

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

- UDAQ is flagging PM2.5 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.

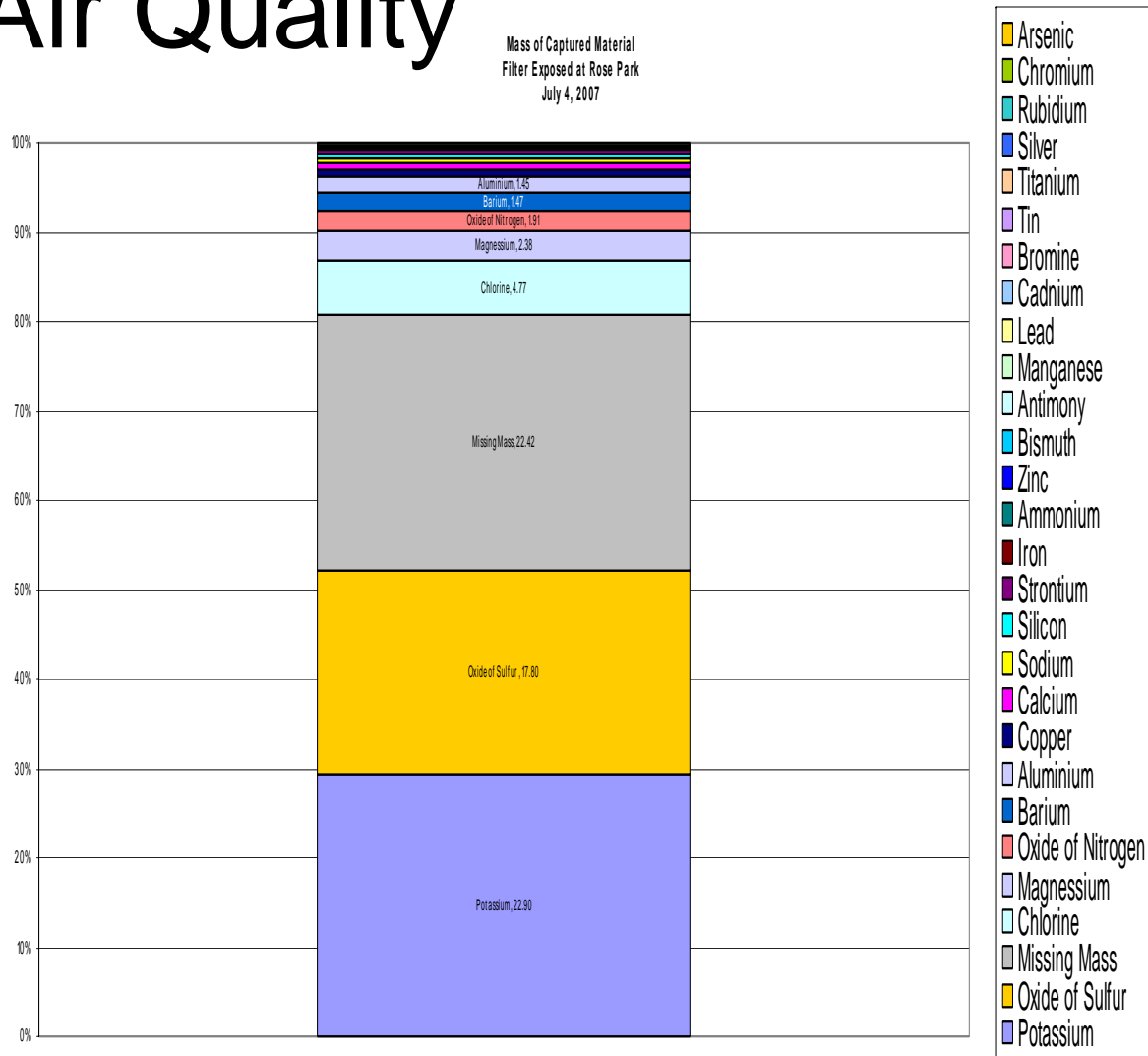
Event Qualifies as an Exceptional Event

- This event is a fireworks event
- It is associated with cultural tradition as stated in the guidance.
 - It involves the use of fireworks
 - Includes municipal displays on various days surrounding the 4th of July, and
 - A general use of personal ground level fireworks on various days surrounding the 4th of July.



