Technical Support Document For the February 23 2012, Alamosa Exceptional Event

Prepared by the
Air Pollution Control Division
Colorado Department of Public Health and Environment

March 10, 2015

Executive Summary

In 2005, Congress identified a need to account for events that result in exceedances of the National Ambient Air Quality Standards (NAAQS) that are exceptional in nature[1] (e.g., not expected to reoccur or caused by acts of nature beyond man-made controls). In response, EPA promulgated the Exceptional Events Rule (EER) to address exceptional events in 40 CFR Parts 50 and 51 on March 22, 2007 (72 FR 13560). On May 2, 2011, in an attempt to clarify this rule, EPA released draft guidance documents on the implementation of the EER to State, tribal and local air agencies for review. The EER allows for states and tribes to "flag" air quality monitoring data as an exceptional event and exclude those data from use in determinations with respect to exceedances or violations of the NAAQS, if EPA concurs with the demonstration submitted by the flagging agency.

Due to the semi-arid nature of large parts of the state, Colorado is highly susceptible to windblown dust events. These events are often captured by various air quality monitoring equipment throughout the state, sometimes resulting in exceedances or violations of the 24-hour PM_{10} NAAQS. This document contains detailed information about the large regional windblown dust event that occurred on February 23, 2012. The Colorado Department of Public Health and Environment (CDPHE) Air Pollution Control Division (APCD) has prepared this report for the U.S. Environmental Protection Agency (EPA) to demonstrate that the elevated PM_{10} concentrations were caused by a natural event.

EPA's June 2012, Draft Guidance on the Preparation of Demonstrations in Support of Requests to Exclude Ambient Air Quality Data Affected by High Winds under the Exceptional Events Rule states, "the EPA will accept a threshold of a sustained wind of 25 mph for areas in the west provided the agencies support this as the level at which they expect stable surfaces (i.e., controlled anthropogenic and undisturbed natural surfaces) to be overwhelmed…". In addition, in Colorado it has been shown that sustained wind speeds of 30 mph or greater and gusts of 40 mph or greater can cause blowing dust (see Blowing Dust Climatologies available at http://www.colorado.gov/airquality/tech_doc_repository.aspx#misc2). For this blowing dust event, it has been assumed that sustained winds of 30 mph and higher or wind gusts of 40 mph and higher can cause blowing dust in the San Luis Valley of south-central Colorado.

On February 23 of 2012, a powerful late winter storm system caused an exceedance of the twenty-four hour PM_{10} standard in Alamosa, Colorado. The Alamosa Municipal Building monitor (08-003-0003) recorded a concentration of 239 $\mu g/m^3$. An elevated concentration of 117 $\mu g/m^3$ was recorded at the nearby Alamosa-Adams State College monitor (08-003-0001). The exceedance in Alamosa was the result of intense surface winds in the wake of a passing cold front. These surface features were associated with a strong upper-level trough that was moving across the western United States. The surface winds were predominantly out of a northerly direction and moved over the dry soils of the northern San Luis Valley producing significant blowing dust.

APCD is requesting concurrence on exclusion of the exceedance PM_{10} value from the Alamosa-Municipal Building (08-003-0003) on February 23, 2012.

[1] Section 319 of the Clear Air Act (CAA), as amended by section 6013 of the Safe Accountable Flexible Efficient-Transportation Equity Act: A Legacy for Users (SAFE-TEA-LU of 2005, required EPA to propose the Federal Exceptional Events Rule (EER) no later than March 1, 2006.

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1.0 Exceptional Events Rule Requirements

In addition to the technical requirements that are contained within the EER, procedural requirements must also be met in order for EPA to concur with the flagged air quality monitoring data. This section of the report lays out the requirements of the EER and discusses how the APCD addressed those requirements.

1.1 Procedural Criteria

This section presents a review of the procedural requirements of the EER as required by 40 CFR 50.14 (Treatment of Air Quality Monitoring Data Influenced by Exceptional Events) and explains how APCD fulfills them.

The Federal EER requirements include public notification that an event was occurring, the placement of informational flags on data in EPA's Air Quality System (AQS), submission of initial event description, the documentation that the public comment process was followed, and the submittal of a demonstration supporting the exceptional events flag. ACPD has addressed all of these procedural and documentation requirements.

Public notification that event was occurring (40 CFR 50.14(c)(1)(i))
APCD did not issue a specific Blowing Dust Advisory for the February 23, 2012 event due to unforeseen and/or sudden weather changes, the APCD has developed and implemented processes and measures within the Final Natural Events Action Plan (NEAP) for Alamosa (See http://www.colorado.gov/airquality/tech_doc_repository.aspx?action=open&file=LamarNaturalEventsActionPlan2012.pdf), including public education programs and Best Available Control Measures (BACM). APCD asserts that continual public outreach and notification in the Lamar area was adequate on February 23, 2012 when drastic weather patterns prevented meteorologists from issuing timely advisories.

Place informational flag on data in AQS (40 CFR 50.14(c)(2)(ii))
APCD and other applicable agencies in Colorado submit data into EPA's AQS. Data from both filter-based and continuous monitors operated in Colorado are submitted to AQS.

When APCD and/or another agency operating monitors in Colorado suspects that data may be influenced by an exceptional event, APCD and/or the other operating agency expedites analysis of the filters collected from the potentially-affected filter-based air monitoring instruments, quality assures the results and submits the data into AQS. APCD and/or other operating agencies also submit data from continuous monitors into AQS after quality assurance is complete.

If APCD and/or the applicable operating agency have determined a potential exists that the sample value has been influenced by an exceptional event, a preliminary flag is submitted for the measurement when the data is uploaded to AQS. The data are not official until they are certified by May 1st of the year following the calendar year in which the data were collected (40 CFR 58.15(a)(2)). The presence of the flag can be confirmed in AQS.

Notify EPA of intent to flag through submission of initial event description by July 1 of calendar year following event (40 CFR 50.14(c)(2)(iii))

In early 2011, APCD and EPA Region 8 staff agreed that the notification of the intent to flag data as an exceptional event would be done by submitting data to AQS with the proper flags and the initial event descriptions. This was deemed acceptable, since Region 8 staff routinely pull the data to review for completeness and other analyses.

On February 23, 2012, a sample value greater than 150 $\mu g/m^3$ was taken at the Municipal Building in Alamosa, Colorado during the high wind event that occurred that day. This site is operated by APCD in partnership with a local operator.

Document that the public comment process was followed for event documentation (40 CFR 50.14(c)(3)(iv))
APCD posted this report on the Air Pollution Control Division's webpage for public review. APCD opened a 30-day public comment period on February 5, 2015 and closed the comment period on March 9, 2015. A copy of comments received will be submitted to EPA, consistent with the requirements of 40 CFR 50.14(c)(3)(iv).

> ***NOTE: No comments were received during the public comment period. Some minor non-substantial grammatical and formatting corrections were made.***

Submit demonstration supporting exceptional event flag (40 CFR 50.14(a)(1-2))
APCD will submit this document, along with any comments received (if applicable), and APCD's responses to those comments to EPA Region VIII headquarters in Denver, Colorado. The deadline for the submittal of this demonstration package is March 31, 2015.

1.2 Documentation Requirements

Section 50.14(c)(3)(iv) of the EER states that in order to justify excluding air quality monitoring data, evidence must be provided for the following elements:

a. The event satisfies the criteria set forth in 40 CFR 501(j) that:
   (1) the event affected air quality,
   (2) the event was not reasonably controllable or preventable, and
   (3) the event was caused by human activity unlikely to recur in a particular location or was a natural event;

b. There is a clear causal relationship between the measurement under consideration and the event;

c. The event is associated with a measured concentration in excess of normal historical fluctuations; and

d. There would have been no exceedance or violation but for the event.

2.0 Meteorological Analysis of the February 23, 2012, Blowing Dust Event and PM_{10} Exceedance – Conceptual Model and Wind Statistics

On February 23 of 2012, a powerful late winter storm system caused an exceedance of the twenty-four hour PM_{10} standard in Alamosa, Colorado. The Alamosa Municipal Building monitor recorded a concentration of 239 $\mu g/m^3$. This elevated reading and the location of the Alamosa Municipal Building monitor along with the nearby Adams State College monitor are plotted on a map of the Greater Alamosa area in Figure 1. The exceedance in Alamosa was the result of intense surface winds in the wake of a passing cold front. These surface features were associated with a strong upper-level trough that was moving across the western United States. The surface winds were predominantly out of a northerly direction and moved over the dry soils of the northern San Luis Valley producing significant blowing dust.

EPA's June 2012, Draft Guidance on the Preparation of Demonstrations in Support of Requests to Exclude Ambient Air Quality Data Affected by High Winds under the Exceptional Events Rule states, "the EPA will accept a threshold of a sustained wind of 25 mph for areas in the west provided the agencies support this as the level at which they expect stable surfaces (i.e., controlled anthropogenic and undisturbed natural surfaces) to be overwhelmed…". In addition, in Colorado it has been shown that sustained wind speeds of 30 mph or greater and gusts of 40 mph or greater can cause blowing dust (see Blowing Dust Climatologies available at http://www.colorado.gov/airquality/tech_doc_repository.aspx#misc2). For this blowing dust event, it has been assumed that sustained winds of 30 mph and higher or wind gusts of 40 mph and higher can cause blowing dust in the San Luis Valley of south-central Colorado.

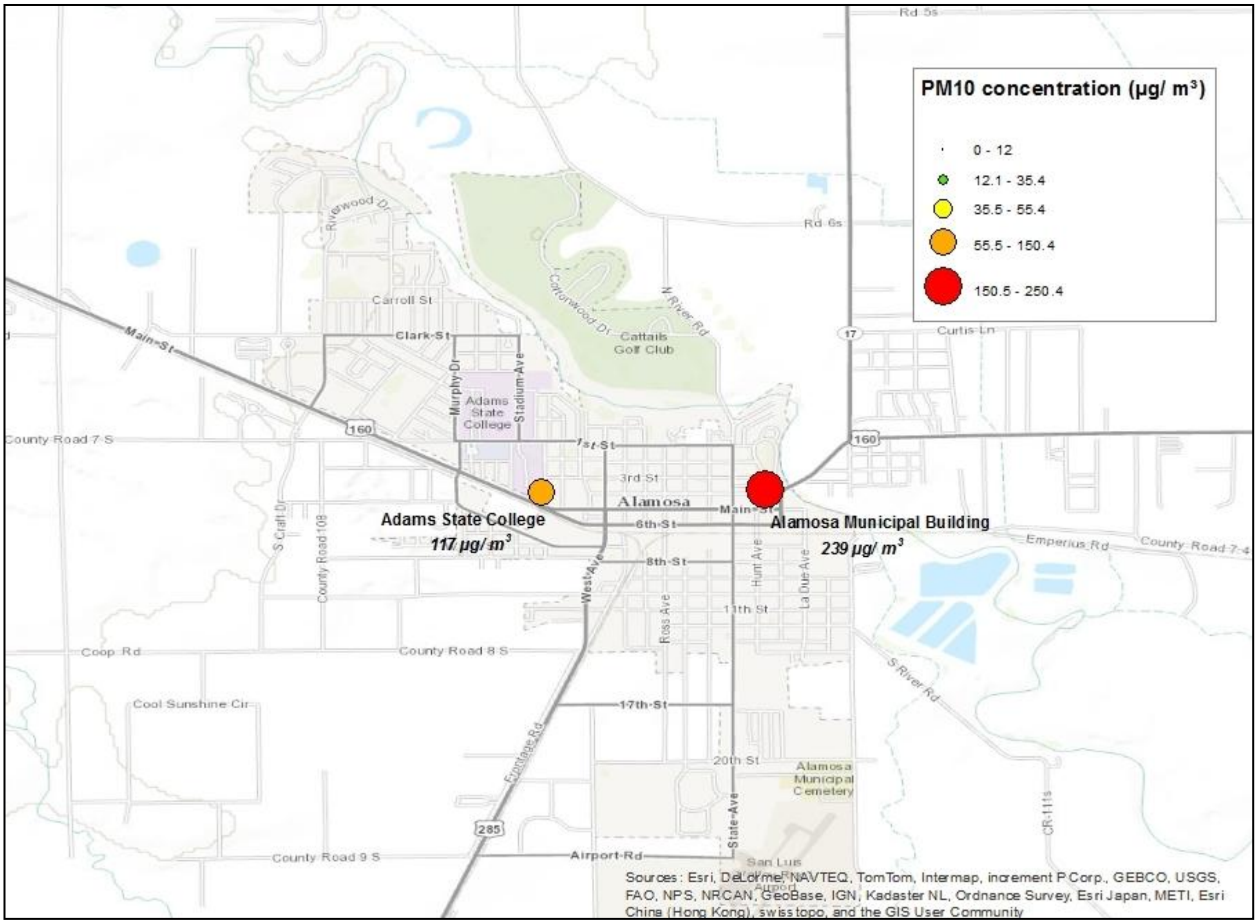

Figure 1: 24-hour PM_{10} concentrations for February 23, 2012.
(Source: http://webapps.datafed.net/datafed.aspx?dataset=AQS_D&parameter=pm10**)**

The surface weather associated with the storm system of February 23, 2012, is presented in Figure 2 through Figure 5; the surface analyses for 11 PM MST February 22 and 5 AM, 11 AM and 5 PM MST February 23, respectively. Significant surface features during this period of time included a cold front that swept across Colorado. Additionally, an intense area of surface low pressure developed along this cold front moving from western Colorado into central New Mexico. Simultaneously a strong high pressure system stretching from the Washington and Oregon coastlines southeastward into the central Rockies was building in behind the cold front. This caused a surface ridge to strengthen over central Colorado. The interaction between the intense low pressure in central New Mexico and building high pressure in central Colorado produced a very tight pressure gradient in south-central parts of Colorado by 5 PM MST February 23 (Figure 5). This tight pressure gradient contributed to the high winds which produced blowing dust in the San Luis Valley of south-central Colorado.

In addition, the upper level trough with this storm system aided in producing very strong winds at the surface. Figure 6 and Figure 7 show the 700 mb height analysis maps for 5 AM MST and 5 PM MST February 23, respectively. The 700 mb level is roughly 3 kilometers above mean sea level (MSL). These two charts show that a deep trough of low pressure aloft was present before and during the blowing dust event of February 23 and that it was moving over the central Rockies.

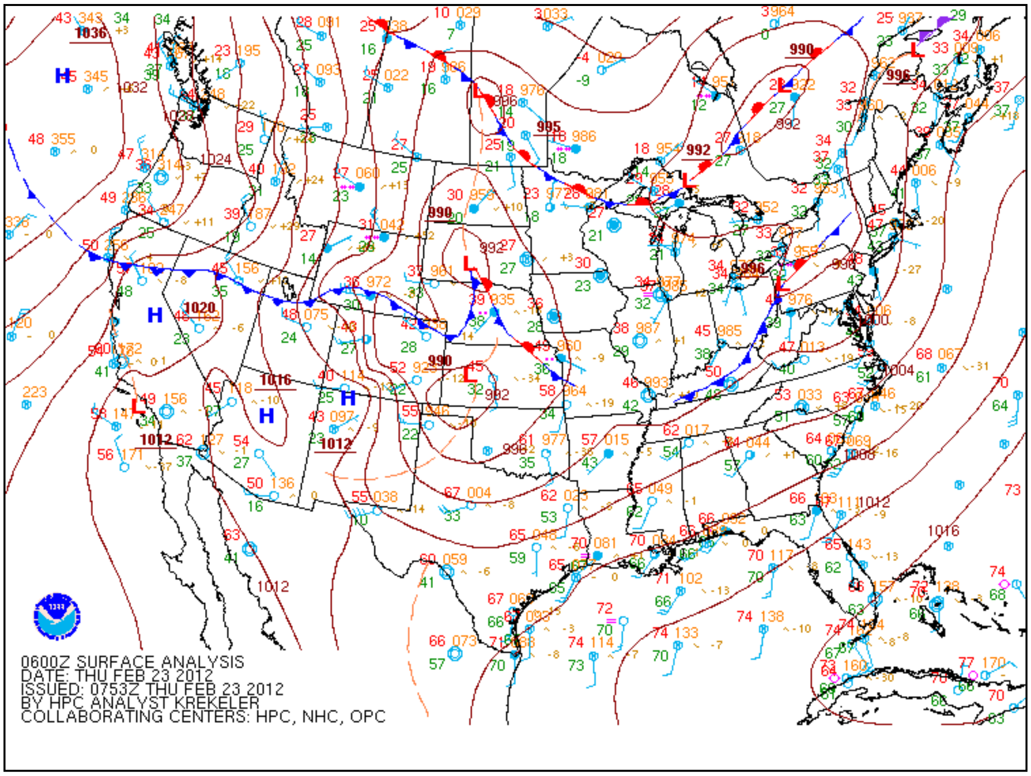

Figure 2: Surface Analysis for 06Z February 23, 2012, or 11 PM MST February 22, 2012. (Source: http://nomads.ncdc.noaa.gov/ncep/NCEP)

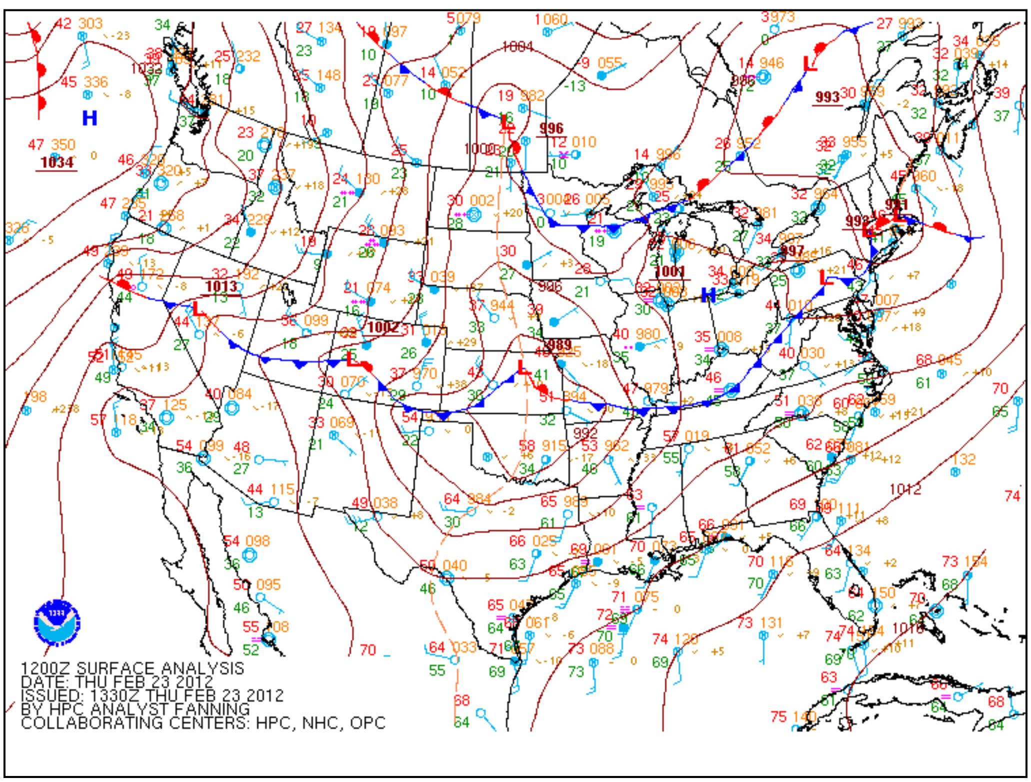

Figure 3: Surface Analysis for 12Z February 23, 2012, or 5 AM MST February 23, 2012. (Source: http://nomads.ncdc.noaa.gov/ncep/NCEP)

