State of Utah
GARY R. HERBERT
Governor

SPENCER J. COX
Lieutenant Governor

Department of
Environmental Quality

Alan Matheson
Executive Director

DIVISION OF AIR QUALITY
Bryce C. Bird
Director

DAQP-030-16

March 14, 2016

Carl Daly, Air Program Director
EPA Region 8
1595 Wynkoop Street
Denver, Colorado 80202-1129

RE: Exceptional Event Documentation – High Wind on April 14, 2015

Dear Mr. Daly:

This letter transmits the documentation necessary to flag data for removal from regulatory consideration during a high wind dust storm event.

The documentation report was prepared in accordance with EPA's regulation for the "Treatment of Data Influenced by Exceptional Events" and the draft guide issued by EPA on May 2, 2011, on the preparation of documentation for high wind events.

The Division of Air Quality established a 30-day comment period from February 1, 2016, to March 2, 2016. No comments were received.

Should you have any questions on this filing or need any further information, please contact Joel Karmazyn of my staff at (801) 536-4423 or jkarmazyn@utah.gov.

Sincerely,

Bryce C. Bird
Director

Attachment

cc: Diedre Rothery, EPA

195 North 1950 West • Salt Lake City, UT
Mailing Address: P.O. Box 144820 • Salt Lake City, UT 84114-4820
Telephone (801) 536-4000 • Fax (801)536-4099 • T.D.D. (801) 903-3978
www.deq.utah.gov

Utah Division of Air Quality

PM_{10} Exceptional Event - High Wind

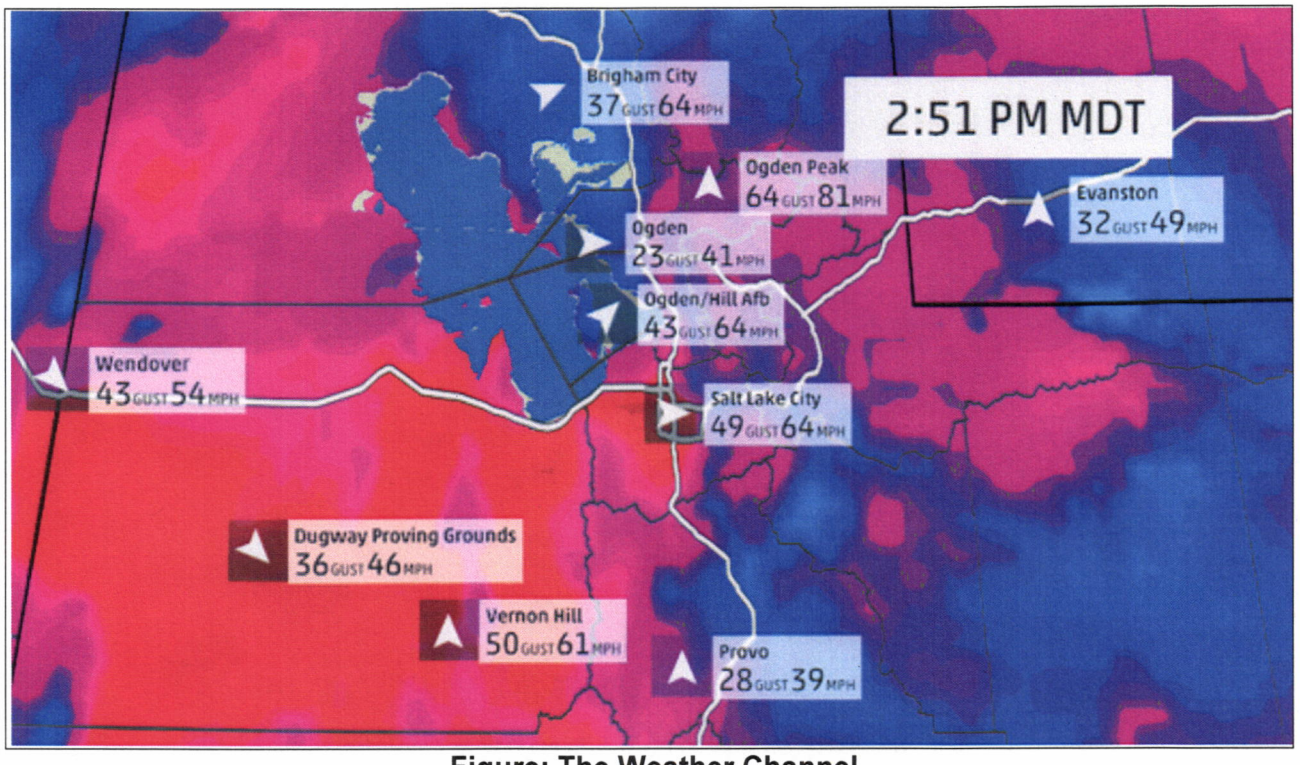

Figure: The Weather Channel

Event Date: April 14, 2015

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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(c)(3)(iv-v) specifies that evidence must be provided that:

1. The event meets the definition of an exceptional event;
2. The event is associated with a measured concentration in excess of normal historical fluctuations, including background;
3. 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;
4. There would have been no exceedance or violation but for the event; and
5. The public comment process was conducted, and documentation of such must be provided to the Environmental Protection Agency (EPA).

