Assessment of Qualification for Treatment under the Federal Exceptional Events Rule: High Particulate (PM_{10}) Concentration Events in the Phoenix and Yuma Areas on May 21, 2008

Air Quality Division

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EXECUTIVE SUMMARY
Assessment of Qualification for Treatment under the Federal Exceptional Events Rule: High Particulate (PM_{10}) Concentration Events in the Phoenix and Yuma Areas on May 21, 2008

This document is a reengineering and repackaging of the information and data related to an exceptional event in order to assist the Environmental Protection Agency's (EPA) Region 9 staff and the public with a better understanding of the nature of that exceptional event. The first example using this format was prepared for the event that occurred on June 4, 2008, as a comprehensive analysis of the documentation sent to EPA on November 17, 2009. This document provides a similar treatment for the May 21, 2008, exceptional event. The materials contained in this Report respond to feedback received from EPA beginning in May 2010 and to criticisms made in the EPA Region 9 May 21, 2010, finding that this exceedance did not qualify for treatment as an exceptional event under 40 CFR 51.14. The Arizona Department of Environmental Quality (ADEQ) contends, however, that the materials sent to EPA in 2009 were sufficient to meet all the requirements of the Exceptional Events Rule (EER) and make adequate demonstrations that all the events qualified under the Rule.

Background

The Arizona Department of Environmental Quality (ADEQ) issues Dust Control Action Forecasts for the Yuma and Phoenix areas as part of their Natural Events Action Plans. On Tuesday May 20, 2008, in response to an approaching trough of low pressure, ADEQ air quality forecasters issued the Maricopa County Dust Control Action Forecast calling for a high risk of wind-blown dust for Wednesday May 21st, in Maricopa County. In anticipation of this potential wind-blown dust event, ADEQ also issued a High Pollution Advisory for Maricopa County for Wednesday, May 21st. The approaching trough was forecast to impact the Yuma area as well, and ADEQ air quality forecasters subsequently called for a high risk of wind-blown dust in their Yuma and Vicinity Dust Control Action Forecast for Wednesday, May 21st. This potential regional high wind event equated to a significant risk of exceeding the PM_{10} National Ambient Air Quality Standards (NAAQS) in both Yuma and Maricopa Counties. The forecasts and advisories satisfy the requirement in 40 CFR 51.930(a)(1).

The forecasts for May 21st for both Maricopa County and Yuma called for sustained winds at 20-30 mph with the possibility of gusts greater than 40 mph capable of producing significant wind-blown dust. This potential wind-blown dust event equated to a high risk of exceeding the PM_{10} NAAQS in Maricopa and Yuma Counties. Strong winds did occur and were observed in the Phoenix Metro and the Yuma areas on May 21st, 2008. Beginning in the morning and continuing through the evening hours of May 21st, strong southwesterly and westerly winds in Phoenix and strong west-northwesterly winds in Yuma generated areas of blowing dust. All appropriate State Implementation Plan (SIP) control measures were in place during the event, demonstrating per 40 CFR 50.1(j) that the event "is not reasonably controllable or preventable." A discussion of commonly employed Best Available Control Measures (BACM) for dust in Maricopa County and controls for Yuma county can be found in "High Wind Exceptional Events and Control Measures for PM_{10} Areas" (Appendix G, see also Section 5.2 and Appendix E).

The start of a wind-blown dust event is evident in the Phoenix visible camera images, as well as the Arizona Meteorological Network (AZMET), Maricopa County (MC), ADEQ, and National Weather Service (NWS) monitors (see Appendix L, M, and N). Strong winds gusting over 25 mph and as high as 35 mph at the MC West 43rd Ave. monitor location and 37 mph at the NWS Luke Air Force Base were reported. The Yuma Marine Corps Air Stations (MCAS) also measured wind gusts up to 37 mph along with reports of reduced visibility. The NWS Gila Bend station reported blowing dust and reduced visibility from 10:00 a.m. through most of the afternoon. This significant wind event brought elevated ambient concentrations of PM_{10} to the Phoenix and Yuma areas that exceeded the NAAQS at the West 43rd Ave. and Yuma Courthouse monitors. Due to the spatial variability of PM sources both within and outside of the Phoenix urban core, the PM_{10} NAAQS was only exceeded at the West 43rd Ave. monitor operated by Maricopa County, though other Phoenix area monitors did show elevated levels of PM_{10} (see Section 2 for more detail). The fact that ambient concentrations exceeded the NAAQS satisfies the criteria in 40 CFR 50.1(j) that the event "affects air quality." The following are the most significant PM_{10} monitor readings for the monitors examined in this report (the Phoenix monitors are organized from south of the Salt River to north of the Salt River in the order of distance from the Salt River, with the West 43rd Ave. being on the bank of the Salt River channel). The PM_{10} concentration gradient emanating to the north and south from the Salt River channel is evident from the data presented in the table.

Monitor (Operator/Type)	AQS ID	24-hr Avg PM_{10}	1-hr Max PM_{10}	Max Time	Flag**
YUMA AREA					
Yuma Courthouse(ADEQ/TEOM)	**04-027-0004**	**164**	**504**	**1700**	**RJ**
PHOENIX METRO AREA					
South Phoenix (MC/TEOM)	04-013-4003	122	334	0900	None
West 43rd Ave. (MC/TEOM)	**04-013-4009**	**279**	**1208**	**0900**	**RJ**
Durango Complex (MC/TEOM)	04-013-9812	110	310	0900	None
Central Phoenix (MC/TEOM)	04-013-3002	91	184/186*	09/13	None
Greenwood (MC/TEOM)	04-013-3010	89	219	0900	None
West Phoenix (MC/TEOM)	04-013-0019	83	142/160*	09/14	None
JLG Supersite (ADEQ/TEOM)	04-013-9997	62	107	0900	None

* 0900 data presented for 9:00 am, the time of the maximum at West 43rd Ave. and the monitor's true hourly maximum value..

**24-hr PM_{10} concentration influenced by natural or exceptional event to be flagged.

Type Abbreviations: TEOM – Tapered Element Oscillating Microbalance Monitor (Continuous monitor)

The preliminary findings from the original analysis of this event were presented at stakeholder meetings on November 19, 2008, and March 19, 2009, in Phoenix, Arizona. Following the stakeholder meetings, ADEQ supplemented and finalized the analysis and a public comment period was held from October 15, 2009, through November 13, 2009. No comments were received during the public comment period. The final report and public process documentation were submitted to EPA on November 17, 2009, to satisfy the requirements in 40 CFR 50.14(c)(3)(i). This supplemental report will undergo a similar public process.

Assessment under the Federal Exceptional Events Rule

Procedural Requirements. A review of the procedural requirements described in EPA's *Treatment of Data Influenced by Exceptional Events* rule (codified in 40 CFR 50) can be found in Section 1.1 of this document. These procedural requirements include a public notification that an event was occurring, the placement of informational flags on data in the Air Quality System, the notification of EPA of the intent to flag through 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. All of these procedural requirements are covered in detail in Section 1.1 and are met, or will be met, with the submittal of this demonstration document.

Documentation Requirements. A description of the documentation requirements required by EPA's *Treatment of Data Influenced by Exceptional Events* rule (codified in 40 CFR 50) can be found in Section 1.2 of this document.

1. Evidence is provided to show that the event satisfies "exceptional event" criteria. These criteria are comprised of four main parts:

a. Affects air quality – Section 5.1 presents information demonstrating the event affected air quality;
b. Is not reasonably controllable or preventable – Section 5.2 presents an analysis of fugitive dust produced along the back trajectory of winds impacting the West 43rd Ave. monitor and shows that during high wind hours the anthropogenic sources contributing to the exceedance of the PM_{10} standard on May 21, 2008, were open space (0.63%), construction (1.3%), riverbeds (30.0%), sand and gravel operations (10.5%), and vacant areas (57.6%) Documentation is presented demonstrating the EPA-approved Serious Area PM_{10} Plan and the 2007 Five Percent Plan for PM_{10} control measures were in place for these sources. This confirms that the sources upwind of the West 43rd Ave. monitor were reasonably controlled during the high wind hours on May 21, 2008;
c. Is caused by either (1) human activity that is unlikely to recur at a particular location or (2) a natural event – Section 5.3 presents an analysis of wind speeds recorded on May 21, 2008, showing that both the gusts and averages recorded during all high wind hours equaled or exceeded the 95th percentile values and in some cases the 99th percentile values recorded during spring months in 2005 – 2008 at the West 43rd Ave. monitoring site. This demonstrates the winds which caused the exceedance of the standard were unusually high and qualify as a natural event; and,
d. Is determined by EPA to be in accordance with 40 CFR 50.14 to be an exceptional event (pending EPA concurrence upon receipt of this document).

2. There is a clear, causal relationship between the measurement under consideration and the event (*40 CFR 50.14(c)(3)(iv)(B)*). The demonstration of a clear causal relationship is evident in the description of the meteorological setup over the southwestern U.S. as well as the various reports of high winds and associated windblown dust. Section 7 shows comparisons between monitor-specific winds and the PM_{10} levels measured at those monitors. With the arrival of high winds came elevated PM_{10} levels.

In Section 4, the meteorology of the event is described, and supplemented with data in Appendix M. Appendix I contains the ADEQ advisories for the high wind event. The NWS issued a number of wind advisories for Southern California, Lower Colorado River, Yuma, and Central Arizona (see Appendix J). Unlike other events assessed using this template, there were no news stories of interest related to this event (normally found in Appendix K). A strong dust/sand storm impacted the Yuma area, Gila Bend reported blowing dust for most of the day, and Phoenix experienced blowing dust along the Salt River channel. Radar information from the Yuma area clearly demonstrates the source of emissions that contributed to the exceedance at the Yuma monitor originated from areas in California. Section 7 demonstrates that high afternoon concentrations do not typically occur unless unusually high winds are present. Data presented in Section 5.2 demonstrate that unusually high winds were recorded on the afternoon of May 21, 2008, at the West 43rd Ave. monitoring site relative to the historical record for spring months. Data presented in Section 7 show that PM_{10} concentrations recorded on the late morning and afternoon of May 21, 2008, were unusually high relative to the historical record for spring months. Collectively, this information demonstrates a clear causal relationship between elevated winds and elevated concentrations recorded on the day of the event. Further evidence of this relationship is available from time-lapse photographs of the area adjacent to the monitor documenting diminished visibility as the afternoon progressed and winds and concentrations increased.

3. Evidence is provided to show that the event was associated with a measured concentration in excess of normal, historical fluctuations (*40 CFR 50.14(c)(3)(iv)(C)*). ADEQ developed a "Historical Distribution" table to show that the 24-hour values fell above the 95th percentile of historical data encompassing the previous five years of data for each monitor. All flagged 24-hr PM_{10} values were well above the 95^{th} percentile when considering both annual and seasonal (spring) data for both the West 43^{rd} Ave. and Yuma monitors. Further evidence of the severity of the concentrations recorded on this date are presented in an analysis of the average concentrations recorded during the high wind hours related to the historical record for 2005 – 2009. It shows the May 21, 2008, values ranked 1^{st} (100^{th} percentile) relative to spring observations. An additional analysis was completed to compare the values recorded at other monitors in the network to their five year historical values. Nearly all monitors showed elevated PM_{10} levels for both the day in question, May 21, 2008, as well as the following day, May 22, 2008. These data are described in more detail in Section 3 of this document and provide further evidence that the event was associated with concentrations in excess of normal historical fluctuations.

4. Evidence is provided to show that there would have been no exceedance or violation "but-for" the event (event contribution analysis) (*40 CFR 50.14(c)(3)(iv)(D)*). Section 6 presents an "Event Contribution Analysis" to show there would not have been an exceedance "but for" the event. Using local measurements of the threshold velocity at which winds could initiate entrainment of PM_{10} impacting monitors in the Salt River area, the event day was divided into periods with low and high wind hours. Alternative estimates of the daily concentrations were made by substituting spring average and 95^{th} percentile concentrations recorded during the high wind hours in 2005 – 2008. The resulting daily average concentrations were well below the ambient 24-hour PM_{10} standard, thus demonstrating that "but-for" the concentrations recorded during the high wind hours, the exceedance would not have occurred at either the West 43^{rd} Ave. or Yuma monitoring sites. A similar calculation using data available for days in 2003 – 2009

showed the resulting daily average concentrations on May 21, 2008, ranked first (100th percentile) at the West 43rd Ave. monitor, providing further evidence of the elevated nature of the concentrations recorded during the high wind hours on that date.

Additionally, descriptions of Air Pollution Control Programs both for the Phoenix and Yuma areas are included in Section 2.2 of this document. Section 5.2 discusses the inspections and violations that were reported during the period May 18 – 24, 2008, and documents the control measures that were in place during that period. The violations noted during May 18 - 24, 2008, were minor and insufficient to contribute to an exceedance of the PM_{10} NAAQS at the magnitude recorded for the May 21, 2008, event. Thus, despite a demonstration that control measures were in place for upwind anthropogenic sources impacting the West 43rd Ave. monitor on May 21, 2008, a high wind event caused the NAAQS exceedance. The blowing dust and sand from sources in California were the cause of the exceedance at Yuma.

Conclusion

The high wind event that caused elevated PM_{10} on May 21, 2008, in Yuma and Maricopa Counties caused the transport of dust and soils from winds that suspended natural soils and soils from areas where all control measures were in place, or were from source areas outside Arizona, and should be flagged for air quality planning purposes. The “high wind” (RJ) flag should be applied to the monitor readings.

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Section 1: Meeting Federal Requirements for Exceptional Events

This document is a reengineering and repackaging of the information and data related to an exceptional event in order to assist the Environmental Protection Agency's (EPA) Region 9 staff and the public with a better understanding of the nature of that exceptional event. The first example using this format was prepared for the event that occurred on June 4, 2008, as a comprehensive analysis of the documentation sent to EPA on November 17, 2009. This document provides a similar treatment for the May 21, 2008, exceptional event. The materials contained in this Report respond to feedback received from EPA beginning in May 2010 and to criticisms made in the EPA Region 9 May 21, 2010, finding that this exceedance did not qualify for treatment as an exceptional event under 40 CFR 51.14. The Arizona Department of Environmental Quality (ADEQ) contends, however, that the materials sent to EPA in 2009 were sufficient to meet all the requirements of the Exceptional Events Rule (EER) and make adequate demonstrations that all the events qualified under the Rule.

EPA's *Treatment of Data Influenced by Exceptional Events* rule (40 CFR 50.14) describes the requirements for exceptional events flagging and documentation. The Arizona Department of Environmental Quality (ADEQ) meets all of these procedural and documentation requirements.

1.1 Procedural Requirements

Public notification that event was occurring (40 CFR 50.14(c)):

The Arizona Department of Environmental Quality (ADEQ) issues Dust Control Action Forecasts for the Yuma and Phoenix areas as part of their Natural Events Action Plans. On Tuesday May 20, 2008, in response to an approaching trough of low pressure, ADEQ air quality forecasters issued the Maricopa County Dust Control Action Forecast calling for a high risk of wind-blown dust for Wednesday May 21st, in Maricopa County. In anticipation of this potential wind-blown dust event, ADEQ also issued a High Pollution Advisory for Maricopa County for May 21, 2008. The approaching trough was forecast to impact the Yuma area as well, and ADEQ air quality forecasters subsequently called for a high risk of wind-blown dust in their Yuma and Vicinity Dust Control Action Forecast for Wednesday, May 21st. This potential regional high wind event equated to a significant risk of exceeding the PM_{10} National Ambient Air Quality Standards (NAAQS) in both Yuma and Maricopa Counties. The forecasts/advisories satisfy the requirement in 40 CFR 51.930(a)(1). Copies of these advisories have been included in Appendix I.

Place informational flag on data in the Air Quality System (AQS) (40 CFR 50.14(c)(2)(i)):

ADEQ and other operating agencies in Arizona submit data into the U.S. Environmental Protection Agency (EPA) Air Quality System (AQS). Data from both filter-based and continuous monitors operated in Arizona are submitted to AQS.

When ADEQ or another agency operating monitors in Arizona suspects that data may be influenced by an exceptional event, ADEQ 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 the agency submits the data into AQS. ADEQ and other operating agencies also submit data from continuous monitors into AQS after quality assurance is complete.

If ADEQ or the operating agency has determined a potential exists that the monitor reading has been influenced by an exceptional event, a preliminary flag is submitted for the measurement in the AQS. The data are not official until they undergo more thorough quality assurance and quality control, leading to certification by July 1st (or starting in 2010 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)):

ADEQ submitted a letter to EPA on June 30, 2009, listing the days ADEQ, and other operating agencies in Arizona, intended to analyze under the Exceptional Events Rule. The May 21, 2008, PM_{10} high wind event was included on this list. Two monitors were identified as being qualified. These were the Yuma Courthouse monitor operated by ADEQ and West 43rd Ave. monitors operated by Maricopa County Air Quality Department (MCAQD). A copy of the transmittal letter and preliminary assessment report are included in Appendix Q.

Document that the public comment process was followed for event documentation (40 CFR 50.14(c)(3)(iv)):

ADEQ updated the assessment report and released it for a formal 30-day public comment period in October 2009. The updated document was submitted to EPA on November 17, 2009. A copy of the transmittal letter, public notice certification, and assessment report are included in Appendix R.

ADEQ is submitting this document in an effort to engage EPA in consultation about the May 21, 2008, event. This document is intended to add additional clarification requested by EPA on the event. This document will be available for a formal 30-day comment period and re-submitted to EPA, along with any comments received, consistent with the requirements of 40 CFR 50.14(c)(3)(iv).

Submit demonstration supporting exceptional event flag (40 CFR 50.14(a)(1-2)):

Prior documentation submitted on November 17, 2009, was intended to accomplish this. This supplemental report is intended to resolve any other outstanding issues.

1.2 Documentation Requirements

Provide evidence that the event satisfies "exceptional event" criteria set forth in 40 CFR 50.1(j) (40 CFR 50.14(c)(3)(iii)(A)):

See Section 5 of this document. According to 40 CFR 50.1(j) and Clean Air Act (CAA) Section 319, an exceptional event meets all of the following criteria:

a. Affects air quality (see Section 5.1 of this document);
b. Is not reasonably controllable or preventable (see Sections 5.2 of this document);
c. Is caused by either (1) human activity that is unlikely to recur at a particular location or (2) a natural event (see Section 5.3 of this document); and,
d. Is determined by EPA to be in accordance with 40 CFR 50.14 to be an exceptional event (pending EPA concurrence upon receipt of this document).

There is a clear, causal relationship between the measurement under consideration and the event (40 CFR 50.14(c)(3)(iii)(B)):

See Section 7 of this document.

Provide evidence that the event is associated with a measured concentration in excess of normal, historical fluctuations (40 CFR 50.14(c)(3)(iii)(C)):

See Section 3 of this document.

Provide evidence that there would have been no exceedance or violation but for the event (event contribution analysis) (40 CFR 50.14(c)(3)(iii)(D)):

See Section 6 of this document.

Section 2: Background on Geographic Setting and Control Programs

This section describes the geographic and climatic setting of the monitors and the control programs in place to protect air quality in the area.

2.1 Geographic Setting of Monitors

Phoenix

Geographic Setting

Phoenix is located in the Salt River Valley in south-central Arizona (see Figure 2-1). It lies at a mean elevation of 1,090 feet above mean sea level (msl) in the northern reaches of the Sonoran Desert. Other than the mountains in and around the city, the topography of Phoenix is generally flat. The Phoenix area is surrounded by the McDowell Mountains (~4,200 ft msl) to the northeast, the foothills of the Bradshaw (~7,900 ft msl) and Mazataal (~7,900 ft msl) ranges to the north, the White Tank Mountains (~4,500 ft msl) to the west, the Sierra Estrella (~4,450 ft msl) to the southwest, and the Superstition Mountains (~5,000 ft msl) far to the east. Within the City are the Phoenix Mountains (~2,600 ft msl) and South Mountain (~2,600 ft msl). Current development is pushing north and west and south into Pinal County.

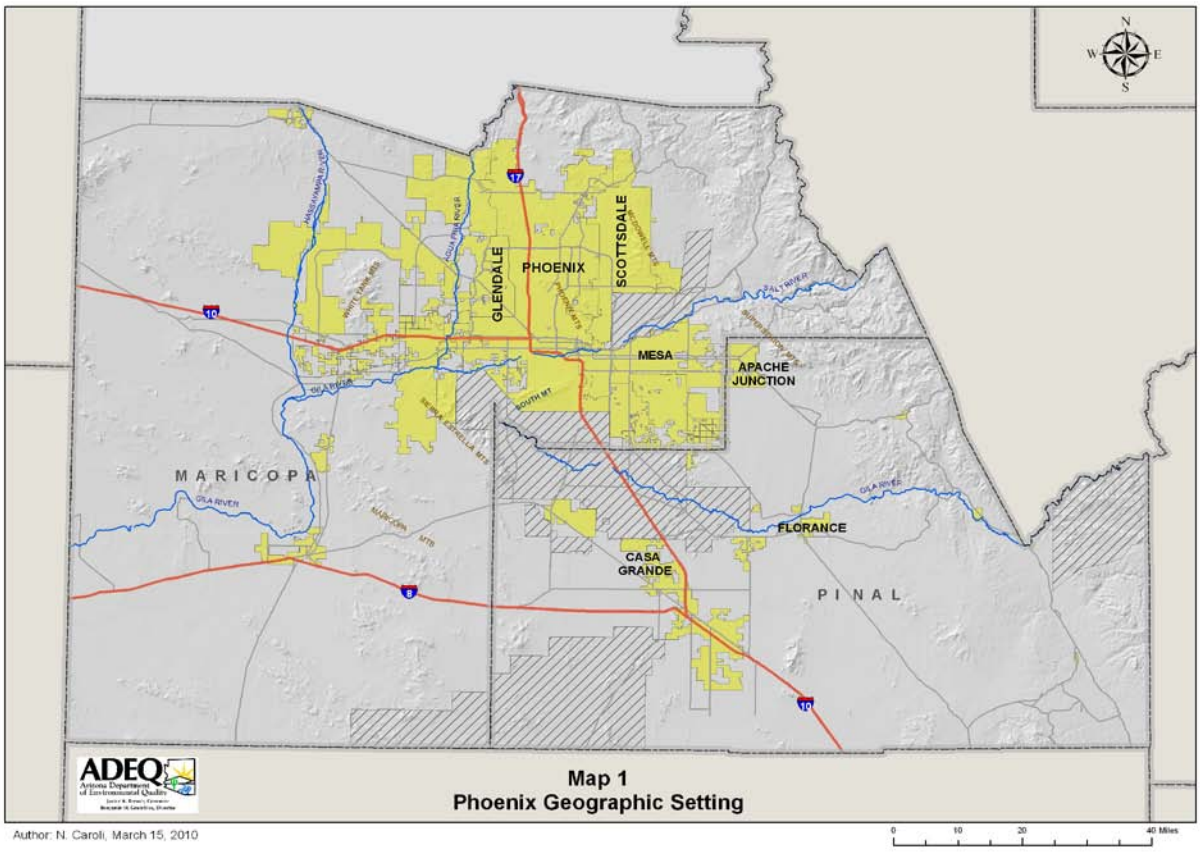


Figure 2-1. Map of Phoenix Geographic Setting

The 2000 census revealed that Phoenix had a population of 1,321,045 people and the Phoenix-Mesa-Scottsdale Metropolitan Statistical Area (MSA), comprised of Maricopa and Pinal counties, had a population of 3,251,876. The official 2008 estimate by the U.S. Bureau of the Census placed the population of Phoenix at 1,567,928 and the population of the MSA at 4,281,899.

Figure 2-2 depicts the drainage systems or watersheds for the State of Arizona. Many of the rivers that form Arizona's drainage system are dry for most of the year and, consequently, are sources of silt and fine soils that become suspended and add to regional PM_{10} loadings during high wind events. Much of this alluvial matter and fine soils have been deposited in the Valley of the Sun in the vicinity of the confluence of the Gila and Salt River channels and the confluence of the Gila and Agua Fria River channels.

This alluvial material and these fine soils contribute significantly to the PM_{10} loading associated with elevated PM_{10} events at the West 43rd Ave. monitor in Phoenix when winds are being directed up the Gila and Salt River channels from the west during high wind events. This can also be true for the Buckeye and Coyote Lakes monitors, which are located adjacent to dry riverbeds.

Figure 2-2 also reveals that the Phoenix airshed and the Yuma airshed are linked by the Gila River channel. The alluvial material and fine soils in the Gila River channel can provide a source of particulate matter to the Greater Phoenix Area, especially to the West Valley if the winds are oriented along the direction of the channel.