Emissions from Fireworks Affected Air Quality

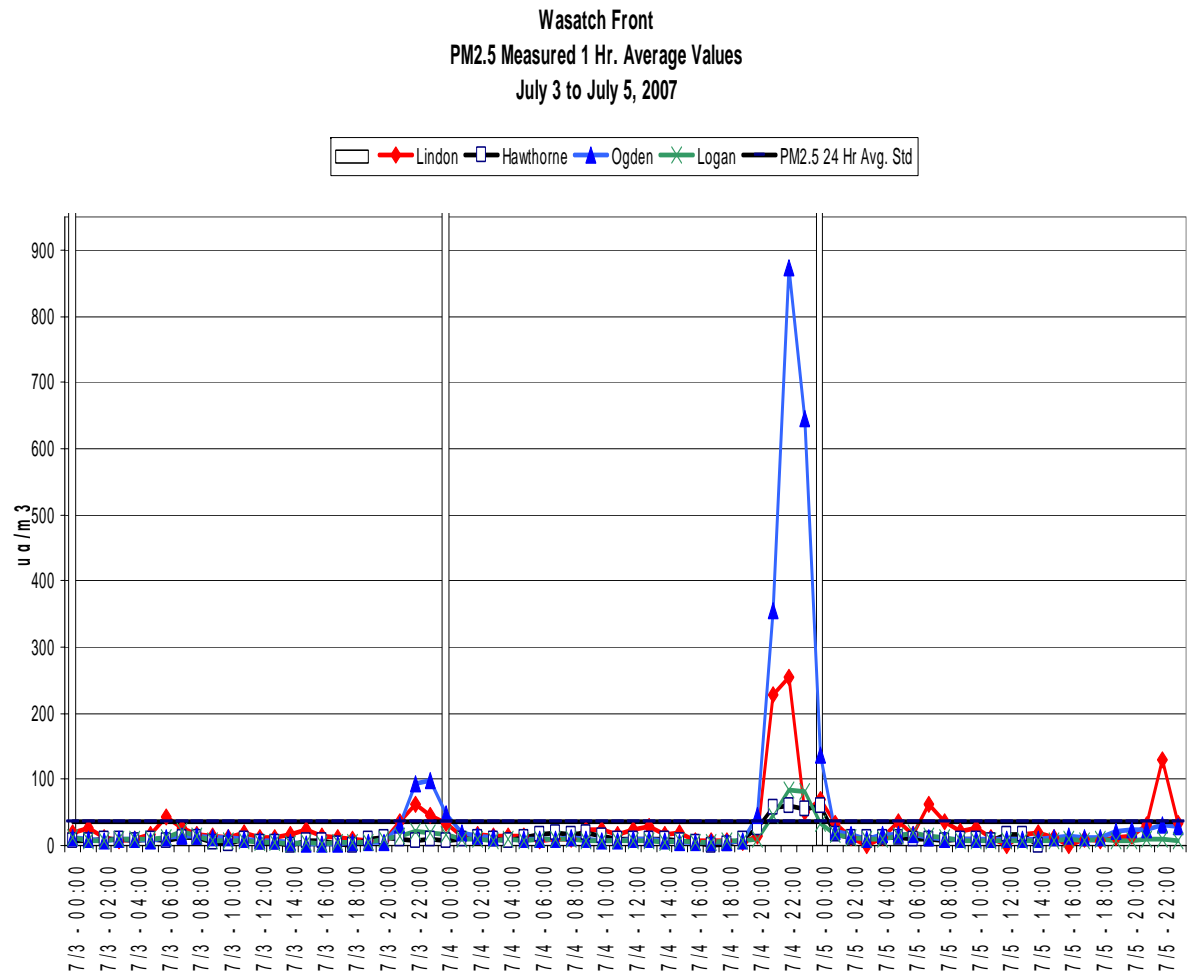
- Clearest evidence comes from the filter analysis.
 - The chemical species found on the filter are characteristic of fireworks. (see slide 9 for more information).



