ENCLOSURE: TECHNICAL SUPPORT DOCUMENT FOR EPA NONCONCURRENCE ON O_3 EXCEEDANCES MEASURED IN CLARK COUNTY, NEVADA ON JUNE 22, 2020 AS AN EXCEPTIONAL EVENT

On July 1, 2021, Clark County Department of Environment and Sustainability (CCDES) submitted an exceptional event demonstration for three exceedances of the 2015 8-hour ozone (O_3) National Ambient Air Quality Standards (NAAQS) of 0.070 parts per million (ppm) that occurred at the Paul Meyer, Walter Johnson and Joe Neal monitoring sites on June 22, 2020.[1,2] The demonstration submitted by CCDES stated that the exceedances measured on June 22, 2020 were caused by multiple wildfires burning in the western portion of Arizona, namely the Mangum, Bush and Bighorn fires, along with the Ivanpah Fire – a smaller fire in the Mojave National Preserve in California.[3] Under the Exceptional Events Rule, air agencies can request the exclusion of event-influenced data, and the EPA can agree to exclude these data, from the data set used for certain regulatory decisions only if the EPA determines that the agencies have demonstrated that the event meets the rule criteria and requirements.

As described further in this document, EPA has concluded that this event does not meet the requirements in the Exceptional Events Rule because the demonstration has not sufficiently shown a clear causal relationship between the specific event and the monitored exceedances. This conclusion was based on review of the extensive evidence presented in the demonstration, including meteorological information, fire emission information, trajectory analysis, satellite data, smoke modeling data, ground level monitoring data, analysis of meteorologically similar days, and statistical modeling analysis. The data and analyses presented in the demonstration, though extensive, do not support that wildfire emissions were transported to the Paul Meyer, Walter Johnson, and Joe Neal monitoring sites and impacted air quality so as to cause exceedances of the NAAQS. As a result, the EPA is nonconcurring on this exceptional event demonstration.

The remainder of this document summarizes the Exceptional Events Rule requirements, the event that is the subject of the submitted demonstration, the EPA's review process, and the bases for the EPA's determinations regarding the event.

EXCEPTIONAL EVENTS RULE REQUIREMENTS

The EPA promulgated the Exceptional Events Rule in 2007, pursuant to the 2005 amendment of Clean Air Act (CAA) Section 319. In 2016, the EPA finalized revisions to the Exceptional Events Rule. The 2007 Exceptional Events Rule and 2016 Exceptional Events Rule revisions added sections 40 CFR §50.1(j)-(r); §50.14; and §51.930 to title 40 of the Code of Federal Regulations (CFR). These sections contain definitions, criteria for EPA approval, procedural requirements, and requirements for air agency demonstrations. The EPA reviews the information and analyses in the air agency's demonstration package using a weight of evidence approach and decides to concur or not concur. The demonstration must satisfy all of the Exceptional Events

[1] "Exceptional Event Demonstration for Ozone Exceedances in Clark County, Nevada – June 22, 2020," (July 2021) ("demonstration").
[2] While submitted by CCDES, the demonstration was prepared by Sonoma Technology under contract with CCDES.
[3] See demonstration, p. 1-1.

Rule criteria for the EPA to concur with excluding the air quality data from regulatory decisions. If any one of the criteria are not met, the EPA will nonconcur with the demonstration.

Under 40 CFR §50.14(c)(3)(iv), the air agency demonstration to justify exclusion of data must include:

A. "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);"

B. "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;"

C. "Analyses comparing the claimed event-influenced concentration(s) to concentrations at the same monitoring site at other times" to support requirement (B) above;

D. "A demonstration that the event was both not reasonably controllable and not reasonably preventable;" and

E. "A demonstration that the event was a human activity that is unlikely to recur at a particular location or was a natural event."[4]

In addition, the air agency must meet several procedural requirements, including:

1. submission of an Initial Notification of Potential Exceptional Event and flagging of the affected data in the EPA's Air Quality System (AQS) as described in 40 CFR §50.14(c)(2)(i),

2. completion and documentation of the public comment process described in 40 CFR §50.14(c)(3)(v), and

3. implementation of any relevant mitigation requirements as described in 40 CFR §51.930.

For data influenced by exceptional events to be excluded from use in initial area designations, air agencies must also meet the initial notification and demonstration submission deadlines specified in Table 2 to 40 CFR §50.14. We include below a summary of the Exceptional Events Rule criteria, including those identified in 40 CFR §50.14(c)(3)(iv).

Regulatory Significance

The 2016 Exceptional Events Rule includes regulatory language that applies the provisions of CAA section 319 to a specific set of regulatory actions. As identified in 40 CFR §50.14(a)(1)(i), these regulatory actions include initial area designations and redesignations; area classifications;

[4] A natural event is further described in 40 CFR §50.1(k) as "an event and its resulting emissions, which may recur at the same location, in which human activity plays little or no direct causal role. For purposes of the definition of a natural event, anthropogenic sources that are reasonably controlled shall be considered to not play a direct role in causing emissions."

attainment determinations (including clean data determinations); attainment date extensions; findings of State Implementation Plan (SIP) inadequacy leading to a SIP call; and other actions on a case-by-case basis as determined by the Administrator. Air agencies and the EPA should discuss the regulatory significance of an exceptional events demonstration during the Initial Notification of Potential Exceptional Event prior to the air agency submitting a demonstration for the EPA's review.

Narrative Conceptual Model

The 2016 Exceptional Events Rule directs air agencies to submit, as part of the demonstration, a narrative conceptual model of the event that describes and summarizes the event in question and provides context for analyzing the required statutory and regulatory technical criteria. Air agencies may support the narrative conceptual model with summary tables or maps. For wildfire O_3 events, the EPA recommends that the narrative conceptual model also discuss the interaction of emissions, meteorology, and chemistry of event and non-event O_3 formation in the area, and, under 40 CFR §50.14(a)(1)(i), must describe the regulatory significance of the proposed data exclusion.

Clear Causal Relationship and Supporting Analyses

The EPA considers a variety of evidence when evaluating whether there is a clear causal relationship between a specific event and the monitored exceedance or violation. For wildfire O_3 events, air agencies should compare the O_3 data requested for exclusion with seasonal and annual historical concentrations at the air quality monitor to establish a clear causal relationship between the event and monitored data. In addition to providing this information on the historical context for the event-influenced data, air agencies should further support the clear causal relationship criterion by demonstrating that the wildfire's emissions were transported to the monitor, that the emissions from the wildfire influenced the monitored concentrations, and, in some cases, air agencies may need to provide evidence of the contribution of the wildfire's emissions to the monitored O_3 exceedance or violation.

For wildfire O_3 events, the EPA has published a guidance document that provides three different tiers of analyses that apply to the "clear causal relationship" criterion within an air agency's exceptional events demonstration.[5] This tiered approach recognizes that some wildfire events may be more clear and/or extreme and, therefore, require relatively less evidence to satisfy the rule requirements. If a wildfire/O_3 event satisfies the key factors for either Tier 1 or Tier 2 clear causal analyses, then those analyses are the only analyses required to support the clear causal relationship criterion within an air agency's demonstration for that particular event. Other wildfire/O_3 events will be considered based on Tier 3 analyses.

- Tier 1: Wildfires that clearly influence monitored O_3 exceedances or violations when they occur in an area that typically experiences lower O_3 concentrations.
    - *Key Factor*: seasonality and/or distinctive level of the monitored O_3 concentration. The event-related exceedance occurs during a time of year that

[5] "Guidance on the Preparation of Exceptional Events Demonstrations for Wildfire Events that May Influence Ozone Concentrations" (September 2016) ("wildfire O_3 guidance document").

typically has no exceedances, or is clearly distinguishable (*e.g.*, 5-10 parts per billion (ppb) higher) from non-event exceedances.
    - In these situations, O_3 impacts should be accompanied by clear evidence that the wildfire's emissions were transported to the location of the monitor.