Climate

Phoenix has an arid climate, with very hot summers and temperate winters. The average summer high temperature is among the hottest of any populated area in the United States. The temperature reaches or exceeds 100ºF an average of 110 days during the year and highs top 110ºF an average of 18 days during the year. Phoenix receives an average of 7.66 inches of rain per year.

Precipitation is sparse during a large part of the summer, but the influx of monsoonal moisture, which generally begins in early July and lasts until mid-September, raises humidity levels and can cause heavy localized precipitation and flooding. March is the wettest month of the year with June being the driest. Although thunderstorms are possible at any time of the year, they are most common during the monsoon season from July to mid-September as humid air surges in from the Gulf of California. These can bring strong winds, large hail, or rarely, tornadoes. Winter storms moving inland from the Pacific Ocean occasionally produce significant rains but occur less frequently.

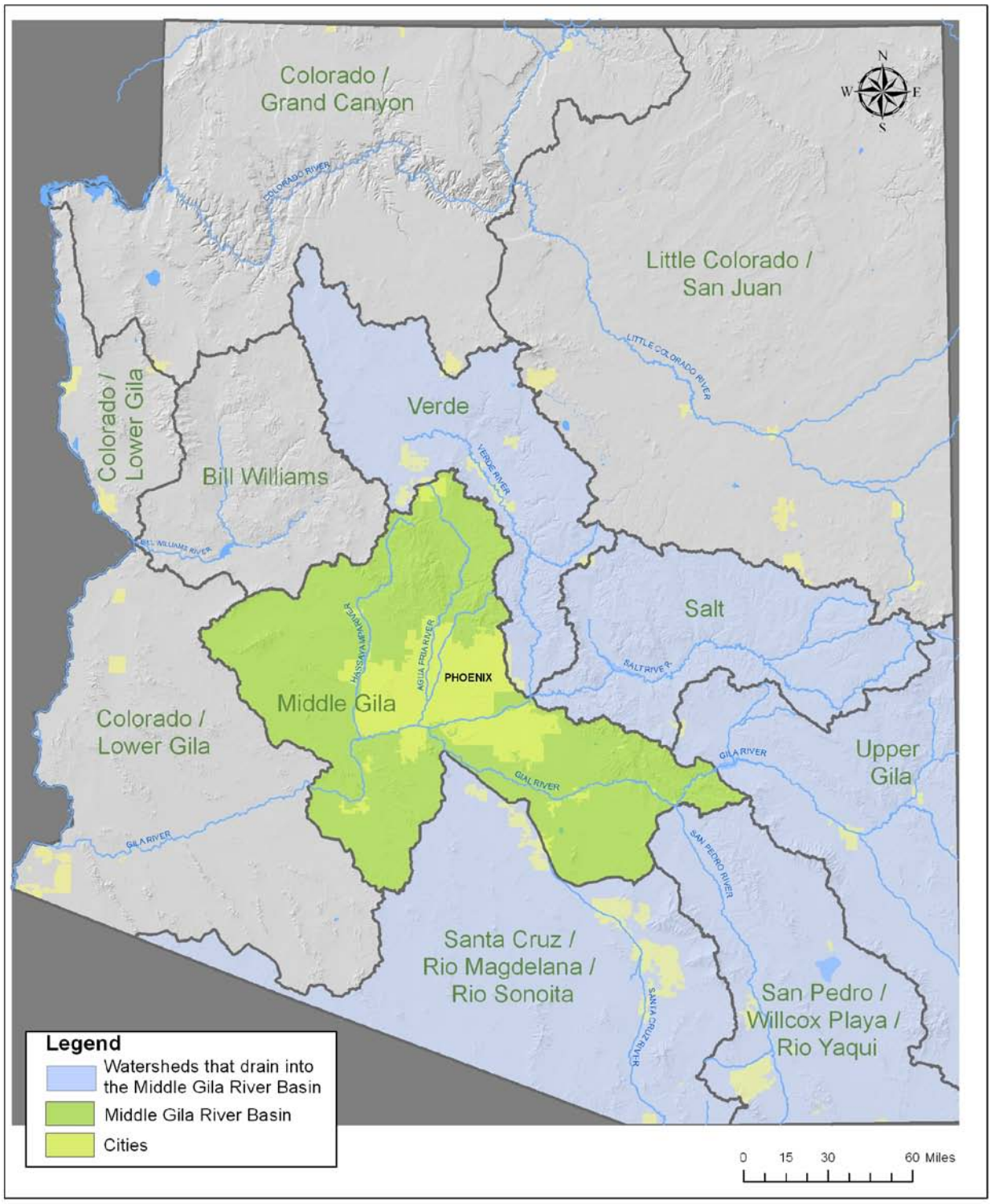


Figure 2-2. Map of Drainage System in Arizona

Yuma

Geographic Setting
Yuma is the county seat of Yuma County. It has of area of 106.7 square miles. Yuma is located in the Lower Colorado River Valley at an elevation of 138 feet above sea level. It is near the borders of California to the west and Mexico to the south, and just west of the confluence of the Colorado and Gila Rivers (see Figure 2-3). Most of the city lies in the part of the Colorado River Floodplain known as the Yuma Valley. Some of the City is built on the Yuma Mesa, another prominent land feature found to the east. The Yuma Mesa extends eastward to the Gila Mountains. The Valley follows the course of the Colorado River to the north and is open all the way to the Sea of Cortez to the south.

According to the U.S. Census, Yuma had 77,515 residents in 2000 and the Yuma MSA, comprised of Yuma County, had a population of 160,026. The U.S. Census Bureau's official estimates place the population of the City of Yuma at 90,041 and the population of the Yuma MSA at 194,322 in 2008, though more than 85,000 winter visitors make Yuma their seasonal residence.

Climate
Yuma is one of the hottest cities of any size in the United States, with average July high temperatures of 107°F. Average January highs are around 70°F. Of the possible 4,456 hours of daylight each year, the sun shines in Yuma for roughly 4,050 hours, or about 90 percent of the time. On average, Yuma receives about 3 inches of rain annually.

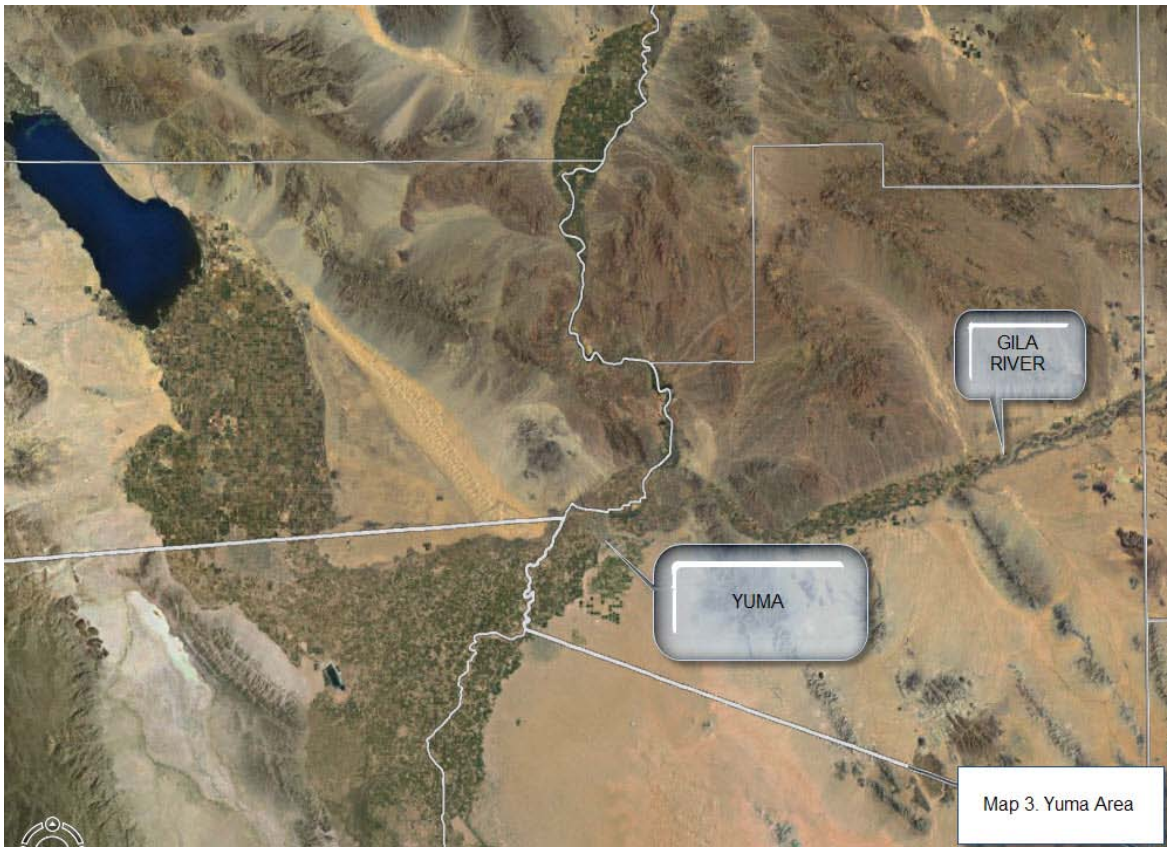


Figure 2-3. Map of Yuma Area

2.2 Air Pollution Control Programs

Phoenix Area

Two programs provide air pollution control measures for the Phoenix area:

- Arizona Department of Environmental Quality (ADEQ) Agricultural Best Management Program or AgBMP (see http://www.azdeq.gov/environ/air/prevent/pcp.html#bmp) under Arizona Administrative Code R18-2-610 and 611 (see http://www.azsos.gov/public_services/Title_18/18-02.htm#Article_6); and
- Maricopa County Air Quality Department, which implements a suite of rules listed in Table 2-1.

In addition to routine inspections and inspections driven by complaints, inspections are often increased when a pollution advisory, high wind advisory or dust forecast is issued. For May 21, 2008, a PM_{10} health watch had been issued and the Dust Control Action Forecast identified a high potential for blowing dust in the Phoenix area.

Upon the flagging of an event that could be classified as exceptional, a control measures report is completed. The report contains any complaints or inquiries made, any inspections conducted, and any enforcement actions issued for a period of time 72 hours prior to the day of the event, the day of the event, and 72 hours after the event within a two mile radius of the monitor (see Appendix P). Upon the issuance of an advisory, additional inspections are often conducted, particularly in areas where reduced compliance or PM_{10} generating activities have historically been an issue.

Table 2-1. Rules Regulating Particulate Matter Emissions in Maricopa County

Rule Number and Title	Rule Description
Rule 300: Visible Emissions	Establishes standards for visible emissions and opacity.
Rule 310: Fugitive Dust from Dust-Generating Operations	Establishes limits for the emissions of particulate matter into the ambient air from any property, operations, or activity that may serve as a fugitive dust source.
Rule 310.01: Fugitive Dust from Non-Traditional Sources of Fugitive Dust	Establishes limits for the emissions of particulate matter into the ambient air from open areas, vacant lots, unpaved parking lots, and unpaved roadways which are not regulated by Rule 310 and which are not required to have either a permit or a dust control plan.
Rule 311: Particulate Matter from Process Industries	Establishes emission rates based on process weight applicable to any affected operations not subject to Rule 316.
Rule 312: Abrasive Blasting	Establishes limits for particulate emissions from abrasive blasting operations.
Rule 313: Incinerators, Burn-Off Ovens, and Crematories	Establishes standards for incinerators that are used for refuse disposal and limits particulate emissions from incinerator burning.
Rule 314: Open Outdoor Fires and Indoor Fireplaces at Commercial and Institutional Establishments	Establishes limits for the emissions of air contaminants produced from open burning.
Rule 315: Spray Coating Operations	Establishes limits for the emissions of particulate matter to the atmosphere from spray coating operations.

Table 2-1. Rules Regulating Particulate Matter Emissions in Maricopa County	
Rule Number and Title	**Rule Description**
Rule 316: Nonmetallic Mineral Processing	Establishes limits for the emissions of particulate matter into the ambient air from any nonmetallic mining operation or rock product processing plant.
Rule 317: Hospital/Medical/Infectious Waste Incinerators	Establishes limits for the emissions of air pollutants from medical waste incinerators.
Rule 318: Approval of Residential Woodburning Devices	Establishes standards for approval of residential woodburning devices.
Rule 319: Ginning Operations	Establishes limits for the emissions of particulate matter from ginning operations.
Rule 322: Power Plant Operations	Establishes limits for the emissions of nitrogen oxides, sulfur oxides, carbon monoxide and particulate matter from existing power plants and cogeneration plants.
Rule 323: Fuel Burning Equipment from Industrial/Commercial/Institutional (ICI) Sources	Establishes limits for the emissions of nitrogen oxides, sulfur oxides, carbon monoxide and particulate matter from ICI sources.
Rule 324: Stationary Internal Combustion (IC) Engines	Establishes limits for the emissions of carbon monoxide, nitrogen oxides, sulfur oxides, volatile organic compounds, and particulate matter from stationary internal combustion engines, including stationary IC engines used in cogeneration.
Rule 325: Brick and Structural Clay Products (BSCP) Manufacturing	Establishes limits for particulate matter emissions from the use of tunnel kilns for curing in the brick and structural clay product (BSCP) manufacturing processes.
P-25: Leaf Blower Restriction Ordinance	Establishes restrictions for leaf blowers in incorporated and unincorporated sections of Area A in Maricopa County.
P-26: Residential Woodburning Restriction Ordinance	Establishes restrictions for residential woodburning.
P-27: Vehicle Parking and Use on Unstabilized Vacant Lots Ordinance	Establishes restrictions for vehicle parking and use on unstabilized vacant lots in unincorporated sections of Area A in Maricopa County.
P-28: Off-Road Vehicle Use in Unincorporated Areas of Maricopa County Ordinance	Establishes restrictions for operating vehicles on unpaved property in unincorporated areas of Maricopa County.

Dust Control Information:
http://www.maricopa.gov/aq/divisions/compliance/dust/Default.aspx

Rule 310, Rule 310.01, Rule 316:
http://www.maricopa.gov/aq/divisions/planning_analysis/AdoptedRules.aspx

Additional Information Rule 316:
http://www.maricopa.gov/aq/divisions/compliance/dust/implementation_resources.aspx

Yuma Area

Two regulatory provisions contain control measures for the Yuma planning area:

- The Yuma Agricultural Best Management Program (AgBMP) under Arizona Administrative Code R18-2-612 and 613[1]; and
- The Yuma PM_{10} Maintenance Plan[2].

In August 2002 Yuma was impacted by an exceptional event. Under the natural and exceptional events regulations at the time, the area qualified for a National Events Action Plan (NEAP). The NEAP allowed for the development of specific measures that would be put in place upon the issuance of a Dust Control Action Forecast. A Dust Control Action Forecast had been issued for the Yuma area on May 20, 2008, indicating a high potential for blowing dust.

It would be possible, in addition, to confirm the status of the existing control measures within the regional transport area of an event to determine if any enforcement actions are on record. A review of all control measures is completed every five years for PM_{10} areas under maintenance plans, and annually for PM_{10} areas under limited maintenance plans.

[1] http://www.azsos.gov/public_services/Title_18/18-02.htm#Article_6
[2] http://www.azdeq.gov/environ/air/plan/notmeet.html#yuma

Section 3: Concentrations Were In Excess of Normal, Historical Fluctuations

In order to qualify as an exceptional event, the concentration must be shown to be in excess of the normal, historical fluctuation of measurements at the site. This section examines this issue and provides the basis that this criterion has been met for the West 43rd Ave. and Yuma monitors.

The historical concentration and meteorological data used in this Section (and in Sections 5 through 7) is limited by the availability of data at each particular monitoring site. Due to different data collection parameters at each site (i.e., hourly data vs. filter data vs. 5-minute data) historical time periods vary between sections depending on the type of analysis being conducted, monitoring sites being considered and/or compared, and the availability of quality assured data.

3.1 Flagged Monitors

The Federal Register Notice[3] promulgating the final rule for exceptional events included the following guidance for preparing this demonstration.

> *The final rule permits a case-by-case evaluation, without prescribed threshold criteria, to demonstrate that an event affected air quality. This demonstration would be based on the weight of available evidence, but must consider the historical frequency of such measured concentrations. While a State may determine the specific approach to use for such analysis, it must compare contemporary concentrations with the distribution of all measured data during the past several years. The evidence that an event affected air quality may be presented on a seasonal or other temporal basis to best compare contemporary concentrations with the distribution of historical values. For consistency with data reporting and computation of NAAQS statistics, a calendar quarter basis is suggested.*

To address this requirement, ADEQ has assembled data for the spring (March, April and May) season, as defined by the NWS. To further support a demonstration that concentrations were in excess of normal, historical fluctuations, comparisons have been prepared using both 24-hour FRM measurements and hourly measurements during high wind hours.

A summary of the frequency distribution of the previous five years of certified data (2003-2007) is contrasted with the May 21st, 2008, value for the West 43rd Ave. and Yuma monitors in Table 3-1. Historical distributions are presented for each monitor for both the entire 5-year dataset and for the spring months. They show the 24-hour PM_{10} concentrations recorded on May 21, 2008, at both monitoring sites exceeded the 95th percentile when compared to both the entire 5-year dataset and to the 5-year spring season dataset. The West 43rd Ave. concentration exceeded the 99.5% annual and spring values. Since this is a methodology similar to one accepted by EPA, it is clear that the PM_{10} levels on May 21, 2008, were outside of normal historical fluctuations.

[3] Federal Register/ Vol. 72, No. 55, Thursday, March 22, 2007 / Rules and Regulations, Environmental Protection Agency, 40 CFR Parts 50 and 51, Treatment of Data Influenced by Exceptional Events, Final Rule

Table 3-1. Historical Distribution

Historical Distribution 5-Yr. Distribution of Values (µg/m^3)						
MONITORS: WEST 43RD AVE. YUMA COURTHOUSE			**Column Index** Yr - All Data (5-Yrs) Sea - Data for Spring season only (5-Yrs)			
Cumulative Frequency	West 43rd		Yuma Courthouse			
	Yr	Sea	Yr	Sea		
Min	5	8	8	8		
0.5%	9	9	12	9		
1.0%	11	11	14	14		
2.5%	15	13	16	16		
5%	19	19	19	19		
10%	29	28	23	22		
25%	44	46	31	29		
50%	65	63	42	40		
75%	91	82	57	51		
90%	121	107	77	76		
95%	139	125	96	109		
97.5%	157	134	127	182		
99.0%	192	194	186	210		
99.5%	227	220	211	212		
Max	313	313	349	349		
Flagged Value	279		164			

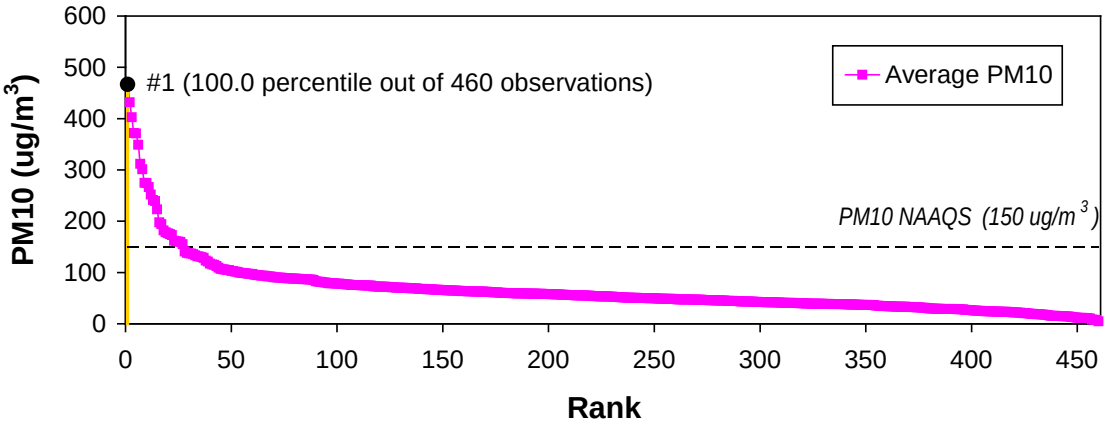
The severity of concentrations recorded at the Yuma and West 43rd Ave. monitors on May 21, 2008, is illustrated in Table 3-1, which contains the distribution of the concentrations for the 2003-2007 5-year dataset. The Yuma monitor reading was almost at the 97.5 percentile for the season. The West 43rd Ave. monitor ranked above the 99.5 percentile.

Additional insight into the unusual nature of concentrations recorded on May 21, 2008, can be gained from a historical examination of concentrations recorded during the high wind hours. As discussed further in Section 5.1, high wind hours are defined to be those in which 5-minute vector average measurements exceeded 13 mph, the lowest threshold speed at which winds can initiate entrainment of PM_{10} impacting local monitors in Maricopa County (see Appendix H). Using this criterion, the high wind hours for the West 43rd Ave. monitor were determined to be 7:00 a.m. to 7:00 p.m. (the period of average for the high wind hours for this event).

The additional analysis used the available hourly dataset (2005-2009) for the spring season. The severity of concentrations recorded during those hours on May 21, 2008, is illustrated in Figure 3-1. It displays the average concentration recorded during those hours at the West 43rd Ave. monitoring site relative to the same period of time in the available hourly dataset (2005 – 2009)

for the spring season. In Figure 3-1 it is clear that the May 21, 2008, monitor reading ranked 1st (100th percentile) out of the available data for the spring season for West 43rd Ave.

Figure 3-1. Distribution of Average PM_{10} Concentrations During High Wind Hours (7:00 a.m. – 7:00 p.m.) at West 43rd Monitor, Spring Season Only (2005 – 2009)



In summary, an examination of the historical record of 24-hour concentrations over annual and the relevant seasonal period demonstrates that concentrations recorded on May 21, 2008, were well outside of normal, historical fluctuations for both the West 43rd Ave. and Yuma monitors.

3.2 Other Non-Flagged Monitors

The complete Phoenix Metropolitan Area 24-hr average PM_{10} data are summarized in Table 3-2 for the period May 20th – May 23rd. It shows that seven other monitors (West Phoenix, Central Phoenix, South Phoenix, Higley, Buckeye, Durango and JLG) exceeded the 95th percentile on May 21st, and the residual dust from the major storm described in Section 4 below continued to affect these monitors on May 22nd before falling below the median (50th percentile) values on May 23rd, further confirming the event was widespread over most of the Phoenix area.

Table 3-2. Historical Analysis of Maricopa County PM_{10} Network Data

Site ID – Name	May 20th	May 21st	May 22nd	May 23rd	March - May 95th Percentile	March - May 75th Percentile	March - May 50th Percentile
4011 – Buckeye	34	123	89	22	83	59	45
4003 – South Phx	46	122	68	18	86	54	45
4009 – West 43rd	78	278	131	16	125	82	63
9812 – Durango	N/A	109	69	18	97	69	52
3002 – Central Phx	38	91	73	N/A	67	44	36
3010 - Greenwood	45	89	71	24	94	56	43
0019 – West Phx	38	83	64	19	68	48	38
9997 – JLG	28	62	57	17	51	37	31
4014 – Coyote Lakes	52	70	49	12	86	57	47
4006 – Higley	58	110	70	24	96	65	46

.Section 4: Description of May 21, 2008, Exceptional Event

On May 21, 2008, strong winds were expected throughout much of Arizona due to a tightening pressure gradient ahead of a cold front approaching Arizona from the northwest associated with a trough of low pressure. The 500 mb weather maps show high upper level winds extending from Oregon to the south and east over Nevada, California, and into Arizona (Figure 4-1). At this 500 mb level, wind speeds on May 21st ranged from 30 – 60 knots in Arizona with strong 100 knot winds over southern California. Winds as strong as 85 – 100 knots were also seen over portions of California, Nevada, and Oregon.