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

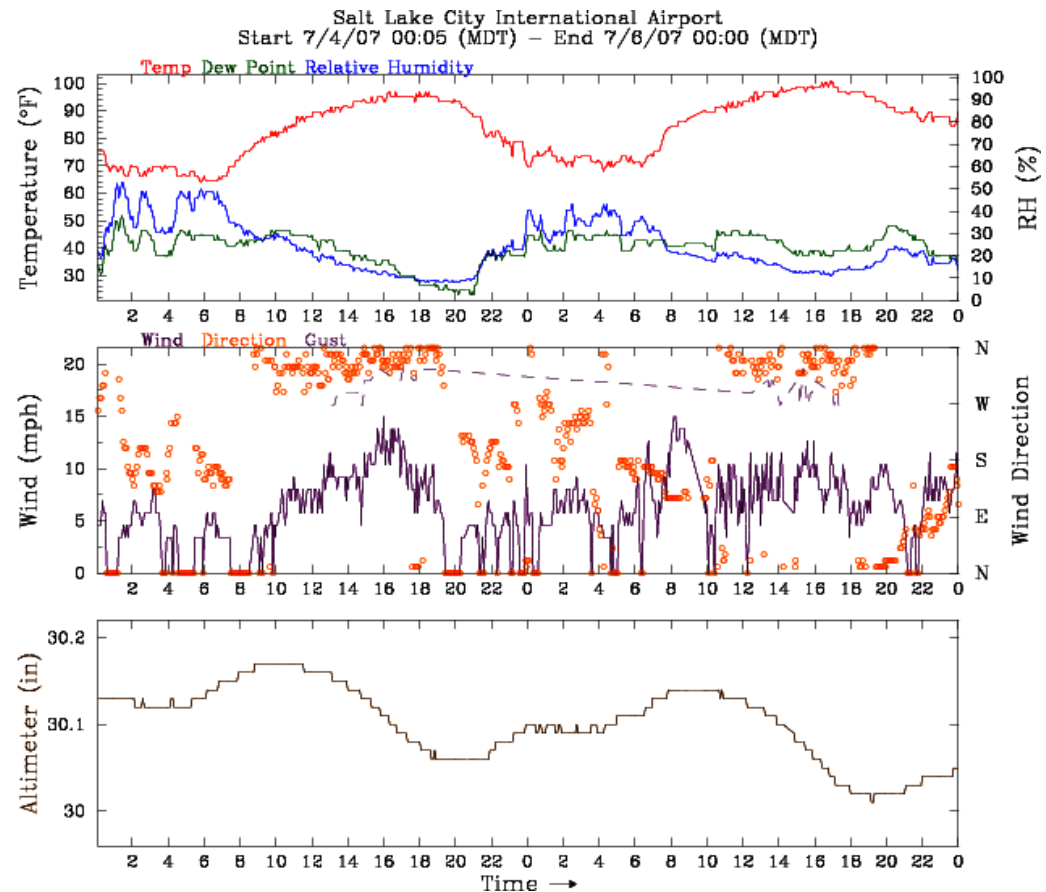


Clear and Causal Relationship (Cont)

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.