- Tier 2: The wildfire event's O_3 influences are higher than non-event related concentrations, and fire emissions compared to the fire's distance from the affected monitor indicate a clear causal relationship. If both key factors are met, then a Tier 2 demonstration will likely be sufficient.
    - *Key Factor 1*: fire emissions and distance of fire(s) to affected monitoring site location(s). Calculated fire emissions of nitrogen oxides (NO_x) and reactive-volatile organic compounds (VOC) in tons per day (Q) divided by the distance from the fire to the monitoring site (D) should be equal to or greater than 100 tons per day/kilometers ($Q/D \geq 100$ tpd/km). The guidance document provides additional information on the calculation of Q/D.
    - *Key Factor 2*: comparison of the event-related O_3 concentration with non-event related high O_3 concentrations. The exceedance due to the exceptional event:
        - is in the 99th or higher percentile of the five-year distribution of O_3 monitoring data, OR
        - is one of the four highest O_3 concentrations within one year (among those concentrations that have not already been excluded under the Exceptional Events Rule, if any).
    - In addition to the analysis required for Tier 1, the air agency should supply additional evidence to support the weight of evidence that emissions from the wildfire affected the monitored O_3 concentration.

- Tier 3: The wildfire does not fall into the specific scenarios (i.e. does not meet the key factors) that qualify for Tier 1 or Tier 2, but the clear causal relationship criterion can still be satisfied by a weight of evidence showing.
    - In addition to the analyses required for Tier 1 and Tier 2, an air agency may further support the clear causal relationship with additional evidence that the fire emissions caused the O_3 exceedance.

Not Reasonably Controllable or Preventable

The Exceptional Events Rule requires that air agencies establish that the event be both not reasonably controllable and not reasonably preventable at the time the event occurred. This requirement applies to both natural events and events caused by human activities; however, it is presumed that wildfires on wildland will satisfy both factors of the "not reasonably controllable or preventable" element unless evidence in the record clearly demonstrates otherwise.[6]

[6] A wildfire is defined in 40 CFR §50.1(n) as "any fire started by an unplanned ignition caused by lightning; volcanoes; other acts of nature; unauthorized activity; or accidental, human-caused actions, or a prescribed fire that has developed into a wildfire. A wildfire that predominantly occurs on wildland is a natural event." Wildland is defined in 40 CFR §50.1(o) as "an area in which human activity and development are essentially non-existent, except for roads, railroads, power lines, and similar transportation facilities. Structures, if any, are widely scattered."

Natural Event

According to the CAA and the Exceptional Events Rule, an exceptional event must be "an event caused by human activity that is unlikely to recur at a particular location *or* a natural event" (emphasis added). The 2016 Exceptional Events Rule includes in the definition of wildfire that "[a] wildfire that predominantly occurs on wildland is a natural event." Once an agency provides evidence that a wildfire on wildland occurred and demonstrates that there is a clear causal relationship between the measurement under consideration and the event, the EPA expects minimal documentation to satisfy the "human activity that is unlikely to recur at a particular location or a natural event" element. The EPA will address wildfires on other lands on a case-by-case basis.

EPA REVIEW OF EXCEPTIONAL EVENTS DEMONSTRATION

On November 30, 2020, CCDES submitted an Initial Notification of a potential Exceptional Event for numerous exceedances of the 2015 8-hour O_3 NAAQS that occurred at monitoring sites within Clark County, Nevada during 2018 and 2020.[7] On July 1, 2021, CCDES submitted an exceptional event demonstration for three exceedances of the 2015 8-hour O_3 NAAQS that occurred at the Paul Meyer, Walter Johnson, and Joe Neal monitoring sites within Clark County, Nevada on June 22, 2020.[8]

Regulatory Significance

The EPA determined that data exclusion of some of the exceedances referenced in the Initial Notification may have a regulatory significance for an attainment date extension or determination of attainment by the Marginal area attainment date for the Las Vegas nonattainment area (NAA) for the 2015 8-hour O_3 NAAQS, and worked with CCDES to identify the relevant exceedances and monitoring sites affected.[9] Table 1 summarizes the exceedances that CCDES included in the demonstration.

Table 1: 2015 8-hour O_3 NAAQS Exceedance Summary

Exceedance Date	Monitoring Site Name	AQS ID	2015 8-hour Avg. (ppm)
June 22, 2020	Joe Neal	32-003-0075	0.078
June 22, 2020	Paul Meyer	32-003-0043	0.074
June 22, 2020	Walter Johnson	32-003-0071	0.073

Narrative Conceptual Model

The demonstration submitted by CCDES provided a narrative conceptual model in Section 1.4 to describe how emissions from the Mangum, Bush and Bighorn wildfires burning in the western portion of Arizona and the Ivanpah fire – a smaller fire in the Mojave National Preserve in California – may have caused the O_3 exceedances at the Paul Meyer, Walter Johnson and Joe

[7] See email from Araceli Pruett, CCDES, to multiple staff at EPA Region 9, dated November 30, 2020.
[8] See letter from Marci Henson, CCDES, to Elizabeth Adams, EPA Region 9, dated July 1, 2021.
[9] See letters from Elizabeth Adams, EPA Region 9, to Michael Sword, CCDES, dated January 26, 2021, and to Marci Henson, CCDES, dated April 26, 2021 and May 4, 2021.

Neal monitoring sites. Additional information addressing narrative conceptual model components was also presented in the Executive Summary and Sections 2 and 3. The narrative conceptual model and additional information in the demonstration included characteristics of the Clark County area, such as descriptions of typical O_3 formation, the ambient O_3 monitoring network, meteorology, geography, topography, emissions, and seasonal O_3 variations.[10] The demonstration incorrectly identified that the exceedances at the three sites could lead to an O_3 nonattainment designation for the Clark County area;[11] the portion of Clark County containing the three monitors is currently designated as the Las Vegas, NV Marginal NAA for the 2015 O_3 NAAQS. The demonstration and the conceptual model did not identify the regulatory action for which this event is significant, which is a determination whether the area attained by the Marginal area attainment date or qualifies for an attainment date extension.

The demonstration described event-related characteristics and included statements that the observed exceedances were caused by emissions from the Mangum, Bush, and Bighorn wildfires in Arizona and the Ivanpah wildfire in California and that these exceedances qualify as an exceptional event under the Exceptional Events Rule.[12] The summary of the event stated that the wildfires were caused by lightning, accidental human ignition, or unknown events, and that smoke from these western Arizona and California fires reached Clark County on June 22, 2020.[13] The demonstration asserts that O_3 concentrations in the Las Vegas area were affected by the wildfires in Arizona, which produced emissions that arrived in Clark County the night of June 21, 2020 and led to the enhanced O_3 concentrations on June 22, 2020; it also notes that while the Ivanpah Fire in California may have contributed to high O_3 late in the afternoon on June 22, 2020, the timing of the smoke impact from the Ivanpah Fire on Clark County is less certain.[14] The demonstration included Clark County perimeter maps with monitor locations; Hazard Mapping System (HMS) fire detection maps from June 19-22, 2020 showing large smoke plumes emanating from the three wildfires from western Arizona and a small plume from the Ivanpah Fire on June 22, 2020; and ground imagery of reduced visibility in the Las Vegas area on June 22, 2020.[15]

The demonstration presented graphs of daily 8-hour maximum O_3 concentrations measured in 2015-2020 for each violating monitor (Paul Meyer, Walter Johnson and Joe Neal), along with hourly O_3 concentrations for all monitors in Clark County from June 15-30, 2020.[16] Graphs of 8-hour maximum concentrations were presented as times series plots, as well as by day of year to show seasonality.[17] These graphs showed 8-hour maximum concentrations above the 99th percentile for Joe Neal and Paul Meyer monitoring sites on June 22, 2020, while the Walter Johnson monitoring site was below the 99th percentile. The hourly O_3 concentration plots showed increasing maximum O_3 in the days leading up to June 22, 2020, with concentrations decreasing slightly after the June 22, 2020 exceedance.[18] The demonstration did not include any evidence

[10] See demonstration, pp. 2-1 to 2-13.
[11] See demonstration, p. ES-1.
[12] See demonstration, pp. 1-7 to 1-8.
[13] See demonstration, p. 1-1.
[14] See demonstration, p. 1-7.
[15] See demonstration, pp. 3-7 to 3-8, pp. 3-25 to 3-26.
[16] See demonstration, pp. 2-6 to 2-13.
[17] See demonstration, pp. 2-10 to 2-12.
[18] See demonstration, p. 2-13.

that CCDES issued any air quality advisories noting that the area was being impacted by wildfire smoke or that high O_3 concentrations were expected due to wildfire emissions.

