Assessment of Potential Peak PM2.5 Values Southeast of Fresno

Release Date: July 2022

For questions, contact:

Laura Carr
Air Pollution Specialist
Central Valley Air Quality Planning Section
California Air Resources Board
Phone: (916) 282-6251
Email: *laura.carr@arb.ca.gov*

OR

Ali Adams
Manager
Central Valley Air Quality Planning Section
California Air Resources Board
Phone: (916) 323-0668
Email: *alicia.adams@arb.ca.gov*

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Executive Summary

This report summarizes analysis by California Air Resources Board (CARB) staff regarding potential peak fine particulate matter (PM2.5) levels in an unmonitored area southeast of Fresno. CARB modeling conducted for the *2018 Plan for the 1997, 2006, and 2012 PM2.5 Standards* (2018 PM2.5 SIP) for the San Joaquin Valley (Valley) showed an area with estimated future PM2.5 values exceeding the National Ambient Air Quality Standard (NAAQS or standard). CARB deployed air quality monitors in the region in the winter of 2018-2019 to collect PM2.5 data to assess whether the modeled peak was an observable high PM2.5 level. Based on analysis of measured daily PM2.5, CARB staff concluded that the data do not show that the area southeast of Fresno experiences higher PM2.5 levels than urban Fresno under the current regime of meteorological conditions and emissions levels.

Unmonitored Area Southeast of Fresno

CARB, local air districts, and other agencies maintain an extensive network of air monitoring stations across California. There are 38 air monitoring sites in the San Joaquin Valley, ten of which are in Fresno County, measuring particulate matter, ozone, and toxics, among other pollutants. The network provides dense coverage of the region far exceeding minimum federal requirements, but there are still some areas that are not near an existing monitor. For a region to attain an air quality standard, all portions of the region must meet the standard, including those areas outside the spatial extent of the existing monitoring network. Air quality computer modeling is used as part of developing a State Implementation Plan (SIP), and model-simulated peaks that are not represented in the air quality network data may arise either legitimately or as an artifact of the modeling process. U.S. Environmental Protection Agency (U.S. EPA) modeling guidance[1] recommends conducting an unmonitored area analysis as part of developing a SIP. This analysis helps to confirm that a region's monitoring network fully captures peak values of air quality within the region by ensuring that there are no areas outside of the existing network that could exceed the air quality standard (i.e., if a monitor were present at a model-simulated peak location).

As part of the 2018 PM2.5 SIP for the Valley, CARB conducted an unmonitored area analysis for PM2.5 in accordance with U.S. EPA guidance.[2] The analysis identified a region to the

