Staff Report

# Update to the San Joaquin Valley PM10 Maintenance Plan

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APPENDICES

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# EXECUTIVE SUMMARY

In 2003, the San Joaquin Valley Air Pollution Control District (District) developed a State Implementation Plan (SIP) to demonstrate attainment of the federal PM10 standard (2003 PM10 Plan). The U.S. Environmental Protection Agency (U.S. EPA) approved the SIP in June 2004.

Due to the implantation of the 2003 PM10 Plan, the San Joaquin Valley attained the PM10 standard and, in 2007, the District prepared a Maintenance Plan for the PM10 standard (2007 Maintenance Plan). The 2007 Maintenance Plan included the following contingency provisions in the event of an exceedance of the federal PM10 standard:

1. Examine each event to determine if the event is a natural or exceptional event;
2. If the event does not quality as a natural or exceptional event, examine possible causes to determine if emission reductions from adopted rules or commitments in adopted or approved plans that were not part of the maintenance demonstration would address the violation; and
3. If reductions from adopted rules or commitments are insufficient, identify new control measures to mitigate the PM10 exceedance.

In 2008, U.S. EPA approved the 2007 Maintenance Plan and designated the San Joaquin Valley as attainment of the federal 24-PM10 standard of 150 $\mu g/m^3$. In 2013 and 2014, PM10 monitors in the San Joaquin Valley recorded a number of days with levels exceeding 150 $\mu g/m^3$. To date, no exceedances have been recorded in 2015 or 2016.

As part of a process to update the 2007 Maintenance Plan's transportation conformity budgets, the California Air Resources Board (CARB) committed to provided U.S. EPA with documentation on the nature and causes of the PM10 exceedances that occurred in 2013 and 2014 in a SIP revision. This document fulfills that commitment. CARB staff assessed available information for each exceedance as to the nature of the event; specifically,

- Evaluate PM10 filter-based and continuous data across the Valley to understand the local or regional nature of each exceedance;
- Analyze PM2.5 data to determine whether fine or coarse particles are contributing to the exceedance;
- Analyze available chemical speciation data, including additional filter speciation analysis as appropriate to assess potential source types contributing to each exceedance; and
- Analyze wind speed and direction, along with geographic visualization tools to help identify the types of sources impacting each monitor.

The next section provides CARB's assessment for each exceedance in Table 1. Further, based on the nature of each exceedance, CARB identified the appropriate contingency mechanism as outlined in the Maintenance Plan.

**Table 1. San Joaquin Valley PM10 Exceedances (2013-2014)**

| | | Value |
|---|---|---|
| 10/3/2013 | Corcoran TEOM | 224 |
| 11/14/2013 | Corcoran TEOM | 163 |
| 12/17/2013 | Corcoran TEOM | 165 |
| 12/18/2013 | Corcoran TEOM | 184 |
| 12/18/2013 | Hanford FRM | 177 |
| 12/18/2013 | Hanford TEOM | 174 |
| 12/18/2013 | Visalia FRM | 155 |
| 1/21/2014 | Bakersfield-CA BAM | 159 |
| 1/22/2014 | Corcoran TEOM | 156 |
| 1/23/2014 | Bakersfield-CA BAM | 260 |
| 1/23/2014 | Oildale FRM | 334 |
| 6/2/2014 | Bakersfield-CA BAM | 172 |
| 6/10/2014 | Oildale FRM | 311 |
| 6/11/2014 | Bakersfield-CA BAM | 178 |
| 10/14/2014 | Corcoran TEOM | 180 |
| 10/14/2014 | Bakersfield-CA FRM (POC 1) | 419 |
| 10/14/2014 | Bakersfield-CA FRM (POC 2) | 430 |
| 10/14/2014 | Oildale FRM | 336 |
| 12/11/2014 | Corcoran TEOM | 202 |

# ANALYSIS OF THE 2013 AND 2014 SAN JOAQUIN VALLEY PM10 EXCEEDANCES

## October 3, 2013

Corcoran PM10 TEOM monitor- 224 μg/$m^3$

The PM10 exceedance was likely driven by high winds and blowing dust. This was a one-day episode that began around 06 Pacific Standard Time (PST), peaked around 10 to 12 PST, and was over by late evening. All sites in the San Joaquin Valley (SJV or Valley) were impacted, although only the monitor at Corcoran exceeded the federal PM10 standard. The District flagged this exceedance as a high wind event.

A surface low pressure system and accompanying trough moved into California from the Pacific, bringing gusty winds to the San Joaquin Valley, southern Sacramento Valley, and the Mojave Desert. The National Weather Service (NWS) issued a wind advisory active until early October 4 for the southeastern Kern County Desert and a blowing dust advisory extending to October 5 for the Kern County Mountains to the south of Kings County. The District issued a health precautionary statement for the entire District, warning of blowing dust as the result of gusty winds.

- **Evaluation of PM10 filter-based and continuous data across the Valley to understand the local or regional nature of each exceedance.**

Concentration increases at all continuous monitors within SJV occurred at the same approximate time in a similar manner. This was not a scheduled filter sampling day.

Figure 1 displays the PM10 filter and hourly data for SJV sites between September 26 and October 10. The PM10 concentrations on October 3 increased throughout the Valley with Corcoran being the only site that exceeded the federal PM10 standard. The nearest PM10 sites to Corcoran (Hanford and Visalia) did not record PM10 data in standard conditions on October 3. Visalia was not scheduled to collect data at all, but Hanford collected continuous hourly data in local conditions, with a 24-hour average of 195 μg/$m^3$. Since hourly PM10 data for Hanford was available in local conditions this data was used to show a more complete diurnal trend at Hanford.

**Figure 1. Daily Regional PM10 Data – September 26 to October 10, 2013**

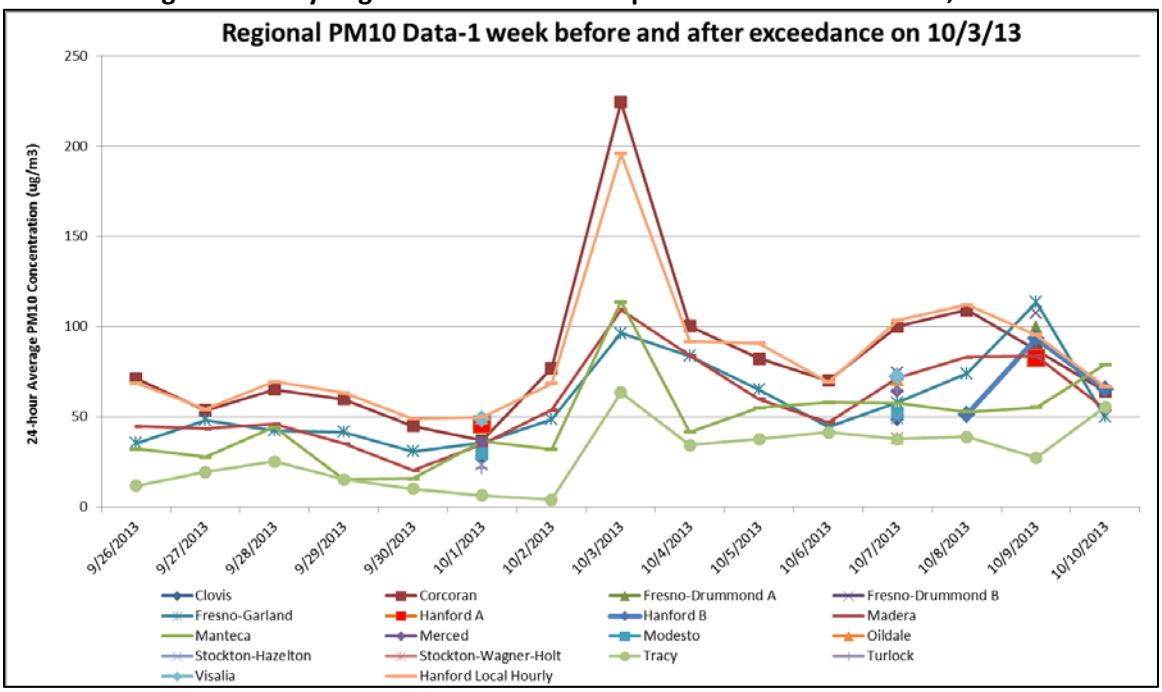
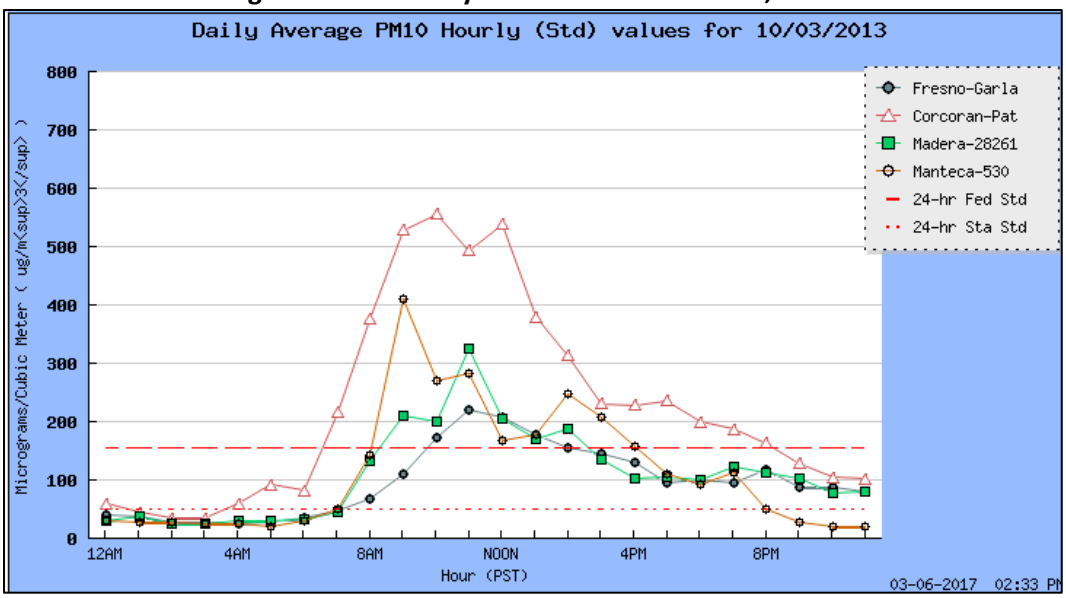



Figure 2 displays the PM10 hourly data from SJV continuous monitors on October 3. The Corcoran site recorded hourly values above the federal 24-hour average PM10 standard of 150 µg/m$^3$ from 07 PST through 21 PST. Other continuous PM10 monitors also showed increased PM10 concentrations but not to the degree seen at the Corcoran site.

**Figure 2. SJV Hourly PM10 Data – October 3, 2013**



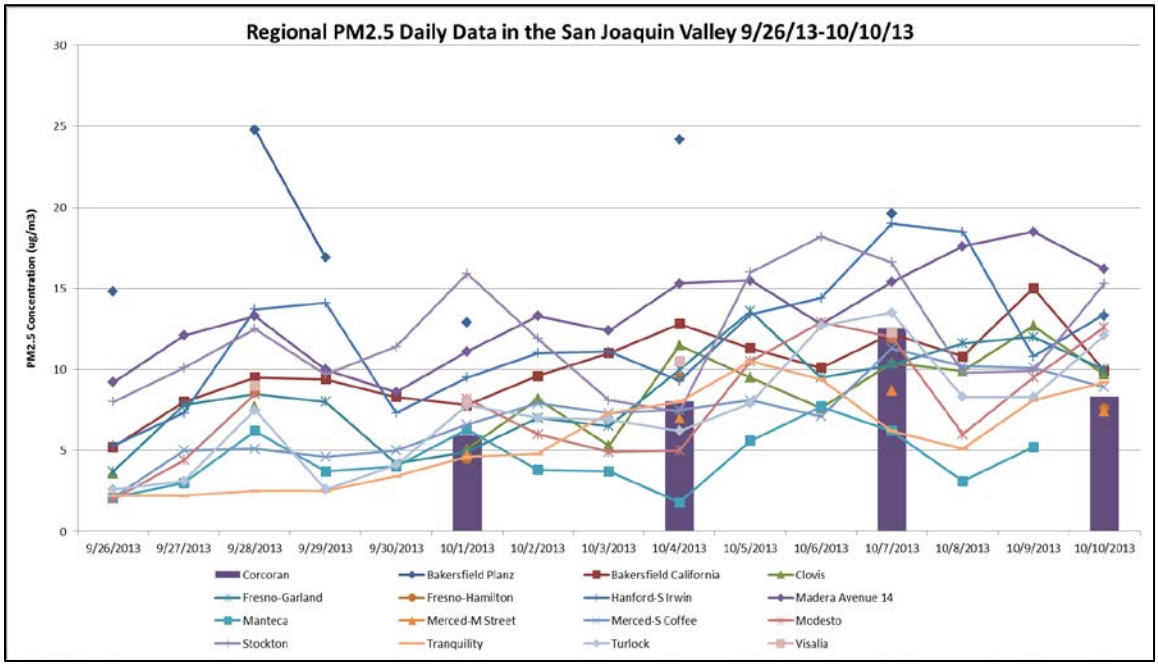

Several PM10 monitors in the State recorded elevated concentrations above the State standard of 50 µg/m$^3$. The majority of these monitors were in the southern portion of the State, primarily in SJV, Great Basin Unified, Mojave Desert, and San Luis Obispo Air Districts. In the San Joaquin Valley, all

continuous monitors exceeded the State standard, but only Corcoran exceeded the federal standard. The NOAA Storm Events Database recorded two events for California; a strong wind event in the Sacramento Metropolitan area and a dust storm in the Owens Valley north of Bishop, which resulted in a PM10 24-hour concentration of 274 μg/m$^3$.

- **Analysis of PM2.5 data to determine whether fine or coarse particles are contributing to the exceedance.**

Figure 3 displays the PM2.5 filter data for SJV sites between September 26 and October 10. The PM2.5 concentrations at the various SJV sites on October 3 do not follow the same pattern as shown in the PM10 chart above. The highest PM2.5 concentration in SJV on October 3 was 12.4 μg/m$^3$ at Madera.

**Figure 3. Daily Regional PM2.5 Data – September 26 to October 10, 2013**




Corcoran does not have a continuous PM2.5 monitor so only PM2.5 data from the filter monitor could be used for comparison to PM10 data on matching days (Figure 4). Since October 3 was not a scheduled filter sampling day, no PM2.5 data was available but data before and after were examined (no data was available for Corcoran on September 28). The comparison between PM2.5 and PM10 at Hanford is also provided below (Figure 5) since this is the closest monitor to Corcoran. These charts show that PM2.5 concentrations were slightly elevated after September 25, PM10 concentrations rose significantly, indicating that coarse particles were a significant portion of PM10 levels. The District's analysis compared PM concentrations at the two monitors. The Corcoran PM10 (223.8 μg/m$^3$) and Hanford PM2.5 (11.2 μg/m$^3$) concentrations on October 3 indicated that approximately 95 percent of the sample was comprised of coarse particulate, while 5 percent was comprised of fine particulate.

**Figure 4. Comparison of PM2.5 and PM10 at Corcoran – September 25 to October 10, 2013**

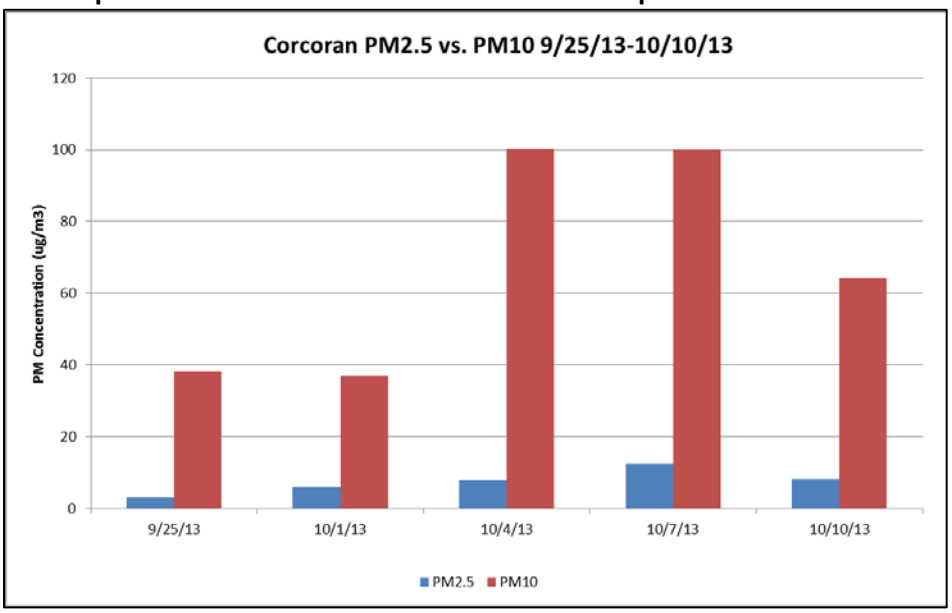
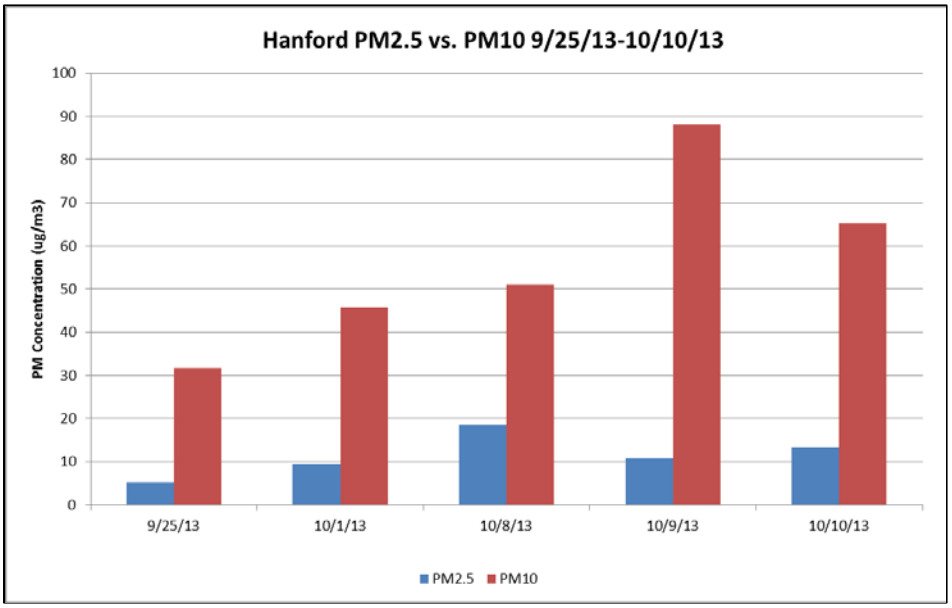



**Figure 5. Comparison of PM2.5 and PM10 at Hanford – September 25 to October 10, 2013**



- **Analysis of available chemical speciation data including additional filter speciation analysis as appropriate to assess potential source types contributing to each exceedance.**

No PM2.5 or PM10 speciation analysis was available for October 3. However, PM2.5 speciation was recorded at Visalia, approximately 20 miles to the northeast, before and after the PM10 exceedance at Corcoran (Table 2). The data shows that PM2.5 species were elevated after October 3 but since the next available data was four days after the PM10 exceedance at Corcoran, a conclusion about speciation on this day could not be made.

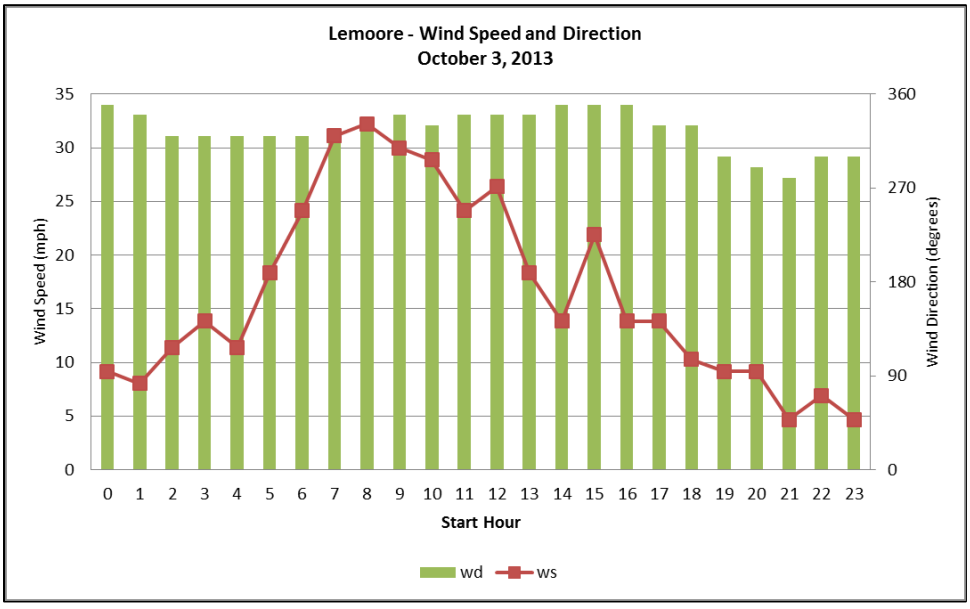
**Table 2. PM2.5 Speciation Data (µg/m$^3$) at Visalia – October 1 to October 7, 2013**

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Visalia | 10/1/13 | 7.7 | 3.4314 | 1.6422 | 2.94 | 0.5 | 1.93116 | 0.47 |
| Visalia | 10/7/13 | 12.9 | 4.2183 | 1.4628 | 4.76 | 0.8 | 3.70614 | 0.4075 |

- **Analysis of wind speed and direction, along with geographic visualization tools to help identify the types of sources impacting each monitor.**

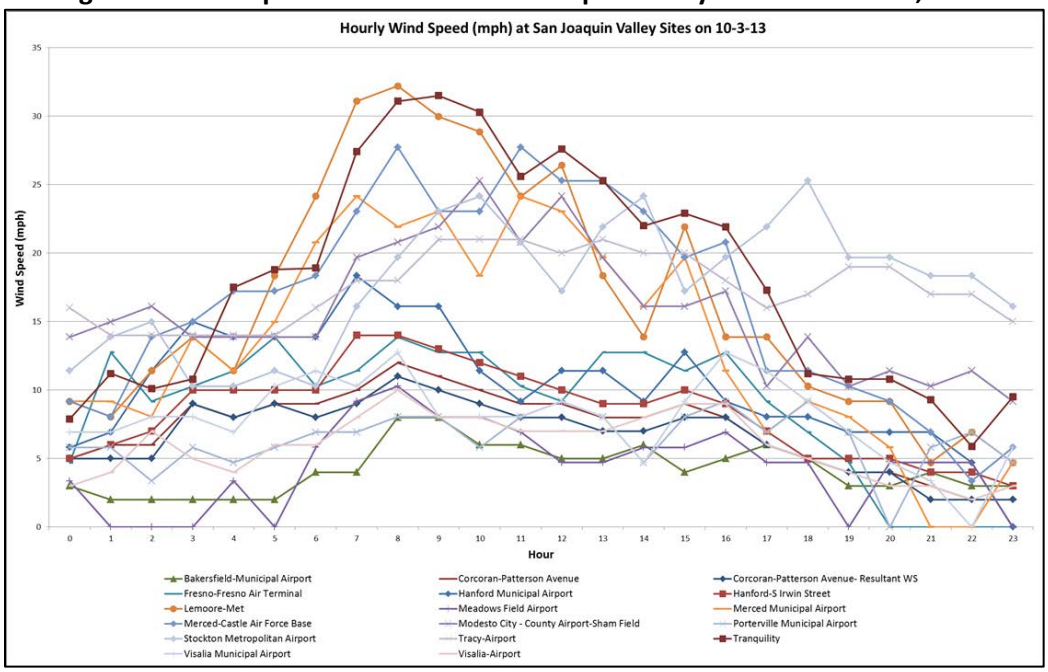
Although the monitoring site at Corcoran reported maximum winds of only 11 mph, the station at Lemoore Naval Air Station, just 20 miles to the north, recorded sustained wind speeds above 25 mph. These high winds began in mid-morning and continued for several hours. Wind speeds of 32 mph were measured during the 08 PST hour, when concentrations at Corcoran were increasing. Wind directions indicated that surface airflow was from the north throughout this period (Figure 6).

**Figure 6. Wind Speed and Direction at Lemoore Naval Air Station – October 3, 2013**




The following chart (Figure 7) shows the hourly wind speed data on October 3 at each site in Kings County as well as selected airport sites in the region.

**Figure 7. Wind Speeds at Selected San Joaquin Valley Sites– October 3, 2013**



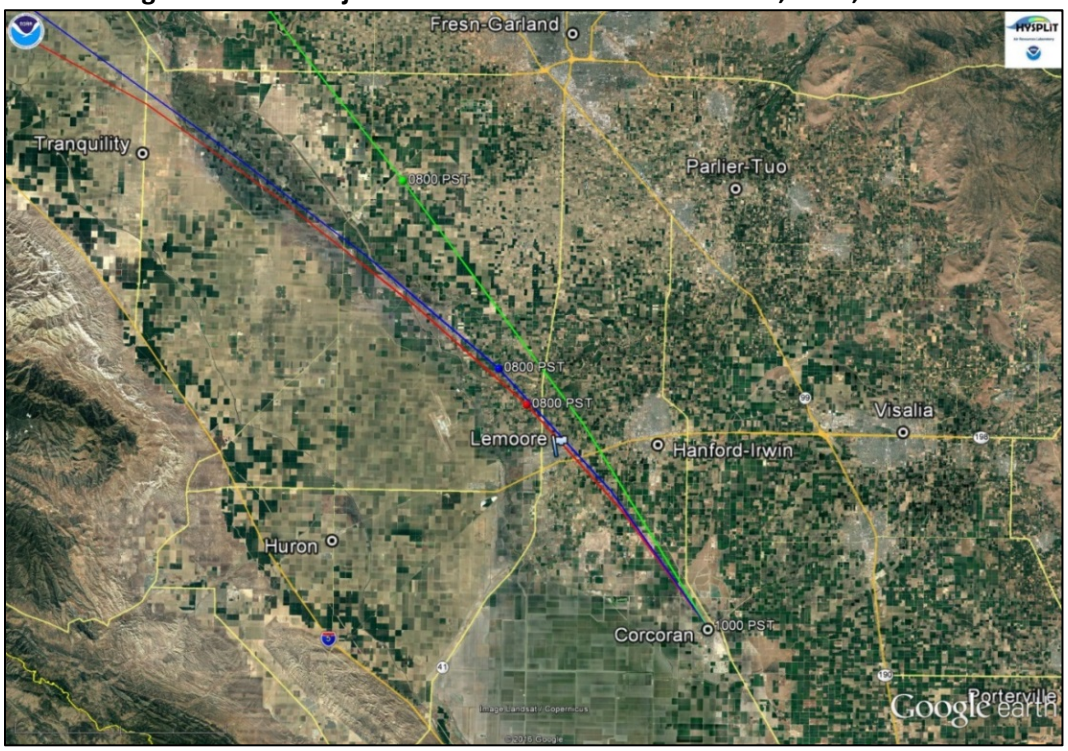

*Corcoran-Patterson Avenue site shows both scalar and resultant wind speed data.

The wind rose below (Figure 8) demonstrates that 87 percent of the winds at Corcoran were above 3 knots (3.45 mph) and were from the northwest on October 3. The remaining 13 percent of the winds on this day were considered calm winds (below 3 knots). High wind speeds can entrain and transport particulate matter, depositing material when reaching an area of lower wind speeds, such as the Corcoran monitor on October 3.

**Figure 8. Wind patterns at Corcoran - October 3, 2013**

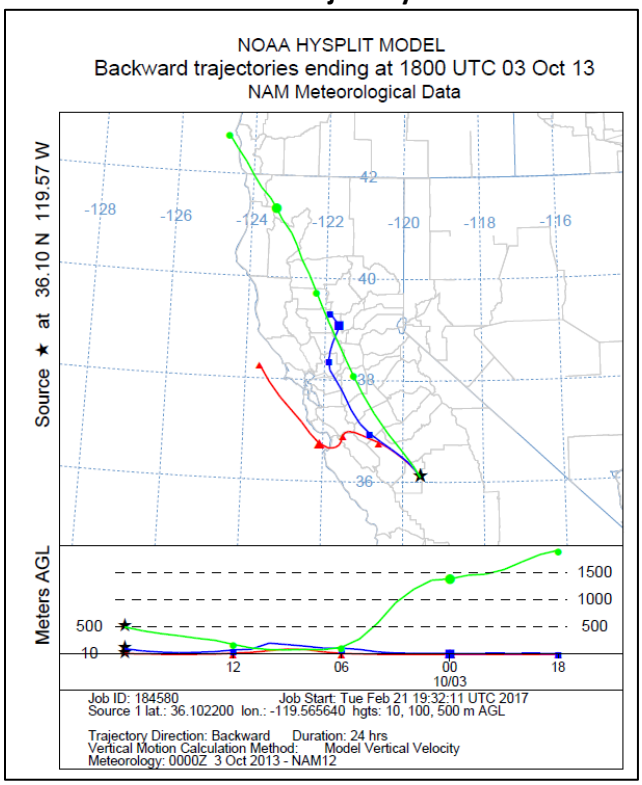
A back trajectory analysis, which traced the path of air flow for the previous 24-hours prior to impact at the monitor, indicated a primarily northern influence (Figure 9). This airflow impacted the Corcoran monitor at 10 PST, when PM10 concentrations were at their peak. The surface trajectory (red) was near Lemoore at 08 PST, at the time winds were above 30 mph and visibility was 1.75 miles. Sustained winds at the nearby Hanford Airport were lower, 16-18 mph, but gusts of up to 29 mph were recorded there, along with reports of haze which had visibility dropping to 4 miles.

**Figure 9. Back Trajectories from Corcoran – October 3, 2013, 10 PST**




As shown in Figure 10, the back trajectory that impacted the surface at the Corcoran monitor (10m - red line) originated off the Sonoma coast, moving onshore south of Monterey Bay, proceeding east and then north down the center of the Valley. This flow remained at surface level almost the entire 24-hours (see lower section of the chart for the altitude of the trajectory path at meters above ground level (AGL)). Both upper level trajectories (100m - blue and 500m -green) showed more of a straight drive from the north. All three paths were at or near the surface between 06 UTC (22 PST on October 2) and 12 UTC (04 PST on October 3), allowing for the possibility of particle entrainment. Surface trajectory (red line) influences from this period would include San Benito County and the west side of the San Joaquin Valley, including the area near the Corcoran monitor; upper level (blue and green lines) influences would be from the upper Sacramento Valley to Madera County in the San Joaquin Valley and the area near the monitor at Corcoran.

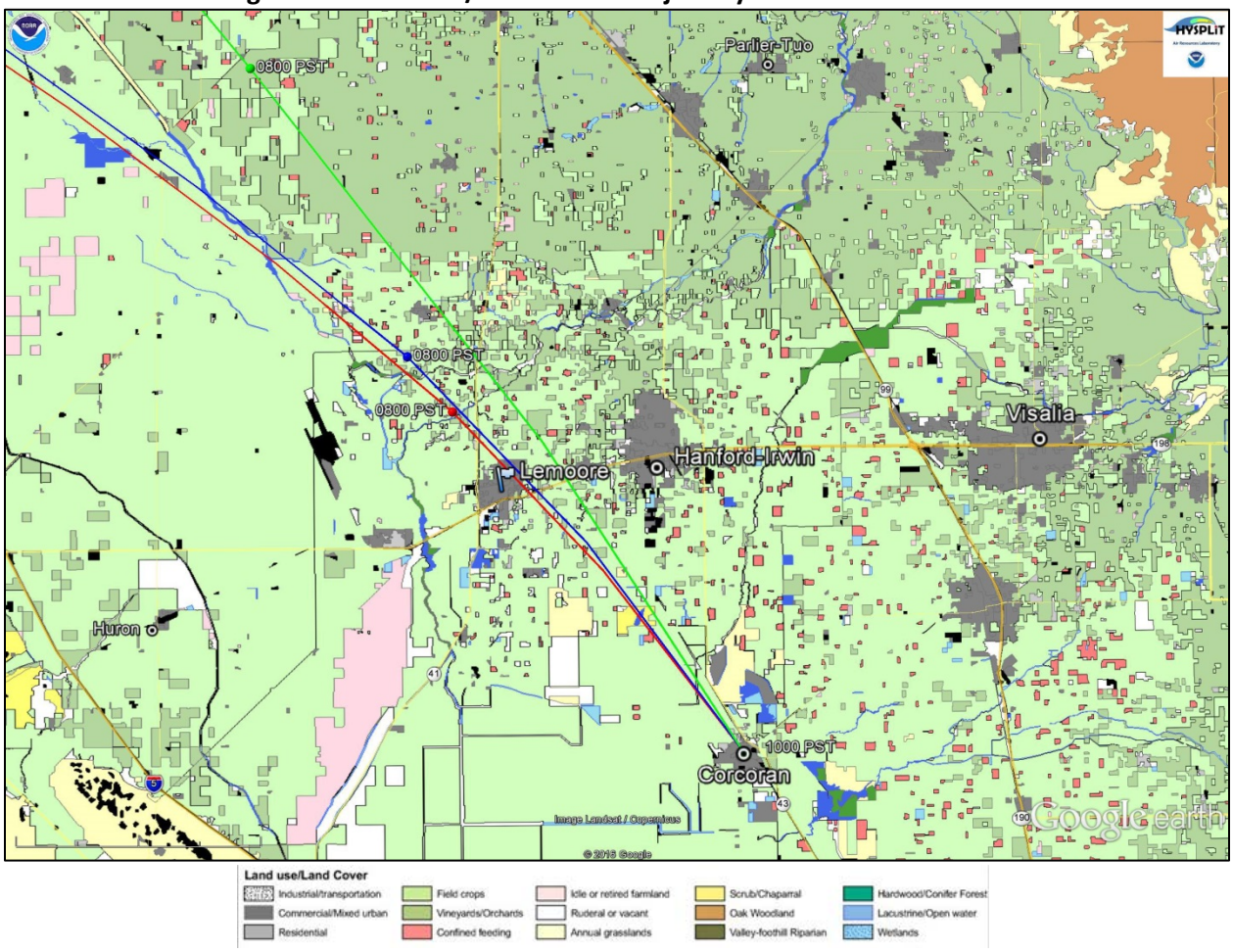
**Figure 10. NOAA HYSPLIT Model Back Trajectory Results – October 3, 2013, 10 PST**




At approximately 05 PST (13 UTC), both the 10m and the 100m back trajectories were near Tranquility, where winds had increased to 19 mph. These trajectories, still near the surface, passed through Lemoore around 08 PST when wind speeds were reaching 30 mph and severely decreased visibility and Hanford Airport was experiencing lower wind speeds but gusts of up to 29 mph and lowered visibility.

A land-use/land cover layer was used with the back trajectories to determine possible emission sources. The image below (Figure 11), combined with the primarily surface level flow toward the monitor, indicates that the primary local emissions would have been from agricultural and local urban areas. A map of the entire area can be found in Attachment A.

**Figure 11. Land Use/Land Cover -Trajectory Paths from Corcoran**




**Summary**

Based on this initial analysis, the exceedance at the Corcoran monitor on October 3, 2013 is potentially the result of high winds and blowing dust. To meet the contingency provisions of the Maintenance Plan, the District will prepare documentation following U.S. EPA's Exceptional Events Rule.

## November 14, 2013

Corcoran PM10 TEOM monitor - 163 μg/$m^3$

The PM10 filter exceedance occurred during a PM episode that was already in progress in SJV. PM10 concentrations increased on November 3 and remained elevated through November 15. Although both PM10 and PM2.5 concentrations were elevated, high winds were not evident. These elevated concentrations were limited to the Corcoran monitor and lasted only for a brief period of time, indicating a localized event.

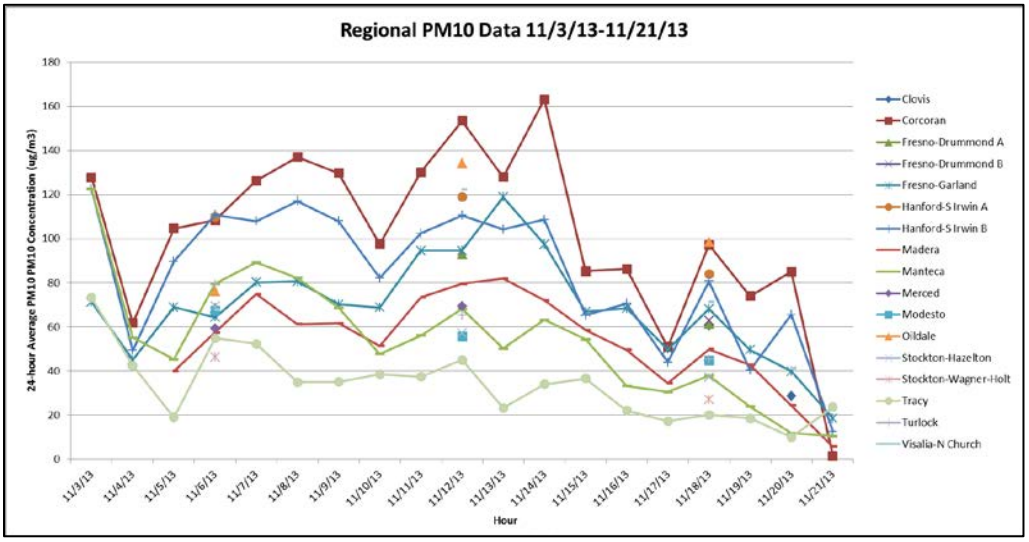
A ridge of high pressure was situated over the area, bringing calm conditions and warm temperatures. A surface trough moved across the Valley, in the evening after the peak concentrations were recorded at Corcoran. According to the NWS, the District prohibited fireplace/wood stove burning for the southern portion of the San Joaquin Valley, including Kings County where the Corcoran monitor is located. The District issued a healthy cautionary statement for all SJV due to potential localized blowing dust from gusty winds. Local airports recorded low wind speeds throughout the morning, ranging from calm conditions to 7 mph, along with hazy/misty conditions and visibilities as low as 1 mile.

- **Evaluation of PM10 filter-based and continuous data across the Valley to understand the local or regional nature of each exceedance.**

Although other continuous PM10 monitors within SJV showed a diurnal trend similar to Corcoran, no others exceeded the standard. This was not a scheduled filter sampling day.

Figure 12 displays the daily average PM10 filter and hourly data for SJV sites between November 3 and November 21. PM10 was elevated at most Valley sites on November 14; Corcoran recorded the highest PM10 concentrations between November 7 and November 20 and was the only site that exceeded the federal PM10 standard on November 14.

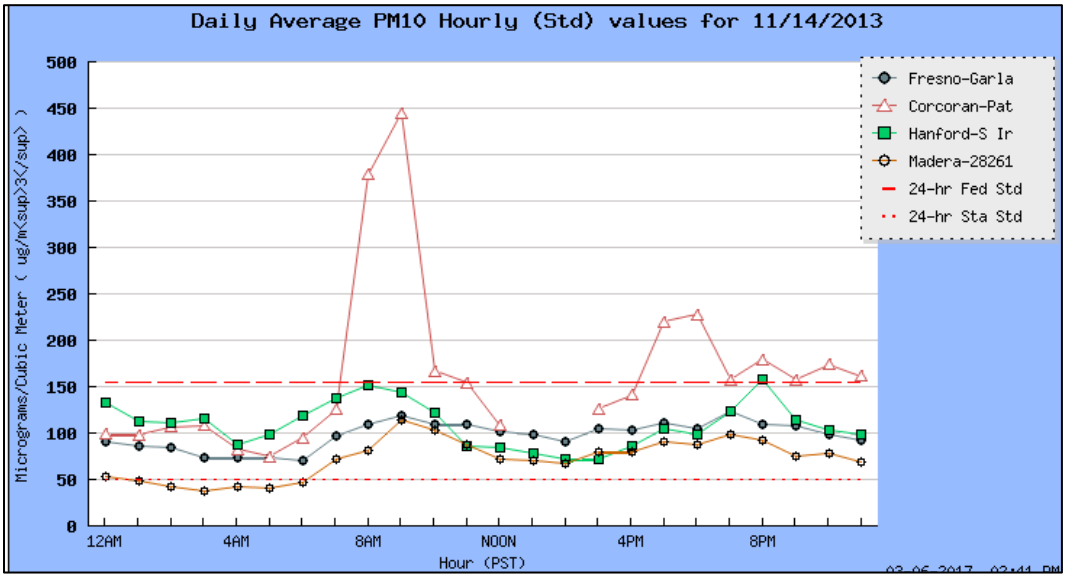
**Figure 12. Daily Regional PM10 Data – November 3 to November 21, 2013**



Although five of the six PM10 monitors operating in the San Joaquin Valley on November 14 exceeded the State standard, few others in the State did. The Corcoran monitor was the only monitor in the State to exceed the federal PM10 standard.

Figure 13 displays the daily average PM10 hourly data on November 14. The Corcoran site recorded hourly values above 150 μg/m$^3$ from 08 PST through 11 PST and from 17 PST through midnight. The hourly PM10 monitor at Hanford went over 150 μg/m$^3$ for one hour at 20 PST but all other sites remained below the federal standard.

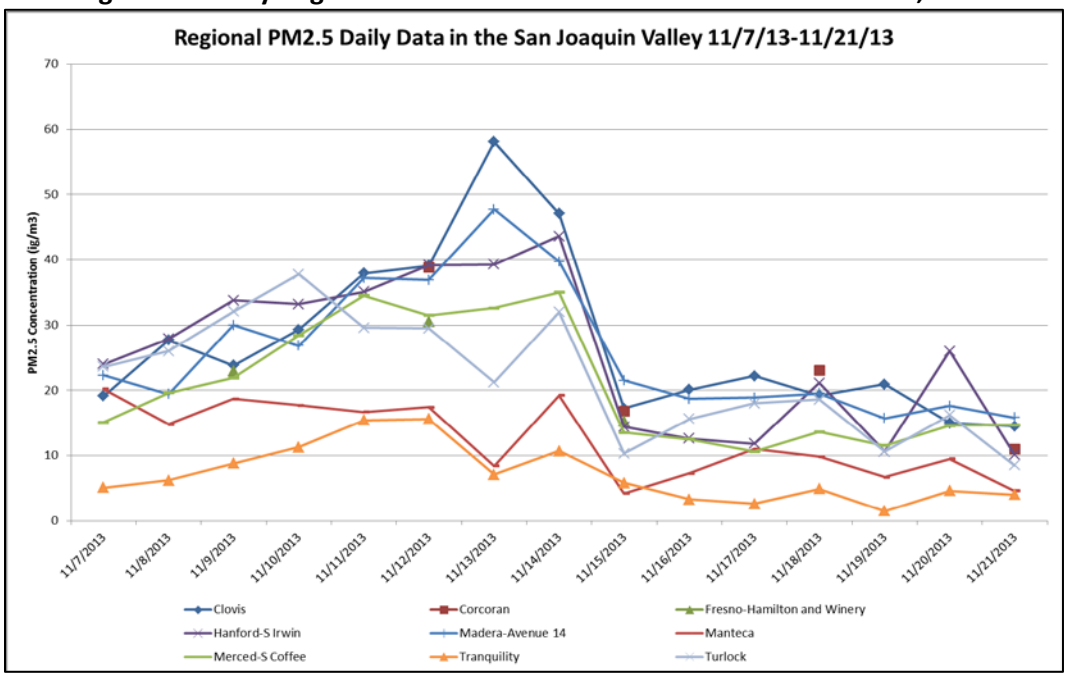
**Figure 13. SJV Hourly PM10 Data – November 14, 2013**




- **Analysis of PM2.5 data to determine whether fine or coarse particles are contributing to the exceedance.**

The chart below (Figure 14) displays the PM2.5 filter data for SJV monitoring sites between November 7 and November 21. The PM2.5 concentrations at most of the Valley sites on November 14 follow a pattern similar to that shown above for PM10 with the highest concentrations on the 13$^{th}$ and the 14$^{th}$. The highest PM2.5 concentration on November 14 was 47.1 μg/m$^3$ at Clovis, 50 miles to the north; Hanford, a site closer to Corcoran, measured 43.6 μg/m$^3$.

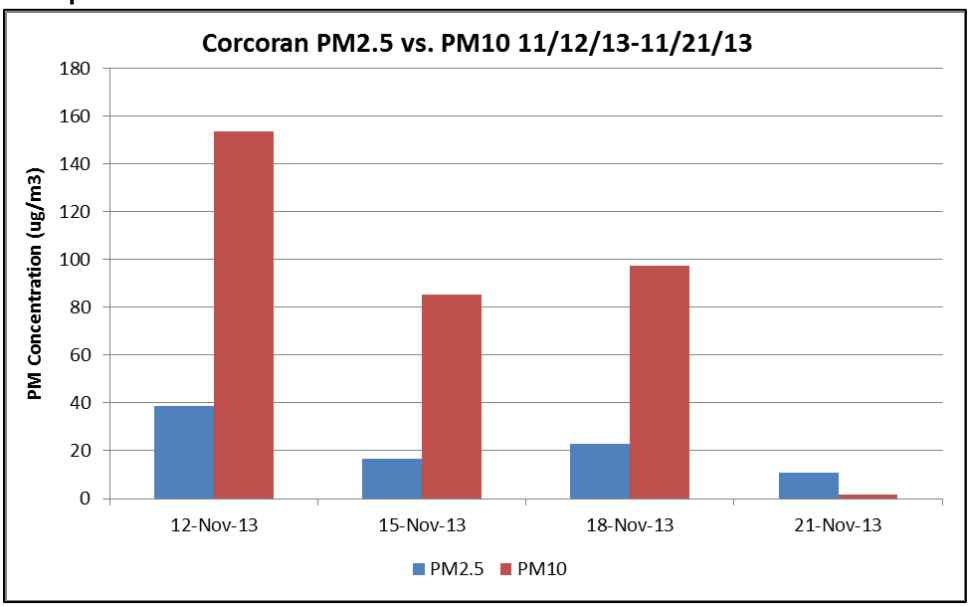
**Figure 14. Daily Regional PM2.5 Data – November 7 to November 21, 2013**




Corcoran does not have a continuous PM2.5 monitor so only PM2.5 data from the filter monitor could be used for comparison to PM10 data on matching days. Since November 14 was not a scheduled filter sampling day, no PM2.5 data was available but data before and after were examined. The comparison between PM2.5 and PM10 at Hanford is also provided below since this is the closest monitor to Corcoran. The District's analysis compared PM concentrations at the two monitors. The Corcoran PM10 (162.5 µg/m$^3$) and Hanford PM2.5 (43.6 µg/m$^3$) concentrations on November 14 indicated that approximately 73 percent of the sample was comprised of coarse particulate, while 27 percent was comprised of fine particulate.

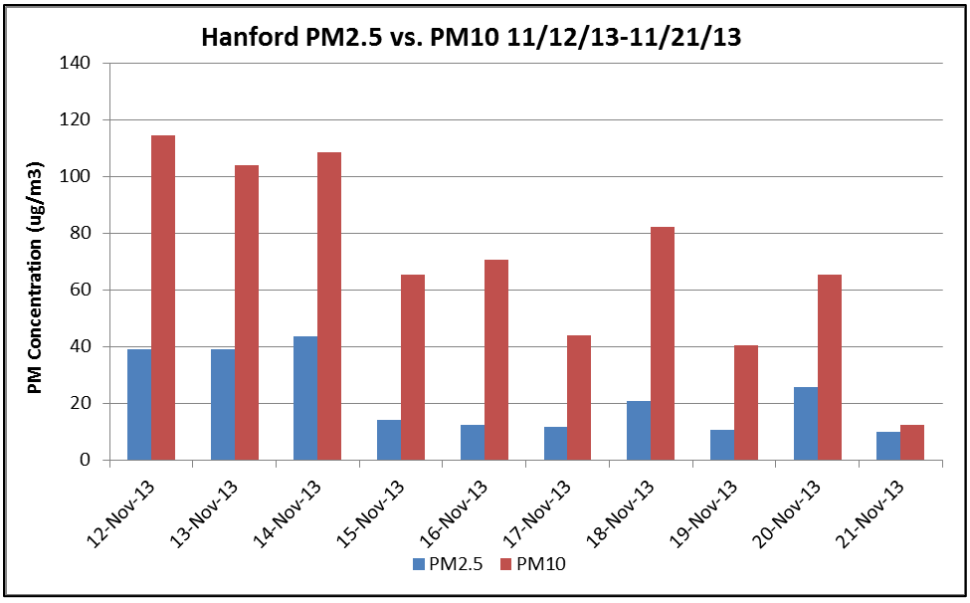
The following charts (Figures 15 and 16) show that while PM2.5 concentrations were slightly elevated before November 15 at Corcoran, PM2.5 concentrations increased on the 14$^{th}$ at Hanford. PM10 concentrations decreased after November 12 at Corcoran but remained steady at Hanford until a decrease on the 15$^{th}$, indicating that although coarse particles were a significant portion of PM10 levels, their impact on the whole was lessened.