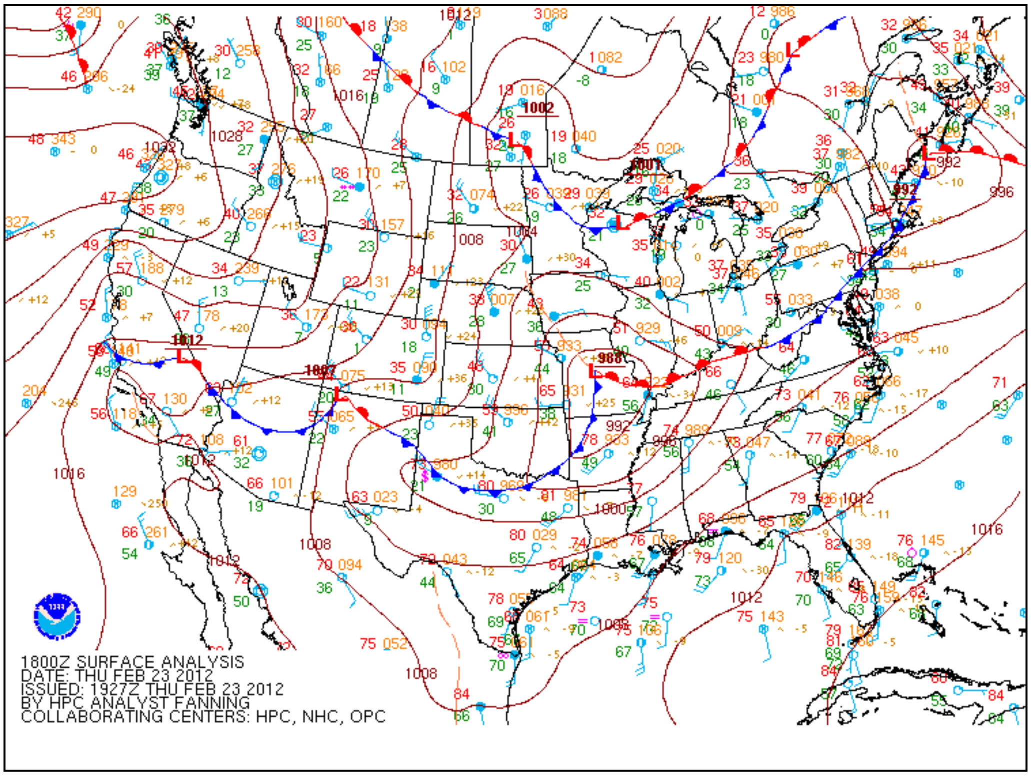

Figure 4: Surface Analysis for 18Z February 23, 2012, or 11 AM MST February 23, 2012. (Source: http://nomads.ncdc.noaa.gov/ncep/NCEP)

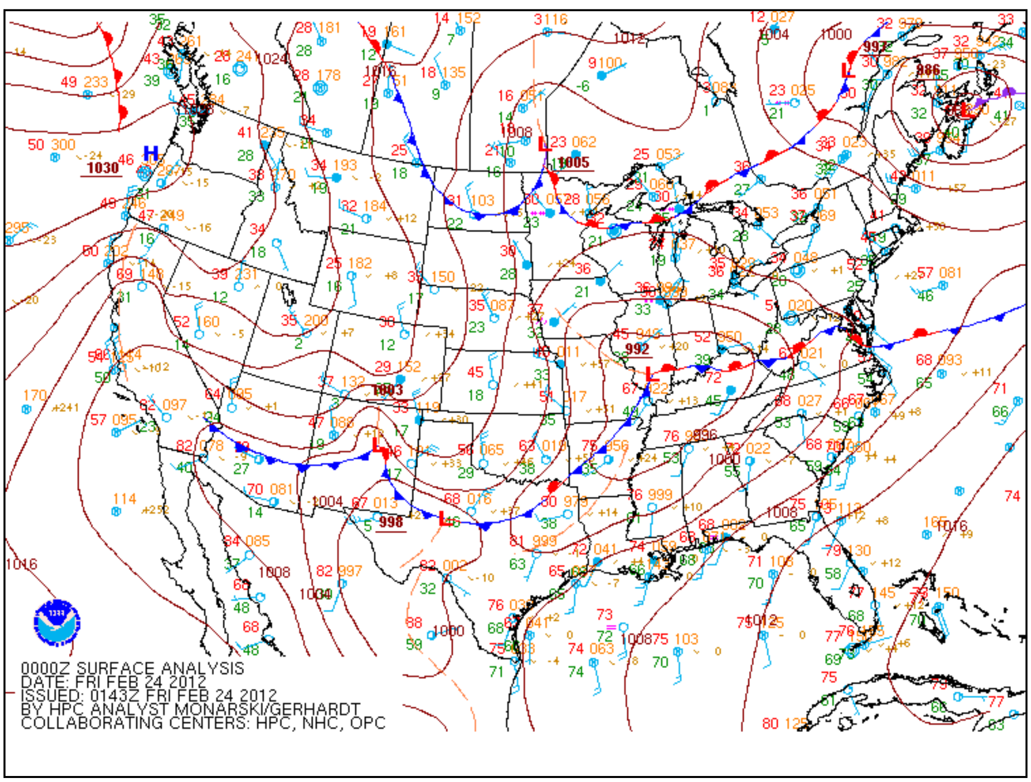

Figure 5: Surface Analysis for 00Z February 24, 2012, or 5 PM MST February 23, 2012. (Source: http://nomads.ncdc.noaa.gov/ncep/NCEP)

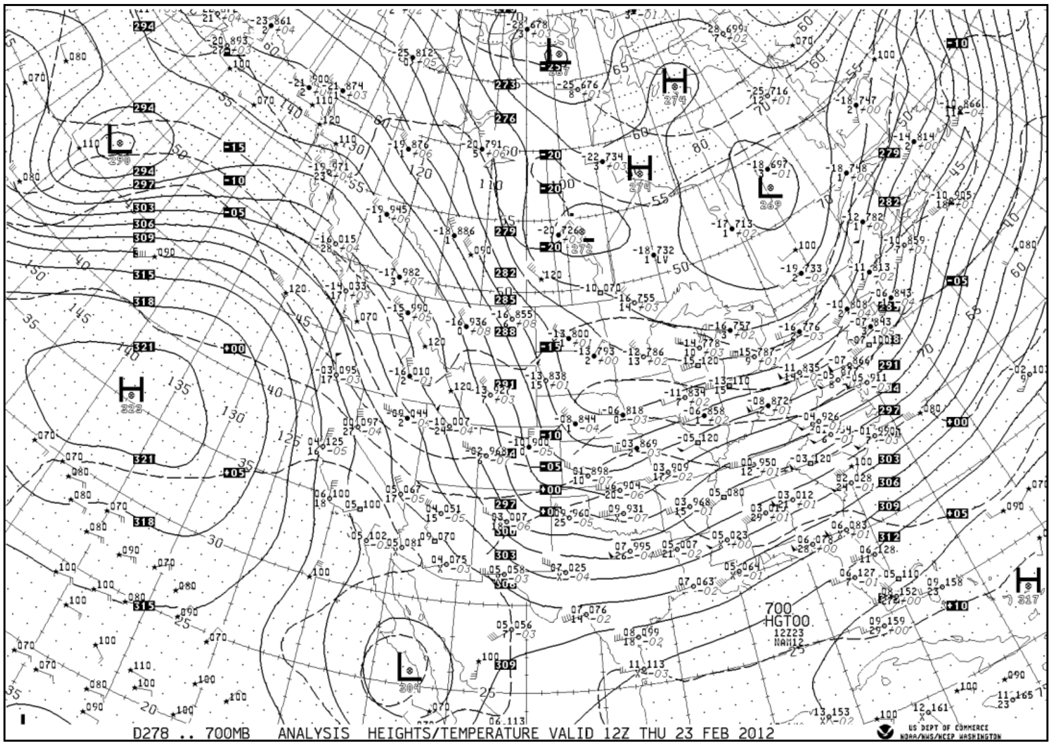

Figure 6: 700 mb (about 3 kilometers above mean sea level) analysis for 12Z February 23, 2012, or 5 AM MST February 23, 2012.
(Source: http://nomads.ncdc.noaa.gov/ncep/NCEP)

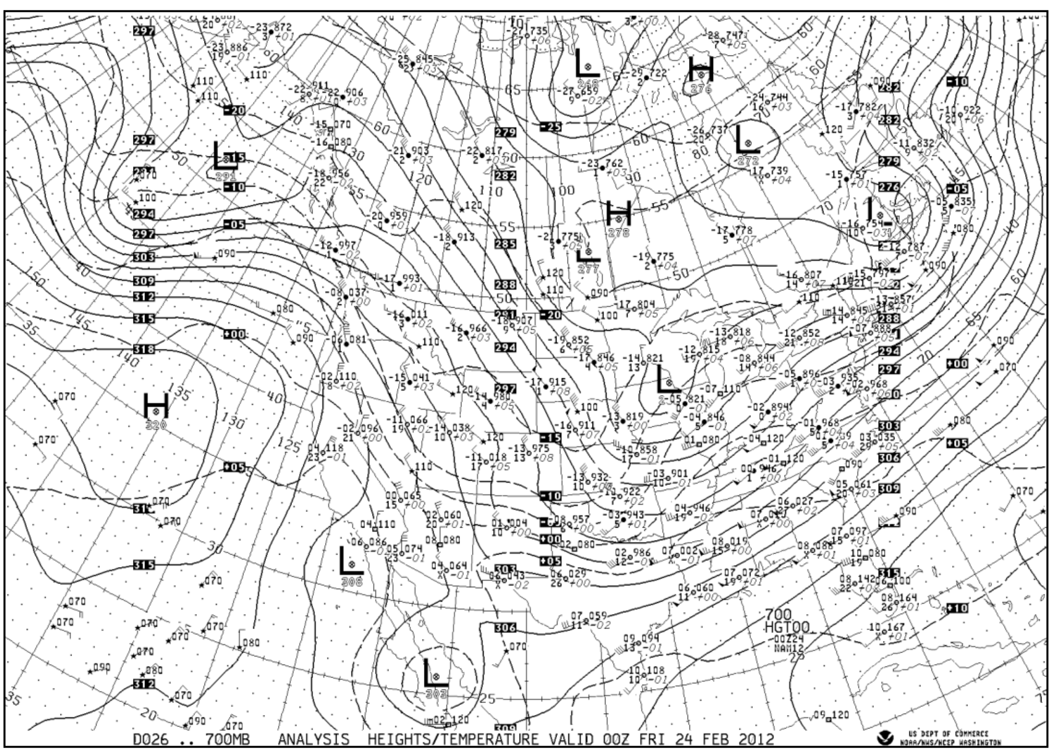

Figure 7: 700 mb (about 3 kilometers above mean sea level) analysis for 00Z February 24, 2012, or 5 PM MST February 23, 2012.
(Source: http://nomads.ncdc.noaa.gov/ncep/NCEP)

The upper level trough (observed at 700 mb) appears to have had a strong impact on surface winds in the San Luis Valley beginning at around 11 AM MST (18Z) on February 23, 2012. Figure 8 and Figure 9 show the height of the top of the mixed layer in kilometers above MSL at 8 AM MST and 11 AM MST, respectively. In Figure 8 we can see that fairly deep mixing of 4-6 km was already taking place over the San Luis Valley by 8 AM MST. As the atmosphere continued to destabilize during the morning hours, mixing increased to 6-7 km by 11 AM MST (Figure 9). Mixing to this degree would have been more than sufficient to transfer momentum to the surface from the zone of strong winds at 700 mb (about 3 km above MSL) taking place over the San Luis Valley during this same time interval (Figure 10). From Figure 10 a well-defined short wave can be observed across southern Colorado extending to the southwest from a strong trough that was moving across the Western High Plains. Along this vigorous shortwave we find clusters of 25-40 knot winds at the 700 mb level, including over the San Luis Valley of south-central Colorado. The deep mixing and strong winds aloft at 11 AM MST correlate well with the 10:52 AM MST weather observation in Alamosa of sustained winds to 32 mph with gusts to 44 mph.

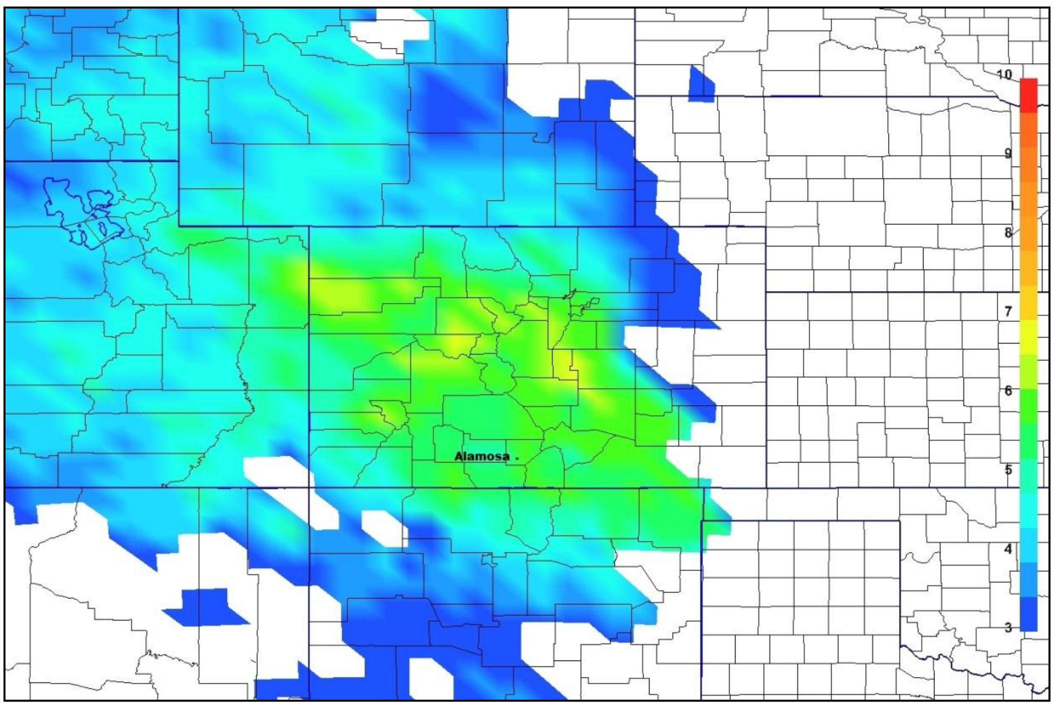

Figure 8: Height of the mixed layer in kilometers above mean sea level from the NARR at 15Z February 23, 2012, or 8 AM MST February 23, 2012. Only heights above 3 kilometers are plotted.
(Source: http://nomads.ncdc.noaa.gov/data.php?name=access#hires_weather_datasets**)**

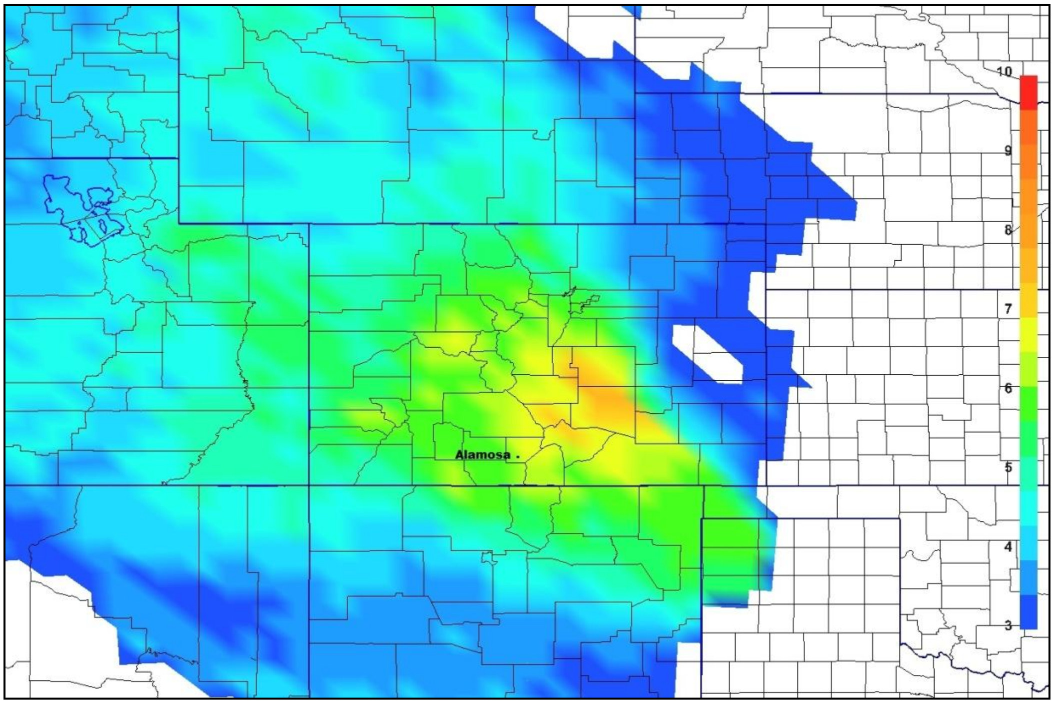

Figure 9: Height of the mixed layer in kilometers above mean sea level from the NARR at 18Z February 23, 2012, or 11 AM MST February 23, 2012. Only heights above 3 kilometers are plotted.
(Source: http://nomads.ncdc.noaa.gov/data.php?name=access#hires_weather_datasets)

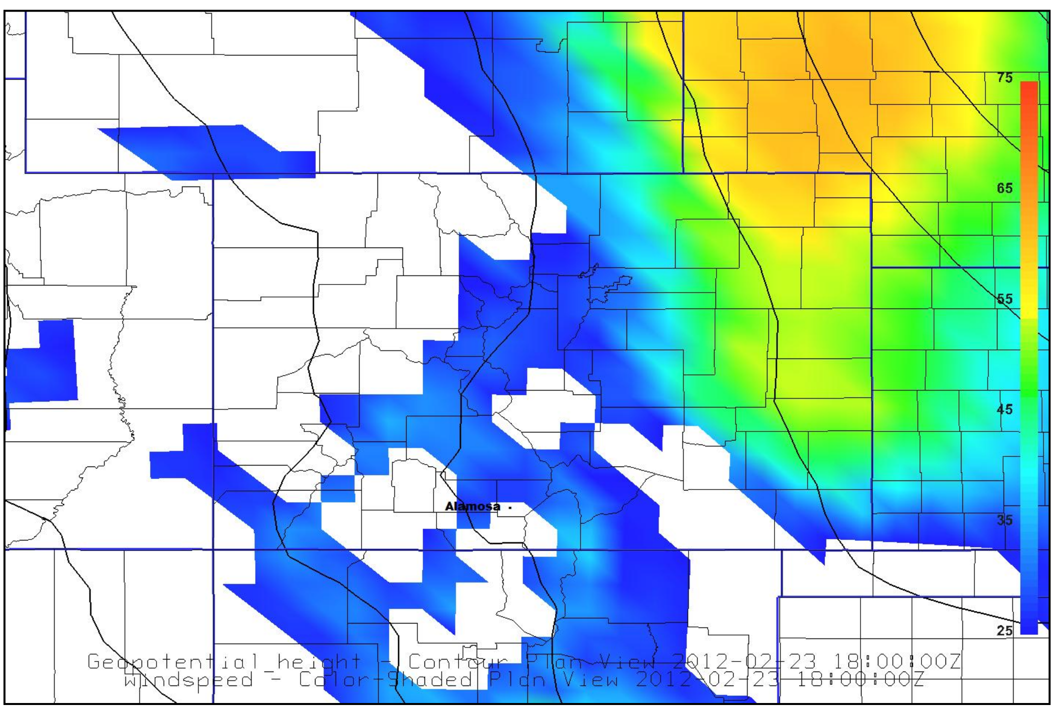

Figure 10: NARR 700 mb (about 3 kilometers above mean sea level) analysis for 18Z February 23, 2012, or 11 AM MST February 23, 2012, showing wind speeds in knots. Only speeds above 30 knots are plotted.
(Source: http://nomads.ncdc.noaa.gov/data.php?name=access#hires_weather_datasets)

