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Governor

# ARIZONA DEPARTMENT OF ENVIRONMENTAL QUALITY

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## Assessment of Qualification for Treatment under the Arizona Natural and Exceptional Events Policy for the High Particulate (PM<sub>10</sub>) Concentration Events in the Phoenix Area on October 22, 2008

### Background

The Arizona Department of Environmental Quality (ADEQ) issues Dust Control Action Forecasts as part of the Natural Events Action Plan for the Phoenix area. On Tuesday, October 21, 2008, a tightening pressure gradient associated with a deep ridge to the east of Arizona and a strong trough of low pressure to the west of the state was in place when ADEQ air quality forecasters issued the Maricopa County Dust Control Action Forecast. While the forecast called for only a low risk of wind-blown dust in Maricopa County on Wednesday, October 22<sup>nd</sup>, it did mention the possibility of gusty north-northeasterly winds up to 25 mph in the Valley with sustained winds ranging from 10 to 20 mph. The forecasts/advisories satisfy the requirement in 40 CFR 51.930(a)(1).

The forecast for October 22<sup>nd</sup> called for gusty winds, and while the risk of exceeding the PM<sub>10</sub> National Ambient Air Quality Standards (NAAQS) in Maricopa County was forecast to be low, these winds had the potential to be strong enough to exceed threshold friction velocities for local soils, causing a wind-blown dust event. Strong winds did occur and were observed throughout portions of Maricopa County and the Phoenix Metro area on October 22<sup>nd</sup>, 2008. Beginning in the mid-morning and continuing through the early afternoon hours, strong north and northeasterly winds were observed over much of the Phoenix Metro area generating blowing dust which caused spikes at multiple West Valley monitors during the

morning hours. 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 and Yuma counties can be found in “High Wind Exceptional Events and Control Measures for PM<sub>10</sub> Areas” (see “References”).

The initialization of a wind-blown dust event can be seen in the Phoenix visible camera images, as well as the data from the Arizona Meteorological Network (AzMET), Maricopa County (MC), ADEQ, and National Weather Service (NWS) monitors (see Fig. 1). Significant winds gusting over 15 and 20 mph were reported between the 9:00 a.m. and 1:00 p.m. hours at the NWS Deer Valley and Glendale monitoring locations, while max wind speeds as high as 35 mph was recorded at the Coyote Lakes monitoring location. Due to the spatial variability of PM sources both within and outside of the Phoenix urban core, the PM<sub>10</sub> NAAQS was only exceeded at the Coyote Lakes monitor operated by Maricopa County (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 key PM<sub>10</sub> monitor readings for the monitors examined in this report:

Monitor (Operator/Type)	AQS ID	24-hr Avg PM <sub>10</sub>	1-hr Max PM <sub>10</sub>	Max Time	Flag**
<b>PHOENIX METRO AREA</b>					
<b>Coyote Lakes (MC/TEOM)</b>	<b>04-013-4014*</b>	<b>167.6</b>	<b>695</b>	<b>0900</b>	<b>RJ</b>
<b>West 43<sup>rd</sup> Ave (MC/TEOM)</b>	<b>04-013-4009*</b>	<b>91.1</b>	<b>378</b>	<b>0600</b>	<b>No</b>
<b>Durango Complex (MC/TEOM)</b>	<b>04-013-9812*</b>	<b>81.4</b>	<b>389</b>	<b>0700</b>	<b>No</b>
<b>Greenwood (MC/TEOM)</b>	<b>04-013-3010*</b>	<b>56.1</b>	<b>175</b>	<b>0600</b>	<b>No</b>
<b>Higley (MC/TEOM)</b>	<b>04-013-4006*</b>	<b>58.8</b>	<b>197</b>	<b>0800</b>	<b>No</b>
<b>West Phoenix (MC/TEOM)</b>	<b>04-013-0019*</b>	<b>45.5</b>	<b>145</b>	<b>0700</b>	<b>No</b>

\* EPA Air Quality System Identification Number

\*\* 24-hr PM<sub>10</sub> concentration influenced by natural or exceptional event to be flagged

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

The preliminary findings from this analysis were presented at a stakeholder’s meeting on March 19, 2009, in Phoenix, Arizona. Following the stakeholders meetings, ADEQ supplemented and finalized the analysis and a public

comment period was held from October 15, 2009 through November 13, 2009. This finalized document and any comments received are being submitted to EPA to satisfy the requirements in 40 CFR 50.14(c)(3)(i).

