

# Fireworks Exceptional Event

PM2.5  
July 4, 2007  
Rose Park

Photo from Olympus Cove looking west 22:11 Hrs  
MDT, July 4, 2007

Photos Furnished by: Meteorological Solutions Inc.  
Open Website.

# Purpose of Report

- Utah Division of Air Quality (UDAQ) is flagging PM<sub>2.5</sub> data for removal from regulatory consideration
  - This is the follow-up documentation for the event that was flagged and described in AQS

# Regulatory Process

- Treatment of Data Influenced by Exceptional Events is covered in 40 CFR Parts 50 and 51.
- Guidance for the regulations can be found at 72 FR 55 March 22, 2007 13560-81.

# Event Description

- Date: July 4, 2007
- Monitor: Rose Park
- 24 hour Avg.: 78.1  $\mu\text{g}/\text{m}^3$
- AQS monitor #: 49-035-3010
- Monitor Location: UTM
  - Zone 12
  - Northing 4516479
  - Easting 421455

# Event Description (Cont)

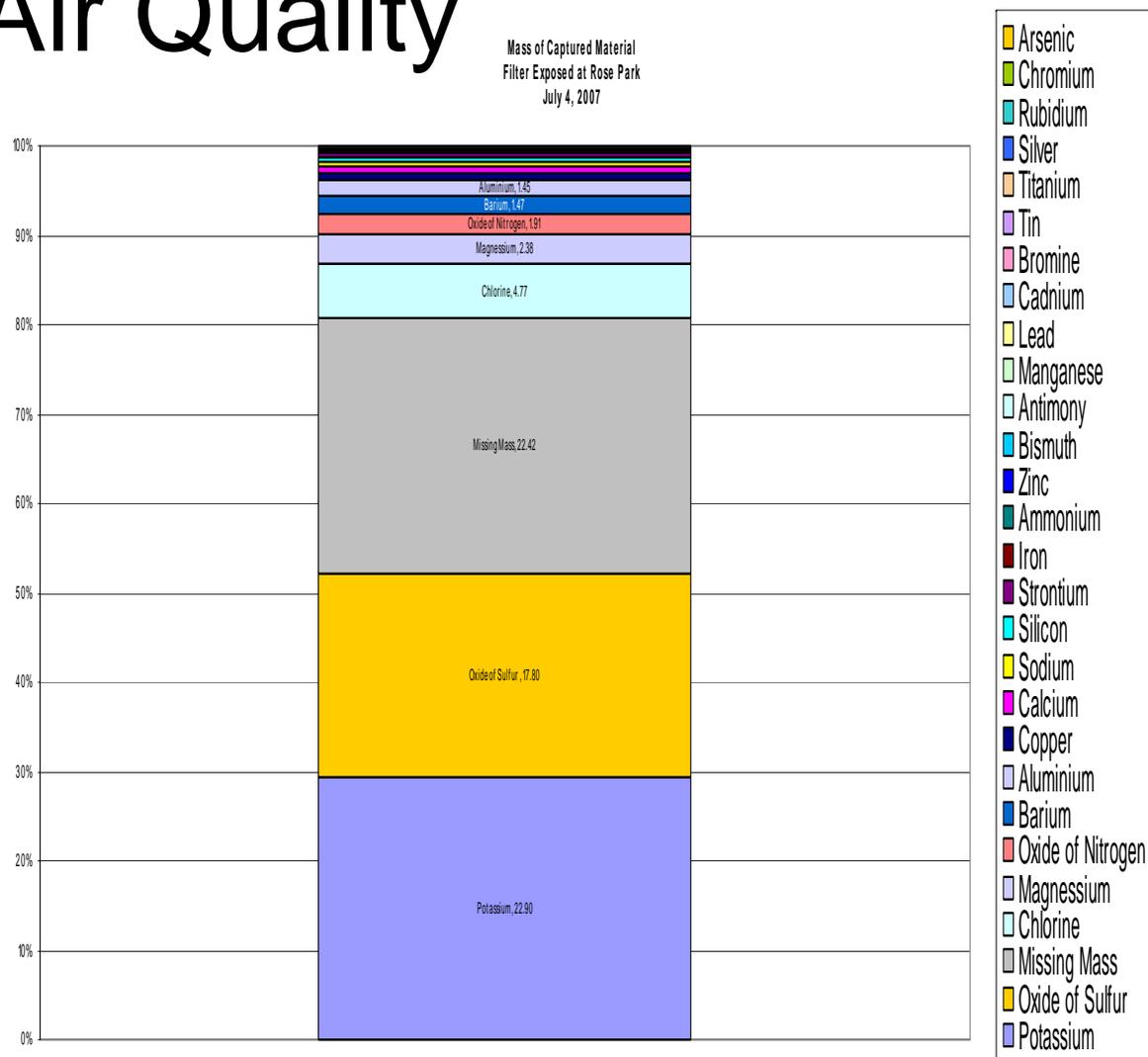
- The following slides will address each of the required elements of the exceptional events regulation regarding this data point.
- A weight of evidence will be provided that concludes this data should be removed from regulatory consideration.



