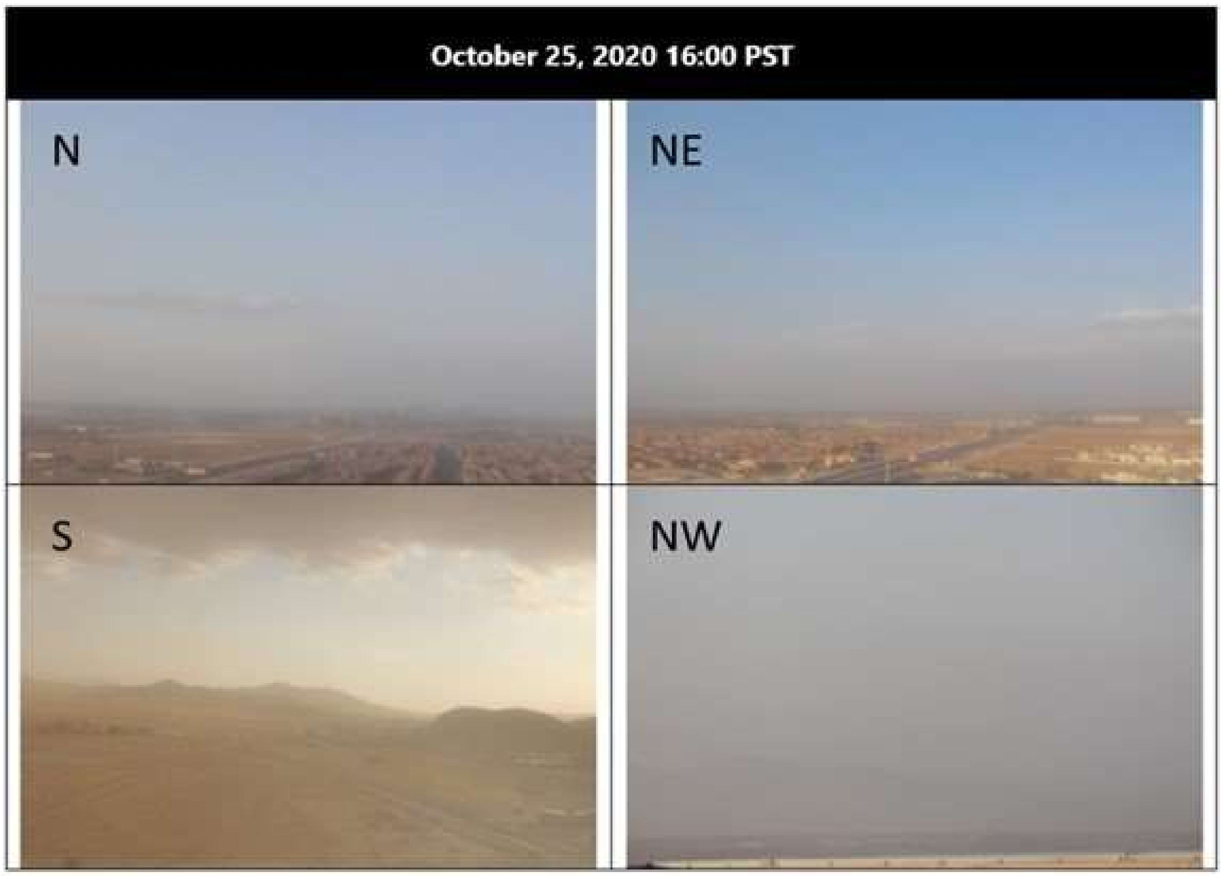
Exceptional Event Demonstration for PM_{10} Exceedances in Clark County, Nevada – October 25, 2020



Final Report Prepared for

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San Francisco, CA

June 2024

STi Sonoma Technology

Exceptional Event Demonstration for PM_{10} Exceedances in Clark County, Nevada – October 25, 2020

Prepared by

Crystal McClure, PhD
Annie Anderson, PhD
Jeff Beamish
Kayla Besong, PhD
Melissa Chaveste
Cari Gostic
Samantha Kramer, PhD
Charles Scarborough
Ningxin Wang, PhD
Patrick Zahn
Steve Brown, PhD

Sonoma Technology
1450 N. McDowell Blvd., Suite 200
Petaluma, CA 94954
Ph 707.665.9900 | F 707.665.9800
sonomatech.com

Prepared for

Clark County Department of Environment and Sustainability
Division of Air Quality
4701 W. Russell Road, Suite 200
Las Vegas, NV 89118
Ph 702.455.3206
www.clarkcountynv.gov

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Cover graphic shows visibility images from the M Resort Hotel in the Las Vegas Valley on October 25, 2020, at 17:00 PST. Visibility images are available in real-time from Clark County DES here: https://bit.ly/408P7yD

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Contents

Figures

Tables

1. Narrative Conceptual Model

In late October 2020, a strong frontal passage traversed northwestern and central Nevada, driving a wind-blown dust event that increased particulate matter (PM) concentrations in Clark County, NV, on October 25. During this episode, the 2012 24-hour National Ambient Air Quality Standards (NAAQS) threshold was exceeded for particles with a diameter of less than 10 microns (PM_{10}) at the Jerome Mack and Sunrise Acres monitoring sites in Clark County, NV. Six other sites throughout Clark County also experienced extremely high PM_{10} concentrations but were not regulatorily significant. This exceedance at Jerome Mack and Sunrise Acres affects the PM_{10} attainment designation for Clark County during the 2020-2022 design value period.

Due to severe drought conditions in the Great Basin and northern Mojave deserts in Nevada, strong winds from the frontal passage lofted, entrained, and transported dust into Clark County, arriving late in the morning on October 25, 2020 (at approximately 11:00 PST). The U.S. Environmental Protection Agency (EPA) Exceptional Event Rule (EER) (U.S. Environmental Protection Agency, 2016) allows air agencies to omit air quality data from the design value calculation if it can be demonstrated that the measurement in question was caused by an exceptional event. In this case, enhanced wind speeds greater than 25 mph in Great Basin Desert and northern Mojave Desert source regions and the Las Vegas Valley coincide with increased PM_{10} concentrations and are consistent with a high-wind dust event as described in the EPA Guidance on High Wind Dust Events (U.S. Environmental Protection Agency, 2019).

Overall, the October 25, 2020, PM_{10} event at Jerome Mack and Sunrise Acres ranks above the 99th percentile (99.89%) for all 2016-2020 PM_{10} events in Clark County, and is clearly exceptional compared to typical PM_{10} conditions. Windblown dust from the Great Basin and northern Mojave deserts is shown to be entirely from natural, undisturbed lands and can be considered a natural event that could not be mitigated by anthropogenic actions beyond public warnings. Overall, this report includes detailed analyses that establishes a clear causal relationship between the high-wind event in the Great Basin and northern Mojave deserts source regions and Clark County with the enhanced PM_{10} concentrations measured at Jerome Mack and Sunrise Acres, designating the October 25, 2020, event as a High Wind Dust Exceptional Event.

Key narrative evidence and timeline elements are shown below and expanded on in this document.

Pre-Event Climatological Context

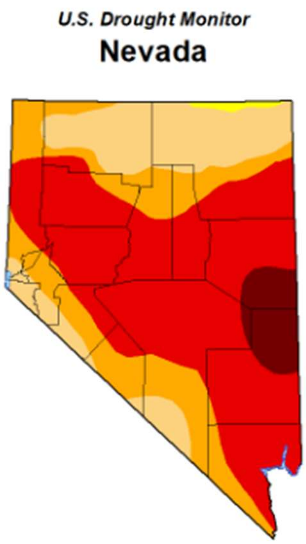


Figure 2.2-7

Clark County, NV, and the surrounding source regions were under increasingly severe drought conditions on October 25, 2020. Temperatures were above normal, and precipitation was well below normal compared to climatology. The barren land cover, including the Great Basin and northern Mojave deserts source regions, was primed for significant dust production during the high-wind event.

See Section 2.2.

Inciting High-Wind Event

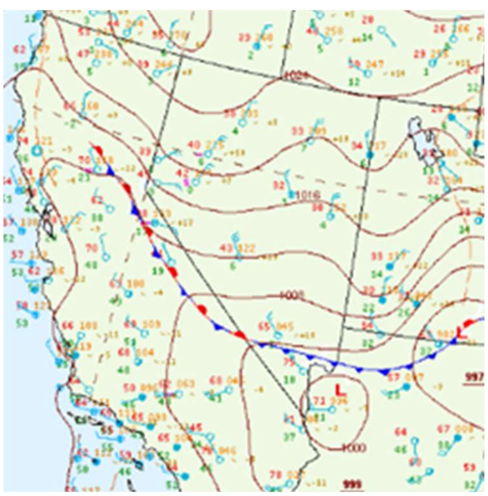


Figure 3.1-3

A frontal passage containing high wind speeds and gusts descended from the north across the Great Basin Desert and northern Mojave Desert into Clark County, NV, between 00:00 and 11:00 PST on October 25, 2020. Sustained wind speeds in the Great Basin and northern Mojave deserts exceeded the 25-mph sustained wind threshold over natural undisturbed lands. This caused lofting, entrainment, and transport of PM_{10} from the source region into Clark County.

See Section 3.1.

Transport of PM_{10} from Source Region to Clark County

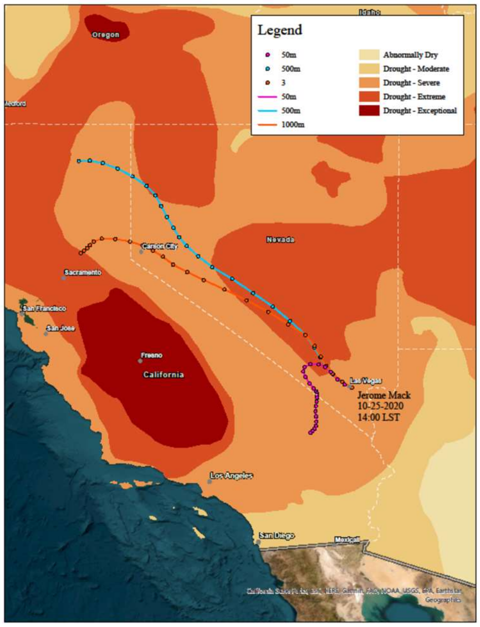


Figure 3.2-2

Back trajectories and meteorological data along the frontal passage confirm the Great Basin Desert and the northern Mojave Desert (located to the north of Clark County) as the source regions for the high-wind dust event. The frontal passage descended from the north through the source regions enroute to Clark County, NV, within 24 hours of the exceedance.

See Section 3.2.

Enhanced PM_{10} from High Wind Dust Event Arrives in Clark County

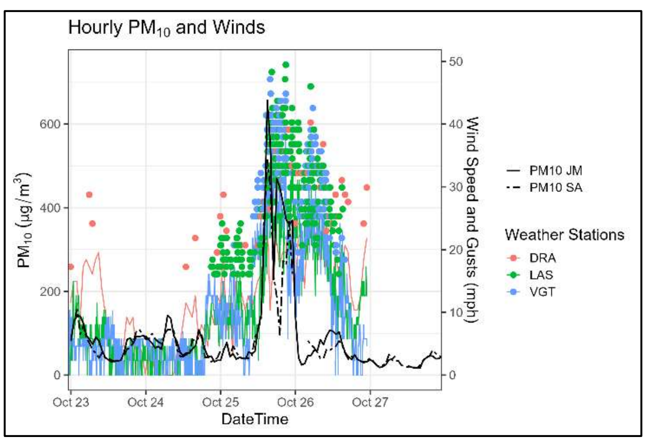


Figure 3.3-3

Enhanced PM_{10} arrives in Clark County beginning at 11:00 PST on October 25, 2020, and remained enhanced through 00:00 PST on October 26, 2020. High PM_{10} concentrations at Jerome Mack and Sunrise Acres coincided with high wind speeds and wind gust measurements. Six other monitoring sites across Clark County also experienced enhanced PM_{10} concentrations (above the 99th percentile for 2016-2020) on October 25, 2020. The widespread high PM_{10} concentrations occurred simultaneously with a regional high-wind event.

See Section 3.3.

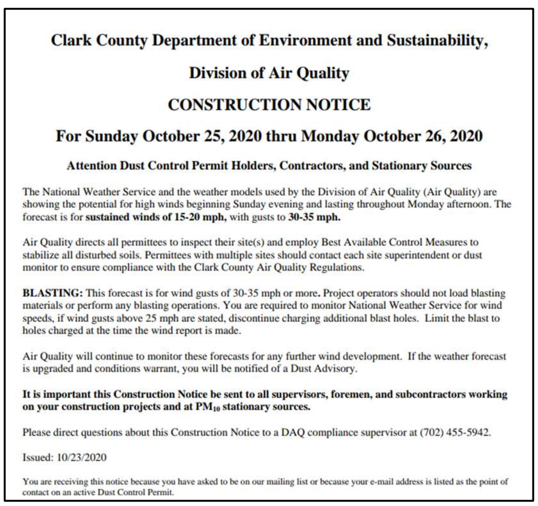
Effect of PM_{10} Concentrations in Clark County

Figure 3.3-12

Poor visibility and obscured camera images show the effects of PM_{10} concentrations in Clark County. $PM_{2.5}/PM_{10}$ ratios decreased, confirming windblown dust as the source of emissions.

See Section 3.3.

High Wind PM_{10} Alerts Issued



Clark County Department of Environment and Sustainability,

Division of Air Quality

CONSTRUCTION NOTICE

For Sunday October 25, 2020 thru Monday October 26, 2020

Attention Dust Control Permit Holders, Contractors, and Stationary Sources

The National Weather Service and the weather models used by the Division of Air Quality (Air Quality) are showing the potential for high winds beginning Sunday evening and lasting throughout Monday afternoon. The forecast is for **sustained winds of 15-20 mph,** with gusts to **30-35 mph.**

Air Quality directs all permittees to inspect their site(s) and employ Best Available Control Measures to stabilize all disturbed soils. Permittees with multiple sites should contact each site superintendent or dust monitor to ensure compliance with the Clark County Air Quality Regulations.

BLASTING: This forecast is for wind gusts of 30-35 mph or more. Project operators should not load blasting materials or perform any blasting operations. You are required to monitor National Weather Service for wind speeds, if wind gusts above 25 mph are stated, discontinue charging additional blast holes. Limit the blast to holes charged at the time the wind report is made.

Air Quality will continue to monitor these forecasts for any further wind development. If the weather forecast is upgraded and conditions warrant, you will be notified of a Dust Advisory.

It is important this Construction Notice be sent to all supervisors, foremen, and subcontractors working on your construction projects and at PM_{10} stationary sources.

Please direct questions about this Construction Notice to a DAQ compliance supervisor at (702) 455-5942.

Issued: 10/23/2020

You are receiving this notice because you have asked to be on our mailing list or because your e-mail address is listed as the point of contact on an active Dust Control Permit.

Figure 3.3-1

Clark County issued a Construction Notice due to high winds forecast for October 25, 2020. The National Weather Service also issued several alerts pertaining to high winds and dusty conditions, as well as social media statements, on October 25, 2020.

See Section 3.3.

Comparison with Historical Data

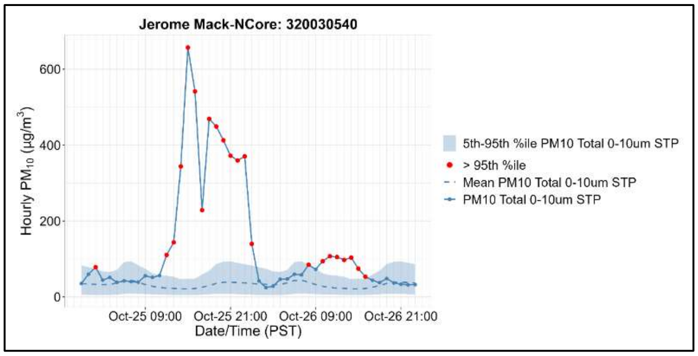


Figure 3.4-5

PM_{10} at Jerome Mack and Sunrise Acres exceeded the five-year 99th percentile and the NAAQS on October 25, 2020. PM_{10} concentrations were also significantly outside typical seasonal and monthly ranges. 30-year climatology analyses show temperatures, wind speeds, and soil moisture are also outside of historical normal on the event date.

See Section 3.4.

Not Reasonably Controllable or Preventable

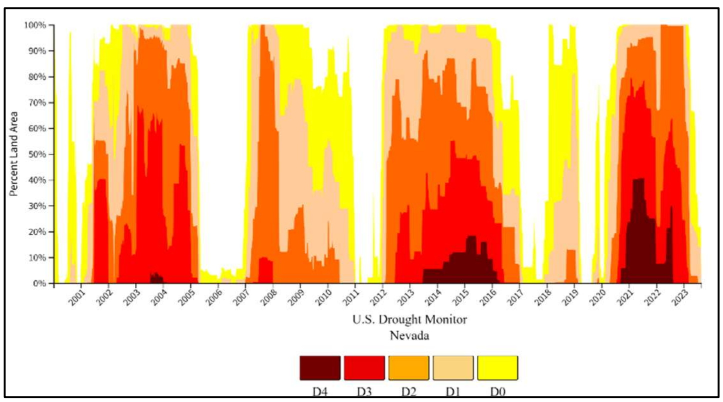


Figure 4.3-3

Based on the severe drought in the source region and the high-wind frontal passage, control measures for PM_{10} within Clark County were quickly overwhelmed and unable to prevent an exceedance event. Significant evidence shows that high winds lofted, entrained, and transported PM_{10} from natural undisturbed lands and indicates that this event was natural and not reasonably controllable or preventable.

See Sections 4 and 5.

2. Background

2.1 Demonstration Description

2.1.1 PM_{10} Exceptional Event Rule Summary

The U.S. EPA EER (U.S. Environmental Protection Agency, 2016) allows air agencies to omit air quality data from the design value calculation if it can be demonstrated that the measurement in question was caused by an exceptional event. According to EER, exceptional events, such as high-wind dust events that affect PM_{10} concentrations, can be subject to exclusion from calculations of the NAAQS attainment (i.e., design values) if a clear causal relationship can be established between a specific event and the monitoring exceedance (U.S. Environmental Protection Agency, 2016). The EER states that an exceptional event demonstration must meet the following six statutory elements:

1. A narrative conceptual model that describes the event(s) causing the exceedance or violation and a discussion of how emissions from the event(s) led to the exceedance or violation at the affected monitor(s),
2. A demonstration that the event affected air quality in such a way that there exists a clear causal relationship between the specific event and the monitored exceedance or violation,
3. Analyses comparing the claimed event-influenced concentration(s) to concentrations at the same monitoring site at other times,
4. A demonstration that the event was both not reasonably controllable and not reasonably preventable (nRCP),
5. A demonstration that the event was a human activity that is unlikely to recur at a particular location or was a natural event, and
6. Documentation that the air agency followed the public comment process.

Specifically, a high-wind dust demonstration must show that the dust event is a “natural event,” where windblown dust is from natural sources or where all significant anthropogenic sources of windblown dust have been reasonably controlled using the best available control measures (BACM) (EPA, 2016). Further, air agencies must show that the event met the high-wind threshold of a sustained wind speed of 25 mph or more, or an alternative area-specific high-wind threshold. The high-wind threshold is the minimum wind speed capable of causing PM emissions from natural, undisturbed lands. If the 25-mph wind speed threshold was not met, a more detailed analysis is necessary to support the “not reasonably controlled or preventable” criterion. The winds contributing to the PM_{10} exceedance on October 25, 2020, met the 25-mph sustained wind speed threshold in the source regions and, at a 5-minute averaging interval, met this threshold in Clark County as well.

2.1.2 Requirements for Demonstration Based on Tier

The EPA "Guidance on the Preparation of Demonstrations in Support of Requests to Exclude Ambient Air Quality Data Influenced by High Wind Dust Events Under the 2016 Exceptional Events Rule" (U.S. Environmental Protection Agency, 2016) describes a three-tier analysis approach to determine a "clear causal relationship" for exceptional event demonstrations from an air agency. A summary of analysis requirements for each tier is listed in **Table 2.1-1**.

- Tier 1 analysis is applicable when the exceptional event is associated with a large-scale dust storm with a recorded visibility of ≤0.5 miles, sustained winds of ≥40 mph, and that is the focus of a Dust Storm Warning.
- Tier 2 analysis is applicable when the impacts of the dust event on PM_{10} levels are less clear and require more supportive documentation than Tier 1 analysis. Tier 2 analysis is warranted when sustained winds are ≥25 mph, but the storm does not meet the other thresholds required by Tier 1 analysis.
- Tier 3 analysis is necessary when the impacts of the dust event on PM_{10} levels are more complicated than conditions described in the first two Tiers. Tier 3 analysis is needed when sustained winds do not meet the 25-mph threshold and may require additional analysis, such as Hybrid Single-Particle Lagrangian Integrated Trajectory (HYSPLIT) model trajectories from the source area or source-specific emissions inventories.

Table 2.1-1. High Wind PM_{10} Exception Event Guidance Requirements by tier.

Tier	Requirements
1	• Referred to as "Large-Scale, High-Energy High Wind Dust Events" • Does not need justification to support the nRCP criterion. • To satisfy the nRCP criterion, the exceedance(s) must be associated with: - Reduced visibility ≤0.5 miles, - Sustained winds that are ≥40 mph, - A dust storm that is the focus of a Dust Storm Warning. • Must occur over a "large geographic area."
2	• Referred to as "High Wind Dust Events with Sustained Winds at or above the High Wind Threshold." • Does not meet criterion of Tier 1 high-wind dust events. • High-wind threshold: - Default of ≥25 mph for certain states, - Measured as "at least one full hour in which the hourly average wind speed was at or above the area specific high-wind threshold;" EPA will consider shorter averaging times as part of the weight-of-evidence demonstration, even if the hourly average was not above the threshold. • Must conduct a controls analysis for events where the dust source was anthropogenic: - Identify anthropogenic and natural sources, - Document whether a SIP, FIP, or other control measures address the event-related pollutant and all sources, - Confirm effective implementation of control measures.
3	• Referred to as "High Wind Dust Events with Sustained Winds less than the High Wind Threshold." • Sustained winds did not meet the threshold (i.e., sustained winds ≤25 mph) • Requirements same as Tier 2, except with the addition of the following possible analyses: - HYSPLIT trajectories of source area, - Source-specific emissions inventories, - Meteorological and chemical transport modeling, - PM filter chemical speciation analysis where filter-based monitors are used.

2.1.3 Demonstration Outline

The PM_{10} exceedance on October 25, 2020, qualifies for Tier 2 analysis since it is a high-wind dust event with sustained winds at or above the high-wind threshold. To be designated as a Tier 2 event, wind speeds must meet the sustained wind threshold of 25 mph. The PM_{10} exceedance on October 25, 2020, wind speeds in the source regions (Great Basin Desert and northern Mojave Desert) show sustained wind speeds greater than the 25-mph threshold. These intense and prolonged sustained winds in the source regions coupled with the severe drought conditions in Nevada during October 2020 shows that October 25, 2020, should be called a high-wind dust event and designated as Tier 2.

Table 2.1-2 provides a breakdown by section of all required analyses for the High Wind Exceptional Event. Sections 3.1-3.3 discuss the high-wind event in detail, including a meteorological analysis (Section 3.1), the timeline of the high-wind dust event (Section 3.2), and evidence of the high-wind dust event observed at the surface (Section 3.3). This includes media coverage of (Section 3.3.2) and ground images during the event (Section 3.3.5). Guidance for a Tier 2 analysis recommends a controls analysis when the dust source is not anthropogenic. Section 2.2 identifies anthropogenic and natural sources of dust. Section 2.2.1 and 2.2.2 discuss the dust source for the event on October 25, natural, undisturbed lands southwest of Las Vegas, including an analysis of climatological factors that fostered prime conditions for lofted dust. Sections 2.2.3 and 4.1 identify regional emissions and other sources of PM_{10}, and Section 4 **Error! Reference source not found.**identifies control measures against PM_{10} emissions that exist in Clark County.

Table 2.1-2. Analysis elements required for a Tier 2 and 3 High Wind Exceptional Event by section in this report.

Tier	Elements	Section of This Report (Analysis Type)
2	High-wind dust event	Section 3 (Clear Causal Relationship)
	Sustained wind threshold	Section 3.1.1 (Meteorological Analysis) and Section 3.2.2 (High Wind Event Timeline)
	Controls analysis for dust source	Section 2.2.3 (Regional Emissions of PM_{10}), Section 4.1 (Other Possible Source of PM_{10} in Clark County), Section 4.2 (PM_{10} Control Measures in Clark County), Section 4.3 (Reasonableness of Control Measures), and Section 4.4 (Effective Implementation of Control Measures)
3	HYSPLIT trajectories of source area	Section 3.2 (Transport to Clark County)
	Source-specific emissions inventories	Section 2.2.3 (Regional Emissions of PM_{10})
	Meteorological and chemical transport modeling	Section 3.1.1 (Meteorological Analysis)
	PM filter chemical speciation analysis where filter-based monitors are used	Section 3.3.4 (Particulate Matter Analysis)

Following the EPA's exceptional event guidance, we performed Tier 2 and Tier 3 analyses to show the "clear causal relationship" between the high-wind dust event and the PM_{10} exceedance event in Clark County, NV, on October 25, 2020. Focusing on the characterization of the meteorology, source region terrain, climatology, transport, and air quality on the days leading up to the event, we conducted the following specific analyses (Section 3):

- Top-down meteorological analysis to trace the conditions between the surface and 250 mb that led to the high-wind event in southern Nevada.
- Compiled maps and imagery of suspended dust, aerosol optical depth (AOD), and regional wind speed from satellite data.
- Showed the transport patterns via HYSPLIT modeling, and identified where the back-trajectory air mass intersected with dust sources.
- Compared the timeline of meteorological events, high wind speeds, and enhanced PM_{10} concentrations.
- Tracked surface meteorological conditions along the transport path between the source region and Clark County.
- Compiled media coverage of the high-wind dust event and ground-based visibility imagery during the event.
- Examined speciated PM concentrations during the event.
- Compared diurnal patterns of PM_{10} during the event to historical measurements.
- Performed meteorologically similar day analysis to assess PM_{10} concentrations on days with comparable wind conditions.

2.1.4 Regulatory Significance

The high-wind dust event that occurred on October 25, 2020, caused a 24-hour PM_{10} NAAQS exceedance with regulatory significance of 210 µg/m^3 at Jerome Mack (Monitor AQS ID 32-003-0540, POC 1) and 163 µg/m^3 at Sunrise Acres (Monitor AQS ID 32-003-0561, POC 1). A NAAQS exceedance that is approved by the EPA as an exceptional event may be excluded from regulatory examination under the EER. Six additional suspected wind-blown dust events occurred between 2020 and 2022. Without EPA concurrence that the wind-blown dust event on October 25, 2020, and the other suspected 2022 events qualify as exceptional events, the 2020-2022 design value is 4.0 at Jerome Mack and 3.0 at Sunrise Acres. This is outside of the attainment standard of 1.0. With EPA concurrence on October 25, 2020, and the other suspected events, the 2020-2022 design value is 1.0 at Jerome Mack and 0.7 at Sunrise Acres, within the attainment standard. Further details may be found in the Initial Notification Summary Information (INI) submitted by Clark County DES to EPA Region 9 on January 15, 2023.

We request that the EPA evaluate the following assessment of the wind-blown dust event that occurred in Clark County on October 25, 2020, and agree to exclude the event from regulatory decisions regarding PM_{10} attainment.

2.2 Historical Non-Event Model

2.2.1 Land Type for Source Region and Clark County

Land use and cover type data from both the 2019 National Land Cover Database (NLCD) (Dewitz, 2021) and Sentinel-2 satellite are shown for the Great Basin Desert in eastern and southern Nevada and the northern portion of the Mojave Desert in southern Nevada and California as the approximate source regions (Figure 2.2-1). The primary land classifications, shown by the Sentinel-2 Land Use/Land Cover map, in this region are bare ground and rangeland, with small pockets of built area. Bare ground is defined as "areas of rock or soil with very sparse to no vegetation for the entire year; large areas of sand and deserts with no to little vegetation." Rangeland is defined as "open areas covered in homogenous grasses with little to no taller vegetation; wild cereals and grasses with no obvious human plotting." The primary classifications shown by the 2019 NLCD map are mostly shrub/scrub, grasslands/herbaceous, and barren land (rock/sand/clay). Classifications from both maps indicate that the source region is primarily land with little to no vegetation cover with natural sources of dust which are predisposed to high-wind events.

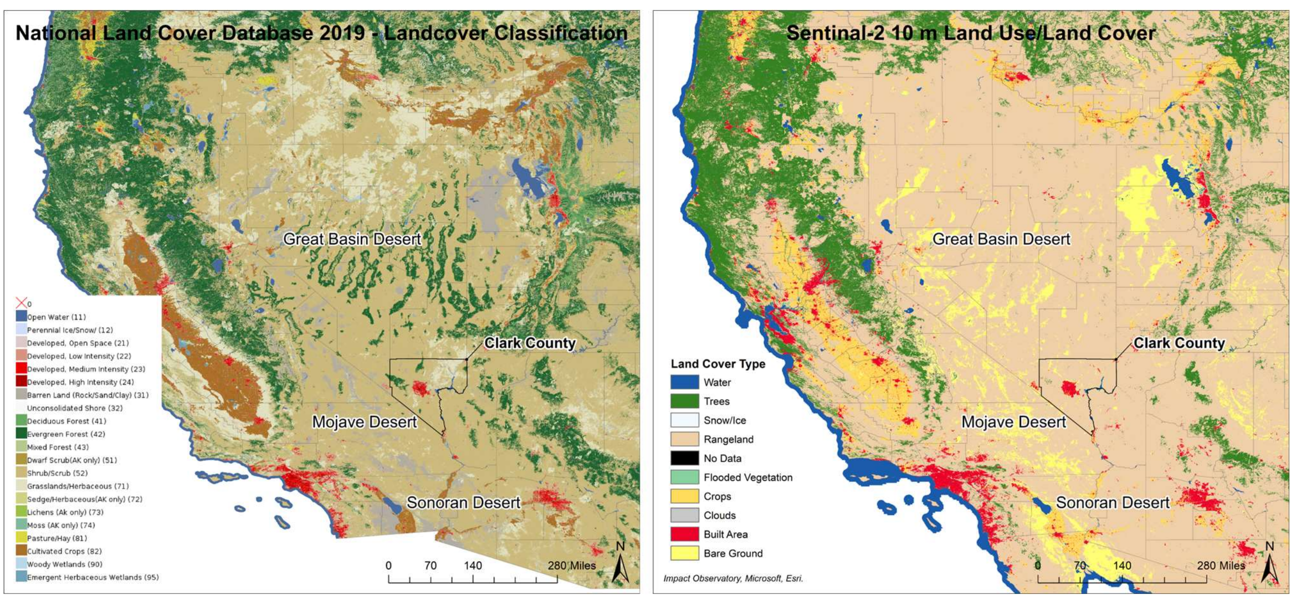


Figure 2.2-1. Land cover type for the western U.S. from (left) the National Land Cover Database-2019 and (right) Sentinel-2 satellite.

Figure 2.2-2 shows the land use and cover of Clark County and the surrounding area. The dominant land cover type in Clark County and the surrounding area is rangeland with pockets of bare ground and built area. Built area is defined as "human made structures; major road and rail networks; large homogenous impervious surfaces including parking structures, office buildings, and residential housing." Central Clark County (i.e., Las Vegas and surrounding communities) is mostly classified as built area with some small areas of bare ground surrounded by rangeland.

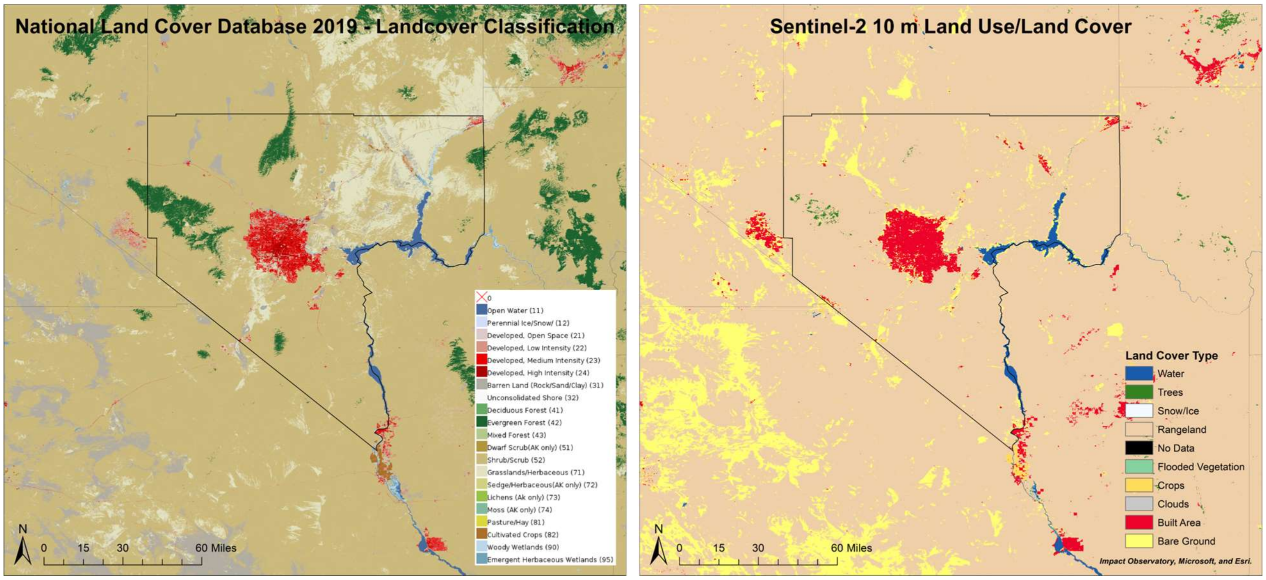


Figure 2.2-2. Land cover type for Clark County, NV, and the surrounding area from the (left) the National Land Cover Database-2019 and (right) Sentinel-2 satellite.

2.2.2 Climatology for Source Region and Clark County

The approximate source region for the event is the Great Basin Desert in southern Nevada and the northern portion of the Mojave Desert in southern Nevada and California. The Great Basin Desert is a region of approximately 492,000 km^2 of cold desert within the greater Great Basin that is located between the Sierra Nevada Mountain range to the west and Wasatch Mountain range to the east. The desert spans a large portion of Nevada and Utah, extends into the southeastern portion of California, and borders the Mojave Desert to the southwest, the Colorado Plateau to the southeast, and the Columbian Plateau to the north. Due to the presence of the Sierra Nevada Mountain range to the west, a rain-shadow effect inhibits significant moisture from reaching the desert. The climate of the desert is arid to semiarid with cold, wet winters and hot, dry summers. The border of the desert extends into western and northern Clark County.

The Mojave Basin and Range Ecoregion is located primarily in southern California and southern Nevada (including Clark County), with smaller portions in Arizona and Utah (Sleeter, 2012). In general, the roughly 130,000-km^2 ecoregion is composed of broad basins and scattered mountains that are generally lower, warmer, and drier than those of the Central Basin and Range, which border the ecoregion to the north and cover the majority of Nevada. The ecoregion climate is characterized by high temperatures during summer months and very little annual precipitation (50–250 mm in the valleys). The ecoregion includes the Mojave Desert and other desert areas in southeastern California and southern Nevada. The Mojave Desert is the driest of the deserts that comprise the greater North

American Desert, due in part to the presence of the Sierra Nevada Mountain range to the west that produce a rain-shadow effect that inhibits significant moisture from reaching the desert.

Clark County is located in southern Nevada and borders California and Arizona. The county includes the city of Las Vegas, one of the fastest growing metropolitan areas in the United States with a population of approximately 2.2 million (U.S. Census Bureau, 2020). Las Vegas is located in a 1,600-km^2 desert valley basin at 500 to 900 m above sea level (Langford et al., 2015) surrounded by the Spring Mountains to the west (3,000 m elevation) and the Sheep Mountain Range to the north (2,500 m elevation). Three mountain ranges comprise the southern end of the valley. The valley floor slopes downward from west to east, which influences surface wind, temperature, precipitation, and runoff patterns. The Cajon Pass and I-15 corridor to the east is an important atmospheric transport pathway from the Los Angeles basin into the Las Vegas Valley (Langford et al., 2015).

The Las Vegas Valley climatology features abundant sunshine and hot summertime temperatures (average summer month high temperatures of 34 °C to 40 °C). Because of the mountain barriers to moisture inflow, the region experiences dry conditions year-round (~107 mm annual precipitation, 22% of which occurs during the summer monsoon season from July through September). The urban heat island effect in Las Vegas during summer leads to large temperature gradients within the valley and generally cooler temperatures on the eastern side. During the summer season, monsoon moisture brings high humidity and thunderstorms to the region, typically in July and August (National Weather Service Forecast Office, 2020). Winds in the Las Vegas basin tend to be out of the southwest during spring and summer (Los Angeles is upwind), while winds in the fall and winter tend to be out of the northwest, with air transported between the neighboring mountain ranges and along the valley.

Compared to the long-term climate record in the Las Vegas area, the temperature range was above the long-term normal maximum temperature for most of October 2020. A large drop in temperature was also observed after the exceedance. Concurrently, precipitation accumulation for the Las Vegas area was well below normal by late October (**Figure 2.2-3 and Figure 2.2-4**).

