Bay Area Air District

2025 Five-Year Air Monitoring Network Assessment

Assessment of and Recommendations for the Air District's Ambient Air Monitoring Network

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About the Bay Area Air District

The California Legislature created the Air District in 1955 as the first regional air pollution control agency in the country. The Air District is tasked with regulating stationary sources of air pollution in the nine counties that surround San Francisco Bay: Alameda, Contra Costa, Marin, Napa, San Francisco, San Mateo, Santa Clara, southwestern Solano, and southern Sonoma counties. It is governed by a 24-member Board of Directors composed of locally elected officials from each of the nine Bay Area counties.

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1. Executive Summary

The Bay Area Air District (Air District) operates a network of fixed-site, ambient air quality monitoring sites equipped with instruments for measuring different air pollutants to support several agency programs. The locations of these monitors depend on the intended data use, but in general, the network is designed to characterize levels of different air pollutants in different locations and subregions of the Bay Area, demonstrate compliance with federal and state air quality standards, meet federal monitoring requirements, and provide timely air quality data to the public.

The United States Environmental Protection Agency (US EPA) requires monitoring organizations to submit an assessment of their ambient air monitoring networks every five years, per 40 CFR 58.10(d). Recognizing that the demands on the monitoring network evolve over time, this assessment is intended to help ensure that the network is properly aligned with the Air District's current and upcoming programs, priorities, and resources. In addition to meeting federal requirements for air monitoring, data from the air monitoring network is increasingly needed to support other Air District priorities, such as assessing air quality in overburdened communities and better characterizing and understanding pollution sources. This assessment focuses on monitoring of the six Criteria Air Pollutants (CAPs): particulate matter (including fine inhalable particulate matter, or $PM_{2.5}$, and inhalable particulate matter, or PM_{10}), carbon monoxide (CO), nitrogen dioxide (NO_2), ozone (O_3), and sulfur dioxide (SO_2), and lead (Pb). For each pollutant, each monitor is evaluated according to how it supports compliance with the National Ambient Air Quality Standards (NAAQS) and compares with other monitors within and adjacent to the network, contributes to federal minimum monitoring requirements, meets monitoring objectives and siting requirements, and serves Air District programs and priorities.

This assessment identified several opportunities for reducing redundancies and streamlining monitoring operations within the fixed-site monitoring network, which will free up resources for other air monitoring priorities that can better inform community air quality concerns in the Bay Area. Some of these opportunities include:

- Consolidating certain monitoring operations at multi-pollutant air monitoring sites and discontinuing operations at certain single-pollutant sites and sites that are redundant with other sites.
- Relocating certain air monitoring sites within nearby communities so that they are sited to be more representative of overburdened communities and of areas where higher concentrations of certain pollutants are expected.
- Decreasing the number of monitors for certain pollutants, in particular for carbon monoxide and ozone, to better align operations with data needs and monitoring requirements.

Section 2 of this document provides a brief background of the Air District's ambient air monitoring network, the criteria used for network evaluation, and a regional description of the Bay Area in the context of air monitoring. Section 3 contains the evaluation of the network by pollutant. Section 4 contains the recommendations and other considerations that emerged from this assessment.

2. Background, Evaluation Criteria, and Regional Description

This section begins with background information on the Air District's ambient air monitoring network, including information on monitoring objectives and purpose of the network. This background is followed by the criteria used for network evaluation in this assessment. This section concludes with a description of Bay Area topography, meteorology, population, and emissions sources, which are some of the key factors considered in determining locations for air monitoring sites.

Air Monitoring Network Background

As a regional air pollution control agency, the Air District is tasked with regulating stationary sources of air pollution in the nine counties that surround San Francisco Bay: Alameda, Contra Costa, Marin, Napa, San Francisco, San Mateo, Santa Clara, southwestern Solano, and southern Sonoma. Among other activities such as air quality planning, rulemaking, permitting, and enforcement, the Air District maintains a network of ambient air quality monitoring sites across the Bay Area. Objectives of the Air District's ambient air monitoring network include:

- collecting air pollution measurements for comparison with the National Ambient Air Quality Standards (NAAQS)[1] and California Ambient Air Quality Standards (CAAQS)[2],
- providing air pollution data to the public in a timely manner,
- supporting development of strategies to improve air quality, and
- supporting and providing data for air pollution research studies.

The Air District designs its ambient air monitoring network to accomplish these objectives by determining where air pollution measurements should be performed, what pollutants should be monitored at each location, and how frequently measurements should be made, among other factors. The population centers throughout the Bay Area represent a variety of conditions in terms of population size, the mix of local emissions sources, topography, and meteorological conditions. While resources do not allow for operation of monitoring sites in every community, US EPA regulations require the Air District to place monitoring sites at locations that reasonably represent other areas with similar pollution sources. This approach allows the Air District to estimate air pollution levels to which many people throughout the region are exposed even if a particular community is not near an actual monitoring site. Generally, locations for air monitoring sites are based on knowledge of population density, local wind patterns, topography, and sources of air pollution, while the final site selection is determined after considering logistical constraints and analyzing available air quality data from previous monitoring or modeling studies.

Operating and maintaining the ambient air monitoring network, in addition to other air monitoring networks and programs operated by the Air District, and reviewing, validating, analyzing,

[1] EPA's National Ambient Air Quality Standards (NAAQS): https://www.epa.gov/criteria-air-pollutants/naaqs-table
[2] California Air Resources Board (CARB) California Ambient Air Quality Standards (CAAQS): https://ww2.arb.ca.gov/resources/california-ambient-air-quality-standards

interpreting, and communicating the resulting data, take considerable capital and staff resources. Thus, one goal of this assessment is to provide recommendations to better optimize use of available resources while continuing to meet monitoring data needs.

For most CAPs[3], minimum monitoring requirements established by US EPA, specified in federal regulations (40 CFR part 58, appendix D)[4], are based off census-designated Core Based Statistical Areas (CBSAs), which are geographic areas that consist of one or more counties anchored by an urban center of at least 10,000 people and adjacent counties that are socioeconomically tied to the urban center by commuting. CBSAs are further classified as Metropolitan Statistical Areas (MSAs) if the population is 50,000 or greater, or as Micropolitan Statisical Areas (μSAs) if the population is less than 50,000. The CBSAs that overlap with the Air District's jurisdiction are all MSAs. The Air District overlaps with five CBSAs:

- San Francisco – Oakland – Berkeley
- San Jose – Sunnyvale – Santa Clara
- Santa Rosa – Petaluma
- Vallejo
- Napa

To meet minimum monitoring requirements for five CBSAs, and to fulfill Air District requirements and priorities, the Air District has limited flexibility in locating air monitoring sites throughout its geographic jurisdiction. However, within these constraints, there are several opportunities for streamlining the existing monitoring network while continuing to provide data needed to support Air District programs and priorities, including providing reliable data and information to the public. In addition to monitoring for compliance with federal minimum monitoring requirements, the Air District continues to operate at least one multi-pollutant air monitoring site in each of the nine counties that the Air District overlaps with. The Air District also prioritizes characterization of and actions to address air quality in overburdened communities that experience disproportionate impacts from air pollution and other environmental concerns.

The Air District's monitoring network consists of different site types across the Bay Area. The site types, defined in 40 CFR Part 58 appendix D, are designed to provide data appropriate to the monitoring objectives and are listed below:

- Highest Concentration: Sites expected to have the highest concentration, even if population density is low in that area. High concentrations may be found close to major sources, or further downwind if pollutants are emitted from tall stacks. High concentrations may also be found at distant downwind locations when the pollutants such as ozone or secondary particulate matter are a result of chemical reactions in the atmosphere.

[3] US EPA website for Criteria Air Pollutants (CAPs): https://www.epa.gov/criteria-air-pollutants
[4] Appendix D to Part 58, Title 40 of the Code of Federal Regulations: https://www.ecfr.gov/current/title-40/part-58/appendix-Appendix D to Part 58

- Maximum Ozone Concentration: Each Metropolitan Statistical Area Combined Statistical Area should have at least one site designed to record the maximum ozone concentration within that particular metropolitan area according to the ozone network design requirement in 40 CFR Part 58 Appendix D §4.1 (b).
- Population Oriented: Sites in areas with high population density are established to evaluate average likely exposure to air pollution where many people live or spend time. In most cases, stations are located within the largest cities in each county. Because people spend more time at home than at work, air monitoring sites are generally located in residential areas rather than at downtown locations.
- Source Impact: Sites in areas downwind of potential major sources of pollutants. In the Bay Area, there are five refineries that are potential pollutant sources: Chevron, Shell, Tesoro, Phillips 66, and Valero. The Port of Oakland also can be a significant source of particulates, CO, and toxics. General aviation airports can be sources of lead because piston engine aircraft continue to use leaded fuel.
- General/Background: Where there are no significant emission sources upwind of a site, then the site is considered a general background site.
- Regional Transport: The Air District shares a common boundary with six other air districts: Monterey Bay Unified APCD, San Joaquin Valley APCD, Sacramento Metropolitan AQMD, Yolo-Solano AQMD, Lake County AQMD, and Northern Sonoma County APCD. Transport of pollution between these air basins and those of the Air District can result in elevated levels of air pollution, even if the sources are located in other air district.
- Welfare-Related Impacts: Sites located to measure impacts on visibility, vegetative damage, or other welfare-based impacts.
- Quality Assurance: Sites where dual or collocated instruments are maintained to confirm that the primary instruments are providing accurate data.

The Air District's long-term ambient air monitoring network, shown in Figure 1, consists mostly of State or Local Air Monitoring Stations (SLAMS), which have specific siting requirements and can fulfill a variety of monitoring objectives including comparisons with the NAAQS and includes sites that are affiliated with other programs or networks such as Photochemical Air Monitoring Stations (PAMS)[5] and NCore[6]. Some of the sites in the Air District's monitoring network and some Special Purpose Monitors (SPMs), which are typically established for special monitoring projects that are conducted to gain better knowledge about certain pollutants and impacts on the surrounding community. SPMs do not count for compliance with minimum monitoring requirements. While monitoring of CAPs is the focus of this assessment, some monitoring sites include measurements of other pollutants, such as nitric oxide (NO), nitrogen oxides (NO_x), black carbon, ultrafine particles, speciated $PM_{2.5}$, hydrogen sulfide (H_2S), and selected Volatile Organic Compounds (VOCs), which are not explicitly evaluated in this assessment.

[5] US EPA website for the Photochemical Air Monitoring Station monitoring network: https://www.epa.gov/amtic/photochemical-assessment-monitoring-stations-pams
[6] US EPA website for the NCore monitoring network: https://www.epa.gov/amtic/ncore-monitoring-network

Figure 1. Map of the Air District's long-term ambient air monitoring network.

Evaluation Criteria

In this assessment, existing monitors for CAPs are evaluated considering several factors, including:

- Measured pollutant concentrations, including design values and other metrics, and how they compare with other monitors within the network
- US EPA minimum monitoring requirements within each CBSA/MSA and Air District requirements for at least one multi-pollutant monitoring site in each county
- Monitoring objective(s), site type(s), and spatial scale as defined by 40 CFR Part 58 Appendix D and potential siting issues or changes around the site (emissions, land use,

obstructions) that may affect the representativeness of the data and how well the data align with monitoring objectives

- Support for Air District programs and priorities, such as:
    - Characterizing regional and community-scale air quality and sources of air pollution
    - Serving environmental justice and overburdened communities
    - Air quality forecasting and modeling
    - Ongoing efforts and strategies to reduce pollution levels throughout the region
- Expected additions or modifications to the network that may affect network design

Evaluation of measured pollutant concentrations across the monitoring network primarily used data collected during the period 2019-2023, as final, validated data for 2024 were not fully available at the time this assessment was prepared. The recommendations made in this assessment are based on long-term factors and trends and are not expected to change with consideration of 2024 data. One of the metrics used for evaluation is the design value. For each CAP measured at each monitoring site, a design value is calculated each year using data collected over the previous three years.[7] Tracking how design values change over time provides information on whether levels of a pollutant are improving, worsening, or holding steady relative to the NAAQS, and helps illustrate how design values vary between locations and for different pollutants.

While the factors listed above are evaluated on a pollutant by pollutant basis, many of the Air District's air monitoring sites have collocated monitors for different pollutants, which is advantageous for data analysis and interpretation and for data comparisons for quality control purposes. Collocation of monitoring assets at common locations is also generally more resource efficient. Therefore, monitors that are located at multipollutant sites are prioritized over single-pollutant sites in this evaluation.

The Air District's Major Stationary Source Community Air Monitoring Program[8] requires enhanced monitoring in communities near refineries. The Air District is in the process of building these enhancements, which will include new multi-pollutant air monitoring sites in some communities. While the Major Stationary Source Community Air Monitoring Program is considered separate from the ambient air monitoring network that this assessment pertains to, the expected enhancements under the program are considered here since they may point to opportunities to streamline Air District monitoring operations.

As shown in Section 3, after evaluating the previously mentioned criteria on a pollutant-by-pollutant basis, each monitor was assigned a rating of Low, Medium, or High for its relative value to the network overall. Generally, a higher rating may be assigned to monitors that have higher historical levels of a pollutant compared to other monitors within the network, are needed to meet US EPA minimum monitoring requirements or Air District monitoring requirements, are critical to

[7] EPA Air Quality Design Values website: https://www.epa.gov/air-trends/air-quality-design-values.
[8] The Air District's Special Air Monitoring Projects webpage, which includes information on the Major Stationary Source Community Air Monitoring Program: https://www.baaqmd.gov/about-air-quality/air-quality-measurement/special-air-monitoring-projects

support Air District programs, are in overburdened communities, or are located at multi-pollutant monitoring sites. Conversely, a lower rating may be assigned to monitors that have lower historical levels of a pollutant compared to other monitors, are not needed to fulfill monitoring requirements, are less critical for informing Air District programs, are potentially redundant with other monitors, or are single-pollutant monitoring sites.

Regional Description

Topography and Meteorology

The San Francisco Bay Area is characterized by complex topography and meteorological conditions, which are important considerations for placement of air monitoring sites. Elevations within the San Francisco Bay Area air basin generally range from sea level to 460 meters (1,500 feet) with some higher peaks. San Francisco and San Pablo bays, around which the bulk of the region's population resides, are bounded by rugged hillsides and inland valleys. Hilly and mountainous terrain largely separates the area's air shed from nearby basins, including Santa Cruz and San Benito counties to the south, and portions of Solano and Sonoma counties to the north.

Seasonal, and often daily, variations between predominant onshore winds (air moving from the ocean toward land) and offshore winds (air moving from land to ocean), in addition to mountain-valley circulations, influence the fate and transport of emitted pollutants and their precursors. In general, from late spring to early autumn, winds prevail from the northwest off the Pacific Ocean, though these winds are significantly altered and distorted by the complex topography and geography of the Bay Area. Stronger daytime heating of inland areas relative to the ocean and coastal locations drives large horizontal temperature gradients, and therefore, pressure gradients, which results in gusty onshore winds, particularly during the afternoon and evening hours. These onshore winds are enhanced through gaps in the coastal terrain, including the Petaluma Gap (from Bodega Bay through Petaluma to San Pablo Bay), the Golden Gate (between San Francisco and Marin counties), San Bruno Gap (extending roughly from near Daly City to San Francisco International Airport), Crystal Springs Gap (roughly along California State Highway 92 in San Mateo County), and Pajaro Gap (connecting Monterey Bay with the southern Santa Clara Valley).

Similarly, as onshore winds progress inland, they are modulated and channeled by the surrounding geography and topography. For example, as onshore winds enter through the Golden Gate they impinge on the East Bay hills and diverge, with one branch flowing northward into San Pablo Bay, the adjacent North Bay valleys, and through the Carquinez Strait. A second branch extends southeastward into San Francisco Bay and into the Santa Clara Valley and the East Bay valleys. Pollutants generated locally in the Bay Area urban core tend to be transported downwind and inland each afternoon by these onshore winds.

From late autumn through early spring , winds are generally more variable and driven by passing high- and low-pressure systems. When low-pressure (storm) systems move through the Bay Area, stronger vertical mixing (cooler temperatures aloft) and winds typically lead to improved air quality. In between storm systems, periods of colder temperatures, strong temperature inversions (due to

radiational surface cooling, wintertime minimum in sun angle and surface heating, and subsidence warming aloft), and calm to light winds or offshore winds can reduce mixing and dispersion of pollutants, resulting in worsened air quality. Offshore winds from the Central Valley can also transport additional pollutants into the Bay Area. In some winters, extended periods of relatively stagnant conditions, offshore winds, and reduced storm activity can develop, allowing for increased potential for poor air quality due to the buildup of locally generated pollution over several days and transport of additional pollutants into the Bay Area. Such conditions typically contribute to the highest episodic levels of $PM_{2.5}$ in the Bay Area outside of wildfire smoke periods.

Observed meteorological and air quality conditions at a given location and time may be (and often are) substantially different than both what is typical and compared to conditions in other nearby locations. At any time of year, periods of calm or light winds regularly occur, particularly when strong high pressure is present over the region, during the overnight and morning hours when local temperature and pressure gradients are minimized, and in inland valleys and other locations that are more protected from prevailing wind flow. Calm or light and variable winds reduce pollutant dispersion and allow pollutant concentrations to increase, especially if a temperature inversion is also present. In urban areas, winds may vary considerably over short distances due to channeling of winds through roadway corridors/canyons and due to microcirculations around buildings or other obstructions.

In some cases, air quality may be particularly impacted during meteorological conditions that occur relatively infrequently. For example, while stronger winds are generally associated with improved air quality for some pollutants, strong and gusty winds loft dust (PM_{10}) and other substances into the air from certain facilities, construction lots, and unpaved surfaces, resulting in local-scale air quality issues near such sources.

Population

The San Francisco Bay Area consists of several densely populated urban cores and suburban areas, largely straddling San Francisco Bay and extending inland along topographical valleys, and rural expanses with lesser population, particularly in portions of the North Bay, inland East Bay, and portions of the Pacific coastline. Population is an important factor in locating air monitoring sites for characterizing typical population exposure and for meeting certain minimum monitoring requirements. Table 1 shows changes in population and population density for each of the nine counties comprising the Air District's jurisdiction between the 2010 Census, 2020 Census and the 2024 population estimates. All nine counties experienced growth between the 2010 Census and the 2020 Census. However, most counties had decreases in population between the 2020 Census at the 2024 population estimates. San Francisco County had the largest decrease in population (-5.8%) during this period, while Contra Costa and Solano counties had slight increases in population (0.6% and 0.3%, respectively). Population densities range from approximately 177 people per square mile in Napa County to 17,656 in San Francisco County. While less dense than San Francisco County, Alameda, Contra Costa, San Mateo and Santa Clara counties each have more than 1000 people per square mile. Areas with higher and denser populations or commercial development,

such as the San Francisco Bay Area, are often characterized by higher emissions of particulate matter, NO_x, and VOCs from area sources and mobile sources compared to less populated areas. Examined by CBSA, the population of the Napa and San Francisco-Oakland-Berkeley CBSAs decreased the most from 2020 to 2024, by -3.8% and -2.2%, respectively (Table 2).

Table 1. Changes in population quantity and density for each of the nine counties comprising the Air District's jurisdiction between the 2010 Census, 2020 Census and the 2024 estimate. Data source: https://www.census.gov/data/tables/time-series/demo/popest/2020s-counties-total.html

County	2010 Census Population	2020 Census Population	2024 Population (estimated)	2020 to 2024 Percent Change	Land Area (miles²)	2024 Population per mile²
Alameda	1,510,271	1,682,296	1,649,060	-2.0%	739.02	2,231
Contra Costa	1,049,025	1,165,983	1,172,607	0.6%	715.94	1,638
Marin	252,409	262,325	256,400	-2.2%	520.31	493
Napa	136,484	138,014	132,727	-3.8%	748.36	177
San Francisco	805,235	878,392	827,526	-5.8%	46.87	17,656
San Mateo	718,451	764,659	742,893	-2.8%	448.41	1,657
Santa Clara	1,781,642	1,936,278	1,926,325	-0.5%	1,290.10	1,493
Solano	413,344	453,551	455,101	0.3%	821.77	554
Sonoma	483,878	488,862	485,375	-0.7%	1,575.85	308

Table 2. Census Population in 2010 and 2020 and Population Estimates in 2024 for Bay Area CBSAs. Data source: https://www.census.gov

Core Based Statistical Area	2010 Census Population (April 1, 2010)	2020 Census Population (April 1, 2020)	2024 Population Estimate (July 1, 2024)	Percent Change 2020 to 2024
San Francisco-Oakland-Berkeley	4,335,391	4,753,655	4,648,486	-2.2%
San Jose-Sunnyvale-Santa Clara	1,836,911	2,000,487	1,995,484	-0.3%
Santa Rosa-Petaluma	483,878	488,862	485,375	-0.7%
Vallejo	413,344	453,551	455,101	0.3%
Napa	136,484	138,014	132,727	-3.8%

Improving air quality in overburdened communities is a major priority for the Air District. Communities of color and lower-income communities often face higher burdens of environmental hazards, including air pollution, compared to other communities. The Air District defines overburdened communities as census tracts that have a composite score at or above the 70th percentile in the California Office of Environmental Health Hazard's (OEHHA) CalEnviroScreen

(Version 4.0)[9] and areas that are within 1,000 feet of the boundaries of those census tracts. Figure 2 shows the locations of the Air District's ambient air monitoring sites as of 2024 and the locations of overburdened communities. In addition, the CalEnviroScreen composite scores for the locations of each Air District monitoring site are shown in Table 3 for reference.

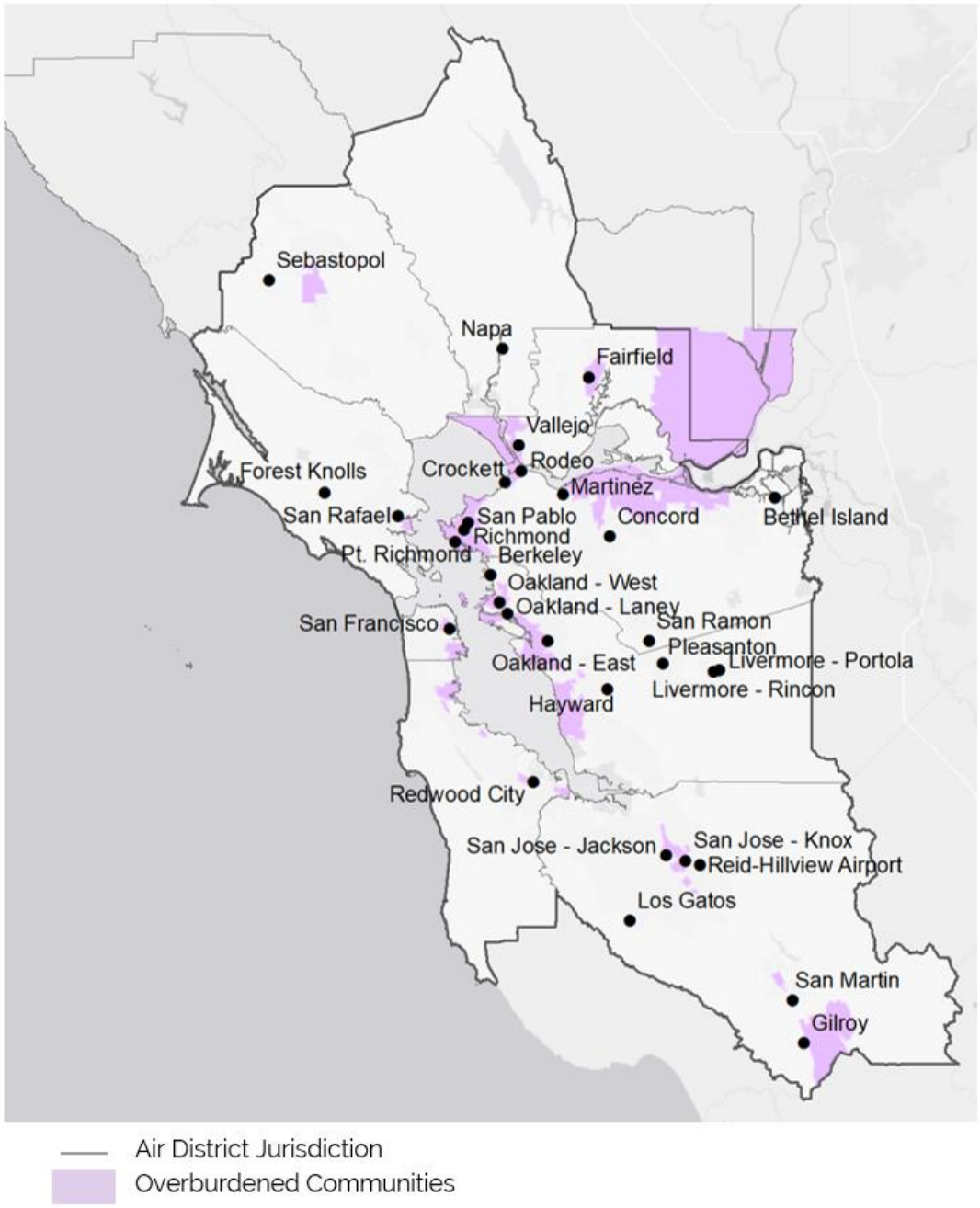

Figure 2. Map of the Air District's ambient air monitoring network as of 2024 and locations of overburdened communities. Air District Regulation 2, Rule 1 defines overburdened communities as census tracts that score at or above the 70th percentile in CalEnviroScreen, Version 4.0, as well as areas that are within 1,000 feet of the boundaries of those census tracts.