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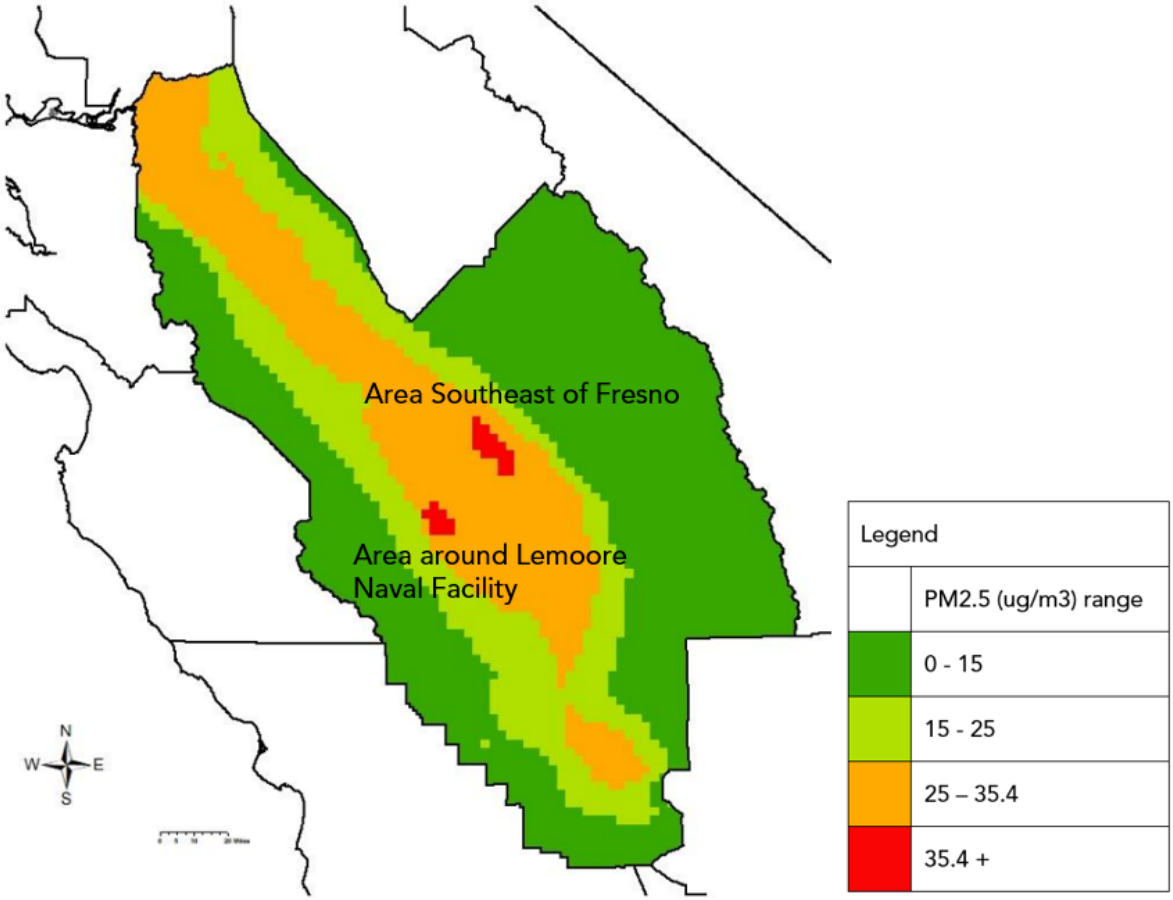
[1] U.S. EPA, 2014, *Draft Modeling Guidance for Demonstrating Attainment of Air Quality Goals for Ozone, PM2.5 and Regional Haze*. *https://www.epa.gov/sites/default/files/2020-10/documents/draft-o3-pm-rh-modeling_guidance-2014.pdf*

[2] For complete discussion of methodology, see: San Joaquin Valley Air Pollution Control District, 2018, *2018 Plan for the 1997, 2006, and 2012 PM2.5 Standards*, Appendix K, Section 5.7. *http://www.valleyair.org/pmplans/documents/2018/pm-plan-adopted/K.pdf*

southeast of Fresno where the air quality model predicted estimated design values[3] above the 2006 24-hour standard of 35 micrograms per cubic meter (µg/m^3) in 2024.

Figure 1 shows the spatial distribution of projected 24-hour PM2.5 design values in the Valley in 2024. Design values not greater than 35.4 µg/m^3 are considered attainment for the 35 µg/m^3 24-hour PM2.5 standard. Projected, model-simulated 2024 24-hour PM2.5 levels within the Valley do not exceed 35.4 µg/m^3 except for a few grid cells located to the southeast of the Fresno metropolitan area as well as a few grid cells surrounding the Naval Air Station Lemoore where elevated concentrations are due to localized emissions associated with military operations.