# Emissions from Fireworks Affected Air Quality

Mass of Captured Material  
Filter Exposed at Rose Park  
July 4, 2007

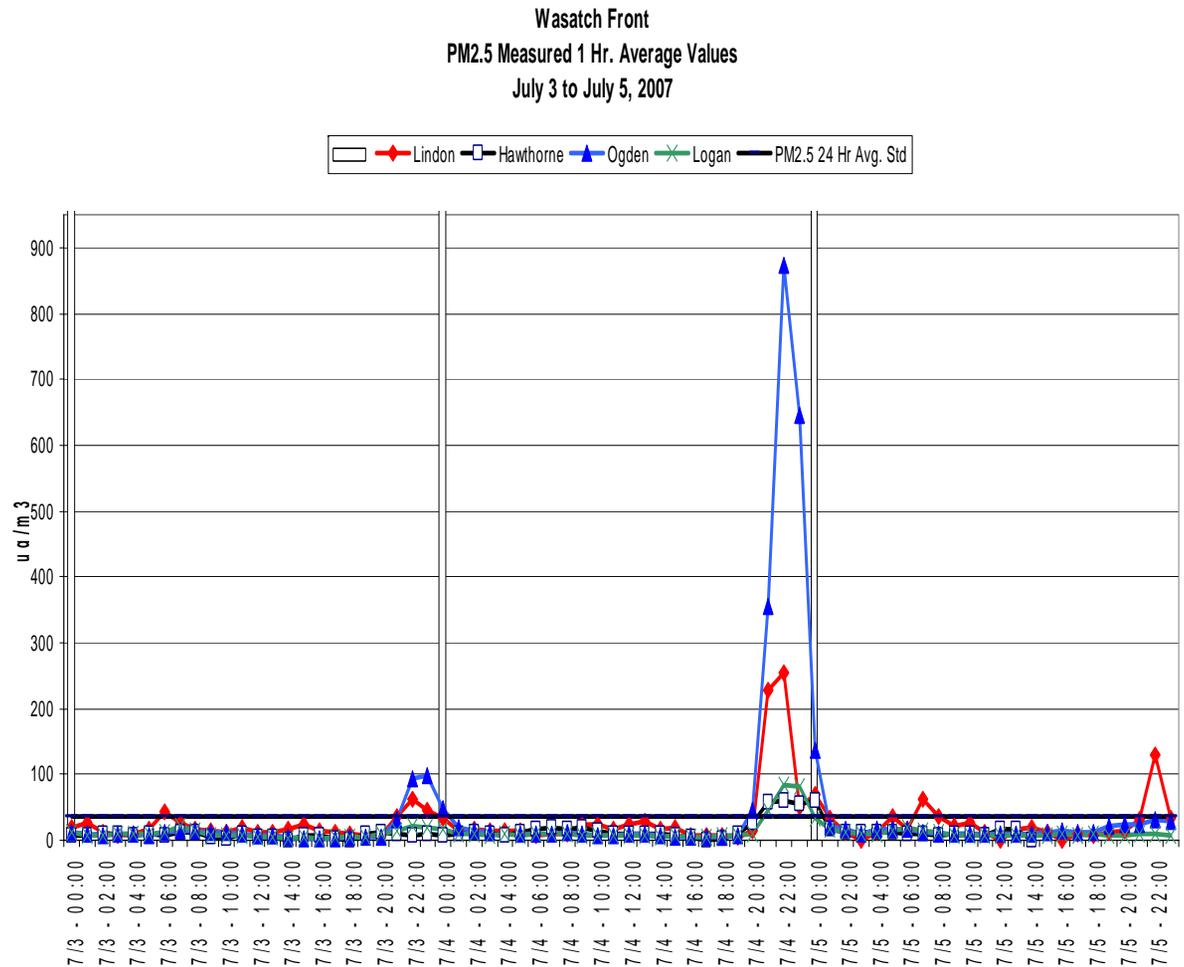
- Clearest evidence comes from the filter analysis.
  - The chemical species found on the filter are characteristic of fireworks. (see slide 9 for more information).



# Emissions from Fireworks Affected Air Quality (Cont)

- Fireworks affected air quality throughout the Wasatch Front as shown in the adjacent graph.

- PM2.5 hourly values show sudden impact which coincides with the onset of firework displays.
- Values peak in conjunction with large firework display commonly presented at 10:00 pm.
- Values peak at the same time on July 3 and 5, which may be due to personal ground level fireworks.



# Clear and Causal Relationship

Evidence that Emissions from Fireworks Impact Rose Park Monitor:

- Analysis of filter chemistry reveals significant quantities elements associated with fireworks.
  - The largest ( over 75 %) quantities represent the components of black powder.
    - Carbon (included in the missing mass on Teflon filter)
    - Potassium Nitrate (Salt Peter)
    - Sulfur
  - Other elements are used for coloring (e.g. calcium, etc)
  - Trace elements
    - Rarely found in air samples.

# Clear and Causal Relationship

## Evidence that Emissions from Fireworks Impact Rose Park Monitor:

Mass of Captured Material  
Filter Exposed at Rose Park  
July 4, 2007

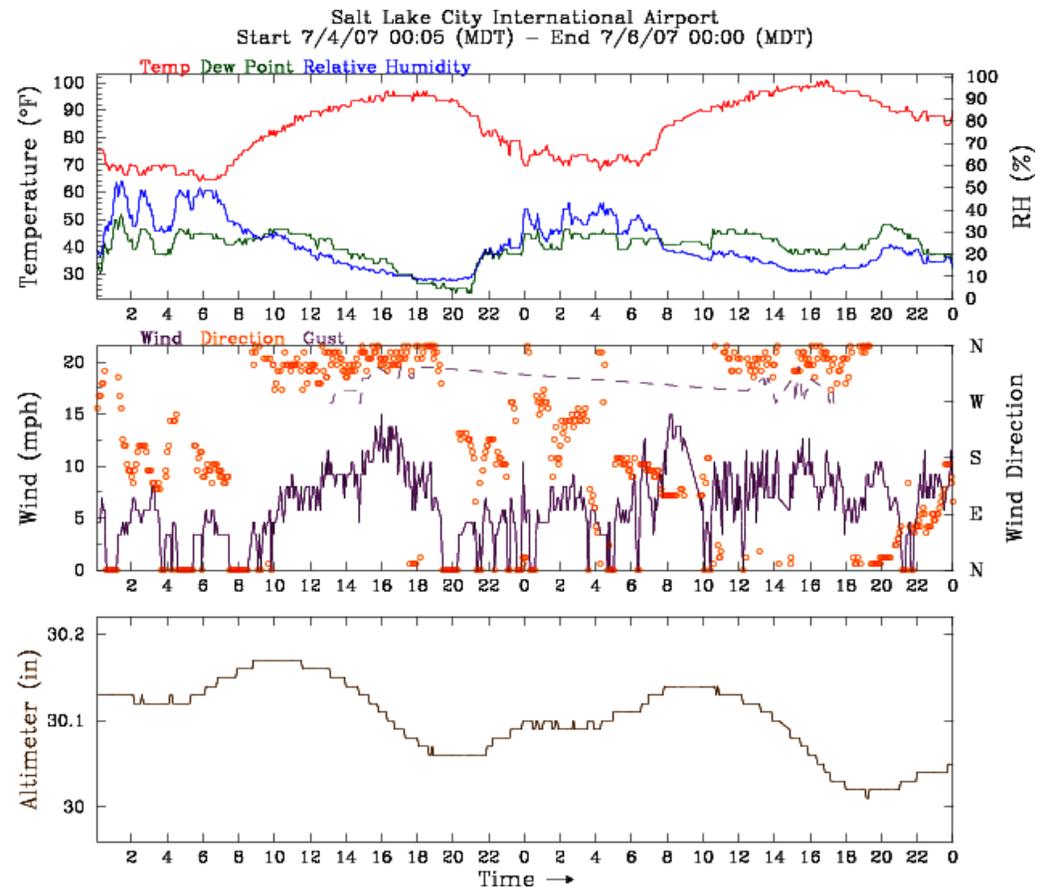


# Clear and Causal Relationship (Cont)

## Evidence that Emissions from Fireworks Impacted the Rose Park Monitor:

Transport of emissions to the monitor comes from various firework displays throughout the Wasatch Front.

