



Air Pollution Control District
San Luis Obispo County



Ambient Air Monitoring Network Assessment

**Planning, Monitoring & Outreach Division
July 2015**

Table of Contents

1.0	INTRODUCTION.....	1
2.0	SAN LUIS OBISPO COUNTY REGIONAL DESCRIPTION.....	1
2.1	Geography.....	1
2.2	Climate and Weather.....	2
2.3	Land Use, Population and Economics	3
3.0	OVERVIEW OF NETWORK OPERATION	4
3.1	Air Monitoring Network Design - Objectives and Spatial Scales	4
3.2	Ambient Air Monitoring Network in San Luis Obispo County	8
3.2.1	Ozone Monitoring Network.....	8
3.2.2	Nitrogen Dioxide Monitoring Network.....	10
3.2.3	Sulfur Dioxide Monitoring Network.....	12
3.2.4	PM ₁₀ and PM _{2.5} Particulate Monitoring Network.....	12
4.0	STATISTICAL ANALYSIS	13
4.1	Measured Concentration Analysis	14
4.1.1	Ozone Measured Concentration Analysis.....	14
4.1.2	PM _{2.5} Measured Concentration Analysis	15
4.1.3	PM ₁₀ Measured Concentration Analysis.....	16
4.2	Monitor to Monitor Correlation Analysis.....	17
4.2.1	Correlation of Ozone Monitors in San Luis Obispo County	18
4.2.2	Correlation of PM _{2.5} Monitors in San Luis Obispo County.....	19

4.3	Area Served Analysis	25
5.0	SITUATIONAL ANALYSIS	31
5.1	Risk of Future NAAQS Exceedances.....	31
5.2	Criteria Allowing Reduction of Monitors	31
5.3	Demographic Shifts	34
5.4	Scientific Research and Public Health.....	34
5.5	Other Circumstances.....	34
6.0	DISCUSSION AND CONCLUSION	35

GLOSSARY AND LIST OF ACRONYMS:

Air Basin	An area with geographical or climatic conditions that result in a relatively homogeneous air mass.	physically
APCD	Air Pollution Control District	
ARB	California Air Resources Board	
BAM	Beta Attenuation Monitor for particulate sampling	
CFR	Code of Federal Regulation	
	District San Luis Obispo County Air Pollution Control District	
EPA	U.S. Environmental Protection Agency	
FEM	Federal Equivalent Method particulate sample	
FRM	Federal Reference Method particulate sampler	
NAAMS	National Ambient Air Monitoring Strategy	
NAAQS	National Ambient Air Quality Standard	
NO ₂	Nitrogen Dioxide	
NO _x	Oxides of nitrogen	
O ₃	Ozone	
ODSVRA	Oceano Dunes State Vehicular Recreation Area	
PM ₁₀	Particulate matter 10 microns or less in aerodynamic circumference	
PM _{2.5}	Particulate matter 2.5 microns or less in aerodynamic circumference	
SLAMS	State and Local Air Monitoring Stations	
SLOCAPCD	San Luis Obispo County Air Pollution Control District	
SO ₂	Sulfur dioxide	
WDV	Vector averaged wind direction	
WSV	Vector averaged wind speed	

1.0 INTRODUCTION

The San Luis Obispo County Air Pollution Control District (SLOCAPCD) 2015 Ambient Air Monitoring Network Assessment is an examination and assessment of the technical aspects of SLOCAPCD's network of air pollution monitoring stations.

The EPA finalized an amendment to the ambient air monitoring regulations on October 17, 2006, adding a requirement for state and local monitoring agencies to conduct a network assessment once every five years [40 CFR 58.10(e)]. The purpose is to determine, at a minimum, if the network meets the monitoring objectives defined in 40 CFR 58.10 Appendix D, if new sites are needed, if existing sites may be discontinued, and whether new technologies are appropriate for incorporation into the ambient air monitoring network.

This requirement is an outcome of implementation of the National Ambient Air Monitoring Strategy (NAAMS). The purpose of the NAAMS is to optimize air monitoring networks to achieve, with limited resources, the best possible scientific value and protection of public and environmental health and welfare.

2.0 SAN LUIS OBISPO COUNTY REGIONAL DESCRIPTION

2.1 Geography

San Luis Obispo County constitutes a land area of approximately 3,616 square miles with varied vegetation, topography, and climate which creates a diversity of environmental conditions greater than its size would suggest. See Figure 1 for a detailed map of the county. The county is bordered by Monterey County to the north, Santa Barbara County to the south, and Kern County to the east, with the Pacific Ocean as the western border. From a geographical and meteorological standpoint, the County can be divided into three general regions: the Coastal Plateau, the Upper Salinas River Valley, and the East County. Air quality in each of these regions is characteristically different, with the physical features that divide them limiting the transport of pollutants between regions.

The Coastal Plateau is about five to ten miles wide and varies in elevation from sea level to about 500 feet. It is bounded on the northeast by the Santa Lucia Mountain Range, which extends almost the entire length of the County. Rising sharply to about 3,000 feet at its northern boundary, the Santa Lucia Range gradually winds southward away from the coast, finally merging into a mass of rugged features on the north side of Cuyama Canyon.



Figure 1 – Map of San Luis Obispo County

Until monitoring began in eastern San Luis Obispo County about 10 years ago, the highest ozone levels in the County were measured in the Upper Salinas River Valley. Transport of ozone precursors from the Coastal Plateau and from the San Joaquin Valley may contribute to this condition. This area of plains and low rolling hills is bounded on the west by the Santa Lucia Range and to the east by the Cholame Hills, a northern extension of the Temblor Range. Southward, the La Panza Range gradually rises east of Santa Margarita and runs roughly parallel to the coast, merging with the Caliente Range near the southern border of the County. Caliente Mountain, the highest peak in the County at 5,104 feet, is found in this range.

Eastern San Luis Obispo County is a large region by land area, but only one percent of the County population resides there. A significant portion of this area is a landlocked drainage basin called the Carrizo Plain, which lies between the La Panza and Caliente Ranges on the west and the Temblor Range to the east. These mountains join together to close the basin at the southeastern tip of the County. The Cholame Hills occupies the extreme northeastern portion of this region and, like the Temblors, lies adjacent to the San Joaquin Valley.

2.2 Climate and Weather

The climate of the County can be generally characterized as Mediterranean, with warm, dry summers and cooler, relatively damp winters. Along the coast, mild temperatures are the rule throughout the year due to the moderating influence of the Pacific Ocean. This effect is diminished inland in proportion to distance from the ocean or by major intervening terrain features, such as the coastal mountain ranges. As a result, inland areas are characterized by a considerably wider range of temperature conditions. Maximum summer temperatures average about 70 degrees Fahrenheit

near the coast, while inland valleys are often in the high 90s. Minimum winter temperatures average from the low 30s along the coast to the low 20s inland.

Regional meteorology is largely dominated by a persistent high pressure area which commonly resides over the eastern Pacific Ocean. Seasonal variations in the strength and position of this pressure cell cause seasonal changes in the weather patterns of the area. The Pacific High remains generally fixed several hundred miles offshore from May through September, enhancing onshore winds and opposing offshore winds. During spring and early summer, as the onshore breezes pass over the cool water of the ocean, fog and low clouds often form in the marine air layer along the coast. Surface heating in the interior valleys dissipates the marine layer as it moves inland.

From November through April the Pacific High tends to migrate southward, allowing northern storms to move across the County. About 90% of the total annual rainfall is received during this period. Winter conditions are usually mild, with intermittent periods of precipitation followed by mostly clear days. Rainfall amounts can vary considerably among different regions in the County. In the Coastal Plain, annual rainfall averages 16 to 28 inches, while the Upper Salinas River Valley generally receives about 12 to 20 inches of rain. The Carrizo Plain is the driest area of the County with less than 12 inches of rain in a typical year.

Airflow around the County plays an important role in the movement and dispersion of pollutants. The speed and direction of local winds are controlled by the location and strength of the Pacific High pressure system and other global patterns, by topographical features, and by circulation patterns resulting from temperature differences between the land and sea. In spring and summer months, when the Pacific High attains its greatest strength, onshore winds from the northwest generally prevail during the day. At night, as the sea breeze dies, weak drainage winds flow down the coastal mountains and valleys to form a light, easterly land breeze.

In fall and winter during Santa Ana wind conditions in Southern California, pollutants may accumulate over the ocean for a period of one or more days and can then be carried onshore with the return of the sea breeze, where they combine with local emissions to cause high pollutant concentrations along the central coast.

Strong inversions can form at any time, and can trap pollutants near the surface, which can result in an increase in pollutant concentrations at SLO County monitoring stations.

2.3 Land Use, Population and Economics

The predominant land use in San Luis Obispo County is agriculture, with the production and processing of vegetable crops, wine grapes, dryland grains, and livestock as the major components. The southern and coastal areas of the County are primarily devoted to the production of row crops (strawberries, lettuce, broccoli, peas, and other vegetables) and vegetable transplants, although cattle ranching prevails along the north coast. Vineyards, grain production, livestock grazing, and horse ranching are the dominant land uses in the Upper Salinas River Valley; the East County Plain supports some cattle ranches and dryland grain farms. Much of the County's agricultural land is property committed to agricultural use for periods of up to 20 years under the Williamson Act. In 2013, agricultural acreage totaled approximately 1,118,555 acres, with a gross crop value of \$960,710,000. Production in the animal industry was valued at \$100,865,000 for the same period.

The largest change in agricultural uses in recent years has been a substantial increase in vineyard plantings for wine grapes. In 1998 there were 11,897 bearing acres; this increased to 36,248 bearing acres in 2013.

The County's urban areas exist as separate and uniquely distinct clusters of development. San Miguel, Templeton, Atascadero, Cambria, Cayucos, Los Osos, Oceano and Nipomo are primarily residential communities; of these Atascadero is the only incorporated city. In contrast, San Luis Obispo, Morro Bay, the Five Cities area and Paso Robles have a much broader mix of commercial and residential uses. Residential development has been limited in some areas of the County as a result of moratoriums, growth management issues, and resource constraints. The 2014 estimated population of the County was 279,083. The two largest cities in the County are San Luis Obispo at 46,377 (2013, estimated) and Paso Robles at 30,875 (2013, estimated).

The City of San Luis Obispo is the County seat and commercial center of the region. Commercial and industrial development has been growing steadily in the northern areas of the County, particularly in Atascadero and Paso Robles.

3.0 OVERVIEW OF NETWORK OPERATION

3.1 Air Monitoring Network Design - Objectives and Spatial Scales

Federal regulations require that a network of State and Local Air Monitoring Stations (SLAMS) be designed to meet a minimum of six basic ambient air monitoring objectives:

1. To determine the highest concentration expected to occur in the area covered by the network;
2. To determine representative concentrations in areas of high population density;
3. To determine the impact on ambient pollution levels of significant sources or source categories;
4. To determine general background concentration levels;
5. To determine the extent of regional pollutant transport among populated areas, and in support of secondary standards;
6. To determine the welfare-related impacts in more rural and remote areas (such as visibility impairment and effects on vegetation).

The goal in designing a SLAMS network is to establish monitoring stations that will provide data to meet these monitoring objectives. The physical siting of the air monitoring station must achieve a spatial scale of representativeness that is consistent with the monitoring objective. The spatial scale results from the physical location of the site with respect to the pollutant sources and categories. It estimates the size of the area surrounding the monitoring site that experiences uniform pollutant concentrations. The categories of spatial scale are:

- Microscale - An area of uniform pollutant concentrations ranging from several meters up to 100 meters.
- Middle Scale - uniform pollutant concentrations in an area of about 110 meters to 0.5 kilometer.
- Neighborhood Scale - an area with dimensions in the 0.5 to 4 kilometer range.
- Urban Scale - Citywide pollutant conditions with dimensions from 4 to 50 kilometers.

- Regional Scale – An entire rural area of the same general geography (this area ranges from tens to hundreds of kilometers).

Table 1: Relationship Among Monitoring Objectives and Scale of Representativeness.