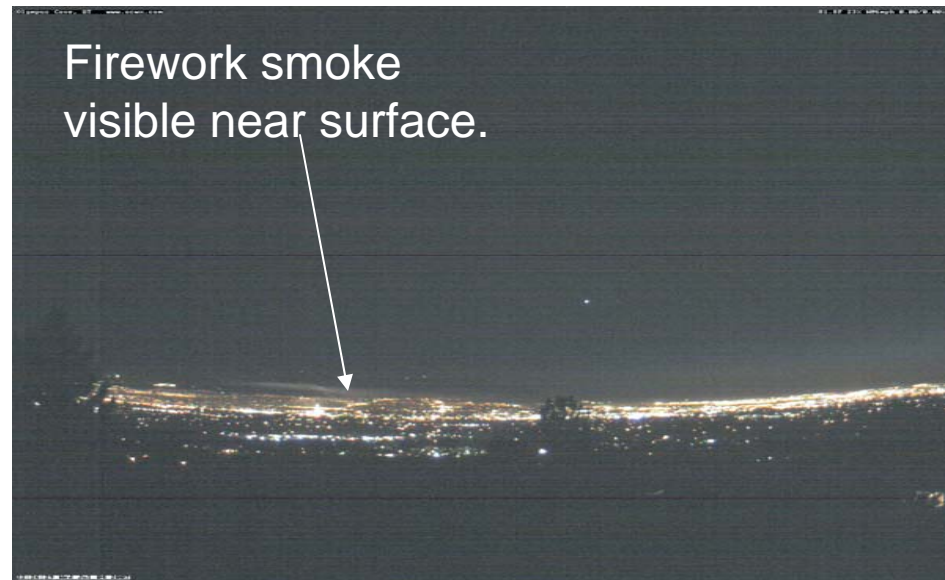
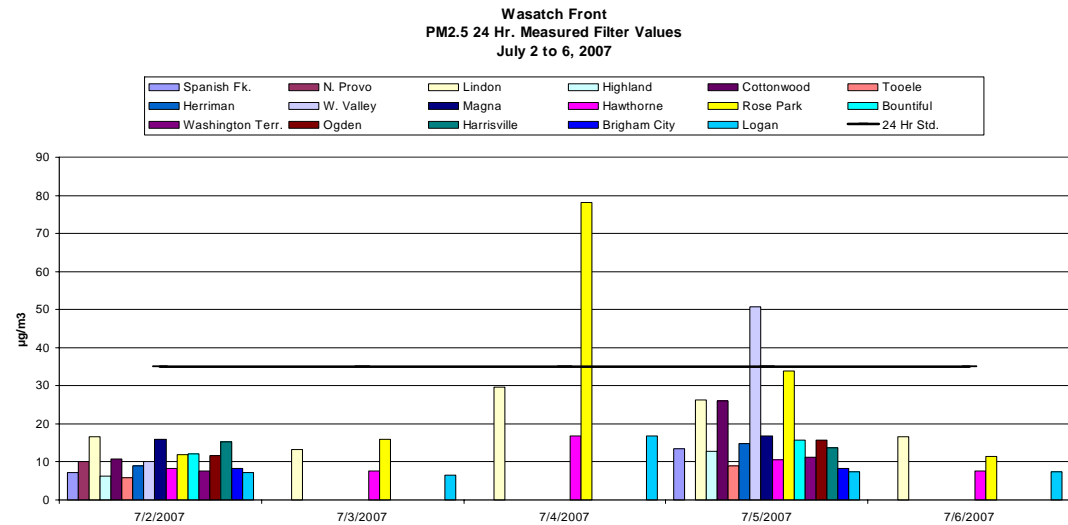
- Around 10 pm southerly light winds transported smoke entrained air mass from the urbanized center to the Rose Park monitor.
- Although there was no singular emission source identified, much the firework displays were located to the south of the Rose Park monitor.



Clear and Causal Relationship (Cont)

Regional scope of emission impact:

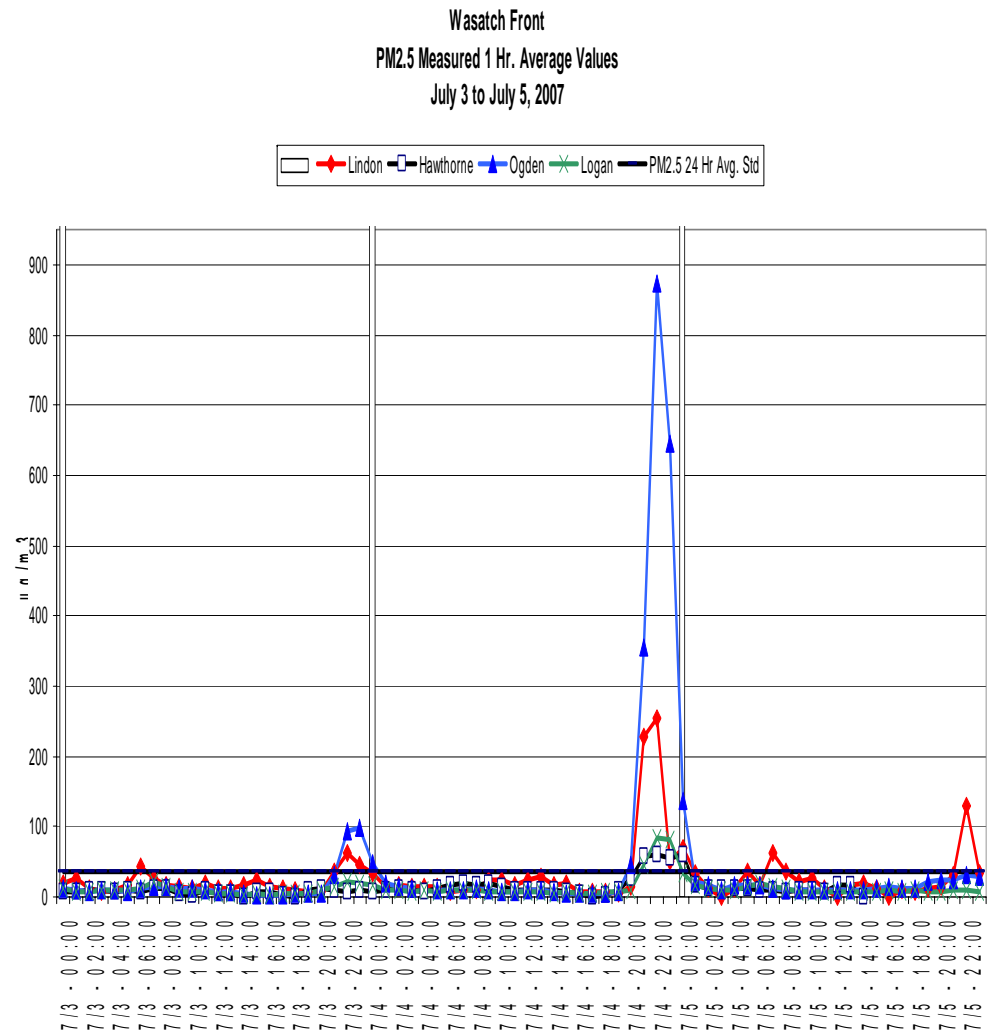
- Smoke from fireworks displays through out the Wasatch Front impacted many of the particulate monitors in the network.
 - PM2.5 values in the Wasatch Front were elevated from the Lindon monitor in Utah County to the Logan monitor in Cache County .
 - Visible observations of the Salt Lake Valley indicate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