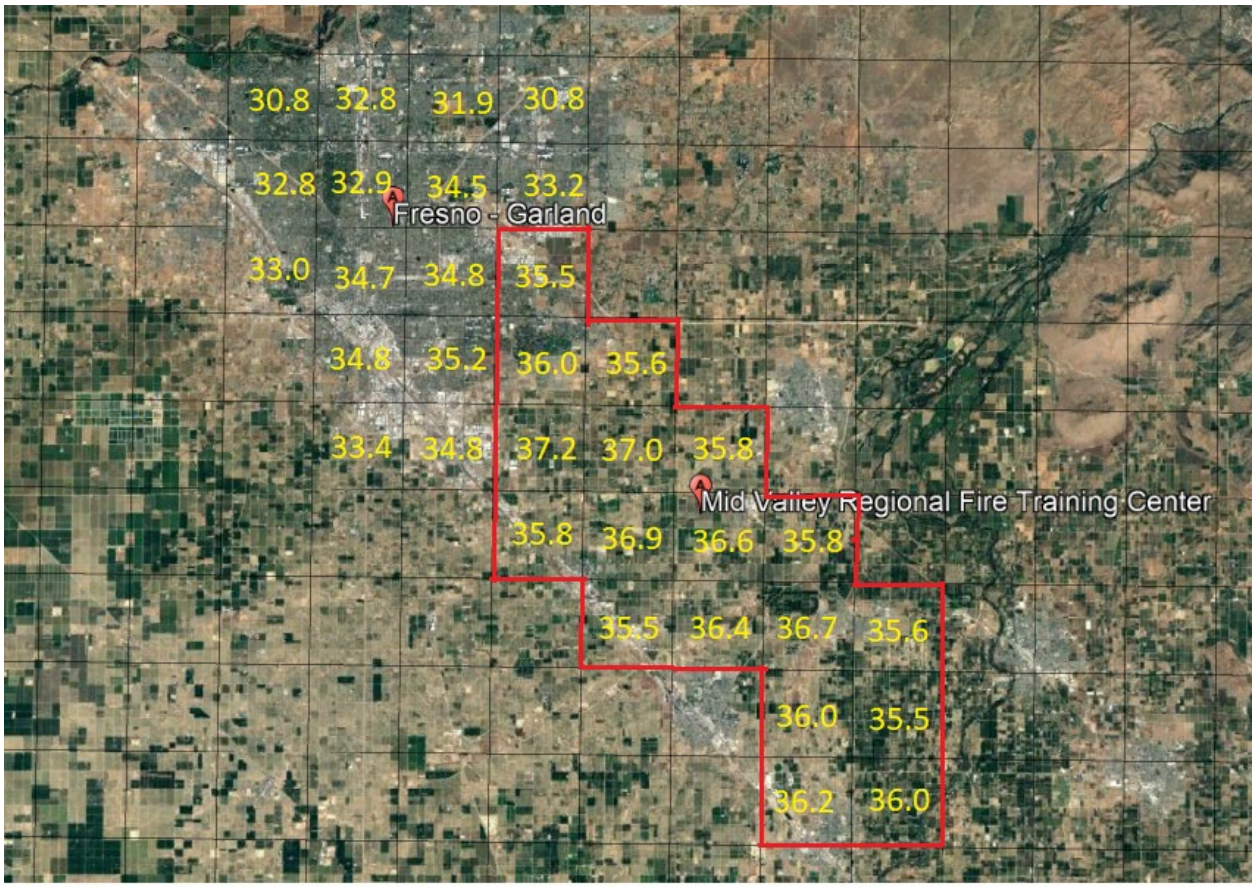
Figure 1. Modeled 24-hour PM2.5 design value (µg/m^3) in 2024



[3] A design value is a statistic that describes the air quality status of a given location relative to the level of the air quality standard. A 24-hour PM2.5 design value represents a three-year average of the 98th percentile of measured PM2.5 concentrations. Depending on a site's 24-hour PM2.5 data collection schedule, the 98th percentile usually corresponds to a value between the 2nd and the 8th highest value. If the design value is equal to or below the NAAQS, in this case 35.4 µg/m^3, the site attains the standard.

Figure 2 shows a zoomed-in view of the area southeast of Fresno. The area within the red line in Figure 2 is the same as the solid red area near Fresno in Figure 1. Each grid square represents a 4-kilometer-by-4-kilometer area. The number in each square is the projected 24-hour PM2.5 design value in 2024. The metropolitan area of Fresno has projected future PM2.5 values ranging from 30.8 µg/m^3 to 35.2 µg/m^3, which are all within attainment of the 24-hour PM2.5 standard. In the rural area southeast of Fresno (area within the red line), projected future PM2.5 levels are higher, ranging from 35.5 µg/m^3 to 37.2 µg/m^3, and over the 24-hour PM2.5 standard. Figure 2 also shows the location of CARB's established monitoring site at Fresno-Garland (Garland) and the temporary monitoring site at Mid Valley Regional Fire Training Center chosen for this analysis to represent the unmonitored area.

Figure 2. Projected 2024 24-hour PM2.5 design values in the Fresno region showing the metropolitan Fresno area and the unmonitored area to the southeast.