Monitoring Objective	Appropriate Spatial Scale
Highest concentration	Micro, middle, neighborhood (sometimes urban)
Population	Neighborhood, urban
Source impact	Micro, middle, neighborhood
General/Background	Neighborhood, urban, regional
Regional transport	Urban, regional
Welfare-related impacts	Urban, regional



Figure 2: Historical Ambient Air Monitoring Locations in San Luis Obispo County

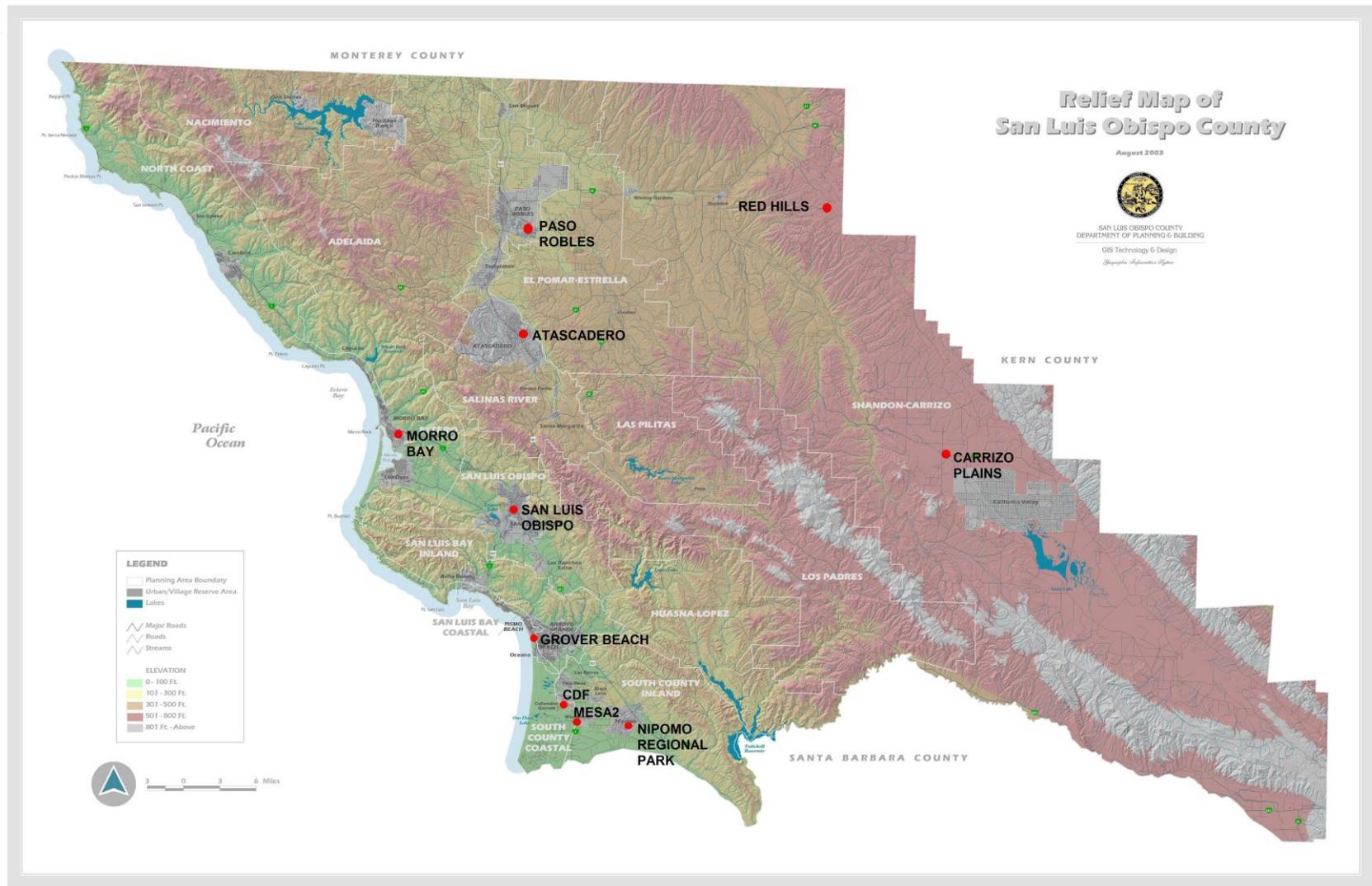


Figure 3: Ambient Air Monitoring Stations Operating in San Luis Obispo County in 2014/2015

3.2 Ambient Air Monitoring Network in San Luis Obispo County

Figure 2 shows a map of the most historical ambient air monitoring locations dating back to 1976. Some of these sites were operated for a year or less during the first few years when monitoring was conducted in the County in order to gauge the need for air quality surveillance at that location. Other sites were part of various studies the District has been involved in over the years such as the Central Coast Ozone Study, the San Joaquin Valley Air Quality Study/AUSPEX, the San Luis Obispo County Regional Ozone Study, and a number of smaller short-term monitoring efforts. The map also includes monitoring stations still in operation. From viewing the map it is clear that all of the populated areas and most of the rural portions of the County have had ambient air monitoring performed at some time in the past. Not included in the map are the more than 20 PM₁₀ monitors that were temporarily deployed on the Nipomo Mesa in 2012 as part of the Community Monitoring Study.

Figure 3 shows a map of all currently operating ambient air monitoring stations in San Luis Obispo County. Table 2 lists these stations, the agency which operates them, the pollutant or meteorological parameters which are monitored at each location and the monitoring objective. The existing monitoring site locations are the result of years of sampling and evaluating data to determine the optimum network configuration. The SLOCAPCD air monitoring network is a dynamic system that can and should change with changing conditions.

There are currently ten permanent ambient air monitoring stations in San Luis Obispo County. Eight of these stations are operated by the District as part of our SLAMS network. The ARB operates two stations in the County as part of their SLAMS network: one at Paso Robles and one in San Luis Obispo. In addition to these 10 stations, a PM₁₀ monitor has recently begun collecting data in the Oso Flaco area of the Oceano Dunes State Vehicular Recreation Area. This special purpose monitor is owned by the State of California Department of Parks and Recreation and may be operated by the District. Its purpose is to fulfill the requirements of District Rule 1001.

3.2.1 Ozone Monitoring Network

All ambient air monitoring stations in the County monitor for ozone except for CDF, Mesa2, and Grover Beach (see Table 2). The SLAMS network in San Luis Obispo County thus features ozone monitors located in Atascadero, Red Hills, Carrizo Plains, Paso Robles, Morro Bay, San Luis Obispo, and Nipomo Regional Park.

Atascadero –SLOCAPCD has operated an ozone monitor in Atascadero since 1988. This station was moved in 2015 from a site located in the central business district of downtown Atascadero to a nearby city property. The original location was bounded on two sides by public schools, and the new site is adjacent to a community center. The monitor continues to be classified as population-oriented and neighborhood scale. It also records the highest ozone concentrations in the western San Luis Obispo attainment area. It provides a measurement of representative ozone concentration for the City of Atascadero. Ozone concentrations at this site exhibit strong diurnal fluctuations caused by titration of ozone by oxides of nitrogen from nearby mobile and residential sources. Measured concentrations at this site are similar to those recorded at Paso Robles, and are often the highest among the five ozone monitors in the western portion of the County that is classified as

attaining the federal ozone standard. The highest ozone concentrations at Atascadero occur when there is transport of ozone and other pollutants into the County. Under these infrequent conditions, transported ozone enhanced by local pollutants can cause highly elevated concentrations.

Carrizo Plains – Operated by SLOCAPCD since January 2006, this station monitors background levels and ozone transport on a regional scale. The monitor is located in an outbuilding at the Carrizo Plains Elementary School. The ozone concentrations recorded here are second only to Red Hills in concentration and persistence; it is located within the eastern San Luis Obispo County non-attainment area.

Morro Bay – Operated since 1975 by SLOCAPCD, this site provides regional scale and general/background ozone monitoring. Located in downtown Morro Bay, the monitor generally measures background levels of ozone from the predominant northwest winds blowing off of the Pacific Ocean. Under Santa Ana meteorological conditions, the site can record elevated ozone concentrations transported from urban areas in southern California. This is the closest monitor to the shore in the County and one of the longest operating; as such it is excellent for tracking long term trends in background levels of ozone.

Nipomo Regional Park (NRP) – Operated by SLOCAPCD since 1998, this station provides monitoring of background levels of ozone on a regional scale. Previously (1979 to 1996) ozone had been monitored in Nipomo on Wilson Street several miles away. The ozone concentrations measured at NRP are representative of interior portions of the Nipomo Mesa and are the highest recorded in the coastal region of San Luis Obispo County.

Paso Robles – Operated by ARB since 1974, this population-oriented neighborhood scale ozone monitor provides a representative ozone concentration for the suburban areas of the City of Paso Robles. The conditions under which elevated ozone levels occur and the location's prevailing winds are similar to Atascadero.

Red Hills – Operated by SLOCAPCD since 2000, this station is located on the summit of the Red Hills east of the community of Shandon at an elevation of about 2,000 feet. This regional scale site is often influenced by ozone transport from outside of the County and consistently records the highest and most persistent ozone concentrations in the network; its site type is thus regional and maximum concentration. In early 2012, the eastern portion of the County was designated as marginally non-attainment for the Federal 8-hr ozone standard based on the design value from this site.

San Luis Obispo – ARB has operated a population-oriented, neighborhood scale ozone monitor in the City of San Luis Obispo since 1970. The monitor has been at its current site since 2005. It provides a representative ozone concentration for the City of San Luis Obispo. The monitor is located in the urban area where ozone concentrations are significantly depleted by titration with local mobile and stationary NO_x sources. As a result the ozone concentrations recorded here are often lower than at Morro Bay.

As noted in Table 2, the SLAMS site types employed by the existing ozone network are:

1. Highest Concentration – The Red Hills station typically records the highest ozone concentrations in the County. High ozone levels tend to occur in the interior areas of the county during summer, or as a result of additional transported pollutants from regions outside of SLO County (SF Bay Area- San Joaquin Valley – Southern California). Among the sites in the western portion of the County, which is classified as attaining the ozone standard, Atascadero and Paso Robles measure the highest concentrations. In 2014, Atascadero had a higher design value than Paso Robles, but in early years Paso Robles has often been higher.
2. Population Exposure – The Paso Robles, Atascadero and San Luis Obispo monitors provide a good representation of the ozone levels in the larger cities of the County.
3. Source Impact – Because ozone is a secondary pollutant the effect of emissions from any single source are experienced five to seven hours later and often many miles distant. As a regional pollutant, monitoring for specific sources of ozone is not performed.
4. General/Background – The monitors at Morro Bay, Carrizo Plains and Nipomo Regional Park provide regional background ozone levels.
5. Regional Transport – The stations located at Carrizo Plains and Red Hills provide excellent surveillance of regional transport of ozone into the interior part of the County. Coastal monitoring stations have provided evidence in the past of regional transport of ozone over water from distant urban sources.

3.2.2 Nitrogen Dioxide Monitoring Network

The SLAMS network in San Luis Obispo County features nitrogen dioxide (NO₂) monitors at Atascadero, Morro Bay, and Nipomo Regional Park. NO₂ levels have always been well below the State and Federal standards at all locations in our County. For this reason NO₂ monitoring is most useful here as an indicator of depletion of ambient ozone through titration with nitric oxide. These monitors also serve long-term air quality surveillance roles.

Atascadero – Operated by SLOCAPCD since 1990 and relocated in 2015, this population-oriented monitor is considered neighborhood scale. This is the only NO₂ monitor in the Salinas River air basin in the County, and it records the highest NO, NO₂ and NO_x levels in the County. The monitor's location downtown has established a strong diurnal inverse relationship between ozone and NO₂ levels caused by local mobile sources and residential and commercial combustion of natural gas.

Morro Bay – Operated by SLOCAPCD since 2001 this monitor is neighborhood scale and was established to monitor emissions from the Morro Bay power plant, located less than a mile upwind. The plant permanently closed in February 2014.

Nipomo Regional Park – Operated by the SLOCAPCD since 1998, this monitor is regional in scale and is representative of background concentrations on the Nipomo Mesa. The site's location in a large natural area away from local or mobile sources makes it ideal for regional surveillance of NO₂.

The SLAMS sites in the existing NO₂ network are:

1. Highest Concentration – The Atascadero monitor historically has measured the highest NO₂ concentrations in the County. NO₂ levels are the result of titration of ambient ozone by local sources of nitric oxide and as a result values are always relatively low. Levels have never exceeded the 1-hr NO₂ standard (100 ppb), with annual maximum 1-hr concentrations typically around 50% of the standard.
2. General/Background – With no significant local sources present the monitors at Nipomo Regional Park and Morro Bay provide excellent information on background levels of NO₂.

Regional Transport and Welfare-Related impacts of NO₂ are not currently addressed by the District's SLAMS network and are not thought to be significant. With the closure of the Morro Bay power plant—the only potentially significant point source of NO₂ in the County—no monitors in the network are considered to be source-oriented. The San Luis Obispo-Paso Robles MSA, does not have any NO₂ sites for vulnerable populations, near-road NO₂ monitoring sites, or area-wide NO₂ sites.

