APPENDIX 1

FIVE FACTOR ANALYSIS FOR CALIFORNIA AIR BASINS

California Air Basins

I. Great Basin Valleys
II. Lake County
III. Lake Tahoe
IV. Mojave Desert
V. Mountain Counties
VI. North Central Coast
VII. North Coast
VIII. Northeast Plateau
IX. Sacramento Valley
X. Salton Sea
XI. San Diego
XII. San Francisco Bay Area
XIII. San Joaquin Valley
XIV. South Central Coast
XV. South Coast

Recommendation

California Air Resources Board (CARB) staff recommend that the following areas be designated as attainment, based on the assessment provided below. The assessment includes an evaluation of the five factors recommended by the United States Environmental Protection Agency (EPA) for purposes of determining the appropriate attainment area boundaries: jurisdictional boundaries, geography/topography, and meteorology (collectively referred to as nature of the region), emissions data, and air quality data.

Staff recommend that air basins be used as the jurisdictional boundaries for the attainment areas. Air basins were used as the jurisdictional boundaries for attainment areas for the federal primary 1-hour sulfur dioxide (SO_2) standard that was established in 2010. Air basins are composed of one or more air districts, each containing one or more counties or portions of counties. Air basins were determined based on similar meteorology and geography of the area which they contain.

Table 1 is a list of all the air basins in California and the counties included within.

TABLE 1

Air Basin	**Counties**
Great Basin Valleys*	Alpine, Inyo, Mono
Lake County	Lake
Lake Tahoe	Portions of El Dorado and Placer
Mojave Desert	Eastern Kern, northeast Los Angeles, eastern Riverside, northeast San Bernardino
Mountain Counties	Amador, Calaveras, western El Dorado, Mariposa, central Placer, Nevada, Plumas, Sierra, Tuolumne
North Central Coast	Monterey, San Benito, Santa Cruz
North Coast*	Del Norte, Humboldt, Mendocino, northern Sonoma, Trinity
Northeast Plateau	Lassen, Modoc, Siskiyou

Air Basin	Counties
Sacramento Valley*	Butte, Colusa, Glenn, western Placer, Sacramento, Shasta, Sutter, northeastern Solano, Tehama, Yolo, Yuba
Salton Sea*	Imperial, central Riverside
San Diego*	San Diego
San Francisco Bay Area*	Alameda, Contra Costa, Marin, Napa, San Francisco, San Mateo, Santa Clara, southern Sonoma, southwestern Solano
San Joaquin Valley*	Fresno, Kings, Madera, Merced, San Joaquin, Stanislaus, Tulare, western Kern
South Central Coast*	San Luis Obispo, Santa Barbara, Ventura
South Coast*	Orange, southern Los Angeles, western Riverside, western San Bernardino

*Air basin has at least one operational SO_2 monitor.

Nine of the 15 air basins in California had at least one operational SO_2 monitor for the 2022 – 2024 time period. In general, the air basins without an SO_2 monitoring network encompass regions of the state that are more rural in nature, and in comparison to the rest of the state, total sulfur oxide (SO_x) emissions are low for most of the air basins without monitors. SO_2 monitoring data is available in areas where the highest SO_2 concentrations are expected to occur, and concentrations at these monitors are far below the standard. These monitors are generally located in the areas with the highest emissions. Since EPA determined the existing SO_2 monitoring network is adequate to provide the data needed to implement the revised secondary standard and the available monitoring data indicate that all areas are well below the level of the standard, staff conclude that areas without monitors would also be considerably below the standard.

The following provides an analysis of the five factors recommended by EPA for each air basin.

I. Great Basin Valleys

Nature of the Region

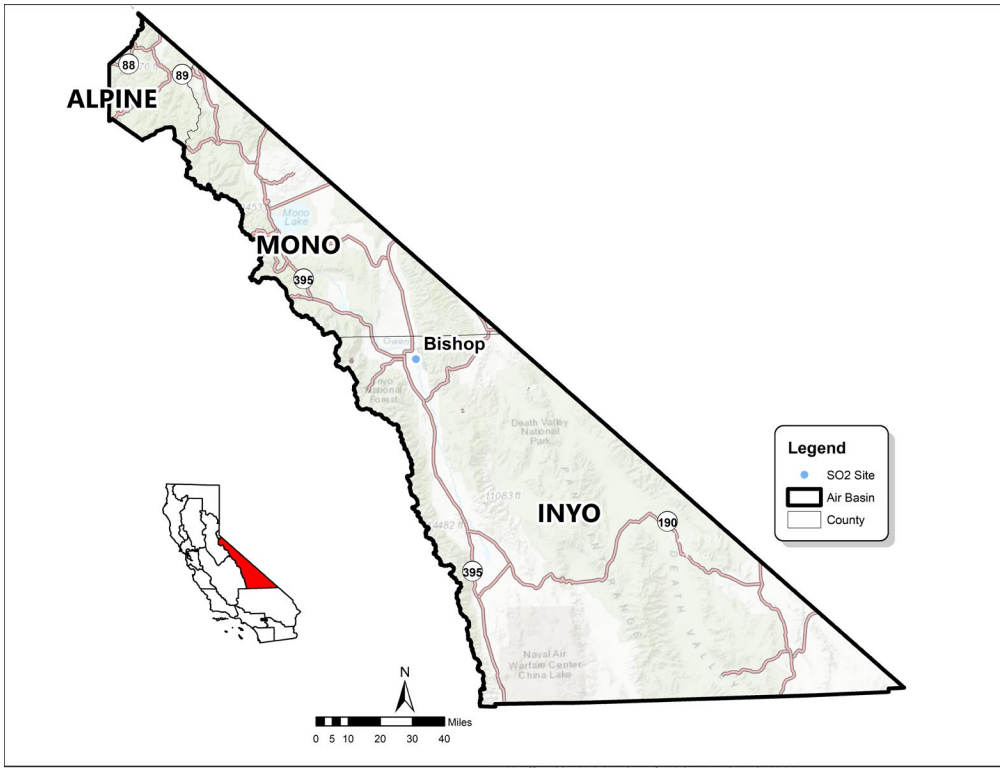
The Great Basin Valleys Air Basin (GBVAB) includes Inyo, Mono and Alpine Counties. The basin is bounded on the west by the Sierra Nevada Mountains, on the east by the Nevada border, and on the south by the desert. As the transition from the Great Basin Valleys to the desert is somewhat indistinct, the Inyo-San Bernardino County line has been chosen as the basin boundary.

The population in the GBVAB is 32,000, which is approximately 2 people per square mile. Much of the land area is open desert. The land use varies from riparian areas along the Owens River to light industry, small commercial, and residential in the City of Bishop (population 4,000). The topography varies from high desert to mountain peaks.

FIGURE 1

SO_2 Monitoring Stations

Great Basin Valleys Air Basin



Emissions

SO_x emissions from all sources in the GBVAB totaled 230 tpy in 2024. Total emissions were 222 tpy in 2011. Although overall emissions in the GBVAB have increased since 2011, total

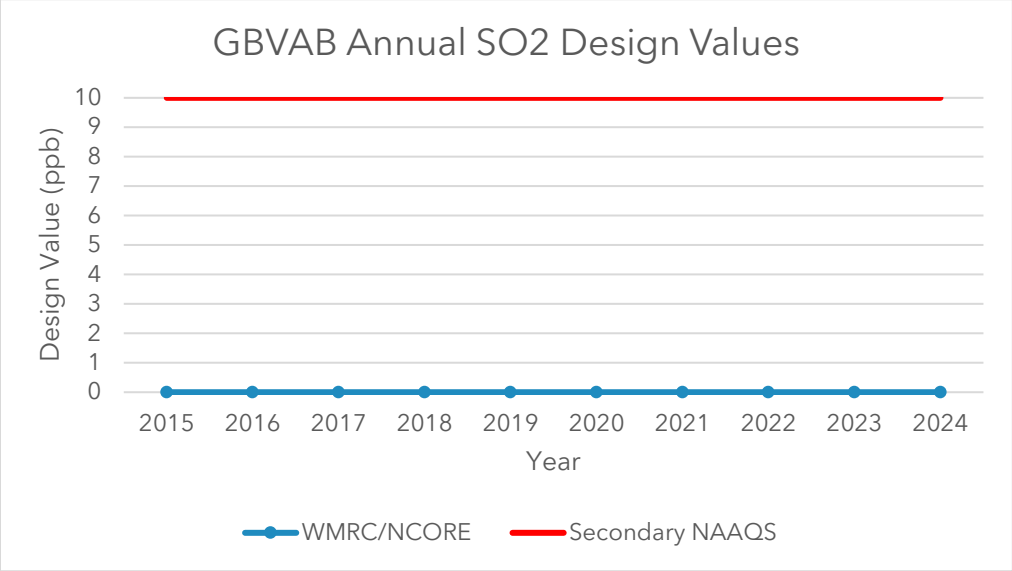
emissions in the basin are still low. The largest contributors of SO_x emissions in GBVAB are fuel combustion (stationary source) and managed burning.

Air Quality Trends

Based on data for record, the GBVAB attains the revised federal secondary SO_2 standard, with a 2024 design value of 0 parts per billion (ppb). Although this value is not considered valid because the data do not meet the U.S. EPA's completeness requirements, it provides a good indication of SO_2 concentrations in relation to the standard. The last valid year in the GBVAB was 2023 with a design value of 0 ppb. The GBVAB currently has one SO_2 monitor at the WMRC/NCORE site in Inyo County (shown in Figure 1) that has been in operation since 2015. As shown in Figure 2, design values at this site have been 0 ppb each year since it began operation.