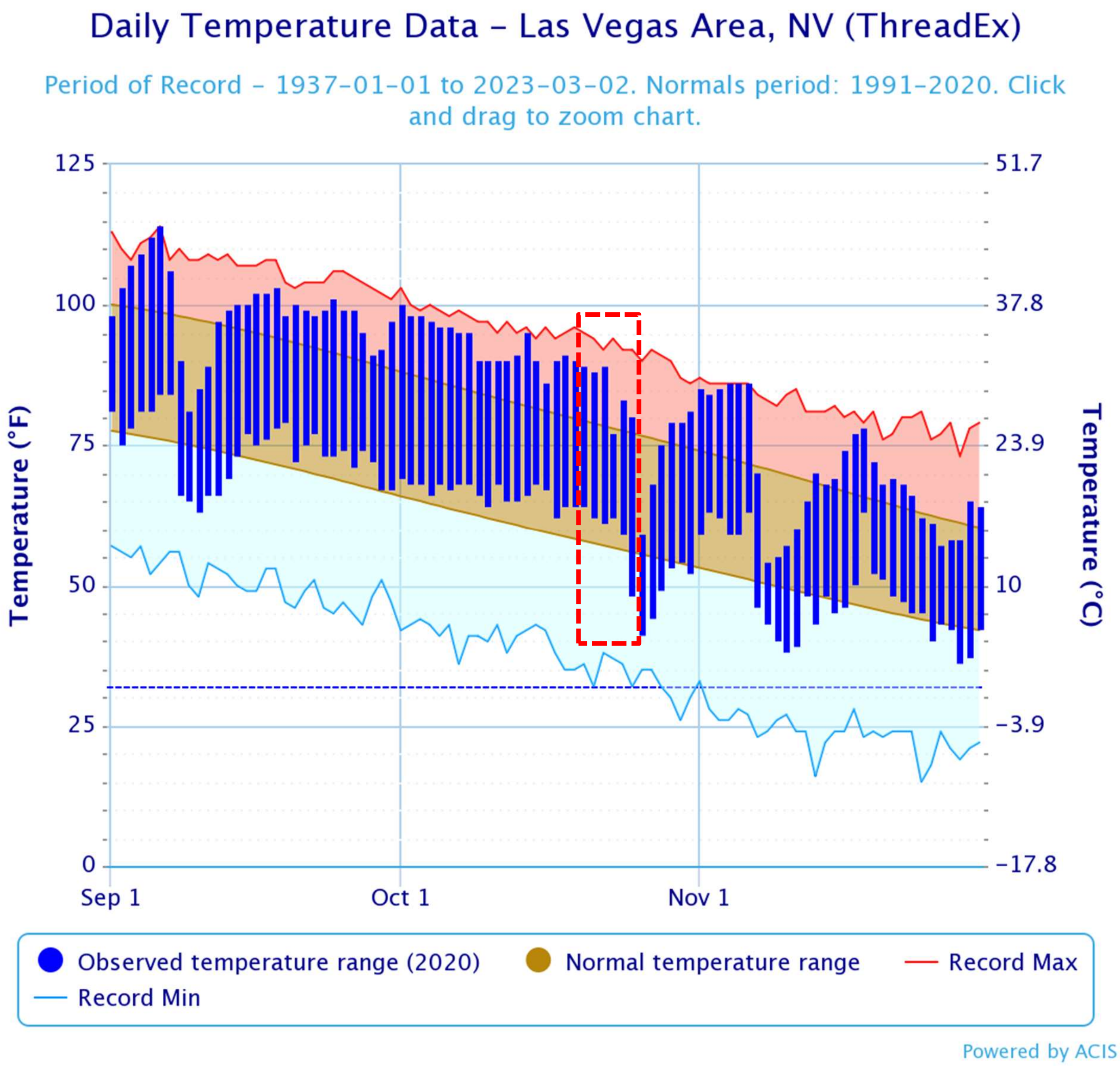


Figure 2.2-3. Las Vegas area, NV, temperature records from January 1, 1937, through December 26, 2022, by day, including (dark blue) observed temperature range 2020, (brown) normal temperature range, (red) record maximum, and (light blue) record minimum. The red box indicates the dates of above-normal temperatures before the event on October 25, 2020. Data from NWS: **https://www.weather.gov/wrh/Climate?wfo=vef**.

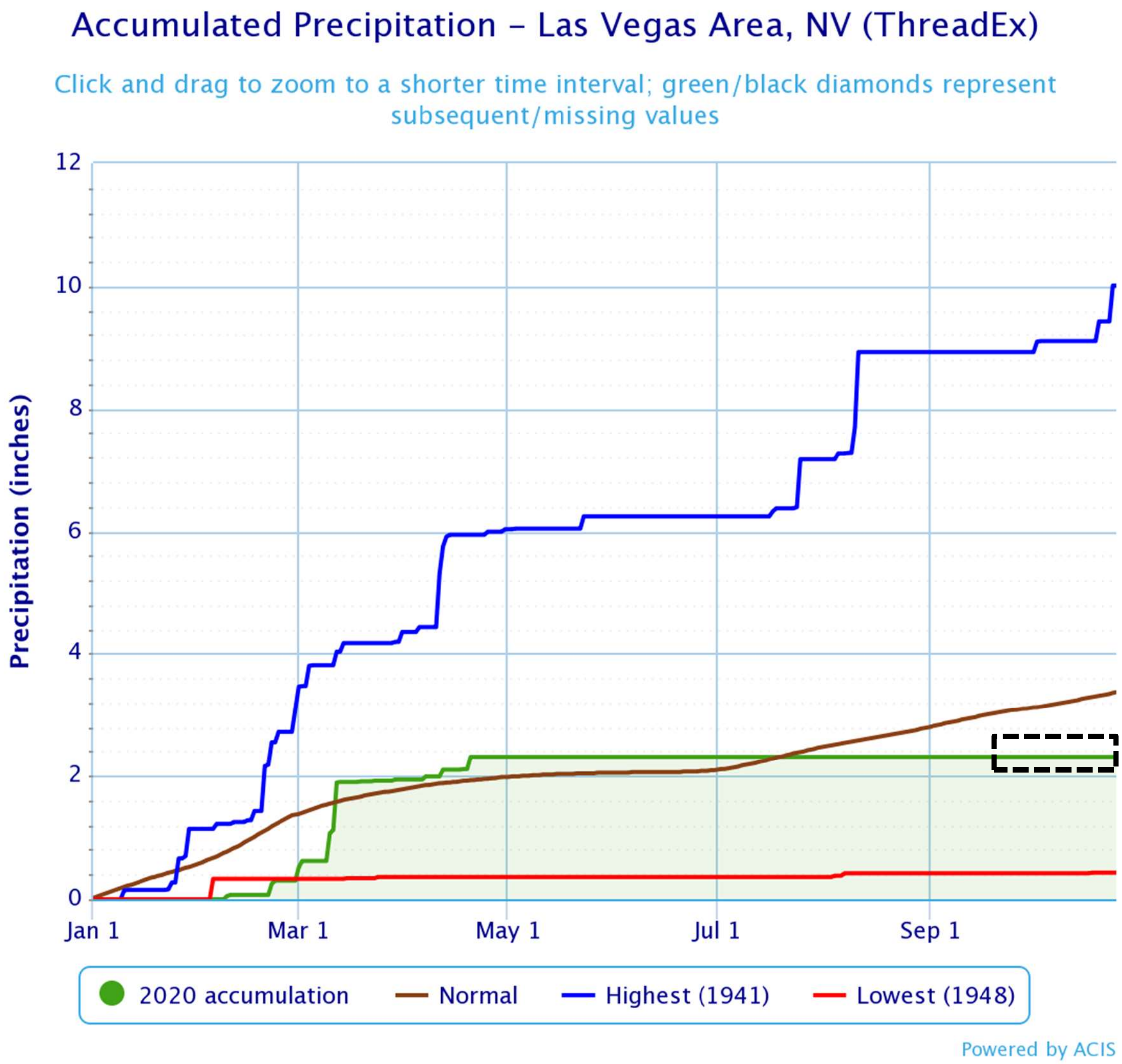


Figure 2.2-4. Las Vegas area, NV, precipitation records by day, including (green) accumulation in 2020, (brown) normal, (blue) record maximum, and (red) record minimum. The black box indicates the period of low accumulated precipitation before the event on October 25, 2020.

The extreme hot and dry conditions in 2020 are also highlighted by the Palmer Drought Severity Index (PDSI) produced by the National Oceanic and Atmospheric Administration's (NOAA) National Centers for Environmental Protection (NCEP). The western U.S. drought conditions progressively increased in area and severity in the months before the PM_{10} exceedance (Figure 2.2-5). In October 2020, all counties in Nevada were classified as moderate to extreme drought.

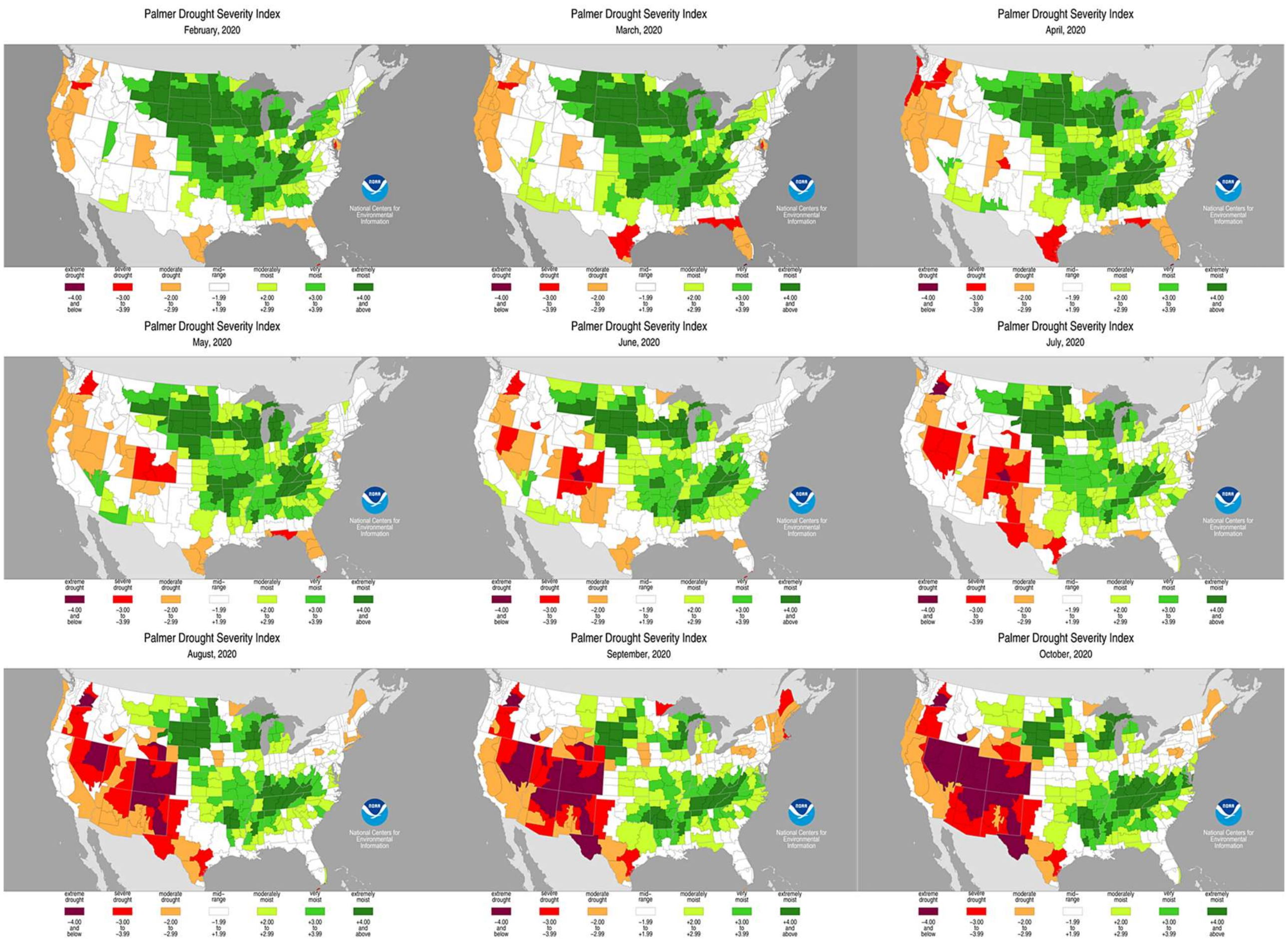
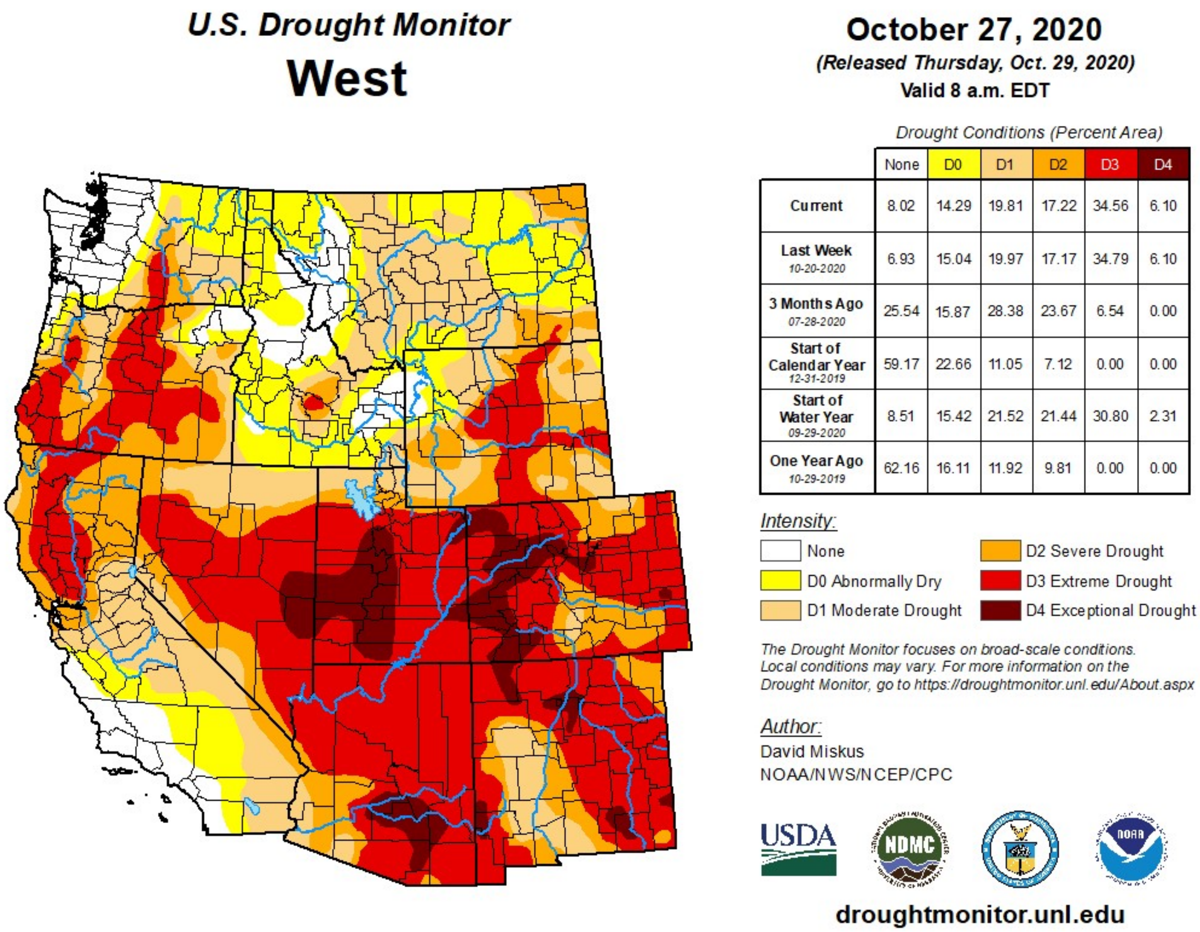


Figure 2.2-5. Palmer Drought Severity Index for February 2020 through October 2020

By the week of October 25, 2020, the western U.S. was under widespread drought conditions (**Figure 2.2-6**). Drought conditions in the western U.S., including Nevada, increased in area and severity over the year, months, and week before the October 25, 2020, PM_{10} exceedance. The source region for this event was classified as abnormally dry to extreme drought (D0-D3). Nearly all (99.36%) of Nevada was included in the drought (**Figure 2.2-7**), including 79.66% in severe drought (D2-D4).



	None	D0	D1	D2	D3	D4
Current	8.02	14.29	19.81	17.22	34.56	6.10
Last Week 10-20-2020	6.93	15.04	19.97	17.17	34.79	6.10
3 Months Ago 07-28-2020	25.54	15.87	28.38	23.67	6.54	0.00
Start of Calendar Year 12-31-2019	59.17	22.66	11.05	7.12	0.00	0.00
Start of Water Year 09-29-2020	8.51	15.42	21.52	21.44	30.80	2.31
One Year Ago 10-29-2019	62.16	16.11	11.92	9.81	0.00	0.00

Figure 2.2-6. U.S. Drought Monitor values for the western U.S. on October 27, 2020.

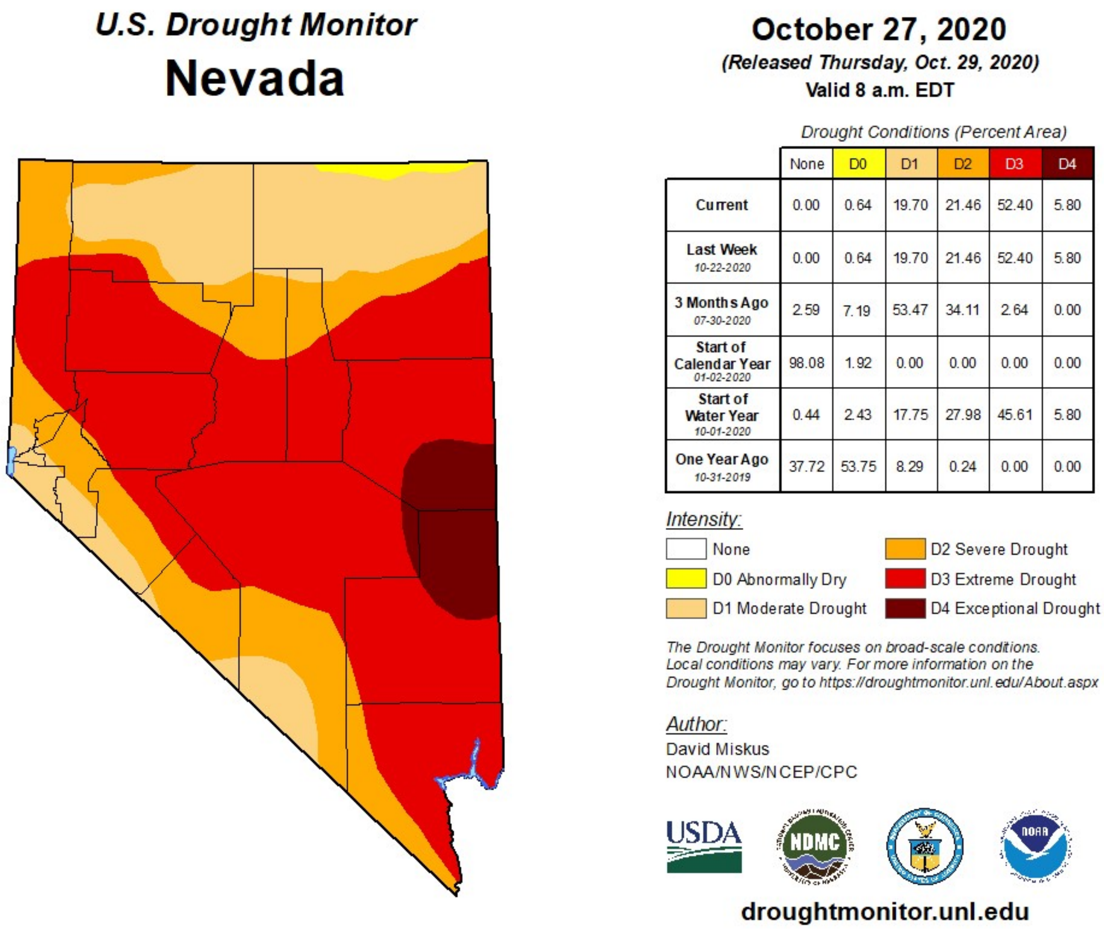


Figure 2.2-7. U.S. Drought Monitor values for Nevada on October 27, 2020.

There are several Automated Surface Observing Systems (ASOS) weather measurement sites in the wind-blown dust source regions with data spanning multiple decades (Figure 2.2-8). Figure 2.2-9 shows the distribution of the maximum daily temperatures at several sites in the wind-blown dust source regions on October 24 and 25 (1990 – 2019). The median maximum daily temperature is between approximately 65 °F and 70 °F at all sites in the Great Basin source region, and 80 °F and 82 °F in the Mojave source region.

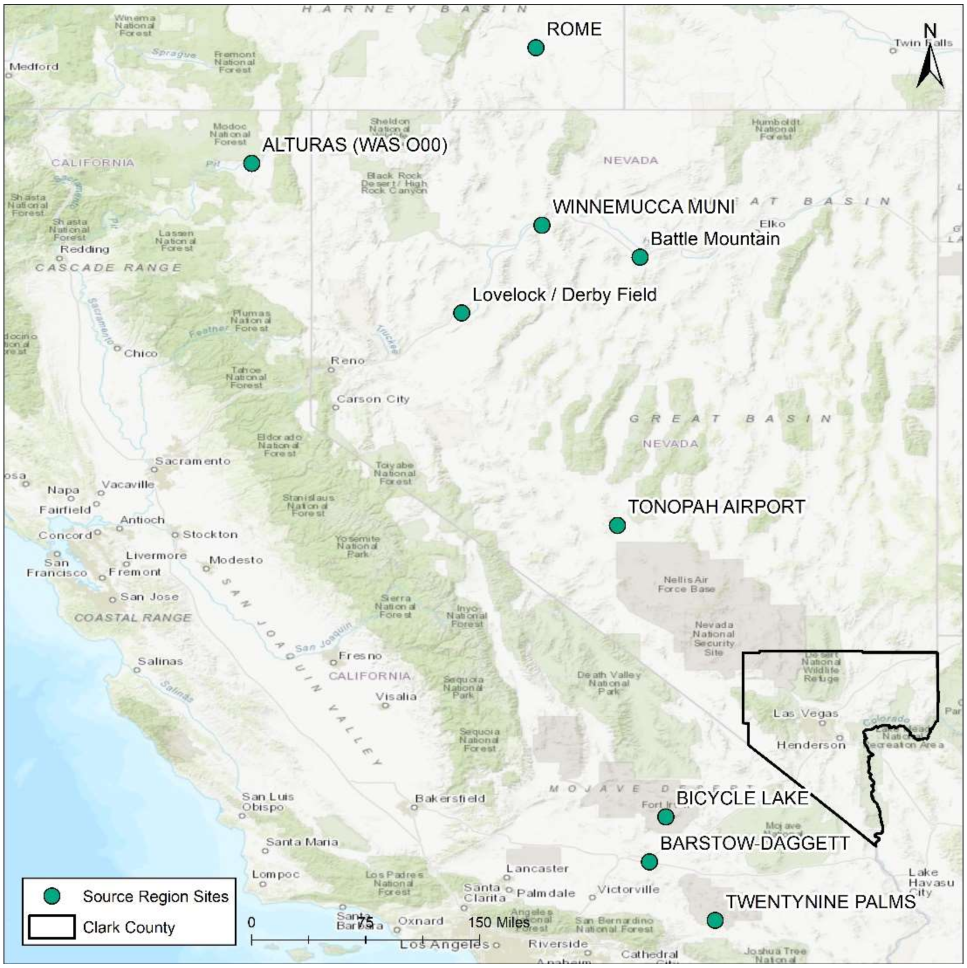


Figure 2.2-8. Location of ASOS measurement sites in the wind-blown dust source regions.

Change color to black.

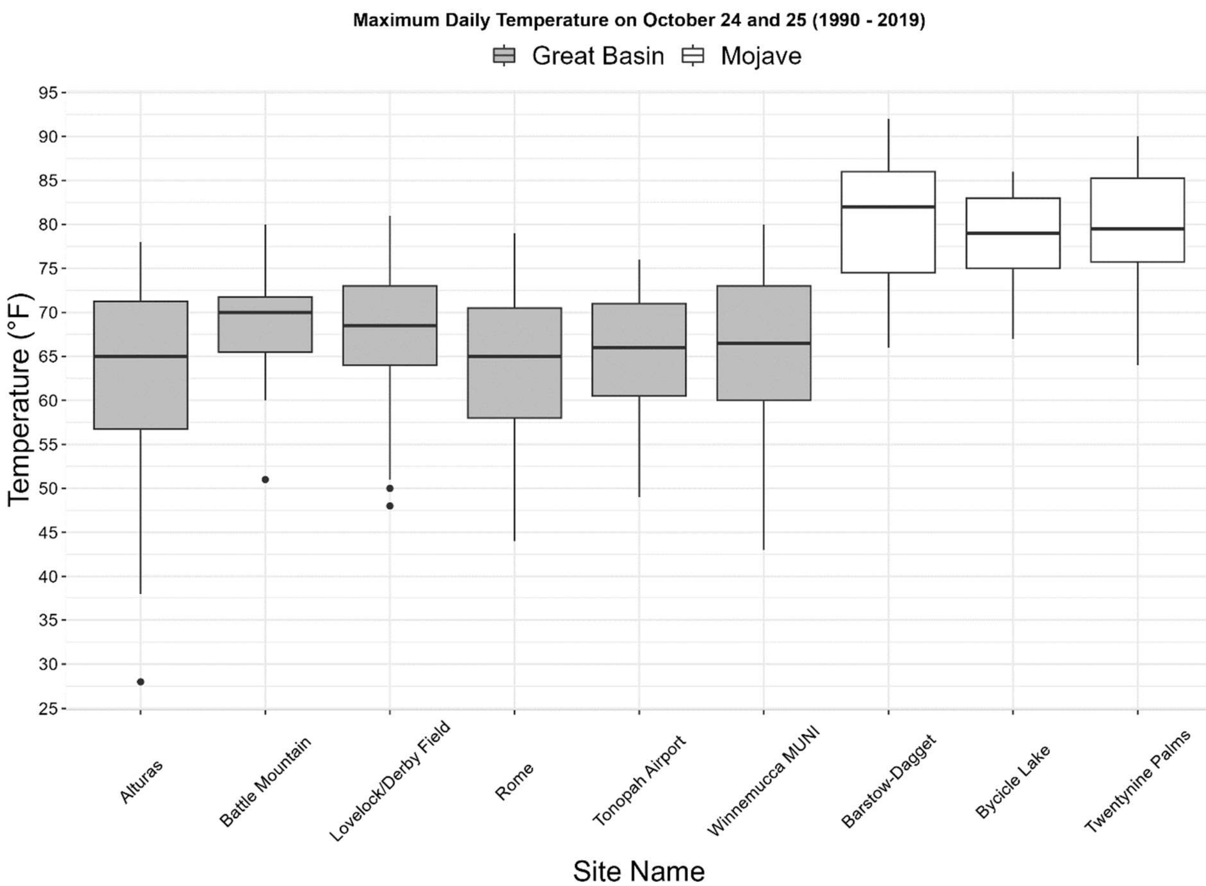


Figure 2.2-9. Maximum daily temperatures on October 24 and October 25, 1990 – 2019. Each boxplots represent sites in the Great Basin source region, and white boxplots represent sites in the Mojave source region.

2.2.3 Regional Emissions of PM_{10}

Open land accounts for approximately 86% of the total area of Clark County (~4.3 million acres), followed by incorporated lands at 8% (~400,000 acres), tribal lands at 1.5% (~80,000 acres), and the remaining planned land use categories at a combined 4.5% (~242,000 acres) (Figure 2.2-10). Open lands and incorporated Clark County largely align with bare ground and rangeland (see Figure 2.2-2) suggesting that dust may have been picked up in Clark County during the high-wind event.

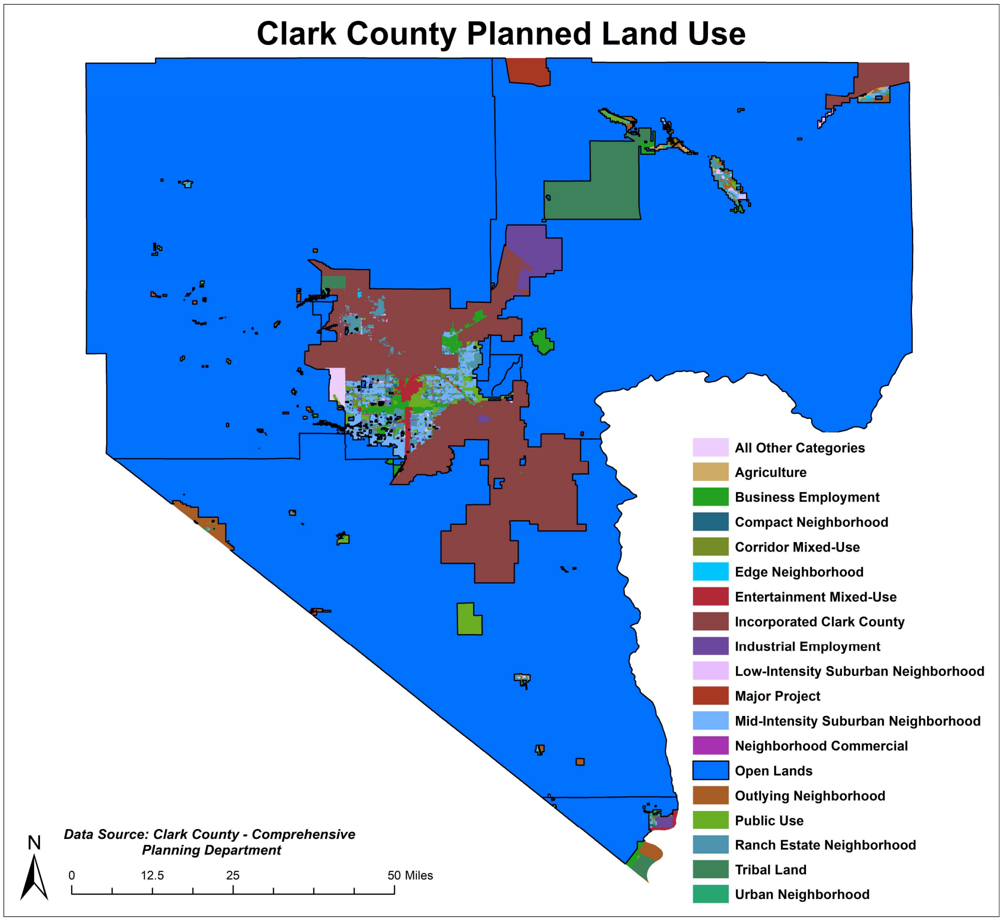


Figure 2.2-10. Planned land use boundaries of Clark County.

Planned land use around the Jerome Mack monitoring site is comprised of public use to the west (Jerome Mack Middle School campus), mid-intensity suburban neighborhood to the south, urban neighborhood to the southeast, compact neighborhood to the northeast, and business employment to the north and northwest. An aqueduct borders Jerome Mack immediately to the north (Figure 2.2-11). Much of the surrounding area is comprised of buildings and paved surfaces consisting of parking lots and roads, with little exposed dirt or gravel.

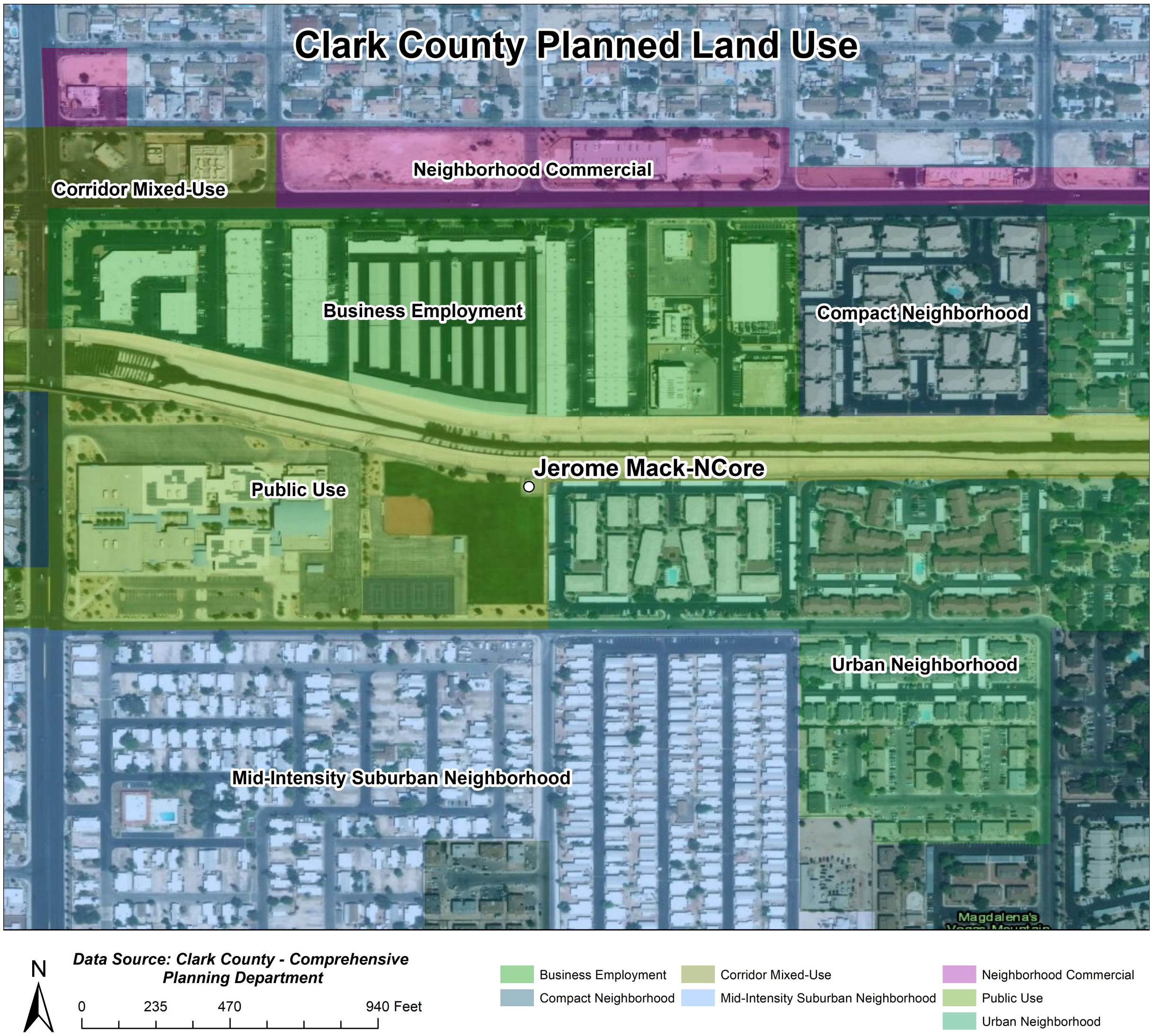


Figure 2.2-11. Planned land use boundaries in the area around the Jerome Mack station.

Planned land use around the Sunrise Acres site is comprised mostly of incorporated land (Figure 2.2-12). Residential areas including compact neighborhood, mid-intensity suburban neighborhood, and commercial neighborhood are also present to the south. Much of the surrounding area is comprised of buildings and paved surfaces consisting of parking lots and roads, with little exposed dirt or gravel. A vacant undeveloped lot and a baseball field are nearby which may contribute to local dust during high-wind events.

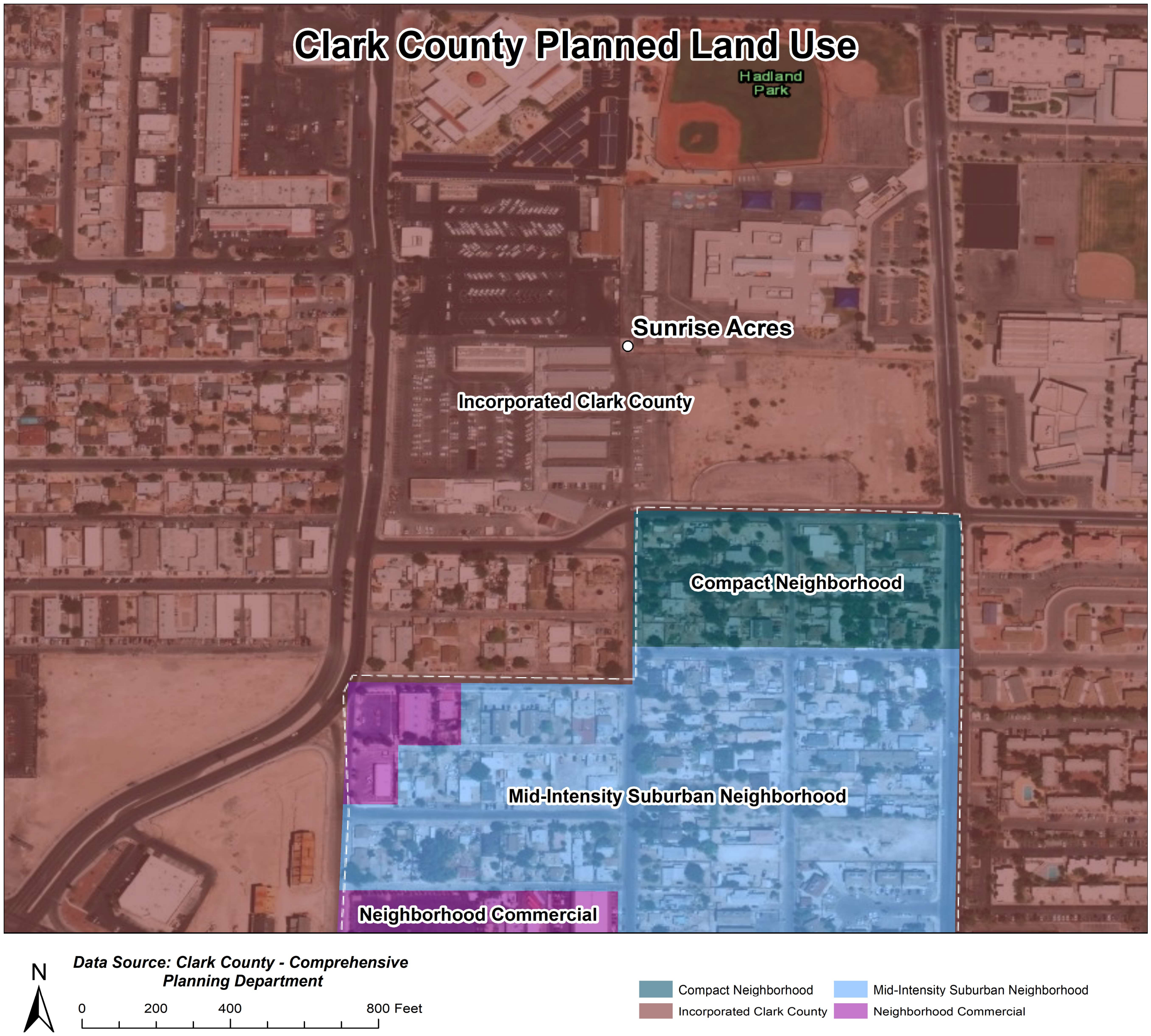


Figure 2.2-12. Planned land use boundaries in the area around the Sunrise Acres station.

Figure 2.2-13 shows the 2020 National Emissions Inventory (NEI) PM_{10} point sources in the Las Vegas Valley and around the Jerome Mack and Sunrise Acres sites, where the size of the point source marker is proportional to the total annual PM_{10} emissions. The map shows that there are no PM_{10} point sources within approximately 2 miles of the Jerome Mack site, and the closest point sources emit less than 3 tons of PM_{10} annually. The Sunrise Acres site is approximately 2 miles east of the nearest point sources, which includes 3 sites emitting 0-7 tons PM_{10} annually.