Table 2: Ambient Air Quality Parameters Monitored and Site Types in San Luis Obispo County in 2014/2015

Site	Ozone ^b	Nitrogen Dioxide	Sulfur Dioxide	PM ₁₀	PM _{2.5}	Wind ^c	Temp
Atascadero	P, C	P, C		P	P	X	X
Carrizo Plains	T, B					X	X
CDF				S, C	S, C	X	
Grover Beach						X	
Mesa2			S, C	S	S	X	X
Morro Bay	B	B				X	
Nipomo Regional Park (NRP)	B	B		B		X	X
Paso Robles ^a	P			P		X	X
San Luis Obispo ^a	P			P	P	X	X
Red Hills	T, C					X	X

Site Types: B = General/Background, C = Highest Concentration, P = Population Exposure, T = Regional Transport, S= Source Oriented, X = Parameter measured at this site. **Notes:** ^a Paso Robles and San Luis Obispo are operated by ARB; all other sites are operated by SLOCAPCD. ^b Atascadero is the highest concentration site for the western County attainment area, while Red Hills is the highest concentration site for the eastern County non-attainment area. ^c Wind speed, wind direction, and sigma theta.

3.2.3 Sulfur Dioxide Monitoring Network

The sulfur dioxide (SO₂) monitoring network in San Luis Obispo County currently consists of one station: Mesa2.

Mesa2 – Established in 1989 and operated by the SLOCAPCD since 2006, this monitor performs surveillance of a nearby oil refinery. It is considered middle scale and highest concentration for SO₂. Since it is located close to and downwind of a major source of SO₂ emissions, it is representative only of the immediate area. The station was sited to optimize surveillance of the refinery's nearby coke calciner, which has since been shut down. Nonetheless, the refinery remains the largest point source of SO₂ in the County, and during upsets this monitor can record concentrations approaching and sometimes exceeding the NAAQS. In addition to meeting NAAQS compliance objectives, this site is also vital for public information and emergency response.

The SLAMS SO₂ monitoring objectives met by the network are:

1. Highest Concentration – The monitor at Mesa2 records the highest SO₂ levels in the County.
2. Source Impact – The monitor at Mesa2 is invaluable in determining the SO₂ source impact upon the immediate region.

Monitoring objectives not addressed by the existing SO₂ network are: General/Background, Population, Regional Transport, and Welfare-Related. Historical SO₂ monitoring performed elsewhere in the County (at NRP from 1998-2006; Morro Bay, 1979-1995; Grover Beach, 1982-2004; and at decommissioned stations in Arroyo Grande "Ralcoa" (06-079-1005), 1991-2002, and "Mesa1" (06-079-3002), 1987-94) suggest that monitoring for these objectives is not needed. Furthermore, background levels of SO₂ in the County are believed to be negligible, since more than 98% of hourly SO₂ levels from Mesa2 were 1 ppb or less in 2014. As demonstrated in the 2015 Annual Network Plan for San Luis Obispo County, the Mesa2 monitor fulfills minimum monitoring requirements for the County.

3.2.4 PM₁₀ and PM_{2.5} Particulate Monitoring Network

The particulate monitoring network in San Luis Obispo County consists of six Federal Equivalent Method (FEM) PM₁₀ monitors (Paso Robles, Atascadero, San Luis Obispo, Mesa2, CDF and Nipomo Regional Park) and four FEM PM_{2.5} monitors (Atascadero, CDF, Mesa2 and San Luis Obispo). The PM₁₀ network has been in place since 1988, and PM_{2.5} samplers began operation in 1999 in response to the establishment of a new Federal standard for PM_{2.5} in 1997. Originally all particulate monitoring in the County was performed as part of ARB's network, but eventually all monitors except those at Paso Robles and San Luis Obispo became part of the SLOCAPCD network.

Initially, all particulate sampling was conducted by filter-based Federal Reference Method (FRM) methods. With the advent of continuous monitoring technologies, all the FRM monitors in the County have been replaced with FEM monitors in recent years. These are continuous semi-real time monitors that report hourly PM concentrations. The hourly data has greatly improved the SLOCAPCD abilities to issue timely air quality forecast which is a significant benefit for the advancement of public health goals.

Atascadero – Operated by SLOCAPCD, PM₁₀ monitoring has been conducted here since 1988, initially via a FRM and currently with a continuous FEM monitor. Collocated FRM PM_{2.5} monitors began operation in 1999 and have since been replaced by a single FEM. All monitors are neighborhood in scale and representative of particulate concentrations in the City of Atascadero. As previously noted, the station was moved about 400 meters north of its original location in February 2015.

Mesa2 – PM₁₀ sampling began at this site in 1991, and the monitors have been operated by the SLOCAPCD since 2006. This site initially featured collocated FRM PM₁₀ samplers that were replaced by a single continuous FEM PM₁₀ monitor in 2009. A continuous PM_{2.5} FEM monitor was installed at the same time. This site monitors source impacts from the nearby oil refinery and coastal dunes. It is neighborhood scale. These monitors record some of the highest particulate levels in the County and are strongly influenced by the extensive coastal sand dunes and the Oceano Dunes State Vehicular Recreation Area (ODSVRA) located upwind.

CDF – Originally established for the SLOCAPCD’s Nipomo Mesa Phase 2 Particulate Study, this site has become a permanent part of our SLAMS particulate network. The site features continuous FEM samplers for PM₁₀ and PM_{2.5}, which are neighborhood in scale and measure source impacts from the ODSVRA. These monitors record the highest particulate levels in the County and are strongly influenced by the ODSVRA, located directly upwind. In 2012, extensive temporary monitoring on the Nipomo Mesa confirmed that this site is located within the one square mile sector of the study area that experiences the highest PM₁₀ levels.¹

Nipomo Regional Park – Operated at this location by SLOCAPCD since 1998, it replaced a site at Wilson Street in Nipomo that operated from 1990-96. The 1-in-6 day FRM PM₁₀ sampler was replaced with a continuous FEM sampler in 2010. The monitor is regional in scale and is representative of PM₁₀ concentrations on the Nipomo Mesa.

Paso Robles – Operated by ARB since 1991 this PM₁₀ monitor is urban in scale and representative of the city of Paso Robles. The FRM sampler at this site was replaced with an FEM PM₁₀ sampler in August 2009.

San Luis Obispo – Operated by ARB, a PM₁₀ sampler has been in place since 1988, and a PM_{2.5} sampler since 1999. ARB replaced the FRM samplers with continuous FEM instruments in 2011. These population-oriented monitors are neighborhood in scale and represent particulate concentrations in the City of San Luis Obispo.

4.0 STATISTICAL ANALYSIS

A variety of statistical tests were run to examine the comprehensiveness and suitability of the SLOCAPCD monitoring network. All analyses, with the exception of the measured concentration statistics, were performed using the assessment tools provided by EPA and Lake Michigan Air

¹ San Luis Obispo County Air Pollution Control District, “South County Community Monitoring Project,” January 2013. Available online: <http://slocleanair.org/communitymonitoringproject>

Directors Consortium.² As discussed in greater detail below, many of these tools fail to accurately capture the on-the-ground reality of air quality in the County. However for the sake of transparency, all results are included below.

4.1 Measured Concentration Analysis

Individual monitors are ranked based on the concentration of pollutants they measure. Monitors that measure high concentrations or have high design values are ranked higher than monitors that measure low concentrations. Results can be used to determine which monitors are less useful in meeting the monitoring objective of NAAQS compliance. Three-year average design values were calculated for the period 2012 to 2014 for ozone, NO₂, and PM_{2.5}. For PM₁₀ the third highest 24-hour average for the period 2013 to 2014 was used, since some monitors had insufficient data for 2012. The results of the measured concentration analysis are presented in Tables 3, 4, 5, and 6.

4.1.1 Ozone Measured Concentration Analysis

For this pollutant, the District considers there to be three distinct air quality regions in the County: the Coastal Plateau, the Upper Salinas River valley, and eastern San Luis Obispo County. Of the three population-oriented monitors only Atascadero and Paso Robles are in the same air quality region. Although the sites are very similar, Atascadero tends to record higher concentrations of ozone than Paso Robles as shown in Table 3, below.

Three ozone monitors are classified as background-oriented monitors. All three of these monitors are in different air quality regions and provide unique information.

² Lake Michigan Air Director's Consortium. "NetAssess," <http://ladco.github.io/NetAssessApp/index.html>. Accessed May 2015.

Table 3: Ozone Measured Concentration Analysis

Site	Address	AQS Site Code	Design Value 2012-2014 (ppm)	Monitoring Objective	Spatial Scale	Rank
Red Hills	3601 Gillis Canyon Road	06-079-8005	0.076	Transport/Highest Concentration	Regional	1
Carrizo Plains	9640 Carrizo Highway	06-079-8006	0.070	Background	Regional	2
Atascadero	6005 Lewis Avenue	06-079-8001	0.063	Population	Neighborhood	3
Paso Robles	235 Santa Fe Avenue	06-079-0005	0.061	Population	Neighborhood	4
NRP	Nipomo Regional Park	06-079-4002	0.058	Background	Regional	5
San Luis Obispo	3220 South Higuera Street	06-079-2006	0.054	Population	Neighborhood	6
Morro Bay	Morro Bay Blvd & Kern	06-079-3001	0.053	Background	Regional	7

4.1.2 PM_{2.5} Measured Concentration Analysis

For this pollutant, there are three air quality regions in the County: the South County Coastal Region, which is strongly influenced by the ODSVRA, the Upper Salinas River Valley, and the Coastal Plateau. Table 4 presents the ranking of PM_{2.5} monitors. Although Atascadero ranked higher than San Luis Obispo in this analysis, the samplers are in different air quality regions. The CDF monitor measured higher concentrations than the Mesa2 monitor; both are source oriented monitors.

Table 4: PM_{2.5} Measured Concentration Analysis

Site	Address	AQS Site Code	24 Hour Design Value 2012-2014 (ug/m ³)	Annual Design Value 2012-2014 (ug/m ³)	Monitoring Objective	Spatial Scale	Rank
CDF	2391 Willow Rd.	06-079-2007	30	11.6	Source	Neighborhood	1
Mesa2	1300 Guadalupe Road	06-079-2004	24	9.3	Source	Neighborhood	2
Atascadero	6005 Lewis Avenue	06-079-8001	20	6.4	Population	Neighborhood	3
San Luis Obispo	3220 South Higuera Street	06-079-2006	13	6.3	Population	Neighborhood	4

4.1.3 PM₁₀ Measured Concentration Analysis

The air quality regions for PM₁₀ are the same as those for PM_{2.5}. The analysis ranked monitors based on third highest measured concentration from 2013 to 2014. (Data for 2012 was omitted because not all monitors had complete data for this year). The two source-oriented monitors, CDF and Mesa2, are in place to perform surveillance of a significant area source of fine particulate at the ODSVRA; recently installed mitigation measures on the ODSVRA were sited to mainly influence the CDF monitor. As was the case with ozone, of the three population-oriented monitors only Atascadero and Paso Robles are in the same air quality region.

Table 5: PM₁₀ Measured Concentration Analysis

Site	Address	AQS Site Code	3 rd High 24 Hour (ug/m ³) 2013-2014	Monitoring Objective	Spatial Scale	Rank
CDF	2391 Willow Road, Arroyo Grande	06-079-2007	158	Source	Neighborhood	1
Mesa2	1300 Guadalupe Road, Arroyo Grande	06-079-2004	125	Source	Neighborhood	2
NRP	Nipomo Regional Park, Nipomo	06-079-4002	86	Background	Regional	3
Paso Robles	235 Santa Fe Avenue, Paso Robles	06-079-0005	79	Population	Urban	4
Atascadero	6005 Lewis Avenue, Atascadero	06-079-8001	59	Population	Neighborhood	5
San Luis Obispo	3220 South Higuera Street, San Luis Obispo	06-079-2006	41	Population	Neighborhood	6

4.1.4 NO₂ Measured Concentration Analysis

The air quality regions for NO₂ are the same as those for ozone. Table 6 presents the ranking of these monitors. The Morro Bay monitor is located just downwind of the Morro Bay Power Plant, which operated sporadically during the period in which these data were collected and closed permanently in 2014.

Table 6: NO₂ Measured Concentration Analysis

Site	Address	AQS Site Code	Design Value (ppb) 2012-2014	Monitoring Objective	Spatial Scale	Rank
Atascadero	6005 Lewis Avenue	06-079-8001	39	Population	Neighborhood	1
Morro Bay	Morro Bay Blvd & Kern	06-079-3001	32	Background	Neighborhood	2
NRP	Nipomo Regional Park	06-079-4002	27	Background	Regional	3

4.2 Monitor to Monitor Correlation Analysis

Concentrations at one monitor are compared to concentrations measured at other monitors to determine if their concentrations correlate temporally. Monitor pairs with Pearson correlation values near one (straight line in the figures) are highly correlated; monitor pairs with Pearson correlation values near zero (circle) have no correlation. Monitors that do not correlate well with other monitors exhibit unique temporal concentration variation relative to other monitors and are likely to be important for assessing local emissions, transport and spatial coverage. Monitor pairs with high Pearson correlation values (e.g., $r > 0.75$) exhibit similar temporal concentrations.

