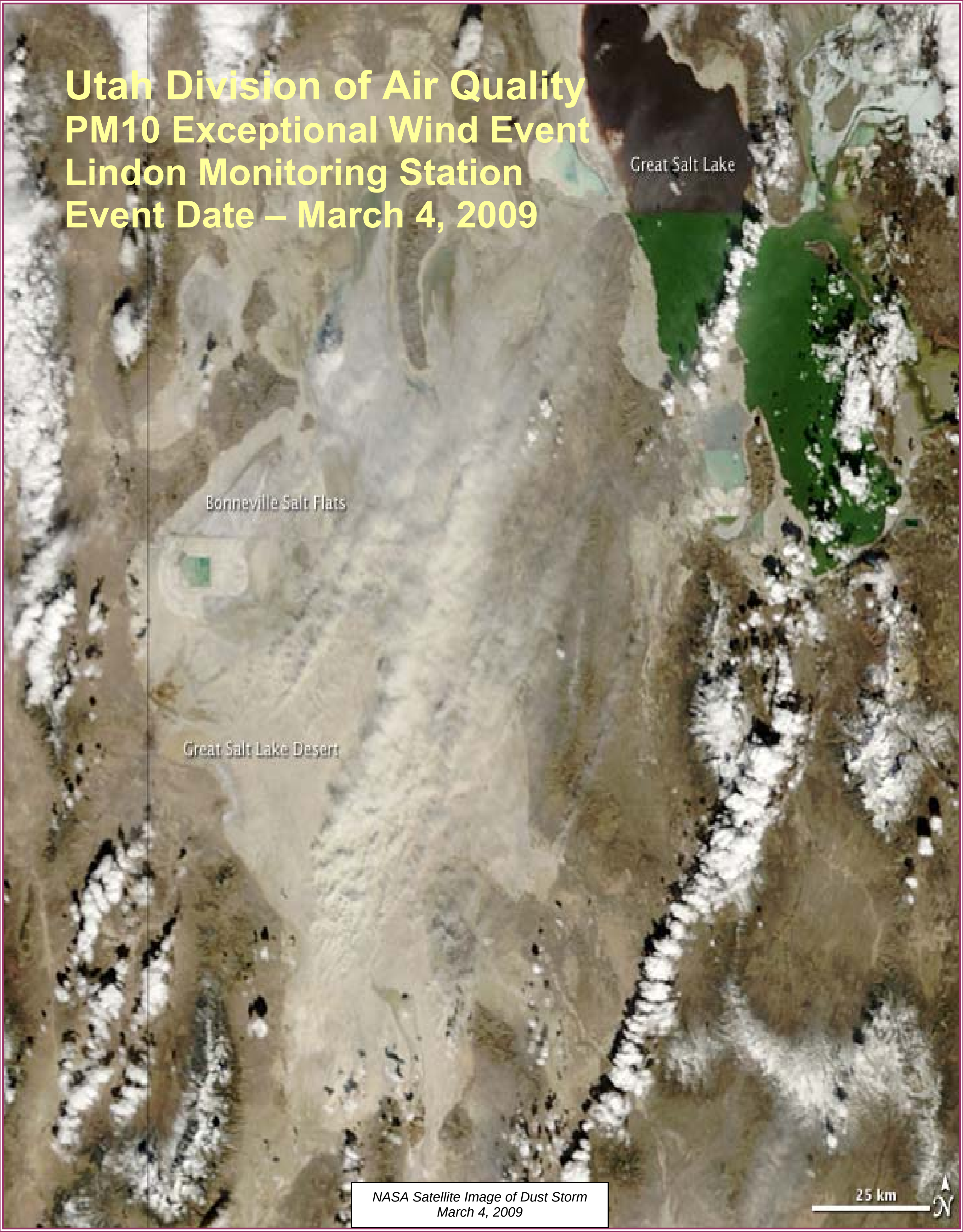
Utah Division of Air Quality
PM10 Exceptional Wind Event
Lindon Monitoring Station
Event Date – March 4, 2009



NASA Satellite Image of Dust Storm
March 4, 2009

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Definition of Event and Introduction

The Code of Federal Regulations (CFR) provides the definition and criteria for determining whether air quality data is impacted by an exceptional event. The 40 CFR 50.1 (j) definition states that "exceptional event means an event that affects air quality, is not reasonably controllable or preventable, is an event caused by human activity that is unlikely to recur at a particular location or a natural event, and is determined by the Administrator in accordance with 40 CFR 50.14 to be an exceptional event." The demonstration to justify data exclusion as outlined in 40 CFR 50.14 specifies that evidence must be provided that:

1. The event meets the definition of an exceptional event;
2. There is a clear causal relationship between the measurements under consideration and the event that is claimed to have affected air quality in the area;
3. The event is associated with a measured concentration in excess of normal historical fluctuations, including background;
4. There would have been no exceedance or violation but for the event; and
5. The demonstration must include a public comment process and documentation of such to the Environmental Protection Agency (EPA).

This report documents that the March 4, 2009, high wind dust storm event meets the above criteria and provides analyses to demonstrate that:

I. The high wind dust storm event was not reasonably controllable or preventable;
II. There is a clear-causal connection between the high wind dust storm event and the exceedance at the Lindon monitoring station;
III. The measured concentration was beyond normal historical levels; and
IV. The exceedance would not have occurred "but for" the dust storm and that a predominate portion of the PM10 originated from a non-anthropogenic source.

Conceptual Model

On Tuesday March 4, 2009, Utah experienced an intense natural meteorological event in association with the passage of a storm pattern. These storm passages have demonstrated high wind velocities. The National Weather Service in Salt Lake City stated that, "gusts of 50 mph would remain throughout the state through Tuesday and gusts of 25 mph will continue through Wednesday March 4." This exceptional natural event entrained particulates into the air by the high winds through a mechanism of surface erosion.

Mark Miller of the U.S. Geological Survey was in the field taking air measurements at the north end of the Milford flat area when he was overtaken by the storm. This photo was taken by Mr. Miller at 10:35 a.m. on March 4, 2009. Mr. Millers dust sampler is located directly in the center of the photo (to the right of the meteorological equipment that is visible) but it is not visible even though the sampler was only 80 ft. away from Mr. Miller. Mr. Miller recorded the wind speed at 25 mph, gusting to 35 mph.

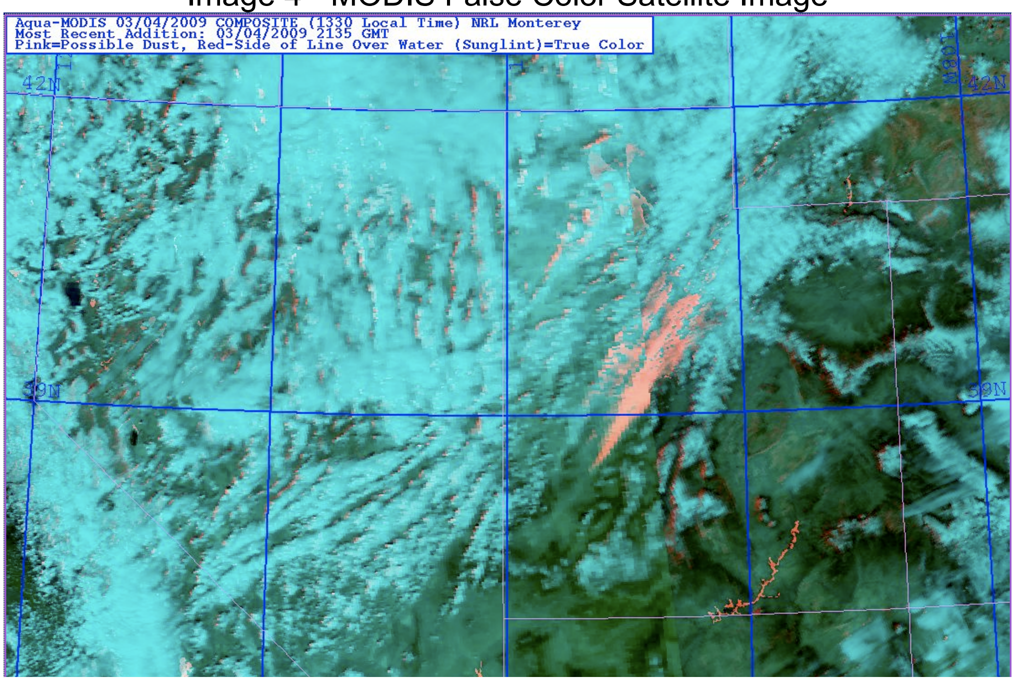
Image 1 - USGS Monitoring at North of Sand Ridge

Mr. Miller captured photos of the dust storm as it progressed.

Image 2 - Dust Emerging From Twin Peaks (March 4, 1:15 p.m.)

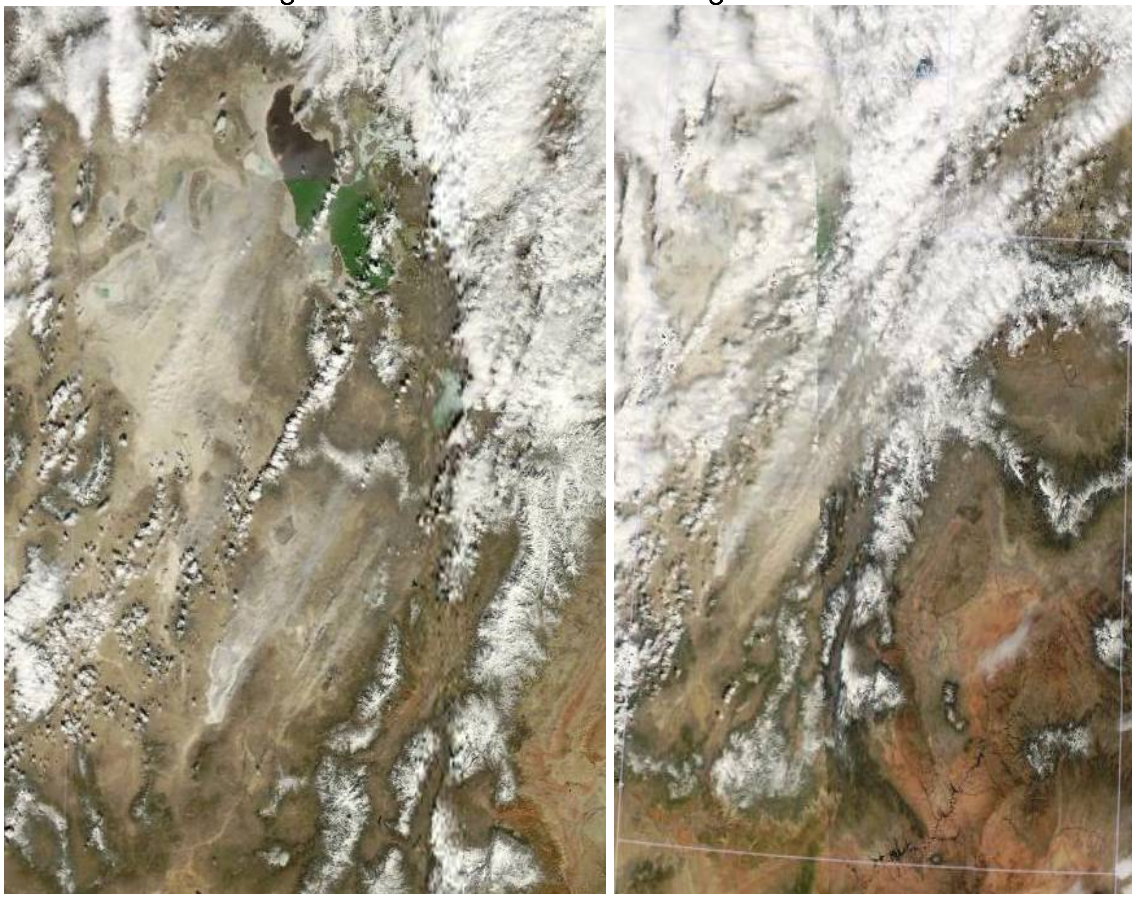
Image 3- Dust Plume at 4:45 p.m. at Kanosh

Image 4 - MODIS False Color Satellite Image



The pink areas in Image 4 are the dust storm. The visible satellite image (Image 5) taken on March 4th at noon shows dust storm clouds over the Great Salt Lake Desert, Bonneville Salt Flats, and the Sevier Desert.

Image 5 – Visible Satellite Showing Dust Storms

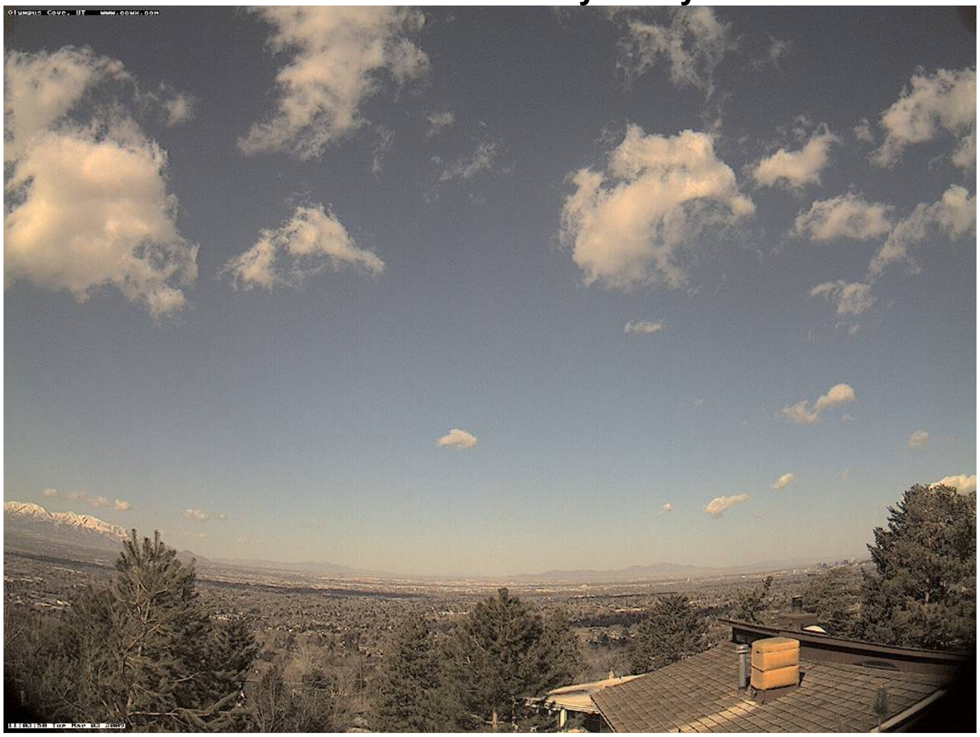


Trajectory and Impacted Area

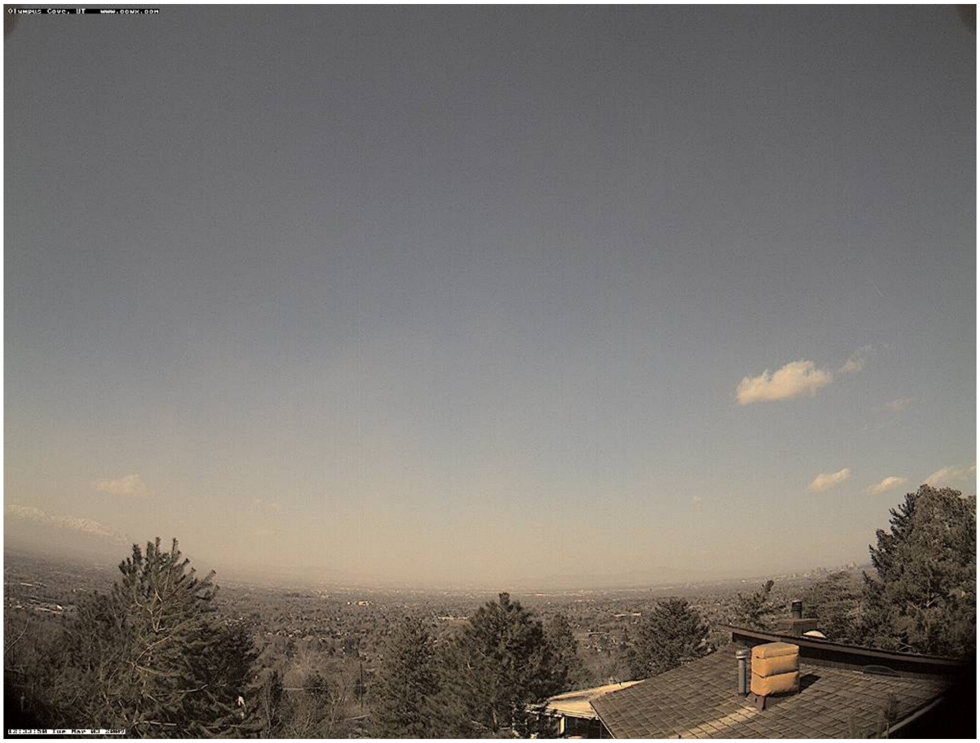
Backward trajectory analysis using the NOAA HYSPLIT model was used to project the winds up to storm height at 7 p.m. The wind was modeled (EDAS meteorological data) at 1000 meters, 8-hour back trajectory and plotted onto a Google Earth satellite image for visual enhancement. A height of 1000 meters was selected to represent the steering height of the air mass over the complex terrain.

The Lindon trajectory is labeled as Source Location and each hour of the trajectory is labeled from the time it crossed the Nevada-Utah border to the height of the PM10 concentration. Trajectories for the North Provo, Cottonwood and North Salt Lake stations are also shown. According to the National Weather Service, winds were oriented from the south-south west at North Provo until 8:30 p.m. and until 4 p.m. in Salt Lake City on the event day. General wind vectors and the trajectories agree, indicating that the natural dust source was the dust cloud from the Sevier Desert shown in the satellite image.

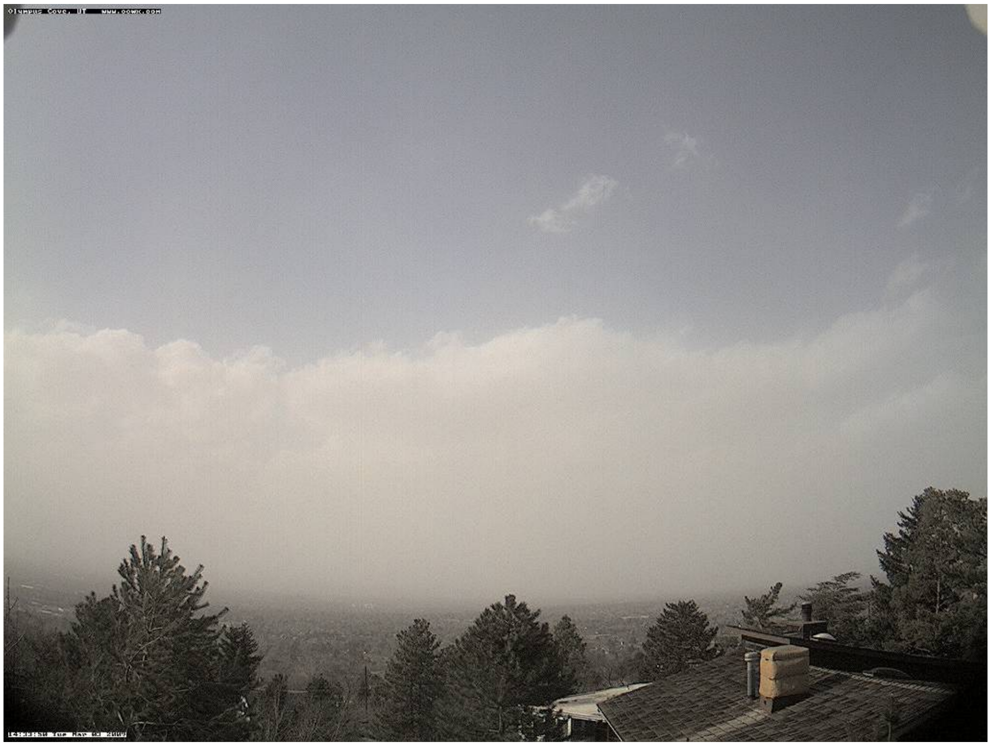
In The Salt Lake City Valley



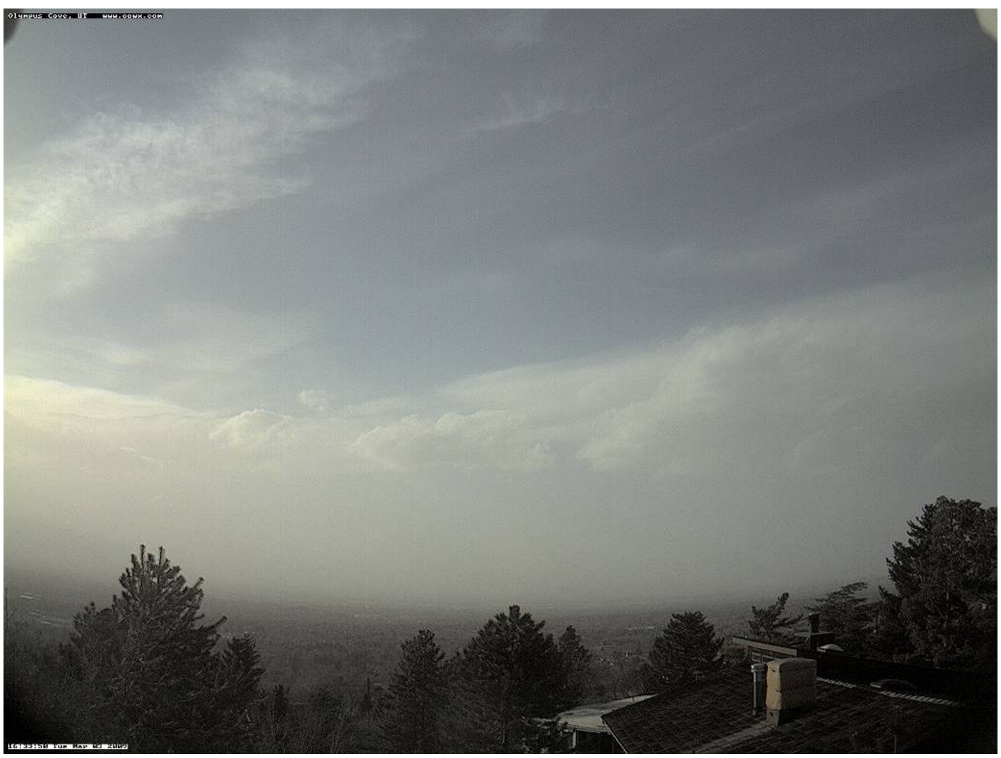
Salt Lake City residents enjoyed a sunny day the morning of March 4.