**Figure 15. Comparison of PM2.5 and PM10 Data at Corcoran – November 12 to November 21, 2013**




**PM10 measured on 11/21 at Corcoran is not realiable since the daily average is based on only two hours of data that were collected that day.*

**Figure 16. Comparison of PM2.5 and PM10 at Hanford – November 12 to November 21, 2013**




- **Analysis of available chemical speciation data including additional filter speciation analysis as appropriate to assess potential source types contributing to each exceedance.**

No PM2.5 or PM10 speciation analysis was available for November 14. However, PM2.5 speciation was recorded at Visalia before and after the PM10 exceedance at Corcoran. The data shows that PM2.5 species increased significantly at Visalia on November 12, before the PM10 exceedance at Corcoran occurred on the 14th. PM2.5 species decreased on November 18 and November 24.

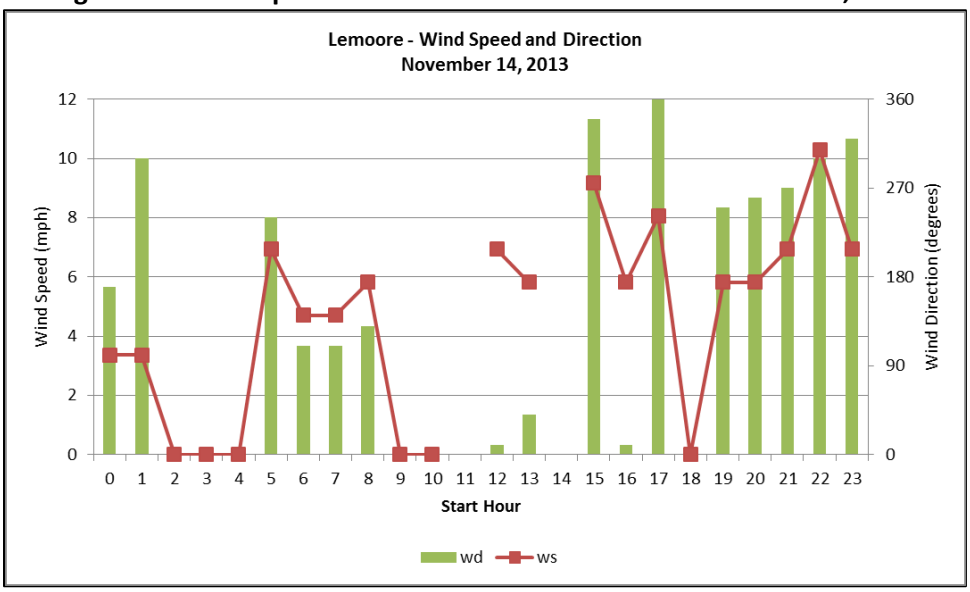
**Table 3. PM2.5 Speciation Data (µg/m$^3$) at Visalia – November 6 to November 24, 2013**

| Monitor | Date | Mass | Ammonium Nitrate | Ammonium Sulfate | Organic Matter | Elemental Carbon | Geologic | Elements |
|---|---|---|---|---|---|---|---|---|
| Visalia | 11/6/13 | 15.4 | 5.547 | 0.83904 | 5.25 | 0.9 | 2.3799 | 0.332 |
| Visalia | 11/12/13 | 51.7 | 31.734 | 3.0084 | 10.15 | 1.5 | 2.51084 | 0.5555 |
| Visalia | 11/18/13 | 23.9 | 9.9717 | 1.5456 | 7.63 | 1.1 | 1.5533 | 0.5 |
| Visalia | 11/24/13 | 20.5 | 8.8752 | 1.0212 | 8.05 | 1.2 | 0.30685 | 0.3565 |

- **Analysis of wind speed and direction, along with geographic visualization tools to help identify the types of sources impacting each monitor.**

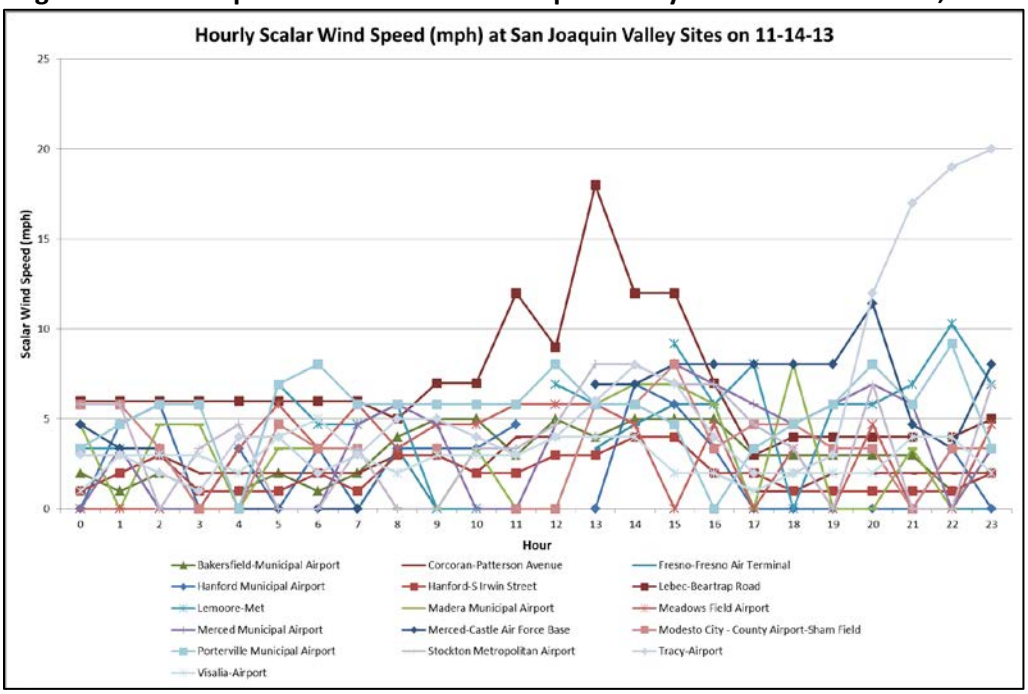
The monitoring site at Corcoran reported a maximum wind speed of 4 mph at 14 PST, five hours after the peak PM10 concentrations at the site. The wind speed at the time of the exceedance was 2-3 mph. The highest wind speeds recorded in the Valley were at Lebec, in Kern County, at 18 mph, and Tracy, to the north in San Joaquin County, at 20 mph. Both high winds occurred after the morning peak in concentrations at Corcoran. Wind speeds around the Valley in the morning were low, with local airports reporting speeds ranging from calm (0 mph) to 9 mph similar to that seen at Lemoore (Figure 17). The airports also reported hazy conditions with visibilities ranging from 1 to 7 miles.

**Figure 17. Wind Speed and Direction at Lemoore – November 14, 2013**



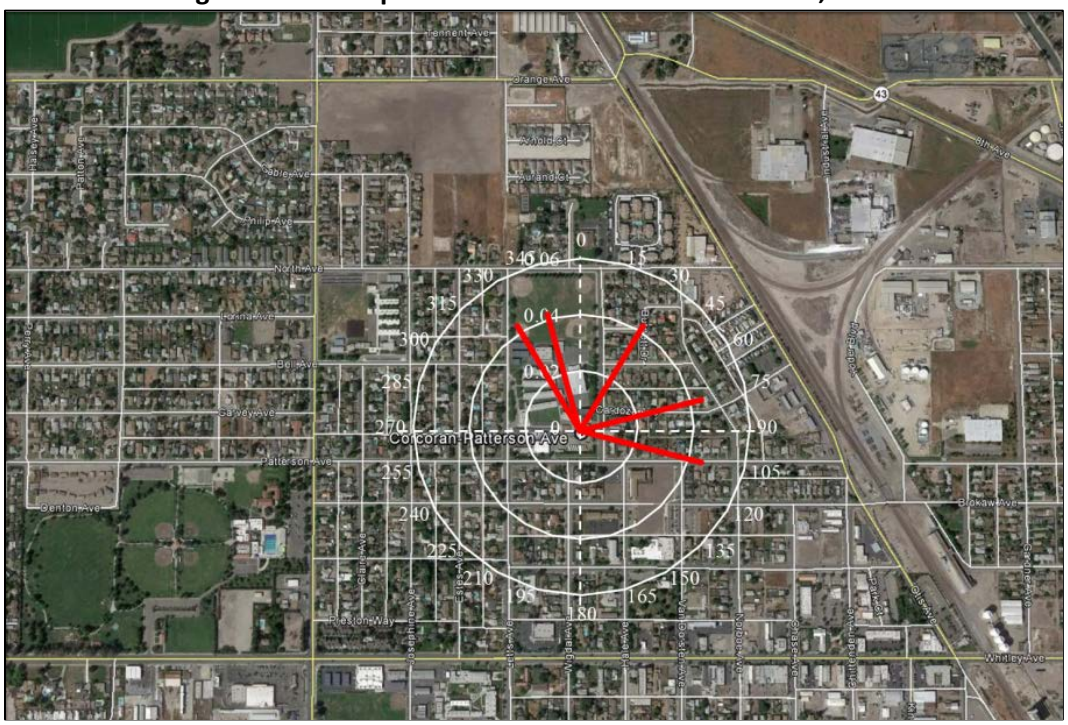

The following chart (Figure 18) shows the hourly wind speed data on November 14 at each site in Kings County, as well as other selected monitoring and airport sites. Wind speeds at all sites were low at the time of the Corcoran exceedance; the increased wind speeds seen at Tracy in the late evening did not correspond with increases in PM10 concentrations at Corcoran.

**Figure 18. Wind Speeds at Selected San Joaquin Valley Sites – November 14, 2013**



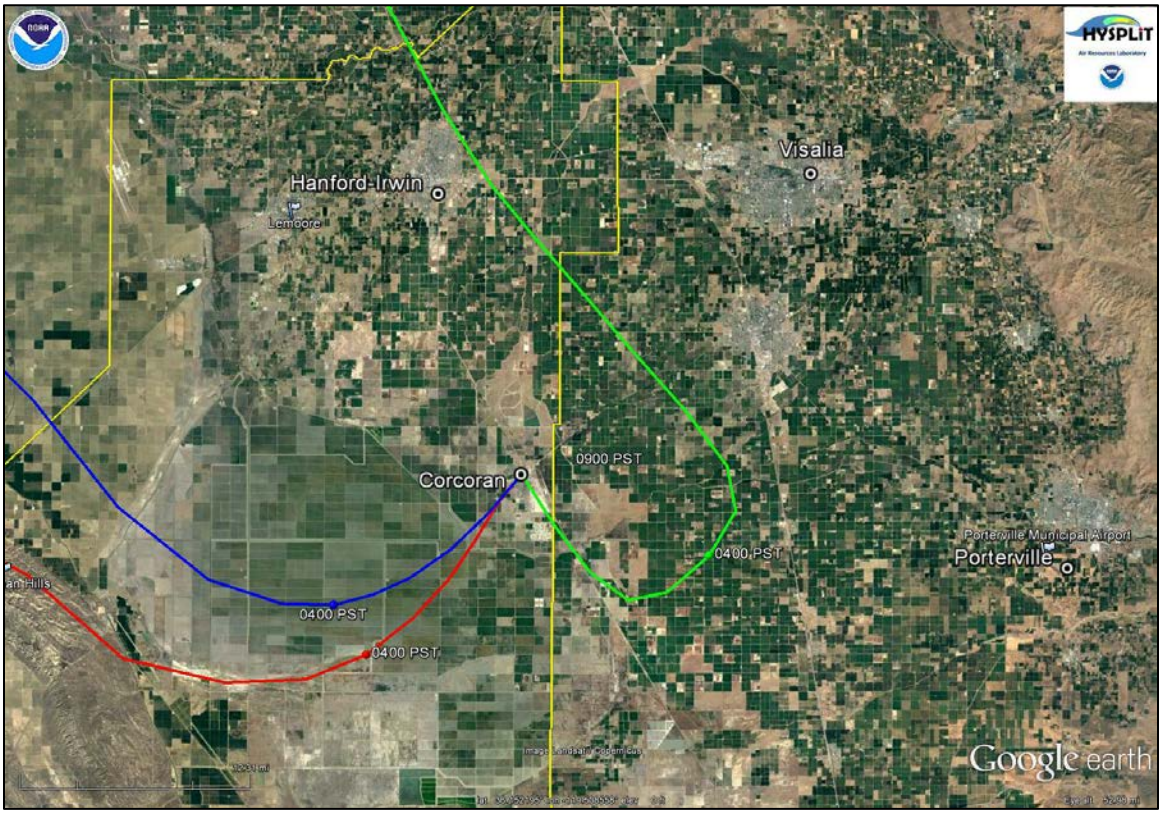

The wind rose below (Figure 19) demonstrates that 21 percent of the winds were above 3 knots (3.45 mph) and were from the northwest, northeast, and east on November 14 at Corcoran. The remaining 79 percent of the winds on this day were considered calm winds (below 3 knots).

**Figure 19. Wind patterns at Corcoran - November 14, 2013**



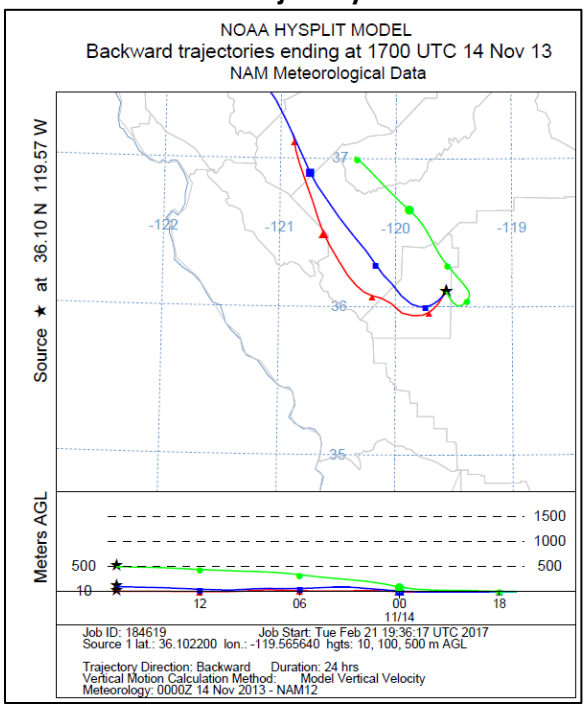
A back trajectory analysis, which traced the path of air flow for the previous 24-hours prior to impact at the monitor, indicated the airflow was primarily from the north and originated within the San Joaquin Valley (Figure 20). The period from 04 to 09 PST, the five hours prior to the peak concentrations at the monitor, showed the back trajectories within 15 miles of the monitor, indicating fairly stagnant conditions with movement of only 3 mph. As noted previously, local airports (Visalia, Hanford, and Bakersfield) reported fairly calm conditions with wind speeds ranging from 0 to 7 mph, with hazy/misty conditions and resulting lowered visibility.

**Figure 20. Back Trajectories from Corcoran – November 14, 2013, 09 PST**



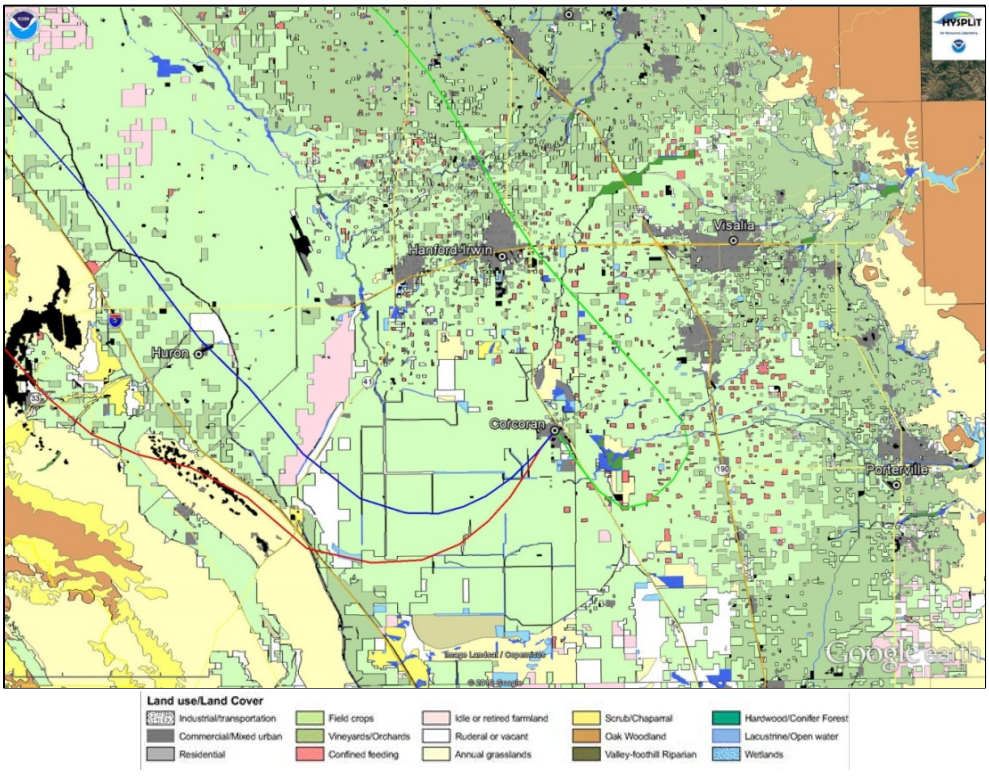

All three trajectories originated in the northern portion of the San Joaquin Valley (Figure 21). All flows can be traced back to the surface level (see lower section of the chart above for the altitude of the trajectory paths at Meters AGL (above ground level)), which would allow for particle entrainment if wind speed were higher. The flow at the surface level (10m – red line) remained at the surface for the entire period while both the other trajectories rose to their eventual heights of 100m and 500m at the monitor. All three trajectories were within 15 miles of the monitor during the last five hours prior to the exceedance (04 to 09 PST). Influences from this time period would have been from the local area.

**Figure 21. NOAA HYSPLIT Model Back Trajectory Results – November 14, 2013, 09 PST**




A land-use/land cover layer was used with the back trajectories to determine possible emission sources. The image below (Figure 22), combined with the primarily calm surface level flow toward the monitor, indicates that the primary local sources would have been agricultural and local urban areas.

**Figure 22. Land Use/Land Cover - Trajectory Paths from Corcoran**



**Summary**

Based on this initial analysis, the exceedance at the Corcoran monitor on November 14, 2013 is the result of the buildup of particulate matter, combined with local emissions on the day of the exceedance, typical of a fall stagnation event.

## December 17-18, 2013

December 17: Corcoran PM10 TEOM monitor - 165 μg/$m^3$
December 18: Corcoran PM10 TEOM monitor - 184 μg/$m^3$
Hanford PM10 FRM monitor - 177 μg/$m^3$
Hanford PM10 TEOM monitor - 174 μg/$m^3$
Visalia PM10 FRM monitor - 155 μg/$m^3$

This PM10 exceedance was exacerbated by high winds and blowing dust, but the winds were not high enough to entrain particles from stable surfaces, and buildup of particles from previous days was a factor. This was the continuation of a multiday episode that began around December 14 and lasted until December 19.

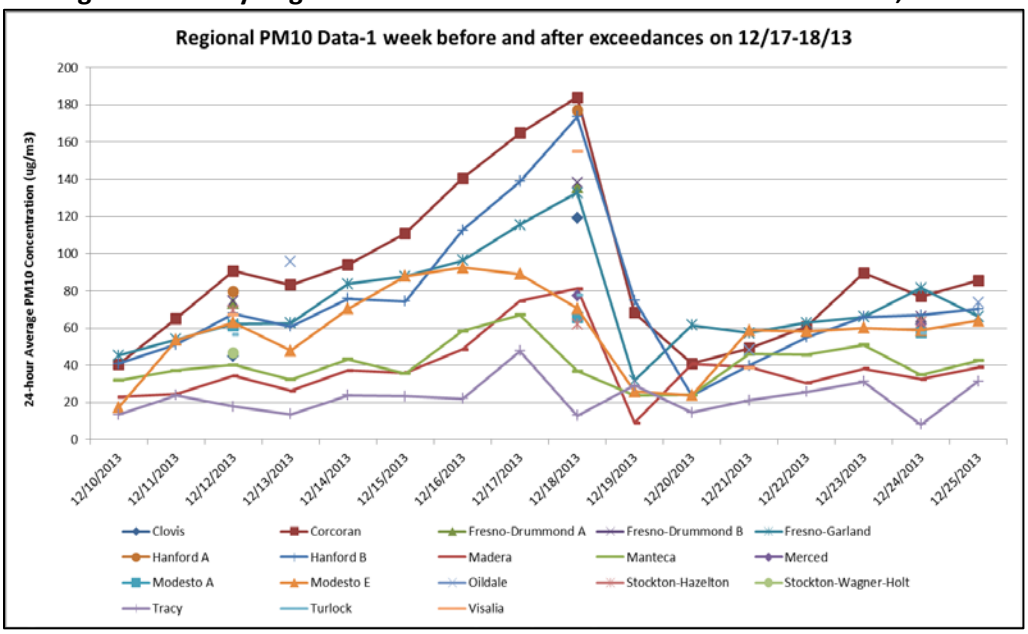
A ridge of high pressure was situated over the area, bringing calm conditions and above normal temperatures. The NWS issued a wind advisory on the morning of the 17th for areas along the I-5 corridor near the Grapevine Pass (southeastern portion of the Valley). This advisory was in effect until 17 PST. The NWS reported a wind gust of 52 mph near the Grapevine in southwestern Kern County at 09 PST. Blowing dust as a result of these gusty winds prompted the District to issue a health cautionary statement for the afternoon and early evening for the southern portion of Kern County, particularly through the Grapevine.

High pressure prevailed on the 18th, but an upper level trough approached bringing slightly unsettled conditions to the Sierra Nevada foothills and the Kern County Mountains. The NWS issued a Hazardous Weather Outlook for these areas for the afternoon and into the early evening as well as a wind advisory for areas above 5000 feet. The wind advisory in effect on the previous day had expired in the early evening and was not renewed for the 18th. A news release issued by the District warned of the persistence of poor air quality due to the high pressure system and discouraged the use of wood-burning appliances.

- **Evaluation of PM10 filter-based and continuous data across the Valley to understand the local or regional nature of each exceedance.**

Figure 23 displays the PM10 filter and hourly data for SJV sites between December 10 and December 25. The PM10 concentrations on December 17 increased throughout the Valley with Corcoran being the only site that exceeded the federal PM10 standard. On December 18, PM10 concentrations increased further throughout the Valley with Corcoran, Hanford, and Visalia all exceeding the federal PM10 standard.

**Figure 23. Daily Regional PM10 Data – December 10 to December 25, 2013**




Figures 24 and 25 below, display the daily average PM10 hourly data on December 17 and December 18. On the 17th, the hourly values above the federal 24-hour PM10 standard of 150 µg/m$^3$ were recorded several times during the day at Corcoran and from 17 PST through 20 PST at Hanford. Other continuous PM10 monitors also showed increased PM10 concentrations on December 17 but not to the degree of the Corcoran site. On the 18th, PM10 concentrations increased further throughout the Valley and multiple PM10 monitors experienced hourly PM10 concentrations above the federal PM10 standard of 150 µg/m$^3$.

**Figure 24. SJV Hourly PM10 Data – December 17, 2013**

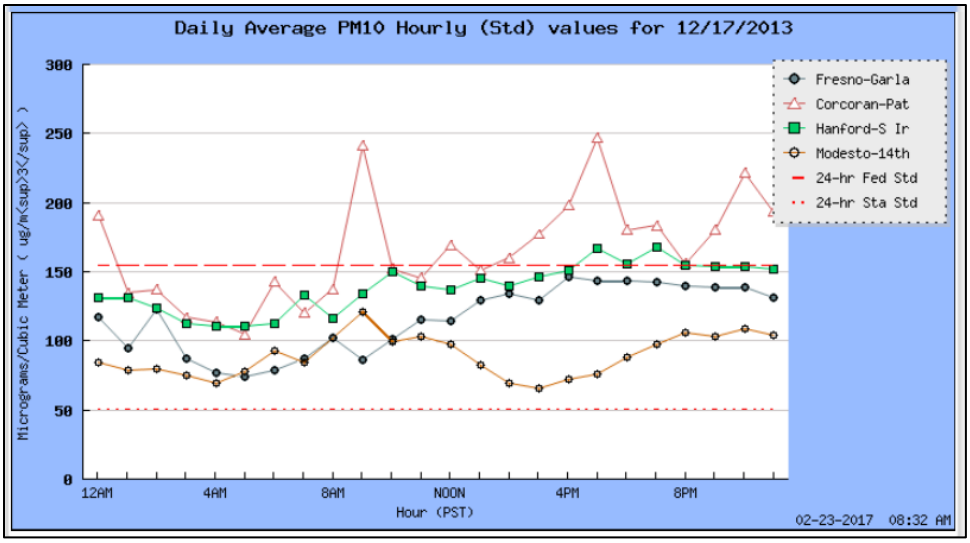
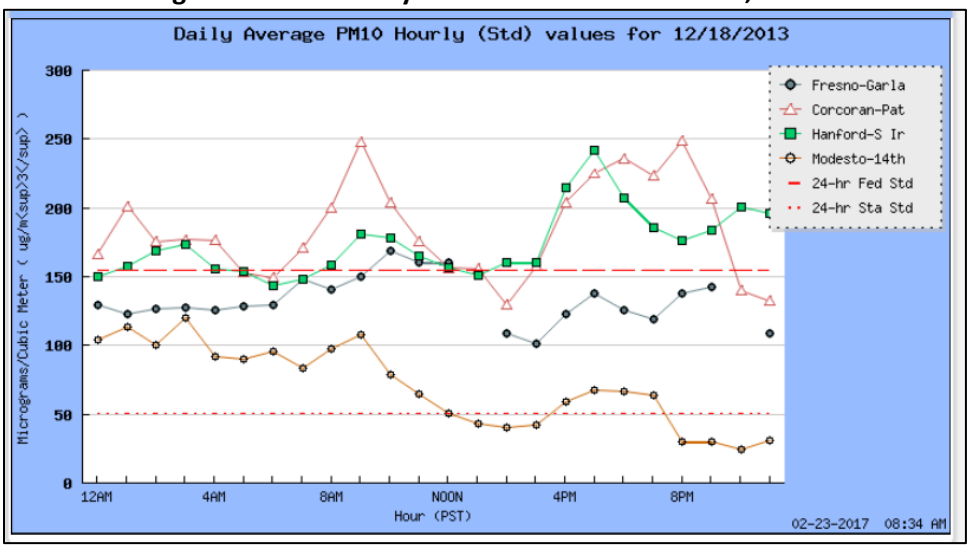


**Figure 25. SJV Hourly PM10 Data – December 18, 2013**

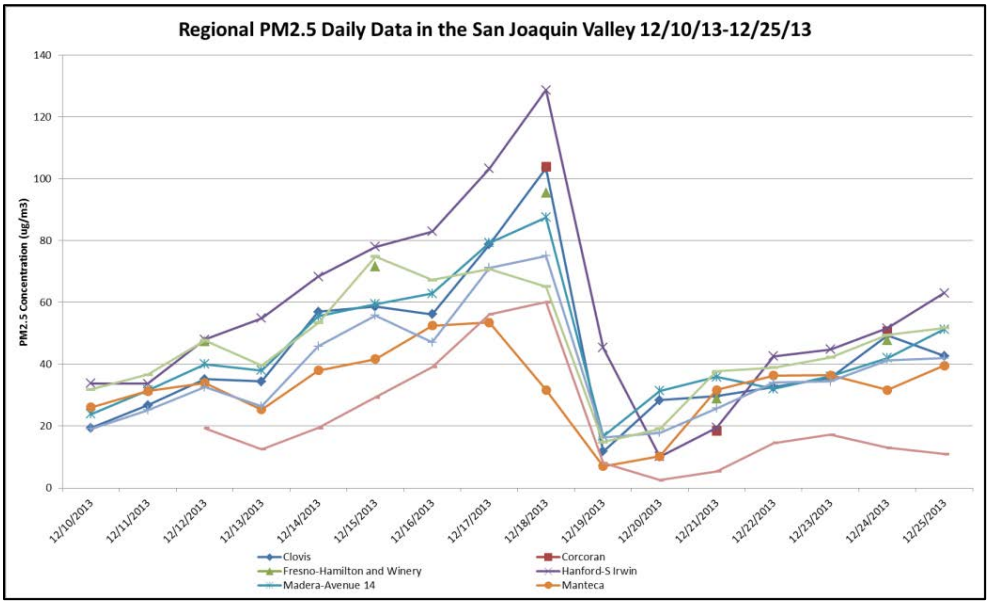



Several PM10 monitors in the State recorded elevated concentrations above the State standard of 50 μg/m$^3$. The majority of these monitors were in the southern portion of the State, primarily in the San Joaquin Valley, but also in the South Coast and the Salton Sea. The only exceedances of the federal PM10 standard of 150 μg/m$^3$, on either day, were in the SJV.

- **Analysis of PM2.5 data to determine whether fine or coarse particles are contributing to the exceedance.**

The chart below (Figure 26) displays PM2.5 filter data for SJV sites between December 10 and December 25. The PM2.5 concentrations at the various SJV sites follow a similar pattern as shown in the PM10 chart above (Figure 23). The highest PM2.5 concentration on were 103.3 μg/m$^3$ and 128.7 μg/m$^3$ both at Hanford on the 17$^{th}$ and 18$^{th}$, respectively.

**Figure 26. Daily Regional PM2.5 Data – December 10 to December 25, 2013**



Corcoran does not have a continuous PM2.5 monitor so only PM2.5 data from the filter monitor could be used for comparison to PM10 data on matching days. Since December 17 was not a scheduled filter sampling day, no PM2.5 data was available but data before and after were examined, including the exceedance on December 18. The following chart (Figure 27) shows that PM concentrations at Corcoran were extremely elevated for both PM2.5 and PM10 on the 18th. PM10 concentrations rose significantly, indicating that coarse particles were a significant portion of PM10 levels. The District's analysis compared the December 18 PM concentrations at the Corcoran monitor. With a PM2.5 concentration of 104 µg/m$^3$ and a PM10 concentration of 183.5 µg/m$^3$, approximately 44 percent of the PM10 sample was comprised of coarse particulate, while 56 percent was comprised of fine particulate.

**Figure 27. Comparison of PM2.5 and PM10 at Corcoran – December 9 to December 24, 2013**

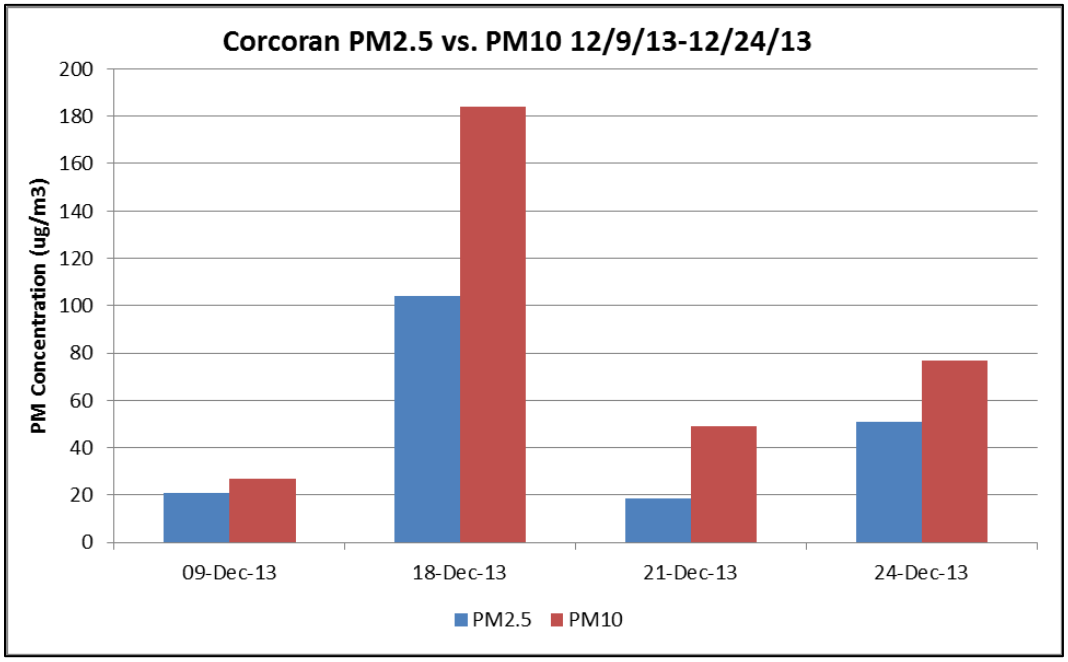
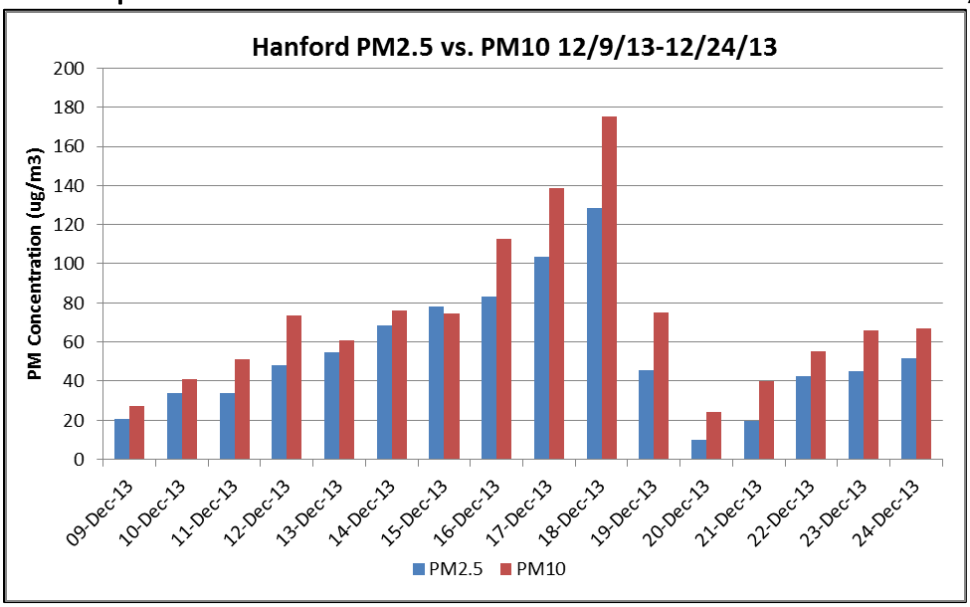


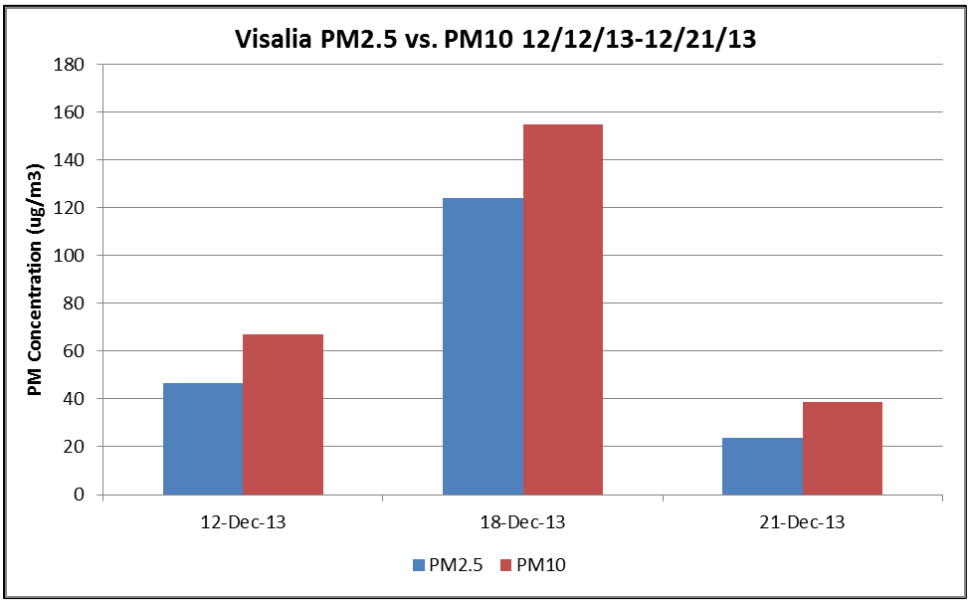

Figure 28, below, shows that PM concentrations at Hanford were increasing long before the PM10 exceedances that occurred on the 17th and the 18th. The highest PM10 and PM2.5 concentrations occurred on December 17 and December 18, with concentrations decreasing after the 18th. The District's analysis compared the December 18 PM concentrations at the Hanford monitor. With a PM2.5 concentration of 128.8 µg/m$^3$ and a PM10 concentration of 177 µg/m$^3$, approximately 28 percent of the PM10 sample was comprised of coarse particulate, while 72 percent was comprised of fine particulate. The increase in PM concentrations on the days leading up to the exceedances and the fact that the PM2.5 to PM10 ratio was very high indicates a stagnation episode had occurred.

**Figure 28. Comparison of PM2.5 and PM10 at Hanford – December 9 to December 24, 2013**




PM concentrations were also elevated for both PM2.5 and PM10 on December 18 at Visalia (Figure 29). The District's analysis compared the December 18 PM concentrations at the Visalia monitor. With a PM2.5 concentration of 124.2 μg/m$^3$ and a PM10 concentration of 155 μg/m$^3$, approximately 20 percent of the PM10 sample was comprised of coarse particles, while 80 percent was comprised of fine particulate.

**Figure 29. Comparison of PM2.5 and PM10 at Visalia – December 12 to December 21, 2013**



- **Analysis of available chemical speciation data including additional filter speciation analysis as appropriate to assess potential source types contributing to each exceedance.**

Speciation data was recorded at Modesto and Visalia on December 18. These sites are located in different counties from the exceeding Corcoran and Hanford sites but still provide valuable information as to the chemical makeup of the December 18 exceedance at Visalia. PM2.5 speciation data before and after the exceedance on the 18th are shown below in Table 4. Speciation data at Modesto, north of the exceeding sites, did not show elevated PM2.5 species on December 18. However, the increase in ammonium nitrate concentrations at Visalia on the 18th is indicative of stagnant conditions, which allowed for the accumulation of secondary PM2.5.

**Table 4. PM2.5 Speciation Data (μg/m$^3$) at Modesto and Visalia – December 12 to December 24, 2013**

| Monitor | Date | Mass | Ammonium Nitrate | Ammonium Sulfate | Organic Matter | Elemental Carbon | Geological | Elements |
|---|---|---|---|---|---|---|---|---|
| Modesto | 12/12/13 | 49 | 22.446 | 1.518 | 16.73 | 2.4 | 1.00392 | 0.9045 |
| Modesto | 12/18/13 | 49.9 | 26.445 | 1.29168 | 13.79 | 2.4 | 0.88484 | 1.1495 |
| Modesto | 12/24/13 | 44.2 | 22.962 | 1.6698 | 10.99 | 3.1 | 0.65697 | 0.679 |
| Visalia | 12/12/13 | 47.3 | 25.284 | 1.35792 | 13.86 | 1.9 | 1.04524 | 1.1575 |
| Visalia | 12/18/13 | 123.9 | 91.203 | 4.9956 | 15.26 | 2.1 | 1.36766 | 1.141 |
| Visalia | 12/21/13 | 22.8 | 10.965 | 1.16748 | 6.86 | 1.3 | 0.58088 | 0.582 |

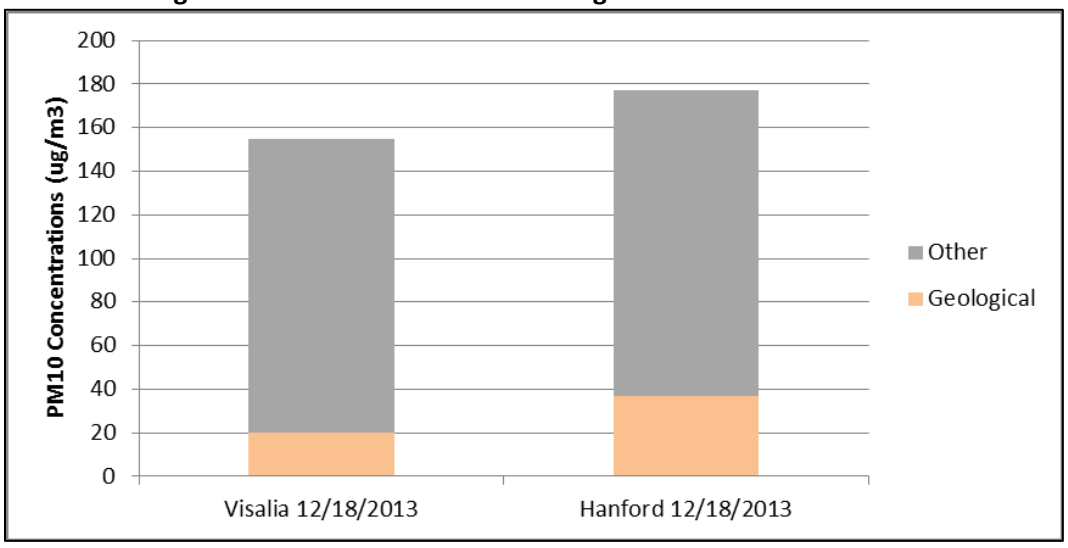
CARB's Monitoring and Laboratory Division (MLD) analyzed six PM10 filters for metals using inductively coupled plasma microscopy (ICP-MS) and for ions using ion chromatography (IC). All filters had very high PM10 concentrations ranging from 155 μg/m$^3$ to over 400 μg/m$^3$. One filter was collected from Bakersfield (October 14, 2014), one from Hanford (December 18, 2013), one from Visalia (December 18, 2013), and three from Oildale (January 23, 2014, June 10, 2014, and October 14, 2014). More detailed information on this analysis is located in Appendix A.

The two filters collected on December 18, 2013 at Bakersfield and Hanford showed fairly low concentrations of fugitive dust. This implies that other sources contributed to high PM10 concentrations on this date. Table 5 and Figure 30 illustrate the relationship between measured PM10 mass and estimated fugitive dust mass.

**Table 5. PM10 and Estimated Fugitive Dust Concentrations (μg/m$^3$)**

| | Visalia 12/18/2013 | Hanford 12/18/2013 |
|---|---|---|
| PM10 (μg/m$^3$) | 155 | 177 |
| Iron (μg/m$^3$) | 1.12 | 2.04 |
| Fugitive Dust (μg/m$^3$) | 21.28 | 38.76 |
| Other (μg/m$^3$) | 133.72 | 138.24 |

**Figure 30. PM10 Filters with Low Fugitive Dust Concentrations**




- **Analysis of wind speed and direction, along with geographic visualization tools to help identify the types of sources impacting each monitor.**

The monitoring site at Corcoran reported a maximum wind speed of 5 mph on the 17th and 7 mph on the 18th. The wind speeds at the time of the high PM concentrations on the 17th were 2-4 mph and 0-4 mph during the peaks seen on the 18th. Wind speeds around the Valley were low on both days. The NWS reported a gust of 52 mph at the Grapevine, south of Lebec, on the morning of the 17th, but was not shown to have an impact on airflow to the Corcoran monitor. On December 18, Tulare County reported a maximum wind speed of 16 mph at the Porterville Municipal Airport at 04 PST, on the east side of the Valley. Local airports reported speeds ranging from calm (0 mph) to the aforementioned 16 mph along with hazy conditions resulting in visibility ranging from 1 to 9 miles, with the majority of this between 3 and 4 miles. The following charts (Figures 31 and 32) show the hourly wind speed data on December 17 and December 18 at each site in Kings County as well as the basin wide airport sites. Wind speeds at all sites were fairly low.

**Figure 31. Wind Speeds at Selected San Joaquin Valley Sites – December 17, 2013**

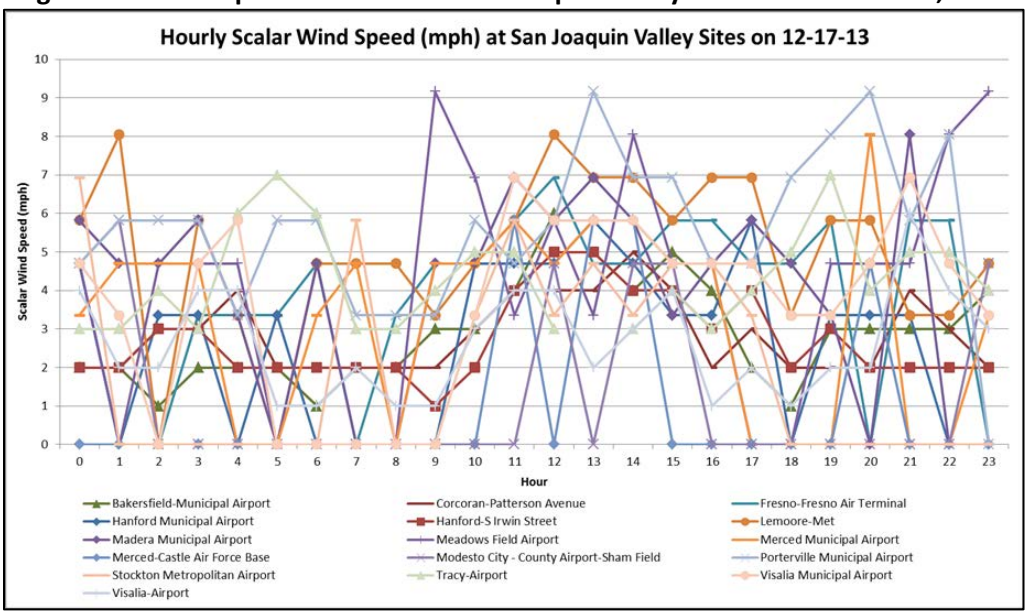
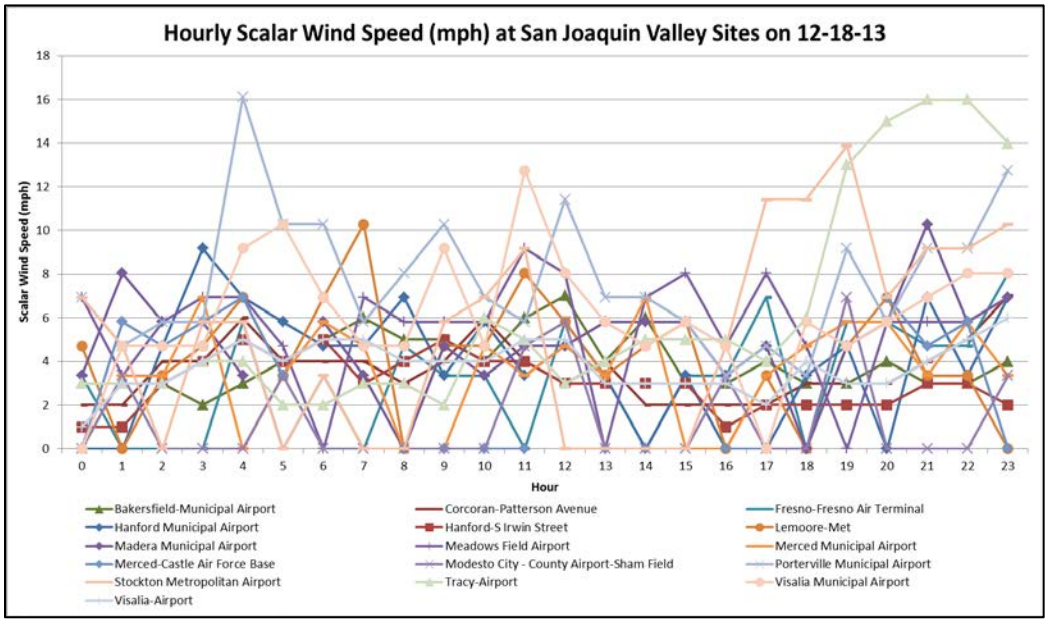
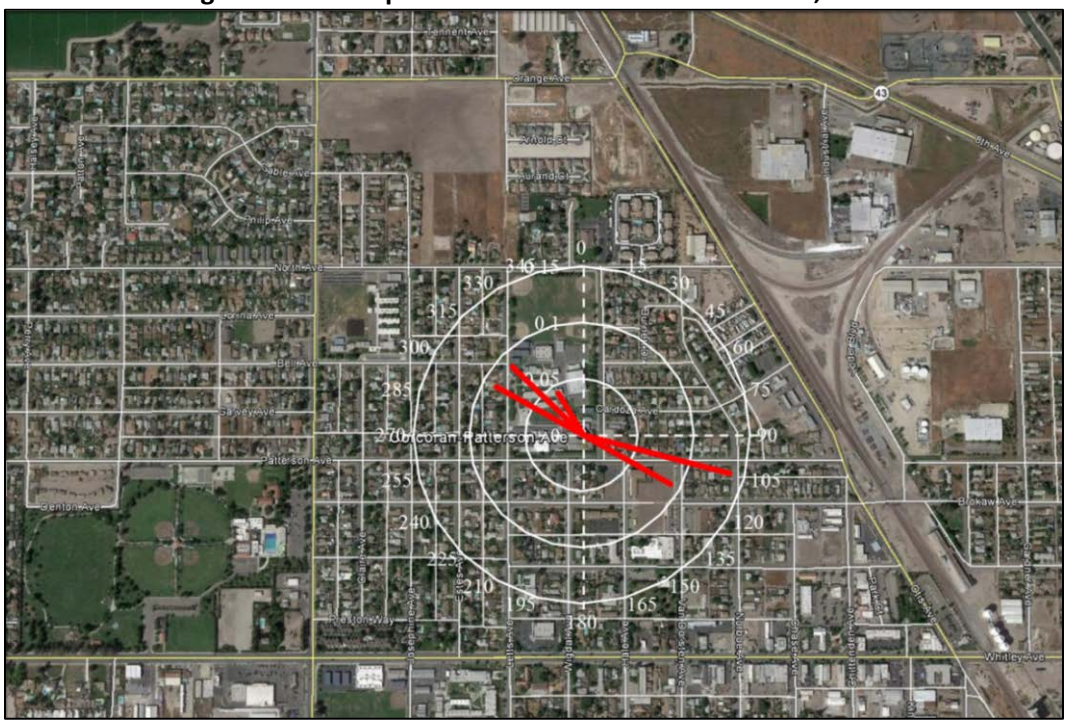



**Figure 32. Wind Speeds at Selected San Joaquin Valley Sites – December 18, 2013**




The wind rose below (Figure 33) demonstrates that 42 percent of the winds at Corcoran were above 3 knots (3.45 mph) and were from the northwest and southeast on December 17. The remaining 58 percent of the winds on this day were considered calm winds (below 3 knots).