Analysis

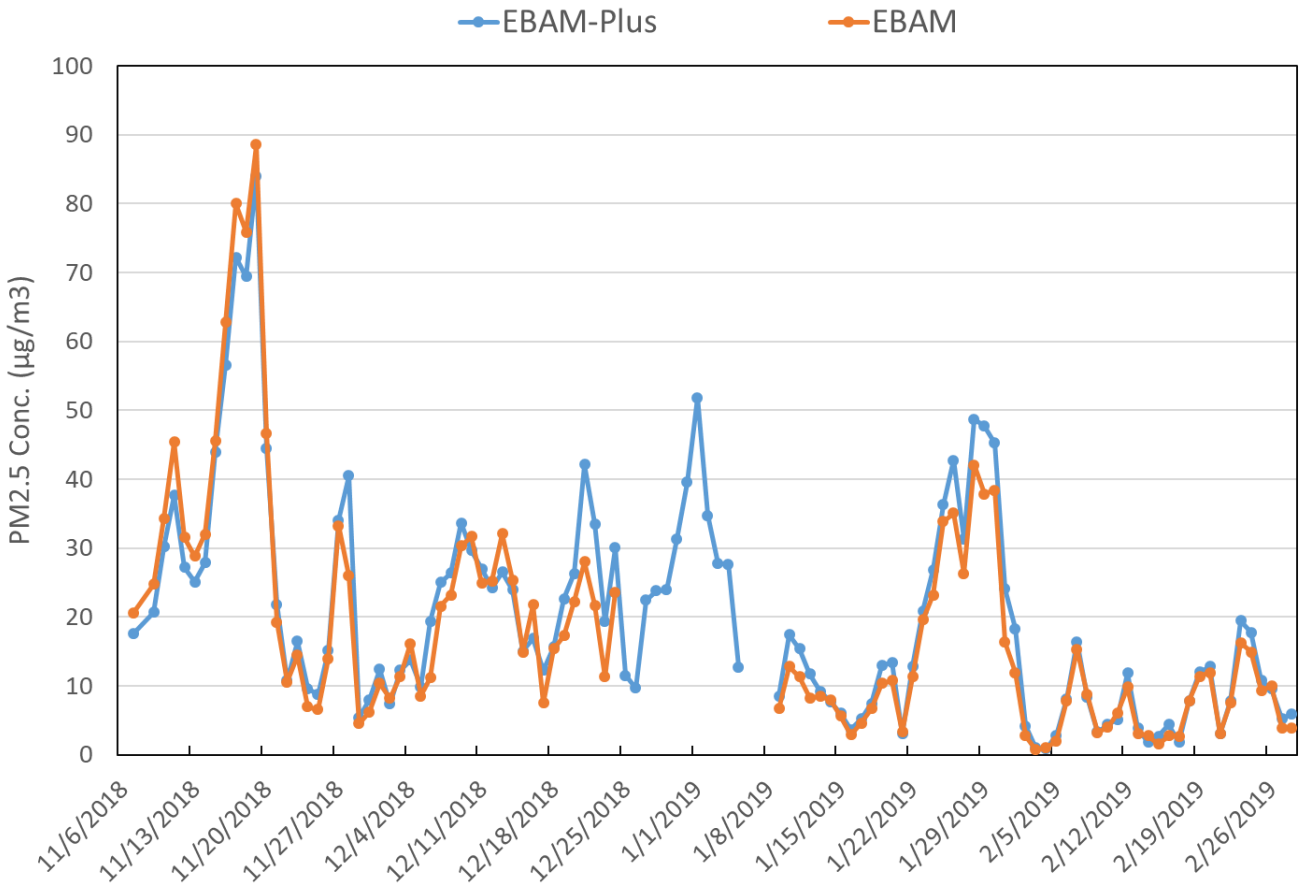
Data Collected with Temporary Monitors

To assess whether the area identified in the unmonitored area analysis represents a true unmonitored peak or whether the values were an artifact of the modeling process, CARB temporarily installed three monitors to measure PM2.5 levels. CARB operated the monitors during the winter from November 2018 through February 2019 to ensure the monitoring period covered the months when 24-hour PM2.5 levels are usually at their highest in the Valley. One monitor was temporarily installed at CARB's established Fresno air monitoring site (Garland) and two monitors were temporarily installed at the Mid Valley Regional Fire Training Center (Fire Station). The Fire Station monitoring site is located near Del Rey, approximately 16 miles southeast of Garland. The location was selected as a monitoring site for this analysis because it is approximately in the center of the region identified in CARB's unmonitored area analysis for the 2018 PM2.5 SIP (see Figure 2 above). In addition, the location satisfied practical requirements for successful monitoring such as security and access to a reliable power source.