Slightly after noon that same day and about the same time as the visible satellite image above, the dust storm became visible in the valley.



Two hours later, half of the valley is no longer visible.



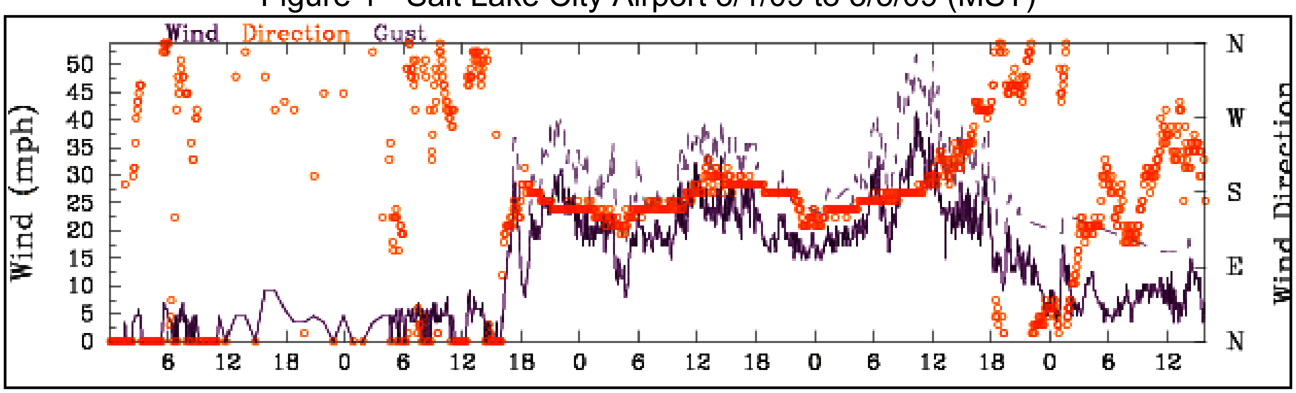
Another couple of hours, the valley is totally engulfed.

Morning of March 5. The dust storm moved out of the valley overnight.

Affect Air Quality

Sustained wind at or above 25 mph, with 35 mph gusts carrying dust appeared in the afternoon of March 2nd and continued to increase overall with gusts up to 50 mph until the late evening of March 4th. These wind speeds exceed the Environmental Protection Agency (EPA) wind threshold of 25 mph for winds to entrain dust.

Figure 1 - Salt Lake City Airport 3/1/09 to 3/5/09 (MST)



The dust storm and associated high winds resulted in elevated particulate levels across the monitoring network from March 2 to March 4. Elevated values were observed on March 2 to 4, with an exceedance of the 24-hour standard for PM10 at the Lindon station (200 µg/m^3). The same pattern held true for PM2.5 without exceedance of the PM2.5 standard.

Figure 2 - Storm Induced Elevated PM10

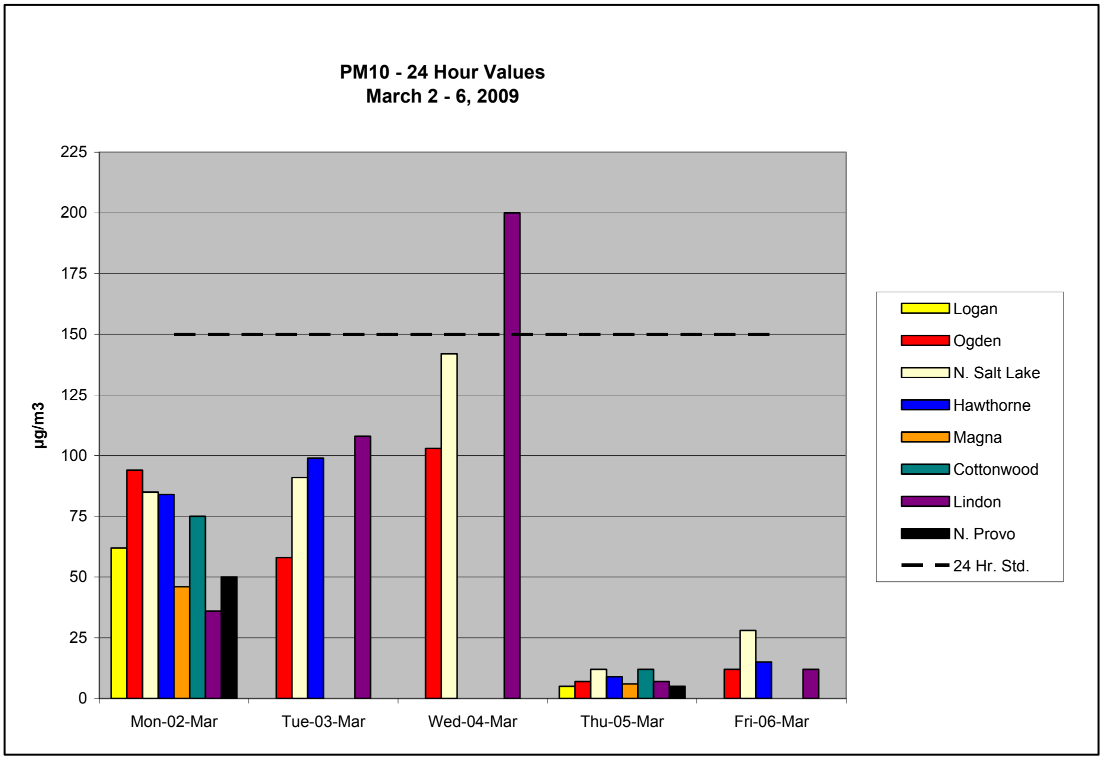
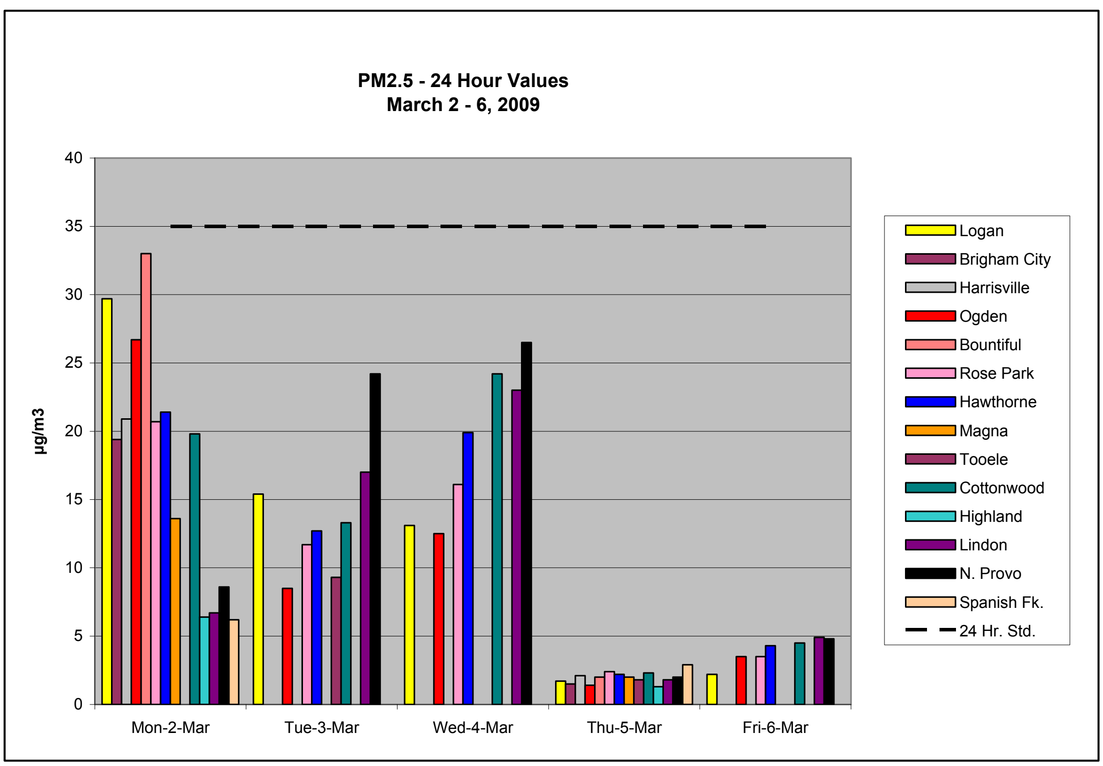


Figure 3 - Storm Induced Elevated PM2.5

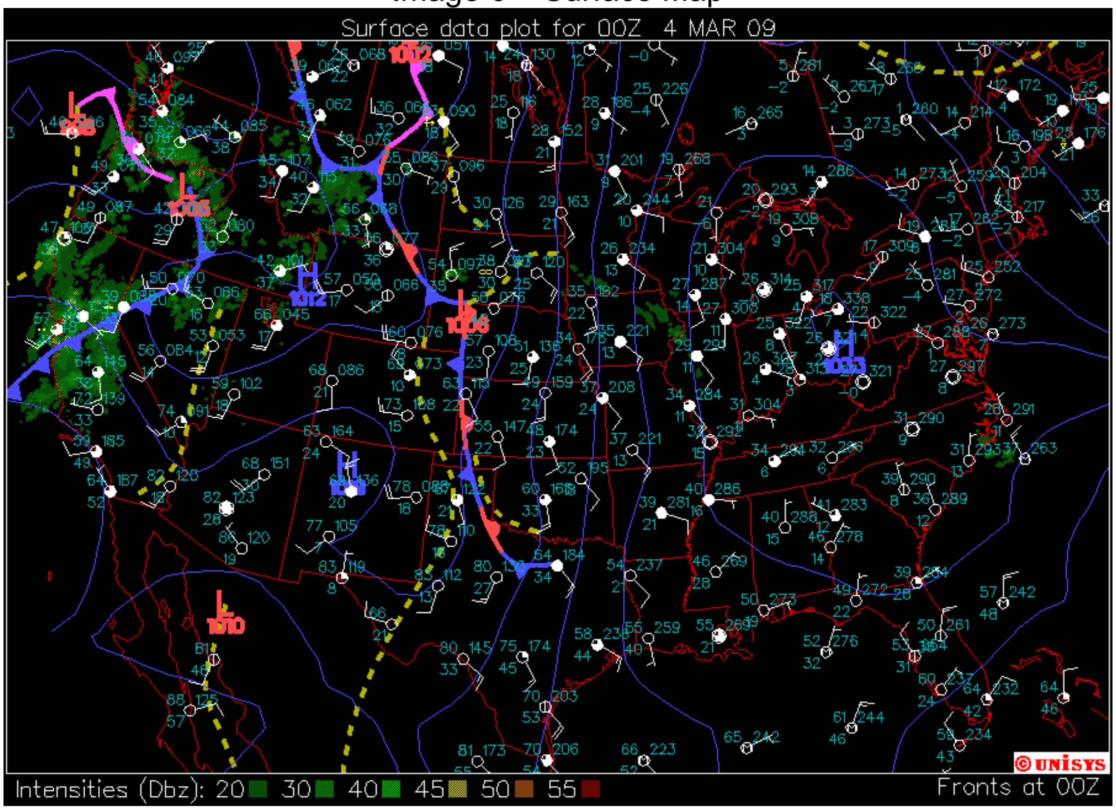


Not Reasonably Controllable or Preventable & Natural Event

Rapidly developed cold fronts produce strong winds and dramatic temperature gradients over the Intermountain West. As such, these storms are natural events. This seasonal spring occurrence creates the potential for wind eroded surface soils in the Utah deserts.

The surface map shows the cold front (blue line) in Nevada, and dry line (yellow line) approaching Utah.

Image 6 – Surface Map



Control Analysis

The Exceptional Events Rule Preamble states that, “where high wind events results in exceedances or violations of the particulate matter standards, EPA proposed that they be treated as natural events if…, and if anthropogenic activities which contribute to particulate matter emissions in conjunction with the high wind event are reasonably well-controlled.”

The State of Utah has developed a comprehensive program of controls for airborne fugitive dust implemented through existing Utah air quality rules, stationary source permitting, and State Implementation Plans (SIP) (approved by EPA). This system of control techniques for fugitive dust has been in place since 1992, when the current Utah PM10 SIP was developed. The SIP requires control measures for both specific and general PM10 fugitive dust sources along the Wasatch Front. The SIP process introduced Reasonably Available Control Technology (RACT) and Best Available Control Measures (BACM) for sources that existed prior to the SIP process and required Best Available Control Technology (BACT) for new sources and modifications of existing sources. BACT requirements are enforced through Utah administrative rule R307-401. Since 1992, the state has implemented and continually updated two administrative rules that control fugitive dust throughout the state. R307-205 and R307-309 which, taken together, apply to all significant fugitive dust sources in the state. These rules require each significant fugitive dust source to develop and implement a site-specific fugitive dust control plan. In effect, an approved dust plan defines BACM for a source, and provides a flexible mechanism for controlling airborne dust. Under the Utah SIP requirements and the Air Quality Rules, all eligible sources in Utah are subject to emission controls defined by RACT, BACT or BACM.

Control strategies contained in the SIP have been successful as evident by the fact that excluding data impacted by exceptional events, Utah would be in compliance with the PM10 national ambient standard.

Additional Rules

R307-202 Emission Standards: General Burning, prohibits burning of trash and other waste and salvage operations by open burning. Persons/agencies wishing to open burn tree cuttings, slash in forest areas etc., must seek a permit from DEQ that include control measures.

R307-204 Emission Standards: Smoke Management, establishes rules and procedures to mitigate the impact on public health and visibility of prescribed fire and wildfire.

R307-206 Emission Standards: Abrasive Blasting, establishes work practice and emission standards to control particulates. R307-30-6, a more stringent version applies in nonattainment areas.

R307-207 Emission Standards: Residential Fireplaces and Stoves, establishes emission standards for opacity. R307-302, a more stringent version applies in nonattainment areas.

Additional Anthropogenic Sources

Agricultural practices, by their nature, require dry field conditions which may generate fugitive dust. Agricultural practices are under the purview of the U.S. Department of Agriculture (USDA). Recognizing the problems associated with soil erosion on agricultural cropland, rangeland and other environmentally sensitive cropland areas, the USDA included conservation provisions in the Farm Security and Rural Investment Act of 2002 (Farm Bill). The conservation provisions of the legislation are designed to assist farmers and ranchers with a number of voluntary programs including cost-share, land rental, incentive payments, and technical assistance. The conservation programs of the Farm Bill are administered by the Natural Resources Conservation Service (NRCS).

The Farm Bill legislation created and reauthorized three programs that are designed to reduce erodible land:

- Conservation Reserve Program (CRP)
- Environmental Quality Incentives Program (EQIP)

The CRP encourages farmers to enter into contracts with USDA to place erodible cropland and other environmentally sensitive land into long-term conservation reserve. The reserves are generally 10 to 15 years in duration and the reserve is established by the implementation of environmental practices to reduce soil erosion.

The CRP systematically reduces soil erosion by planting vegetative cover on highly erodible lands (HEL). In Utah, HEL soils are normally on steeper valley side slopes subject to erosion from washing or open areas vulnerable to high wind events. In exchange, landowners receive annual rental payments for the land and cost-sharing assistance for the established practices. In the early years of the program, the emphasis was on HEL soils. Since 1996, there is an additional authorization to address wild life habitat and air quality. The more recent authorization includes additional conservation practices including windbreaks, riparian buffers and wetland mitigation which are instrumental in reducing soil erosion. Further consideration is also given to air quality where eligible parcels located in or adjacent to nonattainment areas received a higher score in the evaluation process.

The EQIP is a voluntary program that assists farmers and ranchers, who face existing soil and water resource degradation. The EQIP promotes agricultural production in a manner that allows producers to meet federal, state and local environmental requirements. Some of the stated aims of the program are as follows:

- Reduction of non-point source pollution, such as nutrients, pesticides;
- Reduction of emissions including particulate matter, nitrogen oxides, ozone precursors, and volatile organic compounds that can contribute to degradation air quality standards; and
- Reduction in soil erosion and sedimentation on agricultural lands.

In general, NRCS programs encourage agricultural practices that improve topsoil and prevent wind blown dust during high-wind events. Notable examples of techniques and practices advocated include:

- Planting of cover crops and perennials to protect agricultural soils with emphasis on HEL soils;
- NRCS encourages the use of perennial crops and existing weeds on corners and non-utilized areas of agricultural land to resist soil erosion;
- NRCS "costs shares" on conservation practices with local farmers to prevent soil erosion; and
- NRCS works with Utah State University to identify agricultural techniques and practices to minimize soil erosion.

A primary aim of this process is to reduce soil erosion on agricultural land, which in turn reduces wind blown dust during high-wind events. This program is open to attainment and nonattainment areas in Utah. There are 1,133,687 acres in this program in Utah.

Utah Initiatives

Utah Clean Diesel Program

Agriculture: Diesel engines are a major source of pollution, emitting particulates, amongst other pollutants. DAQ applied for and received $750,000 from the American Recovery and

Reinvestment Act to replace 11 agricultural vehicles and equipment, repower 21 engines in agricultural vehicles and equipment, and install 30 Auxiliary Power Units on agricultural vehicles. DAQ collaborated with the Utah Department of Agriculture and Food and Utah State University to identify agricultural operators whose operations are negatively impacting non-attainment areas in the state. The project's scope of replacing, repowering, and installing more fuel efficient technology on agricultural vehicles and equipment will ensure that stricter emissions standards requirements are met and yield more diesel fuel conservation.

School Bus Project: In 2007, DAQ started the Utah Clean School Bus Project in conjunction with Utah Office of Education, local school districts, county and municipal governments, as well as community and non-profit organizations. This coalition is working together to secure funding sources for school districts to purchase emission reducing technologies for buses statewide. The application of these technologies is expected to reduce particulate matter by 30%. A total of 1,179 buses have been retrofitted.

Clean Diesel Trucking Initiative: DAQ initiated the Clean Diesel Grant Program to install APUs (Auxiliary Power Units) on 48 long-haul tractors that will reduce diesel emissions and fuel usage from diesel-powered, long-haul trucks that travel and idle within the non-attainment areas of the Wasatch Front. The funding was provided by a State allocation of $352,941 through EPA's National Clean Diesel Campaign and a State match of $235,294, for a total of $588,235. EPA awarded DAQ a grant in 2010 to continue installation of APUs.

Clean Fuel Vehicle Tax Credit and Loan Program

The Utah Clean Fuels and Vehicle Technology Grant and Loan Program, funded through the Clean Fuels and Vehicle Technology Fund, provides grants to assist businesses and government entities in covering:

1) The cost of converting a vehicle to operate on clean fuels.
2) The incremental cost of purchasing an Original Equipment Manufacturer (OEM) clean fuel vehicle.
3) The cost of retrofitting diesel vehicles with EPA verified closed crankcase filtration devices, diesel oxidation catalysts, and/or diesel particulate filters.

