TULARE CITY WASTEWATER PLANT	S	2697	1	VOC	60	60	60	87
TULE RIVER CO-OP GIN INC	S	2682	1	VOC	0	0	0	13
TURLOCK IRRIGATION DISTRICT	C	607	1	VOC	297	297	297	297
TURLOCK IRRIGATION DISTRICT	C	1116	1	VOC	1080	1080	1079	1079
UNITED STATES GYPSUM COMPANY	C	818	1	VOC	0	0	0	40
UNITED STATES GYPSUM COMPANY	N	661	1	VOC	15000	16335	16334	12331
UNITED STATES GYPSUM COMPANY	S	2543	1	VOC	0	0	0	17

Current ERC Certificate Holder	Certificate Number			Pollutant	Emissions (lb/qtr)			
					1st qtr	2nd qtr	3rd qtr	4th qtr
UNITED STATES GYPSUM COMPANY	S	2816	1	VOC	20000	20000	20000	20000
UNIVERSITY ENERGY SERVICES	S	561	1	VOC	63	54	59	61
VALERO LP	N	578	1	VOC	2372	2372	2372	2371
VANDERHAM WEST	S	3235	1	VOC	240	240	240	240
VARCO PRUDEN BUILDINGS, INC.	N	898	1	VOC	5404	6473	10921	8632
VECTOR ENVIRONMENTAL, INC.	S	4039	1	VOC	40127	48678	45027	5416
VINTAGE PRODUCTION CALIFORNIA LLC	N	1213	1	VOC	163	163	163	163
VISALIA WASTEWATER TREATMENT	S	1837	1	VOC	5067	2634	4107	4614
WESTERN COTTON SERVICES	S	606	1	VOC	0	0	0	9
WESTERN STONE PRODUCTS, INC.	N	17	1	VOC	6	6	7	7
WESTLAKE FARMS INC	C	645	1	VOC	0	0	0	18
WESTSIDE FARMERS COOP #2 & #3	C	1038	1	VOC	5	0	0	57
WESTSIDE FARMERS COOP GIN #6	C	592	1	VOC	6	0	0	44
WESTSIDE FARMERS COOP. GIN	C	164	1	VOC	0	0	0	31

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Appendix M

Summary of Significant Comments and Responses

2016 PLAN FOR THE 2008 8-HOUR OZONE STANDARD

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SUMMARY OF SIGNIFICANT COMMENTS FOR THE PROPOSED *2016 PLAN FOR THE 2008 8-HOUR OZONE STANDARD* POSTED ON MAY 17, 2016

No significant comments were received following the posting of the proposed *2016 Plan for the 2008 8-hour Ozone Standard* on May 17, 2016

SUMMARY OF SIGNIFICANT COMMENTS FOR THE PROPOSED *2016 PLAN FOR THE 2008 8-HOUR OZONE STANDARD*

The District received the following significant comments for the draft *2016 Plan for the 2008 8-Hour Ozone Standard* presented at the public workshops held on March 22, 2016.

EPA Region IX Comments:

No comments were received from EPA.

ARB Comments:

No comments were received from ARB.

Public Comments:

Comments were received from the following:

Aera Energy (Aera)
Earth Justice (EJ)
Evan Ship (ES)
San Joaquin County of Public Works (SJCPW)
Tom Frantz (TF)
Western States Petroleum Association (WSPA)

1. **COMMENT**: Based on studies performed, no further controls are needed to meet the 2008 ozone standard. The District should finalize this plan without committing to any additional control measures. (Aera, WSPA)

RESPONSE: The District's strategy is to attain the standards as expeditiously as practicable, leaving no stone unturned in terms of finding and implementing emissions reductions for sources under its authority to control. This aggressive strategy ensures emission reductions that improve air quality are put into place as expeditiously as practicable to protect public health.

As with all air quality attainment plans for the Valley, the District left no stone unturned in evaluating and identifying further opportunities to advance attainment of the ever-tightening ambient air quality standards for the development of this 2016 Ozone Plan. A comprehensive evaluation of all District rules, including source categories not subject to District rules, was performed to identify potential emissions reductions opportunities (see Appendix C of the plan). The analysis searched for new controls and compared existing District rule requirements with federal regulations in Control Techniques Guidelines, Alternative Control

Techniques, New Source Performance Standards, National Emission Standards for Hazardous Air Pollutants and Maximum Achievable Control Technology; state regulations; and rules in other air districts. The analysis looked at both NOx and VOC. In fact, as a result of this exhaustive evaluation, the District is proposing in this plan to include regulatory commitments for evaluating additional potential emission control requirements in District Rule 4311 (Flares) to reduce NOx emissions and District Rule 4694 (Wine Fermentation and Storage Tanks) to reduce VOC emissions.