This report documents that the event meets the above criteria and provides analyses to demonstrate that:

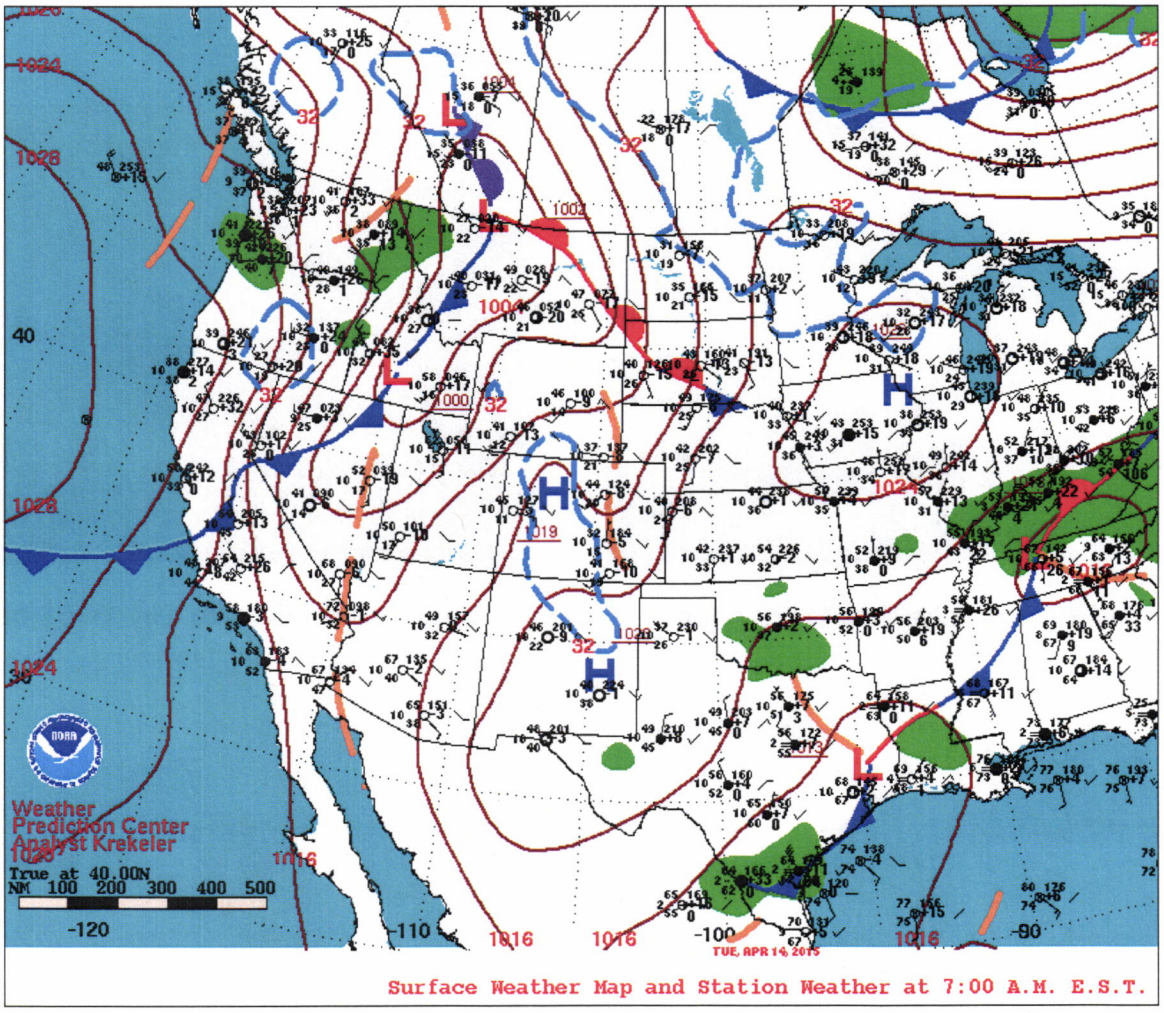
I. The natural dust event was not reasonably controllable or preventable;
II. Reasonable controls, based on EPA guidance, are in place for anthropogenic sources through regulatory structures and programs sponsored by state, federal and local agencies as described in the Mitigation Section;
III. There is a clear-causal connection between the high wind event and the exceedance at the monitoring station network;
IV. The measured concentrations are beyond normal historical levels; and
V. The exceedance would not have occurred "but for" the high winds.

Conceptual Model

The National Weather Service placed the Wasatch Mountains and Western Uintah's under a winter storm warning on April 14, 2015 until 4 p.m. local time. The Weather Channel described the storm as, "Vicious winds ahead of a front swept into the West Tuesday, picking up desert dust and creating dangerous situations on highways and interstates in both Utah and California. In western Utah, outside Salt Lake City, the combination of tropical storm force winds and dust sent visibility plummeting to a quarter-mile at times, and drivers struggled to see. Accidents along Interstate 80 forced UDOT to close eastbound and westbound lanes from the Utah-Nevada state line to mile marker 99 near Tooele....Six semi trucks and 11 cars were involved in the crash, the Utah Highway Patrol told NBC. Eighteen people with various injuries were taken to local hospitals." (Published April 14, 2015, 11:15 PM EDT)