The two types of monitors deployed were EBAM and EBAM Plus. Both are beta attenuation method (BAM) monitors—portable, real-time instruments which measure air quality continuously. These types of monitors are similar to U.S. EPA-designated monitors for PM2.5 which may be used to provide data for comparison to national air quality standards. They are well-suited to this type of study because they are self-contained in an environmentally sealed aluminum enclosure which is placed on a tripod, meaning the system can be placed in a variety of locations. While EBAMs are not robust enough for long-term monitoring, they are easy to deploy for shorter duration PM2.5 monitoring because they do not require extensive infrastructure to operate (e.g., a temperature-controlled environment). CARB deployed an EBAM at Garland and both an EBAM and an EBAM Plus at Fire Station. The monitors provided high-resolution hourly data which CARB staff reviewed, verified, and validated.

The EBAM instrument at Fire Station was non-operational from December 25, 2018, to January 8, 2019; however, the EBAM Plus which was collocated at the same site continued to gather data during that period except for January 6-8, 2019. To retain as complete a dataset as possible from the Fire Station site, CARB substituted EBAM Plus data for the days for which EBAM data were unavailable during that time. This data substitution is appropriate since, as shown in Figure 3, measurements taken by the EBAM Plus were in general consistent with those taken by the EBAM over the duration of the project. Furthermore, the substitution is likely conservative since the EBAM Plus in general measured slightly higher than the EBAM except for at the beginning of the study period. The combined dataset for Fire Station using data from both the EBAM and EBAM Plus monitors enabled CARB to obtain a more complete picture of PM2.5 levels in the unmonitored area southeast of Fresno over the project period. Data from the EBAM at Garland were complete so no data substitution was necessary for that site.

Figure 3. Daily PM2.5 concentrations measured by EBAM and EBAM Plus instruments at Fire Station.



Major wildfires, including the Camp Fire in Butte County and Alder and Mountaineer fires in Sequoia National Park, had a significant impact on air quality in the Valley during November 9-20, 2018; therefore, those days were excluded from this analysis. Wildfire impacts were not part of the original unmonitored area analysis so excluding them here is appropriate. Even if data impacted by wildfires were included, the finding would remain the same.

After substituting EBAM Plus data for missing EBAM data at Fire Station, excluding twelve days with data impacted by wildfires, and excluding three days with incomplete data (i.e., days with less than 75 percent of hourly values), a total of 103 sample days with complete daily measurements were available for analysis.

Comparison of Data from Garland and Fire Station

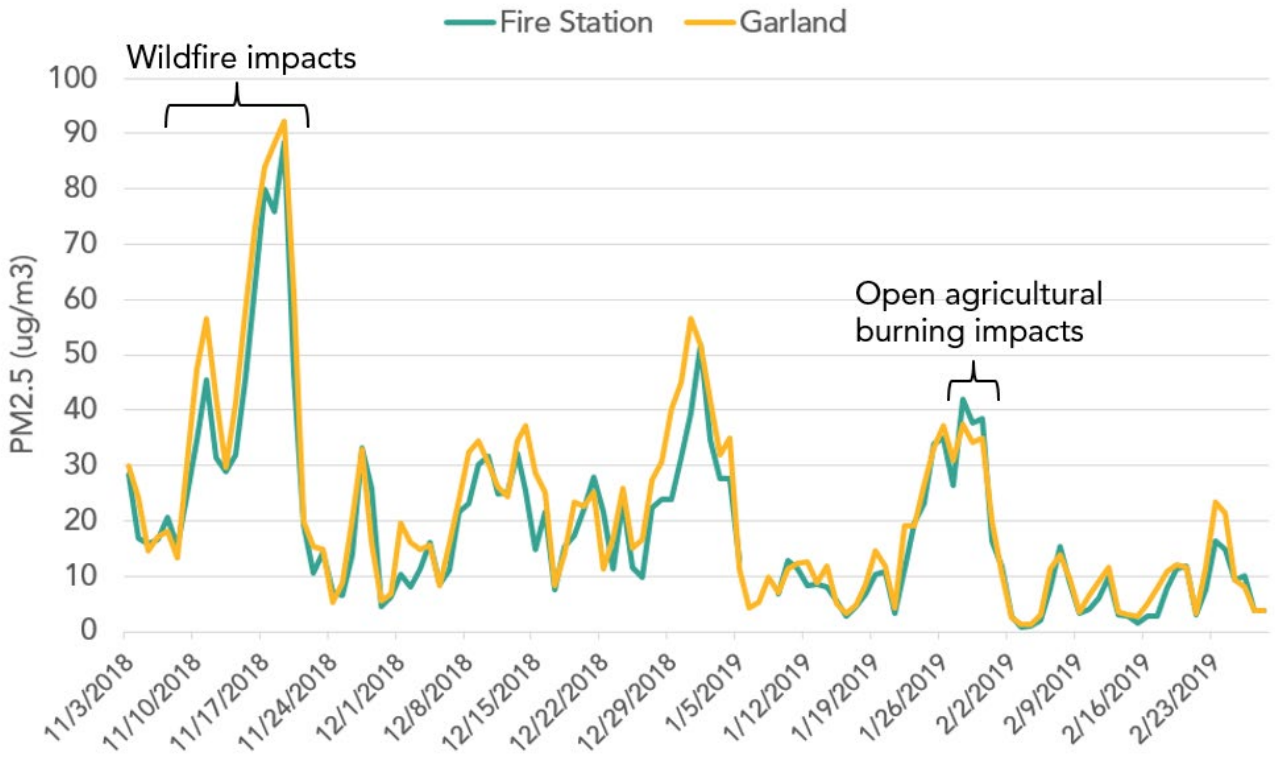
To evaluate whether the area southeast of Fresno has PM2.5 levels higher than those in urban Fresno, CARB compared 24-hour PM2.5 concentrations measured at Garland and Fire Station. First, data from the two sites were compared on average over the whole study