2. **COMMENT**: The District should consider an approach to attaining air quality standards that targets areas with the highest concentrations of ozone, rather than burdening all areas of the Valley with the same controls. (Aera)

RESPONSE: The District is in the process of evaluating a potential "Hot Spot" approach for use in upcoming plans to attain the federal standards in a more cost-effective fashion by targeting a portion or the bulk of District regulatory and incentive-based strategies in areas with the highest concentrations. For more information, please refer to the following: http://www.valleyair.org/Board_meetings/GB/agenda_minutes/Agenda/2015/May/StudySession/final/07.pdf

3. **COMMENT**: How is the modeling accurate for the Ozone standard without the Arvin Bear Mountain monitor? The relocation of the site from Arvin-Bear Mt. to Arvin-DiGiorgio needs more investigation into the possible fluctuations in data due to this move. (TF and ES)

RESPONSE: The comparability of the data between the Arvin-Bear Mountain and Arvin-Di Giorgio sites has been extensively investigated by both the District and ARB. More specifically, the recently completed Arvin Ozone Saturation Study assessed ozone levels throughout the Arvin area. Through this study, it was observed that the peak ozone level in the Arvin area varied geographically during the field campaign, and that no one location consistently captured the peak, including the Arvin-Bear Mountain location. It was also observed that the Arvin-Di Giorgio measurements were often a good representation of the peak ozone levels measured across the Arvin area through the monitoring period, and that the Arvin-Di Giorgio 1-hour and 8-hour average peak values were often higher than those recorded at the Arvin-Bear Mountain location. Based on this, it has been concluded that the Arvin-Di Giorgio location is an adequate replacement site for the Arvin-Bear Mountain site location. This conclusion is further supported by EPA's official approval of the relocation of the ozone monitor at Arvin-Bear Mountain to Arvin-Di Giorgio. [1]

[1] United States Environmental Protection Agency, Region IX. Letter to Ms. Karen Magliano, Chief Air Quality Planning and Science Division, ARB. (2016, May 2)

4. **COMMENT**: NOx-only reductions can result in increases in ozone in certain locations. Has the District looked at the spatial modeled plots to see whether there are local areas of ozone increases in the future with NOx-only reductions? Please explain how NOx plays a stronger role than VOC in reducing ozone in the Valley? (TF and ES)

RESPONSE: Both VOC and NOx emissions contribute to the formation of ozone. Under high-NOx and low-VOC conditions, the reaction is more sensitive to the amount of VOCs and is considered a *NOx-rich regime*. Alternatively, when the atmosphere is under high-VOC and low-NOx conditions, the formation of ozone is influenced by a *NOx-limited regime*, which means ozone formation is sensitive to changes in NOx concentration. Determination of an ozone formation regime requires an understanding of chemical kinetics and the ability to model the spatial and temporal intricacies of the interactions between reactants and products. To date, grid-based photochemical models remain the best available tool to determine relative precursor limitations.

Analysis on the changes in weekday/weekend ozone ratio presented in the modeling protocol and attainment demonstration suggests that the Central and Southern regions of the Valley have already transitioned to a NOx-limited chemistry regime, while the Northern region is in the process of transitioning, such that further NOx emission reductions will push the north into a NOx-limited regime. This is consistent with research findings from UC Berkeley scientists (Pusede et al., 2012[2] and Pusede et al., 2014[3]) and the modeling conducted in support of this SIP. Since all regions of the Valley are either NOx-limited or transitioning to NOx-limited, a NOx focused control strategy will continue to reduce ozone. Sophisticated atmospheric modeling shows that the higher design value regions of the Valley are *NOx-limited regimes*, especially in projections of future years. Therefore, NOx reductions are the most effective way to reduce Valley ozone concentrations.

5. **COMMENT**: What are the contingency measures if there is a failure to make RFP or final attainment deadlines? (TF)

RESPONSE: The District plan as initially proposed demonstrated attainment as expeditiously as possible before the 2031 deadline without the need to rely on a "black box" under §182(e)(5) of the Clean Air Act. By definition, a black box represents reductions that would be needed to attain the standard for which

[2] Pusede, S. E., and R. C. Cohen, 2012, On the observed response of ozone to NOx and VOC reactivity reductions in San Joaquin Valley California 1995–present, *Atmos. Chem. Phys.*, *12*, 8323–8339.

[3] Pusede, S. E., Gentner, D. R., Wooldridge, P. J., Browne, E. C., Rollins, A. W., Min, K.-E., Russell, A. R., Thomas, J., Zhang, L., Brune, W. H., Henry, S. B., DiGangi, J. P., Keutsch, F. N., Harrold, S. A., Thornton, J. A., Beaver, M. R., St. Clair, J. M., Wennberg, P. O., Sanders, J., Ren, X., VandenBoer, T. C., Markovic, M. Z., Guha, A., Weber, R., Goldstein, A. H., and Cohen, R. C.: On the temperature dependence of organic reactivity, nitrogen oxides, ozone production, and the impact of emission controls in San Joaquin Valley, California, Atmos. Chem. Phys., 14, 3373-3395, doi:10.5194/acp-14-3373-2014, 2014.

specific measures or technologies are not currently available. The District was forced to rely on the black box provision to satisfy the contingency requirements under the Clean Air Act. To satisfy these requirements, the District had to hold back 1.6 tons per day of NOx emissions reductions that could have otherwise been used to take credit toward attaining the standard in a timely fashion without using a black box.