### NWS-Phoenix Sky Harbor

Hr	T(F)	VR	Dust	Spd	Gust	Dir
1	70	10	0	0	0	N
2	69	10	0	0	0	N
3	69	10	0	0	0	N
4	66	10	0	0	0	N
5	66	10	0	0	0	N
6	64	10	0	0	0	N
7	66	10	3	3	3	E
8	69	10	6	6	6	E
9	77	10	7	7	7	E
10	81	10	14	14	14	NE
11	82	10	13	23	23	NE
12	84	10	16	20	20	E
1	85	10	13	13	13	E
2	86	10	6	6	6	SE
3	87	10	3	3	3	VR
4	87	10	10	10	10	NE
5	86	10	14	14	14	E
6	82	10	11	11	11	E
7	78	10	6	6	6	E
8	79	10	13	13	13	NE
9	77	10	11	11	11	N
10	73	10	3	3	3	N
11	69	10	0	0	0	N
12	66	10	8	8	8	E

### NWS-Deer Valley Airport

Hr	T(F)	VR	Dust	Spd	Gust	Dir
1	70	10	0	0	0	N
2	69	10	0	0	0	N
3	65	10	0	0	0	N
4	72	10	0	0	0	NE
5	71	10	0	0	0	NE
6	69	10	0	0	0	N
7	69	10	7	7	7	NE
8	74	10	7	7	7	NE
9	77	10	15	23	23	NE
10	79	10	14	21	21	NE
11	81	10	11	11	11	NE
12	84	10	8	8	8	NE
1	84	10	10	10	10	NE
2	85	10	8	8	8	E
3	86	10	7	7	7	E
4	85	10	7	7	7	SE
5	85	10	9	9	9	NE
6	80	10	10	10	10	N
7	78	10	13	20	20	NE
8	74	10	10	10	10	N
9	72	10	9	9	9	N
10	72	10	17	24	24	N
11	70	10	8	8	8	N
12	66	10	5	5	5	N

### MC - COYOTE LAKES

Hr	T(F)	PM	Spd	Max	Dir
1	68	48	1	6	N
2	66	31	1	5	N
3	64	32	2	5	NE
4	68	55	3	17	NE
5	75	104	9	18	NE
6	75	81	9	20	NE
7	74	121	11	25	NE
8	75	355	13	31	NE
9	77	521	14	35	NE
10	79	694	16	35	NE
11	81	493	15	34	NE
12	82	343	14	29	NE
1	84	237	13	26	NE
2	86	136	11	23	NE
3	88	75	10	21	NE
4	88	65	11	23	NE
5	87	124	12	26	NE
6	83	38	9	23	NE
7	79	44	9	17	NE
8	76	33	7	15	NE
9	75	53	8	18	NE
10	73	146	12	25	NE
11	72	143	11	25	NE
12	71	43	12	24	NE

### Event Contrib. Analysis

Hourly PM<sub>10</sub> Conc. (µg/m<sup>3</sup>)

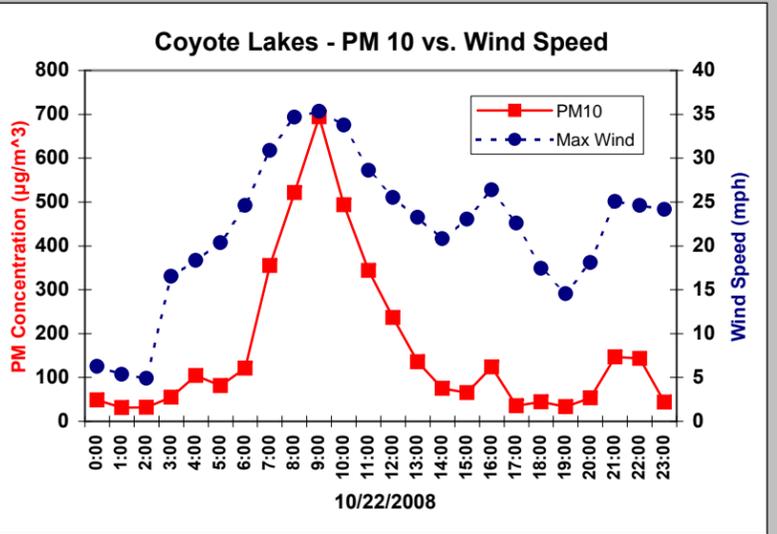
MONITORS:	Hr	1
1-Coyote Lakes	1	48.6
	2	31.5
	3	32.2
	4	55
	5	105
	6	81.4
	7	121
	8	355
	9	522
	10	695
	11	494
	12	344
24-Hr. Avg PM <sub>10</sub>		105
with W/O		81.4
Monitor: Event		
1-Coyote	167	76
> NAAQS		
< NAAQS		
Pink=Event Contrib.		
Conclusion: As shown above, the PM <sub>10</sub> concentration would have been below the NAAQS "BUT FOR" the event contribution (hours highlighted in pink).		



### Figure 1. Key Data for Event of October 22, 2008

WIND & PM10 DATA	ECA HIST DIST	KEY Wx IMAGERY	PM10 & WIND PLOT
			PHX VIS. CAMERAS

**SUMMARY OF EVENT**  
At 9:00 a.m., winds in the Valley were from the north, northeast with gusts between 15 and 23 mph. By noon, winds were from the north and east with gusts between 20 and 35 in some parts of the Valley while Goodyear had a visibility of 7 statute miles during this period.