[9] The California Office of Environmental Health Hazard's (OEHHA) CalEnviroScreen screening tool: https://oehha.ca.gov/calenviroscreen/report/calenviroscreen-40

Table 3. CalEnviroScreen composite scores corresponding to the locations of Air District air monitoring sites.

Monitoring Site	CalEnviroScreen Composite Score
Sebastopol	26
Napa	NA[(a)]
Fairfield	84
Vallejo	78
Forest Knolls	1
San Rafael	41[(b)]
Point Richmond	71
Richmond	71
San Pablo	96
Rodeo	39
Crockett	87
Martinez	37
Concord	11
Bethel Island	60
San Francisco	41

Monitoring Site	CalEnviroScreen Composite Score
Berkeley	66
Oakland – West	71
Oakland – Laney	83
Oakland – East	70
Hayward	5
Pleasanton	32
San Ramon	0
Livermore - Portola[(c)]	35
Livermore - Rincon[(c)]	35
Redwood City	75
San Jose – Jackson	55
San Jose – Knox	76
Los Gatos	4
San Martin	50
Gilroy	56

[(a)] The former Napa monitoring site (Napa Valley College) went offline in May 2021 and identification of a location for a new air monitoring site Napa is pending.

[(b)] Site is within 1000 feet of an area with CalEnviroScreen score > 70%.

[(c)] The Air District's Livermore monitoring site was recently relocated from the former Livermore – Rincon location to the current Livermore – Portola location.

CAPs and Emissions Sources

There are numerous types and individual sources of and contributors to air pollution in the Bay Area. Historically, $PM_{2.5}$ and ozone have been CAPs of particular concern since these are the two pollutants for which the Air District remains in nonattainment with the NAAQS.

$PM_{2.5}$ has many sources and can be directly emitted into the air (referred to as primary PM) or can form in the air through complex reactions of other pollutants that are emitted as gases (often referred to as secondary PM). Combustion is a ubiquitous source of $PM_{2.5}$, including the combustion of fossil fuels for industrial operations; by cars, trucks, and other on-road mobile sources; and off-road mobile sources such as airplanes, trains, and construction equipment. Other combustion sources of $PM_{2.5}$ include residential wood stoves and fireplaces, certain restaurants, and diesel generators. Brake and tire wear from vehicles, and road dust generally, are also sources of $PM_{2.5}$. In the Bay Area, $PM_{2.5}$ levels are typically higher in the winter season, in part due to $PM_{2.5}$ emitted through residential wood burning, but also because meteorological conditions are often more conducive (cooler temperatures, strong temperature inversions, and lighter winds) for stagnation of pollutants from all sources. At times in recent years, smoke from wildfires has notably contributed to higher $PM_{2.5}$ levels in the Bay Area, in particular during the summer and autumn seasons. Prescribed and agricultural burning are also sources of $PM_{2.5}$ in the Bay Area.

Ozone is a pollutant of concern from late spring to early autumn and ozone concentrations are typically highest on sunny, hot days with light winds and poor ventilation, conditions that occur more frequently in the inland East Bay and South Bay regions. Ozone forms due to photochemical

reactions of NO_x and VOCs. Traffic and other mobile sources are collectively the largest source of these ozone-forming pollutants in the Bay Area

Different sources additionally contribute to pollution levels locally and throughout the region beyond ozone and $PM_{2.5}$. In the Bay Area, these permitted stationary sources are distributed throughout the entire region, with higher density in more urbanized areas like San Francisco, San Jose, and the Interstate-880 corridor from Hayward to Richmond (Figure 3). Another cluster of facilities, including five major petrochemical refineries, is located along the Carquinez Strait and Suisun Bay in western Contra Costa County and Solano County. Refineries are some of the largest sources of SO_2 in the Bay Area. Mobile sources in the Bay Area include traffic along many freeways and major arterial thoroughfares, three large airports, two shipping ports, and several rail facilities. More information on the emissions of different pollutants by source types and location can be found on the Air District's Emissions Inventories webpage.

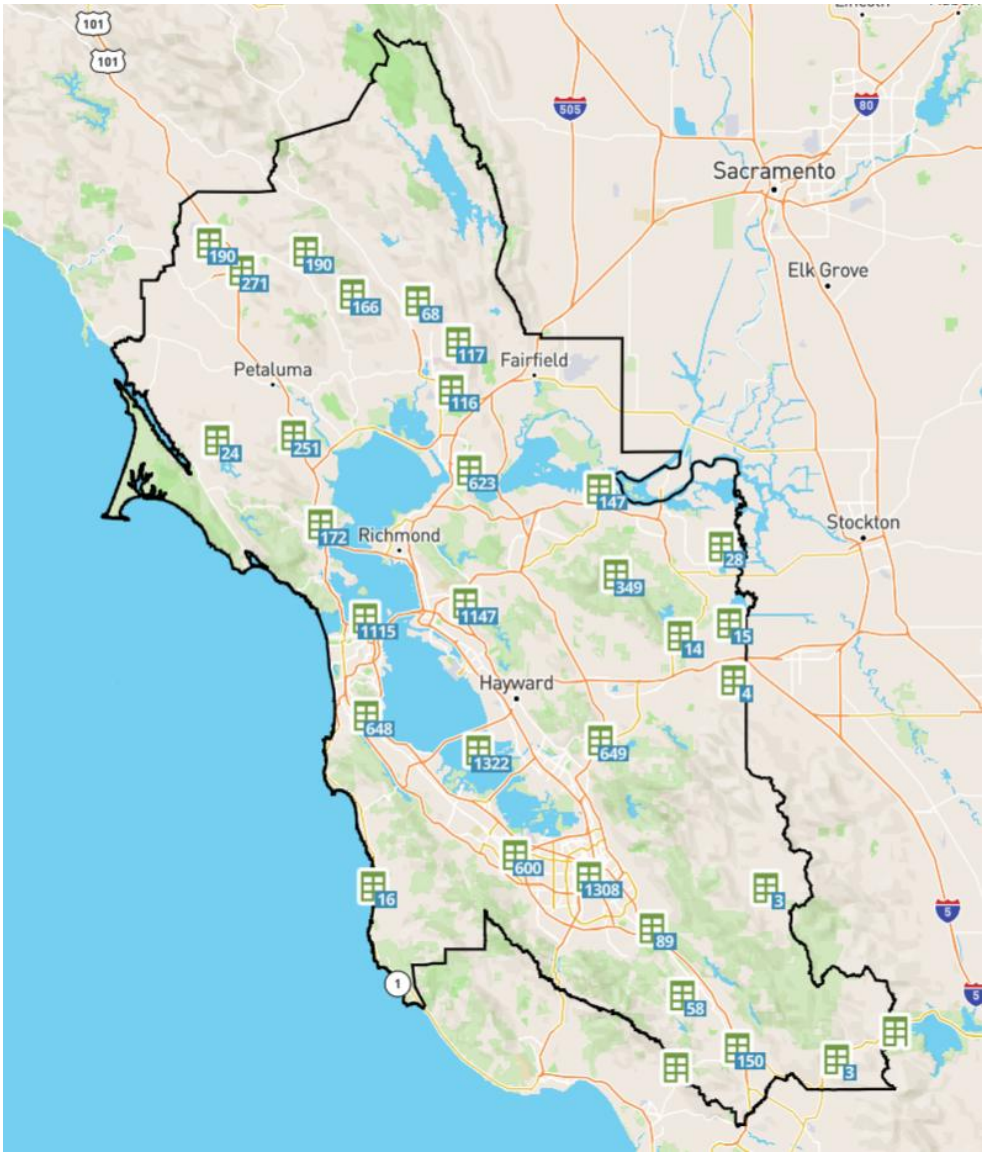

Figure 3. Distribution of permitted stationary sources (facilities) within the Air District's jurisdiction. The numbers in the blue boxes represent the number of facilities in that general area.

3. Pollutant-Specific Network Evaluation

Ozone

The San Francisco Bay Area is currently classified as being in nonattainment of the NAAQS for 8-hour ozone. As shown later in this section, recent design values for ozone have been very near or equal to the NAAQS of 0.070 parts per million (ppm), and several monitors continue to record occasional exceedances of the NAAQS. Ozone concentrations are typically highest on sunny, hot days with light winds and poor ventilation, conditions that occur more frequently in the inland East Bay and South Bay regions.

Ozone is monitored at twenty Air District monitoring sites, shown in Figure 4.[10] Adjacent air districts also conduct ozone monitoring within their portions of shared MSAs, including at the Vacaville monitoring site in Solano County operated by the Yolo-Solano Air Quality Management District (YSAQMD) and the Hollister and Pinnacles monitoring sites in San Benito County operated by Monterey Bay Air Resources District (MBARD) and the National Park Service, respectively.

Table 4 lists each ozone monitor, its monitor and site type(s), monitoring objective(s), and spatial scale, and Table 5 summarizes the US EPA-based minimum monitoring requirements for ozone by MSA. Six of the twenty ozone monitors are designated as SPMs and do not count towards meeting minimum monitoring requirements. The number of ozone monitors required for US EPA minimum monitoring requirements depends on the population of the MSA and the maximum 8-hour ozone design value among ozone monitors within the MSA. The Air District meets or surpasses minimum monitoring requirements for ozone in all MSAs. Ozone monitoring is also required at monitoring sites that are part of the PAMS network (which includes the Livermore air monitoring site) and the national NCore multi-pollutant monitoring network (which includes the San Jose-Jackson monitoring site). Some monitors may be at critical site types (such as a monitoring site that is expected to represent the highest concentrations in an area), are at multi-pollutant monitoring sites, or are affiliated with other monitoring programs (such as PAMS or NCore), and therefore may be of higher value within the network.

Figure 5 shows 8-hour ozone design values at all Air District monitoring sites over the last decade. Livermore[11] has consistently had the highest design value for ozone and has at times had design values above the NAAQS. Other sites with ozone design values near but below the NAAQS include San Martin, Bethel Island, and San Jose – Jackson. Most sites have ozone design values well below the NAAQS, some of which could be considered for closure to better align ozone monitoring with monitoring requirements and data needs. However, several ozone monitors with relatively low ozone design values are located in overburdened communities and may be prioritized.

[10] The former Napa monitoring site (Napa Valley College) went offline in May 2021 and identification of a location for a new air monitoring site Napa is pending.

[11] The Livermore monitoring site was relocated from the previous Livermore-Rincon location to the current Livermore-Portola location. The Air District included a formal request for this site relocation in the 2025 Annual Monitoring Network Plan.

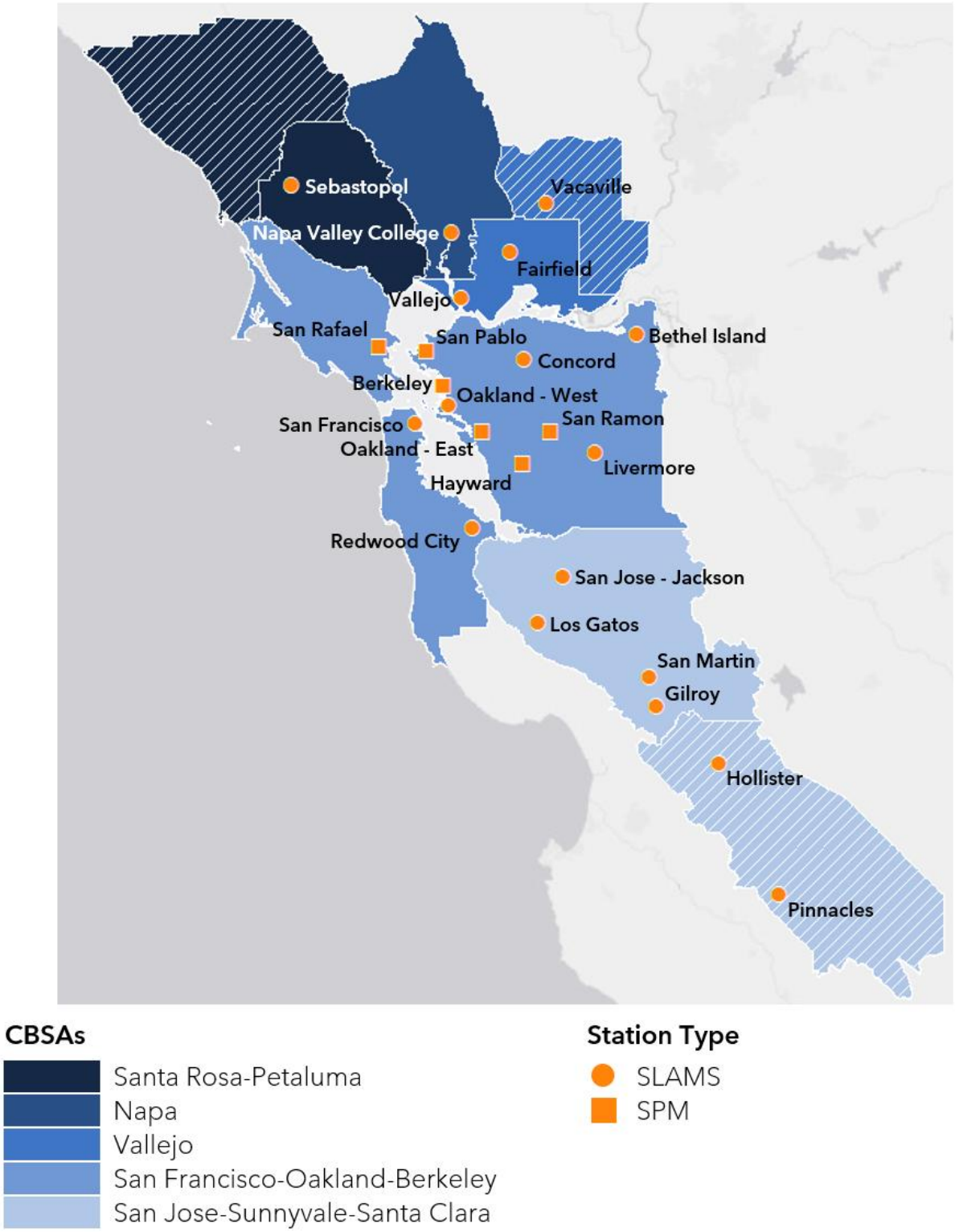

Figure 4. Map of locations of Air District ozone monitors and Core Based Statistical Areas (CBSAs). Hatched areas on the map are outside the Air District boundaries and note portions of a CBSA that are shared with an adjacent air agency.

Table 4. Ozone monitors and their monitor type, monitoring objective(s), site type(s), and spatial scale.

MSA	Monitoring Site	Monitor Type	Monitoring Objective(s)	Site type(s)	Spatial Scale
Santa Rosa-Petaluma	Sebastopol	SLAMS	NC	PE	Neighborhood
Napa[(a)]	Napa	SLAMS	NC	PE	Neighborhood
Vallejo	Fairfield	SLAMS	NC	PE, RT	Urban
	Vallejo	SLAMS	NC	PE	Neighborhood
San Francisco-Oakland-Berkeley	San Rafael	SLAMS	PI	PE	Middle
	San Pablo	SPM	PI	PE	Middle
	Concord	SLAMS	NC	PE	Neighborhood
	Bethel Island	SLAMS	NC	RT, MC	Urban
	San Francisco	SLAMS	NC	PE	Neighborhood
	Berkeley	SPM	PI	PE	Microscale
	Oakland – West	SLAMS	NC	PE	Neighborhood
	Oakland – East	SPM	R	PE	Middle
	Hayward	SPM	NC, R	RT	Urban
	San Ramon	SPM	NC, R	PE	Urban
	Livermore	SLAMS	NC	MC, PE	Neighborhood
	Redwood City	SLAMS	NC	PE	Neighborhood
San Jose-Sunnyvale-Santa Clara	San Jose – Jackson	SLAMS	NC, R	PE	Neighborhood
	Los Gatos	SLAMS	NC	PE	Neighborhood
	San Martin	SLAMS	NC	MC, PE, RT	Urban
	Gilroy	SLAMS	NC	PE, RT	Neighborhood

Monitoring objectives abbreviations:
NC – NAAQS Comparison
PI – Public Information
R – Research

Site type abbreviations:
PE – Population Exposure
MC – Maximum Ozone Concentration
RT – Regional Transport

(a) The former Napa monitoring site (Napa Valley College) went offline in May 2021 and the identification of a location for a new air monitoring site Napa is pending.

Table 5. Summary of US EPA minimum monitoring requirements for ozone by MSA.

MSA	County or Counties	2020 Census Population	2023 8-hour Design Value (ppm)	Design Value Site	Number of SLAMS		
					Required	Active	Additional Needed
Santa Rosa-Petaluma	Sonoma	488,863	0.050	Sebastopol	1	1	0
Napa	Napa	138,019	0.054	Napa Valley College	0	0[(a)]	0
Vallejo	Solano	453,491	0.064	Vacaville	2	3[(b)]	0
San Francisco-Oakland-Berkeley	San Francisco, San Mateo, Alameda, Contra Costa, Marin	4,749,008	0.070	Livermore	3	6	0
San Jose-Sunnyvale-Santa Clara	Santa Clara, San Benito	2,000,468	0.069	San Martin	2	6[(c)]	0

(a) The Napa Valley College monitoring site went offline in May 2021. The most recent valid design value was 0.058 ppm (for 2018-2020 data), which is less than 85% of the NAAQS. Therefore, no monitors are required. However, ozone monitoring will resume in Napa pending relocation of the former air monitoring site.
(b) One of the monitors (Vacaville-Ulatis Drive) is located within the Yolo-Solano Air Quality Management District.
(c) Two of the six monitors are within the Monterey Bay Air Resources District. However, the monitor with the maximum design value in the San Jose-Sunnyvale-Santa Clara MSA (San Martin) is within the Air District.

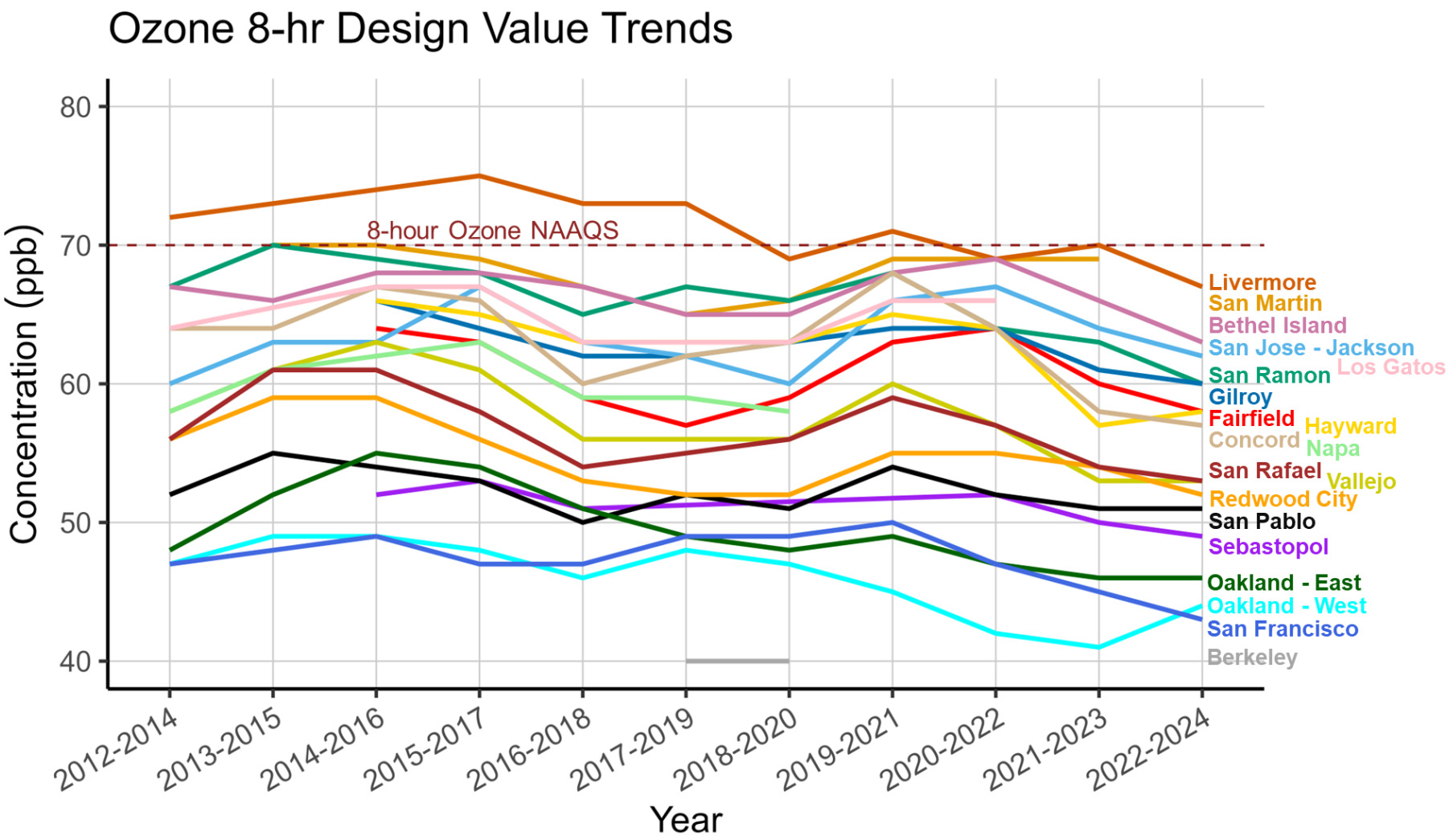

Figure 5. 8-hour ozone design values (in parts per billion, ppb) at Air District monitoring sites. Livermore has consistently had the highest 8-hour ozone design value within the Air District's monitoring network. Design values for 2021-2023 and 2022-2024 are preliminary, pending final data validation and certification. The 2022-2024 design value for Livermore reflects a combined site record for the former and current Livermore monitoring sites. Design values for Napa reflect a combined site record for the former Napa – Jefferson and Napa Valley College monitoring sites, and the design values shown for Sebastopol reflect a combined site record for the former Santa Rosa and current Sebastopol monitoring sites.

Table 6 shows recent measured ozone concentrations by monitor using several metrics. Monitors reporting higher concentrations of ozone, especially if their design values are near or in excess of the NAAQS for 8-hour ozone, are generally more critical to the network compared to monitors reporting consistently lower concentrations. The annual 4th highest daily maximum 8-hour ozone concentration for each monitor is considered, since sites with greater than three exceedances in a given year are at greater risk of violating the NAAQS. The number of exceedance days (over 5 years, 2019-2023) relative to the 8-hour ozone NAAQS (0.070 ppm) is also provided, since frequent exceedances can indicate greater health risks and an increased risk of violation the NAAQS. The 8-hour ozone NAAQS is also a key threshold for the Air District's forecasting program and issuance of Spare the Air Alerts for ozone pollution. Figure 6 shows measured daily 8-hour maximum ozone concentrations by monitoring site for the period 2019-2023, which allows for additional comparison of overall ozone concentrations and frequency of days with relatively high ozone concentrations between locations. Preliminary design values for 2022-2024 (not shown) indicate that the peak design value was 0.067 ppm, occurring at Livermore (using a combined data record for the previous and current Livermore monitoring sites) and at San Martin.

Table 6. Summary of different metrics for measured ozone concentrations for each monitoring site. Bolded values indicate annual 4th highest daily maximum 8-hour ozone concentrations above 0.070 ppm.

MSA	Monitoring Site	Annual 4th Highest Daily Maximum 8-hour Ozone Concentration (ppm)			8-hour Ozone Design Value (2021-2023)	Number of 8-hour Ozone Exceedances (2019-2023)
		2021	2022	2023		
Santa Rosa-Petaluma	Sebastopol	0.055	0.050	0.046	0.050	0
Napa	Napa[a]	NA	NA	NA	NA	NA
Vallejo	Fairfield	0.067	0.061	0.054	0.060	5
	Vallejo	0.061	0.052	0.047	0.053	3
San Francisco-Oakland-Berkeley	San Rafael	0.060	0.053	0.050	0.054	1
	San Pablo	0.057	0.049	0.049	0.051	2
	Concord	0.067	0.056	0.051	0.058	6
	Bethel Island	**0.074**	0.067	0.058	0.066	8
	San Francisco	0.051	0.044	0.041	0.045	1
	Berkeley	0.041[b]	NA[b]	0.037[b]	0.024[b]	0
	Oakland – West	0.042	0.039	0.044	0.041	1
	Oakland – East	0.051	0.043	0.045	0.046	2
	Hayward	0.063	0.059	0.051	0.057	11
	San Ramon	0.069	0.057	0.063	0.063	6
	Livermore	**0.073**	0.068	0.069	0.070	21
	Redwood City	0.059	0.053	0.052	0.054	3
Santa Jose-Sunnyvale-Santa Clara	San Jose – Jackson	**0.072**	0.062	0.059	0.064	9
	Los Gatos	0.069	0.062	0.050[b]	0.060[b]	8
	San Martin	**0.074**	0.066	0.067	0.069	16
	Gilroy	0.065	0.063	0.056	0.061	6

(a) The Napa monitoring site went offline in May 2021. Ozone monitoring will resume in Napa pending relocation of the former air monitoring site.
(b) Value did not meet data completeness criteria.