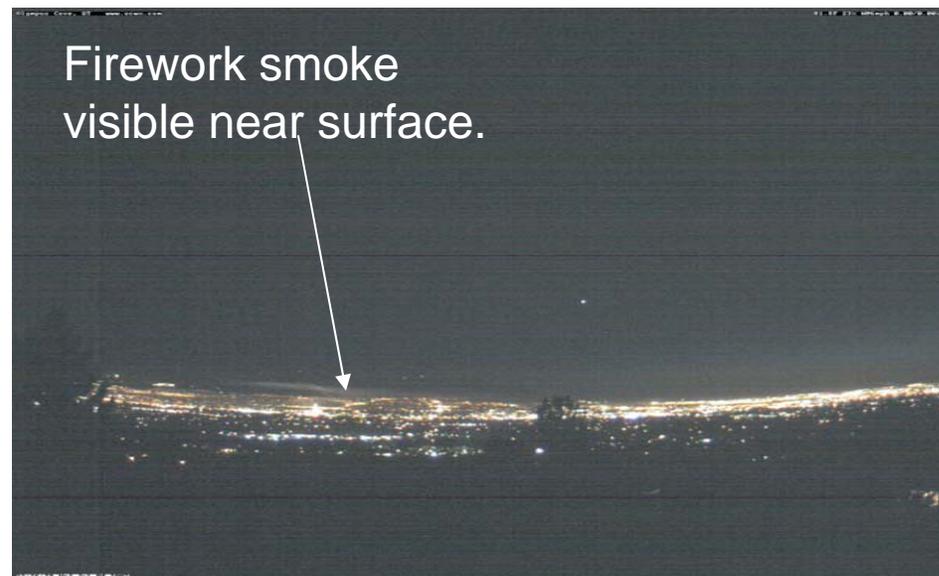
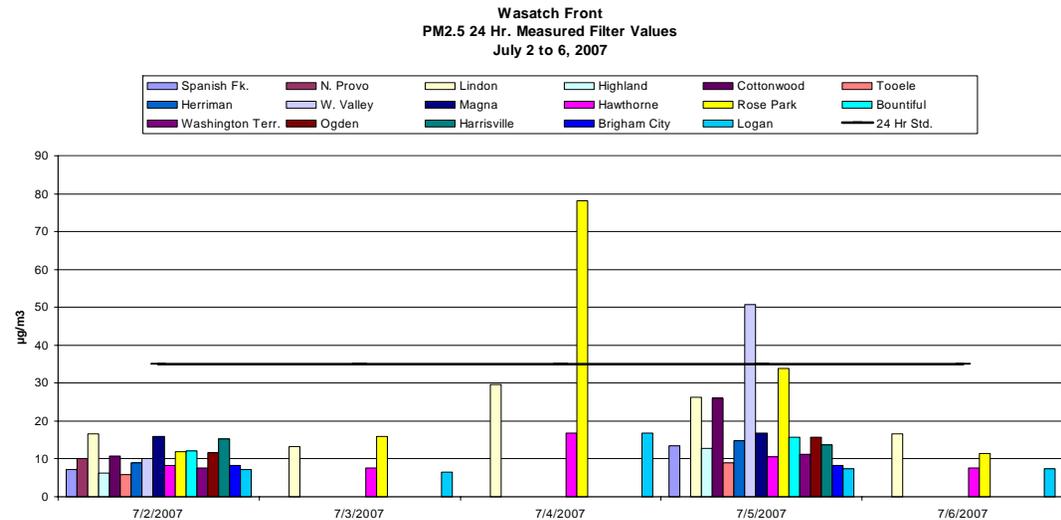
- Around 10 pm southerly light winds transported smoke entrained air mass from the urbanized center to the Rose Park monitor.
- Although there was no singular emission source identified, much the firework displays were located to the south of the Rose Park monitor.



