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New Mexico Environment Department

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Exceptional Events Demonstration 2012

Particulate Matter Exceedances in Southern New Mexico due to Natural Events


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The New Mexico Environment Department's Air Quality Bureau prepared this document. It is available for review at the website located at www.nmenv.state.nm.us/aqb or in person at the addresses listed below. The Air Quality Bureau accepted public comment on this document from November 8, 2013 to December 9, 2013. For further information, please contact the department by phone, email or in writing at:

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1 INTRODUCTION

1.1 Purpose

The U.S Environmental Protection Agency (EPA) sets National Ambient Air Quality Standards (NAAQS) for Particulate Matter (PM) with an aerodynamic diameter of 10 microns or less (PM_{10}) and 2.5 microns or less ($PM_{2.5}$). In 2012, the New Mexico Environment Department (NMED) Air Quality Bureau (AQB) recorded 52high wind blowing dust exceedances on 15 days (Table 1-1) of the PM_{10} NAAQS. The PM_{10} NAAQS is set at a 24-hour average of 150 $\mu g/m^3$ measured from midnight to midnight, not to be exceeded more than one day per year based on a three year rolling average. Due to rounding conventions in the rule, an exceedance must have a 24-hour average concentration of 155 $\mu g/m^3$ or greater. The AQB recorded 6 exceedances of the 24-hour $PM_{2.5}$ NAAQS and 15 exceedances (includes 24-hour exceedances) of the annual $PM_{2.5}$ NAAQS on the same days in which PM_{10} exceedances were recorded. In addition, the AQB recorded 28 $PM_{2.5}$ annual exceedances that were the result of smoke impacts from wildfires. The 24-hour $PM_{2.5}$ NAAQS is set at 35 $\mu g/m^3$ measured from midnight to midnight while the annual standard is set at 12 $\mu g/m^3$.

The evidence presented in this document substantiates the AQB's request to exclude exceedance data from the PM_{10} and $PM_{2.5}$ NAAQS attainment determinations for Doña Ana and Luna Counties in southern New Mexico. Exceedances of the PM_{10} standard were recorded at all seven monitoring sites operated in Doña Ana and Luna Counties using the Federal Equivalent Method (FEM) Tapered Element Oscillating Microbalance (TEOM) continuous instruments. Exceedances of the $PM_{2.5}$ standard were recorded at one of two monitoring sites in Doña Ana County using the Federal Reference Method (FRM) Partisol instrument. Table 1-1 lists the dates, monitoring sites and 24-hour averages of the exceedances requested for exclusion when the EPA makes the determination of whether or not Doña Ana and Luna Counties meet the PM NAAQS. The elevated levels of PM recorded on the dates highlighted in green (PM_{10} and $PM_{2.5}$ 24-hour average standards and $PM_{2.5}$ annual standard) and light blue ($PM_{2.5}$ annual standard only) below were due to natural events, more specifically, high winds entrained dust in the air and transported it to the monitoring sites.

DATE	Anthony PM$_{10}$	Chaparral PM$_{10}$	Deming PM$_{10}$	Holman PM$_{10}$	Desert View PM$_{10}$	SPCY PM$_{10}$	SPCY PM$_{2.5}$	West Mesa PM$_{10}$
2/11/2012	77	45	46	71	158	130	12.7 P	ND
2/14/2012	171	106	167	ND	114	123	13.7 P	ND
2/28/2012	116	183	29	192	276	301	25.7 P	78
3/2/2012	169	221	52	76	153*	251	28.0 P	122
3/7/2012	520	482	1098	313	656	610	84.5 P	301
3/18/2012	1739	1606	646	1449	1691	1261	149.7 P	ND
4/1/2012	96	79	50	53	138	157	33.0 P	ND
4/7/2012	88	60	30	171	80	86	16.1 P	39
4/14/2012	751	803	927	794	961	880	101.6 P	479
4/26/2012	259	274	198	464	408	ND	64.1 P	105
5/23/2012	115	121	86	214	143	163	23.2 P	53
6/15/2012	167	99	215	75	203	143	22.0 P	75
11/10/2012	469	396	48	44	230	331	42.2 P	45
12/14/2012	111	ND	9	16	136	199	16.5 P	14
12/19/2012	ND	ND	381	397	365	500	49.7 P	352

Table 1-1. 24-hour average concentrations for high wind blowing dust exceedances.