FIGURE 2

Great Basin Valleys Air Basin Annual SO_2 Design Values[1]



[1]2015, 2016, 2017, 2018, 2019, 2020, and 2024 data do not meet completeness requirements.

II. Lake County Air Basin

Nature of the Region

The Lake County Air Basin (LCAB) consists of only Lake County. It is located inland from the Pacific Ocean, north of the San Francisco Bay Area, covers an area of 1,327 square miles, and has a population of more than 67,000. The highest peak in the LCAB is Snow Mountain at 7,056 feet in the wilderness area of the Mendocino National Forest. The LCAB has just two incorporated cities, Clearlake and Lakeport, surrounded by several smaller communities.

Emissions

Total SO_x emissions from all sources in the LCAB were 120 tpy in 2024, down from 129 tpy in 2011, a 7% reduction. The largest contributors of SO_x emissions are agricultural production and processing and residential and managed burning.

Air Quality Trends

There is no monitoring data available for the LCAB. However, due to the very low SO_x emissions throughout the region, staff conclude that the area would not exceed the level of the standard.

III. Lake Tahoe Air Basin

Nature of the Region

The Lake Tahoe Air Basin (LTAB) is comprised of the surface of Lake Tahoe (roughly 20 miles long by 10 miles wide) and the land up to the surrounding rim of mountain ridges. The southern portion of the air basin is in El Dorado County, and the northern portion is in Placer County. The basin has a population of less than 60,000. The lake is at 6,200 feet elevation, and the ridges climb to over 10,000 feet. The mountain slopes surrounding the lake are precipitous and are broken by deep valleys carved by streams that drain into the lake.

The meteorology of the LTAB in winter is typified by large amounts of precipitation from Pacific storms that fall mainly as snow, with temperatures below freezing accompanied by winds, clouds, and lake and valley fog. Winter days can also bring cool, brilliantly clear days between storms. In the summer, the LTAB experiences sunny, mild days, with daytime peaks in the upper 70s and low 80s, with an occasional thunderstorm from southern flows of moisture.

Emissions

Total SO_x emissions from all sources in the LTAB were 34 tpy in 2024 and 35 tpy in 2011. The largest contributors of SO_x emissions are airplanes and residential and managed burning.

Air Quality Trends

There is no monitoring data available for the LTAB. However, due to the very low SO_x emissions throughout the LTAB, staff conclude that the area would not exceed the level of the standard.

IV. Mojave Desert Air Basin

Nature of the Region

The Mojave Desert Air Basin (MDAB) comprises portions of four counties: eastern Kern County, northeast Los Angeles County, eastern Riverside County, and all but a small

southwestern portion of San Bernardino County. The MDAB is California's largest air basin, covering a total of 27,287 square miles and has a population of over 900,000.

The region is bounded by the Colorado River Valley to the south and east and by mountains on its remaining sides. The landscape is quite diverse, including low elevation desert, high elevation desert, and mountain areas. Elevations range from below sea level on the desert floor to peaks of more than 7,000 feet. Major thoroughfares, including Interstate 15, Interstate 40, U.S. Highway 395, and California State Highway 58, carry significant amounts of commuter and truck traffic in and out of the Mojave Desert region.

Overall, the MDAB has an arid climate with cool winters, hot summers, and little rainfall. Temperatures generally increase, while precipitation generally decreases from south to north and west to east in this region. In contrast to the desert portions of the region, both temperature and precipitation can be significantly different in the mountain areas, where snowcapped peaks are commonplace during winter. Overall, the MDAB tends to be windy, with winds blowing predominantly from the south and west. During the late spring months, high winds from the coastal areas of southern California blow into the Mojave Desert. In contrast, during fall Santa Ana conditions, hot air from the desert blows into southern California.

Emissions

Total SO_x emissions from all sources in the MDAB were 1,707 tpy in 2024, down from 2,544 tpy in 2011, a reduction of 33%. The largest source category of SO_x emissions in the MDAB is mineral processes, which accounts for 75% of the total emissions.

Air Quality Trends

Currently, no SO_2 monitors operate in the MDAB. Two monitors, Trona-Athol/Telescope #2 and Victorville-Park Avenue, operated from 1997-2022 and 2000-2022, respectively. The 2021 annual design value for both sites was 1 ppb. Because both monitors attained the standard in 2021 when they were in operation, and since SO_x emissions have significantly decreased in the last ten years, staff conclude that it is unlikely the federal standard is currently violated anywhere in the MDAB.

V. Mountain Counties Air Basin

Nature of the Region

The Mountain Counties Air Basin (MCAB) includes Plumas, Sierra, Nevada, central Placer, western El Dorado, Amador, Calaveras, Tuolumne, and Mariposa Counties. The basin lies along the northern Sierra Nevada Mountain Range, close to or contiguous with the Nevada border, and covers an area of roughly 11,000 square miles. The population of the entire air basin is less than 500,000. The western slope of El Dorado County, from Lake Tahoe on the east to the Sacramento County boundary on the west, lies within the MCAB. Elevations range from over 10,000 feet at the Sierra crest down to several hundred feet above sea level

at the Sacramento County boundary. Throughout the basin, the topography is highly variable and includes rugged mountain peaks and valleys with extreme slopes and differences in elevation in the Sierras, as well as rolling foothills to the west.

The general climate of the MCAB varies considerably with elevation and proximity to the Sierra Ridge. The terrain features of the basin make it possible for various climates to exist in relatively close proximity. The Sierra Nevada receives large amounts of precipitation in the winter, with lighter amounts in the summer. Precipitation levels are high in the highest mountain elevations but decline rapidly toward the western portion of the basin. Winter temperatures in the mountains can be below freezing for weeks at a time, and substantial depths of snow can accumulate, but in the western foothills, winter temperatures usually dip below freezing only at night and precipitation is mixed as rain or light snow. In the summer, temperatures in the mountains are mild, with daytime peaks in the 70s to low 80s, but the western end of the basin can routinely exceed 100 degrees.

Emissions

Total SOx emissions from all sources in the MCAB in 2024 were 608 tpy, down from 731 tpy in 2011, a 17% reduction. The largest contribution to SO_x emissions is from fuel combustion (stationary source) and residential and managed burning.

Air Quality Trends

Currently, no SO_2 monitors exist in the MCAB. One monitor, San Andreas-Gold Strike Road, operated from 1980-1982. Due to the low SO_x emissions throughout the MCAB, staff conclude that the area would not exceed the level of the standard today.

VI. North Central Coast Air Basin

Nature of the Region

The North Central Coast Air Basin (NCCAB) consists of Santa Cruz, San Benito, and Monterey Counties. It covers an area of 5,159 square miles along the coast and has a population of over 750,000. The Santa Cruz Mountains dominate the northwest portion of the NCCAB, and the Diablo Range marks the northeastern boundary. The Santa Clara Valley extends into the northeastern tip of the basin. Further south, the Santa Clara Valley becomes the San Benito Valley, which runs northwest to southeast, with the Gabilan Range as its western boundary. To the west of the Gabilan Range is the Salinas Valley, which extends from Salinas at the northwest end to south of King City.

In the summer, a high-pressure system over the Pacific Ocean is dominant and causes persistent west and northwest winds over the entire California coast. The onshore wind brings fog and relatively cool air into the coastal valleys. The northwest to southeast orientation of the mountain ridges tends to restrict and channel the summer onshore air. In the fall, the surface winds become weak. The airflow is occasionally reversed in a weak offshore movement and the relatively stationary air mass is held in place. During the winter,

the Pacific high-pressure system moves south and has less influence on the NCCAB. Air frequently flows in a southeasterly direction out of the Salinas and San Benito Valleys, especially during night and morning hours.

Emissions

Total SO_x emissions from all sources in the NCCAB totaled 455 tpy in 2024. In 2011, SO_x emissions from all sources totaled 415 tpy. Although overall emissions in the NCCAB have increased since 2011, total emissions in the basin are still low. The largest SO_x sources are fuel combustion (stationary source), landfills, and residential burning.

Air Quality Trends

Currently, no SO_2 monitors exist in the NCCAB. One monitor, located in the town of Davenport, operated from 1986 – 2009. The monitor was shut down after the closure of the Cemex Cement Plant in Davenport. The 2008 annual design value for the Davenport site was 1 ppb. Due to the low SO_x emissions throughout the NCCAB, staff conclude that the area would not exceed the level of the standard today.