**Figure 33. Wind pattern at Corcoran – December 17, 2013**




The wind rose below (Figure 34) demonstrates that 25 percent of the winds at Corcoran were above 3 knots (3.45 mph) and were from the northeast and southwest on December 18. The remaining 75 percent of the winds on this day were from northwest, south, and southeast and were considered calm winds (below 3 knots).

**Figure 34. Wind pattern at Corcoran - December 18, 2013**

The monitoring site at Corcoran reported maximum wind speeds of 5 mph on the 17th, and 7 mph on the 18th. No area in the Valley reported wind speeds over 15 mph on either day.

A back trajectory analyis for the Corcoran monitor on the 17th indicated a local event (Figure 35). The path of airflow in the hours prior to the peak concentrations at 17 PST showed a surface level approach from the northwest (10m-red and 100-m blue), traveling a distance of only 20 miles in the last six hours. The surface trajectory was near Lemoore at 11 PST at the time wind speeds were around 5 mph; wind at that site peaked at 8 mph around noon

**Figure 35. Back Trajectories from Corcoran – December 17, 2013, 17 PST**

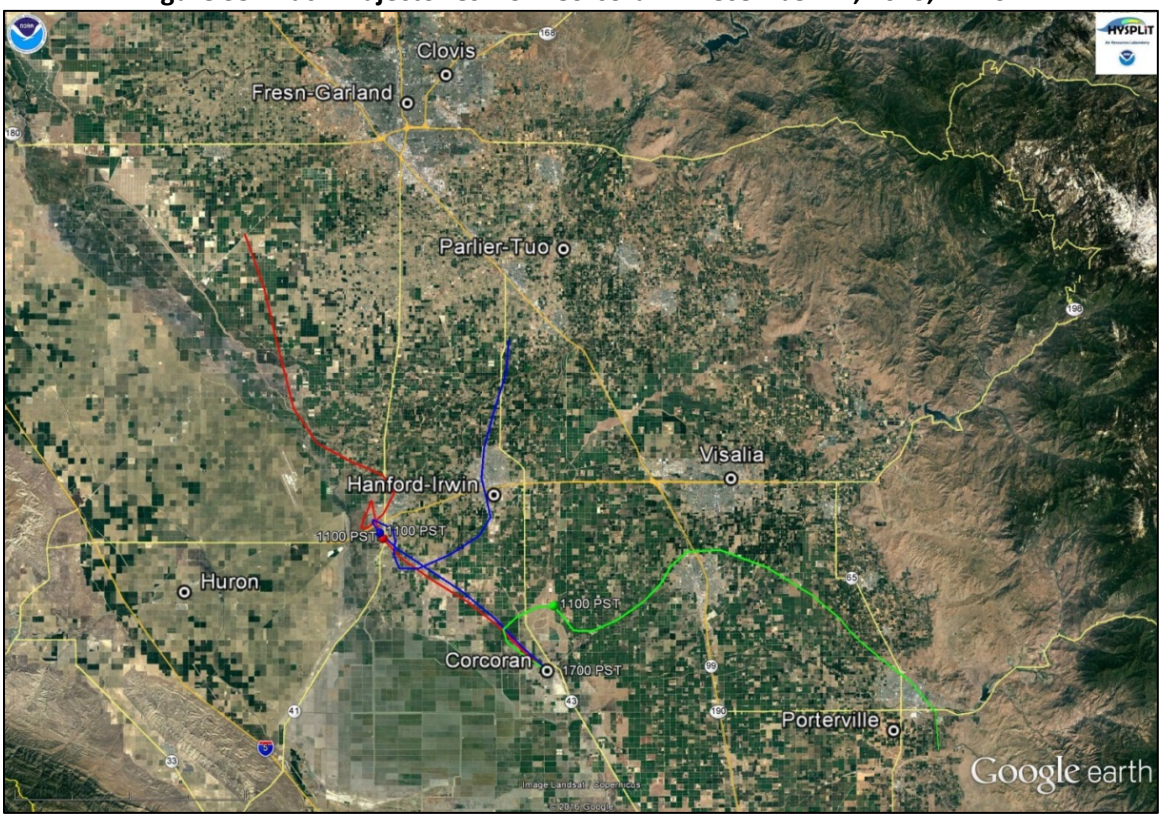
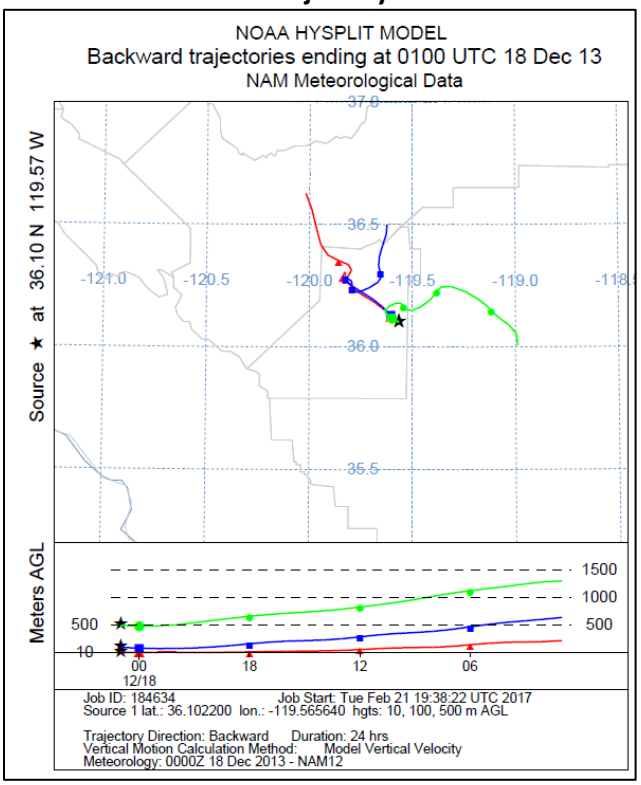


**Figure 36. NOAA HYSPLIT Model Back Trajectory Results – December 17, 2013, 17 PST**




Back trajectories at three levels in the atmosphere traced the path of air flow for the previous 24-hours from the monitor at Corcoran (Figure 36 above). The short length of the trajectories indicated a primarily local influence. The trajectory that impacted the surface at the monitor (10m – red) originated in Fresno County, moving almost directly southeast to Corcoran. This flow began at approximately 250m, descending to the surface approximately 12 hours before reaching the monitor (see lower section of the chart above for altitude of the trajectory path at meters AGL). The 100m trajectory (blue) also originated in Fresno County, but more to the east, and almost immediately moving into Kings County. It eventually joined the surface trajectory near Lemoore before impacting the monitor. The upper-level trajectory at 500m (green) originated to the east in Tulare County, moving west and then, in the final hour, southeast to Corcoran. Neither of the upper level trajectories descended to surface level, allowing for potential transport, but not entrainment at these levels. All three trajectories were within 20 miles of the monitor during the six hours prior to the afternoon peak concentrations. Influences from this time period would have been from the immediate vicinity of the monitor.

**Figure 37. Back Trajectories from Corcoran, Hanford and Visalia – December 18, 2013, 17 PST**

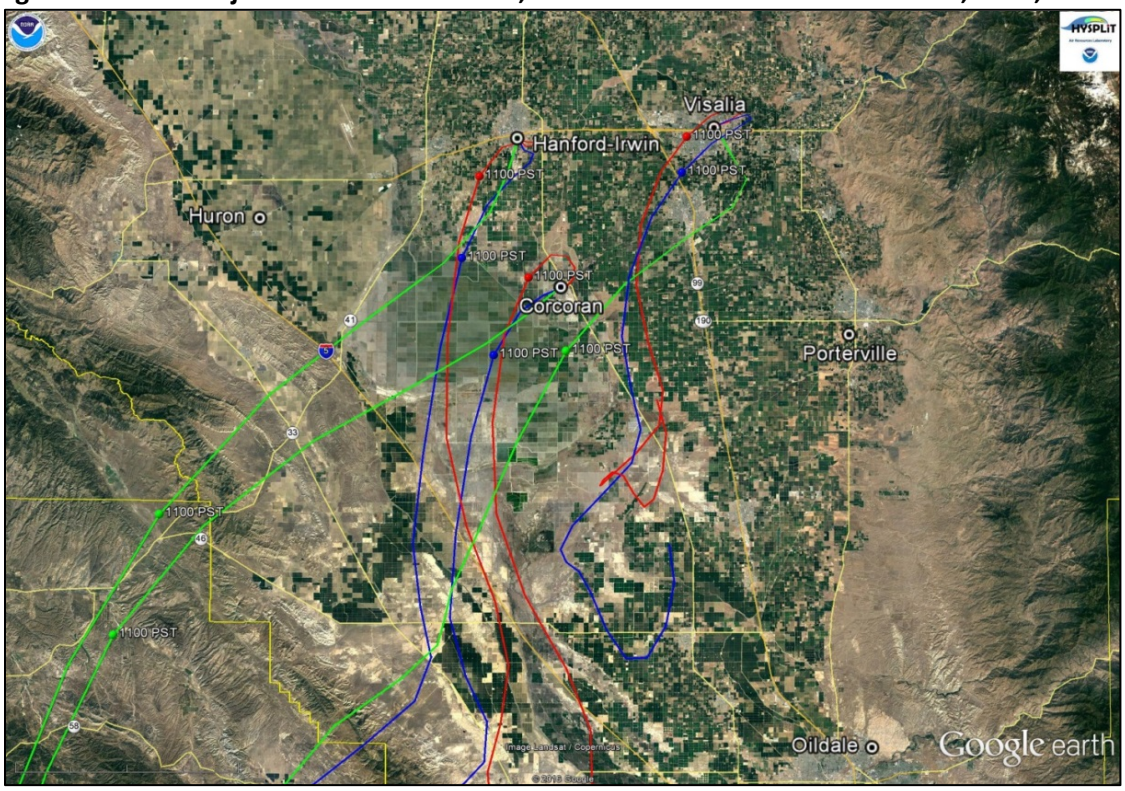
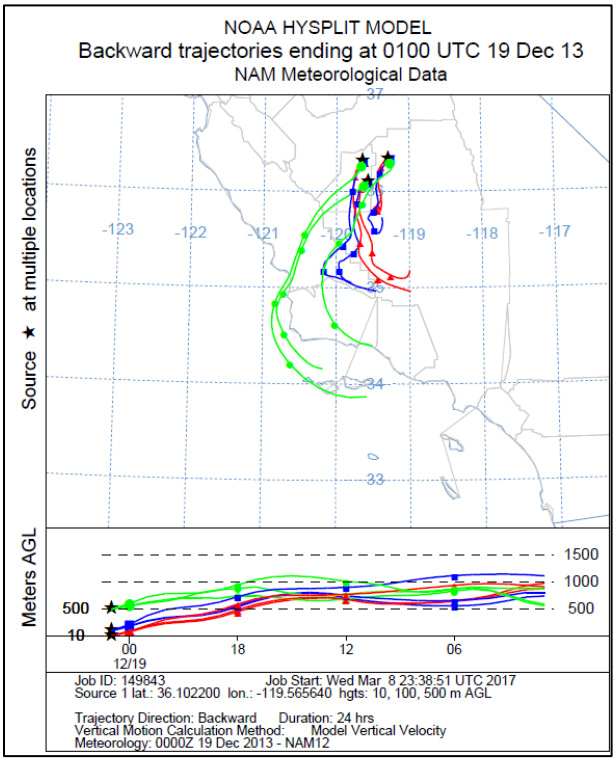


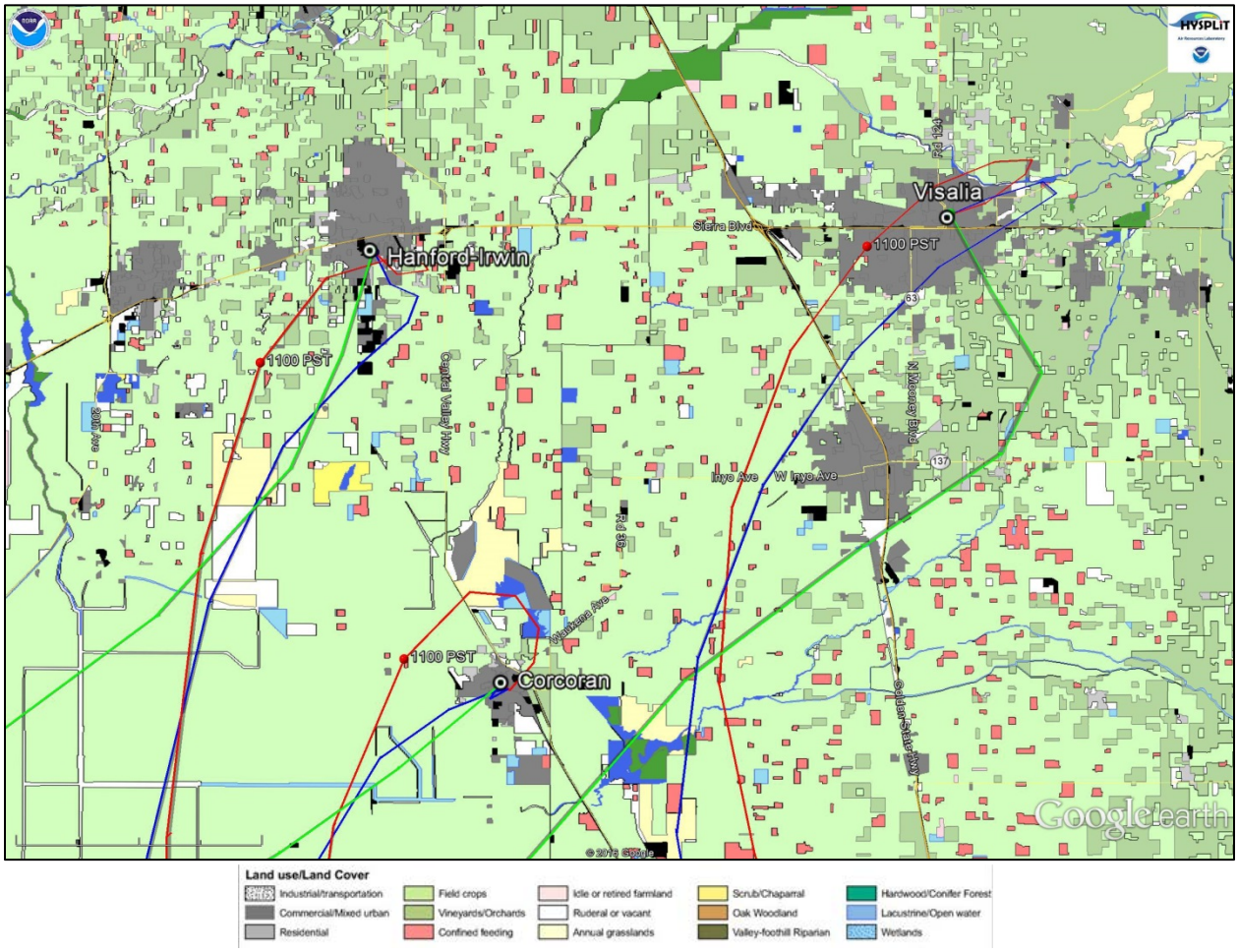

**Figure 38. NOAA HYSPLIT Model Back Trajectory Results – December 18, 2013, 17 PST**



Back trajectories at three levels in the atmosphere traced the path of air flow for the previous 24-hours from the monitors at Corcoran, Hanford, and Visalia (Figures 37 and 38 above). The trajectories all originated in the south and at elevations above 500m. The trajectories that impacted the surface at the monitors (10m – red) all originated locally, in Kern and Tulare Counties at almost 1000m above ground level (AGL). This flow did not descend to the surface until almost an hour prior to impacting the monitors (see lower section of the chart above for altitude of the trajectory path). The 100m trajectory (blue) also originated in Kern and Tulare Counties as well as in San Luis Obispo County, slightly more to the west. They eventually joined the surface trajectories before impacting the monitors. The upper-level trajectory at 500m (green) originated off the coast, moving west then northeast into SJV. Neither of the upper level trajectories descended to the surface, allowing for potential transport, but not entrainment at these levels. Both the 10m and 100m trajectories were within 12 miles of the monitor during the six hours prior to the afternoon period of high concentrations. Influences from this time period would have been from the immediate vicinity of the monitor.

A land-use/land cover layer was used with the HYSPLIT back trajectory to determine possible emission sources. The image below (Figure 39), combined with the primarily calm surface level flow toward the monitor, indicates that the primary local emissions would have been from local areas.

**Figure 39. Land Use/Land Cover - Trajectory Paths from Corcoran, Hanford, and Visalia**



**Summary**

Based on this initial analysis, the exceedances at the monitors on December 17 and 18, 2013 are the result of the buildup of particulate matter, combined with local emissions on the days of the exceedance, typical of a winter stagnation event.

## January 21-22, 2014

January 21: Bakersfield-California PM10 BAM monitor - 159 μg/$m^3$
January 22: Corcoran PM10 TEOM monitor - 156 μg/$m^3$

The PM10 exceedances on January 21 and January 22 occurred at the end of a high PM2.5 episode already in progress in SJV. PM10 concentrations were over the federal standard on both the 21st and the 22nd, at the same time that PM2.5 concentrations, already high, increased.

A ridge of high pressure was situated over the area, bringing calm conditions and above normal temperatures. The District issued a precautionary warning from January 17 through January 20 for potential smoke impacts from the Soda Fire, which started on January 14 in the Sequoia National Forest in the Sierra Nevada Mountains on the east side of the Valley. The NWS noted that the District prohibited fireplace/wood stove burning for both the 21st and the 22nd.

- **Evaluation of PM10 filter-based and continuous data across the Valley to understand the local or regional nature of each exceedance.**

Although other continuous PM10 monitors within SJV showed diurnal trends similar to Bakersfield on the 21st and Corcoran on the 22nd, no others exceeded the standard. Neither of these days were scheduled filter sampling days.

Figure 40 displays the PM10 filter and hourly data for SJV sites between January 21 and January 22. The PM10 concentrations on January 21 increased the most at Bakersfield, being the only site that exceeded the federal PM10 standard. On January 22, PM10 concentrations increased at Corcoran causing an exceedance of the federal PM10 standard, while most sites throughout the Valley saw decreasing concentrations on this day.

Figures 41 and 42, below, display the daily average PM10 hourly data recorded on January 21 and January 22. On January 21, the Bakersfield site recorded hourly values above the federal 24-hour average PM10 standard of 150 μg/$m^3$ between 9 and 10 PST, at 13 PST, and from 17 PST to midnight. Other continuous PM10 monitors also showed increased PM10 concentrations on January 21 but not to the degree seen at the Bakersfield site. On January 22, PM10 concentrations increased at other PM10 sites throughout the Valley but concentrations decreased at the Bakersfield monitor. On January 22, Corcoran was the only site to record a 24-hour PM10 concentration above the federal PM10 standard of 150 μg/$m^3$.

**Figure 40. Daily Regional PM10 Data – January 14 to January 29, 2014**

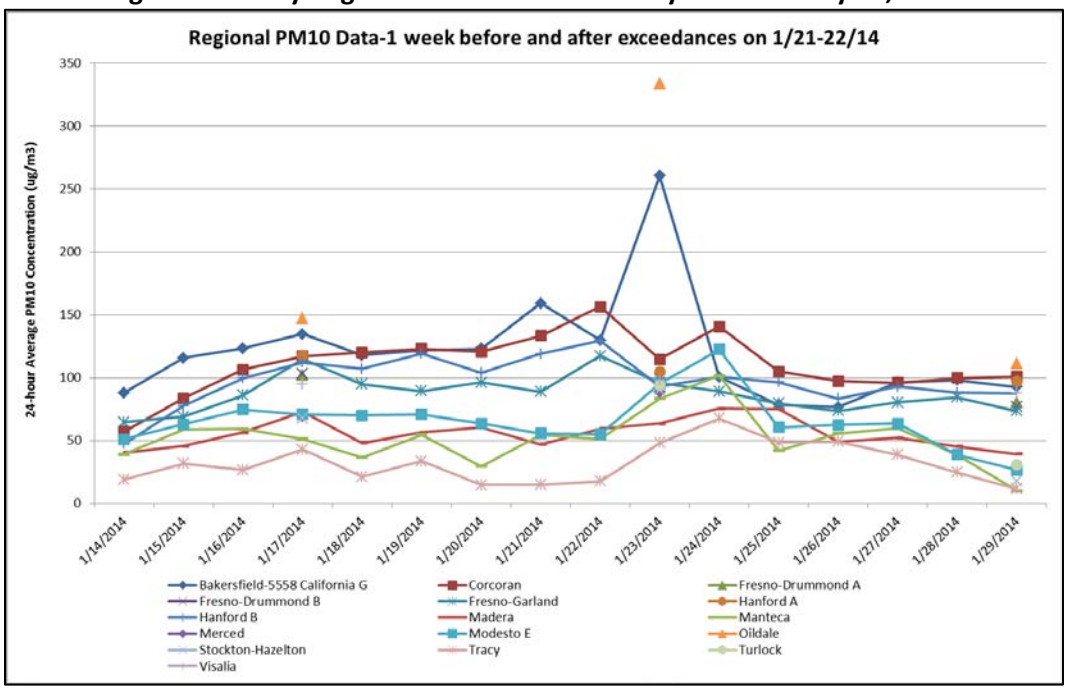



**Figure 41. SJV Hourly PM10 Data – January 21, 2014**

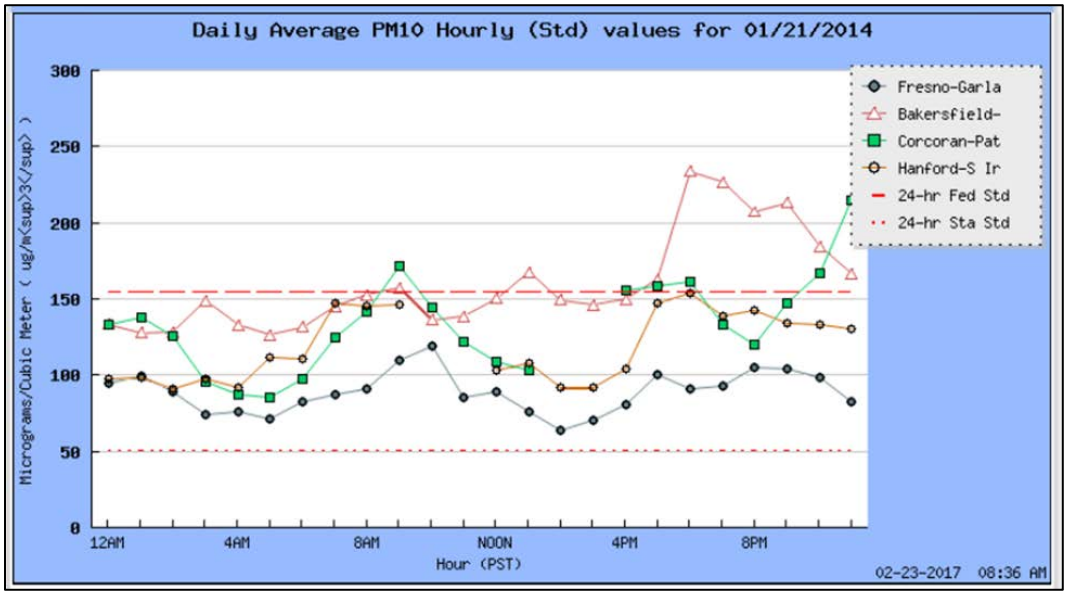
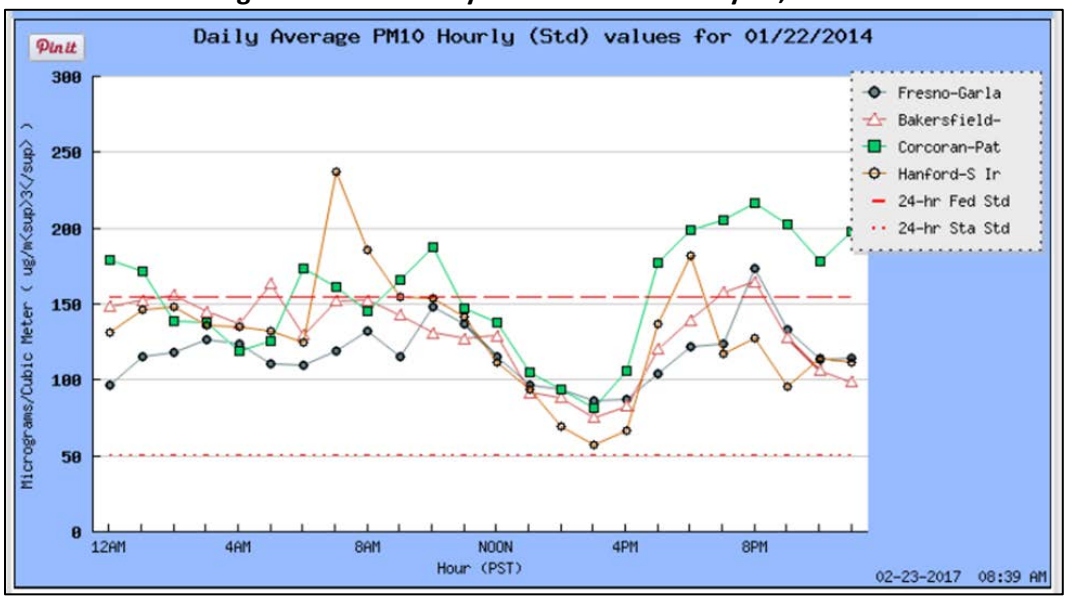


**Figure 42. SJV Hourly PM10 Data – January 22, 2014**




Several PM10 monitors in the State recorded elevated concentrations above the State standard of 50 μg/m$^3$. The majority of these were in the southern portion of the State, primarily in SJV, Mojave Desert, Imperial County, and San Luis Obispo County. In the Valley, six of the eight continuous monitors exceeded the State standard on the 21$^{st}$ and seven out of the eight on the 22$^{nd}$. The only sites that exceeded the federal standard of 150 μg/m$^3$ were Bakersfield on the 21$^{st}$ and Corcoran on the 22$^{nd}$, although Corcoran was close on the 21$^{st}$ and Bakersfield and Hanford were similarly close on the 22$^{nd}$.

- **Analysis of PM2.5 data to determine whether fine or coarse particles are contributing to the exceedance.**

Figure 43, displays the PM2.5 filter data for SJV sites between January 14 and January 29. Corcoran did not record PM2.5 data on January 21 and January 22 so the trend is not comparable to PM10 on the same day. However, the PM2.5 data at Bakersfield show a pattern similar to PM10, with concentrations higher on the 21$^{st}$ and decreasing on the 22$^{nd}$. The highest PM2.5 concentration on January 21 was 81.3 μg/m$^3$ at Bakersfield and 76.7 μg/m$^3$ at Hanford on January 22. Since Hanford is closest to Corcoran, it can be assumed that if PM2.5 data had been measured at Corcoran on January 22, the concentrations would be on par with those at Hanford.

Figure 44 shows that PM concentrations at Bakersfield were below the 24-hour PM10 standard of 150 μg/m$^3$ prior to the PM10 exceedance that occurred on January 21. The highest PM10 and PM2.5 concentrations at Bakersfield occurred on January 21 and January 23 (an event analyzed later in this document) and concentrations decreased after January 23. The increase in PM concentrations on the days leading up to the exceedances and the fact that the PM2.5 made up roughly half of the PM10 concentration on January 21, indicates the possibility that a stagnation episode had occurred. The District's analysis compared the January 21 PM concentrations at the Bakersfield monitor. With a PM2.5 concentration of 81.3 μg/m$^3$ and a PM10 concentration of 158.5 μg/m$^3$, approximately 49 percent of the PM10 sample was comprised of coarse particles, while 51 percent was comprised of fine particulate.

**Figure 43. Daily Regional PM2.5 Data – January 14 to January 29, 2014**

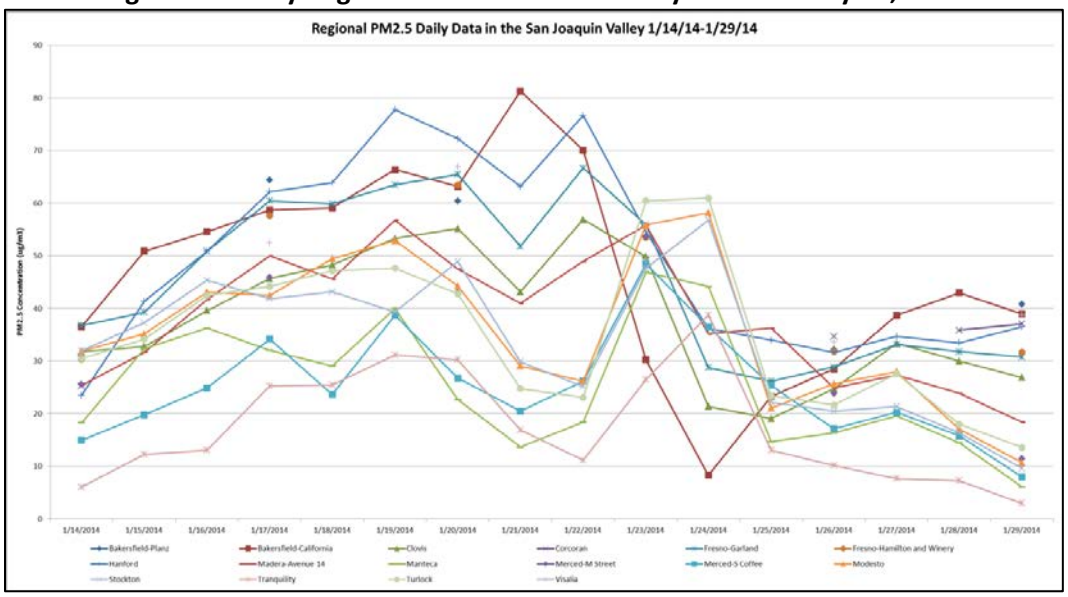
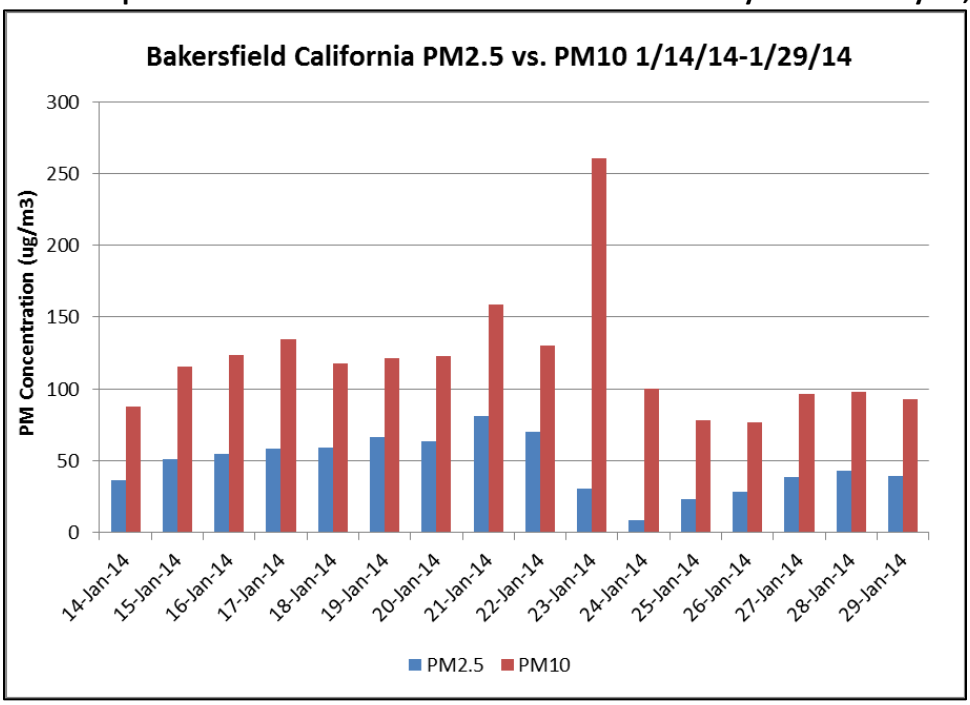



**Figure 44. Comparison of PM2.5 and PM10 at Bakersfield – January 14 to January 29, 2014**




Corcoran does not have a continuous PM2.5 monitor so only PM2.5 data from the filter monitor could be used for comparison to PM10 data on matching days. Since January 22 was not a scheduled filter sampling day, no PM2.5 data was available but data before and after were examined including the exceedance on January 22. The following chart (Figure 45) shows that PM concentrations at Corcoran were elevated for both PM2.5 and PM10 after January 14, with concentrations remaining at the same levels between January 26 and January 29. Daily PM2.5 and PM10 data was available at the Hanford site, which is the closest monitoring site to Corcoran. The Hanford data (Figure 46) shows that PM10 did increase on January 22 even though this site remained under the 24-hour PM10 standard. Both PM2.5

and PM10 concentrations followed a similar pattern. The District's analysis compared PM concentrations at the two monitors. The Corcoran PM10 (156.4 µg/$m^3$) and Hanford PM2.5 (76.8 µg/$m^3$) concentrations on January 22 indicated that approximately 51 percent of the sample was comprised of coarse particulate, while 49 percent was comprised of fine particulate.

**Figure 45. Comparison of PM2.5 and PM10 at Corcoran – January 14 to January 29, 2014**

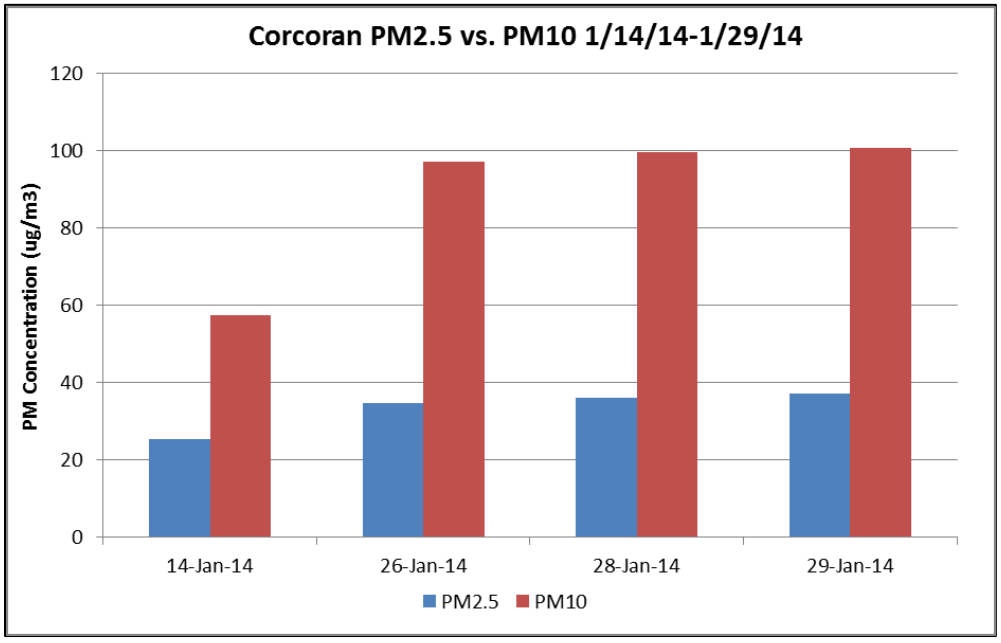
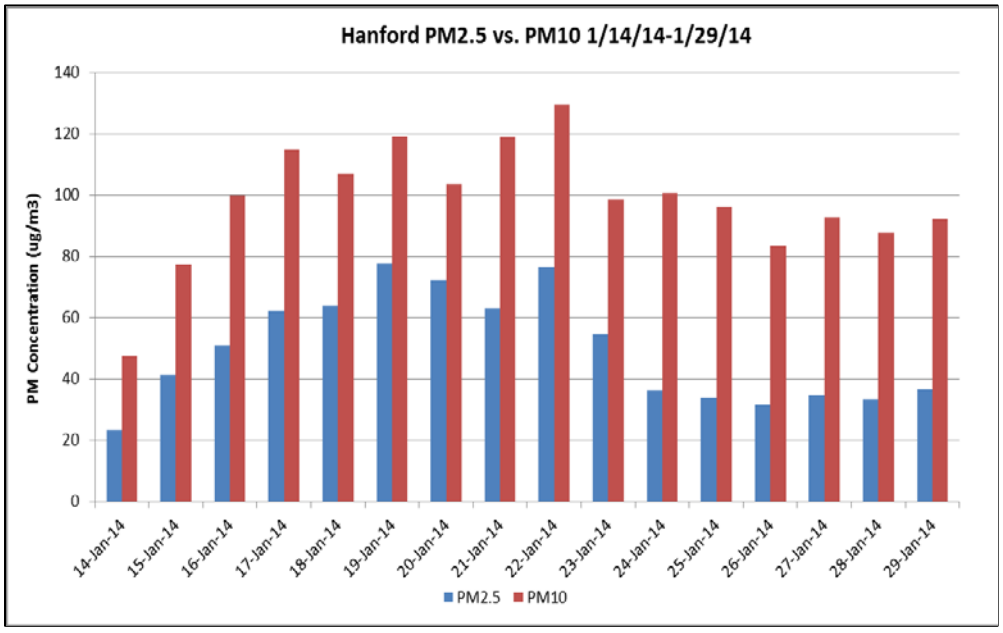



**Figure 46. Comparison of PM2.5 and PM10 at Hanford – January 14 to January 29, 2014**



- **Analysis of available chemical speciation data including additional filter speciation analysis as appropriate to assess potential source types contributing to each exceedance.**

No PM2.5 or PM10 speciation analysis was available for January 21 or January 22. However, PM2.5 speciation was recorded at Visalia before and after the January 21 exceedance at Bakersfield and the January 22 exceedance at Corcoran. The data (Table 6) shows that PM2.5 species increased at Visalia after the PM10 exceedances at Bakersfield and Corcoran occurred on January 21 and January 22. Based on levels of organic matter seen at Visalia during this time, impacts from the Soda Fire to the east are not significant.

**Table 6. PM2.5 Speciation Data (μg/m$^3$) at Visalia – January 5 to January 29, 2014**

| Monitor | Date | Mass | Ammonium Nitrate | Ammonium Sulfate | Organic Matter | Elemental Carbon | Geological | Elements |
|---|---|---|---|---|---|---|---|---|
| Visalia | 1/5/14 | 76 | 48.375 | 3.2154 | 15.33 | 2.1 | 1.17158 | 0.7915 |
| Visalia | 1/11/14 | 35.1 | 19.35 | 2.07 | 7.49 | 1.2 | 0.48066 | 0.597 |
| Visalia | 1/14/14 | 32.1 | 13.932 | 1.656 | 8.61 | 1.5 | 0.77652 | 0.7855 |
| Visalia | 1/23/14 | 48.7 | 29.154 | 1.8768 | 11.13 | 1.5 | 1.91002 | 0.4115 |
| Visalia | 1/29/14 | 39.5 | 23.607 | 1.6698 | 8.33 | 1.2 | 2.2535 | 0.653 |

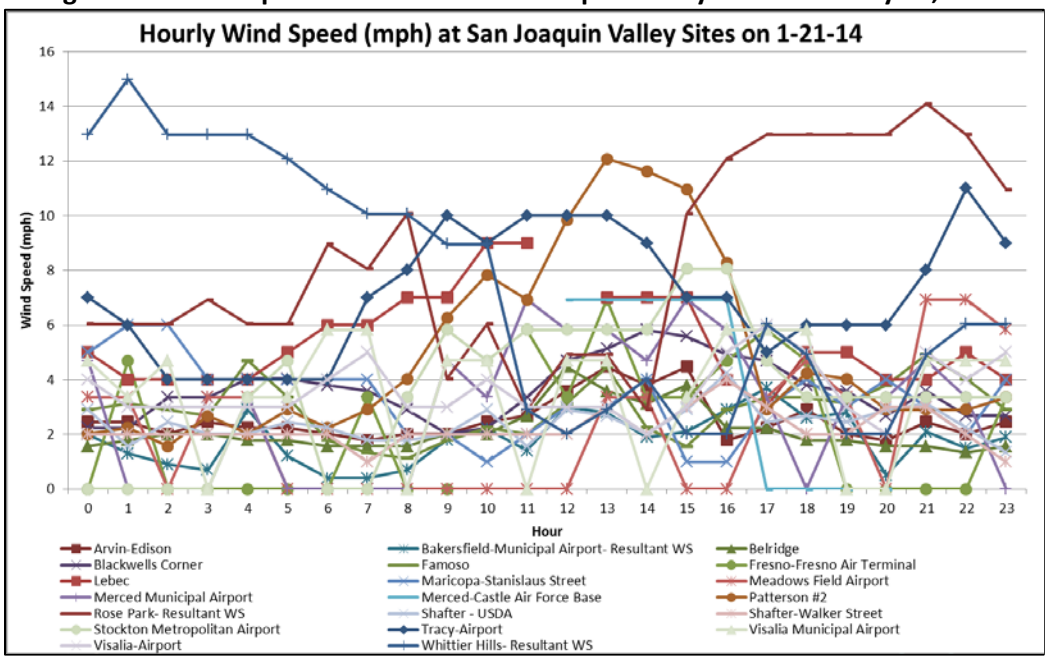
- **Analysis of wind speed and direction, along with geographic visualization tools to help identify the types of sources impacting each monitor.**

The Bakersfield-California monitoring site did not record wind data until late August in 2014. On January 21, the Bakersfield Municipal Airport reported a maximum wind speed of 4 mph at 17 PST; peak concentrations at the site were recorded at from 18 to 00 PST when wind speeds ranged from 2 to 3 mph. The highest wind speeds recorded in the Valley, around 14 mph, were to the north in Stanislaus County at Rose Peak and Patterson, although neither are indicated as potential source areas; Tulare County, which was indicated by the HYSPLIT back trajectory to be a possible source area, recorded a 15 mph wind speed at the Whittier Hills site early in the morning, but that site was far to the east and in the Sierra Nevada Mountains.

On January 22, the monitoring site at Corcoran reported wind speeds of 4 mph from 00 to 02 PST and at 15 PST; high concentrations at the site were recorded between 00 and 02 PST and from 16 to 00 PST when wind speeds were 0-4 mph. The highest wind speeds recorded in the Valley were at Lebec in Kern County (14 mph) and Tracy in San Joaquin County (13 mph). Both these high winds were at 13 PST, when back trajectories indicated air flow was near Corcoran.

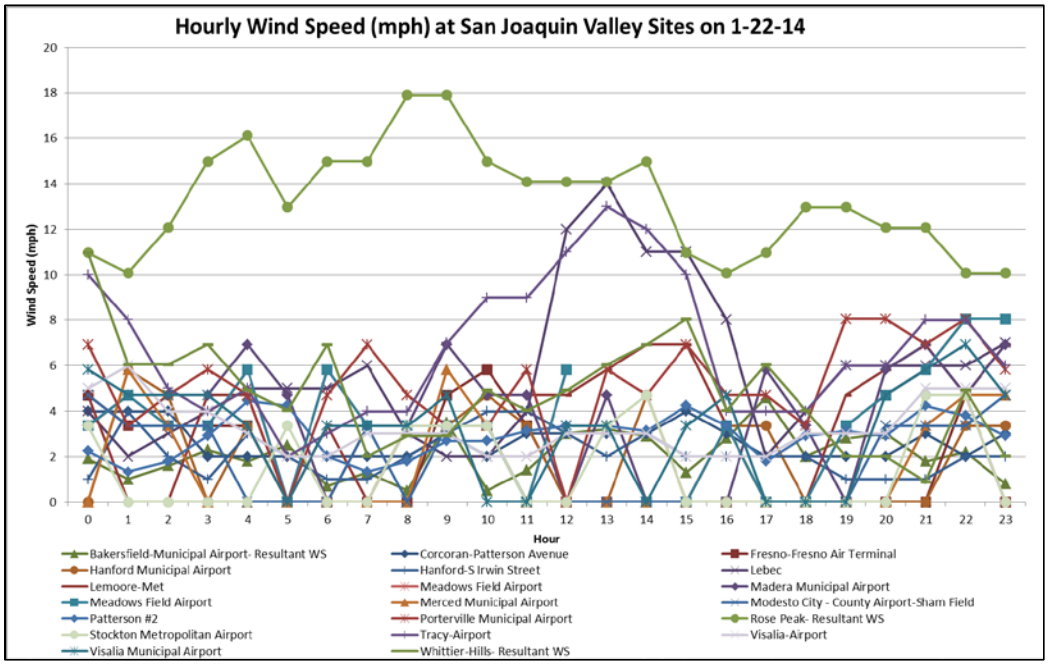
The following charts show the hourly wind speed data on January 21 and January 22 at each site in Kern (Figure 47) and Kings (Figure 48) Counties as well as the basin wide airport sites. Winds were fairly low throughout the Valley sites on both days.

**Figure 47. Wind Speeds at Selected San Joaquin Valley Sites – January 21, 2014**




*Wind data at Bakersfield-Municipal Airport, Rose Peak, and Whittier Hills are resultant wind speed.

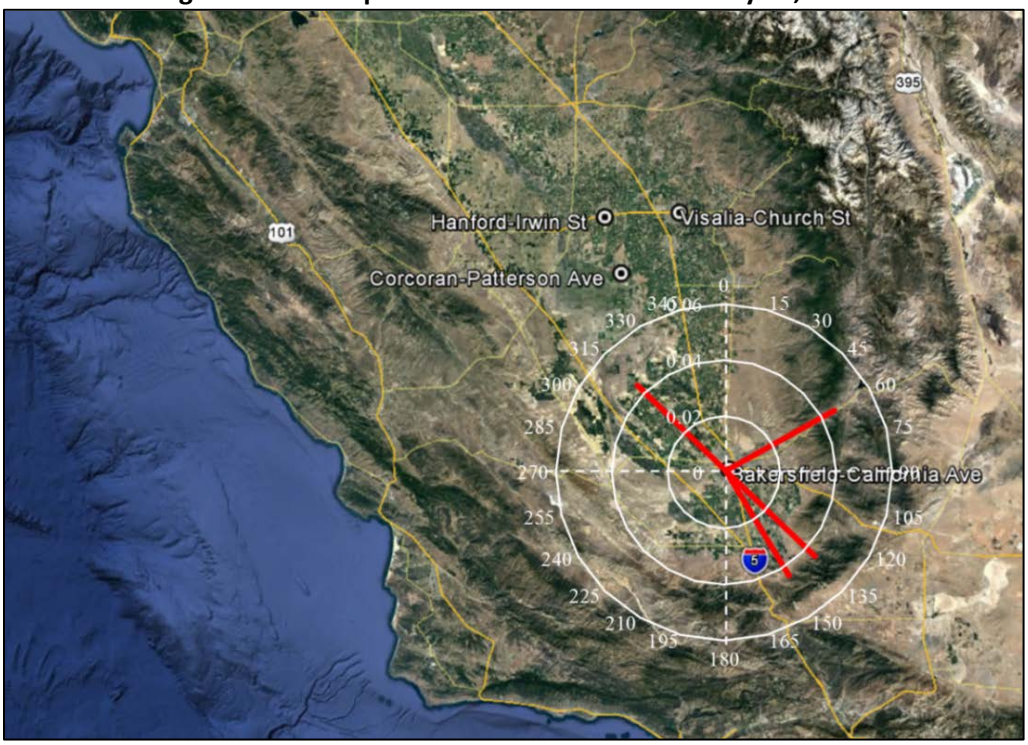
**Figure 48. Wind Speeds at Selected San Joaquin Valley Sites – January 22, 2014**




*Wind data at Bakersfield-Municipal Airport, Rose Peak, and Whittier Hills are resultant wind speed.