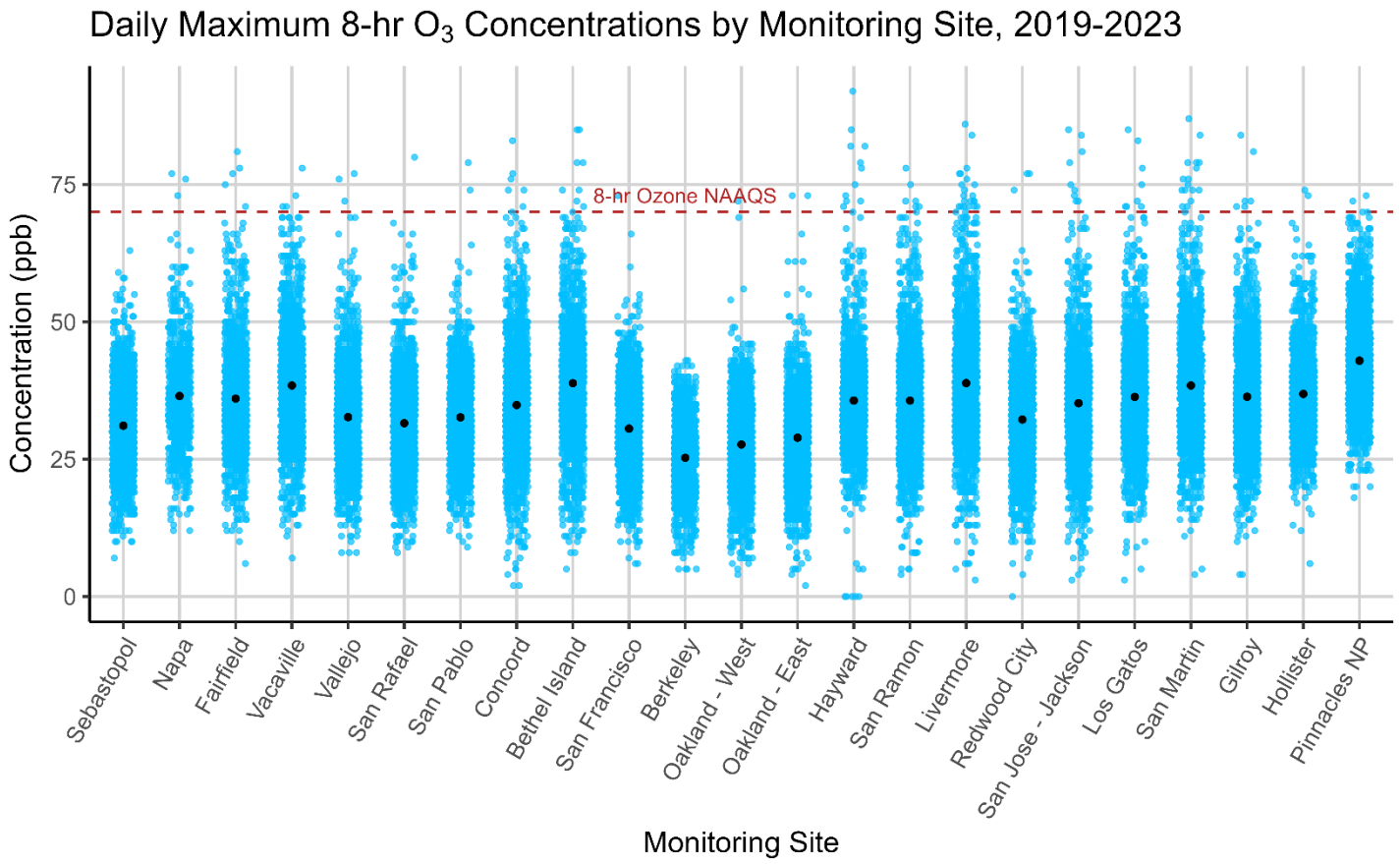

Figure 6. Measured daily maximum 8-hour ozone concentrations by monitoring site, 2019-2023. The Vacaville monitoring site, operated by the Yolo-Solano Air Quality Management District, is also included since it is located near the Air District's Fairfield monitoring site. Each blue dot represents an individual daily maximum 8-hour ozone concentration, and the black dots indicate the average daily maximum 8-hour ozone concentration for that site.

The Livermore and San Martin monitoring sites, respectively, have the highest design values for 8-hour ozone and the greatest number of exceedances of the 8-hour ozone NAAQS. These locations are generally downwind of ozone precursor emissions, and experience meteorological conditions that are conducive to ozone formation (hot temperatures, light winds) more frequently than other Bay Area locations, due to their inland locations that are more geographically and topographically removed from the cooling influences of the Pacific Ocean. Bethel Island, Livermore, San Jose – Jackson, and San Martin are the only sites that had annual 4th highest daily maximum 8-hour ozone concentrations above the NAAQS, and those values all occurred in 2021.

Monitor-to-monitor correlations of pollutant data can also help inform on whether measured data are relatively redundant or unique compared to other locations in the network. Figure 7 shows a correlation matrix for daily maximum 8-hour ozone concentrations measured at Air District monitoring sites and selected sites in neighboring air districts (Vacaville[12] and Hollister[13]) from 2019-

[12] The Vacaville air monitoring site is operated by the Yolo-Solano Air Quality Management District and is part of the Vallejo CBSA.
[13] The Hollister air monitoring site is operated by the Monterey Bay Air Resources District and is part of the San Jose-Sunnyvale-Santa Clara CBSA.

2023. While correlations themselves are generally not justification alone for recommending network changes, they may help inform changes to the network in combination with other assessment tools as part of a weight of evidence. In general, the correlations are strongest between monitors that experience similar meteorological conditions (e.g., monitors nearer the coast or bay versus inland) and are relatively near one another. Several monitor pairs have very highly correlated ozone concentrations (R > 0.9), including San Martin and Gilroy, Livermore and San Ramon, San Pablo and San Rafael, Concord and San Ramon, San Jose-Jackson and Los Gatos, Concord and Livermore, Bethel Island and Livermore, and San Rafael and Vallejo. In contrast, some monitors show relatively low correlations with most other monitors, such as San Francisco (which is located nearer the coast and typically experiences cooler and windier meteorological conditions that limit formation of ozone) and Berkeley (a near-road and bayside site where ozone is significantly scavenged by nitrogen oxides).

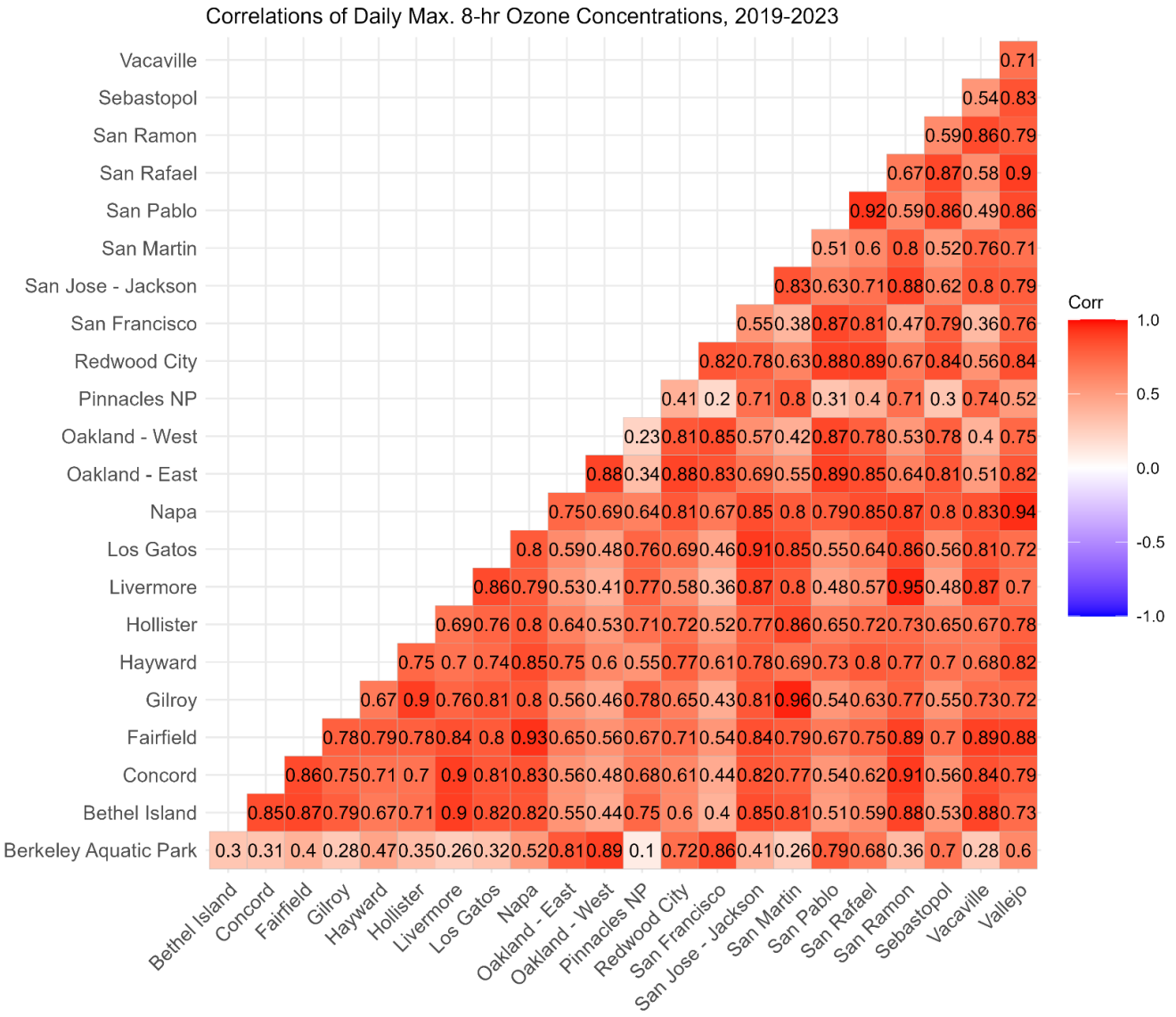

Figure 7. Correlation matrix of daily maximum 8-hour ozone concentrations at Air District-operated air monitoring sites and ozone monitors in shared MSAs, 2019-2023.

Using the information described in this section, each ozone monitor was assigned a rating of Low, Medium, or High for its relative value to the network overall, as shown in Table 7. Comments are also provided to contextualize ratings. Livermore and San Jose - Jackson received ratings of High due to occurrences of higher ozone concentrations at those monitoring sites and their affiliations with the PAMS and NCore monitoring networks, respectively. San Martin also received a rating of High due to occurrences of higher ozone concentrations at that location. Several monitors received ratings of Medium since they are the only Air District-operated ozone monitor in a certain county or are at multipollutant monitoring sites in overburdened communities. Some monitors received Low ratings due to either relatively low measured ozone concentrations or because the monitor is at a single-pollutant monitoring site. Monitors of Low to Medium value could be considered for closure, consolidation with other monitoring sites, or relocation. The information presented in Tables 4, 5, 6, and 7 is also combined in Table A-1 in the Appendix.

Table 7. Ratings assigned to each ozone monitor in terms of value to the overall network.

Monitoring Site	Rating	Comments
Sebastopol	Medium	Only ozone monitor in Sonoma County
Napa	Medium	Only ozone monitor in Napa County
Fairfield	Low	Singe-pollutant site with similar but lower ozone concentrations compared to the nearby Vacaville monitor
Vallejo	High	Only multi-pollutant site in Solano County
San Rafael	Medium	Only ozone monitor in Marin County
San Pablo	Medium	
Concord	Medium	
Bethel Island	Medium	
San Francisco	Medium	Only ozone monitor in SF County
Berkeley	Low	SPM; lowest ozone concentrations in network
Oakland – West	Medium	
Oakland – East	Medium	
Hayward	Low	SPM; Single-pollutant monitoring site
San Ramon	Low	SPM; Lower concentrations than and redundancy with nearby Livermore monitor
Livermore	High	Maximum DV site PAMS
Redwood City	Medium	Only ozone monitor in San Mateo County
San Jose – Jackson	High	Relatively high DV NCore
Los Gatos	Low	Single-pollutant monitoring site Redundant with San Jose-Jackson monitor
San Martin	High	Relatively high DV
Gilroy	Low	Lower concentrations than and redundancy with nearby San Martin monitor

$PM_{2.5}$

The San Francisco Bay Area is classified as being in nonattainment for the 2006 24-hour $PM_{2.5}$ NAAQS of 35 µg/m^3. While design values for 24-hour $PM_{2.5}$ have been below the NAAQS in recent years, exceedances of the 24-hour $PM_{2.5}$ NAAQS still occur, particularly when wildfire smoke affects the Bay Area but also when stagnant meteorological conditions allow pollution levels to build up locally. In 2024, US EPA formally strengthened the annual $PM_{2.5}$ NAAQS from 12.0 µg/m^3 to 9.0 µg/m^3.[14] Multiple sites in the Bay Area have annual average $PM_{2.5}$ levels near or above the new annual $PM_{2.5}$ NAAQS. Attainment designations for the revised annual $PM_{2.5}$ NAAQS are still pending from US EPA.

The composition and levels of $PM_{2.5}$ vary on a day-to-day basis and on a seasonal basis in response to changes in weather and emissions. As noted previously, outside of periods of wildfire smoke, the Bay Area typically experiences its highest $PM_{2.5}$ concentrations in the winter when stagnant weather conditions allow concentrations of $PM_{2.5}$ to build up and favor the production of secondary $PM_{2.5}$. Winter is also when the most residential wood burning occurs, which is a significant source of primary $PM_{2.5}$ in some parts of the Bay Area in addition to $PM_{2.5}$ emitted from other sources like industrial and commercial operations and traffic. Offshore winds can also transport $PM_{2.5}$ from the Central Valley into the Bay Area. Smoke from wildfires or agricultural or prescribed fires can contribute to higher levels of $PM_{2.5}$ in the Bay Area at any time of year, though this more commonly occurs in the summer and fall.

$PM_{2.5}$ is monitored at seventeen Air District monitoring sites, shown in Figure 8.[15] Adjacent air districts also conduct $PM_{2.5}$ monitoring within their portions of shared MSAs. Table 8 lists each $PM_{2.5}$ monitor, its monitor and site type(s), monitoring objective(s), and spatial scale, and Table 9 summarizes the US EPA-based minimum monitoring requirements for $PM_{2.5}$ by MSA. Sixteen of the seventeen air monitoring sites with $PM_{2.5}$ monitoring are SLAMS. One (Pleasanton) is a SPM. Four of the $PM_{2.5}$ monitors (Berkeley, Oakland – Laney, San Jose – Knox, and Pleasanton) are in near-road locations to characterize air quality immediately next to some of the heaviest trafficked roadway segments in the Bay Area. Many of the Air District's $PM_{2.5}$ monitors are also located within overburdened communities. Some monitors may be at critical site types (such as a monitoring site expected to represent the highest concentrations in an area), are at multi-pollutant monitoring sites, or are affiliated with other monitoring programs (such as PAMS, NCore, or near-road monitoring), and therefore may be of higher value within the network. Upon relocation of the former Napa Valley College site, the Air District will meet (or exceed) minimum monitoring requirements for $PM_{2.5}$ in each MSA. The network also meets minimum monitoring requirements for near-road $PM_{2.5}$ monitoring and for collocated $PM_{2.5}$ monitoring, as described in the Air District's Annual Monitoring Network Plan.

[14] EPA Final Reconsideration of the National Ambient Air Quality Standards for Particulate Matter (PM): https://www.epa.gov/pm-pollution/final-reconsideration-national-ambient-air-quality-standards-particulate-matter-pm

[15] The former Napa monitoring site (Napa Valley College) went offline in May 2021 and identification of a location for a new air monitoring site Napa is pending.

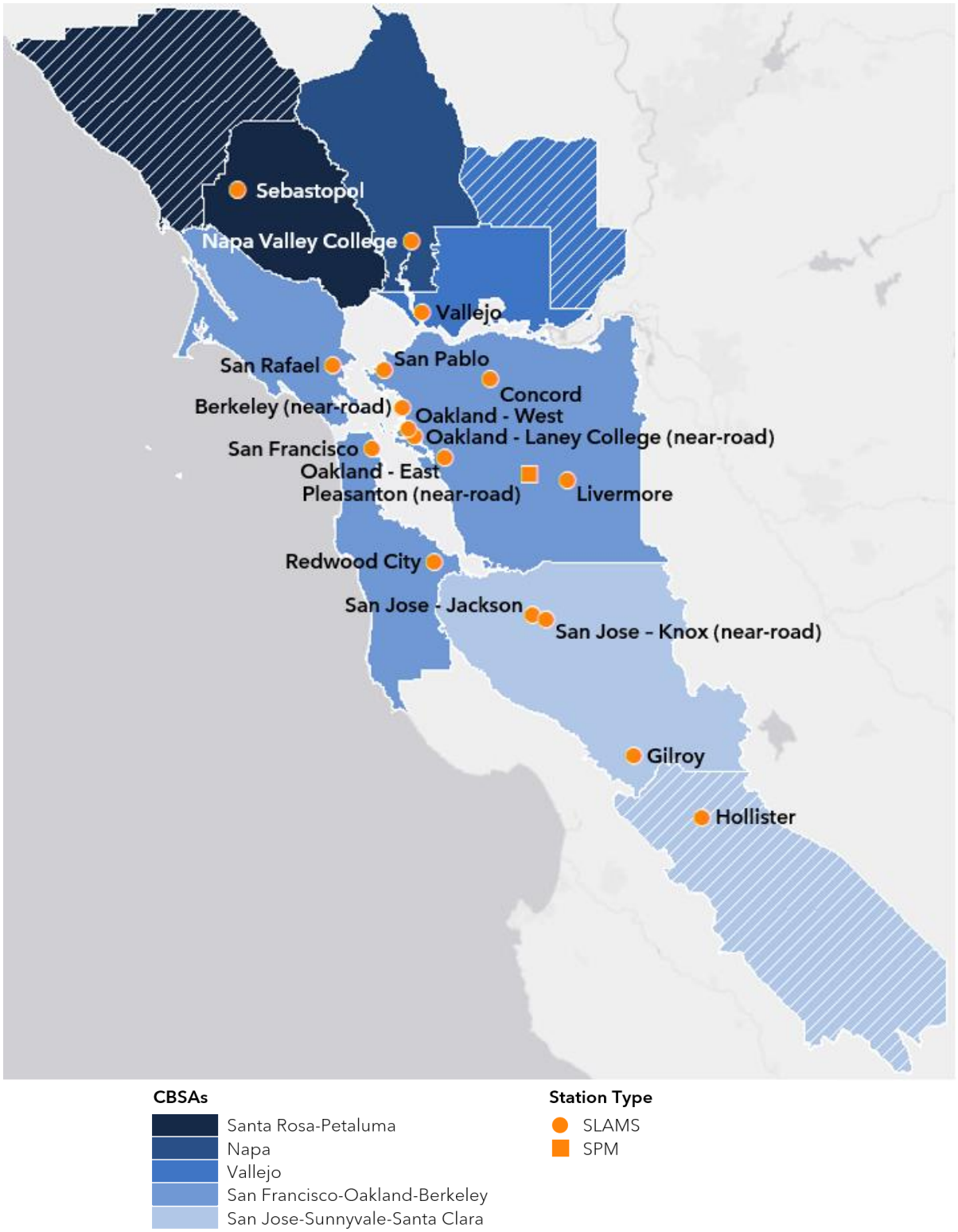

Figure 8. Map of locations of Air District $PM_{2.5}$ monitors and Core Based Statistical Areas (CBSAs). Hatched areas on the map are outside the Air District boundaries and note portions of a CBSA that are shared with an adjacent air agency.

Table 8. $PM_{2.5}$ monitors and their monitor type, monitoring objective(s), site type(s), and spatial scale.

MSA	Monitoring Site	Monitor Type	Monitoring Objective(s)	Site type(s)	Spatial Scale
Santa Rosa-Petaluma	Sebastopol	SLAMS	NC	PE	Neighborhood
Napa	Napa	SLAMS	NC	PE, HC	Neighborhood
Vallejo	Vallejo	SLAMS	NC	PE, HC, RT	Neighborhood
San Francisco-Oakland-Berkeley	San Rafael	SLAMS	NC	PE	Middle
	San Pablo	SPM	NC	PE	Middle
	Concord	SLAMS	NC	PE, HC	Urban
	San Francisco	SLAMS	NC	PE	Neighborhood
	Berkeley	SLAMS	NC	PE, SO	Microscale
	Oakland – West	SLAMS	NC	PE, HC	Neighborhood
	Oakland – Laney	SLAMS	NC	PE, SO	Microscale
	Oakland – East	SLAMS	NC	PE	Middle
	Pleasanton	SPM	NC	PE, SO	Microscale
	Livermore	SLAMS	NC	PE, HC	Neighborhood
	Redwood City	SLAMS	NC	PE	Neighborhood
San Jose-Sunnyvale-Santa Clara	San Jose – Jackson	SLAMS	NC	PE, HC	Neighborhood
	San Jose – Knox	SLAMS	NC	PE, SO	Microscale
	Gilroy	SLAMS	NC	PE, RT	Neighborhood

Monitoring objectives abbreviations:
NC – NAAQS Comparison

Site type abbreviations:
PE – Population Exposure HC – Highest Concentration
RT – Regional Transport SO – Source Oriented

Table 9. Summary of US EPA minimum monitoring requirements for $PM_{2.5}$ by MSA.

MSA	County or Counties	2020 Census Population	2024 24-hour Design Value (µg/m³) and Site[(a)]	2024 Annual Design Value (µg/m³) and Site[(a)]	Number of SLAMS		
					Required	Active	Additional Needed
Santa Rosa-Petaluma	Sonoma	488,863	16 (Sebastopol)	5.0 (Sebastopol)	0	1	0
Napa	Napa	138,019	46 (Napa Valley College)[(b)]	8.9 (Napa Valley College)	1	0	1
Vallejo	Solano	453,491	20 (Vallejo)	6.5 (Vallejo)	0	1	0
San Francisco-Oakland-Berkeley	San Francisco, San Mateo, Alameda, Contra Costa, Marin	4,749,008	22 (Oakland – Laney and San Pablo)	9.8 (San Pablo)	3	10	0
San Jose-Sunnyvale-Santa Clara	Santa Clara, San Benito	2,000,468	25 (San Jose – Jackson)	9.2 (San Jose – Jackson)	3	4[(c)]	0

(a) The design values shown are preliminary pending data certification for years 2023 and 2024.
(b) The most recent complete design value (for 2018-2020 data) for 24-hour $PM_{2.5}$ was 46 µg/m³ and for annual $PM_{2.5}$ was 8.9, both of which are more than 85% of the NAAQS. Therefore, one monitor is required.
(c) One monitor (Hollister) is in the Monterey Bay Air Resources District.

Figure 9 shows annual $PM_{2.5}$ design values at Air District monitoring sites over the last decade. The annual $PM_{2.5}$ design value evaluates long-term, or chronic, exposure to $PM_{2.5}$ over the course of a year. The most recent design values (2022-2024) for San Pablo and San Jose – Jackson are above the annual $PM_{2.5}$ NAAQS of 9.0 µg/m^3, and several other sites have design values near but just below the NAAQS. Gilroy, Sebastopol, San Rafael, and Concord have among the lower annual $PM_{2.5}$ design values within the monitoring network.

Figure 10 shows 24-hour $PM_{2.5}$ design values at all Air District monitoring sites over the last decade. The 24-hour $PM_{2.5}$ design value, as opposed to the annual $PM_{2.5}$ design value, is much more strongly affected by shorter-term air quality events, such as smoke from wildfires. Wildfire smoke contributed to numerous occurrences of high 24-hour $PM_{2.5}$ concentrations across the Bay Area, particularly in the years 2017, 2018, and 2020, leading to design values near or above the NAAQS. Outside of recent years with severe wildfire events, the 24-hour $PM_{2.5}$ design values were below the current 24-hr $PM_{2.5}$ NAAQS. San Jose – Jackson currently has the highest 24-hour $PM_{2.5}$ design value within the network while Gilroy, Sebastopol, and San Rafael have among the lowest.

In recent years, most of the days with 24-hr $PM_{2.5}$ concentrations above the 24-hr $PM_{2.5}$ NAAQS have been during periods of wildfire smoke, as illustrated in Figure 11. However, 24-hr $PM_{2.5}$ levels in exceedance of the NAAQS or near the NAAQS do still occur outside of wildfire smoke periods and have been more frequent at certain monitoring sites, such as Oakland – West, Oakland – Laney, San Jose – Jackson, and San Jose – Knox.

Table 10 summarizes the latest 24-hr and annual $PM_{2.5}$ concentrations by monitor as well as occurrences of 24-hr average $PM_{2.5}$ concentrations that are relatively elevated (> 25 µg/m^3) outside of wildfire smoke periods. Monitors reporting higher concentrations of $PM_{2.5}$, especially if their design values are near or in excess of the NAAQS for 24-hour or annual $PM_{2.5}$, are generally more critical to the network compared to monitors reporting consistently lower concentrations. Frequent occurrences of 24-hr $PM_{2.5}$ concentrations approaching or in excess of the NAAQS can indicate greater short-term health risks and an increased risk of violating the NAAQS. The San Jose – Jackson and San Jose – Knox monitoring sites recorded the most occurrences of non-wildfire days with relatively elevated $PM_{2.5}$ concentrations.

Monitor-to-monitor correlations of pollutant data can also help inform on whether measured data are relatively redundant or unique compared to other locations in the network. Figure 12 shows a correlation matrix for daily (24-hour average) $PM_{2.5}$ concentrations measured at Air District sites from 2019-2023. The $PM_{2.5}$ data are well-correlated ($R > 0.70$) across all monitors, as $PM_{2.5}$ levels are in part strongly driven by day-to-day changes in meteorology. While correlations themselves are generally not justification alone for making network changes, correlations may help inform recommendations in combination with other information as part of a weight of evidence. Some of the highest correlations ($R > 0.95$) are between monitors that are very near each other but are important for informing different data needs, such as Oakland – West (overburdened community) and Oakland – Laney (near-road). Other site pairs with very high correlations may indicate potential redundancies and opportunities for streamlining operations, such as Livermore and Pleasanton.