### MC - WEST FORTY THIR

Hr	T(F)	PM	Spd	Max	Dir
1	68	82	2	6	SE
2	66	56	1	3	E
3	64	62	1	7	E
4	63	81	1	6	SE
5	62	156	3	6	E
6	62	366	1	5	NE
7	61	377	2	4	W
8	63	291	0	4	S
9	70	128	1	4	SE
10	77	95	1	7	W
11	82	69	5	16	NE
12	84	43	10	20	NE
1	85	39	9	19	NE
2	86	36	7	17	NE
3	86	34	5	16	E
4	87	28	5	14	NE
5	87	25	7	14	NE
6	84	36	9	13	E
7	80	44	4	10	E
8	76	45	6	15	N
9	75	29	10	18	N
10	73	32	9	18	N
11	69	29	3	11	NE
12	65	34	2	5	E

### MC - DURANGO COMPLEX

Hr	T(F)	RH	PM	Spd	Max	Dir
1	72	26	53	1	6	SE
2	70	28	53	1	5	NE
3	67	37	67	1	6	E
4	67	36	87	2	5	SE
5	65	40	101	1	4	SE
6	65	39	113	2	6	NE
7	64	40	167	1	4	N
8	65	45	388	1	4	SE
9	70	32	237	1	4	SW
10	76	20	109	1	6	W
11	82	11	72	4	15	NE
12	84	8	78	6	17	NE
1	85	7	62	6	23	NE
2	86	7	33	6	17	E
3	86	6	31	4	14	E
4	87	6	28	3	12	NE
5	87	6	28	5	14	NE
6	85	6	38	5	13	E
7	82	7	33	4	11	E
8	79	7	40	4	11	N
9	77	6	36	5	14	N
10	74	7	34	3	15	N
11	72	7	27	2	8	N
12	69	9	44	1	7	NE