# Clear and Causal Relationship (Cont)

## Regional scope of emission impact:

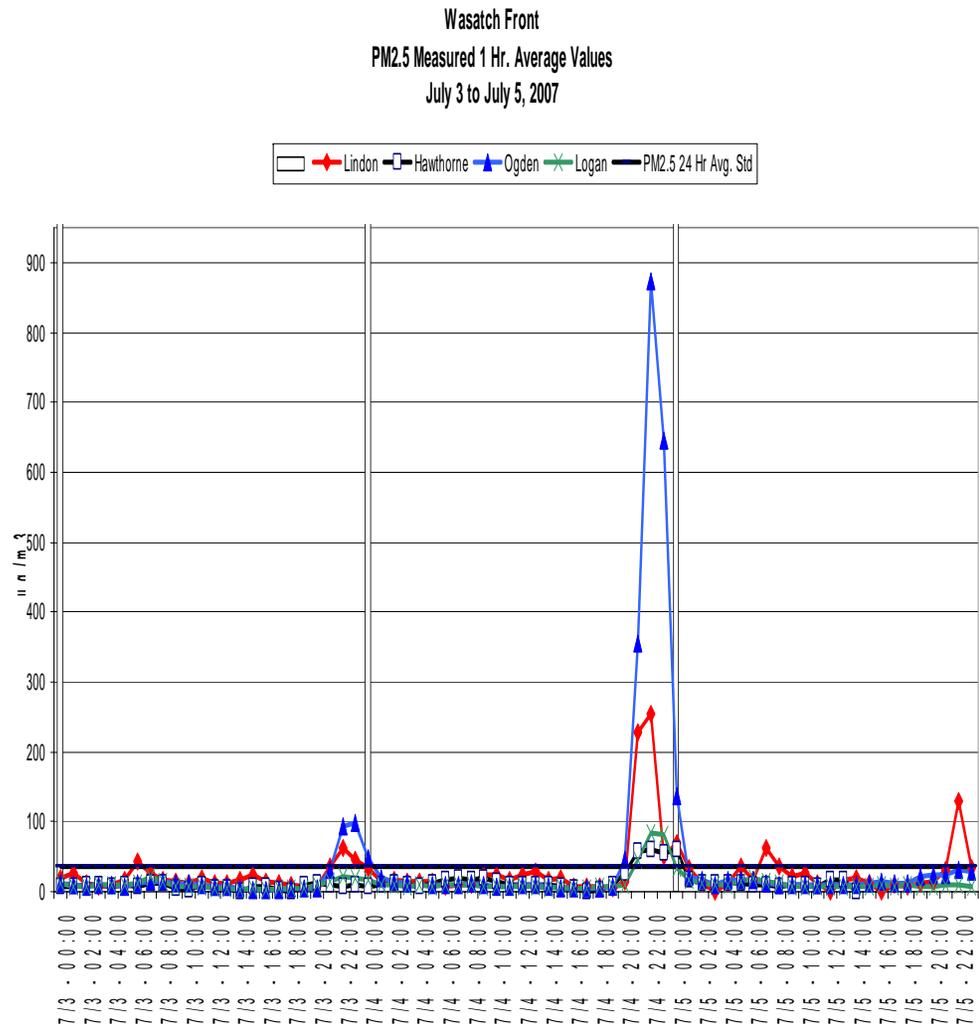
- Smoke from fireworks displays through out the Wasatch Front impacted many of the particulate monitors in the network.
  - PM2.5 values in the Wasatch Front were elevated from the Lindon monitor in Utah County to the Logan monitor in Cache County .
  - Visible observations of the Salt Lake Valley indicate regional impact in calm air.



# Clear and Causal Relationship (Cont)

Relationship in time of emission impact:

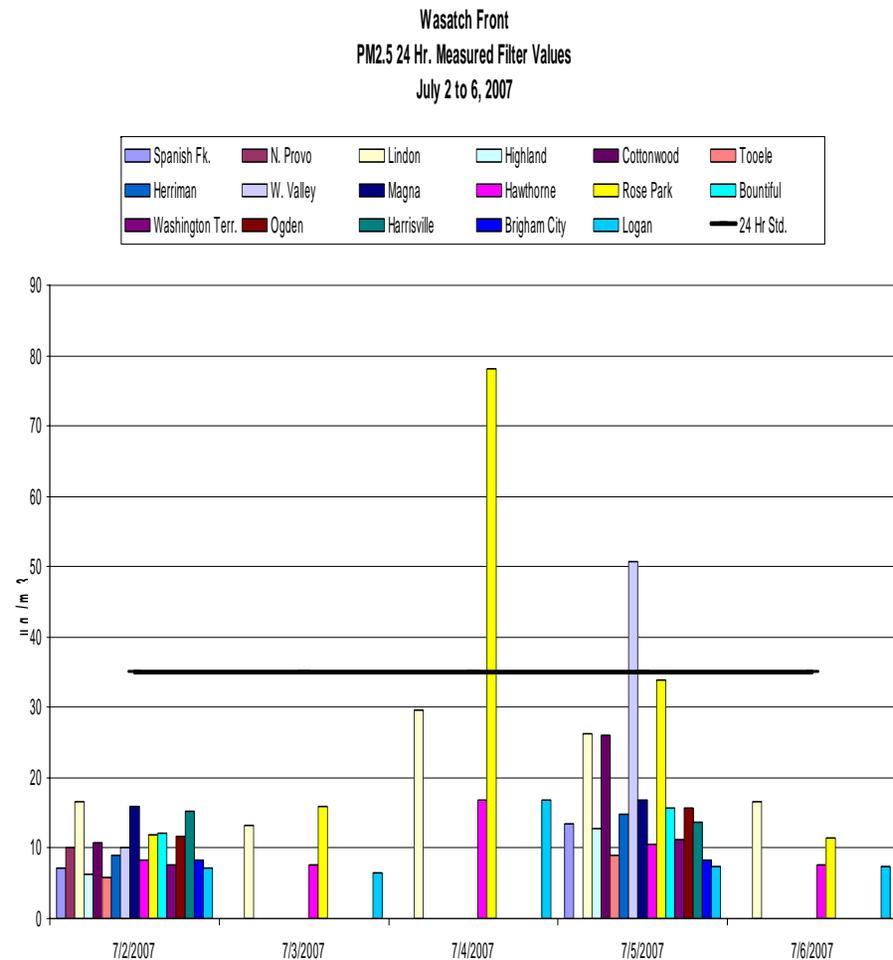
- The impact from fireworks is observed to occur in the evening and night of July 4<sup>th</sup> and continues into the early morning of July 5<sup>th</sup>.
- Graphs of hourly values captured at monitoring sites in the Wasatch Front verify the timing of the impact all along the Wasatch Front.



# Clear and Causal Relationship (Cont)

Relationship in time of emission impact:

- In years past residual smoke from fireworks has been observed to impact the 24-hour PM2.5 filter on the following day. This is what happened on July 5<sup>th</sup> at the West Valley monitor as the filter chemistry verifies.
  - The July 5<sup>th</sup> Value from West Valley and Rose Park monitors likely includes some carryover impact from the 4<sup>th</sup> during the early morning.
  - Had the West Valley monitored on the 4<sup>th</sup>, the value likely would have been higher than what was measured on the 5<sup>th</sup>.



# Concentration in Excess of Normal Fluctuations

- The geometric mean value could be used to describe a background concentration
- The geometric mean was calculated to be  $11.2 \mu\text{g}/\text{m}^3$ .
  - Ten-years of historical data from Rose Park and North Salt Lake was used for the calculation.
  - All data points from June 1 through August 31 for the years 1998 through June 30, 2007 were included.
    - This is statistically characteristic of the summer air quality season.
- Normal historical fluctuation might be described as one standard deviation above or below the geometric mean. The upper bound of this fluctuation for the West Valley monitoring site would then be  $12.7 \mu\text{g}/\text{m}^3$ .