2 BACKGROUND

2.1 Exceptional Events Rule

On March 22, 2007, the EPA adopted its final rule for state and local air quality management agencies regarding the review and handling of certain air quality monitoring data (72 FR 13560). The regulation, "Treatment of Data Influenced by Exceptional Events", or more commonly called the Exceptional Events Rule (EER), became effective on May 22, 2007 (40 CFR Part 50.14). The EER allows the EPA to exclude data affected by an exceptional event that caused an exceedance of a NAAQS when determining an area's ability to meet the standard for a given criteria pollutant. The rule does not include specific requirements concerning the type or level of evidence an agency must provide due to the wide range of events and circumstances covered under the rule. Hence, EPA determines data exclusion on a case-by-case basis after considering the weight of evidence provided in a demonstration. The procedural requirements of the EER are:

1. flagging of data in EPA's Air Quality System (AQS) database by air quality management agencies,
2. submission of demonstrations proving an exceptional event caused an exceedance within three years of the calendar quarter in which it was recorded, and
3. EPA placing a concurrence flag in AQS for those dates that are exceptional events.

In order for EPA to concur on a demonstration and exclude data under the EER, an agency must meet six technical elements. These elements include:

1. whether the event in question was not reasonably controllable or preventable (nRCP),
2. whether there was a clear causal relationship (CCR),
3. whether there would have been no exceedance or violation but for the event in question (NEBF),
4. whether the event affects air quality (AAQ),
5. whether the event was caused by human activity unlikely to reoccur or it was a natural event (HAURL/Natural Event), and
6. whether the event was in excess of normal historical fluctuations (HF).

NMED concludes that the exceedances listed in Table 1-1 are natural events caused by high winds that entrain and transport dust from erodible areas to the monitoring sites. This report demonstrates that NMED met the procedural and technical requirements for excluding data due to exceptional events in Doña Ana and Luna Counties for calendar year 2008.

2.2 Geography, Topography, and Climate

The Rio Grande River runs through the 3,804 square miles comprising Doña Ana County, extending from the northwest corner to the south-central border where Sunland Park, New Mexico, El Paso, Texas and Ciudad Juárez, Mexico come together. The Rio Grande River forms the heavily agricultural Rincon (northern) and Mesilla (southern) Valleys in Doña Ana County continuing southeastward through the El Paso and Juarez Valleys along the entire length of the United States-Mexico border, eventually discharging into the Gulf of Mexico.

The area within and surrounding Doña Ana County is topographically diverse and includes mountain ranges, hills, valleys and deserts. The elevation range for the county is 3,730 feet at the valley floor in the south to 9,012 feet at the peak of the Organ Mountains. The Organ Mountains lay in a north-south direction along the eastern border of the county, separating the Mesilla Valley from White Sands Missile Range (WSMR) and White Sands National Monument. The western half of Doña Ana County is formed by an elevated desert plateau (West Mesa) that extends west through Luna, Grant, and Hidalgo Counties along the international border and into Arizona.

Where New Mexico, Texas and Mexico meet, Mount Cristo Rey lays south of Sunland Park between the Franklin Mountains on the east and the Sierra Juarez Mountains to the southwest. Previous air quality studies in the air shed indicate that this complex topography dictates wind flow patterns carrying air masses from El Paso and Ciudad Juarez into Sunland Park.

Luna County is 2,965 square miles in southwestern New Mexico sharing 54 miles of international border with Mexico. Luna County is within the northern most part of the Chihuahuan Desert, with desert landscape as its most predominant feature. Several mountain ranges are located within the county including: Cooke's Range, the Florida Mountains and the Tres Hermanas Mountains.

Doña Ana County has a mild, semiarid climate with light precipitation, abundant sunshine, low relative humidity, and a large daily and annual temperature range. Annual precipitation averages 9.35 inches with 3.7 inches of snowfall in Las Cruces to 8.71 inches and 5.9 inches of snowfall near El Paso (WRCC, 2011). Windstorms are common during the late winter and spring months. Due to these high velocity winds, Luna and Doña Ana Counties experience the majority of PM_{10} exceedances in the state. Synoptic scale weather activity and to a lesser extent, mesoscale weather systems drive most of the frequent high wind events in the region (Novlan et al., 2007). These periods of high wind may exceed average hourly wind speeds of 30 miles per hour (mph) for several hours and reach peak speeds of 60 mph or more (Aaboe et al., 1998-2007). Blowing dust and soil erosion originate from the numerous exposed and susceptible desert areas. Winds predominately blow from the southeast in summer, from the west in winter, and from the west-southwest in spring. However, local surface wind directions vary greatly because of local topography and mountain and valley breezes.

2.3 Monitoring Network and Data Collection

The AQB operates a State and Local Air Monitoring Stations (SLAMS) network to measure the concentration of criteria pollutants (Table 2-1). The Bureau maintains six PM_{10} monitoring sites in Doña Ana County and two in Luna County to track windblown dust in southern New Mexico. All monitoring sites in Doña Ana County and the Deming Airport site are equipped with continuous FEM TEOM instruments while the Deming Post Office, Anthony and Sunland Park City Yards (SPCY) sites have filter-based FRM Hi-Volume Wedding Monitors. The AQB also operates two $PM_{2.5}$ FRM Partisol and four $PM_{2.5}$ TEOM monitors in Doña Ana County. The

$PM_{2.5}$ TEOM instruments do not meet the specifications for FRM or FEM designation by EPA and are not part of the SLAMS network. The data from these machines are for informational purposes only and EPA does not use it to compare air quality to the NAAQS (Table 2-2).