The above circumstances that force the District to hold back on reductions to satisfy contingency requirements under the Clean Air Act represent a real example of the well-intentioned provisions that were included in the Clean Air Act over 25 years ago that are now leading to unintended consequences. By definition, a region is classified as extreme nonattainment if, despite implementing all available control measures, reductions achieved are not enough to meet the standard. The only way a region can meet the contingency requirements is to hold back on implementing clean air measures and save them for later as a contingency. Of course, this would result in delays in cleaning the air and reducing air pollution. As currently written, the requirements in the Clean Air Act that require extreme areas to include all available measures to ensure expeditious attainment and the requirement for holding back measures as contingency are contradictory.

The District is pursuing legislative efforts to modernize the Clean Air Act with common sense provisions that help prevent similar circumstances as described above for this plan or for future plans where the contingency requirements can actually lead to delayed attainment or reliance on undefined strategies under "black box" provisions. The District, however, hopes that the state Air Resources Board (ARB) or the federal Environmental Protection Agency (EPA) can adopt and implement necessary strategies relating to mobile sources resulting in further reductions in emissions that could satisfy contingency requirements and avoid delays in attaining the standard expeditiously.

6. **COMMENT**: Why is the District working to develop legislative and administrative solutions for addressing implementation issues faced by the Valley under the Clean Air Act? (TF)

RESPONSE: Since its adoption, the Clean Air Act has led to significant improvements in air quality and public health benefits throughout the nation. In many areas of the nation, pollution levels have been reduced to historical lows. In fact, in the San Joaquin Valley, overall emissions have been reduced to historically low levels with the Valley experiencing record clean summer and winter air quality this past year. The District supports the well-intentioned concepts in the Clean Air Act that call for routine review of health-based air quality standards, clean air objectives that are technology-forcing, and clean-air deadlines that ensure expeditious clean-up and timely action.

The Clean Air Act was last amended in 1990. Over the last 25 years, local, state, and federal agencies and affected stakeholders have learned important lessons from implementing the law and it is clear now that a number of well-intentioned provisions in the Act are leading to unintended consequences. For example, in order to comply with the federal Clean Air Act contingency requirements, the *2016 Ozone Plan* must hold back emission reductions and rely on undefined strategies under "black box" provisions that can lead to delayed attainment.

Therefore, the District is pursuing legislative efforts to modernize the Clean Air Act with common sense provisions that help prevent similar circumstances as described above for this plan and for future plans and has prepared a proposal that provides solutions aimed at improving the Act's effectiveness and efficiency. Without action to address these issues, the Clean Air Act sets the Valley and many other regions up for failure and economic devastation as the new federal standards encroach on background pollution concentrations.

7. **COMMENT**: How does the District justify keeping 20 year old emission credits (ERC) in the bank? Does the District give emission reduction credits to facilities that are forced to shut down? (TF)

RESPONSE: All ERCs are tracked in state implementation plans and the quantity of the ERCs used is added to the plan as emissions for the year. This is done regardless of the age or the source of the credits. For instance, even for credits generated decades ago, the portion being used each year is added to the emissions inventory for the State Implementation Plan. This adds to the District's emission reduction obligations to the plan requiring further mitigation to accommodate future growth. Additionally, the District's ERC program has been approved by the state ARB and the federal EPA as being equivalent to federal requirements. The District is required to demonstrate on an annual basis that the District ERC program is at least equivalent to the federal program.

Emission reduction credits are only granted for voluntary reductions in emissions that are not required by law. These credits are granted through a rigorous process, in accordance with District Rule 2301, to ensure that the reductions are real, surplus, permanent, quantifiable, and enforceable. Furthermore, the credits are discounted for current and future controls that are applicable to the source generating the reductions. This often results in discounts as high as 80-90%. The District then reduces 10% of the remaining credit as an additional Air Quality Improvement Deduction (AQID). To further increase air quality benefit, then at the time of use, the new or expanding facility needing ERCs is required to provide 20-50% more in credits compared to proposed increase in emissions.

8. **COMMENT**: The plan presented on March 22, 2016 is missing several key pieces of information required for evaluating the adequacy of the plan and its requirements, the District should post a complete draft plan and provide ample opportunity for the public to review and provide meaningful input prior to considering the plan for adoption. (Aera, EJ, WSPA)

RESPONSE: This 2016 Ozone Plan was prepared through an involved public process that provided multiple opportunities for the public and interested stakeholders to offer suggestions and comments for improving and strengthening the plan. The District initiated the public process for the 2016 Ozone Plan in mid-2014. This public process included providing monthly updates at District Governing Board meetings, CAC meetings, and EJAG meetings. Each of these updates was accompanied by an opportunity for the public to provide comment, ask questions, or request additional information. Additionally, under the guidance of the District Governing Board, the Executive Director/Air Pollution Control Officer (APCO) formed the Public Advisory Workgroup (PAW) ad hoc committee. The PAW committee members consisted of representatives from regulated entities (industry, farms, dairy families and municipalities), community advocates, and advisors from EPA and ARB. The PAW committee held numerous meetings which were also open to the public. As part of the public process for developing this plan, the District also hosted a public workshop in May 2014 and two additional workshops in March 2016. These meetings provided opportunities for the public to provide verbal comments, and written comments have also been encouraged throughout development of this plan. These comments have been integral to the development of this plan, and have been incorporated as appropriate.

The District posted the proposed plan for public review on May 17, 2016, with an associated two week public comment period. Additionally, members of the public wishing to be heard are invited to attend the public hearing and present comments to the Governing Board for their consideration before attainment plan adoption.