Monitor pairs with low average relative difference (white or light yellow color) measure similar ozone concentrations, while monitors with high average relative differences (red to blue color) measure significantly different concentrations.

Possibly redundant sites would exhibit fairly high correlations consistently and would have low average relative difference despite the distance between them. Usually it is expected that the correlation between sites will decrease as distance increases. However, for a regional air pollutant such as ozone, sites in the same airshed can have very similar concentrations and be highly correlated. More unique sites would exhibit the opposite characteristics. They would not be very well correlated with other sites and their relative difference would be higher than other site to site pairs.

4.2.1 Correlation of Ozone Monitors in San Luis Obispo County

Figure 4, below, depicts a correlation matrix comparing ozone monitors from San Luis Obispo and nearby monitors outside the County. The analysis reveals a significant correlation between ozone monitors located in southern coastal San Luis County and Santa Maria in northern Santa Barbara County. In interior San Luis Obispo County, Carrizo Plains and Red Hills show strong correlation. It is not surprising that a regional pollutant like ozone would show correlations within the same air basin. The analysis does show little correlation between monitors in the southern coastal region of San Luis Obispo with monitors in the interior.

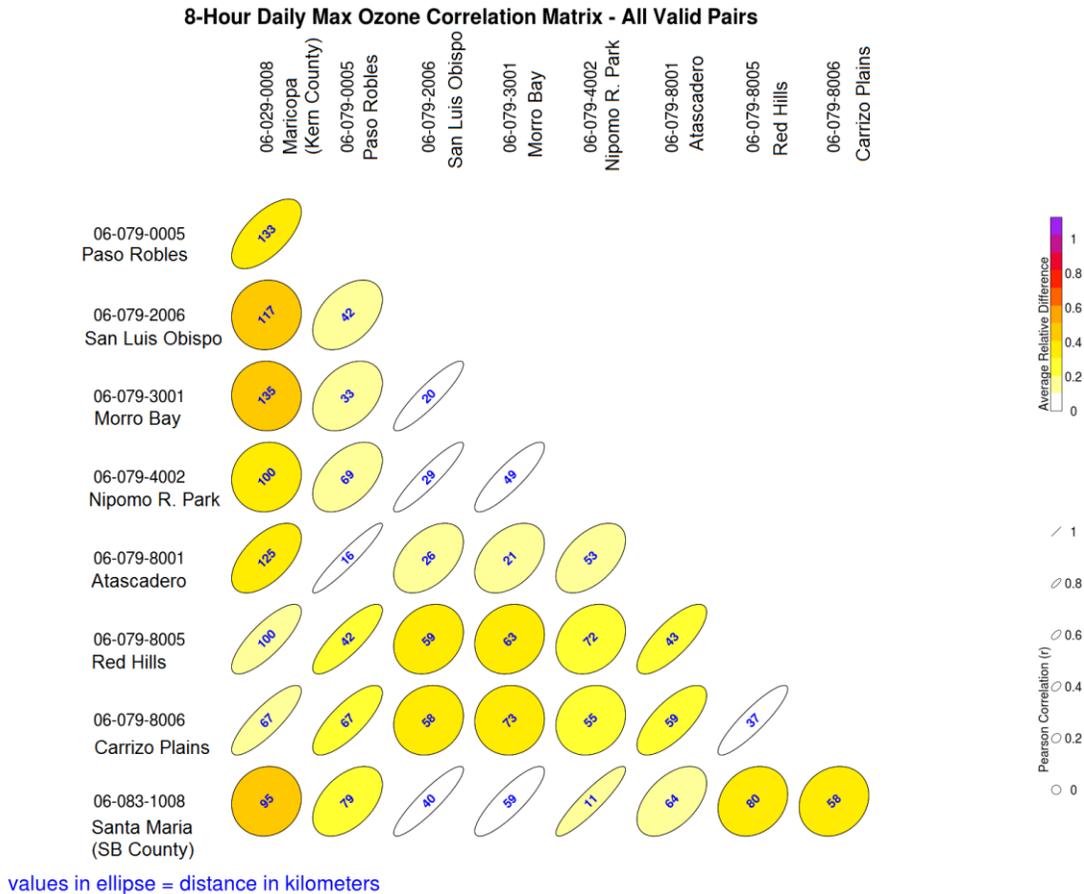
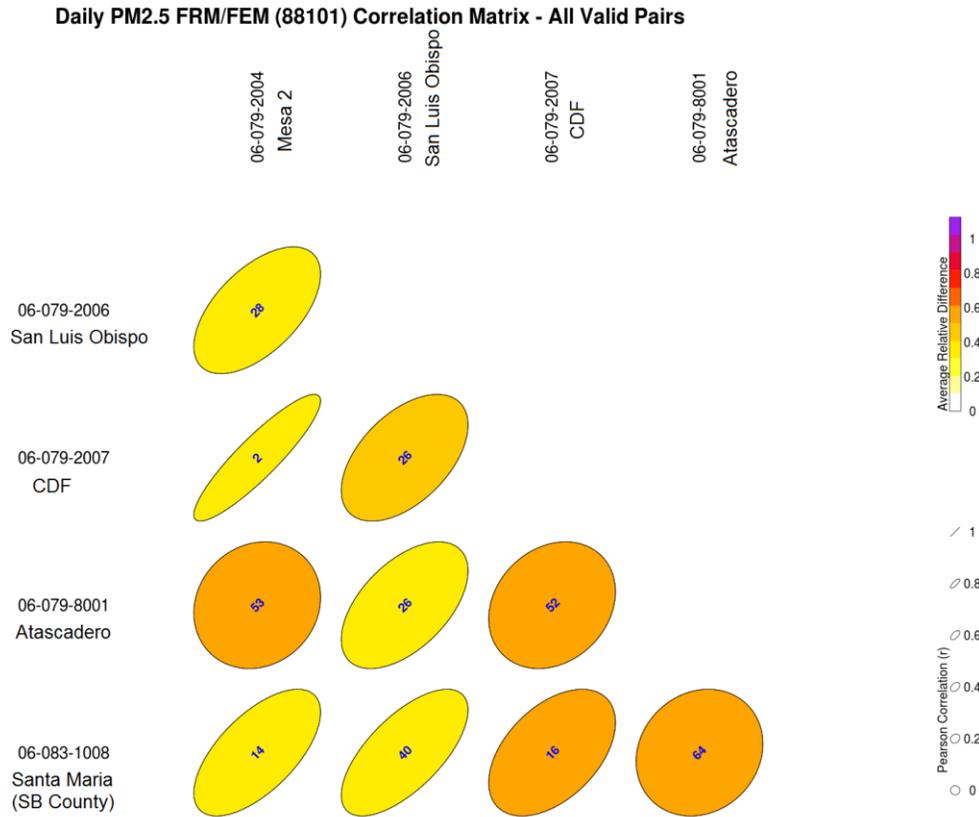


Figure 4: Correlation of Ozone Monitors in San Luis Obispo County

4.2.2 Correlation of PM_{2.5} Monitors in San Luis Obispo County

Figure 5 depicts a correlation matrix comparing PM_{2.5} monitors from San Luis Obispo and adjoining counties. The only two sites with any significant correlation are Mesa2 and CDF. It is not surprising as they are only located 2 km apart and both sites are largely influenced by the same PM source - coastal dunes.



values in ellipse = distance in kilometers

Figure 5: Correlation of FRM PM_{2.5} Monitors in San Luis Obispo County

4.3 Removal Bias Analysis

The removal bias analysis is a tool used in determining possible redundant sites. The bias estimation uses the nearest monitoring site neighbors to each site to estimate the concentration at the location of the site if the site had never existed. This is done using the Voronoi Neighborhood Averaging algorithm with inverse distance squared weighting. The squared distance allows for higher weighting on concentrations at sites located closer to the site being examined. Terrain features, meteorology, and local sources are not included in the analysis. The bias was calculated for each day at each site by taking the difference between the predicted value from the interpolation and the measured concentration. A positive average bias would mean that if the site being examined was removed, the neighboring sites would indicate that the estimated concentration would be larger than the measured concentration. Likewise, a negative average bias would suggest that the estimated concentration at the location of the site is smaller than the actual measured concentration. A site with no bias indicates that the estimated concentration at the location of the site matches the actual measured concentration. Sites with little to no bias are sites where removal could be considered.

4.3.1 Removal Bias Analysis for Ozone in San Luis Obispo County

The removal bias analysis presented in Figure 6 shows low average bias for the Atascadero and Paso Robles monitors, implying that concentrations at these locations are well predicted by the other monitors. However, the maximum and minimum daily relative bias between the predicted and measured concentrations at these sites is significant, indicating that while the mean relative bias is negligible, there are periods where there is significant relative bias between the actual and predicted concentration at these sites.

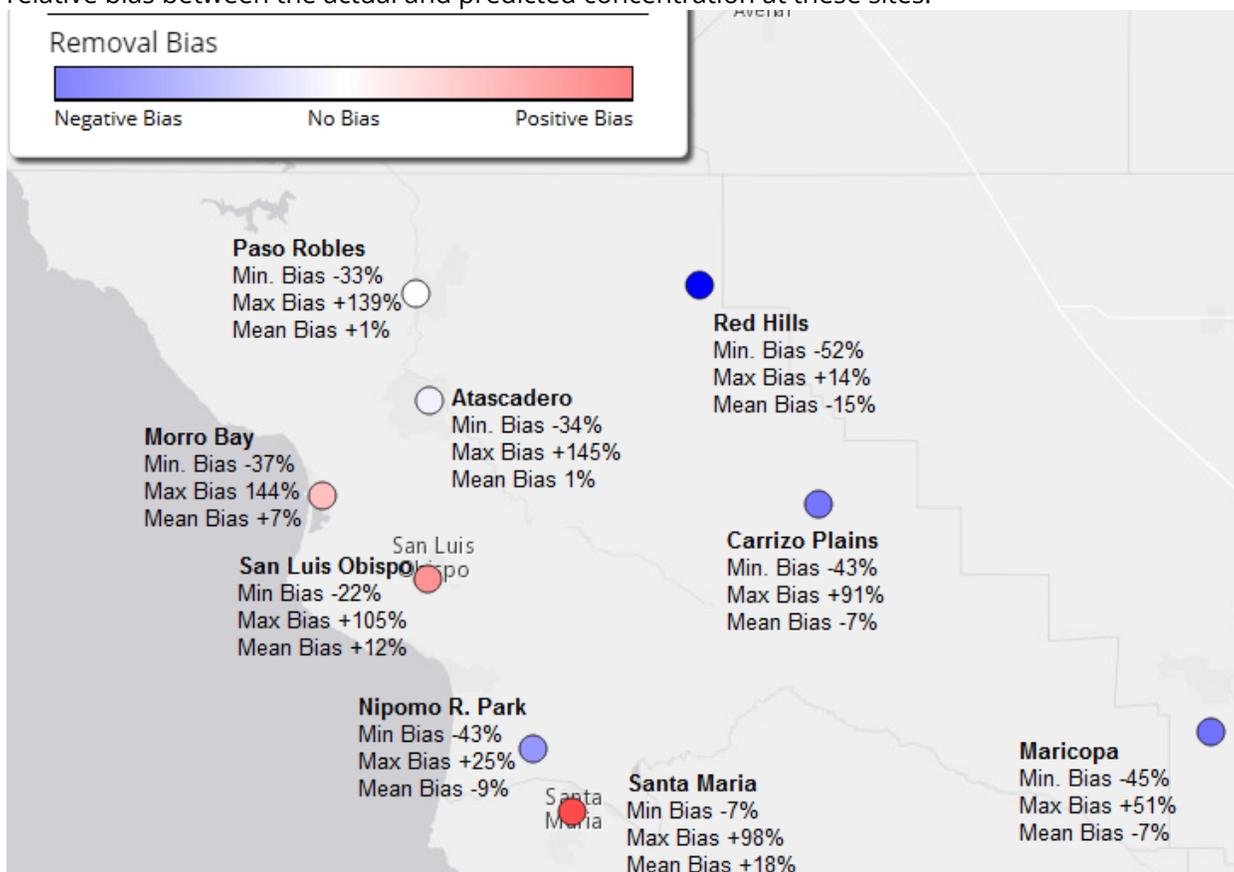


Figure 6: Removal Bias Analysis for Ozone

4.3.2 Removal Bias Analysis for PM_{2.5} in San Luis Obispo County

The PM_{2.5} removal bias analysis presented in Figure 7 shows significant relative bias between predicted and measured concentrations between all sites. This indicates that if any monitor was discontinued, concentrations at that site could not easily be predicted based on the levels measured at the remaining monitors.