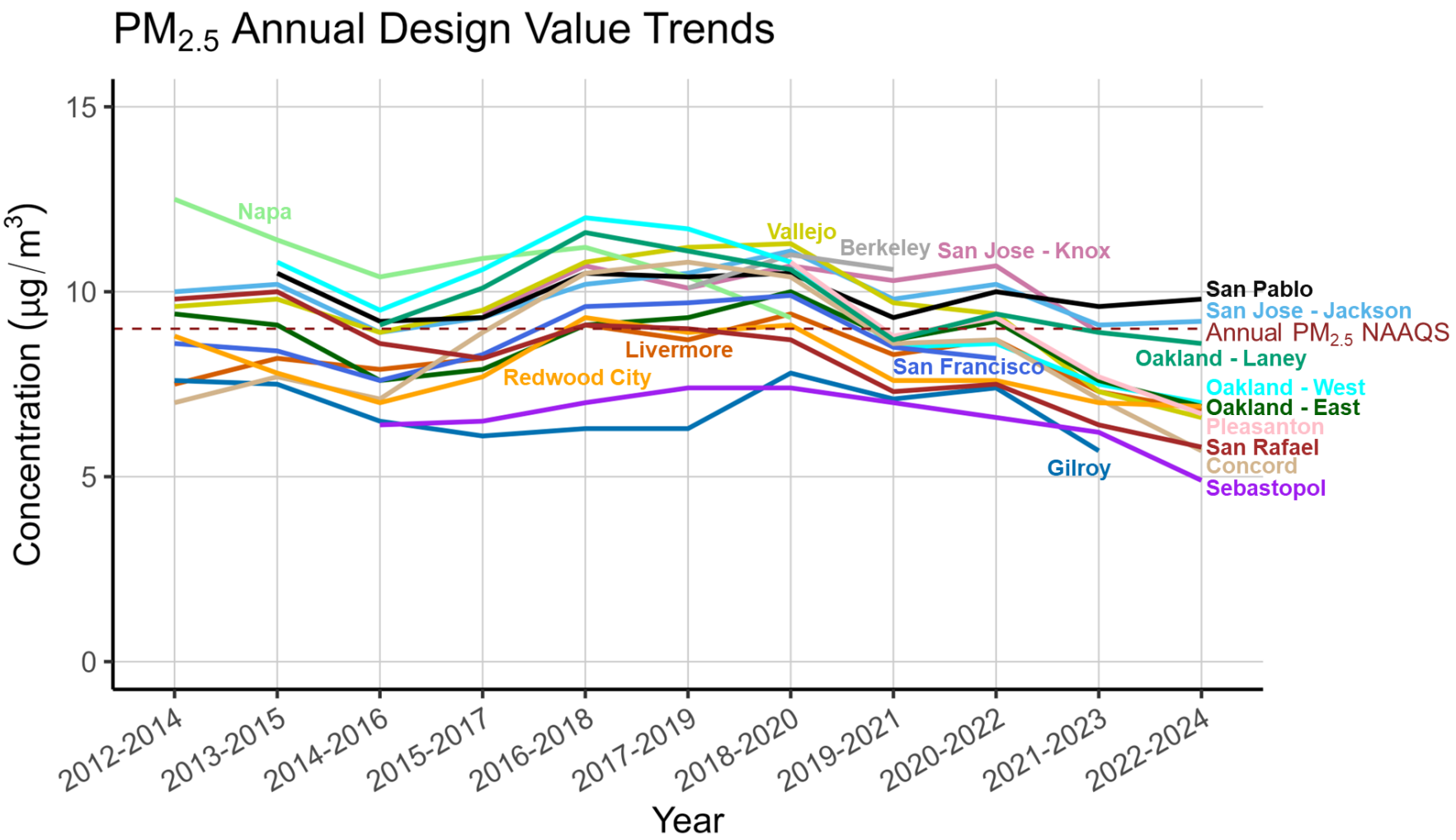

Figure 9. Annual $PM_{2.5}$ design values at Air District monitoring sites. San Pablo, followed by San Jose – Jackson, currently have the highest annual $PM_{2.5}$ design values within the monitoring network. Design values for 2021-2023 and 2022-2024 are preliminary, pending final data validation and certification. The 2022-2024 design value for Livermore reflects a combined site record for the former and current Livermore monitoring sites. Design values for Napa reflect a combined site record for the former Napa – Jefferson and Napa Valley College monitoring sites, and the design values shown for Sebastopol reflect a combined site record for the former Santa Rosa and current Sebastopol monitoring sites.

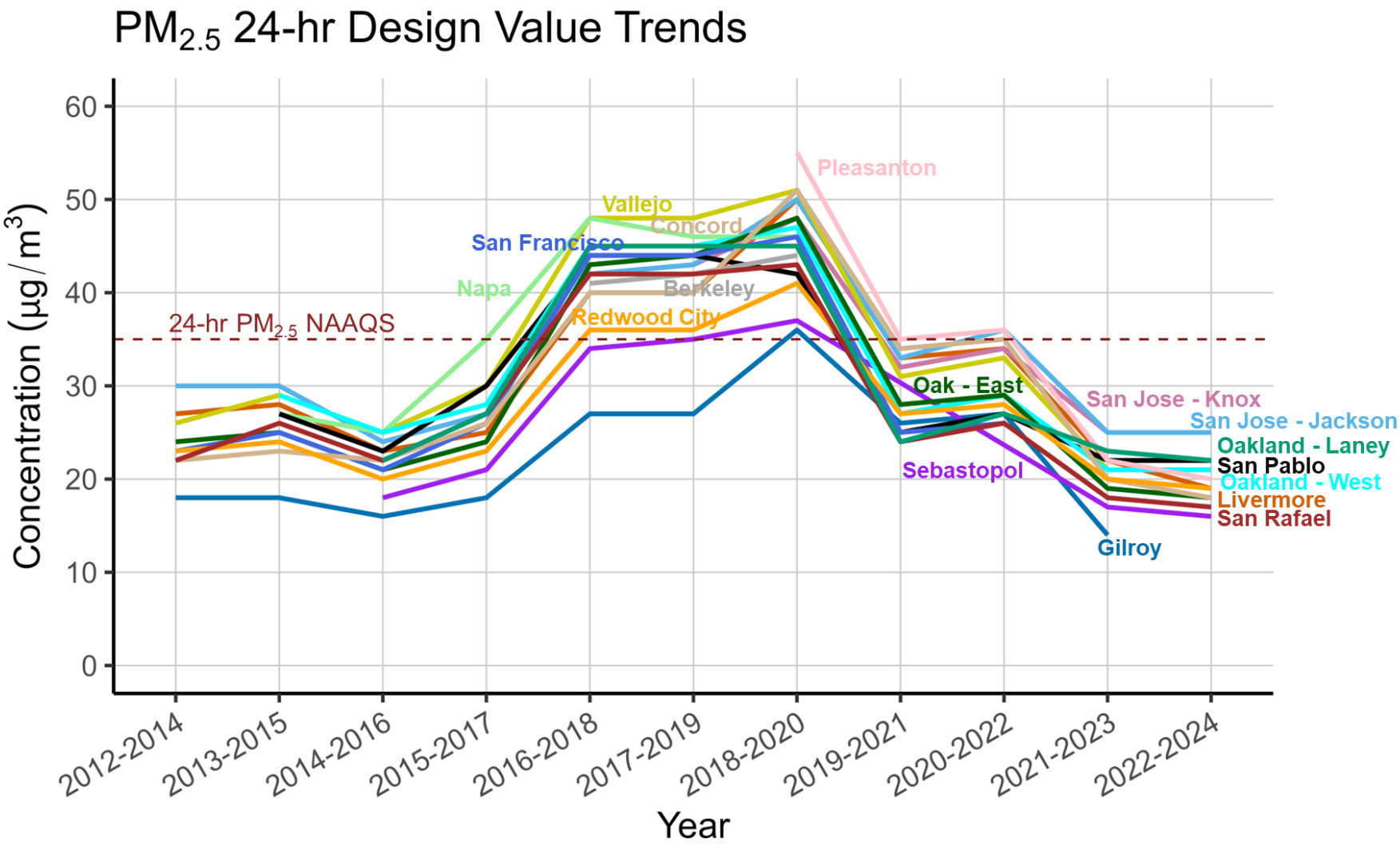

Figure 10. 24-hour $PM_{2.5}$ design values at Air District monitoring sites. Smoke from wildfires, particularly in the years 2017, 2018, and 2020, contributed to higher design values during those periods. San Jose – Jackson currently has the highest 24-hour $PM_{2.5}$ design value within the monitoring network. Design values for 2021-2023 and 2022-2024 are preliminary, pending final data validation and certification. The 2022-2024 design value for Livermore reflects a combined site record for the former and current Livermore monitoring sites. Design values for Napa reflect a combined site record for the former Napa – Jefferson and Napa Valley College monitoring sites, and the design values shown for Sebastopol reflect a combined site record for the former Santa Rosa and current Sebastopol monitoring sites.

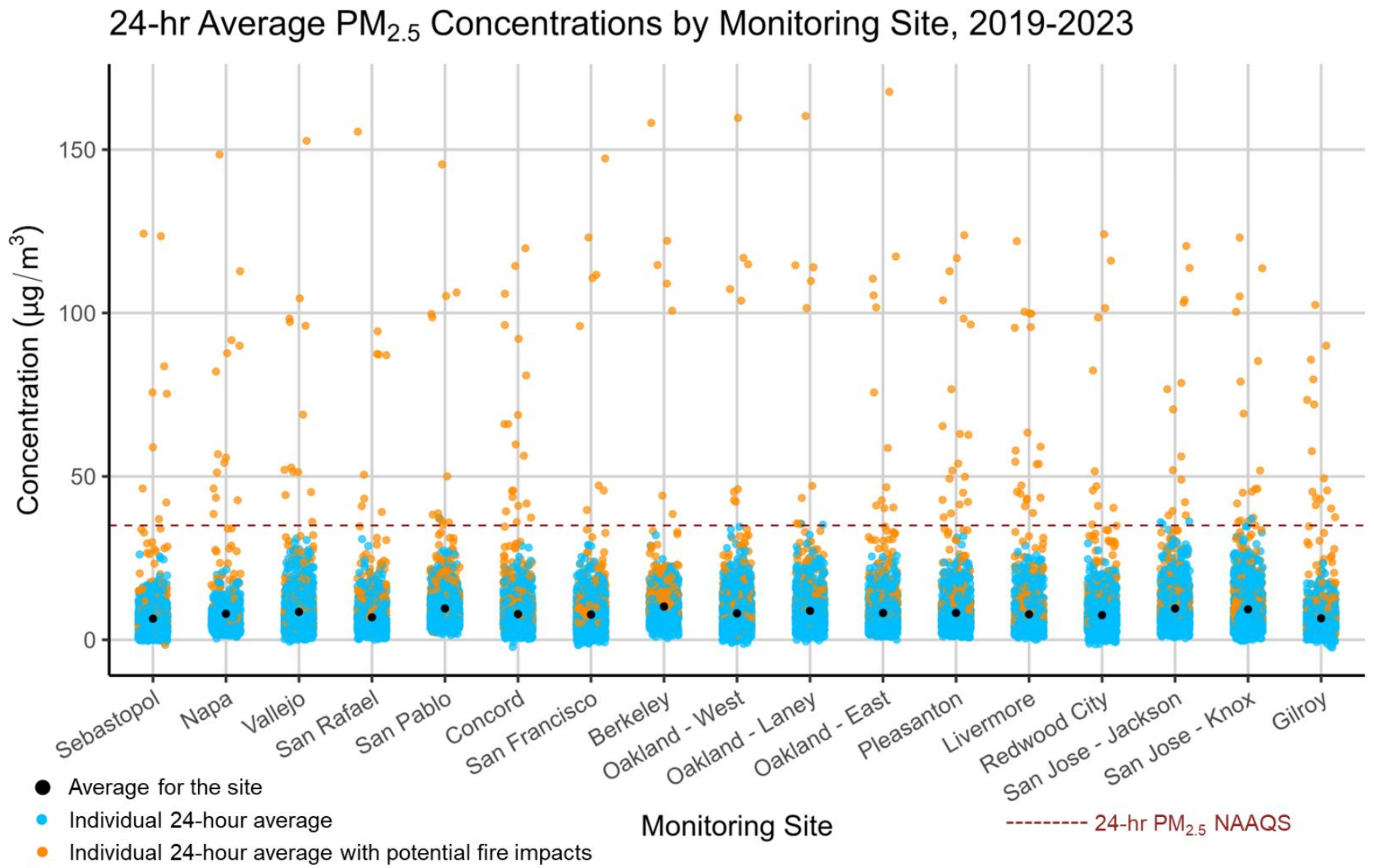

Figure 11. Measured 24-hr average $PM_{2.5}$ concentrations by monitoring site, 2019-2023. The blue dots represent individual 24-hr average $PM_{2.5}$ concentrations, orange dots represent 24-hr average $PM_{2.5}$ concentrations with potential influence from wildfire smoke, and black dots indicate the average of the 24-hr average $PM_{2.5}$ concentrations for that site.

Table 10. Summary of different metrics for measured $PM_{2.5}$ concentrations for each monitoring site. Design values (DV) for 2022-2024 are preliminary pending final data validation and certification.

MSA	Monitoring Site	Annual $PM_{2.5}$ DV (2022-2024)	24-hr $PM_{2.5}$ DV (2022-2024)	Number of non-fire days with 24-hr $PM_{2.5}$ > 25 µg/m³ (2019-2023)
Santa Rosa-Petaluma	Sebastopol	5.0	16	3
Napa	Napa	NA[a]	NA[a]	2[a]
Vallejo	Vallejo	6.5	20	17
San Francisco-Oakland-Berkeley	San Rafael	5.8	17	7
	San Pablo	**9.8**	22	13
	Concord	5.7	18	8
	San Francisco	6.3[b]	17[b]	9
	Berkeley	7.6[b]	17[b]	5
	Oakland – West	7.1	21	16
	Oakland – Laney	8.6	22	16
	Oakland – East	6.9	18	6
	Pleasanton	6.7	20	4
	Livermore	6.9[c]	19[c]	6
	Redwood City	6.9	19	3
San Jose-Sunnyvale-Santa Clara	San Jose – Jackson	**9.2**	25	27
	San Jose – Knox	7.6[b]	24[b]	24
	Gilroy	5.3[b]	14[b]	0

(a) The former Napa monitoring site (Napa Valley College) went offline in May 2021 and identification of a location for a new air monitoring site Napa is pending.
(b) Design value is invalid due to incomplete data.
(c) Data reflect combined data record for the former and current Livermore monitoring sites.

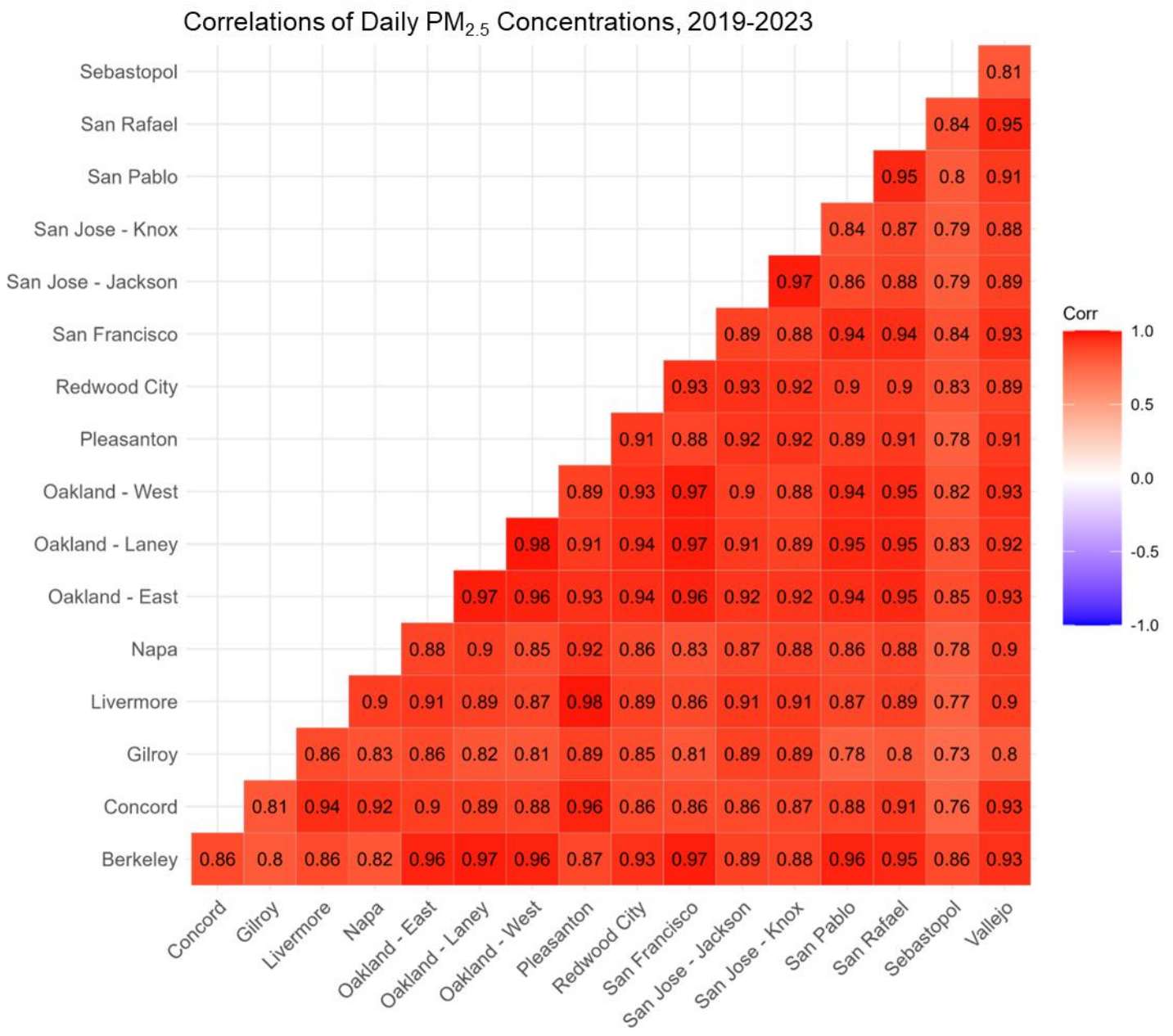

Figure 12. Correlation matrix of 24-hour average $PM_{2.5}$ concentrations at Air District air monitoring sites, 2019-2023.

Using the information described in this section, each $PM_{2.5}$ monitor was assigned a rating of Low, Medium, or High for its relative value to the network overall, as shown in Table 11. Comments are also provided to contextualize ratings. Several sites received ratings of High due to measured $PM_{2.5}$ concentrations near or in excess of the 24-hour or annual $PM_{2.5}$ NAAQS, location in overburdened communities, or affiliation with other monitoring networks such as PAMS, NCore, or near-road monitoring. Monitors of Low to Medium value could be considered for closure, consolidation with other monitoring sites, or relocation. The information in Tables 8, 9, 10, and 11 is also combined in Table A-2 in the Appendix. Recommendations that emerged from this evaluation are summarized in Section 4 of this assessment.

Table 11. Ratings assigned to each $PM_{2.5}$ monitor in terms of value to the overall network.

Monitoring Site	Rating	Comments
Sebastopol	Medium	Only $PM_{2.5}$ monitor in Sonoma County Relatively low $PM_{2.5}$ concentrations; could be relocated
Napa	High	$PM_{2.5}$ monitor required in Napa MSA
Vallejo	High	Only multi-pollutant site in Solano County Collocation with related measurements Located in overburdened community
San Rafael	Medium	Only $PM_{2.5}$ monitor in Marin County Relatively low $PM_{2.5}$ concentrations
San Pablo	High	Maximum annual DV site Located in overburdened community
Concord	Medium	Relatively low $PM_{2.5}$ concentrations; could be relocated
San Francisco	High	Only $PM_{2.5}$ monitor in SF County
Berkeley	Medium	Near-road site
Oakland – West	High	Collocation with related measurements Located in overburdened community
Oakland – Laney	High	Near-road site; relatively high DV Located in overburdened community
Oakland – East	High	Relatively low $PM_{2.5}$ concentrations Located in overburdened community
Pleasanton	Low	Special Purpose Monitor Redundancy with nearby Livermore monitor
Livermore	High	PAMS; collocation with related measurements
Redwood City	High	Only $PM_{2.5}$ monitor in San Mateo County Located in overburdened community
San Jose – Jackson	High	NCore; Maximum 24-hour DV site
San Jose – Knox	High	Near-road site; relatively high $PM_{2.5}$ concentrations Located in overburdened community
Gilroy	Medium	Relatively low $PM_{2.5}$ concentrations

PM_{10}

PM_{10} concentrations are typically relatively low regionally in the Bay Area, given the relative lack of unvegetated land and windblown-dust events compared to more arid regions. However, dust from operations such as earthmoving at construction sites, landscaping and aggregate facilities, and metal shredders, among other sources, contribute to intermittent, localized occurrences of higher levels of PM_{10}. Many of these types of facilities and operations are located in overburdened communities. Smoke from wildfires can also contribute to high PM_{10} concentrations in the Bay Area, though those higher concentrations are typically driven largely by increases in $PM_{2.5}$ concentrations (since PM_{10} includes $PM_{2.5}$).

PM_{10} is currently monitored at six Air District air monitoring sites, as shown by CBSA in Figure 13. Table 12 lists each PM_{10} monitor, its monitor and site type(s), monitoring objective(s), and spatial scale, and Table 13 summarizes the US EPA-based minimum monitoring requirements for PM_{10} by CBSA. Four of the Air District's PM_{10} monitors are SLAMS and two are SPMs. Minimum monitoring requirements for PM_{10} are dependent on the population of a CBSA and the level of measured 24-hour PM_{10} concentrations compared to specific concentration ranges:

- Low: Concentrations less than 80% of the NAAQS (less than 124 µg/m^3)
- Medium: Concentrations exceeding 80% of the NAAQS but not 120% of the NAAQS (between 124 µg/m^3 and 186 µg/m^3)
- High: Concentrations exceeding the NAAQS by 120% or more (at least 186 µg/m^3)

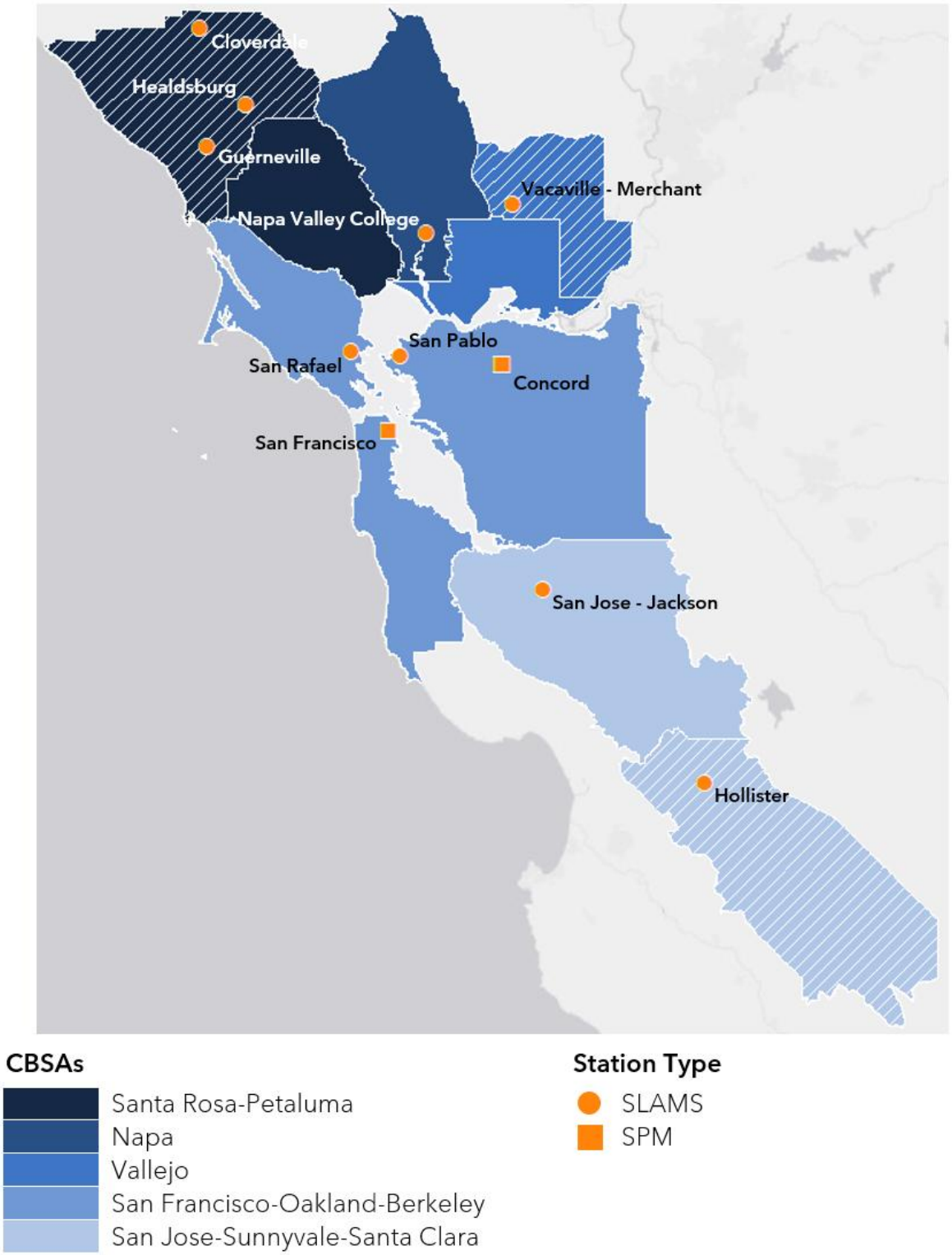

Figure 13. Map of locations of Air District PM_{10} monitors and Core Based Statistical Areas (CBSAs). Hatched areas on the map are outside the Air District boundaries and note portions of a CBSA that are shared with an adjacent air agency.