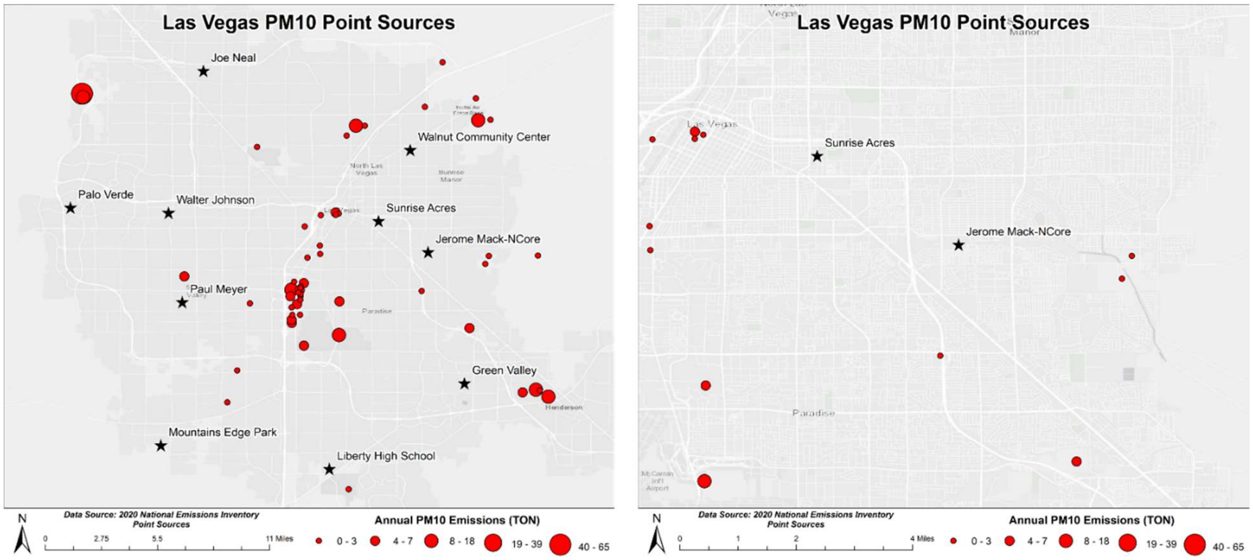


Figure 2.2-13. 2020 National Emissions Inventory (NEI) point sources of PM_{10} in the Las Vegas Valley (left) and near the Sunrise Acres and Jerome Mack monitoring sites (right).

Clark County, NV, provided information on all PM_{10} emissions as part of the 2012 "Redesignation Request and Maintenance Plan for Particulate Matter (PM_{10})" State Implementation (SIP) document for PM_{10}. Point sources contributed 0.31% of PM_{10} emissions in 2008 and are projected to contribute 0.59% of PM_{10} emissions in 2023. Given the small contribution of point sources to total PM_{10} emissions and the lack of significant point sources near the sites, it is unlikely that point sources contributed to the October 25, 2020, exceedance. Nonpoint sources, however, contribute greater than 98% of PM_{10} emissions. The assessment shows a 31% reduction in total PM_{10} emissions between 2008 and 2023, with notable decreases in the contribution of wind erosion (vacant lands) to total PM_{10} emissions between 2008 and 2023 (Figure 2.2-14). Due to increased conversion of vacant lands to built area, there has been an increasing contribution to total emissions from paved roads, construction, and wind erosion associated with construction. The Jerome Mack site is approximately a quarter of a mile away from a major paved road source (S Lamb Blvd), so paved roads and on-road emissions likely did not contribute to the October 25, 2020 exceedance. The Sunrise Acres site is approximately 530 feet from the nearest major paved road source (N Eastern Ave), so these emissions may be more likely to impact this site. Additionally, a Construction Notice was issued for Sunday, October 25, 2020, through Monday, October 26, 2020, which requires construction sites to immediately conduct inspections, implement BACM, and avoid blasting activity at threshold wind speeds to mitigate wind-blown dust.

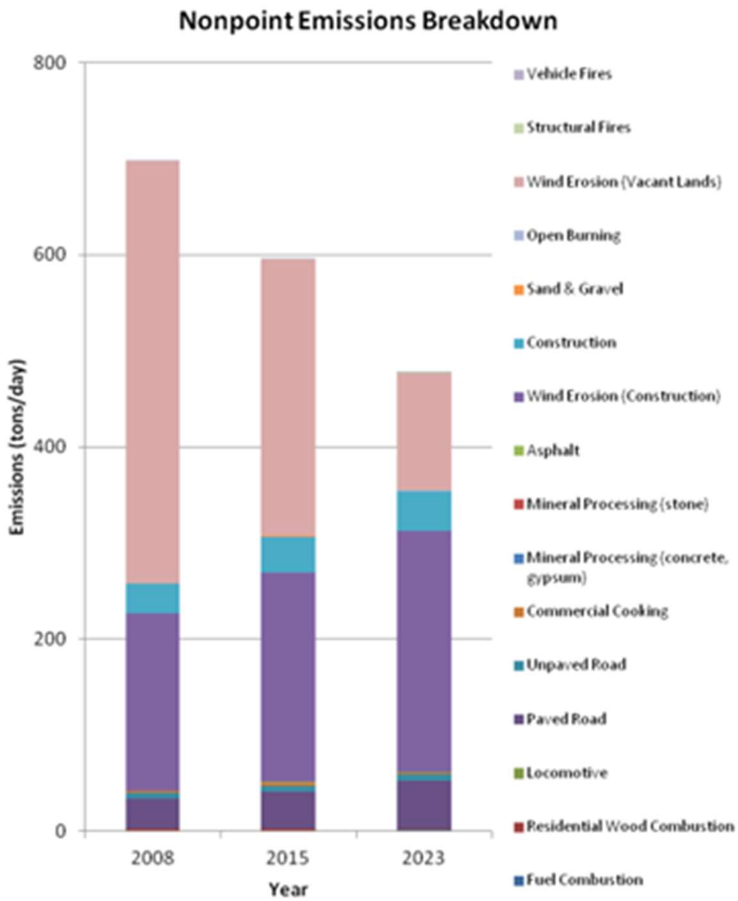


Figure 2.2-14. Nonpoint emissions inventory breakdown from the 2012 'Redesignation Request and Maintenance Plan for Particulate Matter (PM_{10})" document.

2.2.4 Historical Analysis of PM_{10} in Clark County

The values recorded on October 25, 2020, were 210 µg/m^3 at Jerome Mack and 163 µg/m^3 at Sunrise Acres, well above seasonal averages and the 99th percentile for both sites. Table 2.2-1 displays a statistical summary of 24-hour average PM_{10} concentrations from the five years preceding the event (2016-2020). At Jerome Mack, the mean concentration is 32 µg/m^3, the median is 28 µg/m^3, and the 99th percentile is 93 µg/m^3. Similarly, at Sunrise Acres, the mean concentration is 30 µg/m^3, the median is 27 µg/m^3, and the 99th percentile is 83 µg/m^3.

Table 2.2-1. Five-year statistical summary of 24-hour average PM_{10} concentration at affected sites from 2016 – 2020.

Statistic (µg/m^3)	Jerome Mack	Sunrise Acres
Mean	32	30
Median	28	27
Mode	25	23
St. Dev	20	19
Minimum	2	4
95th percentile	62	62
99th percentile	93	83
Maximum	309	330
Range	307	326
Count	1,760	1,764
Exceedances (>150 µg/m^3)	6	3

Seasonal and monthly trends in the 24-hour average PM_{10} data for the five years preceding the event (2016-2020) for both sites combined are shown in boxplots in Figure 2.2-15 and Figure 2.2-16. The lower edges (25th percentile) and upper edges (75th percentile) of the box correspond to the interquartile range, and the middle bar is the median value. The whiskers extend to the smallest and largest value within 1.5 times the interquartile range. Points beyond this range are considered outliers and have been removed for monthly and seasonal trend clarity (see Section 3.4.2 for trends including outliers). Median 24-hour average PM_{10} values were found to be lowest in spring (median value of 20 µg/m^3) and highest in autumn (median value of 35 µg/m^3). For October, the interquartile range was 24 – 49 µg/m^3, with a median value of 35 µg/m^3.

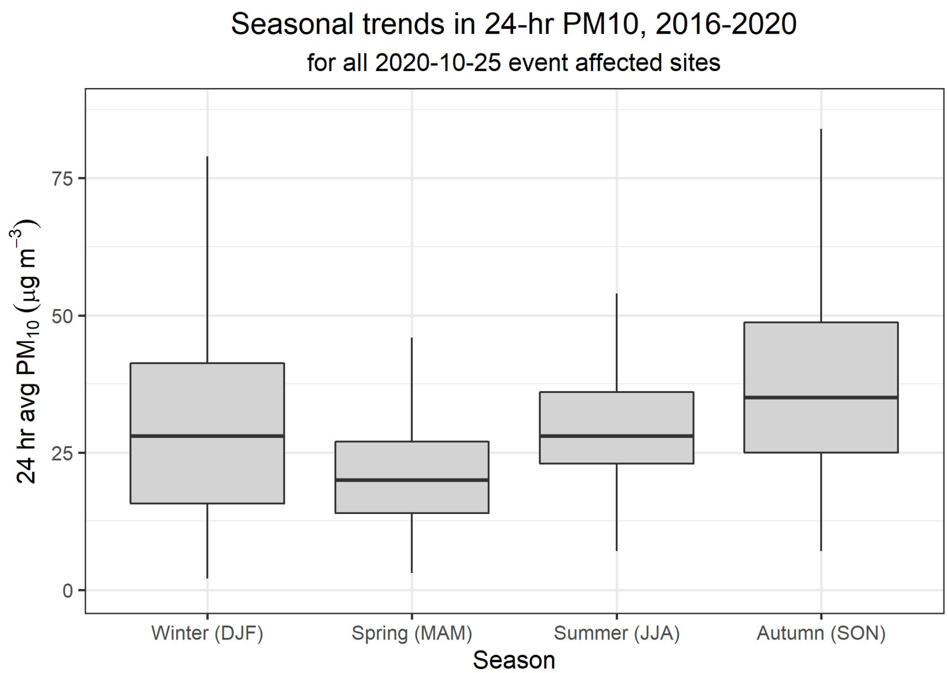


Figure 2.2-15. Seasonal trends in values of PM_{10} from 2016-2020 (outliers have been removed for trend clarity).

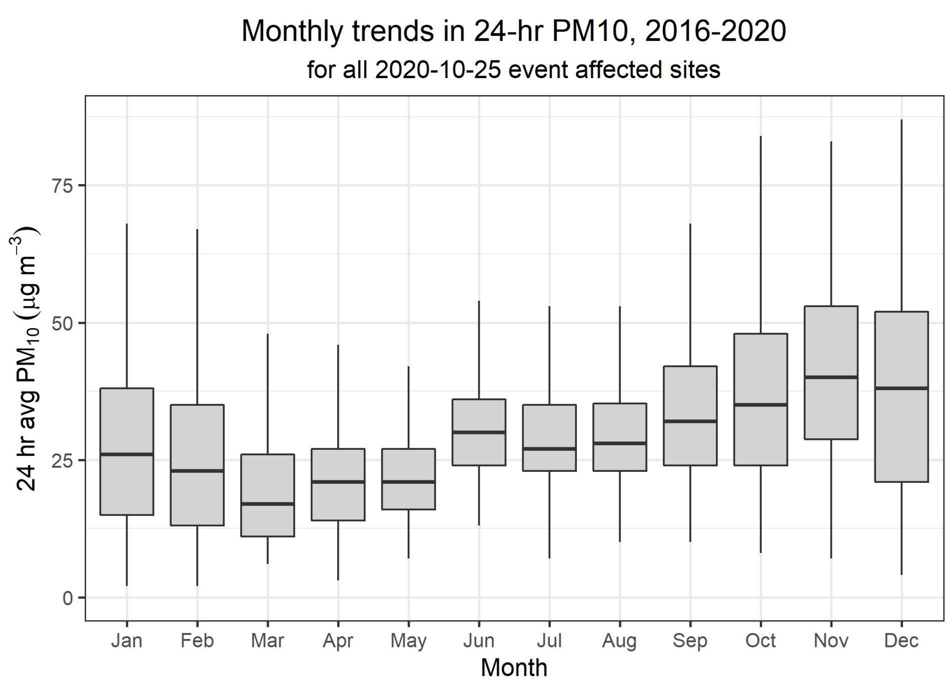


Figure 2.2-16. Monthly trends in values of PM_{10} from 2016-2020 (outliers have been removed for trend clarity).

3. Clear Causal Relationship

During late October, a frontal passage through northwestern and central Nevada drove a wind-blown dust event that increased PM_{10} concentrations in Clark County, NV, on October 25, 2020. Strong winds well above 25 mph from the frontal passage lofted, entrained, and transported dust from the source region into Clark County starting at 11:00 PST on October 25, 2020, and lasting through midnight the next day. The severe drought conditions affecting the Great Basin and northern Mojave Desert in Nevada, as shown in **Section 2.2**, created an ample source of dust from friable soils. Enhanced wind speeds greater than 25 mph (5-minute averaged data from Harry Reid Airport) in the Las Vegas Valley coincided with increased PM_{10} concentrations from October 25 11:00 to October 26 00:00 PST. Within this section, we provide meteorological evidence of lofting, entrainment, and transport of dust from the dust source area (the Great Basin and Mojave Desert regions) with the frontal passage, evidence of transport from the source region to Clark County via HYSPLIT trajectory modeling and meteorological analysis, and impacts of the high-wind dust event at the surface in Clark County. We also provide additional evidence using statistical and meteorological similar event analysis to compare this dust event with other high PM_{10} days in Clark County.

3.1 High-Wind Event Origin

3.1.1 Meteorological Analysis

The PM_{10} exceedance concentration on October 25, 2020, occurred with 24-hour average PM_{10} values of 210 µg/m^3 at Jerome Mack and 163 µg/m^3 Sunrise Acres, well exceeding the 150 µg/m^3 standard. On October 25, 2020, strong winds produced dense blowing dust that impacted the Las Vegas metropolitan area, increasing PM_{10} concentrations starting at 11:00 PST, peaking at 15:00 PST and lasting through midnight on October 26. Though not regulatorily significant, six other sites (Paul Meyer, Walter Johnson, Joe Neal, Green Valley, Boulder City, and Jean) also experienced significantly enhanced PM_{10} concentrations. Several large-scale meteorological factors led to favorable conditions for blowing dust on this day. To account for these meteorological factors, observation data were analyzed leading up to and during the dust event. The observation data reviewed for this analysis includes:

- 250 mb heights and winds, approximately 30,000 feet above sea level (ASL)
- 500 mb heights and winds, approximately 18,000 feet ASL
- Surface fronts, pressure readings, and wind measurements

This meteorological analysis is a “top-down” approach, first investigating the upper-level weather conditions, then linking the upper-level observations to the corresponding lower-level and surface weather patterns. This analysis will focus on the time period between 12:00 UTC (4:00 PST) on October 23, 2020, and 00:00 UTC on October 27, 2020 (16:00 PST on October 26, 2020).

250-mb Analysis

The 250-mb weather map the morning of October 23, 2020, displayed an upper-level ridge of high pressure over the Gulf of Alaska, with a weak low-pressure trough downstream in northern British Columbia (see **Figure 3.1-1**). Along the western side of this trough aloft was a 75-125 knot jet streak over coastal British Columbia. By the evening of the October 23, the axis of the aloft trough had moved into the central portion of British Columbia, while the jet streak was positioned in western British Columbia and the high-pressure ridge remained over the Gulf of Alaska. Because of the jet streak's position west of the trough axis and the persistence of the Gulf of Alaska ridge, the 250-mb trough would intensify and move southward.

By October 24, the jet streak remained intact over western British Columbia, and the upper-level ridge remained stationary over the Gulf of Alaska. Meanwhile, the upper-level trough advanced from British Columbia into southern Oregon. On the morning of October 25, the 250-mb trough advanced into northern Nevada, with the jet streak still positioned west of the trough axis, stretching from southern Alaska into central Oregon. The southerly trajectory of the 250-mb trough continued through the morning of October 26, when the upper-level trough moved past southern Nevada and into northwestern Arizona. At this time, the jet streak stretched from eastern Alberta to northeastern Nevada.

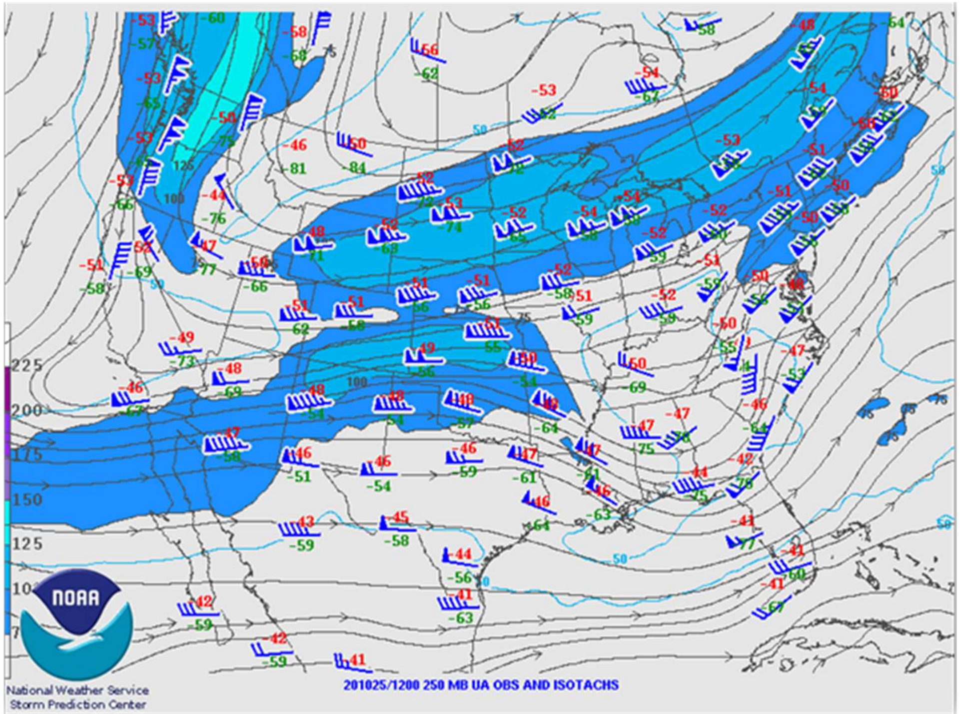


Figure 3.1-1. 250-mb map the morning of October 25, 2020 (12:00 UTC or 04:00 PST). A 125-kt jet streak (light blue contour) steers an upper-level trough into southern Nevada. Source: NOAA Storm Prediction Center

500-mb Analysis

As the 250-mb jet streak deepened the associated upper-level trough into Nevada, it also influenced the development of a low-pressure trough at mid-levels (500 mb). On the evening of October 23, a shortwave 500-mb trough was analyzed over the central and eastern portion of British Columbia. This trough was located in the left exit region (LER) of the 250-mb jet streak that was positioned over western British Columbia at this time. Due to the aloft divergence associated with the LER of the 250-mb jet streak, the 500-mb trough developed and intensified rapidly.

By October 24, the 500-mb trough became better defined, traveling from British Columbia in the morning to northeastern Oregon by late afternoon. Through the day, the 250-mb jet streak remained intact over western British Columbia, allowing the trough at 500-mb to amplify as it moved southward.

While the 500-mb trough was still north of the Las Vegas region, its impacts were starting to influence the geopotential heights. At 12:00 UTC (4:00 PST) on October 24, the 500-mb height at the National Weather Service Las Vegas upper-air meteorological station (code: KVEF) was 582 dm. Twelve hours later, the 500-mb height had fallen to 578 dm.

500-mb height at KVEF continued to fall on October 25. The upper-air sounding at 12:00 UTC (4:00 PST) recorded a 500-mb height of 572 dm at KVEF, with the trough positioned over central Montana, southern Idaho, and far northern Nevada. The 500-mb trough continued to strengthen throughout the day due to its proximity to the LER of the 250-mb jet streak. By the early evening of October 25, the amplified 500-mb trough reached southern Nevada (see Figure 3.1-2). At this time, the 500-mb height at KVEF had fallen to 563 dm.

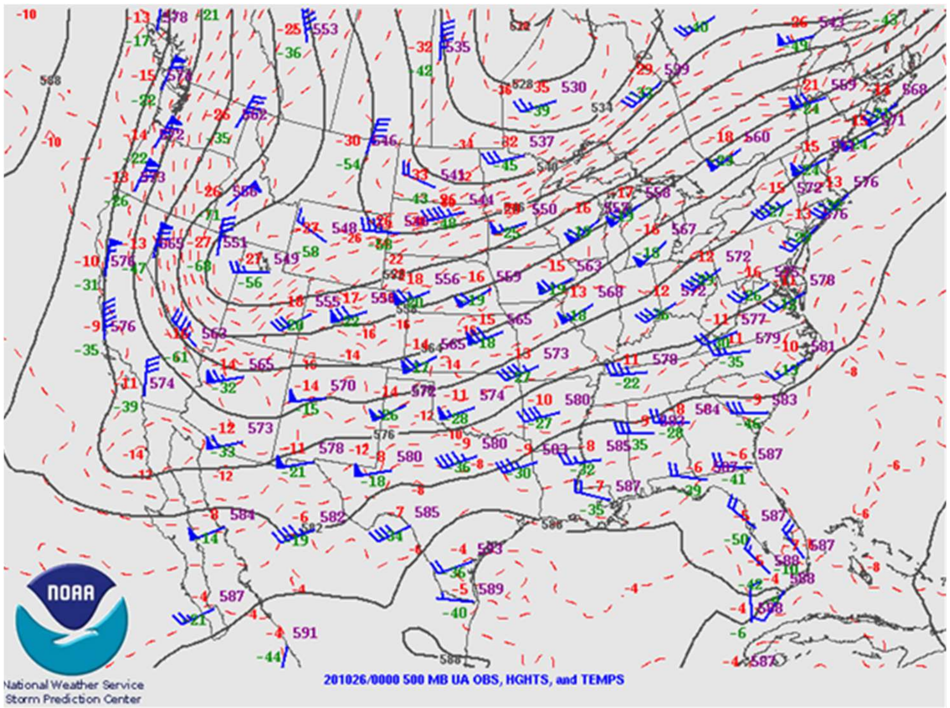


Figure 3.1-2. 500-mb map the evening of October 25, 2020 (16:00 PST on October 25, 2020/00:00 UTC on October 26, 2020). A strong mid-level trough of low pressure extends from far western Ontario to central Nevada. Source: NOAA Storm Prediction Center.

The 500-mb trough exited southern Nevada the morning of October 26, which coincided with the lowest recorded 500-mb height for this event. At 12:00 UTC (4:00 PST), the 500-mb height at KVEF was 556 dm, marking a 16 dm decrease in heights over 24 hours. As the trough advanced further away from southern Nevada, heights started to increase. By the evening, the recorded 500-mb height at KVEF was 562 dm.

Surface Analysis

As the upper-level jet streak intensified the mid-level trough and directed it southward into Nevada, the mid-level trough supported low-level (near-surface) cyclogenesis. On the evening of October 23, a stationary surface front was analyzed from Vancouver Island to central Wyoming. Twelve hours later, on the morning of October 24, a surface low-pressure center developed over central Idaho, with the stationary front transitioning to a cold front over northern Oregon. This change occurred as the 250-mb jet streak dropped down the British Columbia coast. Behind the front, a 1,045-mb high-pressure center was analyzed over Yukon and northern British Columbia, with a strong +45 mb pressure gradient measured between this high and the surface low in Idaho. This pressure gradient produced gusty northerly to northwesterly winds behind the cold front.

The 250-mb jet streak and deep mid-level trough continued to aid in the development of the cold front on October 25, as the jet streak nosed into Washington and Oregon. In the morning hours, the surface low had deepened to 999 mb over eastern Utah and western Colorado, with a cold front extending across southern Utah and central Wyoming. Farther north, a 1044-mb surface high had moved into southern British Columbia, allowing the pressure gradient to remain strong behind the cold front.

In the Las Vegas region, winds ahead of the front during the early morning of October 25 were mainly southerly to southwesterly. Around sunrise and continuing through late morning, winds at the north Las Vegas Airport meteorological station (code: KVGT) shifted to northwesterly and strengthened as the front entered the northern portion of the Las Vegas metropolitan area. As the front pushed across the rest of southern Nevada during the afternoon of October 25, strong northwesterly winds developed regionally as the pressure gradient tightened. By the evening of October 25, a 997-mb low was positioned near the Four Corners, while the cold front had moved past southern Nevada (see **Figure 3.1-3**). To the north, the surface high entered northern Idaho and Montana, with a +42-mb pressure gradient stretching from the high center to the surface low center. Due to the strong pressure gradient behind the front, the strongest winds were recorded from the afternoon hours of October 25 through the late morning hours of October 26, with the peak PM_{10} concentrations registered between the late afternoon of October 25 and the early morning of October 26.

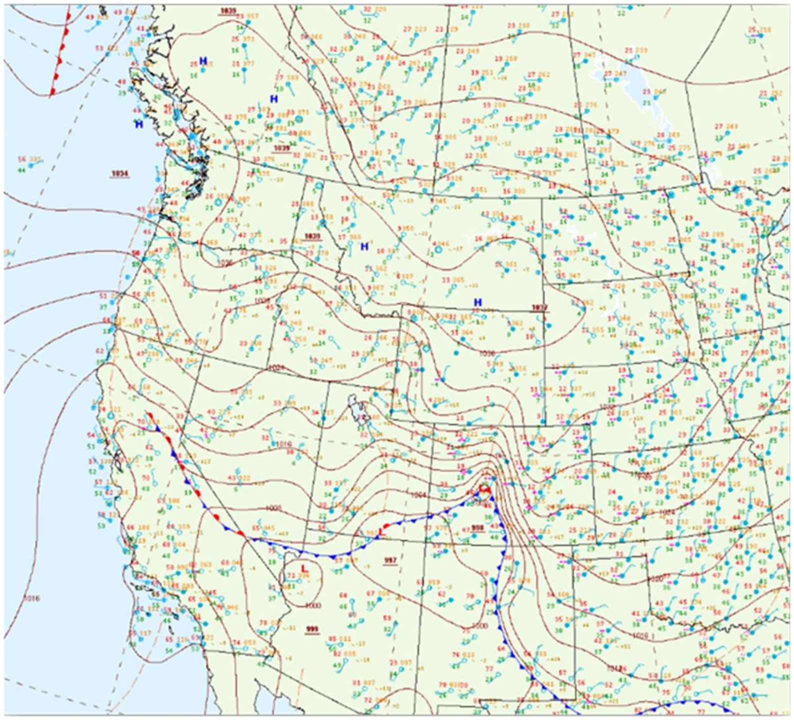


Figure 3.1-3. Surface weather map the evening (16:00 PST) of October 25, 2020, indicating a cold front in southern Nevada and high pressure over Idaho and Montana. The strong pressure gradient is indicated by numerous isobars (brown lines) between the cold front and surface high. Source: NOAA Weather Prediction Center.

3.1.2 Satellite Images and Analysis

Satellite imagery and reanalysis products provide evidence of wildfire smoke and dust corresponding with a frontal passage. Multi-Angle Implementation of Atmospheric Correction (MAIAC) Aerosol Optical Depth (AOD) imagery from MODIS on October 25 shows a streak of high AOD value that included wildfire smoke from central California and dust being pushed through southern Nevada and Clark County with the frontal passage (**Figure 3.1-4**). The highest AOD values are shown in California and across Nevada, Utah, and Colorado, with lower AOD values throughout the state of Nevada. The high values shown are a result of the combination of wildfire smoke and dust indicated by the gray and brown mixture in the same location as the high AOD values in Nevada in the true color image (**Figure 3.1-5**).

The Modern-Era Retrospective analysis for Research and Applications, Version 2 (MERRA-2), reanalysis data show enhanced wind speeds in the source region and the Las Vegas Valley on October 25, 2020 (**Figure 3.1-6 and Figure 3.1-7**). A surface cold front generated northwesterly winds that produced dense blowing dust in the Las Vegas region. The winds, averaging around 10 m/s (22 mph) with maximums greater than 16 m/s (36 mph), occurred on the event date as shown in the MERRA-2 reanalysis figures.

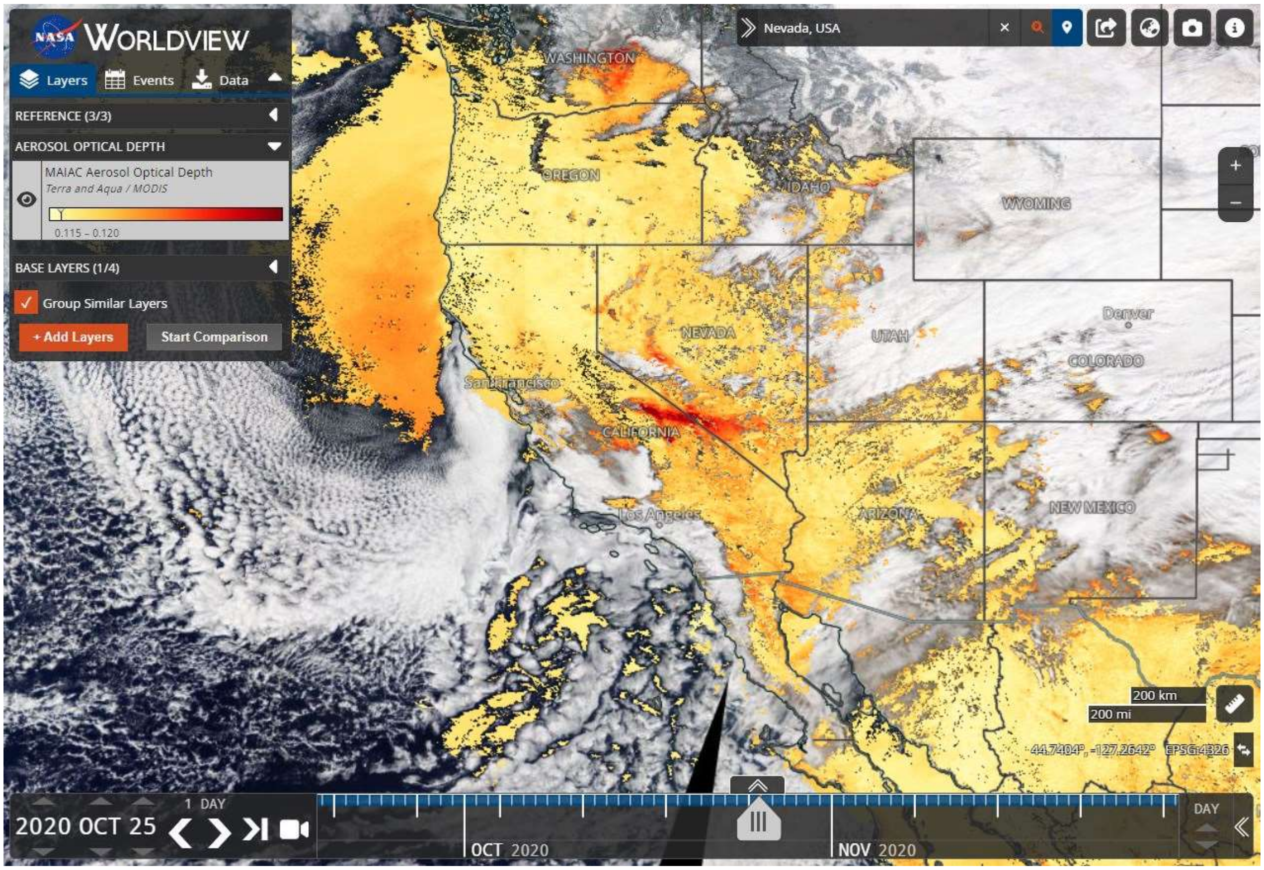


Figure 3.1-4. Satellite aerosol optical depth from MAIAC Aqua and Terra combined. Terra imagery at 10:30 PST and Aqua imagery at 13:30 PST on October 25, 2020.

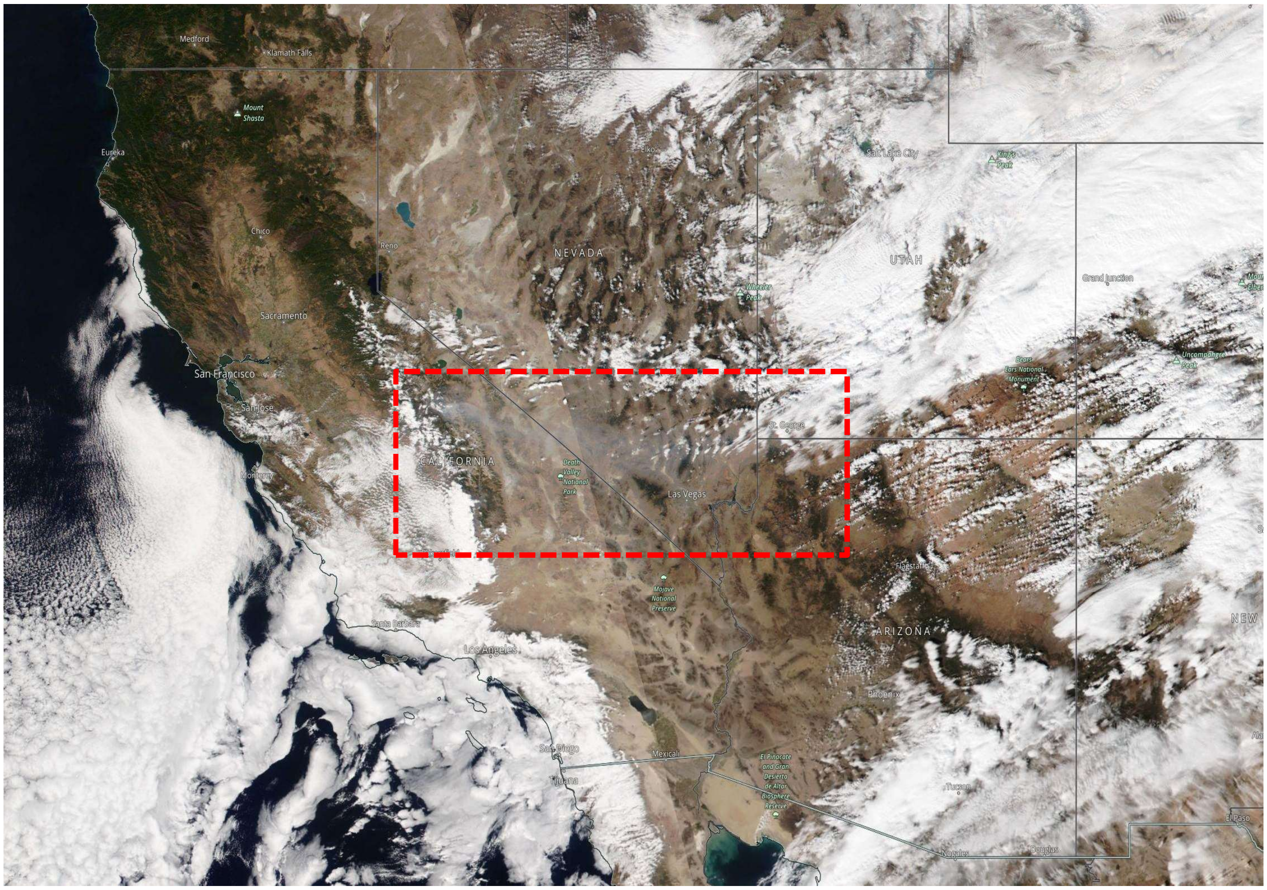


Figure 3.1-5. Satellite imagery of true color from NOAA-20 VIIRS at 14:30 PST on October 25, 2020. A small band of dust moving southward through Clark County is highlighted by the red box.

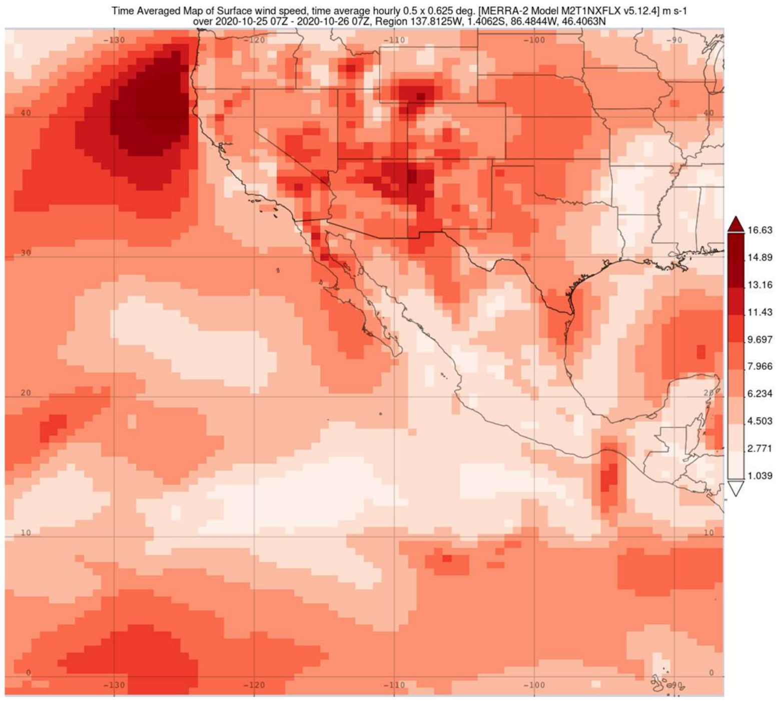


Figure 3.1-6. MERRA-2 reanalysis data hourly averaged surface wind speed (m/s) from October 25, 2020, at 07:00 UTC through October 26, 2020, at 07:00 UTC (October 25, 2020 at 00:00 PDT – October 26, 2020 at 00:00 PDT).

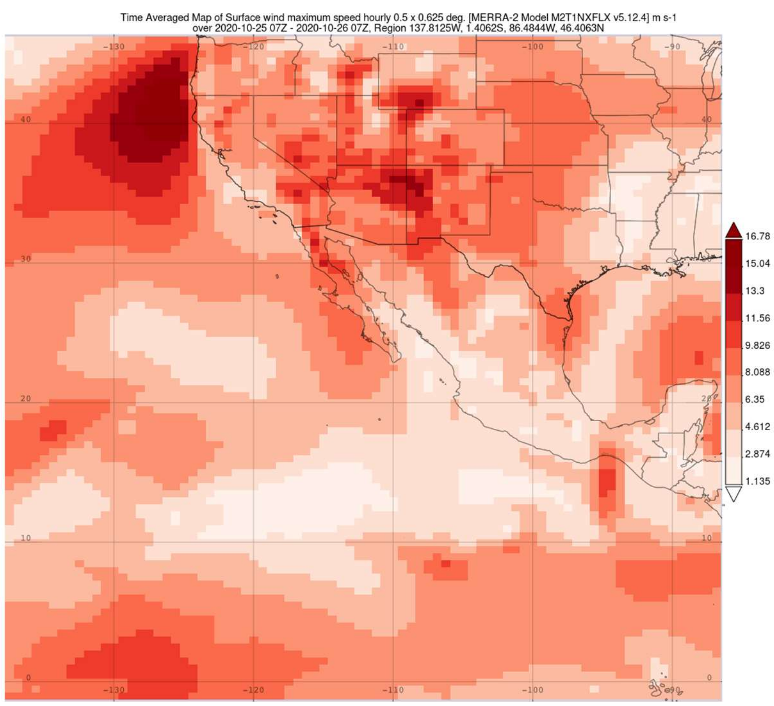


Figure 3.1-7. MERRA-2 reanalysis data hourly maximum surface wind speed (m/s) from October 25, 2020, 07:00 UTC through October 26, 2020, 07:00 UTC (October 25, 2020 at 00:00 PDT – October 26, 2020 at 00:00 PDT).