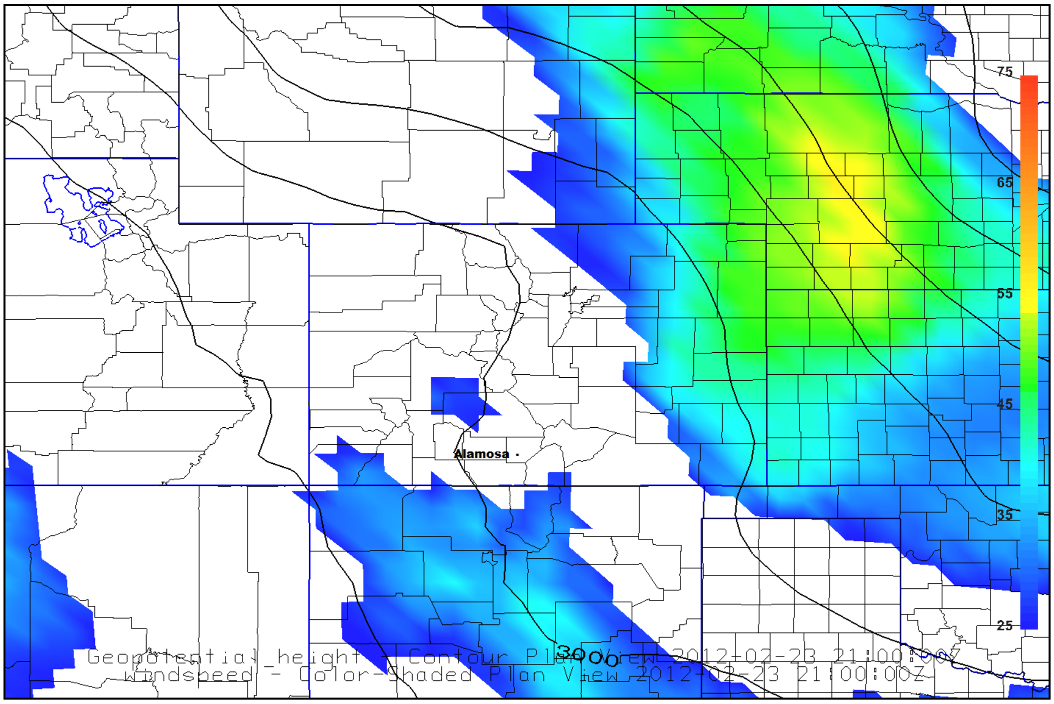

Figure 11: NARR 700 mb (about 3 kilometers above mean sea level) analysis for 21Z February 23, 2012, or 2 PM MST February 23, 2012, showing wind speeds in knots. Only speeds above 30 knots are plotted.
(Source: http://nomads.ncdc.noaa.gov/data.php?name=access#hires_weather_datasets**)**

Between 11 AM and 2 PM MST, the 700 mb winds over the San Luis Valley began to decrease slightly (Figure 10 and Figure 11). However, the surface winds did not weaken and between 2 PM and 5 PM MST they actually increased. This can be attributed to an intensifying surface pressure gradient over the region. Figure 12 through Figure 15 present regional surface maps for 8 AM, 11 AM, 2 PM and 5 PM MST February 23, 2012, respectively. These maps provide a more detailed view of synoptic weather conditions before and during the blowing dust episode. They also display individual station observations throughout the region which greatly aid in reconstructing the events that led to the PM_{10} exceedance recorded in Alamosa.

On the map in Figure 12 at 8 AM MST, the cold front had just passed through the San Luis Valley. At this time the wind in Alamosa (circled in red) was a fairly gentle 5 knots out of a northwesterly direction (one half flag on the wind barb denotes 5 knots). Over the next three hours, however, the winds increased significantly throughout the San Luis Valley due in large part to the intense upper level winds discussed previously. At 11 AM MST (Figure 13) Alamosa shows three full flags of 10 knots on the wind barb. This is equivalent to a sustained wind of 30 knots, or approximately 34 to 35 mph.

Alamosa was continuing to report sustained wind speeds of 30 knots at 2 PM MST (Figure 14). Also included in the Alamosa observation at this time is the weather symbol of infinity (∞) colored pink. The infinity sign is the weather symbol for haze. Haze is often reported during dust storms, and in dry and windy conditions haze typically refers to blowing dust (see the following link for the description of haze published by the National Oceanic and Atmospheric Administration (NOAA): http://www.crh.noaa.gov/lmk/?n=general_glossary).

High winds and haze were persistent in Alamosa at 5 PM MST (Figure 15). Additionally, the pressure gradient in south-central Colorado had strengthened. This can be identified by the increased amount of "bunching" of isobars apparent over southern Colorado and northern New Mexico from Figure 13 to Figure 15. This was due to high pressure building over central Colorado and low pressure intensifying in central New Mexico. Wind speed is directly proportional to the pressure gradient. Hence, a higher pressure gradient will produce stronger winds (see the following link for additional information on pressure gradient and its relationship to wind speed from the National Oceanic and Atmospheric Administration (NOAA): http://www.srh.noaa.gov/jetstream/synoptic/wind.htm).

Note from Figure 15 the atmospheric pressure readings from central New Mexico and central Colorado. In central New Mexico, the barometric pressure at the center of the low pressure system (circled in blue to the north of the low) reads 1003 millibars (mb). Meanwhile in central Colorado, Colorado Springs (circled in green) shows a barometric pressure display of 166. This converts to 1016.6 millibars (mb). The pressure gradient between these two areas equals the difference in barometric pressures: 13.6 mb. This compares to a pressure gradient of approximately 8 to 9 mb over the same distance just 3 hours earlier (Figure 14) and 4 to 5 mb from 6 hours earlier (Figure 13). This strengthening pressure gradient sustained or further intensified the winds in the San Luis Valley resulting in several hours of blowing dust in Alamosa.

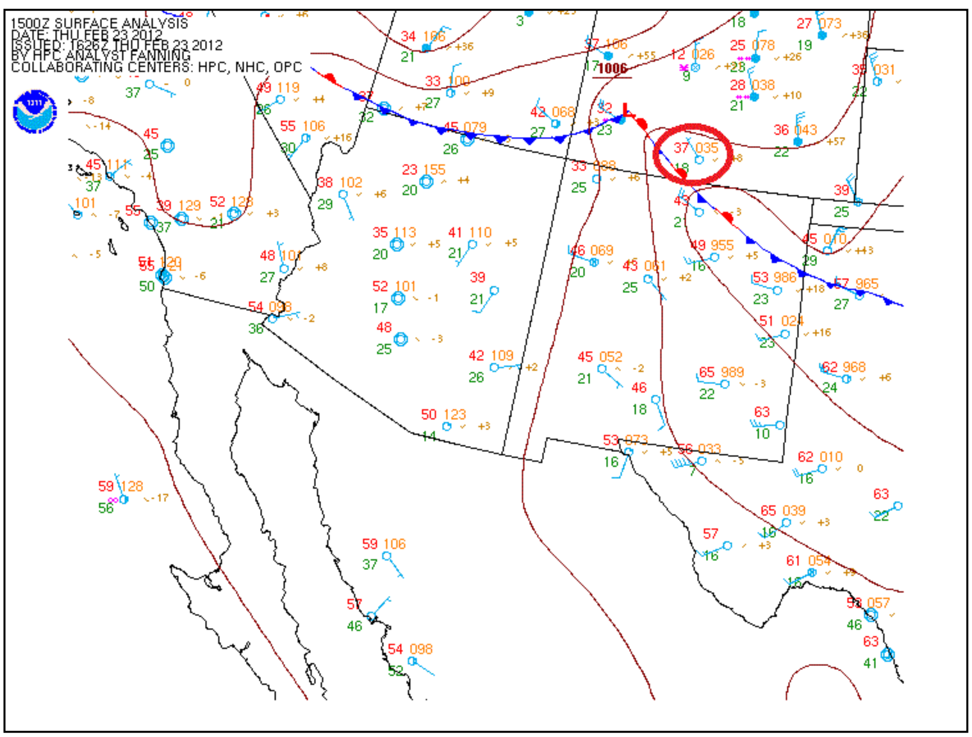

Figure 12: Southwest U.S. Regional Surface Analysis for 15Z February 23, 2012, or 8 AM MST February 23, 2012.
(Source: http://nomads.ncdc.noaa.gov/ncep/NCEP**)**

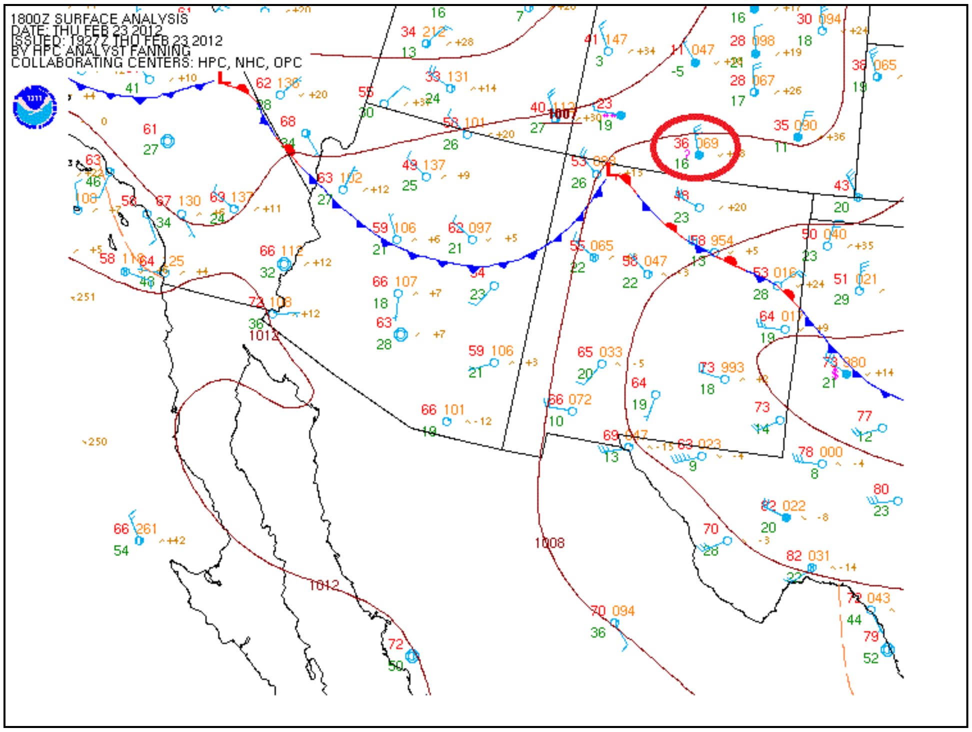

Figure 13: Southwest U.S. Regional Surface Analysis for 18Z February 23, 2012, or 11 AM MST February 23, 2012.
(Source: http://nomads.ncdc.noaa.gov/ncep/NCEP**)**

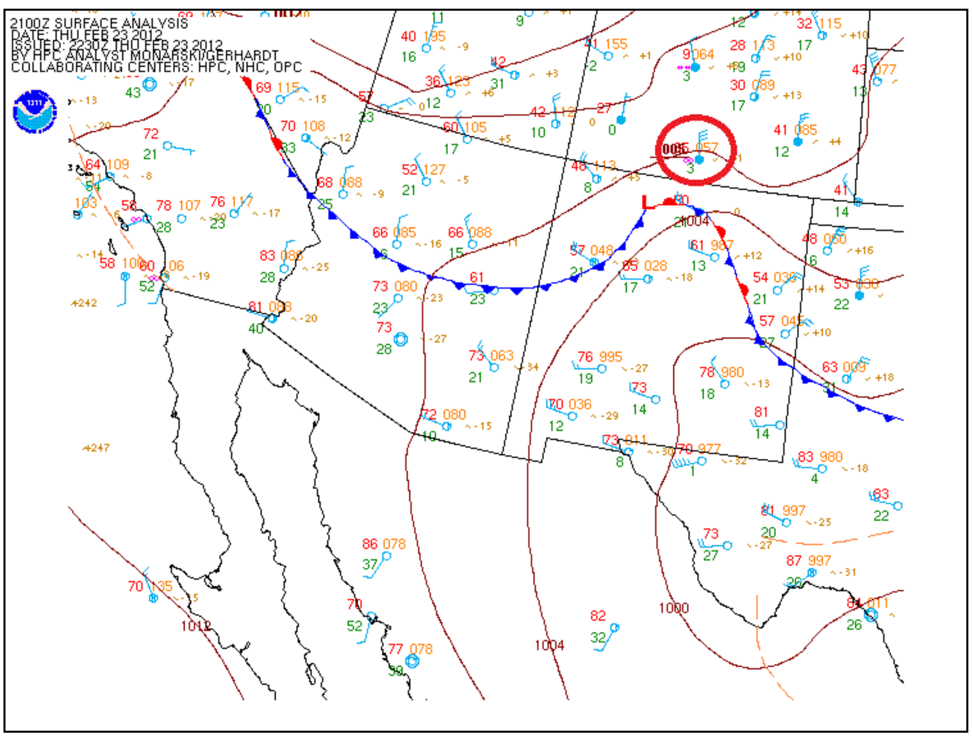

Figure 14: Southwest U.S. Regional Surface Analysis for 21Z February 23, 2012, or 2 PM MST February 23, 2012.
(Source: http://nomads.ncdc.noaa.gov/ncep/NCEP**)**

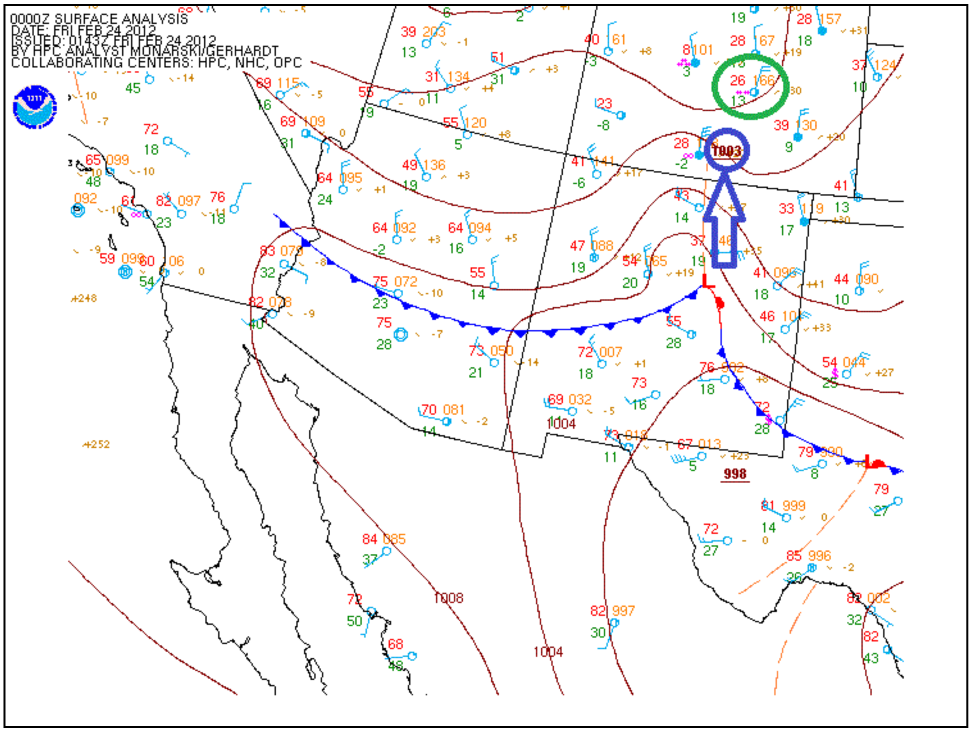

Figure 15: Southwest U.S. Regional Surface Analysis for 00Z February 24, 2012, or 5 PM MST February 23, 2012.
(Source: http://nomads.ncdc.noaa.gov/ncep/NCEP**)**

To expand on the data from these regional weather maps, hourly surface observations were gathered from each of the reporting stations within the San Luis Valley. Figure 16 provides a reference map containing the location of each station utilized for this analysis along with the local topography. Table 1 lists weather observations for the PM_{10} exceedance location of Alamosa. Observations that are climatologically consistent with blowing dust conditions are highlighted in yellow. Table 2 and Table 3 contain the surface weather from the other two stations in the San Luis Valley that logged observations on February 23, 2012. These two stations are Sand Dunes and Hooper, respectively.

The tables reveal that Alamosa experienced several hours of reduced visibility along with sustained wind speeds and gusts at or above the thresholds for blowing dust established earlier in this paper. Meanwhile Sand Dunes reported several hours of wind gusts near or above the threshold for blowing dust. It should be noted that the complete lack of haze and reduced visibility observations at Sand Dunes and Hooper can be attributed to the fact that the Sand Dunes station is a RAWS (Remote Automatic Weather Station) while the Hooper station is a CWOP (Citizen Weather Observer Program). Consequently neither station consistently reports observable weather or visibility.

Observations of sustained wind speeds and gust speeds at or above the blowing dust thresholds and reduced visibilities on February 23, 2012, at weather stations in the San Luis Valley of south-central Colorado show that a dust storm event occurred under north to northwesterly flow in the wake of a cold front. The observations contribute to the body of evidence that shows that dust originating to the north and northwest of Alamosa caused the PM_{10} exceedance at the monitoring site in question.

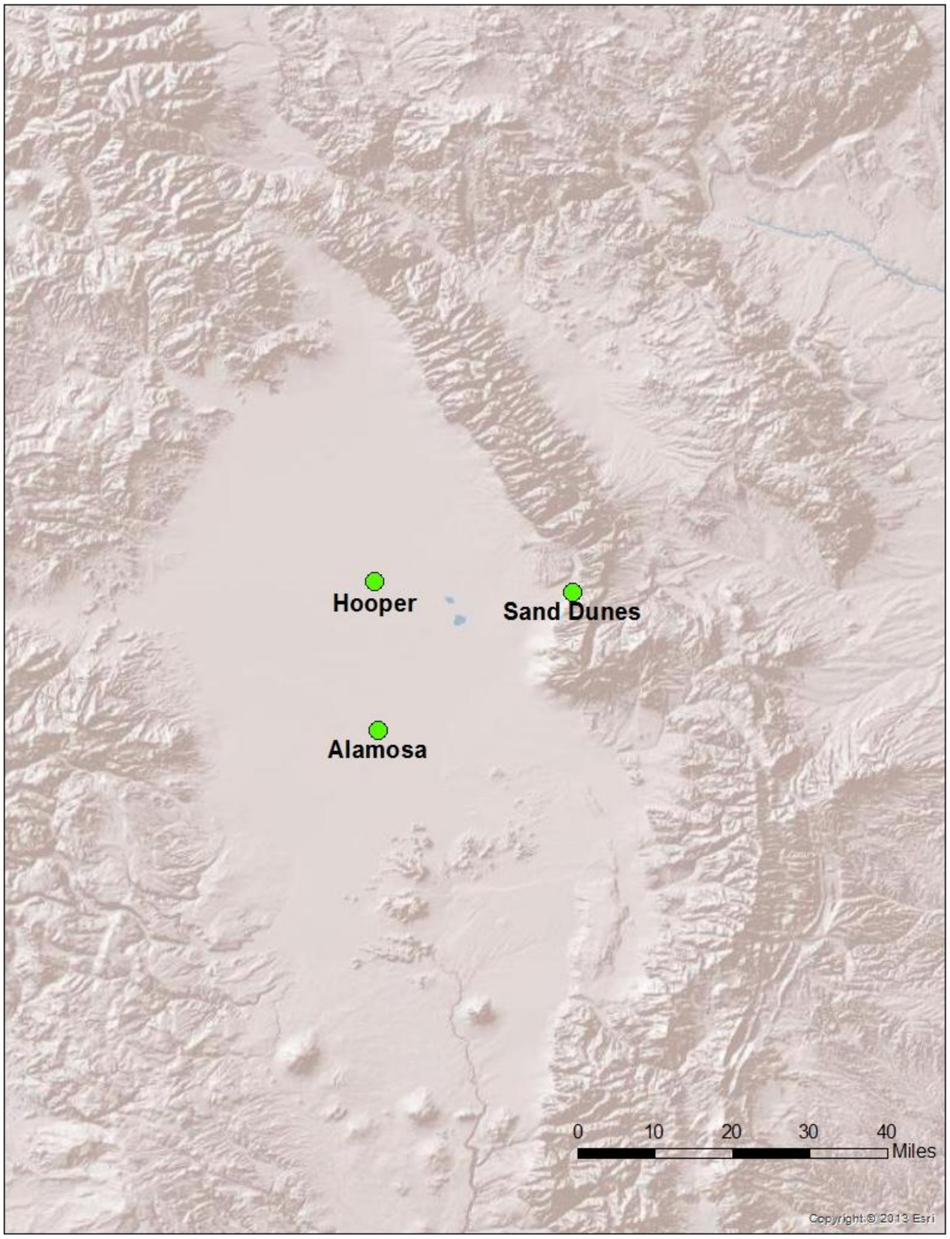

Figure 16: San Luis Valley weather observation stations.