period. Then further analysis focused on comparing the days with the highest measured PM2.5 levels.

Garland has Higher PM2.5 on Average

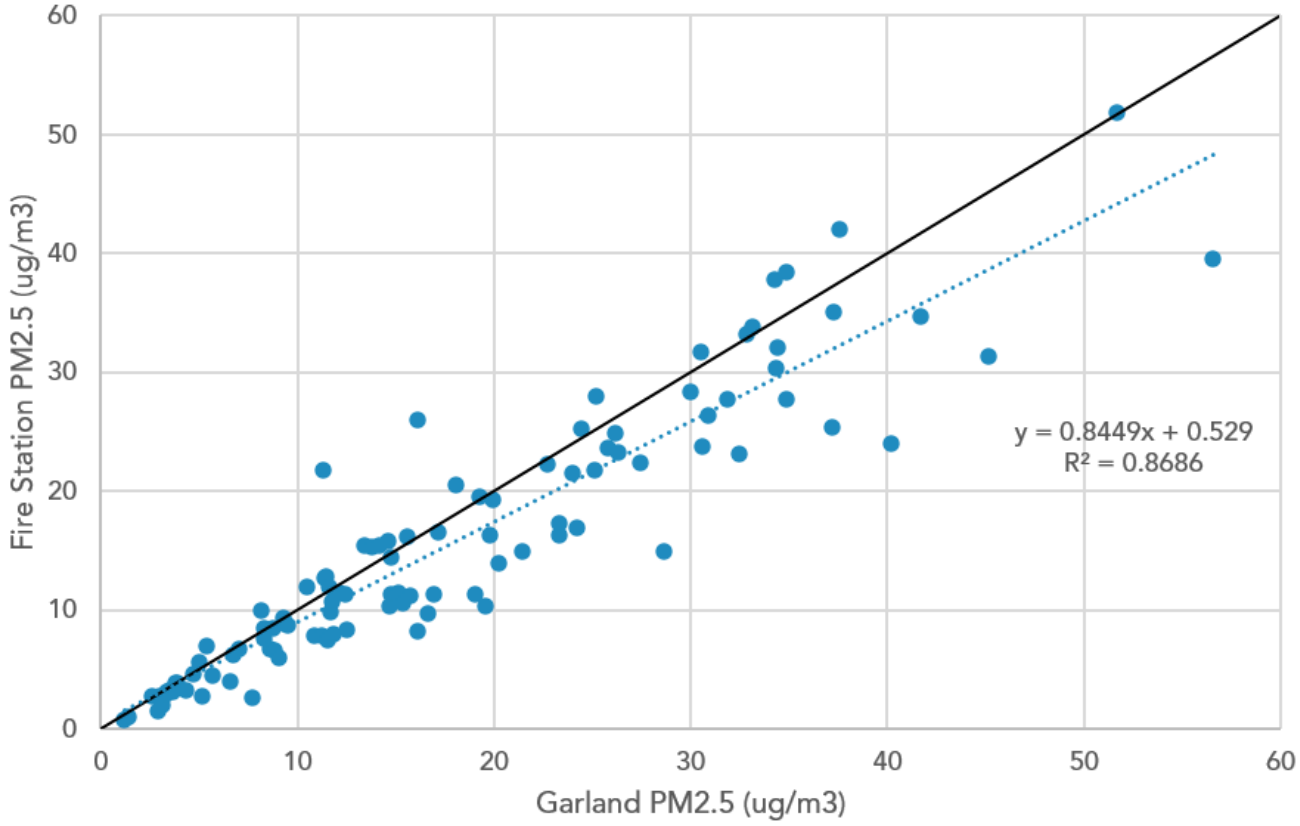
PM2.5 levels measured at Garland and Fire Station were similar and tracked well with each other during the four months of the study period, as illustrated in Figure 4. However, Garland generally recorded values slightly higher than Fire Station. Garland had higher PM2.5 levels than Fire Station on 73 days, or 71 percent of the days analyzed in the study period. On the days on which Garland was higher than Fire Station, on average, Garland measured 3.9 µg/m^3 higher. Fire Station had higher PM2.5 levels than Garland on 30 days, or 29 percent of the period. On the days on which Fire Station was higher than Garland, the difference between the two sites was smaller—1.9 µg/m^3 on average. The higher concentrations at Fire Station measured on January 28-30, 2019, are likely due to open burning of agricultural material observed within ¼ mile of the monitor.