3.1.3 Supporting Ground-Based Data

We were unable to find ground-based images in the source region due to the remote location. Satellite imagery was highlighted in the previous section as a substitute.

Peak sustained winds for Nevada (including the Great Basin and northern Mojave Desert source regions) were developed via the Iowa State University Mesonet Automated Data Plotter. This tool aggregates automated weather data records from selected regions. Figure 3.1-8 shows that e peak sustained wind speeds in the Great Basin and northern Mojave Desert peaked at 41.4 mph on October 25, 2020. These peak sustained wind speeds were well above the 25-mph threshold in the source region and could easily loft, entrain, and transport PM_{10} downwind to Clark County.

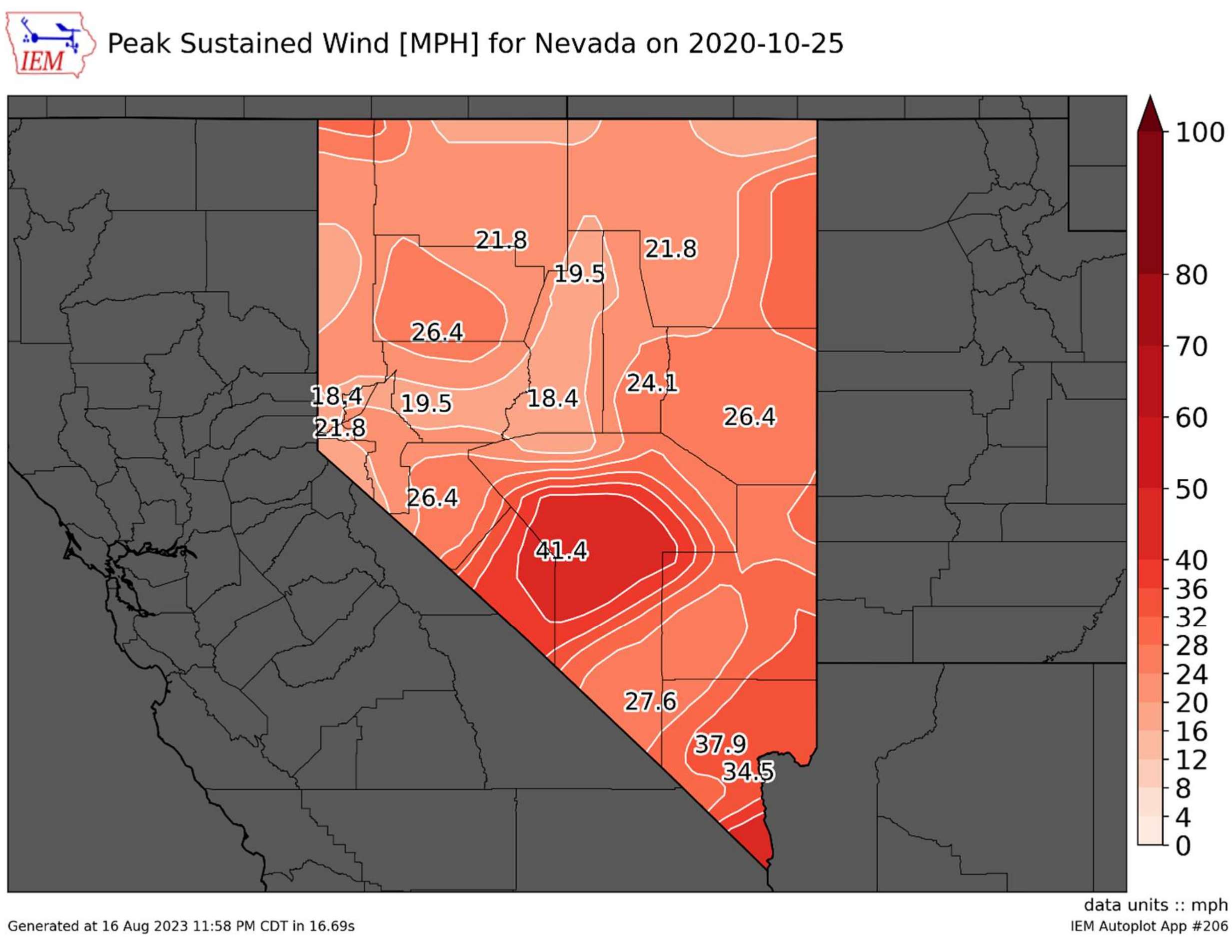


Figure 3.1-8. Peak sustained winds for Nevada on October 25, 2020. Data source https://mesonet.agron.iastate.edu/plotting/auto/.

Figure 3.1-9 shows the distribution of maximum daily temperature recorded at several sites in the wind-blown source regions on October 24 and 25 (1990 – 2019), and the maximum daily temperature recorded on October 24 and 25, 2020. The site locations are shown in Figure 2.2-8. Maximum daily temperature at all sites except Battle Mountain and Rome on October 24, 2020, were above the median in the dust regions and along the transport path compared to maximum daily temperatures from 1990 to 2019. Maximum daily temperatures recorded at all sites on October 25, 2020, the day of the PM_{10} exceedance, were below the median likely as a result of blowing dust reducing incoming solar radiation. The maximum daily temperatures recorded on October 24 provide evidence that the wind-blown dust source regions in the Great Basin and Mojave source regions were unusually hot on the day before the PM_{10} exceedance.

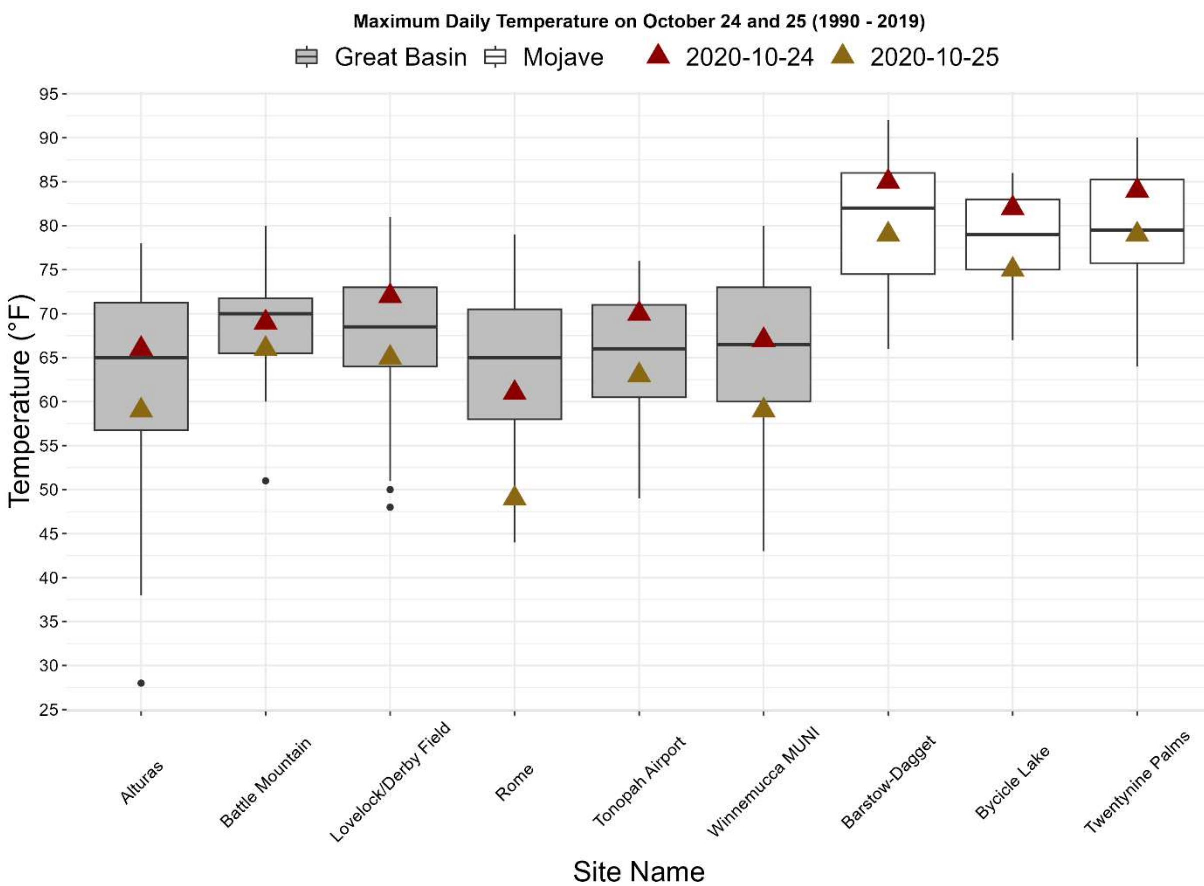


Figure 3.1-9. Maximum daily temperature on October 24 and October 25, 2020, compared to the 1990 – 2019 distribution at each site.

Overall, we find overwhelming evidence that PM_{10} was very likely lofted, entrained, and transported from the Great Basin and northern Mojave Desert regions during the day on October 25, 2020, via a strong frontal passage. The evidence corroborating this assertion includes (1) the meteorological analysis that shows conditions were consistent with a high-wind event in the Great Basin and northern Mojave deserts, (2) satellite retrievals showing high AOD and winds in the Great Basin and northern Mojave deserts, and (3) ground-based measurements of high winds and temperatures in the Great Basin and northern Mojave deserts on October 24 and 25, 2020.

3.2 Transport to Clark County

3.2.1 HYSPLIT Analysis

Backwards trajectories were modeled from Jerome Mack from the point when high PM_{10} concentrations began (hourly concentration greater than 150 µg/m^3) at 14:00 PST at 50-m, 500-m, and 1,000-m heights (**Figure 3.2-2**). Archived North American Mesoscale (NAM) Forecast System data with a resolution of 12 km was used as meteorologic input. Temporal resolution of the NAM 12-km meteorological data is three hours and is run by the NCEP.

At 500-m and 1,000-m heights, trajectories approached the Las Vegas region from the northwest over the Great Basin Desert, revealing it as the source region. The Great Basin Desert is just east of the Sierra Nevada range, located within its rain shadow, yielding barren land with scrub/shrub landcover (**Figure 3.2-2**). Throughout the Great Desert Basin, each trajectory passes through areas in both severe and extreme drought conditions (Figure 3.2-2). The low-level 50-m trajectory approaches from the west-southwest, similarly passing over baren land and scrub/shrub landcover with extreme drought conditions (Figure 3.2-2).

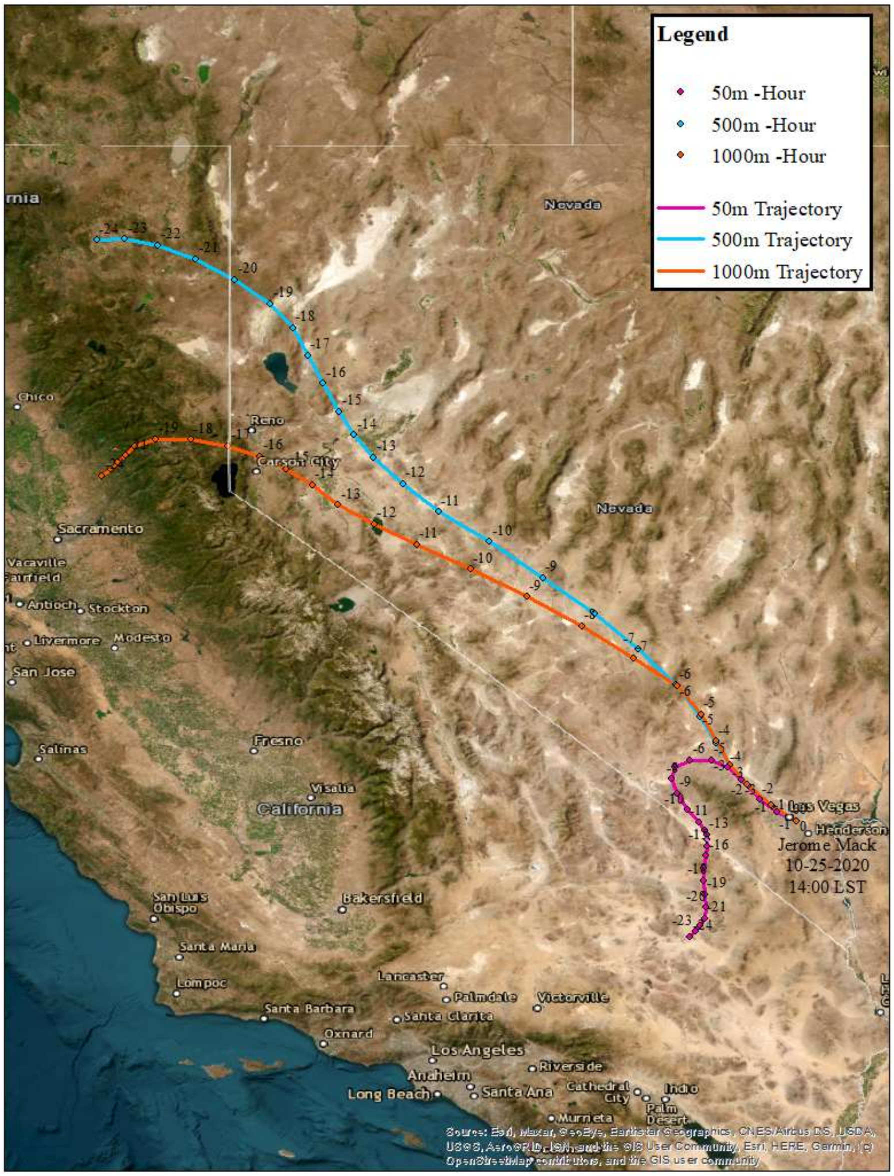


Figure 3.2-1. HYSPLIT 24-hour back trajectories from Jerome Mack on October 25, 2020, at 14:00 PST, originating at (maroon) 50 m, (green) 500 m, and (blue) 1,000 m, with hourly points.

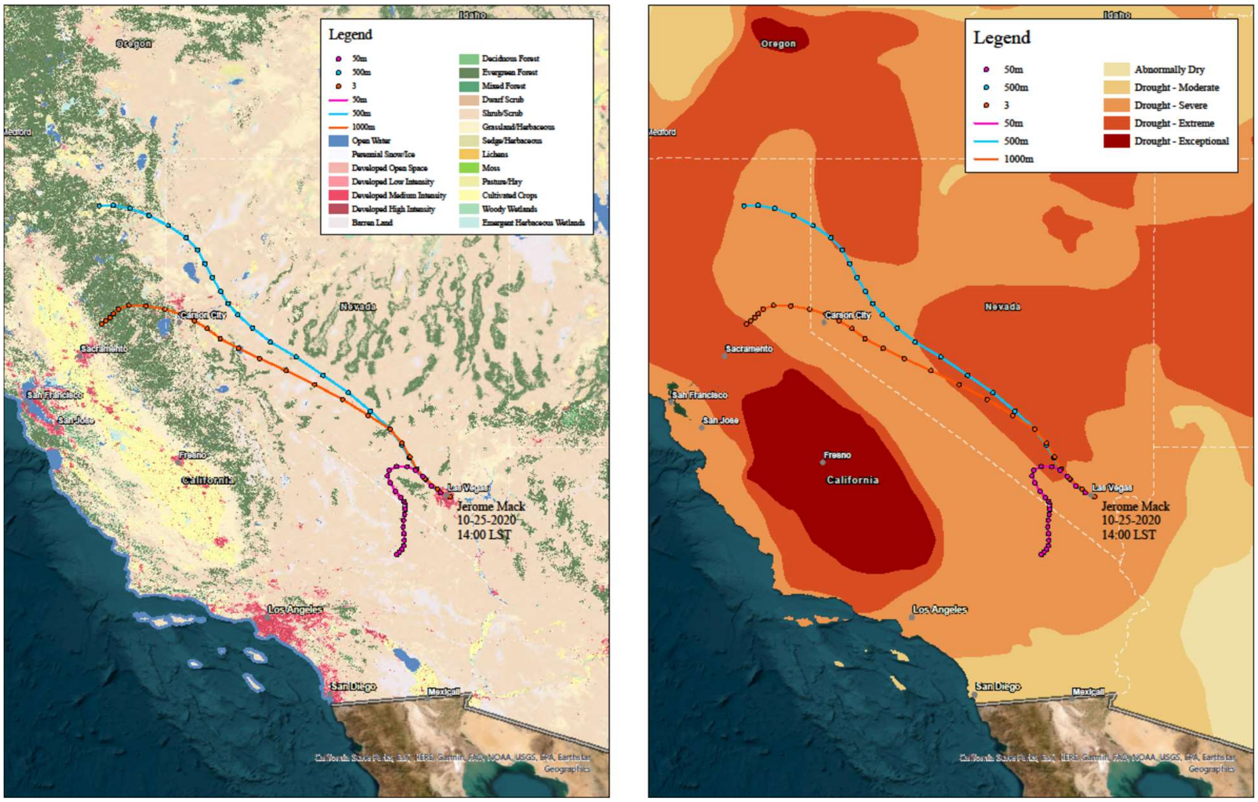


Figure 3.2-2. HYSPLIT 24-hour back trajectories from Jerome Mack on October 25, 2020, at 14:00 PST overlayed on (left) national land type database and (right) drought monitor class.

3.2.2 High-Wind Event Timeline

The PM_{10} exceedance concentration on October 25, 2020, was 210 µg/m^3 at Jerome Mack and 163 µg/m^3 at Sunrise Acres. Concentrations of PM_{10} increased rapidly at 13:00 at Jerome Mack on October 25, 2020, peaking at 15:00 and remaining enhanced until 19:00 PST (**Figure 3.2-3**). **Figure 3.2-4** shows resultant hourly average winds measured at AQS sites in Clark County. The map in **Figure 3.2-5** shows the location of each AQS site, as well as LAS. A rise in wind speed was observed at all Clark County sites between 12:00 and 15:00. Six AQS sites recorded an hourly average wind speed greater than 15 mph during the event, and two sites (Walter Johnson and Jean) recorded an hourly average wind speed exceeding 20 mph. An hourly average wind measurement greater than 25 mph was not recorded on October 25 at any AQS measurement sites in Clark County. However, as shown in Figure 3.1-8, winds speeds north of Las Vegas in the source region were well above the 25-mph threshold on October 25. High wind speeds in the source region as well as the ongoing drought conditions across Nevada suggest that the enhanced dust concentrations during this event were from the natural, undisturbed desert sources north of Clark County.

Winds during the event came from the north and north-westerly directions as shown by the wind rose presented in **Figure 3.2-6**. The wind rose shows the distribution of shorter-averaged wind observations between the hours of 13:00 and 24:00 on October 25, 2020. The north-northwesterly surface wind direction aligns with the meteorological analysis presented in **Section 3.1.1**.

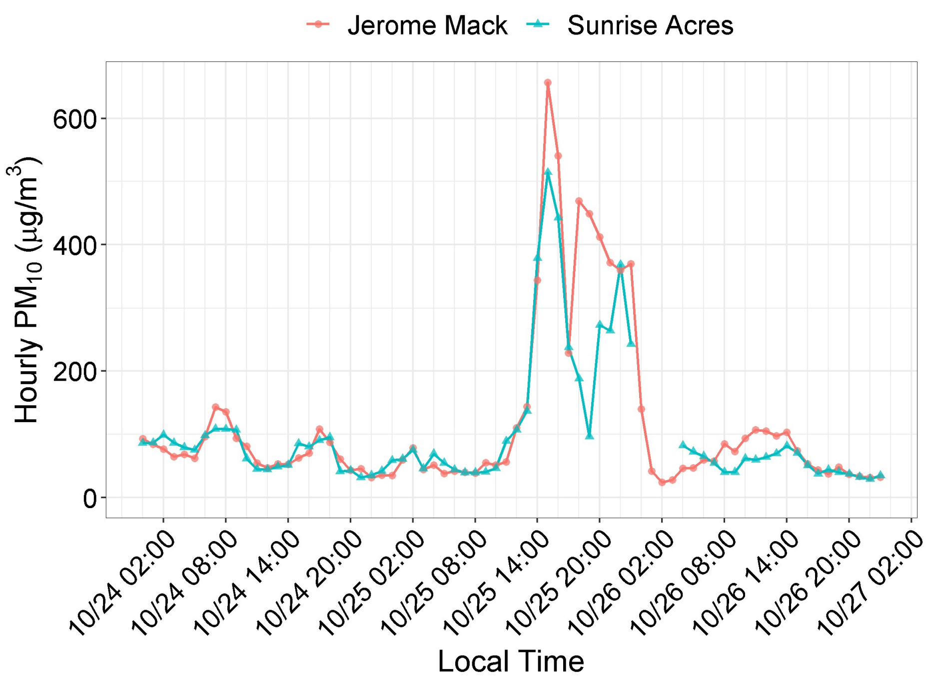


Figure 3.2-3. Hourly PM_{10} measurements in µg/m^3 at Jerome Mack and Sunrise Acres on October 25, 2020.

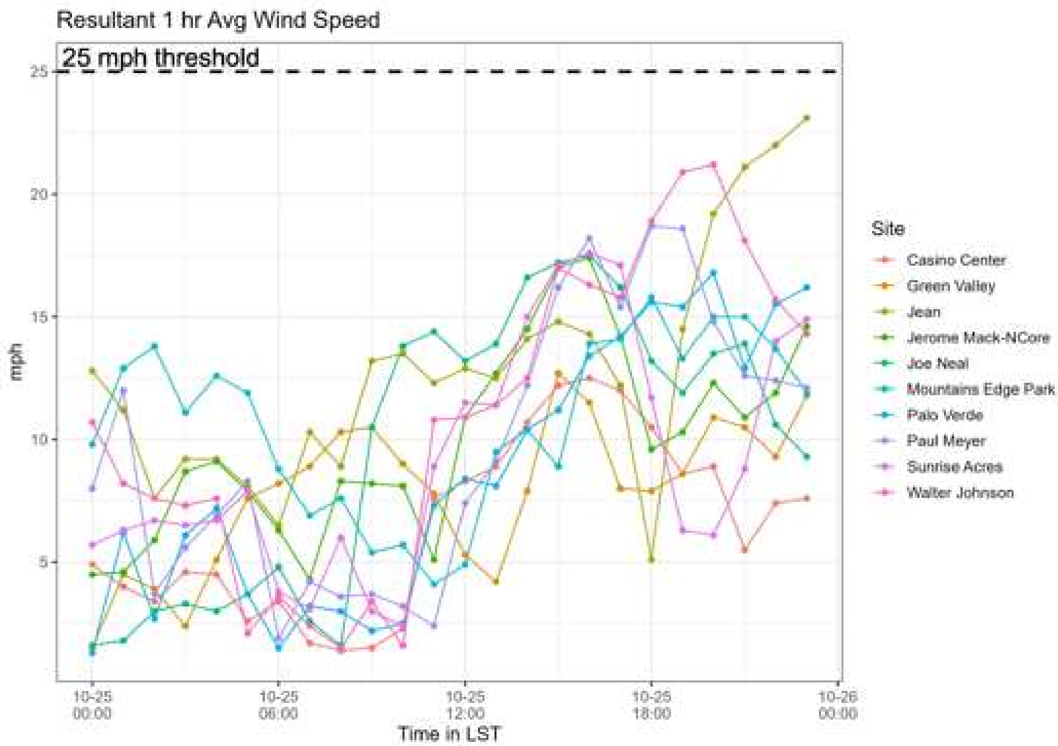


Figure 3.2-4. Resultant hourly average wind speed at AQS sites in Clark County sourced from the AQS database.

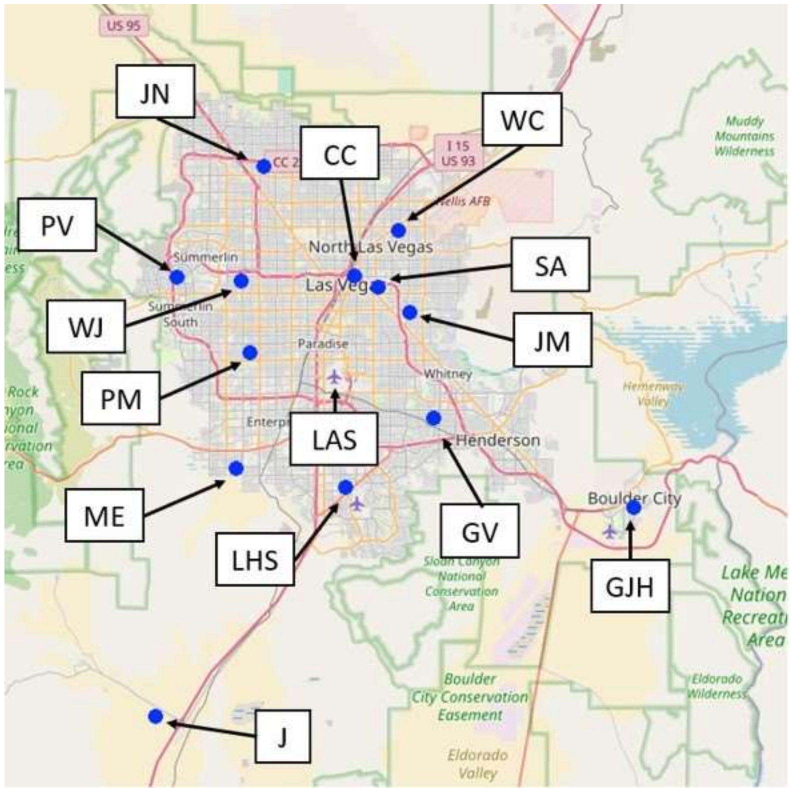


Figure 3.2-5. Map showing the locations of AQS sites in Clark County and at Harry Reid Int'l Airport (LAS). AQS sites include Joe Neal (JN), Casino Center (CC), Walnut Creek Recreation Center (WC), Palo Verde (PV), Walter Johnson (WJ), Sunrise Acres (SA), Paul Meyer (PM), Jerome Mack (JM), Mountain's Edge (ME), Liberty High School (LHS), Green Valley (GV), Garret Jr. High (GJH), and Jean (J).

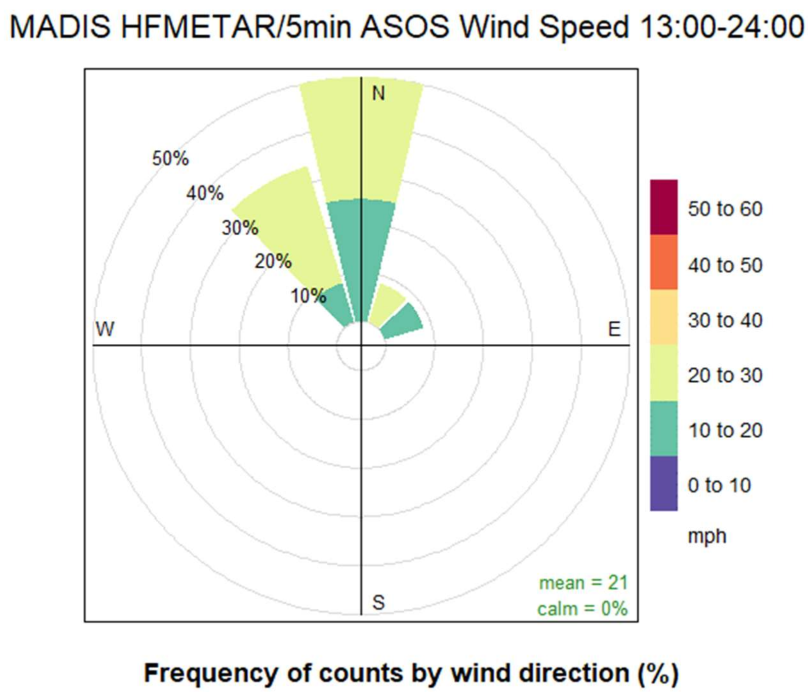


Figure 3.2-6. Wind rose including both wind speed and direction for October 25, 2020, at Harry Reid Int'l Airport (LAS). Wind data is sourced from the Iowa Environmental Mesonet (**https://mesonet.agron.iastate.edu/**).

The progression of the cold front southward across Nevada as discussed in Section 3.1.1 can be tracked by changes in pressure, wind speed, and wind direction. Figure 3.2-7 shows measurements from Lovelock (LOL), Bishop Airport (BIH), Desert Rock (DRA), and Harry Reid Int'l Airport (LAS). Around the time that the minimum pressure occurred at each station, marked by a vertical dotted line in each plot, wind speeds increased and wind direction changed from northerly to westerly, which all mark a frontal passage. The front passed over LOL in northern Nevada at around 22:00 PST on October 24, BIH mid-morning on October 25, and finally reached southern Nevada near Las Vegas around 12:00-15:00 PST on October 25, 2020. This change in pressure coincides with the rapid increase and maximum value of PM_{10} on October 25, 2020. Sustained winds speeds in Clark County area, along the transport path from and in the source region (shown in Figure 3.1-8), were above the 25-mph threshold for high-wind dust events. This evidence confirms the Tier 2 status of this High Wind Dust Exceptional Event on October 25, 2020, in Clark County.

In addition to the meteorological evidence of the frontal passage, PM_{10} concentrations in Reno are provided in Figure 3.2-8. As stated in the meteorological analysis in Section 3.1.1, the frontal passage entered northern Nevada early in the morning on October 25, 2020. The Reno area was the first impacted by lofted dust from the Great Basin Desert and showed enhanced PM_{10} starting around 02:00 PST on October 25, 2020. As the front moved southward through the Great Basin Desert and into the northern Mojave, impacts are seen in Inyo County, CA, in the form of extremely enhanced PM_{10} concentrations. These were first observed at the White Mountain Research Center (the northern most monitoring site) at around 08:00 PST, then at Fort Independence Indian Community around 11:00-12:00 PST, and finally at Keeler and Coso Junction stations by 14:00 PST. Coincidentally with the southernmost monitoring stations in Inyo County, CA, we see that Clark County monitoring stations were affected by the dust event around 11:00 PST, with the largest impacts occurring around 15:00 PST. These measurements provide significant evidence of windblown dust along a frontal passage due to high winds.

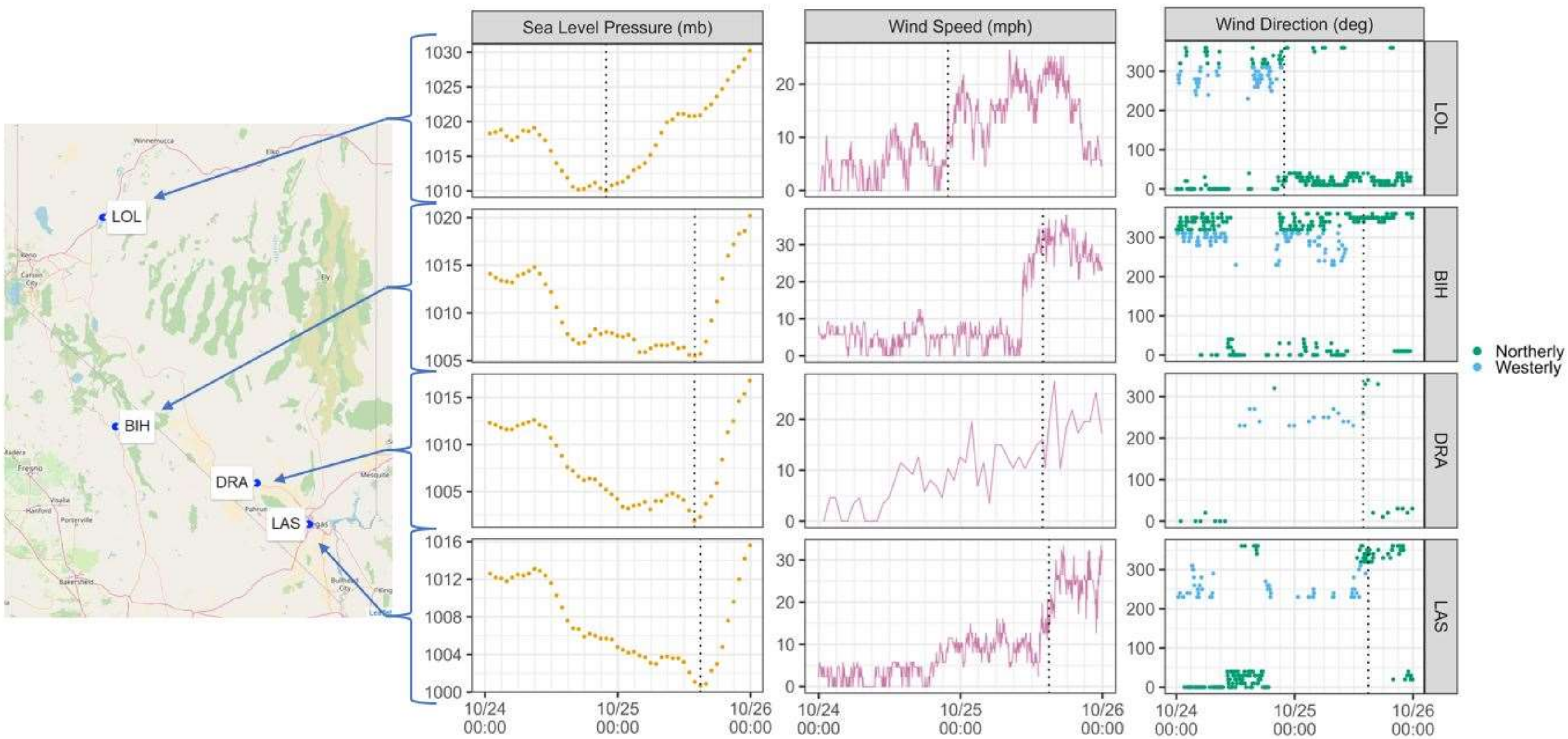


Figure 3.2-7. Timeseries of sea level pressure (SLP), wind speed, and wind direction between 00:00 PST on October 24 and 00:00 PST on October 26 at four weather stations in Nevada and California: LOL, BIH, DRA, and LAS. The black-dotted line in each plot panel marks the time when minimum SLP occurred at that station. In the wind-direction plot panels, "westerly" (blue) refers to the 45-degree arc between 225 and 315 degrees, and "northerly" (green) refers to the 45-degree arc between 315 and 45 degrees (across the discontinuity at 360/0 degrees). Wind and pressure data is sourced from the Iowa Environmental Mesonet (https://mesonet.agron.iastate.edu/).

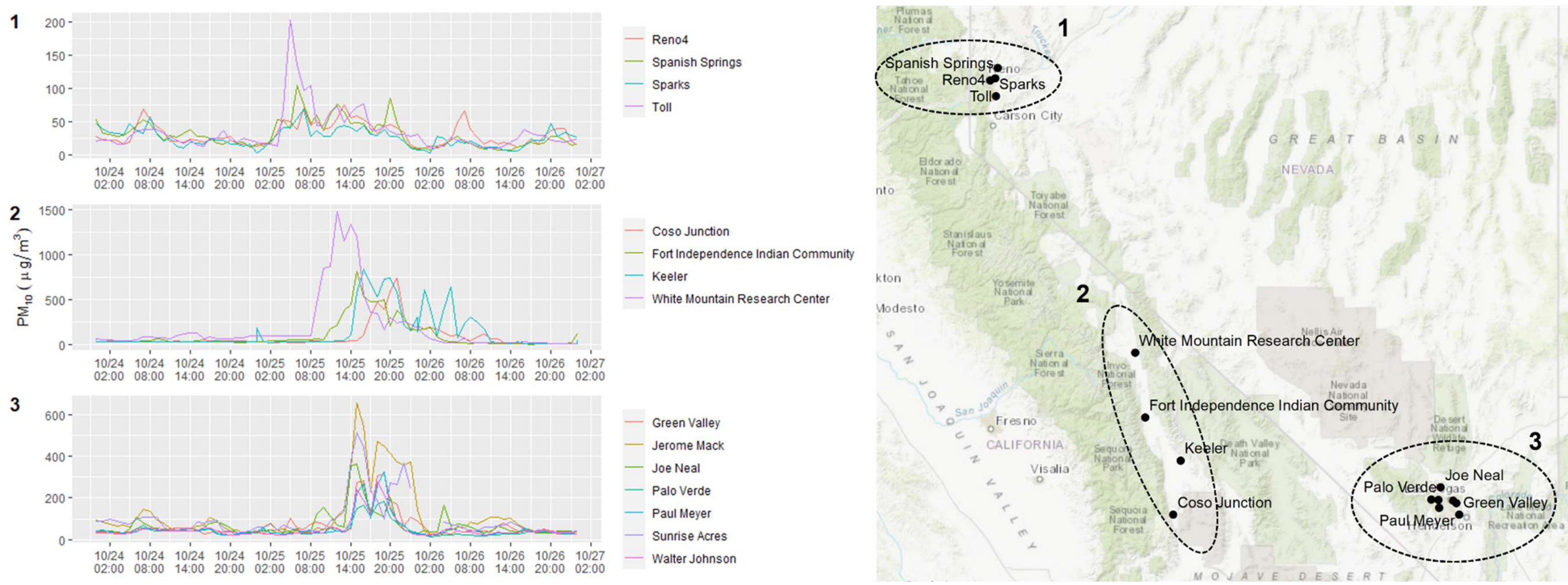


Figure 3.2-8. Timeseries of PM_{10} (left) along the frontal passage. The top left figure (1) includes data from the Reno area, the middle-left figure (2) includes data from Inyo County, CA, and the bottom left figure (3) includes data from the Las Vegas area. The map (right) and site locations circled by region. Numbering in the map corresponds to numbering in the time series figures on the left.

PM_{10} concentrations at all sites in the Las Vegas Valley increased rapidly between 11:00 PST to 15:00 PST on October 25, coinciding with approach of the cold front and rapidly increasing wind speeds north of Las Vegas. **Figure 3.2-9** shows PM_{10} concentrations at Jerome Mack and Sunrise Acres overlaid on wind speeds measured north of the city (BIH and DRA) and within Las Vegas. See Figure 3.2-5 for a map of site locations. PM_{10} concentrations increased to a maximum at 15:00 at Jerome Mack and Sunrise Acres, as wind gusts in the Las Vegas Valley (measured at LAS) approached 40 mph.