The monitoring network in Doña Ana County comprises the Las Cruces (northern) and Paso del Norte (southern) area. The West Mesa and Holman monitoring sites are in the City of Las Cruces, with the rest of the monitoring sites situated along the borders with Texas and Mexico in the south (Figure 2-1). The FEM TEOM and FRM Wedding PM_{10} monitors are collocated at the Anthony and SPCY sites.

Site Name	AIRS Number	Latitude (d-m-s)	Longitude (d-m-s)
6ZL Holman	35-013-0019	32-25-29.69	106-40-26.62
6ZK Chaparral	35-013-0020	32-02-27.48	106-24-33.09
6CM Anthony	35-013-0016	32-00-11.54	106-35-57.67
6ZG SPCY	35-013-0017	31-47-49.91	106-33-24.17
6ZM Desert View	35-013-0021	31-47-46.32	106-35-02.13
6WM West Mesa	35-013-0024	32-16-39.9	106-51-49.68
7E Deming Airport	35-029-0003	32-15-20.99	107-43-21.58
7D Deming Post Office	35-036-0001	32-16-7.86	107-45-29.32
6Q Las Cruces	35-013-0025	32-19-13.8	106-46-13.08

Table 2-1. SLAMS designated PM monitoring sites in southern New Mexico.

Site Name	AIRS Number	Latitude (d-m-s)	Longitude (d-m-s)
6CM Anthony	35-013-0016	32-00-11.54	106-35-57.67
6ZG SPCY	35-013-0017	31-47-49.91	106-33-24.17
6ZM Desert View	35-013-0021	31-47-46.32	106-35-02.13
6ZN Santa Teresa	35-013-0022	31-47-17.16	106-40-57.25

Table 2-2. Informational $PM_{2.5}$ monitoring sites in southern New Mexico.

Monitoring data is quality controlled and quality assured within the department and submitted to AQS by the end of the following quarter in which it is collected. The AQB places flags on exceedances of the NAAQS and investigates the cause of the monitored concentration to determine if it qualifies as an exceptional event. If EPA concurs with a state's flag and subsequent demonstration of an exceptional event, it excludes that monitoring data when determining attainment of the NAAQS for a given pollutant.