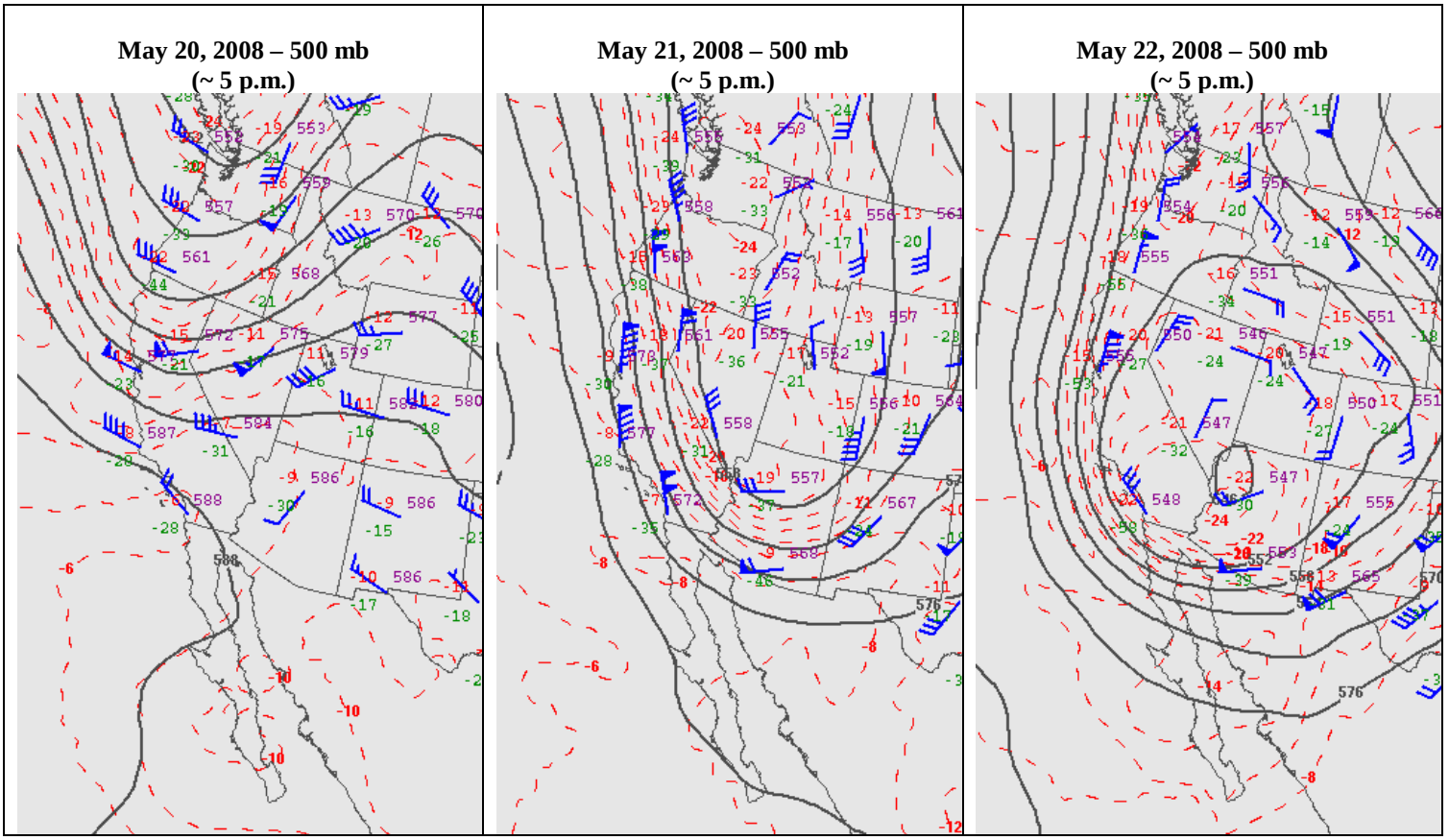


Figure 4-1. Evolution of 500 mb Winds Associated with the Passing of a Low Pressure Trough over 3 Days

Supporting materials for this analysis are contained in the appendices of this report. Appendix J contains the NWS advisories and event reports, Appendix K contains any related news articles, Appendix L contains graphic and tabular summaries of all PM_{10} measurements and local winds at the air quality monitor locations, and Appendix M contains a comprehensive archive of all relevant hourly meteorological (and air quality) data for all stations in the region archived by ADEQ. Information in these appendices should be review to add context to the weather discussion.

By the early morning hours of May 21st, the upper level trough axis was centered along the California /Arizona border with a strong upper level jet located along the western periphery and

at the base of the trough. At the 300 mb level, wind speeds exceeded 130 knots within portions of this jet stream. By the morning of May 21st, a portion of the upper level jet was beginning to enter western Arizona bringing upper level winds of 60 knots while curving around the southern edge of the trough of low pressure. The image on the right in Figure 4-2 shows that by late afternoon, the jet had extended through central and southern Arizona bringing upper level winds in excess of 80 knots to the area. Mostly clear skies, abundant sunshine, and daytime temperatures over 90°F in the deserts of Arizona and to near 90°F in the deserts of southeastern California allowed for a well mixed atmosphere, which enabled the upper level winds to mix down to the surface. This is evident in the numerous reports of high winds by the NWS. Additionally, local topography likely increased surface winds at certain locations

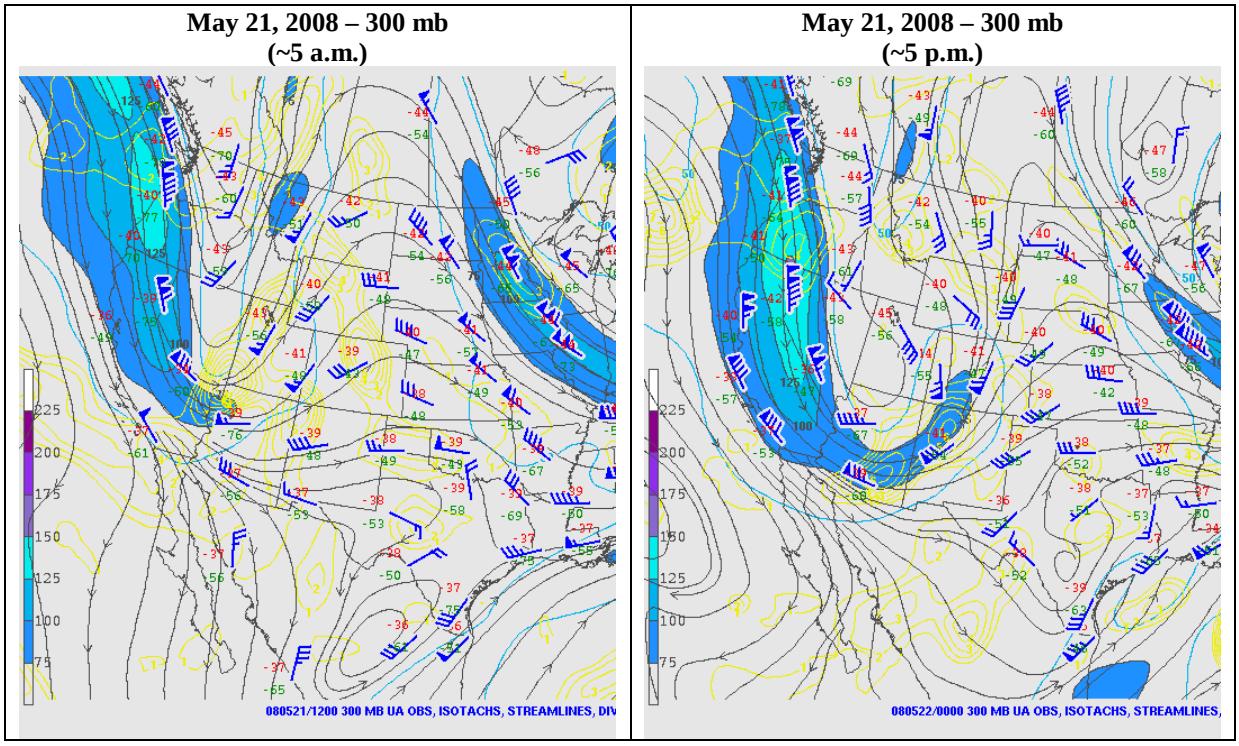


Figure 4-2. Wind Field at 300 mb for the Morning and Afternoon of May 21st (a strong jet maximum was over the western United States, impacting most of Oregon, California, and portions of Nevada and Arizona).

The presence of a cold front over northwestern Arizona is shown in the Surface Weather Map from the early morning hours of May 21, 2008, (Figure 4-3). The left image of Figure 4-3 shows that on the morning of May 21st low pressure was centered over northern Wyoming with the accompanying cold front cutting through Utah and entering the northwestern portions of Arizona. The right image of Figure 4-3 shows that by the following morning, the low pressure center had moved south and was over northern Colorado, and the cold front had progressed through much of Arizona. Strong wind gusts associated with this approaching system were first reported by NWS, ADEQ, Maricopa County, and AZMET stations around 7:00 a.m. on May 21, 2008. Winds increased throughout the morning across much of the Phoenix area with westerly and southwesterly gusts at or greater than 20 mph reported at the West 43rd Ave., Buckeye, Glendale, Greenwood, Higley, Central Phoenix, West Indian School, West Chandler, and Cave

Creek monitors during the 7:00 a.m. hour. Numerous other monitoring locations around the Valley first reached 20 mph wind gusts either slightly before or slightly after the 7:00 a.m. hour. Winds continued to increase throughout the morning, and by noon, most stations were reporting wind gusts in excess of 30 mph with many reporting gusts of 35 mph or greater during the afternoon. NWS stations throughout the Phoenix Metro area reported high gusts throughout the day, with some of the highest being 37 mph at Luke AFB, 31 mph at Goodyear, 38 mph at Phoenix Sky Harbor, 32 mph in Scottsdale, and 54 mph in Chandler. Most of these maximum wind gust reports occurred during the early afternoon hours. The NWS station in Gila Bend reported gusts over 30 mph between 9:00 a.m. and 5:00 p.m. with blowing dust reported every hour from 10:00 a.m. through 5:00 p.m. Most of these NWS stations as well as the monitoring locations previously discussed continued to report strong wind gusts throughout the afternoon and even into the early evening hours. The timing of the onset and the duration of these monitor site and NWS wind gusts are consistent with both the onset of elevated PM_{10} concentrations as well as the maximum hourly PM_{10} concentrations measured at the West 43rd Ave. monitor on May 21, 2008.

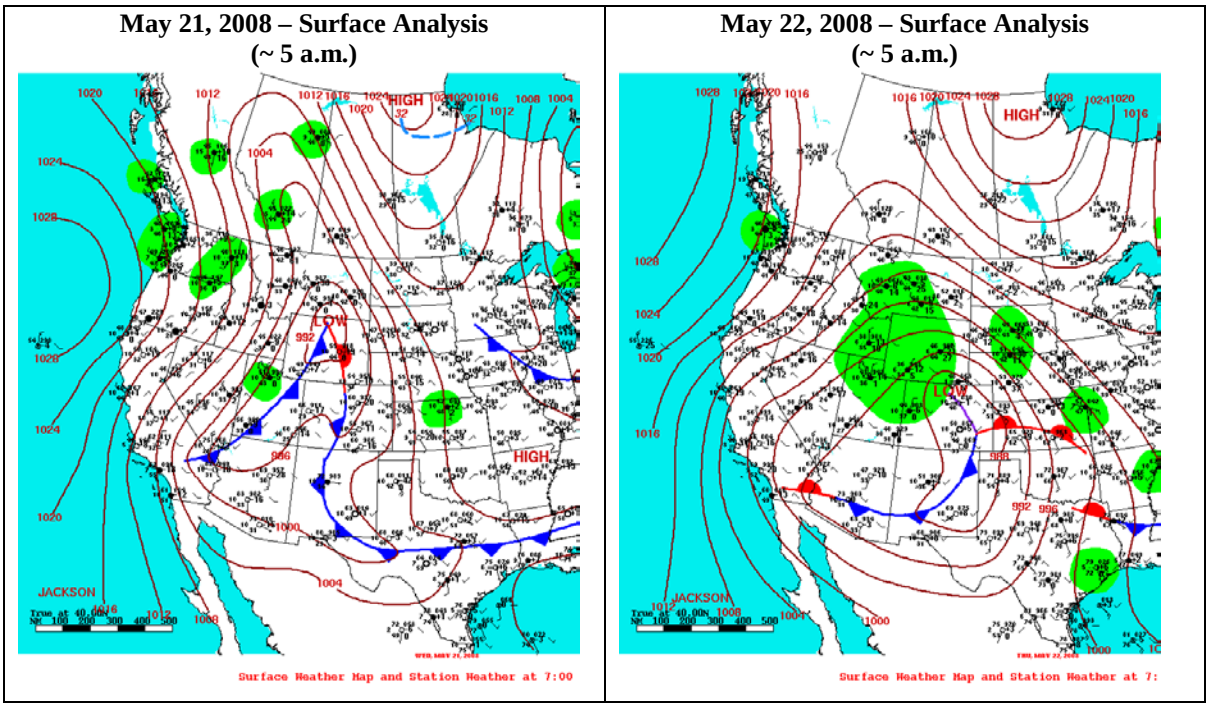


Figure 4-3. Surface Analysis from the Mornings of May 21, 2008, and May 22, 2008 (the progression of a strong low pressure system with the tail of its cold front passing through portions of Arizona is shown).

The strong and gusty winds that generated high PM_{10} levels leading to an exceedance at the West 43rd Ave. monitor site were not confined to only the Phoenix area on May 21, 2008. Significant wind gusts were also reported over areas northern and southern Arizona as well as areas of southeastern California. In fact, the ADEQ monitoring site in Yuma also measured an exceedance of the 24-hour NAAQS for PM_{10} on May 21st. The timing and strength of the winds seen in southwestern Arizona and southeastern California were similar to those seen in the Phoenix area, and the wind directions in and around the Yuma area were mostly westerly with some northwesterly. The NWS station in Imperial County, California and El Centro, California

consistently reported elevated winds gusting out of the west at or greater than 30 mph beginning in the early morning hours and continuing throughout the afternoon until after the 7:00 p.m. hour. Both of these stations reported maximum hourly gusts of 40 mph during the 4:00 p.m. hour. A number of sites in the Yuma area reported elevated winds beginning in the late morning and continuing throughout the afternoon and evening including gusts as high as 33 mph at the Yuma Mesa ADEQ monitor site, 36 at the Yuma Ag ADEQ monitor site, 38 mph at the Yuma Valley AZMET site, and 37 mph at the Yuma MCAS NWS site. The Yuma MCAS NWS station also reported blowing dust and visibility reduced to 4 miles during the 4:00 p.m. and 5:00 p.m. hours, corresponding with the peak wind gusts recorded there on May 21st.

Radar data obtained from the National Oceanic and Atmospheric Administration's National Climatic Data Center in conjunction with MODIS satellite photography obtained from NASA's Rapid Response System allows for a visual reassessment of the dust event in the Yuma area. These data were downloaded as KMZ files and displayed using Google Earth software. The overlay of the products clearly shows that much of the suspended dust originated in southeastern California and was transported to the east. It can be seen that large sources of dust appear to come from the Imperial Sand Dunes of southern California (also known as the Algodones Dunes) and other similar dunes or open desert areas to the southwest of the Salton Sea. Another common source of blowing dust appears to be an area of open desert to the south / southeast of Yuma. While some of the radar images are obscured by noise, the dust sources are still clearly visible (Figure 4-4).

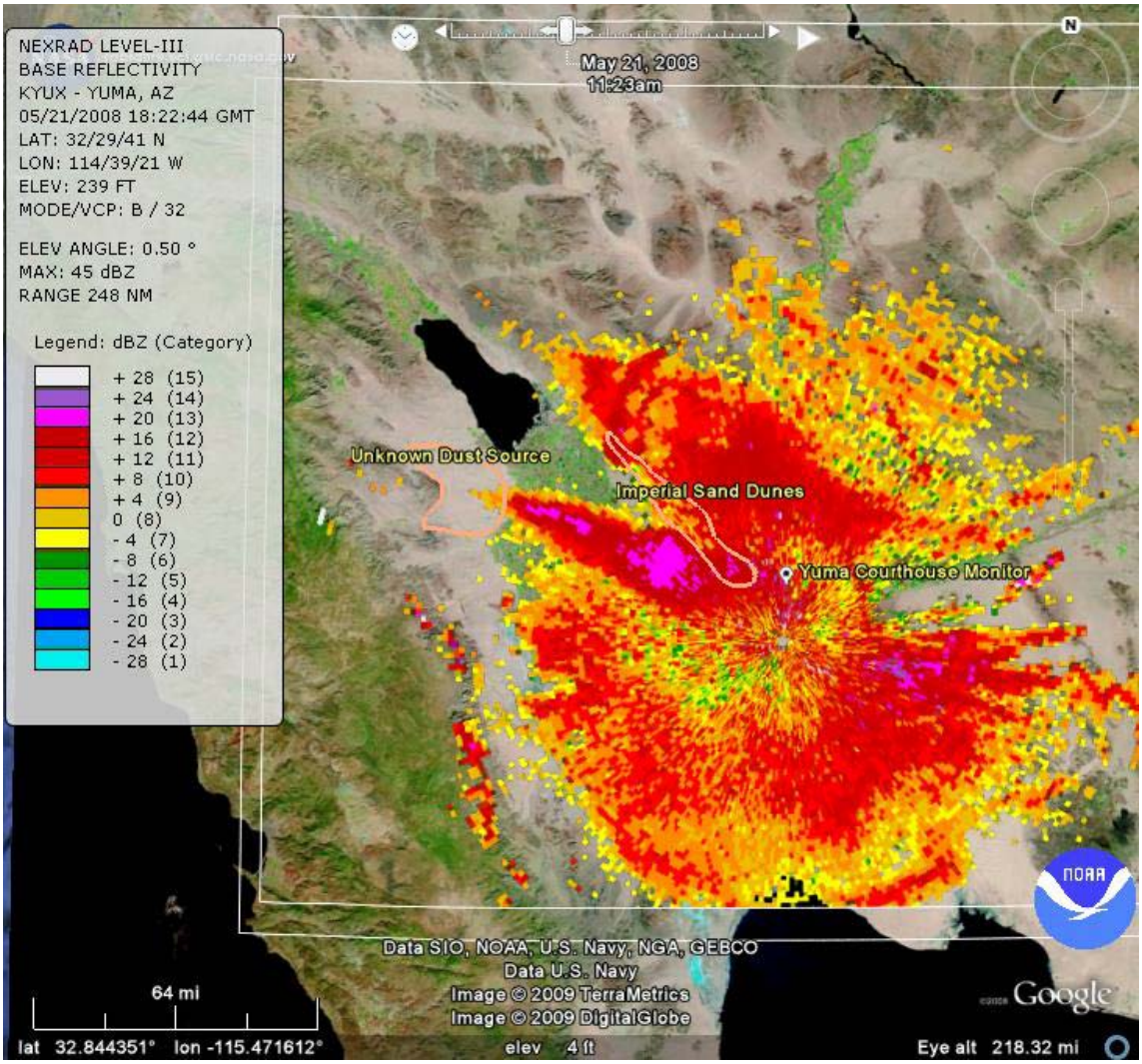


Figure 4-4. Radar Data and MODIS Satellite Imagery Show a Major Source of Blowing Dust Located to the Southwest of the Salton Sea.

Yuma experienced its highest PM_{10} levels around the 4:00 p.m. and 5:00 p.m. hours, and radar data from this time period show what likely are high concentrations of blowing dust from the west and northwest of Yuma. These returns (shown as purple colors) are likely indicative of blowing dust originating from the Imperial Sand Dunes (Figure 4-5).

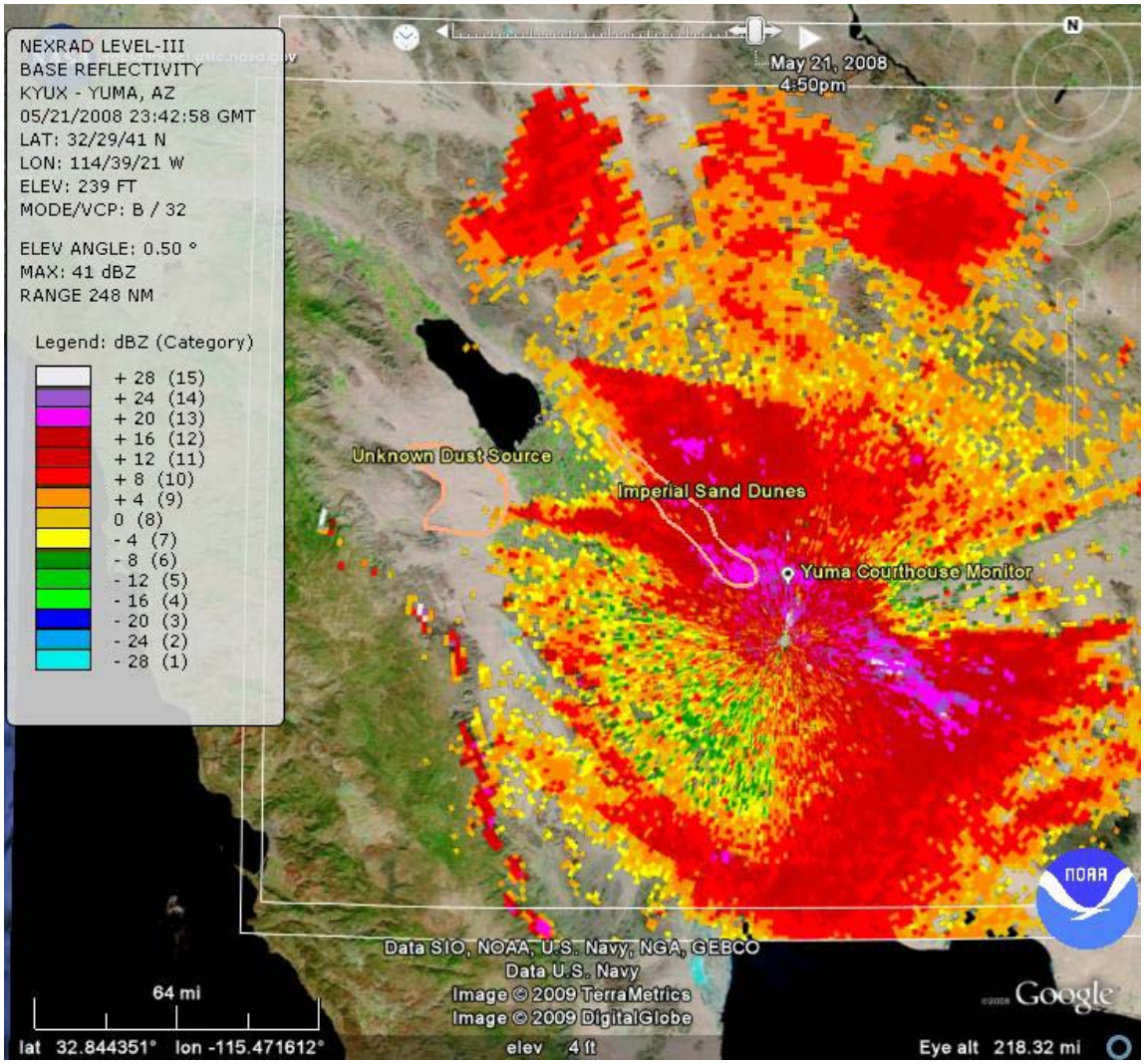


Figure 4-5. Radar Image from About the Time of Highest PM_{10} Concentrations and Lowest Visibilities in Yuma.

The MODIS satellite data are from the Terra satellite with 250 meter resolution and use bands 7, 2, and 1 to accentuate vegetation. Lighter tan areas are indicative of open desert while darker brown areas indicate areas of higher elevation or differing soil type (compared to that of the open desert). The suspected PM_{10} sources are outlined in Figure 4-6.