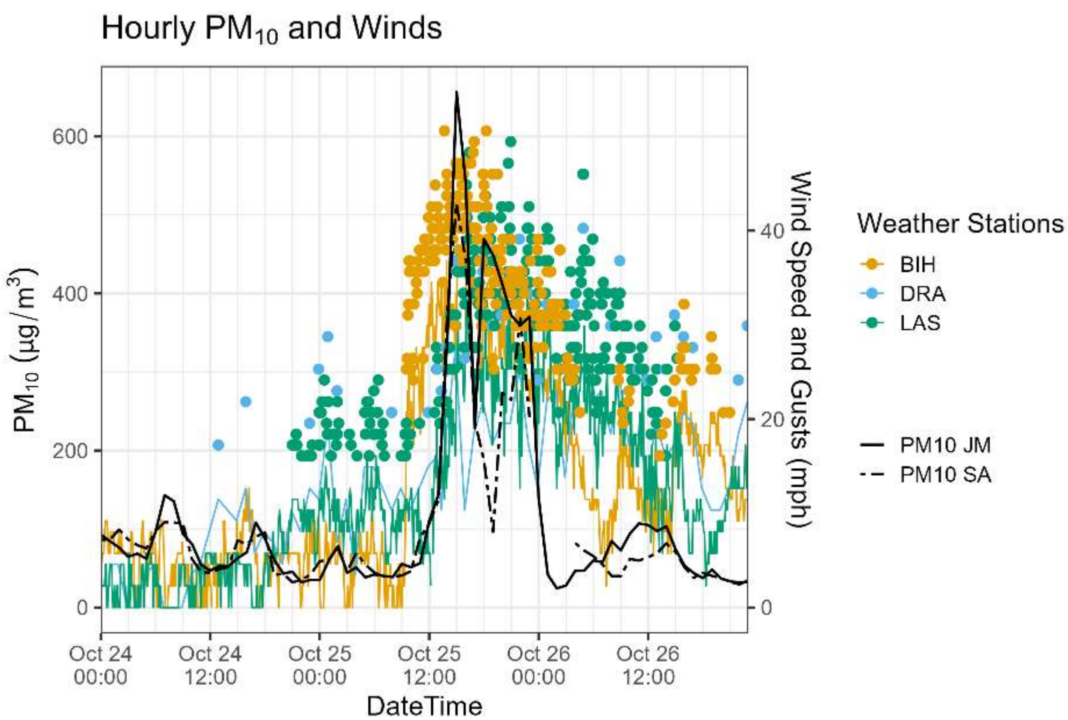


Figure 3.2-9. Hourly PM_{10} in µg/m^3 with wind speeds (lines) and wind gusts (dots) from Bishop Airport (BIH), Desert Rock (DRA), and Harry Redi Int'l Airport (LAS).

Wind speed, wind direction, and concentrations across Clark County, NV, are also consistent with a frontal passage (**Figure 3.2-10 to Figure 3.2-13**). Before the event, winds are light and variable throughout the Las Vegas Valley (11:00 PST). By 12:00 PST, winds shift to the northwest with the approaching frontal passage. PM_{10} starts to increase with the heaviest accumulation at sites in the northwest part of the Valley and lower elevation sites like Jerome Mack and Sunrise Acres. During this event, winds and PM_{10} are funneled into the Valley through the mountain pass between the Spring Mountains (to the west) and Sheep Mounts/Las Vegas Range (to the east) at the northwest end of the Valley. Sites like Joe Neal, Jerome Mack, and Sunrise Acres are directly affected by northwesterly winds and the entrained/transported PM_{10} because this sites are directly downwind of the mountain pass. Jerome Mack and Sunrise Acres tend to accumulate more PM_{10} due to their location at the bottom of the Valley (lowest elevation), as shown by the topographic maps in Figure 3.2-10 to Figure 3.2-13. By 13:00 – 17:00 PST, all sites within the Valley experience multiple hours of high PM_{10} concentrations with consistent winds out of the northwest. Jerome Mack and Sunrise Acres experience the highest concentrations of PM_{10} during this period due to the location of the monitoring sites and elevation. By 18:00 – 19:00 PST, winds start to decline and PM_{10} concentrations decline as well. The consistent wind direction and regional enhancement of PM_{10} is a clear indication of a high-wind dust event with an upwind PM_{10} source.

Enhanced PM_{10} concentrations at the affected sites were likely caused by a high-wind event in the source region rather than local emissions, in part because planned land use around these sites, which can be generally described as developed with little exposed dirt or gravel, is not conducive to enhanced concentrations. Further, the fact that enhanced PM_{10} concentrations were recorded at all sites in the Las Vegas Valley indicates a regional high-wind dust event. While it is possible that some portions of planned land use, there are no significant PM_{10} point sources near the Jerome Mack or Sunrise Acres monitoring sites which could have contributed to local dust during the high-wind event. Evidence of high winds over the natural, undisturbed Mojave Desert region upwind of Clark County is clearly the main driver of this dust event. As shown by the timeline of events, high winds from a front lofted PM_{10} in the Great Basin and northern Mojave Desert source region and caused a regional dust event that extended into Clark County. Even if there were some contributions from local dust sources due to high winds, the regional dust event is the main source of the extreme PM_{10} concentrations experienced on October 25, 2020.

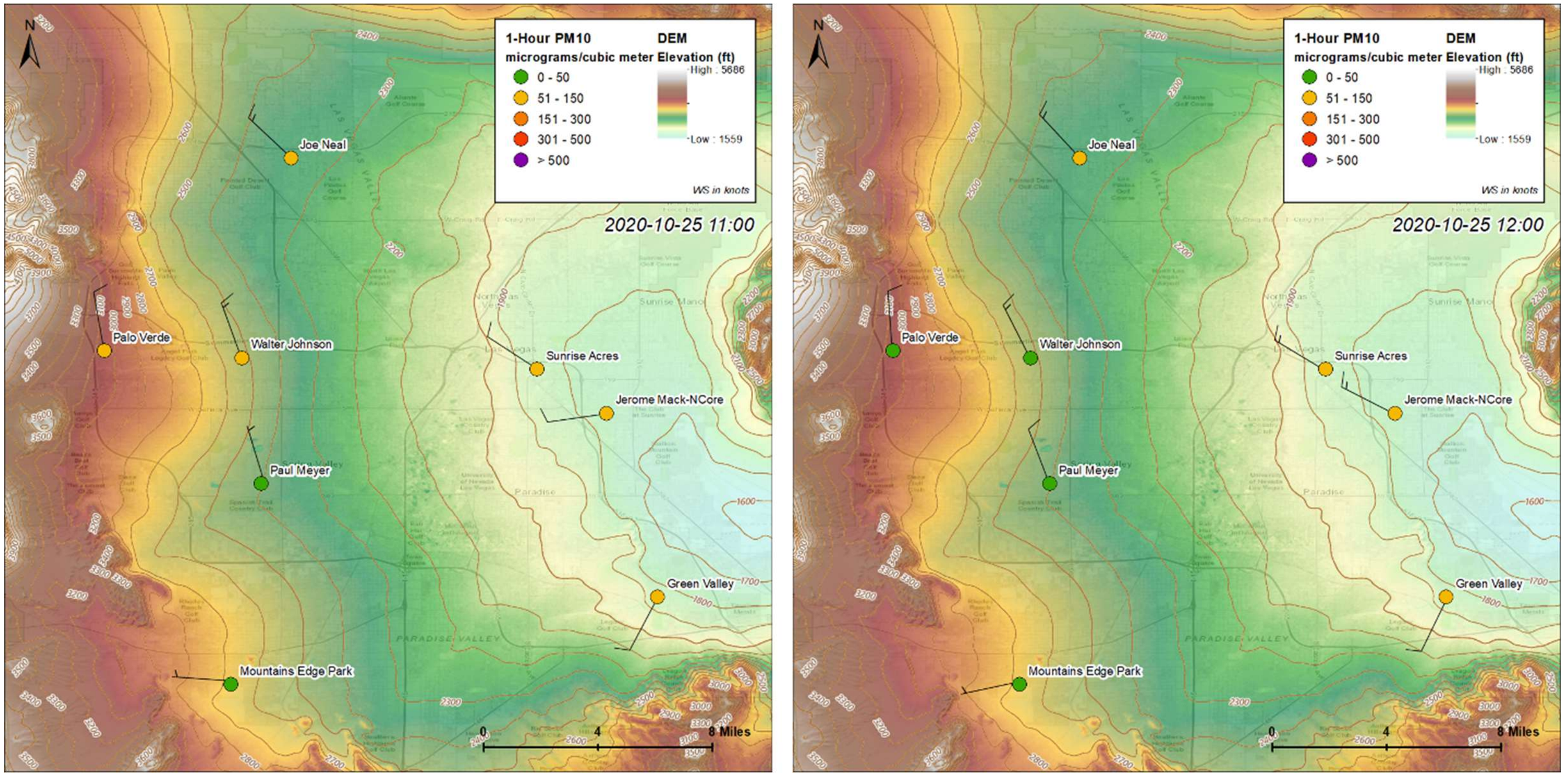


Figure 3.2-10. Topographical map showing surface observations of wind speed, wind direction, and hourly PM_{10} concentrations from each measurement site in Clark County, Nevada, for October 25, 2020, from 11:00 to 12:00 PST.

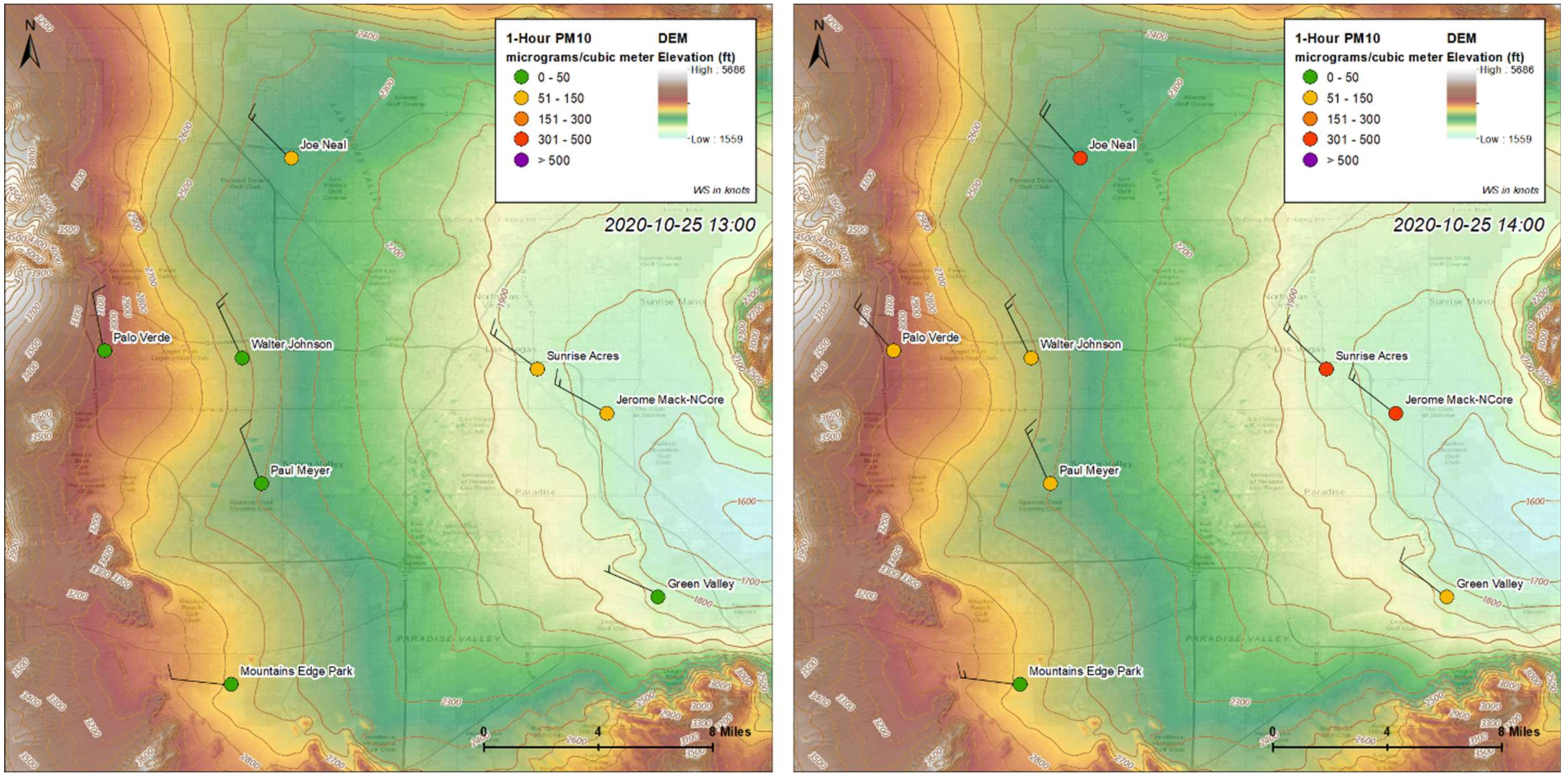


Figure 3.2-11. Topographical map showing surface observations of wind speed, wind direction, and hourly PM_{10} concentrations from each measurement site in Clark County, Nevada, for October 25, 2020, from 13:00 to 14:00 PST.

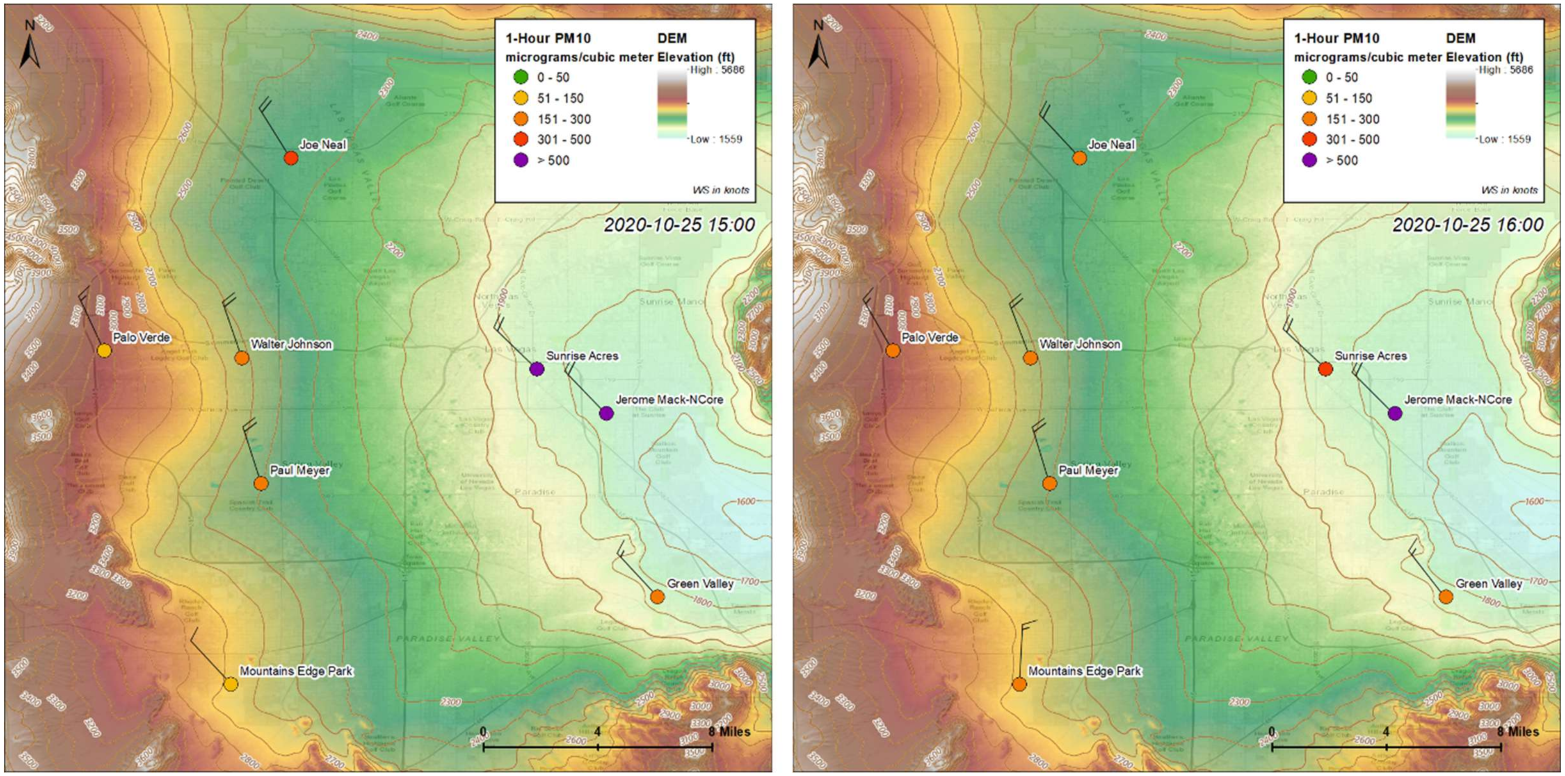


Figure 3.2-12. Topographical map showing surface observations of wind speed, wind direction, and hourly PM_{10} concentrations from each measurement site in Clark County, Nevada, for October 25, 2020, from 15:00 to 16:00 PST.

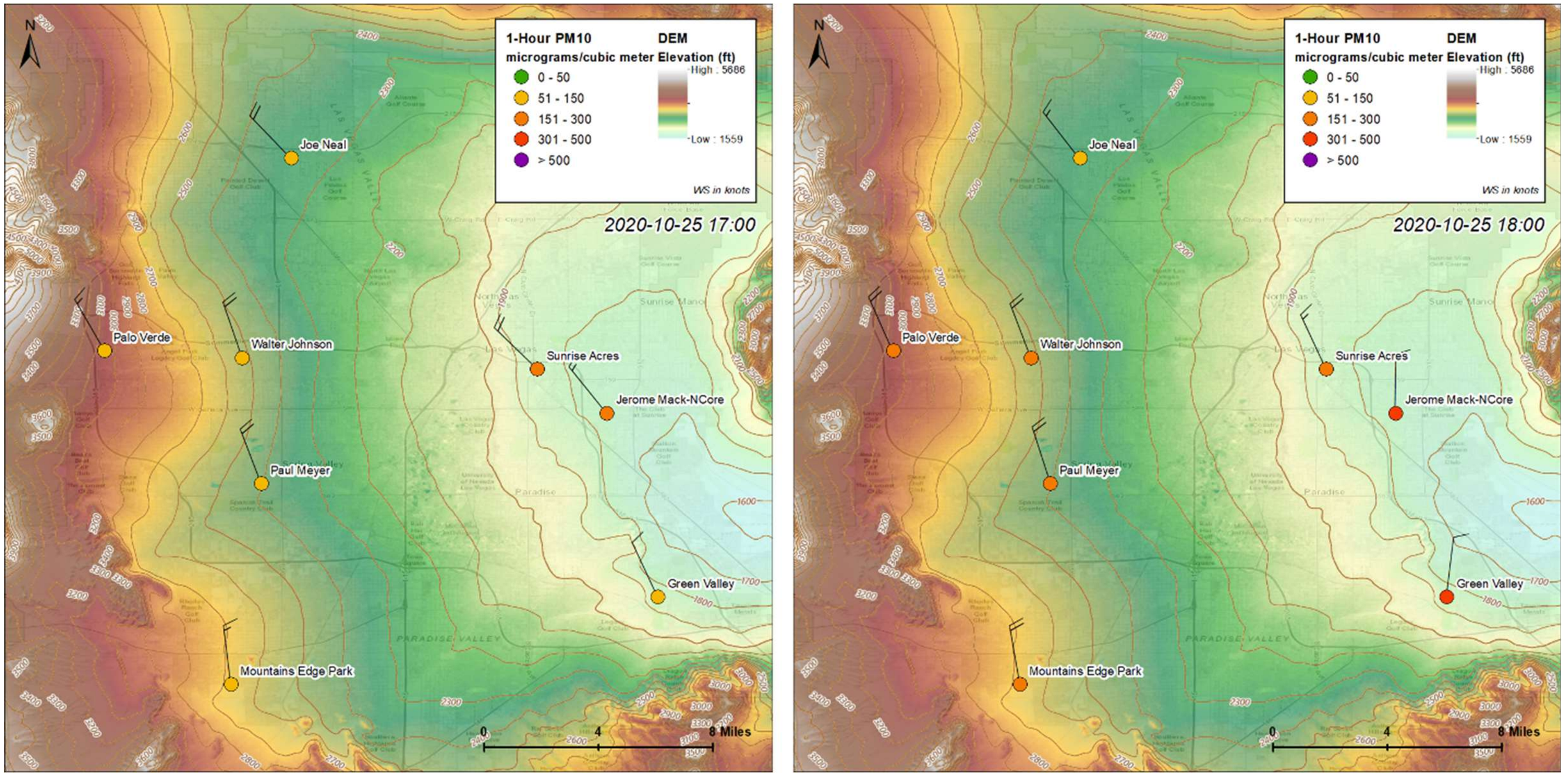


Figure 3.2-13. Topographical map showing surface observations of wind speed, wind direction, and hourly PM_{10} concentrations from each measurement site in Clark County, Nevada, for October 25, 2020, from 17:00 to 18:00 PST.

Peak sustained winds for Clark County and the surrounding regions are shown in **Figure 3.2-14** using the Iowa State University Mesonet Automated Data aggregation tool. This plot shows peak sustained winds greater than the 25-mph high-wind threshold on October 25, 2020, providing further proof that this was a high-wind event.

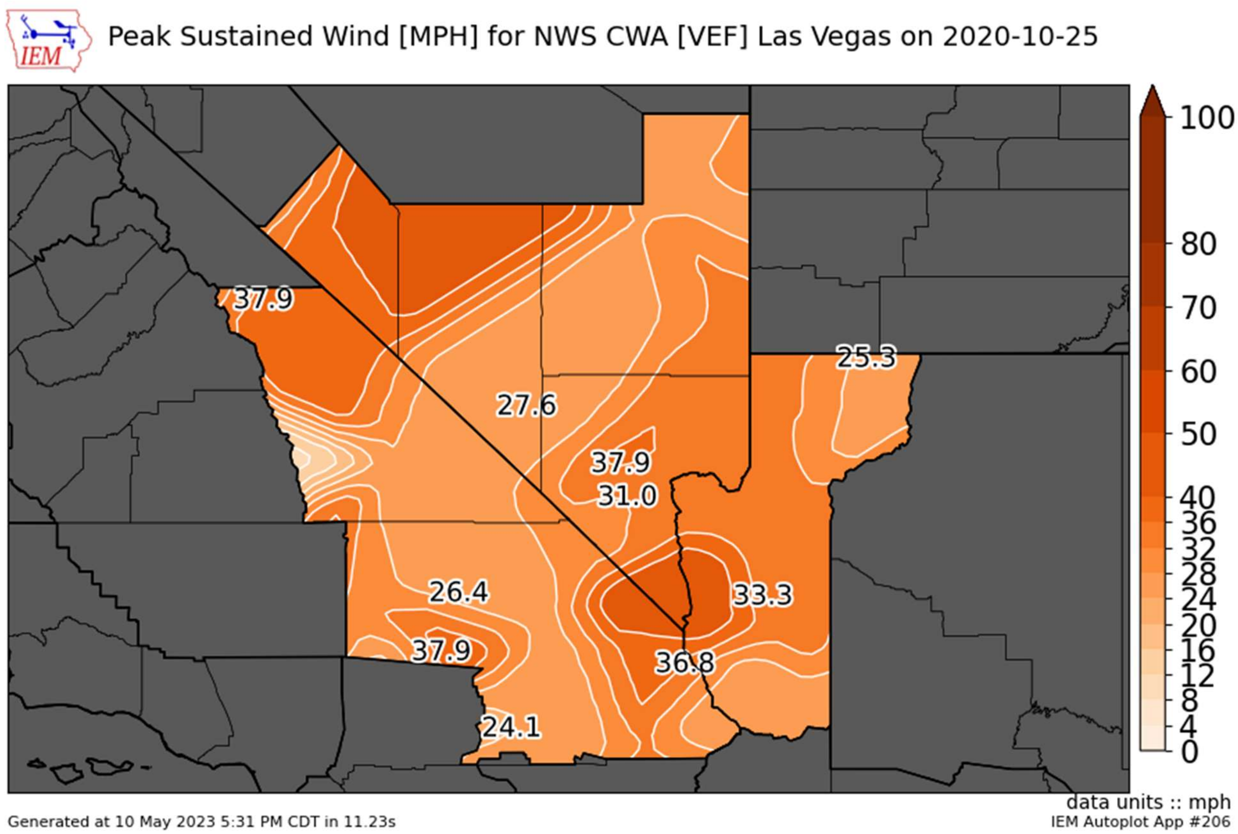


Figure 3.2-14. Peak sustained winds in Clark County and the surrounding counties on October 25, 2020. Data source **https://mesonet.agron.iastate.edu/plotting/auto/**.

Overall, we find overwhelming evidence that PM_{10} was transported from the Great Basin and northern Mojave Desert regions late on October 25 via a strong front. Wind speeds in the source region, along the transport path, and in Clark County show sustained speeds greater than the high-wind threshold of 25 mph. PM_{10} concentrations from monitors along the frontal passage also show the lofted dust from the Great Basin and northern Mojave deserts. The evidence corroborating this assertion includes (1) HYSPLIT analyses showing transport from the Great Basin and northern Mojave Desert regions in less than 24 hours; (2) abrupt changes in SLP, wind speed, and wind direction along the transport path; (3) evidence of PM_{10} from monitoring sites along the transport path; and (4) ground-based observation of PM_{10} and wind speed/direction in Clark County that corroborate the PM_{10} event time of arrival.

3.3 Impacts of Wind-Blown PM_{10} Dust at the Surface

3.3.1 Clark County Alerts

On Friday, October 23, 2020, Clark County issued a Construction Notice to all dust control permit holders, contractors, and stationary sources to immediately inspect their sites and employ BACM to control and stabilize soil in advance of the dust event forecast for Sunday, October 25 through Monday, October 26, 2020. Figure 3.3-1 shows the email sent by Clark County.

Clark County Department of Environment and Sustainability,

Division of Air Quality

CONSTRUCTION NOTICE

For Sunday October 25, 2020 thru Monday October 26, 2020

Attention Dust Control Permit Holders, Contractors, and Stationary Sources

The National Weather Service and the weather models used by the Division of Air Quality (Air Quality) are showing the potential for high winds beginning Sunday evening and lasting throughout Monday afternoon. The forecast is for **sustained winds of 15-20 mph,** with gusts to **30-35 mph.**

Air Quality directs all permittees to inspect their site(s) and employ Best Available Control Measures to stabilize all disturbed soils. Permittees with multiple sites should contact each site superintendent or dust monitor to ensure compliance with the Clark County Air Quality Regulations.

BLASTING: This forecast is for wind gusts of 30-35 mph or more**.** Project operators should not load blasting materials or perform any blasting operations. You are required to monitor National Weather Service for wind speeds, if wind gusts above 25 mph are stated, discontinue charging additional blast holes. Limit the blast to holes charged at the time the wind report is made.

Air Quality will continue to monitor these forecasts for any further wind development. If the weather forecast is upgraded and conditions warrant, you will be notified of a Dust Advisory.

It is important this Construction Notice be sent to all supervisors, foremen, and subcontractors working on your construction projects and at PM_{10} stationary sources.

Please direct questions about this Construction Notice to a DAQ compliance supervisor at (702) 455-5942.

Issued: 10/23/2020

You are receiving this notice because you have asked to be on our mailing list or because your e-mail address is listed as the point of contact on an active Dust Control Permit.

Figure 3.3-1. Email from AQDCP@ClarkCountyNV.gov to all Dust Control Permit holders in advance of the October 25, 2020, dust event.

3.3.2 Media Coverage

The U.S. National Weather Service (NWS) Las Vegas Nevada posted on Facebook about the windy conditions and possible gusts over 40 mph on October 25, 2020 (Figure 3.3-2). (https://www.facebook.com/NWSVegas/posts/the-wind-returns-today-a-strong-cold-front-will-bring-gusty-north-winds-especial/3546060422124799/). Additionally, the NWS Las Vegas office issues Wind Advisories and Urgent Weather Messages concerning dust conditions for the counties listed in Table 3.3-1, including Clark County. Appendix A includes the full NWS advisories issued for the event date.

Figure 3.3-2. Facebook post from U.S. National Weather Service Las Vegas Nevada on October 25, 2020, indicating that a strong cold front would bring gusty north winds.

Table 3.3-1. National Weather Service Las Vegas, NV, warnings issued on October 25, 2020.

Warning	Time (PDT)	Location
Wind advisory	02:03	Southern Clark County, Western Clark and Southern Nye County, Owens Valley, Esmeralda and Central Nye County, Lake Havasu and Fort Mohave-Lake Mead National Recreation Area, Eastern Mojave Desert-Cadiz Basin-San Bernardino County, Upper Colorado River Valley
Urgent Weather Message	12:36	Southern Clark County, Northeast Clark County-Western Clark and Southern Nye County, Owens Valley, Northwest Deserts, Death Valley National Park-Lincoln County-Las Vegas Valley, Northwest Plateau, Western Mojave Desert-Morongo Basin, Lake Mead National Recreation Area, Esmeralda and Central Nye County, Lake Havasu and Fort Mohave-Eastern Mojave Desert-Cadiz Basin, San Bernardino County-Upper Colorado River Valley

3.3.3 Pollutant and Diurnal Analysis

As discussed in Section 3.2, the period of high PM_{10} concentrations in the Las Vegas Valley on October 25, 2020, coincided with high wind speed. Wind speeds measured at the weather stations in and around the Las Vegas Valley rose as the frontal passage moved southward into Clark County on October 25. Figure 3.3-3 shows the wind speeds and gusts measured at three weather stations in and around Las Vegas, together with the hourly PM_{10} concentrations at Jerome Mack and Sunrise Acres from October 23 to 28, 2020. The ASOS meteorological station locations are shown in the lower panel of Figure 3.3-3. The hourly PM_{10} at Jerome Mack exceeded 600 µg/m^3 on October 25, coinciding with enhanced wind speeds above 25 mph and gusts up to 50 mph measured at the weather stations during this five-day period.

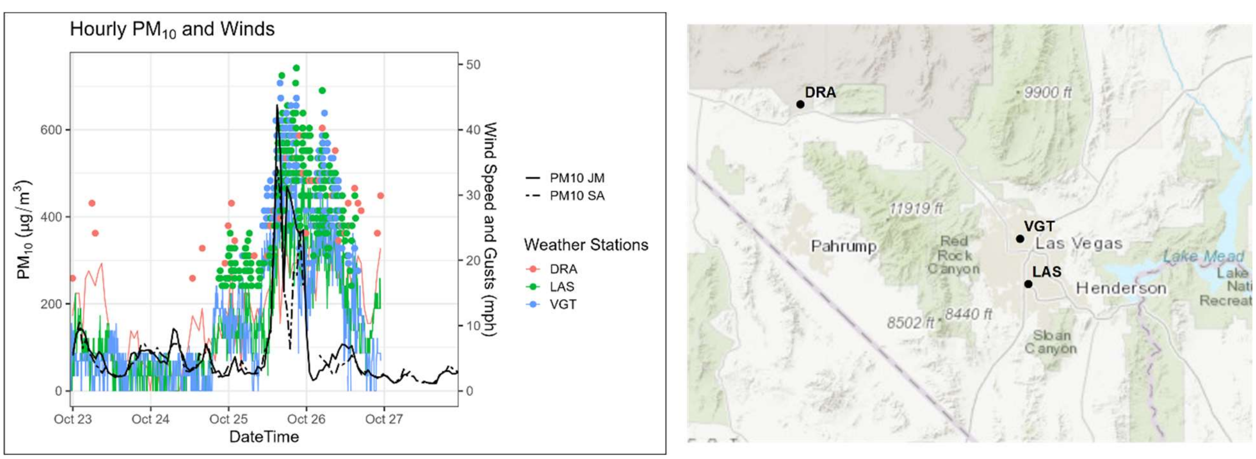


Figure 3.3-3. (Left) Hourly PM_{10} in µg/m^3 with wind speeds (lines) and wind gusts (dots) from DRA, LAS, and VGT weather stations. (Right) The locations of each ASOS meteorological station are shown relative to Las Vegas.

The 24-hour average PM_{10} values at all sites in Clark County before and after the exceedance event on October 25, 2020, remained mostly below the 99th percentile of the five-year (2016-2020) historical values except for one day at both Jerome Mack and Sunrise Acres (**Figure 3.3-4**). On October 24, 2020, the 24-hour average PM_{10} values at Jerome Mack and Sunrise Acres are just below the 99th percentile five-year historical data value (2016-2020) of 74 $\mu g/m^3$. Other sites in the Las Vegas Valley were well below this value. On October 25, 2020, when the exceedance event occurred, the 24-hour average PM_{10} values at 8 out of the 10 sites exceeded the 99th percentile value, while the remaining two sites (Mountains Edge and Palo Verde) were just below this value. PM_{10} concentrations at Jerome Mack and Sunrise Acres exceeded the NAAQS value of 150 $\mu g/m^3$, with Jerome Mack having the highest concentration (210 $\mu g/m^3$) and Sunrise Acres having the second highest (163 $\mu g/m^3$). The simultaneous increase in PM_{10} concentrations at all sites, with many exceeding the 99th percentile threshold, suggests a regional source of PM_{10}, such as a wind-blown dust event.

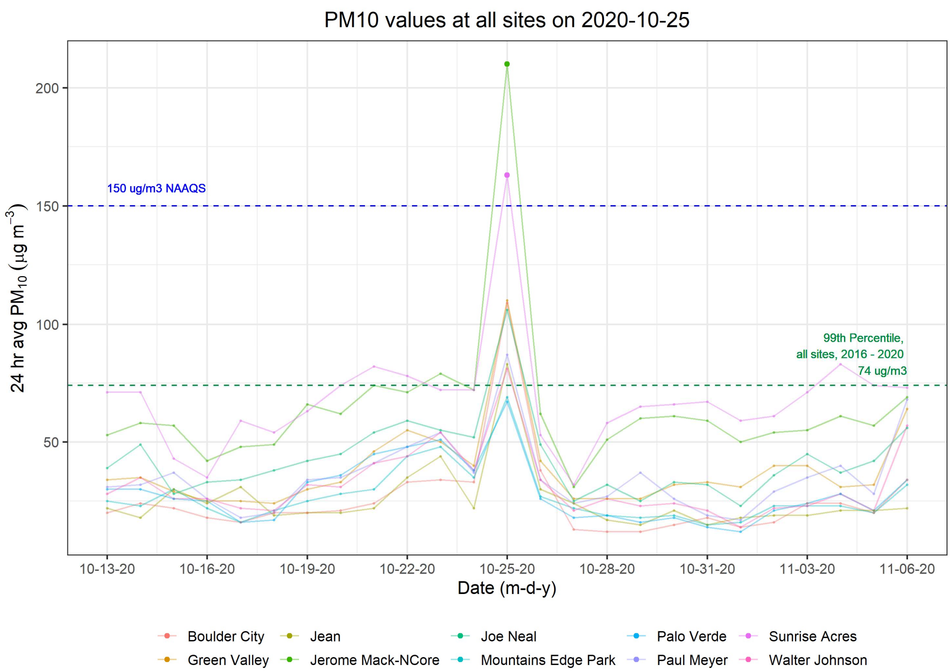


Figure 3.3-4. PM_{10} values at all Clark County, NV, measurement sites from 2016-2020 with NAAQS (blue dash) indicated. The green dashed line indicates the five-year historical 99th percentile value of 74 $\mu g/m^3$ at these sites.

Figure 3.3-5 shows the measured hourly PM_{10} concentrations on October 25, 2020, together with the 5th - 95th percentiles of the five-year historical hourly data from 2016-2020 for the Jerome Mack and Sunrise Acres sites. Starting around 11:00 PST on October 25, 2020, the hourly PM_{10} surpassed the five-year 95th percentile. At both sites, the event reached a maximum at 15:00 PST, recording 656.9 $\mu g/m^3$ at Jerome Mack and 514.5 $\mu g/m^3$ at Sunrise Acres. The concentrations remained above the 95th percentile until early morning (01:00-05:00 PST) the following day.

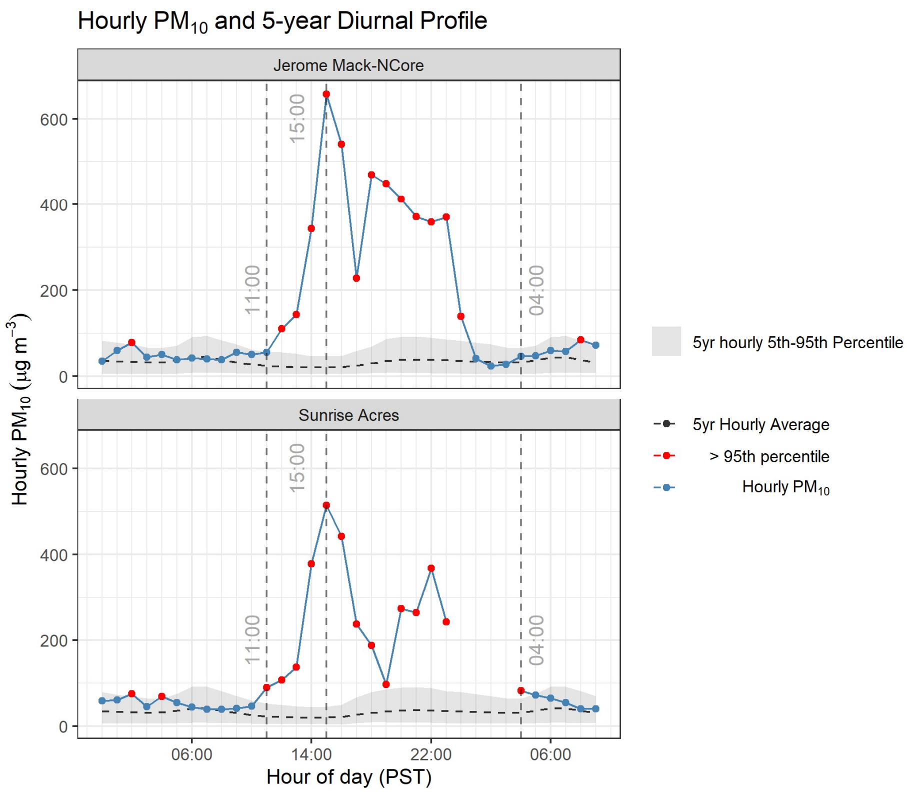


Figure 3.3-5. Hourly PM_{10} concentrations compared to the hourly average (dashed line) and 5th - 95th percentile (shaded area) in 1-hour PM_{10} value at Jerome Mack and Sunrise Acres from 2016-2020.

3.3.4 Particulate Matter Analysis

Before the high-wind dust event on October 25, 2020, the hourly $PM_{2.5}/PM_{10}$ ratio was approximately average at all sites based on 2016-2020 ratio data (Figure 3.3-6). At noon on October 25, the hourly $PM_{2.5}/PM_{10}$ ratio at all sites dropped below the 5th percentile and stayed below that value for the rest of the day. The low value (less than 0.1) is consistent with values from dust events reported in studies (Jiang et al., 2018). The decrease in the $PM_{2.5}/PM_{10}$ ratio observed during midday was also consistent with the increase in hourly PM_{10} concentrations as described in Section 3.2.2. $PM_{2.5}/PM_{10}$ ratios rose early in the morning on October 26, then continued to rise to normal levels throughout the day following the high-wind dust event.