VII. North Coast Air Basin

Nature of the Region

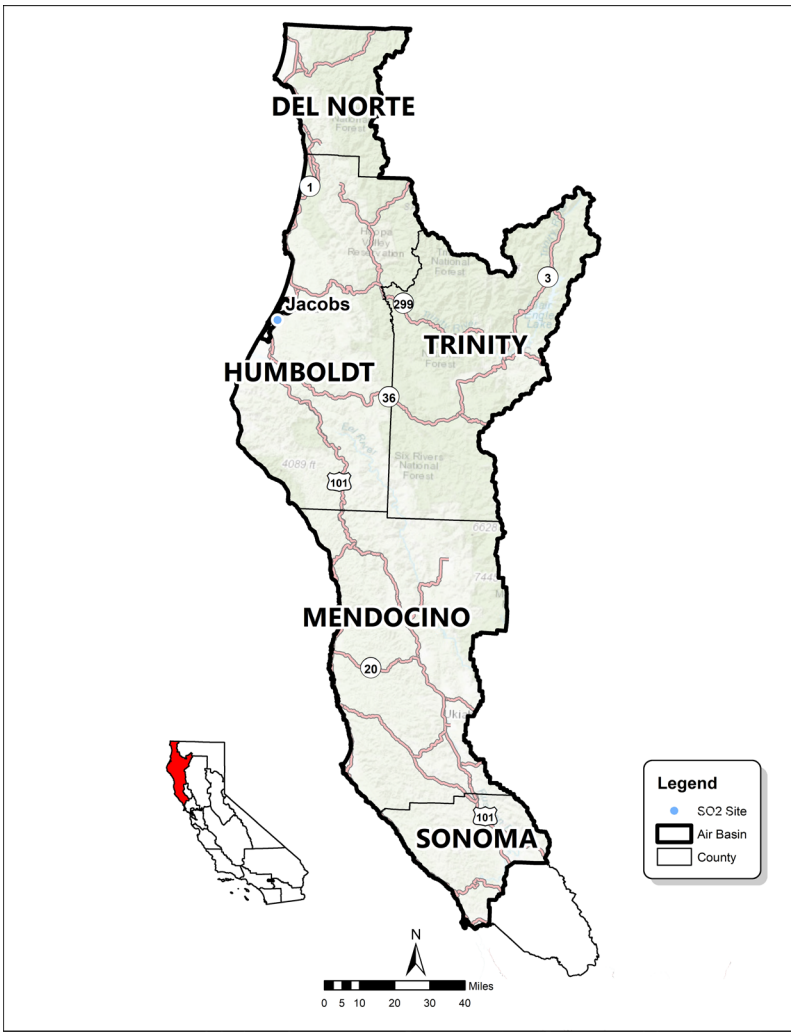
The North Coast Air Basin (NCAB) includes the counties of Del Norte, Humboldt, Trinity, Mendocino, and the northern portion of Sonoma County. It has a land area of more than 12,000 square miles, and a population of approximately 360,000.

In general, the climate of the North Coast is characterized by cool summers with frequent fog and mild winters with lots of rain. In coastal areas, the ocean helps to moderate temperatures year-round. Further inland, the summers are hotter and drier, and the winters are colder and snowier. At higher elevations in inland areas, it is cooler in the summers and snowier in the winter. In the summer months strong northwesterly winds are common. During the winter, storms from the south Pacific lead to winds from the south.

FIGURE 3

SO_2 Monitoring Stations

North Coast Air Basin



Emissions

SO_x emissions from all sources in the NCAB totaled 406 tpy in 2024. In 2011, total SO_x emissions were 388 tpy. Although overall emissions in the NCAB have increased since 2011, total emissions in the basin are still low. The largest sources of SO_x emissions are fuel combustion (stationary source) and residential burning.

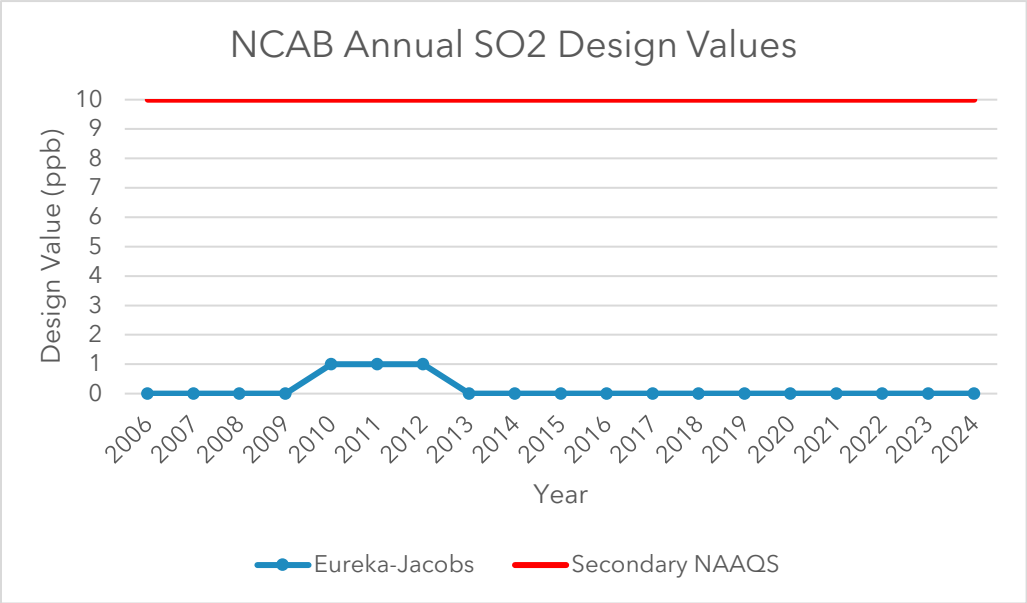
Air Quality Trends

Based on data for record, the NCAB attains the revised federal secondary SO_2 standard, with a 2024 design value of 0 ppb. Monitoring for SO_2 in the NCAB is currently conducted at the Eureka-Jacobs site in Humboldt County (shown in Figure 3), which began operation in 2006. Historic data is available from Eureka-Fort Avenue from 1981-1983, Ukiah-Gobbi

Street from 1992-1995, Ukiah-Highway 101 from 1988-1990, and Willits-S Main Street from 1994-1996. As seen in Figure 4, design values at the operational Eureka-Jacobs site have ranged from 0 – 1 ppb since 2006.

FIGURE 4

North Coast Air Basin Annual SO_2 Design Values[1]



[1]*Data completeness was not verified by U.S. EPA for years prior to 2015.*

VIII. Northeast Plateau Air Basin

Nature of the Region

The Northeast Plateau Air Basin (NEPAB) is located in the northeast corner of California and includes Lassen, Modoc, and Siskiyou Counties. The northern part of the NEPAB has lofty volcanic peaks, such as Mount Shasta and Mount Lassen. Forested mountains dominate the southern and western regions. The NEPAB covers approximately 14,788 square miles and is bordered by the states of Oregon to the north and Nevada to the east. The NEPAB's population of 80,000 predominately resides in rural towns, including Yreka, Mount Shasta, Alturas, and Susanville.

The climate is dry, cool, and windy. The area is separated from the rest of the State by the Cascade Mountains to a degree that permits very little air movement to or from other regions in the State.

Emissions

SO_x emissions from all sources in the NEPAB were 231 tpy in 2024, down from 326 tpy in 2011, a 29% reduction. The largest sources of emissions are from residential and managed burning and fuel combustion (stationary source).

Air Quality Trends

There is no monitoring data available for the NEPAB. However, due to the very low SO_x emissions throughout the basin, staff conclude that the area would not exceed the level of the standard.

IX. Sacramento Valley Air Basin

Nature of the Region

The Sacramento Valley Air Basin (SVAB) is located in the northern portion of the Central Valley. It includes Butte, Colusa, Glenn, Sacramento, Shasta, Sutter, Tehama, Yolo, and Yuba Counties, the western urbanized portion of Placer County, and the northeastern portion of Solano County. The SVAB occupies nearly 15,000 square miles and has a population of nearly 3 million people. More than half of the total population in the eleven-county air basin resides in Sacramento County.

The SVAB is approximately 216 miles from north to south and 95 miles east to west at the widest part. It is bounded to the north and west by the Coast Range Mountains and to the east by the southern portion of the Cascade Mountain Range and the northern portion of the Sierra Nevada Mountains. Within the SVAB, elevations reach heights of approximately 3,500 feet in the southwest, 8,500 feet in the northwest, 1,700 feet in the southeast and 10,500 feet in the northeast. In contrast, the elevation in Sacramento County near the San Francisco Bay Delta is barely above sea level. The mountain ranges provide a significant physical barrier to trap locally created pollution as well as pollution transported into the SVAB from elsewhere.

The Sacramento Valley's usual summer daytime wind flow pattern is characterized by onshore flow from the Bay Area to Sacramento (known as the sea breeze). A portion of the wind flow turns south, blowing into the San Joaquin Valley, a portion continues eastward, across the southern Sacramento Valley, and a portion turns north, blowing into the upper Sacramento Valley. At night, the sea breeze weakens, and the wind direction in the Sacramento Valley changes. Typical downslope flow, known as nocturnal drainage, brings air from the Coast Range and Sierra Nevada Mountains into the Sacramento Valley.

FIGURE 5

SO_2 Monitoring Stations

Sacramento Valley Air Basin

Emissions

SO_x emissions from all sources in the SVAB totaled 1,055 tpy in 2024, down from 1,325 tpy in 2011, a 20% reduction. The largest sources of SO_x emissions in SVAB are residential burning, managed burning, trains, airplanes, and vehicles.