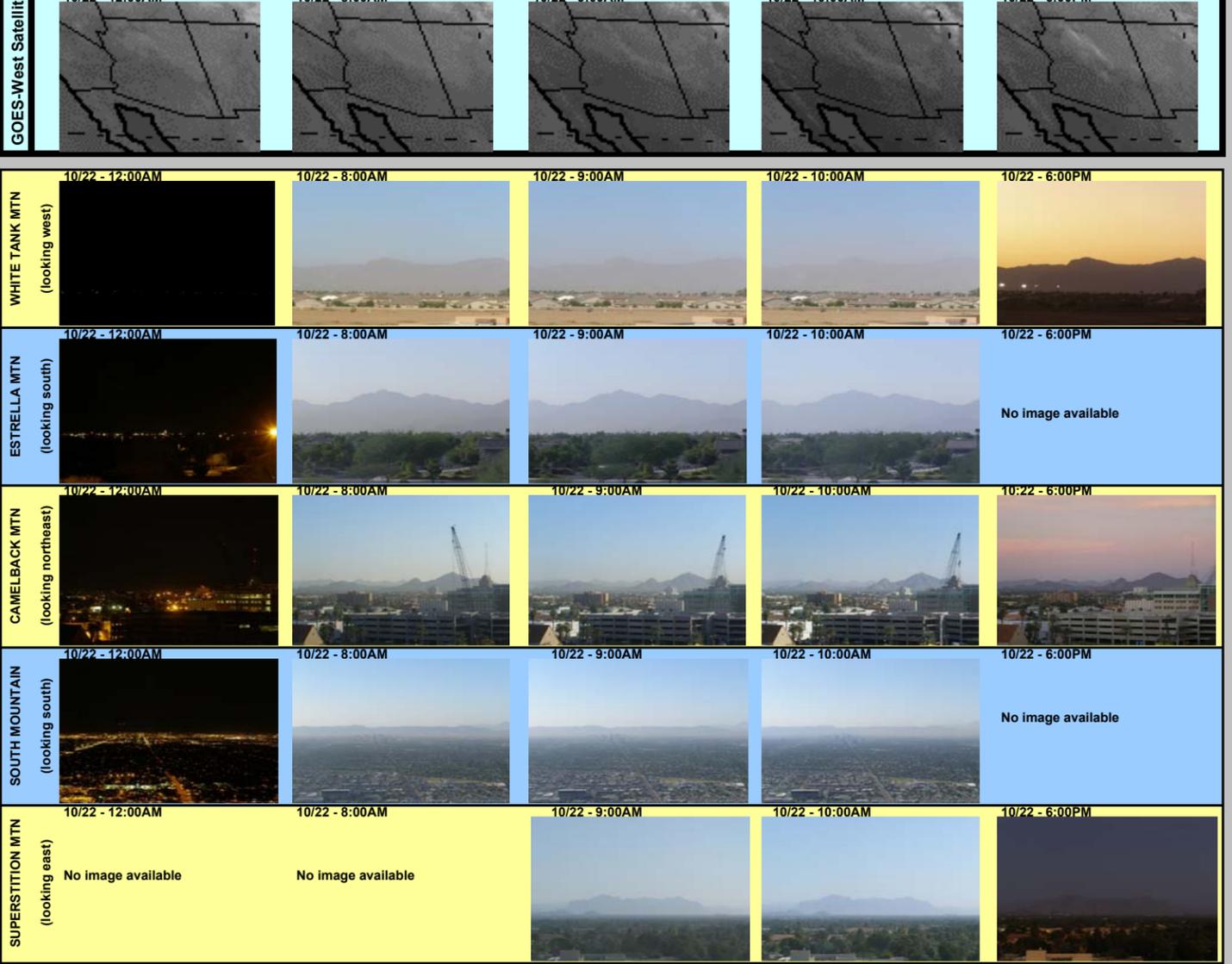
### MC - BUCKEYE

Hr	T(F)	RH	PM	Spd	Max	Dir
1	65	48	32	3	8	SW
2	62	55	21	4	9	N
3	62	54	23	2	7	NE
4	61	56	27	3	8	NE
5	59	60	37	1	6	NW
6	58	59	37	1	5	N
7	58	57	45	2	8	SE
8	62	50	118	5	18	E
9	75	22	366	13	32	NE
10	80	15	358	16	34	NE
11	82	14	246	15	32	NE
12	84	13	138	13	28	NE
1	86	12	88	12	26	NE
2	86	12	48	10	21	NE
3	88	11	42	9	22	NE
4	88	11	44	7	16	NE
5	87	11	42	7	16	NE
6	83	10	30	8	18	NE
7	81	10	30	10	23	NE
8	80	10	28	11	22	NE
9	79	9	39	12	26	NE
10	77	10	52	13	26	NE
11	74	11	26	8	23	NE
12	69	15	26	5	17	NE

### Historical Distribution

5-Yr. Dist. of Values (µg/m<sup>3</sup>)

MONITORS:	Column Index
1-COYOTE LAKES	Yr - All Data (5-Yrs)
	Sea - Data for Autumn season only (5-Yrs)
Cum. Freq.	Mon 1
Min	7 16
0.5%	7 17
1.0%	9 18
2.5%	10 21
5%	14 23
10%	19 25
25%	30 35
50%	44 49
75%	58 66
90%	77 80
95%	91 91
97.5%	109 102
99.0%	122 131
99.5%	219 222
Max	313 313
Flagged Value	167
Conclusion: Flagged Value is exceptional in nature (ie greater than 95% of all data)	



### MC - GLENDALE

Hr	T(F)	RH	Spd	Max	Dir
1	69	30	4	8	N
2	68	31	2	7	E
3	65	36	3	4	NE
4	64	36	3	6	E
5	63	39	1	7	E
6	62	41	1	9	NE
7	64	31	4	9	NE
8	69	17	6	12	NE
9	74	13	5	13	NE
10	78	11	6	14	NE
11	81	9	8	20	NE
12	83	8	6	19	NE
1	84	8	6	15	NE
2	85	7	6	17	NE
3	86	7	4	14	NE
4	86	6	3	14	NE
5	86	7	4	11	NE
6	83	6	7	17	NE
7	79	7	6	13	N
8	77	7	8	17	N
9	74	7	5	12	N
10	71	8	3	7	NE
11	69	8	5	11	NE
12	68	8	6	12	NE

### MC - FOUNTAIN HILLS

Hr	T(F)	RH	Spd	Max	Dir
1	68	31	5	9	NW
2	70	27	6	11	NW
3	69	28	5	9	NW
4	69	26	5	9	NW
5	70	20	7	15	NW
6	69	19	5	14	N
7	71	16	7	14	N
8	72	15	6	18	N
9	76	13	8	21	N
10	78	11	10	30	NE
11	80	10	11	29	NE
12	82	9	10	26	NE
1	84	9	6	23	NE
2	85	8	8	20	NE
3	86	8	8	20	NE
4	85	8	9	21	NE
5	84	8	9	19	NE
6	80	8	5	15	NE
7	77	9	4	10	N
8	74	8	5	14	N
9	71	9	6	15	N
10	70	9	7	15	N
11	68	10	7	14	N
12	66	10	7	16	N

### MC - CAVE CREEK

Hr	T(F)	RH	Spd	Max	Dir
1	76	22	6	18	NE
2	72	23	2	15	NE
3	67	26	2	11	NE
4	77	18	10	22	N
5	77	15	7	23	N
6	74	16	6	23	N
7	74	16	11	25	NE
8	74	16	6	18	NE
9	74	16	8	25	

## Assessment under the Technical Criteria Document (TCD)

1. Properly qualify and validate the air quality measurement to be flagged. As this was not a filter sampling date (1-in-6 run day), only data from the continuous analyzers were examined. The air quality monitoring data were reviewed by the agency responsible for operation of the monitor. All hourly PM<sub>10</sub> readings from the Coyote Lakes monitor were valid for October 22<sup>nd</sup>. Audits of the analyzers revealed operations were within acceptable tolerance.