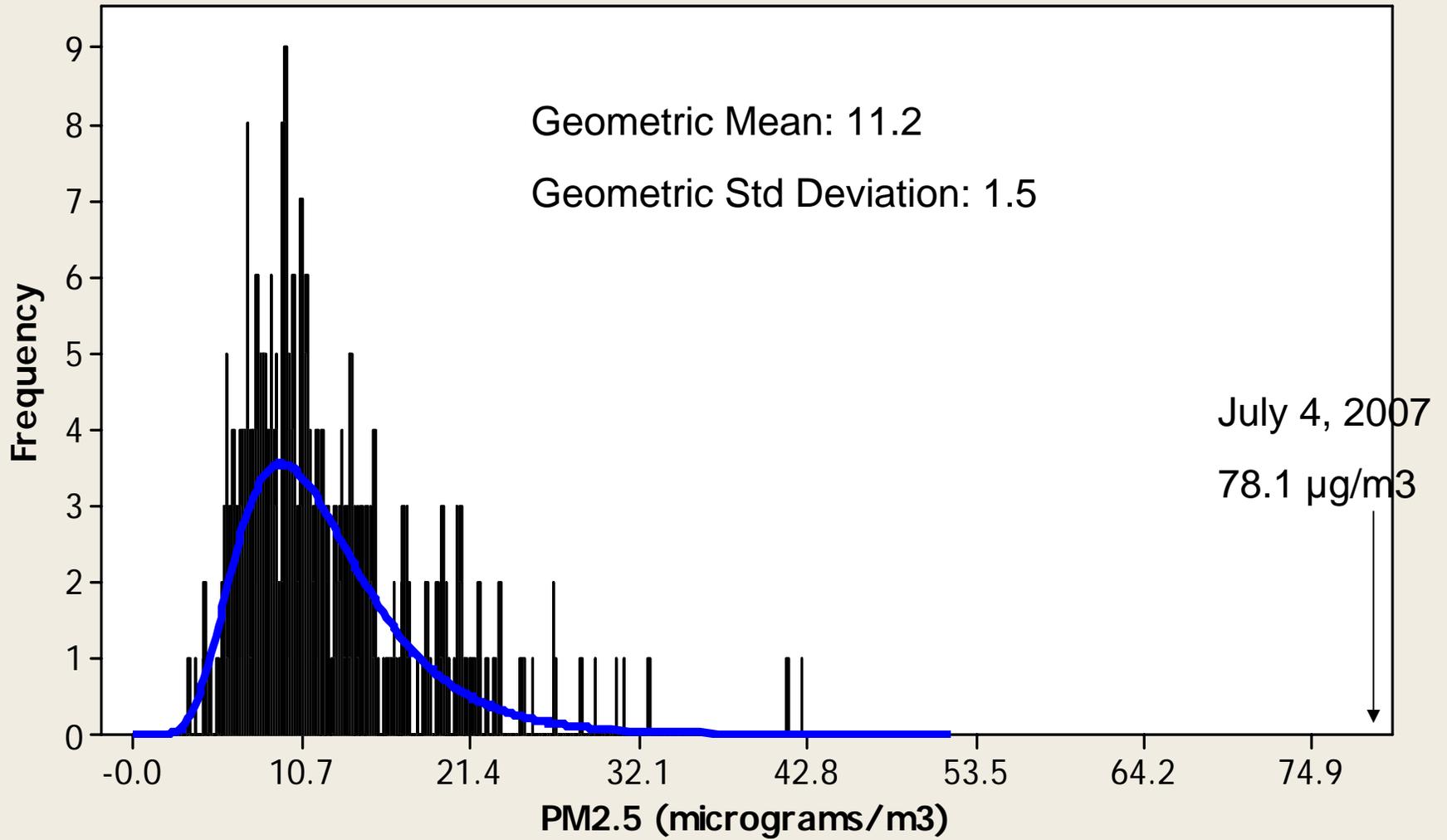
# Concentration in Excess of Normal Fluctuations (Cont)

The measured concentration associated with this event is shown in the graph on the next slide.

- Clearly the measured concentration exceeds  $12.7 \mu\text{g}/\text{m}^3$
- Because of the proximity to the newly established Rose Park monitor, we used data from the North Salt Lake monitor from June 1998 through June of 2007 to represent the Rose Park monitor. The Rose Park monitor was not operational until July 1, 2007. This was the highest summertime value ever recorded at either site.
- Data from the North Salt Lake (and the Rose Park) monitors shows that there have only been 2 days above the 24-hour NAAQS, these days were influenced by a high-wind event and fireworks. Summertime exceedances of the 24-hour NAAQS are therefore not seen in the normal variation of the North Salt Lake/Rose Park data.
- Guidance found at 72 FR 55 March 22, 2007 13560-81, says that a lesser amount of documentation would likely be necessary for “extremely high” concentrations (e.g. > 95th %ile) than for concentrations that were closer to “typical levels” (e.g. < 75th %ile.)

# RosePark June1,1997-June30,2007

Lognormal



# No Exceedance or Violation “but for” the Event

- For the time period surrounding this event one might have expected a background concentration (geometric mean) of 11.2  $\mu\text{g}/\text{m}^3$ 
  - Calculation of the geometric mean was already described in slide 15.
- This is well below the current 24-hour PM<sub>2.5</sub> NAAQS standard.

# No Exceedance or Violation “but for” the Event (Cont)

- Measured concentration associated with the event was  $78.1 \mu\text{g}/\text{m}^3$ .
- The difference between the measured concentration and the expected mean is  $66.9 \mu\text{g}/\text{m}^3$ .
- This difference could be considered the amount of impact from the event.