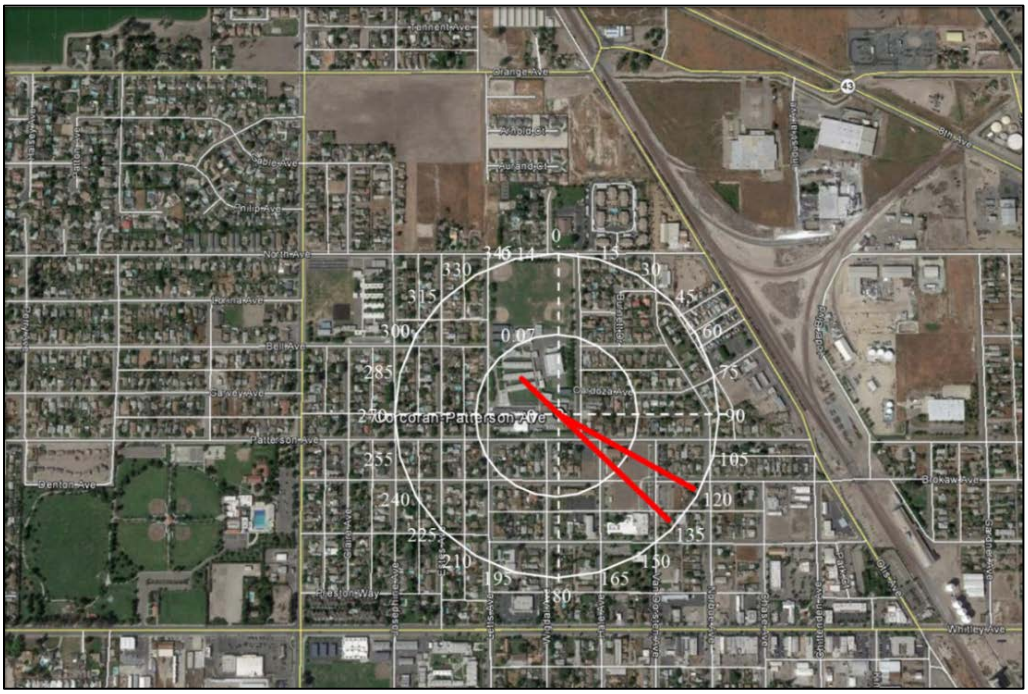
The wind rose below (Figure 49) demonstrates that only 4 percent of the winds at Bakersfield were above 3 knots (3.45 mph) and were from the northeast on January 21. The remaining 96 percent of the winds on this day were considered calm winds (below 3 knots) and were from the northwest and southeast.

**Figure 49. Wind patterns at Bakersfield - January 21, 2014**




The wind rose below (Figure 50) demonstrates that 29 percent of the winds at Corcoran were above 3 knots (3.45 mph) and were from the northwest and southeast on January 22. The remaining 71 percent of the winds on this day were considered calm winds (below 3 knots).

**Figure 50. Wind patterns at Corcoran - January 22, 2014**



A 24-hour HYSPLIT back trajectory from the Bakersfield monitor on the 21st (Figure 51) indicated potential impact by local sources. The path of airflow prior to the high concentrations at 18 PST showed a surface level approach from the northwest (10m-red and 100m-blue), traveling a distance of less than 20 miles in the last six hours.

**Figure 51. Back Trajectories from Bakersfield – January 21, 2014, 18 PST**

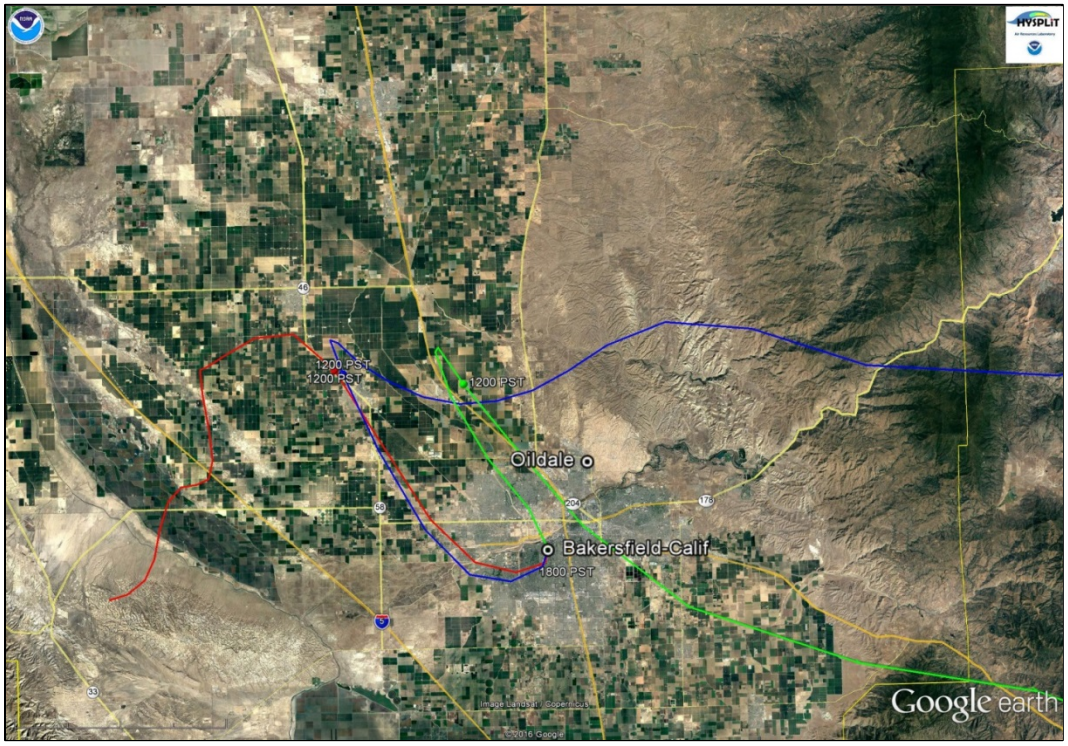
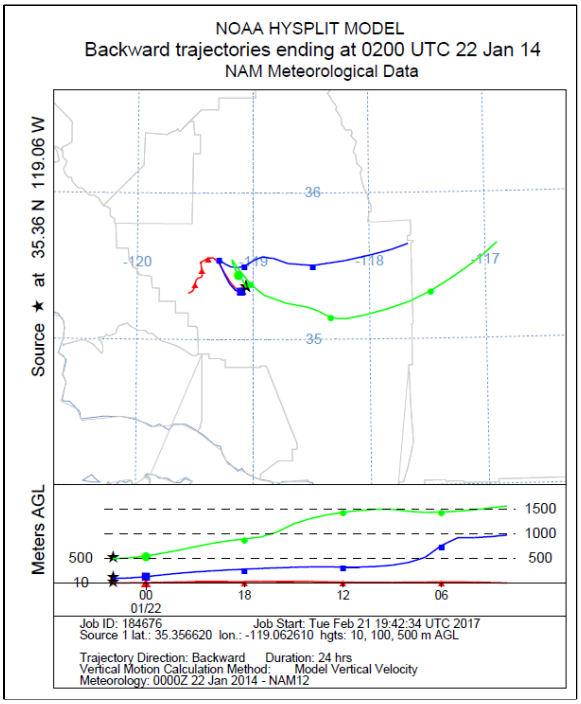


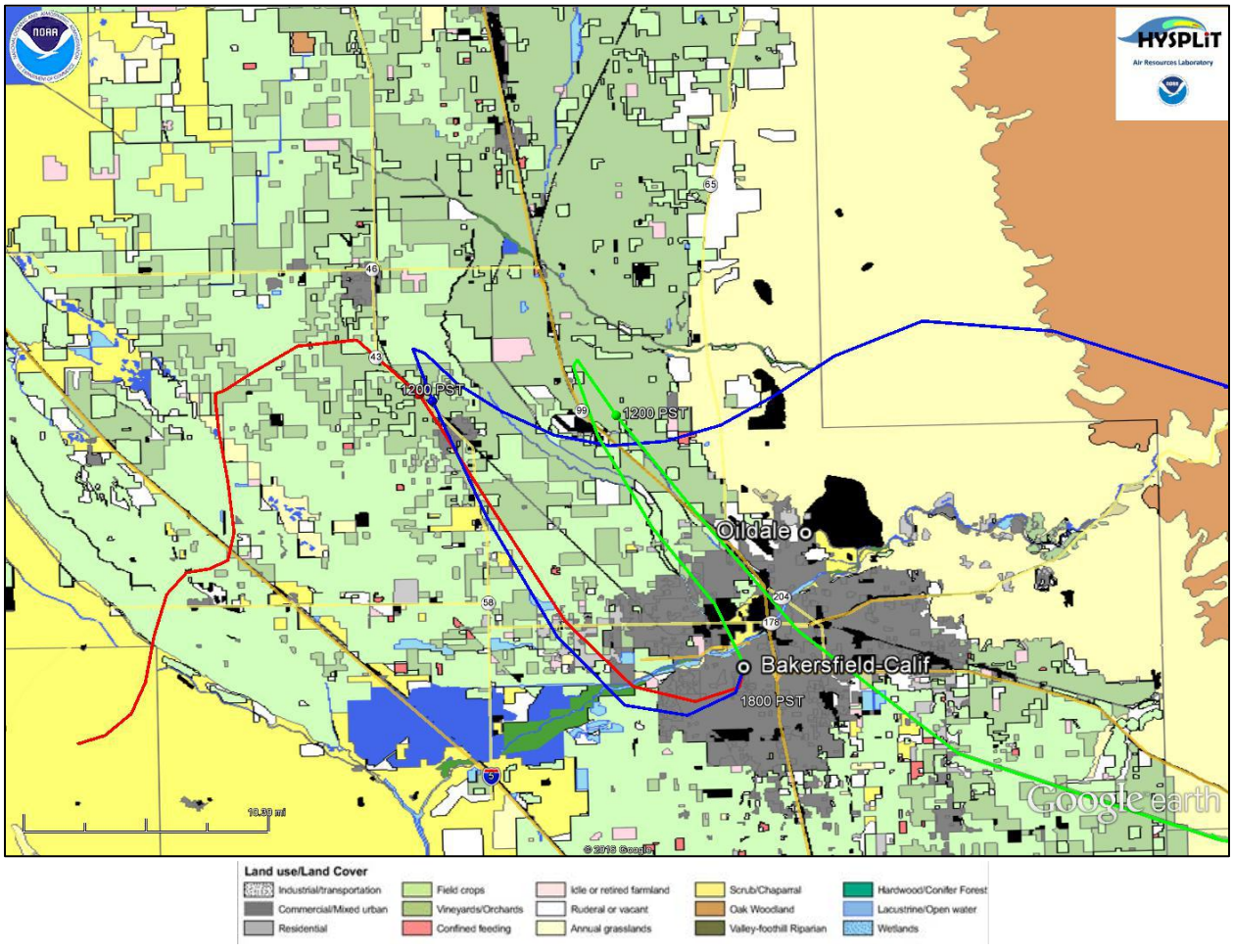

**Figure 52. NOAA HYSPLIT Back Trajectory Results – January 21, 2014, 18 PST**



Back trajectories at three levels in the atmosphere (Figure 52 above) traced the path of air flow for the previous 24-hours and indicated a primarily local and influence. The trajectory that impacted the surface at the Bakersfield monitor (10m – red line) originated in the mountains on the west side of the Valley, moving east and eventually southeast. This flow remained at surface level throughout the entire 24 hours (see lower section of the chart above for the altitude of the trajectory path). Both upper level trajectories (100m – blue and 500m – green) originated to the east of Kern County in the Sierra Nevada Mountains. Both trajectories originated south of the Soda Fire (which was approximately 60 miles east of Corcoran) and never reached the surface. All three trajectories were within 20 miles of the Bakersfield monitor in the six hours prior to the afternoon peak concentrations. Influences from this time period would have been from the immediate vicinity of the monitor.

A land-use/land cover layer was used with the HYSPLIT back trajectory to determine possible emission sources (Figure 53). Ccombined with the predominantly low surface flow toward the monitors, this indicates that the primary emissions would have been from the local area, including a buildup of particulates from previous days.

**Figure 53. Land Use/Land Cover - Trajectory Paths from Bakersfield**




A 24-hour HYSPLIT back trajectory from the Corcoran monitor on the 22nd (Figure 54) indicated impact by northern and local sources. The path of airflow prior to the high concentrations at 20 PST showed an approach from the north at all levels, traveling a distance of less than 30 miles in the final six hours.

**Figure 54. Back Trajectories from Corcoran – January 22, 2014, 20 PST**

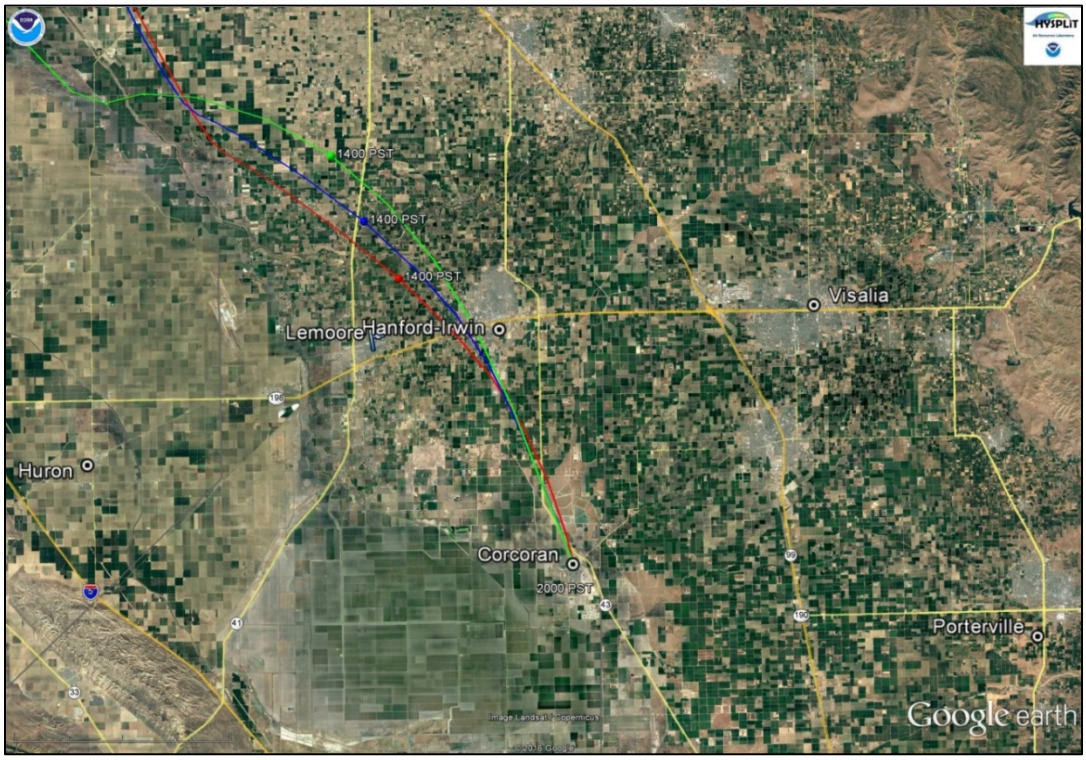
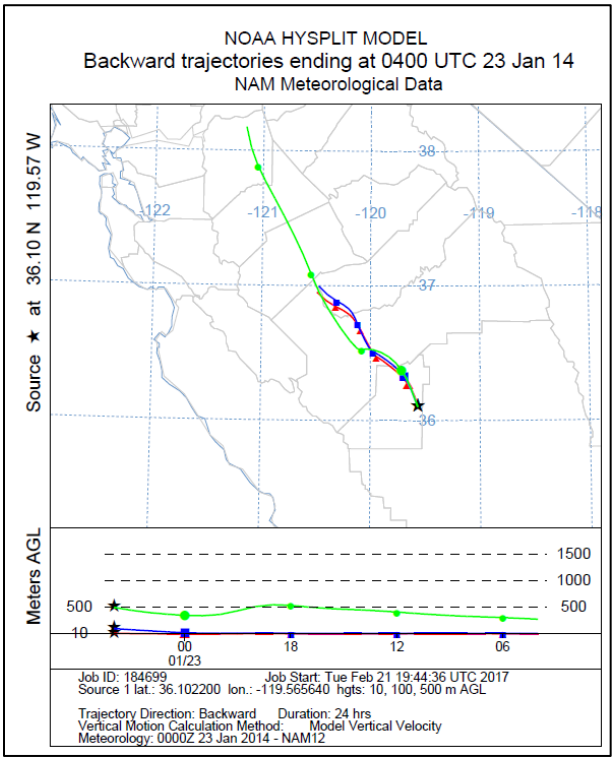


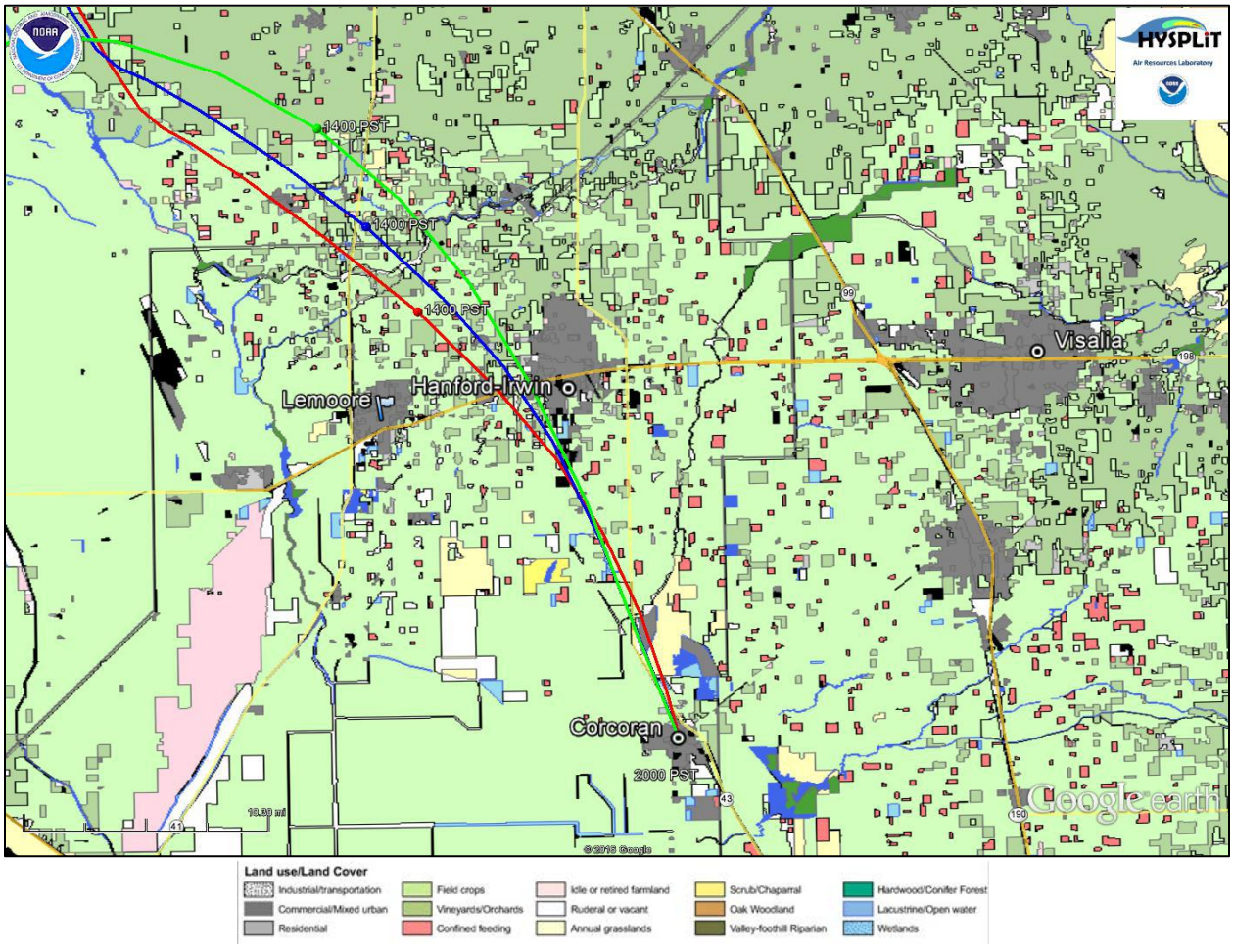

**Figure 55. NOAA HYSPLIT Back Trajectory Results – January 22, 2014, 20 PST**



Back trajectories at three levels in the atmosphere (Figure 55 above) traced the path of air flow for the previous 24-hours and indicated a primarily local and northern influence. The two lower level trajectories that impacted the surface at the Corcoran monitor (10m – red line and 100m – blue line) originated on the western Madera/Fresno County border, moving north almost in sync. These flows remained at surface levels throughout almost the entire time period (see lower section of the chart above for the altitude of the trajectory path), with the 100m trajectory ascending only after 16 PST. The highest level trajectory (500m – green) originated further north in San Joaquin County. All three trajectories were within 30 miles of the Corcoran monitor in the six hours prior to the evening peak concentrations. Influences from this time period would have been from areas to the north and in the immediate vicinity of the monitor.

A land-use/land cover layer (Figure 56) was used with the HYSPLIT back trajectory to determine possible emission sources. The image below, combined with the predominantly low surface flow toward the monitors, indicates that the primary emissions would have been from the local area, including a buildup of particulates from previous days.

**Figure 56. Land Use/Land Cover - Trajectory Paths from Corcoran**



**Summary**

Based on this initial analysis, the exceedances at the monitors on January 21 and 22, 2014 are the result of the buildup of particulate matter, combined with local emissions on the days of the exceedance, typical of a winter stagnation event.

## January 23, 2014

Bakersfield-California PM10 BAM monitor - 260 μg/$m^3$
Oildale PM10 FRM monitor - 334 μg/$m^3$

The PM10 exceedance was likely driven by high winds and blowing dust, exacerbated by high PM concentrations already evidenced in SJV. The District flagged the data in AQS as a high wind event. The PM10 exceedances on January 23 occurred at the end of a high PM episode already in progress. All sites in the Valley were impacted, although only the monitors at Bakersfield and Oildale in Kern County exceeded the federal PM10 standard.

A ridge of high pressure was situated over the area, bringing calm conditions and above normal temperatures. A strong pressure gradient developed over the Valley, resulting in strong gusty winds. A high wind warning and a blowing dust advisory, issued by the NWS, was in effect from the evening of the 23rd to the afternoon of the 24th for the west central and southern portions of the Valley. In the afternoon of the 23rd, the District issued a health cautionary warning for blowing dust as a result of gusty winds for the western and southern portions of the Valley, including Kern County. The NWS noted that the District also prohibited fireplace/wood stove burning. The NOAA Storm Events Database recorded three events: a dust storm in southeast SJV at around 11 PST, a dust storm in southwest SJV at around 12 PST, and a report of 70 mph winds in the Kern County Mountains at 13 PST.

- **Evaluation of PM10 filter-based and continuous data across the Valley to understand the local or regional nature of each exceedance.**

Concentrations at the other continuous monitors in the SJV were below the level of the federal standard and did not show any trends similar to that seen at Bakersfield. This was a scheduled filter sampling day.

Figure 57, below, displays the PM10 filter and hourly data for SJV sites between January 15 and January 23. The PM10 concentrations on January 23 increased the most at Bakersfield and Oildale, with these two sites being the only sites that exceeded the federal PM10 standard. As mentioned in the previous event analysis, on January 22 PM10 concentrations increased at Corcoran causing an exceedance of the federal PM10 standard, when other sites throughout the Valley decreasing concentrations.

**Figure 57. Daily Regional PM10 Data – January 15 to January 30, 2014**

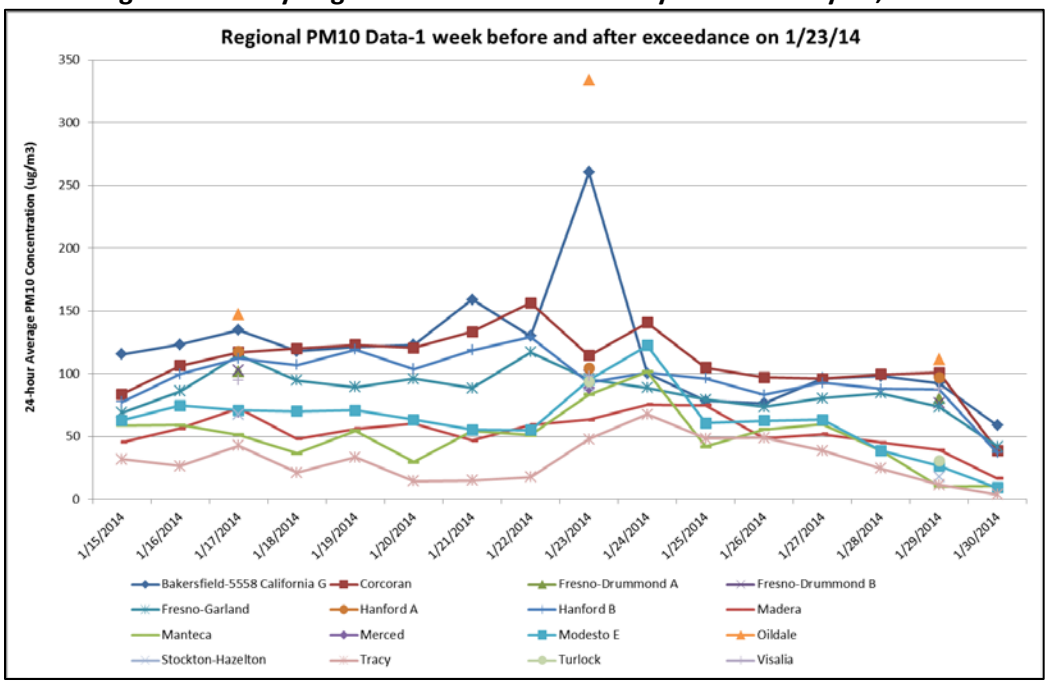
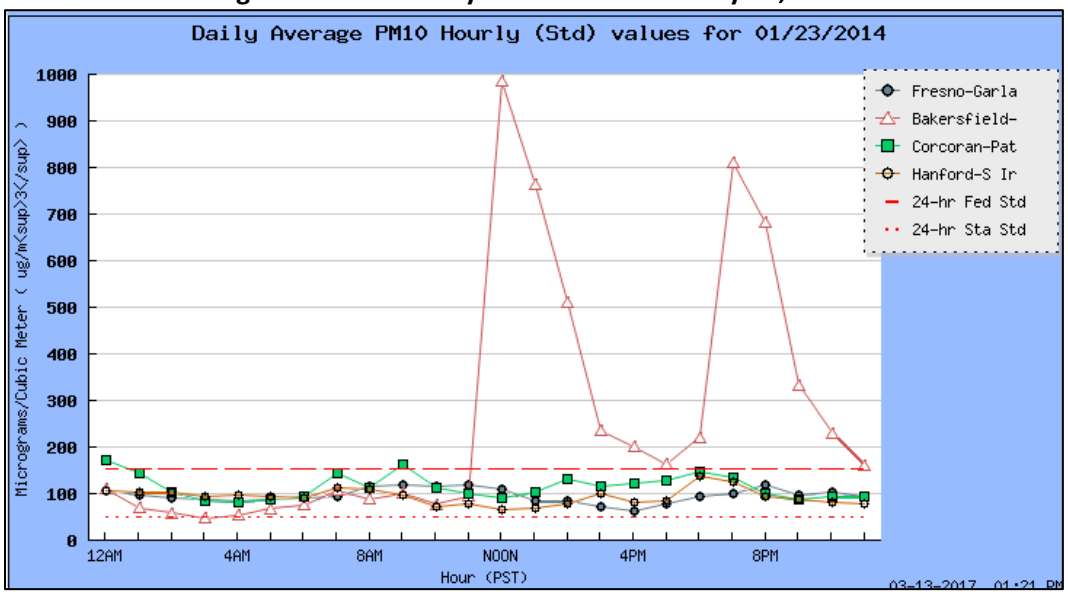



Figure 58 displays the daily average PM10 hourly data on January 23. On this day the Bakersfield site recorded hourly values above the federal 24-hour average PM10 standard of 150 µg/m$^3$ from 12 PST to midnight. The Oildale site only records filter PM10 data so an hourly trend is not available.

**Figure 58. SJV Hourly PM10 Data – January 23, 2014**

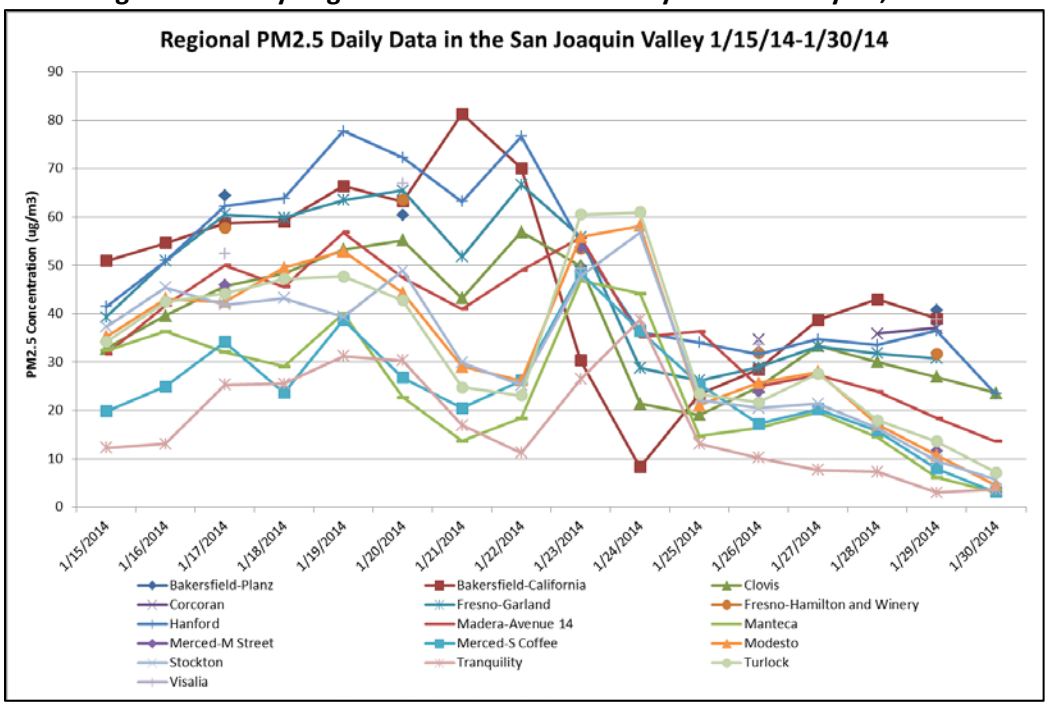



Most of the PM10 monitors in the State that exceeded the State standard of 50 µg/m$^3$ were in the SJV and Imperial County. In the Valley, all but one monitor exceeded the State standard on the 23$^{rd}$; the only sites that exceeded the federal standard of 150 µg/m$^3$ were Bakersfield and Oildale.

- **Analysis of PM2.5 data to determine whether fine or coarse particles are contributing to the exceedance.**

The chart below (Figure 59) displays PM2.5 filter data for SJV sites between January 15 and January 30. Oildale does not record PM2.5 data so the trend is not comparable to PM10 on the same day. PM2.5 data at Bakersfield-California was fairly low on January 23 (30.3 μg/m$^3$) with Bakersfield-Planz measuring higher a higher PM2.5 concentration at 49.7 μg/m$^3$. The highest PM2.5 concentration on January 23 was 60.5 μg/m$^3$ at Turlock. Since Oildale is close to the Bakersfield sites it can be assumed that if PM2.5 data was measured at Oildale on the 23rd, the concentrations would be similar.

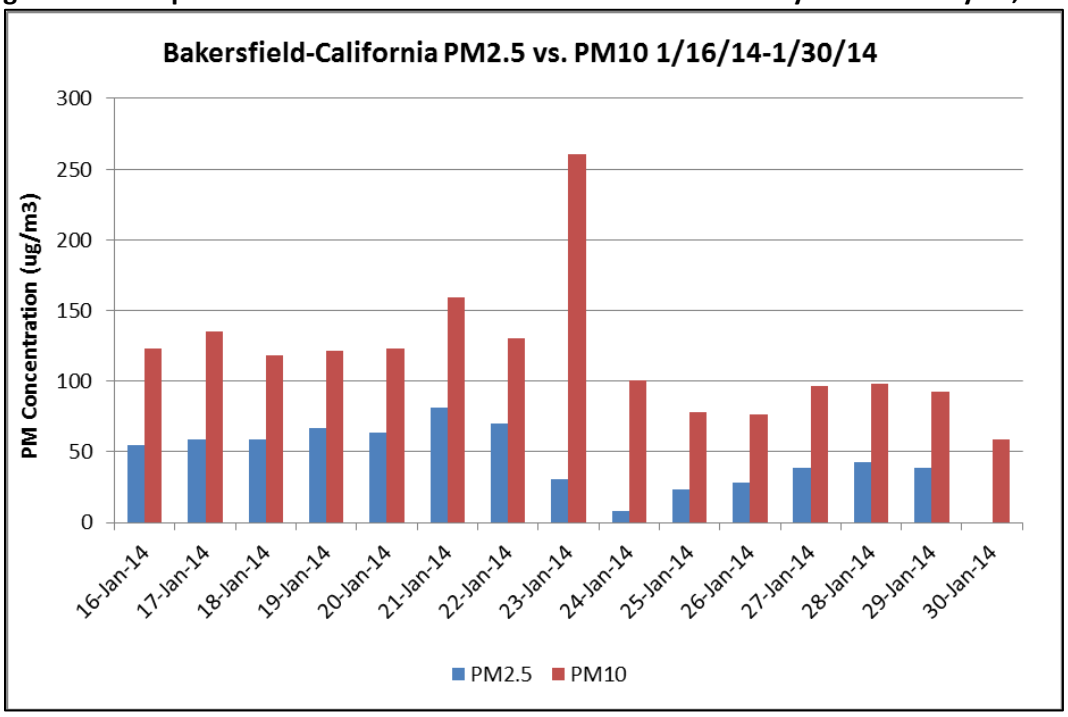
**Figure 59. Daily Regional PM2.5 Data – January 15 to January 30, 2014**




The chart below (Figure 60) shows that PM10 spiked on the 23rd at Bakersfield while PM2.5 slowly decreased from the higher concentrations measured in the week prior to the PM10 exceedance. The District's analysis compared the January 23 PM concentrations at the Bakersfield monitor. With a PM2.5 concentration of 30.3 μg/m$^3$ and a PM10 concentration of 260 μg/m$^3$, approximately 89 percent of the PM10 sample was comprised of coarse particles, while 11 percent was comprised of fine particulate.

The District's analysis compared PM concentrations at the Bakersfield and Oildale monitors. The Oildale PM10 (334 μg/m$^3$) and Bakersfield PM2.5 (30.3 μg/m$^3$) concentrations on January 23 indicated that approximately 91 percent of the sample was comprised of coarse particulate, while 9 percent was comprised of fine particulate.

**Figure 60. Comparison of PM2.5 and PM10 at Bakersfield – January 16 to January 30, 2014**




- **Analysis of available chemical speciation data including additional filter speciation analysis as appropriate to assess potential source types contributing to each exceedance.**

Speciation data was recorded at Fresno, Modesto, and Visalia on January 23 (Table 7). These sites are located in different counties from the Corcoran and Hanford sites. The high ammonium nitrate concentrations on the 23rd indicate the stagnation episode allowed for the accumulation of secondary PM2.5.

**Table 7. PM2.5 Speciation Data (μg/m$^3$) at Fresno, Modesto, and Visalia – January 23, 2014**

| Monitor | Date | Mass | Ammonium Nitrate | Ammonium Sulfate | Organic Matter | Elemental Carbon | Geologic | Elements |
|---|---|---|---|---|---|---|---|---|
| Fresno | 1/23/14 | 55.1 | 34.314 | 2.1804 | 11.90 | 1.49 | 1.4997 | 0.2798 |
| Modesto | 1/23/14 | 55.3 | 33.927 | 2.1114 | 11.48 | 2.2 | 1.7498 | 0.576 |
| Visalia | 1/23/14 | 48.7 | 29.154 | 1.8768 | 11.13 | 1.5 | 1.9100 | 0.4115 |

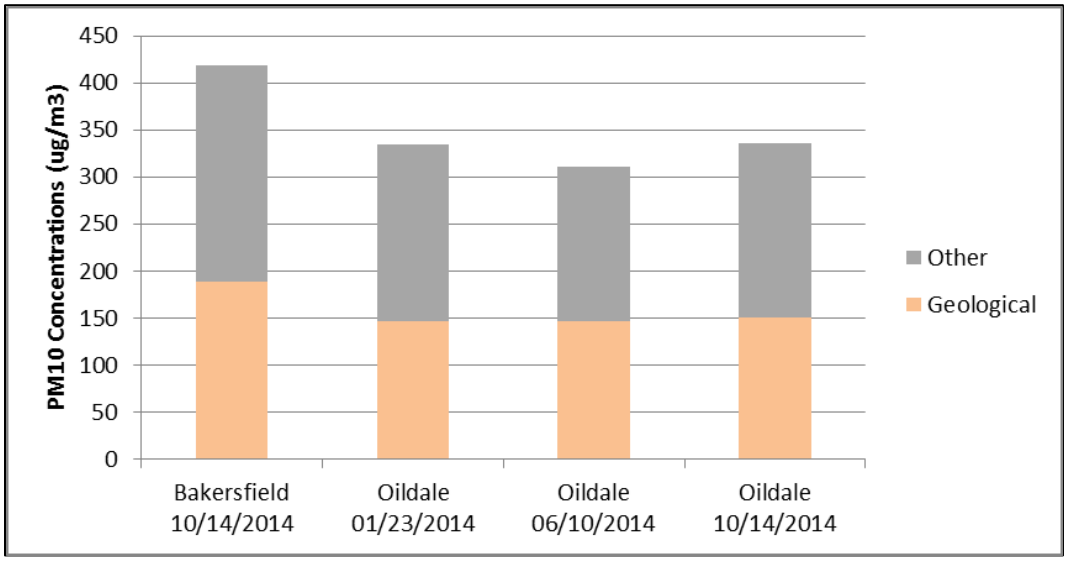
MLD analyzed six PM10 filters for metals using inductively coupled plasma microscopy (ICP-MS) and for ions using ion chromatography (IC). All filters had very high PM10 concentrations ranging from 155 μg/m$^3$ to over 400 μg/m$^3$. One filter was collected from Bakersfield (January 14, 2014), one from Hanford (December 18, 2013), one from Visalia (December 18, 2013), and three from Oildale (January 23, 2014, June 10, 2014, and October 14, 2014). More detailed information on this analysis is located in Appendix A.

Table 8 and Figure 61 illustrate the relationship between measured PM10 mass and estimated fugitive dust mass.

**Table 8. PM10 and Estimated Fugitive Dust Concentrations (μg/m$^3$)**

| | Oildale 01/23/2014 |
|---|---|
| PM10 (μg/m$^3$) | 334 |
| Iron (μg/m$^3$) | 8.16 |
| Fugitive Dust (μg/m$^3$) | 155.04 |
| Other (μg/m$^3$) | 178.96 |

**Figure 61. PM10 Filters with High Fugitive Dust**

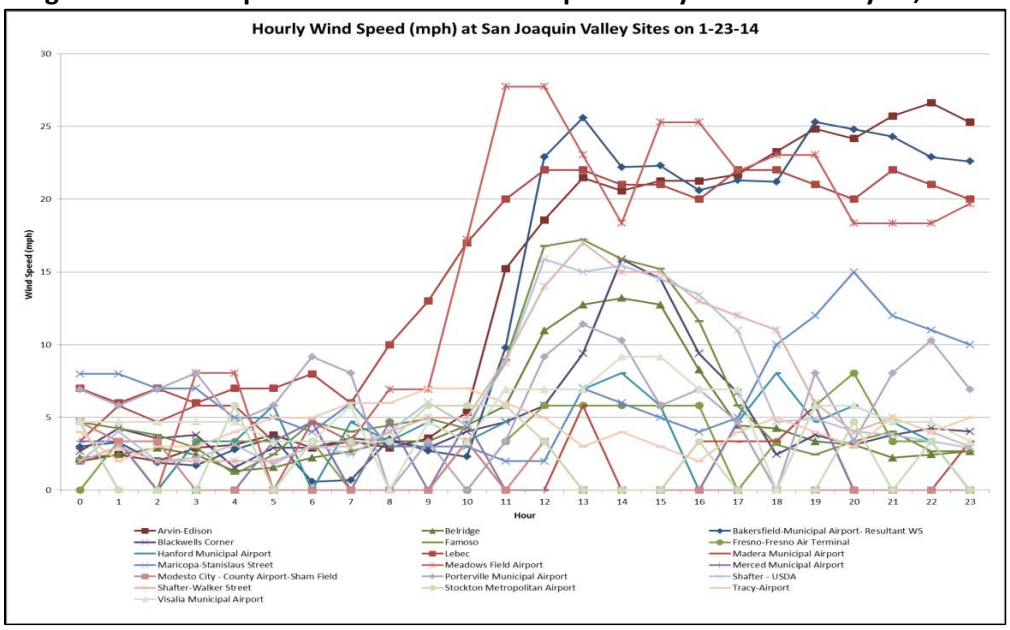



- **Analysis of wind speed and direction, along with geographic visualization tools to help identify the types of sources impacting each monitor.**

The Bakersfield-California monitoring site did not record wind data until late August. The Bakersfield Municipal Airport reported a maximum wind speed of 26 mph at 13 PST at the time of the first peak concentrations at the site; peak PM10 concentrations were recorded from 12 to 14 PST and from 19 to 20 PST. The Municipal Airport recorded winds speeds ranging from 21 to 26 mph for the entire afternoon and evening. The Bakersfield-Meadows Field Airport, also recorded high wind speeds in the afternoon and evening, ranging from 18 to 28 mph. The highest winds speeds documented in the Valley were at Edison, approximately 10 miles to the east of the Bakersfield/Oildale monitors. Winds of 31 mph were recorded from 12 to 13 PST. Unfortunately, wind data for the rest of the afternoon was not available.

Figure 62 shows the hourly wind speed data on January 23 at each site in Kern County as well as the basin wide airport sites.

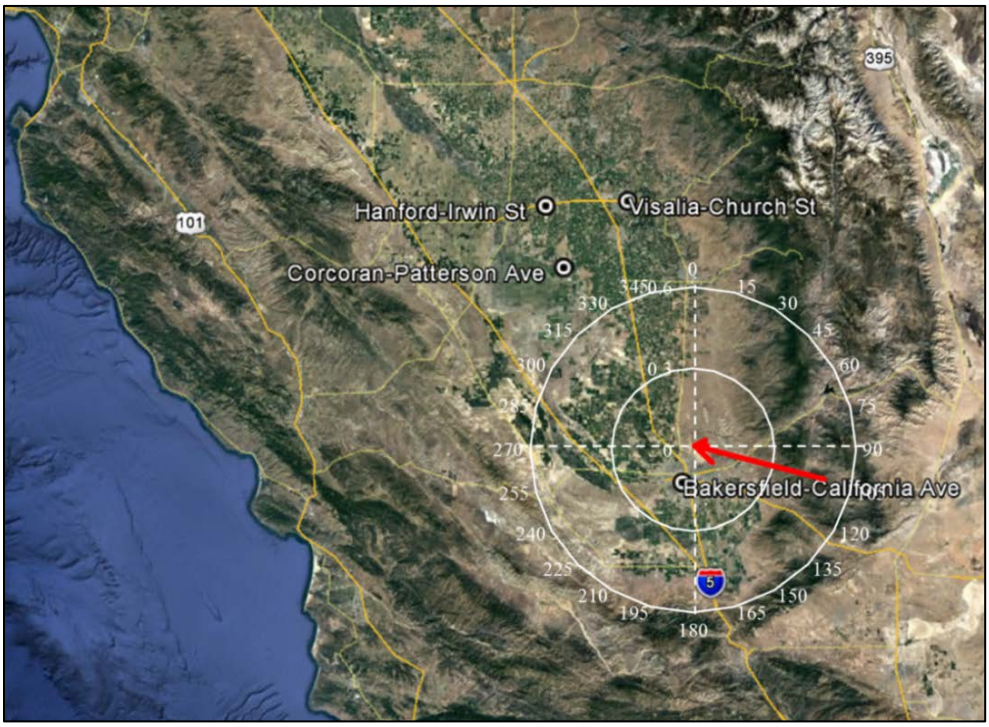
**Figure 62. Wind Speeds at Selected San Joaquin Valley Sites – January 23, 2014**




*Resultant wind speed data was used for the Bakersfield-Municipal Airport site.

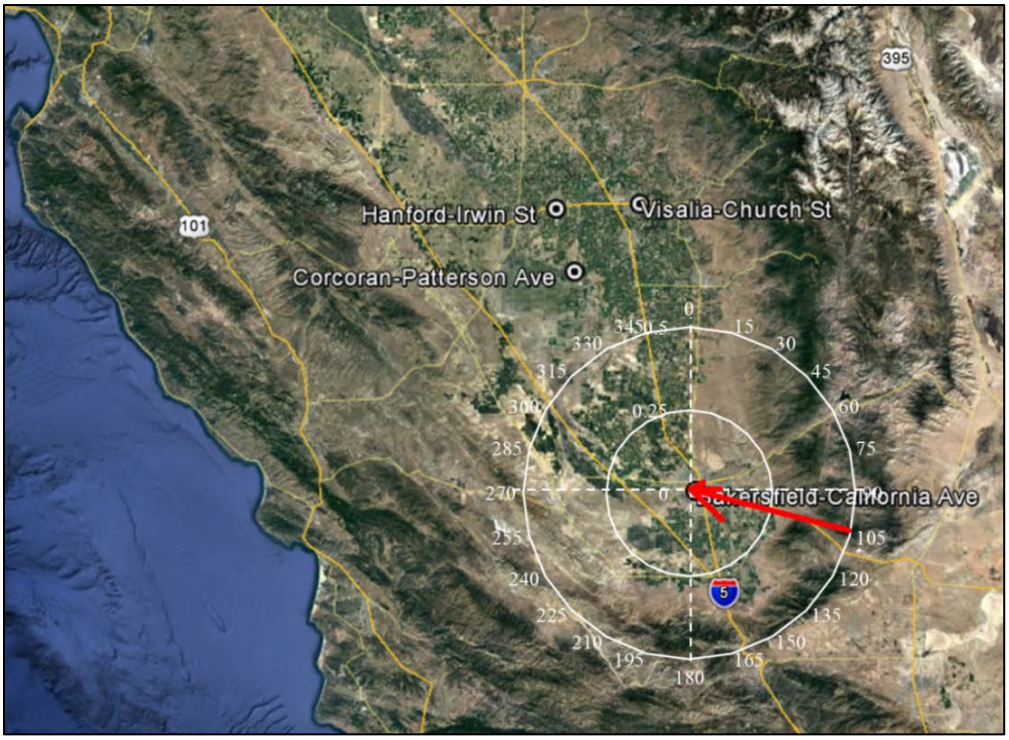
The wind rose below (Figure 63) demonstrates that 62 percent of the winds at Oildale were above 3 knots (3.45 mph) and were from the southeast and east on January 23. The remaining 38 percent of the winds on this day were considered calm winds (below 3 knots).

**Figure 63. Wind patterns at Oildale – January 23, 2014 (wind data from Bakersfield-Municipal Airport)**



The wind rose below (Figure 64) demonstrates that 71 percent of the winds at Bakersfield were above 3 knots (3.45 mph) and were from the southeast and east on January 23. The remaining 29 percent of the winds on this day were considered calm winds (below 3 knots).

**Figure 64. Wind pattern at Bakersfield – January 23, 2014 (wind data from Bakersfield monitor)**




A 24-hour HYSPLIT back trajectory (Figure 65) indicated that airflow from the east impacted the Bakersfield and Oildale monitors. Since there were two distinct peaks at the Bakersfield monitor, two separate back trajectories were analyzed.

The path of airflow prior to the high concentrations at 12 PST (2000 UTC) showed all levels approached the monitors from the east, with an ultimate origination over central Nevada.