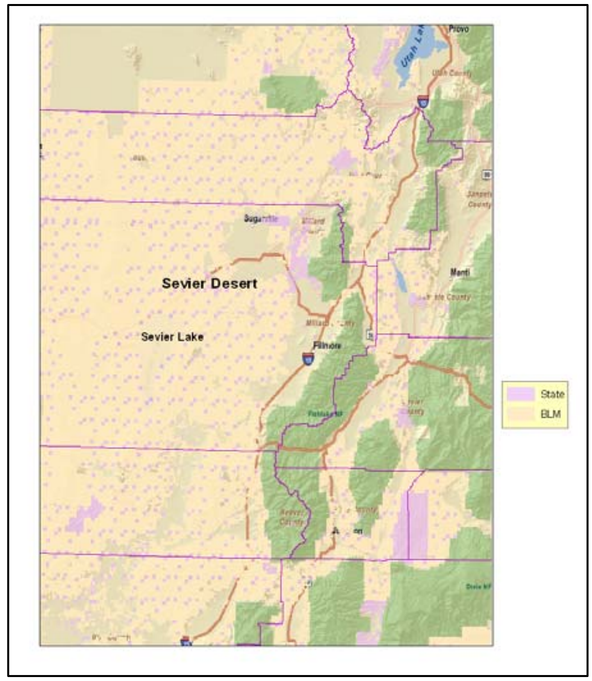
The Clean-Fuels Grant and Loan Program also provides loans for the cost of converting a vehicle to operate on a clean fuel, for the purchase of OEM clean fuel vehicle, and for the purchase of fueling equipment for public/private sector business and government vehicles. Finally, the program can provide grants and loans to serve as matching funds for federal and non-federal grants for the purpose of converting vehicles to operate on a clean fuel, purchasing OEM clean fuel vehicles, or retrofitting diesel vehicles.

Natural Area Sources

Draft EPA guidance on high wind exceptional events issued May 2011, states that it is unreasonable to expect states to have controls in place where states do not have jurisdiction. However, EPA believes that these major source areas should be discussed in exceptional events demonstrations. The land use map shows the predominate jurisdiction for natural areas lies with the Bureau of Land Management (BLM).

Sevier Desert Playa

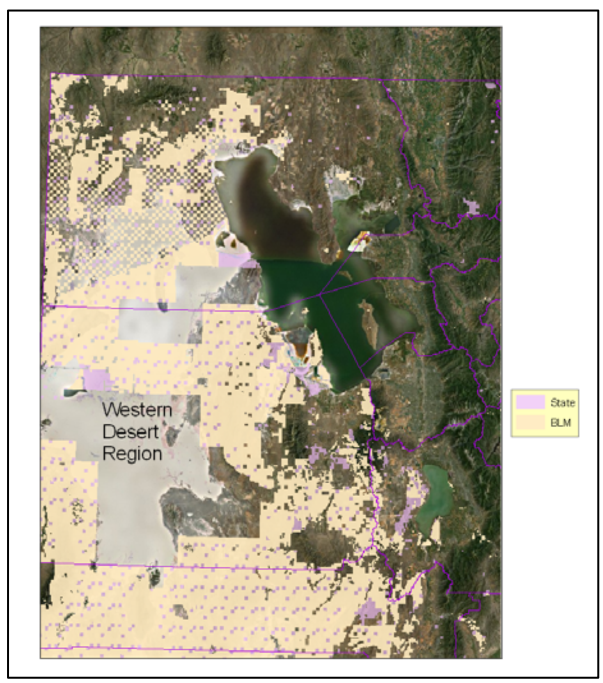
BLM is the dominant land owner for the entire region, including the Sevier Desert. The beige color indicates BLM ownership. The state of Utah owns small, mostly noncontiguous parcels of land, shown in purple, throughout the region that by themselves, are not a major dust source.



The Sevier Desert contains many low lying areas with dry lake beds (playa). The playa areas consist of silt and clay lake bed deposits with particle sizes ranging from 1 to 62.5 micrometers. The evaporite material is high in magnesium, sulfur and chloride ions which is discussed in detail below. The lake beds have been mostly dry throughout recorded history and are a source of wind-blown dust in dust storms that frequently impact the Wasatch Front. Sevier Lake is a large lake bed and is an intermittent and endorheic (terminal) lake which lies in the lowest part of the Sevier Desert, Millard County, Utah. The playa areas are remnants of Pleistocene Lake Bonneville.

Western Desert - Great Salt Lake Desert

The Great Salt Lake Desert, located directly west of the Great Salt Lake, near the Nevada border, is part of an arid region made up of salt flats, playa lake beds and desert lands. Vast acreage is owned by BLM. Like the Sevier Desert, these areas are remnant of Lake Bonneville and are a source of wind-blown dust. The land ownership map identifies the BLM land in beige.



Normal Historical Fluctuation

PM10

Normal historical fluctuation for PM10 was computed in a three-step process in order to assess whether an observed value is in excess.

First, all historical PM10 values from each monitoring station were aligned from least to greatest. The location of the effected value in relation to the rest of the historically values is expressed as a %ile.

Second, a box plot analysis was preformed on the historical data. The interquartile range (IQR) was calculated. This was then compared to the event value.

Third, a lognormal distribution analysis was preformed on the historical data. The geometric mean, geometric standard deviation, and the 1st, 2nd, and 3rd geomantic standard deviations above the geometric mean where calculated. These where then compared to the event value.

In addition, an analysis is included showing that wind speeds during this event are not the norm.

Ranking

Guidance found at 72 Federal Register 55 March 22, 2007, pages 13560-81, states that a lesser amount of documentation would likely be necessary for “extremely high” concentrations (e.g. > 95^{th}%ile) than for concentrations that were closer to “typical levels” (e.g. < 75^{th}%ile).

The data ranking for the Lindon monitoring station data collected from 1993 through 2009 verifies that the PM10 concentration on March 4, 2009, is above the 99^{th}%ile. Consequently, we can conclude that the event day concentration is outside the normal historical fluctuation.

Interquartile Range

The IQR is a measure of statistical dispersion, and is a “robust statistic.” Robust statistics seek to provide methods that emulate classical methods, but which are not unduly affected by outliers or other small departures from model assumptions. The IQR was calculated on a quarterly basis and on a yearly basis.

The following is the IQR for all Lindon data:

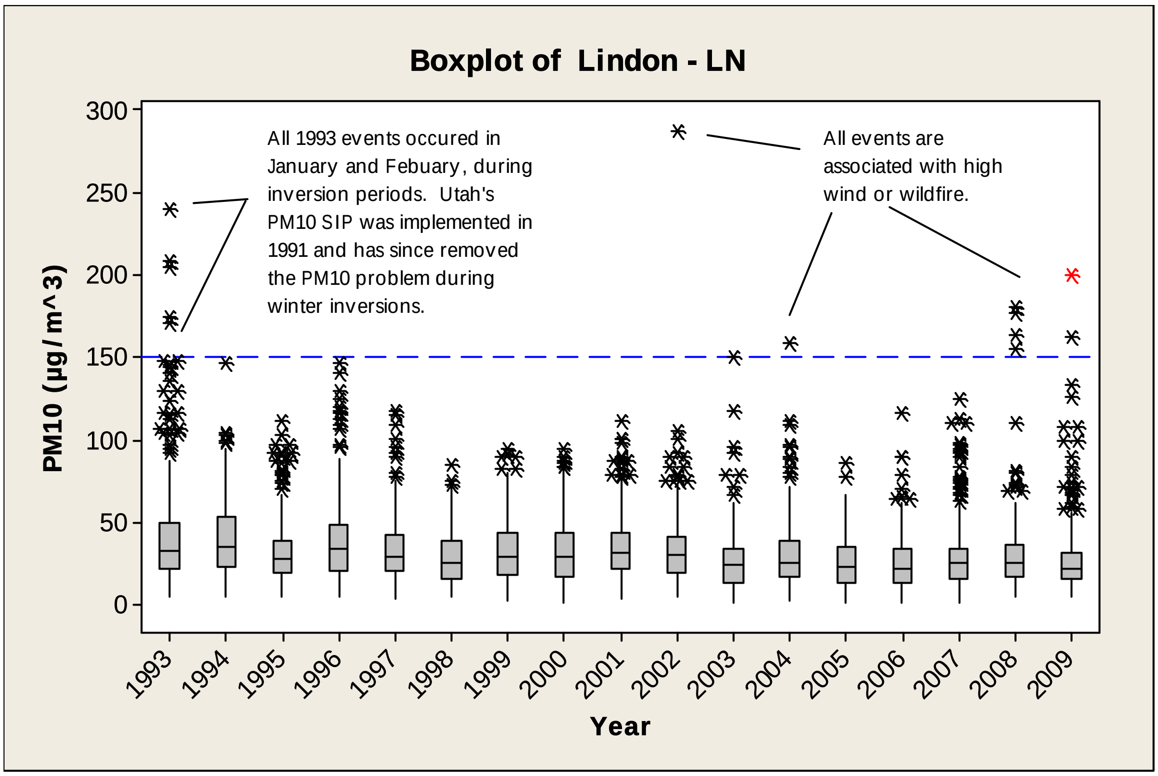
First Quartile (Q1): 17 µg/m^3
Median (Q2): 27 µg/m^3
Third Quartile (Q3): 40 µg/m^3
IQR: 23 µg/m^3

The IQR was calculated on a quarterly basis (shown in Table 1) along with the annual.

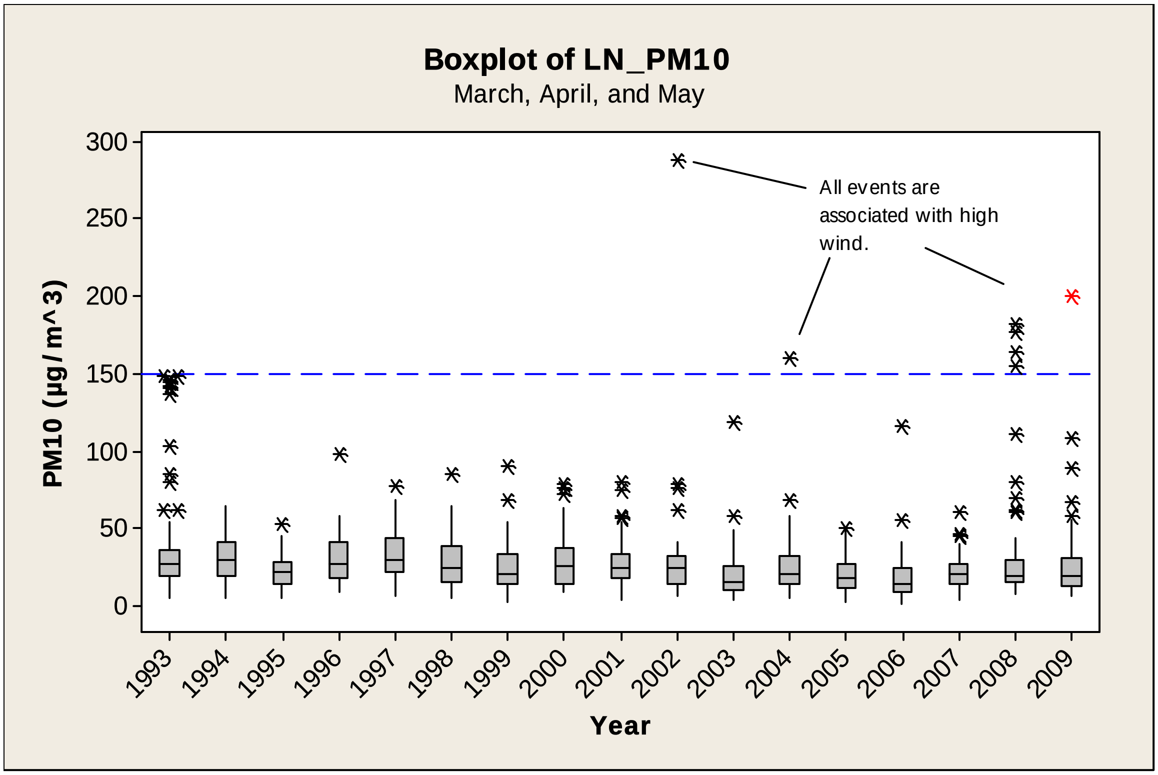
Table – 1 Lindon Interquartile (µg/m3)

Quarter	Sample Size (N)	Q1	Q2	Q3	IQR
1	1456	15	26	48	33
2	1511	14	22	32	18
3	1446	24	32	42	18
4	1389	17	26	38	21
All	5802	17	27	40	23

The boxplot presents the historical PM10 values, by year; the event value is marked in red. The blue dashed line represents the current PM10 standard.



Because this event occurred during the second quarter, it maybe more valuable to focus on other PM10 values during the same time of the year, March-May. The revised boxplot presents the historical PM10 values, by year, during the 2nd quarter (March-May) of each year. The event value is marked in red. The blue dashed line represents the current PM10 standard.



All events that exceed the current PM10 standard are associated with high wind events.

Analysis of the boxplot graphs permit us to conclude that the event concentration is outside of normal historical fluctuation.

Lognormal Distribution

Lognormal distribution analysis was conducted to establish the normal historical fluctuations for the Lindon station (inclusive of exceptional event results). Lognormal distribution was selected because of its ability to accurately describe the distribution of measured concentrations of PM10. The geometric mean (µgeo) was calculated on a quarterly basis (shown in Table 2) and on an annual basis. The annual basis provides the greatest number of data points and is sufficiently similar to the spring quarterly value thus; the annual geometric mean is used to reflect the normal historical value.

Table 2 – Geometric Mean of PM10

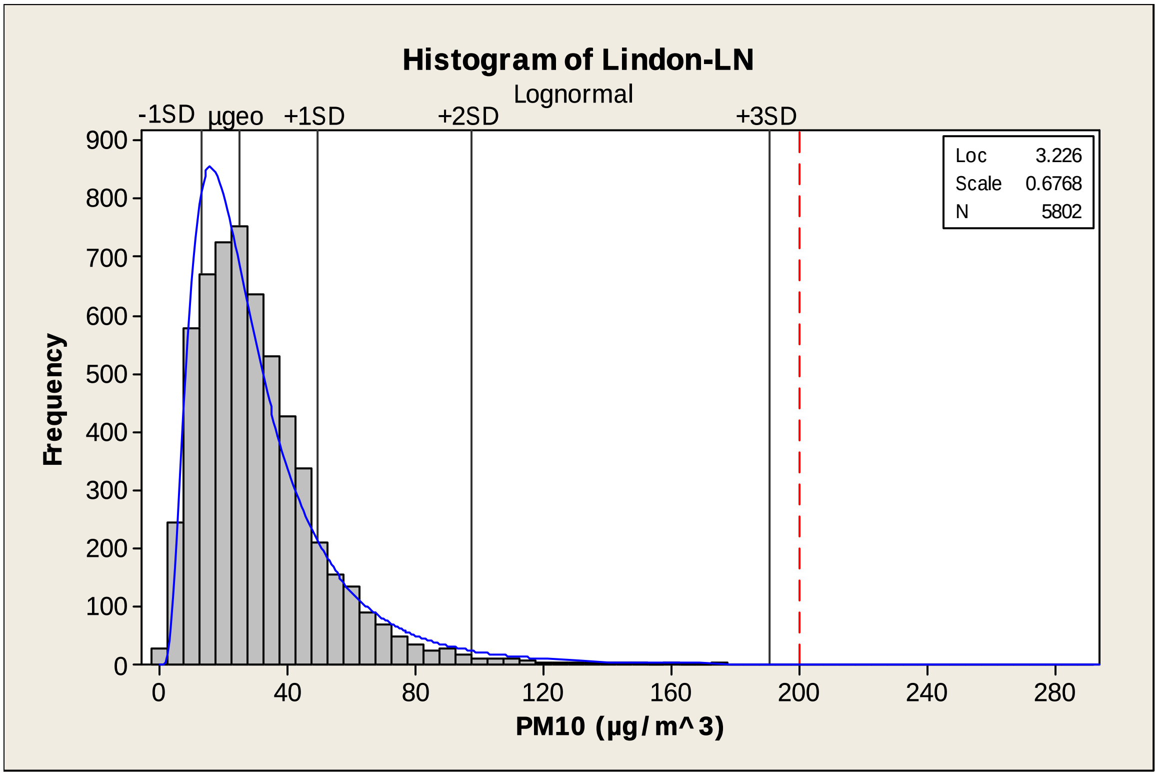
Location	Quarter	N Quarterly	µgeo (µg/m^3)	Annual ugeo (µg/m^3)
Lindon 01/01/1993 to 12/31/2008	1	1456	26.00	25.18
	2	1511	20.64	
	3	1446	31.03	
	4	1389	24.31	

The annual value is far below the March 4th event of 200 µg/m^3.

The following are the calculations for the geometric mean, geometric standard deviation, and the upper boundary of the 1st, 2nd, and 3rd standard deviations from the geometric mean.

Geometric Mean (μgeo): Exp(Loc)=25.18
Geometric Standard Deviation (σgeo): Exp(Scale)= 1.9676
+1 Standard Deviation (+1SD): Exp(Loc +Scale)= μgeo* σgeo= 49.54
+2 Standard Deviation (+2SD): Exp(Loc +2*Scale)= μgeo* (σgeo)^2= 97.48
+3 Standard Deviation (+3SD): Exp(Loc +3*Scale)= μgeo* (σgeo)^3= 191.79

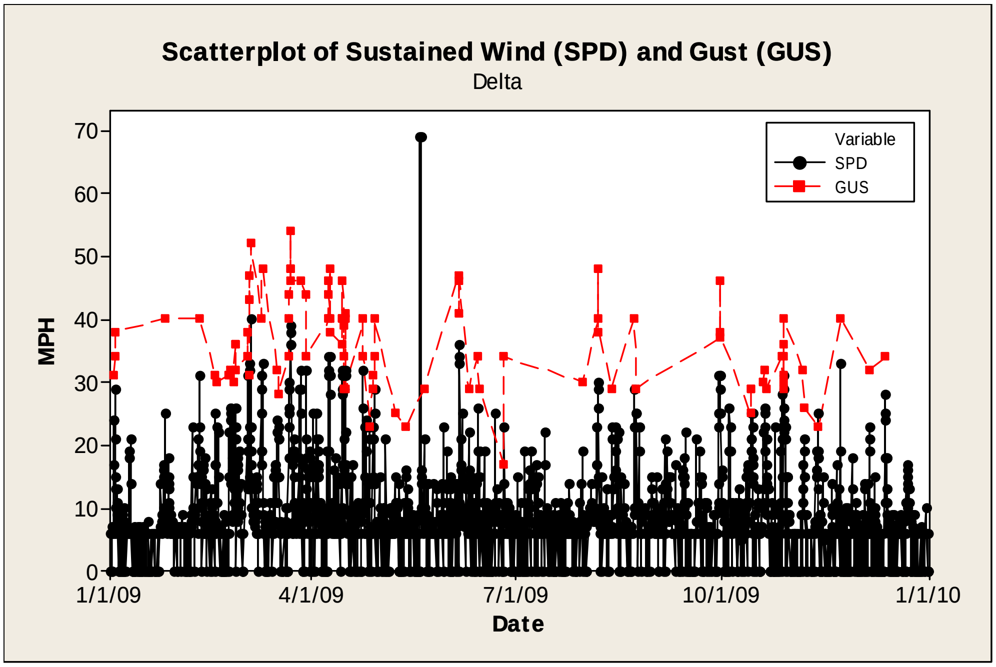
The histogram presents the historical values and the event value with a red dashed line. The blue line is a fitted line overlay of a lognormal distribution.



Noting that the normal historical values fall within the lognormal distribution, it is reasonable to utilize plus or minus 2SD above the geometric mean as the bounds of normal PM10 values. The event value **exceeds 3SD.** The event value is clearly outside the normal historical fluctuation.