# No Exceedance or Violation “but for” the Event (Cont)

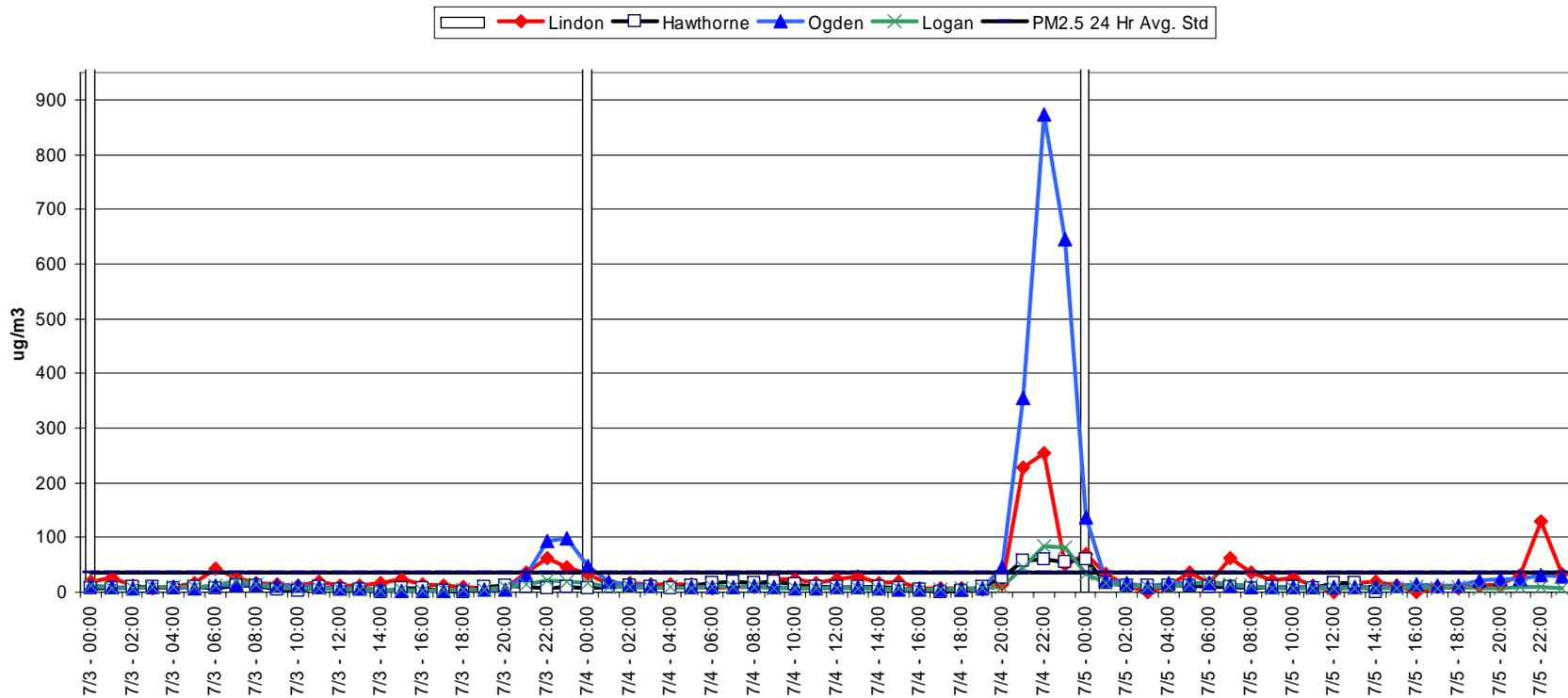
- However, to account for typical fluctuations we must subtract a representative amount.
  - Again, this might be described by one standard deviation above the mean.
  - In this case one standard deviation equates to  $1.5 \mu\text{g}/\text{m}^3$ .
- Hence, the amount of concentration that would be attributable to the event using this approach is  **$65.4 \mu\text{g}/\text{m}^3$** .

# No Exceedance or Violation “but for” the Event (Cont)

- Supporting evidence
- The chart on the next slide is of hourly monitoring data throughout the monitoring network.
  - Even though this data was not collected at the Rose Park monitor, temporal profile is most likely very similar.
  - Expect for the dramatic peak at the end of the day the PM<sub>2.5</sub> values were very consistent.

# No Exceedance or Violation “but for” the Event (Cont)

Wasatch Front  
PM2.5 Measured 1 Hr. Average Values  
July 3 to July 5, 2007



# No Exceedance or Violation “but for” the Event (Cont)

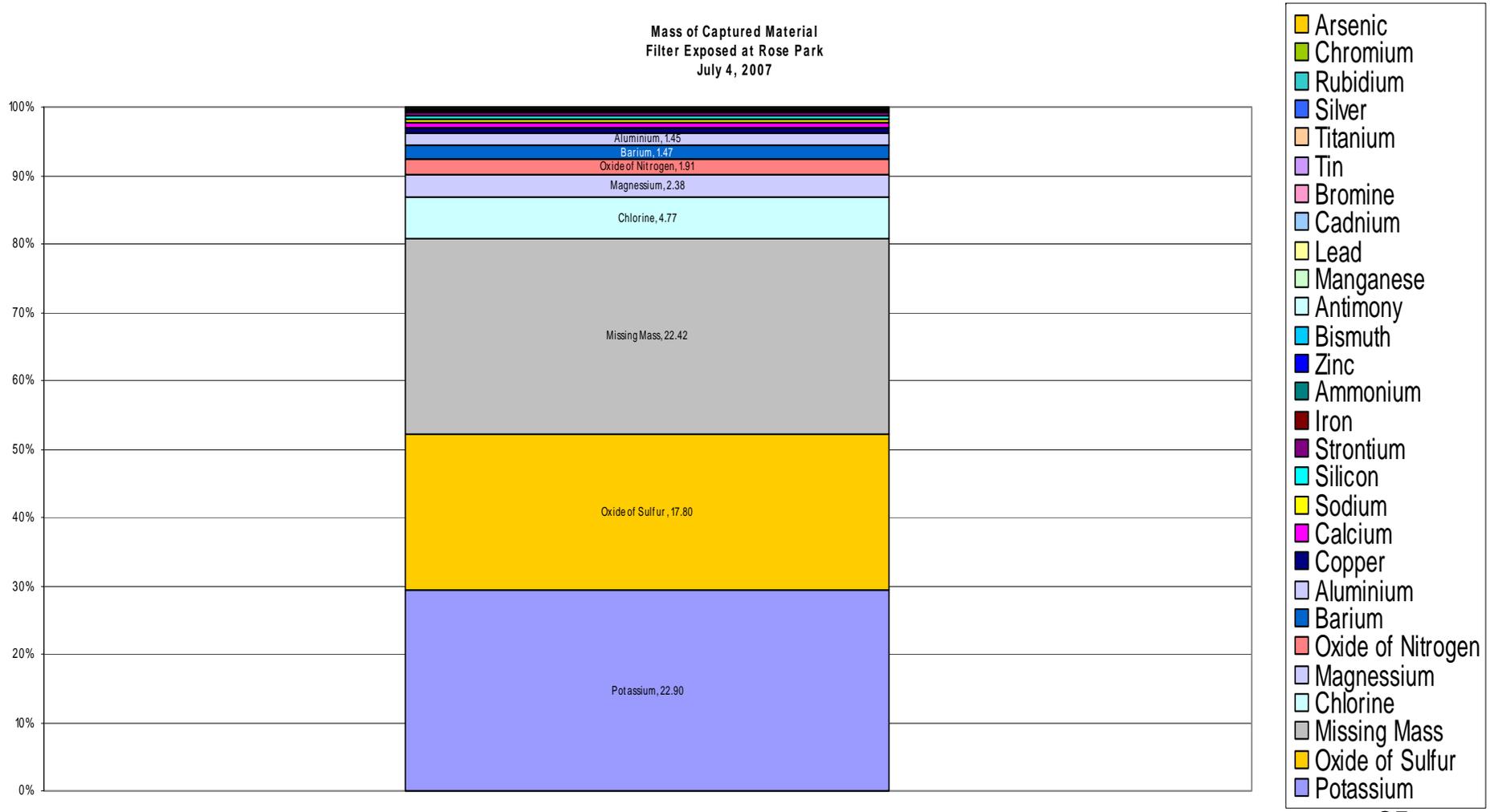
- A closer look at the raw data reveals that
  - Except for emissions from fireworks during the hours between 8 pm to 2 am on the 3<sup>rd</sup>, 4<sup>th</sup>, and 5<sup>th</sup>
  - Concentration values were consistently below the 20 ug/m<sup>3</sup>
  - Any hourly exception to these may indicate impact from localized use of fireworks.