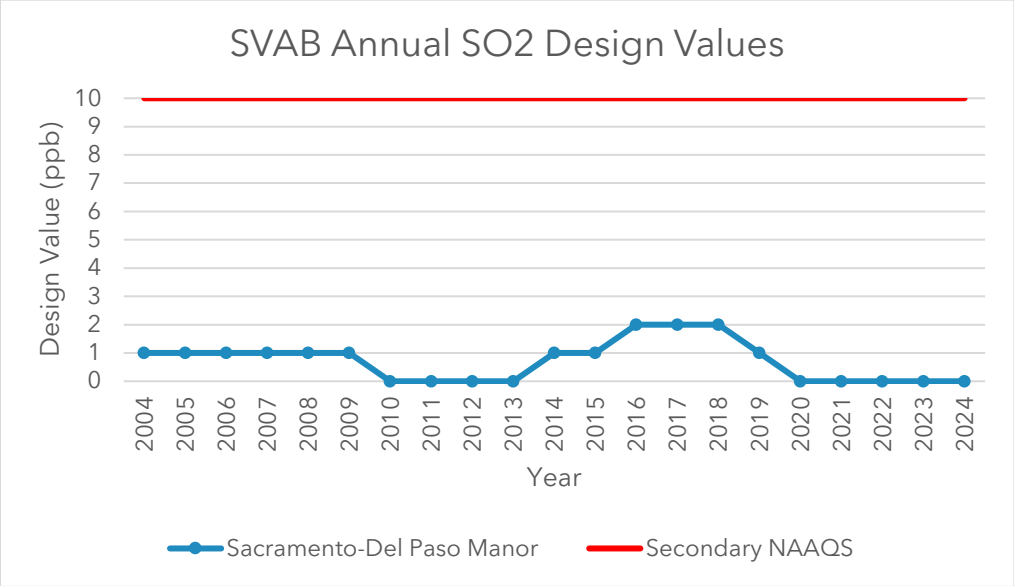
Air Quality Trends

Based on quality-assured data for record, the SVAB attains the revised federal secondary SO_2 standard, with a 2024 design value of 0 ppb. Although this value is not considered valid because the data do not meet the U.S. EPA's completeness requirements, it provides a good indication of SO_2 concentrations in relation to the standard. The last valid year in the SVAB was 2021 with a design value of 0 ppb. Monitoring in the SVAB is currently conducted at the Sacramento-Del Paso Manor site in Sacramento County (see Figure 5).

The SVAB also has historical monitoring data available from four other sites, one in Butte County and three in Sacramento County. The monitor in Butte County was located at Chico-Manzanita Avenue and operated from 1981 to 1984. Monitors in Sacramento County include Citrus Heights-Sunrise Boulevard (1980-1983), Sacramento-P Street (1980-1982), and North Highlands-Blackfoot Way (1980-2010). As shown in Figure 6 below, design values for the Sacramento-Del Paso Manor monitor have ranged from 0 to 2 ppb since 2004, with the design value consistently at 0 ppb since 2020.

FIGURE 6

Sacramento Valley Air Basin Annual SO_2 Design Values[1, 2]



[1]*2016, 2017, 2018, 2019, 2022, 2023, and 2024 data do not meet completeness requirements.*

[2]*Data completeness was not verified by U.S. EPA for years prior to 2015.*

X. Salton Sea Air Basin

Nature of the Region

The Salton Sea Air Basin (SSAB) is composed of the central portion of Riverside County (Coachella Valley) and Imperial County. The Coachella Valley extends southeast from the

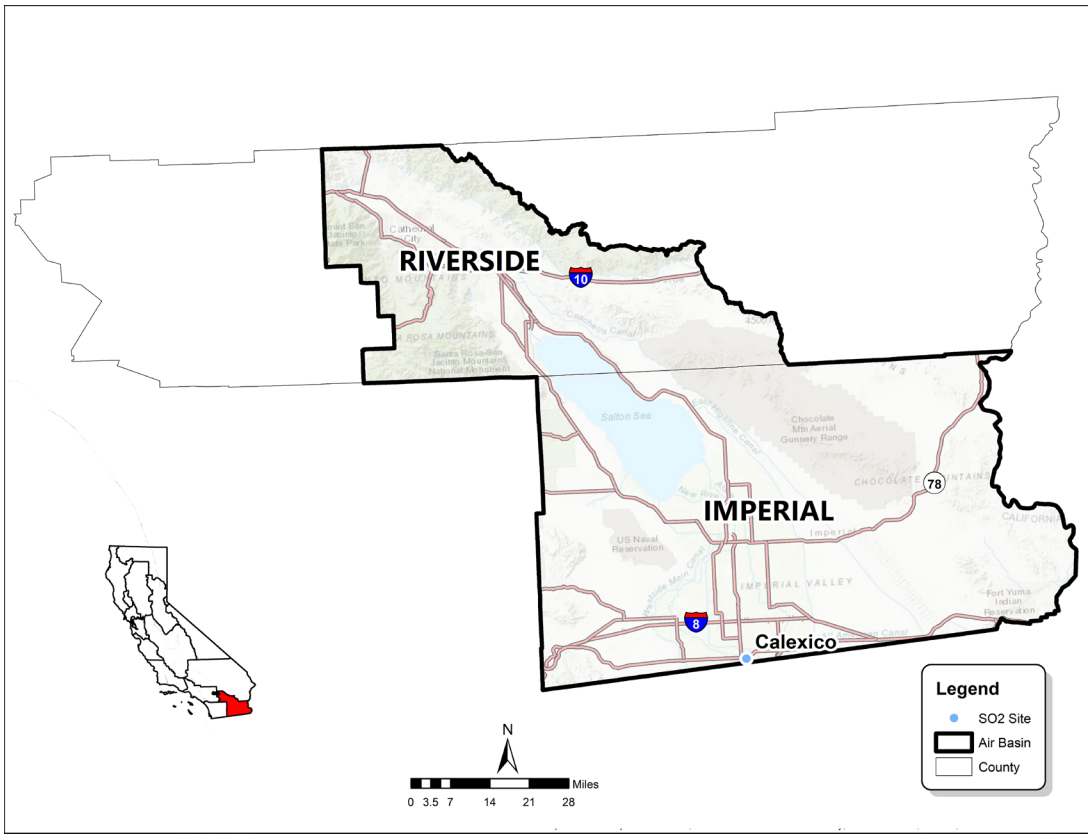
San Bernardino Mountains to the Salton Sea, the largest lake in California. The Riverside County portion of the SSAB is separated from the South Coast Air Basin on the west by the San Jacinto Mountains and the Santa Rosa Mountains and from the Mojave Desert Air Basin to the east by the Little San Bernardino Mountains. Imperial County borders Mexico to the south. The SSAB has a population of approximately 650,000.

The mountain peaks range from 3,000 to 11,000 feet in elevation and prevent offshore winds from flowing into the Coachella Valley and Imperial County. During the summer, high temperatures in the SSAB frequently exceed 100 degrees Fahrenheit. In the winter, daytime temperatures are generally over 70 degrees. The SSAB averages between three and seven inches of precipitation per year.

FIGURE 7

SO_2 Monitoring Stations

Salton Sea Air Basin



Emissions

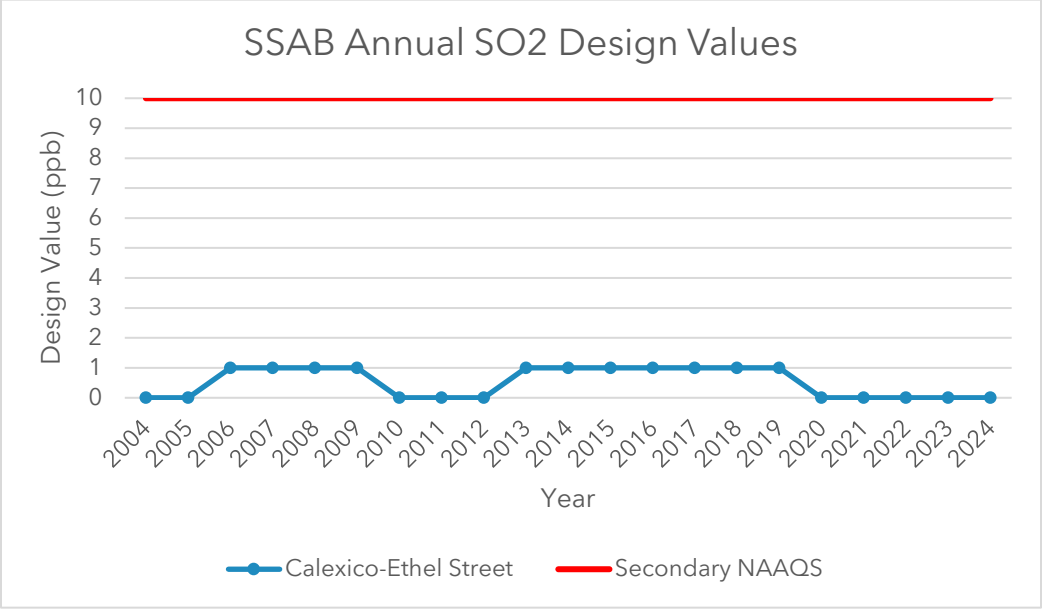
SO_x emissions from all sources in the SSAB totaled 185 tpy in 2024, down from 264 tpy in 2011, a reduction of 30%. The largest SO_x sources are aircraft and other mobile sources, fuel combustion (stationary source), and residential burning.