The demonstration stated that O_3 and O_3 precursor emissions from the fires were transported via a surface low pressure system, facilitating northward and westward transport from the Arizona fires and eastward from the California fire.[19] It also noted high O_3 concentrations in central and southern California on June 21, 2020 that persisted through June 22, 2020 as observed in plots of the Air Quality Index (AQI) on the EPA's AirNow page; the demonstration asserted that the plots show transport of O_3 and O_3 precursors from southern California to the California/Nevada border. Additionally, the demonstration included AirNow maps showing particulate matter with an aerodynamic diameter less than or equal to a nominal 2.5 micrometers ($PM_{2.5}$) in the moderate AQI range observed in southern California on June 21, 2020, continuing into June 22, 2020. The demonstration states the area between Los Angeles and Las Vegas is mostly devoid of $PM_{2.5}$ monitors; thus, elevated $PM_{2.5}$ from the Ivanpah Fire would not have been observed in this area.[20] It should be noted that the Ivanpah Fire did not start until June 22, 2020 and therefore high O_3 and $PM_{2.5}$ in southern California observed on June 21, 2020 was not due to production from the Ivanpah Fire. The demonstration also stated that trajectory analysis and diurnal profiles of ground-level $PM_{2.5}$, carbon monoxide (CO), nitrogen dioxide (NO_2), and total nonmethane organic compounds (TNMOC) showed that wildfire smoke impacted Clark County in the evening of June 21, 2020 and that uncharacteristic increases in O_3 precursors suggest that wildfire emissions were transported into Clark County, diluted in the nighttime boundary layer, and circulated in the Las Vegas Valley overnight, causing the exceedance on June 22, 2020.[21]

The demonstration information referenced above includes several analyses that were located outside of the demonstration's stated narrative conceptual model and within the detailed technical sections addressing other rule criteria. The wildfire O_3 guidance document states that narrative conceptual models are expected to "help readers and the reviewing EPA Regional office understand the event formation and the event's influence on monitored pollutant concentrations before the reader reaches the portion of the demonstration that contains the technical evidence to support the requested data exclusion."[22] The detail provided in Section 1.4 did not clearly or completely outline the conceptual model of the event formation and influence on monitored pollutant concentrations; rather, it presented the conceptual model as a summary of the clear causal relationship evidence. The conceptual model section also did not include the types of information outlined in the wildfire O_3 guidance document. Additional information that reflected the conceptual model requirements was included elsewhere in the demonstration and is described above; however, this information should have been included or specifically referenced in the conceptual model portion at the beginning of the demonstration to clearly outline the demonstration's overall characterization of how the event led to the observed exceedances.

Overall, the demonstration contained the elements required for inclusion in the conceptual model portion of the exceptional events demonstration.

[19] See demonstration, p. 3-55.
[20] See demonstration, pp. 3-5 to 3-6.
[21] See demonstration, p. 3-10, pp. 3-42 to 3-44.
[22] See wildfire O_3 guidance document, p. 7.

Table 2: Documentation of the Narrative Conceptual Model

Exceedance Date	Demonstration Citation	Quality of Evidence	Criterion Met?
June 22, 2020	Executive Summary: p. ES-1 Section 1.4: pp. 1-1, 1-7 to 1-8 Section 2: pp. 2-6 to 2-13 Section 3: pp. 3-5 to 3-8, 3-10, 3-25 to 3-26, 3-42 to 3-44, 3-55	Sufficient	Yes

Clear Causal Relationship

The demonstration included several analyses intended to support a clear causal relationship between the wildfire event and the monitored exceedances. These analyses are presented in Section 2.3 and Section 3 of the demonstration.

Comparison with historical concentrations

The demonstration included a comparison with historical concentrations, as required by 40 CFR §50.14(c)(3)(iv)(C). The demonstration compared the exceedances to six years of historical data (2015-2020) at the three affected monitoring sites.[23] The data was presented in graphs as well as tables. The graphs show that two of the three monitoring sites (Joe Neal and Paul Meyer) experienced maximum 8-hour O_3 concentrations above the 99th percentile when using six years of year-round data, while the Walter Johnson monitoring site fell below the 99th percentile. When comparing to percentiles calculated only for the five-year history (2015-2019) from the week before and after the exceedance day, the concentration measured at Joe Neal on June 22, 2020 was at the 99th percentile value and concentrations at Walter Johnson and Paul Meyer were below the 99th percentile values. Rank-ordered O_3 concentrations showed that the Joe Neal monitoring site was the only violating monitoring site that had a June 22, 2020 exceedance value that fell within the top five O_3 concentrations in 2020. All sites measured multiple other exceedances during the six-year period of historical data that were higher in magnitude than those measured on June 22, 2020.

Tier 1: Key Factor

To meet the key factor for a Tier 1 analysis, exceedances should be clearly higher than other non-event related exceedances or occur during a time of year that typically experiences no exceedances. The exceedances identified in this demonstration fall within the regular O_3 season of Clark County during times when other exceedances similar in magnitude were measured. Therefore, the exceedances do not meet the Tier 1 Key Factor and additional evidence beyond a Tier 1 analysis is needed to support the clear causal relationship.

Tier 2: Key Factors

The demonstration included an evaluation of the Tier 2 Key Factors. For the Tier 2 Key Factor 1, the demonstration provided an analysis of fire emissions (Q) and distance (D) of the wildfires to the monitoring site locations.[24] The demonstration generated 24-hour back trajectories from the affected monitoring sites, establishing a buffer of 25% of the distance traveled by the trajectory to establish which wildfires the demonstration should include in Q/D analysis. None of the western Arizona fires (Bush, Bighorn and Mangum wildfires) fell within the distance buffer,

[23] See demonstration, pp. 2-7 to 2-12, pp. 3-1 to 3-5, pp. 3-34 to 3-36.
[24] See demonstration, pp. 3-27 to 3-33.

indicating transport within the previous 24 hours from western Arizona fires was not likely. To calculate total daily emissions of NO_x and reactive VOCs, the demonstration utilized BlueSky Playground, including information such as the fire's location and daily fire growth derived from news reports citing official sources. The distance-weighted sum for the Ivanpah wildfire is 0.1 tpd of NO_x and VOC per km, which is well below the Tier 2 Key Factor 1 screening value of 100 tpd/km. In Appendix C, the demonstration included additional analyses to calculate Q/D for the western Arizona wildfires along with the Ivanpah Fire over three days, identified as an "extended" Q/D.[25] Gathering fire growth, location and emission data from the Incident Information System (InciWeb) or media reports, the extended Q/D analyses showed an aggregated Q/D value of 2.0 tpd/km, 3.4 tpd/km, and 2.4 tpd/km of NO_x and reactive VOCs on June 22, 21, and 20, respectively. These values are also well below the screening value of 100 tpd/km, even if combined over multiple days. Therefore, the event exceedances do not meet the Tier 2 Key Factor 1.