Date and Time	Lindon	Hawthorne	Ogden	Logan
7/3/07 20:00	7.1	13	5.9	9.5
7/3/07 21:00	36.4	8.5	32.1	13.4
7/3/07 22:00	63.3	7.6	92.4	21.3
7/3/07 23:00	45.6	9.9	99.1	19.9
7/4/07 0:00	34.6	7.7	46.8	16.9
7/4/07 1:00	14.4	8.5	18.6	10.3
7/4/07 2:00	16	12.2	14.7	9.6
7/4/07 3:00	13.8	8.9	11.6	7.1
7/4/07 4:00	13.9	7		8.6
7/4/07 5:00	13.6	12.6	10.5	7.2
7/4/07 6:00	7	16.8	10.4	8.8
7/4/07 7:00	9.3	19.8	9.3	8.8
7/4/07 8:00	10.3	17.9	11.2	10
7/4/07 9:00	23.3	18.4	8.6	8.1
7/4/07 10:00	24.2	15.1	6.3	7.5
7/4/07 11:00	17.5	9	8	6.9
7/4/07 12:00	23.5	8.5	8.5	8.3
7/4/07 13:00	29.8	8.4	9.5	7.4
7/4/07 14:00	17.7	10.5	6.9	5.9
7/4/07 15:00	19.9	6.3	5.8	7
7/4/07 16:00	7.1	4.1	3.9	5.8
7/4/07 17:00	6.4	1	4.1	5.8
7/4/07 18:00	7.4	2.8	3.9	6.7
7/4/07 19:00	5.3	10.3	6.3	8.3
7/4/07 20:00	14.1	26.6	45.1	10.6
7/4/07 21:00	229	56.5	354.5	44.7
7/4/07 22:00	255.4	60.3	873.9	84.9
7/4/07 23:00	51.5	56.2	644.3	81.4
7/5/07 0:00	69.6	60.9	137.1	34.7
7/5/07 1:00	34.4	17.6	21.7	17.5
7/5/07 2:00	11.4	11.9	15.9	11

# No Exceedance or Violation “but for” the Event (Cont)

- Analysis of filter chemistry reveals that  $63.1 \mu\text{g}/\text{m}^3$  is associated with chemicals commonly resulting from firework displays.
  - Carbon (included in the missing mass on Teflon filter)
  - Potassium Nitrate (Salt Peter)
  - Sulfur
- Trace elements were not included in the  $63.1 \mu\text{g}/\text{m}^3$  but also account for some of the measured value that is associated with fireworks.
- Speciated data from a nearby monitor (Bountiful) suggests that missing mass on a typical day in this season would be roughly  $6.2 \mu\text{g}/\text{m}^3$ 
  - Estimated as: [(Elemental Carbon) + 1.4 X (Organic Carbon)]
- Assuming a typical filter would contain roughly  $6.2 \mu\text{g}/\text{m}^3$  carbon compounds one could still attribute  **$56.9 \mu\text{g}/\text{m}^3$**  of this missing mass to the firework event.

# No Exceedance or Violation “but for” the Event (Cont)



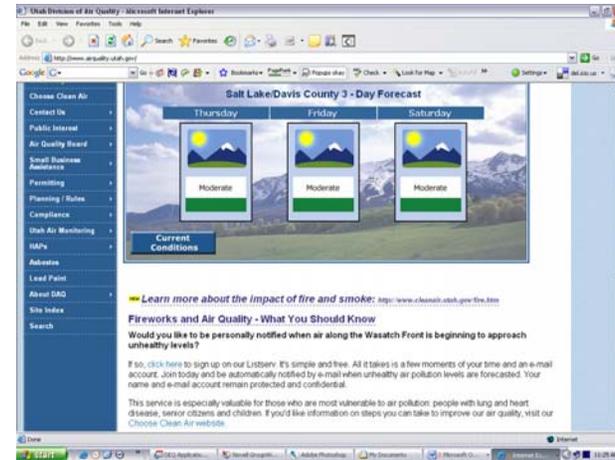
# No Exceedance or Violation “but for” the Event Summary

- Using the statistical approach discussed in slides 15-20 the concentration attributable to the event is **65.4  $\mu\text{g}/\text{m}^3$** .
- Using the filter analysis approach discussed in slides 24-25 the concentration attributable to the event is **56.9  $\mu\text{g}/\text{m}^3$** .
- In addition to other supporting evidence, both numerical approaches suggest that a sufficient concentration was attributed to the firework event and that the measured concentration would not have exceeded the PM<sub>2.5</sub> 24-hour NAAQS **but for** the impact of emissions from fireworks!