Table 12. PM_{10} monitors and their monitor type, monitoring objective(s), site type(s), and spatial scale.

MSA	Monitoring Site	Monitor Type	Monitoring Objective(s)	Site type(s)	Spatial Scale
Napa	Napa	SLAMS	NC	PE	Neighborhood
San Francisco-Oakland-Berkeley	San Rafael	SLAMS	NC	PE	Middle
	San Pablo	SLAMS	NC	PE	Middle
	Concord	SPM	NC	PE	Urban
	San Francisco	SPM	NC	PE	Neighborhood
San Jose-Sunnyvale-Santa Clara	San Jose – Jackson	SLAMS	NC	PE	Neighborhood

Monitoring objectives abbreviations:
NC – NAAQS Comparison

Table 13. Measured PM_{10} concentrations and corresponding minimum monitoring requirements for PM_{10} by MSA.

MSA	2021-2023 Monitoring Data				2022-2024 Monitoring Data			
	Highest 24-Hour Concentration (µg/m³) and Site	Number of SLAMS			Highest 24-Hour Concentration (µg/m³) and Site	Number of SLAMS		
		Required	Active	Additional Needed		Required	Active	Additional Needed
San Francisco-Oakland-Berkeley	53 San Pablo	2-4	2	0	53 San Pablo	2-4	2	0
San Jose-Sunnyvale-Santa Clara	128 Hollister	4-8	2[(a)]	2	77 Hollister	2-4	2[(a)]	0
Santa Rosa-Petaluma	58 Cloverdale	0-1	3[(b)]	0	49 Healdsburg	0-1	3[(b)]	0
Vallejo	50 Vacaville	0-1	1[(c)]	0	37 Vacaville	0-1	1[(c)]	0
Napa	22[(d)] Napa	0-1	0[(e)]	0	22[(d)] Napa	0-1	0[(e)]	0

(a) One of the two PM_{10} monitors is in Hollister, operated by the Monterey Bay Air Resources District.
(b) These PM_{10} monitors are operated by the Northern Sonoma Air Pollution Control District.
(c) This PM_{10} monitor is in Vacaville, operated by the Yolo-Solano Air Quality Management District.
(d) The highest 24-hour PM_{10} concentrations shown for the Napa MSA represent only the period from 2020 to 2021 due to the discontinuation of monitoring operations at the former Napa Valley College monitoring site.
(e) A new monitoring site in the Napa CBSA is pending following the closing of the former Napa Valley College site. It is anticipated that the pending Napa site will include monitoring for PM_{10}.

The minimum monitoring requirements shown in Table 13 are preliminary since Air District-collected data for 2023 and 2024 have not yet been certified. Most CBSAs within the Air District's jurisdiction can be classified as Low Concentration areas, with the exception of the San Jose-Sunnyvale-Santa Clara CBSA, which has varied between Low and Medium Concentration due to occurrences of relatively higher PM_{10} concentrations at the Hollister monitoring site (operated by the Monterey Bay Air Resources District). Additional PM_{10} monitors may be needed in the San Jose-

Sunnyvale-Santa Clara CBSA, and the Air District will work with US EPA, CARB, and MBARD to ensure minimum monitoring requirements are met.

Measured 24-hour average PM_{10} concentrations have generally been well below the NAAQS, as shown in Figure 14. As noted previously, many of the occurrences of relatively high 24-hour average PM_{10} concentrations have been during periods of wildfire smoke, though those higher concentrations are typically driven largely by increases in $PM_{2.5}$ concentrations (since PM_{10} includes $PM_{2.5}$). CARB established CAAQS for PM_{10} at different levels than the NAAQS. The CAAQS (not to be exceeded) for 24-hour average PM_{10} is 50 µg/m^3 and for annual average PM_{10} is 20 µg/m^3. While the CAAQS do not have direct implications on placement of PM_{10} monitoring, the measured levels of PM_{10} relative to the CAAQS could help inform modifications to the monitoring network. Table 14 shows annual average and maximum 24-hour average PM_{10} concentrations at Air District PM_{10} monitors for recent years. While the San Jose – Jackson monitoring site has recorded more exceedances of the 24-hour PM_{10} CAAQS, PM_{10} samples are collected at a higher frequency at that location. Annual average PM_{10} concentrations have been slightly higher at the San Jose – Jackson and San Pablo monitoring sites and relatively lower at the Concord and San Rafael monitoring sites.

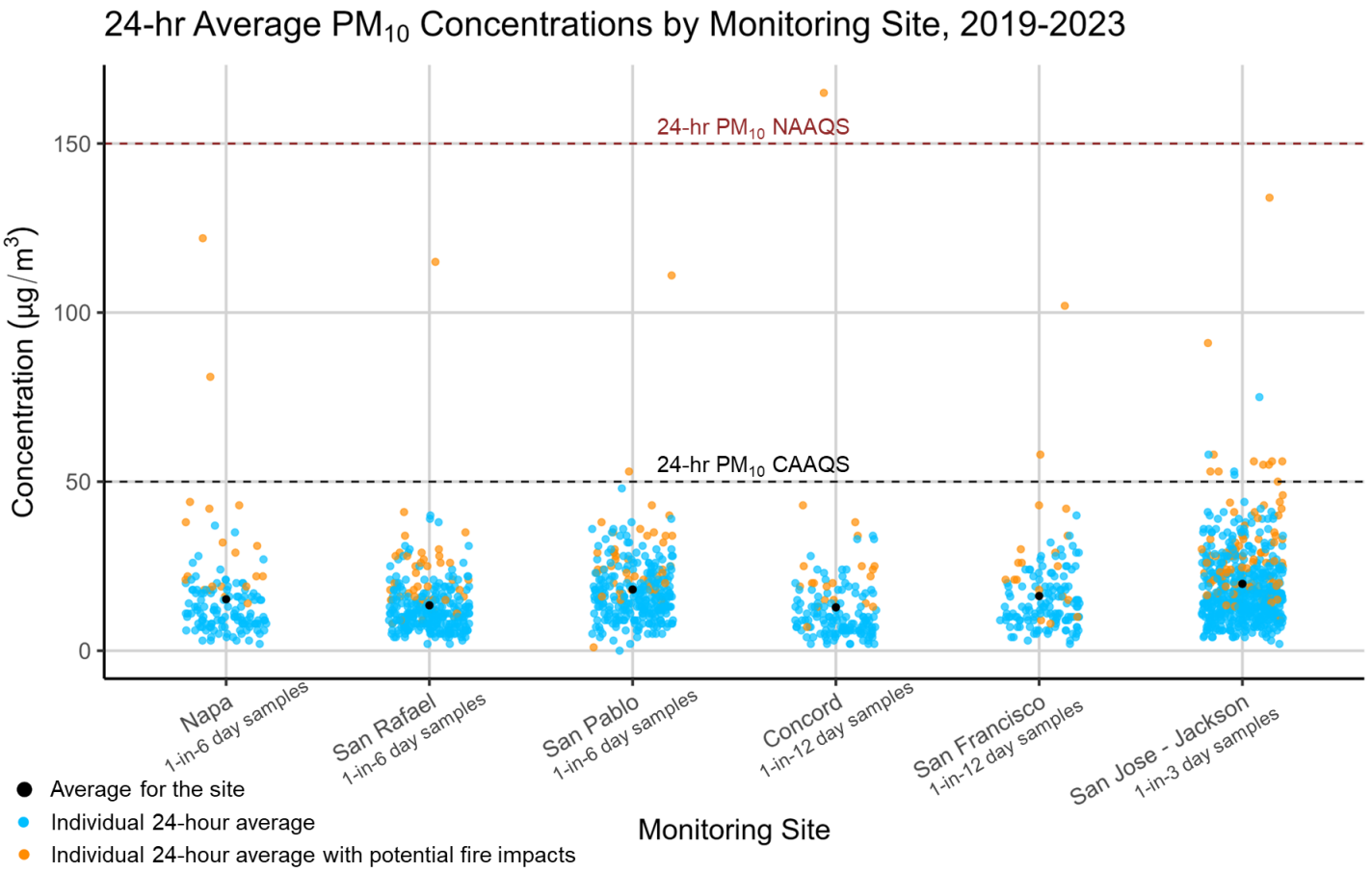

Figure 14. Measured 24-hr average PM_{10} concentrations by monitoring site, 2019-2023. The blue dots represent individual 24-hr average PM_{10} concentrations, orange dots represent 24-hr average PM_{10} concentrations with potential influence from wildfire smoke, and black dots indicate the average of the 24-hr average PM_{10} concentrations for that site.

Table 14. Summary of annual average and maximum 24-hour PM_{10} concentrations measured at Air District air monitoring sites.

Monitoring Site	Monitoring Frequency	Annual Average PM_{10}				Maximum 24-hour PM_{10} Concentration (2021-2023)	Occurrences of 24-hour PM_{10} > 50 µg/m³ (2019-2023)
		2020	2021	2022	2023		
Napa[(a)]	1-in-6 days	18.0	NA	NA	NA	NA	2
San Rafael	1-in-6 days	15.5	13.6	12.6	11.8	41	1
San Pablo	1-in-6 days	19.7	18.5	19.4	17.1	53	2
Concord	1-in-12 days	17.5	11.5	11.3	12.3	33	1
San Francisco	1-in-12 days	22.1	14.9	14.5	15.2	43	2
San Jose - Jackson	1-in-3 days	24.0	18.9	20.2	16.5	43	14

(a) A new monitoring site in the Napa CBSA is pending and will likely include monitoring for PM_{10}.

Using the information described in this section, each PM_{10} monitor was assigned a rating of Low, Medium, or High for its relative value to the network overall, as shown in Table 15. Comments are also provided to contextualize ratings. San Jose – Jackson received a rating of High since PM_{10} monitoring is required for NCore sites and this site is needed to continue meeting minimum monitoring requirements. San Pablo was also given a High rating due to modestly higher PM_{10} concentrations measured there and given the site's location in an overburdened community. PM_{10} monitoring is also recommended to continue in San Francisco, though monitoring in a new location, such as Bayview-Hunter's Point, would be better suited to inform on local PM_{10} sources in overburdened communities. Concord and San Rafael received a Low rating due to relatively lower PM_{10} concentrations measured there, and these monitors could be considered for closure. The information presented in Tables 12, 13, 14, and 15 is also combined in Table A-3 in the Appendix.

Table 15. Ratings assigned to each PM_{10} monitor in terms of value to the overall network.

Monitoring Site	Rating	Comments
Napa	Medium	
San Rafael	Low	
San Pablo	High	Overburdened community
Concord	Low	
San Francisco	Medium	Could be relocated
San Jose - Jackson	High	Required for NCore

An additional PM_{10} monitor may be needed in the San Jose-Sunnyvale-Santa Clara CBSA to meet minimum monitoring requirements. The southern portion of Santa Clara County may be a better candidate for PM_{10} monitoring given proximity to agricultural zones that may be sources for PM_{10}.

The Air District measures PM_{10} using filter-based samplers that provide measurements over 24-hour midnight to midnight periods. Additionally, sampling is conducted on 1-in-3, 1-in-6, or 1-in-12 day intervals, depending on the monitoring site. Data of this duration (24-hour) and frequency (non-continuous) are generally not informative for characterizing intermittent or brief occurrences of relatively high PM_{10} over hourly or sub-hourly time spans. Recommendations for PM_{10} measurements with higher temporal frequency are discussed in Section 4.

Carbon Monoxide

Fuel combustion, and in particular, traffic, is the primary source of carbon monoxide emissions. Carbon monoxide is currently monitored at sixteen Air District monitoring sites, as shown in Figure 15 by CBSA. Table 16 lists each carbon monoxide monitor, its monitor and site type, monitoring objective(s), spatial scale, and network affiliations, and Table 17 summarizes the US EPA-based minimum monitoring requirements for carbon monoxide by MSA. Carbon monoxide monitoring is currently required by US EPA at four locations within the network: three near-road monitoring sites (Berkeley, Oakland – Laney, and San Jose – Knox) and trace-level carbon monoxide monitoring at San Jose – Jackson as part of the NCore program. The Air District meets or surpasses minimum monitoring requirements for carbon monoxide in all CBSAs.

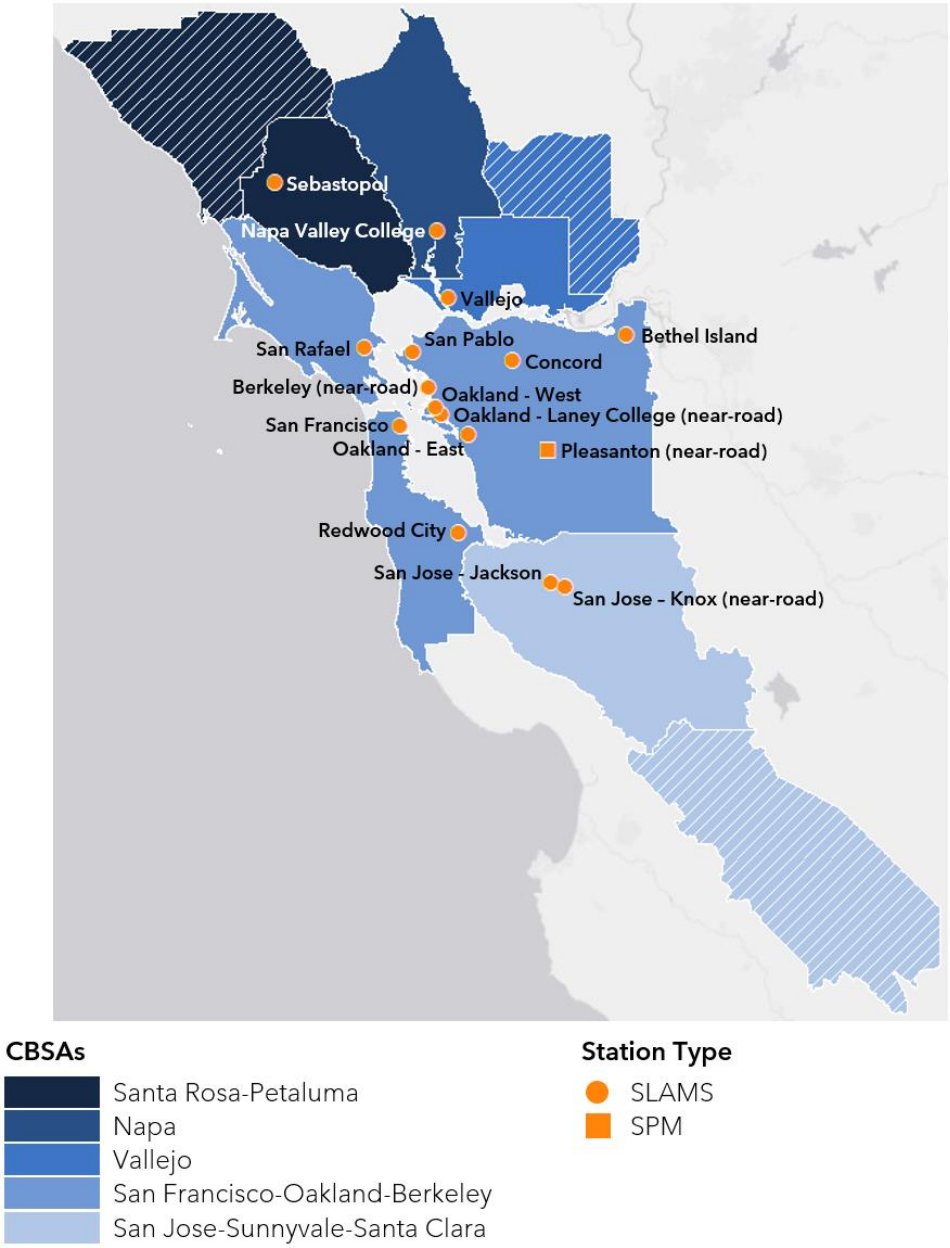

Figure 15. Map of locations of Air District CO monitors and CBSAs. Hatched areas on the map are outside the Air District boundaries and note portions of a CBSA that are shared with an adjacent air agency.

Table 16. Carbon monoxide monitors and their monitor type (SLAMS or SPM), monitoring objective(s), site type(s), spatial scale, and network affiliations.

CBSA	Monitoring Site	Monitor Type	Monitoring Objective(s)	Site type(s)	Spatial Scale	Network Affiliations
Santa Rosa-Petaluma	Sebastopol	SLAMS	NC	PE	Neighborhood	
Napa	Napa	SLAMS	NC	PE	Neighborhood	
Vallejo	Vallejo	SLAMS	NC	PE	Neighborhood	
San Francisco-Oakland-Berkeley	San Rafael	SLAMS	NC	PE	Middle	
	San Pablo	SLAMS	NC	PE	Middle	
	Concord	SLAMS	NC	PE	Neighborhood	
	Bethel Island	SLAMS	NC	RT	Urban	
	San Francisco	SLAMS	NC	PE	Neighborhood	
	Berkeley	SLAMS	NC	PE, SO	Microscale	Near-road network
	Oakland – West	SLAMS	NC	PE	Neighborhood	
	Oakland - Laney	SLAMS	NC	PE, SO	Microscale	Near-road network
	Oakland – East	SLAMS	NC	PE	Middle	
	Pleasanton	SPM	NC	PE, SO	Microscale	
	Redwood City	SLAMS	NC	PE	Neighborhood	
San Jose-Sunnyvale-Santa Clara	San Jose – Jackson	SLAMS	NC, R	PE	Neighborhood	NCore
	San Jose – Knox	SLAMS	NC	PE, SO	Microscale	Near-road network

Monitoring objectives abbreviations:
NC – NAAQS Comparison
R – Research

Site type abbreviations:
PE – Population Exposure
SO – Source Oriented
RT – Regional Transport

Table 17. Summary of US EPA minimum monitoring requirements for carbon monoxide by MSA.

MSA	County or Counties	2020 Census Population	Near-road Monitors Required	Near-road Monitors Active	Additional Near-road Monitors Needed
Santa Rosa-Petaluma	Sonoma	488,863	0	0	0
Napa	Napa	138,019	0	0	0
Vallejo	Solano	453,491	0	0	0
San Francisco-Oakland-Berkeley	San Francisco, San Mateo, Alameda, Contra Costa, Marin	4,749,008	1	2	0
San Jose-Sunnyvale-Santa Clara	Santa Clara, San Benito	2,000,468	1	1	0

Design values for carbon monoxide are calculated using two years of data and are shown for 2021-2022 in Table 18. Recent design values for 8-hr carbon monoxide have been less than one-third of the 8-hr carbon monoxide NAAQS at all monitoring sites in the Bay Area. The Air District has not exceeded the 1-hr carbon monoxide standard (35 parts per million, or ppm) since 1967 and has not exceeded the 8-hour carbon monoxide standard (9 ppm) since 1991. Carbon monoxide levels are generally relatively higher at monitoring sites near high-traffic freeways compared to other monitoring sites but are still well below the NAAQS. Figure 16 shows measured daily 8-hour maximum carbon monoxide concentrations by monitoring site for the period 2019-2023 and illustrates relatively similar carbon monoxide concentrations overall across several locations, indicating potential redundancies within the monitoring network.

Table 18. 1-hour and 8-hour CO design values at Air District monitoring sites, 2021-2022.

CBSA	Monitoring Site	1-hr CO Design Value (ppm)	8-hr CO Design Value (ppm)
Santa Rosa-Petaluma	Sebastopol	0.9	0.7
Napa	Napa	1.0	0.9
Vallejo	Vallejo	2.0	1.6
San Francisco-Oakland-Berkeley	San Rafael	1.3	0.8
	San Pablo	1.3	0.9
	Concord	1.0	0.8
	Bethel Island	1.7	1.0
	San Francisco	1.4	0.9
	Berkeley	1.2	0.9
	Oakland – West	2.2	1.7
	Oakland - Laney	1.6	1.1
	Oakland – East	1.6	1.0
	Pleasanton	1.2	1.0
	Redwood City	1.8	1.0
San Jose-Sunnyvale-Santa Clara	San Jose – Jackson	1.7	1.3
	San Jose – Knox	1.8	1.5

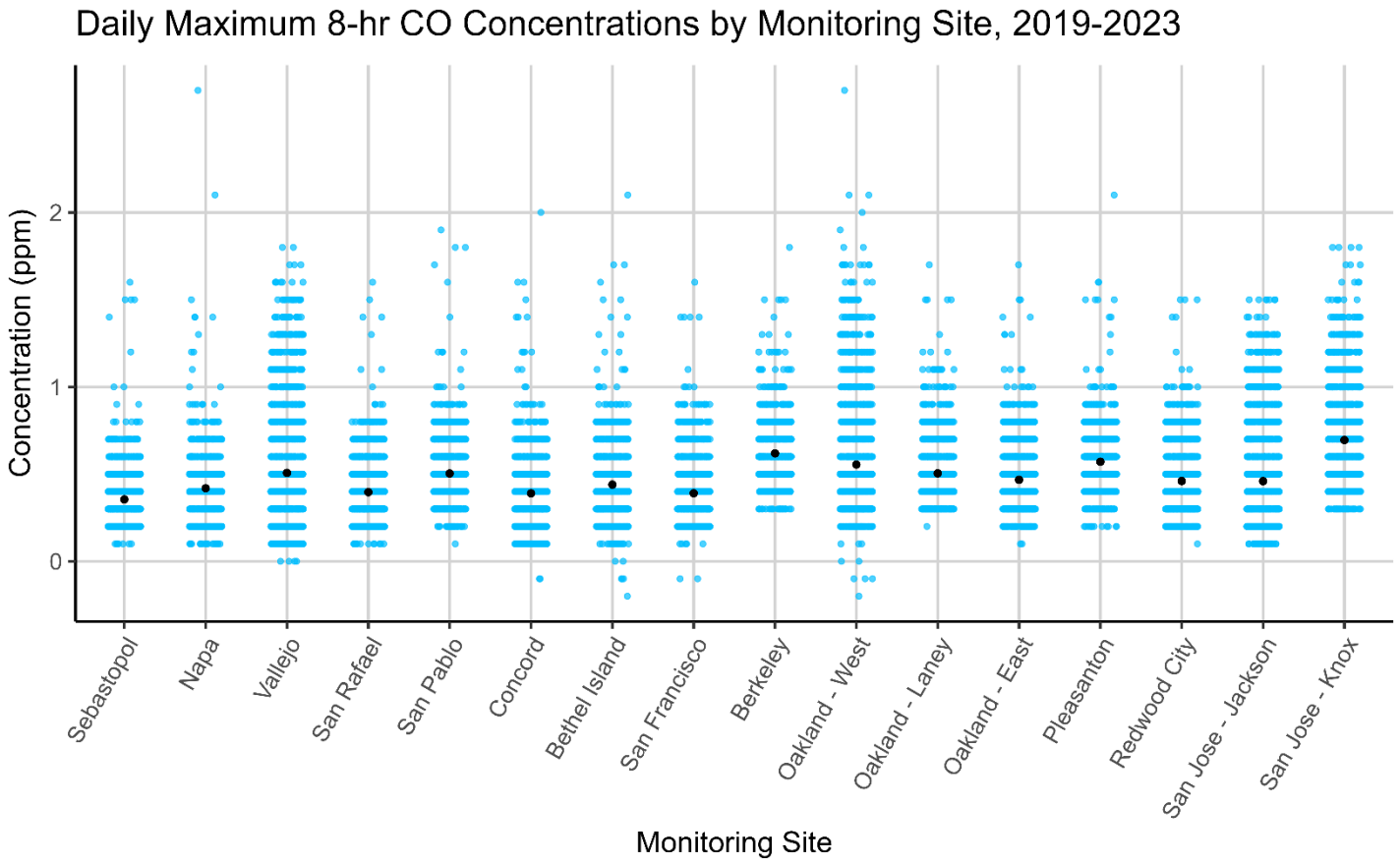

Figure 16. Measured daily maximum 8-hour CO concentrations by monitoring site, 2019-2023. Each blue dot represents an individual daily maximum 8-hour CO concentration, and the larger black dots indicate the average daily maximum 8-hour CO concentration for that monitoring site.

In addition to monitoring required for meeting minimum monitoring requirements, carbon monoxide measurement data can help inform data analyses for source attribution when paired with other pollutant data, including differentiating combustion and non-combustion pollution sources, identifying time periods when air quality was influenced by smoke from wildfires or other biomass burning, and characterizing air quality in overburdened communities. Collocated carbon monoxide data may therefore be of higher importance at sites that have higher $PM_{2.5}$ design values (to support exceptional events and other analyses related to wildfire smoke) and sites with collocated measurements of different types of PM (such as $PM_{2.5}$, PM_{10}, PM speciation, black carbon, ultrafine particles).