For the Tier 2 Key Factor 2, the demonstration included evidence that one of the three exceedances was at or above the 99th percentile from the past five years of O_3 season data (May through September) from 2015-2019 and was among the four highest concentrations measured at the site in 2020, while the other two exceedances were not.[26] The Joe Neal monitoring site was above the 99th percentile of O_3 season data and was among the four highest concentrations in 2020 at 78 ppb. The Walter Johnson and Paul Meyer monitoring sites experienced exceedances below the 99th percentile of O_3 season data; the exceedance at Paul Meyer was, however, above the 99th percentile value for the full five years of O_3 data, while the exceedance at Walter Johnson was below the 99th percentile values calculated using seasonal or annual data. Additionally, the concentrations measured at the Paul Meyer and Walter Johnson monitoring sites on June 22, 2020 were not among the four highest concentrations measured at the site in 2020. The demonstration presented a similar analysis excluding potential exceptional event days and concluded that all three exceedances would be within the top four concentrations measured for the year;[27] however, it was not confirmed that the potential exceptional event days would qualify for exclusion. Therefore, the event exceedances do not meet the Tier 2 Key Factor 2 at the Walter Johnson monitoring site; the event exceedances meet the Tier 2 Key Factor 2 at the other two sites.

Based on the analysis of the Key Factors for Tier 2, the EPA's wildfire O_3 guidance document indicates that a Tier 3 analysis is appropriate for this event. As described below, the demonstration included analyses intended to address the required elements for a Tier 3 clear causal relationship analysis based on the EPA's wildfire O_3 guidance document. This includes evidence intended to support that (1) wildfire emissions were transported from the wildfire to the monitor; (2) wildfire emissions affected the monitor; and (3) wildfire emissions caused the O_3 exceedance(s).

<u>Tier 3 analysis: Evidence of transport of wildfire emissions from the wildfire to the monitors</u>
The demonstration presented HMS fire and smoke maps, smoke tracer modeling, Hybrid Single-Particle Lagrangian Integrated Trajectory model (HYSPLIT) trajectory analysis, meteorological conditions, satellite/surface imagery, and media coverage as evidence to support that fire

[25] See demonstration, Appendix C.
[26] See demonstration, pp. 3-4 to 3-5, 3-34 to 3-36.
[27] See demonstration, p. 3-34.

emissions were transported to the monitoring sites. The HMS fire detection maps included in the demonstration show smoke plumes to the east of Clark County on June 19-22, 2020 that appear to be associated with fires in western Arizona, including the Mangum, Bush, and Bighorn fires.[28] These smoke plumes generally remained well east of Clark County during this period, except on June 20, 2020, when the smoke plume covered the southern tip of Clark County but did not extend to the Las Vegas area. The maps also show the Ivanpah Fire smoke plume on June 22, 2020; this plume is much smaller than the larger eastern plumes and extended about halfway between the fire and Las Vegas but did not reach the Las Vegas area. The demonstration stated that although the HMS smoke plumes from the Arizona wildfires do not extend into Clark County on June 22, 2020, variable wind speeds and the volume of smoke produced likely still contributed to O_3 and O_3 precursor levels in Clark County. However, the maps in the demonstration only show that substantial smoke was produced and transported to the east of Las Vegas in the days leading up to the June 22, 2020 exceedance, and that the Ivanpah Fire did produce smoke at some point on June 22, 2020 to the southwest of Las Vegas. They do not show that smoke from the three Arizona fires or the Ivanpah Fire was transported to the Las Vegas area. Further, the HMS graphics can only indicate that smoke was located somewhere vertically in the atmosphere, but do not show whether smoke was aloft or at ground level.

The demonstration additionally included data showing modeled emissions and dispersion of a particulate matter tracer from the Mangum, Bighorn, and Bush fires on June 21, 2020, modeled using the U.S. Forest Service BlueSky Pipeline.[29] As described in the conceptual model, the demonstration argued that smoke from these fires arrived overnight on June 21, 2020 and affected O_3 concentrations on June 22, 2020. The modeled tracer concentrations averaged between 0-500 meters (m) over June 21, 2020 were plotted and show only the smallest reported magnitude of tracer in portions of Clark County to the east, south, and west of the Las Vegas area, and do not show any tracer concentration within the Las Vegas area. The demonstration stated that this modeling indicates smoke impacts within Clark County on June 21, 2020 in the mixed layer. The tracer was not detected in the Las Vegas area, and for the remaining portions of Clark County where it was detected, a legend was not provided for the smoke tracer so the magnitude of this lowest concentration of smoke impact is unknown. The demonstration also did not include sufficient information to resolve the timing of the modeled smoke tracer arrival in Clark County (*e.g.*, early morning, afternoon, or evening on June 21, 2020).

The demonstration included several different HYSPLIT analyses to assess transport. The demonstration listed the timing of trajectories in both Coordinated Universal Time (UTC) and "local time," which appears to reference Pacific Standard Time (PST).[30] The first analysis was a map of Clark County overlaid with high resolution 48-hour HYSPLIT back trajectories at 50 m, 500 m, and 1000 m altitudes initiated at approximately 00:00 UTC on June 22, 2020 (4:00 PM PST on June 21, 2020), along with HMS smoke plumes from June 20 and 21, 2020.[31] The map shows that an air parcel briefly passed through an area affected by the smoke plume from the Arizona wildfires, but does not address whether transport occurred at levels where smoke was present or whether the timing of transport was consistent with the smoke plumes. The trajectories

[28] See demonstration, p. 3-8.
[29] See demonstration, pp. 3-8 to 3-9.
[30] In June 2020, the local time zone for Las Vegas was Pacific Daylight Time (PDT). However, for consistency with the demonstration, this TSD will use PST. The offset from PDT to PST is one hour later (*i.e.*, 12:00 PM in PST is 1:00 PM in PDT).
[31] See demonstration, p. 3-14.

passed by the areas with smoke between approximately 4:00 PM PST on June 20, 2020 and 4:00 AM PST on June 21, 2020 near ground level. While the HMS smoke plumes indicate smoke in this region between June 20 and June 21, 2020, they do not indicate whether smoke is present at ground level or aloft. The demonstration did not provide any evidence to support that smoke in this area was present near ground level at the time the trajectories passed through at that level. An analysis containing a HYSPLIT trajectory matrix initiated at 00:00 UTC on June 22, 2020 (4:00 PM PST on June 21, 2020) at 500m showed that transport to Las Vegas was generally from the south and most trajectories came from southern California, with a few passing through the western edge of Arizona and the area with smoke plumes.[32] This suggests that transport affecting Las Vegas at that time was primarily not from areas containing smoke from the Mangum, Bighorn, and Bush fires. Importantly, no HYSPLIT trajectories were provided showing transport from areas near those fires, only from areas at the edge of smoke plumes that appeared to be associated with the fires.