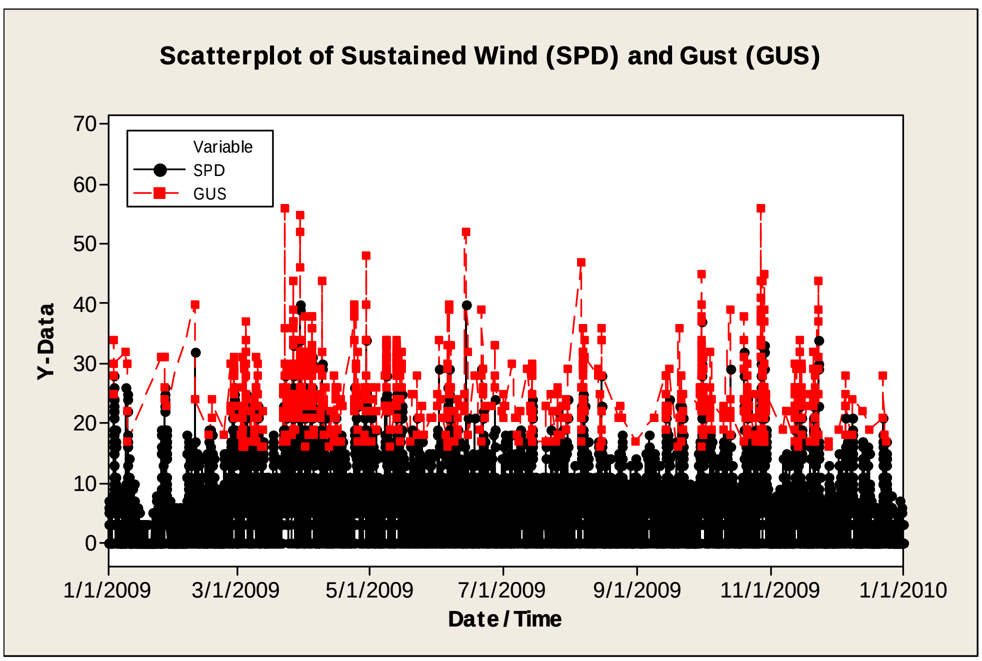
Wind Speed

Predominant Source Area: Southwest Desert, Closest Meteorological Station - Delta, Utah



Wind Speed on 3/4/2009:
Max sustained Wind = 40mph
Max Wind Gust = 52 mph

Receptor Area: Lindon Monitoring Station, Closest Meteorological Station – Provo, Utah



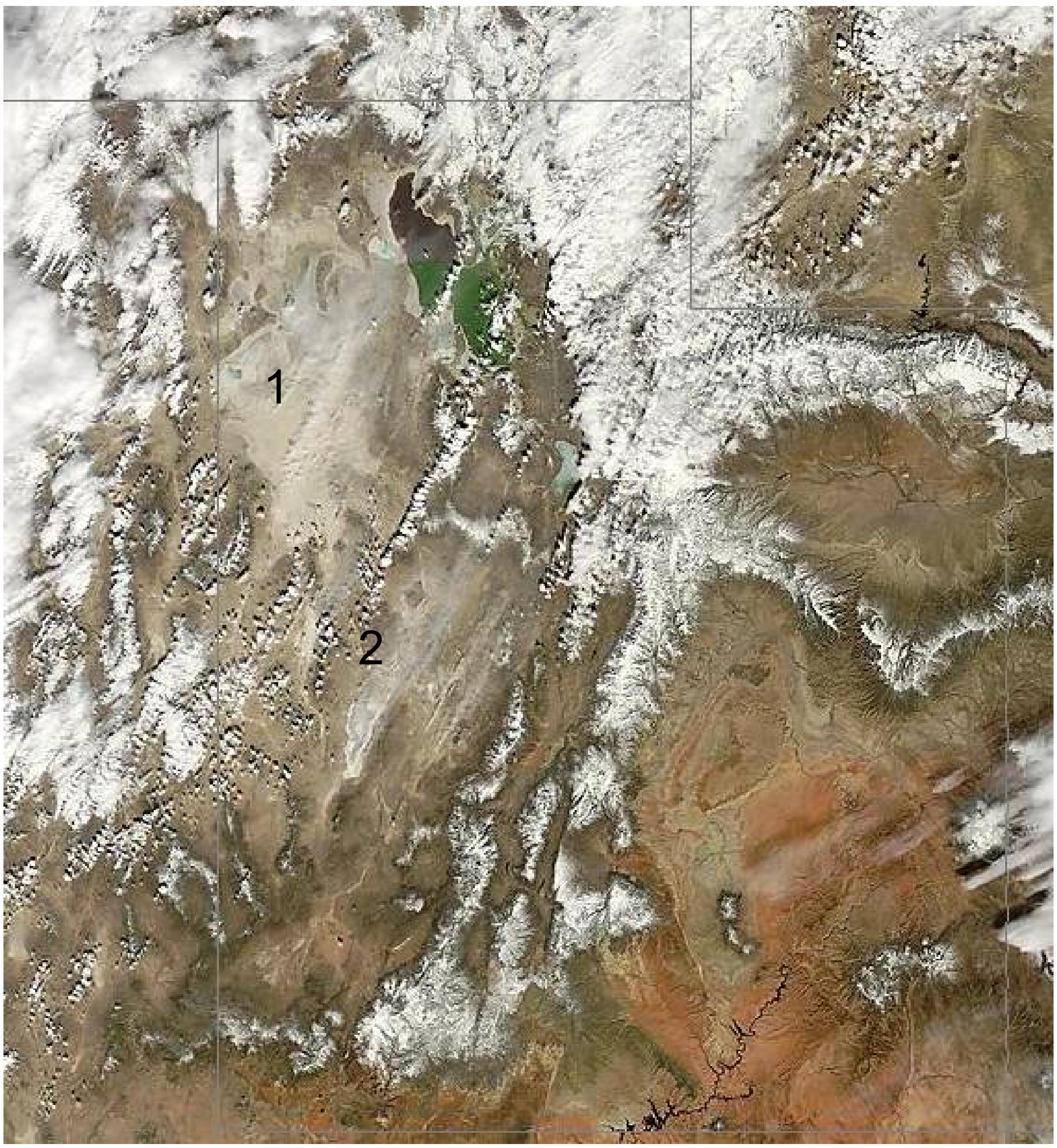
Wind Speed on 3/4/2009:
Max sustained Wind = 25mph
Max Wind Gust = 77 mph

Clear Causal Relationship

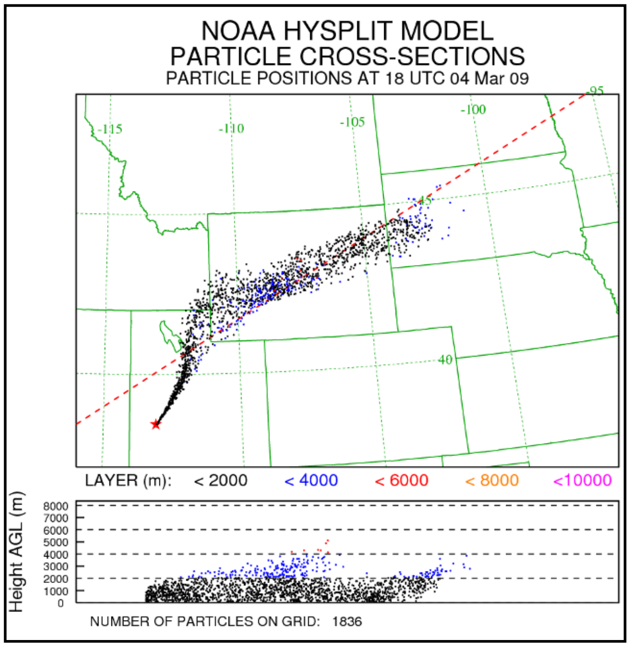
Visible Satellite Imagery

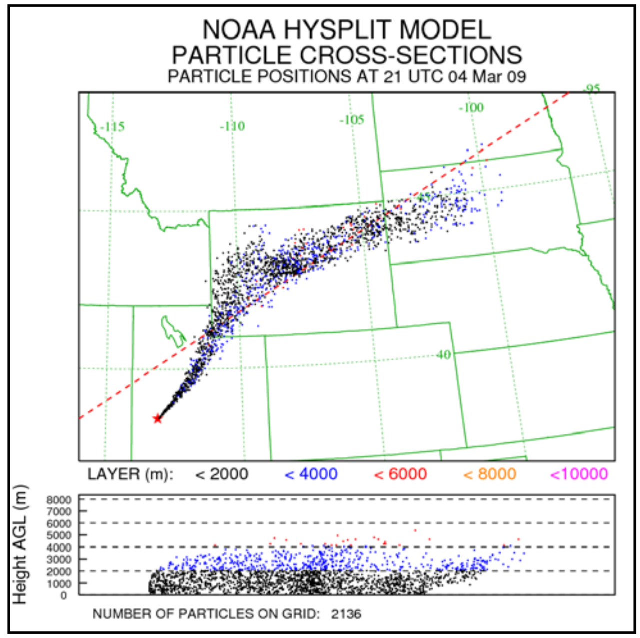
The visible satellite image shows two dust clouds, the larger one labeled as number one, encompasses the Great Salt Lake Desert. The second dust cloud and its plume originated from the Sevier Desert and Lake and can be seen heading towards Utah Lake. Particle modeling presented in this section will show that cloud number two impacted the monitoring stations along the Wasatch Front, because the predominate winds were from the south, while cloud number 1 traveled north to northeast, avoiding the northern monitoring stations.

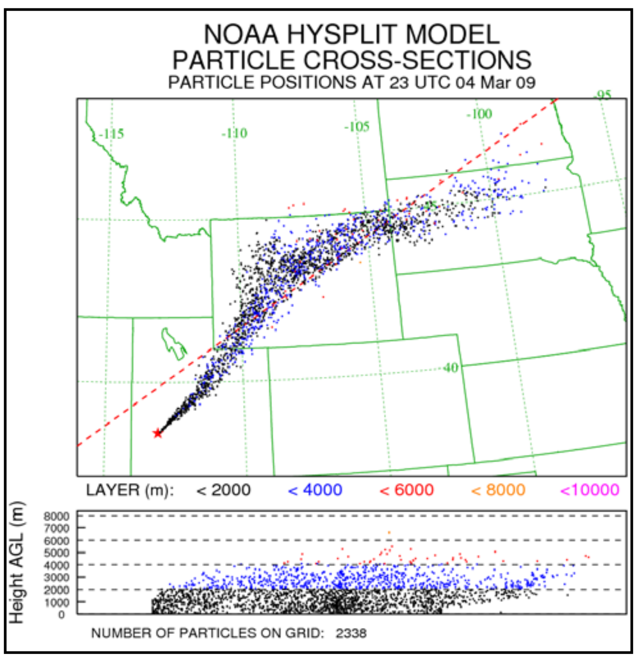
Image 7 – Visible Dust Clouds

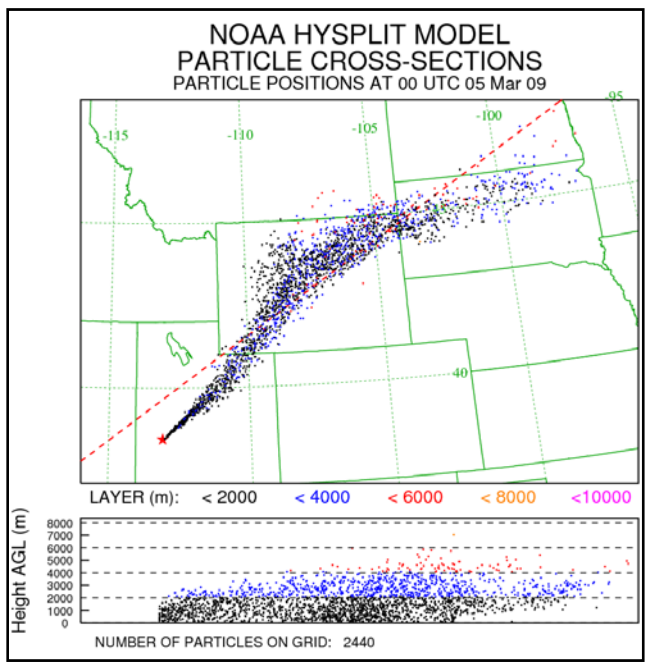


The Hysplit model was used to create a particle tracking of the dust storm from the Sevier Desert and Lake dust cloud (coordinates: 38.4457 -113.1046 at 500 meter). The model indicates that dust from the Sevier Desert and Lake entered the Salt Lake valley in the morning hours, elevating PM10 levels at all stations. By late afternoon, the cloud shifted eastward. This shift examples why the Lindon station was the only one that had exceeded the 24-hr standard, that is, the more northerly stations were no longer receiving dust particles from this plume, thereby reducing the 24 hour PM10 averaging for the other stations.

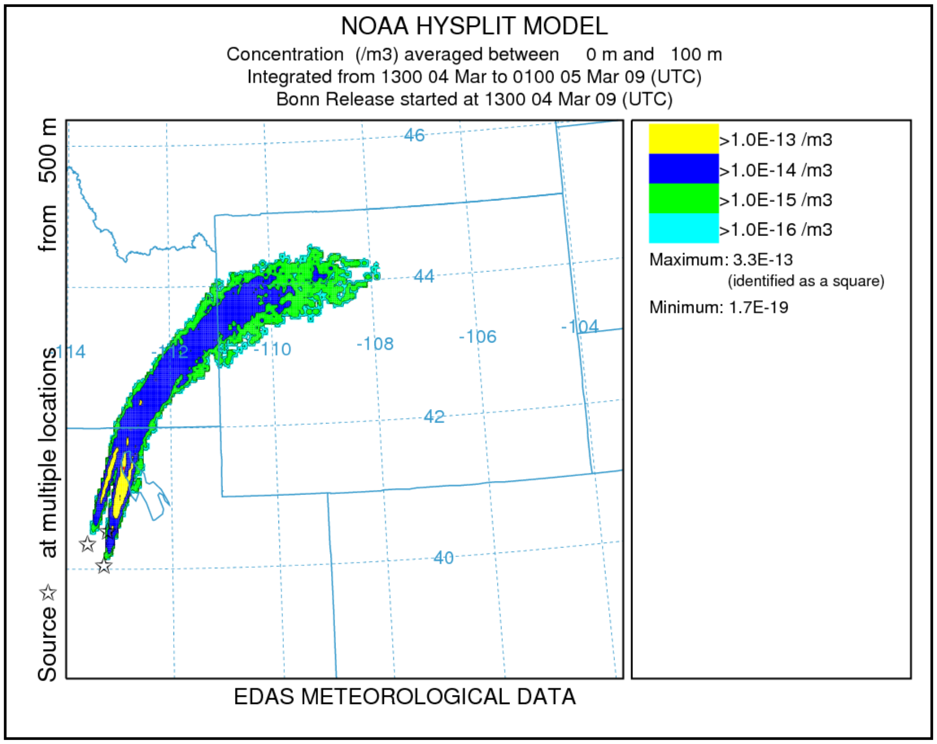


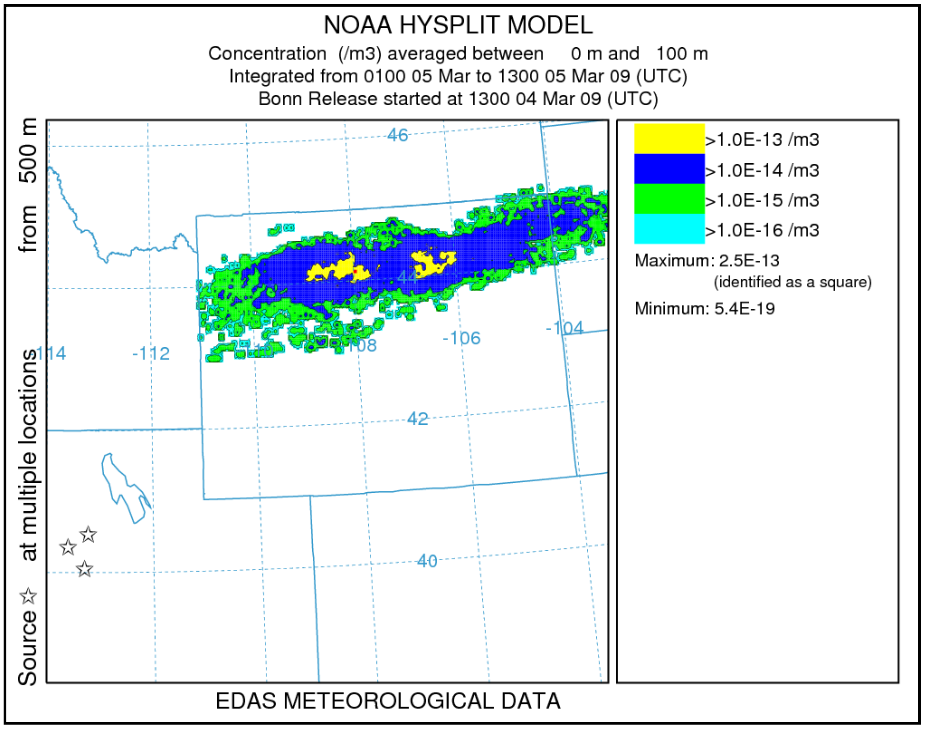






Meanwhile, contribution from the Great Salt Lake Desert dust cloud to the northern monitoring stations was limited, as can be seen from the Hysplit modeling of that plume. Contour plots of the southern, northern and western quadrants (40.465 -113.49, 40.072 -113.282 and 40.447 -113.124) of the Great Salt Lake Desert dust cloud indicates that the dust plume traveled far north of the Salt Lake valley monitoring stations.

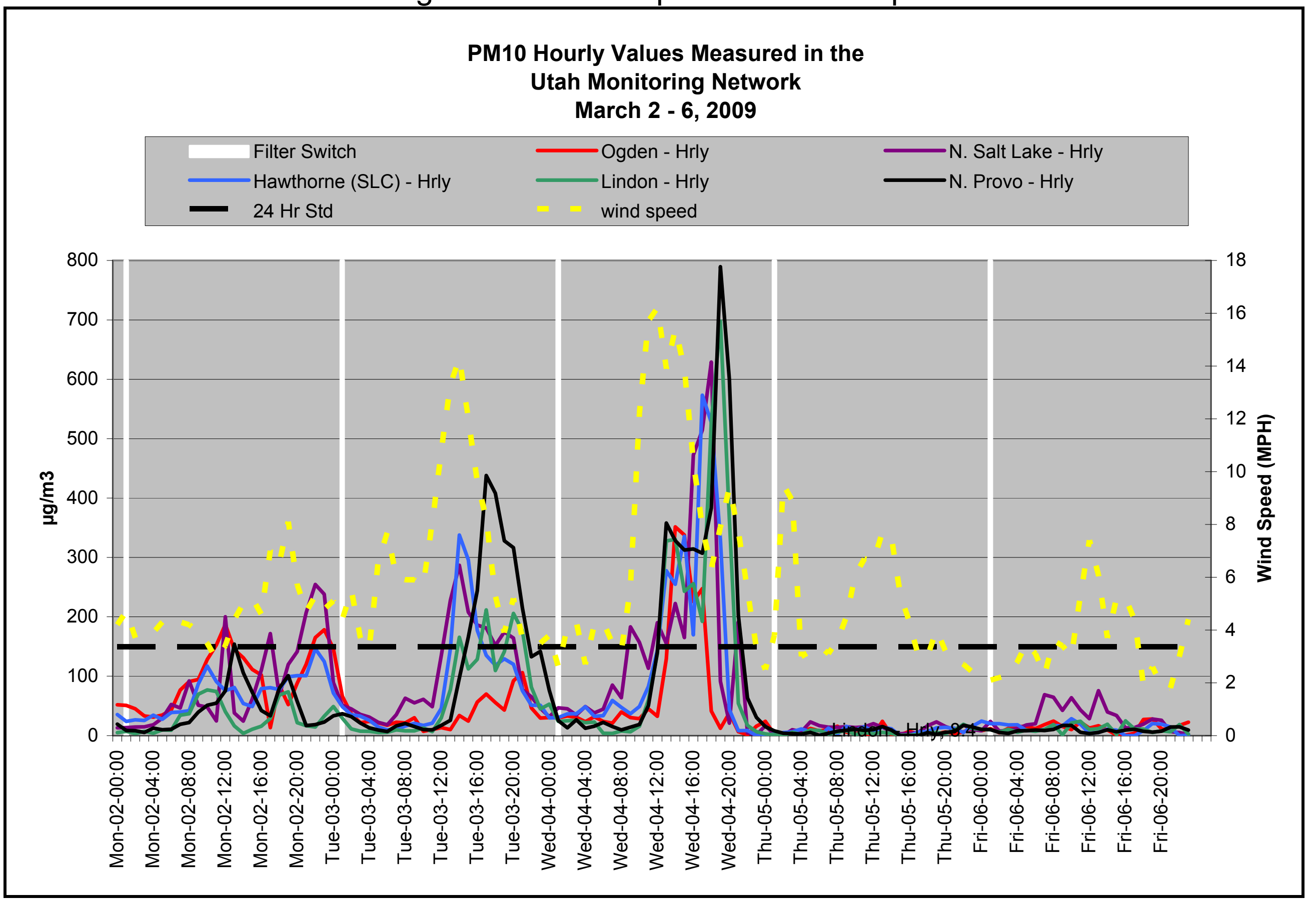

NOAA HYSPLIT MODEL
Concentration (/m3) averaged between 0 m and 100 m
Integrated from 1300 04 Mar to 0100 05 Mar 09 (UTC)
Bonn Release started at 1300 04 Mar 09 (UTC)
Source ☆ at multiple locations from 500 m
>1.0E-13 /m3
>1.0E-14 /m3
>1.0E-15 /m3
>1.0E-16 /m3
Maximum: 3.3E-13
(identified as a square)
Minimum: 1.7E-19
46
44
42
40
-114
-112
-110
-108
-106
-104
EDAS METEOROLOGICAL DATA


NOAA HYSPLIT MODEL
Concentration (/m3) averaged between 0 m and 100 m
Integrated from 0100 05 Mar to 1300 05 Mar 09 (UTC)
Bonn Release started at 1300 04 Mar 09 (UTC)
Source ☆ at multiple locations from 500 m
>1.0E-13 /m3
>1.0E-14 /m3
>1.0E-15 /m3
>1.0E-16 /m3
Maximum: 2.5E-13
(identified as a square)
Minimum: 5.4E-19
46
42
40
-114
-112
-106
-104
EDAS METEOROLOGICAL DATA

Wind and PM Relationship

Figure 4 shows the direct response to PM levels by wind speed measured at the Lindon monitoring station. PM levels shadow wind speed rise and fall, allowing for monitoring response lag. PM levels declined on Thursday due to precipitation from the storm.