9. **COMMENT**: The District should adopt local public fleet regulations in addition to ARB's public fleet regulations. (EJ)

RESPONSE: Advancing the turnover of mobile source fleets is critical to achieving the emissions reductions necessary to attain federal air quality standards. Under pressure from local air districts and as a component of the State's mobile source emission reduction strategy, ARB has adopted fleet regulations that have greatly reduced emissions from public fleet vehicles. These regulations have served as the primary mechanism for reducing emissions from these fleets and have superseded efforts at the local level to regulate public fleets. Additionally, ARB is currently in the latter stages of developing a new *Mobile Source Strategy* that will establish additional requirements for public and

other mobile source fleets. As a complementary strategy to mobile source regulations, the District also operates some of the most effective and robust vehicle grant programs in the nation which have successfully accelerated the clean-up of these fleets and have achieved significant additional emissions reductions.

In preparing the *2016 Ozone Plan*, the District performed an exhaustive analysis of potential emission reduction opportunities from all public fleets, including public transit vehicles, solid waste collection vehicles, school buses, commercial airport ground access vehicles, and other public fleet vehicles (Chapter 5, Section 5.4.3.2 (Public Fleets)). Through this evaluation, the District found that ARB's adopted fleet rules and newly proposed rules under the draft *Mobile Source Strategy* fully address the remaining limited emission reduction opportunities from public fleets.

10. **COMMENT**: Off-road agricultural equipment is currently unregulated by the District and ARB, and yet constitutes a large portion of the Valley's NOx emissions. Regulation of agricultural equipment should be a critical piece of the Draft Plan's attainment strategy. (EJ)

RESPONSE: The commenter's statement that off-road agricultural engines are unregulated is incorrect. Both ARB and the District have the most stringent rules in the nation limiting emissions from off-road agricultural engines including District Rule 4702 (Internal Combustion Engines), the State Airborne Toxic Control Measure for Diesel Particulate Matter from Portable Engines Rated at 50 Horsepower and Greater, the Statewide Portable Equipment Registration Program (PERP), and the State Airborne Toxic Control Measure for Stationary Compression Ignition Engines.

Additionally, the District along with Valley farmers have invested over $166 million to replace over 7,000 agricultural pump engines, reducing over 54,000 tons of emissions. Furthermore, the District along with Valley farmers have invested over $475 million to replace over 5,000 agricultural tractors and other equipment, reducing over 42,000 tons of emissions.

ARB is currently evaluating the best long-term strategy for reducing emissions from off-road agricultural equipment through a combination of incentives and regulation. The District is continuing to work with the agricultural industry and ARB to enhance the successful voluntary incentives programs already achieving significant reductions from off-road agricultural equipment. This includes recently-allocated funds for the tractor trade-up program, which helps farmers who would not normally qualify for these incentives to replace their old, uncontrolled equipment with used, cleaner equipment.

11. **COMMENT**: Why is it important to understand the impact of air pollution transported across the Pacific Ocean on Valley ozone concentrations? (TF)

RESPONSE: As ozone research continues, there is strong evidence that the Valley's ozone concentrations are increasingly being affected by transboundary emissions migrating into the Valley from sources across the Pacific Ocean. The Clean Air Act recognizes this potential threat of international transboundary pollution transport on the ability for regions to attain federal air quality standards. While still responsible for implementing reasonably available controls to reduce emission from sources under their control, Clean Air Act §179B (International Border Areas) mandates that state, local, and regional authorities not be penalized or held responsible for the impact of pollution emissions from foreign sources.

The *2016 Ozone Plan* demonstrates that the Valley will attain the 2008 8-hour ozone standard by the federally mandated deadline even with impacts from transboundary ozone pollution without the need to utilize the provisions under §179B. As the Valley addresses increasingly stringent federal standards and their associated mandates in the coming years, it is imperative that the extent of transboundary pollution impacts be fully understood to ensure that Valley businesses and residents already subject to costly and stringent regulations are not penalized for emissions outside of local control.

12. **COMMENT**: Will the District ask commercial sized dairies to further reduce VOC emissions due to the new ozone standard? The District should require all confined animal facilities regulated under Rule 4570 to demonstrate that the emission reductions associated with selected mitigation measures meet or exceed a set emission reduction amount (TF and EJ)

RESPONSE: District Rule 4570 was originally adopted on June 15, 2006 and was again amended on October 21, 2010. The purpose of this rule is to limit emissions of volatile organic compounds (VOC) from Confined Animal Facilities (CAF). In addition to limiting VOC emissions, District Rule 4570 also includes measures that limit ammonia (NH3) emissions from these operations. Operators subject to the rule requirements must implement a specified number of mitigation measures from various categories to reduce VOC emissions.

District Rule 4570 is the most stringent rule for this source category and has resulted in more than 36 tons per day of VOC emission reductions from CAFs. EPA has determined that District Rule 4570 satisfies Reasonably Available Control Technology (RACT) for VOC emissions from CAFs and incorporated District Rule 4570 into the State Implementation Plan (SIP).

13. **COMMENT**: Will the District allow new installations of combustion agriculture pumps in locations where electricity is readily available? (TF)

RESPONSE: New installation of internal combustion engines used to power agriculture pumps are subject to the Best Available Control Technology (BACT) requirements of District Rule 2201 (New Source Review). BACT requires the use of electric pumps if determined to be cost effective.