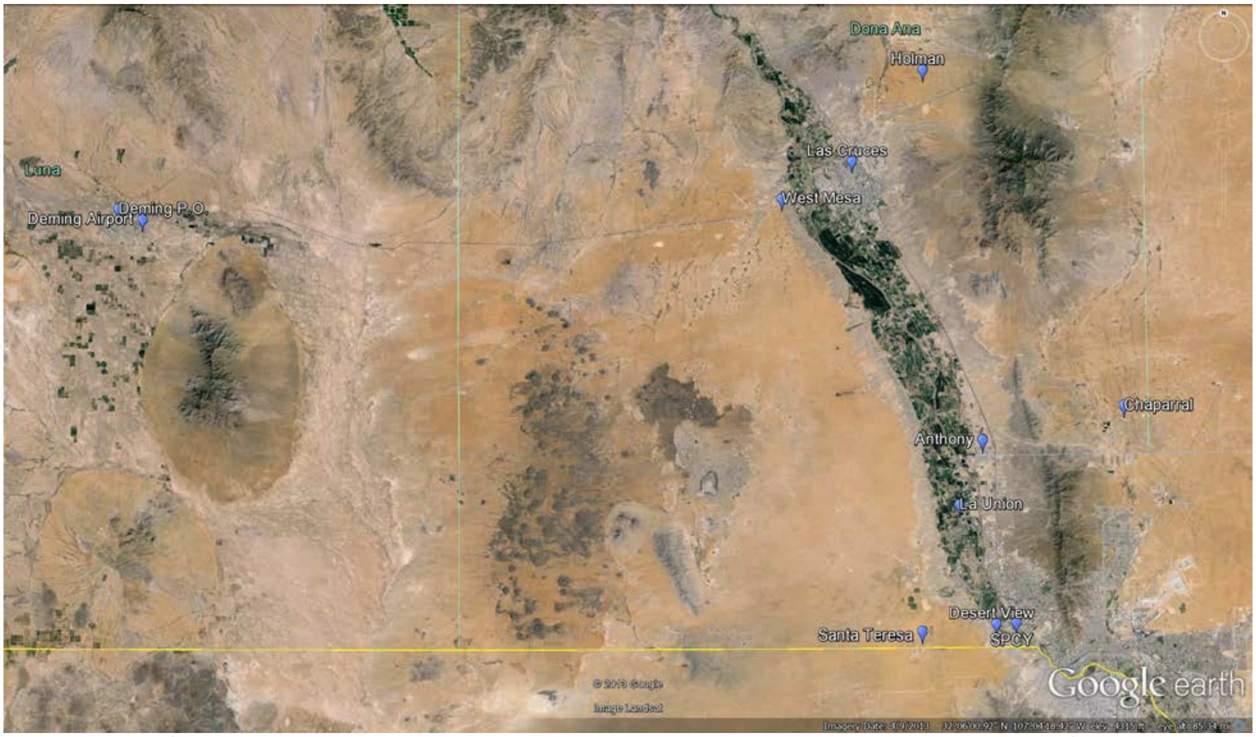

Figure 2-1. Map of New Mexico's monitoring sites. La Union does not have a particulate matter monitor and is used for meteorology.

2.4 Doña Ana and Luna Counties' NEAPs

Since 1977, EPA has recognized the need to review and handle air quality data for which the normal planning and regulatory processes are not appropriate (72 FR 13562). Prior to the implementation of the EER, EPA policy and guidance dictated the handling of data affected by an exceptional event. The policy most pertinent to New Mexico was outlined in the May 30, 1996 Natural Events Policy (NEP). This policy addressed exceedances of the PM_{10} NAAQS caused by natural events such as high winds and wildfires.

Similar to the EER, the NEP allowed the exclusion of ambient air quality monitoring data affected by natural events from attainment determinations, if certain requirements were met. The AQB managed its air quality monitoring data under this policy until the implementation of the EER (1996-2007). Many of the provisions of the NEP are included in the EER.

The NEP set procedures for the development of a Natural Events Action Plan (NEAP) to protect public health in areas where uncontrollable natural events caused a violation of the PM_{10} NAAQS. The AQB developed the Luna and Doña Ana County NEAPs based on the following five major elements:

1) protect public health;
2) public education and awareness;
3) documentation and analysis of exceedances;
4) use of Best Available Control Measures (BACM); and
5) five-year review and evaluation of plan.

EPA approved the NEAPs for Doña Ana and Luna Counties in 2000 and 2003 respectively. Under the NEAPs, the AQB provided documentation and analysis to EPA for exceedances of the PM_{10} NAAQS caused by high wind dust events from 1996-2007. In order for EPA to exclude these exceedances from consideration when determining nonattainment designations, the AQB's documentation had to demonstrate a clear causal relationship (CCR) between the measured exceedance and the natural event and that there would have been no exceedance but for the event (NEBF).

Another important element of the NEAPs required the identification of significant anthropogenic sources of dust and application of Best Available Control Measures (BACM) for these sources. BACM are control methods used to reduce or eliminate windblown dust in areas where natural soils have been disturbed and are prone to wind erosion. To determine what constitutes BACM for a particular community and source, a number of factors are considered. These factors include the sources of anthropogenic dust, when these sources are present, the available measures to control dust emissions, and the cost of these measures compared to their effectiveness to control dust. Due to the varied landscape and activities in the two counties, BACM for PM_{10} were determined on a case-by-case basis considering technological and economic feasibility of implementing each mitigation technique. The largest emission sources include the natural desert terrain, paved and unpaved roads, agriculture, and construction.

Under the Doña Ana County NEAP, the local governments developed wind erosion control ordinances based on BACM in 2000. Luna County and the City of Deming have had their ordinances in place since 2004. Through the efforts of developing the NEAPs, the state and large land managers (New Mexico State University, WSMR, Ft. Bliss, etc.) signed Memorandums of Agreement (MOAs) or Memorandums of Understanding (MOUs). The ordinances and MOUs adopted by each jurisdiction focused on the controllable anthropogenic sources identified in each BACM analysis. New Mexico did not adopt Luna and Doña Ana Counties' NEAPs under its State Implementation Plan; therefore, the AQB does not have the authority to require or enforce BACM in these counties.

After working with concerned citizens and the Las Cruces City Council, an ad hoc committee was formed to evaluate the City's dust control ordinance and make recommendations to improve the implementation of dust control measures. The ad hoc committee formed with a variety of stakeholders and included concerned citizens, the regulated community, academics, the City of Las Cruces and NMED. Three subcommittees were formed to focus on the issues of permitting/planning, mitigation and compliance, and enforcement. The results of the committee were presented to the City Council in the spring of 2011. A revised ordinance was then drafted based on the recommendations of the committee and the City Council adopted the revisions in the fall of 2011.