Air Quality Trends

Based on data for record, the SSAB attains the revised federal secondary SO_2 standard, with a 2024 design value of 0 ppb. Current monitoring is conducted at the Imperial Calexico-Ethel Street site in Imperial County (Figure 7). Historic data is also available from the Riverside-Palm Springs Fire Station. As shown in Figure 8 below, design values for the Imperial Calexico-Ethel Street site have ranged from 0 to 1 ppb since 2004, with the design value consistently at 0 ppb since 2020.

FIGURE 8

Salton Sea Air Basin Annual SO_2 Design Values[1, 2]



[1] *2015, 2018, 2019, and 2020 data do not meet completeness requirements.*

[2] *Data completeness was not verified by U.S. EPA for years prior to 2015.*

XI. San Diego Air Basin

Nature of the Region

The San Diego Air Basin (SDAB) lies in the southwest corner of California and comprises the entirety of San Diego County. Population is concentrated mainly in the western portion of the county. The air basin covers 4,260 square miles and is home to over three million residents. The City of San Diego covers approximately 330 square miles, and has a population of over 1.3 million, 42% of the total population of San Diego County.

The topography in the SDAB varies greatly, from beaches on the west to mountains and deserts on the east. Much of the topography in between consists of mesa tops intersected by canyon areas. Topography, along with local meteorology, influences the dispersal and

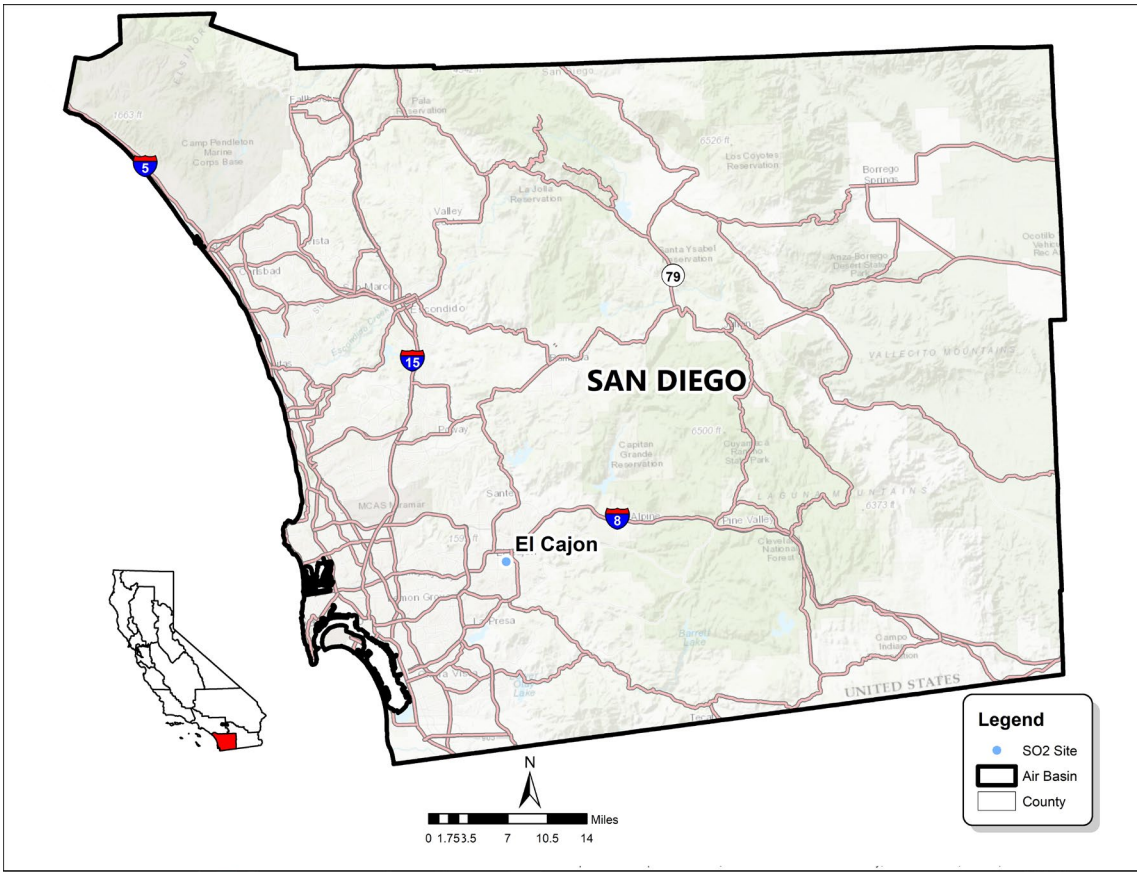
movement of pollutants in the basin. The mountains to the east prohibit dispersal of pollutants and help trap them under inversion layers.

The San Diego region typically has dry, warm summers and mild, occasionally wet winters. The average temperature ranges from the mid-40s to the high 90s. Most of the county's precipitation falls from November to April, with infrequent precipitation during the summer.

FIGURE 9

SO_2 Monitoring Stations

San Diego Air Basin



Emissions

Total SOx emissions from all sources in the SDAB were 489 tpy in 2024, down from 553 tpy in 2011, a reduction of 12%. The largest sources of SO_x emissions in the SDAB are aircraft, shipping ports, fuel combustion (stationary source) and residential burning.

Air Quality Trends

Based on data for record, the SDAB attains the revised federal secondary SO_2 standard, with a 2024 design value of 0 ppb. Although this value is not considered valid because the data do not meet the U.S. EPA's completeness requirements, it provides a good indication of SO_2

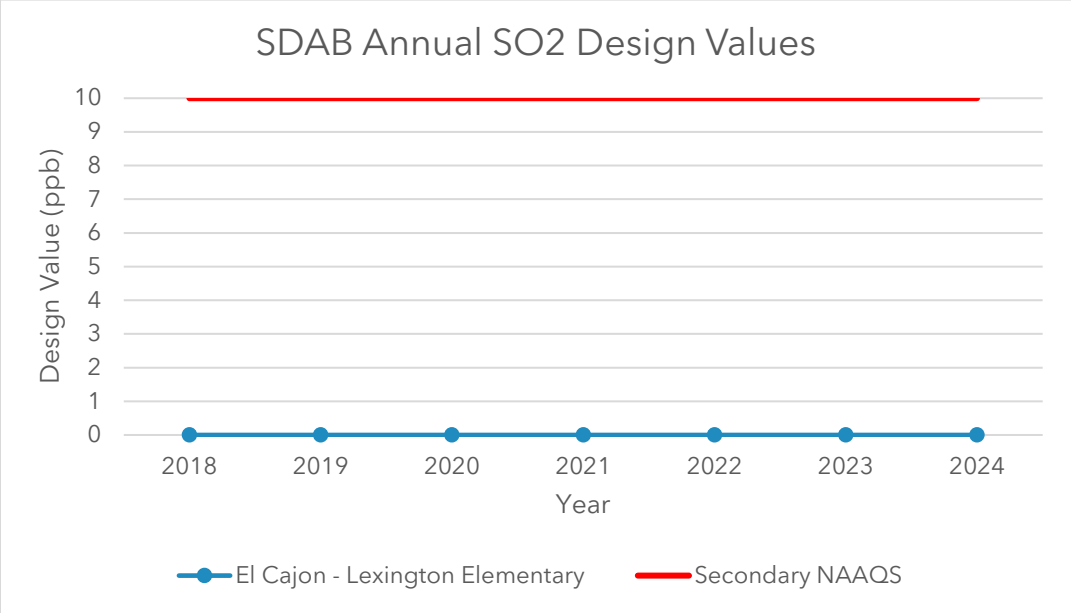
concentrations in relation to the standard. The last valid year in the SDAB was 2022 with a design value of 0 ppb.

As seen in Figure 9, current monitoring in the SDAB is conducted at the El Cajon-Lexington Elementary School site. The monitor has been in operation since 2016 but only has valid design values for the years 2019, 2020, 2021, and 2022. As shown in Figure 10 below, design values for the El Cajon-Lexington Elementary School site have remained 0 ppb since 2018.

Historic data is also available from the San Diego-Beardsley Street (2005-2011), Otay Mesa-Paseo International (1990-2013), and Chula Vista (1972 – 2013) monitors.

FIGURE 10

San Diego Air Basin Annual SO_2 Design Values[1]



[1] *2018, 2023, and 2024 data do not meet completeness requirements.*

XII. San Francisco Bay Area Air Basin

Nature of the Region

The San Francisco Bay Area Air Basin (SFBAAB) is California's second largest metropolitan region. The nine-county area comprises all of Alameda, Contra Costa, Marin, Napa, San Francisco, San Mateo, and Santa Clara counties, the southern half of Sonoma County, and the southwestern portion of Solano County. It includes several large cities, including, San Francisco, Oakland, and San Jose. The SFBAAB is home to nearly 7.2 million people, approximately 20% of California's total population.