14. **COMMENT**: The District should not commit to additional controls on flares. The evaluation of any control measure for flares should consider how the flare is utilized and the quality of the flare gas, as not all flares are utilized in the same manner. It is very difficult to adapt low-NOx technology to safety flares due to its inability to handle drastic changes in flowrates. (WSPA, Aera)

RESPONSE: Given the enormity of reductions needed to develop plans that demonstrate attainment with the latest federal ozone and PM2.5 standards and based on findings from the recent flare further study, the District has committed to include additional ultra-low NOx flare emission limitations for existing and new flaring activities and include additional flare minimization requirements as appropriate. The District will work closely with affected operators to undergo a regulatory amendment process for Rule 4311 that includes an extensive public procedure that provides the public and all effected stakeholders with ample opportunities to provide input. Furthermore, a thorough and detailed analysis will be performed to assess the technological achievability and economic feasibility of the requirements.

15. **COMMENT**: An evaluation of flare minimization practices should be included in the plan, with an opportunity for public review and comment on proposed Rule 4311 amendments. (EJ)

RESPONSE: Given the enormity of reductions needed to develop plans that demonstrate attainment with the latest federal ozone and PM2.5 standards and based on findings from the recent flare further study, the District has committed to include additional ultra-low NOx flare emission limitations for existing and new flaring activities and include additional flare minimization requirements as appropriate. The District will work closely with affected operators to undergo a regulatory amendment process for Rule 4311 that includes an extensive public procedure that provides the public and all effected stakeholders with ample opportunities to provide input. Furthermore, a thorough and detailed analysis will be performed to assess the technological achievability and economic feasibility of the requirements.

16. **COMMENT**: Will the District continue to allow flaring at oil facilities under emergency permits due to lack of a buyer for the gas? (TF)

RESPONSE: District rules do not provide any exemptions to allow flaring of gas due to a lack of buyer for the gas. The exemption the commenter is incorrectly referring to is the "Emergency" exemption, which is defined in Rule 4311 as any situation or a condition arising from a sudden and reasonably unforeseeable and unpreventable event beyond the control of the operator. Examples include, but are not limited to, unpreventable equipment failure, natural disaster, act of war or terrorism, or external power curtailment, excluding a power curtailment due to an interruptible power service agreement from a utility. An emergency situation requires immediate corrective action to restore safe operation. A planned flaring event is not considered an emergency.

17. **COMMENT**: The District should review and strengthen Rule 4402, which controls VOC emissions from sumps, and should assess new potential controls for open-air sumps as part of the Draft Plan's attainment strategy. (EJ)

RESPONSE: As with all air quality attainment plans for the Valley, the District left no stone unturned in evaluating and identifying further opportunities to advance attainment of the ever-tightening ambient air quality standards for the development of this 2016 Ozone Plan. A comprehensive evaluation of Rule 4402 was performed to identify potential emissions reductions opportunities (see Appendix C of the plan). The analysis compared existing District rule requirements with federal regulations in Control Techniques Guidelines, Alternative Control Techniques, New Source Performance Standards, National Emission Standards for Hazardous Air Pollutants and Maximum Achievable Control Technology; state regulations; and rules in other air districts.

No potential emission reduction opportunities were found for Rule 4402 in this evaluation. The District will continue to evaluate potential emission reduction opportunities for this rule in future attainment plans.

18. **COMMENT**: The Draft Plan should commit to strengthening the standards for internal combustion engines emissions under Rule 4702 and not allow owners of internal combustion engines to pay mitigation fees in lieu of compliance with Rule 4702 emission requirements. (EJ)

RESPONSE: As with all air quality attainment plans for the Valley, the District left no stone unturned in evaluating and identifying further opportunities to advance attainment of the ever-tightening ambient air quality standards for the development of this 2016 Ozone Plan. A comprehensive evaluation of District Rule 4702 was performed to identify potential emissions reductions opportunities (see Appendix C of the plan). This exhaustive evaluation demonstrates that Rule

4702 currently has in place the most stringent measures feasible to implement in the Valley.

In regards to mitigation fees, the District elected to incorporate this annual fee option (similar to Rule 4320) in Rule 4702 based on economic feasibility and socioeconomic analyses performed during the rule development process that indicated some operators would incur significant economic hardships, up to and including potentially closing the business, in order to comply with new NOx limits. Section 5.2 allows operators of non-AO spark-ignited engines the option to pay annual fees in lieu of complying with new NOx limits. The District applies the fees generated by the annual fee option to fund other emission-reducing projects that would get equivalent or greater emissions reductions. Operators remain subject to current NOx, CO, and VOC emission concentration limits. To further clarify, if an operator elects to use the fee payment option, the current emission limits would remain in place for these engines. This provision prevents existing engines that are included in a fee payment program from increasing their emissions above the current emission limits. Including this provision fulfills an EPA requirement called "anti-backsliding," meaning changes to a rule cannot allow operators to increase their emissions above whatever is currently in place. The owner of a Non-AO spark-ignited engine who elects to pay annual NOx emission fees to the District in lieu of complying with the new NOx emission limits would be required to submit an Emission Control Plan and the payment would continue annually until the engine is either permanently removed from use in the Valley and the Permit-to-Operate is surrendered, or the operator demonstrates compliance with the rule's emission limits.