For documentation and analysis under the NEAPs, NMED considered the occurrence of peak wind gusts greater than 18 meters per second (~40 miles per hour) to be sufficient evidence, by itself, that an exceedance was caused by high wind and was not reasonably controllable. The AQB's analysis of data for the 101 high wind exceedances that occurred during the years 1999 and 2000 determined this wind gust criterion (Aaboe et al., 1998-2007). For days when an exceedance occurred at a monitoring site that did not have 18 m/s wind gusts, NMED created time series plots of wind data and hourly PM_{10} concentrations to demonstrate that a natural event occurred and resulted in an exceedance. Along with these time series plots, NMED provided news reports, pictures, satellite images, and data from other jurisdictions (TCEQ-El Paso) that monitored exceedances on the same day that were being used as supporting evidence of a natural event (Aaboe et al., 1998-2007).

For more information, copies of the Doña Ana and Luna County NEAPs as well as documentation and analysis for past natural events resulting in PM exceedances are posted on our website at www.nmenv.state.nm.us/aqb. Alternatively, requests for hard copies may be made to the AQB in Santa Fe.

2.5 Sources of Windblown Dust

Many features of the Chihuahuan Desert contribute to the soil's susceptibility to erosion including: aridity, sparse vegetative cover, low soil moisture and large areas of exposed and fragile soil. The largest sources of blowing dust are playas (dry lakebeds) and natural desert located in southeastern Arizona, southern New Mexico, west Texas and northern Mexico. In Doña Ana County, windblown dust from desert land is by far the most prominent source of PM_{10} accounting for nearly 85% of emissions (Table 2-3). No emissions inventory exists for Luna County.

Area and Mobile Sources	PM_{10} Emissions (Tons/year)	$PM_{2.5}$ Emissions (Tons/year)
Wind Erosion	49,242.5	10,833.3
Unpaved Roads	6,166.9	922.5
Paved Roads	1,119.9	153.3
Agriculture	470.7	142.6
Construction	294.2	61.2
Quarrying and Mining	159.2	31.8
Total	58,141.7	12,759.4

Table 2-3. Emission data collected from the 2004 area and mobile emission inventory for Doña Ana County (EPA's ATLAS Project).

2.6 Meteorological Conditions for High Wind Blowing Dust Days

There are three weather systems, which create windstorms capable of producing windblown dust in New Mexico (Comet, 2010; Novlan et al., 2007). Large scale or synoptic weather systems account for two of these conditions. These weather systems often affect entire states and can be large enough to cover multiple states. The other meteorological condition, a small or mesoscale weather system, creates high winds from microbursts and outflow boundaries from thunderstorms. The first and most common weather system creating windblown dust is synoptic scale Pacific cold fronts that frequently pass through New Mexico during the fall, winter and spring (Figure 2-2). Surface winds flow from a west to southwest direction during these conditions. Winds flow perpendicular to the isobars from high to low pressure on the map in Figure 2-2 (red squiggly lines). The next most common cause of high wind blowing dust episodes is synoptic scale cold fronts from the north or east, also known as backdoor cold fronts. The last and least frequent cause of windblown dust events are mesoscale storms caused by thunderstorm outflow fronts and dry or wet microbursts. These storms, known as haboobs, occur mostly during the monsoon season in the summer months when southern New Mexico receives the majority of its annual precipitation.