**Figure 65. Back Trajectories from Bakersfield and Oildale – January 23, 2014, 12 PST**

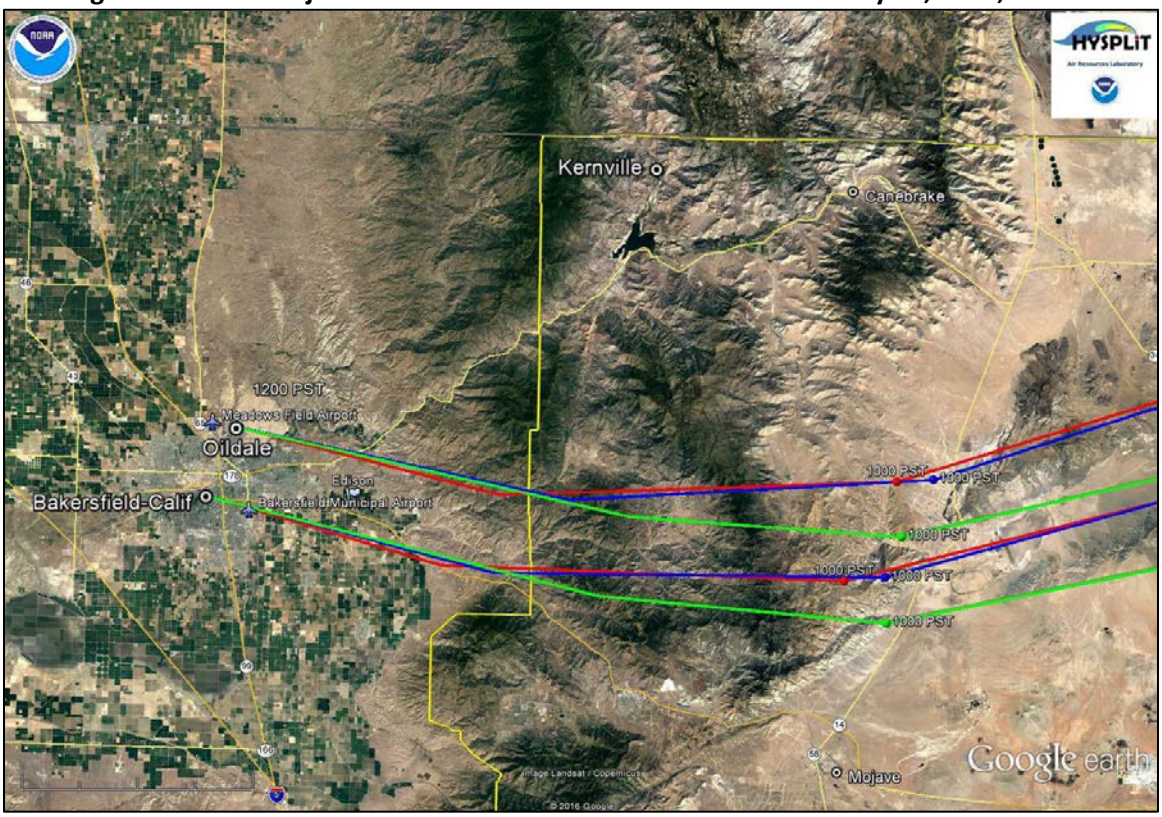
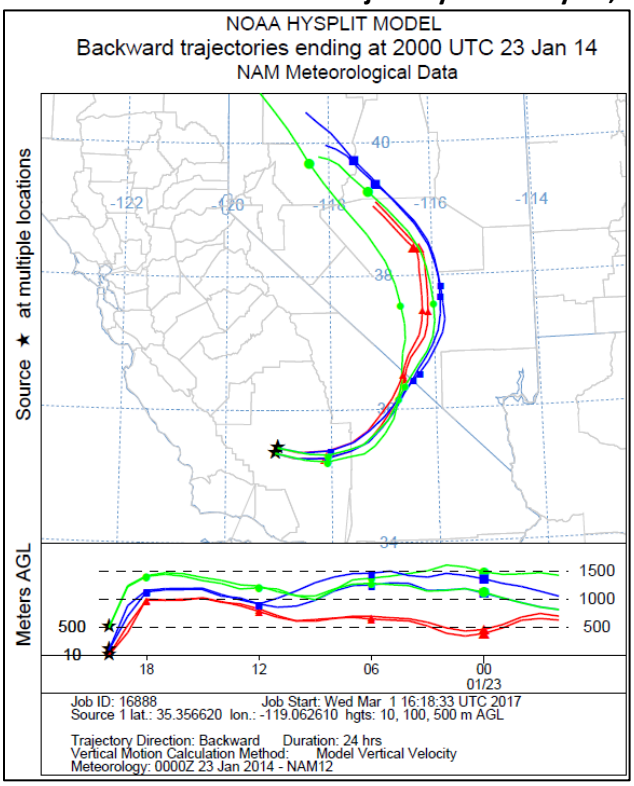


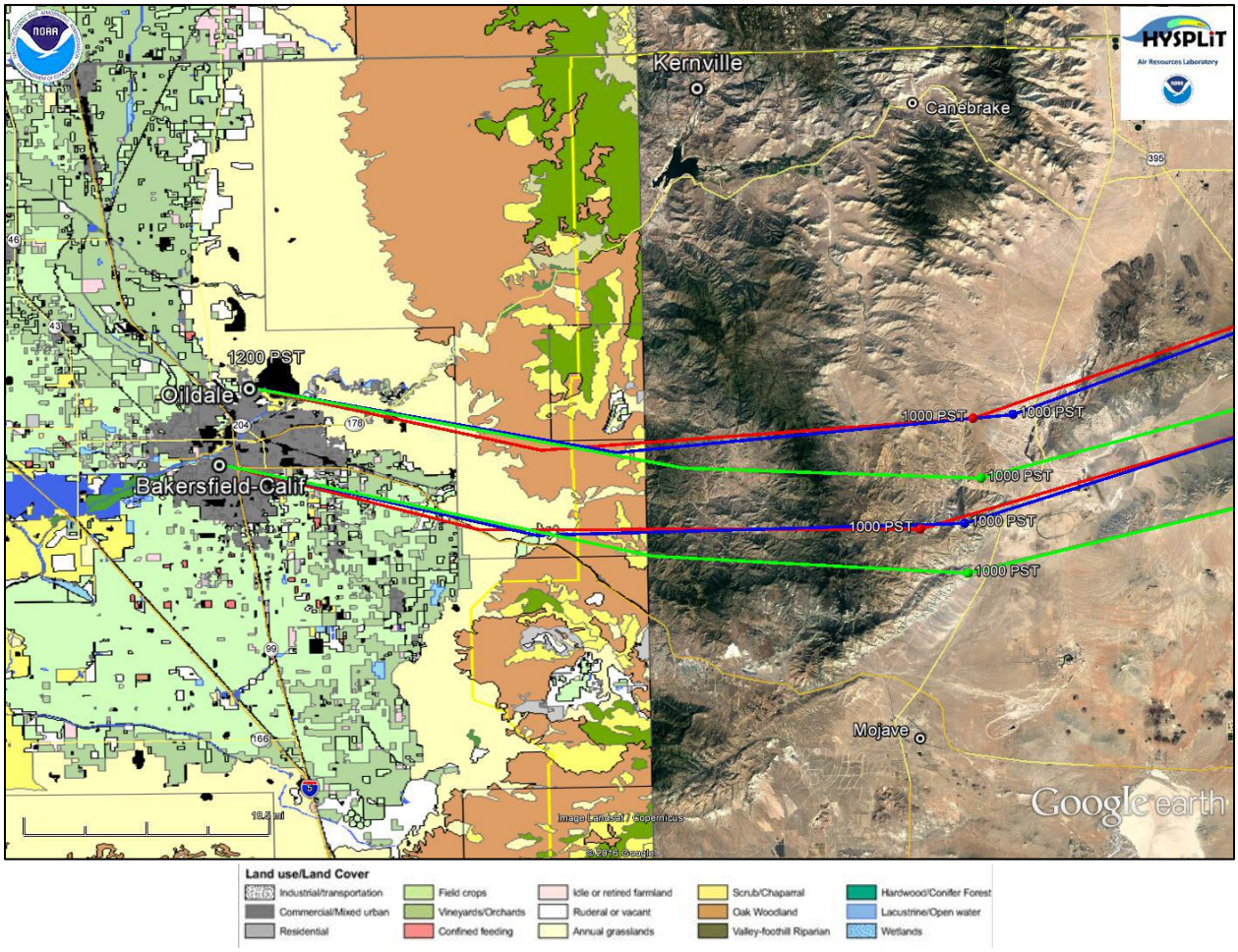

**Figure 66. NOAA HYSPLIT Model Back Trajectory – January 23, 2014, 12 PST**



All back trajectories (Figure 66 above) were at or above 1000m at 18 UTC (or 10 PST), two hours prior to impact at the monitor, dropping to 10m (red), 100m (blue), and 500m (green) at 20 UTC (12 PST). This implies less local influence and more transport from the east.

A land-use/land cover layer, which covers only the District, was used with the HYSPLIT back trajectory to determine possible emission sources. Figure 67 below, combined with the predominantly higher altitude eastern flow indicates that the primary emissions would have been from transport out of the region as well as extremely local area sources overwhelmed by high winds.

**Figure 67. Land Use/Land Cover - Trajectory Paths from Bakersfield and Oildale – 12 PST**




The path of airflow prior to the high concentrations in the early evening at 19 PST (03 UTE January 24) showed all levels still approached the monitors from the east (Figure 68), with an ultimate origination over central Nevada (with one minor exception at the 500m level). Sustained winds at the nearby Edison site were missing for this time, but the Bakersfield Municipal Airports had winds of 25 mph at 19 PST, while the Meadows Field Airport, although missing wind data at the time of the peak PM10 concentrations, recorded wind speeds from 18-21 mph in the hours before and after.

**Figure 68. Back Trajectories from Bakersfield and Oildale – January 23, 2014, 19 PST**

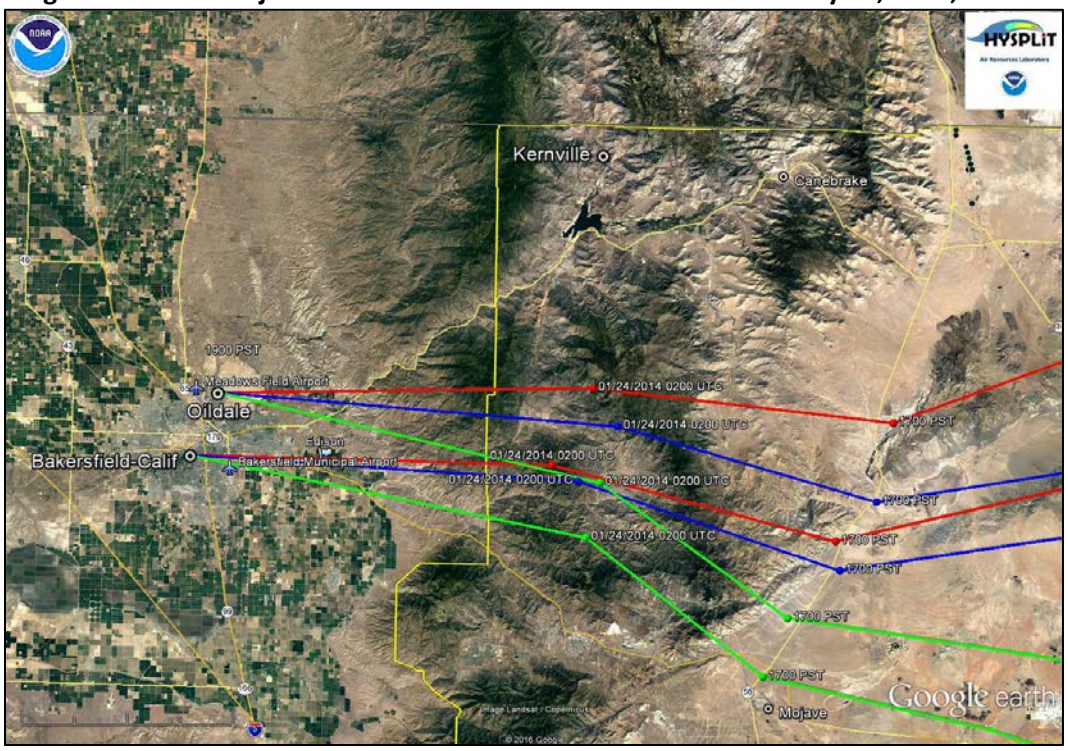
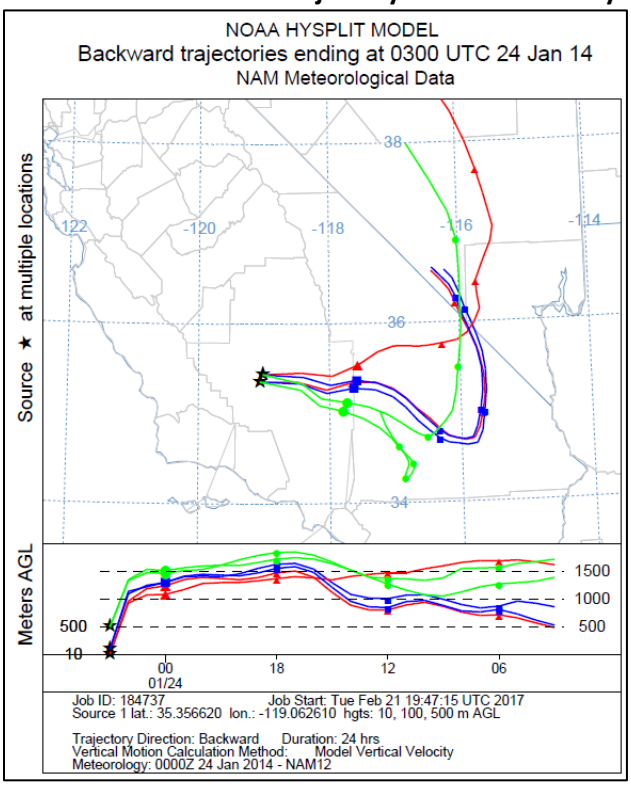


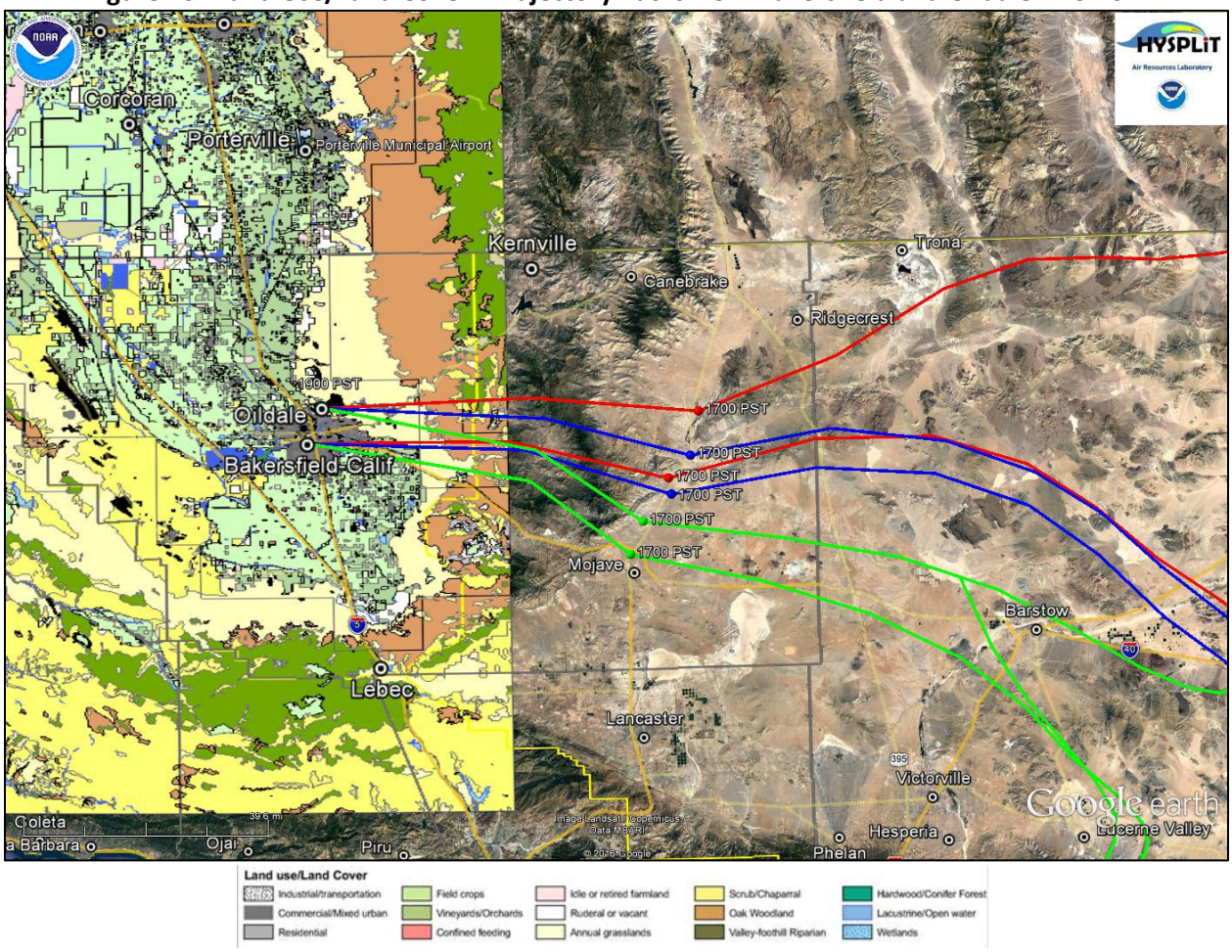

**Figure 69. NOAA HYSPLIT Model Back Trajectory Results – January 23, 2014, 19 PST**



As shown above (Figure 69), all back trajectories were at or above 1000m at 00 UTC January 24 (or 16 PST January 23), three hours prior to impact at the monitor, dropping to 10m (red), 100m (blue), and 500m (green) at 03 UTC January 24 (19 PST January 23). This implies less local influence and more transport.

A land-use/land cover layer (Figure 70) which covers only the District was used with the HYSPLIT back trajectory to determine possible emission sources. The image below, combined with the predominantly higher altitude eastern flow, indicates that the primary emissions would have been from transport out of the region as well as local area sources.

**Figure 70. Land Use/Land Cover - Trajectory Paths from Bakersfield and Oildale – 19 PST**




**Summary**

Based on this initial analysis, the exceedances at the Bakersfield and Oildale monitors on January 23, 2014 are potentially the result of high winds and blowing dust. To meet the contingency provisions of the Maintenance Plan, the District will prepare documentation following U.S. EPA's Exceptional Events Rule.

## June 2, 2014

Bakersfield-California PM10 BAM monitor - 172 μg/m$^3$

The PM10 exceedances on June 2 occurred at the end of a day that exhibited very low concentrations at all continuous monitors in the Valley; only the Bakersfield monitoring site exceeded the federal standard of 150 μg/m$^3$ as well as the State standard of 50 μg/m$^3$. The District flagged the data for this day in AQS as a high wind exceptional event.

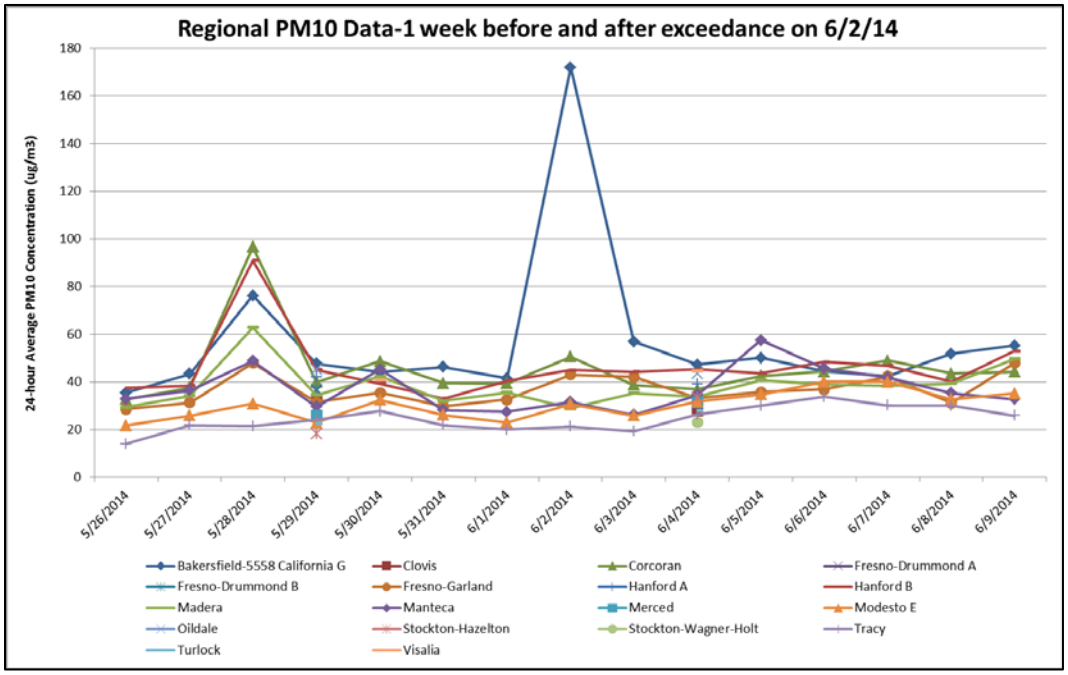
A weak upper-level trough moved over the area, bringing breezy conditions, particularly to the Kern Mountains and nearby desert areas. The NWS indicated that winds would be significant around the coastal passes and the aforementioned Kern County Mountains and desert areas; blowing dust was also noted as possible due to dry soils and fallow crop land. No specific wind or blowing dust advisories were issued by either the NWS or the District.

- **Evaluation of PM10 filter-based and continuous data across the Valley to understand the local or regional nature of each exceedance.**

Concentrations at the other continuous monitors in the SJV were below the level of the both the State and federal PM10 standards and did not show any trends similar to that seen at Bakersfield. This was not a scheduled filter sampling day.

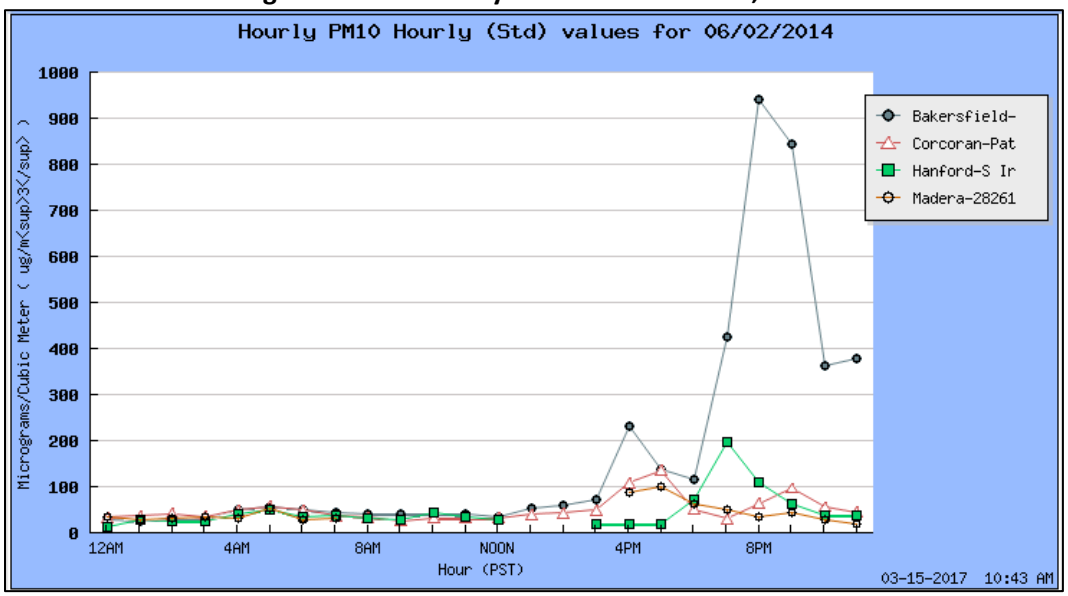
Figure 71 displays the PM10 filter and hourly data for SJV sites between May 26 and June 9. The PM10 concentrations on June 2 only increased at the Bakersfield-California site which was also the only site that exceeded the federal PM10 standard.

**Figure 71 – Daily Regional PM10 Data – May 26 to June 9, 2014**



The chart below (Figure 72) displays the daily average PM10 hourly data on June 2. The Bakersfield-California site recorded hourly values above the federal 24-hour average PM10 standard of 150 μg/m$^3$ at 16 PST and from 19 PST through midnight. The Hanford continuous PM10 monitor also showed an increase in PM10 concentrations at 19 PST but all other sites remained under the 24-hour PM10 standard.

**Figure 72. SJV Hourly PM10 Data – June 2, 2014**




Most of the PM10 monitors in the State were below the State standard of 50 μg/m$^3$. In the Valley, only the Bakersfield monitor exceeded the State standard and it was the only site that exceeded the federal standard of 150 μg/m$^3$.

- **Analysis of PM2.5 data to determine whether fine or coarse particles are contributing to the exceedance.**

Figure 73 displays the PM2.5 filter data for SJV sites between May 26 and June 9. The PM2.5 concentrations at the various SJV sites on June 2 follow a pattern similar to the PM10 chart above (Figure 71). The highest PM2.5 concentration on June 2 was 32.6 μg/m$^3$ at Bakersfield-California.

**Figure 73. Daily Regional PM2.5 Data – May 26 to June 9, 2014**

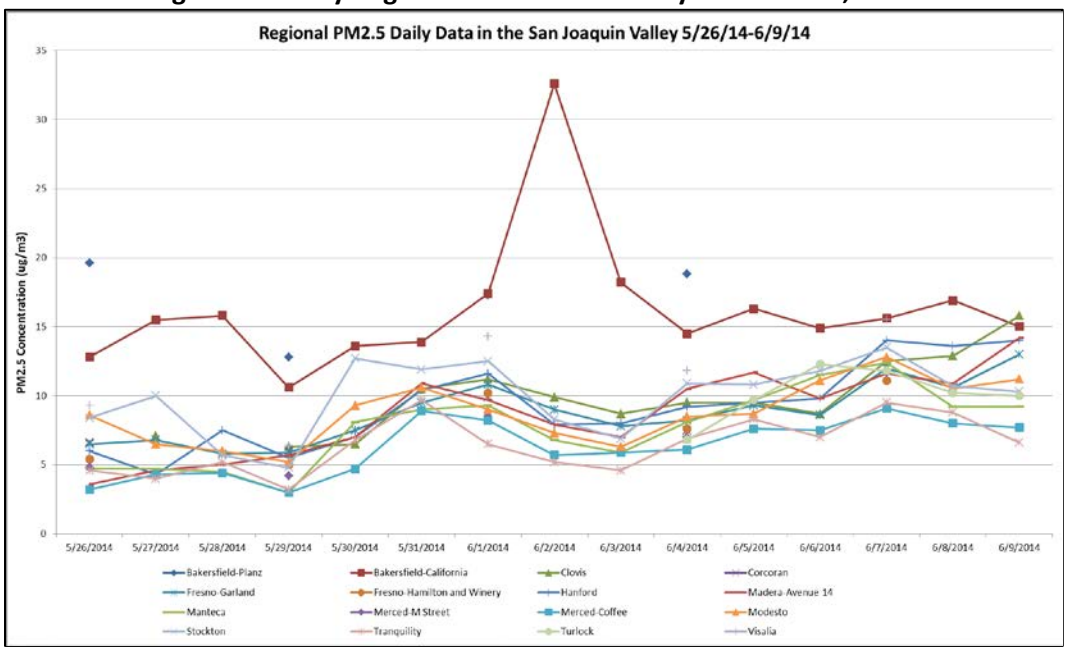
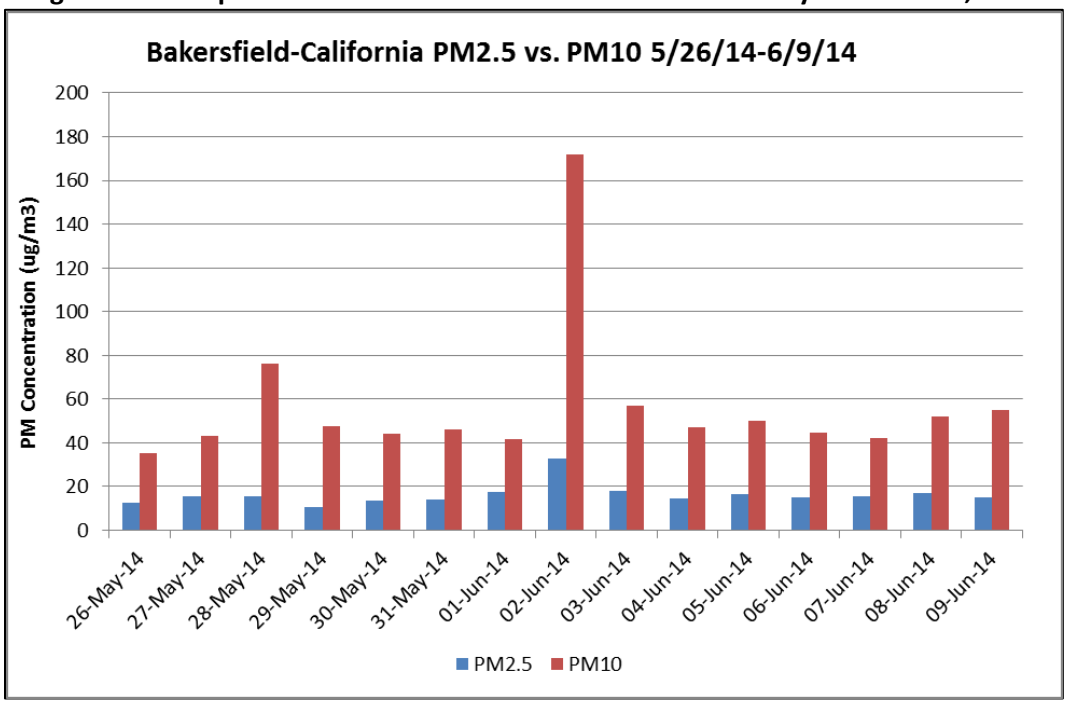



Figure 74 shows that while PM2.5 concentrations were slightly elevated on June 2, PM10 concentrations rose significantly, indicating that coarse particles were a significant portion of PM10 levels. The District's analysis compared the June 2 PM concentrations at the Bakersfield monitor. With a PM2.5 concentration of 32.6 μg/m$^3$ and a PM10 concentration of 171.6 μg/m$^3$, approximately 81 percent of the PM10 sample was comprised of coarse particles, while 19 percent was comprised of fine particulate.

**Figure 74. Comparison of PM2.5 and PM10 at Bakersfield – May 26 to June 9, 2014**



- **Analysis of available chemical speciation data including additional filter speciation analysis as appropriate to assess potential source types contributing to each exceedance.**

No PM2.5 or PM10 speciation analysis was available for June 2. However, PM2.5 speciation was recorded at Visalia before and after the June 2 PM10 exceedance at Bakersfield. The data (Table 9) shows that PM2.5 species increased at Visalia after the PM10 exceedances at Bakersfield on June 2.

**Table 9. PM2.5 Speciation Data (μg/m$^3$) at Visalia – May 29 to June 10, 2014**

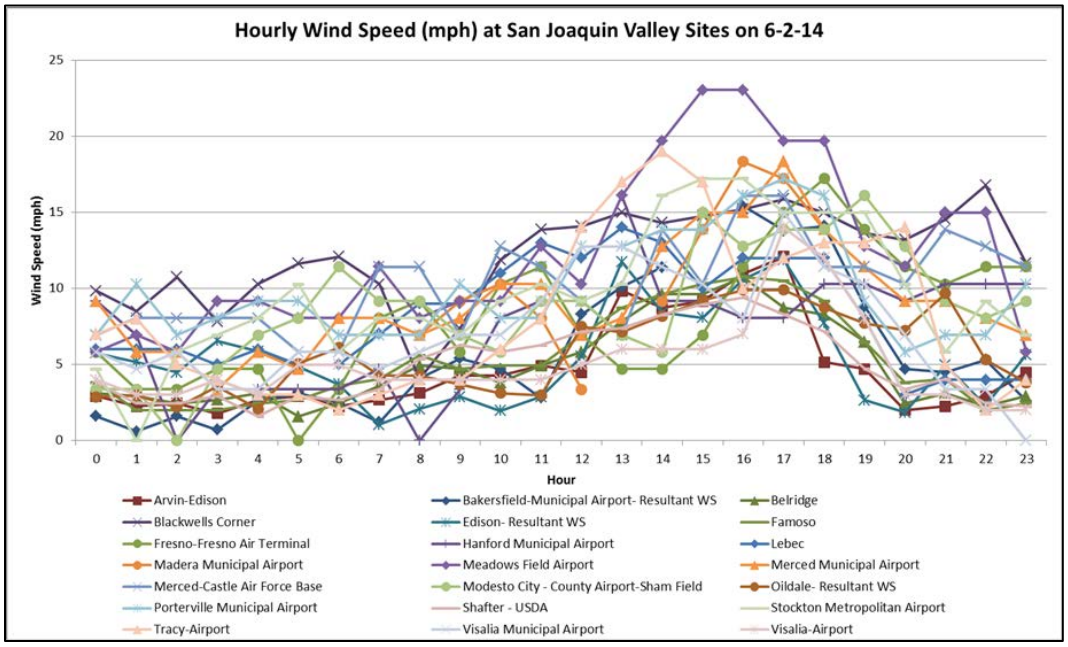
| Monitor | Date | Mass | Ammonium Nitrate | Ammonium Sulfate | Organic Matter | Elemental Carbon | Geological | Elements |
|---|---|---|---|---|---|---|---|---|
| Visalia | 5/29/14 | 7.3 | 1.8576 | 1.242 | 2.24 | 0.3 | 1.84866 | 0.233 |
| Visalia | 6/4/14 | 12.4 | 3.8442 | 3.243 | 3.64 | 0.5 | 2.26484 | 0.349 |
| Visalia | 6/10/14 | 15 | 1.3803 | 2.5944 | | | 4.2668 | 0.6915 |

- **Analysis of wind speed and direction, along with geographic visualization tools to help identify the types of sources impacting each monitor.**

The Bakersfield-California monitoring site did not record wind data until late August. The Bakersfield Meadows Airport recorded the highest wind speed in the Valley, 23 mph at 15 PST. Peak PM10 concentrations at the Bakersfield monitor were recorded from 19 to 23 PST, when wind speeds at Meadows were between 6 and 15 mph. The Municipal Airport recorded winds speeds ranging from 3 to 9 mph for this high concentration period. Other nearby sites, Edison and Oildale, recorded wind speeds during this same period ranging from 2 to 6 mph and 4 to 10 mph, respectively.

Figure 75 shows the hourly wind speed data on June 2 at each site in Kern County as well as the basin wide airport sites.

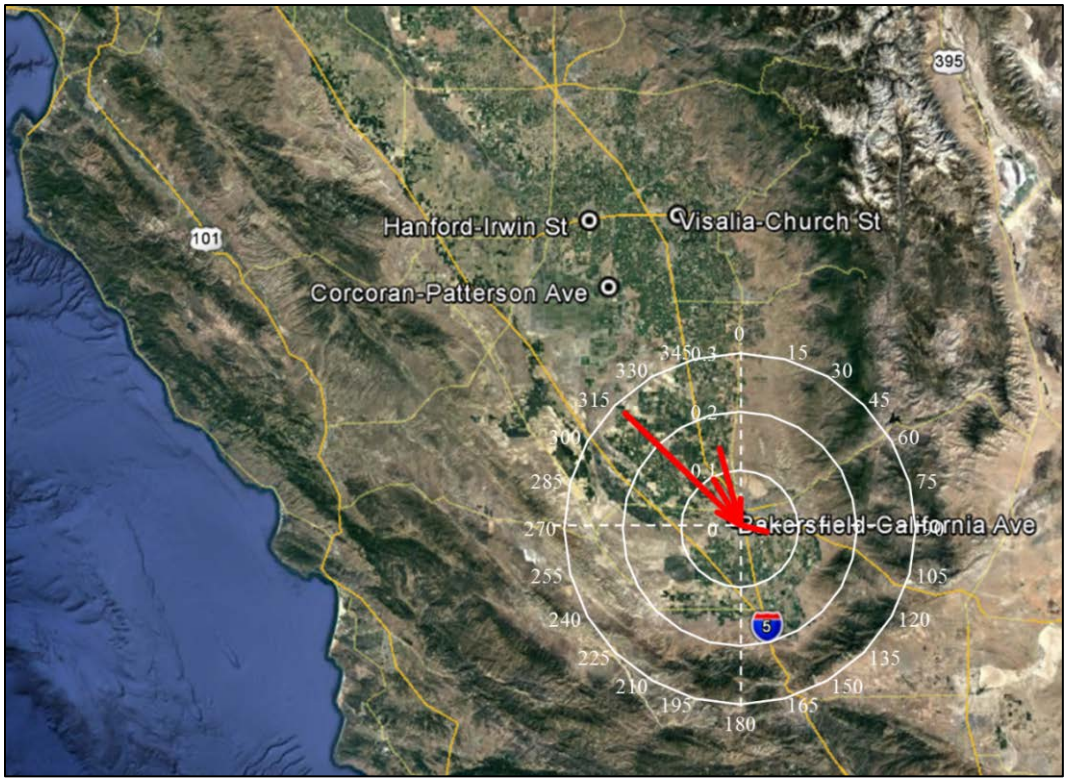
**Figure 75. Wind Speeds at Selected San Joaquin Valley Sites – June 2, 2014**




*Data at Bakersfield Municipal Airport, Edison, and Oildale are resultant wind data.

The wind rose below (Figure 76) demonstrates that 61 percent of the winds at Bakersfield were above 3 knots (3.45 mph) and were from the northwest and east on June 2. The remaining 39 percent of the winds on this day were considered calm winds (below 3 knots).

**Figure 76. Wind patterns at Bakersfield – June 2, 2014**




A 24-hour HYSPLIT back trajectory (Figure 77) indicated that airflow from the west impacted the Bakersfield monitor at the time of the highest concentrations on June 2. The path of airflow prior to the high concentrations at 20 PST (04 UTC June 3) showed all levels approached the monitors from the northwest, with the last two hours prior to impact within Kern County. Sustained wind speeds at 18 PST at the nearby airports and at the Edison and Oildale monitoring sites were moderate, ranging from 8 mph at Edison (to the east and downstream of the monitor) to 20 mph at Meadows Airport, slightly to the north. The surface trajectory was near Lemoore at 18 PST, when wind speeds were 21 mph.

**Figure 77. Back Trajectories from Bakersfield – June 2, 2014, 20 PST**

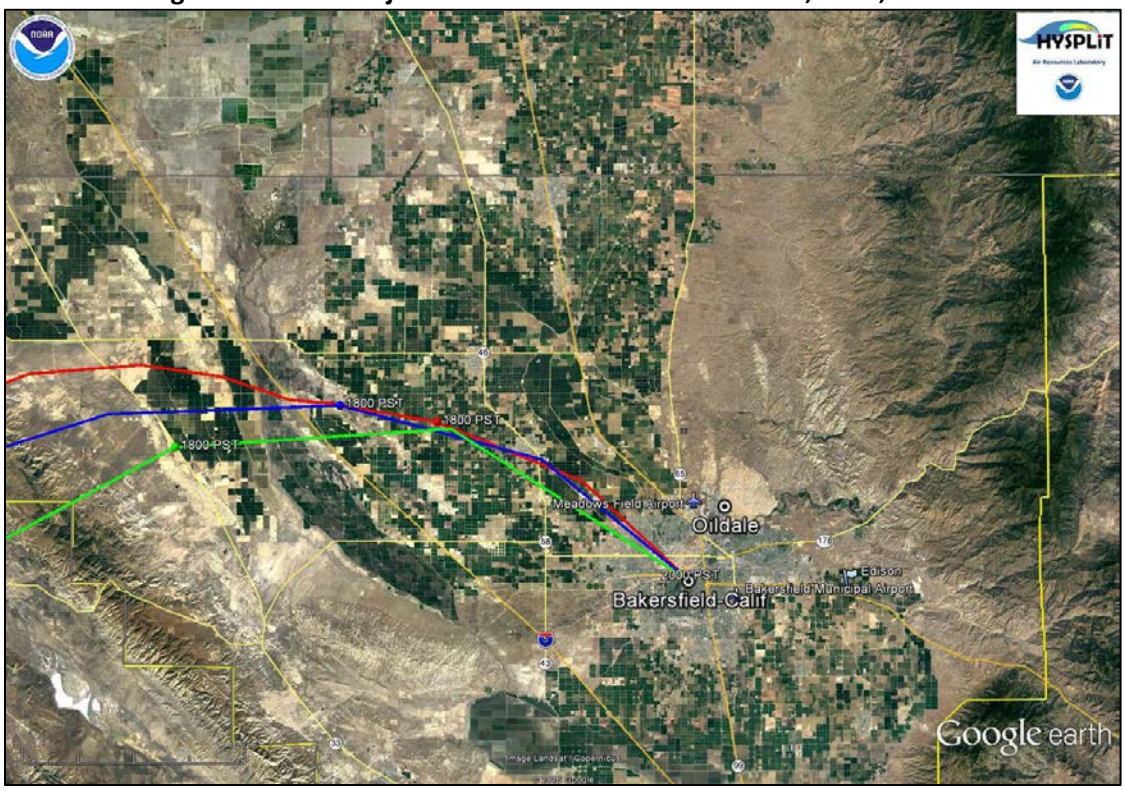
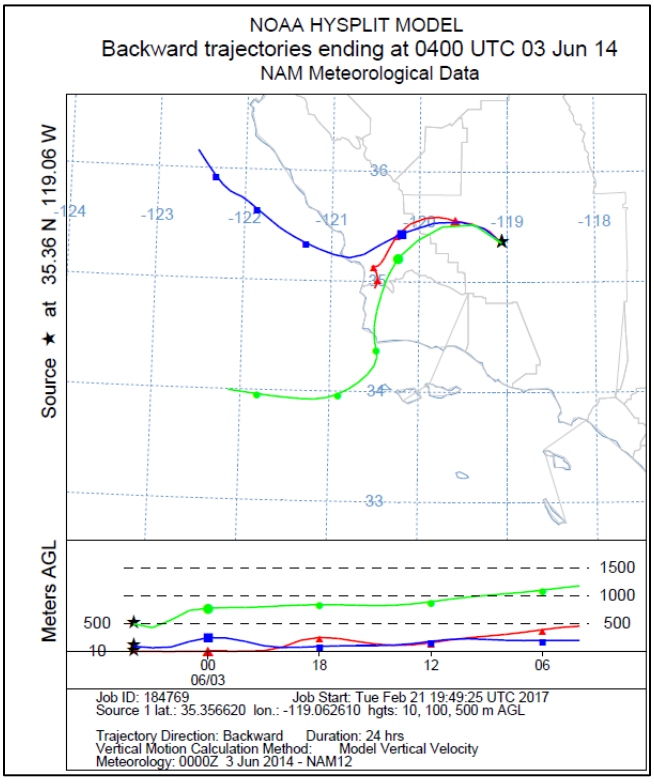


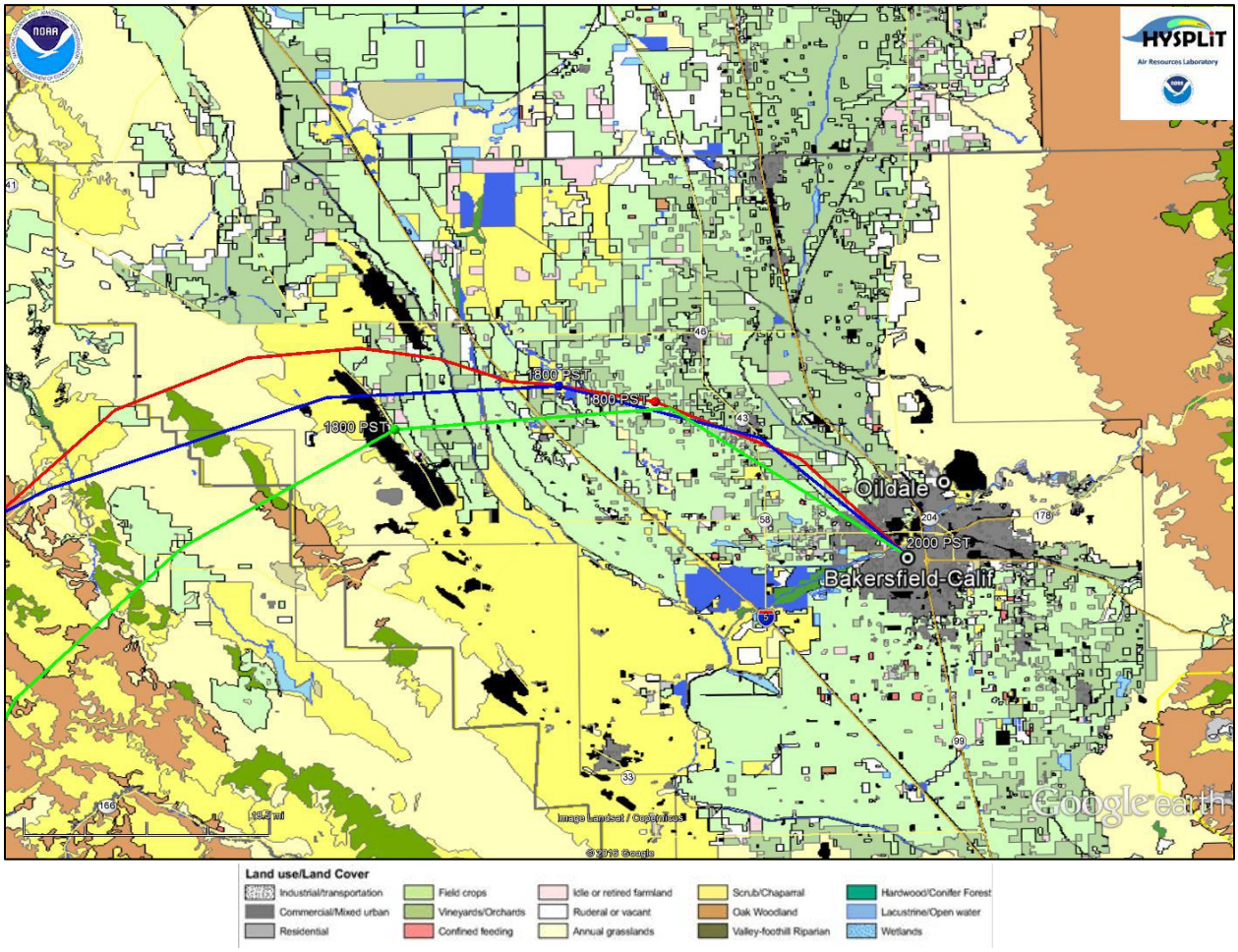

**Figure 78. NOAA HYSPLIT Model Back Trajectory Results – June 2, 2014, 20 PST**



Back trajectories starting from three levels in the atmosphere trace the path of air flow for the previous 24-hours (Figure 78 above) indicating a primarily local and west-northwest influence. The trajectory that impacted the surface at the Bakersfield monitor (10m – red line) originated to the west in San Luis Obispo County, moving northeast, west, and eventually meeting with the airflow at the higher levels and moving southeast toward the monitor. This flow originated at approximately 500m above ground level, eventually descending to the surface at approximately 12 PST (20 UTC) on June 2. Both upper level flows (100m – blue line and 500m – green line) originated over the Pacific, with the 100m flow originating to the north off the Monterey coast and the 500m flow originating to the south and west of the Channel Islands. The 100m flow descended close to the surface around the same time that the surface flow did, around 12 PST, although the surface flow was over the Coastal Range, almost inside of Kern County, while the 100m flow was still a few miles off the Coast of San Luis Obispo County. The highest level trajectory, 500m, originated at over 1000m and remained fairly high throughout the 24-hours prior to impacting the monitor.

A land-use/land cover layer (Figure 79) which covers only the District was used with the HYSPLIT back trajectory to determine possible emission sources. The image below, combined with the relatively low wind speeds in the area, indicates that the primary emissions would have been from transport from the west as well as local area sources.

**Figure 79. Land Use/Land Cover - Trajectory Paths from Bakersfield**



**Summary**

Based on this initial analysis, the exceedance at the Bakersfield monitor on June 2, 2014 is potentially the result of moderate to high winds and blowing dust. To meet the contingency provisions of the Maintenance Plan, the District will prepare documentation following U.S. EPA's Exceptional Events Rule.

## June 10-11, 2014

June 10: Oildale FRM monitor - 311 μg/$m^3$
June 11: Bakersfield-California BAM monitor – 178 μg/$m^{33}$

The PM10 exceedance event encompassed two days, June 10 and June 11. Both days are potential high wind events, although wind speeds in the Valley were below t 25 mph. The District flagged this data in AQS as a high wind exceptional event.

A ridge of high pressure, bringing calm conditions and high temperatures to the Valley, was pushed toward the east by an upper level trough. This provided for some instability bringing thunderstorms and gusty conditions to the Valley. The NWS issued a wind advisory for the north and west side of SJV, particularly Merced and Fresno Counties and areas along Interstate 5. The NWS reported that the District issued air quality alerts for both days, warning of blowing dust as a result of gusty winds for the southern portion of the Valley. Local media reports indicated dust impacts in the Bakersfield area on June 10 and into the morning hours of June 11.

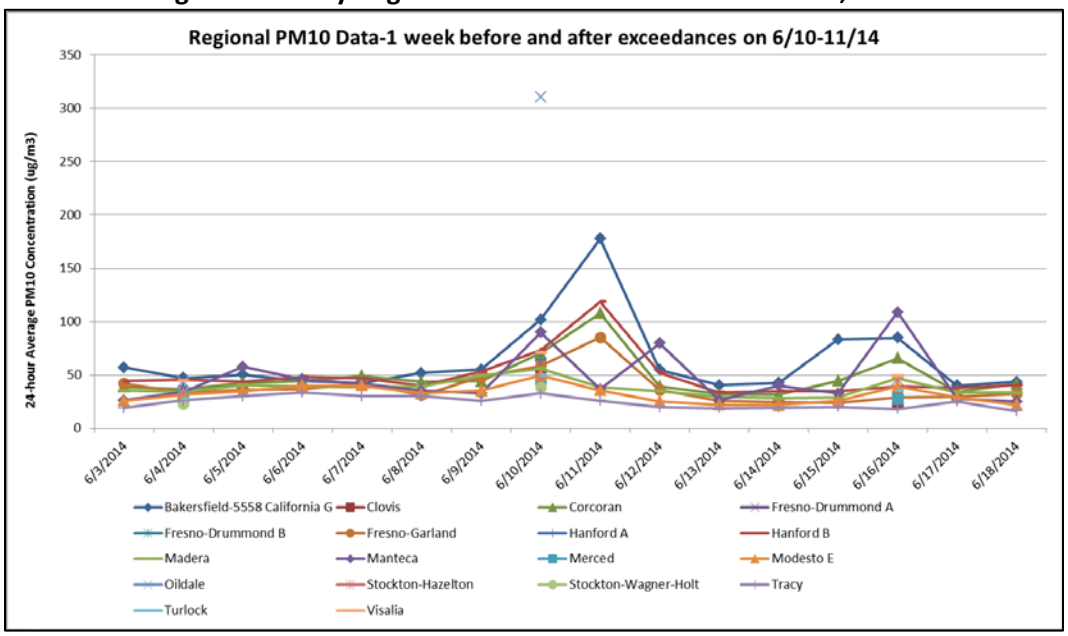
- **Evaluation of PM10 filter-based and continuous data across the Valley to understand the local or regional nature of each exceedance.**

On June 10, concentrations at the other continuous monitors in the SJV were above the level of the State PM10 24-hour standard of 50 μg/$m^3$, but only the Oildale monitoring site exceeded the federal PM10 standard. The continuous monitors all showed a uniform increase in concentrations from early morning until late evening, but none exhibited the peaks seen at the Bakersfield monitor, the closest continuous monitor to the exceeding Oildale site. In the rest of the State, most sites were below the State standard, with the exception of a few scattered in the Mojave Desert and all the monitors in Imperial County. This was a scheduled filter sampling day.