Figure 4 – PM Response to Wind Speed



Speciation

Coarse Mass Analysis

Comparison of nitrate, sulfate and crustal mineral (SiO_2, Al_2O_3, CaO, Fe_2O_3, K_2O, MgO, FeO, Na_2O, TiO_2, SO_2, P_2O_5 and Ba) fraction before, during and after the event, shows that the crustal fraction is always elevated during the event, while nitrate and sulfates are reduced during the event, which are predominately localized anthropogenic sources. This analysis further supports the weight of evidence that the PM was mostly desert dust.

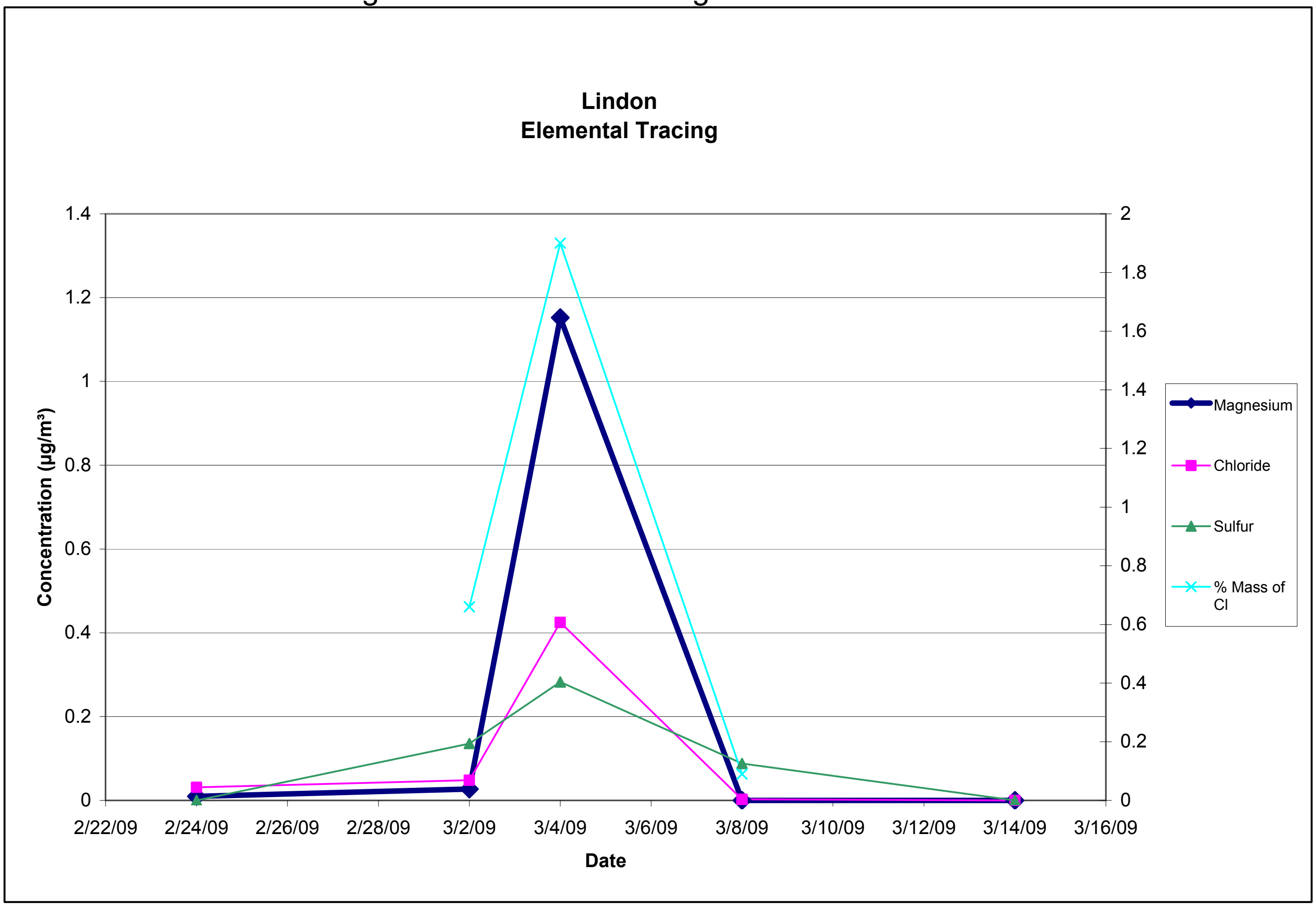
Table 4 – Coarse Mass Analysis PM2.5

	Lindon Pre Event Day 3/2/09	Lindon Event Day 3/4/09	Lindon Post Event 3/8/09
Mineral	17.5%	35.3%	14.2%
Nitrate	11.4%	1.1%	28.5%
Sulfate	8.4%	6.5%	14.6%

Sevier Desert and Lake Playa Analysis

The Utah Geological Survey evaluated 81 Sevier Lake playa samples for abundance in comparison to soil, crustal earth and in common rocks. Chloride is 203 times higher and sulfur is 34 times higher in the playa samples. Plotting chloride (measured as chlorine or chloride) and sulfur content of PM2.5 speciated filters before, during and after the dust storm event shows a 10 fold increase in these elements during the dust storm.

Figure 5 Elemental Tracing Sevier Desert Dust



The light blue line indicates the percentage of chloride of the total mass of the PM2.5, indicating a real increase during the storm event.

Major anthropogenic sources during high winds come from mining quartzite (a source of silica) and limestone (a source of calcium) that are not sources of chloride and sulfur.

Local anthropogenic sources of sulfur and chloride do exist, so we have to evaluate data before and after the wind event and investigate complaint and inspection records to determine whether anthropogenic sources could have contributed. A survey of complaints and inspections reveals that one complaint was logged for the Kennecott tailing pond from March 2-4 for dust due to persistent daily high winds. DAQ responded to the complaint and determined that Kennecott was compliant with their dust control plan by watering the tailing pond. Kennecott uses magnesium chloride as a dust suppressant on the pond. Magnesium chloride forms a surface crust when moisture content can be maintained. Persistent daily high winds exasperate efforts to maintain surface moisture content. Eventually, the magnesium chloride itself becomes a dust source. The Kennecott tailings pond is discounted as a source because it is located 36 miles down wind (north-northwest) of the Lindon station and prevailing winds were from the south, before, through and past the event.

The Lindon station is located in a residential neighborhood. There are no major anthropogenic sources in the general area that would contribute substantial amount of magnesium chloride. Some contribution from road salt is likely given the event occurred during a winter month. Daily temperatures fluctuated from near freezing to the 50's around the time of the event, so we assume that residual road salt dust contributed, but not a ten fold increase.

Eliminating anthropogenic sources as major contributors, we assume that the magnesium is the cation for the chloride ion derived from the Sevier Lake playa dust. Review of the Utah Geological Survey soil analysis does show that magnesium and sodium are abundant in the Sevier Lake.

This analysis adds to the weight of evidence that the increase in PM was greatly influenced by desert entrained dust and not significantly influenced by major anthropogenic dust sources.

Appendix 1 contains the raw speciation data used in this analysis.

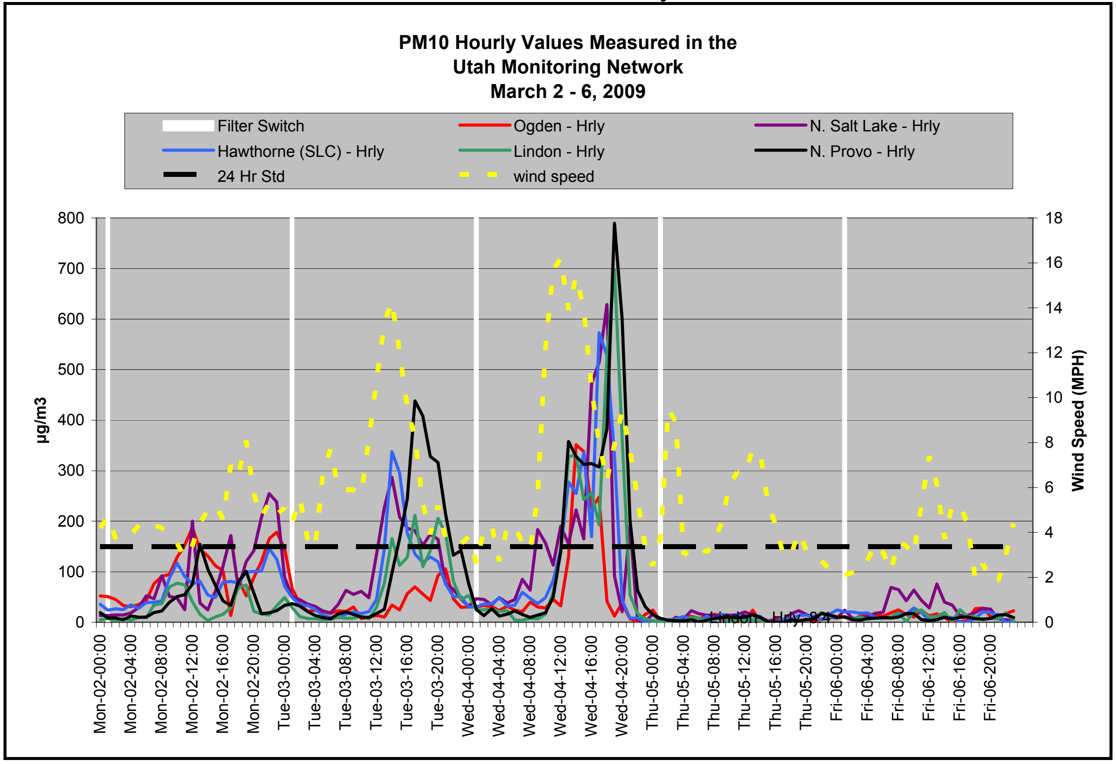
No Exceedance or Violation But For the Event

Wind Storm Event

Figure 6 is a plot of the wind speed measured at the Lindon monitoring station along with the PM10 hourly values for all stations starting on March 2 through March 6, 2009.

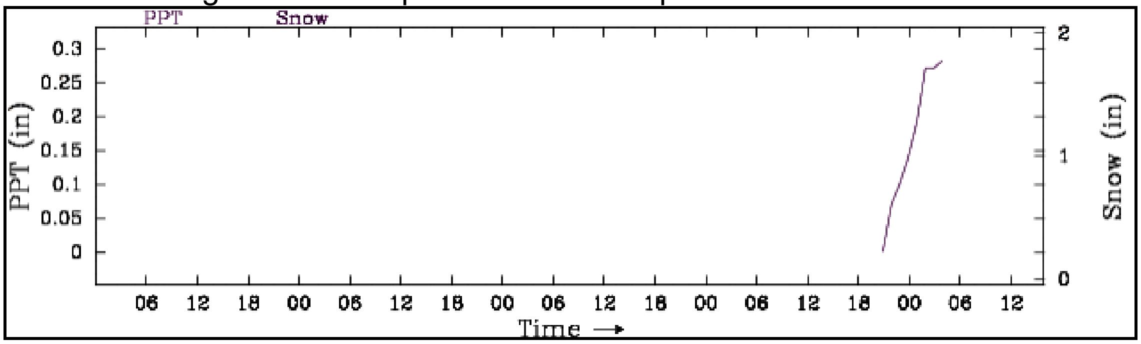
Wind speed increased on Monday along with increased PM10 levels for all stations. PM10 levels declined along the network to normal levels Tuesday morning when wind speed was reduced. PM10 and wind speed substantially increased in tandem Tuesday afternoon and evening. The same pattern was repeated on Wednesday, the day of the exceptional event, with higher wind speed and resultant PM10 levels. Wind speed remained slightly elevated on Thursday and Friday but PM10 levels were suppressed by storm precipitation Wednesday night.

Figure 6 – Lindon Monitoring Station Wind Speed and Monitoring Network PM10 Hourly Data



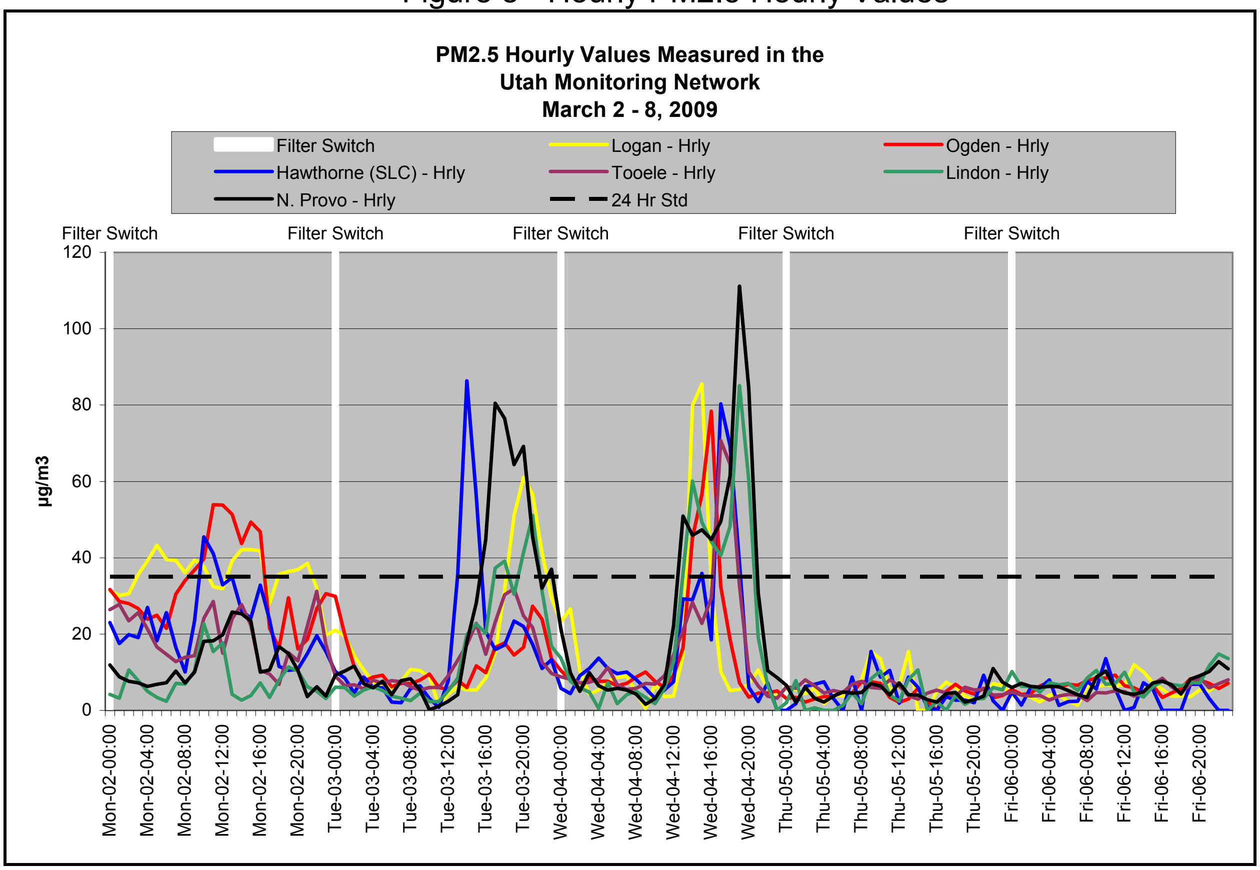
Precipitation arrived late Wednesday night and into Thursday morning (Figure 7). Note that the hourly PM10 concentration decline corresponds with the arrival of the precipitation and does not increase until Friday the 6th, likely due to drying from winds on Thursday and Friday

Figure 7 – Precipitation at SLC Airport 3/01/09 - 3/05/09



The hourly PM2.5 concentration pattern follows the PM10 pattern, validating the impact of the wind on PM levels.

Figure 8 - Hourly PM2.5 Hourly Values



Appendix 2 contains hourly PM and wind data.

If not for the high wind dust storm event crossing salt desert playa regions, the PM10 values would not have been elevated and the PM10 concentration at Lindon would not have exceeded the 24-hr standard.

We substantiate the “but not for” wind storm position based on the demonstration made in the following Mitigation section, that the Utah Division of Air Quality, together with Utah counties and federal agencies, has established reasonably well-controlled dust programs.

Clear Causal Relationship Summary

A clear and casual relationship has been demonstrated based on:

- The cold front produced storms with high winds and dust clouds;
- Satellite images verify dust clouds and their sources;
- Back trajectory and particle tracking analyses support that the dust cloud observed in the Sevier Desert and Lake was the contributor to the natural dust measured in the monitoring network;
- Wind speed and PM concentrations correlate well;
- PM concentrations declined due to cold front precipitation, than slightly increased due to drying from mild winds; and
- Speciation analyses provides strong weight of evidence that the source(s) of the particulates are primarily non-anthropogenic.

Mitigation

The Exceptional Events Rule requires states to “take appropriate and reasonable actions to protect public health from exceedances or violations of the national ambient air quality standards.” The intent of this section is to describe the State of Utah’s dust control and public health protection programs.

Division of Air Quality Community Outreach

Clean Utah

DEQ is committed to working with businesses to ensure the ongoing protection of public health and the environment. Clean Utah is a program that encourages and rewards business and other permit holders for going beyond compliance to preserve and protect Utah's environment. Compliance assistance include: common compliance problems, permitting information, spill reporting, small business assistance, and providing tools for business, for example: pollution prevention and best management practices (please refer to sample pamphlet below).

Smoking Vehicles

Vehicles emitting excessive smoke contribute to airborne particles. Five local health departments (Cache, Davis, Salt Lake, Utah and Weber Counties) operate smoking vehicle education and notification programs. People who spot a vehicle producing excessive smoke can report it through their respective county health department.

In 2009, 724 vehicles were reported to Salt Lake County Health Department alone. The County issued 490 notices.

Utah Clean City

Utah's Clean Cities Coalition is one of 85 coalitions around the country that's part of the U.S. Department of Energy's strategy to reduce America's dependence on imported foreign oil. The Utah coalition sponsored Idle Free Awareness Week which included educating school bus drivers on the air quality value of limiting idling.

Variable Message Signage

The Utah Department of Transportation (UDOT), in conjunction with the DEQ air quality forecasting program, issues air quality warnings on electronic message boards placed along Utah's highways. The signage asks drivers to limit their driving on high alert days. An informal study conducted this winter by UDOT during 6-days with and without air quality alerts indicates that there was a 3-5% auto traffic reduction (per Glen Blackwelder, UDOT Traffic Operations Engineer).

Choose Clean Air

An interactive source of information about ways individuals can help improve air quality by making smart choices in their personal lives can be found on the DEQ website. The site includes 50 suggestions for daily life.

The UDEQ also offers an electronic mail server (Listserv). Subscribers are automatically notified by e-mail when unhealthy air pollution levels are forecast for the Wasatch Front.

Dust Control Education

The DEQ website includes a page on dust control and the aggregate industry. The page is intended to educate the public about dust, control methods and community aggregate locations near them by providing links to aggregate firms Approval Orders containing fugitive dust control conditions.

Utah Air Quality Public Notifications

In order to improve the presentation of air quality information to the public, DAQ has improved our air quality forecasting web page. The web page now shows the air quality forecast for today and the next two days. The Air Monitoring Center (AMC) provides air pollution information based on daily air quality status. The AMC data is used to determine the relationship of existing pollutant concentrations to the National Ambient Air Quality Standards. There is a three tiered air quality alert system: Green, Yellow (alert days), and Red (actions days) that is used to implement winter and summer controls on the use of wood and coal burning stoves, fire places, and motor vehicles. There are five health advisory categories: good, moderate, unhealthy advisories A and B, and very unhealthy. The AMC advisory is calculated for five major pollutants including ground-level ozone, particulate pollution (particulate matter), carbon monoxide, sulfur dioxide, and nitrogen dioxide. The new index now also incorporates recommendations for actions to take on days when concentrations are in the red zone, to mitigate the effects of pollution for affected groups and recommendations for industry and citizens that help reduce pollution levels. The outreach program information consolidated in the three day forecast includes the Summer and Winter Control Programs and Choose Clean Air information.

The web site includes additional information on wind blown dust.

News Release to Media

In additional to web site alerts, DEQ also notifies the media in order to maximize public distribution.

Representative County Dust Control Programs

Salt Lake County

Salt Lake Valley Health Department regulates fugitive dust under section R307-309 of the Utah Air Conservation Rules. The County enforces fugitive dust from construction, aggregate industries, sand blasting, painting and burning. The web site includes information on reporting violations. County inspectors actively inspect dust prone activities.

Davis County

Davis, like Salt Lake County, enforces fugitive dust through Utah R307-309 and also maintains a fugitive dust web page and violation reporting. Inspectors have been known to park themselves all day long on Beck Street to enforce compliance. Beck Street contains refineries and very large aggregate industries that are a source of fugitive dust.