Table 1: Weather observations for Alamosa, Colorado, on February 23, 2012. (Source: http://mesowest.utah.edu)

Time MST February 23	Temperature Degrees F	Relative Humidity in %	Wind Speed in mph	Wind Gust in mph	Wind Direction in Degrees	Weather	Visibility in miles
0:52	23	79	8		150		10
1:52	30	63	10	20	270		10
2:52	32	56	5		330		10
3:52	25	68	4		300		10
4:52	18	77	0				10
5:52	21	70	0				10
6:52	18	73	0				10
7:52	37	46	5		320		10
8:52	45	34	4				10
9:52	46	30	20	25	350		10
10:52	36	44	32	44	340	unknown prcp	6
11:52	33	41	29	38	340		8
12:52	36	31	31	43	350	haze	5
13:52	35	25	32	47	350	haze	4
14:18	34	23	30	45	340	haze	4
14:27	34	23	35	44	350	haze	4
14:37	34	21	33	46	340	haze	3
14:46	32	22	40	53	340	haze	2.5
14:52	32	22	30	48	340	haze	2.5
15:00	32	22	29	40	340	haze	4
15:10	32	22	32	55	340	haze	4
15:52	32	24	32	47	350		8
16:14	30	24	36	48	350	haze	2.5
16:24	30	28	35	52	360	haze	5
16:41	28	28	33	46	360	haze	4
16:52	28	26	33	53	360	haze	2.5
17:08	28	26	38	53	350	haze	4
17:15	27	28	35	51	350	haze	4
17:52	25	33	37	46	360	haze	3
18:22	25	36	31	47	350		10
18:52	24	33	31	44	350		10
19:52	22	33	20	25	350		10
20:52	18	43	9		350		10
21:52	14	52	7		10		10
22:52	10	57	5		310		10
23:52	11	58	6		330		10

Table 2: Weather observations for Sand Dunes, Colorado, on February 23, 2012. (Source: http://mesowest.utah.edu)

Time MST February 23	Temperature Degrees F	Relative Humidity in %	Wind Speed in mph	Wind Gust in mph	Wind Direction in Degrees	Weather	Visibility in miles
0:44	27	59	3	8	130		
1:44	26	64	2	6	139		
2:44	34	44	8	10	218		
3:44	36	37	11	26	212		
4:44	37	36	9	24	216		
5:44	34	39	9	18	242		
6:44	33	41	4	22	239		
7:44	35	41	7	20	256		
8:44	35	44	6	19	76		
9:44	33	55	20	31	318		
10:44	33	50	16	33	307		
11:44	31	34	19	35	309		
12:44	32	29	24	44	319		
13:44	28	22	18	39	315		
14:44	29	28	20	38	325		
15:44	28	29	16	37	329		
16:44	26	29	19	29	325		
17:44	22	33	14	30	317		
18:44	20	30	10	25	298		
19:44	18	34	5	19	294		
20:44	16	34	4	13	211		
21:44	15	36	5	10	211		
22:44	14	36	4	13	312		
23:44	12	39	4	11	193		

Table 3: Weather observations for Hooper, Colorado, on February 23, 2012. (Source: http://mesowest.utah.edu)

Time MST February 23	Temperature Degrees F	Relative Humidity in %	Wind Speed in mph	Wind Gust in mph	Wind Direction in Degrees	Weather	Visibility in miles
0:52	22	85	4	8	124		
1:52	25	83	1	6	138		
2:52	25	82	1	5	168		
3:52	22	84	0	1	168		
4:52	24	78	4	6	198		
5:52	28	70	2	5	260		
6:52	28	68	1	4	272		
7:52	31	71	5	11	268		
8:52	40	57	6	11	295		
9:52	34	71	10	19	320		
10:52	34	54	16	25	348		
11:52	34	43	17	29	9		
12:52	34	36	17	30	336		
13:52	33	35	18	33	355		
14:52	31	38	15	26	44		
15:52	29	39	14	23	355		
16:52	27	41	11	20	355		
17:52	23	52	8	16	9		
18:52	20	60	2	9	333		
19:52	19	57	2	7	315		
20:52	17	61	3	6	310		
21:52	14	64	2	5	286		
22:52	12	68	2	5	286		
23:52	13	61	2	7	292		

The Pueblo National Weather Service (NWS) forecast office issues weather information and alerts for south-central Colorado, including the San Luis Valley. The Area Forecast Discussion from the Pueblo NWS at 3:43 PM MST on February 23, 2012 is presented in Section 4.0. The highlighted text from this product clearly states that the NWS believed the reduced visibility in Alamosa was due to blowing dust and that it would continue through 00Z (5 PM MST). ***Text issued by the NWS shows that very strong winds and areas of blowing dust were taking place in Alamosa on February 23, 2012.***

Figure 17 shows the total precipitation in inches for Colorado from January 22 to February 22, 2012. Notice that south-central parts of the state, particularly the San Luis Valley where Alamosa is centrally located, generally received less than 0.5 inches of precipitation in the 30 days prior to February 23. Based on previous research 0.5 to 0.6 inches of precipitation over a 30 day period has been found to be the approximate threshold, below which, blowing dust exceedances in Colorado are more likely to occur when combined with high winds (see Blowing Dust Climatologies available at http://www.colorado.gov/airquality/tech_doc_repository.aspx#misc2).

Furthermore, the Drought Monitor report for Colorado as of 5:00 AM MST February 21, 2012 (Figure 18) reveals that severe drought conditions were being experienced in south-central Colorado two days before the February 23 dust event. This included the San Luis Valley portions of Costilla, Conejos and Saguache counties along with the entirety of Alamosa County. According to the National Drought Mitigation Center the definition of a severe drought includes, "Crop or pasture losses likely", which would imply high rates of erosion and an increase in vulnerability to particulate suspension (see the following link for more information on drought severity classification from the National Drought Mitigation Center: http://droughtmonitor.unl.edu/AboutUs/ClassificationScheme.aspx). ***30-day precipitation and Drought Monitor reports indicate that soils in the San Luis Valley of south-central Colorado were dry enough to produce blowing dust when winds were above the thresholds for blowing dust.***

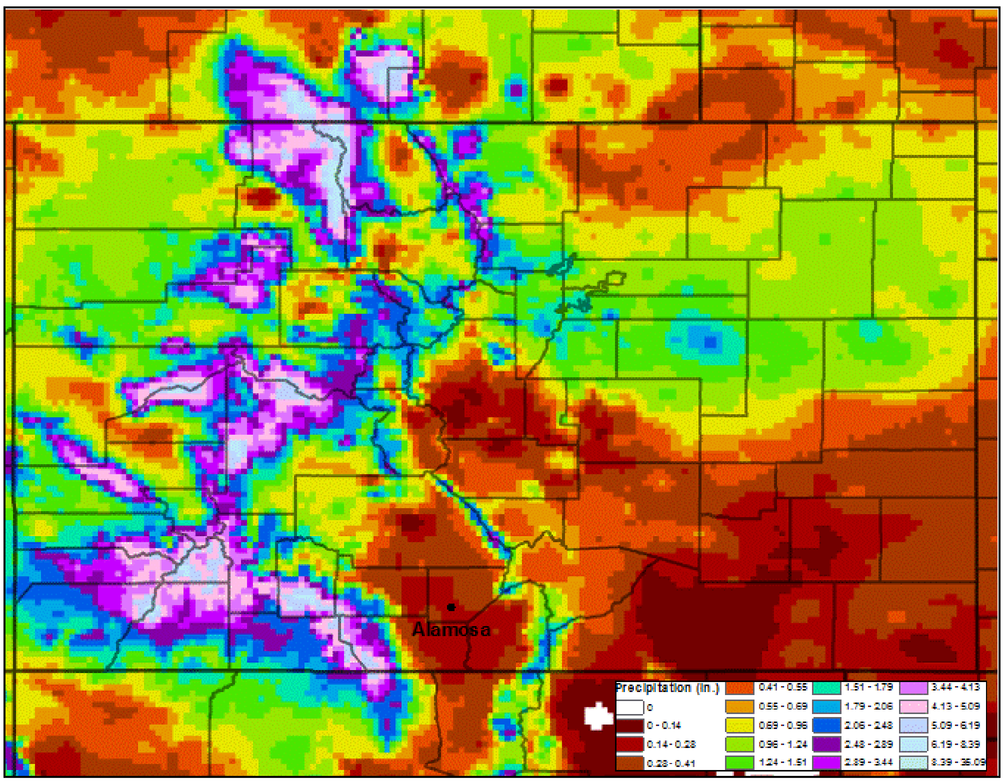

Figure 17: Total precipitation in inches for Colorado, January 22 – February 22, 2012. (Source: http://prism.nacse.org/recent/).

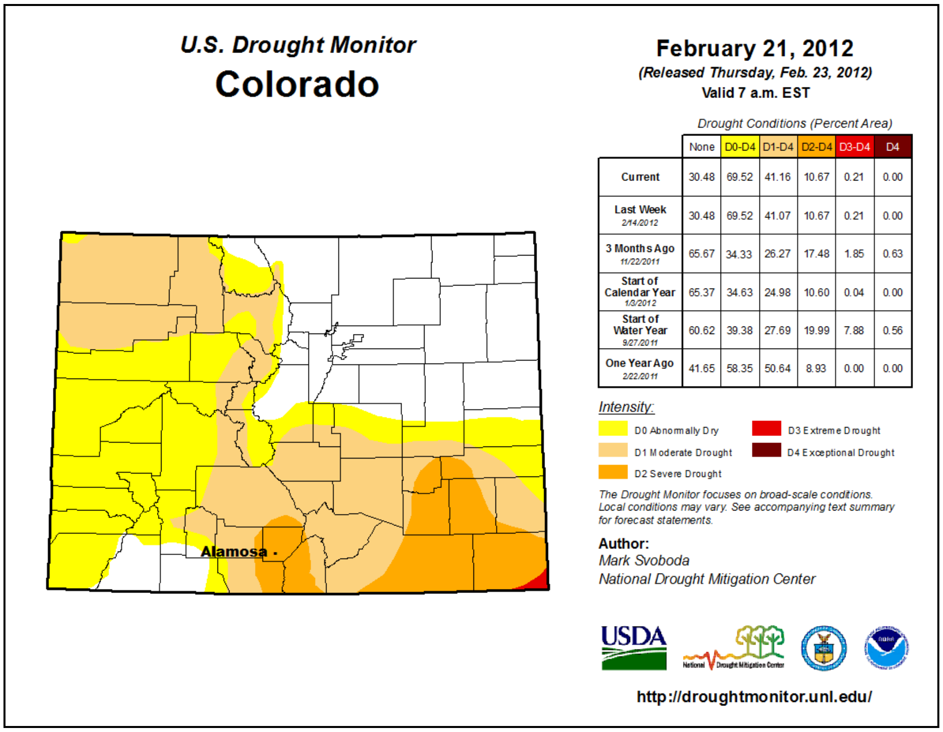

Figure 18: Drought conditions for Colorado at 5 AM MST February 21, 2012. (Source: http://droughtmonitor.unl.edu/MapsAndData/MapArchive.aspx)

Figure 19 shows the MODIS (Moderate Resolution Imaging Spectroradiometer) Aqua satellite image zoomed on south-central Colorado at 1:05 PM MST (2005Z) on February 23, 2012. This image reveals plumes of dust (circled in red) to the north and northeast of Alamosa, stretching from northwest to southeast. Unfortunately the city of Alamosa was blanketed by cloud cover at the time of this image obscuring any potential visible dust. However it should be noted that 13 minutes before this image was captured, Alamosa was reporting sustained winds out of a northerly direction at 31 mph with gusts to 43 mph and visibility reduced to 5 miles due to haze (12:52 AM MST, Table 1). This lends support to the argument that dust was being transported from northern parts of the San Luis Valley southward into Alamosa on February 23, 2012 (see the following link for additional information on MODIS: https://earthdata.nasa.gov/data/near-real-time-data/data/instrument/modis).

The GASP (GOES Aerosol Smoke Product) West Aerosol Optical Depth image at 4:15 PM MST on February 23 is displayed in Figure 20. Aerosol Optical Depth (AOD) is a measure of the degree to which aerosols, such as dust, prevent the transmission of light (see the following link for additional information on GASP: http://www.star.nesdis.noaa.gov/smcd/emb/aerosols/products_geo.php). In Figure 20, two clusters of moderate to high-moderate AOD values of 0.4 - 0.7 (circled in red) can be observed in south-central Colorado. This image corresponds well in both location and time to an observation of poor visibility (2.5 miles) and haze in Alamosa at 4:14 PM MST (Table 1).

MODIS and GASP satellite imagery reveal that a dust storm was taking place in the San Luis Valley of south-central Colorado on February 23. The drought-stricken northern half of the San Luis Valley was the source region for the blowing dust that produced the PM_{10} exceedance in Alamosa.

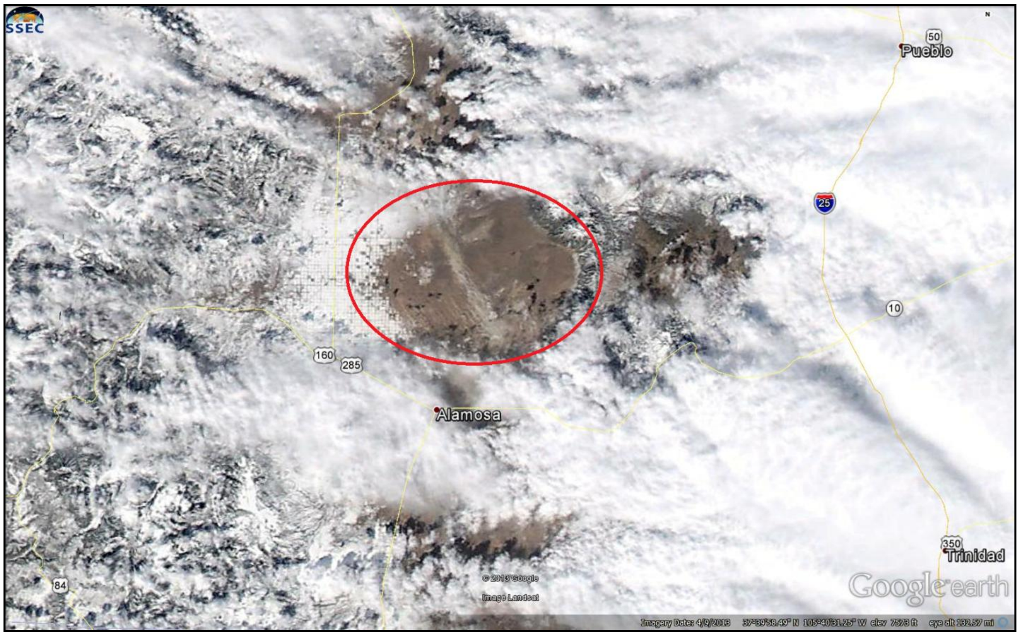

Figure 19: MODIS Aqua satellite image of south-central Colorado at approximately 1:05 PM MST (2005Z) on February 23, 2012.
(Source: http://ge.ssec.wisc.edu/modis-today/index.php).

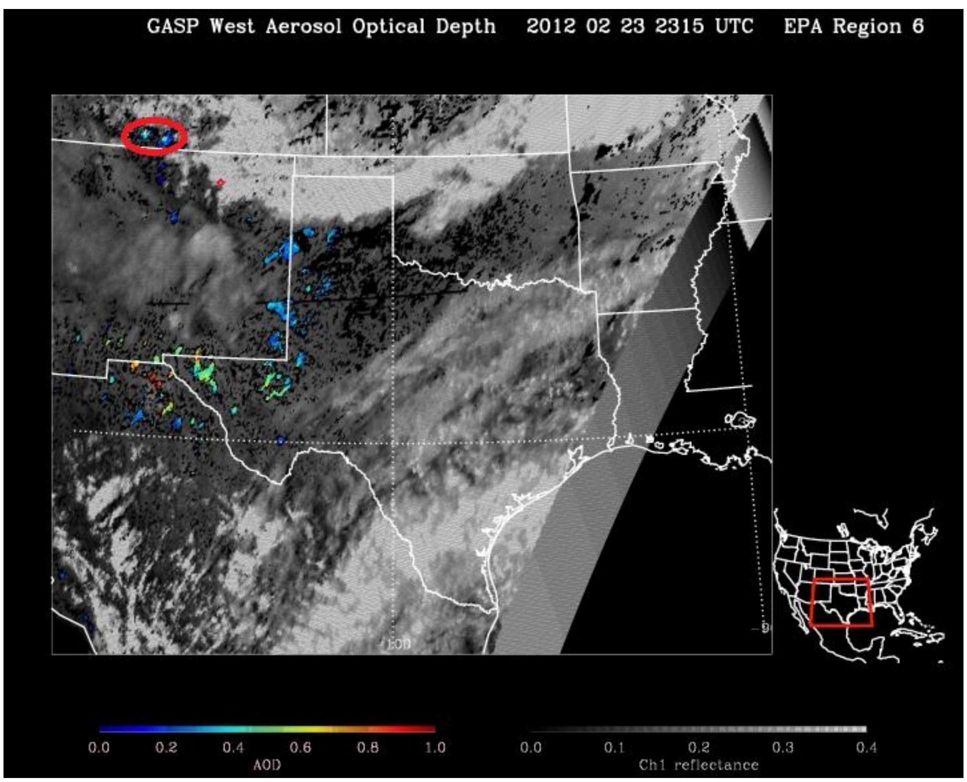

Figure 20: GASP West Aerosol Optical Depth image, EPA Region 6 at 4:15 PM MST (2315Z) February 23, 2012.
(Source: http://www.star.nesdis.noaa.gov/smcd/spb/aq/index.php?product_id=2)

Figure 21 shows the output for blowing dust from the Navy Aerosol Analysis and Prediction System (NAAPS) Global Aerosol Model for 5 PM MST on February 23, 2012. The NAAPS system models blowing dust emissions and transport based on soil moisture content, soil erodibility factors and a variety of meteorological factors known to be conducive to blowing dust (for a description of NAAPS see: http://www.nrlmry.navy.mil/aerosol_web/Docs/globaer_model.html).