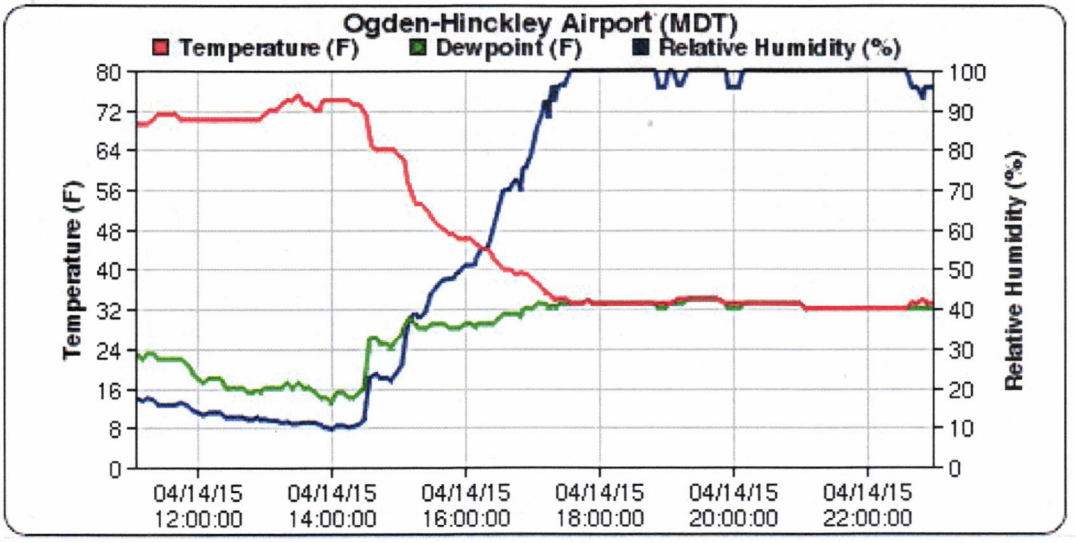
(Photo: Angelo Werito)

The extent of the storm is evident on the surface weather map. The cold front is depicted as the blue line running from the Pacific Ocean up to the Canadian border.



Event Day – April 14, 2015

This storm displayed classical signs of a leading dry line, depicted by the orange broken line in front of the cold front. Blowing dust from high winds are characteristic effects during dry line fronts. The dry line occurs when high temperature rapidly decreases, while the dew point and relative humidity increase.



(Source:MesoWest)

PM_{10} levels escalated around mid-day until about 16:00 hour.

Photo: MSI, Salt Lake City 13:20 hour

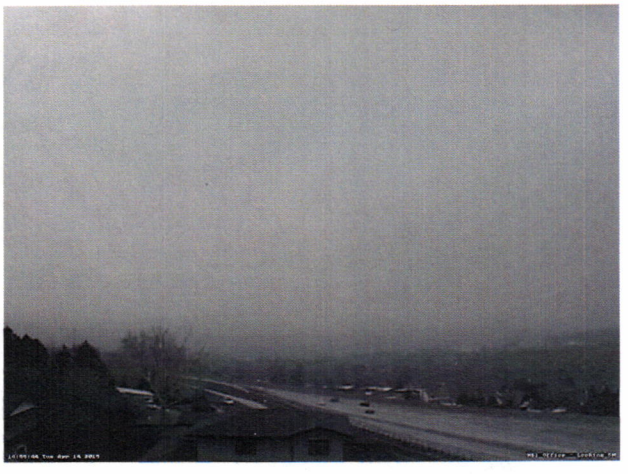
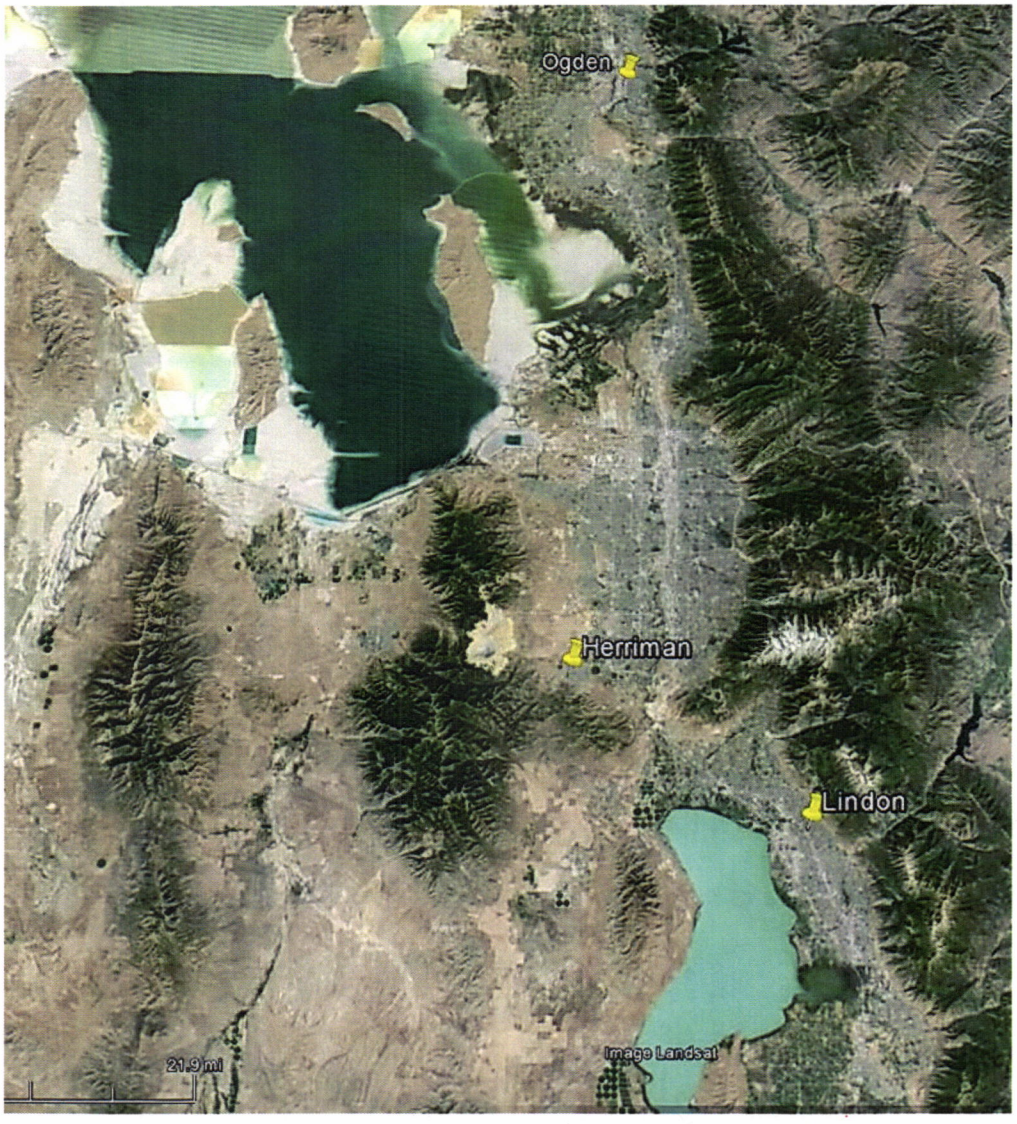