Weber County

Weber County has its own Excavation Ordinance for construction that includes dust control. Application must be made and approved before construction. An application fee includes the cost for reviewing engineering plans and site inspection.

Cache County

Cache County maintains zoning ordnances that include dust controls.

Public Comment

The documentation was made available for public comment through the Utah Bulletin and on the DAQ web page from 9/1/11 to 9/30/11. No comments were received.

Environmental Quality
Air Quality

Notice of Public Comment Period: High Wind Exceptional Events – Event Dates: 03/04/2009

Federal regulations, 40 CFR Part 50, allow states to exclude air quality data that exceed or violate a National Ambient Air Quality Standard (NAAQS) if they can demonstrate that an "exceptional event" has caused the exceedance or violation. Exceptional events are unusual or naturally occurring events that can affect air quality but are not reasonably controllable or preventable using techniques implemented to attain and maintain the NAAQS.

Exceptional events may be caused by human activity that is unlikely to recur at a particular location, or may be due to a natural event. The Environmental Protection Agency (EPA) defines a "natural event" as an event in which human activity plays little or no direct causal role to the event in question. For example, a natural event could include such things as high winds, wild fires, and seismic/volcanic activity. In addition, the EPA will allow states to exclude data from regulatory determinations on a case-by-case basis for monitoring stations that measure values that exceed or violate the NAAQS due to emissions from fireworks displays from cultural events.

Federal regulations (40 CFR Part 50.14(c)(3)(i)) require that all relevant flagged data, the reasons for the data being flagged, and a demonstration that the flagged data are caused by exceptional events be made available by the State for 30 days of public review and comment. These comments will be considered in the final demonstration of the event that is submitted to EPA. The following monitoring station air quality exceedance has been attributed to a high wind exceptional event: Lindon, 200 ug/m^3 PM10.

The documentation for public review and comment to support removing this data from use in regulatory determinations is available at http://www.airquality.utah.gov/Public-Interest/Public-Commen-Hearings/Exceptional_Events/Exceptional_Events.htm or at the Multi Agency State Office Building, 195 North 1950 West, Salt Lake City, Utah. In compliance with the American with Disabilities Act, individuals with special needs (including auxiliary communicative aids and services) should contact Brooke Baker, Office of Human Resources at 801- 536-4412 (TDD 536-4414).

The comment period will close at 5:00 p.m. on September 30, 2011. Comments postmarked on or before that date will be accepted. Comments may be submitted by electronic mail to jkarmazyn@utah.gov or may be mailed to:

Joel Karmazyn
Utah Division of Air Quality
PO Box 144820
195 N 1950 W
Salt Lake City, UT 84114-4820

End of the Special Notices Section

Appendix 1

Speciation Data

LOCATION Lindon **3/2/2009** AIRS_CODE 490494001 POC 5
SAMPLER TYPE URG 3000N
FIELD CUSTODY NO Q174865S ROUTINE
CHANNEL 1 SAMPLE VOLUME 31.70
Sample Handling Validation Checks Performed Level 0: T Level 1: T
Event Flags: Flow Flags:

Field Sampling Data ....

	Value	AIRS Null Value Code
2078 Average Flow	22.0	
2079 End Date		
2080 End Time		
2081 Retrieval Date		
2082 Retrieval Time		
2083 Run Time	24.0	
2084 Start Date		
2085 Start Time		
2086 Total Volume	31.7	

Laboratory Analysis Data ....
Quartz Filter (25 mm) I8687J
Shipping Flags:
Module Disassembly Flags:

Organic and elemental carbon IMPROVE_A

	Analyte Mass (ug)	Conc (ug/m^3)	Det Limit (ug)	Det Limit (ug/m^3)	Analysis Flags	AIRS Null Value Code
2087 E1 IMPROVE	28.8	0.908				
2088 E2 IMPROVE	2.41	0.07620				
2089 E3 IMPROVE	0.372	0.01170				
2090 EC IMPROVE TOR	25.9	0.816				
2091 EC IMPROVE TOT	23.6	0.746				
2092 O1 IMPROVE	3.92	0.124				
2093 O2 IMPROVE	11.4	0.358				
2094 O3 IMPROVE	11.8	0.371				
2095 O4 IMPROVE	8.71	0.275				
2096 OC IMPROVE TOR	41.5	1.31				
2097 OC IMPROVE TOT	43.7	1.38				
2098 OP IMPROVE TOR	5.69	0.179				
2099 OP IMPROVE TOT	7.92	0.250				
2100 TC IMPROVE	67.3	2.12				

7

LOCATION Lindon **3/2/2009** AIRS_CODE 490494001 POC 5
SAMPLER TYPE SASS with URG 3000N
FIELD CUSTODY NO Q174866T ROUTINE
CHANNEL 1 SAMPLE VOLUME 9.693
Sample Handling Validation Checks Performed Level 0: T Level 1: T
Event Flags: Flow Flags: **FHT**

Field Sampling Data ....

	Value	AIRS Null Value Code
2101 Average flow	6.73	
2102 Avg ambient temp	12.4	
2103 Avg BP	637	
2104 Delta T Flag		
2105 End date	3/3/2009	
2106 End time	12:00 AM	
2107 Max ambient temp	17.3	
2108 Max BP	644	
2109 Min ambient temp	6.8	
2110 Min BP	635	
2111 Retrieval date	3/5/2009	
2112 Retrieval time	11:00 AM	
2113 Run Time	24.0	
2114 Run Time Flag		
2115 Sample volume	9.69	
2116 Start date	3/2/2009	
2117 Start time	12:00 AM	

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Laboratory Analysis Data ....

Teflon Filter I5084M
Shipping Flags:
Module Disassembly Flags:

	Analyte Mass (ug)	Conc (ug/m^3)	Det Limit (ug)	Det Limit (ug/m^3)	Analysis Flags	AIRS Null Value Code
<u>Mass - PM2.5</u>						
2118 Particulate matter 2.5u	70.0±4.2	7.22±0.44	7.2	0.74		
<u>Trace elements (33)</u>						
2119 Aluminum	1.04±0.13	0.107±0.014	0.13	0.013		
2120 Antimony	0.00000±0.13	0.00000±0.013	0.38	0.039		
2121 Arsenic	0.00000±0.00590	0.00000±0.00061	0.00900	0.00093		
2122 Barium	0.00000±0.035	0.00000±0.00360	0.11	0.011		
2123 Bromine	0.01640±0.010	0.00169±0.00110	0.013	0.00130		
2124 Cadmium	0.00000±0.055	0.00000±0.00570	0.17	0.017		
2125 Calcium	2.29±0.16	0.236±0.017	0.073	0.00750		
2126 Cerium	0.00000±0.031	0.00000±0.00320	0.094	0.00970		
2127 Cesium	0.03960±0.061	0.00408±0.00630	0.11	0.011		
2128 Chlorine	0.467±0.040	0.04810±0.00410	0.075	0.00780		
2129 Chromium	0.00000±0.00830	0.00000±0.00085	0.025	0.00260		
2130 Cobalt	0.00000±0.00690	0.00000±0.00071	0.013	0.00130		
2131 Copper	0.04100±0.00670	0.00423±0.00069	0.016	0.00160		
2132 Indium	0.00000±0.051	0.00000±0.00530	0.15	0.016		

2133	Iron	1.89±0.14	0.195±0.014	0.016	0.00170
2134	Lead	0.02830±0.016	0.00291±0.00160	0.025	0.00260
2135	Magnesium	0.263±0.043	0.02710±0.00440	0.11	0.012
2136	Manganese	0.108±0.012	0.01110±0.00120	0.018	0.00190
2137	Nickel	0.00000±0.00380	0.00000±0.00040	0.012	0.00120
2138	Phosphorus	0.00000±0.052	0.00000±0.00530	0.15	0.016
2139	Potassium	0.761±0.057	0.07860±0.00590	0.070	0.00720
2140	Rubidium	0.00000±0.00640	0.00000±0.00066	0.019	0.00200
2141	Selenium	0.00158±0.00840	0.00016±0.00086	0.013	0.00130
2142	Silicon	3.46±0.29	0.357±0.030	0.093	0.00960
2143	Silver	0.00000±0.046	0.00000±0.00470	0.13	0.013
2144	Sodium	0.534±0.10	0.05510±0.010	0.30	0.031
2145	Strontium	0.00000±0.081	0.00000±0.00840	0.023	0.00230
2146	Sulfur	1.88±0.14	0.194±0.014	0.095	0.00980
2147	Tin	0.00000±0.086	0.00000±0.00890	0.20	0.020
2148	Titanium	0.09720±0.024	0.01000±0.00240	0.051	0.00530
2149	Vanadium	0.02710±0.015	0.00280±0.00150	0.037	0.00380
2150	Zinc	0.435±0.033	0.04490±0.00340	0.017	0.00180
2151	Zirconium	0.00000±0.085	0.00000±0.00880	0.032	0.00330

....

LOCATION Lindon **3/2/2009** AIRS_CODE 490494001 POC 5
SAMPLER TYPE SASS with URG 3000N
FIELD CUSTODY NO Q174866T ROUTINE
CHANNEL 2 SAMPLE VOLUME 9.697
Sample Handling Validation Checks Performed Level 0: T Level 1: T
Event Flags: Flow Flags: **FHT**

Field Sampling Data ....

		Value	AIRS Null Value Code
2152	Average flow	6.73	
2153	Avg ambient temp	12.4	
2154	Avg BP	637	
2155	Delta T Flag		
2156	End date	3/3/2009	
2157	End time	12:00 AM	
2158	Max ambient temp	17.3	
2159	Max BP	644	
2160	Min ambient temp	6.8	
2161	Min BP	635	
2162	Retrieval date	3/5/2009	
2163	Retrieval time	11:00 AM	
2164	Run Time	24.0	
2165	Run Time Flag		
2166	Sample volume	9.70	
2167	Start date	3/2/2009	
2168	Start time	12:00 AM	

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Laboratory Analysis Data ....

Nylon Filter I51005
Shipping Flags:
Module Disassembly Flags:

	Analyte Mass (ug)	Conc (ug/m^3)	Det Limit (ug)	Det Limit (ug/m^3)	Analysis Flags	AIRS Null Value Code
Cations - PM2.5 (NH4, Na, K)						
2169 Ammonium	3.65±0.26	0.376±0.027	0.16	0.016		
2170 Potassium	0.00000±0.010	0.00000±0.00100	0.13	0.014		
2171 Sodium	0.574±0.63	0.05920±0.065	0.29	0.030		
Nitrate - PM2.5						
2172 Nitrate	8.01±0.58	0.826±0.060	0.070	0.00720		
Sulfate - PM2.5						
2173 Sulfate	5.87±0.44	0.606±0.045	0.10	0.010		

....

Report Number: 09-089
==
Lab ID: 09-X786
Client ID: 9516469
Site: Lindon (LN)
Sample Date: 3/ 4/09
Mass: 550. +- 10. µg
Volume: 24.00 +- 2.400 m³
Deposit Area: 11.3 cm²
Size Fraction: PM2.5
Suspended
Particulates: 22.92 +- 2.33 µg/m³
Analyte µg/filter percent µg/m³
XRF
Na 10.75 ± 1.728 1.955 ± 0.3161 0.4480 ± 0.0848
Mg 27.65 ± 2.076 5.027 ± 0.3883 1.152 ± 0.1441
Al 17.97 ± 1.167 3.267 ± 0.2204 0.7486 ± 0.0893
Si 57.27 ± 3.066 10.41 ± 0.5887 2.386 ± 0.2707
P 0.0000 ± 0.0441 0.0000 ± 0.0080 0.0000 ± 0.0018
S 9.698 ± 0.5209 1.763 ± 0.1000 0.4041 ± 0.0459
Cl 10.20 ± 0.5368 1.854 ± 0.1032 0.4249 ± 0.0480
K 7.738 ± 0.4023 1.407 ± 0.0775 0.3224 ± 0.0363
Ca 52.24 ± 2.640 9.498 ± 0.5101 2.177 ± 0.2439
Ti 0.9436 ± 0.0508 0.1716 ± 0.0098 0.0393 ± 0.0045
V 0.0373 ± 0.0102 0.0068 ± 0.0019 0.0016 ± 0.0005
Cr 0.0136 ± 0.0090 0.0025 ± 0.0016 0.0006 ± 0.0004
Mn 0.1808 ± 0.0147 0.0329 ± 0.0027 0.0075 ± 0.0010
Fe 9.996 ± 0.5028 1.817 ± 0.0972 0.4165 ± 0.0466
Co 0.0260 ± 0.0226 0.0047 ± 0.0041 0.0011 ± 0.0009
Ni 0.0508 ± 0.0147 0.0092 ± 0.0027 0.0021 ± 0.0006
Cu 0.0090 ± 0.0124 0.0016 ± 0.0023 0.0004 ± 0.0005
Zn 0.1130 ± 0.0136 0.0205 ± 0.0025 0.0047 ± 0.0007
Ga 0.0068 ± 0.0090 0.0012 ± 0.0016 0.0003 ± 0.0004
Ge 0.0000 ± 0.0079 0.0000 ± 0.0014 0.0000 ± 0.0003
As 0.0000 ± 0.0113 0.0000 ± 0.0021 0.0000 ± 0.0005
Se 0.0045 ± 0.0056 0.0008 ± 0.0010 0.0002 ± 0.0002
Br 0.0576 ± 0.0068 0.0105 ± 0.0012 0.0024 ± 0.0004
Rb 0.0271 ± 0.0068 0.0049 ± 0.0012 0.0011 ± 0.0003
Sr 0.7616 ± 0.0396 0.1385 ± 0.0076 0.0317 ± 0.0036
Y 0.0000 ± 0.0090 0.0000 ± 0.0016 0.0000 ± 0.0004
Zr 0.0090 ± 0.0113 0.0016 ± 0.0021 0.0004 ± 0.0005
Mo 0.0215 ± 0.0147 0.0039 ± 0.0027 0.0009 ± 0.0006
Pd 0.0215 ± 0.0475 0.0039 ± 0.0086 0.0009 ± 0.0020
Ag 0.1119 ± 0.0508 0.0203 ± 0.0093 0.0047 ± 0.0022
Cd 0.0848 ± 0.0542 0.0154 ± 0.0099 0.0035 ± 0.0023
In 0.1062 ± 0.0599 0.0193 ± 0.0109 0.0044 ± 0.0025
Sn 0.0859 ± 0.0701 0.0156 ± 0.0127 0.0036 ± 0.0029
Sb 0.1797 ± 0.1390 0.0327 ± 0.0253 0.0075 ± 0.0058
Ba 0.0508 ± 0.0486 0.0092 ± 0.0088 0.0021 ± 0.0020
La 0.0000 ± 0.0429 0.0000 ± 0.0078 0.0000 ± 0.0018
Hg 0.0000 ± 0.0158 0.0000 ± 0.0029 0.0000 ± 0.0007
Pb 0.0463 ± 0.0170 0.0084 ± 0.0031 0.0019 ± 0.0007
IC
Cl 12.94 ± 0.6470 2.353 ± 0.0452 0.5392 ± 0.0603
Br 0.0000 ± 0.5000 0.0000 ± 0.0129 0.0000 ± 0.0208
NO3 5.940 ± 0.2970 1.080 ± 0.0220 0.2475 ± 0.0277
SO4 35.74 ± 1.787 6.498 ± 0.1206 1.489 ± 0.1665
Na 18.24 ± 0.9120 3.316 ± 0.0627 0.7600 ± 0.0850
NH4 2.330 ± 0.1165 0.4236 ± 0.0099 0.0971 ± 0.0109
K 1.860 ± 0.0930 0.3382 ± 0.0083 0.0775 ± 0.0087

LOCATION Lindon **3/8/2009** AIRS_CODE 490494001 POC 5
SAMPLER TYPE URG 3000N
FIELD CUSTODY NO Q1778621 ROUTINE
CHANNEL 1 SAMPLE VOLUME 31.70
Sample Handling Validation Checks Performed Level 0: T Level 1: T
Event Flags: Flow Flags:

Field Sampling Data ....

	Value	AIRS Null Value Code
2174 Average Flow	22.0	
2175 End Date		
2176 End Time		
2177 Retrieval Date		
2178 Retrieval Time		
2179 Run Time	24.0	
2180 Start Date	3/8/2009	
2181 Start Time		
2182 Total Volume	31.7	

Laboratory Analysis Data ....

Quartz Filter (25 mm) I9595K
Shipping Flags:
Module Disassembly Flags:

Organic and elemental carbon IMPROVE_A

	Analyte Mass (ug)	Conc (ug/m^3)	Det Limit (ug)	Det Limit (ug/m^3)	Analysis Flags	AIRS Null Value Code
2183 E1 IMPROVE	5.06	0.160				
2184 E2 IMPROVE	0.00000	0.00000				
2185 E3 IMPROVE	0.00000	0.00000				
2186 EC IMPROVE TOR	1.85	0.05830				
2187 EC IMPROVE TOT	0.468	0.01480				
2188 O1 IMPROVE	1.72	0.05420				
2189 O2 IMPROVE	4.19	0.132				
2190 O3 IMPROVE	5.41	0.171				
2191 O4 IMPROVE	2.28	0.07190				
2192 OC IMPROVE TOR	16.8	0.531				
2193 OC IMPROVE TOT	18.2	0.574				
2194 OP IMPROVE TOR	3.21	0.101				
2195 OP IMPROVE TOT	4.60	0.145				
2196 TC IMPROVE	18.7	0.589				

LOCATION **Lindon 3/8/2009**
AIRS_CODE 490494001 POC
5
SAMPLER TYPE SASS with URG 3000N
FIELD CUSTODY NO Q1778632 ROUTINE
CHANNEL 1 SAMPLE VOLUME 9.711
Sample Handling Validation Checks Performed Level 0: T Level 1: T
Event Flags: Flow Flags:

Field Sampling Data ....

		Value	AIRS Null Value Code
2197	Average flow	6.74	
2198	Avg ambient temp	5.5	
2199	Avg BP	633	
2200	Delta T Flag		
2201	End date	3/9/2009	
2202	End time	12:00 AM	
2203	Max ambient temp	11.6	
2204	Max BP	643	
2205	Min ambient temp	-3.5	
2206	Min BP	629	
2207	Retrieval date	3/10/2009	
2208	Retrieval time	12:00 PM	
2209	Run Time	24.0	
2210	Run Time Flag		
2211	Sample volume	9.71	
2212	Start date	3/8/2009	
2213	Start time	12:00 AM	

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Laboratory Analysis Data ....

Teflon Filter I38955
Shipping Flags:
Module Disassembly Flags:

		Analyte Mass (ug)	Conc (ug/m^3)	Det Limit (ug)	Det Limit (ug/m^3)	Analysis Flags	AIRS Null Value Code
Mass - PM2.5							
2214	Particulate matter 2.5u	26.0±4.0	2.68±0.41	7.2	0.74	**5, QL1**	**5**
Trace elements (33)							
2215	Aluminum	0.325±0.084	0.03350±0.00860	0.13	0.013		
2216	Antimony	0.215±0.42	0.02210±0.043	0.38	0.039		
2217	Arsenic	0.00000±0.00590	0.00000±0.00061	0.00900	0.00093		
2218	Barium	0.00000±0.035	0.00000±0.00360	0.11	0.011		
2219	Bromine	0.00983±0.00780	0.00101±0.00081	0.013	0.00130		
2220	Cadmium	0.09040±0.17	0.00931±0.017	0.17	0.017		
2221	Calcium	0.338±0.029	0.03480±0.00300	0.073	0.00750		
2222	Cerium	0.00000±0.031	0.00000±0.00320	0.094	0.00960		
2223	Cesium	0.00000±0.039	0.00000±0.00400	0.11	0.011		
2224	Chlorine	0.02490±0.025	0.00256±0.00260	0.075	0.00770		
2225	Chromium	0.00124±0.00860	0.00013±0.00088	0.025	0.00260		
2226	Cobalt	0.00023±0.00490	0.00002±0.00050	0.013	0.00130		
2227	Copper	0.00655±0.00520	0.00068±0.00054	0.016	0.00160		
2228	Indium	0.00000±0.051	0.00000±0.00530	0.15	0.016		
2229	Iron	0.302±0.024	0.03110±0.00250	0.016	0.00170		
2230	Lead	0.00000±0.013	0.00000±0.00130	0.025	0.00260		
2231	Magnesium	0.00000±0.038	0.00000±0.00390	0.11	0.012		
2232	Manganese	0.01060±0.00780	0.00109±0.00081	0.018	0.00190		
2233	Nickel	0.00000±0.00380	0.00000±0.00040	0.012	0.00120		
2234	Phosphorus	0.00000±0.052	0.00000±0.00530	0.15	0.016		
2235	Potassium	0.253±0.023	0.02610±0.00240	0.070	0.00720		
2236	Rubidium	0.00938±0.00930	0.00097±0.00096	0.019	0.00200		

2237	Selenium	0.00000±0.00610	0.00000±0.00063	0.013	0.00130
2238	Silicon	0.686±0.072	0.07060±0.00740	0.093	0.00960
2239	Silver	0.00000±0.046	0.00000±0.00470	0.13	0.013
2240	Sodium	0.08640±0.10	0.00890±0.010	0.30	0.031
2241	Strontium	0.00000±0.081	0.00000±0.00840	0.023	0.00230
2242	Sulfur	1.22±0.091	0.126±0.00940	0.095	0.00980
2243	Tin	0.00000±0.086	0.00000±0.00890	0.20	0.020
2244	Titanium	0.02260±0.018	0.00233±0.00190	0.051	0.00530
2245	Vanadium	0.00000±0.012	0.00000±0.00130	0.037	0.00380
2246	Zinc	0.02060±0.00610	0.00212±0.00062	0.017	0.00180
2247	Zirconium	0.00000±0.085	0.00000±0.00880	0.032	0.00330

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LOCATION **Lindon 3/8/2009**
AIRS_CODE 490494001 POC
5
SAMPLER TYPE SASS with URG 3000N
FIELD CUSTODY NO Q1778632 ROUTINE
CHANNEL 2 SAMPLE VOLUME 9.692
Sample Handling Validation Checks Performed Level 0: T Level 1: T
Event Flags: Flow Flags:

Field Sampling Data ....