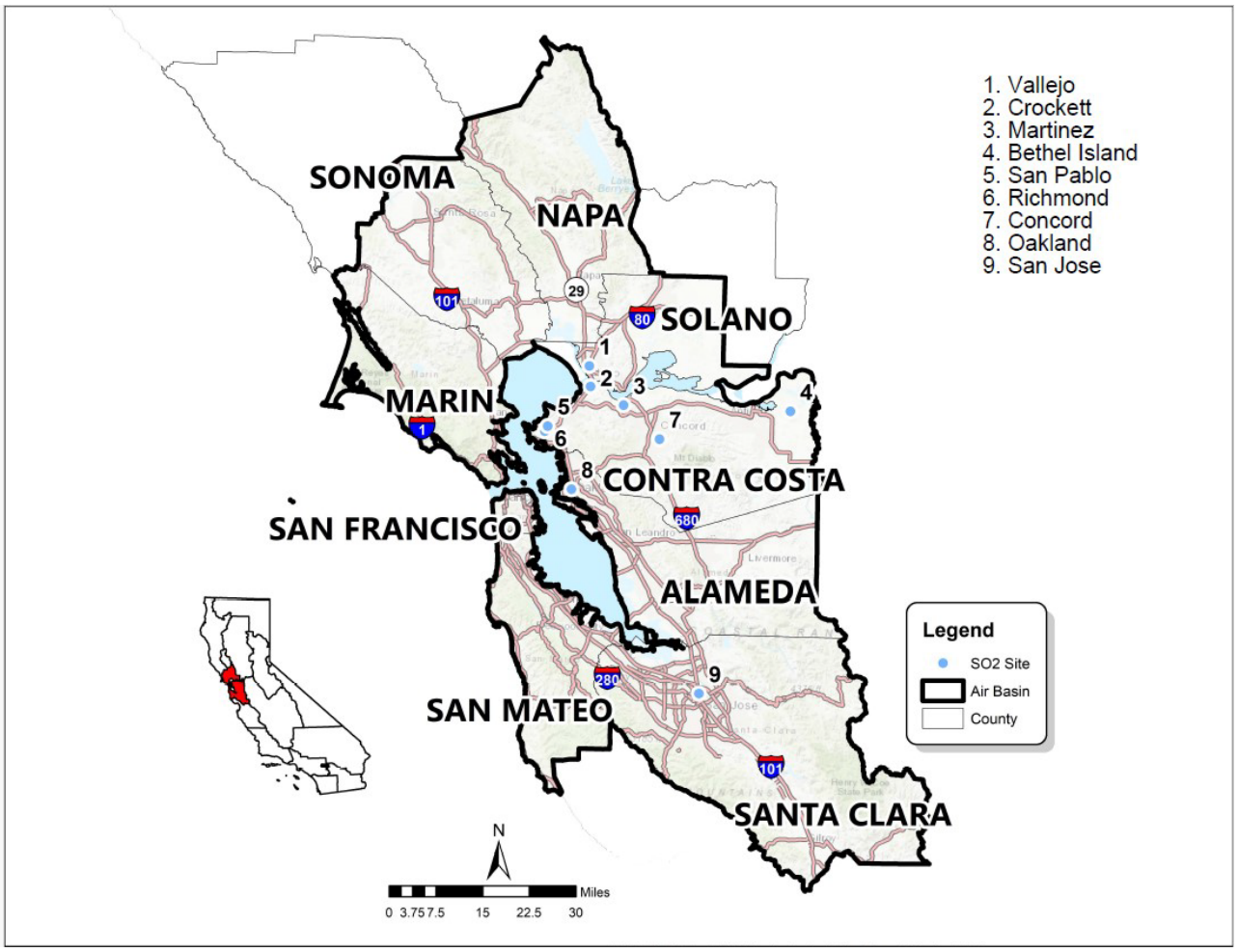
The SFBAAB is approximately 5,340 square miles, 400 of which comprise the north-south oriented Bay. Surrounding the Bay are the Coast Range Mountains, oriented northwest/southeast with elevations up to approximately 2,500 feet. Along the western and northern shores of the Bay are numerous headlands and peninsulas separated by small bays which lead into valleys and canyons in the surrounding foothills. In contrast, much of the eastern side is bordered by a low plain that slopes up into the Berkeley Hills. The highest population densities occur in the heavily urbanized areas surrounding the Bay. These urban centers give way to more suburban areas, to the north, south, and east. Although these areas are less densely populated, they are home to a significant number of people.

As with most of California, the Bay Area exhibits the typical wet winter/dry summer meteorological regime. Because of the variety of terrain, air flow in the region can be complex, especially at the lowest levels. Although flow patterns vary, the Bay Area shows a general sea breeze circulation pattern with onshore flow during the day and offshore flow during the evening and overnight hours. During the summer, surface temperatures over the Bay Area are determined in large part by the effect of differential heating between land and water surfaces. This process produces a large-scale gradient across the region. The temperature difference between coastal locations and inland locations can be 35 degrees Fahrenheit (F) or more on many summer afternoons. At night, the difference is usually less than 10 degrees F. The coastal versus inland temperature extremes reverse during the winter months, with smaller differences during the daytime and larger differences at night.

FIGURE 11

SO_2 Monitoring Stations

San Francisco Bay Area Air Basin



Emissions

Total SOx emissions from all sources in the SFBAAB were 8,943 tpy in 2024. In 2011, total emissions were 9,018 tpy. The largest sources of SO_x emissions in the SFBAAB are petroleum refining, mineral processes, aircraft, and ocean-going vessels.

Air Quality Trends

Nine SO_2 monitors, shown in Figure 11, were operational in the Bay Area during the 2022 through 2024 period. Most of the SFBAAB monitors are located in and around the more heavily industrialized eastern portion of the region. Several others are located downwind of the major source areas (refer to Figure 11). Based on data collected from 2022 through 2024, five of the nine monitoring sites in the Bay Area have 2024 design values of 1 ppb (Crockett – Kendall Ave., Bethel Island, San Pablo, Martinez – Jones St., and Vallejo). These

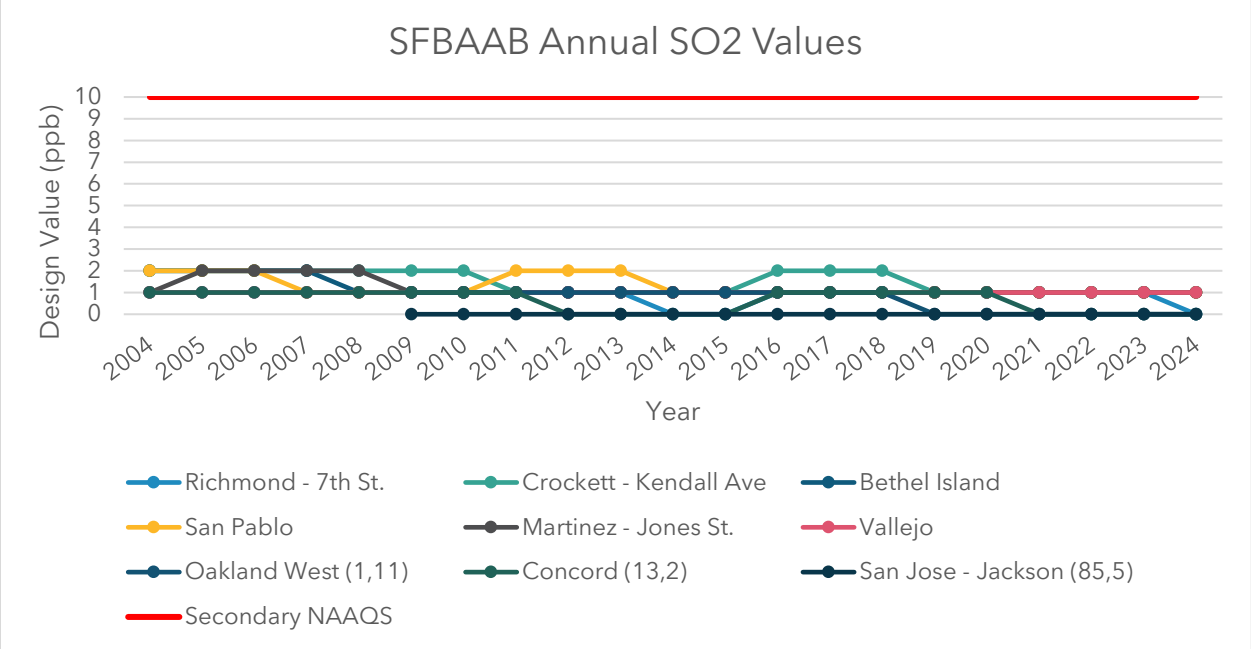
sites are located in the portion of the Bay Area that has the greatest density of stationary SO_2 sources. The design values for these sites are well below the 10 ppb standard. The remaining four sites (Richmond-7th St, Oakland West, Concord, and San Jose-Jackson) have 2024 design values of 0 ppb.

Although the 2024 design values for all the sites in the SFBAAB are not considered valid because the 2024 data have not been certified at the time this report was generated, they provide a good indication of SO_2 concentrations in relation to the standard. All sites in the basin have valid 2023 design values ranging from 0 to 1 ppb.

Figure 12 shows the trend for all sites in the SFBAAB from 2004 – 2024. Design values in the SFBAAB have ranged from 0 – 2 ppb since 2004.

FIGURE 12

San Francisco Bay Area Air Basin Annual SO_2 Design Values[1, 2]



[1]*2024 data have not been certified for all sites.*

[2]*Data completeness was not verified by U.S. EPA for years prior to 2015.*

XIII. San Joaquin Valley Air Basin

Nature of the Region

The San Joaquin Valley Air Basin (SJVAB) is one of California's largest air quality control regions and includes all of Fresno, Kings, Madera, Merced, San Joaquin, Stanislaus, and Tulare counties, as well as the western portion of Kern County. The SJVAB occupies nearly 23,500 square miles and has a population of approximately 4.2 million.