Figure 3.3-6. Ratio of $PM_{2.5}/PM_{10}$ concentrations at the Green Valley, Jean, Jerome Mack, Paul Meyer, and Sunrise Acres sites before, during, and after the October 25, 2020, PM_{10} exceedance. The five-year average $PM_{2.5}/PM_{10}$ diurnal ratio is displayed as a dotted line, and the 5th - 95th percentile range is shown as a shaded ribbon. The 5th - 95th percentile ratio is calculated from September to November 2016-2020.

No chemical speciation data are available on October 25, 2020, since speciated $PM_{2.5}$ measurements are collected on a three-day cadence in Clark County. Measurements were not taken on the event date, and the observations from surrounding days, October 24 and 27, do not reflect conditions on October 25.

3.3.5 Visibility/Ground-Based Images

Visibility data are available from airport monitoring sites through the NWS Weather and Hazards Data Viewer. Figure 3.3-7 shows visibility observations on October 25, 2020, at each of the four airports in Las Vegas. Concurrent with the increasing wind speeds and the estimated time of frontal passage, visibility at all four monitoring sites decreased between 14:00 and 16:00 PST with KHND and

KLSV showing more drastic reductions in visibility later in the evening. This is confirmed by camera images in the Las Vegas Valley (**Figure 3.3-8 through Figure 3.3-13**), which show the intensification of dusty conditions and low visibility between 12:00 and 16:00 PST, especially in the northwest direction. Images end at 17:00 PST due to the limitations of photography after sunset. While the visibility metric does not show dramatic reductions during this event, the camera images provide the critical proof, showing increasingly dusty conditions, especially in the northwest image (i.e., the direction of the dust storm).

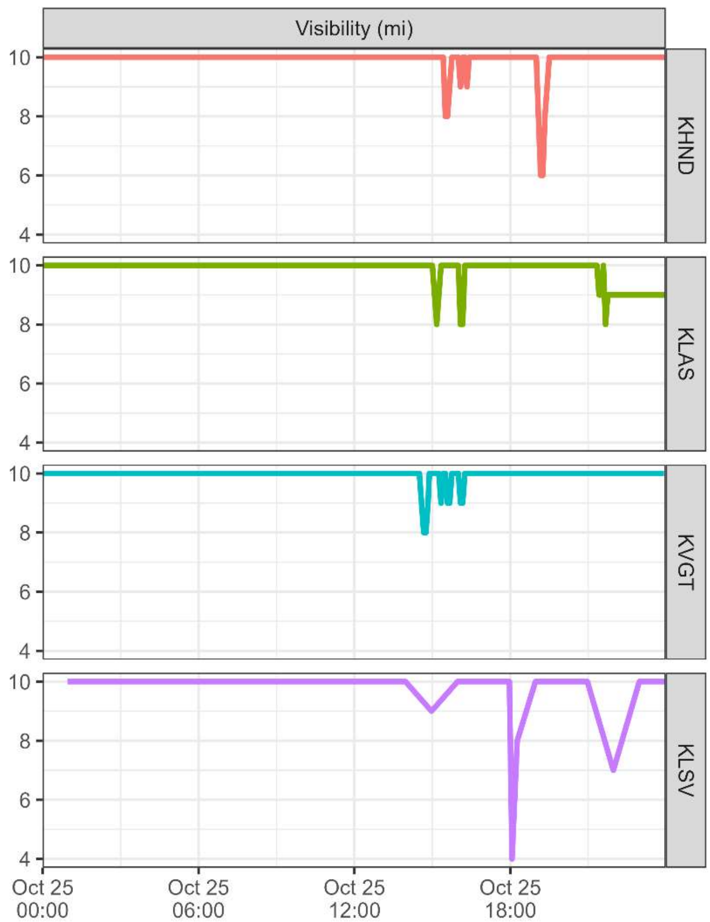


Figure 3.3-7. Visibility in miles on October 25, 2020, recorded at Henderson Airport (KHND), Harry Reid Int'l Airport (KLAS), North Las Vegas Airport (KVGT) and Nellis Airforce Base (KLSV). Visibility data is sourced from the National Weather Service Weather & Hazards Data Viewer (**https://www.wrh.noaa.gov/map/**).

Figure 3.3-8. Camera images for north (top left), south (bottom left), northeast (top right), and northwest (bottom right) coordinal directions from Clark County, Nevada, on October 25, 2020, at 12:00 PST.

Figure 3.3-9. Camera images for north (top left), south (bottom left), northeast (top right), and northwest (bottom right) coordinal directions from Clark County, Nevada, on October 25, 2020, at 13:00 PST.

Figure 3.3-10. Camera images for north (top left), south (bottom left), northeast (top right), and northwest (bottom right) coordinal directions from Clark County, Nevada, on October 25, 2020, at 14:00 PST.

Figure 3.3-11. Camera images for north (top left), south (bottom left), northeast (top right), and northwest (bottom right) coordinal directions from Clark County, Nevada, on October 25, 2020, at 15:00 PST.

Figure 3.3-12. Camera images for north (top left), south (bottom left), northeast (top right), and northwest (bottom right) coordinal directions from Clark County, Nevada, on October 25, 2020, at 16:00 PST.

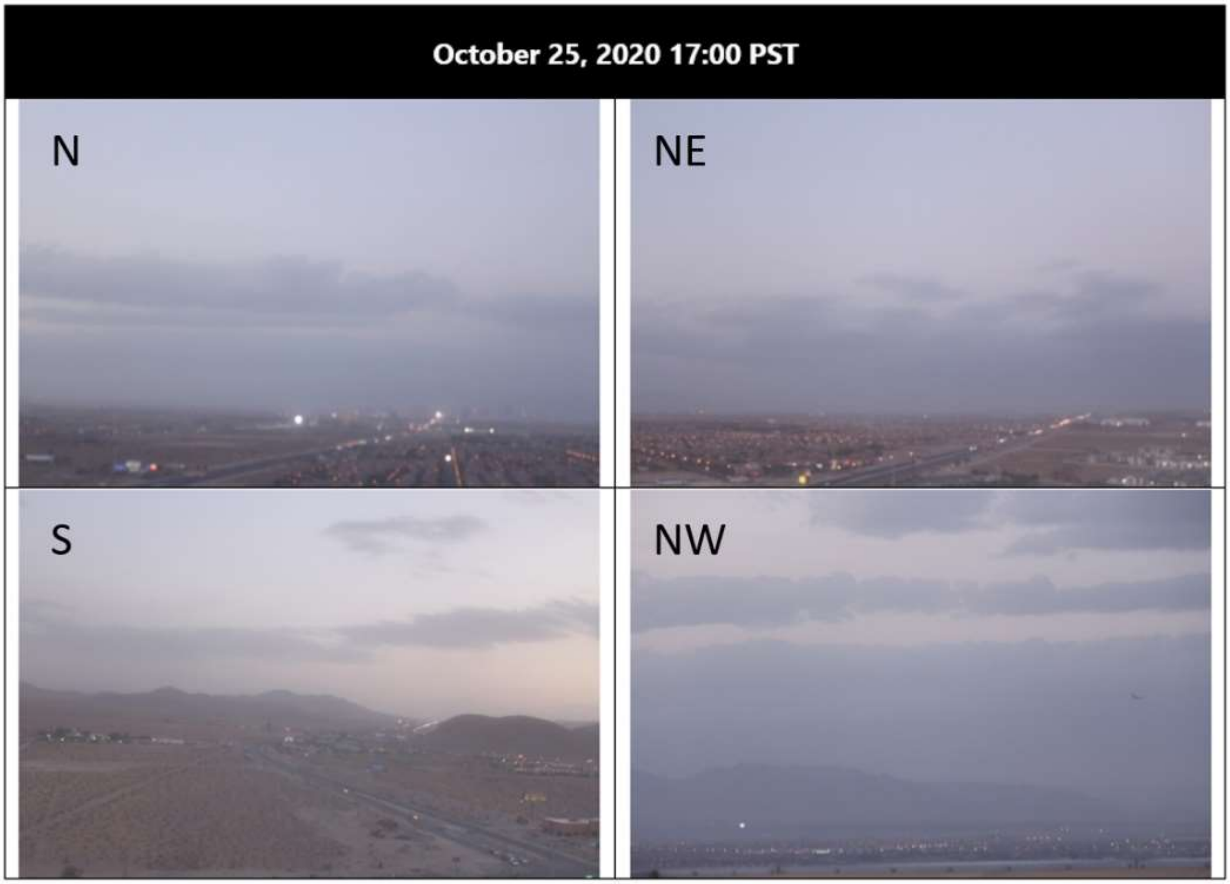


Figure 3.3-13. Camera images for north (top left), south (bottom left), northeast (top right), and northwest (bottom right) coordinal directions from Clark County, Nevada, on October 25, 2020, at 17:00 PST.

Overall, we find overwhelming evidence that PM_{10} was transported from the Great Basin and northern Mojave Desert regions to Clark County by midday on October 25, 2020. PM_{10} concentrations increased at the same time as wind speeds in Clark County starting on October 25, 2020 at 11:00 PST and peaked at 15:00 PST. This suggests that Clark County was impacted by a high-wind dust event originating in the Great Basin and northern Mojave Desert regions. The evidence corroborating this assertion includes (1) forecast alerts and media coverage in Clark County and surrounding areas; (2) abrupt increases in wind speed corresponding with abrupt increases in PM_{10} concentrations in Clark County; (3) a drop in $PM_{2.5}/PM_{10}$ values indicating windblown dust sources; and (4) decreased visibility and camera images of Clark County that show dust corresponding with the PM_{10} event time of arrival on October 25, 2020.

3.4 Comparison of Exceptional Event with Historical Data

3.4.1 Percentile Ranking

An annual time series of 24-hour average PM_{10} concentrations is provided in **Figure 3.4-1 and Figure 3.4-2,** showing the second highest annual concentration occurred on October 25 for both Jerome Mack and Sunrise Acres.

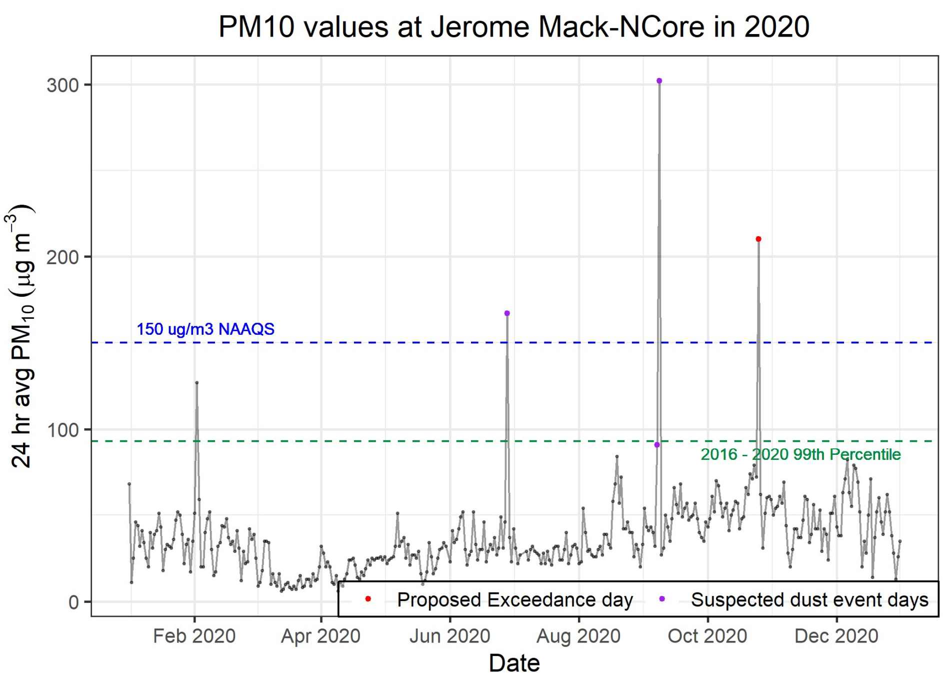


Figure 3.4-1. Jerome Mack 24-hour PM_{10} measurement in µg/m^3 for 2020 with (green dash) 2016-2020 99th percentile, (blue dash) NAAQS, (purple points) suspected dust event days, and (red point) the proposed exceedance day indicated.

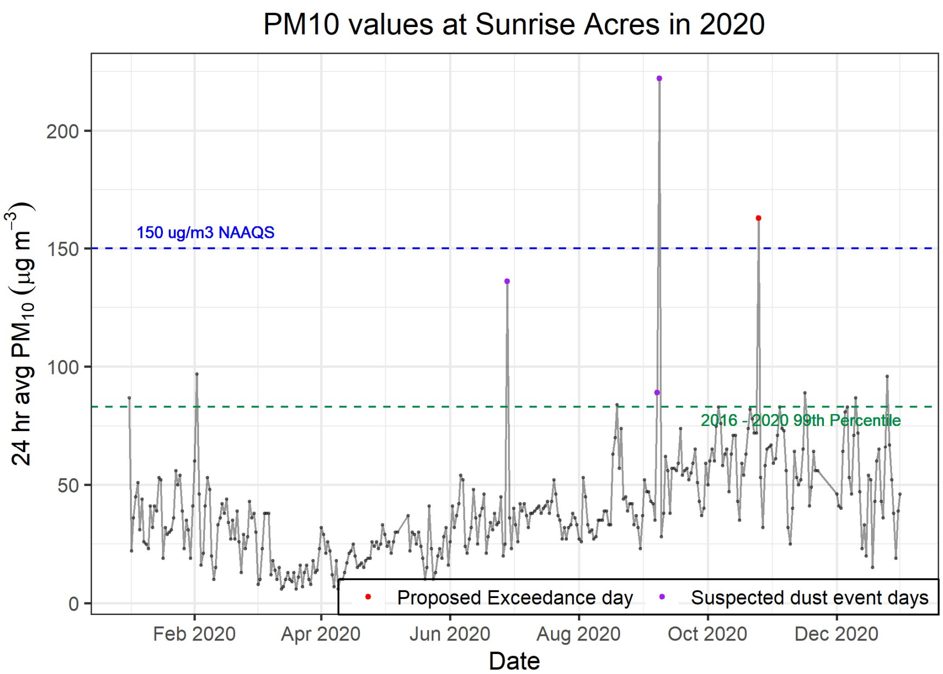


Figure 3.4-2. Sunrise Acres 24-hour PM_{10} measurement in µg/m^3 for 2020 with (green dash) 2016-2020 99th percentile, (blue dash) NAAQS, (purple points) suspected dust event days, and (red point) the proposed exceedance day indicated.

A five-year annual time series is provided in Figure 3.4-3 and Figure 3.4-4, indicating the range of normal values with October 25, 2020, marked by an orange point for comparison. For both sites, observations on October 25, 2020, were well above the 99th percentile for the preceding five years (dashed green line) and had the third highest overall PM_{10} concentration from 2016-2022.

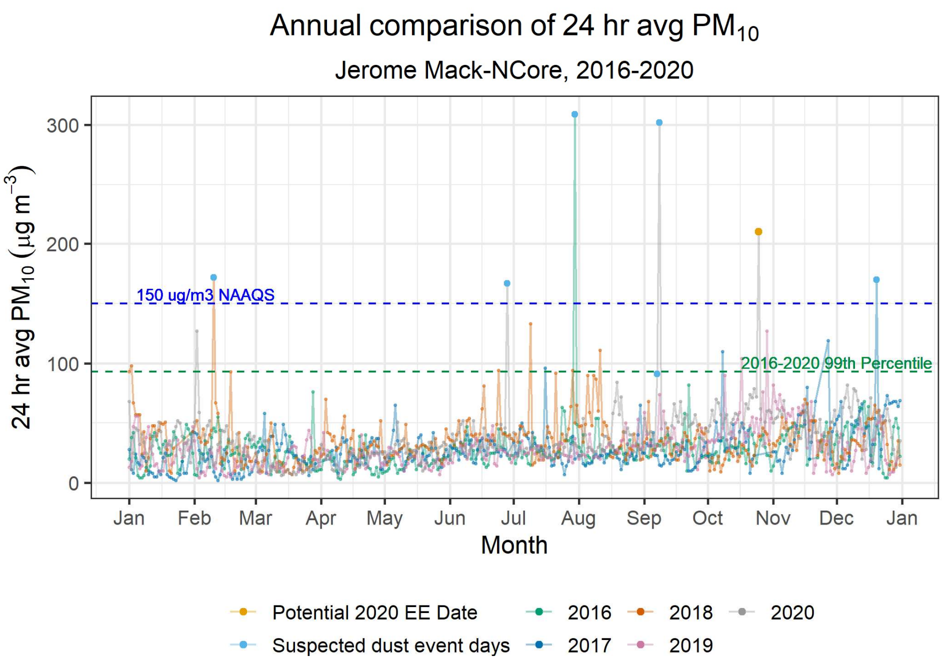


Figure 3.4-3. Jerome Mack 24-hour PM_{10} measurements in μg m^{-3} from 2016-2020 by year with 99th percentile (green dash) and NAAQS (grey dash) indicated.

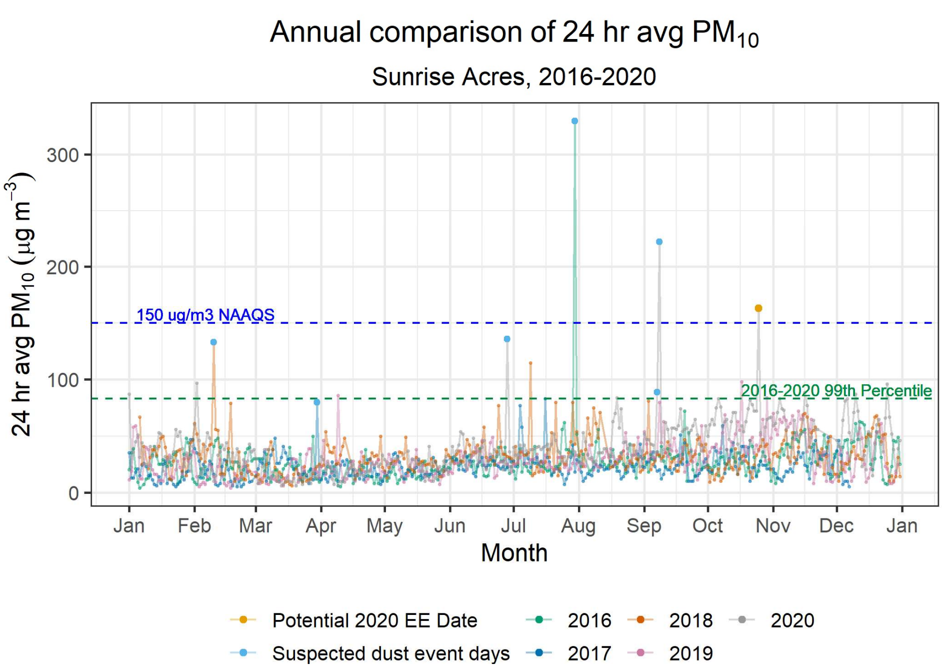


Figure 3.4-4. Sunrise Acres 24-hour PM_{10} measurements in μg m^{-3} from 2016-2020 by year with 99th percentile (green dash) and NAAQS (grey dash) indicated.

The 24-hour average PM_{10} concentration observed on October 25, 2020, ranked as the 99.89 percentile of all concentrations from the 2016-2020 five-year period at both the Jerome Mack and Sunrise Acres sites (Table 3.4-1). Only two days during this five-year period recorded higher values: July 30, 2016, and September 8, 2020. The highest value at each site was recorded on July 30, 2016, which has preliminary evidence of also being a high-wind dust event: a dust layer likely moved over the Las Vegas Valley based on evidence in satellite imagery and visibility cameras. A full report of the exceptional event demonstration has been prepared for this date. In short, strong winds from a strong frontal passage through an area of severe drought conditions in the Great Basin Desert in northern Nevada lofted, entrained, and transported wind-blown dust into Clark County from natural, undisturbed lands. Supporting information for the suspected dust event days is available in Appendix B.

Table 3.4-1. Five-year top ten percentile of PM_{10} values at affected sites.

Rank	Date	Arithmetic mean (µg/m^3	Data Percentile	Notes
Jerome Mack				
1	7/30/2016	309	100	Suspected dust event, a mesoscale convective complex
2	9/8/2020	302	99.94	Suspected dust event, exceptional event demonstration prepared
3	10/25/2020	210	99.89	Current demonstration
4	2/10/2018	172	99.83	Suspected dust event, cameras show dust
5	12/20/2017	170	99.77	Suspected dust event, high winds
Sunrise Acres				
1	7/30/2016	330	100	Suspected dust event, a mesoscale convective complex
2	9/8/2020	222	99.94	Suspected dust event, exceptional event demonstration prepared
3	10/25/2020	163	99.89	Current demonstration
4	6/28/2020	136	99.83	Suspected dust event, cameras show dust
5	2/10/2018	133	99.77	Suspected dust event, cameras show dust

3.4.2 Event Comparison with Diurnal/Seasonal Patterns

It is clear from the comparison of hourly PM_{10} concentrations on October 25, 2020, to their counterparts from the past five years that unusual factors were contributing to the exceedance event on that day. Figure 3.4-5 and Figure 3.4-6 show the hourly PM_{10} concentrations compared to the five-year (2016-2020) hourly average and 5th - 95th percentile at Jerome Mack and Sunrise Acres. At

Jerome Mack, the hourly PM_{10} concentration doubled between 11:00 and 12:00 PST, rising from 56.4 µg/m^3 to 110.3 µg/m^3 and exceeding the five-year hourly 95th percentile of 55.8 µg/m^3. The event reached a maximum of 656.9 µg/m^3 at Jerome Mack at 15:00 PST, a 13-fold increase above the five-year 95th percentile. Concentrations remained elevated throughout the day, with a noticeable dip to 228.3 µg/m^3 at 17:00, until observations quickly decreased at 23:00 from 370.2 µg/m^3 to 41.9 µg/m^3 at 01:00 PST on October 26, returning to a value that was within the five-year 5th - 95th hourly percentile range.

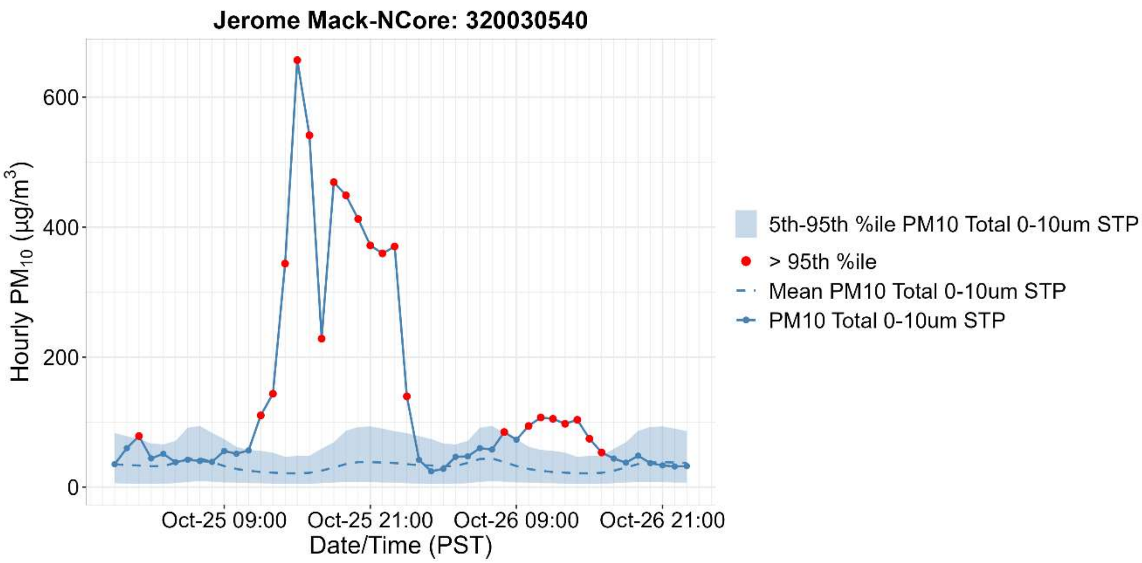


Figure 3.4-5. Measured hourly PM_{10} values at the site for each hour of the day. The solid blue line represents the hourly PM_{10} values measured on October 25, 2020. The upper boundary of the blue area indicates the 95th percentile hourly PM_{10} from 2016-2020 at the site, while the lower boundary indicates the 5th percentile. The dashed line represents the mean hourly PM_{10} for each hour of the day from 2016-2020.

Similar trends were observed at Sunrise Acres, with the event beginning to exceed the five-year 95th hourly percentile at 11:00 PST and peaking at 15:00 PST (Figure 3.4-6). The hourly PM_{10} concentration at 11:00 PST was 89.2 µg/m^3 (95th percentile value 52.2 µg/m^3), and the maximum hourly PM_{10} observed at Sunrise Acres was 514.5 µg/m^3 at 15:00 PST, 10 times the five-year 95th percentile of 49.1 µg/m^3. At this site, a dip is observed at 19:00 PST to 96.5 µg/m^3, and hourly data is not available on October 26 from 00:00 to 03:00 PST. Concentrations were otherwise observed to be enhanced throughout October 25, returning to be within the five-year 5th - 95th hourly percentile range on October 26 at 05:00 PST.

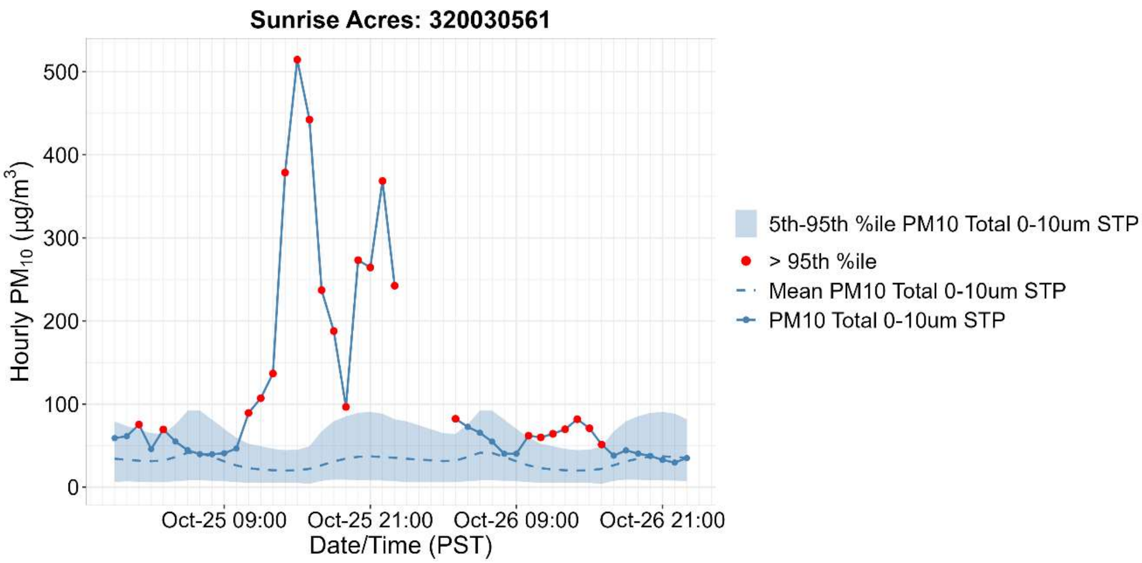


Figure 3.4-6. Measured hourly PM_{10} values at the site for each hour of the day. The solid blue line represents the hourly PM_{10} values measured on October 25, 2020. The upper boundary of the blue area indicates the 95th percentile hourly PM_{10} from 2016-2020 at the site while the lower boundary indicates the 5th percentile. The dashed line represents the mean hourly PM_{10} for each hour of the day from 2016-2020.

The 24-hour average PM_{10} concentrations were compared to five-year (2016-2020) monthly and seasonal averages in boxplots shown in Figure 3.4-7 and Figure 3.4-8. The edges of the boxes correspond to the interquartile range, with the lower representing the 25th percentile, the upper representing the 75th percentile, and the middle bar indicating the median value. The whiskers extend to the smallest and largest value within 1.5 times the interquartile range. Points beyond this range are considered outliers. The concentrations recorded on October 25, 2020, are shown to be the highest recorded outlier for October and within the top five highest values for autumn during the entire five-year period.

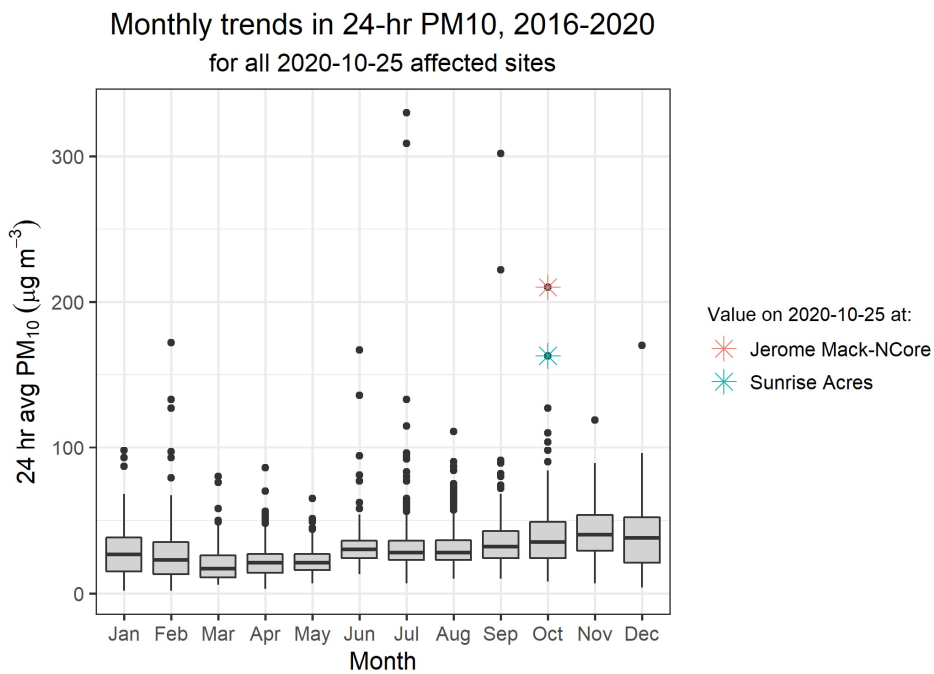


Figure 3.4-7. Monthly trends in 24-hour PM_{10} concentrations for 2016-2020, including outliers, with the potential exceedance event day highlighted.

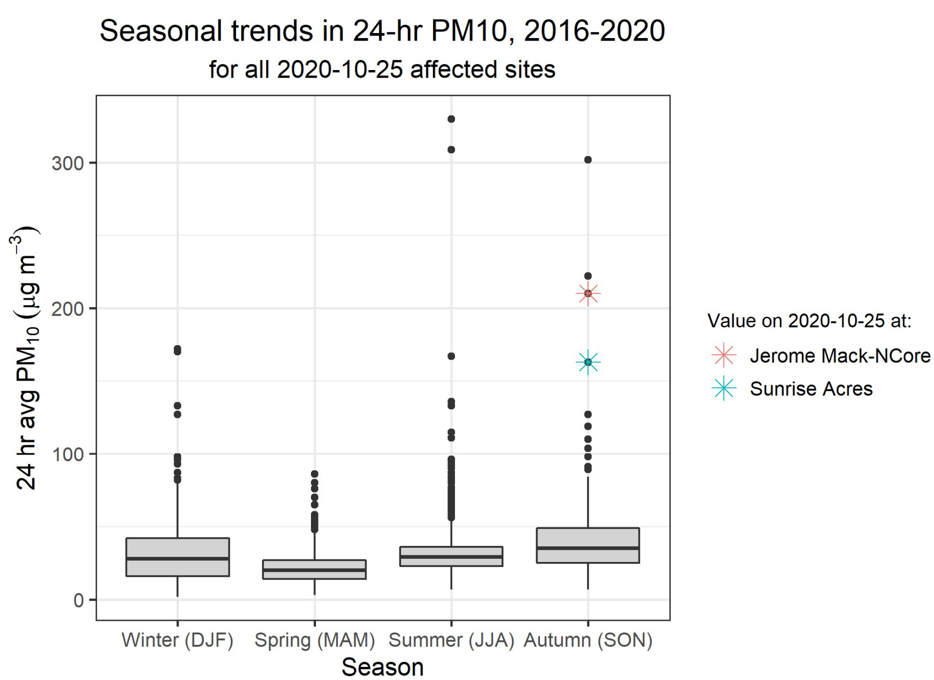


Figure 3.4-8. Seasonal trends in 24-hour PM_{10} concentrations for 2016-2020, including outliers, with the potential exceedance event day highlighted.

3.4.3 Event Comparison with Climatology

Thirty-year seasonal climatology was created using European Environment Agency (ERA5) reanalysis at 0.25° x 25° horizontal resolution from 1993 through 2022 for both the source region and Clark County. Temperature, volumetric soil moisture, and maximum winds speed were chosen and modeled as the most likely variables to influence a windblown dust event in both the source region and Clark County. This analysis shows the seasonal September-October-November thirty-year average for each variable in the top panel and the event date departure from the seasonal climatology in the bottom panel. Figure 3.4-9 shows the climatology compared with the event date for the source region. On the event date the source region was experiencing ground level temperatures 2-5 °F above the long-term average, significantly lower-than-normal soil moisture, and max ground level wind speeds significantly above average along the HYSPLIT transport path shown in Section 3.2.1. Figure 3.4-10 shows the climatology compared with the event date for Clark County. On the event date Clark County was experiencing ground level temperatures above the long-term average, lower-than-normal soil moisture, and max ground level wind speeds slightly above the climatological average. This climatological evidence provides proof that the conditions on the event date were abnormal in both the source region and Clark County, leading to a windblown dust event.

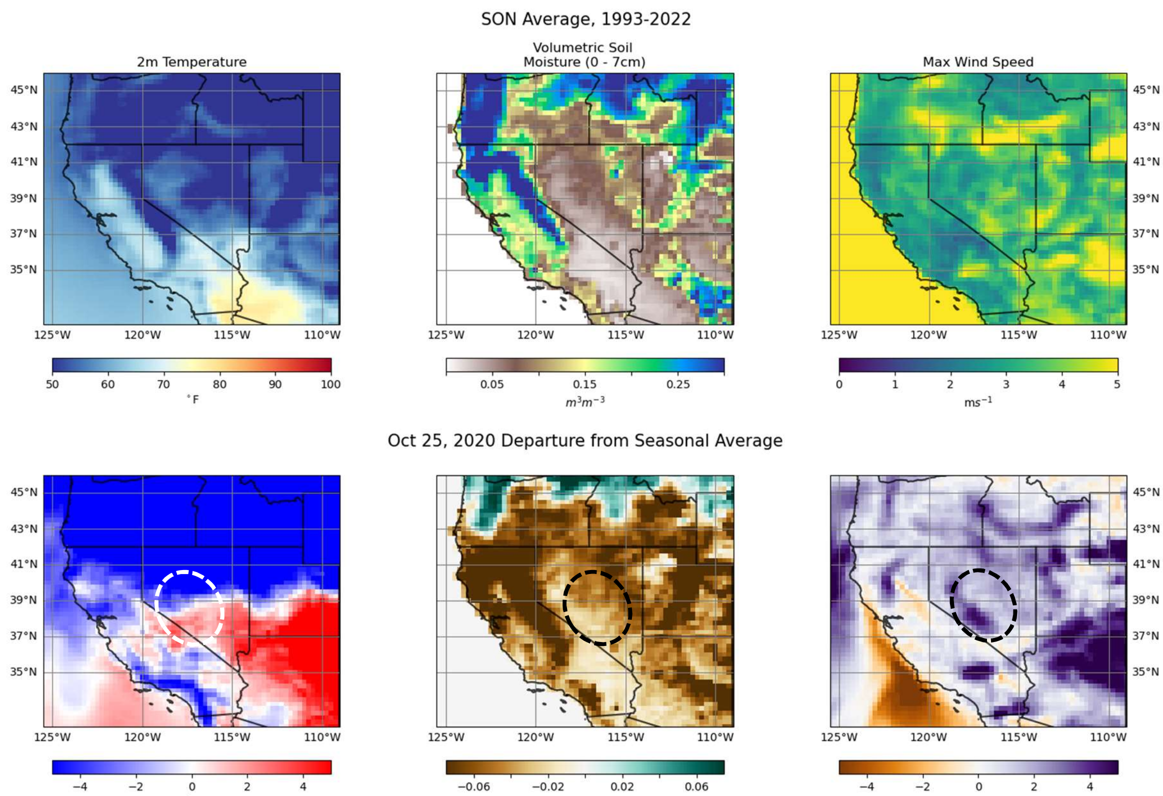


Figure 3.4-9. The thirty-year September-November seasonal climatological average based on ERA5 reanalysis for 2-m temperature, volumetric soil moisture of the first 7 centimeters, maximum 10-m wind speed (top row), and the daily departure for October 25, 2020, from the 30-year average (bottom row). The source region is circled.

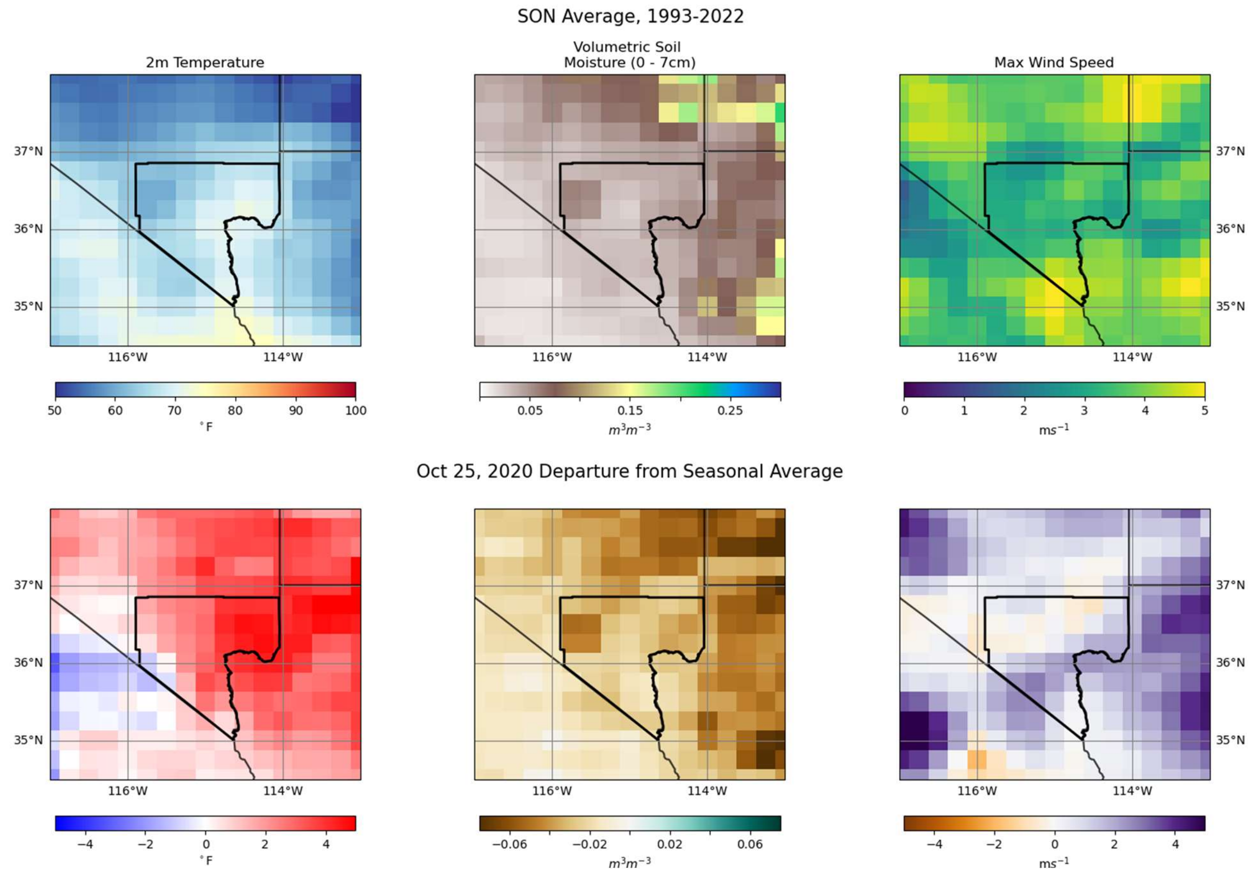


Figure 3.4-10. The thirty-year September-November seasonal climatological average for Clark County based on ERA5 reanalysis for 2-meter temperature, volumetric soil moisture of the first 7 centimeters, and maximum 10-meter wind speed (top row) and the daily departure for October 25, 2020 from the 30-year average (bottom row). Clark County is outlined in black.