Figure 4. Daily PM2.5 concentrations measured at Fire Station and Garland from November 2018 through February 2019.



The good correlation between the sites and the fact that Garland consistently measured higher PM2.5 levels than Fire Station can also be seen when Garland and Fire Station data are plotted against each other (Figure 5). An R^2 value of 0.87 indicates a high level of correlation in the data collected at the two sites. A slope of 0.84 in the line fitting the data indicates that Garland tended to measure higher PM2.5 levels than Fire Station. The black line shown has a slope of 1—which would indicate two sites measuring exactly the same PM2.5 levels—for comparison.

Figure 5. PM2.5 concentrations measured at Garland versus Fire Station.



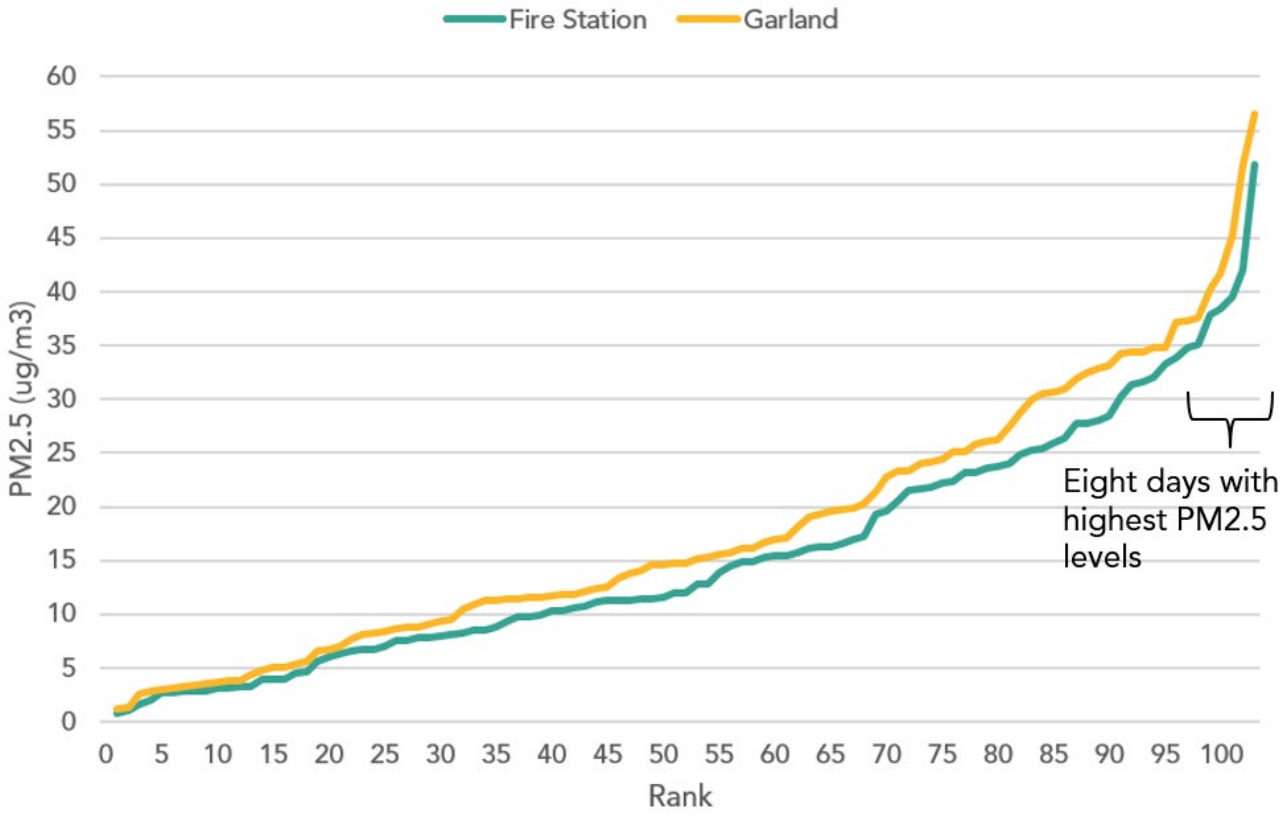
Garland has Higher PM2.5 on Peak Days

CARB also more closely examined the days with the highest PM2.5 levels. Attainment of the 24-hour PM2.5 standard is determined based on the 98th percentile 24-hour PM2.5 concentration for the year, which is represented by the eighth highest value, assuming 365 days' worth of data are collected. CARB ranked the 103 days by highest to lowest PM2.5 levels at each site and compared the top eight days.[4] Fire Station's eight highest days ranged from 51.9 µg/m^3 to 33.8 µg/m^3 and Garland's eight highest days ranged from 56.6 µg/m^3 to

[4] These top eight days would likely remain the same even if the measurements were extended to cover an entire year since PM2.5 concentrations in the Valley are generally highest in the winter.

37.2 µg/m^3. Figure 6 graphically compares the ranked data, with the eight highest days from each site bracketed on the far right of the graph, and shows that Garland's peak PM2.5 values are consistently higher than those at Fire Station. In fact, this relationship holds true beyond those top eight highest days and is consistent across all the ranked data.

Figure 6. Ranked PM2.5 concentrations at Fire Station and Garland.