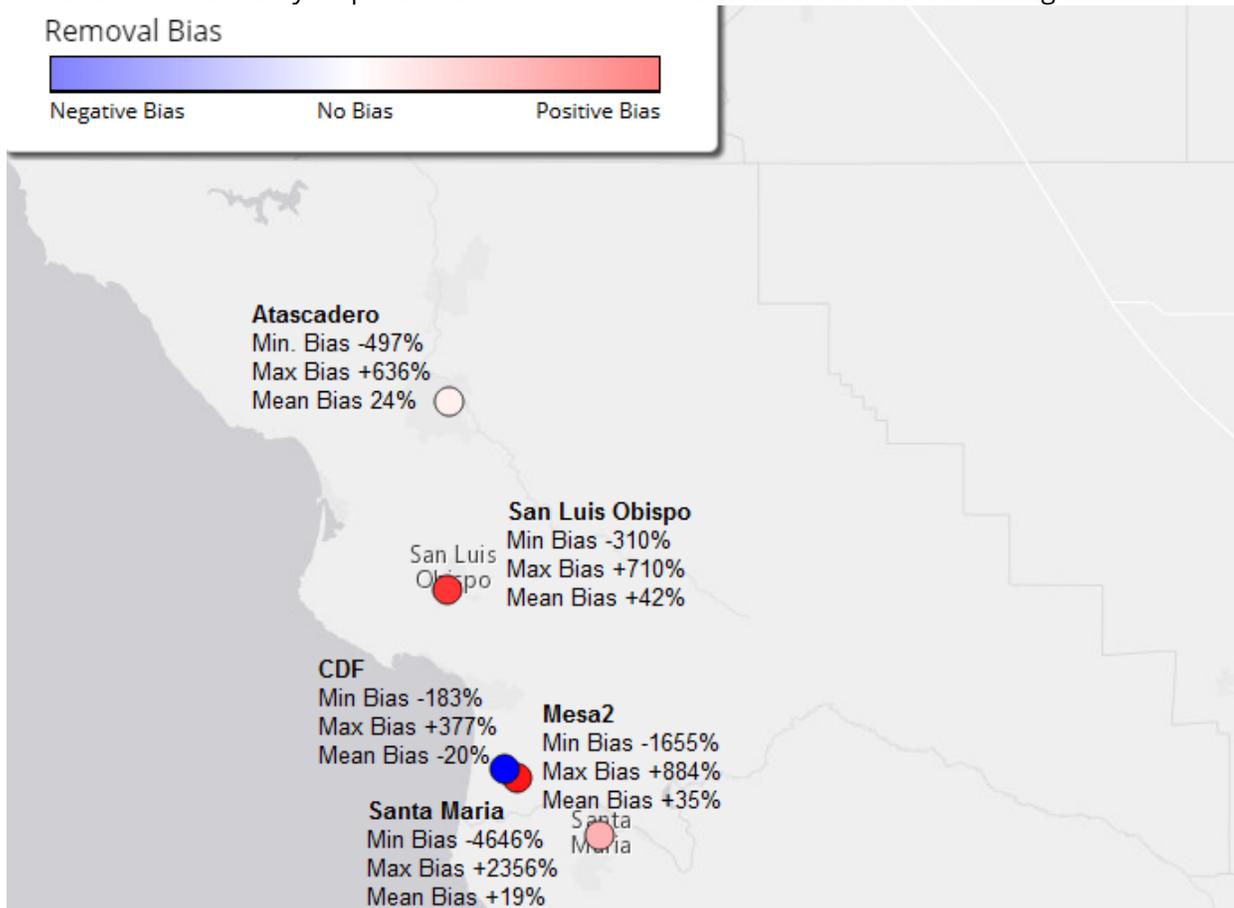


Figure 7: Removal Bias Analysis for PM_{2.5}

4.4 Exceedance Probability Surface Maps

A significant goal of the network assessment is to determine if new sites are needed. In order to make that decision, it is helpful to have some estimation of the extreme pollution levels in areas where no monitors currently exist. To assist in understanding the probability of exceedances occurring in areas where no monitors exist, surface probability maps were generated. These maps were generated by calculating estimates of the pollutant of interest for the centroid of each census tract. These are statistical estimates from “fusing” modeling data and ambient monitoring data using Bayesian space-time methods.

These maps are intended to be used as a spatial comparison and not for probability estimates for a single geographic point or area. The probability estimates displayed on the map alone should not be used to justify a new monitor. The maps should be used in conjunction with existing monitoring data. This information, along with demographic and emissions data, could be used in a weight of evidence approach for proposing new monitor locations. It is important to note that in compiling the data to generate these maps, some details are lost in the fusing of modeling and monitoring data. For example, the ozone probability maps show a slightly higher probability of an exceedance occurring at the Carrizo Plains site than the Red Hills site, yet monitoring data from the two sites show the opposite. Another example is the PM_{2.5} probability map, which shows low exceedance probability for the area of the CDF and Mesa2 monitors, while monitoring data show occasional exceedances of Federal PM Standards. It is therefore important to utilize these maps for general patterns, not absolute values.

4.4.1 Ozone Surface Probability Maps for San Luis Obispo County

In November 2014, EPA announced plans to lower the ozone standard from the current 75 ppb level to somewhere between 65 ppb and 70 ppb. At this time, it is unknown what level the revised standard will be set at, or if it will change at all. Therefore surface probability maps were generated for the existing standard of 75 ppb for an 8 hour average, a potential new standard set at 70 ppb, and a potential new standard set at 65 ppb. These maps are presented as Figures 8, 9, and 10. All of the maps show low probability of finding a new site location in the coastal portion of San Luis Obispo County where ozone exceedances might be measured. The maps do show that it is the interior portion of San Luis Obispo County where there is greater probability of measuring ozone exceedances.

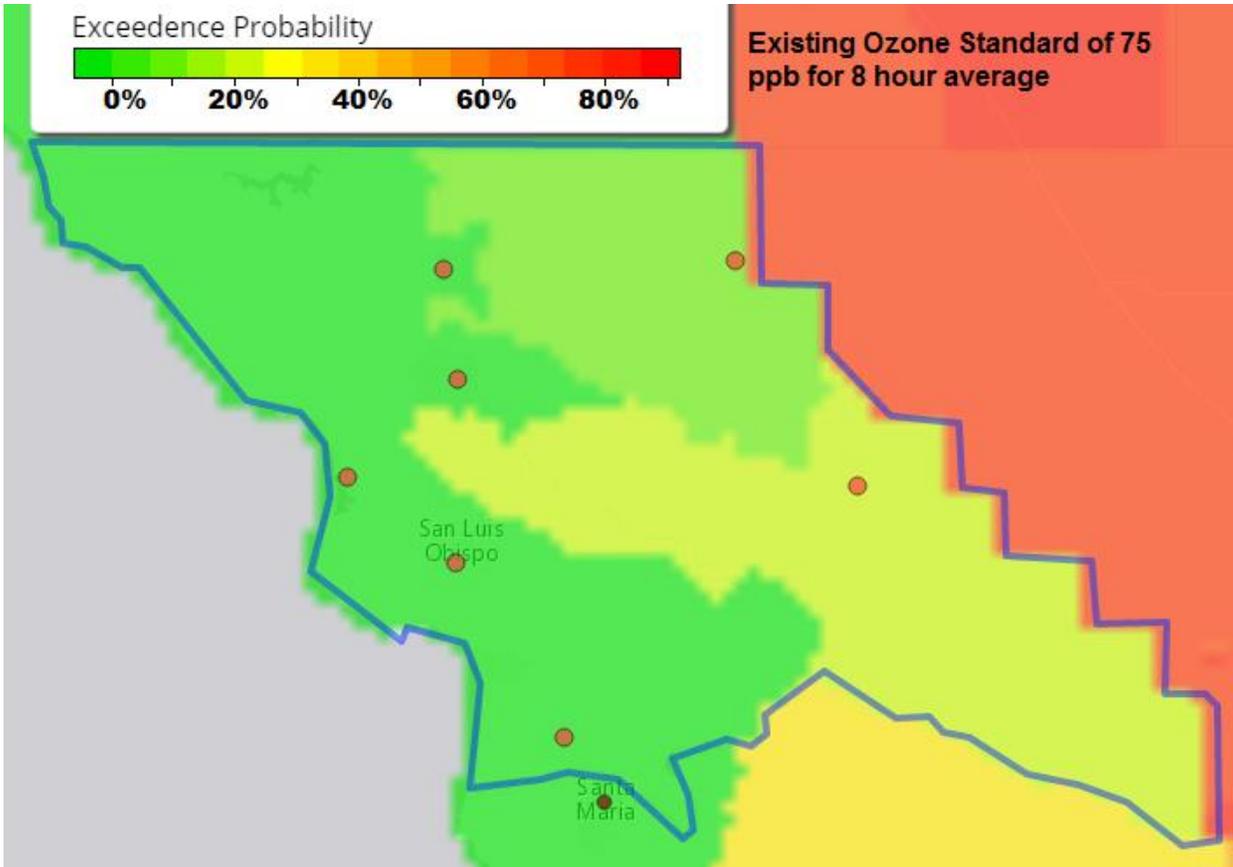


Figure 8: Surface Probability Map for Ozone Evaluated to Existing Standard

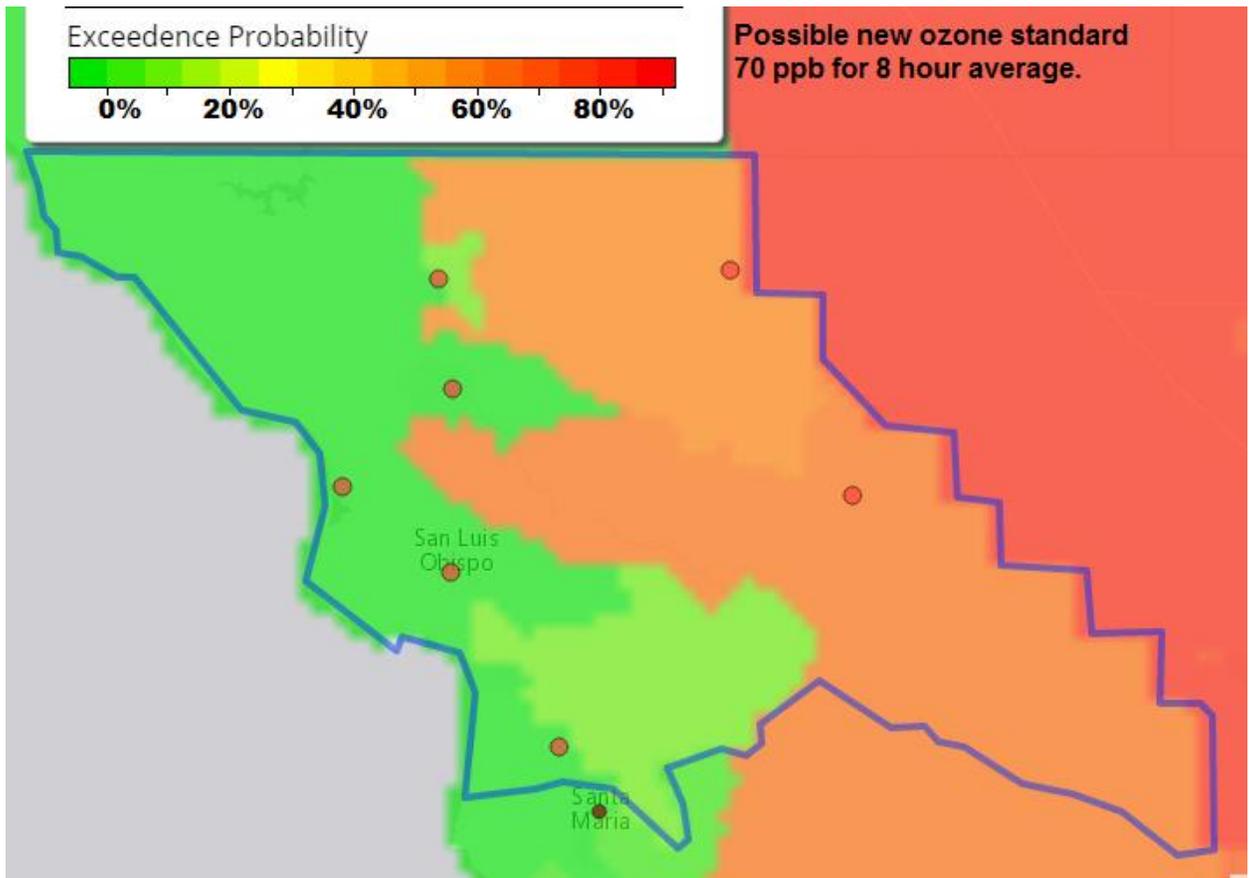


Figure 9: Surface Probability Map for Ozone Evaluated for Possible New Standard at 70ppb