With very few exceptions, the SJVAB is flat, with most of the area lying below 400 feet elevation. The long flat valley area is bordered by the Coast Range to the west, the Sierra Nevada to the east, the Transverse Range to the south, and the Sacramento Valley to the north. In contrast to other California areas, the San Joaquin Valley is not dominated by one large urban area. Instead, there are several moderately sized urban areas spread along the main axis of the Valley. Most residents are distributed along the two major thoroughfares: Highway 99 and Interstate 5. The Valley's major population centers include the Fresno, Bakersfield, and Stockton/Modesto urban areas.

In general, the San Joaquin Valley experiences a climate with cool wet winters and hot dry summers. The northern Valley experiences a more temperate climate than the rest of the SJV because it is located closer to the Pacific Ocean, and the marine influence extends into the area through gaps in the Coast Range Mountains. This keeps temperatures cooler and favors better air flow. Moving farther south down the Valley, maximum daily temperatures increase, and rainfall totals decrease. The amount of stagnation and the complexity of local circulation patterns also increase from north to south. As a result, prevailing conditions in the central and southern portions of the SJV are more likely to trap pollutants and prevent their dispersal.

FIGURE 13

SO_2 Monitoring Stations

San Joaquin Valley Air Basin

Emissions

SOx emissions from all sources in the SJVAB totaled 2,330 tpy in 2024, down from 3,728 tpy in 2011, a 38% reduction. The largest sources of SO_x emissions in the SJVAB are oil and gas production, industrial processes, and fuel combustion (stationary source).

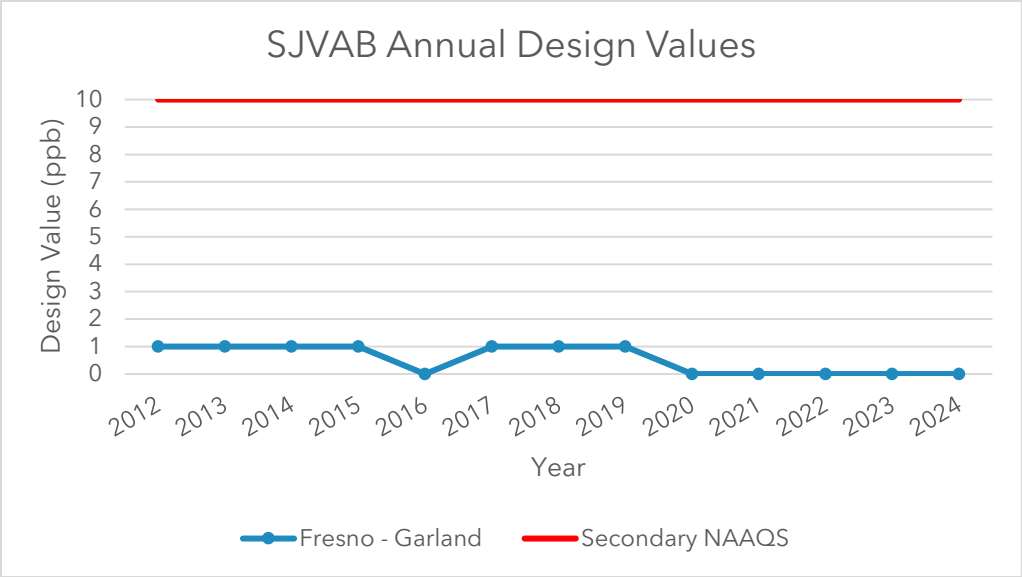
Air Quality Trends

Based on data for record, the SJVAB attains the revised federal secondary SO_2 standard, with a 2024 design value of 0 ppb. Although this value is not considered valid because the data do not meet the U.S. EPA's completeness requirements, it provides a good indication of SO_2 concentrations in relation to the standard. The last valid year in the SJVAB was 2021 with a design value of 0 ppb.

As seen in Figure 13, current SO_2 monitoring is conducted at the Fresno-Garland site in Fresno County, which has been in operation since 2011. Historical monitoring data is also available for the Fresno-1st St site, which was in operation from 1990 to 2012. Figure 14 shows annual design values for the Fresno-Garland site from 2011 to present. Design values at the Fresno-Garland site have ranged from 0 – 1 ppb. Because SO_x emissions are now lower, it is unlikely the federal standard is currently violated anywhere in the SJVAB.

FIGURE 14

San Joaquin Valley Air Basin Annual SO_2 Design Values[1, 2]



[1]*2022, 2023, and 2024 data do not meet completeness requirements.*

[2]*Data completeness was not verified by U.S. EPA for years prior to 2015.*

XIV. South Central Coast Air Basin

Nature of the Region

The South Central Coast Air Basin (SCCAB) comprises all of San Luis Obispo, Santa Barbara, and Ventura counties. Overall, the region covers 7,887 square miles and is home to more than 1.5 million people. More than half the region's population lives in Ventura County, and the largest cities include Oxnard, Thousand Oaks, and Ventura.

The region is bounded by the Pacific Ocean on the west and south, and it includes six of the eight Channel Islands. All three counties comprise a relatively narrow coastal strip that gives way to inland mountains, with the highest elevations ranging from 6,000 to over 8,000 feet.

In terms of climate, the SCCAB generally has relatively wet winters and warm dry summers. Coastal areas benefit from the marine influence, where onshore breezes keep beach communities cooler in summer and warmer in winter than communities located further inland. Year-round temperatures near the coast are mild. Moving inland, temperatures increase and precipitation decreases.

FIGURE 15

SO_2 Monitoring Stations

South Central Coast Air Basin

Emissions

SO_x emissions from all sources in the SCCAB totaled 573 tpy in 2024, down from 658 tpy in 2011, a 13% reduction. The largest sources of emissions are from fuel combustion (stationary source), mobile sources, and residential and managed burning.

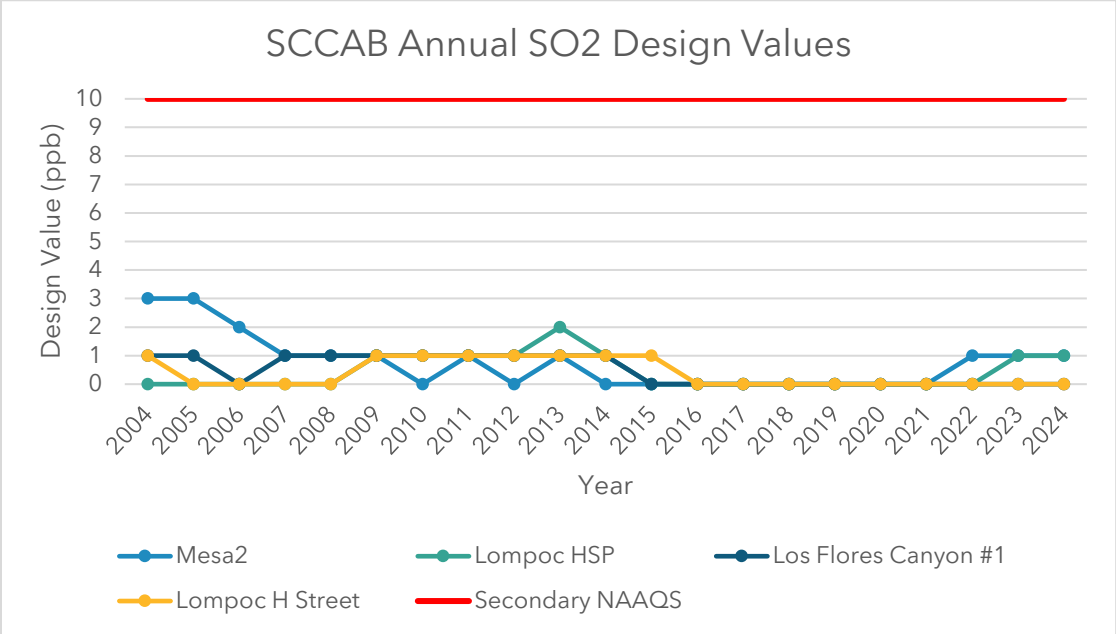
Air Quality Trends

Based on data for record, the SCCAB attains the revised federal secondary SO_2 standard, with a 2024 design value of 1 ppb. Four SO_2 monitors, shown in Figure 16, are currently in operation in the SCCAB – Mesa2, Lompoc HSP, Lompoc H St, and Los Flores Canyon #1. The Lompoc HSP and Los Flores Canyon #1 sites are excluded from NAAQS decision-making because they are not regulatory monitors, but are shown below for reference. As

shown in Figure 16 below, design values in the SCCAB have ranged from 0 – 3 ppb since 2004, which is well below the level of the federal secondary annual standard.

FIGURE 16

South Central Coast Air Basin Annual SO_2 Design Values[1, 2]



[1]*Lompoc HSP and Los Flores Canyon #1 sites are not used for regulatory decisions.*

[2]*Data completeness was not verified by U.S. EPA for years prior to 2015.*

XV. South Coast Air Basin

Nature of the Region

The South Coast Air Basin (SCAB) is California's largest metropolitan region. The area includes the southern two-thirds of Los Angeles County, all of Orange County, and the western urbanized portions of Riverside and San Bernardino counties. It covers a total of 6,480 square miles and is home to more than 17 million people – 44% of the State's population.