As the District continues to develop future attainment plans to address increasingly stringent federal air quality standards, this source category will be re-evaluated for additional potential opportunities to reduce emissions.

19. **COMMENT**: The District should continue to evaluate additional control options for NOx emissions originating from solid fuel fired boilers, steam generators, and process heaters. Rule 4352 should require more stringent controls on solid fuel fired boilers consistent with industry standard control technologies. (EJ)

RESPONSE: Bio-energy plants utilizing biomass waste from agriculture, regulated under Rule 4352, are a cleaner alternative to open burning. Without bio-energy plants, much of the progress in reducing open burning is likely to be undone. Additionally, reducing fuel loads in the forest is a primary method of controlling wild fires. The bio-energy industry provides an outlet for forest debris and materials from forest thinning projects. This reduces the occurrence of catastrophic wildfires and the attendant damage to public resources, property, and air quality impacts. Finally, bio-energy plants burn materials that would likely be placed in landfills if the plants were no longer viable, so bio-energy plants play a role in meeting the state's landfill diversion requirements.

Since 2012, six Valley biomass facilities have shut down operations and only five remain open today. The loss of these facilities has considerably reduced the available options to dispose of agricultural wood waste, especially material from large orchard removals. As a result, many agricultural growers have lost the primary economically feasible disposal option for their orchard removal material. This could not come at a worse time as there has been an increase in the number of large orchard removals over the past year due in large part to the effects of the extreme drought emergency currently facing the state.

As with all air quality attainment plans for the Valley, the District left no stone unturned in evaluating and identifying further opportunities to advance attainment of the ever-tightening ambient air quality standards for the development of this 2016 Ozone Plan. The District evaluated potential emission reduction and demonstrated that Rule 4352 currently has in place the most stringent measures feasible to implement in the Valley.

20. **COMMENT**: The current Rule 9510, Indirect Source Review, should be updated to require further NOx emission reductions and encourage investment in zero emission vehicle infrastructures such as charging stations. (EJ)

RESPONSE: The District is the first air agency to adopt an indirect source rule regulating new development projects. The District's rule is recognized as the benchmark, or best available control, for regulating indirect sources. The state and federal laws are prescriptive in establishing the District's authority regulating indirect sources. These complex legal requirements were well documented and litigated as the District spent over five years successfully defending its existing rule through the highest courts at the state and federal levels. The emission control requirements under the District's current rule are as stringent as possible in adherence with all applicable state and federal regulations and case law. Nonetheless, Rule 9510 is currently being amended to strengthen the rule by expanding the applicability requirements to cover all large indirect sources even when a lead agency chooses to process the project as non-discretionary under CEQA.

In regards to encouraging investment in zero emission vehicle infrastructures, the District's "Charge Up!" program funds the purchase and installation of publicly accessible electric vehicles chargers, helping build a robust charging network throughout the San Joaquin Valley. Since 2015, the District has awarded more than $1.4 million in incentives for the installation of 140 Level 2 and Level 3 electric vehicle chargers. In addition, the District is currently developing new ways to leverage its Charge Up! program by working with several different Valley entities to take advantage of current funding opportunities with the California Energy Commission and ARB to further meet the electric vehicle goals in California of reaching 1.5 million electric vehicles by 2025.

21. **COMMENT**: The District Health Risk Reduction Strategy (HRRS) ignores sectors and pollutants that should be controlled in the 2016 Ozone Plan. The 2016 Ozone Plan should focus on achieving emissions reductions from the highest stationary source NOx emitters rather than lawn care equipment and consider the impacts of VOC emissions with carcinogenic components to nearby communities. (EJ)

RESPONSE: It appears that the commenter does not have a clear understanding of the District's Health Risk Reduction Strategy, the attainment strategy outlined in Chapter 5 of the 2016 Ozone Plan, and how location specific risk from toxic emissions are addressed.

While the federal air quality standards and plan process are motivated by public health, the process set forward under the federal CAA does not guarantee that the public health benefits of control strategies will be maximized. The HRRS implements diverse control measures and strategies throughout the Valley with clear and quantifiable public health benefits that are not fully accounted for under the conventional approach. The 2016 Ozone Plan has gone well beyond just evaluating the highest stationary source NOx emitters. A comprehensive evaluation of all District rules, including source categories not subject to District rules, was performed to identify potential emissions reductions opportunities (see Appendix C of the plan). The District has also been highly successful in decreasing the urban, localized health risks associated with the use of gas-powered equipment by replacing over 3,900 high-polluting gas-powered lawn mowers with clean electric mowers.

In regards to addressing impacts of VOC emissions with carcinogenic components to nearby communities, the District operates a comprehensive air toxic program that integrates the state and federal requirements and is aimed at protecting public health. Under this program, Toxic Best Available Control Technology must be applied to all units that may pose greater than de minimus levels of risk (i.e., a cancer risk greater than one in one million). Projects that would pose significant impacts to nearby residences or businesses (i.e., a cancer risk of greater than 20 in one million) are not approvable. Additionally, under the Air Toxics "Hot Spots" Information and Assessment Act (AB2588), the District works with Valley facilities to quantify emissions of air toxics, determine the health impacts caused by those emissions, report emissions and any significant risks through written public reports and neighborhood public meetings, and take steps to reduce such risks. As a result of these efforts and the resulting emissions reductions, the risk from new and existing Valley facilities have been reduced significantly.