Overall, we find overwhelming evidence that the October 25, 2020, high-wind dust event in Clark County was well outside normal conditions. This suggests that Clark County was impacted by a high-wind dust exceptional event. The evidence corroborating this assertion includes (1) the event rank was at the 99.9th percentile; (2) the abrupt increase in PM_{10} was well outside the typical diurnal profile; (3) the PM_{10} 24-hour average event concentration was well outside the typical monthly or seasonal norms; and (4) thirty-year climatology shows higher temperatures, lower soil moisture and higher winds on the event date in the source region and Clark County than climatological averages.

3.5 Meteorological Similar Analysis

Enhanced surface-level wind speeds and frequent wind gusts on October 25, 2020, created prime conditions to maintain the suspension of fine dust particles in the air in the midst of regional drought. The sustained wind speed was above 20 mph for most of the nine-hour period between 15:00 PST on October 25 and 00:00 PST on October 26, 2020, and many wind gusts greater than 40 mph were recorded. The maximum gust for the day reached 49 mph. The strongest winds came from the southwest direction. The timing of highest wind speeds and wind gusts aligns with the timing of enhanced PM_{10} concentrations. Visibility at LAS dropped to 8 miles at LAS on the afternoon of October 25, 2020, during peak wind gusts.

The following sections compare surface-level wind and visibility on October 25, 2020, to dates that show (1) comparable wind profiles without PM_{10} concentrations above the NAAQS and (2) PM_{10} concentrations above the NAAQS without notable wind speeds. All PM_{10} concentrations in the subsequent two sections reference observations recorded at Jerome Mack, and all wind speed, wind direction, and visibility values were measured at LAS and downloaded from the Iowa Environmental Mesonet (IEM) data portal (http://mesonet.agron.iastate.edu/).

3.5.1 Wind-Event Days without High Concentration

The comparison of the event date to specific non-event high-wind days without enhanced PM concentrations shows key differences between each comparable wind event and the event date in October 2020. All dates from 2016-2020 were considered when identifying days with a wind event comparable to the event date. Two criteria descriptive of the magnitude and length of the wind event on October 25, 2020, were applied to identify comparable dates: (1) six or more hourly-reported wind speed observations greater than 25 mph; and (2) eight or more wind gusts greater than 45 mph. Additionally, dates were filtered to those without enhanced PM_{10} (<100 µg/m^3) at monitors in Clark County and without expected external influences (e.g., New Years Eve). Three dates were identified as having comparable wind events without high PM_{10} concentrations and are listed in Table 3.5-1.

Table 3.5-1. Similar meteorological event days without enhanced PM_{10} concentrations identified by days with six wind speed observations >25 mph and eight wind gusts >45 mph. PM_{10} concentrations are reported at Jerome Mack (JM) and Sunrise Acres (SA).

Date	Daily Wind Speed (mph)	Peak Wind Gust (mph)	Daily PM_{10} (µg/m^3)	
			JM	SA
2020-10-25 (event date)	7	49	210	163
2016-04-15	22	47	29	28
2021-02-24	10	56	48	43
2022-03-20	17	62	41	50

A key difference between the event date and comparable wind events is season. Each comparable event occurred in winter or spring, while the event date was in the fall. Historically, the highest soil moisture in Clark County occurs during winter and spring, a condition that suppresses the likelihood of windblown dust. The event date, on the other hand, occurred after the hottest and driest months of the year, and further coincided with severe drought conditions that persisted during 2020.

Another key condition that distinguished the event date from all identified comparable dates was low-altitude transport of air into the region that facilitated entrainment of dust from the source region. Air transport into Clark County on all comparable dates occurred at high altitudes, hindering surface-level transport from bare-ground sources of dust surrounding Las Vegas.

A specific comparison between October 25, 2020, and the first comparable date, April 15, 2016, is outlined below. Comparisons between the event date the other comparable dates can be found in Appendix B. **Figure 3.5-1, Figure 3.5-2, and Figure 3.5-3** compare surface-level wind and visibility conditions on the event date and April 15, 2016. The wind profile on April 15, 2016, exceeds the intensity of winds experienced on the event date, with wind gusts exceeding 45 mph and sustained winds over 20 mph occurring for a prolonged period between 02:00 – 20:00 (Figure 3.5-1). Figure 3.5-2 shows that wind gusts came primarily from the north on both the suspected event date and April 15, 2016. However, on April 15, visibility remained at the maximum value of 10 miles throughout the day (Figure 3.5-3). The maintenance of high visibility on April 15, 2016, confirms that the high-wind event did not dramatically affect levels of suspended dust particles, a claim supported by the fact that the daily PM_{10} concentration was relatively low, less than 30 µg/m^3, at both Sunrise Acres and Jerome Mack. **Figure 3.5-4** compares 24-hour HYSPLIT back trajectories from Las Vegas ending at 15:00 PST on October 25, 2020, and 07:00 PST April 15, 2016. End times for trajectories were chosen based on time of maximum PM_{10} concentrations in Clark County for each date. On the event date, near-surface transport towards Las Vegas occurred with transport paths below 200 m which facilitated entrainment and transport of dust from the source region. On April 16, 2016, the transport paths towards Las Vegas occurred at high altitudes greater than 500 m, inhibiting surface-level transport from dust sources surrounding Las Vegas.

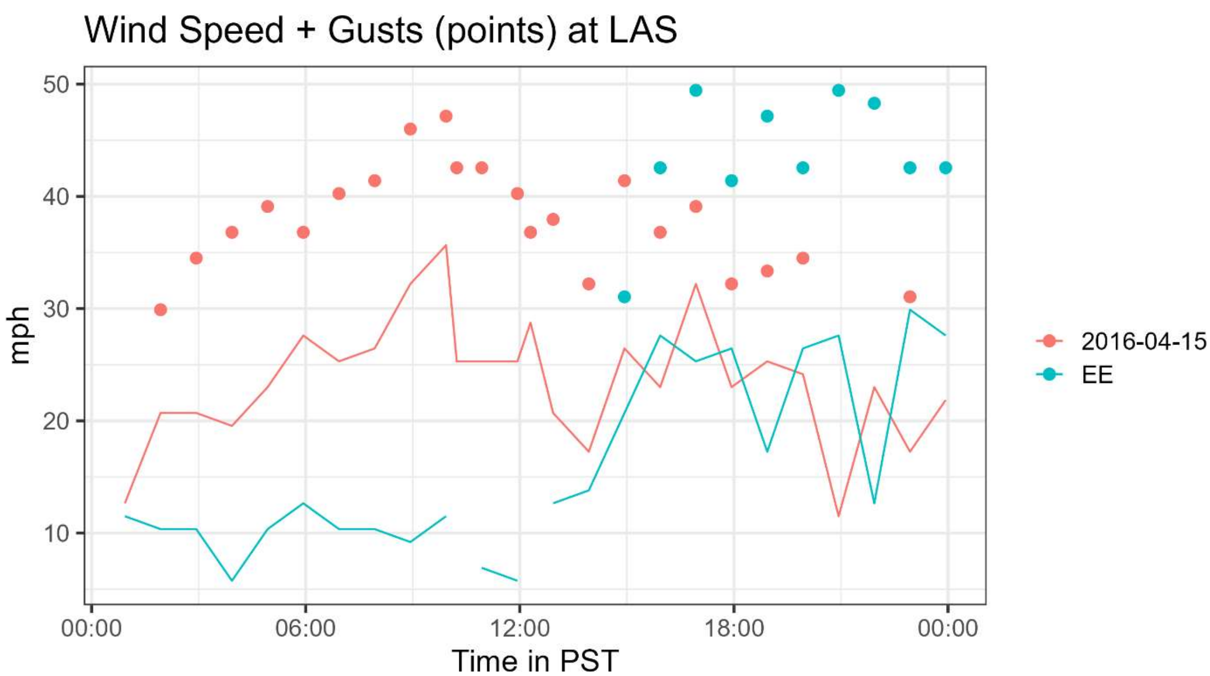


Figure 3.5-1. Wind speed and maximum hourly wind gust in mph at LAS for April 15, 2016, (pink) and the October 25, 2020, suspected exceptional event (EE) day (teal).

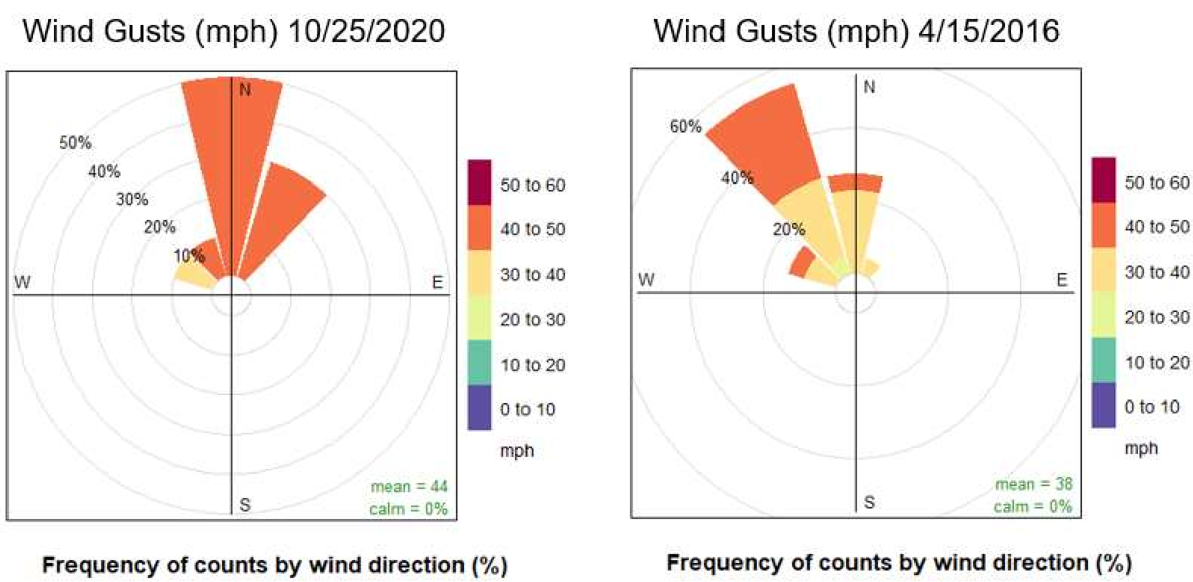


Figure 3.5-2. Wind gust and direction frequency for the suspected exceptional event day October 25, 2020 (left), and April 15, 2016 (right).

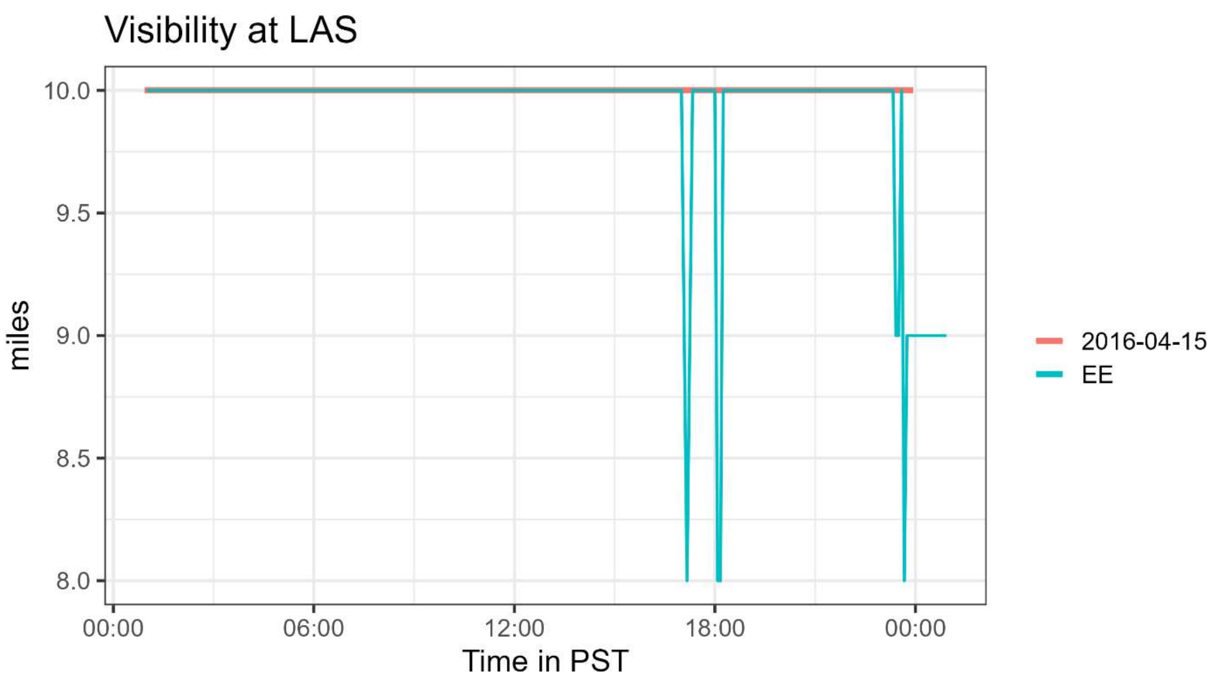


Figure 3.5-3. Visibility in miles at LAS for April 15, 2016, (pink) and the October 25, 2020, the suspected exceptional event (EE) day (teal).

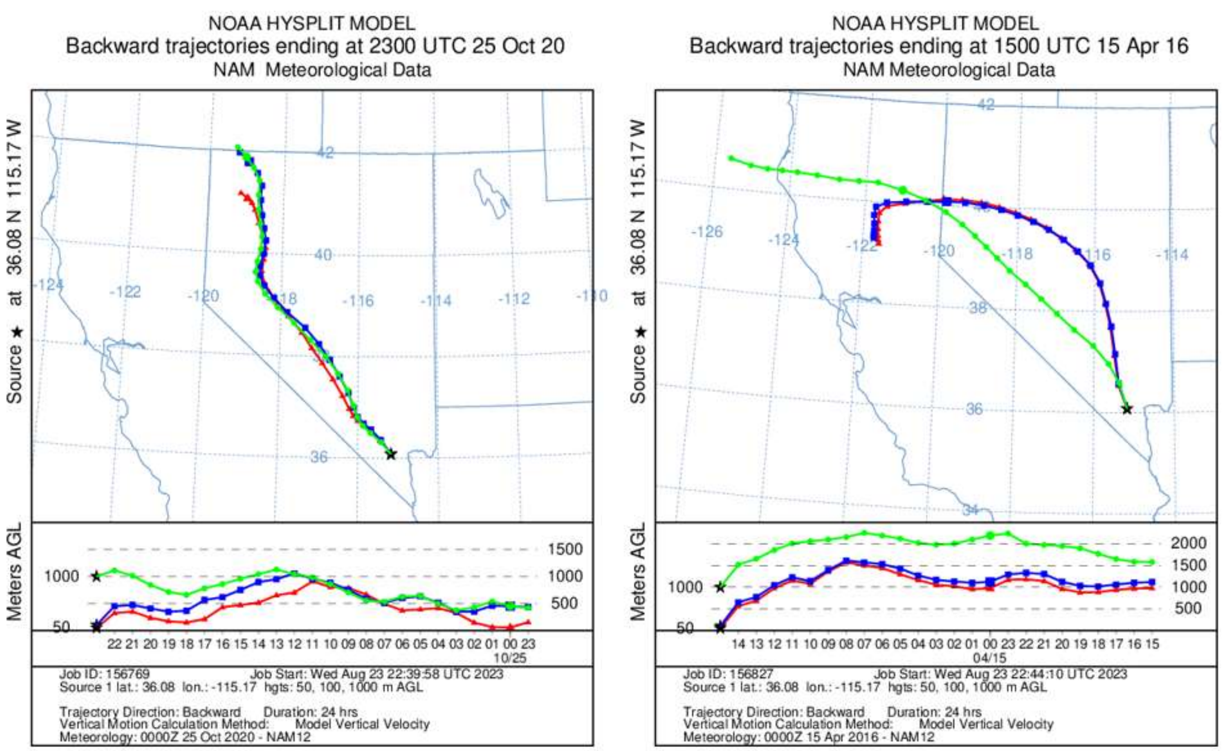


Figure 3.5-4. 24-hour HYSPLIT back-trajectories initiated from Las Vegas at (left) 23:00 UTC on October 25, 2020 (event date), and (right) 15:00 UTC on April 15, 2016, at 50 m (red), 100 m (blue) and 1,000 m (green).

3.5.2 High-Concentration Days in the Same Season

Dates in the same season as the suspected exceptional event were screened by daily PM_{10} concentration to compare surface meteorological conditions against conditions on the event date. All dates in the late summer and fall seasons between August and December 2020 were screened. The only other day when PM_{10} exceeded the NAAQS during this period was September 8, 2020, which is also a suspected high-wind dust event.

4. Not Reasonably Controllable or Preventable

4.1 Other Possible Sources of PM_{10} in Clark County

According to the EPA 2019 High Wind Dust Event Guidance document (and quoted Code of Federal Regulations [CFR] therein), agencies are required to (1) identify natural and anthropogenic sources of emissions contributing to the monitored exceedance, including contributions from local sources; (2) identify a relevant State Implementation Plan (SIP) for sources identified as natural and anthropogenic sources of emissions contributing to the monitored exceedance, including contributions from local sources and the implementation of these controls; and (3) provide evidence of effective implementation to satisfy the nRCP criterion.

Section 2.2.3 provides evidence for natural and anthropogenic sources near the Jerome Mack and Sunrise Acres sites of PM_{10} that could have contributed to the October 25, 2020, exceedance. As shown in **Section 3.2**, however, the main source of PM_{10} is the large bare ground/land area to the north of Clark County (identified in the rest of the document as the Great Basin Desert and northern Mojave Desert source regions) which is outside of the jurisdiction of Clark County and, therefore, not subject to control measures. Additional conclusions from this analysis indicate that anthropogenic point sources were unlikely to contribute to a PM_{10} exceedance event and BACM are in place to control fugitive sources such as construction emissions. According to the 2012 "Redesignation Request and Maintenance Plan for Particulate Matter (PM_{10})," the main sources of enhanced PM_{10} emissions in Clark County, Nevada, are (1) wind-blown dust, (2) re-entrained road dust, and (3) construction emissions. These nonpoint emission sources contribute approximately 98% of total annual PM_{10} emissions and are often amplified by dry arid conditions. Control measures have been implemented and enforced to mitigate emissions from the sources listed above within the jurisdiction of Clark County. Therefore, since natural bare ground was identified as the most likely source that contributed to the October 25, 2020, event (fulfilling nRCP part 1), in this section we focus on providing information on control measures used in Clark County to mitigate emissions from construction sites and possible dust sources in both the SIP (fulfilling nRCP part 2), and providing evidence of effective implementation (fulfilling nRCP part 3).

4.2 PM_{10} Control Measures in Clark County

For an air quality episode to qualify as a high-wind exceptional event, Clark County DES must show that all anthropogenic sources of PM_{10} are reasonably controlled (40 CFR 50.14(b)(5)(ii)). The Exceptional Event rule provides that enforceable control measures that EPA approved into the SIP within five years of the date of the event (40 CFR 50.14(b)(8)(v)) are presumptively reasonable. Controls adopted into the SIP more than five years before the event date may also be reasonable (81 FR 68238), and EPA will also consider other control measures not approved into the SIP if the air pollution control agency is implementing and enforcing the control measures (81 FR 68238-9).

Clark County DES operates one of the most robust fugitive emissions control programs in the country to reduce ambient air concentrations of PM_{10}. The 2001 PM_{10} SIP details emission sources and BACM that have been coded into the Clark County Air Quality Regulation (AQR). These include (1) stabilization of open areas and vacant lands (Section 90); (2) stabilization of unpaved roads and paving of unpaved roads when traffic volume is equal to or greater than 150 vehicles per day (Section 91); (3) stabilization of unpaved parking areas, including material handling and storage yards, and generally prohibiting the construction of new unpaved parking lots in the nonattainment area (Section 92); (4) requirements for paved roads, street sweeping equipment, and other dust-mitigating devices (Section 93); and (5) permitting and dust control requirements for construction activities (Section 94). These BACM are updated and continued in the most recent 2012 Redesignation Request and Maintenance Plan for Particulate Matter (PM_{10}) (2012 Maintenance Plan) document for Clark County, Nevada, which was approved by EPA and extends through 2023. The 2012 updated SIP and AQR document are provided as evidence in **Appendix C**.

The 2012 Maintenance Plan also identified the Natural Events Action Plan for High-Wind Events: Clark County, Nevada (DES 2005) as a control measure. Since submission of the 2012 Maintenance Plan, DES replaced this action plan with the Clark County Mitigation Plan for Exceptional Events (DES 2018). DES developed this revised plan in response to EPA's 2016 EER (81 FR 68216) that required areas with historically documented or known seasonal exceptional events to develop mitigation plans (40 CFR 51.930(b)). EPA does not require this plan to be included in the SIP or be federally enforceable, but did review each plan to assure that the required elements were included. The revised plan includes practices from the first action plan:

- A high-wind event notification system that includes an early warning procedure.
- Education and outreach programs.
- Enhanced enforcement and compliance programs to reduce emissions.
- Submittal of required documentation to EPA in the event of an exceedance.

The new plan includes more sophisticated air quality advisories and alerts, and commits to maintaining an open line of communication with neighboring areas involved in high PM_{10} ambient air concentration events. The new plan also references the Clark County flood control system (Clark County 2018) and street sweeping schedule for Las Vegas Valley, Hydrological Area 212 (HA 212) referenced in Appendix J of the 2001 PM_{10} SIP (DES 2001). This system maintains a robust flood control system that minimizes silt deposition from flood waters onto roads, parking areas, and undeveloped land. The system undergoes continuous expansion to accommodate new development in the Las Vegas Valley, with the following recent plan changes:

- Duck Creek – Gilispie System: March 2023;
- Harry Reid Airport Peaking Basin Outfall and Van Buskirk System: Feb. 2022;
- Monson Channel-Jimmy Durant to Boulder Highway: Apr. 2022;
- Blue Diamond 02 Channel, Decatur-Le Baron to Richmar: July 2020;
- Gowan Outfall Facilities-Simmons to Clayton: May 2021;
- Pittman Wash-Interstate Channel: June 2020.[1]

The Nevada Department of Transportation, Clark County, the City of Las Vegas, the City of North Las Vegas, and the City of Henderson maintain policies requiring rapid removal of silt deposits from paved roads after storm events.

In addition to regulating direct releases of PM_{10} to the atmosphere, DES' control measures includes requirements to reduce precursors, including VOC, NO_x, and SO_x, which can react in the atmosphere to form PM_{10} emissions under certain meteorological conditions. The control measures also regulate mercury emissions. Mercury emissions are a source of PM pollution when emitted in a non-gaseous form or when adsorbed by PM to form particulate mercury. Thus, standards designed to control mercury emissions also reduce PM_{10} ambient air concentrations.

The following section explains the reasonable control measures that collectively assure that all local sources of anthropogenic sources impacting HA 212 were reasonably controlled before and after the event. The measures include controls that are presumptively reasonable because EPA approved the control measure into the SIP within five years of the event, along with other reasonable measures.

4.2.1 Presumptively Reasonable Controls

The following measures are reasonable because EPA approved the control measures into the SIP within five years of the event date:

Section 12.0-12.6 Permitting Programs – Sections 12.0 and 12.1 originally adopted November 3, 2009; last amended February 20, 2024, and awaiting SIP approval. Section 12.2 originally adopted May 18, 2010; last amended March 14, 2014, and SIP-approved October 17, 2014. Sections 12.3 and 12.4 originally adopted May 18, 2010; last amended July 20, 2021, and awaiting SIP-approval. Section 12.5 originally adopted May 18, 2010 and awaiting SIP-approval. Section 12.1 requires all minor stationary sources to obtain a permit to construct and operate if they have the potential to emit 5 tons per year (tpy) or more of a regulated pollutant, or if they are subject to another AQR, such as a control technique guideline (CTG) Reasonable Available Control Technologies (RACT) rule, that requires a minor source to obtain a permit. Some emissions units at these minor stationary sources must comply with RACT requirements when proposing an emissions increase that meet or

[1] The flood plan and updates are available at https://www.regionalflood.org/programs-services/document-library/master-plan-documents.

exceed the significance thresholds. Sections 12.2-12.5 requires all major stationary sources to obtain a permit to construct and operate. Some emissions units must comply with RACT requirements when they are the subject of an emissions increase in PM_{10} or its precursors that meets or exceeds the minor New Source Review (NSR) significance thresholds. In addition, these rules implement the federally mandated NSR Program for attainment, unclassifiable, and nonattainment areas. New major sources and existing major sources undertaking a modification that results in a significant increase in PM_{10} emissions or its precursors must install and operate Best Available Control Technology (BACT) or Lowest Achievable Control Technology (LAER).

Section 26 Emissions of Visible Air Contaminants – Amended April 26, 1983; last amended May 5, 2015; and SIP-approved June 16, 2017. This rule requires all sources to generally maintain an average opacity below 20%, with certain sources subject to a lower 10% average opacity standard.

Section 41 Fugitive Dust – Originally adopted June 25, 1992; last amended January 21, 2020; and SIP-approved May 19, 2022. This rule requires fugitive emissions abatement to prevent airborne PM emissions during construction and deconstruction activities, and during use of unpaved parking lots, agricultural operations, and raceways. The rule includes notice, registration, and permitting requirements.

Section 90 Fugitive Dust from Open Areas and Vacant Lots – Originally adopted June 22, 2000; last amended January 21, 2020; and SIP-approved May 19, 2022. This rule requires certain owners of land to take measures to prevent access of trespassers operating motor vehicles on the land. Owners must also create a stable surface area, including gravel installation that provides a 20% non-erodible cover. Landowners of large parcels must develop and submit a dust mitigation plan.

Section 93: Fugitive Dust from Paved Roads and Street Sweeping Equipment – Originally adopted June 22, 2000; last amended January 21, 2020; and SIP-approved May 19, 2022. This rule requires construction and reconstruction of roads in accordance with road shoulder widths and drivable median stabilization requirements. It also establishes an opacity standard for unpaved shoulders and medians, and for the use of road cleaning equipment. The rule requires road wetting when using rotary brushes and blowers to clean roads and allows only vacuum type crack cleaning seal equipment.

Section 94 Permitting and Dust Control for Construction and Temporary Commercial Activities – Adopted June 22, 2000; amended January 21, 2020; SIP-approved May 19, 2022; last amended August 3, 2021; and awaiting further revision before SIP approval. This rule applies to all construction and temporary commercial activities that disturb or have the potential to disturb soil. It requires a dust control permit and maintenance of a dust mitigation plan.

4.2.2 Other Reasonable Control Measures

The following identifies additional reasonable control measures that assure that all anthropogenic sources of PM_{10} emissions were controlled before and after the event. The controls fall into one of three categories: (1) EPA approved the control measures into the SIP more than five years before the event date; (2) the state submitted revisions that EPA has not yet approved into the SIP; or, (3) the Clean Air Act (CAA) and EPA do not require states to submit the type of control measure for SIP approval. As explained below, these control measures are reasonable because they meet or exceed CAA requirements, enhance enforcement efforts, and are equal or more stringent than control programs found in other state SIPs.

State Control Measures

Nevada Regional Haze State Implementation Plan – Originally adopted October 2009 and partially SIP approved March 26, 2012, and August 28, 2013, awaiting SIP approval. Prepared by the Nevada Division of Environmental Protection (NDEP) and codified by DES in AQR Section 12.14 on June 7, 2022. This plan requires reductions in visibility impairing pollutants, and thereby reduces the potential for PM_{10} formation. The plan specifically required Reid Gardner (a point source in Clark County) to meet PM control requirements by June 30, 2016, or to shutdown Units 1, 2, 3 by this date. The 2022 revised plan, which should become effective during the second maintenance period, requires the installation of low NO_x burners and selective non-catalytic reduction control equipment to reduce visibility impairing pollution on lime kilns operating in Clark County. This rule is reasonable because the controls imposed met the CAA's Best Available Retrofit Technology (BART) standard.

NAC 445B.737-774, Heavy-Duty Vehicle Program – adopted October 22, 1992; last amended October 18, 2002. The NDEP and Nevada Department of Motor Vehicles (DMV) jointly developed this rule to reduce motor vehicle related pollution by limiting excessive tailpipe or smokestack emissions from any gasoline or diesel-powered vehicle with a manufacturer's gross vehicle weight rating (GVWR) of 14,001 lbs. or more. Enforcement inspectors pull over heavy-duty vehicles for random roadside testing to determine if the exhaust from their vehicle exceeds state opacity standards. Violators must repair and retest the vehicle within 30 days. Fleets may also request opacity testing in their fleet yard. Fleet managers voluntarily repair and re-test vehicles failing the inspection. This regulation is reasonable because it exceeds EPA's inspection and maintenance program requirements, and actively prevents smoking vehicles from operating on roads.

NAC 445B.400-735, Inspection and Maintenance Program – adopted September 28, 1988; subsequently amended and SIP-approved July 3, 2008; last amended October 18, 2022. The NDEP and the Nevada DMV jointly developed this rule, administered by the DMV, to control vehicle emissions. The rule reduces motor vehicle-related NO_x and VOC emissions through the vehicle inspection and emissions-related repairs. Clark County requires annual emissions testing before renewing a vehicle's registration. All gasoline-powered vehicles must be tested, with limited exceptions, as well as diesel-powered vehicles weighing up to 14,000 lbs. gross vehicle weight rating (GVWR). EPA approved the inspection and maintenance program as part of the Carbon Monoxide State Implementation Plan: Las Vegas Valley Nonattainment Area, Clark County, Nevada (CO SIP[2]), in September 2004 (69 FR 56351). This inspection and maintenance program is reasonable because it (1) exceeds EPA's requirements for a basic inspection and maintenance program, and (2) follows a standard that qualifies as a low-enhanced performance standard.

NAC 445B.3611-3689 Nevada Mercury Control Program – Originally adopted May 4, 2006; last revised November 2, 2016. Mercury emissions can also be a source of PM pollution when emitted as in non-gaseous form a particulate or when adsorbed by PM to form particulate mercury. Thus, standards designed to control mercury emissions also reduce PM_{10} ambient air concentrations. The rule requires particulate emissions control technologies to reduce mercury emissions from thermal units located in precious metal mines. The CAA does not require states to submit hazardous air pollutant control measures for SIP approval. These measures are reasonable because they reduce the ambient air concentration of PM_{10} by requiring use of the Maximum Achievable Control Technology (MACT) and apply in addition to the federal standards at 40 CFR Part 63, Subpart E.

County Air Quality Regulations

Section 14 New Source Performance Standards (NSPS) - Originally adopted September 3, 1981; last amended March 15, 2022. Regulations in this section are reasonable because they implement EPA's federal PM and total suspended particulate (TSP) emissions limitations in 40 CFR Part 60 "New Source Performance Standards" (NSPS) that apply to a variety of stationary sources. EPA has delegated implementation and enforcement of the federal standards to DES. The CAA does not require states to submit NSPS control measures for SIP approval.

Section 13 National Emissions Standards for Hazardous Air Pollutants (HAP) – Originally adopted September 3, 1981; last amended March 15, 2022. Regulations in this section are reasonable because they implement federal HAP emissions limitations in 40 CFR Part 63 that apply to a variety of stationary sources that emit particulate emissions in the form of metal HAP. These standards are based on Maximum Achievable Control Technology. EPA has delegated implementation and enforcement of the standards to DES. The CAA does not require states to submit HAP control measures for SIP approval.

Section 27 Particulate Matter from Process Weight Rate – Originally adopted September 3, 1981 (SIP approved June 18, 1982); last amended July 1, 2004. Establishes process weight restrictions for PM emissions for all operations. This regulation is reasonable because it establishes maximum rates for PM emissions from stationary sources that are more stringent than any specific CAA or SIP

[2] https://webfiles.clarkcountynv.gov//Environmental%20Sustainability/SIP%20Related%20Documents/Carbon_Monoxide_State_Implementation_Plan_Revision-without_Appendices.pdf

requirement, and comparable to limits found in other state SIPs. Compare the rule, for example, to Chapter 1200-3-7 "Process Emission Standards" in the Tennessee SIP.[3]

Section 28 Fuel Burning Equipment – Originally adopted December 28, 1978; SIP-approved August 27, 1981; last amended July 1, 2004. This rule applies to fuel burned for the primary purpose of producing heat or power by indirect heat transfer. It regulates the burning of coke, coal, lignite, coke breeze, fuel oil, and wood, but not refuse. The regulation targets reductions in PM_{10} emissions, but by promoting good combustion practices, the rule also produces NO_x and VOC emissions reduction co-benefits that further reduce the potential for PM_{10} formation. The rule establishes PM emissions rates based on heat input. This regulation is reasonable because it establishes maximum rates for PM emissions from stationary sources that are more stringent than any specific CAA or SIP requirement and emissions limitations found in other states. Compare the rule, for example, to Chapter 13 "Emission Standards for Particulate Matter" in the Louisianna SIP.[4]

Section 42 Open Burning – Originally adopted December 28, 1978; SIP-approved August 27, 1981; last amended July 1, 2004. This rule requires preauthorization to burn any combustible material and prohibits open burning during air pollution episodes, which is consistent with the Nevada Emergency Episode Plan. This regulation is reasonable because it allows the Control Officer to assess and prevent any burning that could lead to a PM_{10} NAAQS exceedance. The rule also is comparable to similar control measures found in other SIPs. See, for example, South Coast Air Quality Management District's Rule 444[5].

Section 91 Fugitive Dust from Unpaved Roads, Unpaved Alleys, and Unpaved Easement Roads – Originally adopted June 22, 2000; last amended April 15, 2014; and SIP-approved October 6, 2014. This rule applies to unpaved roads, including unpaved alleys, unpaved road easements, and unpaved access roads for utilities and railroads. It requires PM emissions control measures including paving or application of dust palliatives. This regulation is reasonable because it targets and reduces emissions of event-related fugitive dust emissions using state-of-the-art emissions controls, which are more stringent than the best practices recommended by EPA. See "Fugitive Dust Control Measures and Best Practices," EPA, January 2022[6].

Section 92 Fugitive Dust from Unpaved Parking Lots and Storage Areas – Originally adopted June 22, 2000; amended April 15, 2014; SIP-approved October 6, 2014; last amended August 3, 2021. This rule applies to lot and storage areas greater than 5,000 ft^2. The rule generally requires owners of a lot or storage area to pave the area or cover it in two inches of gravel. It also prohibits visible dust plumes from crossing the property boundary. This regulation is reasonable because it targets and reduces emissions of event-related fugitive dust emissions using state-of-the-art emissions controls, which are more stringent than the best practices recommended by EPA. See "Fugitive Dust Control

[3] https://www.epa.gov/system/files/documents/2021-12/chapter-1200-3-7.pdf
[4] https://www.epa.gov/air-quality-implementation-plans/louisiana-lac-33iii-ch-13-section-1301-emission-standards
[5] https://ww2.arb.ca.gov/sites/default/files/2021-06/SouthCoastSMP.pdf
[6] https://www.epa.gov/system/files/documents/2022-02/fugitive-dust-control-best-practices.pdf

Measures and Best Practices," EPA, January 2022. The rule also regulates sources not typically regulated in other state SIPs.

Section 94 Permitting and Dust Control for Construction and Temporary Commercial Activities – Adopted June 22, 2000; amended January 21, 2020; SIP-approved May 19, 2022; last amended August 3, 2021. This rule applies to all construction and temporary commercial activities that disturb or have the potential to disturb soil. It requires a dust control permit and maintenance of a dust mitigation plan. This regulation is reasonable because it targets and reduces emissions of event-related fugitive dust emissions using state-of-the-art emissions controls, which are more stringent than the best practices recommended by EPA. See "Fugitive Dust Control Measures and Best Practices," EPA, Jan. 2022. The rule also regulates sources not typically regulated in other state SIPs.

Transportation Conformity – Clark County works closely with the Regional Transportation Commission of Southern Nevada (RTC) to assure that regional transportation plans and transportation improvement programs in HA 212 are consistent with and conform to Clark County's air quality program requirements, including the PM_{10} SIP and corresponding motor vehicle emissions budget (MVEB).

In this section (and in Appendix C), we have provided information on adopted presumptively and other reasonable control measures used in Clark County to mitigate emissions from construction sites and other possible dust sources, fulfilling part 2 of the nRCP criterion.

4.3 Reasonableness of Control Measures

Table 2 in the 2019 High-wind Dust Exceptional Event Guidance document provides example factors that an air agency and EPA may consider when assessing the reasonableness of controls as part of the nRCP criterion. This table details example factors, such as (1) control requirements based on area's attainment status, (2) the frequency and severity of past exceedances, (3) the use of widespread measures, and (4) jurisdiction. In this section, we address all the possible factors that evaluate the reasonableness of controls.

4.3.1 Historical Attainment Status

The 2012 Redesignation Request and Maintenance Plan for Particulate Matter (PM_{10}) document for Clark County, Nevada, provides a comprehensive historical analysis of the Clark County nonattainment area. Briefly, after the passage of the 1990 Clean Air Act Amendments, EPA designated all areas previously classified as Group I areas as "moderate" nonattainment areas, including HA 212 (CAA §107(d)(4)(B)). EPA required these moderate nonattainment areas to submit a SIP by November 1991 that would demonstrate attainment of the PM_{10} NAAQS by December 1994. Because of unprecedented regional growth, high-wind events, and other factors, Clark County could not demonstrate attainment by the required date, and EPA reclassified HA 212 as a "serious" nonattainment area on January 8, 1993 (58 FR 3334). In 1997, a PM_{10} SIP revision was submitted. In December 2000, the Clark County Board of County Commissioners (BCC) requested that the state formally withdraw all previously submitted SIPs and addenda because none demonstrated attainment of the NAAQS.