Photo: MSI, Salt Lake City 14:58 hour

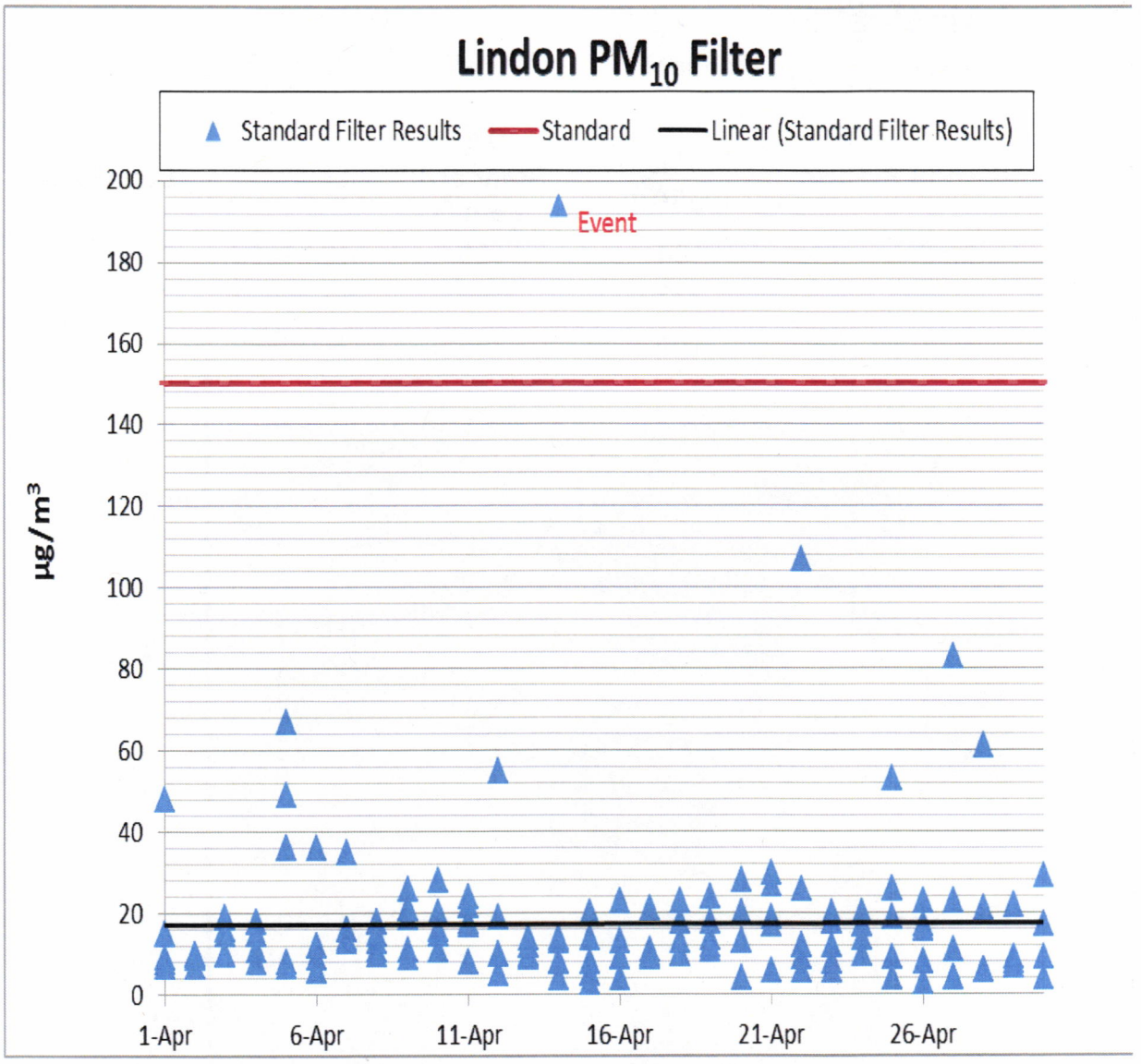
Affected Air Quality

The following are the PM_{10} exceedances:

Monitoring Station	PM_{10} ($\mu g/m^3$)	PM_{10} Standard ($\mu g/m^3$)	Latitude	Longitude
Lindon	194	150	40.33952	-111.71344
Ogden	332	150	41.20693	-111.97509
Herriman	256	150	40.4964	-112.0363

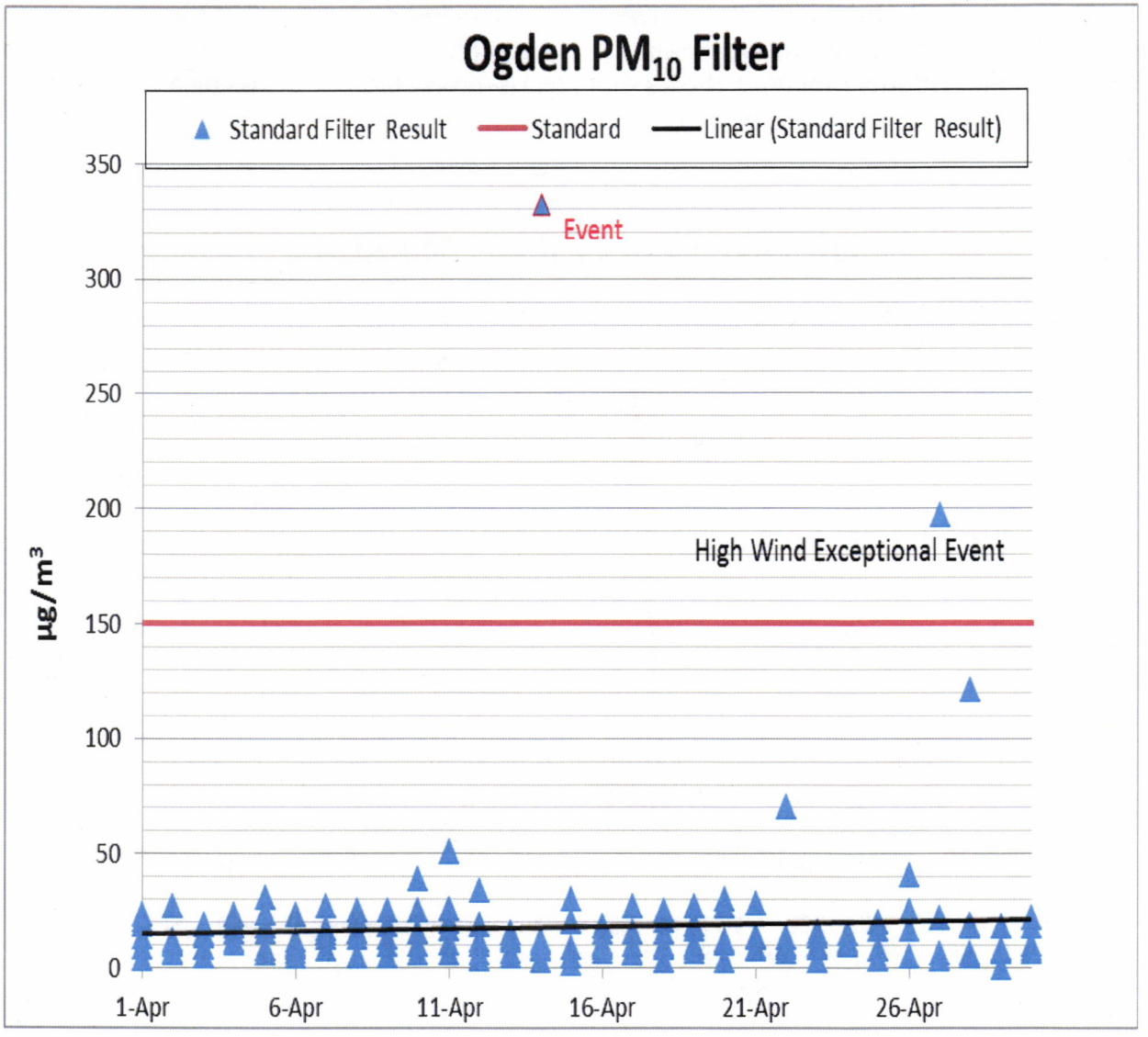


Historical Fluctuation



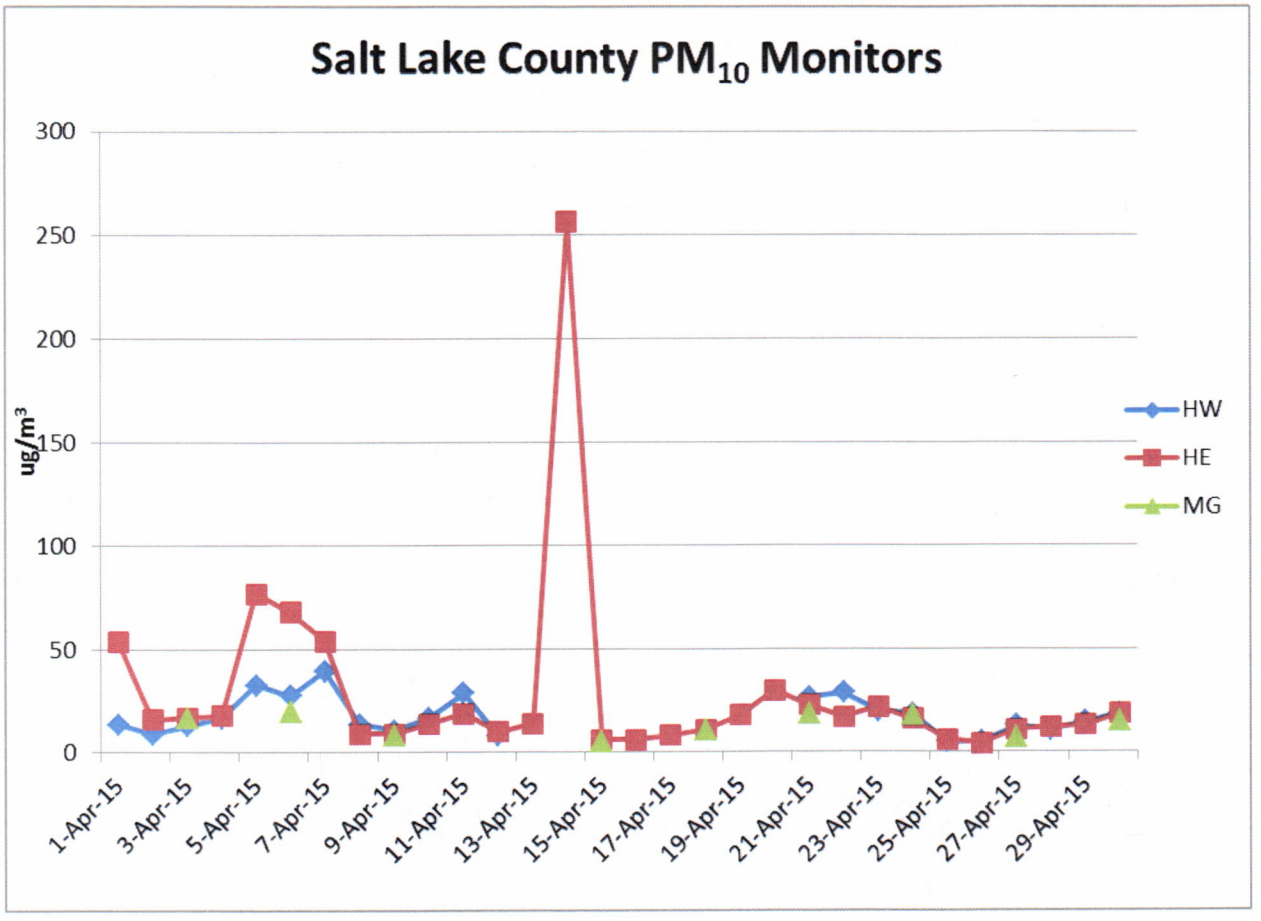
- Six year (2010-2015) April filter data.
- The sole exceedance is the April 14, 2015 event day.
- The linear trend line is below 20 µg/m^3.

Event Day – April 14, 2015



- Six year (2010-2015) April filter data.