22. **COMMENT**: To ensure that grant funding for emissions reductions provide benefits for environmental justice communities, the District should adopt a rule that requires a certain percentage of grant funding received to spend on projects that specifically benefit environmental justice communities. (EJ)

RESPONSE: It is not clear if the commenter is suggesting whether certain communities deserve less action to reduce air pollution and improve quality of life. In working to improve public health, the District does not believe that any community in the San Joaquin Valley be left behind. The District places a strong emphasis in providing funding in a manner that benefits environmental justice communities. The District Governing Board adopted the Environmental Justice Strategy in 2007 and was the first air district to establish the Environmental Justice Advisory Group in 2010. The District works cooperatively with the Environmental Justice Advisory Group to understand the Valley's environmental justice communities and issues, and craft programs that reduce emissions in these areas. As a result of this focused effort, the District has been highly successful in designing a wide range of incentive programs that prioritize the needs of Valley Environmental Justice communities. Examples of these programs include:

- Under the District's Public Benefits Grant program, District provides additional funding of $10,500 per ton of reductions achieved in Environmental Justice communities.
- Under the Lower Emission School Bus Program, District provided match assistance to school districts in Environmental Justice communities, as determined by participation in the Free and Reduced Price Meal (FRPM) Program.
- Under the District's "Burn Cleaner" Program, District provides extra incentive ($2,500) for woodstove upgrades in low-income households.
- Under the District's Tune In Tune Up Program, District provides incentives for repairing high polluting vehicles with focused outreach in low-income communities (majority of participants from Environmental Justice communities)
- Under the District's Enhanced Fleet Modernization Program, District provides up to $15,000 in incentives for replacing high polluting vehicles for low income residents in Environmental Justice communities.

Overall, the majority of the District's incentive program grant funds have been invested in projects that have provided direct benefits to Valley Environmental Justice communities.

23. **COMMENT**: The District should require that fines or penalties paid as a result of permit violations be spent in the communities affected by the violation. (EJ)

RESPONSE: Fines or penalties paid as a result of permit violations are used efficiently to help administer an active and effective permitting and enforcement

program throughout the Valley. As has been documented in a number of independent audits of District operations, including those by oversight agencies and environmental groups, the District's robust programs have a history of exceptional performance in both effectiveness and efficiency.

24. **COMMENT**: The San Joaquin County Department of Public Works submitted a No Comment letter. (SJCPW)

RESPONSE: Comment letter has been received.

SUMMARY OF SIGNIFICANT COMMENTS
FOR THE PUBLIC WORKSHOP ON
THE DEVELOPMENT OF THE PLAN TO ADDRESS
THE 2008 8-HOUR OZONE STANDARD
HELD ON MAY 23, 2014

The District received the following comments for the public workshop on the development of the plan to address the 2008 8-hour ozone standard held on May 23, 2014.

EPA REGION IX COMMENTS:

No comments were received from EPA.

ARB COMMENTS:

No comments were received from ARB.

PUBLIC COMMENTS:

Comments were received from the following:

Aera Energy (Aera)
Milk Producers Council (MPC)
Southern California Gas Company (SoCal Gas)
United States Department of Agriculture Natural Resources Conservation Service (USDA-NRCS)
Valley Improvement Projects (VIP)

1. **COMMENT:** What is the base year of the emissions inventory used for this plan? (SoCal Gas)

RESPONSE: The base year for this plan is 2012.

2. **COMMENT:** Do high temperatures or direct ultraviolet (UV) radiation increase ozone formation? (SoCal Gas)

RESPONSE: Ozone formation is the result of photochemical reactions between oxides of nitrogen and volatile organic compounds in the presence of sunlight. Variable weather parameters, such as temperature, wind, ultraviolet radiation, and vertical stability impact ozone concentration levels. In general, strong sunlight and weak dispersion generate relatively high ozone levels while weak sunlight and strong dispersion generate relatively low ozone levels.

3. **COMMENT:** Provide more information on the air quality modeling performed for this plan. (SoCal Gas)

RESPONSE: The air quality modeling for this *2016 Plan for the 2008 8-Hour Standard* (*2016 Ozone Plan*) is an ongoing process that is currently underway with collaboration between the District and California Air Resources Board (ARB). The methodology and results from the modeling will be discussed in greater detail in future public workshops and drafts of the plan.

4. **COMMENT:** Is section 179B of the Clean Air Act (CAA), which states that an area shall not be penalized for the impact of emissions from foreign sources, addressed in the planning guidelines for the 2008 8-hour ozone standard? Has it been used by other areas in other plans, and is the District going to attempt to use it for this plan? (SoCal Gas)

RESPONSE: EPA accounts for CAA section 179B in its implementation rule for the 2008 8-hour ozone standard and sets up a framework for air districts to use it if the area would attain were it not for emissions from foreign sources; however, there is very little detail on what analyses would be required in order to rely on CAA section 179B to demonstrate attainment. Four other air districts have used section 179B, but only to address emissions from Mexico traveling into Arizona, Texas, and San Diego. If the District were to use section 179B, it would be to account for the transboundary ozone emissions emanating from China into the Valley. There is a distinction in EPA guidelines between using section 179B in a single instance, comparable to an exceptional event, and integrating it into actual attainment plan modeling which incorporates impacts over a greater period of time.