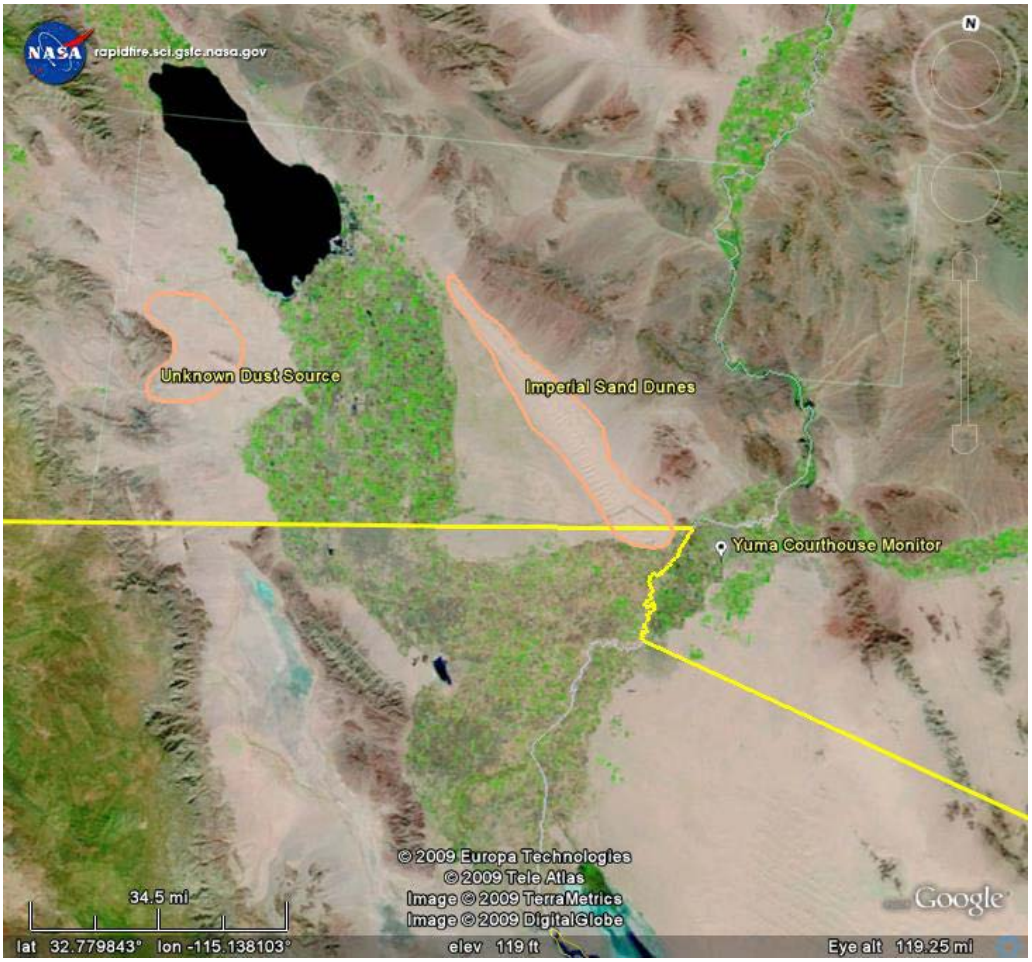


Figure 4-6. MODIS Satellite Image of Sand Dunes Near Yuma (image courtesy of MODIS Rapid Response Project at NASA/GSFC displayed using Google Earth software).

While elevated wind speeds and strong wind gusts were reported throughout much of central and southwestern Arizona and throughout southeastern California, windblown dust generation was localized and concentrated in areas with lower threshold friction velocities, such as the dry river channels found in and around the Phoenix area and the sand dunes to the west-northwest of the Yuma area. As can be seen in Table 3-2 of this report, on May 21, 2008, many Phoenix area PM_{10} monitors recorded 24-hr average PM_{10} concentrations that were about 2 times greater than each monitor's respective median concentration for the March through May time frame (based on 5 years of data). Monitors located at West 43rd Ave., West Phoenix, South Phoenix, Central Phoenix, Higley, Durango, JLG Supersite, and Buckeye all recorded 24-hour average PM_{10} concentrations greater than their 95th percentile levels for the March through May period. The Greenwood and Coyote Lakes monitors both reported 24-hour average PM_{10} concentrations greater than their respective 75th percentile values. This suggests that, while only the West 43rd Ave. and Yuma Courthouse monitors exceeded the PM_{10} NAAQS in Arizona on May 21, 2008, many portions of the Valley were influenced by elevated concentrations of dust particles as most areas were above their respective 95th percentile values. The urbanized core of the Phoenix metropolitan area may have acted to reduce the amount of blowing dust compared to the western periphery due to increased surface roughness. The evidence of a gradient of PM_{10} emanating

from the Salt River channel suggests that alluvial dust was a major contributor to the windblown dust event.

The meteorological phenomena associated with this event were regional in nature, as evidenced by the numerous reports of strong surface winds throughout California and Arizona. Additionally, the synoptic scale weather maps show the approaching upper level trough and the extent to which it affected the southwestern United States. While the meteorological aspect of this event covered a large geographical area, the blowing dust that was generated from these high winds occurred at sporadic locations, though these locations also covered a wide geographic area. Essentially, concentrations of blowing dust were highest where dust sources were located and where threshold friction velocities were low (see Appendix H, white paper on unusual winds). In the arid southwest, these dust sources are typically located in depositional areas where fine and coarse particles are deposited during times of precipitation, such as the dry river channels in Maricopa County including the Gila and Salt River channels which are located upwind, and in close proximity to, the West 43rd Ave. monitor, as well as the sand dunes located west-northwest of Yuma in southeastern California.

Section 5: Event Analysis

In this section, the Exceptional Events Criteria are examined. 40 CFR 50.1(j) of the Exceptional Events Regulation defines an exceptional event as an event that:

- Affects air quality;
- Is not reasonably controllable or preventable;
- Is either an event caused by human activity that is unlikely to recur at a particular location or a natural event; and,
- Is determined by the EPA Administrator in accordance with the Exceptional Events Rule to be an exceptional event.

Sections 5.1 to 5.3 describe how the first three criteria are met for the May 21, 2008, high wind exceptional events in Phoenix, and Yuma areas. In addition, Section 5.4 is a re-statement that all reasonable measures were taken to protect public health.

5.1 Affects Air Quality

For an event to qualify as an exceptional event, it is necessary to show that the event affected air quality. This criterion can be met by establishing that the event is associated with a measured exceedance in excess of normal historical fluctuations, including background. The demonstration of a clear causal relationship is necessary to establish that the event affected air quality and is also a separate requirement.

The documentation provided herein for the May 21, 2008, natural event that affected southeastern California and much of Arizona provides the required information to establish a causal connection between the high winds and the high concentrations measured at the Yuma Courthouse and West 43rd Ave. PM_{10} monitors. The measured 24-hour PM_{10} concentrations at these monitors show that air quality was affected. Concentrations were lower on the days before and after the high wind event, as is shown in Table 3-2. The hourly PM_{10} concentrations increased rapidly as the winds peaked, as is shown in Section 5.2. As was shown previously in Section 3, in the last five years of analyzed data, high PM_{10} concentrations exceeding the 24-hour NAAQS do not often occur and fall above the 95th percentile of the data. Section 7 includes meteorological and particulate data showing a clear correlation between strong, gusty winds and increased hourly PM_{10}. The supporting documentation also includes NWS forecasts and advisories of high winds and windblown dust (see Appendix J). The measured exceedances on May 21, 2008, were in excess of normal fluctuations.

5.2 Is Not Reasonably Controllable or Preventable

The Federal Register Notice[4] promulgating the final rule for exceptional events included the following guidance for preparing this demonstration:

[4] Federal Register/ Vol. 72, No. 55, Thursday, March 22, 2007 / Rules and Regulations, Environmental Protection Agency, 40 CFR Parts 50 and 51, Treatment of Data Influenced by Exceptional Events, Final Rule

The EPA's final rule concerning high wind events states that ambient particulate matter concentrations due to dust being raised by unusually high winds will be treated as due to uncontrollable natural events where (1) the dust originated from nonanthropogenic sources, or (2) the dust originated from anthropogenic sources within the State, that are determined to have been reasonably well-controlled at the time that the event occurred, or from anthropogenic sources outside the State.

The analytical steps required to prepare this demonstration include selecting high wind hours, plotting a back trajectory during high wind hours, determining the land use along the trajectory, estimating emissions, determining anthropogenic and nonanthropogenic source contributions, and documenting that identified anthropogenic sources were "reasonably well controlled." Presented below is a summary of the approach used to complete each of these steps.

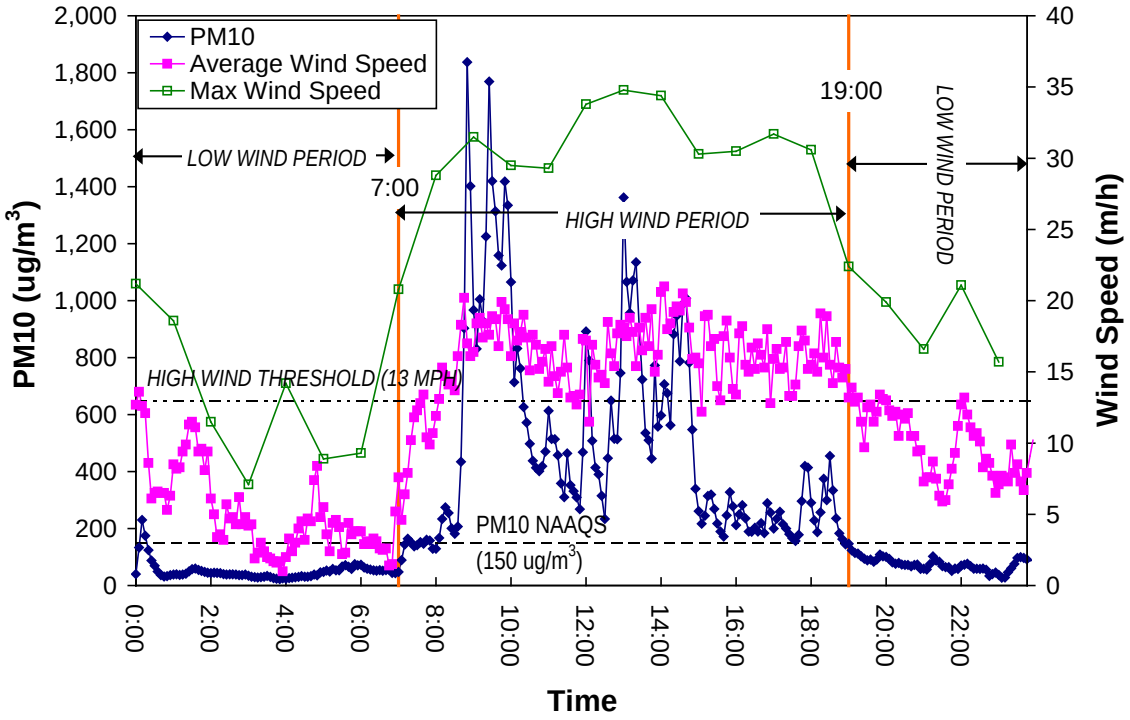
Selection of High Wind Hours

As discussed in the Unusual Winds White paper,[5] hours containing one or more 5-minute periods with an average wind speed of 13 mph or higher were designated as high wind hours. Generally, these hours are found to group together in a continuous period. In some cases, however, wind speeds tailed off after the initial weather front moved through the region, fell below the 13 mph threshold, and then again rose above the 13 mph threshold. In these cases, a second criterion can be used to determine if the hour was to be designated a high wind hour, which was whether PM_{10} concentrations continued to exceed the ambient 24-hour standard. If concentrations remained below the standard, the conclusion was that the reservoir of erodible soil was exhausted by elevated winds in previous hours and that even though the 5-minute threshold had been exceeded, there was no significant impact at the monitor. This second criterion did not apply to May 21, 2008.

A summary of the diurnal profile of 5-minute average wind speeds and PM_{10} concentrations and maximum hourly wind gusts recorded at the West 43rd Ave. monitor for May 21, 2008, is displayed in Figure 5-1. It shows the 13 mph threshold divides the day into two low wind periods from midnight to 7:00 a.m. and from 7:00 p.m. to the end of the day, and a high wind period from 7:00 a.m. to 7:00 p.m. It also shows that PM_{10} concentrations began increasing after 7:00 a.m., and peaked at about 9:00 a.m., then declined but remained elevated until winds dropped below the 13 mph threshold at 7:00 p.m. and remained at lower levels for the remainder of the day. It also shows that the maximum hourly gusts during the high wind hours exceeded 25 mph.

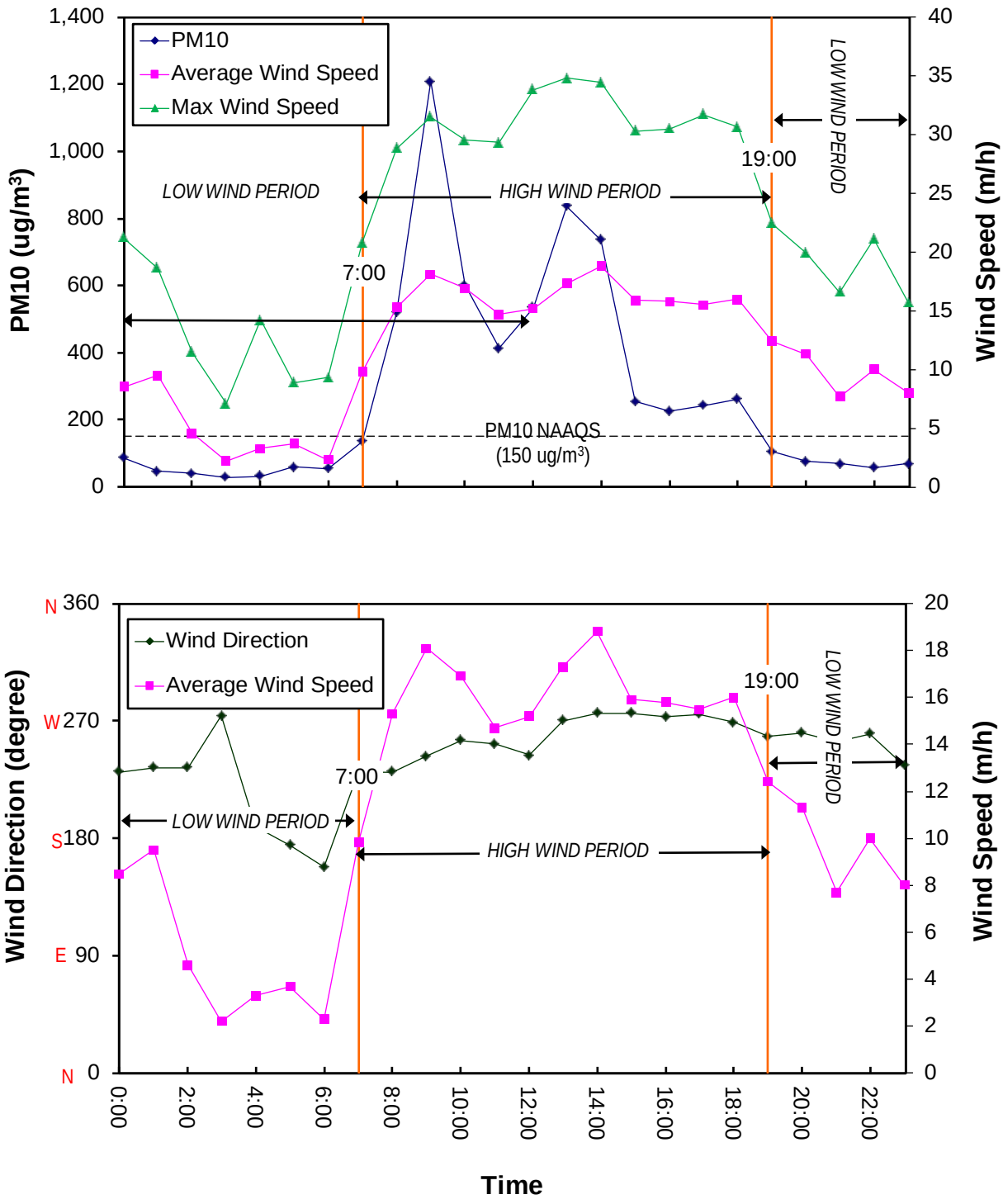
[5] The Impact of Exceptional Events 'Unusual Winds' on PM_{10} Concentrations in Arizona, ADEQ, Appendix H

Figure 5-1. Diurnal Profile of 5-Minute Average PM_{10} Concentrations and Wind Speed and 1-Hour Average Max Wind Speed at West 43rd Ave. Monitor (5/21/2008)



A similar plot of one-hour average values, along with the maximum hourly wind speeds, is presented in the top panel of Figure 5-2; hourly average wind speed and wind direction are presented in the bottom panel. As can be seen, the plots of the average hourly values significantly smooth the spikes and do not offer the insight provided by the 5-minute data. They also show that the maximum wind speed remained well above the 13 mph threshold between 7:00 a.m. and 7:00 p.m. Figure 5-2 also shows that the wind direction shifted during the early low wind hours of the day. Starting about 9:00 a.m., however, the wind shifted to the southwest and gradually shifted toward the west by 1:00 p.m. and remained from that direction for the remainder of the high wind period before shifting back toward the southwest for the remainder of the day. Once the wind shifted to the southwest, the speeds and PM_{10} concentrations began to increase, reaching a peak at about 9:00 a.m. In subsequent hours the winds remained high, but the concentrations declined before reaching another peak at 1:00 p.m. when the wind stabilized from the west after which concentrations declined for the remainder of the high wind period. Once winds declined below the 13 mph threshold the concentrations fell further and remained uniformly low for the remainder of the day.

Figure 5-2. Diurnal Profile of 1-Hour Average PM_{10} Concentrations and Wind Speed at West 43rd Monitor (5/21/2008)



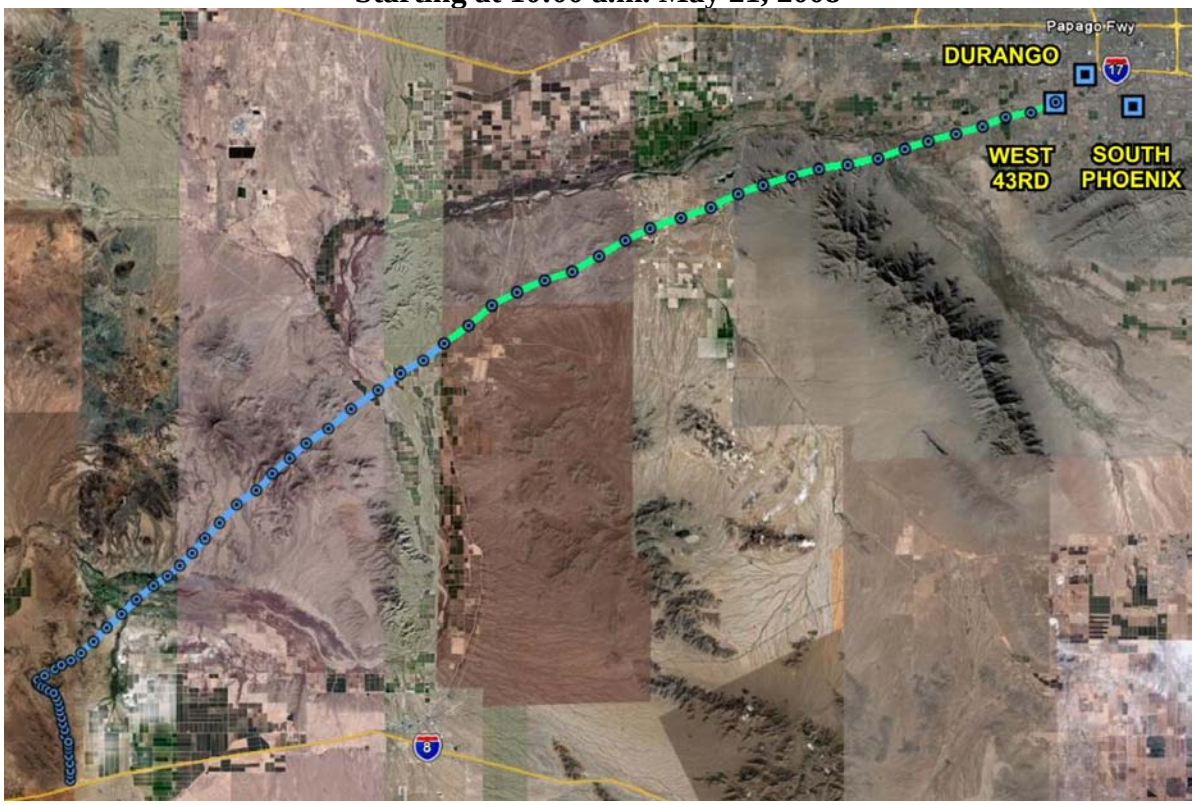
Plotting a Back Trajectory During High Wind Hours

Several factors were considered in the selection of hours used in the back trajectory calculations, including:

- Hours when peak concentrations occurred at the West 43rd Ave. monitoring site – both the hourly and 5-minute data suggest 8:00 a.m. – 6:00 p.m. and,
- Identifying anthropogenic sources impacting the West 43rd Ave. monitoring site – the distance from the West 43rd Ave. monitor to the edge of the desert depends on wind speed and direction, but as shown in Figure 5-2, both are relatively stable during the period from 7:00 a.m. – 7:00 p.m.

Since the highest concentration was recorded at 9:00 a.m., the ending hour of the back trajectory was selected to be 10:00 a.m. to ensure the areas producing the maximum emissions impacting the monitor on May 21, 2008, are represented in trajectory and related emission calculations. The duration of the trajectory was set at six hours (10:00 a.m. to 5:00 a.m.) to ensure that all high wind/high concentration activity was captured. Given the wind speeds measured during those hours, the trajectory extended far out into the desert. Because land use within the desert provides no insight into the anthropogenic sources impacting the monitor, the analysis focused on land use during the last 2 hours of the back trajectory, which is roughly equivalent to the distance from the West 43rd Ave. monitor to the desert along a southwest trajectory. A plot of the selected back trajectory is presented in Figure 5-3. As can be seen, the trajectory traverses an extended desert area in which there is no anthropogenic activity.

Figure 5-3. Back Trajectory of Wind Impacting the West 43rd Ave. Monitor Starting at 10:00 a.m. May 21, 2008



Determination of Land Use Along the Back Trajectory

Maricopa Association of Governments (MAG) staff used land use GIS files to determine the zoned uses of all lands within a ½ mile of each back-trajectory track over which wind parcels traveled during the two hours prior to delivering the peak PM_{10} concentration to the W. 43rd Ave. monitor. Lands under active construction on each exceedance day were identified from MCAQD earthmoving permit records. Parcel areas were aggregated within seven general categories for which limited emission factor data were available: vacant, agriculture, construction, open/restricted access, riverbed, landfill/sand and gravel, and other lands. The uses of these land categories are generally defined as follows:

- Vacant – represents undeveloped land to which public access is not restricted;
- Agriculture – represents lands under agricultural cultivation;
- Construction – represents lands being developed for long term use that will include ground coverage elements such as pavement, structures, or landscaping that will prevent the generation of windblown dust;
- Passive/restricted open space – represents undeveloped or partially developed lands to which public vehicular access is restricted (these lands include public parks, national forests, military posts, and Indian reservations);
- Riverbed – represents riverbed channels of the Salt and Gila River branches;
- Landfill/sand and gravel – represents lands being used for mineral extraction or waste deposit; and
- Other – represents developed lands that are protected from windblown dust generation by elements such as paving, structures, and landscaping.

These categories correspond to those used in the windblown dust emission inventory published in the MCAQD's 2008 Periodic PM_{10} Emission Inventory[6] with the exception of the riverbed category, which was split out from the passive/restricted open space category and reported separately. The separate reporting and analysis of windblown emissions from riverbed lands was deemed necessary because of the finer soil texture and higher emission rate in comparison to other restricted open space lands, and because of the high prevalence of riverbed lands in the zones along the mapped back-trajectories.

A summary of the total acreages reported within each of the seven land use categories within a ½ mile of the wind back trajectory for the West 43rd Ave. monitoring site on May 21, 2008, is presented in Table 5-1. It shows that while the distribution of the source-specific acreage varies by hour, the total acreage is very similar, confirming that there is little difference in the wind speed between the two hours.

[6] 2008 PM_{10} Periodic Emissions Inventory for the Maricopa County, Arizona, Nonattainment Area, Appendix 4. Windblown Dust Emission Estimates Methodology, Final Draft, Maricopa County Air Quality Department, June 2010

Table 5-1. Total Acreage Within ½ Mile of Back Trajectory by Land Use Category West 43rd Ave. Monitor – May 21, 2008		
Land Use Category	**1st Hour (10:00 a.m.)**	**2nd Hour (9:00 a.m.)**
Vacant	1,372	8,480
Agriculture	794	242
Construction	117	144
Passive/Restricted	4	128
Riverbed	3,039	75
Sand & Gravel/Landfill	624	5
Other	4,933	1,582
Total	10,883	10,657

Estimation of Anthropogenic and Nonanthropogenic Emissions

A detailed discussion of the methodology used to prepare source-specific emission estimates is presented in Appendix O. In addition to the source-specific acreage values listed above, it details the rule effectiveness rates extracted from the 2008 Periodic Emissions Inventory (PEI), information on crop-specific agricultural activity, the Nickling and Gillies emission factors applied to each land use category, determination of the portion of land use which is disturbed and undisturbed, and the method used to allocate related emission estimates into anthropogenic and nonanthropogenic estimates. A summary of the resulting emission estimates for the combined two-hour period is presented in Table 5-2. It shows that anthropogenic emissions are estimated to account for roughly 50% of the mass impacting the West 43rd Ave. monitor on May 21, 2008. One significant finding is that agricultural emissions are estimated to have no impact on the West 43rd Ave. monitor during that period. As shown below, this is because interviews with local farmers, farming organizations, and inspection of 2008 crop distribution aerial images showed that much of the land within the back trajectory zone was being used to cultivate alfalfa, which fully protected these lands from wind erosion and greatly reduced emissions from agricultural lands. The principal reason other sources were estimated to have no emissions impacting the West 43rd Ave. monitor on May 21, 2008, is that the winds recorded during the two-hour period did not exceed the threshold friction velocities based on the Nickling & Gillies data.