The forecast panel in the lower left of Figure 21 shows an area of elevated surface dust concentrations over much of central and eastern Colorado. The upper left panel also reveals above normal Total Optical Depth values attributed to dust for the same geographic area. ***Forecast products from the Navy Aerosol Analysis and Prediction System model provide supporting evidence for a blowing dust event on February 23, 2012, in the San Luis Valley of south-central Colorado.***

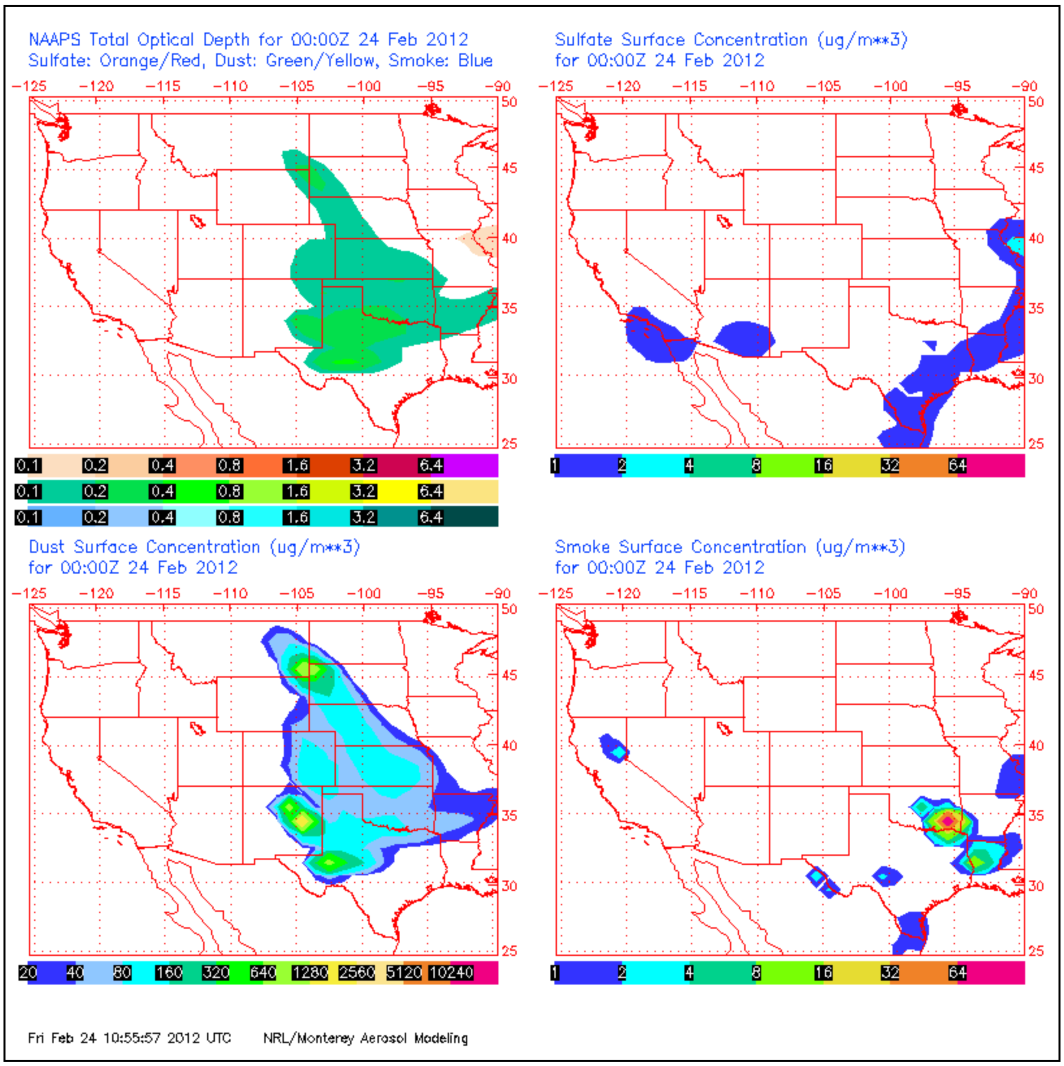

Figure 21: NAAPS forecasted dust concentrations for 5 PM MST February 23 (00Z February 24), 2012.

In a 1997 paper, “Factors controlling threshold friction velocity in semiarid and arid areas of the United States” (Marticorena et al., 1997), the authors characterized the erodibility of both disturbed and undisturbed desert soil types. The threshold friction velocity, which is described in detail in the Marticorena paper, is a measure for conditions necessary for blowing dust. This value is higher for undisturbed soils and lower for disturbed soils.

Friction velocities in south-central Colorado were calculated for 2 PM MST February 23, 2012 using the 12 km NAM (North American Mesoscale Model). These friction velocities are presented in Figure 22. According to data presented by Marticorena et al. (1997), even undisturbed desert soils normally resistant to wind erosion will be susceptible to emission of blowing dust when threshold friction velocities are in the 1.0 to 2.0 m/s range. In Figure 22 portions of the San Luis Valley, including the area immediately surrounding Alamosa, show friction velocities of around 1.0 m/s. Therefore it is reasonable to assume that undisturbed soils surrounding the Alamosa area were susceptible to blowing dust at 2 PM MST on February 23, 2012.

At approximately the same time (1:52 PM MST), the Alamosa observation station reported sustained winds of 32 mph, gusts to 47 mph with haze and an obscured visibility of 4 statute miles (Table 1). Note that this is the same part of the San Luis Valley where 30-day precipitation totals were below 0.5 inches (Figure 17) and where severe drought conditions were being experienced (Figure 18). Blowing dust will typically only occur where friction velocities are high and soils are dry, and this is exactly the combination that the San Luis Valley was experiencing on February 23, 2012.

The elevated friction velocities shown in Figure 22, the data on soil moisture conditions presented elsewhere in this report and the prevalence of winds above blowing dust thresholds prove that this dust storm was a natural event that was not reasonably controllable or preventable.

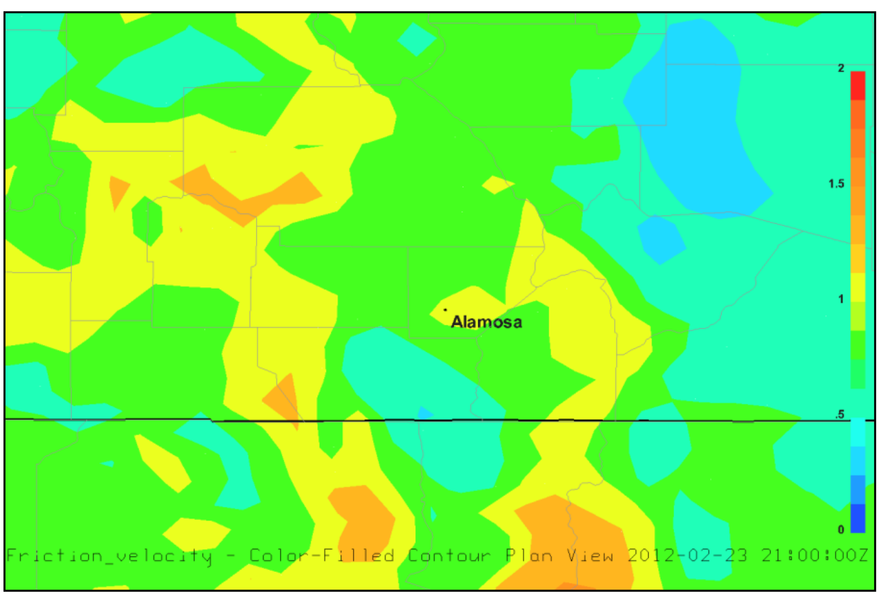

Figure 22: 12 km NAM friction velocities in meters/second at 2 PM MST (21Z) February 23, 2012.
(Source: http://nomads.ncdc.noaa.gov/data.php?name=access#hires_weather_datasets)

3.0 Ambient Air Monitoring Data and Statistics

On February 23, 2012, a strong cold front moved across Colorado. During this event a sample in excess of 150 µg/m^3 were recorded at Alamosa - Municipal (Alamosa Muni, 239 µg/m^3). An elevated sample was also recorded at Alamosa – Adams State College (Alamosa – ASC, 117 µg/m^3). No other sites/samples were affected by this event. The elevated PM_{10} readings in Alamosa resulted from blowing dust associated with strong, gusty winds behind the passage of the front. The winds transported blowing dust into Alamosa from the northern parts of the San Luis Valley.

3.1 Historical Fluctuations of PM_{10} Concentrations in Alamosa

This evaluation of PM_{10} monitoring data for sites affected by the February 23, 2012, event was made using valid samples from PM_{10} samplers in Alamosa from 2008 through 2012, APCD has been monitoring PM_{10} concentrations in the area since 1985. The overall data summary for the affected sites is presented in Table 4, with all data values being presented in µg/m^3.

Table 4: February 23, 2012 Event and 2008-2012 Data Summary

Evaluation	*Alamosa ASC*	*Alamosa Muni*
2/23/2012	**117**	**239**
Mean	23.5	29.7
Median	19	24
Mode	13	18
St. Dev.	26.15	28.3
Variance	683.7	801.5
Minimum	1	1
Maximum	440	635
Count	1634	1510

A snapshot summary of data from all those sites affected by the event is presented in Table 5. The approximate percentile value that the February 23, 2012, sample represents for each site for their unique historical data sets, for the month of the event (every sample in any February), and for the year of the event. All percentile calculations presented in this section were made using the entire dataset, including known high wind events. There is no difference between the two datasets (with and without high wind events) in regards to percentile calculations. Percentile calculations for both sites affected by the event are presented in Table 5.

Table 5: February 23, 2012, Site Percentile (All Affected Sites)

Evaluation	*Alamosa ASC*	*Alamosa Muni*
2/23/2012	**117**	**239**
Overall	99.10%	99.8%
Any February	*Max Value*	*Max Value*
2012	98.90%	*Max Value*

Regarding the sample of 239 µg/m^3 at Alamosa Muni, it is the largest sample in any February and the largest value from 2012. Overall, it is the third highest sample in this dataset. Although the sample from Alamosa ASC was not greater than 150 µg/m^3 it is the largest sample in any February, the fifth largest in 2012, and is the 15^{th} largest sample in this dataset. The overall magnitude of the samples suggests that there was a common contribution to each sample from other than local sources.

The data set for Alamosa Muni is further summarized by month in Table 6. As with previous submittals these summaries the data presents no obvious 'season'; PM_{10} levels at any particular site in Colorado do not necessarily fluctuate by season. Of greater importance affecting day-to-day, typical PM_{10} concentrations are local sources, e.g. road sanding and sweeping, local burning from agriculture and residential heating, vehicle contributions via road dust, unpaved lots or roads, etc. While the historic monthly mean values for the affected sites can be higher during the winter and spring months there is little month-to-month variation. Additionally, some of the sites exhibit monthly medians over these periods (winter and early spring) that are generally lower than other months of the year. This time frame (winter and early spring) is that which is most likely to experience the meteorological and dry soil conditions necessary for this type of event and are discussed elsewhere in this document. Although the maximum values for these months (winter and early spring) are the highest in the data set the 'typical' data (i.e. day-to-day, reflective of local conditions) are similar or lower than the same 'typical' data for the rest of the year. The summary data for the month of February (all samples in any February from 2008-2012) and for 2012 for both Alamosa sites are presented in Table 6.

Table 6: February 23, 2012, PM_{10} Evaluation by Month and Year Using 2008-2012 Data

	Alamosa ASC		Alamosa Muni	
	February	All 2012	February	All 2012
Mean	17.9	26.9	27.4	32.3
Median	15	20	22	25
Mode	14	19	20	18
St. Dev.	14.45	32.9	25.65	28.6
Variance	208.9	1087.8	658.3	817.3
Minimum	1	5	6	6
Maximum	117	389	239	239
Count	118	357	115	314

3.2 Alamosa Muni – 08-003-0003

The PM_{10} sample on February 23, 2012, at Alamosa Muni of 239 µg/m^3 is the largest sample recorded among all February samples from 2008 through 2012; is the largest sample of all 2012 data, and is greater than the 99^{th} percentile value (126 µg/m^3) for the entire dataset. Overall, this sample is the third largest sample in the entire data set. Both samples greater than the event sample are associated with a high wind event. There are 1510 samples in this dataset. The sample of February 23 clearly exceeds the typical samples for this site.

The following plots graphically characterize the Alamosa Muni PM_{10} data. The first, Figure 23, is a simple time series; every sample in this dataset (2008 – 2012) greater than 150 µg/m^3 is identified. Note the overwhelming number of samples occupying the lower end of the graph; an interested reader can count the number of samples greater than 100 µg/m^3. Of the 1510 samples in this data set, less than 2% are greater than 100 µg/m^3.

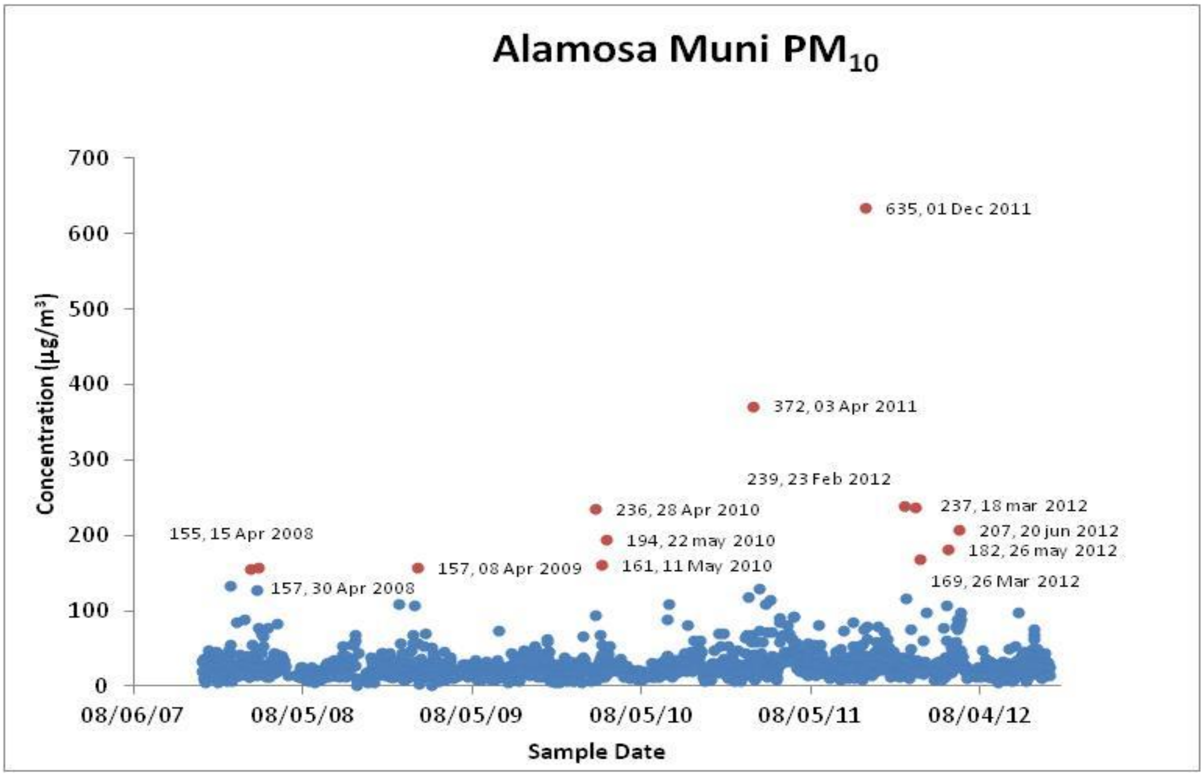

Figure 23: Alamosa Municipal PM_{10} Time Series, 2007-2012

Figure 26 is a simple histogram, demonstrating the overwhelming weight of samples on the low end of the curve. This range of data can be considered typical, representing contributions from local sources. Almost 70% of the samples in this data set are less than 30 µg/m^3. Even in the highly variable month of winter and early spring over 90% of the samples are less than 50 µg/m^3. Clearly the sample of February 23, 2011, exceeds what is typical for this site.

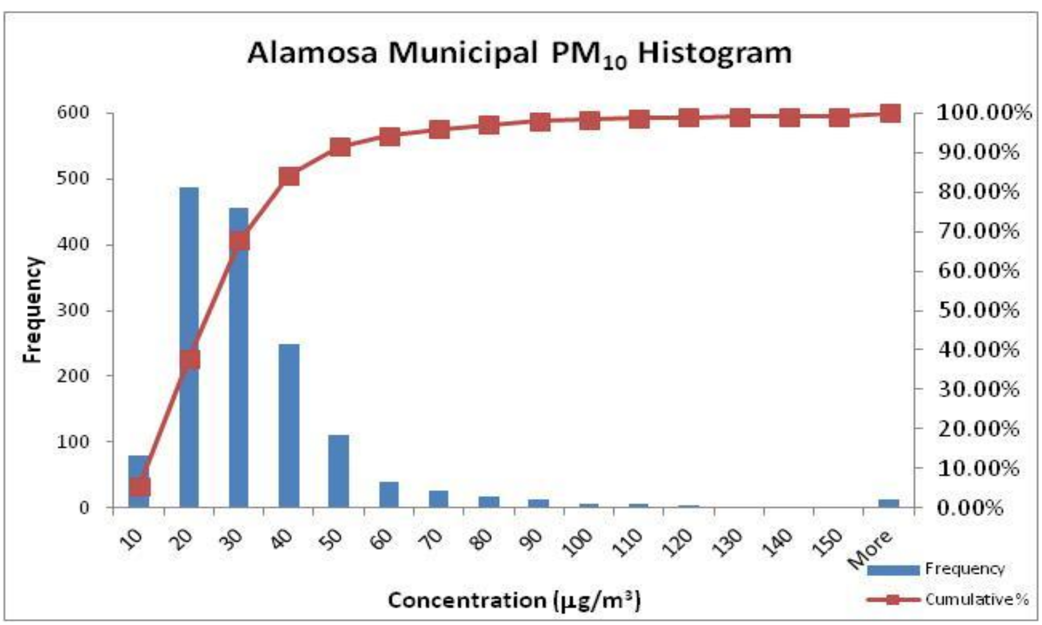

Figure 24: Alamosa Municipal PM_{10} Histogram, 2007-2012

The monthly box-whisker plot in Figure 25 highlights the consistency of the majority of data from month to month. Note the greater variability (wider inner-quartile range) and greater range of the data through the winter and early spring months that's accompanied by typically greater monthly maxima. Recall, this time period experiences a greater number of days with meteorological conditions similar to those experienced on February 23, 2012. Although these high values affect the variability and central tendency (average) of the dataset they aren't representative of what is typical at the site.

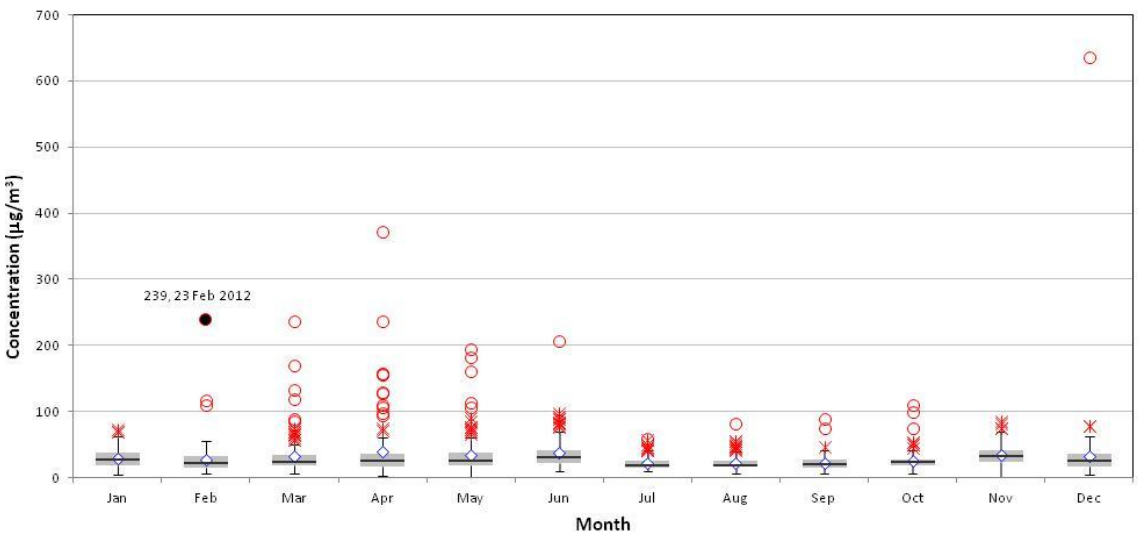

Figure 25: Alamosa Municipal PM_{10} Box-whisper Plot, 2007-2012

The box-whisper plots graphically represent the overall distribution of each data set including the mean ( ), the inner quartile range (IQR, defined to be the distance between the 75^{th}% and 25^{th}%), the median (represented by the horizontal black line) and two types of outliers identifed in these plots: outliers greater than 75th% +1.5*IQR ( )and outliers greater than 75th% + 3*IQR ( ). The outliers that satisfy the last criteria and are greater than 150 µg/m^3 are labeled with sample value and sample date. Each of these outliers is associated with a known high-wind event similar to that of February 23, 2012.