The District and Western Regional Air Partnership held a conference on the impacts of transboundary ozone in the spring of 2015.[4] This conference was a collaboration between the scientific community, air quality managers, ARB, and EPA to explore the complex issues of transboundary ozone and the use of CAA section 179B for air quality plans.

As the development of the attainment plan progresses, the District will determine the need to include a Section 179B discussion.

[4] SJVAPCD. Transboundary Ozone Pollution Conference at Tenaya Lodge. (2015) Webpage and supporting documents available at: http://www.valleyair.org/topc/presentations.htm.

5. **COMMENT:** What is the difference between modeling and planning inventories? (SoCal Gas)

RESPONSE: The modeling inventory uses the planning inventory and allocates emissions in each category to certain times in the year and certain locations in the District for modeling purposes.

6. **COMMENT:** What are spatial surrogates? (SoCal Gas)

RESPONSE: Spatial surrogates are used to allocate emissions to specific locations for purposes of modeling inventory development. Because air quality modeling attempts to replicate the physical and chemical processes that occur in an inventory it is important that the physical location of emissions be specified as accurately as possible. Ideally, the actual location of all emissions would be known exactly. In reality, however, some categories of emissions would be virtually impossible to determine – for example, the actual amount and location of consumer products used every day. Therefore, the spatial allocation of emissions in a modeling inventory approximates the actual location of the emissions. For the spatial allocation of emissions to be performed, each area source category is assigned a spatial surrogate. Examples of surrogates include population, land use, and other data with known geographic distributions for allocating emissions to grid cells.

7. **COMMENT:** If the Valley is deemed in attainment for the 1-hour ozone standard, will that change the District's obligations for submitting attainment plans with reasonably available control technology (RACT) analyses? (MPC)

RESPONSE: Attainment of the 1-hour ozone standard would not alleviate the District's legal requirements to submit attainment plans and associated demonstrations for other federal ozone or PM2.5 standards, including RACT analyses.

8. **COMMENT:** In measuring background ozone levels, is it possible to distinguish between biogenic emissions and emissions from transboundary anthropogenic sources? (MPC)

RESPONSE: Yes, the District and ARB have estimates of the background contributions from biogenic emissions and transboundary anthropogenic ozone. However, many challenges remain to refine estimates of the influence of transboundary anthropogenic ozone, its precursors, and the evolving fraction of the total transboundary flow that is anthropogenic.

9. **COMMENT:** Conversations with ARB have led me to believe that they do not support voluntary incentive-based emission reductions because they are ineffective in reducing air pollution concentrations and mandatory regulatory measures are far more effective. (VIP)

RESPONSE: This is incorrect. The District currently operates one of the largest and most well-respected incentive programs in California. Since 1992, the District's incentive programs have provided over $688 million in incentive funds. This has been matched by cost-sharing on the part of participating businesses, public agencies, and residents, who together have invested over $526 million, for a total public/private investment of well over $1.2 billion in low and zero emissions equipment and operations. These combined efforts have accelerated the adoption of cleaner technologies (beyond that achieved by stringent regulations alone), achieved over 117,000 tons of lifetime emission reductions, improved air quality and public health, and progressed the San Joaquin Valley towards attainment of increasingly stringent federal air quality standards. In addition to District-administered incentive programs, the California Air Resources Board (ARB) and the United States Department of Agriculture (USDA) Natural Resources Conservation Service (NRCS) also implement highly effective incentive programs, further reducing emissions in the Valley.

10. **COMMENT:** Public workshops should be held at times that are more accessible to the general public, such as in the evening or on weekends. (VIP)

RESPONSE: The District appreciates the comment and will consider alternative times when scheduling future workshops.

11. **COMMENT:** Why has more information not been presented on the Covanta incinerator in Stanislaus County? (VIP)

RESPONSE: This plan includes a comprehensive evaluation of emissions from all sources within the District, including the Covanta incinerator in Stanislaus County.

12. **COMMENT:** Are the impacts of all NOx emission reductions the same no matter where the reductions occur geographically, or is it more effective to reduce NOx in some areas rather than others? (Aera)

RESPONSE: The District is in the process of evaluating a potential "Hot Spot" approach for use in upcoming plans to attain the federal standards in a more cost-effective fashion by targeting a portion or the bulk of District regulatory and incentive-based strategies in areas with the highest concentrations. For more information, please refer to the following:

http://www.valleyair.org/Board_meetings/GB/agenda_minutes/Agenda/2015/May/StudySession/final/07.pdf

13. **COMMENT:** Did the results of ARB's update to the farm equipment inventory make it into the 2012 baseline inventory, and were any of the voluntary incentive reductions included? (USDA-NRCS)

RESPONSE: The results of that update were included in the 2012 baseline inventory. The emissions reductions achieved through the District or USDA-NRCS agricultural equipment incentive programs were not included in the baseline inventory and are therefore additional to the emission reduction projections included in the plan.

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