- The April 14, 2015 event day and a 2010 high wind exceptional event are the only exceedances.
- The linear trend line is between 15 and 20 µg/m^3.

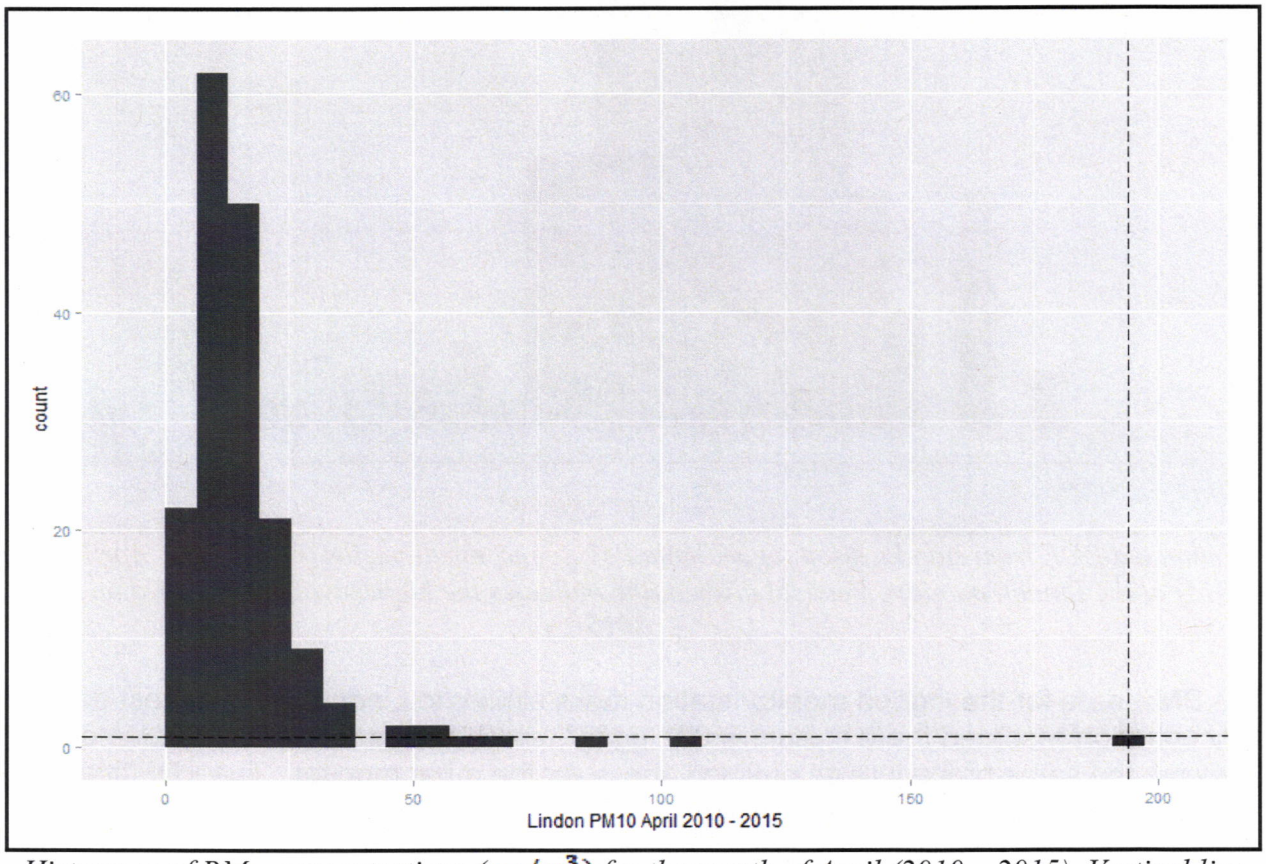
The Herriman (HE) monitoring station was newly installed during the 2015 winter; consequently, there is no historical data for this station. A plot of the April filter results for the PM_{10} Salt Lake County monitors shows that the Herriman station is well alligned with the other stations.