Table 5-2. Anthropogenic and Nonanthropogenic Windblown PM_{10} Emissions From W. 43rd Ave. Monitor Back-Trajectory Lands on May 21, 2008			
Land Use Category	**PM_{10} Emissions (lb)**		**% of Anthropogenic**
	Anthropogenic	**Nonanthropogenic**	
Vacant/Undisturbed	-	0	
Vacant/Disturbed	4,841	-	57.6%
Agriculture/Undisturbed	0	-	0.0%
Agriculture/Disturbed	0	-	0.0%
Construction/Undisturbed	0	-	0.0%
Construction/Disturbed	113	-	1.3%
Passive-Restricted/Undisturbed	-	0	
Passive-Restricted/Disturbed	49	-	0.6%
Riverbed/Undisturbed	-	8,603	
Riverbed/Disturbed	2,519	-	30.0%
Sand & Gravel Landfill/Undisturbed	0	-	0.0%
Sand & Gravel Landfill/Disturbed	884	-	10.5%
Other		-	
Total	8,407	8,603	
% of Grand Total	49.4%	50.6%	

Although Table 5-1 indicates significant differences in land use between hour 1 and hour 2 of the back trajectory, there is little difference in the anthropogenic emission distributions between the hours. This is largely the result of the selected threshold friction velocities.

Documentation that Identified Anthropogenic Sources Were "Reasonably Well Controlled"

Table 5-2 identifies the sources of PM_{10} emissions located upwind of the West 43rd Ave. monitor. This section describes the measures that were in place on May 21, 2008, to control PM_{10} emissions from these sources. The control measures in the EPA-approved Serious Area PM_{10} Plan and the 2007 Five Percent Plan for PM_{10} are legally binding commitments that must be implemented by the sponsoring agency. The control measures that were implemented for the major sources upwind of the West 43rd Ave. monitor on May 21, 2008, are discussed below.

Agriculture

Although Table 5-2 indicates that agricultural emissions did not contribute to the exceedance at the West 43rd Ave. monitor on May 21st, agricultural land uses represent five percent of the acreage along the back trajectory for the West 43rd Ave. monitor. The State of Arizona has implemented Agricultural Best Management Practices in Area A, which includes the back trajectory area for May 21st. The Serious Area PM_{10} Plan requires farmers to implement at least one best management practice (BMP) for tilling and harvesting, cropland, and non-cropland.

The Five Percent Plan required farmers to implement a second BMP for each of these agricultural activities. The four committed control measures in the Serious Area and Five Percent Plans are described below.

Serious Area Plan Measure

Measure 49, Agricultural Best Management Practices – The Arizona Legislature passed S.B. 1427 in 1998 which includes Best Management Practices for Agriculture to reduce particulate emissions. The legislation established a Best Management Practices Committee for Regulated Agricultural Activities appointed by the Governor.

By June 10, 2000, the Best Management Practices Committee adopted by rule an agricultural general permit specifying best management practices for regulated agricultural activities to reduce PM_{10} emissions. The ADEQ Director submitted the rule to the U.S. Environmental Protection Agency as a revision to the State Implementation Plan.

As defined by state law, an agricultural general permit means best management practices that reduce PM_{10} emissions from tillage practices and from harvesting on a commercial farm; from those areas of a commercial farm that are not normally in crop production; and from those areas of a commercial farm that are normally in crop production including prior to plant emergence and when the land is not in crop production. Best management practices are defined as techniques verified by scientific research, that on a case-by-case basis are practical, economically feasible and effective in reducing PM_{10} emissions from a regulated agricultural activity.

The Best Management Practices Committee adopted by rule a list of best management practices, at least one of which was used to demonstrate compliance with the agricultural general permit.

A person engaged in a regulated agricultural activity on the effective date of this act (August 21, 1998) was required to comply with the agricultural general permit by December 31, 2001. A person who begins a regulated agricultural activity after December 31, 2000, is required to comply with the general permit within eighteen months of beginning the activity.

Five Percent Plan Measures and Implementation Status

The following measures are included in Chapter Six of the MAG 2007 Five Percent Plan for PM_{10} for the Maricopa County Nonattainment Area. The implementation status of each measure in calendar year 2008 is shown in italics after the measure.[7]

Measure 41, Forward to the Governor's Agricultural Best Management Practices Committee that cessation of tilling be required on high wind days and that agricultural best management practices be required in existing Area A – *Agricultural Best Management Practices required in Area A by S.B. 1552; on September 25, 2007, the Governor's Agricultural Best Management Practices (BMP) Committee revised its rule to double the number of BMPs that farmers must*

[7] MAG, 2008 Implementation Status of Committed Measures in the MAG 2007 Five Percent Plan for PM_{10} for the Maricopa County Nonattainment Area, January 2010.

implement, added 5 BMP choices (including cessation of tilling on High Pollution Advisory Days) and expanded the land area in which BMPs must be applied.

Measure 50, Require two agricultural best management practices, Required by SB 1552 – *The Legislature adopted a requirement that expanded the regulated area for Agricultural BMPs to include the portion of Area A in Maricopa County and increased the number of required Ag BMPs from one to two for each category by December 31, 2007.*

Construction

Table 5-1 indicates that construction activity accounted for one percent of the acreage along the May 21st back trajectory and Table 5-2 indicates that construction sources produced one percent of the emissions producing the peak concentration recorded at the West 43rd Ave. monitor on May 21st. However, there were 14 measures in place to control construction activities on May 21, 2008: three from the Serious Area Plan and 11 from the Five Percent Plan, as described below. For the Five Percent Plan, the implementation status of the measures on May 21, 2008, is also described. Detailed descriptions of these measures are contained in Chapter Seven of the Serious Area Plan and Chapter Six of the Five Percent Plan.

Serious Area Plan Measures

Measure 30, Encourage the Use of Temporary Electrical Power Lines Rather than Portable Generators at Construction Sites – Seventeen cities and towns and Maricopa County committed to implement this measure.

Measure 39, Strengthening and Better Enforcement of Fugitive Dust Control Rules – Maricopa County indicates that this measure involves achieving improved compliance with existing air pollution rules through the provision of additional inspection and enforcement personnel. In addition, it involves evaluating the effectiveness of rules and improving clarity.

January to February 2001	Draft rule revisions, if necessary
March to May 2001	Workshop draft rule, if rule revisions are necessary
June to September 2001	Board consideration of rule revision, if necessary

The Maricopa County schedules for implementation of increases in inspection frequency and Rule 310 revisions are shown below.

Inspection Frequency Part II--Sources Requiring Permits:

June 1997	Scheduled weekend inspections randomly at least once a month.
July 1999	Proactively inspect sites larger than 10 acres 3 to 6 times per year. Proactively inspect sites less than 10 acres once within 30 days of project start date listed on the permit application form.

January 2000	Develop inspection priorities for permitted sources
March 2000	Revise Standard Operating Procedure and checklists for fugitive dust inspections to be consistent with revised rules.
March 2000	Provide a shortened complaint response time with a goal of 8 hours for high priority complaints. Maintain the current goal of 24 hours for all others.
September 2000	Conduct mid-year review of program to evaluate its progress and future needs.
September to January 2001	Draft Fugitive Dust Operating Plan to track progress and identify future needs.
March 2001	Review program to evaluate its effectiveness and potential future needs.

Evaluate and Revise Rule 310:

December 1999 to February 2000	Revise earth moving application forms and dust control plans to be consistent with the revised rule and to improve program effectiveness.
December 1999 to July 2001	Research and develop a standard(s) and test method(s) for earth moving sources, considering field research sponsored by EPA, designed to be enforceable and meet BACM requirements as to stringency and the number of sources that it applies to. If research reveals problems with the existing opacity standard's enforceability, feasibility or stringency for some or all earthmoving operations, revise rule by June-September 2001 to modify the existing opacity test method to address the problems as warranted and adopt a new standard(s) and test method(s) to deal with any problems that cannot be addressed by modifying the opacity test method.
January 2000 to July 2001	Research, develop and incorporate additional requirement for dust suppression practices/equipment into dust control plans and/or Rule 310 by June - September 2001.
June 2000 to June 2001	Revise the sample daily recordkeeping logs for new and renewed Rule 310 permits to be consistent with rule revisions and to provide sufficient detail documenting the implementation of dust control measures required by Rule 310 and contained in the dust control plan. Distribute sample log sheets with issued permits and conduct outreach to sources by June 2000.

Measure 47, Dust Control Plans for Construction/Land Clearing and Industrial Sites (Including Active Landfills), With Elements Addressing Trackout Prevention, Site and Material Maintenance, Construction Staging, and High Wind Operating Restrictions– Maricopa County indicates that this measure involves requiring dust control plans for construction, demolition, land clearing, and industrial projects. Dust control plans are an element of Maricopa County's fugitive dust program described in the measure, Strengthening and Better Enforcement of Fugitive Dust Control Rules 97-DC-1. Credit for the fugitive dust program including dust control plans will be taken under Measure 22, Strengthening and Better Enforcement of Fugitive Dust Control Rules.

Five Percent Plan Measures and Implementation Status

The following measures are included in Chapter Six of the MAG 2007 Five Percent Plan for PM_{10} for the Maricopa County Nonattainment Area. The implementation status of each measure in calendar year 2008 is shown in italics after the measure.

Measure 2, Extensive Dust Control Training Program – *In March 2008, Maricopa County hired 2 dust control compliance and 2 administrative personnel to coordinate and conduct the training program. During 2008, 11,100 individuals completed County-certified dust control training classes.*

Measure 3, Dust managers required at construction Sites of 50 acres or more – *Dust Managers were required by SB 1552. In March 2008, Maricopa County adopted Rules 310 and Rule 316 revisions in regard to dust managers.*

Measure 6, Better tarping requirements in Rule 310 to include enclosure of the bed – *In March 2008, Maricopa County adopted Rule 310 and Rule 310.01 revisions in regard to tarping*.

Measure 8, Conduct nighttime and weekend consistent inspections – *Nighttime and weekend inspections conducted in 2008 included complaint inspections and targeted inspections of specific industries that operate at night and on weekends.*

Measure 9, Increase consistent inspection frequency of permitted sources – *In March 2008, Maricopa County adopted Rule 280 revisions in regard to inspection frequency. In 2008, Maricopa County hired 32 inspectors, 13 administrative and permit technicians, 6 inspector supervisors and 4 administrative supervisors for the Dust Control Compliance Program. Maricopa County issued 4,355 permits for dust control sources (Rule 310) and conducted 12,303 inspections of dust control permitted sources (Rule 310).*

Measure 11, Notify violators more rapidly to promote immediate compliance – *Maricopa County continued the standard practice of dust compliance inspectors who observe potential violations making reasonable efforts to inform a person on-site or call the permit holder so that measure can be taken to prevent, reduce or mitigate dust generation before a violation occurs.*

Measure 13, Develop a program for subcontractors – *Required by SB 1552; In March 2008, Maricopa County adopted Rule 200 and Rule 280 revisions in regard to the subcontractor*

registration program. In 2008, Maricopa County hired 4 permit technicians to administer the subcontractor registration program and registered 4,882 subcontractors.

Measure 16, Require dust coordinators at earthmoving sites of 5-50 acres – *Dust coordinator required by SB 1552; In March 2008, Maricopa County adopted Rule 310 and Rule 316 revisions in regard to dust coordinators.*

Measure 36, Require barriers in addition to Rule 310 stabilization requirements for construction activities where all activity has ceased, except for sites in compliance with storm water permits – *In March 2008, Maricopa County adopted Rule 310 revisions in regard to barriers. Maricopa County revised long-term stabilization control measures to reduce the period of inactivity to 30 days and added the requirement for barriers, if water is chosen as the control option.*

Measure 37, Reduce the tolerance of trackout to 25 feet before immediate cleanup is required for construction sites be placed in Maricopa County Rule 310 – *In March 2008, Maricopa County adopted Rule 310 revisions in regard to the trackout requirements by reducing the toleration of trackout to 25 feet before cleanup is required.*

Measure 38, No visible emission across the property line be placed in Maricopa County Rule 310 and 310.01, and in local ordinances for nonpermitted sources as appropriate – *In March 2008, Maricopa County adopted Rule 310 and Rule 310.01 in regard to visible emissions.*

Open Space, Riverbeds and Vacant Areas

Table 5-1 shows that less than one percent of the land in the back trajectory for May 21st was passive, restricted open space. An additional 14 percent of the land is located in the dry riverbeds of the Salt River and the Gila River, while another 46 percent is vacant land. Together, these land uses represent nearly 61 percent of the area of the May 21st back trajectory. Table 5-2 indicates that these sources were collectively responsible for 88 percent of the emissions producing the peak concentration recorded at the West 43rd Ave. monitor on May 21st. The measures that were in place on May 21, 2008, to control emissions from these sources are legally binding commitments in the Serious Area and Five Percent Plans. These 12 measures are described below. For the Five Percent Plan, the implementation status of the measures on May 21, 2008, is also provided.

Serious Area Plan Measures

Measure 39, Strengthening and Better Enforcement of Fugitive Dust Control Rules − Maricopa County indicates that this measure involves achieving improved compliance with existing air pollution rules through the provision of additional inspection and enforcement personnel. In addition, it involves evaluating the effectiveness of rules and improving clarity. Maricopa County's schedule for increasing the frequency of inspections for nonpermitted sources is shown below.

Increase Inspection Frequency Part I--Sources Not Requiring a Permit:

June 1999	Board adopted Rule 310.01 that addressed vacant lots, unpaved parking lots and public unpaved roads.
April 2000	Develop inspection priorities for vacant lot and unpaved parking lot inspections considering lot size and number of sources. Larger lots will be inspected first and smaller lots in succeeding years. Department resources will be directed initially to areas that lack municipal programs.
January 2000	Department obtains copies of local government plans developed pursuant to A.R.S. Section 9-500.04 or 49-474.01 to stabilize targeted unpaved roads, alleys and stabilize unpaved shoulders on targeted arterials.
Annually Thereafter	Review reports filed on those plans

Measure 46, Reduce Particulate Emissions from Vacant Disturbed Lots – Eighteen cities and towns, Maricopa County, and the Arizona Department of Transportation made commitments to implement this measure.

Measure 48, Dust Abatement and Management Plan for State Lands – The Arizona Legislature passed S.B. 1427 in 1998 which appropriated $200,000 from the State General Fund to the State Land Department for implementing a Dust Abatement and Management Plan to include measures to control particulate pollution on State Trust Lands in Area A. The plan may include measures to close areas to illegal use by off-highway vehicles, closing roads that are unused or illegal, and increasing the enforcement of no trespassing areas (Section 36 of S.B. 1427).

Measure 77, Additional Dust Control Measures – The City of Tempe, in 1997, indicates that earlier this year, construction began on the Rio Salado Development, which will ultimately improve approximately 4.5 miles of the dry Salt River bed and adjacent properties. Included in this project is the construction of a two mile long lake, which is due to be completed in 1999. The Salt River and the properties adjoining its banks constitute the largest unimproved portion of land remaining within Tempe.

Five Percent Plan Measures and Implementation Status

The following measures are included in Chapter Six of the MAG 2007 Five Percent Plan for PM_{10} for the Maricopa County Nonattainment Area. The implementation status of each measure in calendar year 2008 is shown in italics after the measure.

Measure 4, Dedicated enforcement coordinator for unpaved roads, unpaved parking, and vacant lots – *In 2008, Maricopa County assigned a supervisor to oversee the vacant lot program.*

Measure 8, Conduct nighttime and weekend consistent inspections – *Nighttime and weekend inspections conducted in 2008 included complaint inspections and targeted inspections of specific industries that operate at night and on weekends.*

Measure 11, Notify violators more rapidly to promote immediate compliance – *Maricopa County continued the standard practice of dust compliance inspectors who observe potential violations making reasonable efforts to inform a person on-site or call the permit holder so that measure can be taken to prevent, reduce or mitigate dust generation before a violation occurs.*

Measure 14, Reduce dragout and trackout emissions from nonpermitted sources – *In March 2008, Maricopa County adopted Rule 310.01 revisions in regard to dragout and trackout. Maricopa County added the requirement to install a trackout control device to sections covering unpaved parking lots and off-site hauling of bulk materials by livestock operations. Also, in Rule 310.01, Maricopa County added the definitions of "trackout/carryout" and "trackout control device."*

Measure 30, Strengthen and increase enforcement of Rule 310.01 for vacant lots – *Maricopa County hired a supervisor to oversee the vacant lot program. In 2008, Maricopa County conducted 5,005 vacant lot inspections.*

Measure 31, Restrict vehicular use and parking on vacant lots – *Ordinance required by SB 1552; In February 2008, Maricopa County adopted the P-27 Vehicle Parking and Use on Unstabilized Vacant Lots Ordinance. In addition, 23 local governments have new or existing ordinances to prohibit vehicle trespass on vacant land.*

Measure 32, Enhanced enforcement of trespass ordinances and codes – *In February 2008, Maricopa County adopted the P-28 Off-Road Vehicle Use in Unincorporated Areas of Maricopa County and P-27 Vehicle Parking and Use on Unstabilized Vacant Lots Ordinance. In addition, 18 local governments report increased enforcement of vehicle trespass ordinances and codes for vacant lots.*

Measure 33, Ability to assess liens on parcels to cover the costs of stabilizing them – *SB 1552 requires rule revisions for stabilization of disturbed surfaces of vacant lots. Maricopa County adopted Rule 310.01 revisions in March 2008 to allow the County to recover stabilization costs through the penalty process.*

Sand and Gravel Operations

Table 5-1 indicates that less than 3 percent of the land area in the back trajectory was devoted to sand and gravel operations. Table 5-2 shows that these operations were responsible for roughly 11 percent of the emissions contributing to the exceedance of the PM_{10} standard at the West 43rd Ave. monitor. The measures that controlled these sources on May 21, 2008, were implemented as part of the Serious Area and Five Percent Plans. These nine measures are described below; for the Five Percent Plan measures, the implementation status is also addressed.

Serious Area Plan Measures

Measure 38, PM_{10} Best Available Control Technology (BACT) Determinations for Stationary Sources – Maricopa County indicates that this measure involves an industry-by-industry study of the major point sources that could be made to determine the best types of control technologies that are available to yield emission reductions.

Most stationary sources already have BACT controls. In analyzing the sources, incremental benefits may be obtained from revising Rule 316--Nonmetallic Mineral Mining and Processing. Several provisions need to be clarified to improve its effectiveness. Maricopa County's implementation schedule for this measure is shown below:

May to August 1997	Research and draft revision
September to October 1997	Workshop draft revision
November to December 1997	Consideration by Board of Supervisors

Five Percent Plan Measures and Implementation Status

The following measures are included in Chapter Six of the MAG 2007 Five Percent Plan for PM_{10} for the Maricopa County Nonattainment Area. The implementation status of each measure in calendar year 2008 is shown in italics after the measure.

Measure 8, Conduct nighttime and weekend consistent inspections – *Nighttime and weekend inspections conducted in 2008 included complaint inspections and targeted inspections of specific industries that operate at night and on weekends.*

Measure 9, Increase consistent inspection frequency of permitted sources – *In March 2008, Maricopa County adopted Rule 280 revisions in regard to inspection frequency. In 2008, Maricopa County hired 5 inspectors and issued 117 permits for nonmetallic mineral processing facilities. Maricopa County also conducted 443 inspections of nonmetallic mineral processing facilities (Rule 316).*

Measure 11, Notify violators more rapidly to promote immediate compliance – *Maricopa County continued the standard practice of dust compliance inspectors who observe potential violations making reasonable efforts to inform a person on-site or call the permit holder so that measure can be taken to prevent, reduce or mitigate dust generation before a violation occurs.*

Measure 17, Fully implement Rule 316 – *The Rule 316 litigation was settled on June 20, 2007. In 2008, Maricopa County is enforcing the provision of Rule 316 for nonmetallic mineral processing sources of PM_{10}.*

Other Sources

Other sources of PM_{10} emissions along the May 21st back trajectory include industrial sources (other than sand and gravel) and fugitive dust from paved and unpaved roads. There are numerous control measures from the Serious Area and Five Percent Plans that have been implemented to control PM_{10} emissions from these sources. Since Table 5-1 indicates these sources represent roughly 30 percent of the land in the back trajectory and Table 5-2 indicates that these sources did not contribute to the exceedance at the West 43rd Ave. monitor on May 21, 2008, the measures that control these sources are not described here. However, a complete list of measures is provided in Appendix E, Table 1 and detailed descriptions of the committed control measures are included in Chapter Seven of the Serious Area Plan and Chapter Six of the Five Percent Plan.

Inspection Records – Agriculture

Agricultural Dust Inquiries / Complaints in 2008

Air Quality Compliance staff of the Arizona Department of Environmental Quality (ADEQ) reviewed their records of agricultural dust inquires / complaints received in 2008. According to their records, no dust inquires / complaints were received for the high wind PM_{10} exceedance day of May 21, 2008, in Maricopa County.

Agricultural Best Management Practices in 2008

In June 2010, ADEQ Air Quality Compliance staff conducted a telephone survey of farmers in the agricultural area bounded by the West 43rd Ave. PM_{10} monitor on the east and the Buckeye PM_{10} monitor on the west. This agricultural area is the largest agricultural area upwind of the West 43rd Ave. PM_{10} monitor.

Fourteen farmers responded to ADEQ's telephone survey of the Agricultural Best Management Practices (BMPs) that had been implemented on their farms in 2008. According to ADEQ Air Quality Compliance staff, these farmers have the bulk of the field operations in the agricultural area bounded by the West 43rd Ave. PM_{10} monitor on the east and the Buckeye PM_{10} monitor on the west.

Table 5-3 summarizes the results of the telephone survey of the Agricultural BMPs that were in place in 2008 for the agricultural area bounded on the east by the West 43rd Ave. PM_{10} monitor and the Buckeye PM_{10} monitor on the west. This table lists the percentage of farmers that implemented the Agricultural BMPs contained in the "Guide to Agricultural Best Management Practices, Governor's Agricultural Best Management Practices Committee," Second Edition, 2008.[8] The BMPs are ranked from largest percentage implemented to smallest percentage implemented for the three categories of Agricultural BMPs – Tilling and Harvest BMPs, Non-Cropland BMPs, and Cropland BMPs. The percentage of farmers that selected more than two Agricultural BMPs for the three categories ranged from 64 percent to 43 percent.

[8] *http://www.azdeq.gov/environ/air/plan/download/webguide.pdf*

Table 5-3. Survey of Agricultural BMPs Implemented in 2008	
Tilling & Harvest BMPs	
• Limited Activity During a High Wind Event	86%
• Multi-Year Crop	64%
• Combining Tractor Operations	57%
• Reduced Tillage System	36%
• Equipment Modification	29%
• Planting Based on Soil Moisture	21%
• Chemical Irrigation	14%
• Precision Farming	14%
• Timing of a Tillage Operation	14%
• Green Chop	7%
• Integrated Pest Management	7%
• Reduced Harvest Activity	7%
• Tillage Based on Soil Moisture	7%
• Cessation of Night Tillage	0%
• Transgenic Crops	0%
• Farmers Selecting More than 2 Tillage & Harvest BMPs	64%
Non-Cropland BMPs	
• Reduce Vehicle Speed	86%
• Watering	57%
• Access Restriction	43%
• Manure Application	21%
• Aggregate Cover	14%
• Track-Out Control System	14%
• Synthetic Particulate Suppressant	7%
• Artificial Wind Barrier	0%
• Critical Area Planting	0%
• Tree, Shrub, or Windbreak Planting	0%
• Farmers Selecting More than 2 Non-Cropland BMPs	43%
Cropland BMPs	
• Multi-Year Crop	64%
• Cross-Wind Ridges	29%
• Manure Application	29%
• Cover Crop	21%
• Mulching	21%
• Residue Management	21%
• Sequential Cropping	21%
• Surface Roughening	21%

Table 5-3. Survey of Agricultural BMPs Implemented in 2008	
Cropland BMPs - Continued	
• Integrated Pest Management	14%
• Planting Based on Soil Moisture	14%
• Artificial Wind Barrier	0%
• Cross-Wind Strip-Cropping	0%
• Cross Wind Vegetative Strips	0%
• Permanent Cover	0%
• Transgenic Crops	0%
• Tree, Shrub, or Windbreak Planting	0%
• Farmers Selecting More than 2 Cropland BMPs	43%

Agricultural Field Operations on May 21, 2008

A crop calendar of usual field activities by month and crop for Maricopa County was developed from the "Usual Planting and Harvesting Dates for U.S. Crops," Agricultural Handbook Number 628, USDA, ARS, NASS, December 1997 and from consultation with Maricopa County Farm Bureau staff and University of Arizona Cooperative Extension staff for farming practices specific to Maricopa County. [9] This crop calendar is contained in Table 5-4. As shown in the calendar, no active field operations typically occur in Maricopa County during the month of May and thus not on the high wind PM_{10} exceedance day of May 21, 2008.