2. Review suspected contributing sources. The NWS, MC, ADEQ, and AzMET surface data for Arizona, along with the visible camera images in Phoenix, provide a good explanation as to what meteorological conditions were in place on October 22<sup>nd</sup>. Strong north and northeasterly winds were occurring in the Phoenix area due to a tightening pressure gradient associated with a low pressure system to the east and a high pressure ridge building in the west. The plot of hourly PM<sub>10</sub> concentration data in the upper right corner of Figure 1 confirms the similar timing of the elevated PM<sub>10</sub> concentrations and high winds recorded at the Coyote Lakes monitor. PM<sub>10</sub> concentrations also spiked at several other monitors during the morning hours; however, the 24-hour averages at these monitoring sites remained below that of the NAAQS. While this high wind event affected the entire Phoenix Metro area, PM sources are spatially diverse, and therefore, the locations of higher PM<sub>10</sub> concentrations (West Valley) are likely an indication that these locations (or areas upwind of these locations) contain greater sources of PM than the urbanized core of the Phoenix Metropolitan area. In particular, recent elevated PM<sub>10</sub> events at Coyote Lakes indicate that this monitoring location is susceptible to high PM<sub>10</sub> concentrations under strong northerly and northeasterly flow regimes.

3. Examine all air quality monitoring information. Data from all monitors in the network were reviewed. Monitors from the affected areas are summarized in the table in the Background section of this assessment. Pursuant to 40 CFR 50.14(c)(3)(iii)(C), the “Historical Distribution” Table in Figure 1 has been included to demonstrate that the event is associated with a measured concentration in excess of normal historical fluctuations, including background (i.e., concentrations greater than the 95<sup>th</sup> percentile). Additionally, the winds associated with the elevated PM<sub>10</sub> concentrations may be characterized as unusual as described in “Impact of Exceptional Events’ ‘Unusual Winds’ on PM<sub>10</sub> Concentrations” (see “References”).

4. Examine the meteorological conditions before and during the event. The meteorological data are summarized in Figure 1. The wind data are highlighted yellow if the max wind speed in the hour exceeds 15 mph and orange if it exceeds 25 mph. As can be seen in Figure 1, wind speeds did not pick up in central Arizona until approximately 8:00 or 9:00 a.m., when several NWS and MC stations first began to report significant winds. Multiple weather stations in and around Maricopa County continued to report strong, gusty winds through the early afternoon hours. This timing corresponds to the onset and continuation of elevated PM<sub>10</sub> concentrations recorded at the Coyote Lakes monitoring site. Concentrations there remained elevated through the morning and afternoon hours until a time when winds decreased to below 15 mph.

5. Perform a qualitative attribution to emission source(s). All evidence indicates the elevated PM<sub>10</sub> concentrations in the Phoenix area can be attributed to soil emissions that were transported over portions of the Phoenix Metro area in Maricopa County. No source specific emission allocation is possible based on the data available for analysis. The hourly concentration data do not show any significant source other than the wind-blown dust event occurring on October 22, 2008. Visual evidence of reduced visibility can be seen in the images located in the lower right portion of Figure 1. These images, along with the graph of Phoenix area wind gusts and Coyote Lakes PM<sub>10</sub> concentrations, provide evidence that the elevated PM<sub>10</sub> concentrations at Coyote Lakes were coincident with strong gusty winds and can be attributed to soil emissions.

6. Estimation of Contribution from Source or Event. The primary source appears to be wind-blown dust over portions of central Arizona for which there is not an effective or efficient method to estimate the relative contributions from specific sources. The demonstration analysis contained in this report establishes the linkage between the measurements to be flagged and the event, thus satisfying the requirement in 40 CFR 50.14(c)(3)(iii)(B). Pursuant to 40 CFR 50.14(c)(3)(iii)(D), the “Event Contrib. Analysis” Table in Figure 1 has been included to demonstrate that there would have been no exceedance or violation but for the event (i.e., the contribution during the event overwhelmed the 24-hour average).

7. Determination that a Natural or Exceptional Event Contributed To an Exceedance. Based on this analysis, the event satisfies the requirement in 40 CFR 50.1(j) that the elevated concentration at Coyote Lakes was attributed to a natural event.