Figures 4 and 5 showed that in general 24-hour PM2.5 concentrations at Fire Station are lower than those at Garland; Figure 6 further reinforces that this is the case when 24-hour PM2.5 concentrations are at their highest. These results indicate that the unmonitored peak shown in the modeling conducted for the unmonitored area analysis in the 2018 PM2.5 SIP is not present under current meteorological conditions and emissions levels. The unmonitored area analysis for the 2018 PM2.5 SIP estimated PM2.5 levels in regions outside the existing monitoring network, based on 2013 meteorological conditions and future emission projections for 2024. Given the difference in meteorology between the modeling and observations (2013 versus 2018/19) as well as the emissions inventory (projected 2024 versus actual 2018/19) and complicating factors such as 4-square kilometer averaging in the modeling versus point measurements in the observations, differences arising between observations and modeling for the 2018 PM2.5 SIP are not surprising.

Conclusion

Monitoring conducted by CARB over the winter of 2018-2019 does not show that the area southeast of Fresno experiences higher PM2.5 levels than the regulatory monitoring site at Garland. Analysis of overall average and peak PM2.5 concentrations show that PM2.5 levels are roughly the same in urban Fresno and the area to the southeast, with Garland generally recording values slightly higher than Fire Station.

Since the observations do not indicate an unmonitored peak, CARB does not recommend further measurements at the Fire Station site. CARB will continue to revisit and update the unmonitored area analysis as a routine part of future PM2.5 SIP development efforts for the San Joaquin Valley under different meteorological conditions and with an updated emissions inventory. If future modeling identifies another unmonitored peak, CARB will consider a similar short-term deployment of monitors to verify the modeled peak concentrations.