Each carbon monoxide monitor was assigned a rating of Low, Medium, or High for its relative value to the network overall, as shown in Table 19. Carbon monoxide monitoring could be discontinued at several locations within the network, particularly those rated as Low value, while still meeting minimum monitoring requirements and informing other data needs. For sites where Carbon monoxide monitoring is continued, trace-level monitoring should be considered since legacy instruments are less sensitive to the low ambient concentrations of carbon monoxide that are typically present today. The assessment also recommends adding carbon monoxide monitoring at the Livermore site since it is a multipollutant anchor site. The information in Tables 16, 17, 18, and 19 is also combined in Table A-4 in the Appendix.

Table 19. Ratings assigned to each carbon monoxide monitor in terms of value to the overall network.

Monitoring Site	Rating	Comments
Sebastopol	Low	
Napa	Low	
Vallejo	Medium	Collocated at anchor site
San Rafael	Low	
San Pablo	High	Highest site for annual $PM_{2.5}$
Concord	Low	
Bethel Island	Low	
San Francisco	Low	
Berkeley	Medium	Near-road monitoring site
Oakland – West	Medium	Collocated at anchor site
Oakland – Laney	High	Near-road monitoring site
Oakland – East	Low	
Pleasanton	Low	
Redwood City	Low	
San Jose – Jackson	High	NCore; collocated at anchor site
San Jose – Knox	High	Near-road monitoring site

Nitrogen Dioxide

In the Bay Area, fuel combustion, and in particular, traffic, is the main source of NO_2 emissions. The Air District operates NO_2 monitors at eighteen monitoring sites, as shown in Figure 17 by CBSA and Table 20 lists each NO_2 monitor, its monitor and site type(s), monitoring objective(s), spatial scale, and contribution to monitoring requirements, if any.

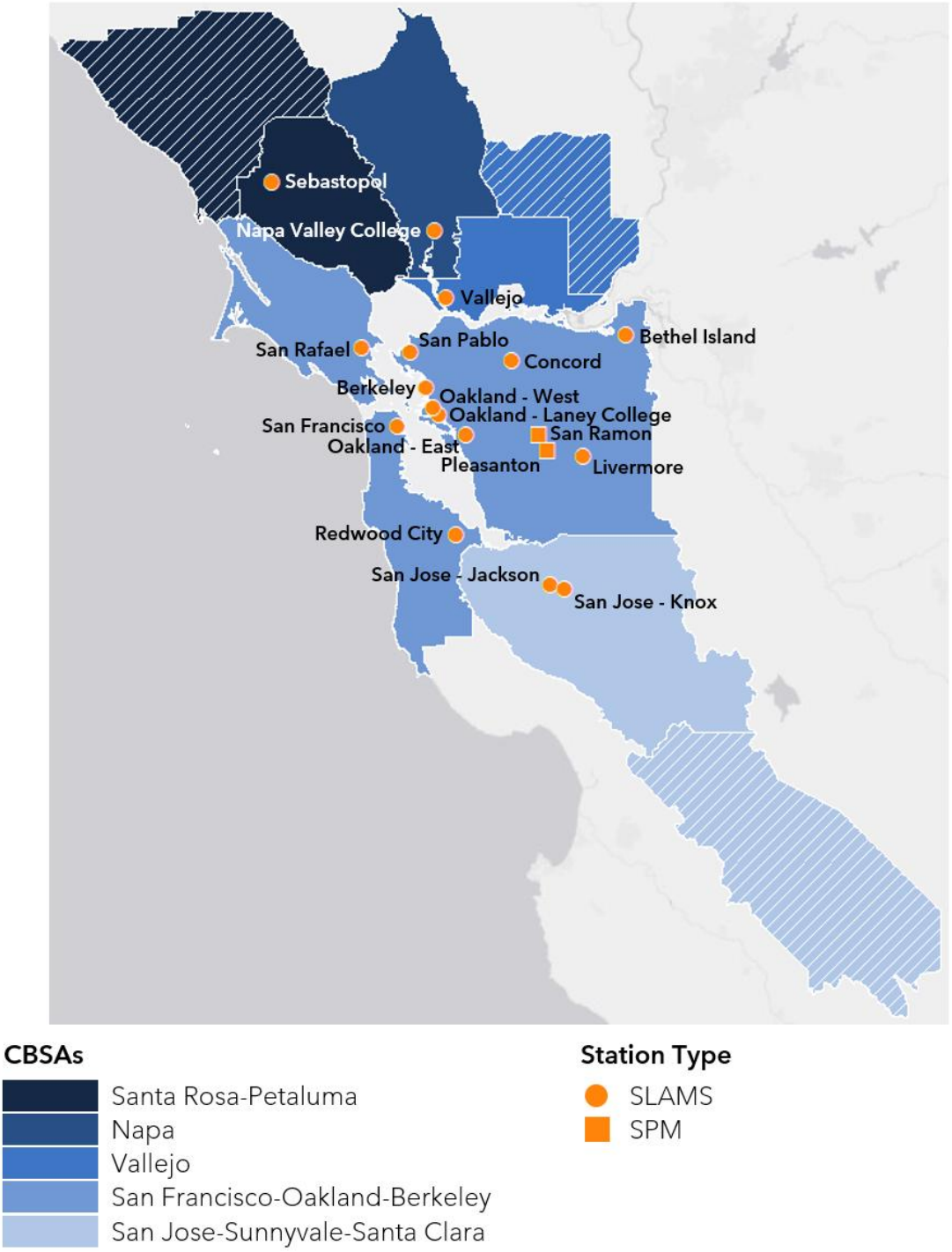

Figure 17. Map of locations of Air District NO_2 monitors and Core Based Statistical Areas (CBSAs). Hatched areas on the map are outside the Air District boundaries and note portions of a CBSA that are shared with an adjacent air agency.

Table 20. Nitrogen dioxide monitors and their monitor type (SLAMS or SPM), monitoring objective(s), site type(s), spatial scale, and contribution to minimum monitoring requirements.

CBSA	Monitoring Site	Monitor Type	Monitoring Objective(s)	Site type(s)	Spatial Scale	Contribution to Monitoring Requirements
Santa Rosa-Petaluma	Sebastopol	SLAMS	NC	PE	Neighborhood	
Napa	Napa	SLAMS	NC	PE	Neighborhood	
Vallejo	Vallejo	SLAMS	NC	PE	Neighborhood	
San Francisco-Oakland-Berkeley	San Rafael	SLAMS	NC	PE	Middle	
	San Pablo	SLAMS	NC	PE	Middle	
	Concord	SLAMS	NC	PE	Neighborhood	
	Bethel Island	SLAMS	NC	RT	Urban	
	San Francisco	SLAMS	NC	PE	Neighborhood	
	Berkeley	SLAMS	NC	PE, SO	Microscale	Near-road network
	Oakland – West	SLAMS	NC	PE	Neighborhood	RA required monitoring
	Oakland - Laney	SLAMS	NC	PE, SO	Microscale	Near-road network
	Oakland – East	SLAMS	NC	PE	Middle	
	Pleasanton	SPM	NC	PE, SO	Microscale	
	San Ramon	SPM	R	PE	Neighborhood	
	Livermore	SLAMS	NC, R	PE	Neighborhood	
	Redwood City	SLAMS	NC	PE	Neighborhood	
San Jose-Sunnyvale-Santa Clara	San Jose – Jackson	SLAMS	NC, R	PE	Neighborhood	Area-wide requirement
	San Jose – Knox	SLAMS	NC	PE, SO	Microscale	Near-road network

Monitoring objectives abbreviations:
NC – NAAQS Comparison
R – Research

Site type abbreviations:
PE – Population Exposure
SO – Source Oriented
RT – Regional Transport

Table 21 summarizes the US EPA-based minimum monitoring requirements for NO_2 by CBSA. US EPA has revised the minimum monitoring requirements for NO_2 multiple times in recent years and current requirements for NO_2 pertain to:

- Near-road monitoring, which is based on the population of a CBSA and traffic counts of roadway segments within the CBSA,
- Area-wide monitoring, which requires one NO_2 monitor at the neighborhood or larger spatial scale in each CBSA with a population of at least one million persons, and
- Regional Administrator required monitoring, which required a minimum of forty NO_2 monitors nationwide sited in locations to protect susceptible and vulnerable populations.

The Air District currently meets or surpasses minimum monitoring requirements for NO_2 in all CBSAs, except for near-road monitoring in the San Jose-Sunnyvale-Santa Clara CBSA where the most recently available maximum annual average daily traffic (AADT) for one freeway segment now exceeds 250,000 and an additional near-road NO_2 monitor may be required. The Air District will continue to track whether AADT remains consistently above the 250,000 threshold.

One area-wide NO_2 monitor is required each in the San Francisco-Oakland-Berkeley CBSA and San Jose-Sunnyvale-Santa Clara CBSA. The Regional Administrator (RA) required monitoring is fulfilled by the Oakland – West monitoring site.

Table 21. Summary of US EPA minimum monitoring requirements for NO_2 by CBSA.

CBSA	2020 Census Population	Maximum AADT (2022)	Near-road Monitors			Area-wide Monitors			Monitoring for RA-requirement		
			Required	Active	Additional Needed	Required	Active	Additional Needed	Required	Active	Additional Needed
Santa Rosa-Petaluma	488,863	138,000	0	0	0	0	1	0	0	0	0
Napa	138,019	135,000	0	0	0	0	0[(a)]	0	0	0	0
Vallejo	453,491	232,000	0	0	0	0	1	0	0	0	0
San Francisco-Oakland-Berkeley	4,749,008	293,000	2	2	0	1	6	0	1	1	0
San Jose-Sunnyvale-Santa Clara	2,000,468	264,000	2	1	1[(b)]	1	1	0	0	0	0

(a) The Napa monitoring site went offline in May 2021. NO_2 monitoring is expected to resume in Napa pending relocation of the former air monitoring site.

(b) Recent increases in AADT indicate that a second near-road monitor may be needed in the San Jose-Sunnyvale-Santa Clara CBSA. The Air District will continue to track whether traffic counts are expected to remain consistently above the 250,000 AADT threshold.

Table 22 shows recent annual 98th percentile 1-hour NO_2 concentrations, 1-hour NO_2 design values, and maximum 1-hour NO_2 concentrations at Air District monitoring sites. The annual 98th percentile concentrations and design values have all been below 50 percent of the NAAQS and there have been no recorded exceedances of the 1-hour NO_2 NAAQS (100 ppb) in the last five years. Relatively higher levels of NO_2 levels within the network tend to occur at monitoring sites in urban areas and at some of the designated near-road monitoring sites. Figure 18 shows measured daily 1-hour maximum NO_2 concentrations by monitoring site for the period 2019-2023 to illustrate variability in overall NO_2 concentrations and occurrences of relatively higher NO_2 concentrations across different locations.

Table 22. Recent 1-hour NO_2 annual 98th percentiles, 1-hour NO_2 design values, and maximum 1-hour NO_2 concentrations at Air District monitoring sites.

CBSA	Monitoring Site	Annual 98th Percentile Value (ppb)			1-hour DV (ppb)	Maximum 1-hour Concentration (ppb)
		2021	2022	2023	2021-2023	2019-2023
Santa Rosa-Petaluma	Sebastopol	20.1	25.3	24.8	23	36.3
Napa	Napa	NA[(a)]	NA[(a)]	NA[(a)]	NA[(a)]	36.6
Vallejo	Vallejo	35.1	39.2	34.6	36	52.5
San Francisco-Oakland-Berkeley	San Rafael	33.1	32.8	30.8	32	49.9
	San Pablo	30.7	32.0	28.4	30	42.0
	Concord	25.3	25.5	24.8	25	40.6
	Bethel Island	21.3	23.8	22.4	23	31.7
	San Francisco	38.2	40.5	39.6	39	61.0
	Berkeley	35.7	NA[(b)]	39.1	37[(b)]	49.8
	Oakland – West	39.1	40.4	38.0	39	50.0
	Oakland - Laney	39.8	43.0	35.9	40	58.3
	Oakland – East	35.3	39.8	36.0	37	61.8
	Pleasanton	35.8	34.5	NA[(b)]	NA[(b)]	63.7
	San Ramon	26.2	32.0	27.5	29	64.5
	Livermore	32.7	34.1	30.3	32	47.5
	Redwood City	20.1	25.3	24.8	23	55.2
San Jose-Sunnyvale-Santa Clara	San Jose – Jackson	39.2	43.6	43.9	42	59.8
	San Jose – Knox	38.8	42.4	42.5	41	65.1

(a) A new monitoring site in the Napa CBSA is pending and will likely include monitoring for NO_2.
(b) Metric could not be calculated due to incomplete data.

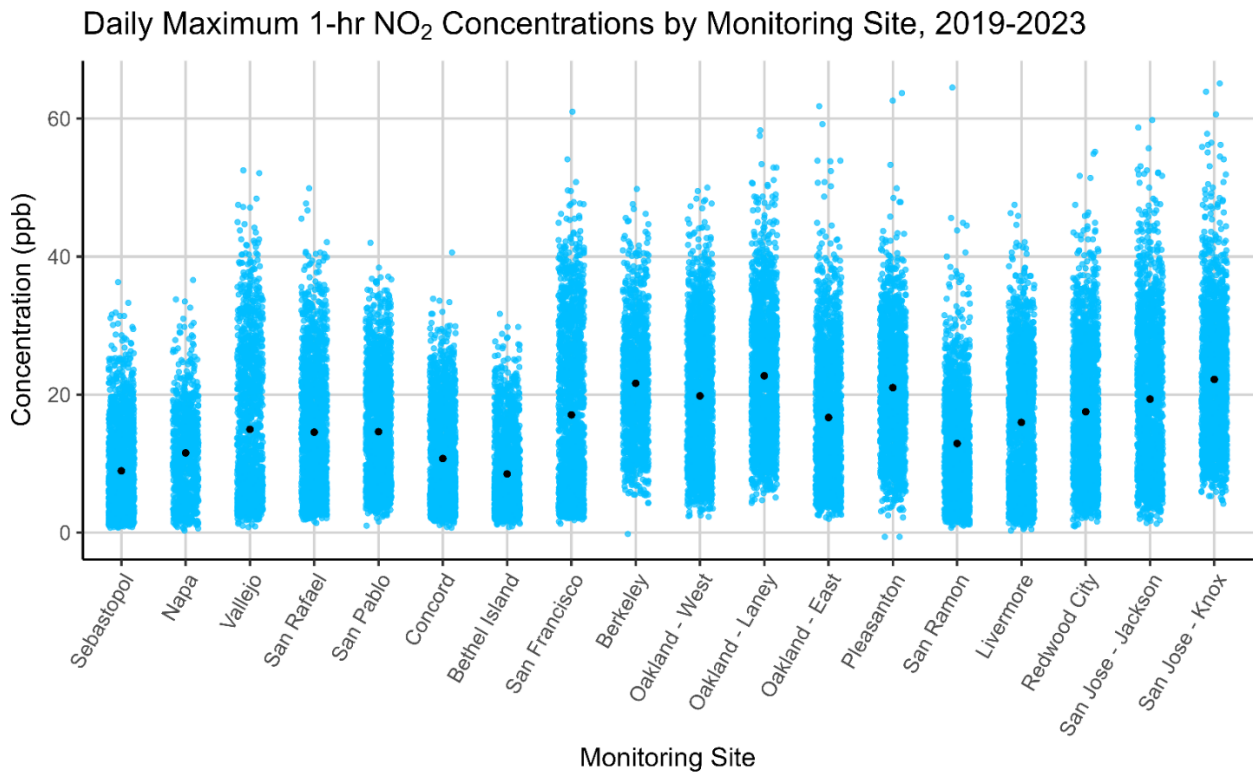

Figure 18. Measured daily maximum 1-hour NO_2 concentrations by monitoring site, 2019-2023. Each blue dot represents an individual daily maximum 1-hour NO_2 concentration, and the larger black dots indicate the average daily maximum 1-hour NO_2 concentration for that monitoring site.

NO_2 (and NO and NO_x) measurement data can help inform data analyses for source attribution when paired with other pollutant data, air quality forecasting (as an ozone precursor), and characterizing air quality in overburdened communities. Collocated NO_2 data may therefore be of higher importance at sites that have higher $PM_{2.5}$ and/or ozone design values, and at other multi-pollutant anchor sites.

Each NO_2 monitor was assigned a rating of Low, Medium, or High for its relative value to the network overall, as shown in Table 23. Overall recommendations are summarized in Section 4 of this assessment. Monitors that received a High rating were either required for meeting monitoring requirements and/or are located at recommended multi-pollutant anchor sites. Several monitors were assigned a Medium rating despite relatively low historical levels of NO_2 because they are at the only multi-pollutant monitoring site in a county, though NO_2 monitoring may not be needed in the long-term at all of these locations, in particular ones that are not located in overburdened communities. NO_2 monitoring could be discontinued sooner at monitors that received a Low rating while still meeting minimum monitoring requirements and informing other data needs. The information in Tables 20, 21, 22, and 23 is also combined in Table A-4 in the Appendix.

An additional near-road NO_2 monitor may be required in the San Jose-Sunnyvale-Santa Clara CBSA to meet minimum monitoring requirements. The existing near-road monitoring site (San Jose – Knox) in this CBSA is already located in the area of maximum AADT. Other potential locations for a new near-road NO_2 monitor could include the US-101 corridor northwest of San Jose or the I-880 corridor north of San Jose, to additional fill potential geographic gaps in the overall network.

Table 23. Ratings assigned to each nitrogen dioxide monitor in terms of value to the overall network.

Monitoring Site	Rating	Comments
Sebastopol	Medium	
Napa	Medium	
Vallejo	High	Multi-pollutant anchor site
San Rafael	Medium	
San Pablo	High	High site for annual $PM_{2.5}$
Concord	Low	
Bethel Island	Low	
San Francisco	Medium	
Berkeley	High	Required for near-road monitoring
Oakland – West	High	Multi-pollutant anchor site
Oakland - Laney	High	Required for near-road monitoring
Oakland – East	Medium	
Pleasanton	Low	SPM
San Ramon	Low	SPM
Livermore	High	PAMS, multi-pollutant anchor site
Redwood City	Medium	
San Jose – Jackson	High	NCore, required for area-wide monitoring, multi-pollutant anchor site
San Jose – Knox	High	Required for near-road monitoring

Sulfur Dioxide

In the Bay Area, the largest sources of SO_2 are refineries, located along San Pablo Bay and the Carquinez Strait from Richmond to near Concord. The Air District operates SO_2 monitors at nine monitoring sites, as shown in Figure 19 by CBSA, Table 24 lists each SO_2 monitor, its monitor and site type, monitoring objective(s), spatial scale, and contribution to minimum monitoring requirements, and Table 25 summarizes the US EPA-based minimum monitoring requirements for SO_2 by CBSA.

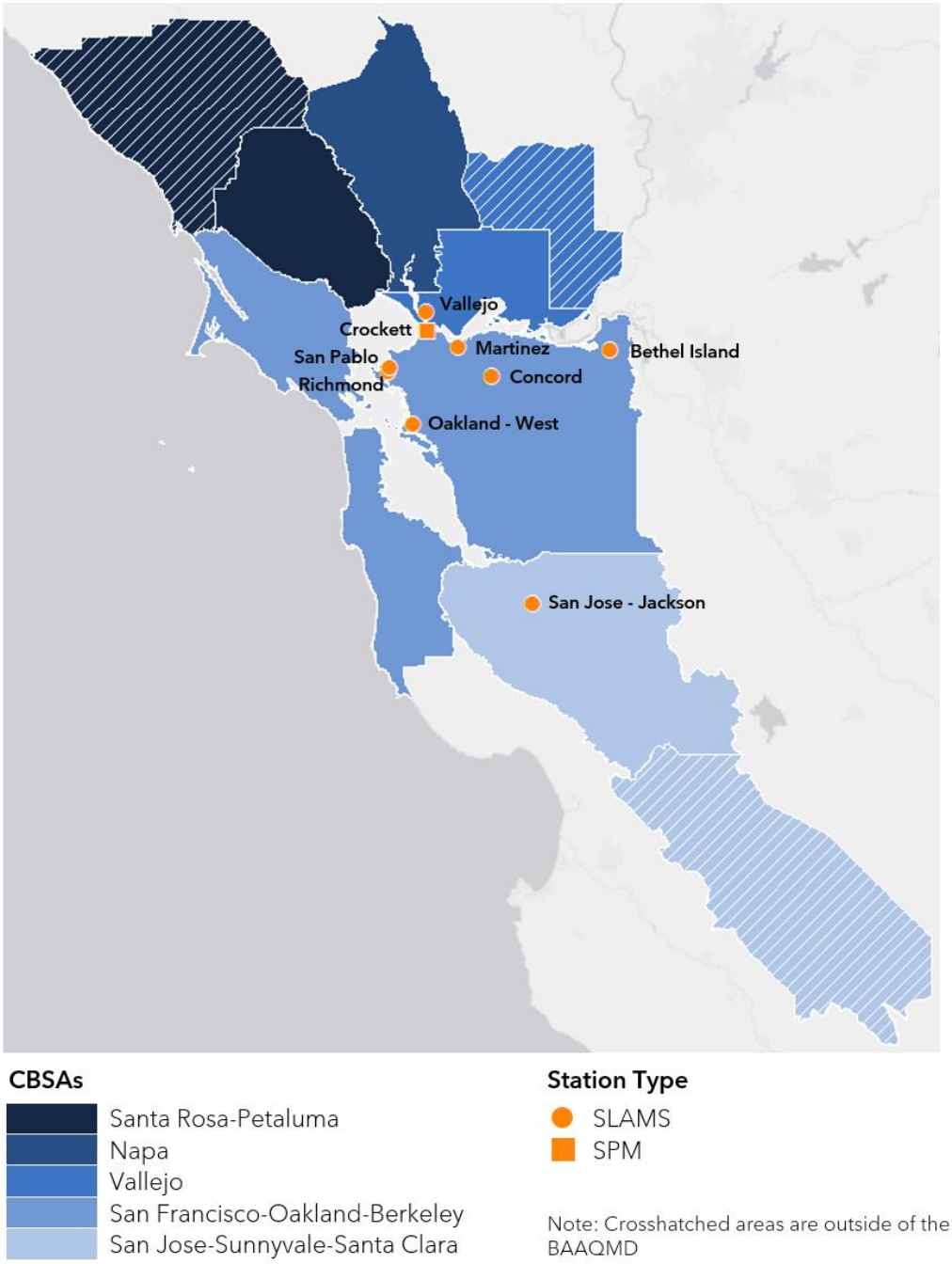

Figure 19. Map of locations of Air District SO_2 monitors and Core Based Statistical Areas (CBSAs). Hatched areas on the map are outside the Air District boundaries and note portions of a CBSA that are shared with an adjacent air agency.

Table 24. Sulfur dioxide monitors and their monitor type (SLAMS or SPM), monitoring objective(s), site type(s), spatial scale, and contribution to minimum monitoring requirements.

CBSA	Monitoring Site	Monitor Type	Monitoring Objective(s)	Site type(s)	Spatial Scale	Contribution to Monitoring Requirements
Vallejo	Vallejo	SLAMS	NC	PE, SI	Neighborhood	
San Francisco-Oakland-Berkeley	Richmond-7th St.	SLAMS	NC	PE, SO	Neighborhood	
	San Pablo	SLAMS	NC	PE, SO	Neighborhood	
	Crockett	SPM	NC	PE, SO	Neighborhood	
	Martinez	SLAMS	NC	PE, SO	Neighborhood	DRR
	Concord	SLAMS	NC	PE, SO	Neighborhood	
	Bethel Island	SLAMS	NC	RT	Urban	
	Oakland – West	SLAMS	NC	PE	Neighborhood	
San Jose-Sunnyvale-Santa Clara	San Jose – Jackson	SLAMS	NC, R	PE	Neighborhood	NCore

Monitoring objectives abbreviations:
NC – NAAQS Comparison
R – Research

Site type abbreviations:
PE – Population Exposure
SO – Source Oriented
RT – Regional Transport

Other abbreviations:
DRR – Data Requirements Rule

Table 25. Summary of US EPA minimum monitoring requirements for SO_2 by CBSA that overlaps with the Air District's jurisdiction.

CBSA	Counties	2020 Census Population	SO_2 Emissions (tons/year)[(a)]	PWEI (million-person-tons/year)	Number of SLAMS		
					Required	Active	Additional Needed
Santa Rosa-Petaluma	Sonoma	488,863	16	8	0	0	0
Napa	Napa	138,019	9	1	0	0	0
Vallejo	Solano	453,491	101	46	0	1	0
San Francisco-Oakland-Berkeley	San Francisco, San Mateo, Alameda, Contra Costa, Marin	4,749,008	3,597	17,083	1[(b)]	6	0
San Jose-Sunnyvale-Santa Clara	Santa Clara, San Benito	2,000,468	370	740	1[(c)]	1	0

(a) Based on data from the 2020 National Emissions Inventory.
(b) There is a requirement for one SO_2 monitor both from the PWEI and from the final SO_2 DRR. These requirements can be met by the same monitor, so the requirement is stated as one monitor. The Air District intends to continue operating additional SO_2 monitors to characterize the effects of sources in this CBSA.
(c) A trace-level SO_2 monitor is required at the San Jose – Jackson site as part of the NCore program.