## Conclusion

Transport of dust from soils by high winds. The elevated PM<sub>10</sub> concentrations at Coyote Lakes on October 22, 2008, was a result of the transport of dust and soils due to high winds that suspended natural soils and soils from areas where Best Available Control Measures are in place and should be flagged for air quality planning purposes. The

“high wind” (RJ) flag should be applied to the monitor readings indicated in the table at the beginning of this report, as the monitor would have been below the NAAQS but for the contribution of the event.

**ATTACHMENTS AND REFERENCES**  
**FOR EXCEPTIONAL EVENTS ANALYSIS**

**The following are supplemental materials helpful in understanding the exceptional event summarized in the main report. In addition, the reader is referred to the following references.**

**REFERENCES**

Arizona Department of Environmental Quality (ADEQ), *Air Quality Exceptional and Natural Events Policy*, Policy Number 2009.002 (April 28, 1999; revised January 10, 2006 and June 22, 2007).

Arizona Department of Environmental Quality (ADEQ), *Technical Criteria Document for Determination of Natural Exceptional Events for Particulate Matter Equal to or Less Than Ten Microns in Aerodynamic Diameter (PM<sub>10</sub>)* (May 31, 2000).

Arizona Department of Environmental Quality (ADEQ), *Technical Criteria Document for Determination of Natural and Exceptional Events* (December 12, 2005).

Arizona Department of Environmental Quality (ADEQ), *Impact of Exceptional Events 'Unusual Winds' on PM<sub>10</sub> Concentrations* (October 14, 2009).

Arizona Department of Environmental Quality (ADEQ), *High Wind Exceptional Events and Control Measures for PM<sub>10</sub> Areas* (October 14, 2009).

Environmental Protection Agency (EPA), *The Treatment of Data Influenced by Exceptional Events (Exceptional Event Rule)*, 73 FR 70597; 40 CFR Parts 50 and 51 (November 21, 2008).



**MARICOPA COUNTY  
 DUST CONTROL ACTION FORECAST  
 ISSUED TUESDAY, OCTOBER 21, 2008**

Three-day weather outlook:

The mid-latitude storm track will undergo amplification over the western U.S. late today and Wednesday resulting in the building of a strong ridge to the west of AZ and a deep trough to the east. The resulting tight pressure gradient will promote local north to northeasterly breezes Wednesday and Thursday. Increased ventilation will help to decrease PM-10 levels.

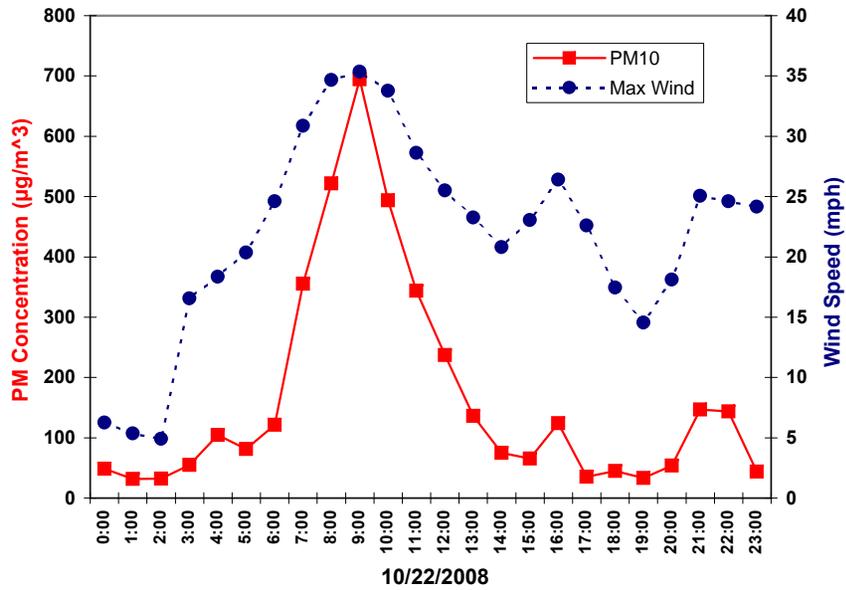
**R I S K F A C T O R S**

	<u>WINDS</u>	+	<u>STAGNATION</u>	=	<u>RISK LEVEL</u>
<b>Day #1: Wed 10/22/2008</b>	North to northeasterly 10-20 mph with a few gusts to 25 mph.		Rather stagnant during the morning hours with improvement by afternoon.		LOW
<b>Day #2: Thu 10/23/2008</b>	Northeast to easterly 10-20 mph becoming 5-15 mph by afternoon.		Somewhat stagnant during the morning hours with improvement by afternoon.		LOW
<b>Day #3: Fri 10/24/2008</b>	Northwest to northerly 5-15 mph by afternoon.		Somewhat stagnant during the morning hours with improvement by afternoon.		LOW