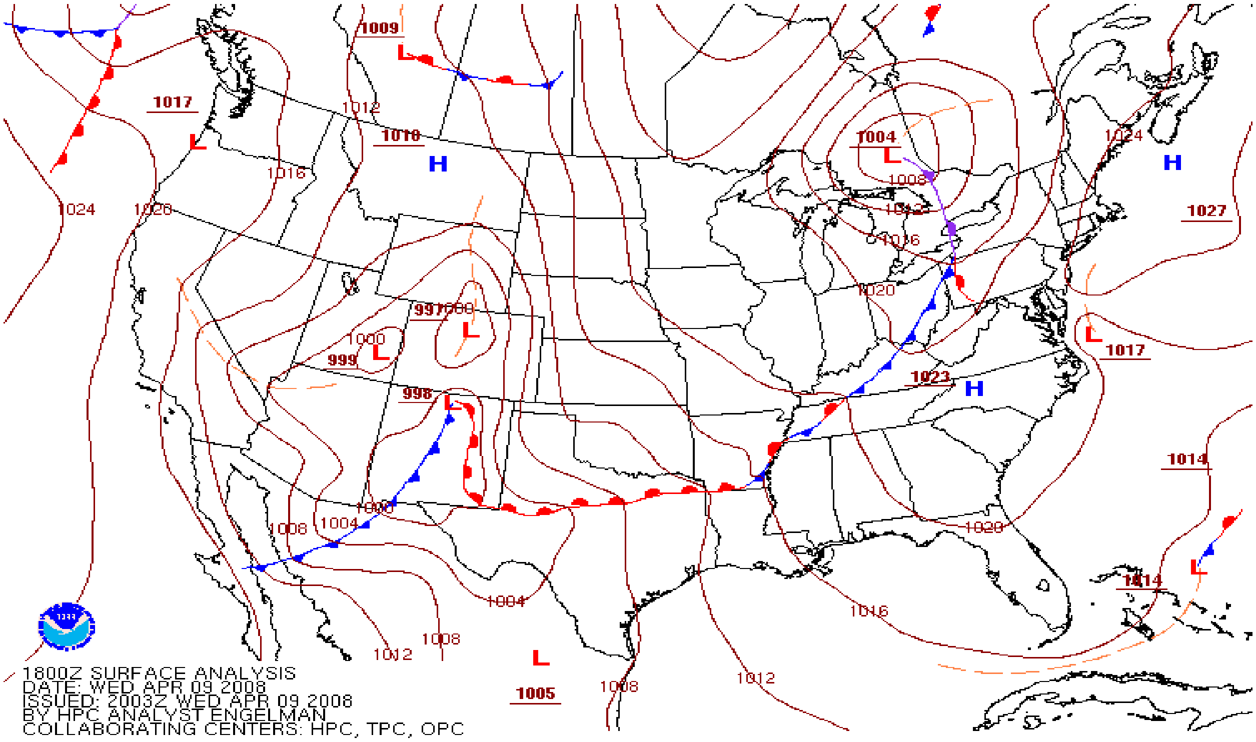

Figure 2-2. Surface weather map depicting a Pacific cold front.

The optimal meteorological conditions for high wind blowing dust days occur when an upper level trough of low pressure and a Pacific cold front pass through the region at the same time on days with high velocity winds aloft and at the surface, minimal cloud cover, low relative humidity, and maximum temperature (Novlan et al, 2007). As the surface pressure and density gradient begins to form due to the upper level trough and surface cold front passage, daytime heating of the surface creates a mixing layer that allows for entrainment of dust as well as downward mixing of strong winds aloft, further enhancing wind speeds at the surface. If the surface winds cross the vast sources of dust in the area with the correct angle and speed, a high potential for entraining and transporting dust occurs. There are many variations of this scenario and weather conditions that may cause high wind and blowing dust at different intensities.

Figure 2-3 depicts the upper air patterns associated with the Pacific cold front from Figure 2-2. This map is for the 500 hour on April 10 and shows that the cold front has passed toward north central Texas. Due to the lack of friction in the atmosphere, winds flow parallel to the isobars on an upper air map (brown lines).