A second set of HYSPLIT analyses was provided to explore possible contributions from the Ivanpah Fire on June 22, 2020, analogous to the two analyses provided for the Arizona fires. The first HYSPLIT analysis similarly included a map of Clark County overlaid with HMS smoke plumes from June 22, 2020 and high resolution 24-hour back trajectories at 50 m and 100 m altitudes, initiated at 23:00 UTC on June 22, 2020 (3:00 PM PST on June 22, 2020).[33] These trajectories, which reached Las Vegas several hours after the highest O_3 concentrations in the area (O_3 concentrations at the exceeding sites peaked around 11:00 AM to 1:00 PM PST)[34] shows transport from the area around the Ivanpah Fire approximately 12-18 hours prior (*i.e.*, between approximately 9:00 PM PST on June 21, 2020 and 3:00 AM PST on June 22, 2020). The demonstration acknowledges that the Ivanpah Fire did not become active until the late morning or early afternoon on June 22, 2020.[35] The demonstration identified that the fire was not detected during the morning overpass of the Moderate Resolution Imaging Spectroradiometer (MODIS) instrument at approximately 10:30 AM PST and was first reported at 1:42 PM PST, and therefore suggested that the fire likely started in late morning or early afternoon.[36] The HYSPLIT analysis therefore shows transport from near the Ivanpah Fire location at a time when the fire was not yet burning; it appears that the timing of the fire is such that it is unlikely to have impacted air quality in the Las Vegas area on June 22, 2020, and would not have contributed to the peak O_3 concentrations measured on June 22. Similarly, a 24-hour HYSPLIT back trajectory matrix initiated at 23:00 UTC on June 22, 2020 (3:00 PM PST on June 22, 2020) shows transport occurring generally from areas in southern California, including regions with significant O_3 production from anthropogenic sources (*e.g.*, Los Angeles-South Coast).[37] While some of the trajectories pass near the location of the Ivanpah Fire, they do so at times when the fire was not yet burning, and those trajectories arrived in Las Vegas after the hours of peak O_3 concentrations at the exceeding sites. The demonstration further included a 10-hour forward trajectory matrix analysis from the Ivanpah Fire initiated at 19:00 UTC on June 22, 2020 (11:00 AM PST on June 22, 2020) at 250 m.[38] This analysis shows that transport to the Las Vegas area

[32] See demonstration, pp. 3-13, 3-15.
[33] See demonstration, p. 3-16.
[34] See demonstration, pp. 3-45 to 3-47.
[35] See demonstration, p. 3-13.
[36] See demonstration, p. 3-27.
[37] See demonstration, p. 3-17.
[38] See demonstration, pp. 3-21 to 3-23.

from the fire may have occurred, but most likely impacted the Las Vegas area approximately 7-10 hours after the trajectories were initiated or later (*i.e.*, no earlier than 6:00 PM PST, well after the peak O_3 concentrations were measured at the affected monitoring sites, and when hourly O_3 concentrations measured at the three exceeding monitors had been falling for hours and were below 70 ppb).[39]

The demonstration also included HYSPLIT trajectory frequency analyses, which showed results consistent with the other HYSPLIT analyses presented in the demonstration.[40] In summary, the HYSPLIT trajectory analyses show at best limited evidence of transport from the Mangum, Bighorn, and Bush fires in Arizona on June 21, 2020, the day prior to the exceedances, and do not show transport from the Ivanpah Fire in California such that active fire emissions could have been transported to the Las Vegas area in time to affect the observed high O_3 concentrations related to the exceedances measured on June 22, 2020.

The demonstration further included maps of satellite data related to smoke-emitted pollutants, (*i.e.*, aerosol optical depth (AOD), CO, and NO_2).[41] These maps do not provide any evidence that any smoke was present in the area; concentrations appear well within normal concentration ranges as compared to the surrounding areas and to days prior to and following the event. The demonstration stated that MODIS AOD retrievals indicated normal levels of aerosols in the Clark County area, while no CO retrieval information was available for Clark County on June 22, 2020, and the NO_2 retrievals were inconclusive and are therefore presented only in Appendix D. The demonstration also included surface photos from webcams showing a decrease in visibility over the area as compared to a reference day without smoke impacts (May 21, 2020).[42] The decrease in visibility appears to be relatively slight. Surface imagery with limited visibility impairment is not indicative of smoke without the presence of O_3 precursors and more specifically, smoke-emitted pollutants such as particulate matter, CO, organic carbon (OC) or levoglucosan.

The demonstration provided an example of media coverage of the Bush Fire in Arizona on June 21, 2020.[43] This analysis, along with additional media articles provided in Appendix B, primarily describes the larger fires in western Arizona. None of the news articles supplied in the demonstration depict transport of wildfire smoke to the Clark County area. A news release regarding the Ivanpah Fire from the San Bernardino County Fire Department reports that fire crews from the county were dispatched to the Ivanpah Fire on June 23, 2020, the day after the exceedances.[44]

Overall, the trajectory analysis, meteorological conditions and satellite imagery do not provide sufficient support that emissions from the fires in western Arizona and California were transported to the Joe Neal, Walter Johnson, and Paul Meyer monitoring sites in Clark County on June 22, 2020; the analyses primarily support potential transport from areas in southern California experiencing high anthropogenic O_3 concentrations.

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[39] See demonstration, pp. 3-45 to 3-47.
[40] See demonstration, pp. 3-18 to 3-21.
[41] See demonstration, pp. 3-37 to 3-41.
[42] See demonstration, pp. 3-25 to 3-26.
[43] See demonstration, p. 3-24.
[44] See demonstration, Appendix B, p. B.7.

Tier 3 analysis: Evidence that the wildfire emissions affected the monitors

The demonstration provided an analysis of ambient monitoring data of O_3, precursors, and pollutants associated with smoke as evidence intended to show that smoke affected monitoring sites in the Las Vegas area.[45] This analysis included diurnal profiles of O_3, NO_2, $PM_{2.5}$, TNMOC and CO from all monitors in the Clark County area on June 21-23.[46] The demonstration also provided diurnal profiles of $PM_{2.5}$ at the three monitors that measured O_3 exceedances on June 22, 2020 (Joe Neal, Walter Johnson and Paul Meyer monitoring sites), diurnal profiles of CO and NO_2 at the Joe Neal monitoring site, and diurnal profiles of NO_2 at the Jerome Mack monitoring site for the period of June 21-24, 2020, along with the seasonal 5th and 95th historical percentile concentrations and the seasonal average concentration of the respective pollutants for each hour.[47]

The analysis in the demonstration points to peaks in precursor concentrations ($PM_{2.5}$, CO, NO_2, and TNMOC) at 9:00 to 10:00 PM PST on June 21, 2020, the night before the O_3 exceedances occurred on June 22, 2020, stating that these peaks demonstrate the arrival of smoke at the Clark County monitors.[48] The analysis acknowledges that the peaks could be related to dynamics in the planetary boundary layer around this time, but states that the HYSPLIT trajectories and HMS smoke maps in the demonstration supported that this was more likely smoke transport. This assessment is inconsistent with the EPA's evaluation of the HMS and HYSPLIT analyses, which indicate that smoke transport was unlikely. Further, the graphs with the diurnal profiles and percentile concentrations show that for $PM_{2.5}$, CO, and NO_2, the peaks measured late on June 21, 2020 fall within the range of concentrations typically measured and peaks at that time of day are common for all three pollutants, suggesting boundary layer dynamics, as well as reduced photolysis rates in the evening for NO_2, are the main reason for the observed peaks in the evening on June 21, 2020.[49] Of these three pollutants, $PM_{2.5}$ is the pollutant most often associated with wildfire emissions. The graphs show $PM_{2.5}$ concentrations on June 21 and 22, 2020, fluctuating around the seasonal hourly average values at the affected monitoring sites, with concentrations consistently below the average during the night of June 21, 2020 at the Walter Johnson and Paul Meyer monitoring sites and mostly below the average at the Joe Neal site. The diurnal profiles of CO and NO_2 at the Joe Neal monitor show small increases over the mean values in the night of June 21, 2020 and the morning of June 22, 2020, but neither of these peaks are near the 95th percentile values, and both are typically associated with local anthropogenic pollution as well as fires, particularly NO_2 as NO_x is typically a much larger component of anthropogenic source emissions than fire emissions.