The presence of the extreme values distorts the graph, losing definition and distorting information presented across the range where the majority of data resides. The same plot graphed to 100 µg/m^3, which includes almost 99% of all the data, is presented in Figure 26. This expanded plot demonstrates that February is a month where contributions from local sources are similar to other months of the year but with a broad interquartile range – indicating a large amount of variation in samples.

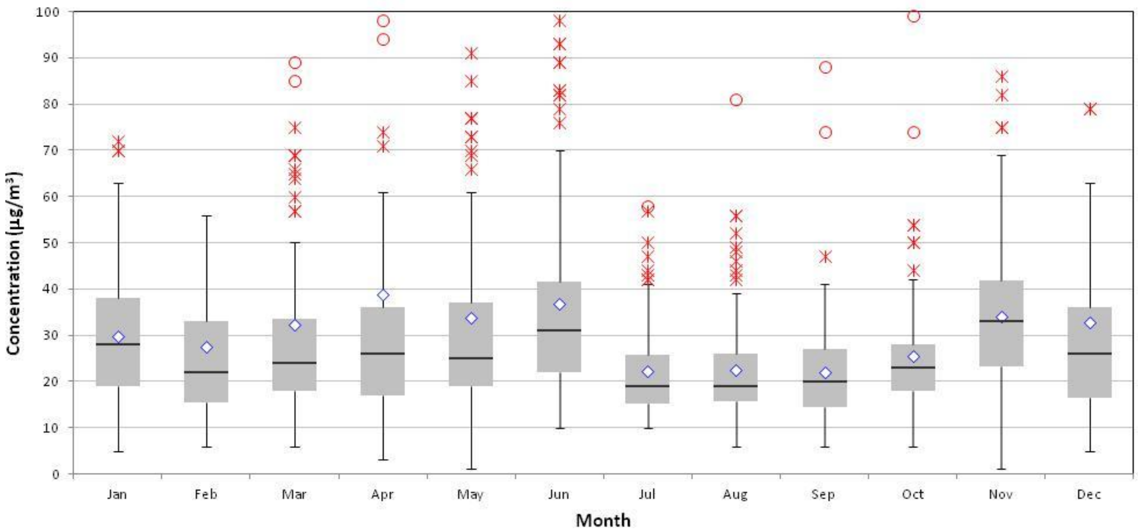

Figure 26: Alamosa Municipal PM_{10} Box-whisper Plot, Reduced Scale, 2007-2012

Note the degree to which the data in the months of winter and spring, beginning in December and extending through June, are skewed. The February mean (23.4 µg/m^3) is greater than the February median value (22 µg/m^3) and is greater than the 65% of all samples in any February. The skew in the data is due to the presence of a handful of extreme values and can create the perception that those months experiencing these high wind events are somehow 'dirtier' than other months of the year. This data exposes that perception as flawed, typical data subject to local sources of variation are similar to every other month of the year. Figure 4 suggests that typical, day to day PM_{10} concentrations exposures for the month of November are highest among all months. The sample of February 23, 2012, clearly exceeds the typical data at this site.

3.3 Clear Causal Relationship

Wind speeds around San Luis Valley increased early in the morning February 23, 2012 and stayed elevated throughout the day, gusting to speeds in excess of 50 mph. The following chart display wind speed (mph) as a function of date from the Alamosa Airport (KALS) for a number of days before and after the event.

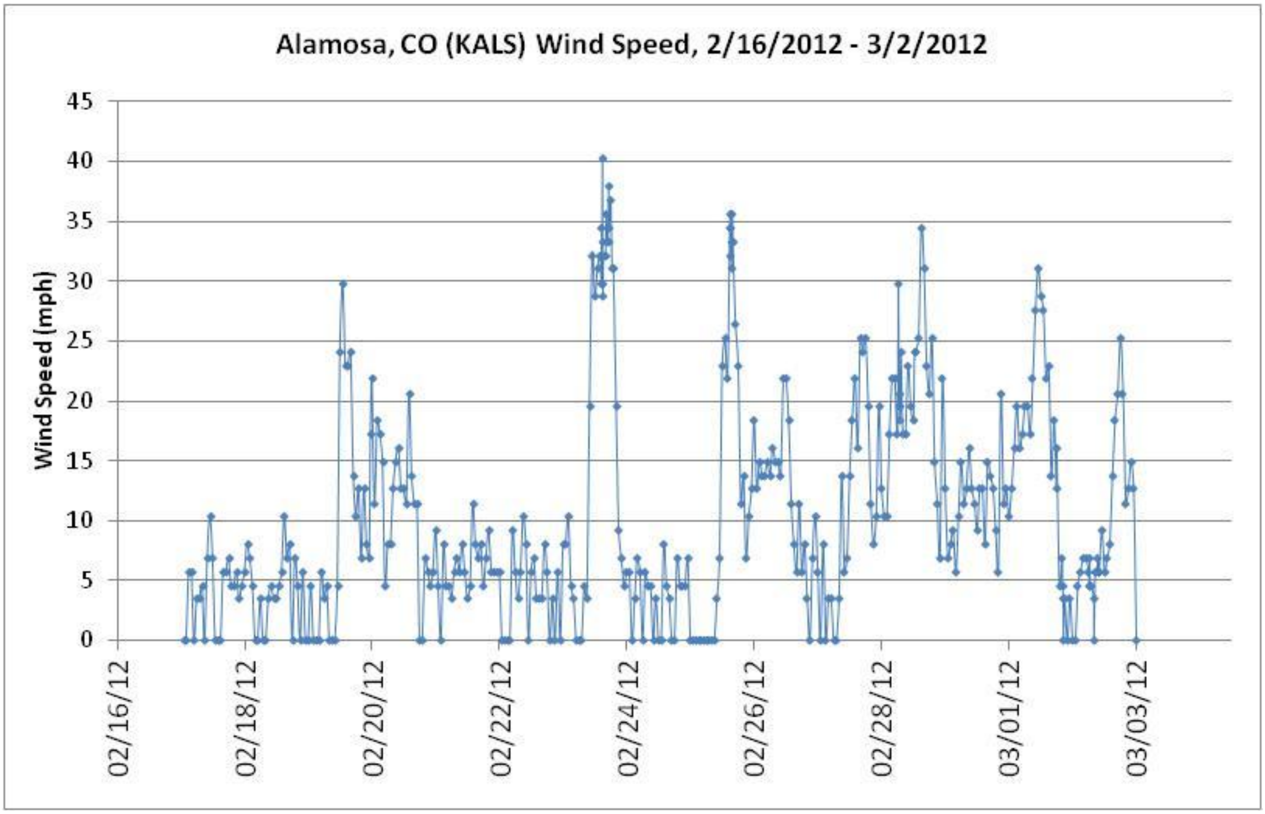

Figure 27: Wind Speed (mph) in Alamosa, 2/16/2012 – 3/2/2012

Figure 28 plots PM_{10} concentrations from the affected sites in Alamosa for the period for seven days prior to and following the sample(s) of February 23, 2012.

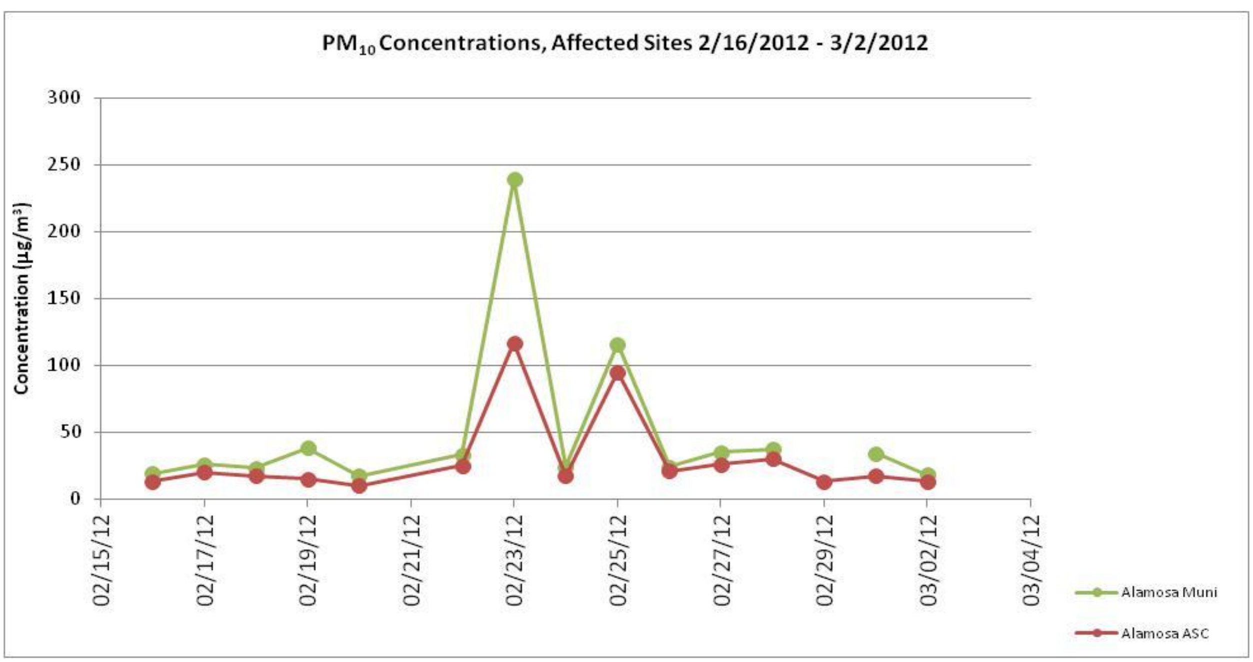

Figure 28: PM_{10} Concentrations, Affected Sites, 02/16/2012 – 03/02/2012

Figure 28**Error! Reference source not found.** mimics the Figure 27 plot for wind speed, suggesting an association between the regional high winds and PM_{10} concentrations at the samplers in Alamosa. Although both samples were affected to differing degrees by the high winds the elevated concentrations are clearly associated with the elevated wind speeds. Given the spatial dislocation of the sites the relationship between the two data sets would suggest that the regional high winds had an effect on PM_{10} samples in Alamosa on February 23, 2012.

3.4 No Exceedance But For the Event

Monthly percentile plots demonstrate a high degree of association between monthly median values and relatively high monthly percentile values, e.g. the Pearson's r value between the Alamosa Muni monthly 90^{th} percentile value and the Alamosa Muni monthly median is 0.64, and the same value for Alamosa ASC is 0.50. As the percentile value decreases (i.e. 85%, 75%, etc) the correlation between those values and the monthly median values increases sharply. The monthly percentile plots for each site are presented in Figure 29.

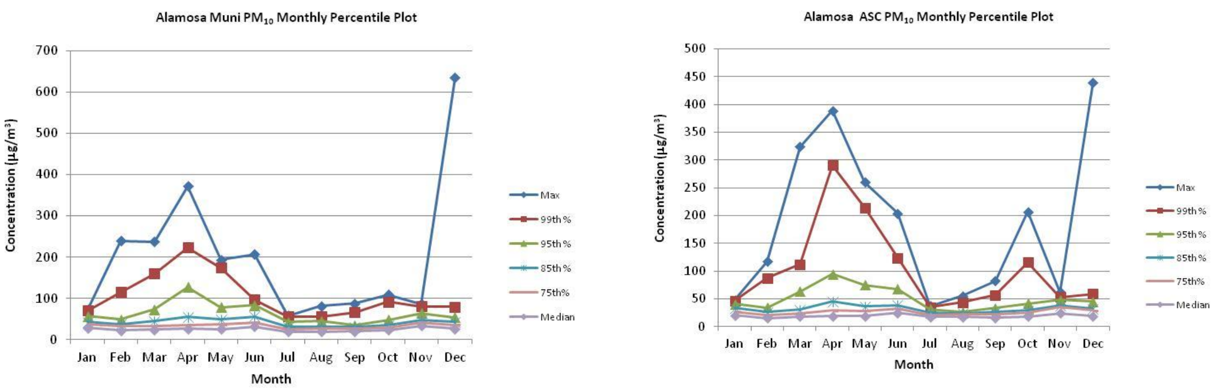

Figure 29: Monthly PM_{10} Percentile Plots

It is certainly the case that monthly median values are indicative of typical, day to day concentrations. Additionally, there is a range of samples that are a product of normal variation subject to typical, day to day local effects. This range may be restricted to percentile values that are well correlated with the median. For the data set of concern (Alamosa Muni) a robust estimate of the percentile value that is reflective of typical, day to day variation is the 75^{th} percentile value. Nearly all of the variation (r = 0.95) in the monthly 75^{th} percentile values of the Alamosa Muni data set can be explained by the variation in the monthly median. A less robust but more conservative estimate of the contribution to the event from local sources for these data sets may be the monthly 90^{th} percentile value; the correlation between the Alamosa Muni monthly median value and the 90^{th} percentile value is r = 0.64. For both estimates of local contribution (the 75^{th} and 90^{th} percentile value) the portion of the sample concentration greater than these monthly percentile values would be the sample contribution due to the event; using both we can estimate a concentration range, from robust to conservative, due to the event.

Table 7 identifies various percentile values that are representative of the maximum contribution due to local sources for Alamosa Muni from all February data. The range estimate in the 'Est. Conc. Above Typical' column is derived using the difference between the actual sample value and the 90^{h} percentile as the minimum (conservative) event contribution estimate and the difference between the actual sample value and the 75th percentile as the maximum (robust) event contribution estimate.

Table 7: Estimated Maximum Event PM_{10} Contribution - Alamosa Muni

Site	Event Day Concentration (µg/m^3)	February Median (µg/m^3)	February Average (µg/m^3)	February 75th % (mg/m3)	February 90th % (mg/m3)	Est. Conc. Above Typical (µg/m^3)
Alamosa Muni	237	22	27.4	33	41.6	**195 - 204**

Clearly, there would have been no exceedance but for the additional contribution to the PM_{10} sample provided by the event.

4.0 News and Credible Evidence

578
FXUS65 KPUB 232243
AFDPUB

AREA FORECAST DISCUSSION
NATIONAL WEATHER SERVICE PUEBLO CO
343 PM MST THU FEB 23 2012

.SHORT TERM...
(TONIGHT AND FRIDAY)

CURRENTLY...AN UPPER LEVEL STORM SYSTEM IS TRACKING ACROSS COLORADO AND INTO THE CENTRAL PLAINS. MEANWHILE AT THE SURFACE...A BAND OF SNOW HAS TRACKED SOUTH ACROSS THE EASTERN PLAINS DROPPING A QUICK COUPLE OF INCHES UNDER IT. THE MAIN BAND IS CURRENTLY SET UP OVER THE SOUTHERN I-25 CORRIDOR WITH LIGHT SNOW. BEHIND THE DEPARTING SYSTEM IN THE COLD AIR AND INSTABILITY...AREAS OF LIGHT SNOW SHOWERS HAVE DEVELOPED...ESPECIALLY OVER THE COLORADO SPRINGS METRO AND PUEBLO COUNTY. WINDS REMAIN BREEZY OVER THE PLAINS WITH GUSTS CURRENTLY AROUND 30 MPH IN MAY AREAS.

TONIGHT AND FRIDAY...THE UPPER LEVEL STORM SYSTEM WILL CONTINUE EAST INTO THE MISSOURI VALLEY WITH HIGH PRESSURE BUILDING OVER THE INTERMOUNTAIN WEST. EXPECT PRECIPITATION TO COME TO AN END ACROSS THE REGION OVER THE EARLY EVENING HOURS WITH CLEARING CONDITIONS BY MIDNIGHT. WINDS WILL ALSO CONTINUE TO SUBSIDE WITH LIGHT WINDS BY MORNING. LOWS TONIGHT WILL FALL INTO THE UPPER TEENS TO LOWER 20S FOR THE PLAINS.

NORTHWESTERLY FLOW WILL CONTINUE THROUGH THE DAY FRIDAY WITH COOL EASTERLY FLOW ACROSS THE REGION. THIS WILL HELP KEEP TEMPERATURES IN THE 40S FOR MOST OF THE PLAINS. DRY CONDITIONS ARE FORECAST FOR THE AREA. MOZLEY

.LONG TERM...
(FRIDAY NIGHT THROUGH THURSDAY)

TEMPS AND WINDS THE FORECAST CONCERNS FRIDAY NIGHT THROUGH SATURDAY AS WESTERLY FLOW STRENGTHENS AHEAD OF UPPER WAVE DIGGING INTO THE CENTRAL ROCKIES. FRIDAY NIGHT...FLOW LOOKS WEAK ENOUGH THAT MOST AREAS SHOULD DE-COUPLE AND FALL TO FAIRLY COLD LEVELS...THOUGH EASTERN MOUNTAIN SLOPES MAY MIX AND BEGIN TO WARM TOWARD SUNRISE SATURDAY. SURFACE PRESSURE FALLS OVER THE PLAINS LEAD TO A DEEP LEE TROUGH NEAR THE KS BORDER BY SATURDAY AFTERNOON...WHICH SHOULD PRODUCE WINDIER/WARMER WX OVER MOST OF THE EASTERN MOUNTAINS AND PLAINS BY LATE DAY. SOME CONCERN THAT WINDS/WARMING MAY NOT REACH THEIR FULL POTENTIAL OVER THE PLAINS

AS NAM SOUNDINGS KEEP A WEAK INVERSION IN PLACE EAST OF I-25...WHICH PREVENTS COMPLETE MIX-DOWN OF HIGHER MOMENTUM AIR SEEN AROUND 700 MB. OTHER NEGATING FACTORS FOR WARM TEMPS INCLUDE STRONG INVERSIONS SAT MORNING/MOIST GROUND AND PATCHY RESIDUAL SNOW IN SPOTS. OVERALL...DIDN'T GO AS WARM AND WINDY SAT AS SYNOPTIC SET-UP WOULD SUGGEST. SNOW CHANCES SATURDAY AFTERNOON AND EVENING LOOK LIMITED TO THE CENTRAL MOUNTAINS...AS UPPER WAVE AND BEST MOISTURE WHIP BY FAIRLY FAR TO THE NORTH. COLD FRONT DROPS THROUGH MOST OF THE REGION SUNDAY MORNING...THOUGH POST FRONTAL AIR MASS DOESN'T LOOK PARTICULARLY COLD AS ARCTIC AIR REMAINS WELL NORTH. FLOW BENDS BACK TO THE SOUTHWEST MON AS NEXT UPPER TROUGH DIGS INTO THE GREAT BASIN...WITH A RETURN TO WARM/WINDY CONDITIONS MOST LOCATIONS. SNOW WILL INCREASE OVER THE CONTINENTAL DIVIDE MONDAY NIGHT...THEN SPREAD EASTWARD TUES AS TROUGH EJECTS INTO THE EASTERN PLAINS. CURRENT PROGS KEEP UPPER TROUGH AND SURFACE LOW SLIGHTLY TOO FAR NORTH FOR A BIG SNOW EVENT OVER MOST OF THE REGION...THOUGH THE CENTRAL MOUNTAINS COULD DO FAIRLY WELL BY TUESDAY. COLDER AIR DROPS INTO THE AREA TUES AND WED...THOUGH AGAIN WITH WESTERLY JET REMAINING STRONG...BIG SOUTHWARD PUSH OF ARCTIC AIR LOOKS UNLIKELY. --PETERSEN

&&

.AVIATION...SNOW SHOWERS ARE CURRENTLY IMPACTING THE EASTERN PLAINS AND WILL PASS NEAR KPUB AND KCOS THROUGH THE EARLY EVENING HOURS. ANY SNOW SHOWERS THAT PASS OVER THE TERMINALS WILL PRODUCE IFR TO LIFR CONDITIONS AS THEY PASS. WINDS WILL BE GUSTY OUT OF THE NORTH AT KCOS. WINDS AT KPUB HAVE BEEN EASTERLY TO SOUTHERLY BUT SHOULD RETURN TO NORTHERLY THIS EVENING. CLEARING CONDITIONS ARE EXPECTED AFTER AROUND 03Z FOR BOTH TERMINALS WITH VFR CONDITIONS INTO TOMORROW.