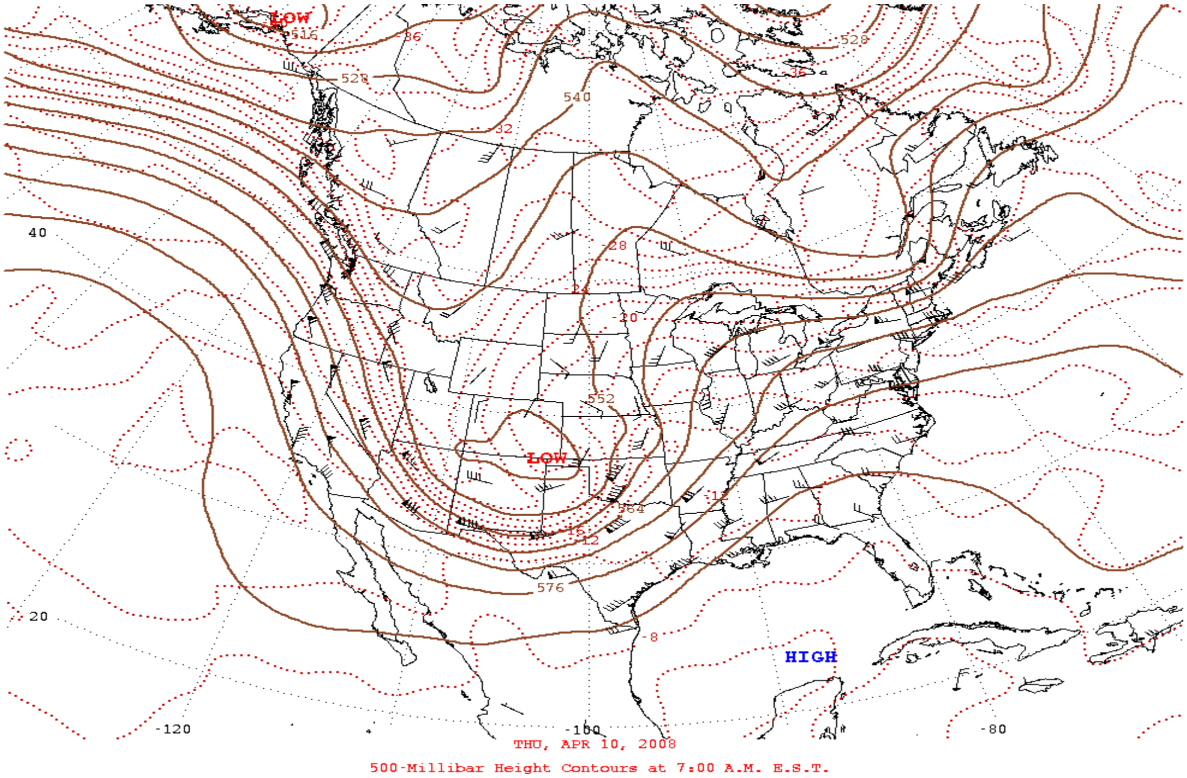

Figure 2-3. Upper air weather map for winds at the 500 millibar height (approximately 5-6 km above ground level).

2.7 Drought Conditions

The U.S. Drought Monitor is produced in partnership between the National Drought Mitigation Center at the University of Nebraska-Lincoln (UNL), the United States Department of Agriculture (USDA), and the National Oceanic and Atmospheric Administration (NOAA). The Drought Monitor uses multiple indices and impacts to try and describe drought conditions in a number of circumstances and represents a consensus of federal and academic scientists.

Although the severity of drought was less in 2012 than 2011, New Mexico still experienced drier than normal conditions. According to the Drought Monitor, New Mexico experienced drought conditions throughout 2012 with nearly 50% of the state classified in the severe drought category or worse. Conditions consistently worsened throughout the year with the entire border region classified as moderate to severe when the first high wind blowing dust event occurred (Figure 2-4). The normal monsoon moisture that begins in June brought little relief to the area as conditions worsened until they reached a peak in August when conditions were classified as severe for over 95% of the border. The entire state was classified in the moderate to extreme range in August (Figure 2-5).

The lack of moisture provided the conditions for large areas of desert to be more prone to wind erosion and blowing dust for the second consecutive year. Small plants and shrubs that normally act to inhibit sand movement and eventual entrainment were unable to grow without moisture. Top soil also lacked the natural crust that forms when precipitation falls and evaporates, binding nutrients together to resist the forces of wind that causes erosion. These factors together enhanced the area's susceptibility to wind erosion accounting for the exceedances at the monitoring sites.

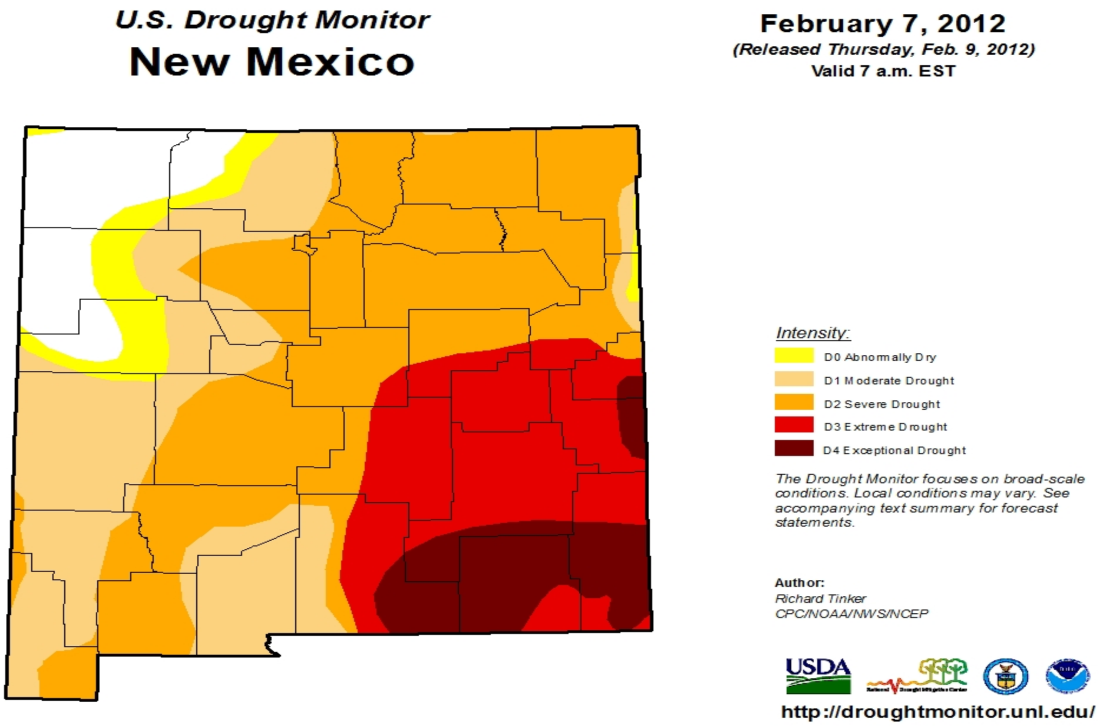

Figure 2-4. Drought conditions in New Mexico as of February 7, 2012. Map courtesy of NDMC-UNL.