Clear and Causal Relationship (Cont)

Relationship in time of emission impact:

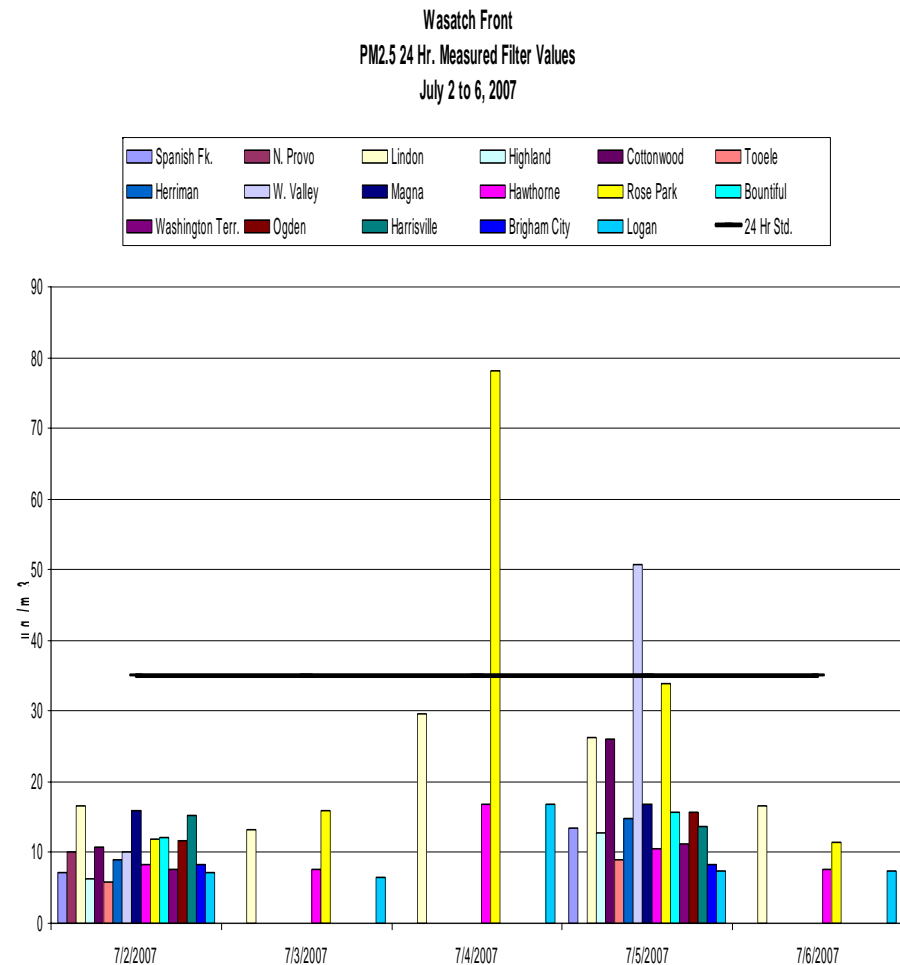
- The impact from fireworks is observed to occur in the evening and night of July 4th and continues into the early morning of July 5th.
- Graphs of hourly values captured at monitoring sites in the Wasatch Front verify the timing of the impact all along the Wasatch Front.