On June 11, the continuous PM10 monitors in the southern portion of the Valley exceeded the State PM10 24-hour standard, but only Bakersfield exceeded the federal standard. SJV monitors to the north of the Valley were below both standards. The continuous monitors all showed peak concentrations in mid-morning, with the exception of the site at Corcoran, which peaked just after midnight. As with the previous day, most monitors in the State were below the lower State PM10 24-hour standard, with the exception of a few scattered sites in Mojave Desert and all the continuous PM10 monitors in Imperial County. This was not a scheduled filter sampling day.

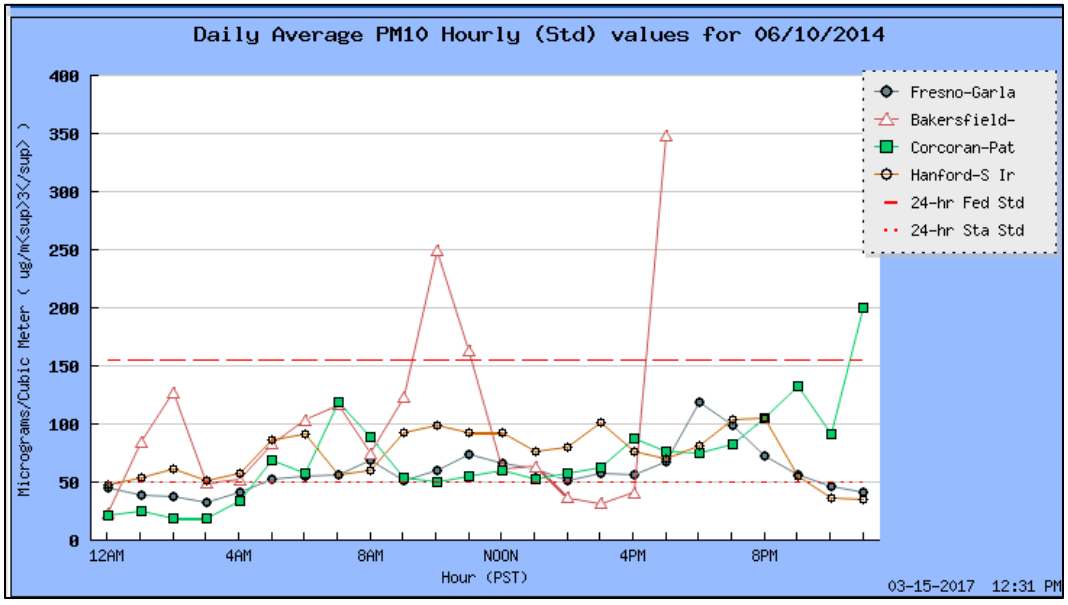
The chart below (Figure 80) displays the PM10 filter and hourly data for SJV sites between June 3 and June 18. The Oildale site was the only site that exceeded the federal 24-hour PM10 standard on June 10 and the Bakersfield-California site was also the only site that exceeded the federal 24-hour PM10 standard on June 11.

**Figure 80. Daily Regional PM10 Data – June 3 to June 18, 2014**




The charts below (Figures 81 and 82) display the daily average PM10 hourly data on June 10 and June 11. The Bakersfield-California site recorded hourly values above the federal 24-hour average PM10 standard of 150 μg/m$^3$ at 10, 11, and 17 PST on June 10. The Corcoran continuous PM10 monitor showed an increase in PM10 concentrations at midnight but all other sites remained under the 24-hour PM10 standard.

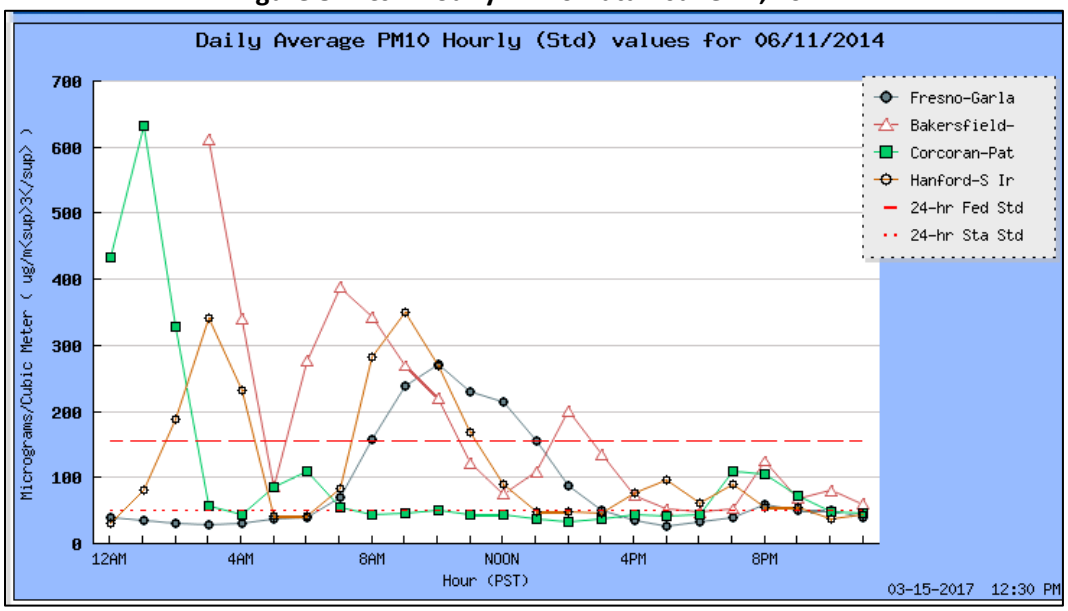
**Figure 81. SJV Hourly PM10 Data – June 10, 2014**




On June 11, Corcoran recorded PM10 values above the 24-hour PM10 standard from midnight to 03 PST, but remained below 150 μg/m$^3$ for the remainder of the day. The Bakersfield-California, Fresno,

and Hanford sites had multiple hours throughout the day with PM10 concentrations over the 24-hour PM10 standard of 150 μg/m$^3$ but concentrations decreased at all sites after 15 PST.

**Figure 82. SJV Hourly PM10 Data – June 11, 2014**




On both June 10 and June 11, with the exception of monitors in the San Joaquin Valley and Imperial County, most of the PM10 monitors in the State were below the State standard of 50 μg/m$^3$. In the Valley, only the Oildale (on the 10$^{th}$) and the Bakersfield (on the 11$^{th}$) monitors exceeded the federal standard of 150 μg/m$^3$.

- **Analysis of PM2.5 data to determine whether fine or coarse particles are contributing to the exceedance.**

The chart below (Figure 83) displays the PM2.5 filter data for SJV sites between June 3 and June 18. The PM2.5 concentrations at the various SJV sites on June 10 and June 11 follow a similar pattern as shown in the PM10 chart above, with the most notable increase in PM10 and PM2.5 being at the Bakersfield-California site. The highest PM2.5 concentrations on June 10 and June 11 were 79.9 μg/m$^3$ and 74 μg/m$^3$ which were recorded at the Bakersfield-California site and flagged in AQS as high wind exceptional events. The Oildale site does not collect PM2.5 data so the correlation between PM2.5 and PM10 at this site could not be made.

**Figure 83. Daily Regional PM2.5 Data – June 3 to June 18, 2014**

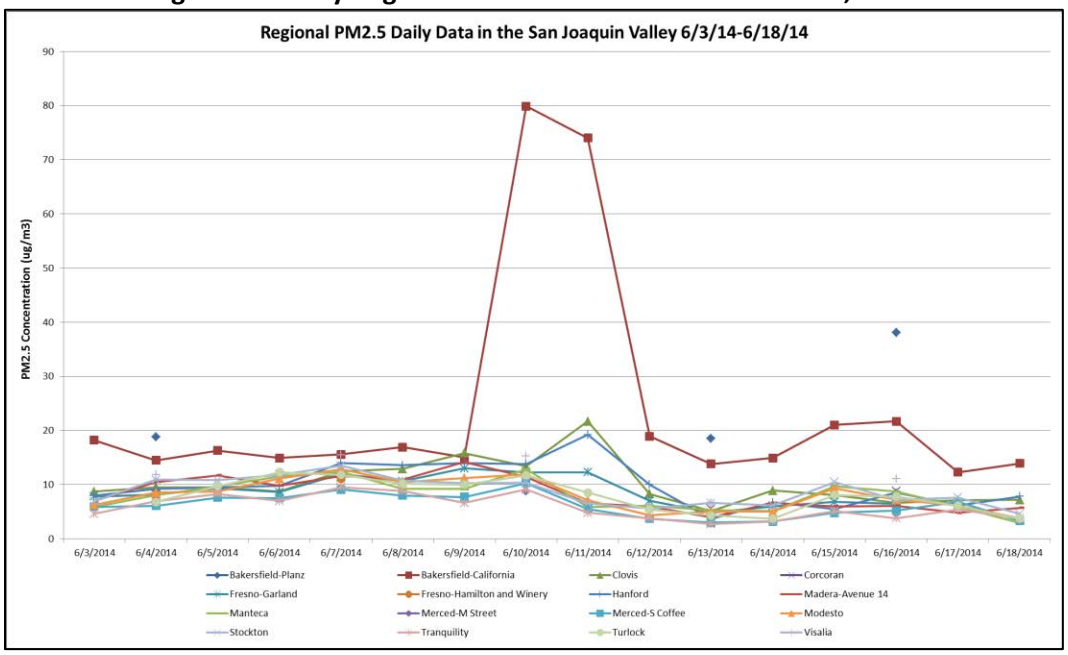
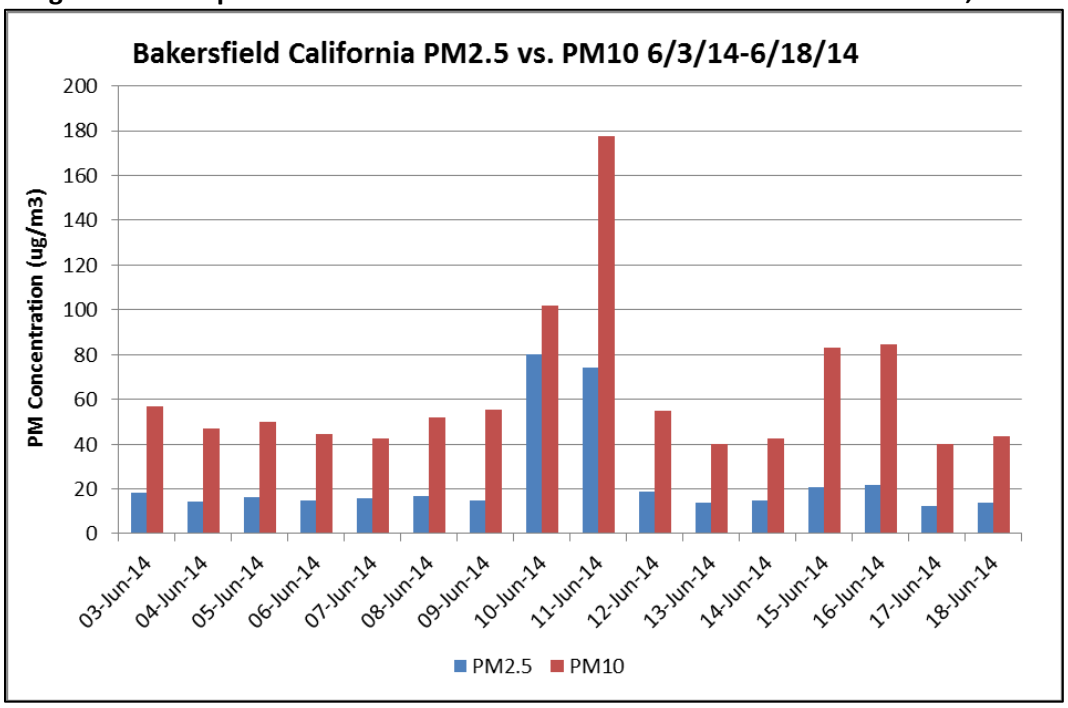



Figure 84 shows that PM2.5 and PM10 concentrations were elevated on June 10 and June 11 at Bakersfield-California. Although Bakersfield-California did not exceed the 24-hour PM10 standard on the 10$^{th}$, the PM2.5 component on this day was fairly high. On June 11, PM10 concentrations rose significantly at Bakersfield-California, indicating that coarse particles were a significant portion of PM10 levels on this day.

The District's analysis compared June 10 PM concentrations at the Bakersfield and Oildale monitors. The Oildale PM10 (310 µg/m$^3$) and Bakersfield PM2.5 (79.9 µg/m$^3$) concentrations indicated that approximately 75 percent of the sample was comprised of coarse particulate, while 25 percent was comprised of fine particulate.

In addition, the District's analysis compared the June 11 PM concentrations at the Bakersfield monitor. With a PM2.5 concentration of 74 µg/m$^3$ and a PM10 concentration of 177.3 µg/m$^3$, approximately 59 percent of the PM10 sample was comprised of coarse particles, while 41 percent was comprised of fine particulate.

**Figure 84. Comparison of PM2.5 and PM10 at Bakersfield – June 3 to June 18, 2014**




- **Analysis of available chemical speciation data including additional filter speciation analysis as appropriate to assess potential source types contributing to each exceedance.**

Speciation data was available on June 10 at Fresno, Modesto, and Visalia (Table 10). Based on the PM2.5 concentrations and composition, the majority of the PM10 mass was in the coarse fraction. Coarse PM is generally high during fugitive dust events. Visalia was the closest site to Oildale on June 10 and the geological concentration at this site was the highest among the three sites that recorded speciation data.

**Table 10. PM2.5 Speciation Data (μg/m$^3$) at Fresno, Modesto, and Visalia – June 10, 2014**

| Monitor | Date | Mass | Ammonium Nitrate | Ammonium Sulfate | Organic Matter | Elemental Carbon | Geologic | Elements |
|---|---|---|---|---|---|---|---|---|
| Fresno | 6/10/14 | 17.3 | 1.677 | 2.2908 | 4.14659 | 0.441 | 1.989373 | 0.46846 |
| Modesto | 6/10/14 | 10.3 | 1.4706 | 1.6284 | | | 1.4091 | 1.155 |
| Visalia | 6/10/14 | 15 | 1.3803 | 2.5944 | | | 4.2668 | 0.6915 |

MLD analyzed six PM10 filters for metals using inductively coupled plasma microscopy (ICP-MS) and for ions using ion chromatography (IC). All filters had very high PM10 concentrations ranging from 155 μg/m$^3$ to over 400 μg/m$^3$. One filter was collected from Bakersfield (October 14, 2014), one from Hanford (December 18, 2013), one from Visalia (December 18, 2013), and three from Oildale (January 23, 2014, June 10, 2014, and October 14, 2014). More detailed information on this analysis is located in Appendix A.

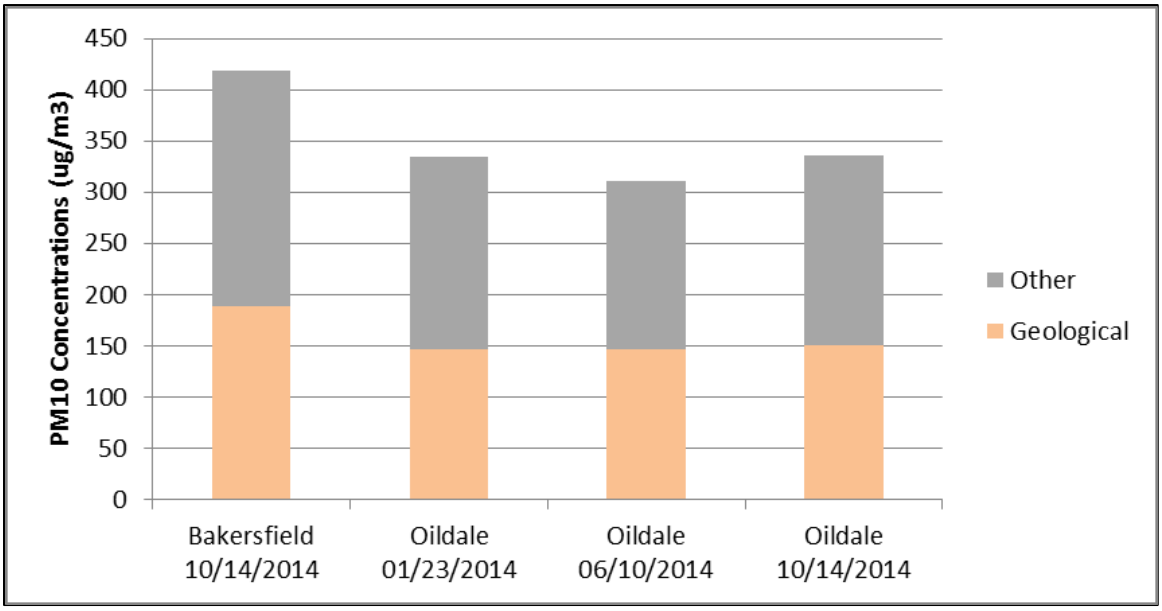
Four out of six filters analyzed had high concentrations of iron indicating that fugitive dust was a significant component of the mass. However, even on these four days over half of the measured mass

remains unassigned. While we are certain that these four days had significant fugitive dust component, it is not possible to accurately calculate the actual concentrations due to uncertainty about uniformity of iron distribution on the filter and the relationship between iron and other fugitive dust components. Table 11 and Figure 85 illustrate the relationship between measured PM10 mass and estimated fugitive dust mass on June 10 at Oildale.

**Table 11. PM10 and Estimated Fugitive Dust Concentrations (μg/m$^3$)**

| | **Oildale 06/10/2014** |
|---|---|
| PM10 (μg/m$^3$) | 311 |
| Iron (μg/m$^3$) | 8.12 |
| Fugitive Dust (μg/m$^3$) | 154.28 |
| Other (μg/m$^3$) | 156.72 |

**Figure 85. PM10 Filters with High Fugitive Dust**

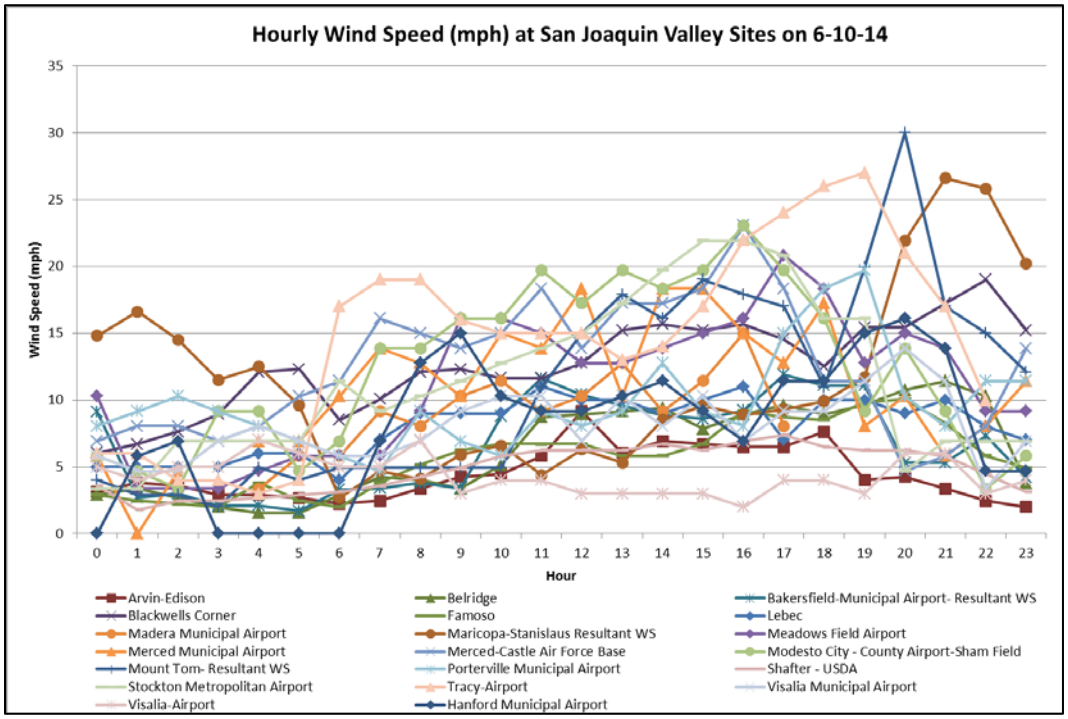



- **Analysis of wind speed and direction, along with geographic visualization tools to help identify the types of sources impacting each monitor.**

On June 10, the highest wind speed recorded in the SJV was 30 mph at the Mount Tom site in eastern Fresno County in the Sierra Nevada Mountains. On the Valley floor, the highest wind speed was 27 mph at the Tracy-Airport monitoring site in San Joaquin County to the north (Figure 86). Nearer to the exceeding monitor at Oildale, the local airports, Meadows Airport and Bakersfield Municipal Airport, recorded maximum wind speeds of 18 and 12 mph, respectively. The Meadows Airport observed dust storm conditions beginning at 18 PST and continuing into the next day with visibility dropping to 1 mile. At the Bakersfield monitoring site, a maximum wind speed of 9 mph was recorded at the same approximate time that PM10 concentrations were elevated (based on hourly data from the Bakersfield continuous monitor). Higher wind speeds were reported on the west side of the Valley at Blackwells

Corner in the mountains northwest of the monitor (22 mph) and at Maricopa-Stanislaus St further to the southwest (27 mph).

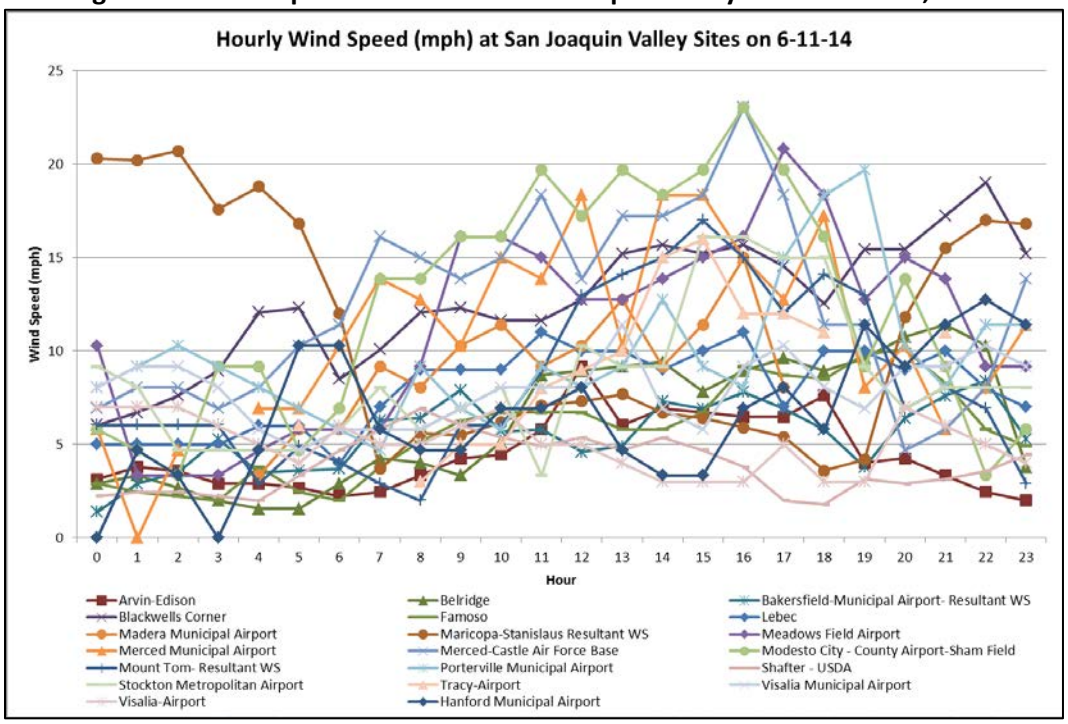
**Figure 86. Wind Speeds at Selected San Joaquin Valley Sites – June 10, 2014**




*Data at Bakersfield Municipal Airport, Maricopa, and Mount Tom are resultant wind data.

On June 11, wind speeds were generally lower, with the highest wind speeds below or close to 20 mph (Figure 87). The local airports, Meadows Airport and Bakersfield Municipal Airport, recorded maximum wind speeds of 15 and 8 mph, respectively. The Meadows Airport, however, observed dust storm conditions continuing from the previous day until 09 PST with visibility dropping to 1.75 miles. The Oildale monitoring site recorded a maximum wind speed of 11 mph at the approximate time that PM10 concentrations were elevated at Bakersfield. Higher wind speeds were again reported on the west side of the Valley at Blackwells Corner, 21 mph at 04-05 PST, and at Maricopa-Stanislaus St, 21 mph at 02-03 PST.

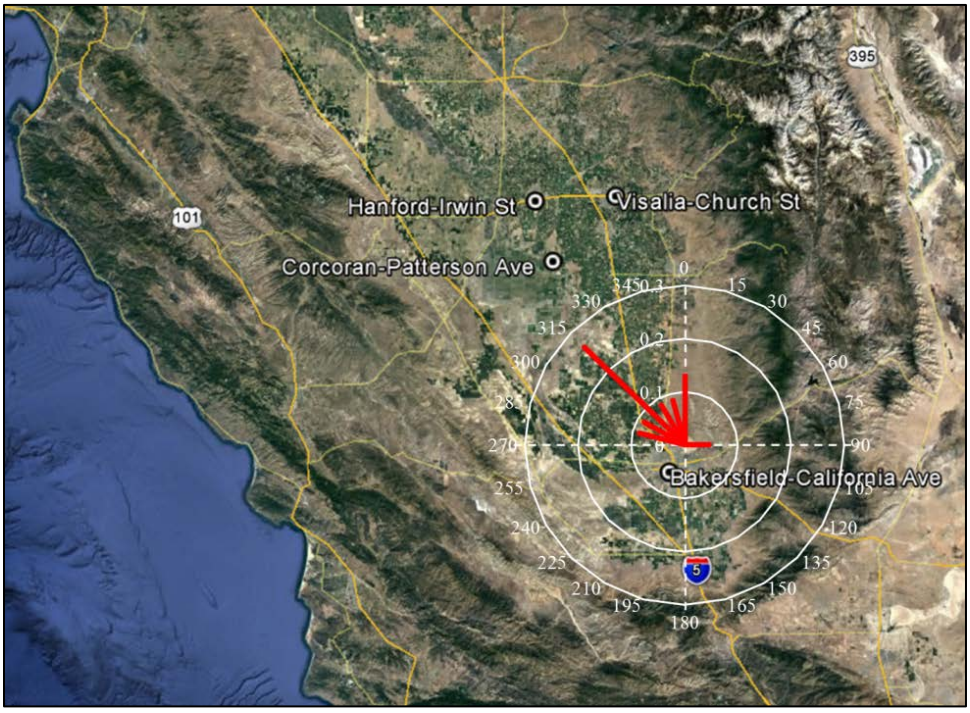
**Figure 87. Wind Speeds at Selected San Joaquin Valley Sites – June 11, 2014**




*Data at Bakersfield Municipal Airport, Maricopa, and Mount Tom are resultant wind data.

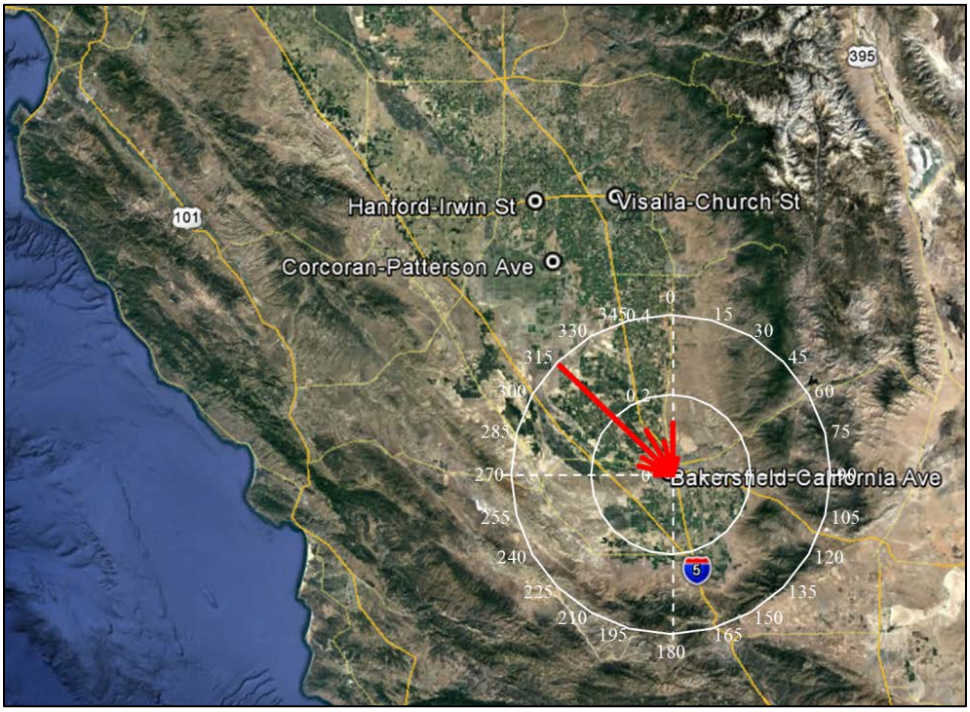
The wind rose below (Figure 88) demonstrates that 75 percent of the winds at Oildale were above 3 knots (3.45 mph) and were from the northwest and north on June 10. The remaining 25 percent of the winds on this day were considered calm winds (below 3 knots).

**Figure 88 - Wind patterns at Oildale – June 10, 2014.**



The wind rose below (Figure 89) demonstrates that 96 percent of the winds at Bakersfield were above 3 knots (3.45 mph) and were from the northwest and north on June 11. The remaining 4 percent of the winds on this day were considered calm winds (below 3 knots).

**Figure 89 - Wind patterns at Bakersfield – June 11, 2014.**




A 24-hour HYSPLIT back trajectory indicated that airflow primarily from the west impacted the Oildale and Bakersfield monitors at the time of the highest concentrations on both days.

On June 10, the path of airflow from the Oildale monitor indicated impact from local sources within Kern County (Figure 90) as well as the possibility of transport from the west.

**Figure 90. Back Trajectories from Oildale – June 10, 2014, 18 PST**

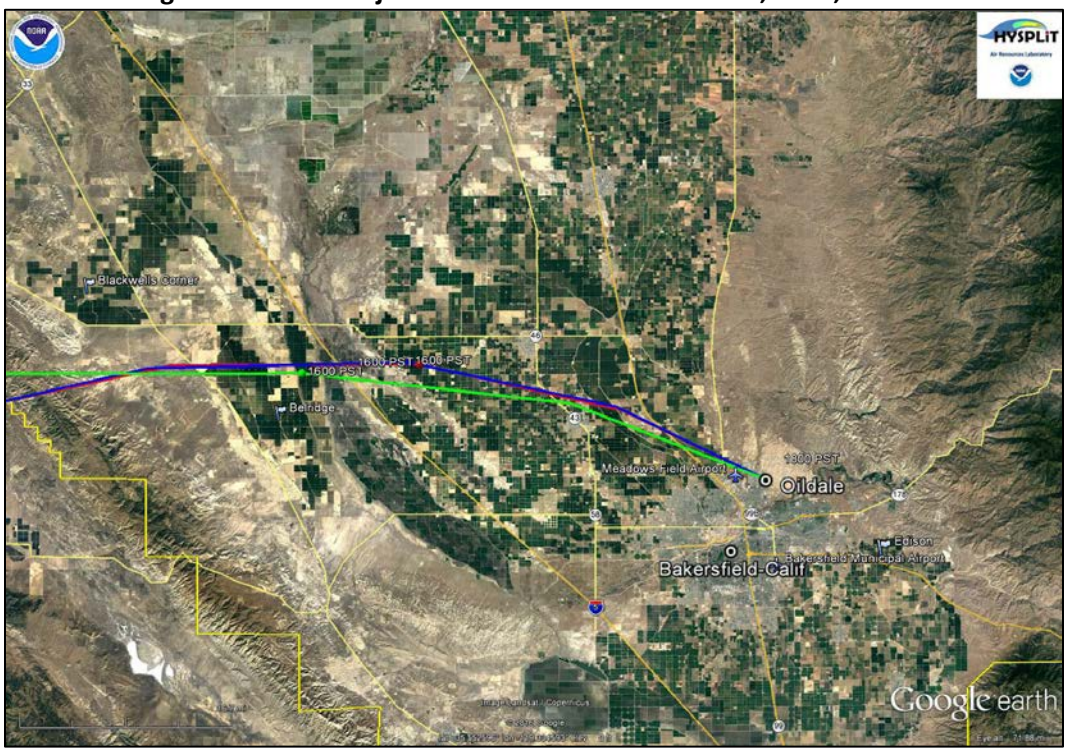
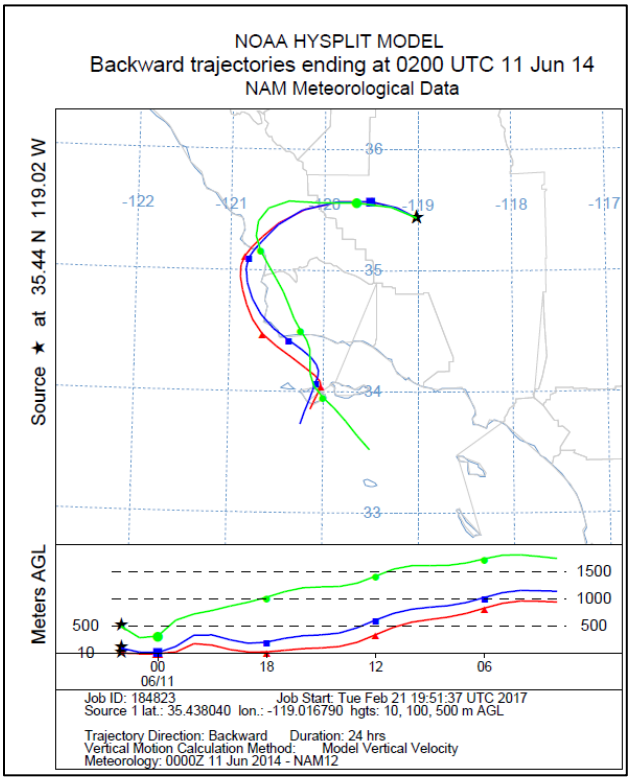


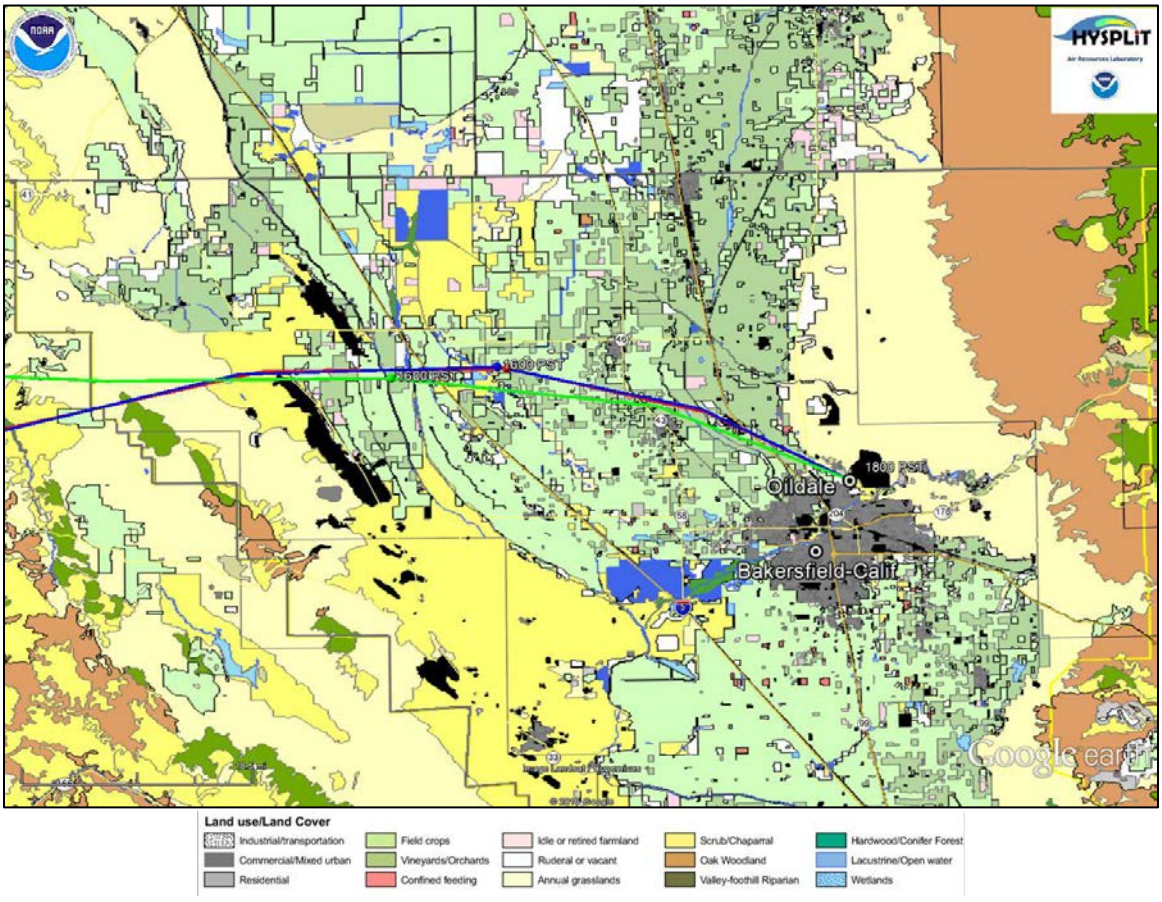

**Figure 91. NOAA HYSPLIT Model Back Trajectory Results – June 10, 2014, 18 PST**



Back trajectories starting from three levels in the atmosphere trace the path of air flow for the previous 24-hours (Figure 91 above) indicating a primarily western influence. All three trajectories originated at or above 1000m off the southern California coast, moved north and then west to Kern County. The trajectory that impacted the surface at the Oildale monitor (10m – red line) originated at approximately 1000m above ground level, eventually descending to the surface at approximately 10 PST (18 UTC) on the 10th, before rising to about the 200m level, and the returning to the surface at approximately 15 PST (23 UTC). Both upper level flows (100m – blue line and 500m – green line) followed a similar pattern, dipping to their lowest levels at approximately 16 PST (00 UTC June 11). The 100m flow descended close to the surface around the same time that the surface flow did, around 16 PST. The highest level trajectory, 500m, originated at over 1500m and remained above the surface throughout the 24-hours prior to reaching the monitor.

A land-use/land cover layer (Figure 92) which covers only the District was used with the HYSPLIT back trajectory to determine possible emission sources. The image below, combined with the relatively low wind speeds in the area, indicates that the primary emissions would have been from local area sources or transported from sources upwind and deposited in the Bakersfield/Oildale area.

**Figure 92. Land Use/Land Cover - Trajectory Paths from Oildale**




On June 11, the path of airflow from the Bakersfield monitor indicated impact from local sources with the possibility of transport from the north (Figure 93). The path of airflow prior to high concentrations seen at the monitor showed an approach from the immediate north, with the lower level trajectories traveling a distance of less than 20 miles in the final two hours.

**Figure 93. Back Trajectories from Bakersfield – June 11, 2014, 07 PST**

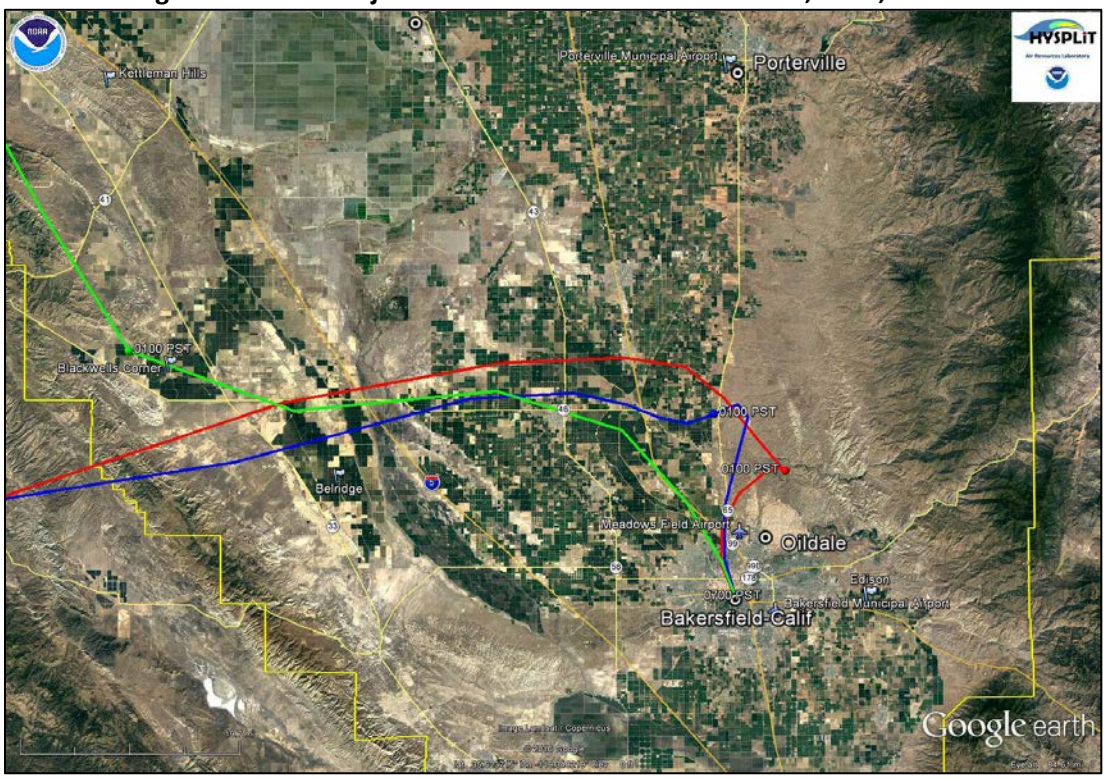
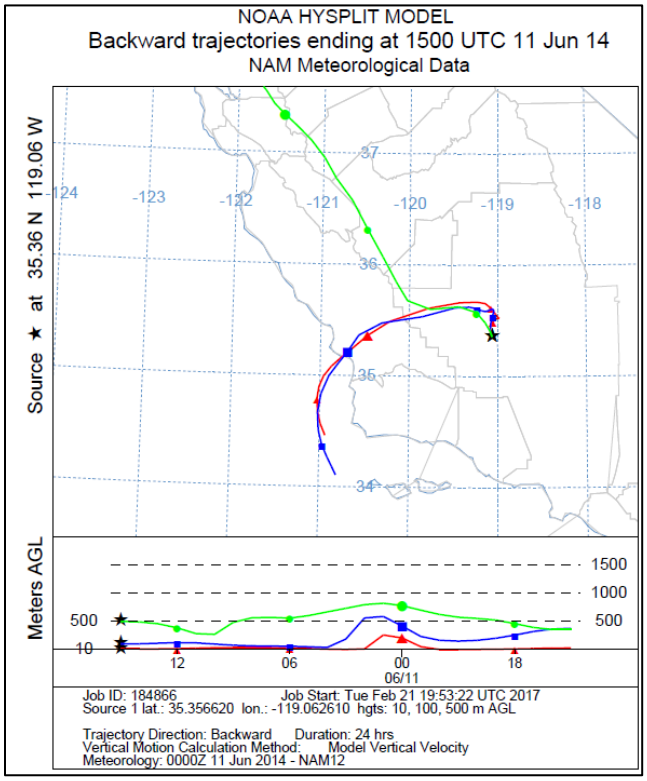


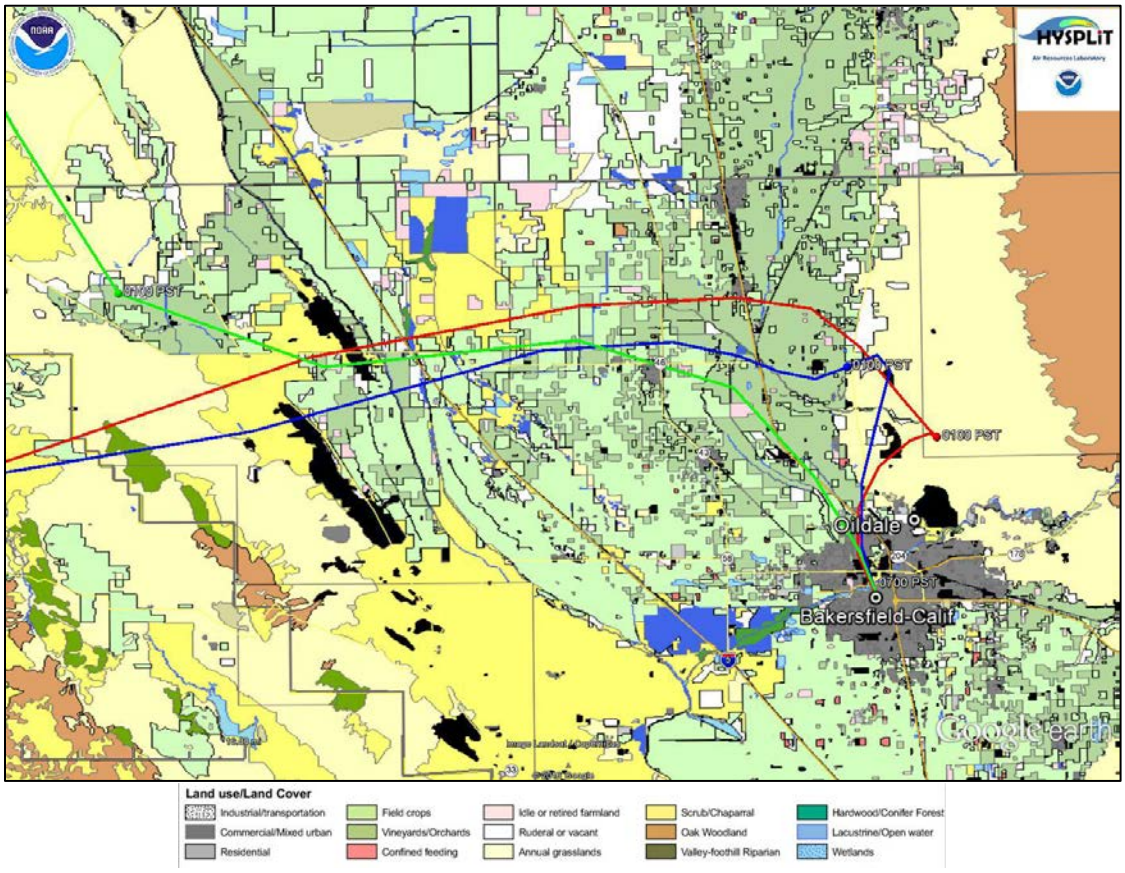

**Figure 94. NOAA HYSPLIT Model Back Trajectory Results – June 11, 2014, 07 PST**



Back trajectories starting from three levels in the atmosphere trace the path of air flow for the previous 24-hours (Figure 94 above) indicating a primarily western influence. The lower two trajectories (10m – red line and 100m – blue line) originated off the southern California coast, moved north and then west to Kern County, dropping from the north before reaching the monitor at Bakersfield. The 500m trajectory originated far to the north over the San Francisco Bay Area. The trajectory that impacted the surface at the Bakersfield monitor (10m – red line) remained at surface level for most of the 24-hours. The 100m trajectory (blue line) showed a similar pattern (albeit higher in the atmosphere) and descended close to surface level at around 20 PST on the previous day (04 UTC) when within 30 miles of the monitor. The highest level trajectory, 500m, originated at just under 500m and remained above the surface throughout the 24-hours prior to reaching the monitor.

A land-use/land cover layer (Figure 95) which covers only the District was used with the HYSPLIT back trajectory to determine possible emission sources. The image below, combined with the relatively low wind speeds in the area, indicates that the primary emissions would have been from local area sources or transported from upwind sources and deposited in the Bakersfield/Oildale area.

**Figure 95. Land Use/Land Cover - Trajectory Paths from Bakersfield**




**Summary**

Based on this initial analysis, the exceedances at the Oildale monitor on June 10, 2014, and the Bakersfield monitor on June 11, 2014, are potentially the result of high winds and blowing dust as well as potential impact from local sources. To meet the contingency provisions of the Maintenance Plan, the District will prepare documentation following U.S. EPA's Exceptional Events Rule.