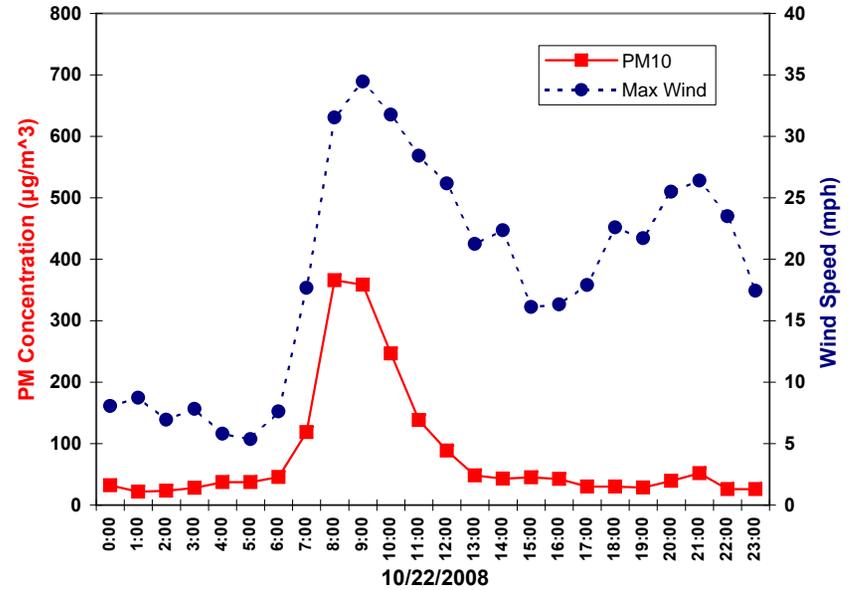
The Maricopa County Dust Control Action Forecast is issued to assist in the planning of work activities to help reduce dust pollution. To review the complete air quality forecast for the Phoenix metropolitan area and the health effects of air pollution, please see ADEQ's Air Quality Forecast at <http://www.azdeq.gov/environ/air/ozone/ensemble.pdf>, or call 602-771-2367 for recorded forecast information.