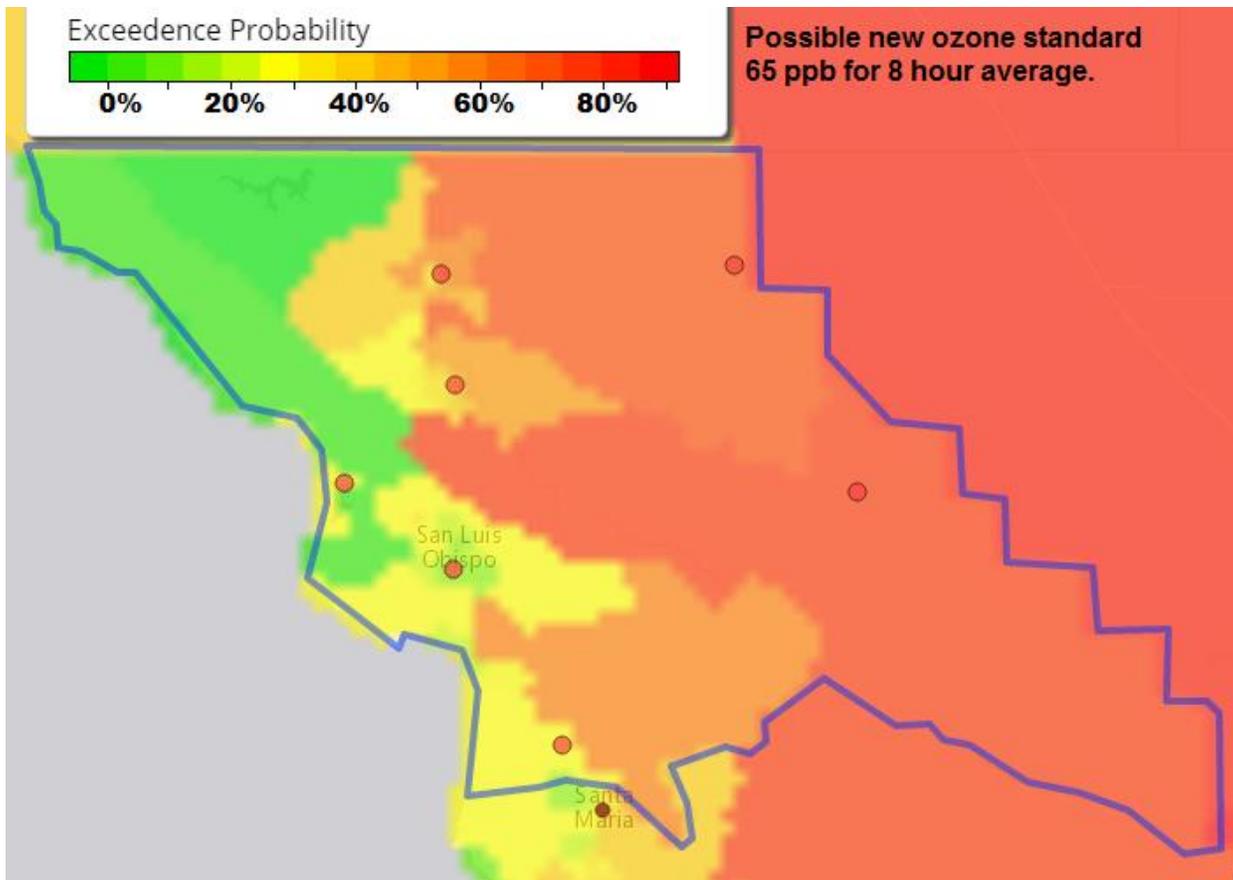


Figure 10: Surface Probability Map for Ozone Evaluated for Possible New Standard at 65ppb

4.4.2 PM_{2.5} Surface Probability Map for San Luis Obispo County

The PM_{2.5} probability map shows a similar pattern as the ozone probability maps, with a low probability of measuring exceedances in the coastal region and higher probabilities in the eastern interior portions of San Luis Obispo County where there are few local sources of PM_{2.5}. The higher probability for this area is due to high PM_{2.5} measurements recorded in the San Joaquin Valley (to the east), and their potential transport into San Luis Obispo County. The District has not performed PM_{2.5} measurements east of Atascadero, but did measure PM₁₀ at the Carrizo Plains site for one year, and found very low levels. Therefore, while the modeling shows a significant probability of exceeding the PM_{2.5} standard in the eastern portion of San Luis Obispo County, monitoring data indicate a low likelihood in the southeast portion of the County, where the Carrizo Plains site is located.

It is interesting to note that this analysis shows a very low probability of exceeding the standard at the CDF and Mesa2 sites. Measurement data shows that these sites measure significantly higher values of PM_{2.5} than any other site in the County, with the CDF site approaching the annual PM_{2.5} standard.

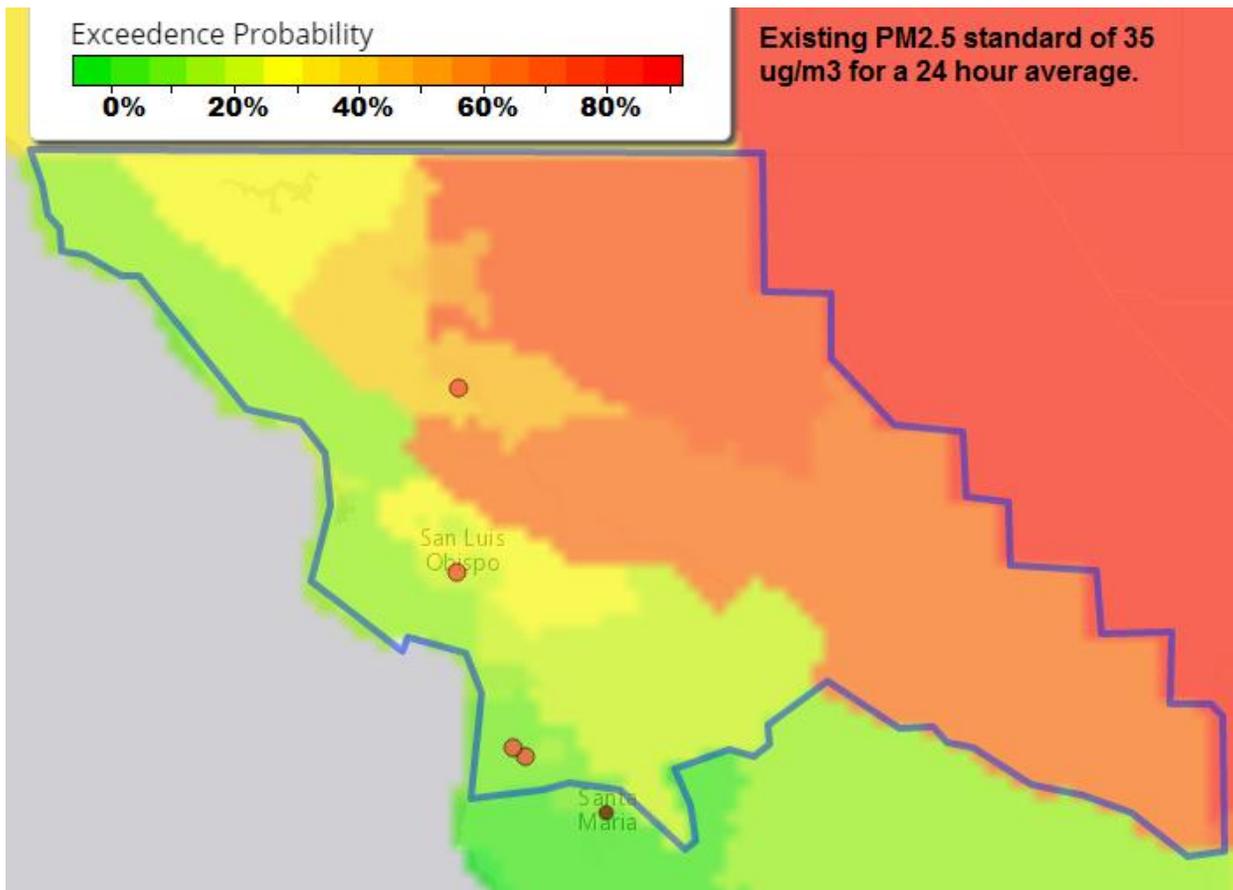


Figure 11: Surface Probability Map for PM_{2.5}

4.5 Area Served Analysis

This exercise uses a spatial analysis technique known as Voronoi or Thiessen polygons to approximate the area served by a monitoring site. The shape and size of each polygon is dependent on the proximity of the nearest neighboring air monitor to a particular site. While this technique provides an easy way to understand the general area and demographics represented by a particular monitoring site, it is important to understand that the polygons constructed by this analysis are based only on the distance to the nearby monitors, not on the area of representativeness for the monitor's data. Terrain, meteorology, and local pollution sources are not taken into account in this analysis. The AQI forecast map (Figure 12) developed by the district more accurately describes the area served by each monitoring station. Air quality forecast zones define geographical areas with relatively similar air quality characteristics that are represented by at least one of the air monitoring stations in SLO County. These forecast map polygons are different from the maps in Figures 13, 14, 15 and 16 in that the zone boundaries are defined by air quality characteristics, not distance from the nearest air monitoring station. The APCD issues daily air quality forecasts for each of these zones. Despite the limitations of the Voronoi/Thiessen polygon approach, understanding demographic distribution surrounding a monitor can be helpful in ensuring that a monitor is not removed that serves a historically underserved, vulnerable or disadvantaged segment of the population. Figures 13, 14, 15 and 16 depict the results of this analysis for ozone, PM_{2.5}, PM₁₀, and NO₂ respectively. The demographic data displayed with each figure shows that the sites in the northern and southern portions of the County serve a slightly higher percentage of "other races"; however, there are no sites serving a high proportion of underserved, vulnerable or disadvantaged segments of the population. Data on age distribution shows that the Atascadero, Paso Robles, Mesa2, and CDF monitors serve a slightly higher proportion of children and the Morro Bay and Mesa2 monitors serve a slightly higher proportion of elderly. It would be important to consider monitors serving these sensitive populations prior to any consideration of removal of the monitor. Note that the San Luis Obispo PM₁₀ monitor is not listed in this analysis due to data issues.