The crop calendar in Table 5-4 does not list any months for the planting of alfalfa, hay (Bermuda Grass) or orchards because these crops are multi-year crops which maintain an established plant cover for a number of years. According to Maricopa County Farm Bureau staff, the ideal months for planting and establishing a new stand of alfalfa is September through November, and hay (Bermuda Grass) is typically planted in June. Citrus is usually planted either March through April or October through November.[10] ADEQ Air Quality Compliance staff also reviewed their notes for new alfalfa, hay (Bermuda Grass) fields or orchards that may have been established in May 2008. According to their notes, no alfalfa, hay (Bermuda Grass) or orchards were established in May 2008 in the agricultural area bounded on the east by the West 43rd Ave. PM_{10} monitor and the west by the Buckeye PM_{10} monitor.

Crop distribution data in GIS format for 2008 were provided by the Arizona Cotton Research and Protection Council with assistance from the Arizona Cotton Growers Association. The 2008 crop distribution data were overlain on the May 21, 2008, back trajectory developed by Sierra Research (see Figures 5-4 through 5-7). The solid red line on these maps is the May 21, 2008, back trajectory and the dashed red lines are the boundaries of the 1-mile wide buffer area (1 mile on each side of the back trajectory) around the back trajectory.

[9] *http://usda.mannlib.cornell.edu/usda/nass/planting/uph97.pdf*
[10] *http://ag.arizona.edu/hypermail/arid_gardener/4062.html*

Table 5-4. Crop Calendar for Maricopa County, Usual Field Activity by Month and Crop

	Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec
Alfalfa[1]												
Corn - Silage[1]												
Cotton[1]												
Grain[2]												
Hay (Bermuda Grass)[3]												
Orchard												
Sorghum - Grain[3]												
Sorghum - Silage[3]												
Days of Interest			3/14/08	4/30/08	5/21/08	6/4/08						

Field Activities Legend	
• Tilling =	
• Planting =	
• Irrigated =	
• Crop Growing =	
• Harvest =	
• No Activity =	

Notes

1. "Revised PM10 State Implementation Plan for the Salt River Area, Technical Support Document", ADEQ, June 2005. http://www.azdeq.gov/environ/air/plan/download/tsdrevised.pdf. (See crop calendar in Appendix F which is based on 2003 meetings with Maricopa County Farm Bureau and University of Arizona Cooperative Extension.)
2. "Usual Planting and Harvesting Dates for U.S. Crops", Agricultural Handbook Number 628, USDA, ARS, NASS, December 1997. http://usda.mannlib.cornell.edu/usda/nass/planting/uph97.pdf.
3. Communication with Maricopa County Farm Bureau, May 11, 2010 and July 16, 2010. In 2008, a majority of the sorghum was sorghum was grown for grain instead of silage. Common practice is to plant sorghum in July in the same field that field that corn had been harvested from in July, with minimum tillage in the transition between corn and sorghum. Hay (Bermuda Grass) is a multi-year crop.
4. Cotton fields must be plowed down by February 15th and cannot be irrigated until March 15th as required by the Pink Bollworm Program. Most cotton farmers now plant into fields with moisture (May 17, 2010 communication with Maricopa County Farm Bureau and University of Arizona Cooperative Extension).
5. Planting - fields are either irrigated prior to planting or shortly after planting. Wind erosion during planting months is reduced due to irrigation keeping topsoil moist.
6. Harvesting crop as silage (haylage) produces minimal emissions since crop is harvested green.
7. Typically, there are no agricultural fields being disced or ripped in April in Maricopa County (May 17, 2010 communication with Maricopa County Farm Bureau).

Inspection of the May 21, 2008, back trajectory and crop distribution maps (with a comparison of the crops present on these maps with the crop calendar in Table 5-4) indicate that: (1) The majority of the agricultural land along the May 21, 2008, back trajectory had actively growing /established crops that would produce minimum PM_{10} emissions, (2) No active field operations typically occur in Maricopa County during the month of May.

Inspection Records − Other Anthropogenic Sources

The Maricopa County inspection records for May 18-24, 2008, indicate that there were 261 inspections of construction sites (i.e., Rule 310) on May 18-24, 2008, 30 of which resulted in notices of violation. Eight of the Rule 310 inspections were conducted in the area upwind of the West 43rd Ave. monitor; two of these, on May 20 and May 22, resulted in the issuance of a notice of violation.

In addition, Maricopa County conducted two inspections of nonmetallic mineral processing facilities (i.e., Rule 316) on May 18-24, 2008. Only one of these inspections, on May 22, resulted in the issuance of a notice of violation, but this was not in the area upwind of the West 43rd Ave. monitor.

Maricopa County records also indicate that there were 35 vacant lot inspections (i.e., Rule 310.01) on May 18-24, 2008, four of which resulted in notices of violation. None of these Rule 310.01 violations occurred in the area upwind of the West 43rd Ave. monitor.

There were a total of 298 inspections of construction sites, nonmetallic mineral processing facilities, and vacant lots conducted by Maricopa County on May 18-24, 2008; 35 of these (12 percent) resulted in notices of violation. Only two of these (6 percent) occurred in the area upwind of the West 43rd Ave. monitor and these were both violations of Maricopa County Rule 310 (construction).

In summary, the Maricopa County inspection records indicate that there was no unusual anthropogenic dust-generating activity in the area upwind of the West 43rd Ave. monitor during the seven-day period that included May 21, 2008. This provides conclusive evidence that the anthropogenic sources upwind of the West 43rd Ave. monitor were reasonably controlled during the high wind conditions on May 21, 2008.

Summary

According to Table 5-2, the anthropogenic sources contributing to the exceedance of the PM_{10} standard on May 21, 2008, during the high wind hours were open space (0.63%), construction (1.3%), riverbeds (30.0%), sand and gravel operations (10.5%), and vacant areas (57.6%). The previous discussion demonstrates that there were 14 unique and legally binding measures in place to control these sources on May 21, 2008. The large number of measures implemented and the strengthened enforcement of Rules 316 and 310.01 by Maricopa County in March 2008 confirm that the sources upwind of the West 43rd Ave. monitor were reasonably controlled during the high winds on May 21, 2008.

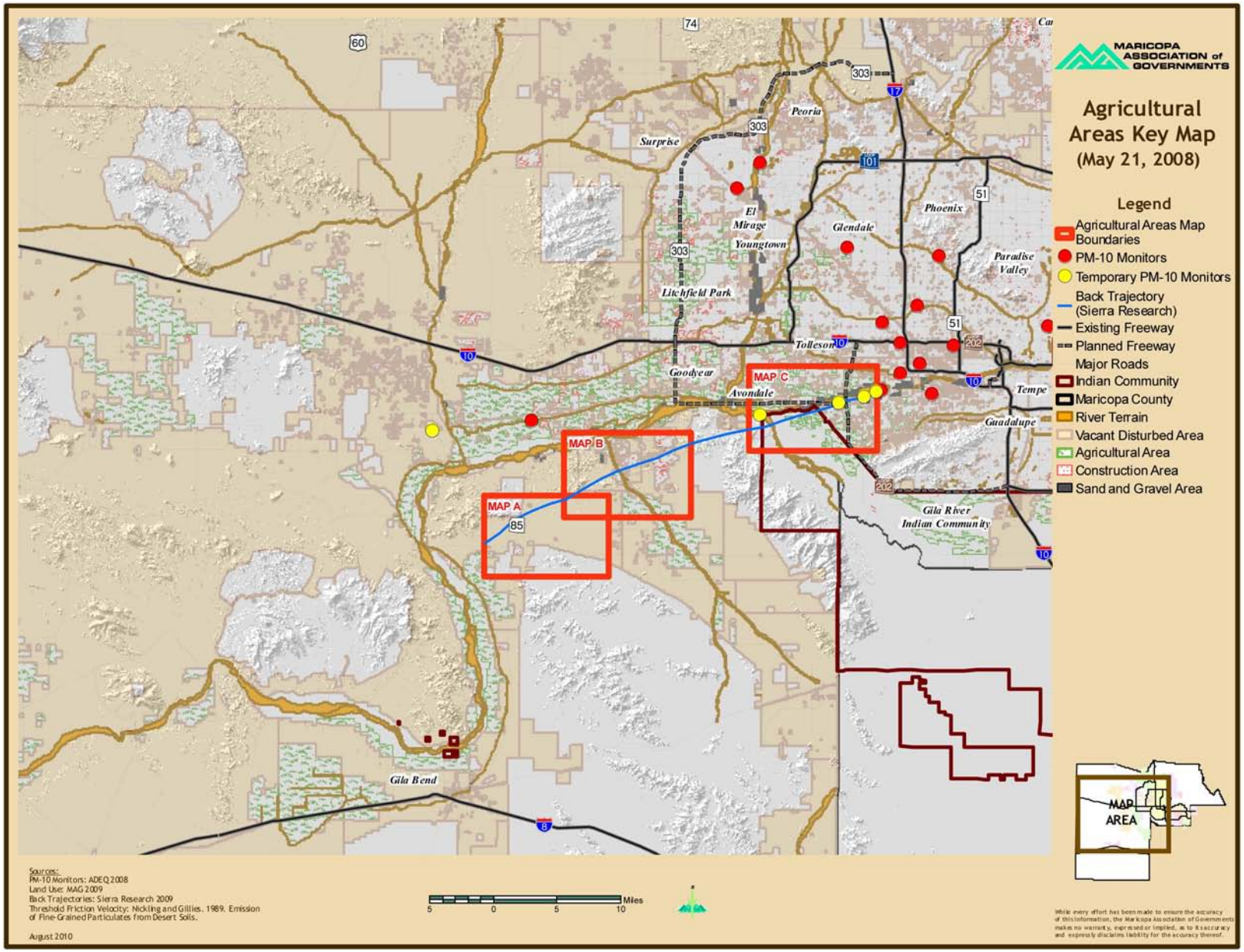


Figure 5-4. Agricultural Areas Key Map for May 21, 2008, Back Trajectory

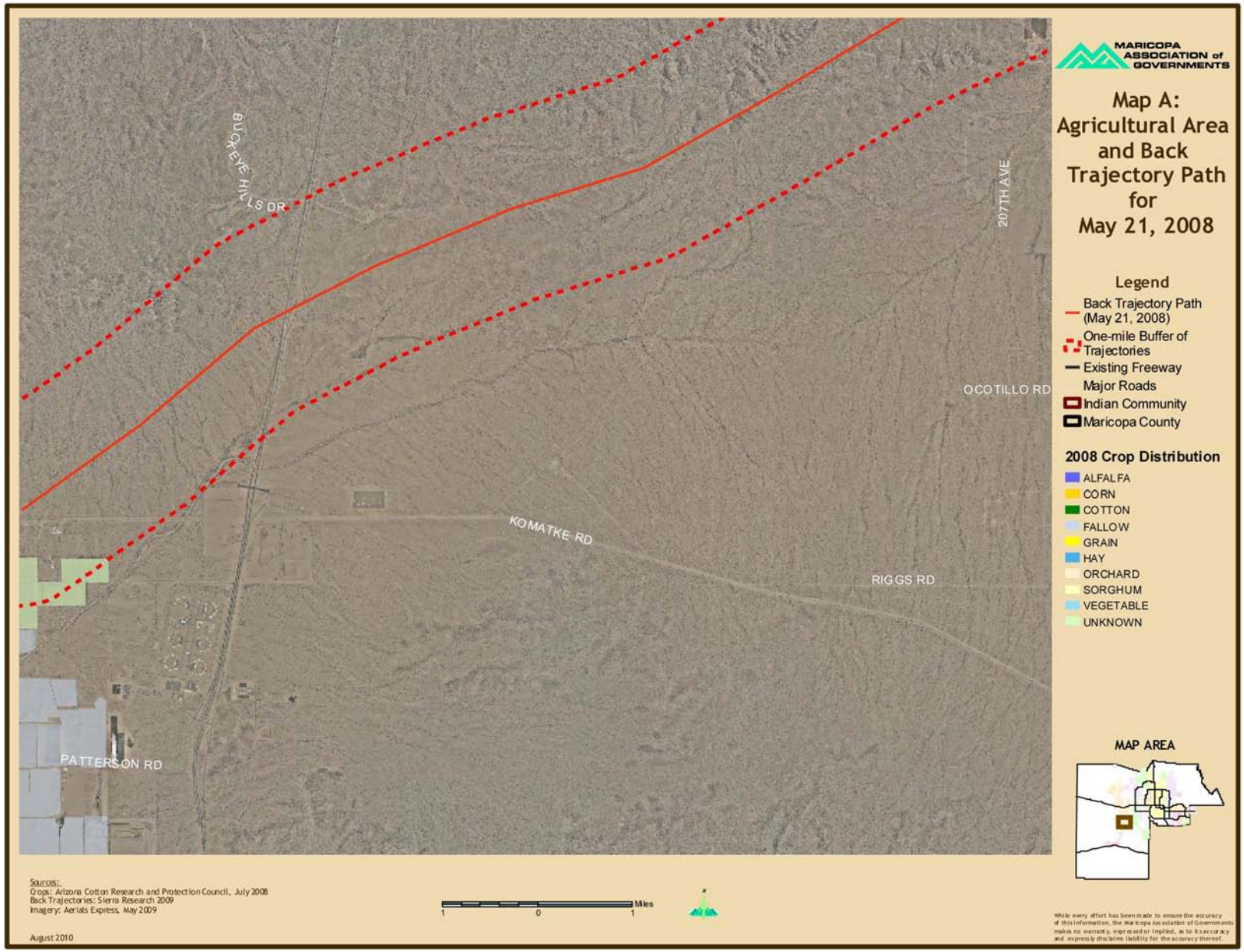


Figure 5-5. Agricultural Area A Map for May 21, 2008, Back Trajectory

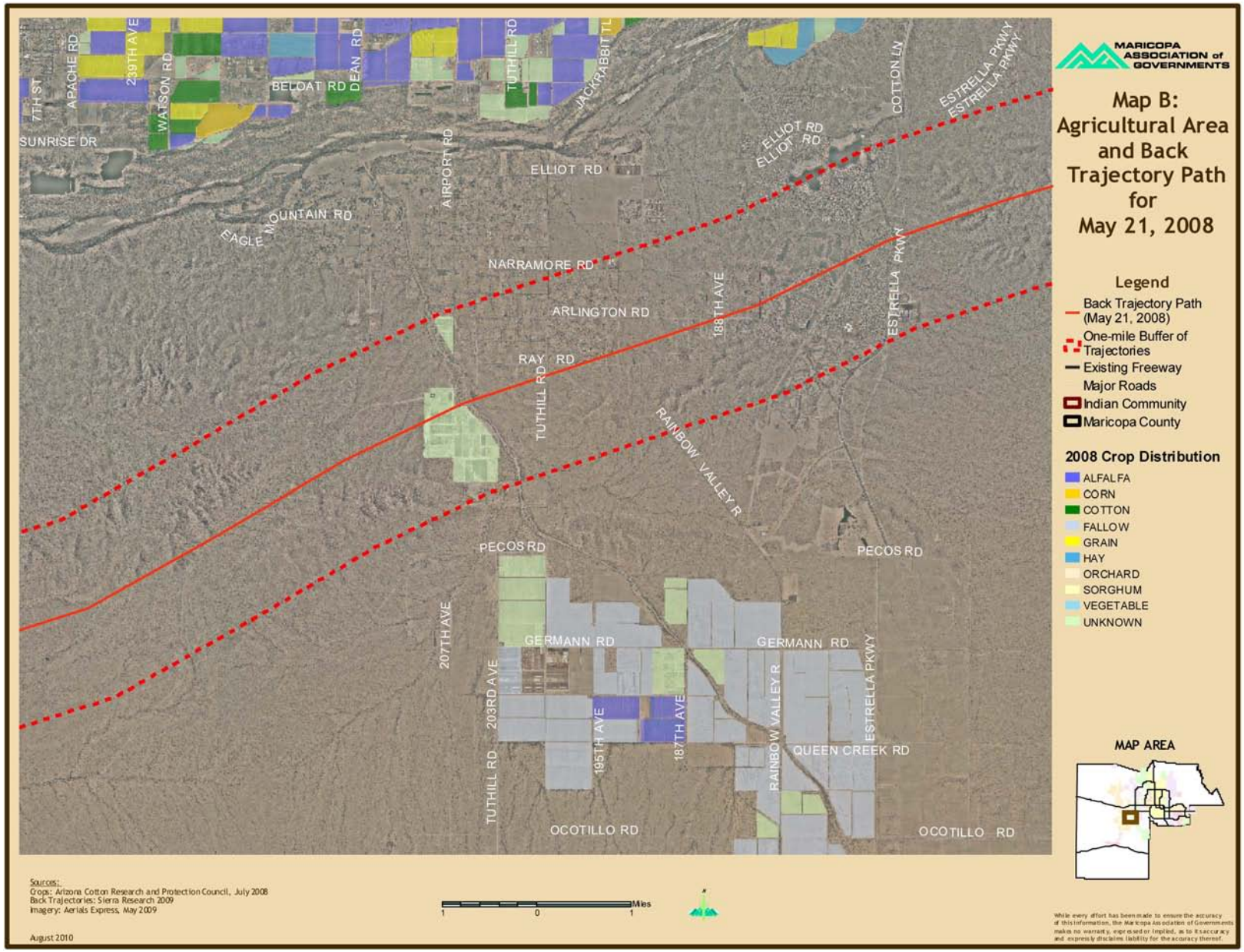


Figure 5-6. Agricultural Area B Map for May 21, 2008, Back Trajectory

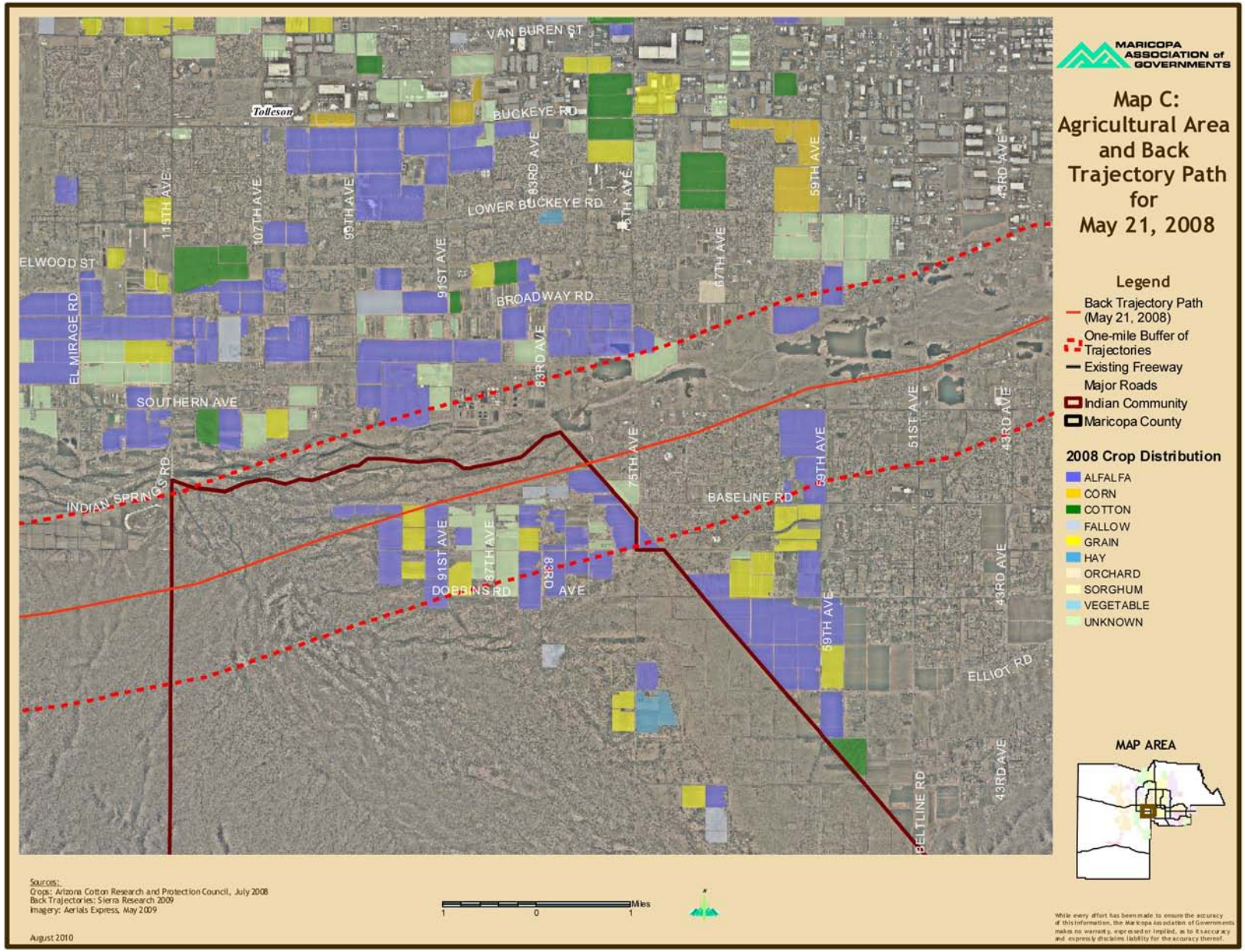


Figure 5-7. Agricultural Area C Map for May 21, 2008, Back Trajectory

5.3 Was a Natural Event

The Federal Register Notice[11] promulgating the final rule for exceptional events included the following guidance for preparing this demonstration

> *The EPA is retaining the term ''high wind'' event because it accurately connotes the type of natural event that should be excluded under this rule, as well as the action which caused the exceedance or violation of the standard. The term also serves as an indicator concerning the level of wind which caused the exceedance or violation of the standard and indicates that it was unusually high for the affected area during the time period that the event occurred. Therefore, States must provide appropriate documentation to substantiate why the level of wind speed associated with the event in question should be considered unusual for the affected area during the time of year that the event occurred. The EPA will evaluate such instances on a case-by-case basis, including factors such as historically typical wind speed levels for the season of the year that the event is claimed.*

The steps required to prepare a demonstration that May 21, 2008, was a "high wind" event include assembly of the historical wind measurements at the West 43rd Ave. monitoring site and analysis of historic distribution of winds during individual hours. Since multiple measurements of winds are available, an analysis of the historic distributions is prepared for both average hourly wind speeds and hourly wind gusts