## October 14, 2014

Bakersfield-California PM10 FRM monitor (POC1) - 419 $\mu g/m^3$
Bakersfield-California PM10 FRM monitor (POC2) - 430 $\mu g/m^3$
Corcoran PM10 TEOM monitor - 180 $\mu g/m^3$
Oildale PM10 FRM monitor – 336 $\mu g/m^3$

The PM10 exceedances on this day seem to be separate incidents. The exceedance at the Corcoran monitor was driven by high winds and blowing dust. The exceedances further south at the Bakersfield and Oildale monitors, while driven by winds and blowing dust, are also likely influenced by emissions from local sources exacerbated by the moderate to high winds. The District flagged data in AQS for three of these monitors as high wind exceptional events; data for the fourth monitor, Bakersfield-California (POC2), was flagged with an informational high wind flag.

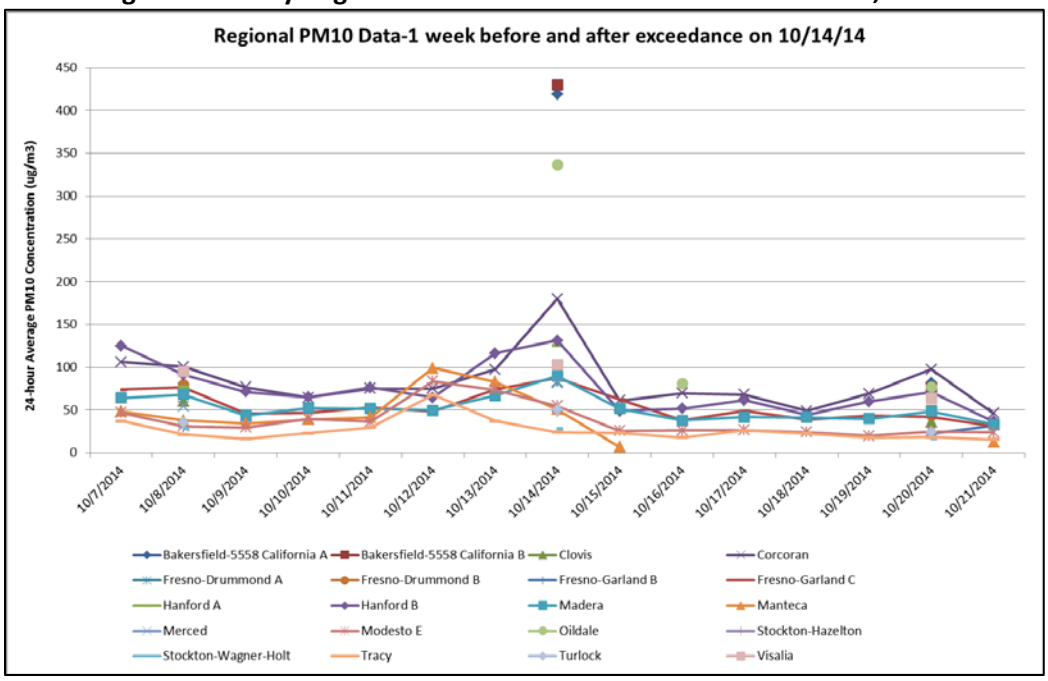
A surface cold front moved through northern California bringing gusty winds, particularly along the west side of the Valley. The NWS issued a wind advisory in effect from 10 to 23 PST for locations along Interstate 5 through Fresno, Kings, and northwest Kern Counties. The District issued a health cautionary statement for the entire SJV due to concerns for blowing dust resulting from these gusty winds. The NOAA Storm Events Database reported two high wind events in west central and southwest SJV as well as a report of near zero visibility west of Corcoran along I-5 and Highway 41.

- **Evaluation of PM10 filter-based and continuous data across the Valley to understand the local or regional nature of each exceedance.**

Concentrations at the continuous monitors in the SJV showed low concentrations in the morning and peaks in the late afternoon to early evening. This was a scheduled filter sampling day.

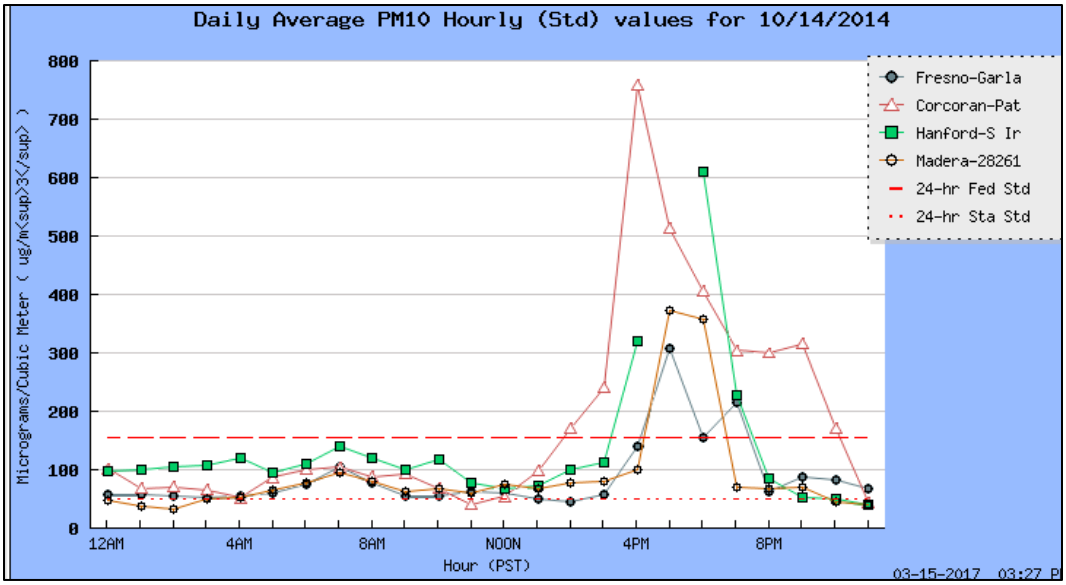
Figure 96 displays the PM10 filter and hourly data for SJV sites between October 7 and October 21. The POC1 (A) and POC2 (B) monitors at Bakersfield-California, the Corcoran TEOM, and the Oildale filter PM10 monitors all exceeded the federal 24-hour PM10 standard on October 14. The highest PM10 concentrations occurred in Kern County at the Bakersfield-California and Oildale sites.

**Figure 96. Daily Regional PM10 Data – October 7 to October 21, 2014**




The chart below (Figure 97) displays the daily average PM10 hourly data on October 14. The Corcoran site recorded hourly values above the federal 24-hour average PM10 standard of 150 µg/m$^3$ from 14 PST to 23 PST. The Fresno, Hanford, and Madera sites also experienced hours over the 24-hour PM10 standard but not to the same degree as the Corcoran site.

**Figure 97. SJV Hourly PM10 Data – October 14, 2014**




The majority of the State was below the State PM10 24-hour standard of 50 µg/m$^3$, with the majority of SJV and Imperial County exceeding. The only exceedances of the federal PM10 standard of 150 µg/m$^3$ were in the Valley at the Bakersfield, Corcoran, and Oildale monitoring sites.

- **Analysis of PM2.5 data to determine whether fine or coarse particles are contributing to the exceedance.**

The chart below (Figure 98) displays the PM2.5 filter data for SJV sites between October 7 and October 21. The PM2.5 concentrations at the Bakersfield sites on October 14 follow a similar pattern as shown in the PM10 chart above. Corcoran did not record PM2.5 data on the 14th and the Oildale site does not measure PM2.5 so the comparison to PM10 could not be made at these sites on this day. The highest PM2.5 concentration on October 14 was 44.5 μg/m$^3$ recorded at the Bakersfield-Planz site.

**Figure 98. Daily Regional PM2.5 Data – October 7 to October 21, 2014**

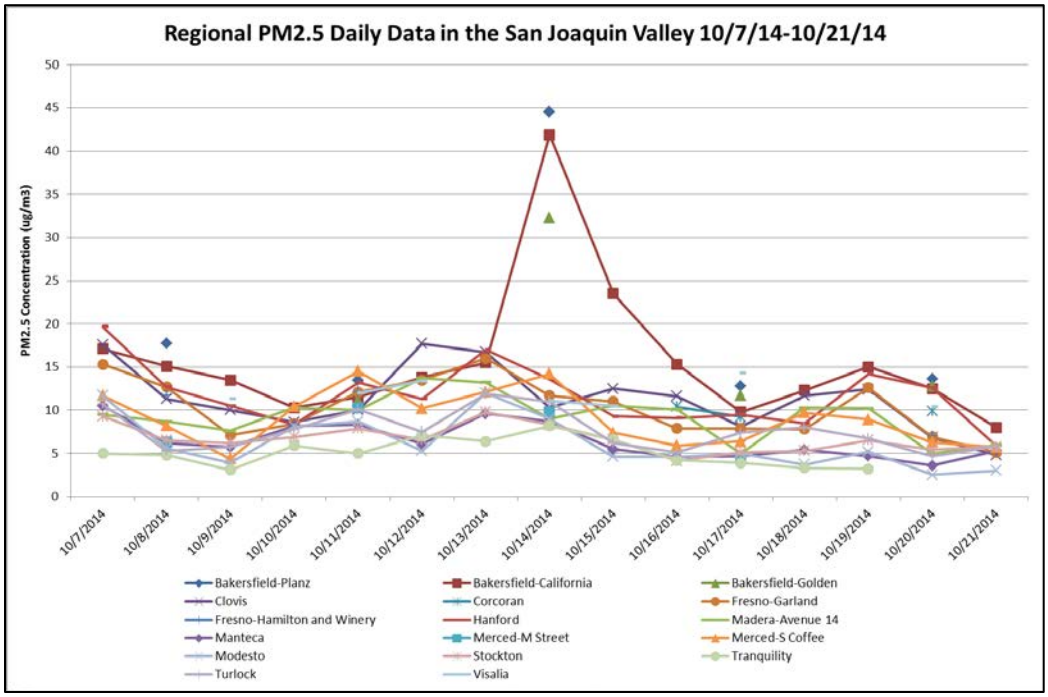
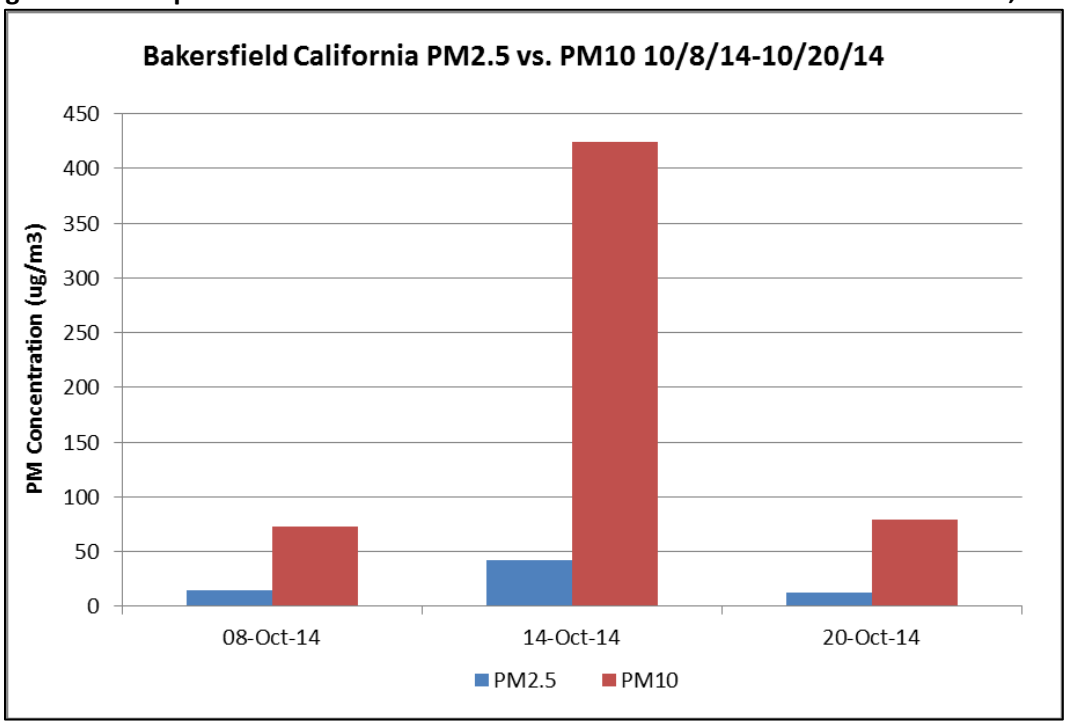



Figure 99 shows that PM2.5 and PM10 concentrations were elevated on October 14 at Bakersfield-California over the previous comparison on October 8. PM2.5 was a small fraction of the PM10 concentration measured on this day. PM10 concentrations rose significantly at Bakersfield-California, indicating that coarse particles were a significant portion of PM10 levels on this day. All Bakersfield sites were high compared to the rest of the SJV. The District's analysis compared the October 14 PM concentrations at the Bakersfield monitor. With a PM2.5 concentration of 41.9 μg/m$^3$ and a PM10 concentration of 419 μg/m$^3$, approximately 90 percent of the PM10 sample was comprised of coarse particles, while 10 percent was comprised of fine particulate.

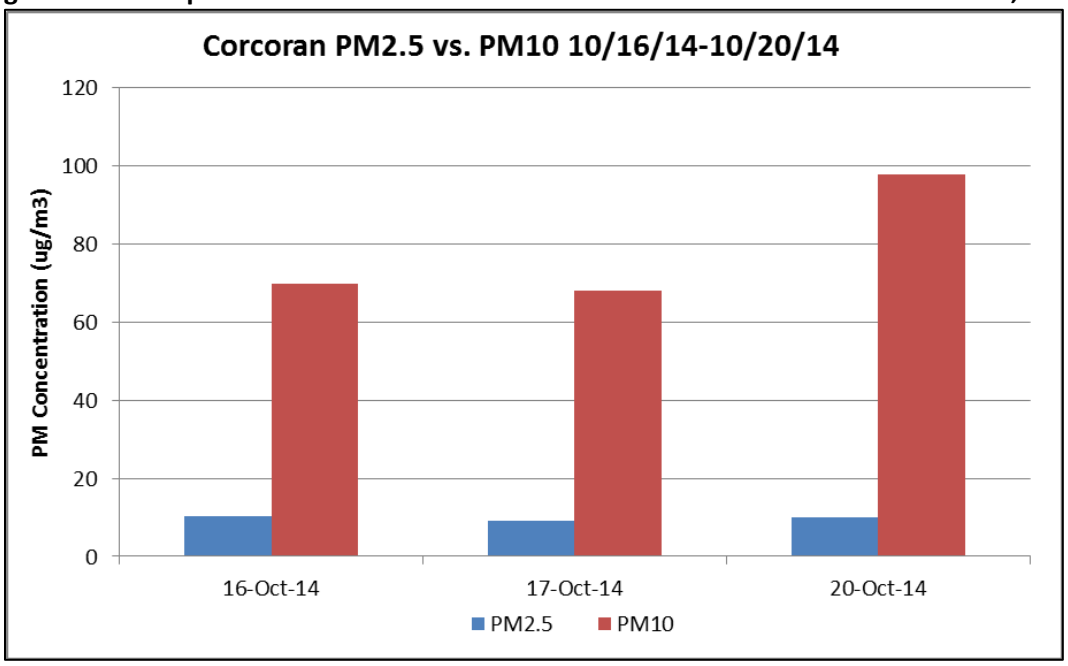
**Figure 99. Comparison of PM2.5 and PM10 at Bakersfield – October 8 to October 20, 2014**




Corcoran (Figure 100) did not record PM2.5 data on October 14 so a direct comparison to PM10 could not be made. However, the District's analysis compared October 14 PM concentrations at the Corcoran and Hanford monitors. The Corcoran PM10 (179.3 µg/m$^3$) and Hanford PM2.5 (13.6 µg/m$^3$) concentrations indicated that approximately 93 percent of the sample was comprised of coarse particulate, while 7 percent was comprised of fine particulate.

In addition, the Oildale site measured a PM10 concentration of 336 µg/m$^3$. Although PM2.5 is not measured at the Oildale site, a comparison with the PM2.5 measurement at the nearby Bakersfield site can be made. The District's analysis compared the Oildale PM10 (336 µg/m$^3$) and Bakersfield PM2.5 (41.9 µg/m$^3$) concentrations , which indicated that approximately 88 percent of the sample was comprised of coarse particulate, while 12 percent was comprised of fine particulate.

**Figure 100. Comparison of PM2.5 and PM10 at Corcoran – October 16 to October 20, 2014**




- **Analysis of available chemical speciation data including additional filter speciation analysis as appropriate to assess potential source types contributing to each exceedance.**

Speciation data was available on October 14 at Modesto and Visalia. Based on the PM2.5 concentrations and composition, the majority of the PM10 mass was in the coarse fraction. Coarse PM is generally high during fugitive dust events. Visalia was closest to Corcoran, 20 miles to the northeast, and further from the Bakersfield sites, almost 70 miles to the south, while the Modesto site was an additional 110 miles north. On October 14, the geological concentration at Visalia was the highest among the two sites that recorded speciation data, indicating a higher geologic component in the Corcoran area, but not necessarily in the Bakersfield/Oildale area.

**Table 12. PM2.5 Speciation Data (μg/m$^3$) at Modesto and Visalia – October 14, 2014**

| Monitor | Date | Mass | Ammonium Nitrate | Ammonium Sulfate | Organic Matter | Elemental Carbon | Geologic | Elements |
|---|---|---|---|---|---|---|---|---|
| Modesto | 10/14/14 | 9.5 | 2.4252 | 2.3046 | | | 1.47157 | 0.6575 |
| Visalia | 10/14/14 | 11.3 | 1.23195 | 1.725 | | | 3.62244 | 0.5315 |

MLD analyzed six PM10 filters for metals using inductively coupled plasma microscopy (ICP-MS) and for ions using ion chromatography (IC). All filters had very high PM10 concentrations ranging from 155 μg/m$^3$ to over 400 μg/m$^3$. One filter was collected from Bakersfield (October 14, 2014), one from Hanford (December 18, 2013), one from Visalia (December 18, 2013), and three from Oildale (January 23, 2014, June 10, 2014, and October 14, 2014). More detailed information on this analysis is located in Appendix A.

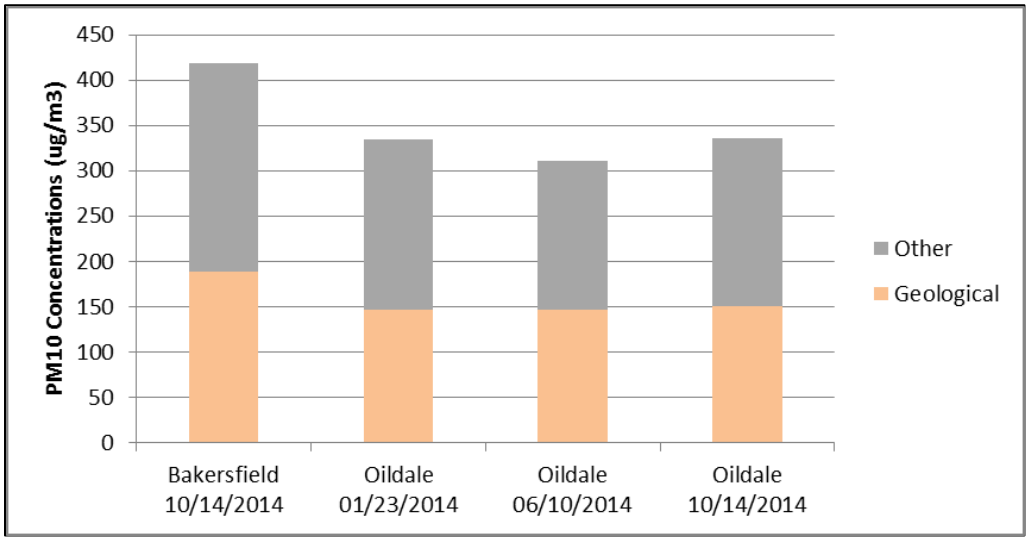
Four out of six filters analyzed had high concentrations of iron indicating that fugitive dust was a significant component of the mass. However, even on these four days over half of the measured mass remains unassigned. While we are certain that these four days had significant fugitive dust component,

it is not possible to accurately calculate the actual concentrations due to uncertainty about uniformity of iron distribution on the filter and the relationship between iron and other fugitive dust components. Table 13 and Figure 101 illustrate the relationship between measured PM10 mass and estimated fugitive dust mass on October 14 at Bakersfield.

**Table 13. PM10 and Estimated Fugitive Dust Concentrations (μg/m$^3$)**

| | Bakersfield 10/14/2014 |
|---|---|
| PM10 (μg/m$^3$) | 419 |
| Iron (μg/m$^3$) | 10.5 |
| Fugitive Dust (μg/m$^3$) | 199.5 |
| Other (μg/m$^3$) | 219.5 |

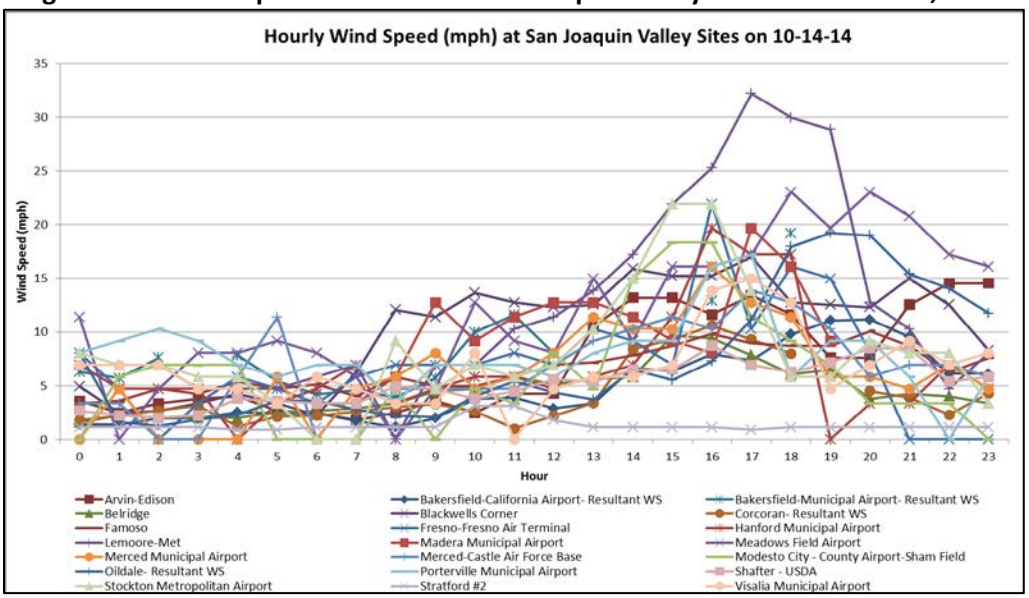
**Figure 101. PM10 Filters with High Fugitive Dust**




- **Analysis of wind speed and direction, along with geographic visualization tools to help identify the types of sources impacting each monitor.**

The highest wind speed recorded in the SJV was 32 mph at the Lemoore Naval Air Station in Kings County (Figure 102). Other local airports near the exceeding sites, Meadows Airport, Bakersfield Municipal Airport, Hanford Municipal Airport, and Visalia Municipal Airport, recorded maximum wind speeds of 17, 19, 20, and 12 mph, respectively. Low visibility was reported at all the local airports, with hazy conditions also reported at Meadows and Hanford. Lemoore Naval Station reported blowing dust in the late afternoon with gusts up to 44 mph. Wind speeds at the Corcoran and Bakersfield monitoring sites were fairly low at the time of the peak concentrations in the afternoon, 3-11 mph. The Oildale site, just northeast of the Bakersfield site, had much higher wind speeds, ranging from 6-19 mph.

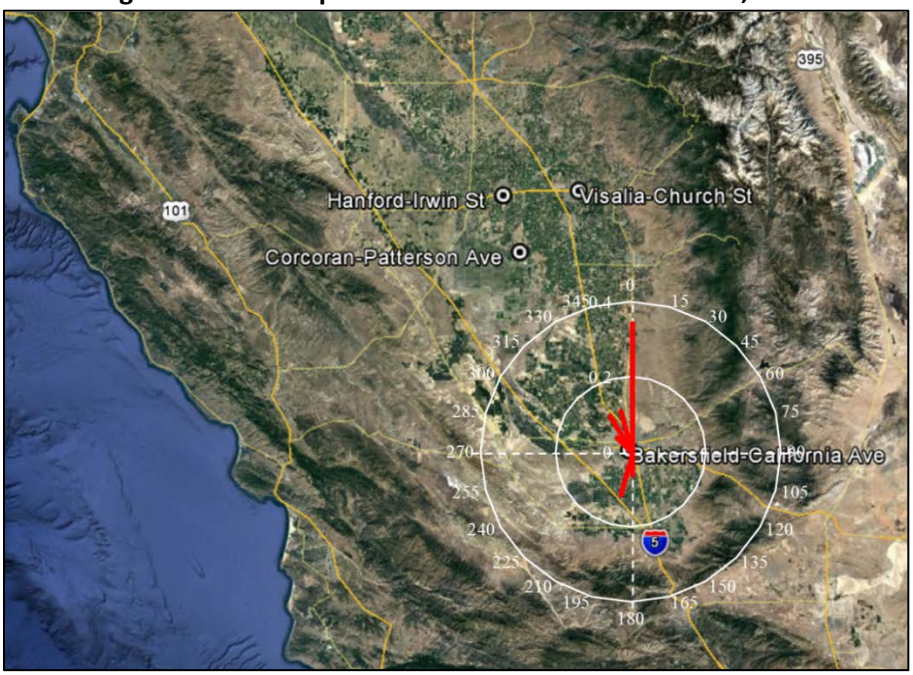
**Figure 102. Wind Speeds at Selected San Joaquin Valley Sites – October 14, 2014**




*Data at Bakersfield California, Bakersfield-Municipal Airport, Corcoran, and Oildale are resultant wind data.

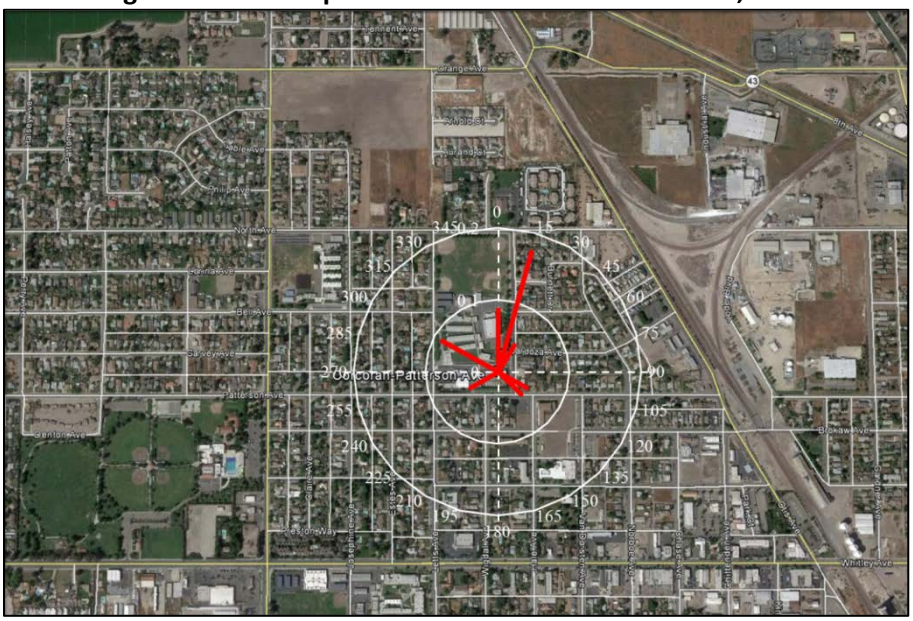
The wind rose below (Figure 103) demonstrates that 58 percent of the winds at Bakersfield were above 3 knots (3.45 mph) and were from the north, northwest, and southwest on October 14. The remaining 42 percent of the winds on this day were considered calm winds (below 3 knots).

**Figure 103. Wind pattern at Bakersfield - October 14, 2014**



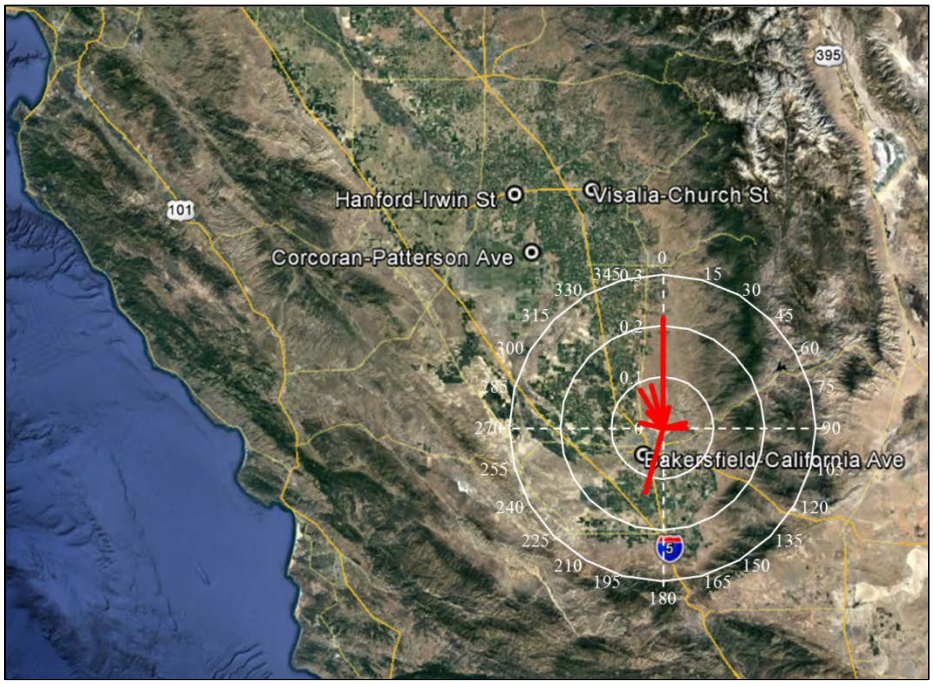

The wind rose below (Figure 104) demonstrates that 50 percent of the winds at Corcoran were above 3 knots (3.45 mph) and were from the north, northeast, and northwest on October 14. The remaining 50 percent of the winds on this day were considered calm winds (below 3 knots).

**Figure 104. Wind patterns at Corcoran – October 14, 2014**




The wind rose below (Figure 105) demonstrates that 71 percent of the winds at Oildale were above 3 knots (3.45 mph) and were from the north, northwest, and southwest on October 14. The remaining 29 percent of the winds on this day were considered calm winds (below 3 knots).

**Figure 105. Wind patterns at Oildale - October 14, 2014**




A 24-hour HYSPLIT back trajectory (Figures 106 and 107) indicated that varied airflows impacted the monitors at the time of the highest concentrations.

The trajectories from the Corcoran monitor indicated impact from sources to the southwest. The Bakersfield and Oildale back trajectories, however, showed impacts from the southeast as well as the local.

**Figure 106. Back Trajectories from Bakersfield, Corcoran, and Oildale – October 14, 2014, 16 PST**

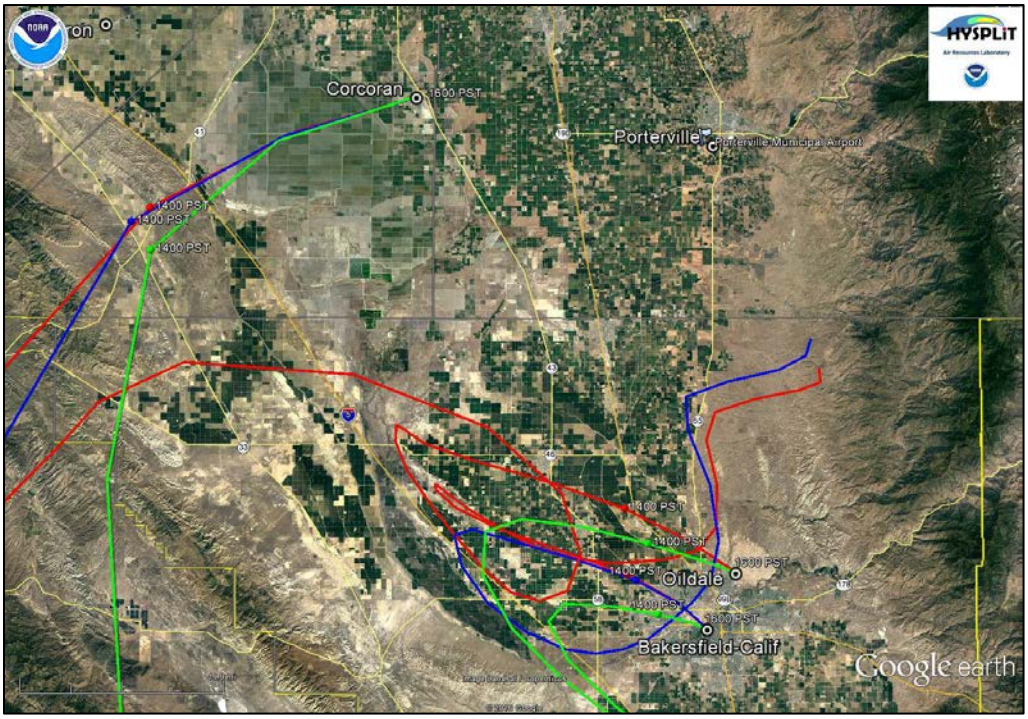
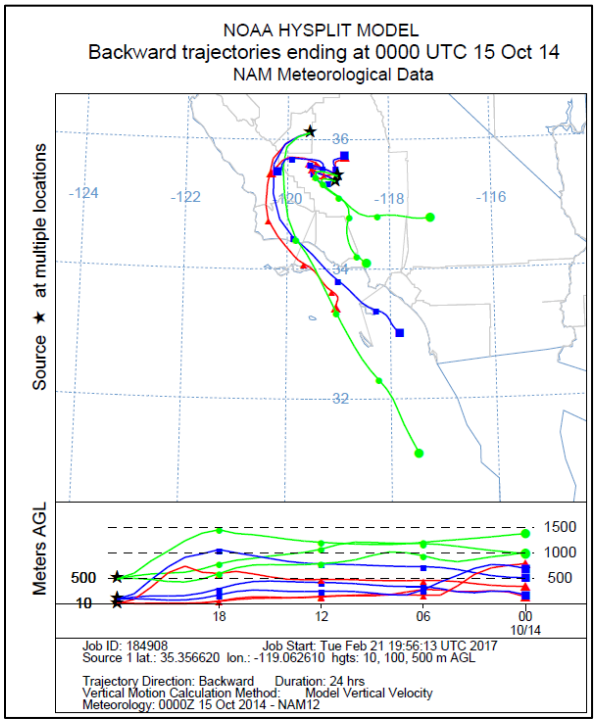
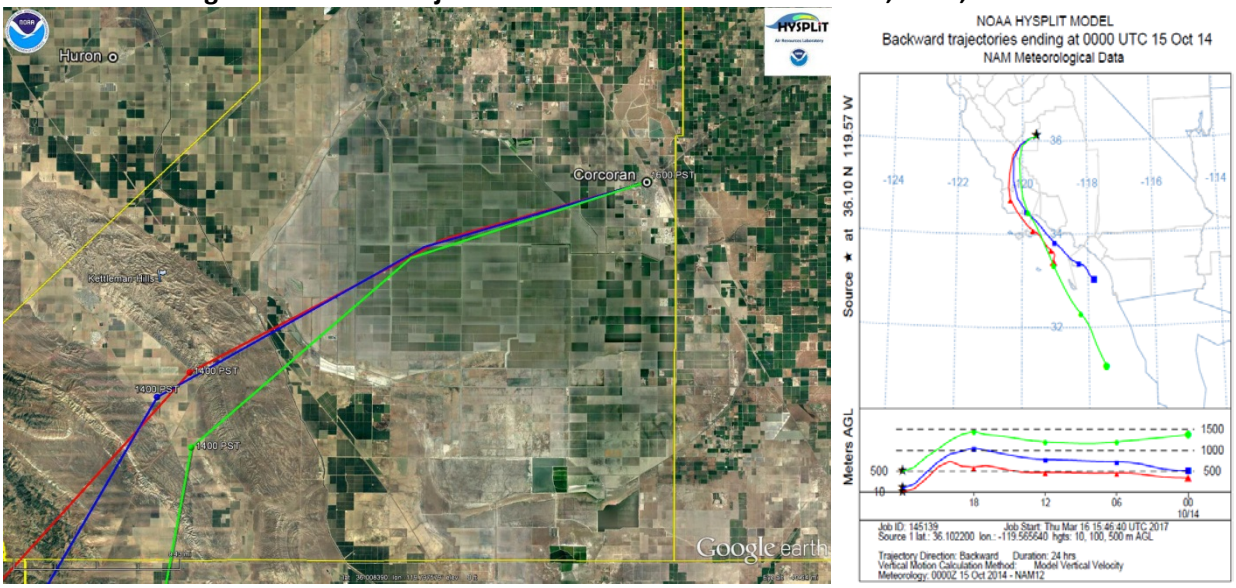



**Figure 107. NOAA HYSPLIT Model Back Trajectory Results – October 14, 2014, 16 PST**



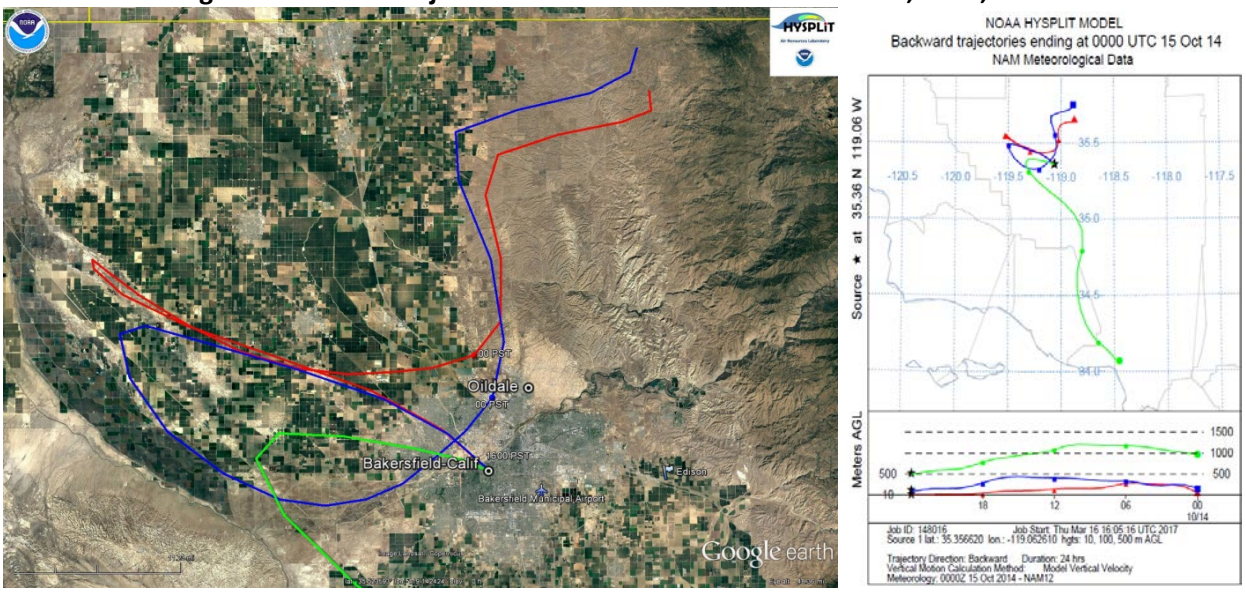
The back trajectories ending at Corcoran at 16 PST, when PM10 concentrations were high, trace the path of air flow for the previous 24-hours, indicating a primarily southwestern influence (Figure 108). All three trajectories originated off the southern California coast, moved north over Santa Barbara and San Luis Obispo Counties and then to the northwest over Kings County before impacting the monitor at Corcoran. All three trajectories maintained fairly high altitudes, at or above 500m above ground level, before dipping toward the surface at approximately 15 PST.

**Figure 108. Back Trajectories from Corcoran – October 14, 2014, 16 PST**



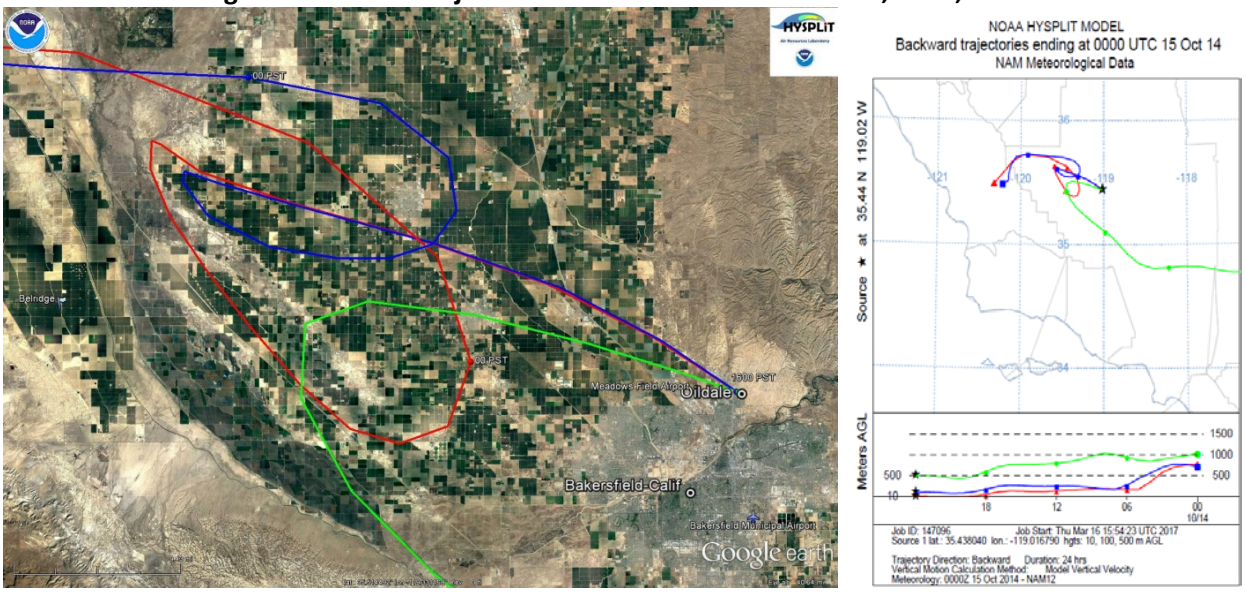

The 24-hour back trajectories ending at Bakersfield at 16 PST when PM10 concentrations were high indicate eastern and local influences (Figure 109). The higher level trajectory (500m above ground level – green line) originated over Los Angeles County, at 1000m, moving north into the San Joaquin Valley before descending to the 500m level and impacting the monitor from the west. Both trajectories that impacted the monitor at the surface (red line) and 100m (blue line) levels originated in the northeast corner of that portion of Kern County within the District. These followed similar paths, moving west then south before circling the area west of the monitor from approximately midnight until 16 PST.

**Figure 109. Back Trajectories from Bakersfield – October 14, 2014, 16 PST**



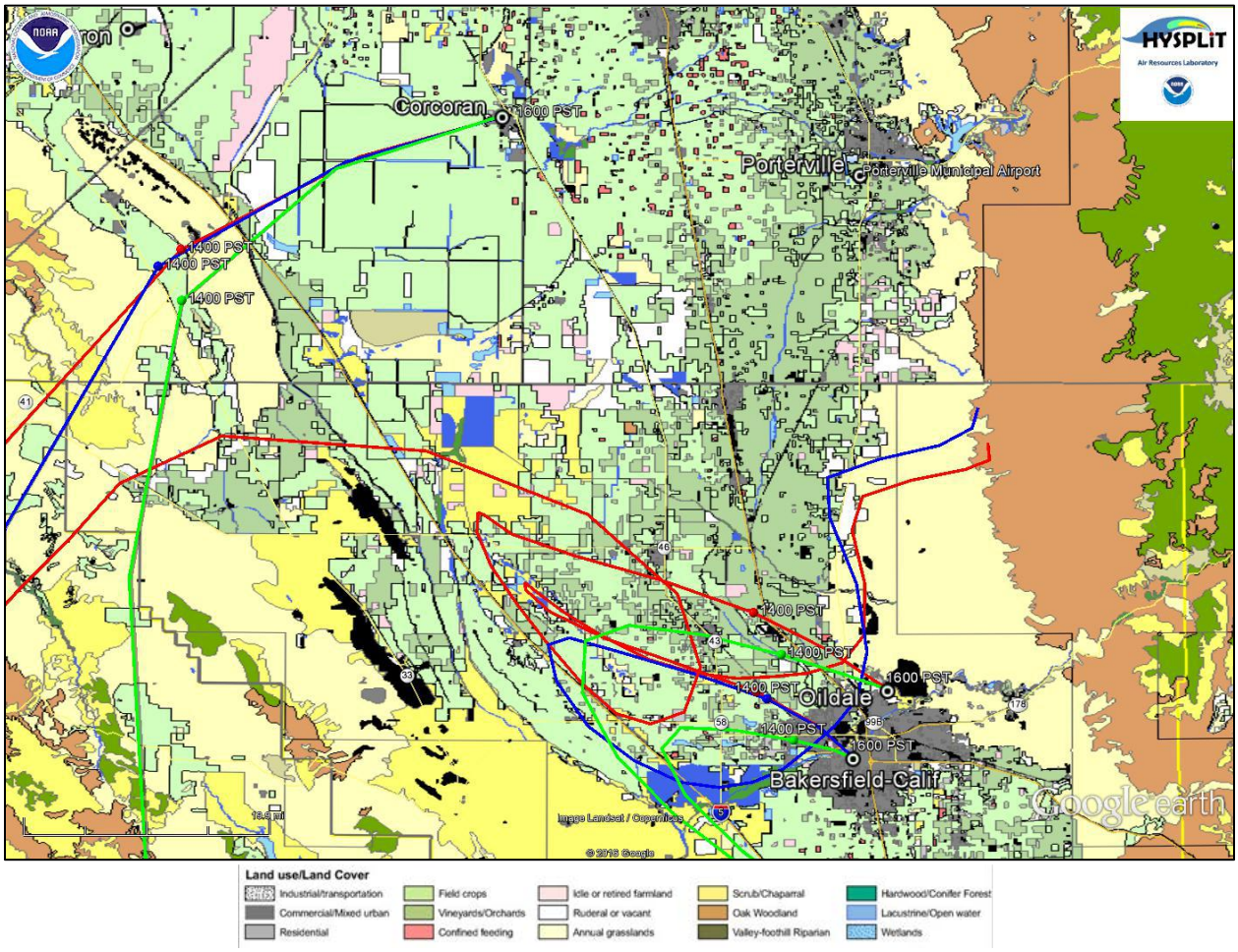

The 24-hour back trajectories ending at Oildale at 16 PST also indicate eastern and local influences (Figure 110). The higher level trajectory (500m above ground level – green line) originated to the southwest over western San Bernardino County, just southwest of Barstow, at 1000m, moving west into Kern County then northwest before descending to the 500m level and turning east toward the monitor. Similar to the situation seen at Bakersfield above, the two lower level back trajectories tracked each other, originating near the surface in the Coastal Range just inside of San Luis Obispo County before moving northeast and then east into Kern County where they circled around the west of the monitor from approximately midnight until 16 PST.

**Figure 110. Back Trajectories from Oildale – October 14, 2014, 16 PST**



A land-use/land cover layer, which covers only the District, was used with the HYSPLIT back trajectory to determine possible emission sources (Figure 111). The image below, combined with the relatively low wind speeds in the area, indicates that the primary emissions in the Bakersfield/Oildale area would have been from the east as well as local area sources, while the high wind speeds and the straighter trajectory at Corcoran, points to transport of dust from the southwest.

**Figure 111. Land Use/Land Cover - Trajectory Paths from Bakersfield, Corcoran, and Oildale**




**Summary**

Based on this initial analysis, the exceedance at the Corcoran monitor on October 14, 2014 is potentially the result of high winds and blowing dust. To meet the contingency provisions of the Maintenance Plan, the District will prepare documentation following U.S. EPA's Exceptional Events Rule.

Based on this initial analysis, the exceedances at the Bakersfield and Oildale monitors are potentially the result of transport of blowing dust from high winds outside the area as well as potential impact from local sources. To meet the contingency provisions of the Maintenance Plan, the District will prepare documentation following U.S. EPA's Exceptional Events Rule. Should additional analysis indicate that there are other contributing factors, the District will proceed with identifying control measures from any feasibility studies completed to date that recommend future controls and prioritize development of the measures most relevant to reducing PM10 emissions during these types of events

## December 11, 2014

Corcoran PM10 TEOM monitor – 202 μg/$m^3$

The PM10 exceedance at the Corcoran monitor was driven by high winds and blowing dust. The District flagged this data in AQS as a high wind exceptional event.