The required number of SO_2 monitors in each CBSA is determined by the CBSA Population Weighted Emissions Index (PWEI), which is a product of the total amount of SO_2 emissions in the CBSA and its population. One SO_2 monitor is required for the San Francisco-Oakland-Berkeley CBSA based on its PWEI. In addition to the PWEI-related monitoring requirements, US EPA requires trace-level SO_2 monitoring at NCore sites, which is fulfilled by a trace-level SO_2 monitor at the San Jose – Jackson monitoring site in the San Jose-Sunnyvale-Santa Clara CBSA. Finally, the Data Requirements Rule (DRR) for the 2010 1-hour SO_2 NAAQS also requires monitoring or modeling to characterize ambient SO_2 concentrations near sources that emit more than 2,000 tons of SO_2 per year. While there is no single source in the Bay Area that exceeds this emission threshold, US EPA required further air quality characterization of three SO_2 sources in the San Francisco-Oakland-Berkeley CBSA:

- the Marathon refinery
- the Martinez Refining Company refinery, and
- the Eco Services Operations Corporation sulfuric acid plant

The SO_2 monitor at the Martinez monitoring site meets this additional requirement, and the Air District currently meets or surpasses minimum monitoring requirements for SO_2 based on the PWEI, NCore, and DRR requirements.

Table 26 shows recent annual 99th percentile 1-hour SO_2 concentrations and 1-hour SO_2 design values at Air District monitors, which have all been below 25 percent of the NAAQS. Of the nine SO_2 monitors currently in operation, six are located along or near the refinery corridor, where facilities have the potential for infrequent but relatively high emissions of SO_2 compared to other sources in the area. SO_2 is also monitored at the Oakland – West monitoring site to inform on nearby port and shipping-related emissions. SO_2 has historically been monitored at the Bethel Island monitoring site to inform on background concentrations and regional transport.

Table 26. 1-hour SO_2 annual 99th percentiles and design values at Air District monitoring sites, 2021-2023.

CBSA	Monitoring Site	Annual 99th Percentile Value (ppb)			1-hour SO_2 Design Value (ppb)
		2021	2022	2023	
Vallejo	Vallejo	3.8	4.9	3.2	4
San Francisco-Oakland-Berkeley	Richmond-7th St.	11.3	8.0	6.5	9
	San Pablo	5.5	9.5	5.2	7
	Crockett	12.7	8.0	10.5	10
	Martinez	9.3	15.1	17.5	14
	Concord	6.1	6.2	4.5	6
	Bethel Island	3.8	4.1	3.1	4
	Oakland – West	3.1	5.0	1.8	3
San Jose-Sunnyvale-Santa Clara	San Jose – Jackson	1.5	1.5	1.7	2

Figure 20 shows measured daily 1-hour maximum SO_2 concentrations by monitoring site for the period 2019-2023 to illustrate variability in overall SO_2 concentrations and occurrences of relatively higher SO_2 concentrations across different locations. The vast majority of measured SO_2 concentrations have been well below 25 ppb, or one-third of the NAAQS for 1-hr SO_2. One exceedance of the NAAQS was recorded at the Crockett monitor, occurring on December 5, 2020.

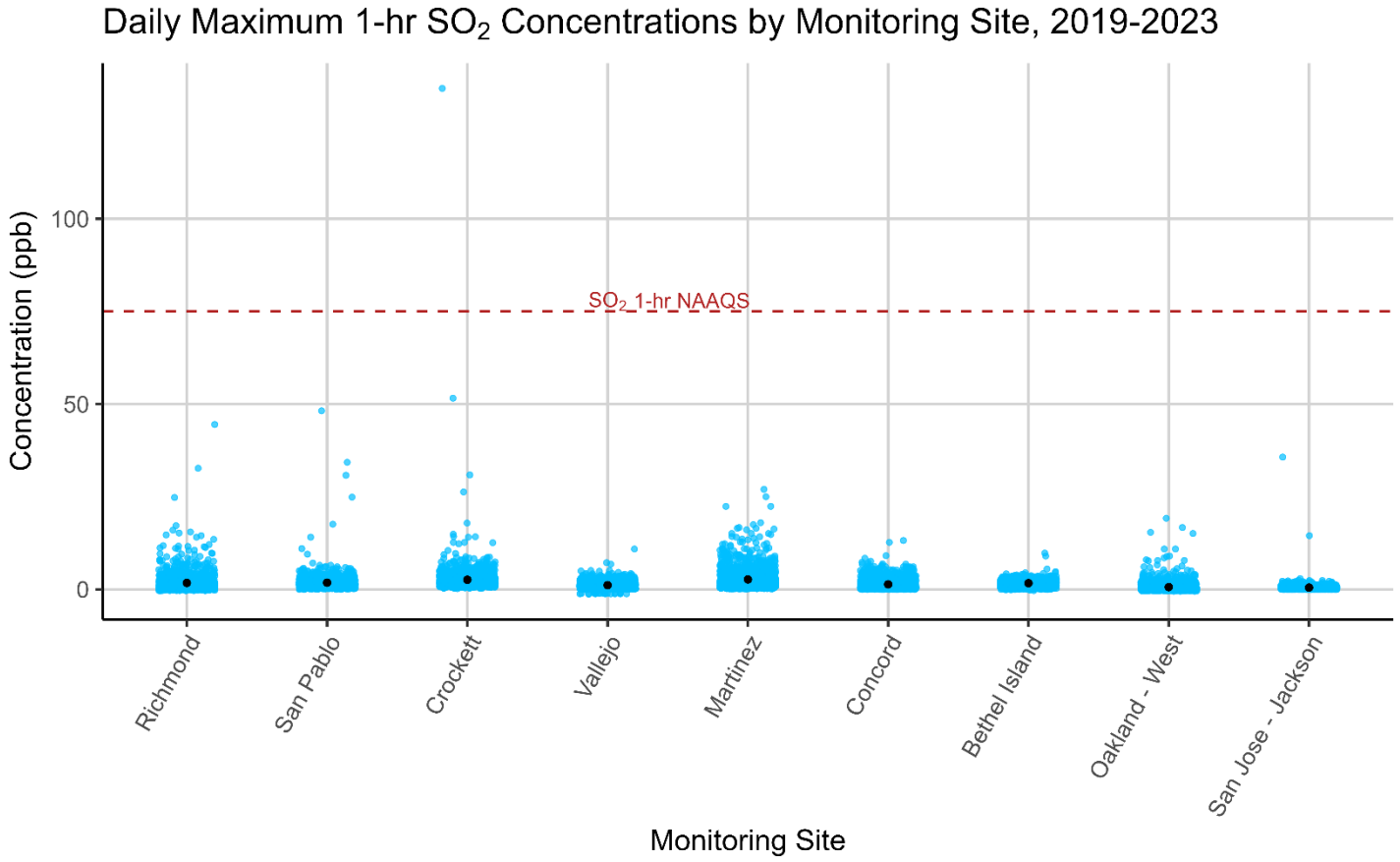

Figure 20. Measured daily maximum 1-hour SO_2 concentrations by monitoring site, 2019-2023. Each blue dot represents an individual daily maximum 1-hour SO_2 concentration, and the larger black dots indicate the average daily maximum 1-hour SO_2 concentration for that monitoring site.

SO_2 monitoring at new locations under the Air District's Major Stationary Source Community Air Monitoring Program could replace some of the existing sites with SO_2 monitoring that cannot accommodate additional monitoring equipment and/or are not appropriately sited, such as the existing Martinez, Crockett, and Richmond-7th Street air monitoring sites.

Each SO_2 monitor was assigned a rating of Low, Medium, or High for its relative value to the network overall, as shown in Table 27. The information in Tables 24, 25, 26, and 27 is also combined in Table A-6 in the Appendix. SO_2 monitoring could be discontinued at some locations within the network while still meeting minimum monitoring requirements and informing other data needs. In addition, some existing monitors are likely to be redundant with new SO_2 monitoring locations that are pending under the Air District's Major Stationary Source Community Air Monitoring Program.

Table 27. Ratings assigned to each sulfur dioxide monitor in terms of value to the overall network.

Monitoring Site	Rating	Comments
Vallejo	Medium	Near refinery corridor; multi-pollutant site
Richmond-7th St.	High	Refinery community; re-evaluate pending Major Stationary Source Community Air Monitoring Program
San Pablo	High	Refinery community; re-evaluate pending Major Stationary Source Community Air Monitoring Program
Crockett	Medium	Refinery community; siting issues at this location
Martinez	High	DRR monitor and refinery community; new monitoring pending under Major Stationary Source Community Air Monitoring Program
Concord	Low	New monitoring pending under Major Stationary Source Community Air Monitoring Program
Bethel Island	Low	Other monitors can represent background concentrations
Oakland – West	Medium	Near port/shipping-related emissions; multi-pollutant anchor site
San Jose – Jackson	High	Required for NCore; can represent urban background concentrations

Lead

In 2011, EPA revised the ambient air monitoring requirements for Pb to better assess potential population exposure from air emissions. The revised requirements reduced the emissions threshold for non-airport stationary sources that require SLAMS from 1.0 tons per year (tpy) to 0.5 tpy and required monitoring at airports with emissions greater than 1.0 tpy. The Bay Area does not have any stationary sources or airports that exceed these emission thresholds, so no source-oriented lead monitoring is required.

In addition, EPA required that agencies perform a one-year Pb monitoring study at 15 airports across the U.S. with emissions between 0.5 tpy and 1.0 tpy.[16] Airports were selected based on estimated Pb emissions, airport runway configuration and meteorology, and ambient air within 150 meters of the location(s) of maximum emissions. Three of the fifteen airports selected were in the Bay Area (Palo Alto Airport, Reid-Hillview Airport, and San Carlos Airport).

The Air District currently measures Pb at Reid-Hillview Airport. This monitoring site has been in operation since February 2012, with a temporary closure from June 2020 to May 2021. Pb concentrations (3-month rolling means) at Reid-Hillview Airport have consistently been below 50% of the Pb NAAQS of 0.15 µg/m^3 since April 2018, as shown in Figure 21. The most recent Pb design value (2022-2024) for Reid-Hillview Airport was 0.04 µg/m^3 and demonstrates that the airport is not contributing to a maximum Pb concentration in excess of 50% of the NAAQS. US EPA allows for the shutdown of Pb monitoring sites if data are below 50% of the NAAQS, and the Air District has therefore requested approval of a waiver to discontinue this monitoring at Reid-Hillview Airport in the Air District's 2025 Annual Monitoring Network Plan.

[16] Per the Code of Federal Registry (CFR), Title 40, Part 58, Appendix D, section 4.5, any monitor with Pb measurements that exceed 50% of the Pb NAAQS of 0.15 µg/m^3 on a rolling 3-month average shall continue to operate indefinitely. State or local air agencies can request a waiver to discontinue airport Pb monitoring upon demonstration that the Pb source will not contribute to a maximum Pb concentration in excess of 50% of the NAAQS, based on review of additional monitoring data, modeling, or other means.

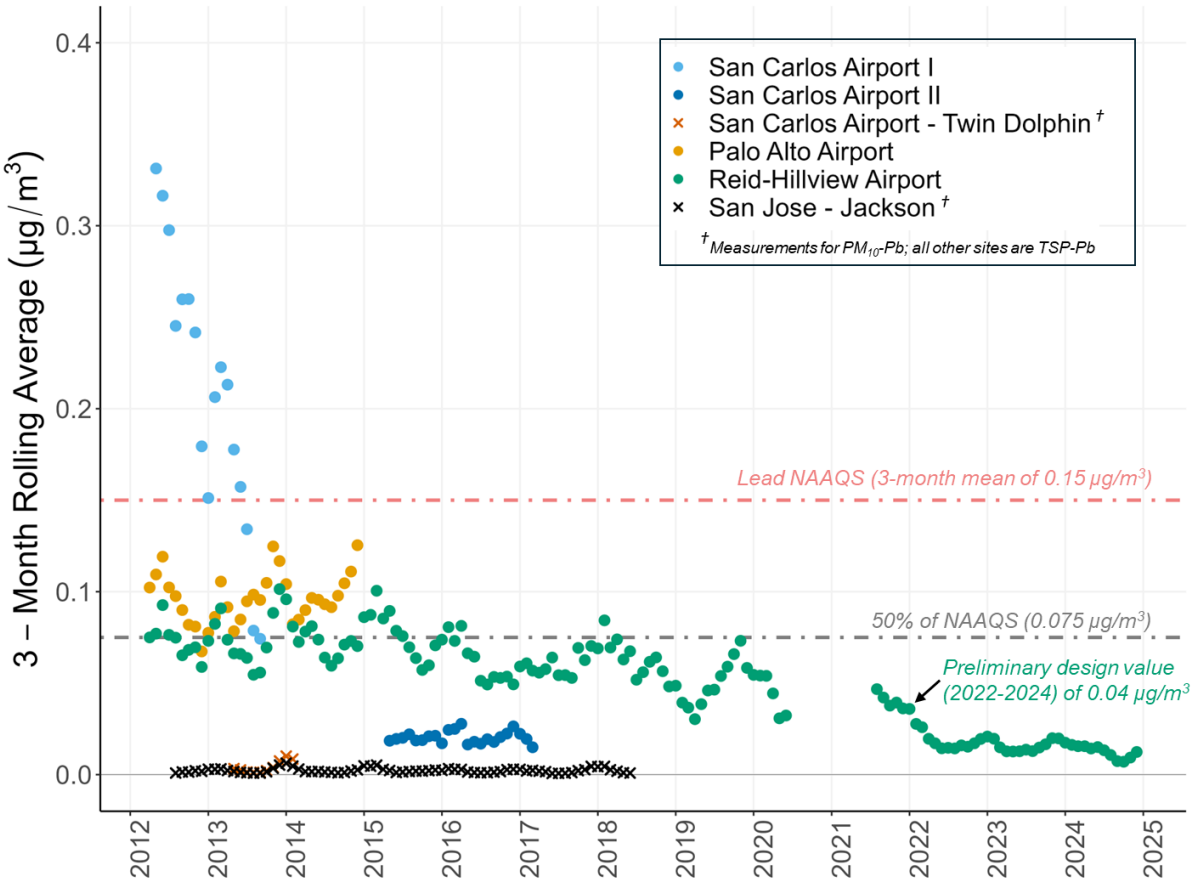

Figure 21. 3-month rolling average lead concentrations measured at different Air District monitoring locations from 2012-2024.

Additional recent developments also support discontinuation of Pb-TSP monitoring at Reid-Hillview Airport. As of January 1, 2022, Santa Clara County no longer permits the sale of leaded aviation fuel at the airport. In addition, on August 17, 2021, the Santa Clara County Board of Supervisors unanimously voted to seek closure of the airport prior to 2031, which is the soonest date that the airport could close under the terms of existing grants from the Federal Aviation Administration.

The Air District also previously measured Pb at Palo Alto and San Carlos airports (the other two airports selected by EPA for Pb monitoring) but monitoring at both sites was discontinued due to logistical constraints beyond the Air District's control. Pb concentrations measured at these locations were also below the Pb NAAQS for several years. Generally, Pb concentrations measured on airport property are higher than concentrations observed at sites outside the airport fenceline, indicating a very strong gradient in Pb concentrations and that measured concentrations are primarily dependent on how close the monitor is to the airport run-up area.

Airport monitoring sites are also particularly resource intensive from a siting, operational, and analysis standpoint, Generally, Pb concentrations measured on airport property are higher than concentrations observed at sites outside the airport fenceline, indicating a very strong gradient in

Pb concentrations and that measured concentrations are primarily dependent on how close the monitor is to the airport run-up area.

The combination of the factors above indicates that Pb monitoring at these airports provides limited value and could be discontinued without jeopardizing Air District programs. In addition to the requested waiver to discontinue Pb monitoring at Reid-Hillview Airport based on recent monitoring data there, the Air District will also request EPA approval to formally shut down monitoring at Palo Alto Airport and San Carlos Airport given the intractable siting issues in those locations.

4. Recommendations

A summary of the ratings assigned to each monitor by site is shown in Table 28, followed by specific recommendations that emerged from this assessment. Some monitors that received Low or Medium ratings are recommended for discontinuation, consolidation with other monitoring sites, or for relocation to better serve data needs. These recommendations are intended to free up resources for other high priority air monitoring efforts that will better inform community air quality concerns. Many of the recommendations in this assessment reflect recommendations that were included in the 2015 and 2020 Five-Year Air Monitoring Network Assessments but have not yet been implemented. The Air District is developing a plan to implement the proposed recommendations in this assessment and will continue to evaluate these recommendations in coordination with stakeholders as data needs and operations evolve.

Table 28. Summary of ratings for criteria air pollutant monitors at each site.

CBSA	Monitoring Site	Ozone	$PM_{2.5}$	PM_{10}	Carbon Monoxide	Nitrogen Dioxide	Sulfur Dioxide
Santa Rosa-Petaluma	Sebastopol	Medium	Medium		Low	Medium	
Napa	Napa	Medium	High	Medium	Low	Medium	
Vallejo	Fairfield	Low					
	Vallejo	High	High		Medium	High	Medium
San Francisco-Oakland-Berkeley	San Rafael	Medium	Medium	Low	Low	Medium	
	Pt. Richmond						
	Richmond						High
	San Pablo	Medium	High	High	High	High	High
	Rodeo						
	Crockett						Medium
	Martinez						High
	Concord	Medium	Medium	Low	Low	Low	Low
	Bethel Island	Medium			Low	Low	Low
	San Francisco	Medium	High	Medium	Low	Medium	
	Berkeley	Low	Medium		Medium	High	
	Oakland – West	Medium	High		Medium	High	Medium
	Oakland – Laney		High		High	High	
	Oakland – East	Medium	High		Low	Medium	
	Hayward	Low					
	Pleasanton		Low		Low	Low	
	San Ramon	Low				Low	
	Livermore	High	High			High	
	Redwood City	Medium	High		Low	Medium	
San Jose-Sunnyvale-Santa Clara	San Jose – Jackson	High	High	High	High	High	High
	San Jose – Knox		High		High	High	
	Los Gatos	Low					
	San Martin	High					
	Gilroy	Low	Medium				

Streamline Monitoring Operations

Discontinuation of monitoring operations that are no longer well aligned with data needs or may be redundant with other monitoring operations can free up resources for other air monitoring efforts that can better inform community air quality concerns and data needs. The following monitoring sites or monitors are recommended for discontinuation:

- **Pleasanton:** This monitoring site, established in 2018 at request by an Air District board member, provides continuous measurements for $PM_{2.5}$, NO_2 (and NO and NO_x), and CO, and 1-in-12 day measurements of selected VOCs. The Pleasanton site is a SPM that does not contribute to meeting minimum monitoring requirements and has a relatively short period of record. While the site is located to sample the near-road environment along I-580, the measurement data is not appreciably different from other Air District near-road air monitoring sites. Additionally, $PM_{2.5}$ measurements from Pleasanton are similar to and highly correlated with $PM_{2.5}$ measurements from the nearby Livermore air monitoring site, indicating a likely redundancy in the network. The Air District noted planned closure of this monitoring site in the 2025 Annual Monitoring Network Plan.
- **Fairfield:** The Air District has operated the Fairfield (Chadbourne Rd.) air monitoring site since 2002. This is an ozone-only monitoring site. While this site has recorded occasional exceedances of the 8-hour ozone NAAQS, ozone concentrations at the Fairfield air monitoring site have been highly correlated with and have been generally lower than the nearby Vacaville air monitoring site, which is located 11 miles to the northeast and is operated by the Yolo-Solano AQMD. This recommendation was also included in the Air District's 2015 and 2020 5-year Air Monitoring Network Assessments. The Air District requested closure of this monitoring site in the 2025 Annual Monitoring Network Plan.
- **San Ramon:** The Air District discontinued operations at the San Ramon monitoring site in December 2024. This site included monitors for ozone, NO_2 (and NO and NO_x), and speciated VOCs as part of the Air District's former voluntary PAMS program. As SPMs, these monitors did not contribute to meeting minimum monitoring requirements, and measured ozone concentrations have been highly correlated with and lower than other nearby monitoring sites.
- **Hayward:** The Air District has operated the Hayward air monitoring site since 1977. This is an ozone-only monitoring site. Historically, data from this site was used to provide an indication of ozone levels aloft and sub-regional transport, given the relatively higher elevation (951 feet) of this site. More recently, the data from this site has been less critical to forecasting and other data needs. Additionally, while exceedances of the 8-hour ozone NAAQS occasionally occur at Hayward, the site design value is relatively low. The ozone monitor was converted from a SLAMS to a SPM in 2019 and therefore does not contribute to minimum monitoring requirements. The Air District noted planned closure of this monitoring site in the 2025 Annual Monitoring Network Plan.
- **Los Gatos:** The Los Gatos air monitoring site, operated since 1972, has a long period of record. However, it is an ozone-only monitoring site and measured ozone concentrations

have been highly correlated with and have been lower than ozone concentrations at the San Jose – Jackson air monitoring site. The Air District requested closure of this monitoring site in the 2025 Annual Monitoring Network Plan.

- **Berkeley (ozone monitoring):** Ozone concentrations measured at the Berkeley air monitoring site have been low, and as a SPM, the monitor does not contribute to minimum monitoring requirements. The Air District noted planned closure of this monitoring site in the 2025 Annual Monitoring Network Plan.

Consolidating measurements at certain existing air monitoring sites or at new locations will reduce potential redundancies within the network and free up resources for other air monitoring efforts. The following air monitoring sites are recommended for consolidation:

- **Major Stationary Source Community Air Monitoring Program:** As enhanced monitoring is deployed near refineries as part of this program, existing monitoring should be reevaluated to minimize redundancies and streamline operations. Many of the existing monitoring sites in refinery communities cannot accommodate additional monitoring equipment and/or are not appropriately sited, and monitoring at those sites could be consolidated at new locations under the Major Stationary Source Community Air Monitoring Program.
- **Eastern Contra Costa County:** Existing monitoring sites in northern and eastern Contra Costa County could be consolidated at a new, multi-pollutant site in the Highway 4 corridor. Currently, the Air District operates a multi-pollutant site in Concord (Treat Blvd.), which has measured relatively low pollutant concentrations and is located in a less-burdened community compared to parts of Concord that are nearer large pollution sources. Monitoring at the Concord site may eventually be redundant with enhanced monitoring pending deployment near the MRC and Marathon refineries. The Air District also operates a site in Bethel Island that has also measured relatively low concentrations of different pollutants. The Air District previously operated a limited monitoring site in Pittsburg that included monitors for black carbon and selected VOCs, though operations at this site ended in 2023. The Pittsburg-Antioch-Oakley-Brentwood corridor has experienced more population growth in recent years compared to much of the Bay Area and several communities in this corridor are overburdened and are near or downwind of multiple large and/or complex pollution sources. This corridor is also an important transport pathway for pollutants between the Bay Area and the Central Valley. A new location for a multi-pollutant air monitoring site within an overburdened community in this area would help provide data to better characterize air quality in this corridor.
- **Gilroy and San Martin:** The Air District operates two air monitoring stations in southern Santa Clara County (Gilroy and San Martin). These sites are less than six miles apart. The Gilroy site measures ozone and $PM_{2.5}$ while the San Martin site measures ozone only. The $PM_{2.5}$ concentrations at the Gilroy site are relatively low compared to other Air District locations. Ozone concentrations at the Gilroy and San Martin sites have been highly correlated with each other, indicating a likely redundancy, and ozone concentrations at the San Martin site have generally been higher compared to concentrations at the Gilroy site. Consolidation of

the Gilroy and San Martin sites into one monitoring site at a new location in southern Santa Clara County would help reduce redundancy and streamline operations. A new site in this location could also include PM_{10} monitoring, since minimum monitoring requirements have indicated that additional PM_{10} monitoring may be needed in the San Jose-Sunnyvale-Santa Clara CBSA.

Relocating Monitoring Sites

The assessment recommends relocation of two existing air monitoring sites to better align data collection with Air District priorities for characterizing air quality in overburdened communities while continuing to meet minimum monitoring and other requirements. These recommendations include:

- **Sebastopol:** This site was opened in 2014 after relocation of the former Santa Rosa-5th Street monitoring site. Concentrations of $PM_{2.5}$ and other pollutants at this site have been relatively low and the site may not well represent the highest concentrations of different pollutants in Sonoma County. This site should be considered for relocation in Santa Rosa, which has a much larger population, and scoping of a new site location should focus on overburdened communities in this area.
- **San Francisco:** This monitoring site has a long period of record and is the only site in San Francisco County. However, it is not located in an overburdened community and may no longer represent the highest concentrations of $PM_{2.5}$ and other pollutants in San Francisco. This site should be considered for relocation within San Francisco and scoping of a new site location should focus on the overburdened communities of Bayview and Hunters Point.

Additional Recommendations and Considerations

Modernize PM_{10} monitoring: Currently, the Air District's PM_{10} monitoring relies solely on filter-based sampling, where each sample represents a 24-hour period and sampling is not continuous. Filter-based sampling is particularly labor intensive as samples must be transported to the Air District Laboratory for review and analysis. The existing data validation process for filter-based samples is also cumbersome, and the high-volume sampling used for most of the Air District's PM_{10} data is not as accurate as other filter-based or continuous monitoring options. Switching to continuous, hourly (or sub-hourly) PM_{10} data would have several benefits, including providing more accurate and meaningful information about how PM_{10} levels vary with time and compare with other PM-related measurements, real-time reporting of PM_{10} data, and reduced staff and resource time on sample transport and lab analysis. Additional data to better characterize intermittent or brief occurrences of relatively high PM_{10} over hourly or sub-hourly time spans would be especially helpful in overburdened communities where PM10 sources are often located.