The last high wind exceptional event occurred in 2010; therefore, it is assumed that high wind exceedances would not have occurred in Herriman since 2010.

Statistical Analysis

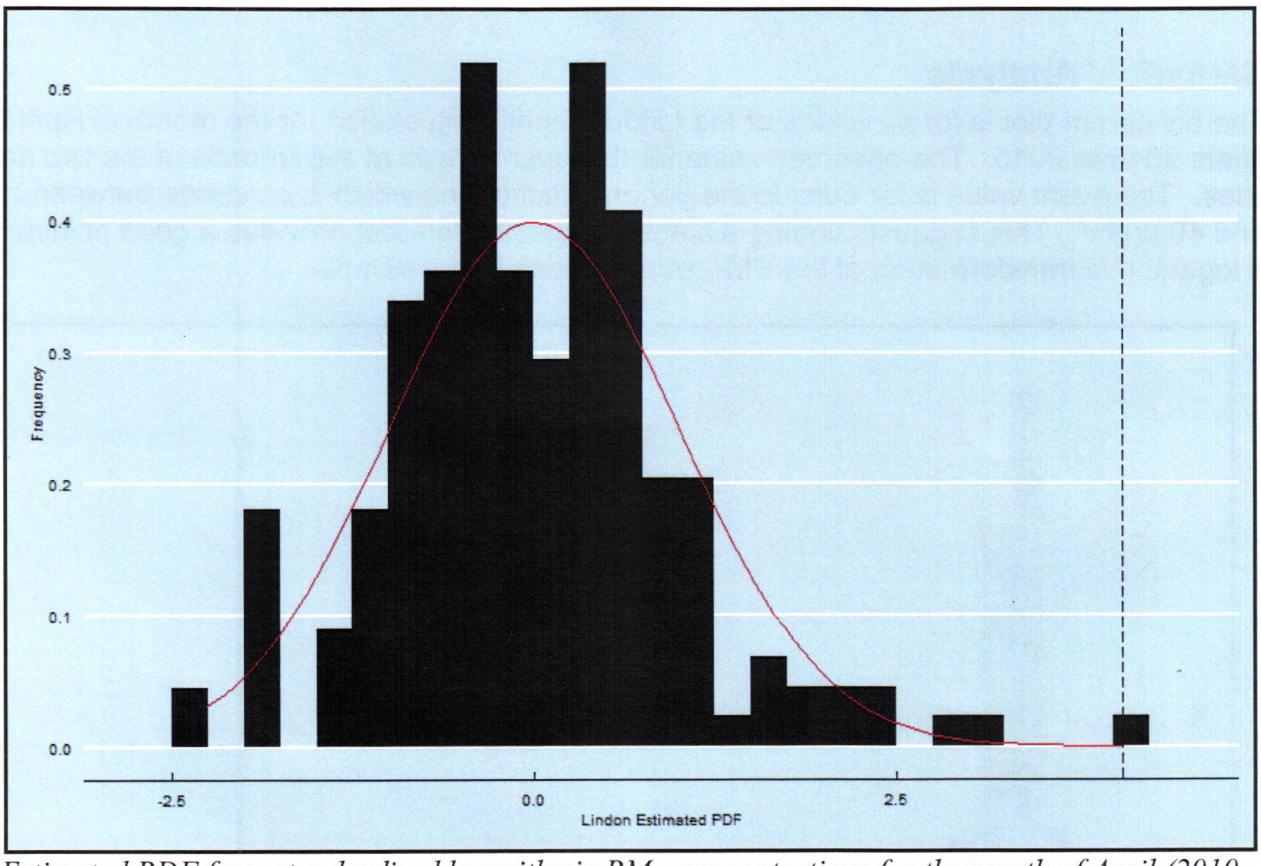
The histogram plot is for all values at the Lindon monitoring station for the month of April from years 2010 to 2015. The observed value for this event day is at the junction of the two dotted lines. The event value is far outside the general distribution which is clustered between zero and 40 µg/m^3. This suggests finding a statistical distribution that provides a good fit involves a logarithmic transformation of the PM_{10} observations in our sample.