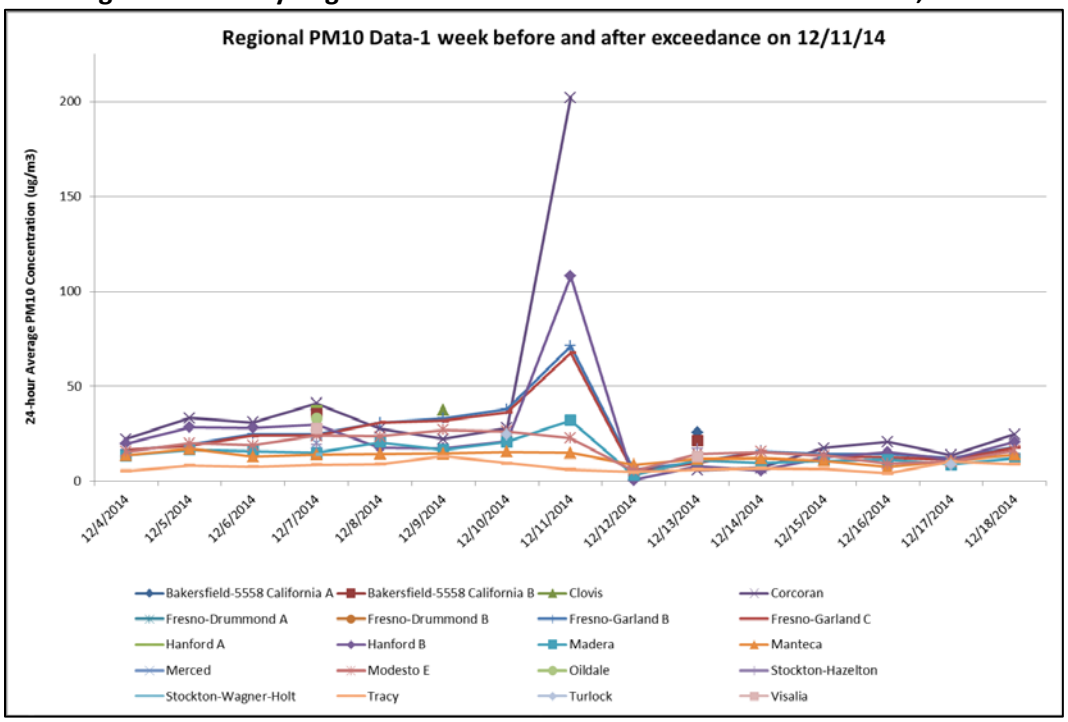
A strong cold front moved through California bringing gusty winds and precipitation to areas throughout the State. The NWS issued a high wind warning in effect from 10 PST on December 11 to 04 PST on December 12 for the southern portions San Joaquin Valley and the Kern County Mountains, including the Corcoran area. A high wind warning was also in effect for the central portion of the San Joaquin Valley from 10 to 22 PST on December 11. A Public Information Statement issued by the NWS in the early afternoon of the 10th noted wind gusts in the SJV ranging from 30 to 48 mph. There was no indication on the District website or through the NWS that the District issued any air quality alerts for this event. The NOAA Storm Events Database reported one incident of high winds in the west central portion of the SJV (gusts of 55 mph in Bakersfield) and noted that there were numerous reports of downed trees and power line in the Bakersfield area. There were multiple incidents throughout the State with wind gusts ranging from 33 to 96 mph.

- **Evaluation of PM10 filter-based and continuous data across the Valley to understand the local or regional nature of each exceedance.**

Concentrations at the continuous monitors in the SJV showed a similar trend, with low concentrations in the morning and all sites with high concentrations in the late afternoon to evening. This was not a scheduled filter sampling day.

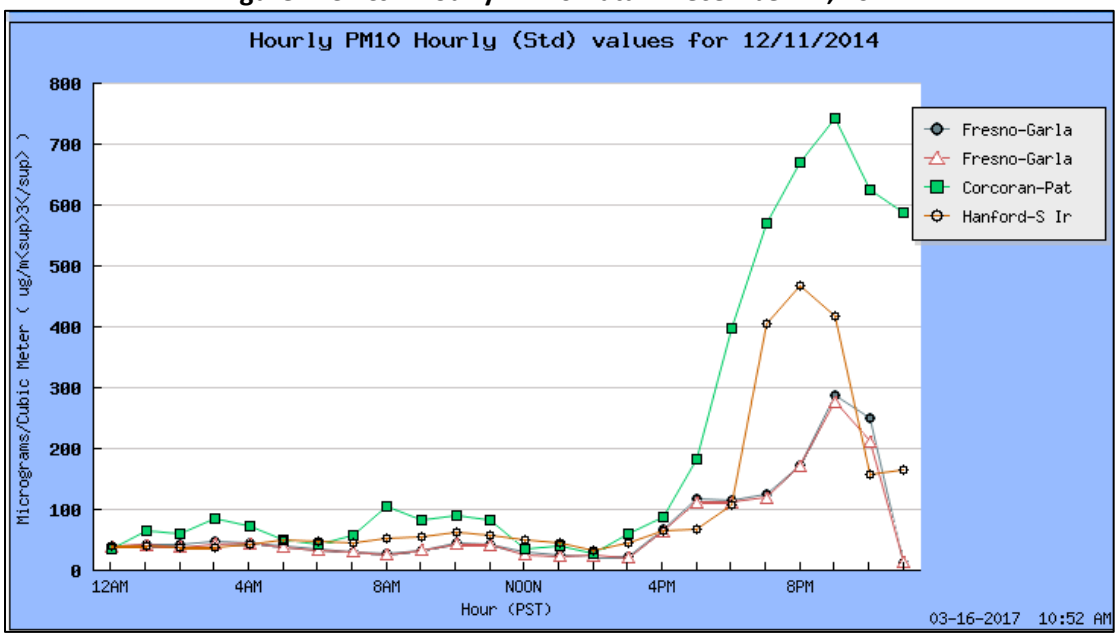
Figure 112 displays the PM10 filter and hourly data for SJV sites between December 4 and December 18. The Corcoran TEOM exceeded the federal 24-hour PM10 standard on December 11. The Hanford monitor, in the same county as the Corcoran site, recorded the next highest PM10 concentration on December 11.

**Figure 112. Daily Regional PM10 Data – December 4 to December 18, 2014**




The chart below (Figure 113) displays the daily average PM10 hourly data on December 11 at sites in Fresno, Corcoran, and Hanford. The Corcoran site recorded hourly values above the federal 24-hour average PM10 standard of 150 µg/m$^3$ from 17 PST to midnight. The Fresno and Hanford sites also experienced several hours over the 24-hour PM10 standard but not to the same degree as the Corcoran site.

**Figure 113. SJV Hourly PM10 Data – December 11, 2014**



The majority of the State was below the State PM10 24-hour standard of 50 μg/m$^3$, but four of the seven continuous monitors operating in SJV were above the State standard. The only exceedances of the federal PM10 standard of 150 μg/m$^3$ were at Corcoran in Kings County and Mono Lake in Mono County in the Great Basin Unified District.

- **Analysis of PM2.5 data to determine whether fine or coarse particles are contributing to the exceedance.**

Figure 114 displays the PM2.5 filter data for SJV sites between December 4 and December 18. Corcoran did not record PM2.5 data on December 11 so the comparison to PM10 could not be made at this site on this day. The highest PM2.5 concentration on December 11 was 28.7 μg/m$^3$ at the Hanford site in Kings County, the same county where the Corcoran site is located.

**Figure 114. Daily Regional PM2.5 Data – December 4 to December 18, 2014**

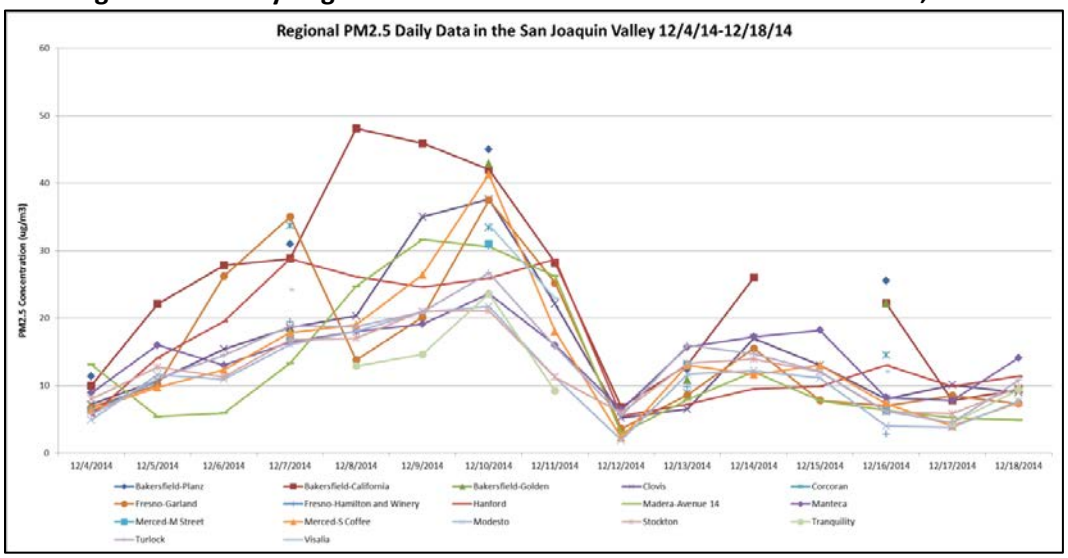
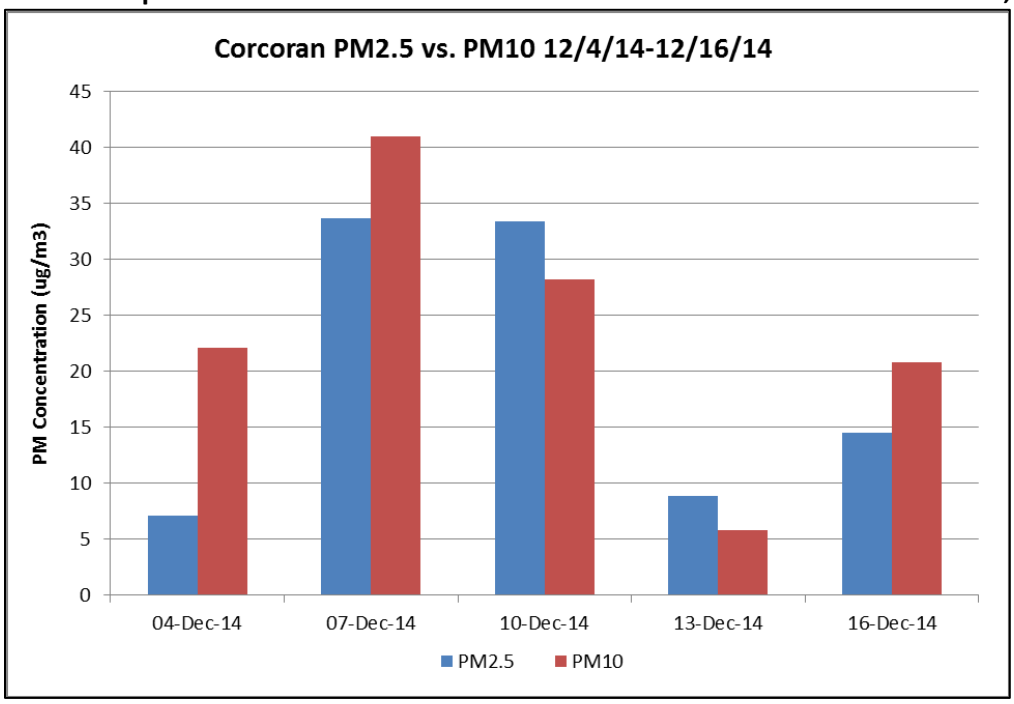



Figure 115 shows that PM2.5 and PM10 concentrations were elevated before the PM10 exceedance on December 11 at Corcoran. PM2.5 data was not available on the 11$^{th}$ so a direct comparison to PM10 could not be made. However, PM2.5 concentrations on December 10 and December 13 recorded higher than PM10. The District's analysis compared December 11 PM concentrations at the Corcoran and Hanford monitors. The Corcoran PM10 (201.8 μg/m$^3$) and Hanford PM2.5 (28.7 μg/m$^3$) concentrations indicated that approximately 86 percent of the sample was comprised of coarse particulate, while 14 percent was comprised of fine particulate.

**Figure 115. Comparison of PM2.5 and PM10 at Corcoran – December 4 to December 16, 2014**




- **Analysis of available chemical speciation data including additional filter speciation analysis as appropriate to assess potential source types contributing to each exceedance.**

PM2.5 speciation data was not available on December 11. However, PM2.5 speciation was recorded at Visalia before and after the December 11 exceedance at Corcoran (Table 14). The data shows that PM2.5 species were highest prior to the PM10 exceedance at Corcoran on December 11 and decreased after that day.

**Table 14. PM2.5 Speciation Data (μg/m$^3$) at Visalia – December 7 to December 16, 2014**

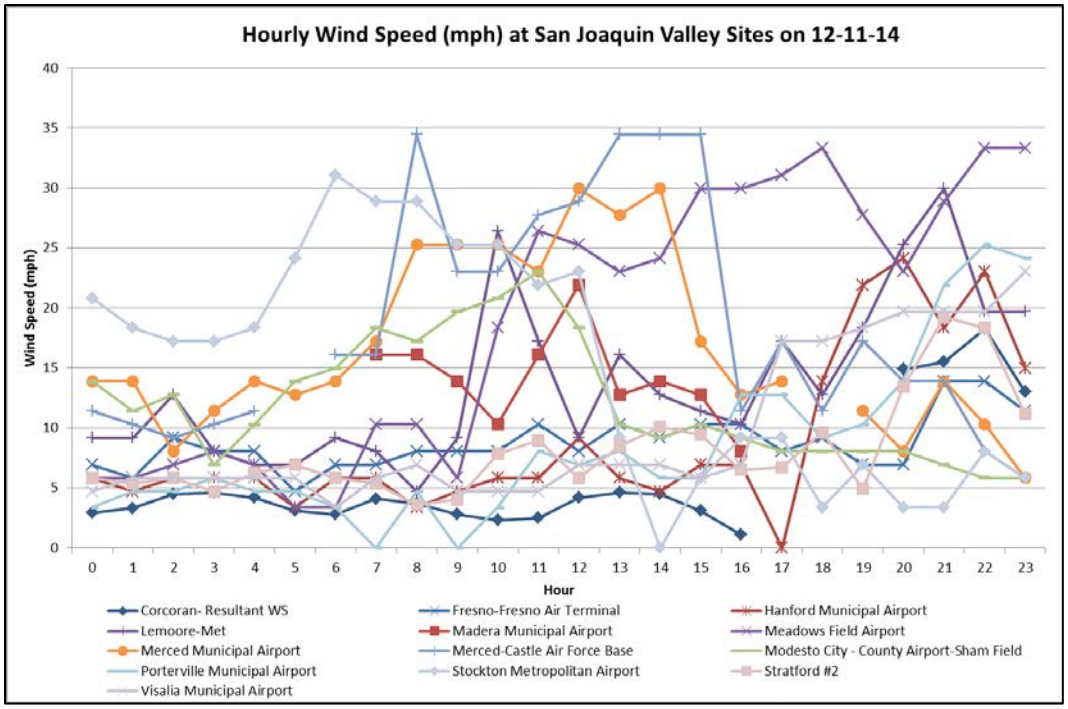
| Monitor | Date | Mass | Ammonium Nitrate | Ammonium Sulfate | Organic Matter | Elemental Carbon | Geologic | Elements |
|---|---|---|---|---|---|---|---|---|
| Visalia | 12/7/14 | 24.5 | 9.5847 | 1.07778 | 7.7 | 1.0 | 0.37832 | 0.396 |
| Visalia | 12/13/14 | 12.7 | 2.3865 | 0.61824 | 5.74 | 0.8 | 0.15353 | 0.3615 |
| Visalia | 12/16/14 | 13.7 | 5.3922 | 0.5865 | 4.62 | 0.6 | 0.30616 | 0.266 |

- **Analysis of wind speed and direction, along with geographic visualization tools to help identify the types of sources impacting each monitor.**

Local airports near the Corcoran site, Lemoore Naval Air Station, Hanford Municipal Airport, and Visalia Municipal Airport, recorded maximum wind speeds of 30, 24, and 20 mph, respectively (Figure 116). Low visibility was reported at both Lemoore and Visalia, with hazy conditions also reported at Lemoore. All three airports reported gusts ranging from 29 to 41 mph. Wind speeds at the Corcoran monitoring site was fairly high at the time of the peak concentrations in the afternoon, ranging from 10 to 18 mph.

Further south, in the Bakersfield/Oildale area, the Meadows Airport and the Bakersfield Municipal Airport reported high wind speeds of 33 and 28 mph, with respectively, with wind gusts reported at Meadows from 30 to 53 mph.

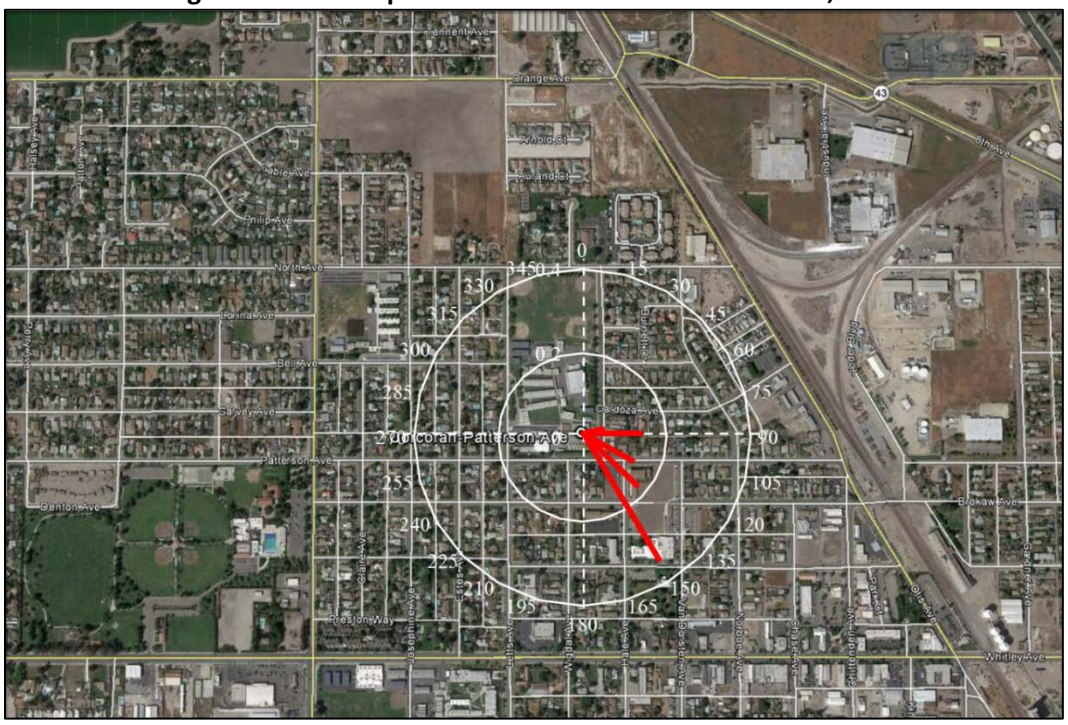
**Figure 116. Wind Speeds at Selected San Joaquin Valley Sites – December 11, 2014**




*Data at Corcoran uses resultant wind data.

The wind rose below (Figure 117) demonstrates that 79 percent of the winds at Corcoran were above 3 knots (3.45 mph) and were from the southeast and east on December 11. The remaining 21 percent of the winds on this day were considered calm winds (below 3 knots).

**Figure 117. Wind patterns at Corcoran – December 11, 2014**




A 24-hour HYSPLIT back trajectory indicated that airflow impacting the Corcoran monitor was primarily from the southeast (Figure 118).

**Figure 118. Back Trajectories from Corcoran – December 11, 2014, 21 PST**

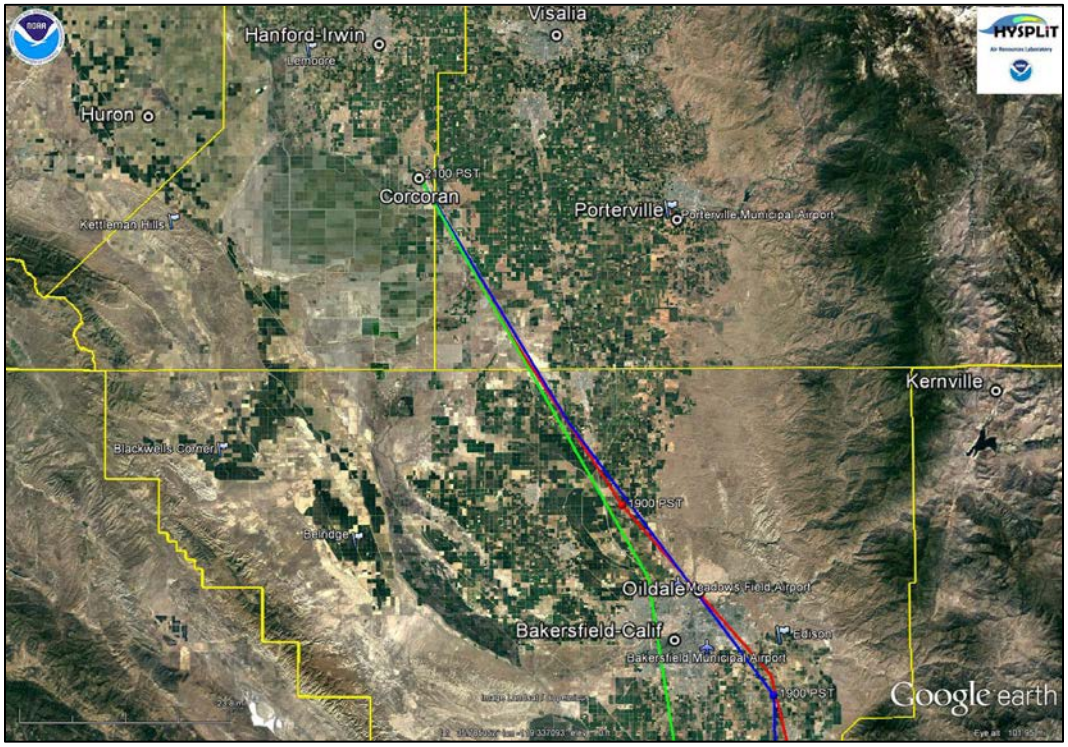
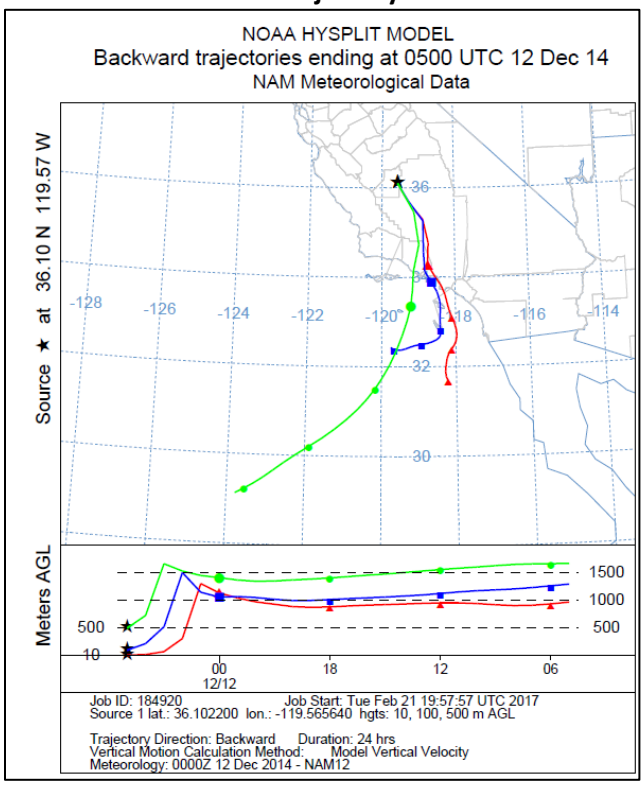


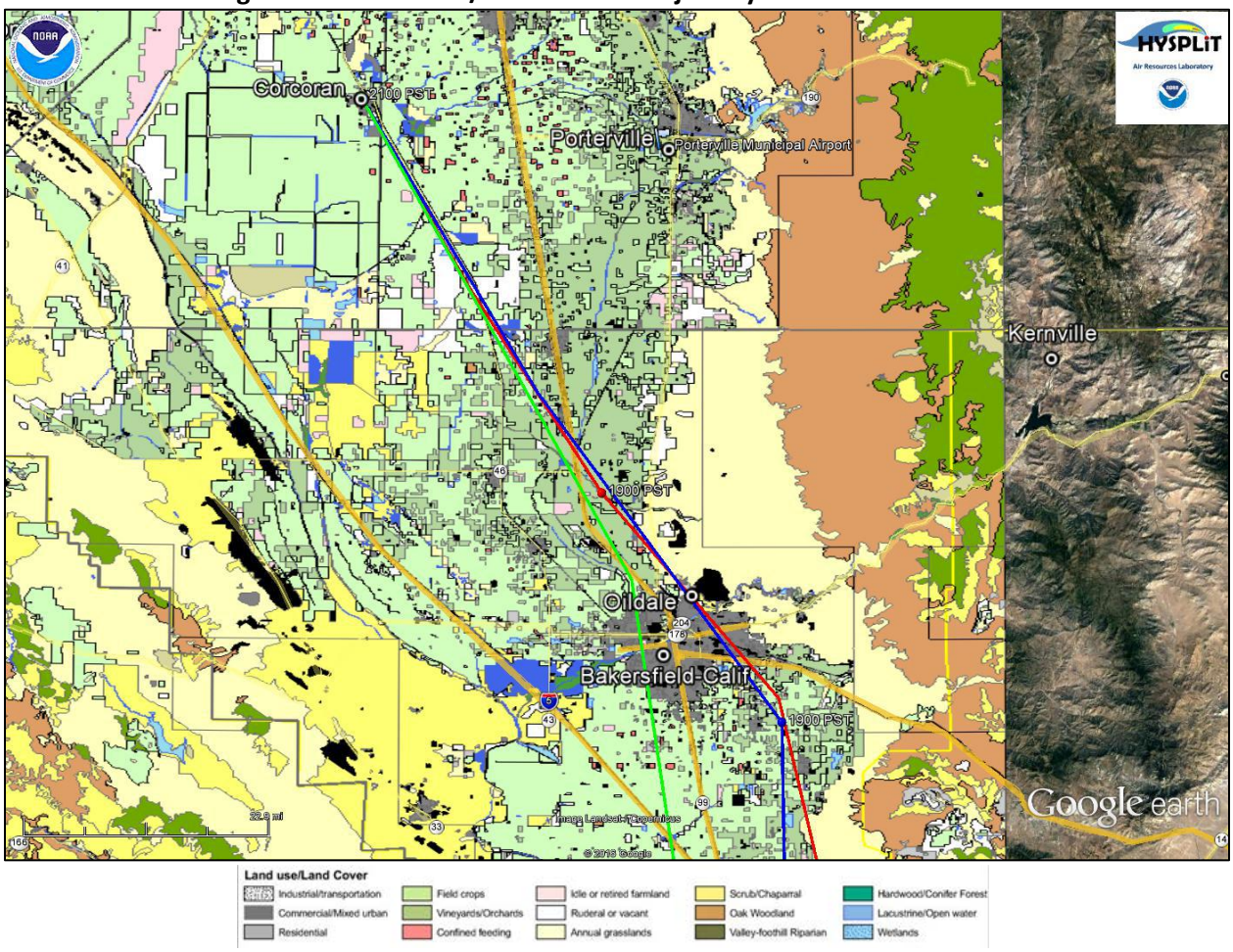
**Figure 119. NOAA HYSPLIT Model Back Trajectory Results – December 11, 2014, 21 PST**




The back trajectories ending at Corcoran trace the path of air flow for the previous 24-hours, indicating a primarily southern influence (Figure 119 above). All three trajectories originated off the southern California coast, moved north over Ventura County and into Kern County. All three trajectories maintained fairly high altitudes, at or above 1000m above ground level, before descending after 17 PST. The trajectory that ultimately impacted the monitor at the surface (red line) descended to surface level at approximately 19 PST, when just past the Bakersfield/Oildale area where sustained winds were over 30 mph.

A land-use/land cover layer (Figure 120) which covers only the District was used with the HYSPLIT back trajectory to determine possible emission sources. The image below, combined with the high wind speeds in the area and the trajectory heights, indicates that the primary emissions in the Corcoran area would have been from sources to the south as well as the local area.

**Figure 120. Land Use/Land Cover - Trajectory Paths from Corcoran**




**Summary**

The exceedance at the Corcoran monitor on December 11, 2014 is potentially the result of high winds and blowing dust. To meet the contingency provisions of the Maintenance Plan, the District will prepare documentation following U.S. EPA's Exceptional Events Rule.

# CONCLUSION

Through the above analyses, CARB staff identified the nature of each event and the appropriate contingency mechanism as outlined in the Maintenance Plan. The exceedances fell into three categories: exceptional event, winter stagnation event or fall stagnation event. CARB staff findings are summarized in Table 15 below.

**Table 15 - San Joaquin Valley Event Determination**

| Date | Monitor | Type of Event |
|---|---|---|
| 10/3/2013 | Corcoran TEOM | Exceptional Event |
| 11/14/2013 | Corcoran TEOM | Fall Stagnation |
| 12/17/2013 | Corcoran TEOM | Winter Stagnation |
| 12/18/2013 | Corcoran TEOM | Winter Stagnation |
| 12/18/2013 | Hanford FRM | Winter Stagnation |
| 12/18/2013 | Hanford TEOM | Winter Stagnation |
| 12/18/2013 | Visalia FRM | Winter Stagnation |
| 1/21/2014 | Bakersfield-CA BAM | Winter Stagnation |
| 1/22/2014 | Corcoran TEOM | Winter Stagnation |
| 1/23/2014 | Bakersfield-CA BAM | Exceptional Event |
| 1/23/2014 | Oildale FRM | Exceptional Event |
| 6/2/2014 | Bakersfield-CA BAM | Exceptional Event |
| 6/10/2014 | Oildale FRM | Exceptional Event |
| 6/11/2014 | Bakersfield-CA BAM | Exceptional Event |
| 10/14/2014 | Corcoran TEOM | Exceptional Event |
| 10/14/2014 | Bakersfield-CA FRM | Exceptional Event |
| 10/14/2014 | Bakersfield-CA FRM | Exceptional Event |
| 10/14/2014 | Oildale FRM | Exceptional Event |
| 12/11/2014 | Corcoran TEOM | Exceptional Event |

**Exceptional Events**

For the PM10 exceedances identified as potential exceptional events, the District will proceed with the required exceptional events documentation according to U.S. EPA's guidance for the Exceptional Events Rule. This documentation will be submitted to CARB for evaluation before being forwarded to U.S. EPA for exclusion.

**Winter Stagnation Events**

Winter stagnation type events are events that were not identified as potential exceptional events. The District identified NOx and residential burning emission reductions as the strategy for reducing PM10 levels under this condition in the 2003 PM10 Plan. All of the winter stagnation events occurred in the winter of 2013/2014. CARB's motor vehicle emission control program has continued to provided NOx reductions since winter 2013/2014. In addition, on September 18, 2014, the District strengthened their residential wood burning curtailment program. Also, the District continues to incentivize the change out of old wood stoves with cleaner more efficient wood stoves. Both CARB mobile reductions and District programs related to residential wood burning are sufficient to address the winter stagnation type PM10 exceedances.

**Fall Stagnation Events**

Fall stagnation type events are also events that were not identified as potential exceptional events. To ensure continued maintenance of the PM10 standard, the District will proceed with identifying control measures from any feasibility studies completed to date that recommend future controls and prioritize development of the measures most relevant to reducing PM10 emissions during these types of events.

## Appendix A: Chemical Analysis of Filter Media for Select PM10 Exceedance Days

CARB's Monitoring and Laboratory Division (MLD) analyzed six PM10 filters for metals using inductively coupled plasma microscopy (ICP-MS) and for ions using ion chromatography (IC). All filters had very high PM10 concentrations ranging from 155 μg/m$^3$ to over 400 μg/m$^3$. One filter was collected from Bakersfield (October 14, 2014), one from Hanford (December 18, 2013), one from Visalia (December 18, 2013), and three from Oildale (January 23, 2014, June 10, 2014, and October 14, 2014).

While MLD analyzed each filter for nitrate and sulfate and found concentrations to be low, this information could be misleading. Since filters were stored at room temperature for several years, most of the nitrate originally captured on the filters could have been lost. Four out of six filters were analyzed for nitrate twice, the first time in 2014 and the second time in 2016. Each time a different portion of the filter was analyzed. The second measurement was 3.4 percent to 41 percent lower. Additionally, some of the nitrate could have been lost prior to the first analysis. Other information, particularly PM2.5 composition, should be examined to estimate potential nitrate and sulfate contribution.

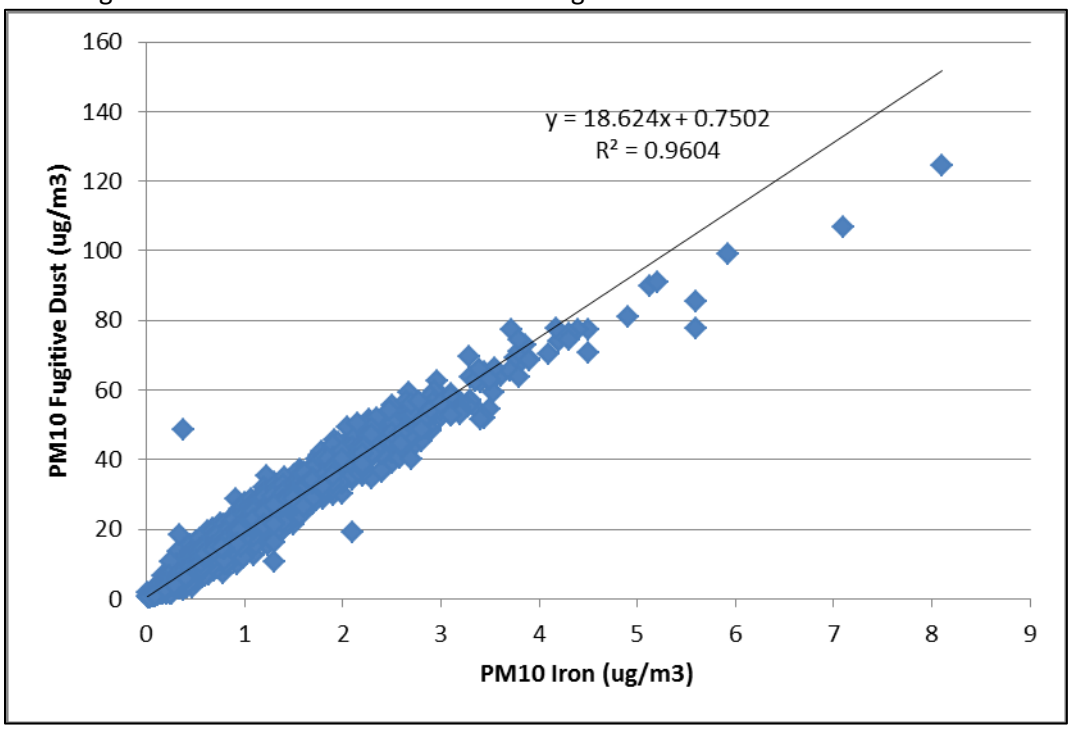
All six filters had moderate concentrations of PM10 soluble potassium, ranging from 0.34 μg/m$^3$ to 0.65 μg/m$^3$. Soluble potassium is often used as an indicator of wood burning, but it's not a very good indicator of wildfires, because the amount of soluble potassium emitted could vary significantly depending on the material burned. In this case it is unlikely that wildfires contributed to these elevated concentrations because a major wildfire capable of generating PM10 concentrations of the magnitude measured on the filters would be recorded as an exceptional event.

Typically multiple crustal elements are used to estimate fugitive dust concentrations. In the absence of complete data set, single crustal elements, including iron, have also been used to estimate fugitive dust. Since iron and titanium were the only crustal elements analyzed by the lab and iron is typically more abundant of the two, we evaluated iron as a potential marker of fugitive dust. Iron concentrations ranged from 1 to 11 μg/m$^3$. We examined PM10 dichot data collected in the San Joaquin Valley to develop a relationship between iron and fugitive dust concentrations in the Valley. Concentrations of PM10 fugitive dust were estimating using the IMPROVE equation (http://views.cira.colostate.edu/improve/Tools/AerTypeEqs.htm):

$$2.2 \times \text{Aluminum} + 2.49 \times \text{Silicon} + 1.63 \times \text{Calcium} + 2.42 \times \text{Iron} + 1.94 \times \text{Titanium}$$

As illustrated in Figure A1, there was a strong correlation between fugitive dust and iron concentrations. The average ratio of fugitive dust to iron concentrations in this data set was 19.

Figure A1. Correlation between PM10 Fugitive Dust and Iron Concentrations




Using 19 as the ratio of fugitive dust to iron concentrations, we estimated concentrations of fugitive dust on the six filters analyzed by MLD (Table A1). Four out of six filters analyzed had high concentrations of iron indicating that fugitive dust was a significant component of the mass. However, even on these four days over half of the measured mass remains unassigned. While we are certain that these four days had significant fugitive dust component, it is not possible to accurately calculate the actual concentrations due to uncertainty about uniformity of iron distribution on the filter and the relationship between iron and other fugitive dust components. Two filters collected on December 18, 2013 at Bakersfield and Hanford had fairly low concentrations of fugitive dust. This implies that other sources contributed to high PM10 concentrations. Figures A2 and A3 illustrate the relationship between measured PM10 mass and estimated fugitive dust mass.

Table A1. PM10 and Estimated Fugitive Dust Concentrations ($\mu g/m^3$)

| | Bakersfield 10/14/2014 | Oildale 01/23/2014 | Oildale 06/10/2014 | Oildale 10/14/2014 | Visalia 12/18/2013 | Hanford 12/18/2013 |
|---|---|---|---|---|---|---|
| PM10 ($\mu g/m^3$) | 419 | 334 | 311 | 336 | 155 | 177 |
| Iron ($\mu g/m^3$) | 10.5 | 8.16 | 8.12 | 8.35 | 1.12 | 2.04 |
| Fugitive Dust ($\mu g/m^3$) | 199.5 | 155.04 | 154.28 | 158.65 | 21.28 | 38.76 |
| Other ($\mu g/m^3$) | 219.5 | 178.96 | 156.72 | 177.35 | 133.72 | 138.24 |

Figure A2. PM10 Filters with High Fugitive Dust

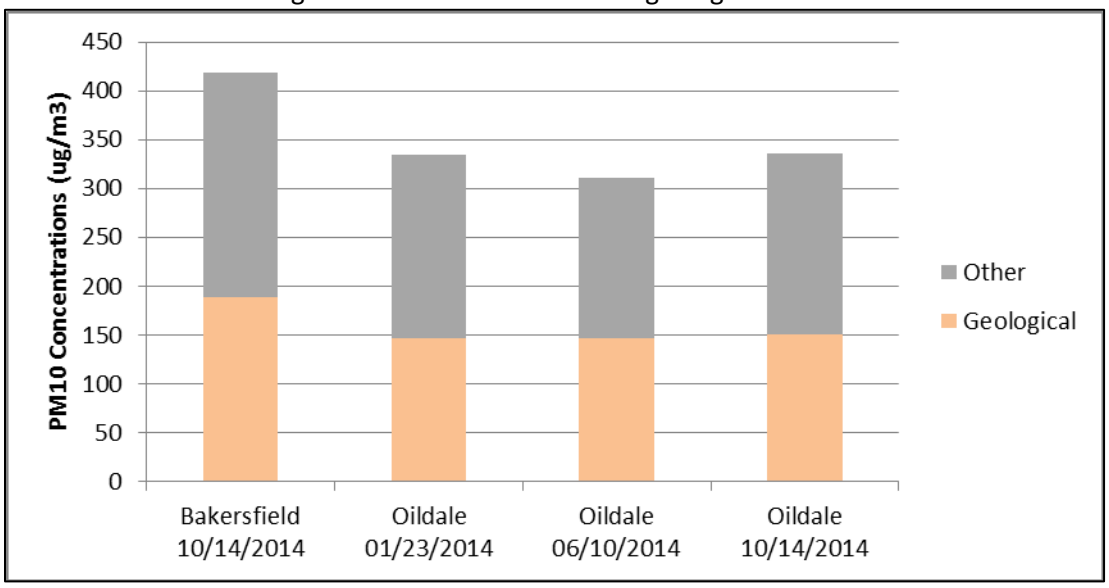
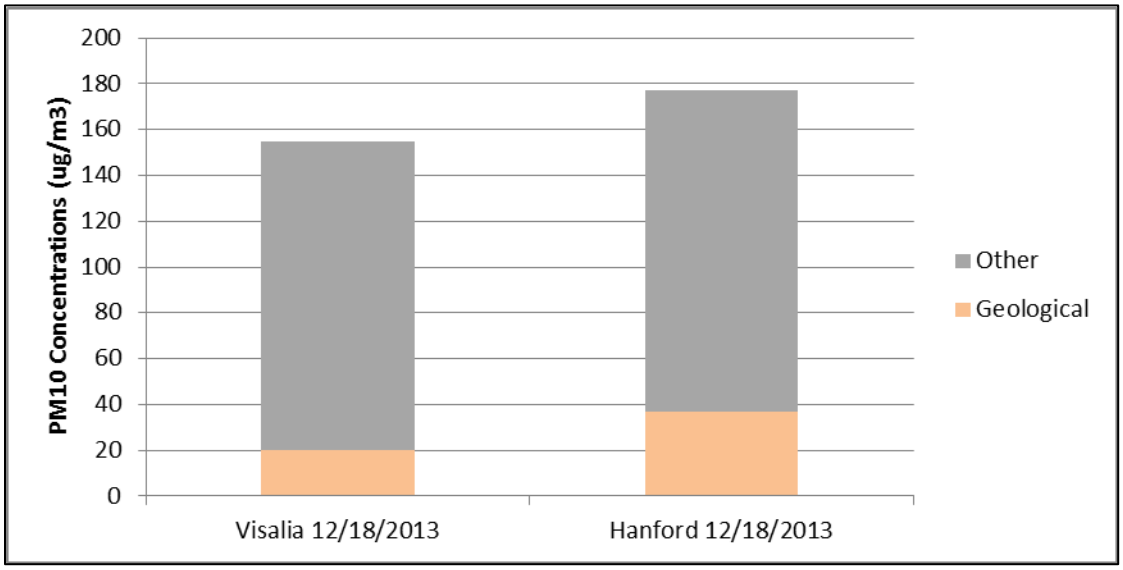



Figure A3. PM10 Filters with Low Fugitive Dust Concentrations

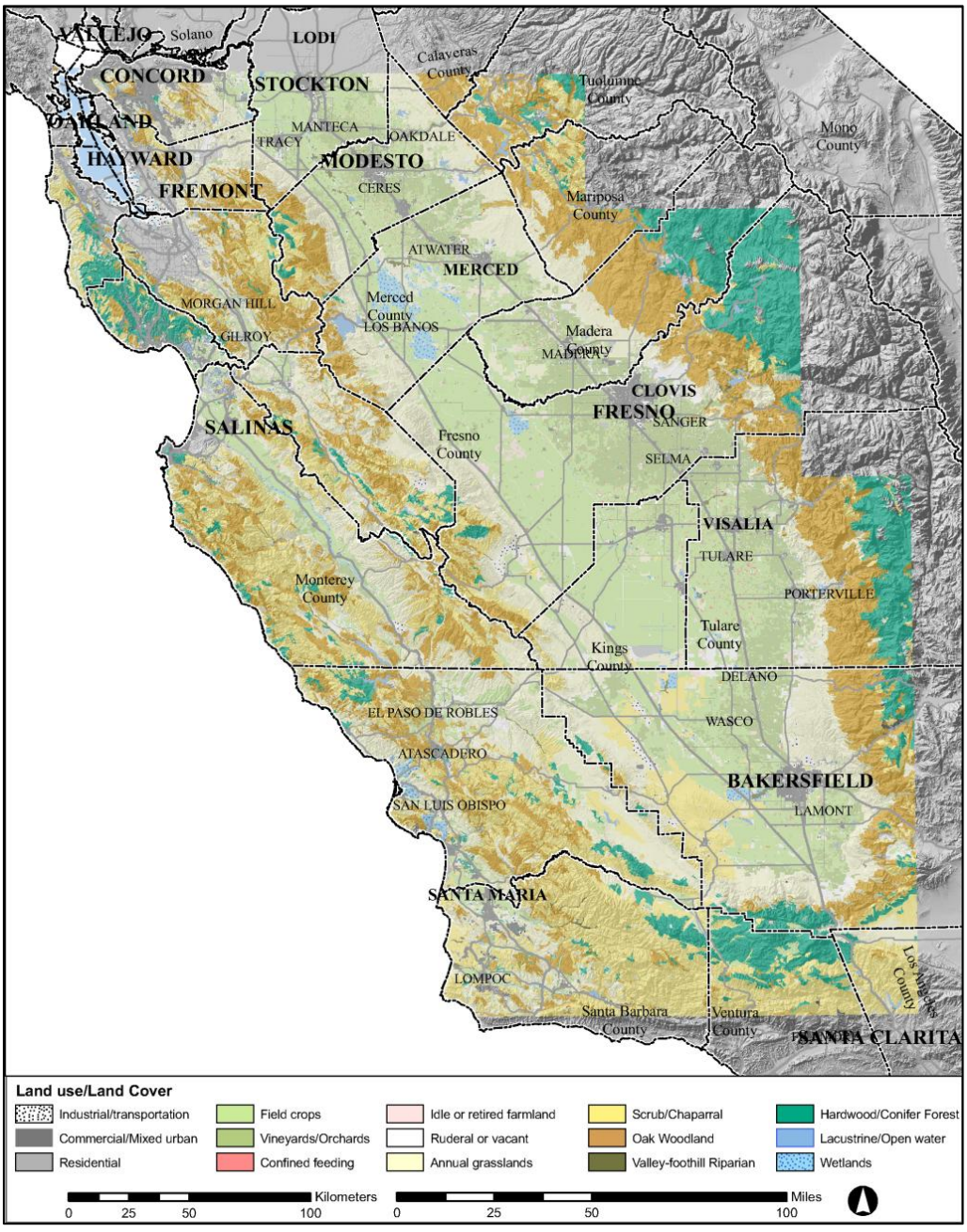



The results of these analyses and the estimates of fugitive dust concentrations should be used only qualitatively to determine if fugitive dust was a significant contributor to the measured PM10 mass. There are significant differences between the analyses performed on these six filters and analyses used to measure elemental species concentrations on PM2.5 or dichot filters. Typically, PM2.5 or dichot Teflon filter is analyzed by XRF. The large quartz PM10 filters were cut into quarters with metal scissors. One quarter of each filter was analyzed and the assumption was made that concentrations were uniformly distributed across the entire filter surface. Each piece was submerges in the extraction solution and the extract was analyzed by inductively coupled plasma microscopy (ICP-MS). While the results should not be used to make definitive quantitative findings, they could be used to determine whether fugitive dust was present on the filter in significant concentrations.

# Appendix B: Land Use/Land Cover Data

**Land Use/Land Cover Data**

*Land use and land cover of the San Joaquin Valley of California and surrounding areas (2004-06)*
California State University, Stanislaus, Endangered Species Recovery Program
[http://esrp.csustan.edu/gis]



# Appendix C: Data Sources

**PM10 and PM2.5 Concentration Data**
California Air Resources Board, Air Quality and Meteorological Information System (AQMIS), https://www.arb.ca.gov/aqmis2/aqmis2.php. Last accessed: March 23, 2017

U.S. Environmental Protection Agency, Air Quality System (AQS), https://www.epa.gov/aqs. Last accessed: March 21, 2017

**PM2.5 Speciation Data**
PM2.5 Speciation Data is detailed in Appendix A.

**Meteorological Data**
National Weather Service Text Products
Iowa Environmental Mesonet (IEM), Iowa State University of Science and Technology, https://mesonet.agron.iastate.edu/wx/afos/list.phtml. Last accessed: March 17, 2017,
*The IEM archives National Weather Service text products. This is not an official National Weather Service archive.*

NOAA Storm Event Reports
National Oceanic and Atmospheric Administration (NOAA), National Center for Environmental Information, https://www.ncdc.noaa.gov/stormevents/. Last accessed: March 23, 2017

**Wind Data**
National Oceanic and Atmospheric Administration (NOAA), Quality Controlled Local Climatological Data (QCLCD), https://www.ncdc.noaa.gov/qclcd/QCLCD. Last accessed: March 17, 2017

California Air Resources Board, Air Quality and Meteorological Information System (AQMIS), https://www.arb.ca.gov/aqmis2/aqmis2.php. Last accessed: March 23, 2017

**Trajectory Analysis**
National Oceanic and Atmospheric Administration (NOAA) Air Resources Laboratory HYSPLIT model. http://ready.arl.noaa.gov/HYSPLIT.php. Last accessed: March 17, 2017

**Land Use/Land Cover**
Land use and land cover of the San Joaquin Valley of California and surrounding areas (2004-2006), California State University, Stanislaus, Endangered Species Recovery Program, http:esrp.csustan.edu/gis/lulc. Last accessed: March 21, 2017

**District News and Press Releases**
San Joaquin Valley Air Pollution Control District, Press Releases and Recent News, http://www.valleyair.org/recent_news/recent_district_news.htm. Last accessed: March 17, 2017.

**District Analysis of the 2013 and 2014 PM10 Exceedances**
San Joaquin Valley Air Pollution Control District, Evaluation of Exceedances of the Federal 24-hour PM10 Standard in the San Joaquin Valley in 2013 and 2014, communication by electronic mail, J.Klassen, SJVAPCD to W.Tasat, CARB, March 20, 2017