		Value	AIRS Null Value Code
2248	Average flow	6.73	
2249	Avg ambient temp	5.5	
2250	Avg BP	633	
2251	Delta T Flag		
2252	End date	3/9/2009	
2253	End time	12:00 AM	
2254	Max ambient temp	11.6	
2255	Max BP	643	
2256	Min ambient temp	-3.5	
2257	Min BP	629	
2258	Retrieval date	3/10/2009	
2259	Retrieval time	12:00 PM	
2260	Run Time	24.0	
2261	Run Time Flag		
2262	Sample volume	9.69	
2263	Start date	3/8/2009	
2264	Start time	12:00 AM	

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Laboratory Analysis Data ....

Nylon Filter I38966
Shipping Flags:
Module Disassembly Flags:

	Analyte Mass (ug)	Conc (ug/m^3)	Det Limit (ug)	Det Limit (ug/m^3)	Analysis Flags	AIRS Null Value Code
Cations - PM2.5 (NH4, Na, K)						
2265 Ammonium	2.63±0.19	0.271±0.019	0.16	0.017		
2266 Potassium	0.00000±0.010	0.00000±0.00100	0.13	0.014		
2267 Sodium	0.305±0.62	0.03140±0.063	0.29	0.030		
Nitrate - PM2.5						
2268 Nitrate	7.40±0.54	0.764±0.056	0.070	0.00720		
Sulfate - PM2.5						
2269 Sulfate	3.79±0.29	0.392±0.030	0.10	0.010		

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Element	Earth's crust	Ultra-mafic	Basalt	AVERAGE Grano-diorite	Granite	Shale	Lime-stone	Soil	Sevier Lake Playa	
Ag	**0.070**	0.060	0.10	0.07	0.04	0.05	1.00	0.1		
Al	**79,600.000**								28,400	
As	**1.700**	1.00	2.0	2.0	1.5	15	2.5	1-50		
Au	**0.003**	0.005	0.004	0.004	0.004	0.004	0.005	-		
B	**11.000**	5.0	5.0	20	15	100	10.0	2-100		
Ba	**584.000**	2	250	500	600	700	100	100-3000		
Be	**2.400**		0.5	2.0	5.0	3	1.0	6		
Bi	**0.085**	0.020	0.15	-	0.10	0.18	-	-		
Br	**1.000**	1.00	3.6	-	2.9	4	6.2	-	10	**10**
C	**1,990.000**								58,400	
Ca	**38,500.000**								195,100	
Cd	**0.100**	-	0.20	0.2	0.20	0.2	0.1	1.00		
Ce	**60.000**	8	35	40	46	50	10	-		
Cl	**472.000**	85	60	-	165	180	150	-	95,800	**203**
Co	**24.000**	150.0	50.0	10	1	20	4	1-40		
Cr	**126.000**	2,000	200	20	4	100	10	5-1000	34	
Cs	**3.400**	-	1.0	2.0	5.0	5	-	6		
Cu	**25.000**	10	100	30	10	50	15	2-100		
Dy	**3.800**	0.59	3.0	3.2	0.5	5	0.4	-		
Er	**2.100**	0.36	1.7	4.8	0.2	2	0.5	-		
Eu	**1.300**	0.16	1.27	1.2	-	1	-	-		
F	**525.000**	100	400	-	735	740	330	-		
Fe	**43,200.000**	94,300	86,500		14,200	47,000	9,800	21,000	163,000	
Ga	**15.000**	1.0	12.0	18	18	20	0.1	15		
Gd	**4.000**	0.65	4.7	7.4	2.0	6	0.6	-		
Ge	**1.400**	1.00	1.5	1.0	1.5	1.5	0.1	1		
Hf								-		

	4.900	0.50	2.0	2.0	4.0	3	0.5		
Hg	**0.040**	-	0.08	0.08	0.08	0.50	0.05	0.03	
Ho	**0.800**	0.14	0.64	1.6	0.07	1	0.1	-	
I	**0.800**	0.500	0.50	-	0.50	2.2	1.2	-	
In	**0.050**	0.010	0.10	0.1	0.10	0.10	0.02	-	
Ir	**0.000**	-	-	-	-	-	-	-	
K	**21,400.000**	34	8,300		42,000	26,600	2,700	11,000	175,000
La	**30.000**	3.3	10.5	36	25	20	6	-	
Li	**18.000**	-	10.0	25	30	60	20	5-200	
Lu	**0.350**	0.064	0.20	-	0.01	0.5	-	-	
Mg	**22,000.000**								57,600
Mn	**716.000**	1,300	2,200	1,200	500	850	1,100	850	2,000
Mo	**1.100**	0.30	1.0	1.0	2.0	3	1.0	2	
N	**60.000**								
Na	**23,600.000**								90,600
Nb	**19.000**	15.0	20.0	20	20	20	-	-	
Nd	**27.000**	3.4	17.8	26	18	24	3	-	
Ni	**56.000**	2,000	150	20	1	70	12	5-500	
O	**472,000.000**								
Os	**0.000**	-	-	-	-	-	-	-	
P	**757.000**	220	1,100		600	700	400	300	1,100
Pb	**14.800**	0.1	5.0	15	20	20	8.0	2-200	
Pd	**0.000**	0.020	0.020	-	0.002	-	-	-	
Pr	**6.700**	1.02	3.9	8.5	4.6	6	1.0	-	
Pt	**0.000**	0.020	0.020	-	0.008	-	-	-	
Rb	**78.000**	-	30	120	150	140	5	20-500	
Re	**0.000**	-	0.0005	-	0.0005	-	-	-	
Rh	**0.000**	-	-	-	-	-	-	-	
Ru	**0.000**	-	-	-	-	-	-	-	
S								100-	

	697.000	300	300		300	2,400	1,200	2000	23,400	**34**
Sb	**0.300**	0.100	0.20	0.2	0.20	1.0	-	5.00		
Sc	**16.000**	10.0	38.0	10	5	15	5	-		
Se	**0.120**	-	0.05	-	0.05	0.60	0.08	0.2		
Si	**288,000.000**								108,300	
Sm	**5.300**	0.57	4.2	6.8	3.0	6	0.8	-		
Sn	**2.300**	0.50	1.0	2.0	3.0	4	4.0	10		
Sr	**333.000**	1	465	450	285	300	500	50-1000	1,500	
Ta	**1.100**	1.00	0.5	2.0	3.5	2	-	-		
Tb	**0.650**	0.088	0.63	1.3	0.05	1	-	-		
Te	**(0.005)**	0.001	0.001	0.001	0.001	0.01	-	-		
Th	**8.500**	0.003	2.2	10	17	12	2.0	13		
Ti	**4,010.000**	3,000	9,000	8,000	2,300	4,600	400	5,000	1,800	
Tl	**0.520**	0.050	0.10	0.5	0.75	0.3	-	0.1		
Tm	**0.300**	0.053	0.21	0.5	-	0.2	0.1	-		
U	**1.700**	0.001	0.6	3.0	4.8	4	2.0	1		
V	**98.000**	50	250	100	20	130	15	20-500		
W	**1.000**	0.50	1.0	2.0	2.0	2	0.5	-		
Y	**24.000**	-	25.0	30	40	25	15	-		
Yb	**2.000**	0.43	1.1	3.6	0.1	3	0.1	-		
Zn	**65.000**	50	100	60	40	100	25	10-300		
Zr	**203.000**	50	150	140	180	160	20	300		

Rose, Hawk, and Webb, 1979

Notes: Dashes (-) indicate no data are available.

1. Earth's crust: All data from Taylor (1964, 1966) except for Mn, Ti and Se (Saxby, 1969);

2. Igneous rocks, shales and limestones: All data from Taylor (1964, 1966, 1969) except for Mn, Ti and Se (Andrews-Jones, 1968; Saxby, 1969); Re, Ir, Os, Pd, Pt, Rh and Ru (ap-propriate chapters in Wedepohl, 1969); Te (Parker, 1967); F, Cl, Br and I (Turekian and Wedepohl, 1961).

3, Soil: All data from Taylor (1966) except for Ag, Cs, Hg, I-lf, Mn, Sb, Ti, Tl and Zr (Saxby, 1969, who also reports total rare earth elements in soils as approximately 100 ppm); Th (Andrews-Jones, 1968).

LOCATION Lindon **2/24/2009** AIRS_CODE 490494001 POC 5
SAMPLER TYPE URG 3000N
FIELD CUSTODY NO Q174861O ROUTINE
CHANNEL 1 SAMPLE VOLUME 31.70
Sample Handling Validation Checks Performed Level 0: T Level 1: T
Event Flags: Flow Flags:

Field Sampling Data ....

		Value	AIRS Null Value Code
1886	Average Flow	22.0	
1887	End Date		
1888	End Time		
1889	Retrieval Date	2/25/2009	
1890	Retrieval Time	01:00 PM	
1891	Run Time	24.0	
1892	Start Date		
1893	Start Time		
1894	Total Volume	31.7	

Laboratory Analysis Data ....

Quartz Filter (25 mm) I8691F
Shipping Flags:
Module Disassembly Flags:

		Analyte Mass (ug)	Conc (ug/m^3)	Det Limit (ug)	Det Limit (ug/m^3)	Analysis Flags	AIRS Null Value Code
Organic and elemental carbon IMPROVE_A							
1895	E1 IMPROVE	10.3	0.325				
1896	E2 IMPROVE	3.03	0.09570				
1897	E3 IMPROVE	0.00000	0.00000				
1898	EC IMPROVE TOR	10.4	0.327				
1899	EC IMPROVE TOT	7.20	0.227				
1900	O1 IMPROVE	2.17	0.06840				
1901	O2 IMPROVE	9.01	0.284				
1902	O3 IMPROVE	7.89	0.249				
1903	O4 IMPROVE	5.59	0.176				
1904	OC IMPROVE TOR	27.7	0.872				
1905	OC IMPROVE TOT	30.8	0.972				
1906	OP IMPROVE TOR	2.99	0.09440				
1907	OP IMPROVE TOT	6.15	0.194				
1908	TC IMPROVE	38.0	1.20				

LOCATION Lindon **2/24/2009** AIRS_CODE 490494001 POC 5
SAMPLER TYPE SASS with URG 3000N
FIELD CUSTODY NO Q174862P ROUTINE
CHANNEL 1 SAMPLE VOLUME 9.699
Sample Handling Validation Checks Performed Level 0: T Level 1: T
Event Flags: Flow Flags:

Field Sampling Data ....

		Value	AIRS Null Value Code
1909	Average flow	6.73	
1910	Avg ambient temp	11.7	
1911	Avg BP	637	
1912	Delta T Flag		
1913	End date	2/25/2009	
1914	End time	12:00 AM	
1915	Max ambient temp	16.4	
1916	Max BP	644	
1917	Min ambient temp	8.5	
1918	Min BP	635	
1919	Retrieval date	2/25/2009	
1920	Retrieval time	01:00 PM	
1921	Run Time	24.0	
1922	Run Time Flag		
1923	Sample volume	9.70	
1924	Start date	2/24/2009	
1925	Start time	12:00 AM	

Laboratory Analysis Data ....

Teflon Filter I3907S
Shipping Flags:
Module Disassembly Flags:

		Analyte Mass (ug)	Conc (ug/m^3)	Det Limit (ug)	Det Limit (ug/m^3)	Analysis Flags	AIRS Null Value Code
Mass - PM2.5							
1926	Particulate matter 2.5u	44.0±4.0	4.54±0.41	7.2	0.74		
Trace elements (33)							
1927	Aluminum	0.446±0.10	0.04600±0.010	0.12	0.013		
1928	Antimony	0.00000±0.13	0.00000±0.014	0.40	0.042		
1929	Arsenic	0.00000±0.00610	0.00000±0.00063	0.016	0.00160		
1930	Barium	0.00000±0.038	0.00000±0.00390	0.099	0.010		
1931	Bromine	0.01990±0.011	0.00205±0.00110	0.017	0.00180		
1932	Cadmium	0.00000±0.060	0.00000±0.00620	0.18	0.019		
1933	Calcium	1.38±0.099	0.142±0.010	0.046	0.00470		
1934	Cerium	0.00000±0.023	0.00000±0.00240	0.066	0.00680		
1935	Cesium	0.00000±0.11	0.00000±0.011	0.33	0.034		
1936	Chlorine	0.303±0.030	0.03130±0.00310	0.048	0.00490		
1937	Chromium	0.00656±0.00840	0.00068±0.00086	0.021	0.00220		
1938	Cobalt	0.00463±0.00610	0.00048±0.00063	0.011	0.00110		
1939	Copper	0.00090±0.00690	0.00009±0.00071	0.013	0.00130		
1940	Indium	0.102±0.24	0.01050±0.024	0.21	0.022		
1941	Iron	0.884±0.064	0.09110±0.00660	0.014	0.00140		
1942	Lead	0.00000±0.016	0.00000±0.00160	0.047	0.00480		
1943	Magnesium	0.09670±0.037	0.00997±0.00380	0.11	0.011		
1944	Manganese	0.01030±0.00900	0.00106±0.00092	0.017	0.00180		
1945	Nickel	0.00136±0.00430	0.00014±0.00044	0.011	0.00110		
1946	Phosphorus	0.00000±0.040	0.00000±0.00410	0.098	0.010		
1947	Potassium	0.288±0.026	0.02970±0.00270	0.038	0.00390		
1948	Rubidium	0.00000±0.00570	0.00000±0.00058	0.017	0.00180		

1949	Selenium	0.00000±0.00640	0.00000±0.00066	0.019	0.00200
1950	Silicon	1.92±0.17	0.198±0.017	0.11	0.011
1951	Silver	0.00000±0.047	0.00000±0.00490	0.14	0.015
1952	Sodium	0.153±0.13	0.01580±0.013	0.39	0.040
1953	Strontium	0.00113±0.014	0.00012±0.00140	0.022	0.00230
1954	Sulfur	0.963±0.075	0.09930±0.00770	0.071	0.00730
1955	Tin	0.00000±0.10	0.00000±0.011	0.31	0.032
1956	Titanium	0.03170±0.015	0.00326±0.00150	0.042	0.00430
1957	Vanadium	0.00000±0.00970	0.00000±0.00100	0.029	0.00300
1958	Zinc	0.150±0.014	0.01550±0.00140	0.034	0.00350
1959	Zirconium	0.00000±0.081	0.00000±0.00840	0.044	0.00450

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LOCATION Lindon **2/24/2009** AIRS_CODE 490494001 POC 5
SAMPLER TYPE SASS with URG 3000N
FIELD CUSTODY NO Q174862P ROUTINE
CHANNEL 2 SAMPLE VOLUME 9.705
Sample Handling Validation Checks Performed Level 0: T Level 1: T
Event Flags: Flow Flags:

Field Sampling Data ....

		Value	AIRS Null Value Code
1960	Average flow	6.74	
1961	Avg ambient temp	11.7	
1962	Avg BP	637	
1963	Delta T Flag		
1964	End date	2/25/2009	
1965	End time	12:00 AM	
1966	Max ambient temp	16.4	
1967	Max BP	644	
1968	Min ambient temp	8.5	
1969	Min BP	635	
1970	Retrieval date	2/25/2009	
1971	Retrieval time	01:00 PM	
1972	Run Time	24.0	
1973	Run Time Flag		
1974	Sample volume	9.71	
1975	Start date	2/24/2009	
1976	Start time	12:00 AM	

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Laboratory Analysis Data ....

Nylon Filter I3908T
Shipping Flags:
Module Disassembly Flags:

		Analyte Mass (ug)	Conc (ug/m^3)	Det Limit (ug)	Det Limit (ug/m^3)	Analysis Flags	AIRS Null Value Code
Cations - PM2.5 (NH4, Na, K)							
1977	Ammonium	1.57±0.11	0.162±0.011	0.16	0.016		
1978	Potassium	0.00000±0.010	0.00000±0.00100	0.13	0.014		
1979	Sodium	0.388±0.62	0.04000±0.064	0.29	0.030		
Nitrate - PM2.5							
1980	Nitrate	4.42±0.33	0.455±0.034	0.070	0.00720		
Sulfate - PM2.5							
1981	Sulfate	2.97±0.23	0.306±0.024	0.10	0.010		

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LOCATION Lindon **3/14/2009** AIRS_CODE 490494001 POC 5
SAMPLER TYPE URG 3000N with Dynamic
FIELD CUSTODY NO Q1778643 ROUTINE
CHANNEL 1 SAMPLE 31.71
Sample Handling Validation Checks Performed Level 0: T Level 1: T
Event Flags: Flow Flags:

Field Sampling Data ....

		Value	AIRS Null Value Code
2252	Average Flow	22.0	
2253	End Date		
2254	End Time		
2255	Retrieval Date		
2256	Retrieval Time		
2257	Run Time	24.0	
2258	Start Date	3/14/2009	
2259	Start Time		
2260	Total Volume	31.7	

Laboratory Analysis Data ....

Quartz Filter (25 mm) I9597M
Shipping Flags:
Module Disassembly Flags:

Organic and elemental carbon
IMPROVE_A

		Analyte Mass (ug)	Conc (ug/m^3)	Det Limit (ug)	Det Limit (ug/m^3)	Analysis Flags	AIRS Null Value Code
2275	E1 IMPROVE	20.8	0.656				
2276	E2 IMPROVE	0.841	0.02650				
2277	E3 IMPROVE	0.00000	0.00000				
2278	EC IMPROVE TOR	12.5	0.395				
2279	EC IMPROVE TOT	8.05	0.254				
2280	O1 IMPROVE	3.03	0.09560				
2281	O2 IMPROVE	7.63	0.240				
2282	O3 IMPROVE	13.7	0.433				
2283	O4 IMPROVE	6.35	0.200				
2284	OC IMPROVE TOR	39.9	1.26				
2285	OC IMPROVE TOT	44.3	1.40				
2286	OP IMPROVE TOR	9.12	0.288				
2287	OP IMPROVE TOT	13.6	0.429				
2288	TC IMPROVE	52.4	1.65				

LOCATION Lindon **3/14/2009** AIRS_CODE 490494001 POC 5
SAMPLER TYPE SASS with URG 3000N
FIELD CUSTODY NO Q1778654 ROUTINE
CHANNEL 1 SAMPLE 9.696
Sample Handling Validation Checks Performed Level 0: T Level 1: T
Event Flags: Flow Flags: **FHT**

Field Sampling Data ....

		Value	AIRS Null Value Code
2289	Average flow	6.73	
2290	Avg ambient temp	6.1	
2291	Avg BP	634	
2292	Delta T Flag		
2293	End date	3/15/2009	
2294	End time	12:00 AM	
2295	Max ambient temp	15.7	
2296	Max BP	644	
2297	Min ambient temp	-4.3	
2298	Min BP	630	
2299	Retrieval date	3/17/2009	
2300	Retrieval time	12:00 PM	
2301	Run Time	24.0	
2302	Run Time Flag		
2303	Sample volume	9.70	
2304	Start date	3/14/2009	
2305	Start time	12:00 AM	

Laboratory Analysis Data ....