Trace-Level carbon monoxide monitoring: In concurrence with the Air District's 2015 and 2020 5-year Air Monitoring Network Assessments, this assessment assigned Low ratings to several of the Air District's CO monitors and recommends a significant reduction in CO monitoring. Specifically, this assessment recommends continuing CO monitoring only at sites where monitoring is required

(near-road, NCore, and PAMS), at sites identified as anchor sites in the PM network assessment to support data analyses, and at selected other locations that experience relatively high PM concentrations. To provide more useful CO data, this assessment recommends replacing existing CO monitoring with trace-level monitoring. Trace-level instruments have several advantages, including improved sensitivity and detection of pollutants at lower concentrations, compared with legacy instrumentation currently used at most air monitoring sites.

New Near-Road Monitoring Site: As noted in the evaluation of NO_2 monitoring, an additional near-road monitoring site may be required in the San Jose-Sunnyvale-Santa Clara CBSA. The existing near-road monitoring site (San Jose – Knox) is already located in the area of maximum AADT in the CBSA. Other potential locations for a new near-road NO_2 monitor could include the US-101 corridor northwest of San Jose or the I-880 corridor north of San Jose, to additional fill potential geographic gaps in the overall network.

Potential data gaps: While current resources may not allow for the addition of new air monitoring sites, some geographic and information gaps may exist in the current network and may be opportunities for new air monitoring in the long-term. Additional analyses may help inform whether new air monitoring is needed in these areas, such as analysis of lower-cost sensor data.

- **Eastern Contra Costa County:** As noted previously in discussion of consolidation of existing monitoring operations, eastern Contra Costa County has a growing population and is located on an important corridor for transport of pollutants between the Bay Area and the Central Valley. This area includes numerous emissions sources and several communities with high CalEnviroScreen scores.
- **US-101 Corridor in the Peninsula:** The heavily populated US-101 corridor between San Francisco and San Jose has one air monitoring site (Redwood City) and represents a potential gap in the monitoring network. There are several overburdened communities within this corridor, including East Palo Alto, South San Francisco, and San Bruno. This area also includes several freeways (US-101, I-280, I-380) and San Francisco International Airport, among other sources of air pollution. A monitoring site in this corridor could also potentially fulfill the requirement for an additional near-road monitoring site in the San Jose-Sunnyvale-Santa Clara CBSA if sited along US-101 in Santa Clara County.
- **I-880 Corridor in Southern Alameda County/northern Santa Clara County:** The area from San Leandro south through Fremont and Milpitas has a high population and the nearest Air District multi-pollutant monitors are in East Oakland (to the north) and San Jose (to the south). This area includes the heavily trafficked I-880 corridor and numerous warehousing facilities and various light to moderate industrial and commercial corridors. A monitoring site in this corridor could also potentially fulfill the requirement for an additional near-road monitoring site in the San Jose-Sunnyvale-Santa Clara CBSA if sited along I-880 in Santa Clara County.

Appendix: Detailed Information Tables by Pollutant

Table A-1. Summary of ozone monitoring requirements, locations and metadata for existing ozone monitors, recent ozone concentrations, and ratings assigned in this assessment.

MSA	MSA Population	Number of SLAMS			Monitoring Site	Monitor Type	Monitoring Objective(s)	Site type(s)	Spatial Scale	CalEnviro-Screen Score	Annual 4th Highest Daily Maximum (ppm)			8-hr Design Value (ppm)	Number of Exceedances	Rating	Comment
		Required	Active	Additional Needed							2021	2022	2023	2021-2023	2019-2023		
Santa Rosa-Petaluma	488,863	1	1	0	Sebastopol	SLAMS	NC	PE	Neighborhood	26	0.055	0.050	0.046	0.050	0	High	Only ozone monitor in Sonoma County
Napa	138,019	0	0	0	Napa[a]	SLAMS	NC	PE	Neighborhood	NA	NA	NA	NA	NA	NA	High	Only ozone monitor in Napa County
Vallejo	453,491	2	3[b]	0	Fairfield	SLAMS	NC	PE, RT	Urban	84	0.067	0.061	0.054	0.060	5	Low	Singe-pollutant site with similar but lower ozone concentrations compared to the nearby Vacaville monitor
					Vallejo	SLAMS	NC	PE	Neighborhood	78	0.061	0.052	0.047	0.053	3	High	Only multi-pollutant site in Solano County
San Francisco-Oakland-Berkeley	4,749,008	3	6	0	San Rafael	SLAMS	PI	PE	Middle	41[d]	0.060	0.053	0.050	0.054	1	High	Only ozone monitor in Marin County
					San Pablo	SPM	PI	PE	Middle	96	0.057	0.049	0.049	0.051	2	Medium	
					Concord	SLAMS	NC	PE	Neighborhood	11	0.067	0.056	0.051	0.058	6	Low	
					Bethel Island	SLAMS	NC	RT, MC	Urban	60	0.074	0.067	0.058	0.066	8	Medium	
					San Francisco	SLAMS	NC	PE	Neighborhood	41	0.051	0.044	0.041	0.045	1	High	Only ozone monitor in SF County
					Berkeley	SPM	PI	PE	Microscale	66	0.041[e]	NA[e]	0.037[e]	0.024[f]	0	Low	SPM; lowest ozone concentrations in network
					Oakland – West	SLAMS	NC	PE	Neighborhood	71	0.042	0.039	0.044	0.041	1	Medium	
					Oakland – East	SPM	R	PE	Middle	70	0.051	0.043	0.045	0.046	2	Medium	
					Hayward	SPM	NC, R	RT	Urban	5	0.063	0.059	0.051	0.57	11	Low	SPM; Single-pollutant monitoring site
					San Ramon	SPM	NC, R	PE	Urban	0	0.069	0.057	0.063	0.63	6	Low	SPM; Lower concentrations than and redundancy with nearby Livermore monitor
					Livermore	SLAMS	NC	MC, PE	Neighborhood	35	0.073	0.068	0.069	0.70	21	High	Maximum DV site PAMS
					Redwood City	SLAMS	NC	PE	Neighborhood	75	0.059	0.053	0.052	0.54	3	High	Only ozone monitor in San Mateo County
San Jose-Sunnyvale-Santa Clara	2,000,468	2	6[c]	0	San Jose – Jackson	SLAMS	NC, R	PE	Neighborhood	55	0.072	0.062	0.059	0.64	9	High	Relatively high DV NCore
					Los Gatos	SLAMS	NC	PE	Neighborhood	4	0.069	0.062	0.050[e]	0.60[f]	8	Low	Single-pollutant monitoring site Redundant with San Jose-Jackson monitor
					San Martin	SLAMS	NC	MC, PE, RT	Urban	50	0.074	0.066	0.067	0.69	16	High	Relatively high DV
					Gilroy	SLAMS	NC	PE, RT	Neighborhood	56	0.065	0.063	0.056	0.61	6	Low	Lower concentrations than and redundancy with nearby San Martin monitor

Monitoring objectives abbreviations:
NC – NAAQS Comparison
PI – Public Information
R – Research

Site type abbreviations:
PE – Population Exposure
MC – Maximum Ozone Concentration
RT – Regional Transport

(a) The Napa monitoring site went offline in May 2021. Ozone monitoring will resume in Napa pending relocation of the former air monitoring site.
(b) One monitor (Vacaville-Ulatis Drive) is located within and operated by the Yolo-Solano Air Quality Management District. The other two ozone monitors in the Vallejo MSA are within and operated by the Air District.
(c) Two of the six monitors are within the Monterey Bay Air Resources District. However, the monitor with the maximum design value in the San Jose-Sunnyvale-Santa Clara MSA (San Martin) is within and operated by the Air District.
(d) Monitoring site is within 1000 feet of an area with CalEnviroScreen score > 70%
(e) Annual value did not meet completeness criteria
(f) Incomplete design value for 2021-2023

Table A-2. Summary of $PM_{2.5}$ monitoring requirements, locations and metadata for existing $PM_{2.5}$ monitors, recent $PM_{2.5}$ concentrations, and ratings assigned in this assessment.

MSA	MSA Population	Number of SLAMS			Monitoring Site	Monitor Type	Monitoring Objective(s)	Site type(s)	Spatial Scale	CalEnviro-Screen Score	Annual $PM_{2.5}$ DV (2022-2024)[a]	24-hr $PM_{2.5}$ DV (2022-2024)[a]	Number of non-fire days with 24-hr $PM_{2.5}$ > 25 µg/m³ (2019-2023)	Rating	Comment
		Required	Active	Additional Needed											
Santa Rosa-Petaluma	488,863	0	1	0	Sebastopol	SLAMS	NC	PE	Neighborhood	26	5.0	16	3	Medium	Only $PM_{2.5}$ monitor in Sonoma County Relatively low $PM_{2.5}$ concentrations; could be relocated
Napa	138,019	1	0	1	Napa[b]	SLAMS	NC	PE, HC	Neighborhood	NA	NA[b]	NA[b]	2[b]	High	$PM_{2.5}$ monitor required in Napa MSA
Vallejo	453,491	0	1	0	Vallejo	SLAMS	NC	PE, HC, RT	Neighborhood	78	6.5	20	17	High	Only multi-pollutant site in Solano County Collocation with related measurements Located in overburdened community
San Francisco-Oakland-Berkeley	4,749,008	3	10	0	San Rafael	SLAMS	NC	PE	Middle	41[c]	5.8	17	7	Medium	Only $PM_{2.5}$ monitor in Marin County Relatively low $PM_{2.5}$ concentrations
					San Pablo	SLAMS	NC	PE	Middle	96	**9.8**	22	13	High	Maximum annual DV site Located in overburdened community
					Concord	SLAMS	NC	PE, HC	Urban	11	5.7	18	8	Medium	Relatively low $PM_{2.5}$ concentrations; could be relocated
					San Francisco	SLAMS	NC	PE	Neighborhood	41	6.3[d]	17[d]	9	High	Only $PM_{2.5}$ monitor in SF County
					Berkeley	SPM	NC	PE, SO	Microscale	66	7.6[d]	17[d]	5	Medium	Near-road site
					Oakland – West	SLAMS	NC	PE, HC	Neighborhood	71	7.1	21	16	High	Collocation with related measurements Located in overburdened community
					Oakland - Laney	SLAMS	NC	PE, SO	Microscale	83	8.6	22	16	High	Near-road site; relatively high DV Located in overburdened community
					Oakland – East	SLAMS	NC	PE	Middle	70	6.9	18	6	High	Relatively low $PM_{2.5}$ concentrations Located in overburdened community
					Pleasanton	SPM	NC	PE, SO	Microscale	32	6.7	20	4	Low	Special Purpose Monitor Redundancy with nearby Livermore monitor
					Livermore	SLAMS	NC	PE, HC	Neighborhood	35	6.9[e]	19[e]	6	High	PAMS; collocation with related measurements
					Redwood City	SLAMS	NC	PE	Neighborhood	75	6.9	19	3	High	Only $PM_{2.5}$ monitor in San Mateo County Located in overburdened community
San Jose-Sunnyvale-Santa Clara	2,000,468	3	4[f]	0	San Jose – Jackson	SLAMS	NC	PE, HC	Neighborhood	55	**9.2**	25	27	High	NCore; Maximum 24-hour DV site
					San Jose - Knox	SLAMS	NC	PE, SO	Microscale	76	7.6[d]	24[d]	24	High	Near-road site; relatively high $PM_{2.5}$ concentrations Located in overburdened community
					Gilroy	SLAMS	NC	PE, RT	Neighborhood	56	5.3[d]	14[d]	0	Medium	Relatively low $PM_{2.5}$ concentrations

Monitoring objectives abbreviations:
NC – NAAQS Comparison

Site type abbreviations:
PE – Population Exposure
HC – Highest Concentration
SO – Source Oriented
RT – Regional Transport

(a) The design values shown are preliminary pending data certification for years 2023 and 2024.
(b) The Napa monitoring site went offline in May 2021. $PM_{2.5}$ monitoring will resume in Napa pending relocation of the former air monitoring site.
(c) Monitoring site is within 1000 feet of an area with CalEnviroScreen score > 70%
(d) Design value is invalid due to incomplete data.
(e) Data reflect combined data record for the former and current Livermore monitoring sites.
(f) One monitor (Hollister) is in the Monterey Bay Air Resources District.

Table A-3. Summary of PM_{10} monitoring requirements, locations and metadata for existing PM_{10} monitors, recent PM_{10} concentrations, and ratings assigned in this assessment.

MSA	MSA Population	Number of SLAMS			Monitoring Site	Monitor Type	Monitoring Objective(s)	Site type(s)	Spatial Scale	CalEnviro-Screen Score	Annual Average PM_{10}			Maximum 24-hr PM_{10} Concentration ($\mu g/m^3$)	Number of occurrences of 24-hr PM_{10} > 50 $\mu g/m^3$	Rating	Comment
		Required	Active	Additional Needed							2021	2022	2023	(2019-2023)	(2019-2023)		
Santa Rosa-Petaluma	488,863	0-1	3[a]	0	NA												
Napa	138,019	0-1	0[b]	0	Napa[b]	SLAMS	NC	PE	Neighborhood	NA	NA[b]	NA[b]	NA[b]	NA[b]	2[b]	Medium	
Vallejo	453,491	0-1	1[c]	0	NA												
San Francisco-Oakland-Berkeley	4,749,008	2-4	2	0	San Rafael	SLAMS	NC	PE	Middle	41[d]	13.6	12.6	11.8	41	1	Low	
					San Pablo	SLAMS	NC	PE	Middle	96	18.5	19.4	17.1	53	2	High	Overburdened community
					Concord	SPM	NC	PE	Urban	11	11.5	11.3	12.3	33	1	Low	
					San Francisco	SPM	NC	PE	Neighborhood	41	14.9	14.5	15.2	43	2	Medium	Could be relocated to BVHP
San Jose-Sunnyvale-Santa Clara	2,000,468	2-4	2[e]	0	San Jose – Jackson	SLAMS	NC	PE	Neighborhood	55	18.9	20.2	16.5	43	14	High	Required for NCore

Monitoring objectives abbreviations:
NC – NAAQS Comparison
PI – Public Information
R – Research

Site type abbreviations:
PE – Population Exposure
MC – Maximum Ozone Concentration
RT – Regional Transport

(a) These PM_{10} monitors are operated by the Northern Sonoma Air Pollution Control District.
(b) The Air District does not conduct PM_{10} monitoring in the Santa Rosa-Petaluma and Vallejo MSAs as PM_{10} monitoring is either not required or is fulfilled by neighboring air districts.
(c) A new monitoring site in the Napa CBSA is pending following the closing of the former Napa Valley College site. It is anticipated that the pending Napa site will include monitoring for PM_{10}.
(d) This PM_{10} monitor is in Vacaville, operated by the Yolo-Solano Air Quality Management District.
(e) Monitoring site is within 1000 feet of an area with CalEnviroScreen score > 70%.
(f) One of the two PM_{10} monitors is in Hollister, operated by the Monterey Bay Air Resources District.

Table A-4. Summary of CO monitoring requirements, locations and metadata for existing CO monitors, recent CO concentrations, and ratings assigned in this assessment.

CBSA	CBSA Population	Number of Near-Road CO Monitors			Monitoring Site	Monitor Type	Monitoring Objective(s)	Site type(s)	Spatial Scale	CalEnviroScreen Score	1-hr CO Design Value (2021-2022)	8-hr CO Design Value (2021-2022)	Rating	Comments
		Required	Active	Additional Needed										
Santa Rosa-Petaluma	488,863	0	0	0	Sebastopol	SLAMS	NC	PE	Neighborhood	26	0.9	0.7	Low	
Napa	138,019	0	0	0	Napa[a]	SLAMS	NC	PE	Neighborhood	NA	1.0	0.9	Low	
Vallejo	453,491	0	0	0	Vallejo	SLAMS	NC	PE	Neighborhood	84	2.0	1.6	Medium	Collocated at anchor site
San Francisco-Oakland-Berkeley	4,749,008	1	2	0	San Rafael	SLAMS	NC	PE	Middle	41[b]	1.3	0.8	Low	
					San Pablo	SLAMS	NC	PE	Middle	96	1.3	0.9	High	Highest site for annual $PM_{2.5}$
					Concord	SLAMS	NC	PE	Neighborhood	11	1.0	0.8	Low	
					Bethel Island	SLAMS	NC	RT	Urban	60	1.7	1.0	Low	
					San Francisco	SLAMS	NC	PE	Neighborhood	41	1.4	0.9	Low	
					Berkeley	SLAMS	NC	PE, SO	Microscale	66	1.2	0.9	Medium	Near-road monitoring site
					Oakland – West	SLAMS	NC	PE	Neighborhood	71	2.2	1.7	Medium	Collocated at anchor site
					Oakland - Laney	SLAMS	NC	PE, SO	Microscale	83	1.6	1.1	High	Near-road monitoring site
					Oakland – East	SLAMS	NC	PE	Middle	70	1.6	1.0	Low	
					Pleasanton	SPM	NC	PE, SO	Microscale	32	1.2	1.0	Low	
					Redwood City	SLAMS	NC	PE	Neighborhood	75	1.8	1.0	Low	
San Jose-Sunnyvale-Santa Clara	2,000,468	1	1	0	San Jose – Jackson	SLAMS	NC, R	PE	Neighborhood	55	1.7	1.3	High	NCore; collocated at anchor site
					San Jose – Knox	SLAMS	NC	PE, SO	Microscale	76	1.8	1.5	High	Near-road monitoring site

Monitoring objectives abbreviations:
NC – NAAQS Comparison
R – Research

Site type abbreviations:
PE – Population Exposure
SO – Source Oriented
RT – Regional Transport

(a) The Napa monitoring site went offline in May 2021. CO monitoring will resume in Napa pending relocation of the former air monitoring site.
(b) Site is within 1000 feet of an area with CalEnviroScreen score > 70%

Table A-5. Summary of NO_2 monitoring requirements, locations and metadata for existing NO_2 monitors, recent NO_2 concentrations, and ratings assigned in this assessment.

CBSA	CBSA Population	Maximum AADT	Near-road Monitors	Area-wide Monitors	Monitoring for RA-requirement	Monitoring Site	Monitor Type	Monitoring Objective(s)	Site type(s)	Spatial Scale	CalEnviro-Screen Score	Annual 98th Percentile Value	1-hour DV (ppb)	Maximum 1-hour	Rating	Comments

			Required	Active	Additional Needed	Required	Active	Additional Needed	Required	Active	Additional Needed							2021	2022	2023	2021-2023	Concentration (ppb) 2021-2023		
Santa Rosa-Petaluma	488,863	138,000	0	0	0	0	1	0	0	0	0	Sebastopol	SLAMS	NC	PE	Neighborhood	26	20.1	25.3	24.8	23	36.3	Medium	
Napa	138,019	135,000	0	0	0	0	0[a]	0	0	0	0	Napa	SLAMS	NC	PE	Neighborhood	NA	NA	NA	NA	NA	36.6	Medium	
Vallejo	453,491	232,000	0	0	0	0	1	0	0	0	0	Vallejo	SLAMS	NC	PE	Neighborhood	78	35.1	39.2	34.6	36[d]	52.5	High	Multi-pollutant anchor site
San Francisco-Oakland-Berkeley	4,749,008	293,000	2	2	0	1	6	0	1	1	0	San Rafael	SLAMS	NC	PE	Middle	41[c]	33.1	32.8	30.8	32	49.9	Medium	
												San Pablo	SLAMS	NC	PE	Middle	96	30.7	32.0	28.4	30	42.0	High	High site for annual $PM_{2.5}$
												Concord	SLAMS	NC	PE	Neighborhood	11	25.3	25.5	24.8	25	40.6	Low	
												Bethel Island	SLAMS	NC	RT	Urban	60	21.3	23.8	22.4	23	31.7	Low	
												San Francisco	SLAMS	NC	PE	Neighborhood	41	38.2	40.5	39.6	39	61.0	Medium	
												Berkeley	SLAMS	NC	PE, SO	Microscale	66	35.7	NA	39.1	37[d]	49.8	High	Required for near-road monitoring
												Oakland – West	SLAMS	NC	PE	Neighborhood	71	39.1	40.4	38.0	39	50.0	High	Multi-pollutant anchor site
												Oakland - Laney	SLAMS	NC	PE, SO	Microscale	83	39.8	43.0	35.9	40	58.3	High	Required for near-road monitoring
												Oakland – East	SLAMS	NC	PE	Middle	70	35.3	39.8	36.0	37	61.8	Medium	
												Pleasanton	SPM	NC	PE, SO	Microscale	32	35.8	34.5	NA[d]	NA[d]	63.7	Low	SPM
												San Ramon	SPM	R	PE	Neighborhood	0	26.2	32.0	27.5	29	64.5	Low	SPM
												Livermore	SLAMS	NC, R	PE	Neighborhood	35	32.7	34.1	30.3	32	47.5	High	PAMS, multi-pollutant anchor site
												Redwood City	SLAMS	NC	PE	Neighborhood	75	20.1	25.3	24.8	23	55.2	Medium	
San Jose-Sunnyvale-Santa Clara	2,000,468	264,000	2	1	1[b]	1	1	0	0	0	0	San Jose – Jackson	SLAMS	NC, R	PE	Neighborhood	55	39.2	43.6	43.9	42	59.8	High	NCore, required for area-wide monitoring, multi-pollutant anchor site
												San Jose – Knox	SLAMS	NC	PE, SO	Microscale	76	38.8	42.4	42.5	41	65.1	High	Required for near-road monitoring

Monitoring objectives abbreviations:
NC – NAAQS Comparison
R – Research

Site type abbreviations:
PE – Population Exposure
SO – Source Oriented
RT – Regional Transport

(a) The Napa monitoring site went offline in May 2021. NO_2 monitoring will resume in Napa pending relocation of the former air monitoring site.
(b) Recent increases in AADT indicate that a second near-road monitor may be needed in the San Jose-Sunnyvale-Santa Clara CBSA. The Air District will continue to track whether traffic counts are expected to remain consistently above the 250,000 AADT threshold.
(c) Site is within 1000 feet of an area with CalEnviroScreen score > 70%
(d) As of the time of writing, there were insufficient valid data for calculating a valid design value

Table A-6. Summary of SO_2 monitoring requirements, locations and metadata for existing SO_2 monitors, recent SO_2 concentrations, and ratings assigned in this assessment.

CBSA	2020 Census Population	SO_2 Emissions (tons/yr)[a]	PWEI (million-person-tons/year)	Number of SLAMS			Monitoring Site	Monitor Type	Monitoring Objective(s)	Site type(s)	Spatial Scale	CalEnviro-Screen Score	Annual 99th Percentile Value (ppb)			1-hr Design Value (ppb)	Maximum 1-hour Value (ppb)	Rating	Comments
				Required	Active	Additional Needed							2021	2022	2023	2021-2023	2019-2023		
Santa Rosa-Petaluma	488,863	16	8	0	0	0	NA[d]												
Napa	138,019	9	1	0	0	0	NA[d]												
Vallejo	453,491	101	46	0	1	0	Vallejo	SLAMS	NC	PE, SI	Neighborhood	78	3.8	4.9	3.2	4	10.9	Medium	Near refinery corridor; multi-pollutant site
San Francisco-Oakland-Berkeley	4,749,008	3,597	17,083	1[b]	6	0	Richmond-7th St.	SLAMS	NC	PE, SO	Neighborhood	71	11.3	8.0	6.5	9	44.5	High	Refinery community; re-evaluate pending Major Stationary Source Community Air Monitoring Program
							San Pablo	SLAMS	NC	PE, SO	Neighborhood	96	5.5	9.5	5.2	7	48.2	High	Refinery community; re-evaluate pending Major Stationary Source Community Air Monitoring Program
							Crockett	SPM	NC	PE, SO	Neighborhood	87	12.7	8.0	10.5	10	135.2	Medium	Refinery community; siting issues at this location
							Martinez	SLAMS	NC	PE, SO	Neighborhood	37	9.3	15.1	17.5	14	27.0	High	DRR monitor and refinery community; new monitoring pending under Major Stationary Source Community Air Monitoring Program
							Concord	SLAMS	NC	PE, SO	Neighborhood	11	6.1	6.2	4.5	6	13.2	Low	New monitoring pending under Major Stationary Source Community Air Monitoring Program
							Bethel Island	SLAMS	NC	RT	Urban	60	3.8	4.1	3.1	4	9.8	Low	Other monitors can represent background concentrations
							Oakland – West	SLAMS	NC	PE	Neighborhood	71	3.1	5.0	1.8	3	19.2	Medium	Near port/shipping-related emissions; multi-pollutant anchor site
San Jose-Sunnyvale-Santa Clara	2,000,468	370	740	1[c]	1	0	San Jose – Jackson	SLAMS	NC, R	PE	Neighborhood	55	1.5	1.5	1.7	2	35.7	High	Required for NCore; can represent urban background concentrations

Monitoring objectives abbreviations:
NC – NAAQS Comparison
R – Research

Site type abbreviations:
PE – Population Exposure
SI – Source Impact
SO – Source Oriented
RT – Regional Transport

(a) Based on data from the 2020 National Emissions Inventory.
(b) There is a requirement for one SO_2 monitor both from the PWEI and from the final SO_2 DRR. These requirements can be met by the same monitor, so the requirement is stated as one monitor. However, the Air District intends to continue operating more SO_2 monitors than are required to characterize the effects of sources in this CBSA.
(c) A trace-level SO_2 monitor is required at the San Jose – Jackson site as part of the NCore program (40 CFR Part 58 Appendix D, § 4.4.5). There are no monitoring requirements based on the PWEI for the San Jose-Sunnyvale-Santa Clara CBSA.
(d) The Air District does not conduct SO_2 monitoring in the Santa Rosa-Petaluma and Napa CBSAs as SO_2 emissions are comparatively low in those CBSAs and SO_2 monitoring is not required.