The demonstration also included an analysis of $PM_{2.5}$ speciation data showing that the percentage of OC and elemental carbon (EC) of total $PM_{2.5}$ concentrations increased from around 25 percent to 50 percent from June 17, 2020 to June 20, 2020, and remained around 40 percent for the next few sample days (June 23, 26, and 29, 2020).[50] The demonstration did not provide an analysis of the typical percentages of OC and EC for the monitoring site and season or provide data for any other period outside of the June 17-29, 2020 period; there is therefore no evidence that the

[45] See demonstration, pp. 3-41 to 3-54.
[46] See demonstration, p. 3-43.
[47] See demonstration, pp. 3-44 to 3-47, pp. 3-50 to 3-51.
[48] See demonstration, p. 3-42.
[49] See demonstration, pp. 3-45 to 3-47, pp. 3-50 to 3-51.
[50] See demonstration, p. 3-48.

increase observed is a statistically significant increase or that it falls outside the range of typical values for non-smoke impacted periods. The demonstration did not provide any evidence to support that emissions from the fires in Arizona or other fires were transported to the Las Vegas area as early as June 20, 2020 or explain how evidence of increased EC and OC on June 20, 2020 could provide support for a causal connection between the wildfires and the exceedances measured two days later, on June 22, 2020. The demonstration referenced a demonstration submitted by the Arizona Department of Environmental Quality (ADEQ) that was concurred on by the EPA and contained a similar figure comparing EC and OC to total $PM_{2.5}$;[51] however, that demonstration was supplemented by an addendum containing further analysis documenting the statistical range of historical EC and OC measurements and evaluating additional ratios of EC and OC that better correlate with wildfire activity, including the relative ratio of OC to EC.[52] The EPA's concurrence TSD for the ADEQ demonstration outlined how the initial demonstration analysis was inadequate to show wildfire impacts in the Phoenix NAA and relied on the supplemental analysis showing that OC was unusually elevated and the EC/OC ratio was unusually low as compared to historical measurements.[53]

Levoglucosan is a tracer that is commonly indicative of emissions from wood smoke and fires. The demonstration presented the concentration of levoglucosan from a filter collected at the Jerome Mack site in the Las Vegas area.[54] The analysis compared the concentration of levoglucosan measured on June 23, 2020 (7 nanograms per cubic meter, or ng/m^3) to the average concentration measured on selected "background" days (2 ng/m^3 with a standard deviation of 3 ng/m^3) and concluded that the concentration measured on June 23, 2020 was elevated compared to the normal range of levoglucosan concentrations, and that concentrations on the exceedance day (prior) would likely have been higher.

The raw levoglucosan data from 2018-2020 was provided by CCDES to the EPA on request.[55] The EPA more closely reviewed the data treated as background concentrations in the demonstration analysis. Of the 18[56] filter dates used to calculate the background average concentration of levoglucosan for the primary monitor at the Jerome Mack site, 12 had a reported concentration of 0 ng/m^3 because levoglucosan was not detected. The remaining background concentrations ranged from 2.09 ng/m^3 to 11.18 ng/m^3. Interpretation of the mean value of this dataset is difficult because the concentrations do not follow a normal distribution. The levoglucosan concentration measured on June 23, 2020 at Jerome Mack falls within the range of concentrations measured on background days; three of the 18 background day concentrations were higher than the concentration measured on June 23, 2020. Additionally, even though the dataset is not normally distributed, the concentration of 7 ng/m^3 also falls within 2 standard

[51] See demonstration, p. 3-47; "State of Arizona Exceptional Event Documentation for Wildfire-Caused Ozone Exceedances on June 20, 2015 in the Maricopa Nonattainment Area," (September 2016), p. 61.
[52] "Addendum to: State of Arizona Exceptional Event Documentation for Wildfire-Caused Exceedances on June 20, 2015 in the Maricopa Nonattainment Area – September 2016; Additional Evidence that Ozone and Ozone Precursor Emissions From the Lake Fire Reached and Affected Ozone Monitors Within the Maricopa Nonattainment Area" (May 2018), pp. 10-16.
[53] "Technical Support Document for EPA Concurrence on O_3 Exceedances Measured in the Phoenix-Mesa 2008 8-Hour O_3 Nonattainment Area on June 20, 2015 as Exceptional Events," (May 2019), pp. 12-13.
[54] See demonstration, pp. 3-53 to 3-54.
[55] *20210720_LVG_Data_2018-2020.xlsx*
[56] The demonstration states that data from 19 dates were used to calculate the background concentration (see p. 3-53); however, in the file provided by CCDES with the raw data (*20210720_LVG_Data_2018-2020.xlsx)*, only 18 dates were labeled as background dates with reported values for the Jerome Mack site.

deviations of the mean value. The concentration measured on June 23, 2020 therefore does not appear to be elevated above background levoglucosan concentrations for the area.

The demonstration also included ceilometer mixing height data from the Jerome Mack monitoring site in the Las Vegas area and an assessment of upper-level meteorology to address whether vertical transport of smoke above the surface to the ground level could have occurred.[57] However, the demonstration stated that since the HYSPLIT trajectories showed that transport primarily occurred near ground level, neither the ceilometer data nor the upper-level meteorological maps provided useful evidence connecting the emissions from the Ivanpah Fire and Arizona wildfires to impacts at the surface. The lack of evidence of smoke over the Las Vegas area in the satellite observations discussed previously (HMS, AOD, CO, and NO_2) further renders the analysis of upper-level meteorology and mixing height irrelevant for the purposes of showing ground level impacts of wildfire smoke.

Overall, the profiles and analysis of TNMOC, $PM_{2.5}$, CO, NO_2, OC/EC ratios, and levoglucosan concentrations, which all failed to show any clear enhancement in ground level concentrations above the ranges associated with typical, non-event concentrations in the Las Vegas area, do not support the conclusion that wildfire emissions reached ground level and impacted the exceeding monitors.

<u>Tier 3 analysis: Additional evidence that the wildfire emissions caused the O_3 exceedances</u>
The demonstration included additional evidence intended to support the conclusion that the wildfire emissions specifically affected O_3 concentrations at the exceeding Paul Meyer, Walter Johnson and Joe Neal monitoring sites and caused the O_3 exceedances, including matching day analysis and Generalized Additive Model (GAM) statistical modeling as further evidence that the O_3 concentrations were not explained by normal meteorology and emissions in the Las Vegas area.

The demonstration included an analysis of data from days that were meteorologically similar to the exceedance day.[58] The demonstration identified that on June 22, 2020, maximum temperature was in the 86th percentile, mixing layer mixing ratio was in the 75th percentile, and average wind speed was in the 38th percentile, as compared to the 30-day period surrounding June 22 over a seven-year period.[59] Matching dates were selected based on synoptic and local meteorological conditions. HYSPLIT trajectories were used to cluster dates with similar transport patterns, and then meteorological parameters were used to determine the best matching dates among those in the same cluster. The parameters included daily average wind speed, resultant wind direction and speed, geopotential height, relative humidity, and temperature at 1000 millibars (mb) and 500 mb and daily average atmospheric pressure, maximum temperature, and minimum temperature at the surface. Each day selected had a surface level low pressure system in the area. The formal analysis only considered the daily statistics, instead of evaluating, for example, wind speeds during peak O_3 hours. Prioritizing maximum and average temperatures, ten days were provided in the demonstration, with two of the ten days highlighted as especially valuable comparisons to the exceedance event as these two days, along with the exceedance event, fell when COVID-19

[57] See demonstration, pp. 3-54 to 3-56.
[58] See demonstration, pp. 3-62 to 3-65.
[59] See demonstration, p. 3-62.

restrictions were occurring.[60] The days selected had O_3 concentrations ranging from 54 to 70 ppb at the sites that exceeded on June 22, 2020, and the maximum and average temperatures were within six degrees Fahrenheit of the event date temperatures. The demonstration generally found that concentrations on the identified matching days were below the level of the NAAQS and below the concentrations measured on the event day of June 22, 2020.