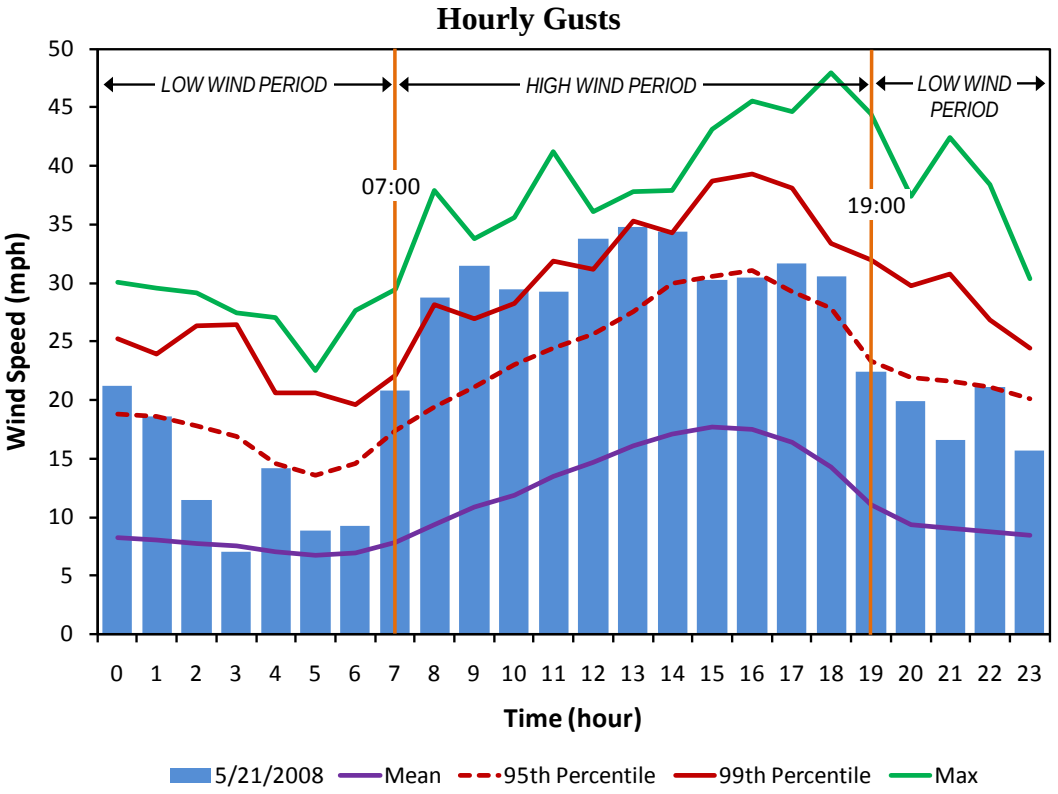
<u>West 43rd Ave. Monitor</u>

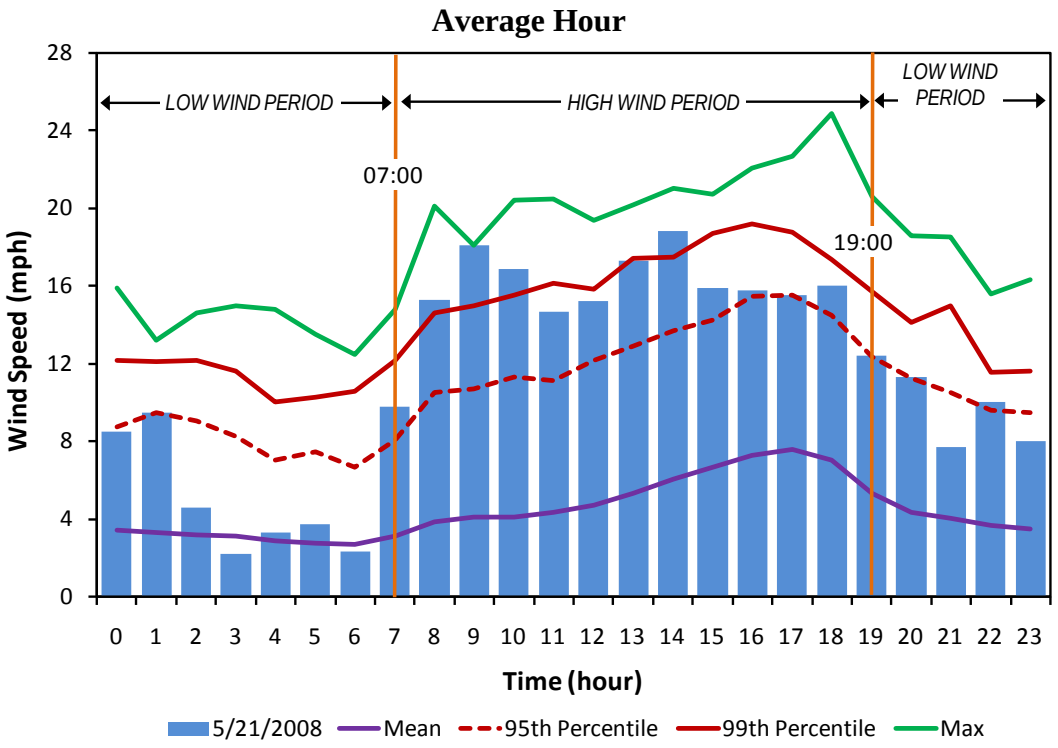
The analysis of hourly wind distributions contrasted event specific values with average values and 95th and 99th percentile values recorded during the spring season for the period 2005 – 2008. A summary of the results for spring months is presented in Figure 5-8. It is clear using either metric (gusts or averages) that many hours had wind speeds in excess of the 95th and even 99th percentile, thus demonstrating that unusual wind speeds occurred on May 21, 2008.

Further evidence of the unusual wind speeds comes from a historical examination of average wind speeds during high wind hours. A description of the process used to select high wind hours is presented in Section 5.2. A threshold of 13 mph was selected as the threshold speed at which winds could initiate the entrainment of PM_{10} impacting monitors in the Salt River Area. Each hour containing one or more 5-minute periods with an average wind speed of 13 mph or higher was designated as a high wind hour. The 13 mph threshold divides the day into two low wind periods from midnight to 7:00 a.m. and 7:00 p.m. to the end of the day and a high wind period from 7:00 a.m. to 7:00 p.m. A summary of the diurnal profile of 5-minute average wind speeds and the different periods of the day is presented in Figure 5-1 of Section 5.2.

[11] Federal Register/ Vol. 72, No. 55, Thursday, March 22, 2007 / Rules and Regulations, Environmental Protection Agency, 40 CFR Parts 50 and 51, Treatment of Data Influenced by Exceptional Events, Final Rule

Figure 5-8. Relationship of Wind Speeds on May 21, 2008, to Historical Values Recorded During the Spring Months at West 43rd Ave. Monitor





A summary of the relative severity of wind speeds during the high wind hours on May 21, 2008, in comparison to the history of hourly average and hourly gusts for the spring season is presented in Figures 5-9 and 5-10. They show that for the period between 2005 – 2009, the wind speeds recorded during the high wind hours were the highest recorded using both measurements. This information clearly demonstrates that wind speed levels on May 21, 2008, recorded at the West 43rd Ave. monitor were unusual from a historical perspective.

Figure 5-9. Distribution of Average Wind Gusts During High Wind Hours (7:00 a.m. – 7:00 p.m.) at West 43rd Monitor, Spring Season Only (2005 – 2009)

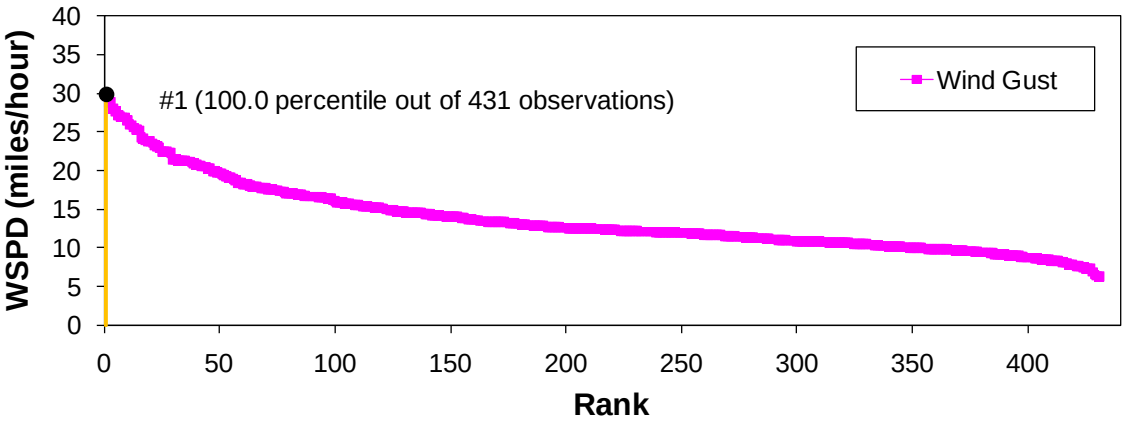
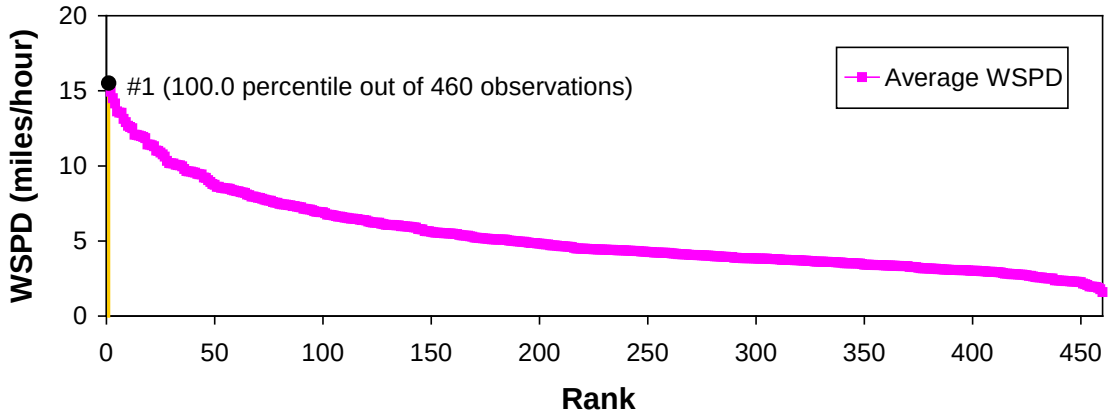


Figure 5-10. Distribution of Average Wind Speed During High Wind Hours (7:00 a.m. – 7:00 p.m.) at West 43rd Monitor, Spring Season Only (2005 – 2009)



5.4 Reasonable Measures

Section 2.2 describes the air pollution control programs in place in the Phoenix and Yuma areas to control anthropogenic sources of PM_{10}. Section 5.2 described the increased enforcement and inspection programs that were implemented in the days surrounding the event. These show that BACM were in place during the event.

ADEQ issues Dust Control Action Forecasts for the Yuma and Phoenix areas and an Air Quality Forecast in Maricopa County were discussed in Section 1.1. All available measures were taken to advise the public that a potential existed for elevated PM_{10} levels from windblown dust. The forecasts/advisories satisfy the requirement in 40 CFR 51.930(a)(1). Copies of these advisories have been included in Appendix I.

Section 6: Event Contribution Analysis

The Federal Register Notice[12] promulgating the final rule for exceptional events included the following guidance for preparing this demonstration

> *The EPA will maintain the proposed ''but-for'' requirement that air quality data may not be excluded except where States, Tribes, or local agencies show that exceedances or violations of applicable standards would not have occurred ''but for'' the influence of exceptional events. Through analyses, it is possible to demonstrate that an exceedance or violation would not have occurred but for the event… This analysis does not require a precise estimate of the estimated air quality impact from the event. The weight of evidence demonstration can present a range of possible concentrations which is not as technically demanding as justifying a specific adjustment to a measured value.*

The steps required to prepare a demonstration that "but-for" the influence of the exceptional events exceedances or violations of the applicable standards would not have occurred, include assembly of historical wind and concentration measurements, selection of high wind hours, substitution of historical values for high wind hours, recalculation of daily average concentrations using actual low wind values and substituted high wind values and assessment relative to the ambient standard and historical performance.

Separate analyses were prepared for West 43rd and Yuma monitors for the 2005 – 2008 period.

6.1 West 43rd Ave. Monitor

The methodology used to select high wind hours on the event day is presented in Section 5.2 and discussed in Appendix H. Using the 13 mph threshold speed at which winds could initiate entrainment of PM_{10} impacting monitors in the Salt River area, May 21, 2008, was divided into two periods: low wind (midnight – 7:00 a.m. and 7:00 p.m.to the end of the day) and high wind (7:00 a.m. through 7:00 p.m.). To address the "but-for" requirement, the concentrations recorded during the low wind hours were kept constant; substitutions of average and 95th percentile concentrations recorded during the period from 2005 – 2008 were prepared. The daily average concentrations were computed with the substituted values to assess the influence of the high wind hours on the event. The results of the analysis are presented in Table 6-1 for the spring season. Table 6-1 shows the use of the spring average hourly concentrations during the high wind hours significantly depressed the 24-hour average concentration relative to the event value. It also shows that use of the 95th percentile average hourly concentration during the high wind hours did not cause the 24-hour concentration to exceed the ambient standard.

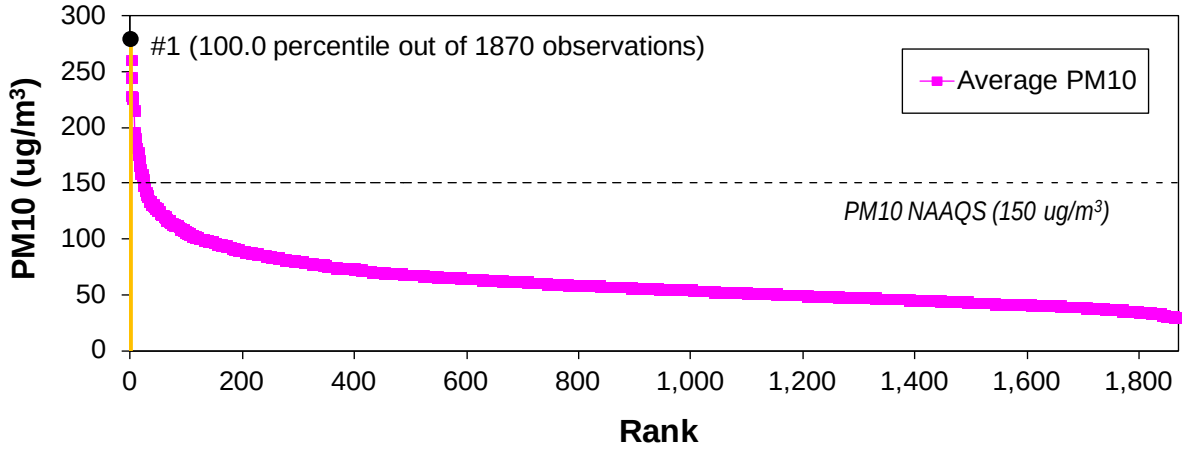
The information presented in Table 6-1 clearly demonstrates that concentrations recorded on May 21, 2008, would not have exceeded the standard "but-for" the concentrations recorded during the high wind hours.

[12] Federal Register/ Vol. 72, No. 55, Thursday, March 22, 2007 / Rules and Regulations, Environmental Protection Agency, 40 CFR Parts 50 and 51, Treatment of Data Influenced by Exceptional Events, Final Rule

Table 6-1. "But For" Analysis of West 43rd Ave. Monitor May 21, 2008, PM_{10} Concentrations – Using Spring Values					
Hour	**Average Wind Speed (mph)**	**Max Wind Speed (mph)**	**Event PM_{10} ($\mu g/m^3$)**	**Mean PM_{10} ($\mu g/m^3$)**	**95th Percentile PM_{10} ($\mu g/m^3$)**
Low Wind Hours *(no substitutions performed for mean & 95th percentile)*					
0	9	21	87	87	87
1	10	19	47	47	47
2	5	12	40	40	40
3	2	7	29	29	29
4	3	14	32	32	32
5	4	9	60	60	60
6	2	9	55	55	55
High Wind Hours *(with mean & 95th percentile substitutions)*					
7	10	21	135	128	284
8	15	29	519	97	208
9	18	32	1208	75	157
10	17	30	601	60	131
11	15	29	413	60	117
12	15	34	535	54	145
13	17	35	837	60	183
14	19	34	735	65	227
15	16	30	255	64	231
16	16	31	225	65	213
17	16	32	243	58	186
18	16	31	263	57	154
19	10	22	105	66	169
Low Wind Hours *(no substitutions performed for mean & 95th percentile)*					
20	12	20	77	77	77
21	11	17	69	69	69
22	8	21	58	58	58
23	10	16	70	70	70
Average Daily Concentration:	N/A	N/A	279	64	126

A further demonstration of the unusual concentrations recorded during the high wind hours was prepared by again holding the concentrations recorded during the low wind hours on the event constant and substituting concentrations recorded during high wind hours from all days with data available in 2003 – 2009. The results are displayed in Figure 6-1 and show that May 21, 2008, ranked 1st out of the 1,870 calculated days for a 100th percentile value. This ranking from measurements collected over a seven-year period clearly demonstrates that unusually high concentrations were recorded during the high wind hours on May 21, 2008.

Figure 6-1. Distribution of Composite 24-Hour Average PM_{10} Concentrations at West 43rd Ave. Monitor Using Actual Low Wind Values from 5/21/2008 with High Wind Hour Values for All Days (2003 – 2009)



6.2 Yuma Courthouse Monitor

The methodology used to select high wind hours on the event day is presented in Section 5.2 and discussed in Appendix H. Using the 17- 21 mph maximum wind threshold speed at which winds could initiate entrainment of PM_{10} impacting the monitor in Yuma, May 21, 2008, was divided into two periods: low wind (midnight – 6:00 a.m.) and high wind (7:00 a.m. through the end of the day). To address the "but for" requirement, the concentrations recorded during the low wind hours were kept constant; substitutions of average and 95th percentile concentrations recorded during the period from 2005 – 2008 were prepared. The daily average concentrations were computed with the substituted values to assess the influence of the high wind hours on the event. The results of the analysis are presented in Table 6-2 for the spring season. Table 6-2 shows the use of the spring average hourly concentrations during the high wind hours significantly depressed the 24-hour average concentration relative to the event value. It also shows that use of the 95th percentile average hourly concentration during the high wind hours did not cause the 24-hour concentration to exceed the ambient standard.

The information presented in Table 6-2 clearly demonstrate that concentrations recorded on May 21, 2008, would not have exceeded the standard "but-for" the concentrations recorded during the high wind hours.

Table 6-2.
"But For" Analysis of Yuma Monitor
May 21, 2008, PM_{10} Concentrations – Using Spring Values

Hour	Average Wind Speed (mph)	Max Wind Speed (mph)	Event PM_{10} ($\mu g/m^3$)	Mean PM_{10} ($\mu g/m^3$)	95th Percentile PM_{10} ($\mu g/m^3$)
Low Wind Hours *(no substitutions performed for mean & 95th percentile)*					
0	9	19	51	51	51
1	4	13	67	67	67
2	5	13	71	71	71
3	7	12	39	39	39
4	4	9	49	49	49
5	6	9	58	58	58
6	5	11	67	67	67
High Wind Hours *(with mean & 95th percentile substitutions)*					
7	13	24	84	57	105
8	15	25	178	52	114
9	15	25	171	45	108
10	16	25	196	43	92
11	16	27	192	44	102
12	14	22	192	40	91
13	13	23	160	41	107
14	14	25	140	43	117
15	15	27	161	48	136
16	20	35	467	53	179
17	20	36	504	57	191
18	17	32	210	63	188
19	20	28	266	75	215
20	14	25	175	71	160
21	16	25	168	64	143
22	21	32	139	56	117
23	20	33	140	49	101
Average Daily Concentration:	N/A	N/A	164	54	111

6.3 Summary

Using local measurements of the threshold velocity at which winds could initiate entrainment of PM_{10} impacting monitors in the Salt River area and Yuma, the event day was divided into periods with low and high wind hours. Alternative estimates of the daily concentrations were made by substituting spring average and 95th percentile concentrations recorded during the high wind hours in 2005 – 2008. The resulting daily average concentrations were well below the ambient 24-hour PM_{10} standard, thus demonstrating that "but-for" the concentrations recorded during the high wind hours the exceedance would not have occurred at the West 43rd Ave. and Yuma monitoring sites. A similar calculation using data available for days in 2003 – 2009 showed the resulting daily average concentration on May 21, 2008, ranked first at (100th percentile) for the West 43rd Ave. monitoring site, providing further evidence of the severity of the concentrations recorded during the high wind hours on that date.

Section 7: Clear Causal Connection

The Federal Register Notice[13] promulgating the final rule for exceptional events included the following guidance for preparing this demonstration

> *Section 319 requires that, in order to have a flagged value excluded from regulatory determinations, a State must make an affirmative demonstration that an event occurred (as shown by reliable and accurate data that are promptly produced) and that there is a clear causal relationship between measured exceedances or violations of a standard and the exceptional event in question to ''demonstrate that the exceptional event caused a specific air pollution concentration''*

The steps required to prepare a demonstration that there is a clear causal relationship between the observed elevated winds and the exceedance at the West 43rd Ave. monitor on May 21, 2008, include assembly of historical wind and concentration measurements and photographic records of the area and analysis of historic distributions of winds and concentrations and photographic records during the course of the event day. Analyses of the historical data were prepared for the spring season using both maximum hourly gusts and hourly average wind speed.

7.1 Historical Analysis

An analysis of hourly concentrations and hourly maximum wind speeds was prepared for spring months in the period 2005 – 2008. Figures 7-1 through 7-4 display the relationships for mean, 5th, 95th and 99th percentile values. The low and high wind periods from May 21, 2008, are highlighted so the relationship between concentrations and wind speeds for the different periods can be examined. Figure 7-1 displays the relationship for mean values. It shows the hours of highest concentrations typically occurred in early morning hours when winds speeds were lowest. It also shows that elevated late morning and afternoon concentrations were not common. Figure 7-2 displays the hourly PM_{10} concentrations when gusts were at their lowest 5th percentile. The highest PM_{10} concentrations occurred during morning hours when wind gusts were lowest. A different picture emerges with the display of concentrations associated with the 95th percentile wind gusts presented in Figure 7-3. It shows that when wind gusts were near their highest levels, the early morning concentrations were the lowest and the later morning and afternoon concentrations were highest. When contrasted with the mean values presented in Figure 7-1, it becomes clear that elevated later morning and afternoon concentrations were not a common occurrence unless high winds were present. A more dramatic illustration of this relationship is presented in Figure 7-4. It displays PM_{10} concentrations when winds gusts were at the 99th percentile and shows the highest concentrations continue to occur in the later morning and afternoon hours when wind gusts were at their highest levels. Since several high wind hours on May 21, 2008, exceeded the 99th percentile wind gust values, as shown in Figure 5-8, the relationship displayed in Figure 7-4 is particularly relevant.

Figures 7-5 through 7-8 present a series of hourly concentration and average wind comparisons; a relationship similar to that observed between wind gusts and PM_{10} concentrations appears. Overall the information presented in these figures demonstrated a clear causal relationship between elevated PM_{10} concentrations and elevated winds.