KALS HAS HAD REDUCED VIS DUE TO BLOWING DUST AT TIMES THIS AFTERNOON. EXPECT THESE CONDITIONS TO CONTINUE THROUGH AROUND 00Z THIS EVENING WITH VFR CONDITIONS AFTER. WINDS HAVE BEEN VERY GUSTY...APPROACHING 50 KTS OUT OF THE NORTH. WINDS WILL SUBSIDE HEADING INTO THE OVERNIGHT HOURS. MOZLEY

&&

.PUB WATCHES/WARNINGS/ADVISORIES...
NONE.
&&

$$

5.0 Not Reasonably Controllable or Preventable: State and Local Particulate Matter Control Measures

While it is likely that some dust was generated within the local communities as gusts from the regional dust storm passed through the area, the amount of dust generated locally was easily overwhelmed by, and largely unnoticeable as compared to the dust transported in from the source regions of the dust storm. The following sections will describe in detail the regulations and programs in place designed to control PM_{10} in each affected community. These sections will demonstrate that the event was not reasonably controllable, as laid out in Section 50.1(j) of Title 40 CFR 50, within the context of reasonable local particulate matter control measures. As shown from the meteorological and monitoring analyses (Sections 2 and 3), the source region for the associated dust that occurred during the February 23, 2012 exceedance was the result of a very tight pressure gradient in the wake of a passing cold front. This produced intense surface winds predominantly from the eastern side of the San Luis Valley outside of the monitored area in Alamosa.

The APCD conducted thorough analyses and outreach with local governments in the valley to confirm that no unusual anthropogenic PM_{10}-producing activities occurred in this area and that, despite reasonable control measures in place, high wind conditions overwhelmed all reasonably available controls. The following subsections describe in detail Best Available Control Measures (BACM), other reasonable control measures, applicable federal, state, and local regulations, appropriate land use management, and an in-depth analysis of potential areas of local soil disturbance for Alamosa during the February 23, 2012 event, as well as subsequent outreach designed to administer these activities. This resulting information confirms that no unusual anthropogenic actions occurred in the local area of Alamosa during this event.

5.1 Regulatory Measures - State

The APCD's regulations on PM_{10} emissions are summarized in Table 8**Error! Reference source not found.**.

Table 8: State Regulations Regulating Particulate Matter Emissions

Rule/Ordinance	Description
Colorado Department of Public Health and Environment Regulation 1- Emission Control For Particulate Matter, Smoke, Carbon Monoxide, And Sulfur Oxides	Applicable sections include but are not limited to: Everyone who manages a source or activity that is subject to controlling fugitive particulate emissions must employ such control measures and operating procedures through the use of all available practical methods which are technologically feasible and economically reasonable and which reduce, prevent and control emissions so as to facilitate the achievement of the maximum practical degree of air purity in every portion of the State. Section III.D.1.a) Anyone clearing or leveling of land greater than

Rule/Ordinance	Description
	five acres in attainment areas or one acre in non-attainment areas from which fugitive particulate emissions will be emitted are required to use all available and practical methods which are technologically feasible and economically reasonable in order to minimize fugitive particulate emissions.(Section III.D.2.b) Control measures or operational procedures for fugitive particulate emissions to be employed may include planting vegetation cover, providing synthetic cover, watering, chemical stabilization, furrows, compacting, minimizing disturbed area in the winter, wind breaks and other methods or techniques approved by the APCD. (Section III.D.2.b) Any owner or operator responsible for the construction or maintenance of any existing or new unpaved roadway which has vehicle traffic exceeding 200 vehicles per day in the attainment/maintenance area and surrounding areas must stabilize the roadway in order to minimize fugitive dust emissions (Section III.D.2.a.(i))
Colorado Department of Public Health and Environment Regulation 3- Stationary Source Permitting and Air Pollutant Emission Notice Requirements	Construction Permit required if a land development project exceeds 25 acres and spans longer than 6 months in duration (Section II.D.1.j)
Colorado Department of Public Health and Environment Regulation 6- Standards of Performance for New Stationary Sources	Implements federal standards of performance for new stationary sources including ones that have particulate matter emissions. (Section I)
Colorado Department of Public Health and Environment Regulation 9- Open Burning, Prescribed Fire, and Permitting	Prohibits open burning throughout the state unless a permit has been obtained from the appropriate air pollution control authority. In granting or denying any such permit, the authority will base its action on the potential contribution to air pollution in the area, climatic conditions on the day or days of such burning, and the authority's satisfaction that there is no practical alternate method for the disposal of the material to be burned. Among other permit conditions, the authority granting the permit may impose conditions on wind speed at the time of the burn to minimize smoke impacts on smoke-sensitive areas. (Section III)

Rule/Ordinance	Description
Federal Motor Vehicle Emission Control Program	The federal motor vehicle emission control program has reduced PM_{10} emissions through a continuing process of requiring diesel engine manufacturers to produce new vehicles that meet tighter and tighter emission standards. As older, higher emitting diesel vehicles are replaced with newer vehicles; the PM_{10} emissions in areas will be reduced.

5.2 Alamosa Regulatory Measures and Other Programs

Natural Events Action Plan (NEAP)

The Final NEAP for High Wind Events in Alamosa, Colorado was completed in May 2003. The NEAP addresses public education programs, public notification and health advisory programs, and determines and implements Best Available Control Measures (BACM) for anthropogenic sources in the Alamosa area. The APCD followed up with the City and County of Alamosa in January 2007 and in the spring of 2013 on whether the NEAP mitigation measures and commitments were satisfied, the results of which are detailed below. The City of Alamosa, Alamosa County, the APCD, and participating federal agencies worked diligently to identify contributing sources and to develop appropriate BACM as required by the Natural Events Policy.

Regulatory Measures - City and County

The APCD, the City of Alamosa, and Alamosa County are responsible for implementing regulatory measures to control emissions from agricultural sources, stationary sources, fugitive dust sources, and open burning within Alamosa. Alamosa's ordinances of PM_{10} emissions are summarized in Table 9**Error! Reference source not found.**.

Table 9: Rules and Ordinances Regulating Particulate Matter Emissions in Alamosa

Rule/Ordinance	Description
City of Alamosa Code of Ordinances Article VII of Section 21-140 (5)	Addresses dust control for home occupations
City of Alamosa Code of Ordinances Article V Sec. 17-87(3))	Requires all new roads and alleys to be paved
City of Alamosa Code of Ordinances (Article VI Sec. 21-119(g)(3)).	New large commercial/retail establishments must install underground automatic irrigation systems for all landscaped areas
Alamosa County Land Use and Development Code (1.4.2)	Agriculture an important part of the economy and adds intrinsic value to life in Alamosa County. Agriculture, as a business, brings dust and other inconveniences. To maintain this way of life, Alamosa County intends to protect agricultural operators from unnecessary, intrusive litigation. Therefore, no inconvenience shall be considered a nuisance so long as it occurs as a part of non-

	negligent and legal agricultural practice, as stated in C.R.S. 35-3.5-101, 102 and 103.
Alamosa County Land Use and Development Code (3.5.2(A)(8))	For Feed lot, animal waste treatment, or animal waste collection facilities fugitive dust shall be confined on the property
Alamosa County Land Use and Development Code (3.5.6(D)(2))	For a proposed oil and gas well installation, any interior transportation network shall be paved, or the company shall undertake appropriate dust abatement measures
Alamosa County Land Use and Development Code (3.5.7(G))	All roads, driveways, parking lots and loading and unloading areas within 500 feet of any lot line shall be graded and paved with an approved concrete or asphalt/concrete surface as to limit adjoining lots and public roads the nuisance caused by wind-borne dust.
Alamosa County Land Use and Development Code (4.2.3(C)(2))	Where off-street facilities are provided for parking or any other vehicular use area, they shall be surfaced with asphalt bituminous, concrete or other dustless material approved by the administrator and shall be maintained in a smooth, well-graded condition.

City of Alamosa's Control Measures

The City of Alamosa has been active in addressing potential PM_{10} sources within the Alamosa area through various efforts. Some of these efforts, plus other potential future measures, include the adoption of local ordinances to reduce PM_{10}. Copies of current ordinances and any related commitments are included in the NEAP (See http://www.colorado.gov/airquality/tech_doc_repository.aspx?action=open&file=AlamosaNaturalEventsActionPlan2003.pdf). According to the City's Public Works Director, as of 2013, the City is planning on adding additional dust control best management practices to the International Building Codes that are adopted by the city in the next update. The best management practices will include requiring a Dust Control Plan for any site that is issued a clearing permit for any site over 2 acres. The City is also currently (as of 2013) working on revising part of their landscaping ordinances to require mulch in areas that are not vegetated or covered by rock to help mitigate fugitive particulate emissions. These efforts have been stalled in the past due to employee turnover at City Manager's Office.

Street Sweeping

The City of Alamosa sweeps on an every 4-week schedule or as needed, as determined by local officials on a case by case situation (e.g., following each snowstorm and/or where sand was applied). Sweeping occurs on every single City street with an emphasis on the downtown corridor where public exposure is expected to be greatest. Since the spring of 2013, street sweeping in the downtown corridor currently occurs on a twice per week schedule according to the City's Public Works Director.

According to the City's Public Works Director, the city (as of 2013) owns an Elgin Pelican (mobile mechanical sweeper) and a Tymko 600 (brush-assisted head) street sweeper. As of June 2013, the City will also own a new Elgin Broom Badger street sweeper at which time the Tymko 600 will be sent in for a re-build. The new Elgin Broom Badger street sweeper can be used in the winter months when the Tymko cannot due to freezing of the water delivery system.

Unpaved Roads within the City
The City of Alamosa (as of 2008) requires all new roads and alleys to be paved according to the Municipal Code (Article V Sec. 17-87(3)) and some existing unpaved roads are being treated with dust suppressants until all underground utilities are installed. No new development is allowed until paving is complete unless a performance bond is in place.

According to the City's Public Works Director, as of 2013, less than 3% of City roads are unpaved; most of these unpaved roads are legacy annexations. One of these unpaved roads is scheduled for paving this year (2013). The remaining unpaved roads are all low traffic (less than 100 ADT) and the City continues to seek funding sources for paving these streets.

Sod/Vegetative Cover Projects in the City of Alamosa
As of 2008, the City of Alamosa placed vegetative cover in all city parks and has installed irrigation systems to maintain the cover. As of 2013, the City has been emphasizing more low-water use landscaping with shrubs, mulch, etc. including both organic and rock. All turf areas do have irrigation systems which utilize drip systems for specimen plantings.

Alamosa County
Alamosa County has also been active in addressing blowing dust as detailed below.

Unpaved Roads
Alamosa County continues to address unpaved roads and lanes that are anticipated to contribute to PM_{10} emissions in the community including the area east of the city called East Alamosa. As of 2002, Alamosa County was nearing the end of its five-year road paving plan and was developing their next plan with the intention of paving on a yearly basis, based on traffic, community needs/priorities, and funding availability.

In 2002, Alamosa County addressed approximately ten (10) miles of unpaved roads. This includes the stabilization of approximately five section roads, the seal coating of two roads, and the overlay (repaving) of four (4) additional roads.

In 2003, approximately 14 miles of roads were paved. This includes the Seven Mile Road (three miles long), Road 109 (one mile long), and 10th Street (also one mile long). These roads are in close proximity to the City of Alamosa, are upwind (prevailing) from the city, and have heavy traffic. Paving is anticipated to greatly reduce blowing dust and impacts in the vicinity.

No paving projects took place between 2004 and 2010 due to lack of funding. Between 2010 and 2013, the County was able to get funding but only for maintenance paving on previously paved roads that needed repair. Now that the county is caught up on maintenance paving, it is focusing on paving the remaining unpaved roads. The County's goal is to pave about 2.5 miles of unpaved road per year depending on funding availability.

As of 2013, Alamosa County has funding to pave approximately 2.5 miles of County Road 106 North (located north of Alamosa off of Highway 17) which is currently unpaved. After this paving project the County will only have 2.5 miles of unpaved road remaining on the 106 North which was paved in the summer of 2013.

In the summer time the County regularly hauls water and wets down the unpaved roads (mostly gravel, clay and sand) to reduce the fugitive particulate emissions. The County wets the unpaved roads on an as needed basis based on weather conditions and traffic volume. In addition, when it gets cold enough in the area, the County wets down some of the more sandy roads. Once the water soaks in and freezes, good dust suppression is seen. Road construction areas are being dampened with water for dust control. These practices reduce PM_{10} emissions in and near Alamosa. This control measure is balanced with the availability of water in the area.

Alamosa County used to assess the need to use $MgC1_2$ treatment on roads in front of residences that request such service. This practice stopped in 2004 when funding was lost. Assessments included the sensitivity to dust of residents, the materials of the road base for safety reasons, and possible environmental concerns of the neighborhood. Most requests for treatment are were granted. Other areas for treatment, such as commercial construction zones or gravel pits, are investigated on a case by case basis. The County hopes to be able to start offering this service again when funding is restored.

Dust Control Plans

Alamosa County requires dust control plans for selected construction/developments. The dust control plans are typically done through a negotiated agreement by the Alamosa Land Use Department and is supported by zoning codes.

The County may update the Comprehensive Plan to include dust control plans for developers. The Land Use Administrator is researching the potential for a dust control ordinance. This effort is anticipated to reduce PM_{10} emissions in Alamosa, especially as it relates to impacts on the community and high recorded PM_{10} values. At the time of this submittal (June 2013), this effort is still underway.

Wind Erosion of Open Areas

To reduce PM_{10} emissions from open areas outside of the City limits, low tilling and other soil conservation practices continue to be utilized in the community. The Mosca-Hooper Conservation District and Natural Resources Conservation Service is working on education efforts to promote cover crops and no-till agriculture. In addition, the community is using in strategic areas the Colorado State Forest Service's

program to purchase and plant shelter trees to reduce wind erosion in open areas. Nursery seedlings from the program have been sold in Alamosa County since 1956. The number of seedlings sold has varied over the last few years as illustrated in Table 10**Error! Reference source not found.**.

Table 10: Number of seedlings sold in Alamosa per year, 2008-2013.

Year:	2008	2009	2010	2011	2012	2013
Seedlings Sold:	7,432	5,963	2,805	4,197	3,327	4,231

These trees have a demonstrated advantage for the community and for air quality. Once the trees reach maturity, it is anticipated that the equivalent of 112 miles of double-rowed trees will be in place. The survival rate of the tree seedlings varies but according to the District Coordinator for the Seedling Tree Program, potted seedlings have about a 60% to 80% survival rate and the bare root seedlings have about a 40 to 60% survival rate. The Seedling Program recommends Siberian elm and Rocky Mountain juniper trees for low maintenance, drought resistance windbreaks in the valley, but offers over 40 varieties to suit specific site conditions. The Colorado State Forest Service and the Mosca-Hooper Conservation District promote the windbreak program through workshops and consulting landowners.

In addition, there is ongoing planting of trees (approximately 50) on newly developed Alamosa County property south/southwest of Alamosa (prevailing winds from southwest) and the Airport south of Alamosa for added air quality improvement. Also, The Bureau of Reclamation has an ongoing project to plant windbreaks along their Closed-Basin Canal.

Windblown Dust from Disturbed Soils

Alamosa has a semi-arid climate with approximately 7.25 inches of precipitation annually. The San Luis Valley, as noted within 25 miles of the San Luis Valley Regional Airport in Alamosa, is primarily comprised of forests (43%) and shrublands (42%). Consequently, soils in all areas are typically a mixture of silt and sand with limited vegetation due to low precipitation. In winter and spring, windstorms are common, especially in drier years. It is due to these high velocity windstorms that Alamosa experiences most of the PM_{10} problems for the area. The City zoning map which was provided by the City of Alamosa, depicts various areas of possible soil disturbance. These were evaluated by APCD staff in conjunction with local input from the City and County staff for the Alamosa Adams State PM_{10} monitor and Municipal monitors over the past years. The area zoned agricultural remains mostly natural grassland and “Chico” shrubs.

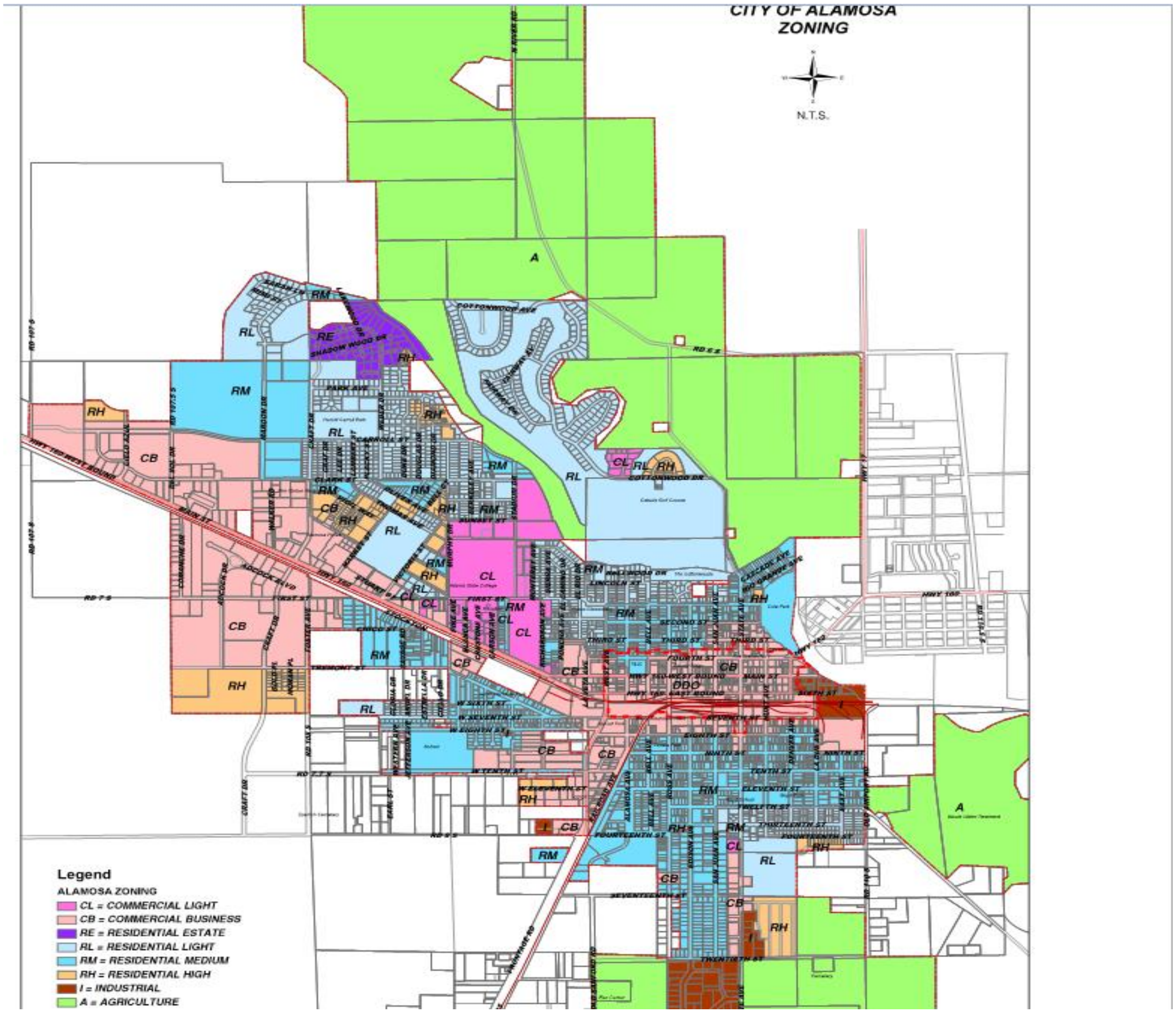

Figure 30: 2011 City of Alamosa Zoning Map (Provided by the Public Works Department)

The APCD also conducted thorough assessments in 2012 and 2013 to determine if the potential soil disturbances shown in Figure 31Error! Reference source not found. were present during the February 23, 2012 exceedance. During the course of these assessments, the APCD discovered that these sites were either reasonably controlled or considered to be natural sources during the December 1, 2011 high wind event. Therefore, these sites were not significant contributors to fugitive dust in the Alamosa area during the December February 23, 2012 high wind event.