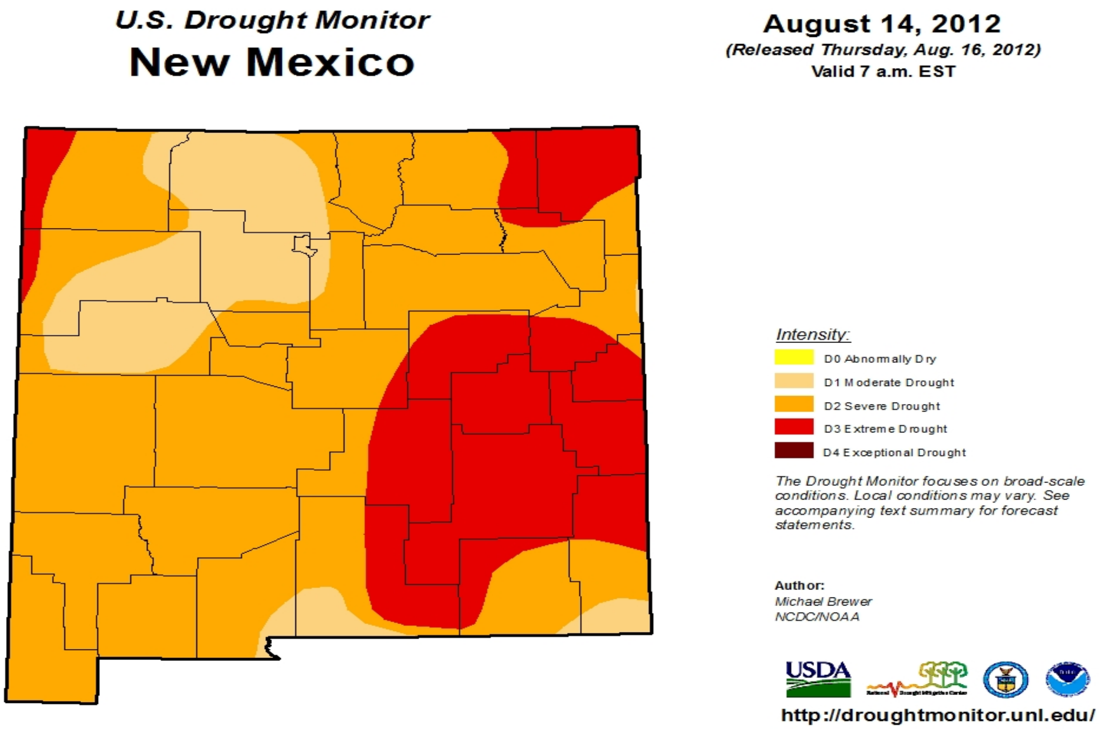

Figure 2-5. Drought conditions in New Mexico as of August 14, 2012. Map courtesy of NDMC-UNL.

2.8 2012 Wildfires

While 2012 was not considered a particularly active fire season, significant fire activity nevertheless created smoke impacts throughout the year. Beginning in February and as late as October, northern Mexico saw significant fire activity. In Arizona, New Mexico and West Texas, 2012 saw 2,633 wildfires for a total burn area of 543,750 acres (SWCC, 2012). Of these fires, the Southwest Coordination Center classified 31 as large fires (over 1000 acres). The most significant fires for Doña Ana County, because of their proximity, may have been the Apache Pass, School Canyon, Montezuma, Fox, Cottonwood, Grapevine and Canyon fires in southeastern Arizona, and the McCauley and Whitewater-Baldy fires in New Mexico. The Whitewater-Baldy fire was, according to the El Paso Times, “the largest fire in New Mexico history.” This fire burned nearly 300,000 acres from May 9 to July 19, 2012 in the Gila National Forest, northwest of Doña Ana County. Figure 2-6, below, shows a map of large fires in Arizona and New Mexico.

Figure 2-6. SWCC-reported large fire locations in Arizona and New Mexico. The record fire, Whitewater Baldy, was located northwest of the area covered in this demonstration, and is circled in yellow.

Average PM_{10} emissions may be estimated to range from 0.0105 tons/acre burned to .246 tons/acre burned, depending on the fuel type. The range for $PM_{2.5}$ is from .00603 to .151 tons/acre burned, again depending on type of fuel. Fire season in Arizona and New Mexico contributed to many of the high levels of PM_{10} and $PM_{2.5}$. Fires in northern Mexico also contributed to elevated levels during 2012. This information should be kept in mind during the following demonstrations for high wind exclusions.