[13] Federal Register/ Vol. 72, No. 55, Thursday, March 22, 2007 / Rules and Regulations, Environmental Protection Agency, 40 CFR Parts 50 and 51, Treatment of Data Influenced by Exceptional Events, Final Rule

Figure 7-1. Comparison of Hourly Mean PM_{10} Concentrations & Mean Wind Gusts Spring Months at West 43rd Ave. Monitor

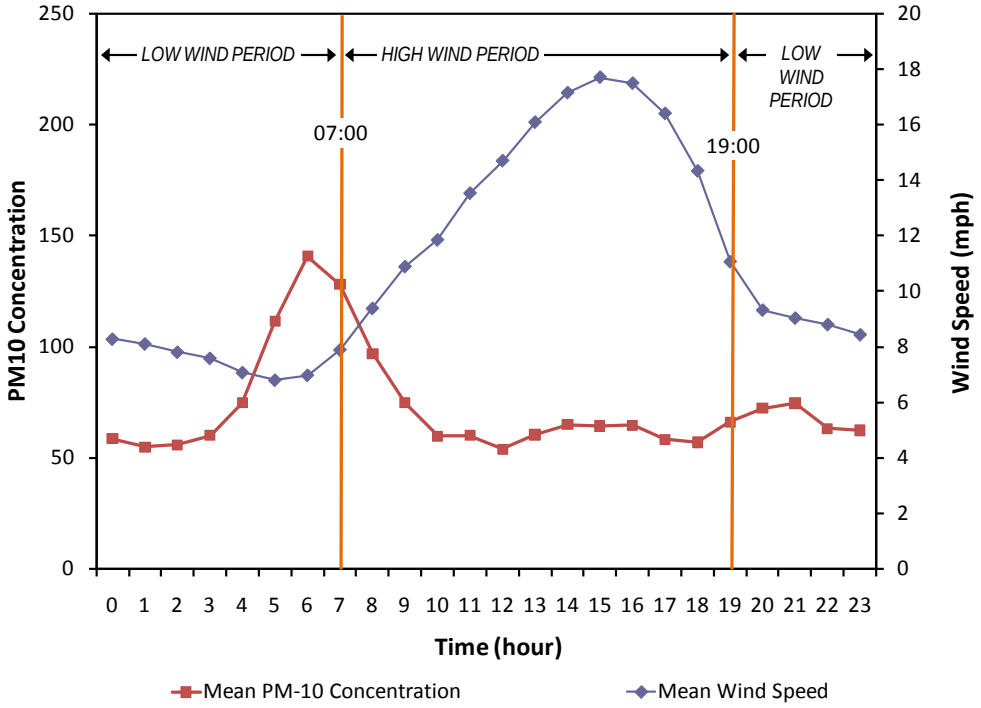


Figure 7-2. Hourly PM_{10} Concentrations at 5th Percentile Wind Gusts Spring Months at West 43rd Ave. Monitor

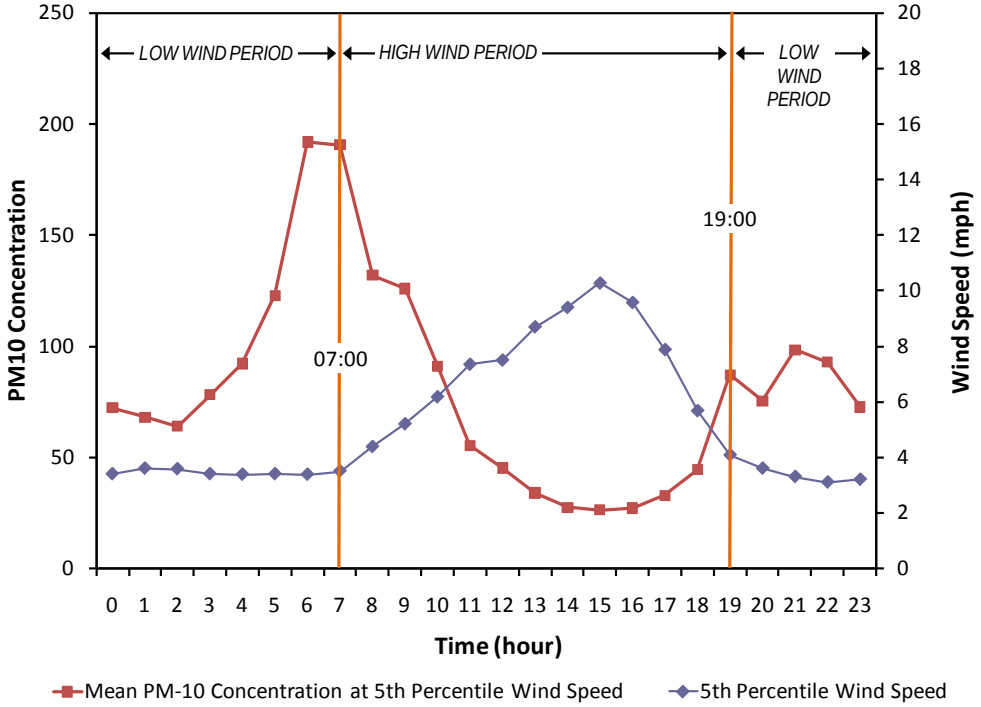


Figure 7-3. Hourly PM_{10} Concentrations at 95th Percentile Wind Gusts Spring Months at West 43rd Ave. Monitor

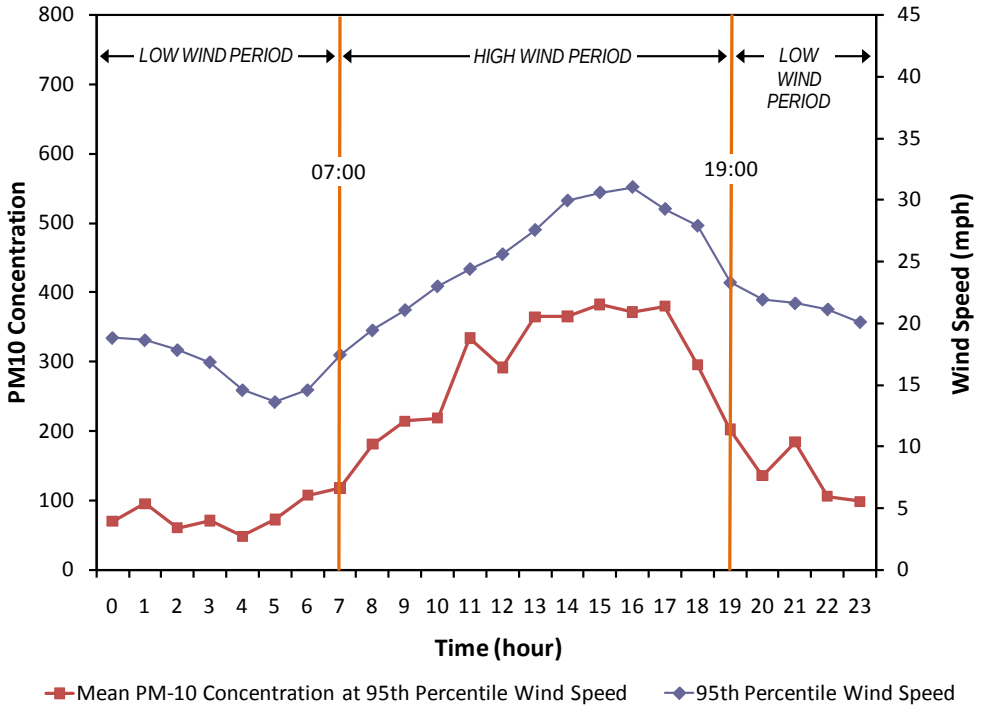


Figure 7-4. Hourly PM_{10} Concentrations at 99th Percentile Wind Gusts Spring Months at West 43rd Ave. Monitor

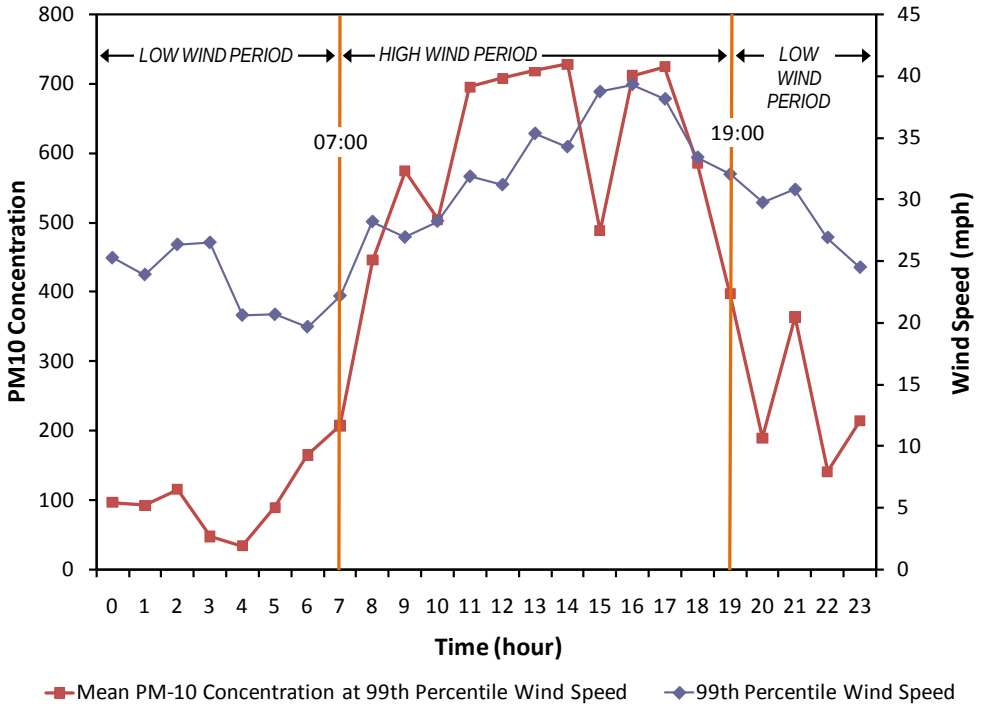


Figure 7-5. Comparison of Hourly Mean PM_{10} Concentrations & Mean Wind Speeds Spring Months at West 43rd Ave. Monitor

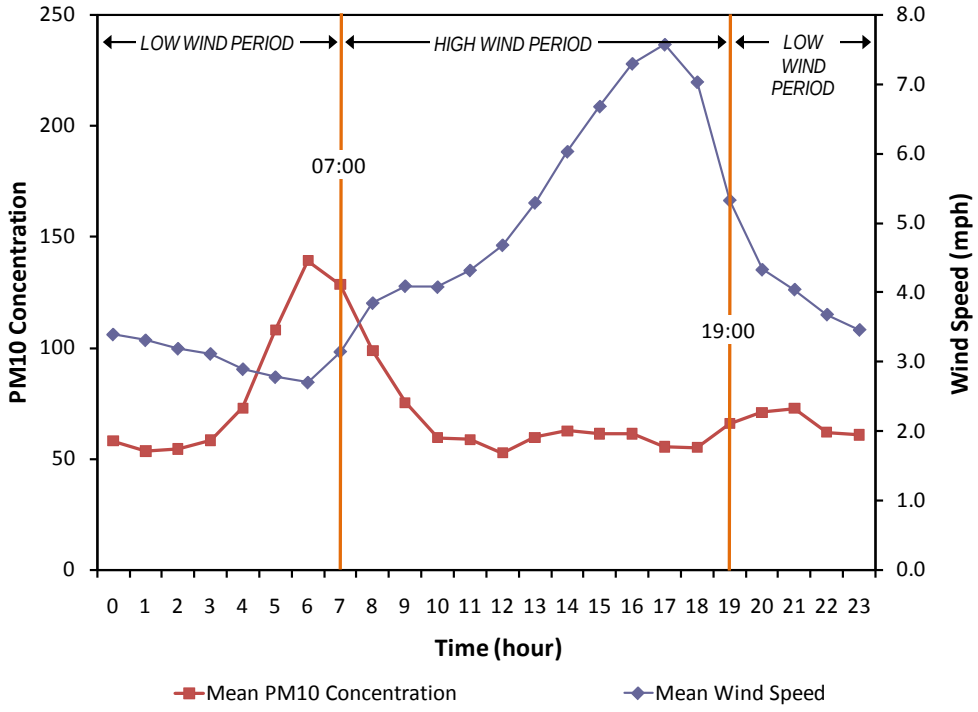


Figure 7-6. Hourly PM_{10} Concentrations at 5th Percentile Mean Wind Speeds Spring Months at West 43rd Ave. Monitor

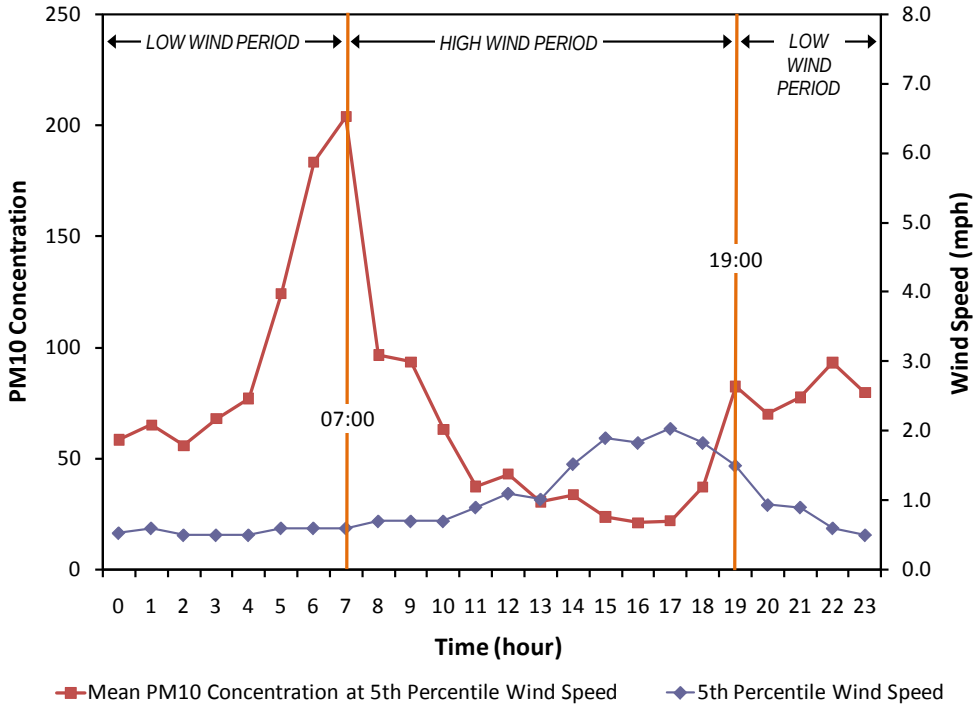


Figure 7-7. Hourly PM_{10} Concentrations at 95th Percentile Mean Wind Speeds Spring Months at West 43rd Ave. Monitor

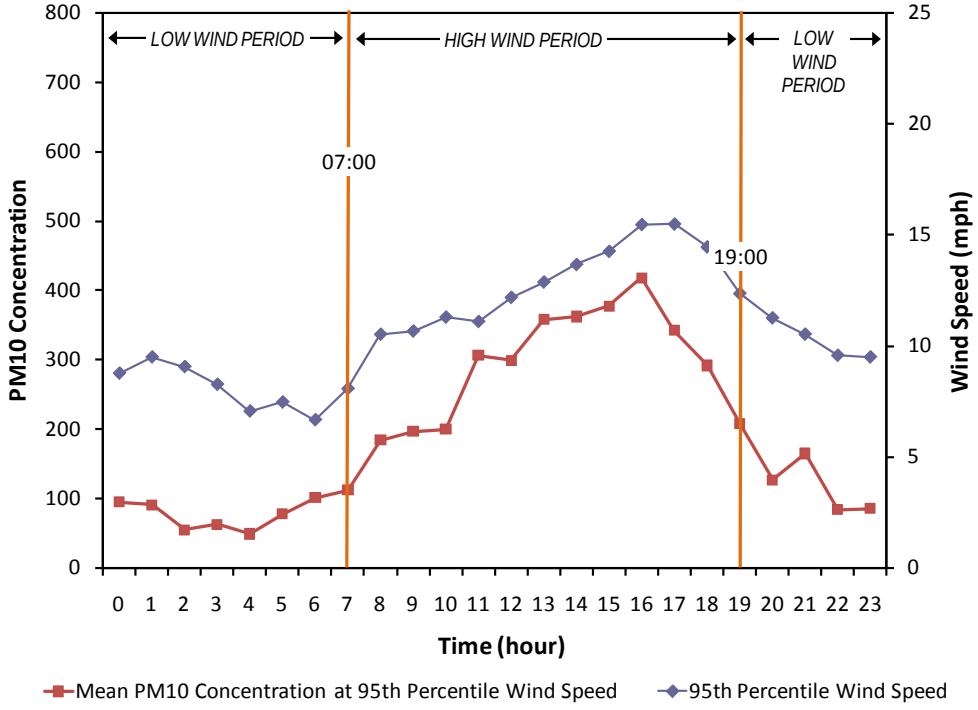
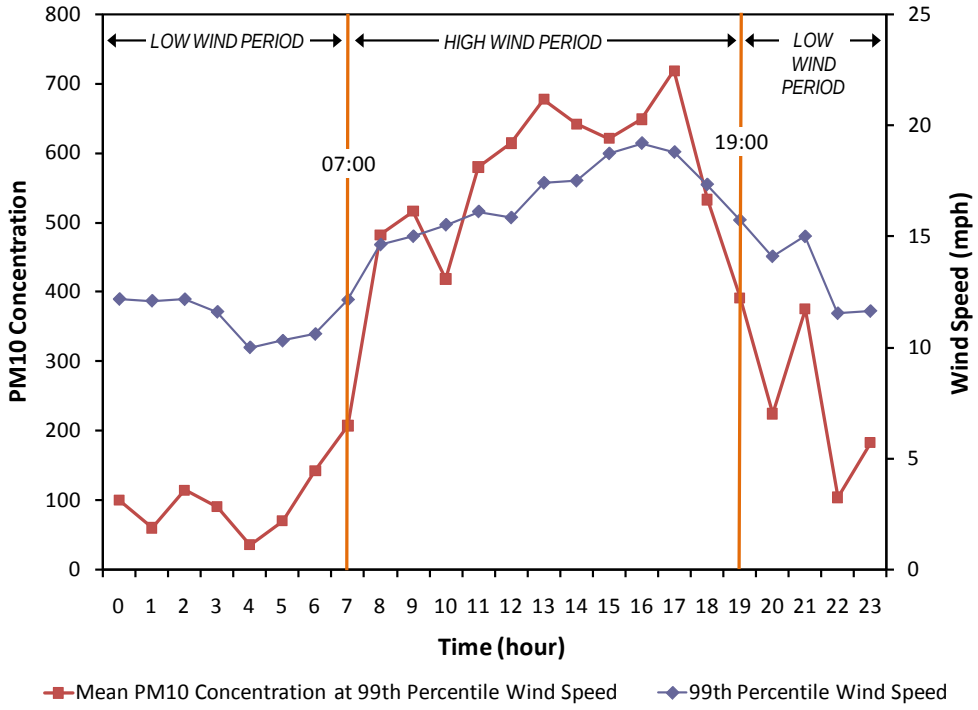


Figure 7-8. Hourly PM_{10} Concentrations at 99th Percentile Mean Wind Speeds Spring Months at West 43rd Ave. Monitor



An examination of the hourly distribution of PM_{10} concentrations recorded on May 21, 2008, relative to the historical values recorded at the West 43rd Ave. monitor is presented in Figure 7-9 for spring months. The hourly values were contrasted with average, 95th and 99th percentile, and maximum values recorded for the period 2005 – 2008. The pattern of exceptionally high concentrations, consistent with those of unusually high winds, is evident. All of the high wind hours exceed the 95th percentile spring concentration; six of those hours exceed the 99th percentile concentration, and one has the maximum value recorded during those months. This information is entirely consistent with the clear causal relationship between elevated concentrations and elevated winds presented in Figures 7-1 – 7-8.

7.2 Visibility

Further evidence of the relationship between elevated winds and elevated concentrations is presented in Figure 7-10. It displays time-lapse photographs from the South Mountain Camera (zoomed view) located on North Mountain looking south. A map of the field of view is included in the figure and shows that it covers the area just east of the West 43rd Ave. monitoring site. Also included in the figure is a view of pristine conditions in the frame of South Mountain and Estrella Mountain. The peak in the far ground, visible in the photograph, is in the Estrella range. The south end of the Estrella range is 26.1 miles from the camera and is not visible on the map. South Mountain is at a range of 17 to 20 miles. The time sequence of photographs starting at 8:00 a.m. shows progressively less visibility as the day progressed, which is entirely consistent with the concentrations displayed in Figure 7-9 and the pattern of elevated afternoon winds displayed in Section 5.3. A more complete presentation of the time-lapse photography is presented in Appendix N.

7.3 Summary

The information presented in this section demonstrated that high afternoon concentrations do not typically occur unless unusually high winds are present. Data presented in Section 5.2 demonstrated that unusually high winds were recorded on the afternoon of May 21, 2008, at the West 43rd Ave. monitoring site relative to the historical record for spring months. Information presented in Figure 7-9 shows that PM_{10} concentrations recorded on the afternoon of May 21, 2008, were unusually high relative to the historical record for spring months. Collectively, this information demonstrated a clear causal relationship between elevated winds and elevated concentrations recorded on the day of the event. Further evidence of this relationship is available from time-lapse photographs of the area adjacent to the monitor documenting diminished visibility as the afternoon progressed and winds and concentrations increase.

Figure 7-9. Relationship of PM_{10} Concentrations on May 21, 2008, to Historical Values Recorded During the Spring Months at West 43rd Ave. Monitor

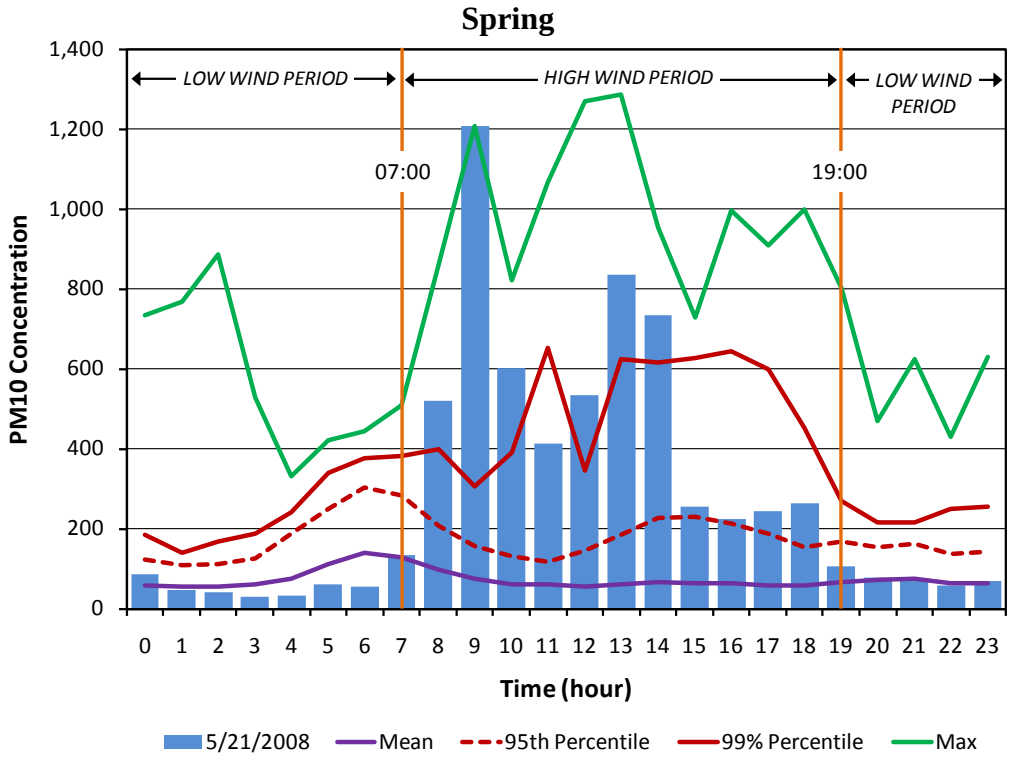
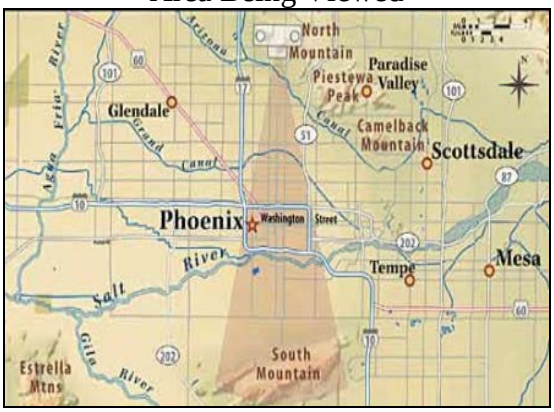


Figure 7-10. Photographs of May 21, 2008, Event Obscuring Visibility of South Mountain as Captured by North Mountain Camera

Pristine Conditions

8:00 a.m.

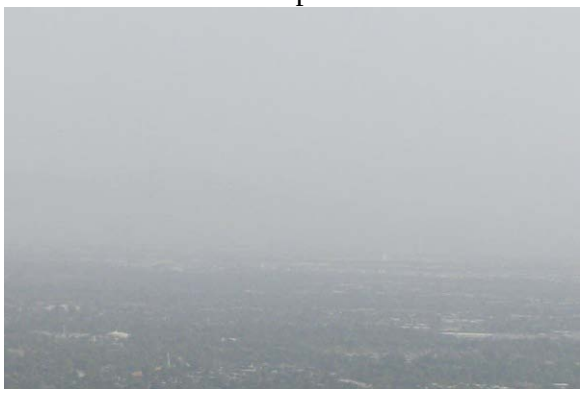
Area Being Viewed



10:00 a.m.

2:00 p.m.

6:00 p.m.



Section 8: Conclusions

High winds on May 21, 2008, caused severe dust storms and sand storms in the California and Arizona desert areas which significantly impact air quality in Yuma, and in the Phoenix area.

The following specific conclusions can be drawn from the analysis in this report:

- The 24-hour concentrations at the West 43rd Ave. and Yuma monitors exceeded "historical fluctuations" during spring months.

- The average concentration during high wind hours at the West 43rd Ave. monitor exceeded "historical fluctuations" during spring months

- All reasonable controls were in place for anthropogenic sources impacting the West 43rd Ave. monitor during high wind hours.

- The winds were "unusual."

- No exceedance of the ambient PM_{10} standard would have occurred "but for" the influence of concentrations recorded during the high wind hours.

- There is a "clear causal relationship" between high winds and increased concentrations at the West 43rd Ave. monitor.

- The exceedance of the NAAQS measured in Yuma was a direct result of dust storms originating in California

The regional high wind event that caused elevated PM_{10} event on May 21, 2008, in Yuma and Maricopa Counties caused the transport of dust and soils from winds that suspended natural soils and soils from areas where all reasonable control measures were in place, or were from source areas outside Arizona, and should be flagged for air quality planning purposes. The "high wind" (RJ) flag should be applied to the monitor readings.

ADEQ has demonstrated that the air quality readings addressed in this report were influenced by an exceptional event, and requests EPA's concurrence with ADEQ's findings in accordance with the Exceptional Events Rule. This report clearly delineated the requirements of the Rule in Section 1 of this report, and the report and Appendices, which supplement the assessment submitted on November 17, 2009, have satisfied those requirements.

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