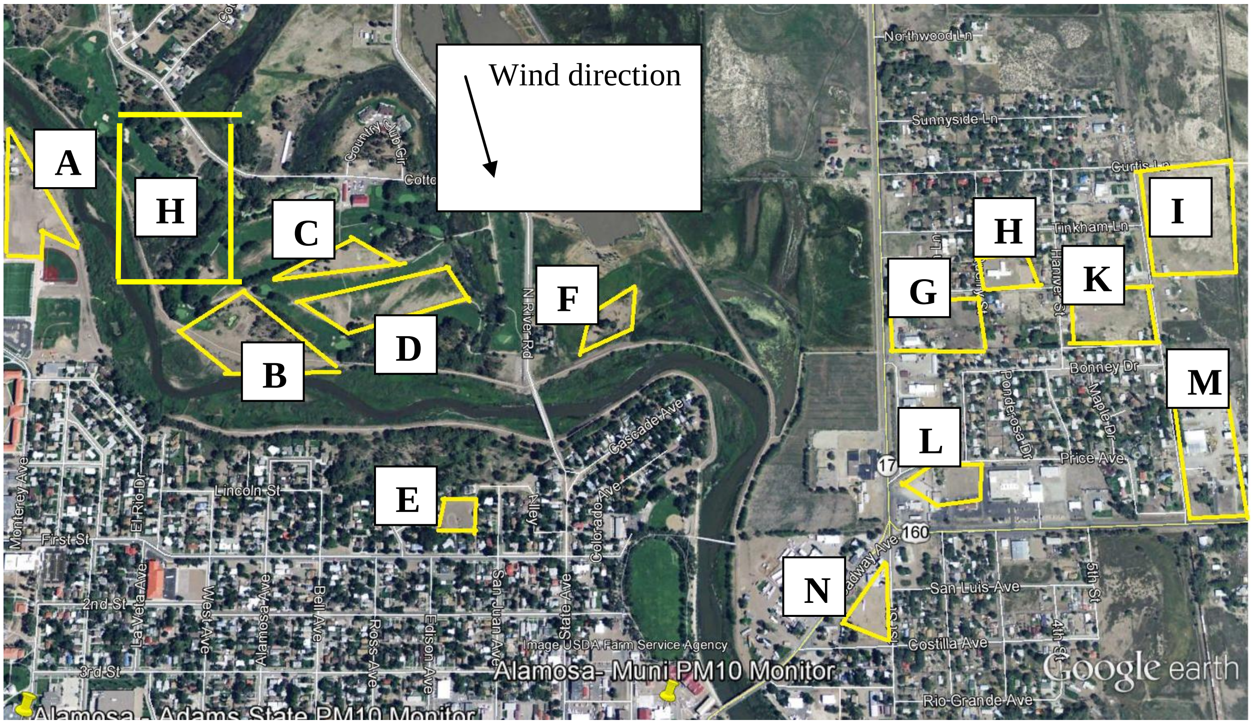

Figure 31: North and east of the Alamosa Municipal Building PM10 Monitor (Google Image 2011)

Site A in Figure 32 is an Astroturf baseball field located to the north of the Adams State College softball field. The field was constructed in 2012.

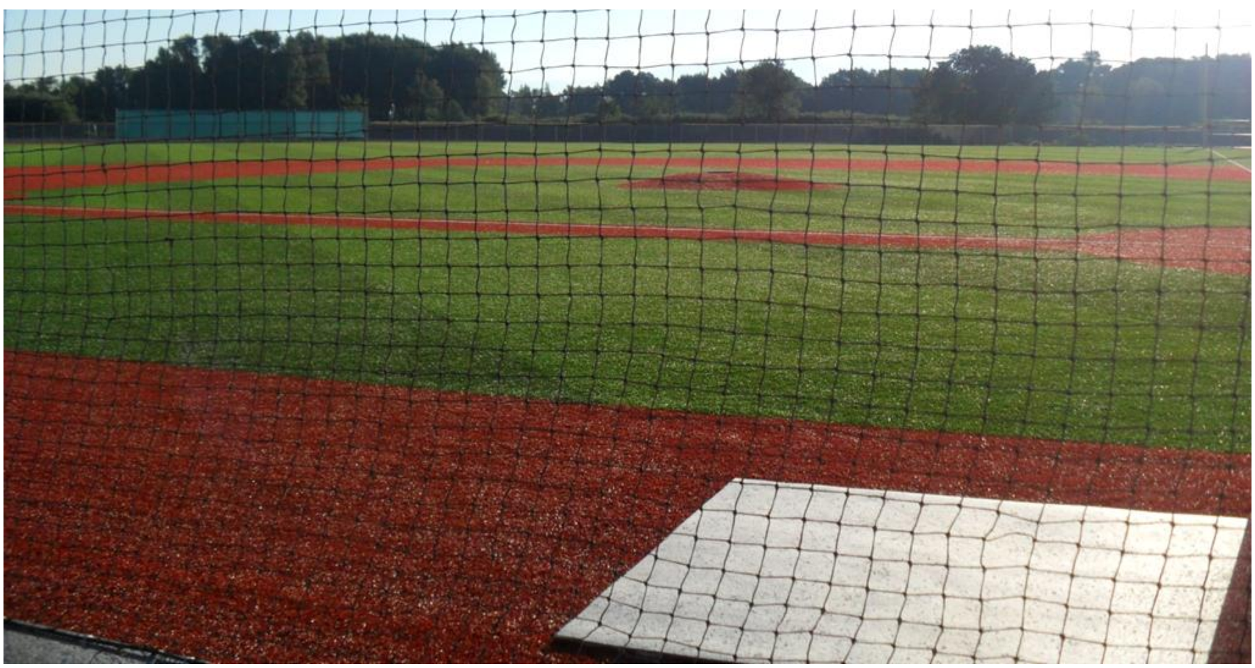
Figure 32: Site A as of August 2013

Site B, C, and D in Figure 33 are located on a golf course. These areas of the golf course are natural, undisturbed, and unmaintained. These areas receive some of the irrigation sprinkling from the golf course but are not irrigated themselves. The golf carts use the designated paths and park on the greenways; they do not disturb these natural areas.

Figure 33: Representative of Site B, C and D as of August 2013 (also showing golf cart path)

Site E in Figure 33Figure 34 is a private vacant lot in a residential area. The area is covered in gravel and weeds. The land is used to store farm equipment in-between harvest seasons.

Figure 34: Site E as of August 2013

Site F in Figure 35 is a public green space and gravel walking path maintained by the City of Alamosa. Motor vehicles are not permitted on the path. Adjacent to the path is private property that is fenced in with barbed wire. All the private land is irrigated and maintained by the owner.

Figure 35: Site F as of August 2013

Site G in Figure 36 is a vacant lot in a residential neighborhood. The vacant lot is for sale as of August 2013. The soil is hard packed with a crust.

Figure 36: Site G as of August 2013

Site H in Figure 37 is a church parking lot. The lot is well maintained gravel that is watered on an as needed basis.

Figure 37: Site H as of August 2013

Site I in Figure 38 is private property with a fence that restricts access. The land is irrigated and is covered with vegetation as shown in the photo.

Figure 38: Site I as of August 2013

Site K in Figure 39 is a vacant lot in a residential area. As of August 2013, the lot is for sale. The vacant lot has natural dense vegetation.

Figure 39: Site K as of August 2013

Site L in Figure 40 is a well maintained gravel parking lot for the Day's Inn. The parking lot is graded and watered on an as needed basis to mitigate blowing dust.

Figure 40: Site L as of August 2013

Site M in Figure 41 is owned by a Southway Construction Company. The land is large gravel parking lot that is used to store construction equipment. Local government employees reported that the gravel is graded several times per year and is watered on an as needed basis. Also, vehicle speed is restricted to 5 mph on site.

Figure 41: Site M as of August 2013

Site N in Figure 42 is a gravel parking lot for a semi-truck service station. The gravel is graded and watered on an as needed basis.

Figure 42: Site N as of August 2013

Additionally, there were several other areas that were identified by APCD staff. Similar to the sites described previously. These sites were also either reasonably controlled or considered to be natural sources during the February 23, 2012 high wind event. Therefore, these sites were not significant contributors to fugitive dust in the Alamosa area during the February 23, 2012 high wind event.

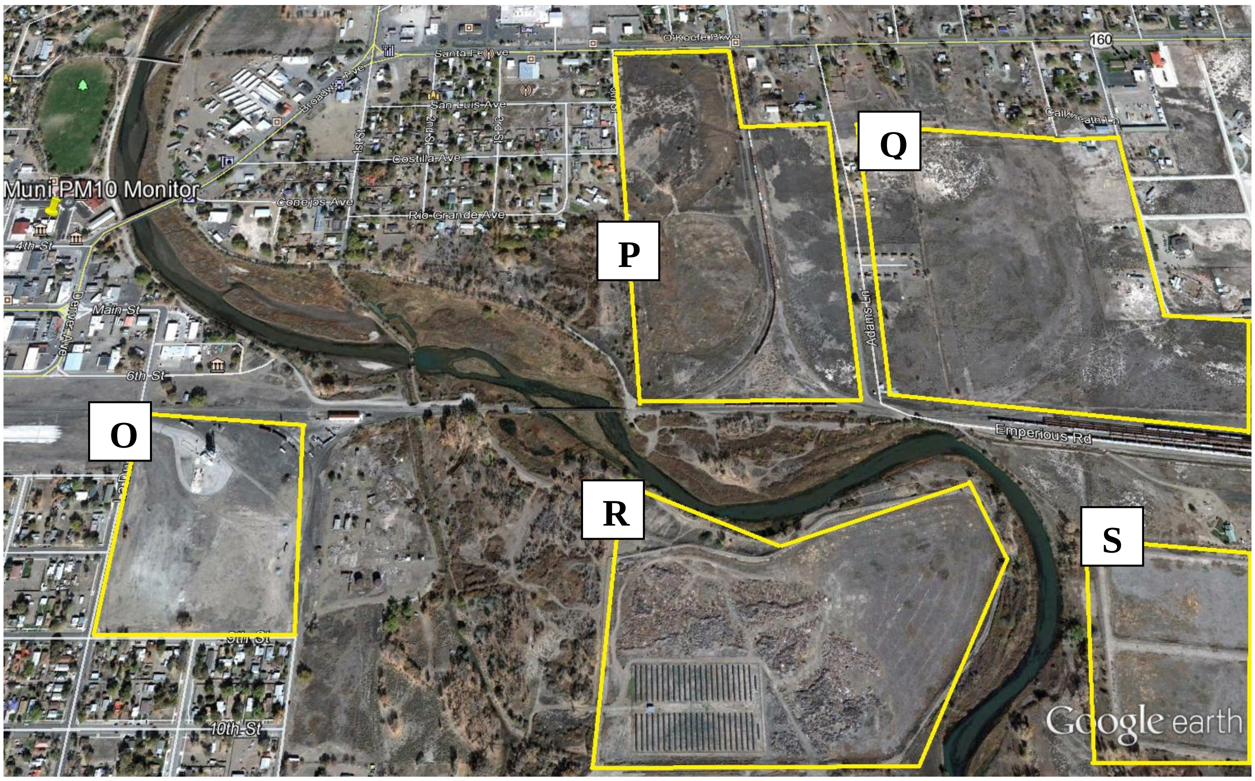

Figure 43: Area southeast of the Alamosa Muni Monitor (Google 2011)

Site O in Figure 43 (approximately 22 acres) is east of La Due Ave, south of 6th St, north of 9th St, and west of Old Airport Rd. It is zoned by the city as “Commercial Business” and “Industrial”.

Site P in Figure 43 (approximately 20 acres) is a vacant lot that is for sale as of August 2013. The undisturbed land is fenced in with barbed wire. The land is in a heavily wooded area and has dense natural vegetation as shown in Figure 44.

Site Q in Figure 45 is all private undisturbed land (multiple owners) that is fenced in with barbed wire. The land has dense natural vegetation.

Site R in Figure 46 is a solar farm surrounded by open naturally vegetated land. Access to the solar farm is very restricted; the road to the facility is private and gated.

NOTE: No photo of Site S is provided as there is no physical access to it or public roads to be able to investigate.


Figure 44: Site P as of August 2013


Figure 45: Site R as of August 2013

Figure 46: Site R as of August 2013

Soil and Vegetative Projects in the County

The development and construction of a local park, Eastside Park, is complete in Alamosa County. It has been completed with turf grass, shrubs, and landscape rock.

Numerous other projects to reduce blowing dust and its impacts have happened or are happening at the County Airport. For example:

- Through additional grounds maintenance of the 40-acre Alamosa County airport south of the city, “Xeriscape” has been installed for aesthetics and dust control.

- Decorative rock and xeriscape have been implemented in the landscaping of the Alamosa County property (2007-2012). These measures have directly abated blowing dust at the Airport.

- Also, the widening of the airport’s safety areas (250 feet on either side of the runway) is complete and seeding of natural grasses was incorporated in the project. Trees and grass were incorporated in the approaches to the airport and have provided additional wind-break advantages to South Alamosa.

In other areas where watering is a problem, xeriscape (the use of native drought resistant vegetation and/or rock cover) is being encouraged for County owned property and for all other property owners.

Colorado State University Co-Op Extension Office

In response to extremely dry conditions, the need to maintain area topsoil, and reduce impacts, the Colorado State University Co-Op Extension Office of Alamosa County provides the following outreach efforts and recommendations:

- Modification of grazing practices to improve protective crop cover
- Increasing crop residues left in the fields to reduce blowing dust
- Planting of Fall crops to maintain fields
- Application of manure to protect top soils from blowing away
- Staggering of the harvest to minimize blowing dust
- Outreach programs on soil conservation efforts
- Development of outreach/education materials (e.g., news articles, newsletters, fact sheets, etc.), and
- Attendance at Statewide workshop to educate other Co-Op offices to various practices to reduce blowing top soil and minimize impacts.

These control strategies are not meant to be enforceable. They are meant only to demonstrate the regional nature of cooperation in addressing blowing dust and its impacts on the community.

Natural Resources Conservation Service (NRCS)

Alamosa County is a predominately agricultural area where limited water, coupled with the frequent high winds experienced during late fall and early spring, can destroy crops, encourage pests, and damage soil surfaces lending them susceptible to wind erosion. Thus, activities that improve the topsoil and prevent its lifting during high wind events are encouraged. Some notable NRCS and agricultural examples include:

- Local Conservation Districts and farmers hold monthly meetings as an informal Soil Health Group, discussing ways to improve soil health. Cover crops, compost applications, and reduced tillage are the targeted practices. Public tours are held twice a year.
- NRCS continues to work with area farmers in the development of conservation compliance plans to also protect topsoil;
- NRCS encourages planting perennial grasses or the leaving weeds undisturbed or mowed on the corners of center pivots (instead of tilling that might lead to open, barren lands) to reduce soil blowing;
- NRCS "cost shares" on soil health practices and perennial grass seeding conservation practices with local farmers to prevent soil erosion, and;
- The NRCS is working with Colorado State University, local Water Conservation District, and Farm Service Agency to encourage retirement of marginal cropland in the Conservation Enhanced Reserve Program (CREP) and seeding those acreages back to native grass, forbs and shrubs.

Other successful agricultural practices encouraged in the area include: timing of tillage, crop rotation, amount of crop residue left on the land, and proper water usage. These control strategies are not meant to be enforceable. They are meant only to demonstrate the regional nature of cooperation in addressing blowing dust and its impacts on the community.

Please refer to the Final NEAP at: http://www.colorado.gov/airquality/tech_doc_repository.aspx?action=open&file=AlamosaNaturalEventsActionPlan2003.pdf for more detail if needed.

6.0 Summary and Conclusions

APCD is requesting concurrence on exclusion of the exceedance PM_{10} value from the Alamosa-Municipal Building (08-003-0003) on February 23, 2012.

On February 23, 2012, a strong cold front moved across Colorado. During this event, a sample in excess of 150 µg/m^3 was recorded at Alamosa - Municipal (Alamosa Muni, 239 µg/m^3). An elevated sample was recorded at Alamosa – Adams State College (Alamosa – ASC, 117 µg/m^3), no other samples were affected by this event. The elevated PM_{10} readings in Alamosa resulted from blowing dust associated with strong, gusty winds behind the passage of the front. The winds transported blowing dust into Alamosa from eastern parts of the San Luis Valley.

MODIS and GASP satellite imagery reveal that a dust storm was taking place in the San Luis Valley of south-central Colorado on February 23. The drought-stricken northern half of the San Luis Valley was the source region for the blowing dust that produced the PM_{10} exceedance in Alamosa.

The elevated friction velocities shown in Figure 22, the data on soil moisture conditions presented elsewhere in this report and the prevalence of winds above blowing dust thresholds prove that this dust storm was a natural event that was not reasonably controllable or preventable.

This evaluation of PM_{10} monitoring data for sites affected by the February 23, 2012, event was made using valid samples from PM_{10} samplers in Alamosa from 2008 through 2012, APCD has been monitoring PM_{10} concentrations in the area since 1985. The overall data summary for the affected sites is presented in Table 4**Error! Reference source not found.**, with all data values presented in µg/m^3.

It is certainly the case that monthly median values are indicative of typical, day to day concentrations. Additionally, there is a range of samples that are a product of normal variation subject to typical, day to day local effects. This range may be restricted to percentile values that are well correlated with the median. For the data set of concern (Alamosa Muni) a robust estimate of the percentile value that is reflective of typical, day to day variation is the 75th percentile value. Nearly all of the variation ($r = 0.95$) in the monthly 75th percentile values of the Alamosa Muni data set can be explained by the variation in the monthly median. A less robust but more conservative estimate of the contribution to the event from local sources for these data sets may be the monthly 90th percentile value; the correlation between the Alamosa Muni monthly median value and the 90th percentile value is $r = 0.64$. For both estimates of local contribution (the 75th and 90th percentile value) the portion of the sample concentration greater than these monthly percentile values would be the sample contribution due to the event; using both we can estimate a concentration range, from robust to conservative, due to the event.

Clearly, there would have been no exceedance but for the additional contribution to the PM_{10} sample provided by the event.

7.0 References

Colorado Department of Public Health and Environment, City of Alamosa, Alamosa County Commissioners, *Natural Events Action Plan for High Wind Events – Alamosa, Colorado*, May 2003

Draxler, R.R. and Rolph, G.D., 2012. HYSPLIT (HYbrid Single-Particle Lagrangian Integrated Trajectory) Model access via NOAA ARL READY Website (http://ready.arl.noaa.gov/HYSPLIT.php). NOAA Air Resources Laboratory, Silver Spring, MD.

Marticorena, B., G. Bergametti, D. Gillette, and J. Belnap, 1997, Factors controlling threshold friction velocity in semiarid and arid areas of the United States, *Journal of Geophysical Research 102 D19*, 23,277-23, 287.

United States Environmental Protection Agency, June 2012, draft Guidance on the Preparation of Demonstrations in Support of Requests to Exclude Ambient Air Quality Data Affected by High Winds under the Exceptional Events Rule.