The SCAB region generally forms a lowland coastal plain, bounded by the Pacific Ocean on the west and by mountains on the other three sides. Although the coastal plain comprises only about a third of the region's land area, more than 80% of the South Coast population lives in the coastal area.

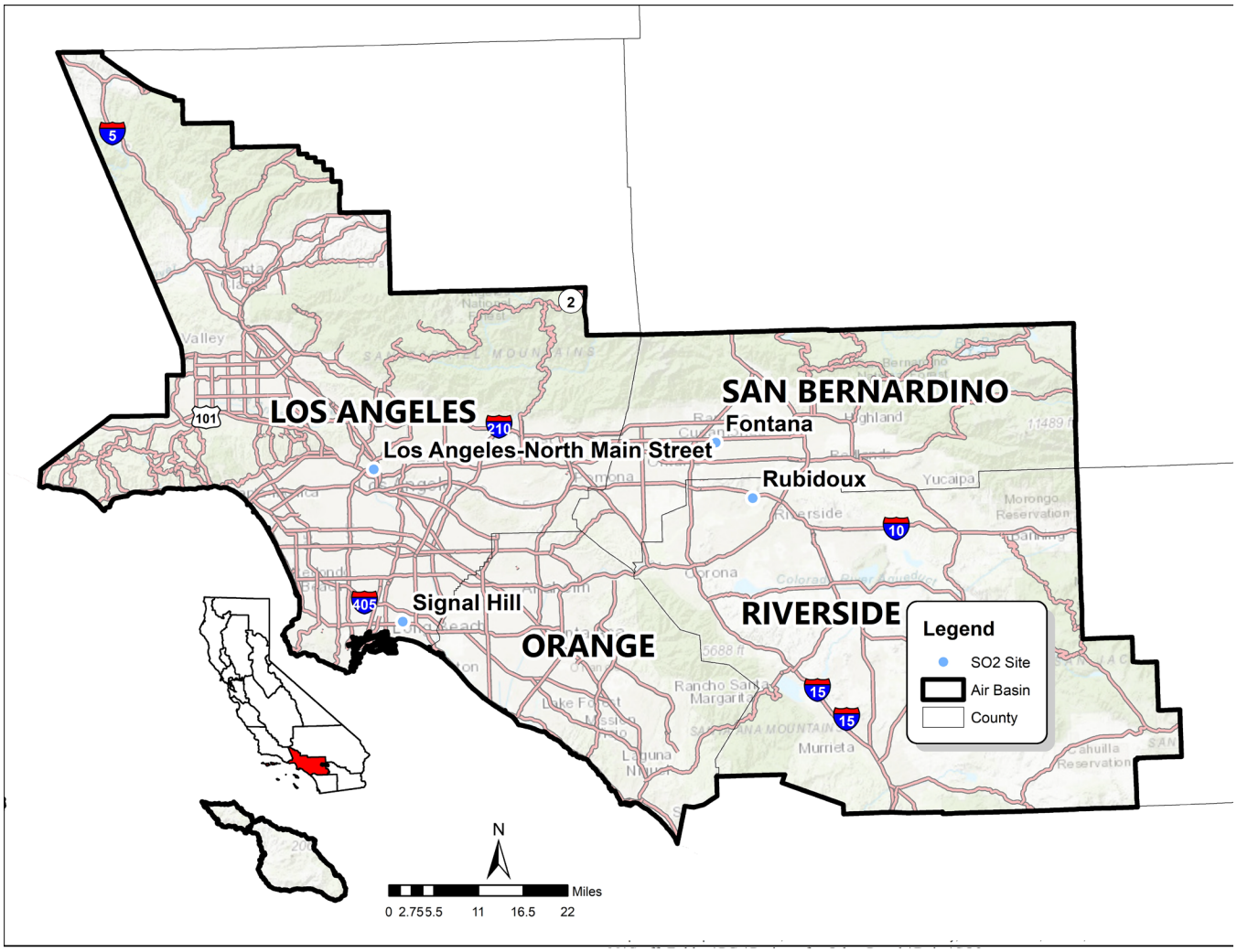
Overall, the South Coast region experiences more days of sunlight than any other major urban area in the nation except Phoenix. However, the climate does vary, from mild near the coast to more extreme at inland locations. The coastal area benefits from the marine influence, which moderates temperatures, and the daily onshore/offshore circulation

pattern tends to disperse pollutants, which keeps concentrations low. Compared to the coastal regions, temperatures increase and precipitation decreases further inland. In contrast to the low elevation areas, the surrounding inland mountains reach elevations of more than 10,000 feet. These areas see temperatures below freezing in the winter and precipitation in the form of snow.

FIGURE 17

SO_2 Monitoring Stations

South Coast Air Basin



Emissions

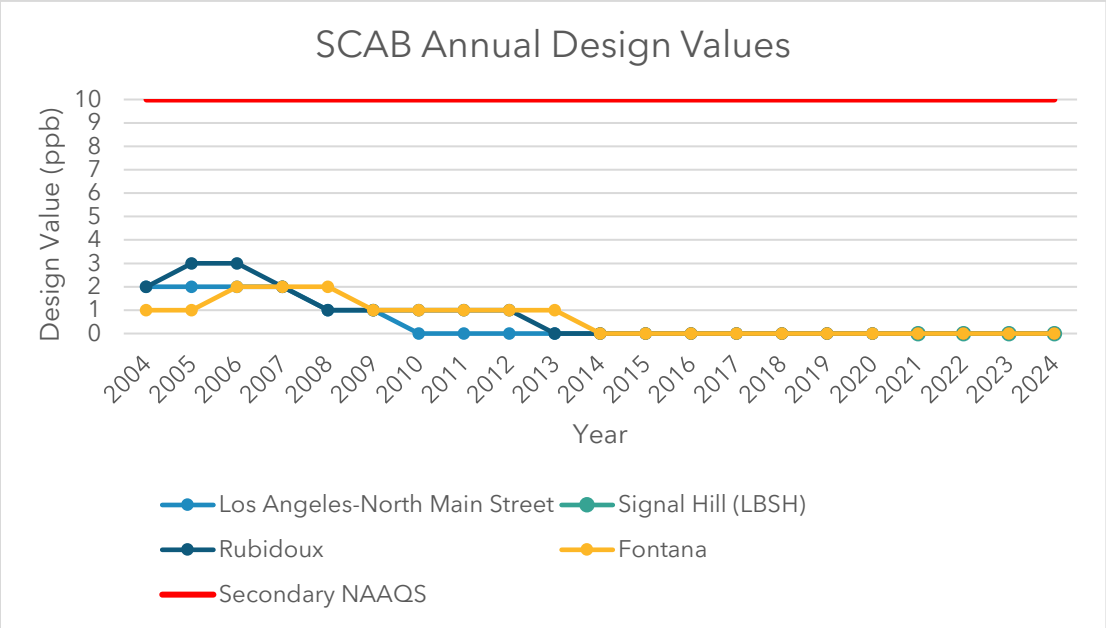
Total SO_x emissions from all sources in the SCAB were 4,975 tpy in 2024, down from 6,623 tpy in 2011, a 25% reduction. The largest sources of SO_x emissions in the SCAB are petroleum refining, aircraft, and ocean-going vessels.

Air Quality Trends

Based on data for record, the SCAB attains the revised federal secondary SO_2 standard, with a 2024 design value of 0 ppb. As seen in Figure 17, there are four SO_2 monitors in the SCAB that collect quality-assured data for record. Two monitors (Los Angeles-North Main Street and Signal Hill) are located in Los Angeles County near the larger sources of SO_x emissions. In addition to these monitors, there is one monitor in Riverside County (Rubidoux) and one in San Bernardino County (Fontana). These sites monitor public SO_2 exposure from smaller facilities and from area wide transportation sources. Based on data for record collected from 2022 through 2024, the South Coast attains the federal secondary annual SO_2 standard with design values of 0 ppb for all individual sites. Since 2004, design values in the SCAB have ranged from 0 – 3 ppb, with the design value at all sites consistently at 0 ppb since 2014.

FIGURE 18

South Coast Air Basin Annual SO_2 Design Values[1, 2]



[1]*2021 and 2022 data for Signal Hill (LBSH) do not meet completeness requirements.*

[2]*Data completeness was not verified by U.S. EPA for years prior to 2015.*

Summary

CARB staff have evaluated the five factors recommended by U.S. EPA for purposes of determining the appropriate attainment status and boundaries: air quality data, emissions data, meteorology, geography/topography, and jurisdictional boundaries. Based on the five-factor analysis, the above-mentioned air basins should be designated as attainment areas for the federal secondary annual SO_2 standard. This recommendation is based on the following weight of evidence:

- CARB maintains a statewide monitoring network, with monitoring sites in the areas with the highest expected SO_x emissions. All design values in areas with monitors are well below the standard and areas without monitors generally have significantly lower SO_x emissions. Therefore, staff conclude that the areas without monitors would also attain the standard.
- Since 2011, SO_x emissions have decreased in all but three air basins in California.
- Stringent statewide SO_2 control measures will reduce emissions from sources including diesel fuel, locomotives, and shipping.
- Air basins were used as the jurisdictional boundaries for attainment areas for the federal primary 1-hour SO_2 standard that was established in 2010.
- There are no specific meteorological or topographical factors which would warrant different boundaries for the attainment areas.