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 5th at the West Valley monitor as the filter chemistry verifies.
 - The July 5th Value from West Valley and Rose Park monitors likely includes some carryover impact from the 4th during the early morning.
 - Had the West Valley monitored on the 4th, the value likely would have been higher than what was measured on the 5th.



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 $12.7 \mu\text{g}/\text{m}^3$.

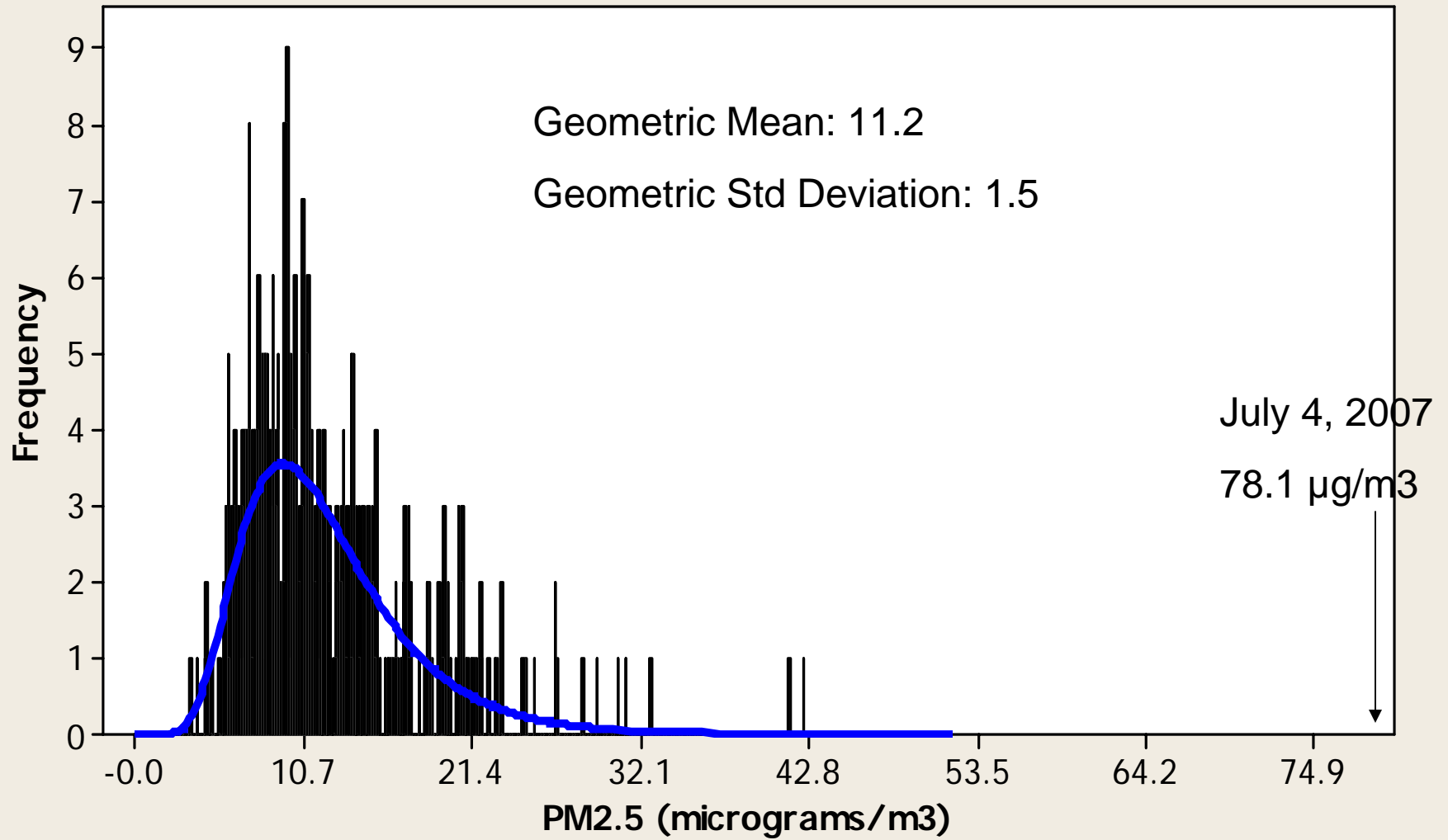
Concentration in Excess of Normal Fluctuations (Cont)