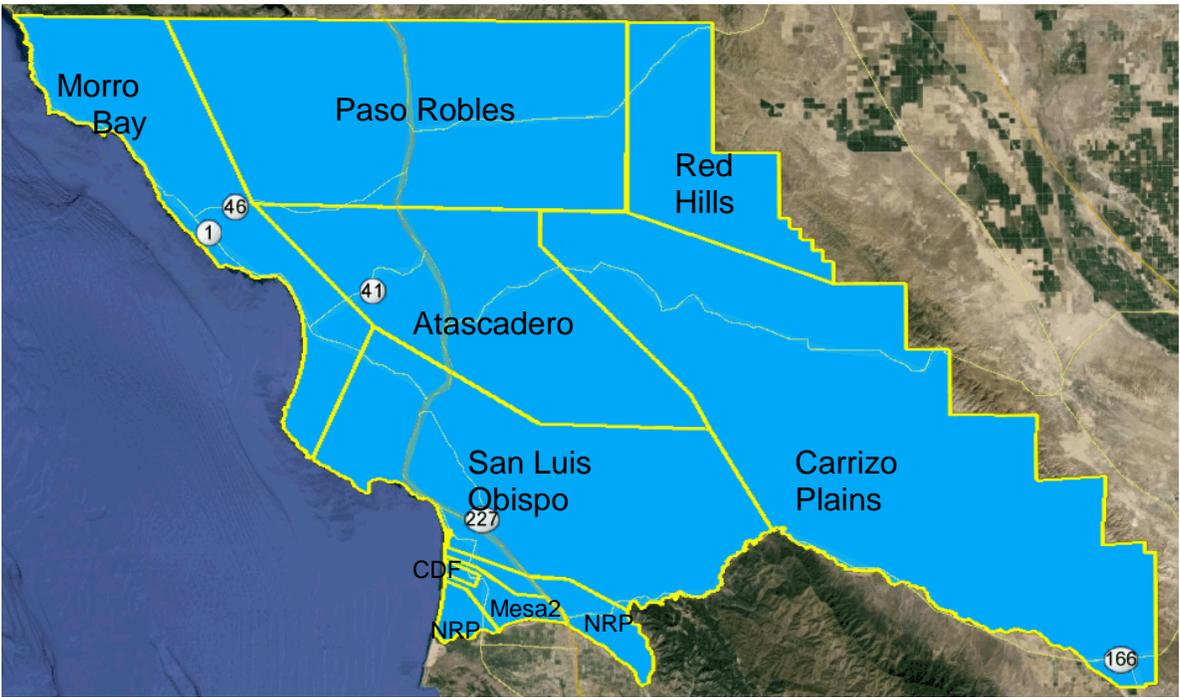
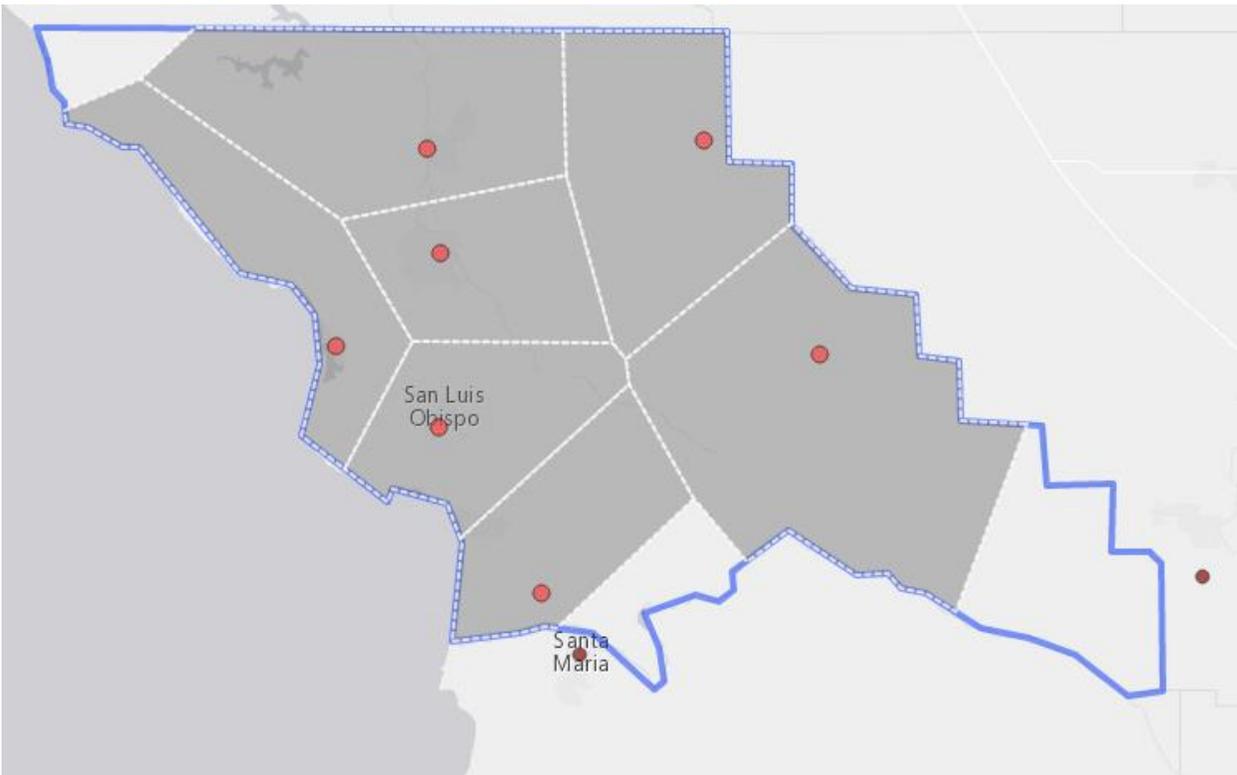


Figure 12: Air Quality Forecast Zones



Monitor	Total Population	White	Black	Native American	Asian	Pacific Islander	Other Race	Multiple Races	Male	Female	Area Km2	Spatial Scale of Monitor
Paso Robles	39088	79.5%	1.9%	1.2%	1.7%	0.2%	11.8%	3.7%	49.1%	50.9%	522	Urban
San Luis Obispo	74705	81.4%	4.4%	0.7%	4.9%	0.1%	4.6%	3.8%	56.0%	44.0%	293	Neighborhood
Morro Bay	31730	86.2%	0.5%	0.8%	3.6%	0.1%	5.7%	3.1%	48.8%	51.2%	320	Regional
Nipomo Regional Park	62435	79.7%	0.9%	1.1%	3.0%	0.1%	10.8%	4.4%	49.2%	50.8%	283	Regional
Atascadero	37962	87.1%	1.7%	1.1%	2.1%	0.2%	4.3%	3.5%	50.1%	49.9%	278	Neighborhood
Red Hills	10043	84.5%	0.9%	1.0%	0.8%	0.1%	9.2%	3.5%	50.0%	50.0%	431	Regional
Carrizo Plains	6550	87.8%	0.5%	1.3%	1.7%	0.1%	5.0%	3.6%	49.9%	50.1%	760	Regional

Monitor	Age <14	Age 15-24	Age 25-49	Age 50-64	Age 65-74	Age >75
Paso Robles	21.3%	13.3%	32.7%	19.1%	7.1%	6.6%
San Luis Obispo	9.2%	34.3%	28.1%	16.4%	5.8%	6.2%
Morro Bay	13.3%	10.7%	27.6%	26.7%	10.8%	10.9%
Nipomo Regional Park	18.3%	12.2%	30.2%	22.6%	9.0%	7.8%
Atascadero	18.0%	12.3%	32.4%	23.8%	7.2%	6.4%
Red Hills	18.7%	12.3%	30.1%	25.7%	8.2%	5.0%
Carrizo Plains	16.0%	11.9%	29.1%	28.3%	8.3%	6.4%

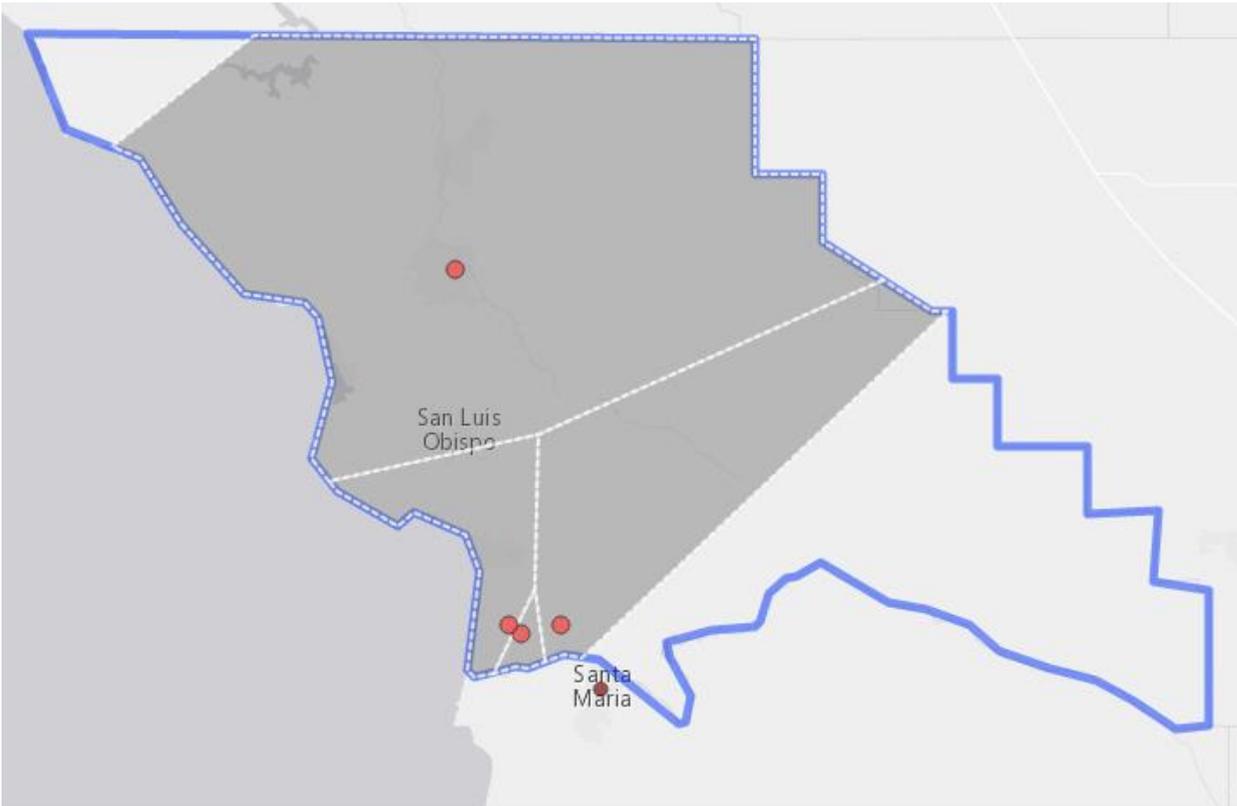
Figure 13: Area Served Plot and Demographic Data for Ozone Monitors in San Luis Obispo County



Monitor	Total Population	White	Black	Native American	Asian	Pacific Islander	Other Race	Multiple Races	Male	Female	Area Km2	Spatial Scale of Monitor
Mesa2	24672	77.6%	1.0%	1.1%	2.7%	0.2%	13.2%	4.3%	49.4%	50.6%	94	Neighborhood
San Luis Obispo	87759	82.8%	3.8%	0.6%	5.0%	0.1%	4.1%	3.5%	54.9%	45.1%	418	Neighborhood
CDF	38583	79.3%	1.0%	1.2%	3.4%	0.1%	10.3%	4.8%	48.8%	51.2%	74	Neighborhood
Atascadero	99812	83.6%	1.5%	1.1%	1.9%	0.2%	8.2%	3.5%	49.6%	50.4%	1512	Neighborhood

Monitor	Age <14	Age 15-24	Age 25-49	Age 50-64	Age 65-7	Age >75
Mesa2	19.2%	12.4%	29.4%	22.5%	9.6%	7.0%
San Luis Obispo	9.5%	30.7%	27.5%	18.3%	6.7%	7.3%
CDF	17.9%	12.4%	32.1%	21.6%	7.9%	8.1%
Atascadero	18.7%	12.4%	31.6%	22.5%	7.8%	6.9%

Figure 14: Area Served Plot and Demographic Data for PM_{2.5} Monitors in San Luis Obispo County



Monitor	Total Population	White	Black	Native American	Asian	Pacific Islander	Other Race	Multiple Races	Male	Female	Area Km2	Spatial Scale of Monitor
Mesa2	8954	84.9%	0.9%	0.9%	3.0%	0.1%	6.6%	3.7%	49.4%	50.6%	16	Neighborhood
CDF	53945	82.2%	1.0%	1.0%	3.4%	0.1%	8.1%	4.2%	49.2%	50.8%	161	Neighborhood
Nipomo R. Park	20855	77.6%	0.9%	1.2%	2.4%	0.2%	13.5%	4.3%	49.6%	50.4%	504	Regional
Atascadero	175997	82.8%	2.7%	0.9%	3.3%	0.1%	6.6%	3.6%	52.1%	47.9%	1706	Neighborhood

Monitor	Age <14	Age 15-24	Age 25-49	Age 50-64	Age 65-74	Age >75
Mesa2	14.7%	9.4%	24.7%	27.7%	14.5%	8.9%
CDF	16.6%	12.9%	30.4%	22.8%	8.7%	8.6%
Nipomo R.	20.6%	13.2%	30.5%	21.8%	7.7%	6.2%
Atascadero	14.4%	21.3%	29.8%	20.3%	7.2%	7.0%

Figure 15: Area Served Plot and Demographic Data for PM₁₀ Monitors in San Luis Obispo County

5.0 SITUATIONAL ANALYSIS

This section examines the network taking into account research, policy and resource needs.

5.1 Risk of Future NAAQS Exceedances

The exceedance probability surface maps presented above (Figures 8-11) show that eastern San Luis Obispo County is most at risk for exceeding the current NAAQS standard for ozone; this result agrees with historical monitoring data. The PM_{2.5} map also suggests that there is significant risk for exceeding the PM_{2.5} 24-hr standard in this region, while predicting only a low exceedance probability for the Nipomo Mesa, a prediction that is contrary to the historical data.

Eastern San Luis Obispo County is sparsely populated, but the District operates two monitoring stations in this region to study the transport of pollutants from outside of the County. Back trajectory analysis of recent exceedances of the ozone NAAQS has demonstrated that ozone-laden air enters this part of the County from the San Joaquin Valley to the east. This is the only region of the County where ozone concentrations routinely exceed Federal standards. PM_{2.5} has never been measured in this region, but it is possible that under transport conditions some parts of this area could experience exceedances of the PM_{2.5} NAAQS standard.

On the Nipomo Mesa the State PM₁₀ standard is exceeded frequently during blowing dust events, and the Federal PM₁₀ standard is exceeded occasionally. The Nipomo Mesa is downwind of a significant source of wind-blown particulate in the ODSVRA. The District is currently working with the California Department of Parks and Recreation to find ways to mitigate emissions from the ODSVRA. During blowing dust events there is a significant amount of particulates in the PM_{2.5} fraction, and during the most extreme events, PM_{2.5} concentrations approach and occasionally exceed the 24-hour NAAQS standard at CDF and Mesa2. Additionally, the CDF annual PM_{2.5} average for the period 2013-2015 may exceed the annual NAAQS standard. Until this source can be mitigated, the District maintains three monitoring locations at CDF, NRP and MESA2 that all measure particulate emissions. Wildfires and stagnant conditions can result in elevated PM_{2.5} levels at all monitors in the County, though only rarely do such conditions result in exceedances of the NAAQS.