Teflon Filter I38988
Shipping Flags:
Module Disassembly Flags:

	Analyte Mass (ug)	Conc (ug/m^3)	Det Limit (ug)	Det Limit (ug/m^3)	Analysis Flags	AIRS Null Value Code
Mass - PM2.5						
2306 Particulate matter 2.5u	81.0±4.7	8.35±0.49	7.2	0.74		
Trace elements (33)						
2307 Aluminum	0.262±0.13	0.02700±0.013	0.22	0.023		
2308 Antimony	0.00000±0.13	0.00000±0.013	0.27	0.028		
2309 Arsenic	0.00000±0.007	0.00000±0.000	0.014	0.00150		
2310 Barium	0.00000±0.037	0.00000±0.003	0.099	0.010		
2311 Bromine	0.03090±0.011	0.00318±0.001	0.011	0.00110		
2312 Cadmium	0.00000±0.085	0.00000±0.008	0.100	0.010		
2313 Calcium	0.572±0.048	0.05900±0.004	0.071	0.00740		
2314 Cerium	0.00000±0.029	0.00000±0.003	0.080	0.00820		
2315 Cesium	0.00000±0.042	0.00000±0.004	0.097	0.010		
2316 Chlorine	0.07130±0.026	0.00736±0.002	0.078	0.00810		
2317 Chromium	0.00599±0.008	0.00062±0.000	0.019	0.00200		
2318 Cobalt	0.00000±0.006	0.00000±0.000	0.014	0.00140		
2319 Copper	0.01850±0.008	0.00191±0.000	0.024	0.00250		
2320 Indium	0.00000±0.091	0.00000±0.009	0.13	0.014		

2321	Iron	0.523±0.040	0.05400±0.004	0.020	0.00210
2322	Lead	0.04290±0.025	0.00443±0.002	0.027	0.00280
2323	Magnesium	0.00000±0.058	0.00000±0.006	0.18	0.018
2324	Manganese	0.01030±0.007	0.00106±0.000	0.015	0.00160
2325	Nickel	0.00000±0.005	0.00000±0.000	0.016	0.00170
2326	Phosphorus	0.00000±0.046	0.00000±0.004	0.10	0.010
2327	Potassium	0.449±0.039	0.04630±0.004	0.11	0.011
2328	Rubidium	0.00000±0.005	0.00000±0.000	0.014	0.00140
2329	Selenium	0.00260±0.009	0.00027±0.000	0.025	0.00260
2330	Silicon	1.22±0.13	0.126±0.013	0.18	0.018
2331	Silver	0.07910±0.18	0.00816±0.019	0.082	0.00840
2332	Sodium	0.00000±0.18	0.00000±0.018	0.53	0.054
2333	Strontium	0.02030±0.016	0.00210±0.001	0.017	0.00170
2334	Sulfur	1.44±0.11	0.148±0.011	0.085	0.00880
2335	Tin	0.136±0.42	0.01400±0.043	0.19	0.020
2336	Titanium	0.00000±0.016	0.00000±0.001	0.048	0.00500
2337	Vanadium	0.00000±0.012	0.00000±0.001	0.031	0.00320
2338	Zinc	0.07070±0.011	0.00730±0.001	0.025	0.00260
2339	Zirconium	0.00000±0.12	0.00000±0.012	0.027	0.00280

LOCATION Lindon **3/14/2009** AIRS_CODE 490494001 POC 5
SAMPLER TYPE SASS with URG 3000N
FIELD CUSTODY NO Q1778654 ROUTINE
CHANNEL 2 SAMPLE 9.691
Sample Handling Validation Checks Performed Level 0: T Level 1: T
Event Flags: Flow Flags: **FHT**

Field Sampling Data ....

		Value	AIRS Null Value Code
2340	Average flow	6.73	
2341	Avg ambient temp	6.1	
2342	Avg BP	634	
2343	Delta T Flag		
2344	End date	3/15/2009	
2345	End time	12:00 AM	
2346	Max ambient temp	15.7	
2347	Max BP	644	
2348	Min ambient temp	-4.3	
2349	Min BP	630	
2350	Retrieval date	3/17/2009	
2351	Retrieval time	12:00 PM	
2352	Run Time	24.0	
2353	Run Time Flag		
2354	Sample volume	9.69	
2355	Start date	3/14/2009	
2356	Start time	12:00 AM	

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Laboratory Analysis Data ....

Nylon Filter I38999
Shipping Flags:
Module Disassembly Flags:

		Analyte Mass (ug)	Conc (ug/m^3)	Det Limit (ug)	Det Limit (ug/m^3)	Analysis Flags	AIRS Null Value Code
<u>Cations - PM2.5 (NH4, Na, K)</u>							
2357	Ammonium	10.7±0.81	1.10±0.084	0.24	0.025		
2358	Potassium	0.242±0.089	0.02490±0.009	0.23	0.024		
2359	Sodium	0.297±0.053	0.03060±0.005	0.11	0.011		
<u>Nitrate - PM2.5</u>							
2360	Nitrate	35.2±2.5	3.63±0.26	0.070	0.00720		
<u>Sulfate - PM2.5</u>							
2361	Sulfate	4.18±0.32	0.431±0.033	0.10	0.010		

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Appendix 2

Hourly PM and Wind Data

Concentrations in μg/m^3

	Ogden	N. Salt Lake	Hawthorne (SLC)	Lindon	N. Provo	LN wind speed (MPH)	Logan	Ogden	Hawthorne (SLC)	Tooele	Lindon	N. Provo
3/2/09 0:00	52	13.3	35.5	5	19.3	4.2	31.4	31.7	23	26.4	4.2	11.9
3/2/09 1:00	50.7	13.4	23.9	7.3	8.4	4.7	30.1	28.5	17.5	27.8	3.2	8.8
3/2/09 2:00	45.2	14.6	26.7	3.4	8.3	3.7	30.6	28	19.9	23.5	10.6	7.6
3/2/09 3:00	33	14.7	25.4	7.1	5.1	3.8	35.6	26.7	19.1	25.6	7.8	7.2
3/2/09 4:00	31	18.2	34.4	3.9	12.7	3.9	39.2	23.9	27	21.3	5	6.3
3/2/09 5:00	34.7	29.1	27.4	9.5	9.8	4.3	43.3	24.9	18.2	16.6	3.4	6.8
3/2/09 6:00	43.1	52.5	38.9	9	10.5	4.5	39.5	21.5	25.6	14.7	2.4	7.3
3/2/09 7:00	76.7	46.5	39.9	34.4	19	4.3	39.3	30.5	16.5	12.8	7.1	10.3
3/2/09 8:00	91	91.9	42	36.7	22.1	4.2	36.1	34	10.1	13.9	6.9	7.2
3/2/09 9:00	94.5	51.1	86.8	69.6	39.5	3.9	39.4	36.8	23.5	14.3	10.3	10
3/2/09 10:00	128.2	47.7	117	77.1	51	3.5	37.7	39.7	45.5	24.1	22.7	18.1
3/2/09 11:00	152.5	24.8	90.8	74.4	54.7	2.9	32.4	53.9	41.1	28.5	15.4	18.2
3/2/09 12:00	187.3	200	75.7	40.4	75.3	3.4	31.9	53.8	32.9	15	17.7	19.8
3/2/09 13:00	144.8	38.2	81.1	16.2	154.1	4.4	39.2	51.4	34.8	24	4.2	25.8
3/2/09 14:00	131.1	24.6	54.1	3.6	105.7	5	42.1	43.7	26.1	27.7	2.7	25.3
3/2/09 15:00	111.6	61.7	49	10.7	73.2	5.2	42.1	49.4	24.2	22.3	3.9	23.4
3/2/09 16:00	102	110.4	79.2	15.7	42.2	4.6	41.8	46.8	32.8	10.5	7.2	10
3/2/09 17:00	13.5	171.9	80.6	28.9	33.4	7	28	21.5	23.7	9.5	3.4	10.6
3/2/09 18:00	84.8	67.4	77.6	68.5	79.8	6.5	35.7	16.4	11.5	6.8	7.9	16.7
3/2/09 19:00	52.1	119.8	99	73.6	100.7	8.1	36.4	29.5	10.5	15.1	11.4	14.9
3/2/09 20:00	88.4	141.5	100.7	21.8	57.7	5.7	36.9	16.1	10.8	13	10.3	10.5
3/2/09 21:00	120.1	206.9	100.9	16.6	16.9	4.7	38.5	18.6	14.9	22.1	6.2	3.6
3/2/09 22:00	165.1	254.4	146.2	14.4	18.6	5.3	32.1	26.7	19.6	31.2	5	6.2
3/2/09 23:00	178.2	238.1	124.8	32.7	22.8	4.8	19.7	30.6	15.4	17.3	3.1	3.8
3/3/09 0:00	146.3	89.3	71.6	49.1	33.4	5.1	21	29.9	10.2	9	6.1	9.3
3/3/09 1:00	66.2	51	48.6	29.1	36.7	4.4	19.4	19.9	8.5	6.5	6	10.3
3/3/09 2:00	36.6	44.9	35.2	11.1	32	5.5	14.3	11.4	4.6	6.7	3.7	11.6
3/3/09 3:00	21.6	35.8	32.8	7.4	21.3	3.7	10.6	7.7	8.7	5.6	5.3	7
3/3/09 4:00	23.8	31.2	25.7	7	13.2	3.3	7.5	8.7	6.1	7.9	6.2	5.9
3/3/09 5:00	21.5	22.3	14.6	5.4	9.3	6.6	5.8	9.2	5.9	7.1	5.2	7.6

3/3/09 6:00	17.5	18.2	9.5	5.6	6.9	7.7	5.9	6.2	2.2	7.8	3.7	4.1
3/3/09 7:00	22.6	35.1	9.7	9.6	16.3	6	7.6	7.1	2	7.5	3.2	7.8
3/3/09 8:00	21.5	63.1	16.1	8.1	20.4	5.9	10.7	7	5.7	6.2	2.6	8.3
3/3/09 9:00	30.1	55.2	20.5	7.9	15.4	5.9	10.4	7.9	6.5	5.3	4.5	5.4
3/3/09 10:00	7.2	61.2	17.3	12.8	10.2	5.7	8.8	9.5	3.1	6	2.3	0.2
3/3/09 11:00	10.1	48.6	20.9	6.8	9.5	8.1	1.2	6	0.8	6	2.3	1.1
3/3/09 12:00	13.5	134.8	45.7	29.8	17.1	10.8	4.3	5.5	7.8	9.1	5.2	2.4
3/3/09 13:00	10.2	227.8	146	77.2	25.7	13.3	6.2	7.9	35.7	13.2	8.5	4.1
3/3/09 14:00	34	286.9	337.8	165.5	97	14.3	5.4	6	86.4	17.2	19.9	17.9
3/3/09 15:00	24.3	208	295.8	112.3	165.7	12	5.3	11.7	56	22.8	22.6	28.2
3/3/09 16:00	56.6	186	177.2	128.3	244.2	9.6	8.4	9.9	20.6	14.7	20.2	44.8
3/3/09 17:00	69.9	181.2	135	211.5	437.9	8.2	15.1	16.5	15.9	23.1	37.3	80.5
3/3/09 18:00	55.8	151.7	118.5	109.7	408.1	5.3	31.6	17.7	17.1	30.3	39.1	76.5
3/3/09 19:00	43.1	174.5	129.3	141.5	328	3.9	51.1	14.5	23.4	31.9	30.4	64.4
3/3/09 20:00	92.3	164.2	119.9	205.6	316.5	5.2	61	16.5	22	24.8	41.3	69.2
3/3/09 21:00	106	77.2	75.6	176.2	215	3.7	56.6	27.3	17.3	21.7	51.1	45.4
3/3/09 22:00	46.3	65.3	50.9	81.5	132.6	3.6	41.3	23.9	11	12.6	31.2	32
3/3/09 23:00	29.5	45.9	50.9	44.9	141.8	3.5	29.3	13.5	13.3	9.7	16.8	37
3/4/09 0:00	30.5	31.6	29.8	53.1	76.1	3.8	23.2	10.4	5.8	8.8	13.7	21.3
3/4/09 1:00	29.9	46.8	30.4	23.8	25.2	2.6	26.6	7.9	4.4	8.2	7.6	9.9
3/4/09 2:00	33.2	45.1	36.5	24.9	13.1	4.1	10.4	5.4	9.1	7.2	5.9	5
3/4/09 3:00	30.9	34.7	36.7	25.9	26.7	4.3	4.3	8.7	11	7.4	4.8	9.9
3/4/09 4:00	23.4	49	48.7	21.6	12.2	2.7	5.4	7.6	13.7	8.2	0.5	6.5
3/4/09 5:00	31.7	38.2	32.6	22.8	16	4.2	7.6	7.7	11	11.2	7.3	5.3
3/4/09 6:00	23.9	44.7	33.5	4.1	22.2	4.3	8.6	6.4	9.6	6.7	1.8	5.8
3/4/09 7:00	20.9	85	59.2	3.7	15.3	3.5	9	7.1	10.1	5.5	4.1	5.3
3/4/09 8:00	39.9	63.6	47.5	7.7	9.6	3.2	4.6	8.7	8.1	5.8	5	4.3
3/4/09 9:00	30.2	183.2	36.8	6.4	14.2	5.6	0.5	10.1	5.7	7.1	3.4	1.6
3/4/09 10:00	28.4	156.9	49	15.9	18.7	12.2	6.7	7.6	3.2	6.9	1.8	3.1
3/4/09 11:00	45.3	113.2	82.6	59.5	50.3	15.7	3.6	6.1	5.4	9.1	5.7	6.9
3/4/09 12:00	32.6	190	143.5	138.1	140.5	16.2	3.8	9.2	7.5	14.6	12.7	22.2
3/4/09 13:00	129.3	155.2	277.7	327.8	357.9	13.9	14.5	16.3	29.2	20.9	35.8	50.9
3/4/09	351.4	222.4	254.8	330.6	328.4	15.4	79.9	45.2	29	28.3	60.1	45.9

14:00												
3/4/09 15:00	337.7	165	335.7	243	312.5	13.9	85.6	56.6	35.9	22.8	49.3	47.3
3/4/09 16:00	225.6	472.3	169.6	255.9	314.2	10.4	32.5	78.4	18.5	29.5	44.2	44.8
3/4/09 17:00	247.5	514.4	573.1	192.4	307.2	7.9	10.2	32.4	80.3	70.7	40.6	49.5
3/4/09 18:00	41.4	628.8	527.3	527.3	383	6.3	5.2	18.6	69.3	64.5	48.2	61.4
3/4/09 19:00	12.3	91.4	330.1	698	789.6	7.9	5.5	7.2	38.6	32.6	85.1	111.2
3/4/09 20:00	38.2	20.8	43.6	364.4	599.7	9.4	6.9	3.5	6.1	10.1	60.3	84.4
3/4/09 21:00	6.8	191.8	8.2	54.3	202.8	7.7	10.6	4.5	2.3	6.4	19.1	30.9
3/4/09 22:00	1.6	4.7	8.5	17.3	63.4	5.5	5.6	4.6	7.2	3.7	6.6	10.4
3/4/09 23:00	15.8	1.1	0.1	6.6	30.6	3.3	3.8	5.1	0	3.2	0	8.6
3/5/09 0:00	23.8	16.6	0	2.9	14.9	2.5	5.7	3.1	0	6.2	2	6.6
3/5/09 1:00	2.7	1.5	2.5	1.6	7.8	3.8	5.5	3.4	1.8	5.8	7.8	2.1
3/5/09 2:00	1.1	0.6	4.9	0	4	9.5	4.4	2.2	6.3	8	0	6.1
3/5/09 3:00	7.3	9.7	6.4	5.6	3.3	8.9	5.7	3	6.8	6.5	0.7	3.2
3/5/09 4:00	5.3	6.6	11.4	2	2.4	3	1.8	3.6	7.5	4.6	0	2.2
3/5/09 5:00	12	22.9	6.5	9.5	5.3	3.2	4.1	3.7	3.1	5.2	0	3.7
3/5/09 6:00	7.8	16.7	0	8.4	0.4	3.4	3.8	4.8	0	4.7	1.3	4.8
3/5/09 7:00	10.2	14.2	12.5	2.6	3.8	3.1	4.6	4.6	8.7	6.9	4.6	4.5
3/5/09 8:00	15.9	14	2.9	5.9	7.5	3.6	8.2	7.5	0	7.6	1.7	4.7
3/5/09 9:00	5.7	14.9	15.6	8.2	9	4.5	15.4	7.5	15.4	6	8.3	7
3/5/09 10:00	4.1	13.6	9.5	2.1	10.5	6.1	13.5	7.1	8.7	5.8	10.3	6.4
3/5/09 11:00	2.5	14.8	15.2	5	8.8	6.7	5.4	3.4	10.5	8	4	4
3/5/09 12:00	1.5	20.1	6.6	3.1	10.2	6.6	6.4	2.1	1.9	6.4	2.4	7.2
3/5/09 13:00	23.9	14	14.5	5.5	15.1	7.7	15.4	3	8.7	3.9	8.1	4.1
3/5/09 14:00	1.6	7	11.5	3.7	9.4	7.5	0	5.8	6.1	2.9	10.6	4
3/5/09 15:00	1.2	3.1	0	0.8	0	5.3	0	2.4	1	4.5	0	2.8
3/5/09 16:00	7.2	4.1	0	0.9	0	4.3	5	0	0	5.3	2.3	2.2
3/5/09 17:00	2.7	5.3	5.7	1.5	0	3	7.4	5	3.6	4.5	0	4.4
3/5/09 18:00	7.1	16.6	6.9	4.6	4.9	3	6	6.8	2.7	3.6	4	4.7
3/5/09 19:00	3.3	23.1	13.2	5.3	2	4	3.7	5.1	2.7	6.1	1.6	2.2
3/5/09 20:00	6.2	15.2	14	3.5	5.5	3.2	2.7	4.3	2	5.4	3	2.8
3/5/09 21:00	3.5	9.7	12.3	9	6.6	2.9	3.5	5.8	9.2	5.5	3.1	3.7
3/5/09 22:00	6.1	18.1	5.4	19	17.5	2.7	7	3.3	2.5	4	6	11

3/5/09 23:00	12.6	10.2	16	12	14.5	2.4	6.6	3.9	0	4.1	5.4	7.4
3/6/09 0:00	8.3	8.3	24.3	10.7	10.4	2.2	3.7	5.5	4.8	4.8	10.2	6
3/6/09 1:00	11.6	23.9	20.1	9.8	10.2	2.1	4.4	4.2	1.4	4	6.3	7.1
3/6/09 2:00	4.7	7.4	20.1	5.8	5.3	2.2	3.5	4.4	5.9	3.8	6.3	6.3
3/6/09 3:00	12.3	9.4	18	10.8	3.7	2.3	2.2	6.4	5.9	3.9	4.8	6.1
3/6/09 4:00	15.4	11.6	18.2	5.6	7.8	2.8	4	7.4	8	2.7	7.3	6.3
3/6/09 5:00	15.2	18.1	8.4	9.2	8.2	3.5	4	6.1	1.3	3.8	6.7	6.2
3/6/09 6:00	11.7	19.9	7.8	7.1	9.4	3.1	2.4	6.8	2.3	4.2	7.1	5.2
3/6/09 7:00	18.6	68.8	10.3	10.4	8.5	2.3	1.4	6.6	2.4	4	5.2	4.1
3/6/09 8:00	24.4	64.6	16.8	18.3	10.4	3.6	6.2	7.8	7.6	2.6	8.5	3.4
3/6/09 9:00	15.3	42.5	16.2	1.2	17.3	3.4	6.2	8.5	5.6	4.7	10.5	8.7
3/6/09 10:00	10.2	63.8	28.5	21.1	17.3	3	6.7	8.5	13.6	4.6	6.8	10.3
3/6/09 11:00	23.2	43.3	19.3	24.2	5.5	5.3	6.5	9.3	5.7	5.1	7.1	5.6
3/6/09 12:00	12.6	28.3	3.6	10.2	3.5	7.4	6.7	6.5	0	4.9	10	4.6
3/6/09 13:00	16.6	75.6	5.2	11.6	5.4	6.1	12	5.9	0.8	3.7	4.8	4.2
3/6/09 14:00	9.2	39.8	11	19	9.8	3.7	10.1	4.7	7.3	4.5	3.5	4.9
3/6/09 15:00	0.9	33.9	9	1.7	6.4	5.2	7.2	6.4	5.5	6.9	6.2	7.2
3/6/09 16:00	1	12.9	0	24.7	9.4	5.2	5.5	3.4	0	8.4	7.6	7.7
3/6/09 17:00	4	13.4	0	11.4	10.7	4.4	3.7	4.6	0	6.2	6.8	6.7
3/6/09 18:00	27.3	19.2	8.3	11	7	1.9	3.8	5.7	0	4.6	6.4	4.3
3/6/09 19:00	27.8	27.7	20.4	5.1	6	2.6	3.6	8.3	6.8	6.8	7.3	8.2
3/6/09 20:00	11.2	25.6	19.3	7.8	7.5	1.9	5.4	7.9	6.9	8.6	7.2	9.1
3/6/09 21:00	9.5	6.6	14.3	6.4	14.5	1.8	5.1	7.1	3.1	5.9	11.7	10.2
3/6/09 22:00	17.1	5	0	18.3	14.8	3	7.1	5.7	0	7	14.8	12.8
3/6/09 23:00	22.5	2.2	0.6	2.6	9.2	4.4	7	7.1	0	8	13.6	10.9
3/7/09 0:00	12.7	1.9	9.9	2.5	14.5		6.3	7.8	7.2	6.6	10.5	13