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_{2.5} 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)

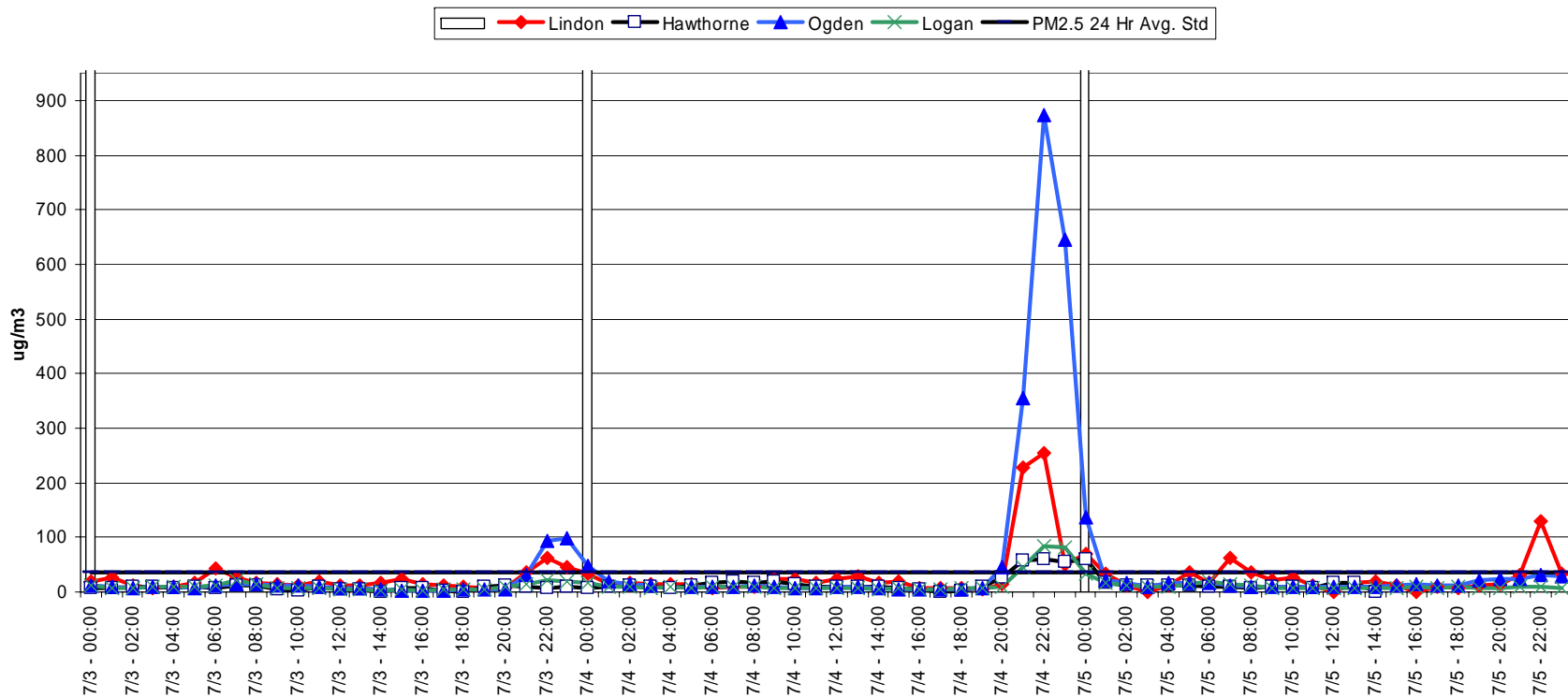
- However, to account for typical fluctuations we must subtract a representative amount.
 - Again, this might be described by one standard deviation above the mean.
 - In this case one standard deviation equates to $1.5 \mu\text{g}/\text{m}^3$.
- Hence, the amount of concentration that would be attributable 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_{2.5} values were very consistent.