After completing comprehensive research and work programs to address the problems identified in the 1997 PM_{10} SIP revision, Clark County submitted a new SIP to EPA in June 2001 that met federal requirements for remediating serious PM_{10} nonattainment areas. This new SIP demonstrated that the adoption and implementation of BACM for fugitive sources and continuation of controls for stationary sources would result in attainment of the annual average PM_{10} NAAQS by 2001, and attainment of the 24-hour NAAQS by December 31, 2006. Although the CAA required the SIP demonstrate attainment of the PM_{10} NAAQS no later than December 31, 2001, EPA granted Clark County a five-year extension for the 24-hour NAAQS attainment date. Clark County supported its extension request with a "Most Stringent Measure" control analysis that showed the emission control programs proposed for the valley were at least as stringent, if not more so, than control programs implemented in other nonattainment areas.

In June 2004, EPA published final approval of the Clark County PM_{10} SIP (69 FR 32273). In June 2007, Clark County submitted a milestone achievement report that described the county's progress in implementing the SIP. In August 2010, EPA determined HA 212 had attained the PM_{10} NAAQS (75 FR 45485).

In August 2012, the Redesignation Request and Maintenance Plan for Particulate Matter (PM_{10}) (i.e., 2012 Maintenance Plan) was formally approved, and EPA redesignated the Clark County PM_{10} nonattainment area to attainment for the 1987 24-hour NAAQS. To achieve attainment of the 1987 24-hour PM_{10} NAAQS, Clark County DES implemented emissions control measures that lead to a permanent and enforceable improvement in air quality, as required by CAA Section 107(d)(3)(E)(iii) (42 U.S.C. 7407). The 2012 Maintenance Plan explained that Clark County adopted comprehensive fugitive dust controls in the Section 90 series of the AQR, and implemented and enforced SIP and non-SIP regulations to control PM_{10} emissions from stationary and nonpoint sources. The maintenance plan summarized the progress in attaining the PM_{10} standard, demonstrated that all Clean Air Act and Clean Air Act Amendment requirements for attainment had been met, and presented a plan to assure continued maintenance over the next 10 years. The plan became federally enforceable and determined how Clark County maintained the 1987 PM_{10} NAAQS through 2023.

In 2022, Clark County began work on a Second PM_{10} Maintenance Plan. For this plan, Clark County DES must show attainment in the background and assessment design value periods, specified as the 2017-2019 background period and the 2021-2023 assessment period. This exceptional event demonstration and the associated demonstrations for the 2021-2023 design value period will show that Clark County's HA 212 area is in attainment of the PM_{10} NAAQS but for the proven exceptional event dates. Approval and implementation of the Second PM_{10} Maintenance Plan is expected in 2024.

4.3.2 Historical Analysis of Past PM_{10} Exceedances

The 2012 Maintenance Plan document for Clark County, Nevada, provides historical context of regulatory efforts by Clark County to achieve attainment of PM_{10} NAAQS over the past 30 years, and a robust weight-of-evidence trend analysis for PM_{10} concentrations from 2001-2010. With the implementation of the PM_{10} SIP control measures, evidence shows a decreasing trend in PM_{10} design values, especially after BACM implementation (Figure 4.3-1). The decrease in wind erosion from vacant lands has driven the decreasing trend of PM_{10} emissions as construction within the Las Vegas Valley overtakes vacant lands. Given that the Las Vegas Valley was designated as being in "moderate" and later "serious" nonattainment for the PM_{10} NAAQS in the early 1990s, PM_{10} emissions before 1999 were likely high relative to the 2008-2010 period shown in Figure 4.3-1. This confirms that PM_{10} emissions have decreased over the past 30 years since the implementation of BACM from anthropogenic sources.

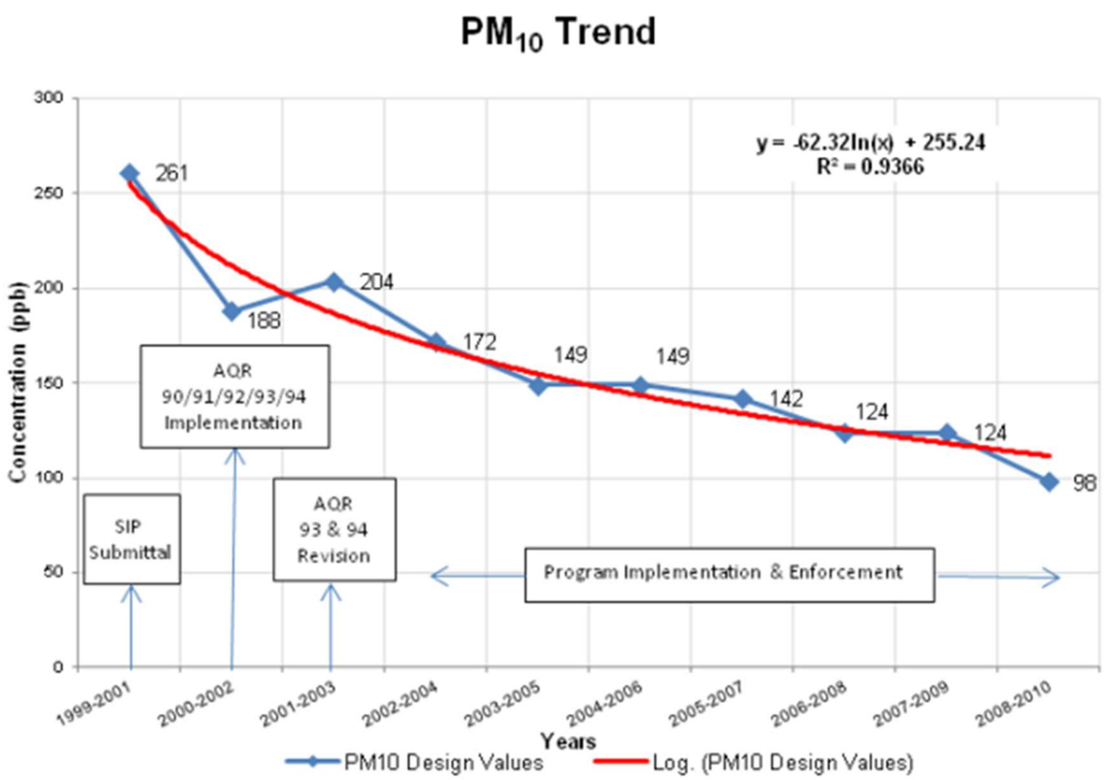


Figure 4.3-1. PM_{10} trends from the 2012 Maintenance Plan.

Continuing this evaluation through 2022, Figure 4.3-2 shows the three-year running average concentration at a long-running PM_{10} monitoring site in Clark County (Paul Meyer: AQS ID 32-003-0043) (orange line), along with the three-year running average of drought conditions in Nevada (blue bars). Drought conditions are categorized on a scale of D0 (abnormally dry) to D4 (exceptional), and Figure 4.3-2 shows the three-year running average of D2 (severe) conditions. We see that the typical five-year cyclical drought pattern in Nevada has increased in magnitude in the most recent years and this has corresponded to an uptick in average PM_{10} concentrations. This suggests that the control measures put in place via the 2012 SIP have been at least partially counterbalanced by increasing drought throughout the state of Nevada, affecting PM_{10} concentrations. Figure 4.3-3 shows the D0 - D4 drought conditions for 2000-2023, highlighting the increase in D3 (extreme) and D4 drought conditions through the most recent years. According to NLCD 2019 data, 87% of Nevada's land cover is bare ground or land that has little vegetation cover. The expansion in magnitude of severe-to-exceptional drought conditions will disproportionately affect natural areas prone to dust lofting, entrainment, and transport, ultimately enhancing PM_{10} concentrations.

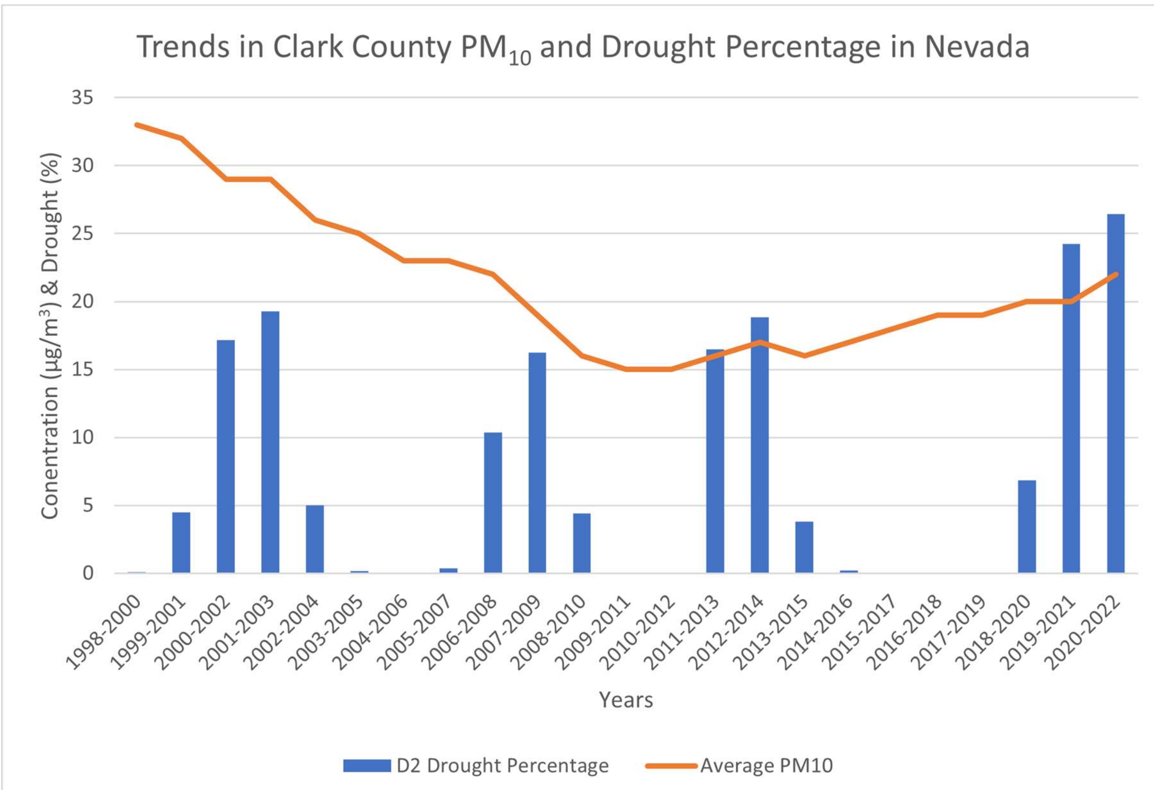


Figure 4.3-2. Three-year running average of PM_{10} concentrations (µg/m^3) at the long-running Paul Meyer monitoring site (AQS: 32-003-0043) (orange line) and the D2 (severe) drought percentage of Nevada (blue bars). Source: https://www.drought.gov/states/nevada.

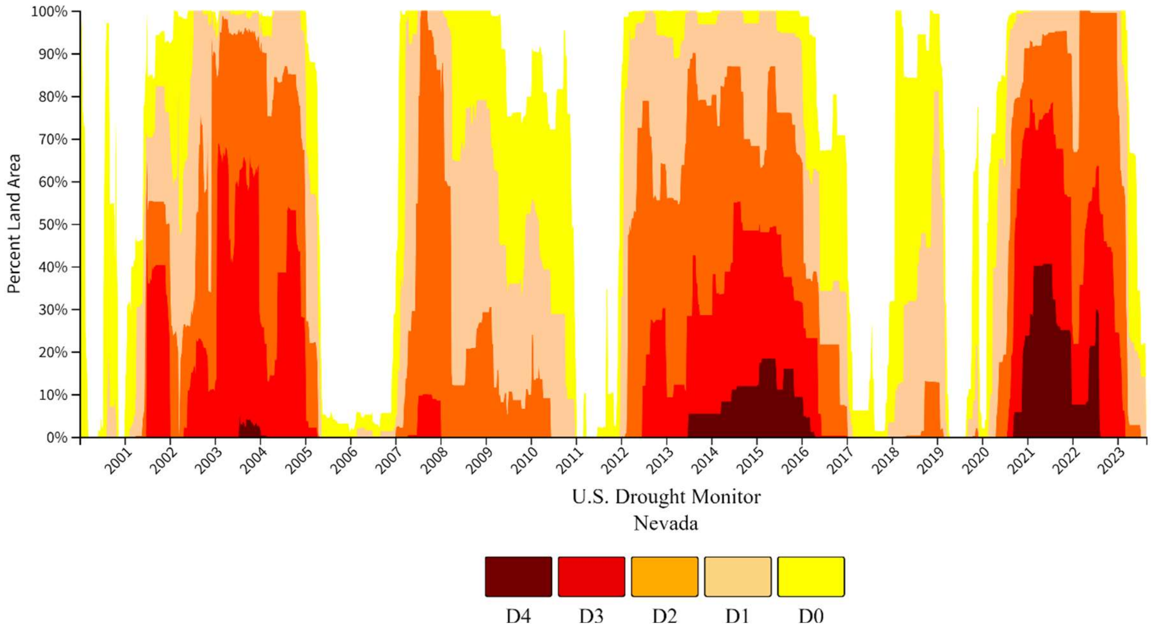


Figure 4.3-3. Drought statistics for Nevada from 2000-2023, colored by drought severity for D0 to D4. Source: https://www.drought.gov/states/nevada.

Historical PM_{10} exceedance frequency in Clark County has varied among air quality monitoring sites since the late 1990s and early 2000s. Figure 4.3-4 and Figure 4.3-5 show historical 24-hour PM_{10} exceedance count and concentration and design values at site in HA212 with at least 20 years of data. PM_{10} exceedances at the Joe Neal and Green Valley sites occurred at a greater frequency (≥1 exceedance per year) in the late 1990s and early 2000s followed by a drop to no exceedances per year in the mid-2000s coinciding with BACM implementation and less severe drought conditions. Other sites show one exceedance every few years before 2022. The number of exceedances per year increased in the 2010s for most long-term sites, coinciding with more widespread and severe drought conditions in Nevada. The number of exceedances rose significantly for all long-term sites in 2022 and 2023 due to the wind-blown dust exceptional events. Without these 2022 and 2023 events, the number of exceedances would more closely align with the mid-2000s period. These observations are consistent with the historical PM_{10} and drought analysis presented in the 2012 Maintenance Plan.

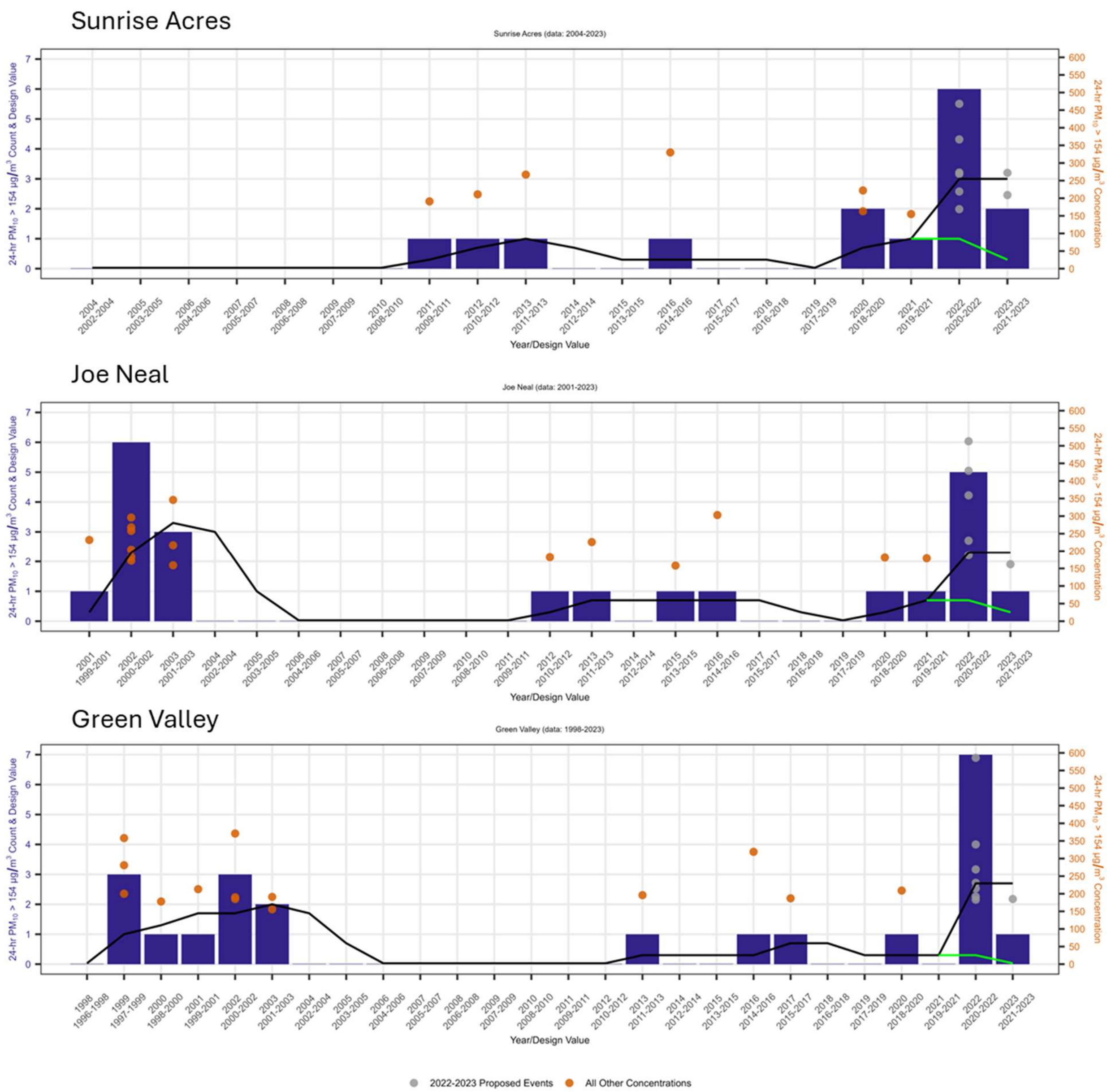


Figure 4.3-4. Historical 24-hour PM_{10} exceedance count (purple bars) and concentration (orange dots) per year/design value period at the Sunrise Acres, Joe Neal, and Green Valley monitoring sites (AQS: 32-003-0561; 32-003-0075; 32-003-0298). The gray dots represent the proposed 2022-2023 PM_{10} exceptional events, the black line represents the design value for all periods with all PM_{10} exceptional events included, and the green line represents the design value for the period with the 2022-2023 PM_{10} exceptional events excluded.

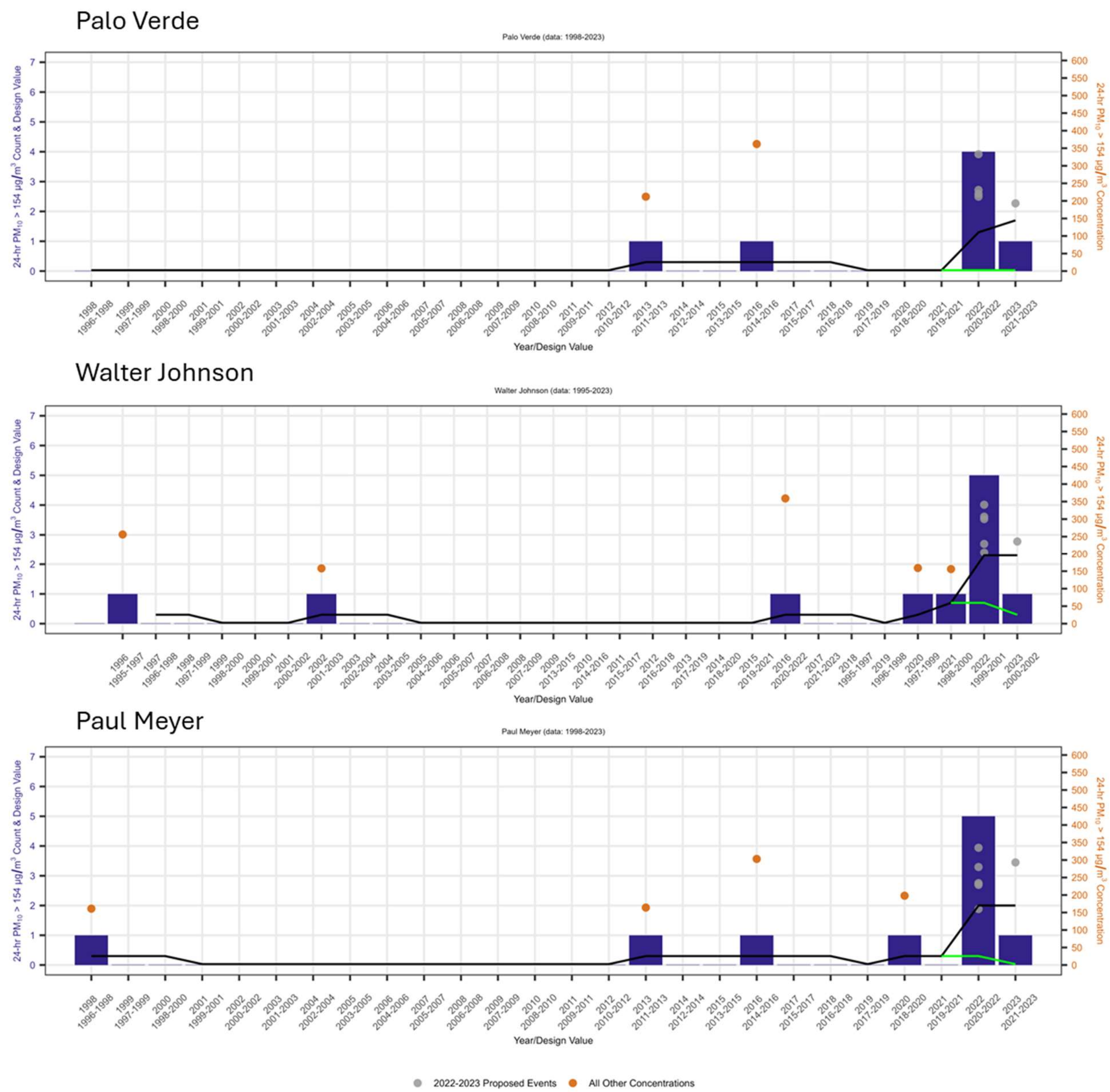


Figure 4.3-5. Historical 24-hour PM_{10} exceedance count (purple bars) and concentration (orange dots) per year/design value period at the Palo Verde, Walter Johnson, and Paul Meyer monitoring sites (AQS: 32-003-0073; 32-003-0071; 32-003-0043). The gray dots represent the proposed 2022-2023 PM_{10} exceptional events, the black line represents the design value for all periods with all PM_{10} exceptional events included, and the green line represents the design value for the period with the 2022-2023 PM_{10} exceptional events excluded.

4.3.3 Widespread Use of Controls

In addition to the similar controls listed per rule in Section 4.2, Clark County's dust control measure regulatory framework is similar to that of nearby jurisdictions. Rule 403 in the Rules and Regulations of the Mojave Desert Air Quality Management District (MDAQMD)[7] and Rule 310 of Maricopa County's (Arizona) Air Pollution Control Regulations[8] describe the regulations and enforcement of fugitive dust control measures. Like the fugitive dust controls outlined in Clark County's AQR, MDAQMD and Maricopa County provide definitions of control measures that dust-producing operations in the air agency's jurisdiction must apply to prevent, reduce, or mitigate fugitive dust. The control measures implemented by Clark County, MDAQMD, and Maricopa County emphasize the stabilization of site surfaces, and have requirements for equipment usage, permitting, and enforcement. The rules of the respective jurisdictions provide differing levels of detail and requirements regarding fugitive dust control measures. Further, the rules of the respective jurisdictions are tailored to fit the specific dust control challenges each jurisdictions faces.

The stabilization of site surfaces is defined similarly across Clark County, MDAQMD, and Maricopa County as the reduction of dust-producing capability of a disturbed surface through the treatment of the surface using methods such as watering, paving, manual compacting, or chemical treatment. Stabilization of site surfaces—where a portion of the earth's surface or material placed on the earth's surface is disturbed and has the potential to produce fugitive dust emissions—is required across all three jurisdictions. Stabilization is a critical component of dust control measures across the three jurisdictions. During high-wind events, all three jurisdictions must ensure that site surfaces are stabilized to prevent wind-blown dust. Maricopa County and Clark County specify in their respective rules that, during high-wind events, certain operations that destabilize surfaces such as blasting must cease, whereas MDAQMD requires that "non-essential" destabilizing operations must be reduced.

Specific rules regarding equipment use vary slightly across the three jurisdictions in requirements and level of detail, but generally include requirements such as speed limits for equipment while on site and limits on hauling vehicles (e.g., covers over dust-producing material). For example, MDAQMD requires that hauling vehicles working at a mining, stone, asphalt, or clay facility maintain at least six inches of freeboard (i.e., the distance between the hauled material and the top of the hauling container) on haul vehicles when transporting material on public roads, whereas Maricopa County requires that hauling vehicles working off-site in areas accessible to the public maintain at least three inches of freeboard on haul vehicles when transporting material. Maricopa County also provides detail on hauling truck operations working under other circumstances, such as on-site and not accessible to the public.

Dust control plans required across the three jurisdictions vary slightly, but are integral parts of the permitting process that detail control measures that will be implemented. All dust control plans require basic information such as site details, control measures, contingency control measures, and a summary of general day-to-day operations. The circumstance under which a dust-generating operation must submit a dust control plan differs between the jurisdictions. For example, there are seven circumstances that would require the submittal of a dust control plan to MDAQMD, such as a

[7] https://www.mdaqmd.ca.gov/home/showpublisheddocument/8482/637393282546170000

[8] https://www.maricopa.gov/DocumentCenter/View/5354/Rule-310---Fugitive-Dust-from-Dust-Generating-Operations-PDF?bidId=

"Residential Construction/Demolition Activity with a Disturbed Surface Area of at least ten (10) acres." Maricopa County, however, requires the submittal of a dust control plan for any potential dust-generating operation that would meet or exceed 0.10 acres. Clark County, under Section 94 of the AQR, requires the submittal of a dust control plan for "Construction and Temporary Commercial Activities" under four circumstances (e.g., Construction Activities that disturb soils 0.25 acres or greater in overall area).

Enforcement of dust control regulations and dust control plan compliance are also similar, but differ in level of detail and stringency between the three jurisdictions. Clark County's enforcement activities are extensive and detailed. For example, per Section 94 of the AQR, Clark County requires that, under certain circumstances, a Dust Control Monitor (i.e., a construction superintendent or other on-site representative) is given power to ensure the dust-generating operation is compliant with dust control regulations and follows the dust control plan. Maricopa County has similar rules regarding an official monitor of dust control regulation and dust control plan compliance. Officials in charge of monitoring dust-producing activities are trained in dust control practices and are generally responsible for managing and enforcing dust control practices at the dust-producing site. Dust-producing operations in violation of regulations and their dust control plan are subject to penalties.

The prevalence of similar standard fugitive dust control practices employed by Clark County, MDAQMD, and Maricopa County provide a benchmark for reasonable dust controls for similar environments in the southwest U.S.

During early September, a strong frontal passage through northern Nevada drove a wind-blown dust event that increased PM_{10} concentrations in Clark County, NV, on September 8, 2020. Strong winds well above 25 mph from the frontal passage lofted, entrained, and transported dust into Clark County starting in the early morning on September 8, 2020, at 03:00 and lasting through 10:00 PST. The severe drought conditions affecting the Great Basin Desert in Nevada, as shown in **Section 2.2**, created an ample source of dust from friable soils. Enhanced wind speeds greater than 25 mph in the Las Vegas valley coincided with increased PM_{10} concentrations during the 03:00-10:00 PST period. Within this section, we provide meteorological evidence of lofting, entrainment, and transport of dust from the dust source region, (the Great Basin Desert Region) with the frontal passage, evidence of transport from the source region to Clark County via HYSPLIT trajectory modeling and meteorological analysis, and impacts of the high-wind dust event at the surface in Clark County. We also provide additional evidence using statistical and meteorological similar event analysis to compare this dust event with other high PM_{10} days in Clark County.

4.3.4 Jurisdiction

As detailed in **Section 3.1.1**, on October 25, 2020, dense blowing dust from the Great Basin and northern Mojave Desert source region impacted the Las Vegas metropolitan area. Due to the strong frontal passage through northern Nevada, surface wind speeds increased in the Great Basin and northern Mojave Desert and Clark County, which produced blowing dust northwest of Las Vegas on

October 25, 2020. Strong winds in the Great Basin Desert source region were well above 25 mph from the frontal passage, which lofted, entrained, and transported dust from the source region to Clark County. The hourly PM_{10} concentrations detailed in **Section 3.2.2** show a southeastward progression of high PM_{10} concentrations and wind speeds consistent with the direction of travel of the cold front. By 15:00 PST, all sites in the Las Vegas Valley showed high concentrations of PM_{10} and caused a 24-hour PM_{10} NAAQS exceedance at the Jerome Mack and Sunrise Acres sites. Ground-based evidence, including particulate matter analysis (**Section 3.3.4**) and visibility monitors (**Section 3.3.5**), provide additional strong evidence that PM_{10} control measures within Clark County were overwhelmed and unable to prevent an exceedance event on October 25, 2020. The timeline shown in this exceptional event demonstration highlights the progression of high concentrations of PM_{10} from the source region into Clark County (and HA 212) within a short period of time. This progression clearly indicates an upwind source of windblown dust. As the strong winds lofted, entrained, and transported dust from the Great Basin and northern Mojave Desert in Nevada, this source region was outside the jurisdiction of Clark County and the implemented control measures.

4.4 Effective Implementation of Control Measures

In addition to the SIP and AQR documentation previously provided, the Clark County DES is responsible for monitoring and forecasting air quality and enforcing dust mitigation measures before, during, and after an exceptional event. Clark County issues “advisories” and “Construction Notices” when weather conditions are forecast to be favorable for a wind-blown dust event. Advisories consist of health-based notifications disseminated to the public that provide educational materials on how to limit exposure and mitigate emissions for dust, $PM_{2.5}$, seasonal ozone, ozone, and/or smoke. Construction Notices are notifications to stationary sources, dust control permit holders, and contractors that detail mitigation measures. The issuance of Construction Notices may not meet the wind threshold for a potential high-wind dust event, but if weather conditions change to prompt a public advisory or alert, stationary sources are sent a detailed form of the public advisory or an alert with language specific to their operations and dust abatement requirements.

Dust Advisories are issued for forecasts of sustained wind speeds of 25 mph or more, or wind gusts of 40 mph or more. Construction Notices are issued for forecasts of sustained wind speeds of 20 mph or more, or wind gusts of 30-35 mph or more. Upon issuance of either a Construction Notice or an Advisory, the DES directs stationary sources to inspect their site(s), cease blasting operations, and employ BACM to stabilize all disturbed soils and reduce blowing dust. Recipients of a Construction Notice are informed that the DES officials will inspect sites to ensure BACM is being implemented.

Specific construction-related control measures include required dust control classes for construction superintendents or other on-site representatives.[9] Clark County also collects air quality complaints (including dust complaints) submitted online, over the phone, or via email, and responds to all

[9] https://www.clarkcountynv.gov/government/departments/environment_and_sustainability/compliance/dust_classes.php

complaints within 24 hours or the next business day.[10] Expansive rules and BACM for dust control at construction and temporary commercial activities are included in AQR Section 94. These include requirements for dust control monitors, soil stabilization standards, testing methods, and rules for non-compliance or violations if a permit or Dust Mitigation Plan has been violated. During high-wind dust periods, Clark County compliance officers inspect construction and stationary source sites to ensure BACM are being implemented, and any observed violation may receive a Notice of Non-Compliance or a Notice of Violation.

On October 25, 2020, a Construction Notice was issued by Clark County to all dust control permit holders, contractors, and stationary sources instructing them to immediately inspect their site(s) and employ BACM to stabilize disturbed soils and reduce blowing dust (see **Appendix E**). This and other Clark County public-facing alerts shown in **Section 3.3.1** indicate the implementation of BACM and enforcement procedures. **Appendix D** also provides all inspection information and notices of violation from the October 25, 2020, event.

The Clark County DES is comprised of Monitoring, Compliance and Enforcement, and Planning divisions. The Monitoring Division is primarily responsible for weather and air quality monitoring, forecasting Air Quality Index (AQI) levels and coordinating with other divisions and Clark County more broadly on the issuance of Construction Notices or Advisories. The Compliance and Enforcement Division is responsible for disseminating Construction Notices to appropriate stationary sources, dust control permit holders, and contractors. This department also disseminates Advisories to the public, conducts field inspections of sources before and during a dust event, alerts alleged violators of compliance statuses, and documents observations made in the field of enforcement actions. The Planning Division is responsible for coordinating with the other divisions to prepare exceptional event packages. Full details on these procedures can be found in Appendix E. Based on the implementation of increased control measures, as well as compliance and the enforcement of advisories for windblown dust, part 3 of the nRCP requirement is fulfilled.

The documentation and analysis presented in this demonstration and appendices demonstrate that all identified sources that caused or contributed to the exceedance were reasonably controlled, effectively implemented, and enforced at the time of the event; therefore, emissions associated with the October 25, 2020, PM_{10} event were not reasonably controllable or preventable.

[10] https://www.clarkcountynv.gov/government/departments/environment_and_sustainability/division_of_air_quality/air_quality_complaints.php

5. Natural Event

The October 25, 2020, event is the result of a frontal passage with high winds proceeding directly over the Great Basin and northern Mojave Desert source regions and into Clark County, NV. In the case when high-wind events pass over natural undisturbed lands, the EPA considers high-wind dust events natural. In addition, there were controls in place for anthropogenic sources, **Section 4.2**, during the high-wind dust event. Therefore, we conclude this event meets the EPA criteria for a natural event.

6. Conclusions

The evidence provided within this report demonstrates that the PM_{10} exceedance on October 25, 2020, was caused by a High Wind Dust Event where dust was lofted, entrained, and transported from the extremely dry Great Basin and northern Mojave Desert source regions. Key elements and evidence associated with the event timeline include:

1. A strong frontal passage quickly pushed through northern and central Nevada (and the Great Basin Desert and northern Mojave Desert) at approximately 00:00 PST on October 25, 2020. With this frontal passage, dust from the Great Basin Desert was lofted, entrained, and transported to Clark County. As the front passed through the northern Mojave Desert in the mid-morning on October 25, additional dust was lofted and entrained (as shown by the PM_{10} concentration in Inyo County, CA). Meteorological stations along the transport path show winds greater than the 25-mph threshold.
2. Back trajectories and meteorological data along the frontal passage confirm the Great Basin Desert and northern Mojave Desert as the source regions for the high-wind dust event. The frontal passage descended from the north through the source region enroute to Clark County, NV, within 24 hours of the exceedance. Satellite data, meteorological data, and visual evidence all align to confirm event transport from the Great Basin and northern Mojave Desert. PM_{10} concentrations in the Reno, NV, and Inyo County, CA, regions confirm high PM_{10} along the timeline and trajectories established.
3. The frontal passage entered Clark County by 11:00 PST and peaked in intensity by 15:00 PST on October 25, 2020. Along with the frontal passage, PM_{10} was extremely enhanced, construction and weather alerts were issues, camera images and visibility show dusty conditions, and $PM_{2.5}/PM_{10}$ dropped (indicating windblow dust). Although some wildfire smoke was present in California during this time, the low $PM_{2.5}/PM_{10}$ ratios suggest that the major impact on this event was due to windblown dust.
4. PM_{10} concentrations increased at the same time as wind speeds in Clark County, starting at 11:00 PST and peaking at 15:00 PST on October 25, 2020. 24-hour PM_{10} concentrations were well above the NAAQS threshold of 150 µg/m^3 (regulatory significance: Jerome Mack at 210 µg/m^3 and Sunrise Acres at 163 µg/m^3). Six other monitoring sites throughout the Las Vegas Valley also recorded PM_{10} concentrations above the 99th percentile but were not regulatorily significant in this case.
5. PM_{10} at Jerome Mack and Sunrise Acres exceeded the five-year 99th percentile and the NAAQS on October 25, 2020. PM_{10} concentrations are also significantly outside typical diurnal, monthly, and seasonal ranges.
6. Clark County, NV, and the surrounding source regions were under increasingly severe drought conditions on October 25, 2020. The 30-year climatology shows that temperatures and wind speeds were above normal, while soil moisture was below normal. The barren land

cover, including the Great Basin and northern Mojave Desert source region, was primed for significant dust production during the high-wind event. PM_{10} control measures within Clark County were quickly overwhelmed and unable to prevent an exceedance event on October 25, 2020. Dust lofted and transported from this natural, undisturbed area experiencing severe drought is considered to be a natural event that is not reasonable or controllable.

7. Analyses comparing other dates similar to October 25, 2020, include dates with comparable wind profiles that did not show PM_{10} concentrations above the NAAQS. This analysis indicates that in the absence of an extremely dry source region and high surface winds, PM_{10} concentrations would not have been exceptionally high.

Within this document the following requirements for the EER have been met:

1. A narrative conceptual model that describes the event(s) causing the exceedance or violation and a discussion of how emissions from the event(s) led to the exceedance or violation at the affected monitor(s),
2. A demonstration that the event affected air quality in such a way that there exists a clear causal relationship between the specific event and the monitored exceedance or violation,
3. Analyses comparing the claimed event-influenced concentration(s) to concentrations at the same monitoring site at other times,
4. A demonstration that the event was both not reasonably controllable and not reasonably preventable,
5. A demonstration that the event was a human activity that is unlikely to recur at a particular location or was a natural event, and
6. Documentation that the air agency followed the public comment process (included in **Appendix F**).

The high-wind dust event that occurred on October 25, 2020, caused a 24-hour PM_{10} NAAQS exceedance with regulatory significance of 210 $\mu g/m^3$ at Jerome Mack (Monitor AQS ID 32-003-0540, POC 1) and 163 $\mu g/m^3$ at Sunrise Acres (Monitor AQS ID 32-003-0561, POC 1). Six additional suspected wind-blown dust events occurred between 2020 and 2022. Without EPA concurrence that the wind-blown dust event on October 25, 2020, and the other suspected 2022 events qualify as an exceptional event, the 2020-2022 design value is 4.0 at Jerome Mack and 3.0 at Sunrise Acres. With EPA concurrence on October 25, 2020, and the other 2022 suspected events, the 2020-2022 design value is 1.0 at Jerome Mack and 0.7 at Sunrise Acres, which are both within the attainment standard. Within this demonstration, all elements of the EER have been addressed. Therefore, we request that the EPA consider the overwhelming evidence of windblown dust that occurred in Clark County on October 25, 2020, and agree to exclude the event from regulatory decisions regarding PM_{10} attainment.

7. References

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