5.2 Criteria Allowing Reduction of Monitors

Requests to the EPA Regional Administrator to allow shut-down of criteria pollutant monitors are considered on a case by case basis, however 40CFR58.14(c)(1) provides guidance on what conditions would likely result in approval for shut-down of a criteria pollutant monitor. These conditions are described in the referenced CFR below:

40 CFR 58.14(c)(1):

Any PM_{2.5}, O₃, CO, PM₁₀, SO₂, Pb, or NO₂ SLAMS monitor which has shown attainment during the previous five years, that has a probability of less than 10 percent of exceeding 80 percent of the applicable NAAQS during the next three years based on the levels, trends, and variability observed in the past, and which is not specifically required by an attainment plan or maintenance plan. In a non-attainment or maintenance area, if the most recent attainment or maintenance plan adopted by the State and approved by EPA contains a contingency measure to be triggered by an air quality concentration and the monitor to be discontinued is the only SLAMS monitor operating in the non-attainment or maintenance area, the monitor may not be discontinued.

Statistical tests to determine what monitors in San Luis Obispo County have a probability of less than 10% of exceeding 80% of NAAQS were calculated and presented below in Table 7. Based on the results of the statistical tests, the following monitors would likely not be approved for shut-down by the EPA Regional Administrator due to failing to meet the requirements in 40CFR58.14(c)(1).

Ozone Monitors Not Meeting 40CFR58.14(c)(1)

1. Nipomo Regional Park
2. Atascadero
3. Paso Robles
4. Red Hills
5. Carrizo Plains

PM₁₀ Monitors Not Meeting 40CFR58.14(c)(1)

1. CDF
2. Mesa2

PM₁₀ Monitors with Insufficient Data to Shut Down

1. San Luis Obispo
2. Paso Robles

PM_{2.5} Monitors Not Meeting 40CFR58.14(c)(1)

1. CDF
2. Mesa2

Table 7 - Calculations of 90% Confidence of Not Measuring > 80% of NAAQS

24-HOUR PM10 NAAQS								
Site	Year 1 Max	Year 2 Max	Year 3 Max	Year 4 Max	Year 5 Max	90% Upper CI (ug/m3)	80% NAAQS (ug/m3)	Test
	(ug/m3) 2010	(ug/m3) 2011	(ug/m3) 2012	(ug/m3) 2013	(ug/m3) 2014			
CDF	167	134	180	163	165	177.9	120	FAIL
Mesa2	139	119	146	132	150	148.9	120	FAIL
Nipomo Regional Park	40	62	75	107	93	100.3	120	PASS
Atascadero	35	75	62	59	69	74.6	120	PASS
San Luis Obispo	33	21		70	41	65.8	120	Insufficient data
Paso Robles				87	79	108.2	120	Insufficient data
Red Value Indicates Year Did Not Meet Completeness Requirement								
Blue Value Indicates 1 in 6 Sampling								
ANNUAL PM2.5 NAAQS								
Site	Year 1 Design Value	Year 2 Design Value	Year 3 Design Value	Year 4 Design Value	Year 5 Design Value	90% Upper CI (ug/m3)	80% NAAQS (ug/m3)	Test
	(ug/m3) 2010	(ug/m3) 2011	(ug/m3) 2012	(ug/m3) 2013	(ug/m3) 2014			
CDF	10	12	9.6	12.5	12.8	12.8	9.6	FAIL
Mesa2	8.2	8.3	8.1	9.7	10.2	9.8	9.6	FAIL
Atascadero	6.3	7.5	6	7.5	5.8	7.4	9.6	PASS
San Luis Obispo	5.5	6.7	6.2	6.8	6	6.7	9.6	PASS
24-Hour PM2.5 NAAQS								
Site	Year 1 Design Value	Year 2 Design Value	Year 3 Design Value	Year 4 Design Value	Year 5 Design Value	90% Upper CI (ug/m3)	80% NAAQS (ug/m3)	Test
	(ug/m3) 2010	(ug/m3) 2011	(ug/m3) 2012	(ug/m3) 2013	(ug/m3) 2014			
CDF	23.9	30.2	30	30.6	30	31.6	28	FAIL
Mesa2	22.4	20.8	24.6	24.8	21.3	24.5	28	PASS
Atascadero	16	22.2	15.7	23.2	20.2	22.8	28	PASS
San Luis Obispo	10.7	14.1	13.6	13.2	13.1	14.2	28	PASS
8-Hour Ozone NAAQS								
Site	Year 1 Design Value	Year 2 Design Value	Year 3 Design Value	Year 4 Design Value	Year 5 Design Value	90% Upper CI (ppb)	80% NAAQS (ppb)	Test
	(ppb) 2010	(ppb) 2011	(ppb) 2012	(ppb) 2013	(ppb) 2014			
Nipomo Regional Park	67	58	53	56	66	65.9	60	FAIL
Morrow Bay	53	47	49	50	60	56.6	60	PASS
San Luis Obispo	57	55	51	50	62	59.6	60	PASS
Atascadero	63	62	65	61	63	64.2	60	FAIL
Paso Robles	69	63	66	61	58	67.5	60	FAIL
Red Hills	83	75	81	75	73	81.5	60	FAIL
Carrizo Plains	77	77	75	67	68	77.5	60	FAIL
1-Hour SO2 NAAQS								
Site	Year 1 Design Value	Year 2 Design Value	Year 3 Design Value	Year 4 Design Value	Year 5 Design Value	90% Upper CI (ppb)	80% NAAQS (ppb)	Test
	(ppb) 2010	(ppb) 2011	(ppb) 2012	(ppb) 2013	(ppb) 2014			
Mesa2	4	4	5	53	4	34.8	60	PASS
1-Hour NO2 NAAQS								
Site	Year 1 Design Value	Year 2 Design Value	Year 3 Design Value	Year 4 Design Value	Year 5 Design Value	90% Upper CI (ppb)	80% NAAQS (ppb)	Test
	(ppb) 2010	(ppb) 2011	(ppb) 2012	(ppb) 2013	(ppb) 2014			
Nipomo Regional Park	26	28	26	30	25	28.9	80	PASS
Morrow Bay	28	32	35	31	31	33.8	80	PASS
Atascadero	36	37	40	37	41	40.3	80	PASS

5.3 Demographic Shifts

San Luis Obispo County is experiencing population growth, with most of this growth occurring in two areas: Paso Robles/Templeton and the Nipomo Mesa. Both of these fast-growing areas have an adequate complement of monitors for ozone, PM₁₀ and PM_{2.5}, which are the pollutants of greatest concern. With a County population of 270,000 in 2010, population growth over the next 10 years would far exceed all reasonable estimates before the current network would no longer meet Federal minimum monitoring requirements. For example, per 40 CFR 58 Appendix D, a near-road NO₂ monitor would not be required until County population reached 500,000; additional PM₁₀ monitors would not be required until population exceeded 1 million.

5.4 Scientific Research and Public Health

The Atascadero monitoring station has historical importance as a research site. The station has hosted a variety of special instrumentation and has played a important role in epidemiological and other studies.

The particulate monitoring network on the Nipomo Mesa has been expanded in recent years to address the public health risk from particulate emissions upwind at the ODSVRA. The network may be modified to meet the needs of air quality surveillance as we move forward with mitigating impacts from the State Park. Special monitoring studies have been performed in the area to better understand the relationship between natural impacts of wind-blown dust and impacts of off-road vehicle use as well as a study to map the plume of emissions from the dunes to better understand the level of impact on the downwind communities.

5.5 Other Circumstances

The San Luis Obispo and Paso Robles monitoring stations are operated by ARB. Although they are included in this assessment, they are not under the District's authority and may not be readily modified by the results of this analysis. We expect that ARB is performing its own network assessment which will address the technical aspects related to its stations. Also note that the CDF monitoring station is being used by the California Department of Parks and Recreation to fulfill some of their requirements under local rule 1001, and because of this the District receives funding from them to operate this station. Likewise, operation of the Mesa2 station is funded in part by the Santa Maria Refinery.

6.0 DISCUSSION AND CONCLUSIONS

The 2015 Annual Network Plan for San Luis Obispo County demonstrates that the air monitoring network in the County meets the minimum monitoring requirements specified in Federal regulations (40 CFR 58). The various analyses performed in this Network Assessment indicate that all monitors add value to the network and are necessary to adequately characterize air quality in the County. Furthermore, the network is anticipated to remain adequate as County population increases. As such, no network modifications are proposed at this time.

Nonetheless if Federal regulations, local priorities, emission sources, and/or District resources change significantly, network modifications may become necessary. For example, while the analysis of the probability of exceeding the NAAQS has its limitations, it does reveal a significant probability of exceeding the 24-hr $PM_{2.5}$ standard in eastern San Luis Obispo County. Therefore, should resources become available, adding a $PM_{2.5}$ monitor to an existing east County site would be desirable.

Not captured in any of these analyses, is monitoring intended for emergency response and public information in the event of an accident at Philips 66's Santa Maria Refinery. Particulates are already monitored at two nearby stations (CDF and Mesa2) and sulfur dioxide at one (Mesa2), but in the event of a catastrophic release, additional real-time monitoring of pollutants would be invaluable. Sulfur dioxide monitors could be installed at the CDF and NRP stations. Similarly, hydrogen sulfide monitoring could be considered for the residential area near the Price Canyon Oilfield.³ Odor complaints are already common in this area; with oil production increasing and proposals for new housing developments nearby, the potential for exposure to hydrogen sulfide is increasing.

Wind-blown dust from the ODSVRA remains among the largest air pollution challenges in the County. As discussed in the 2015 Annual Network Plan, the available evidence suggests that the CDF monitor is optimally sited to characterize maximum ambient particulate levels downwind of the ODSVRA. Newly installed particulate matter mitigations (or mitigations installed in the future) could change this. For example, it is possible that the mitigations could selectively reduce particulate levels at CDF to such a degree that other areas would then experience higher particulate levels. This would necessitate establishing a new monitor in the new area of greatest impact.

It would also be valuable to establish a particulate monitor *within* the most emissive part of ODSVRA to determine PM_{10} exposure experienced by park visitors. While such a monitor would likely not be considered NAAQS comparable, it would nonetheless be important for public information and it would support research on emissions from the ODSVRA. Establishing such a monitor would of course require close cooperation with the California Department of Parks and Recreation.

Additional particulate monitors along the coast north of the ODSVRA might also be beneficial. PM_{10} monitors in Los Osos and/or Morro Bay would be useful for comparing emissions from other dune systems to those from the ODSVRA. $PM_{2.5}$ monitors in Morro Bay, Cayucos, and/or Cambria would be useful for evaluating wood smoke impacts from residential wood burning and the transport of smoke from wildfires.

³ An on-site H_2S is scheduled to begin operation later this year.

The analyses described above are also useful for prioritizing monitors to preserve in the event that changing priorities or funding levels necessitate shutting down some monitors that are currently active. For example, only one NO₂ monitor is required for the County. Atascadero measures the highest NO₂ levels and concentrations there rarely approach even 50% of the 24-hr NAAQS. Therefore, the Morro Bay and NRP monitors would be better candidates for removal, if the need were to arise. Similarly, the Grover Beach station only monitors meteorology and has no required monitors, so this would be a good candidate for removal.

The analyses described above show the PM_{2.5} monitor in San Luis Obispo currently measures the lowest concentrations in the County and has the lowest probability of exceeding the NAAQS. This monitor, however, is located in the most populated city in the County, so it serves vital public information goals. Finally, the only ozone monitors that qualify for shutdown under 40 CFR 58.14(c)(1) are those in Morro Bay and San Luis Obispo.⁴ These have a low probability of exceeding the ozone NAAQS, even if it is revised to 65 ppb. The Morro Bay monitor, however, is extremely useful for monitoring long term trends. In addition, the air quality forecast zones associated with these monitors serve large portions of the County population beyond the boundaries of both cities (Fig. 12).

As identified above, a number of enhancements to the existing monitoring network could be implemented to provide increased area coverage and additional data for priority pollutants in specific areas. Sufficient funding and staffing resources, however, are not available to install and maintain such enhancements, and the current network meets the minimum requirements to adequately characterize community and regional air quality countywide. Thus, the potential enhancements cited above are not proposed for implementation.

⁴ Ozone levels are trending downward, but the ozone NAAQS is also likely to be revised downward, thus it is unlikely any additional sites would qualify for shutdown under 40 CFR 58.14(c)(1) in the foreseeable future.