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

Wasatch Front
PM_{2.5} Measured 1 Hr. Average Values
July 3 to July 5, 2007



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

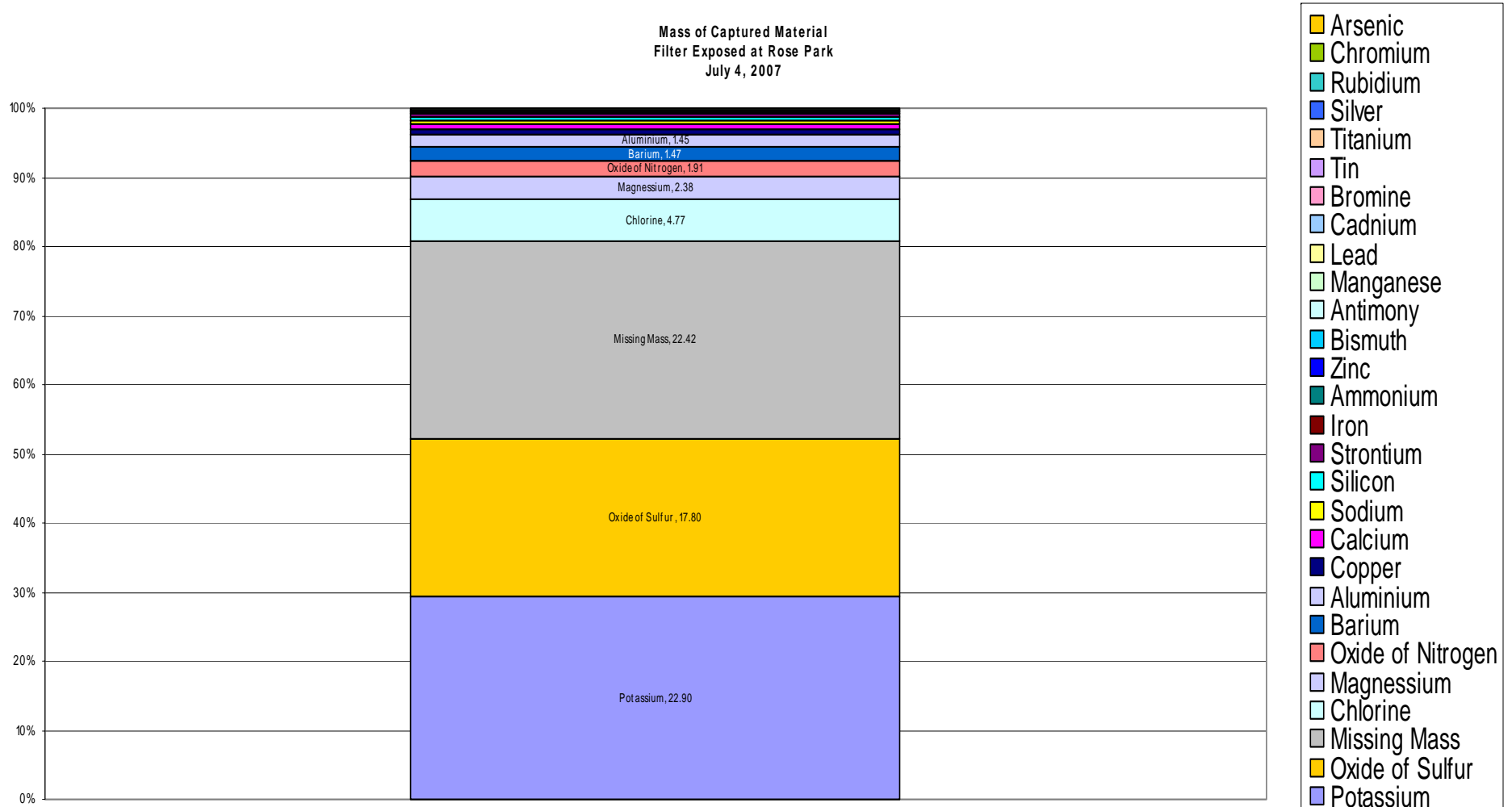
- A closer look at the raw data reveals that
 - Except for emissions from fireworks during the hours between 8 pm to 2 am on the 3rd, 4th, and 5th
 - Concentration values were consistently below the 20 ug/m³
 - Any hourly exception to these may indicate impact from localized use of fireworks.

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 wildfire 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 PM2.5 24-hour NAAQS **but for** the impact of emissions from fireworks!

Mitigation of Event

State Action included:

- Providing a news release prior to July 4th 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.