# Mitigation of Event

State Action included:

- Providing a news release prior to July 4<sup>th</sup> that advised citizens of the potential health impacts of firework emissions.
  - Staff also participated in interviews with news media (both print and TV).
- Website that address emissions from fireworks was posted on the web before the event.
- This website covered the following items:
  - The health impacts of PM
  - The actions a person could take to minimize exposure to PM.



# Public Review and Comment

- UDAQ established a 30-day comment period from November 1, 2007 through December 1, 2007. No comments were received.
  - The announcement of the comment period was published in the Salt Lake Tribune and Deseret News on October 22, 2007. See the Affidavit of Publication to the right.

4770 S. 5600 W.  
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**The Salt Lake Tribune** **MEDIA One** **Morning News**

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UTAH AIR QUALITY DIVISION  
NOV 9 2007

ACCOUNT NAME	ADORDER# / INVOICE NUMBER
UT ST DEPT OF ENV QUALITY	6000166276 /

TELEPHONE	SCHEDULE
8015364000	Start 10/22/2007 End 10/22/2007

CUST. REF. NO. DAQPN-008-07

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PUBLISHED ON Start 10/22/2007 End 10/22/2007

SIGNATURE *Stacy Crest*

DATE 10/23/2007

NOTARY PUBLIC  
ELIZABETH G. CORDOVA  
6462 West 4200 South  
West Valley City, Utah 84128  
My Commission Expires  
January 16, 2010  
STATE OF UTAH

*Elizabeth G. Cordova*

THIS IS NOT A STATEMENT BUT A "PROOF OF PUBLICATION"  
PLEASE PAY FROM BILLING STATEMENT

Federal regulations (40 Code of Federal Regulations, CFR Part 51.101) states to include an early start to the comment period. A "notarized" copy of "exceptional event" has caused the suspension of certain reporting events. For this effect the quality and cost responsibility considerations are presented to the extent of the notice. The notice is intended to inform and encourage the public. Exceptional events are events for which the by the Clean Air Act for the appropriate.

Exceptional events may be caused by human activities that are likely to result in a significant increase in the level of air pollution. If a release of a pollutant is an "exceptional event" it is not subject to the same reporting requirements as other events. For example, a pollutant event would not be subject to the same reporting requirements as other events. In order to comply, the EPA will allow states to include data from regulatory determinations on a case-by-case basis for monitoring systems that produce values that are significantly higher than the applicable standard for the pollutant. The following monitoring values have been attributed to exceptional events:

- July 4, 2007: Peak Hour Average, 78.1 ug/m<sup>3</sup> PM<sub>2.5</sub> (due to fireworks display activities)
- July 5, 2007: Peak Hour Average, 50.7 ug/m<sup>3</sup> PM<sub>2.5</sub> (due to fireworks display activities)
- July 6, 2007: Peak Hour Average, 44.3 ug/m<sup>3</sup> PM<sub>2.5</sub> (due to fireworks display activities)
- July 11, 2007: Peak Hour Average, 45.1 ug/m<sup>3</sup> PM<sub>2.5</sub> (due to fireworks display activities)
- July 11, 2007: Peak Hour Average, 48.3 ug/m<sup>3</sup> PM<sub>2.5</sub> (due to fireworks display activities)

The documentation to support reviewing this data from the monitoring system will be produced by the Utah Department of Environmental Quality. For more information, please contact the Utah Department of Environmental Quality at 801-536-4000 or visit our website at www.airquality.utah.gov. Publications are available at www.airquality.utah.gov.

Notarized Copy of Notice: Events Exceptional. Exceptional events are events for which the by the Clean Air Act for the appropriate. The notice is intended to inform and encourage the public. Exceptional events are events for which the by the Clean Air Act for the appropriate.

The comment period will close at 5:00 p.m. on December 1, 2007. Comments, questions, or other material will be accepted. Comments may be submitted by electronic mail to [stacy@utah.gov](mailto:stacy@utah.gov) or by mail to:

Utah Department of Environmental Quality  
144375, 500 East 5000, UT 84118-9820 (MAIL)

# Public Review and Comment (Cont)

- To aid in the public review and comment period, a website was developed to post the justification documentation for this event.

The screenshot shows the Utah Division of Air Quality website in Microsoft Internet Explorer. The page title is "Utah Division of Air Quality - Microsoft Internet Explorer". The address bar shows the URL: <http://www.airquality.utah.gov/Public-Interest/Public-Comment-Hearings/Exceptional-Events/Exceptional-Events.htm>. The website header includes "DEQ utah.gov" and "Utah Department of Environmental Quality". The main content area is titled "Exceptional Events" and contains text explaining that exceptional events are unusual or naturally occurring events that can affect air quality but are not reasonably controllable. It also mentions that the EPA has issued a rule (203 kb) that will govern the review and handling of air quality data influenced by exceptional events. Below this text is a photograph of a landscape with a large fire in the background, likely a wildfire. A section titled "Current Exceptional Events out for Public Comment:" states that the new federal regulations (40 CFR Part 50.14 (c) (3)(i)) require all relevant flagged data to be made available by the State for a 30-day public review and comment period. A table titled "Exceptional Events out for Public Comment" lists the following data:

Dates of Flagged Data	Monitor	Value	Pollutant	Type of Exceptional Event	Event Demonstration	Comment Period
July 4, 2007	Rose Park	78.1 $\mu\text{g}/\text{m}^3$	$\text{PM}_{2.5}$	Fireworks	Available (525 kb)	November 1- December 1, 2007
July 5, 2007	West Valley	50.7 $\mu\text{g}/\text{m}^3$	$\text{PM}_{2.5}$	Fireworks	Available (507 kb)	November 1- December 1, 2007
July 9, 2007	Lindon	44.3 $\mu\text{g}/\text{m}^3$	$\text{PM}_{2.5}$	Wildfire	Available (2,584 kb)	November 1- December 1, 2007
July 11, 2007	Lindon	42.1 $\mu\text{g}/\text{m}^3$	$\text{PM}_{2.5}$	Wildfire	Available (1,077 kb)	November 1- December 1, 2007