The matching day analysis did not consider several factors in selecting similar days for comparison, such as ambient NO_x concentrations, weekday/weekend effects, O_3 concentrations on the preceding days, and evaluation of timing of wind speeds in the context of O_3 formation. For example, O_3 can build up gradually over several days; wind speeds in the late morning and early afternoon hours, when O_3 production is typically highest, may factor more strongly into the determination of daily maximum 8-hour average concentrations of O_3. The effects of these potential factors were not discussed, weakening the conclusions drawn in the matching day analysis. Additionally, of the 10 matching days selected, six of the days had measured concentrations above 62 ppb for at least one of the three sites analyzed in the demonstration, while four of the days had measured concentrations above 65 ppb, suggesting that even if the matching days themselves did not measure exceedances, the conditions observed were favorable to elevated O_3 concentrations, and small differences in meteorology, emissions, or other factors between the event day and the selected matching days could be responsible for the higher O_3 values observed on the event day.

While the demonstration did compare the exceedance day to other meteorologically similar days, it did not perform a comprehensive analysis of how the exceedance day compared to other, regular non-event exceedance days to identify any clear differences. As noted in the percentile rank analysis, the event day had relatively high temperatures and low wind speeds for the time of year, conditions conducive to local O_3 formation. The matching day analysis presented in the demonstration does not show that conditions on the event day were notably different than conditions that led to elevated O_3 concentrations and non-event exceedances, nor that the event day meteorology in the presence of normal area emissions alone was insufficient to cause the measured exceedances on the event day. The demonstration referred to a matching day analysis included as part of an addendum to the previously mentioned ADEQ exceptional event demonstration that was concurred on by the EPA and stated that the analysis presented in this demonstration is an expansion of that type of work;[61] however, unlike the demonstration reviewed here, the referenced ADEQ demonstration addendum included a more extensive analysis, including a comprehensive review of exceedance days and associated meteorology and day-of-week effects to show how the event day was unusual in comparison.[62]

To further address the claim that wildfire emissions caused the O_3 exceedances, the demonstration included information on and analysis of output from a GAM analysis that was developed for monitors in the Las Vegas area.[63] GAMs are statistical models intended to allow for prediction of a response (in this case, maximum daily 8-hour O_3 concentrations) based on

[60] See demonstration, pp. 3-62, 3-64.
[61] See demonstration, p. 3-65.
[62] "Addendum to: State of Arizona Exceptional Event Documentation for Wildfire-Caused Exceedances on June 20, 2015 in the Maricopa Nonattainment Area – September 2016; Additional Evidence that Ozone and Ozone Precursor Emissions From the Lake Fire Reached and Affected Ozone Monitors Within the Maricopa Nonattainment Area" (May 2018), pp. 21-28.
[63] See demonstration, pp. 3-65 to 3-85.

linear and non-linear effects from multiple input variables. The GAM described in the demonstration used 16 separate input variables, primarily meteorological in nature, to predict O_3 concentrations each day at eight monitors in the Las Vegas area.

The demonstration provided several analyses to evaluate the GAM performance. An analysis of GAM residuals (*i.e.*, the difference between the observed concentration and the predicted concentration) found that residuals were close to zero (less than 0.5 ppb) when averaged across the dataset, and similarly when considering all days that were not flagged as exceptional events.[64] The flagged day residuals were larger; average residuals across all 2018 and 2020 flagged days ranged between 6-9 ppb for the five sites within the Las Vegas NAA, and were higher (over 12 ppb) for the sites within Clark County and operated by CCDES but outside of the NAA.[65] Values for sites outside of the NAA were based on a much smaller number of dates (2-4 as opposed to 11-22) as the monitors outside of the NAA did not exceed on most of the flagged days. As demonstrated by the R^2 values ranging from 0.55 to 0.61 for the various sites, the data presented show that there is a large amount of variability in concentrations that remains after considering the variables selected.

The wildfire O_3 guidance document states: "Users of regression models should consider the uncertainties in the model's prediction abilities, specifically at high concentrations, before making conclusions based on the modeled results. A key question when considering model uncertainty is whether the model predicts O_3 both higher and lower than monitored values at high concentrations (above 65 or 70 ppb) or whether the model displays systematic bias on these high monitored days."[66] The analysis included in the demonstration attempts to address this concern. The demonstration included a calculation of the average residual of points not flagged as exceptional events with measured concentrations at or above 60 ppb. The average residuals of these higher concentration points were higher than the averages of all residuals and of the non-flagged day residuals, in the range of 3-5 ppb for all sites. This suggests that at least some of the 6-9 ppb average residuals reported for the flagged dates at the sites within the Las Vegas NAA can be explained by the performance of the statistical model at high concentrations, since the flagged dates are typically among the highest concentrations measured. This is common in regression models, as implied by the text in the wildfire O_3 guidance document; points considered for exceptional events demonstrations are typically among the highest observed concentrations at the monitor, and selecting points with high observed concentrations, whether exceptional events or not, will not result in a selection that is normally distributed around the mean of the regression model. Therefore, a positive residual is expected for data with high observed concentrations, even considering the typical performance of the model. In other words, the positive residual is not itself indicative of an unusual source of O_3 affecting the monitors.

The demonstration also included a case study analysis of days not flagged as exceptional events where most monitors measured concentrations above 60 ppb, to evaluate the model performance

[64] See demonstration, p. 3-71.
[65] Of the sites included in the GAM analysis, the sites that fall within the Las Vegas NAA boundaries are Green Valley, Jerome Mack, Joe Neal, Paul Meyer, and Walter Johnson. The GAM analysis also included three sites (Jean, Indian Springs, and Boulder City) which are operated by CCDES and fall outside of the NAA boundaries but are still within Clark County, and are located to the southwest, northwest, and southeast of the NAA, respectively. Refer to p. 2-3 of the demonstration for a map showing the relative locations of the monitors.
[66] See wildfire O_3 guidance document, p. 28.

at higher concentrations.[67] The median residuals across all monitors for each case study day ranged from 0.24 ppb to 3.89 ppb. The demonstration also gave the range (minimum and maximum) of residuals for individual monitors on each case study day. On every case study day, the highest residual for an individual monitor was between 3 ppb and 7 ppb. This further supports that a positive residual of several ppb is common for any individual monitor on higher O_3 days outside of any potential exceptional event impact. In addition, on the case study days selected, the highest concentration measured by any monitor was 72 ppb; residuals might be higher on days that measured higher concentrations.

In order to account for the normal variability inherent in the statistical model, the wildfire O_3 guidance document states that the proper calculation to estimate the contribution from an atypical source of O_3 is to compare the sum of the predicted O_3 concentration and the 95th percentile of the residuals for the model to the observed concentration, rather than the direct comparison of the predicted O_3 concentration to the observation.[68] The demonstration presented a calculation using both the 95th percentile and the 75th percentile values of the residuals.[69] Using the 95th percentile value for the residuals as described in the wildfire O_3 guidance document, a potential fire contribution of 2 ppb for Paul Meyer, 2 ppb for Walter Johnson, and 6 ppb for Joe Neal was found. When this potential fire contribution is subtracted from the observed concentration, the values for all sites on June 22, 2020 are still above the level of the NAAQS (71 ppb for Walter Johnson and 72 ppb for Paul Meyer and Joe Neal). Therefore, the model does not support that an unusual O_3 source affected monitors in the Las Vegas NAA on June 22, 2020 sufficiently to cause exceedances of the NAAQS; even if wildfire impacts resulted in the fire contributions listed above, the sites still would have exceeded the NAAQS. While the demonstration includes a similar analysis using the 75th percentile values and concludes that the concentrations are sufficiently outside this narrower range of normal to have caused exceedances, this does not meet the criteria described in the wildfire O_3 guidance document, which is appropriately conservative to distinguish between potential wildfire impact and the inherent variability and potential bias in the regression model.