# 10/22/2008 - ADDITIONAL GRAPHS

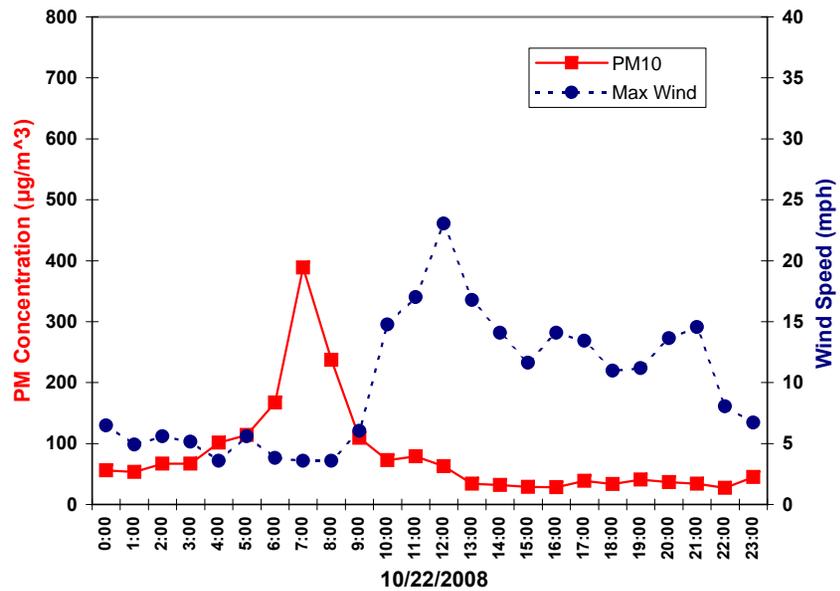
### Coyote Lakes - PM 10 vs. Wind Speed



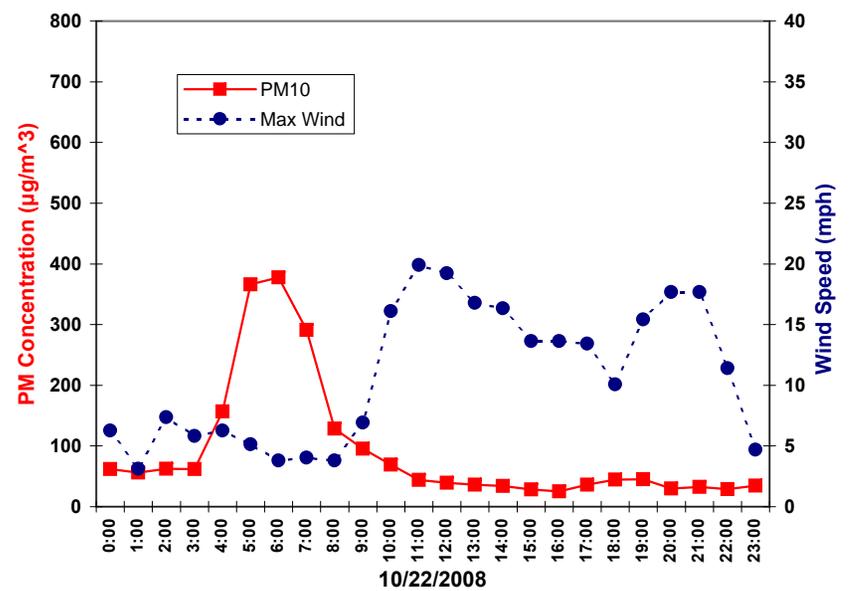
### Buckeye - PM 10 vs. Wind Speed



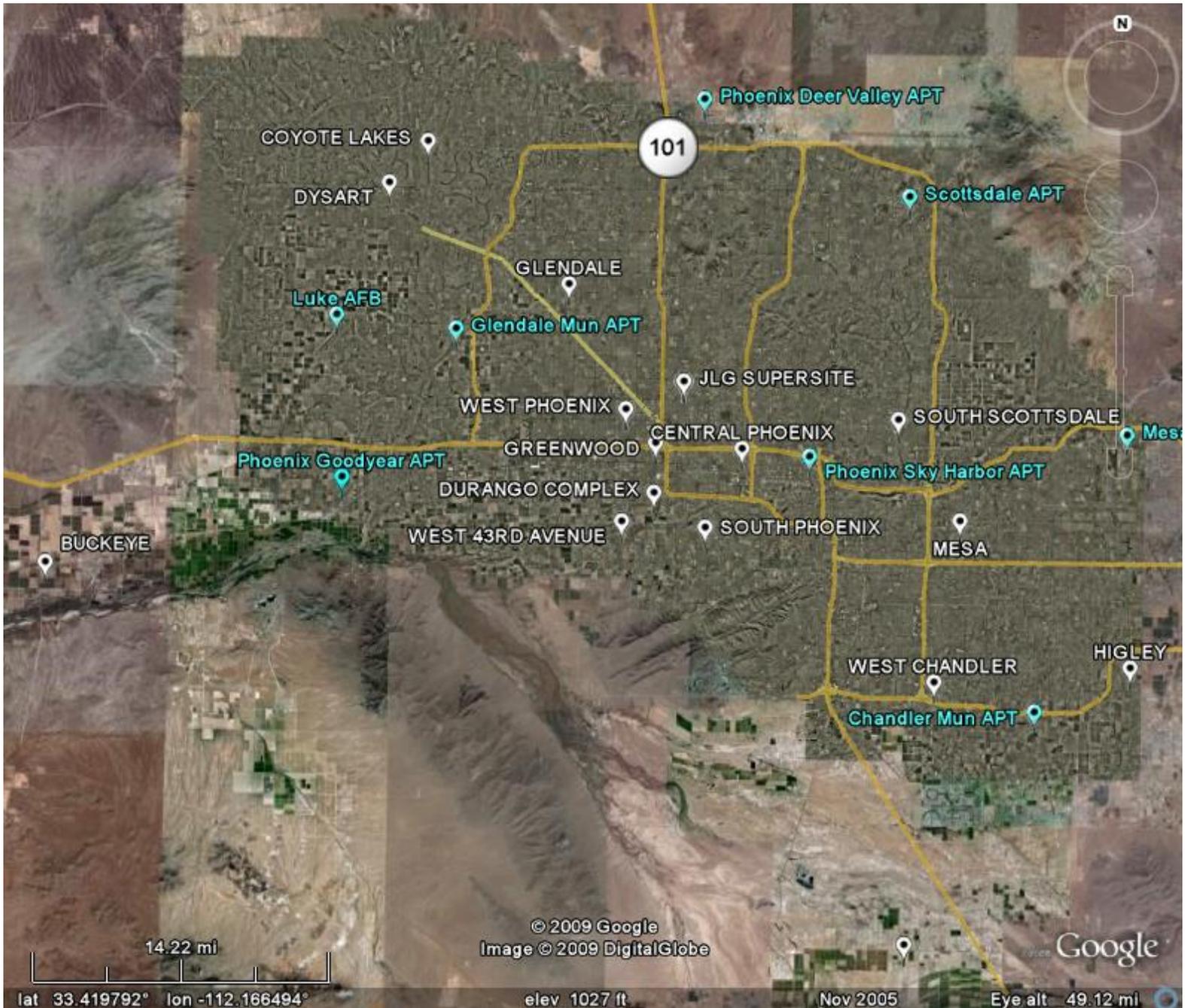
### Durango - PM 10 vs. Wind Speed



### West 43rd - PM 10 vs. Wind Speed



## Phoenix Area PM<sub>10</sub> and Meteorological Monitors



Source: US EPA, ADEQ, & Google Earth