Overall, the results from the matching day analysis and the GAM model analysis do not support that an unusual source, such as a fire, caused the O_3 exceedances measured at monitoring sites in the Las Vegas NAA on June 22, 2020.

<u>Conclusion regarding the clear causal relationship criterion</u>
The analyses included in the demonstration do not sufficiently demonstrate a clear causal relationship between the emissions generated by the Bighorn, Mangum and Bush fires in western Arizona and the Ivanpah wildfire in California and the exceedances measured at the Paul Meyer, Walter Johnson, and Joe Neal monitoring sites. Specifically, the evidence presented to show transport (*i.e.*, HMS fire and smoke maps, smoke tracer modeling, HYSPLIT trajectory analysis, meteorological conditions, satellite/surface imagery, and media coverage), smoke impacts at the monitors (*i.e.*, O_3, precursor, and other smoke pollutant concentrations including CO, NO_2, $PM_{2.5}$, OC and EC, and levoglucosan), and quantification of smoke impacts (*i.e.*, matching day analysis and GAM modeling results) are inadequate to demonstrate a clear causal relationship between the emissions generated by the Bush, Mangum, Bighorn, and Ivanpah fires and the

[67] See demonstration, p. 3-74.
[68] See wildfire O_3 guidance document, p. 28.
[69] See demonstration, p. 3-84.

exceedances measured at the respective monitoring sites. Meteorological conditions during the period leading up to and including the exceedances were favorable to local O_3 production due to typical sources in the Las Vegas area and transport of elevated O_3 and precursors from southern California; the demonstration did not present sufficient evidence to establish that the named wildfires were the cause of the observed exceedances on June 22, 2020.

Table 3: Documentation of the Clear Causal Relationship criterion

Exceedance Date	Demonstration Citation	Quality of Evidence	Criterion Met?
June 22, 2020	Section 2.3: pp. 2-3, 2-6 to 2-13 Section 3: pp. 3-1 to 3-87 Appendices A-G	Insufficient	No

Not Reasonably Controllable or Preventable

The Exceptional Events Rule presumes that wildfire events on wildland are not reasonably controllable or preventable [40 CFR §50.14(b)(4)]. The demonstration provided evidence that the wildfire event meets the definition of wildfire [40 CFR §50.1(n)]. Specifically, the demonstration included evidence that the Ivanpah, Bush, Bighorn, and Mangum Fires were wildfires (caused by lightning, human activity, or unknown causes) and predominantly occurred on wildland in areas designated as National Forests.[70] Therefore, the documentation sufficiently demonstrates that the wildfire event was not reasonably controllable and not reasonably preventable.

Table 4: Documentation of the Not Reasonably Controllable or Preventable criterion

Exceedance Date	Demonstration Citation	Quality of Evidence	Criterion Met?
June 22, 2020	Section 4: p. 4-1 Section 5: p. 5-1	Sufficient	Yes

Natural Event

The definition of "wildfire" at 40 CFR §50.1(n) states, "A wildfire that predominantly occurs on wildland is a natural event." As previously described, the demonstration included documentation that the event meets the definition of a wildfire and occurred predominantly on wildland and has therefore shown that the event was a natural event.

Table 5: Documentation of the Natural Event criterion

Exceedance Date	Demonstration Citation	Quality of Evidence	Criterion Met?
June 22, 2020	Section 4: p. 4-1	Sufficient	Yes

Schedule and Procedural Requirements

In addition to technical demonstration requirements, 40 CFR §50.14(c) and 40 CFR §51.930 specify schedule and procedural requirements an air agency must follow to request data exclusion. Table 6 outlines the EPA's evaluation of these requirements.

[70] See demonstration, p. 4-1.

Table 6: Schedules and Procedural Criteria

	Reference	Demonstration Citation	Criterion Met?
Did the agency provide prompt public notification of the event?	40 CFR §50.14 (c)(1)(i)	August 11, 2021 Letter; Addendum to "Exceptional Event Demonstration for Ozone Exceedances in Clark County, Nevada – June 22, 2020"[71]	No. Notifications were for seasonal elevated levels of O_3, but not specific to this event date or type.
Did the agency submit an Initial Notification of Potential Exceptional Event and flag the affected data in the EPA's Air Quality System (AQS)?	40 CFR §50.14 (c)(2)(i)	November 30, 2020 email[72]	Yes
Did the initial notification and demonstration submittals meet the deadlines for data influenced by exceptional events for use in initial area designations, if applicable? Or the deadlines established by the EPA during the Initial Notification of Potential Exceptional Events process, if applicable?	40 CFR §50.14 Table 2 40 CFR §50.14 (c)(2)(i)(B)	July 1, 2021 Letter[73]	Yes
Was the public comment process followed and documented? • Did the agency document that the comment period was open for a minimum of 30 days? • Did the agency submit to the EPA any public comments received? • Did the state address comments disputing or contradicting factual evidence provided in the demonstration?	40 CFR §50.14 (c)(3)(v)	August 11, 2021 Letter;[74] Appendix H, "Documentation of Public Comment Process June 22, 2020 Demonstration"	Yes
Has the agency met requirements regarding submission of a mitigation plan, if applicable?	40 CFR §51.930 (b)	October 22, 2018 Letter,[75] December 17, 2018 Letter.[76]	Yes

Conclusion

The EPA has reviewed the documentation provided by CCDES to support claims that smoke from the Bush, Bighorn, Mangum, and Ivanpah wildfires in Arizona and California caused exceedances of the 2015 8-hour O_3 NAAQS at the Paul Meyer, Walter Johnson and Joe Neal

[71] Letter from Marci Henson, CCDES, to Elizabeth Adams, EPA Region 9, dated August 11, 2021.
[72] Email from Araceli Pruett, CCDES, to multiple staff at EPA Region 9, dated November 30, 2020.
[73] Letter from Marci Henson, CCDES, to Elizabeth Adams, EPA Region 9, dated July 1, 2021.
[74] Letter from Marci Henson, CCDES, to Elizabeth Adams, EPA Region 9, dated August 11, 2021.
[75] Letter from Mike Sword, CCDES, to Elizabeth Adams, EPA Region 9, dated October 22, 2018.
[76] Letter from Elizabeth Adams, EPA Region 9, to Mike Sword, CCDES, dated December 17, 2018.

monitoring sites on June 22, 2020. The EPA has determined that the flagged exceedances at the Paul Meyer, Walter Johnson and Joe Neal monitoring sites on this day do not satisfy the exceptional event criteria. Specifically, although the demonstration presented evidence that these wildfires occurred on wildland in Arizona and California and therefore meet the requirements that the event be not reasonably controllable or preventable and a natural event, the demonstration failed to show that there exists a clear causal relationship between the event and the monitored exceedances. This conclusion was based on the review of the evidence presented in the demonstration, including meteorological information, fire emission information, HYSPLIT trajectories, satellite data, smoke modeling data, ground level monitoring data, analysis of meteorologically similar days, and statistical modeling analysis. The exceedance day experienced conditions favorable to local O_3 production and transport of anthropogenic O_3 from southern California within the normal summer O_3 season. The data and analyses presented in the demonstration do not support that significant wildfire emissions were transported to the Las Vegas NAA and impacted monitors there sufficiently to cause exceedances of the NAAQS. As the demonstration failed to show that there exists a clear causal relationship between the wildfire event and the June 22, 2020 monitored exceedances at O_3 monitors in the Las Vegas NAA, EPA is nonconcurring on this exceptional event demonstration.