Histogram of PM_{10} concentrations ($\mu g/m^3$) for the month of April (2010 – 2015). Vertical line indicates highest value (recorded on April 14, 2015), while horizontal line indicates a frequency of only one sample.

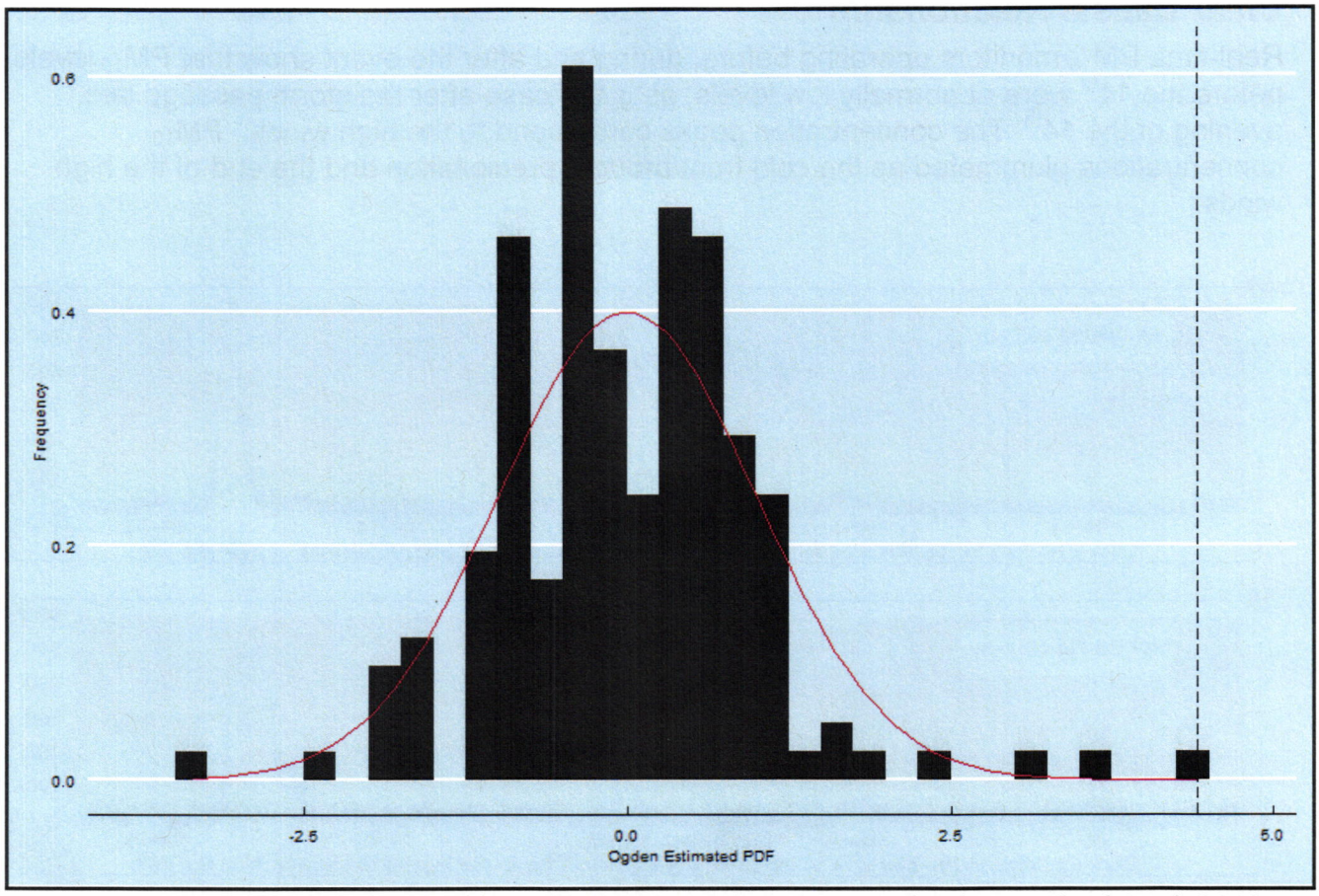
First we calculate z-values by statistically standardizing the logarithm of April PM_{10} concentrations collected over six years. Then we assume these z-values are normally distributed with a mean of 0 and standard deviation of 1. According to this probability distribution function (PDF; displayed below), the probability of a PM_{10} concentration in Lindon, greater than the April 14, 2015 daily PM_{10} value, is essentially zero:

$$P(z > 4.063) = P\left(PM_{10,April} > 194\mu g/m^3\right) = 2.43 * 10^{-5}$$



Estimated PDF from standardized logarithmic PM_{10} concentrations for the month of April (2010 – 2015) at the Lindon monitor. Vertical dashed line indicates the highest value (recorded on April 14, 2015).

The PM_{10} data for the Ogden monitor station looks similar to Lindon. The highest daily PM_{10} concentration recorded there in April is 332 µg/m^3, which corresponds to a z-value of 4.077 following the same procedure as outlined above for the other monitor. The PDF fitted to the transformed Ogden data is shown below.



Estimated PDF from standardized logarithmic PM_{10} concentrations for the month of April (2010 – 2015) at the Ogden monitor. Vertical dashed line indicates the highest value (recorded on April 14, 2015).

According to our statistical model, the probability of ever recording a daily PM_{10} concentration above what was witnessed in Ogden on April 14, 2015, is virtually zero:

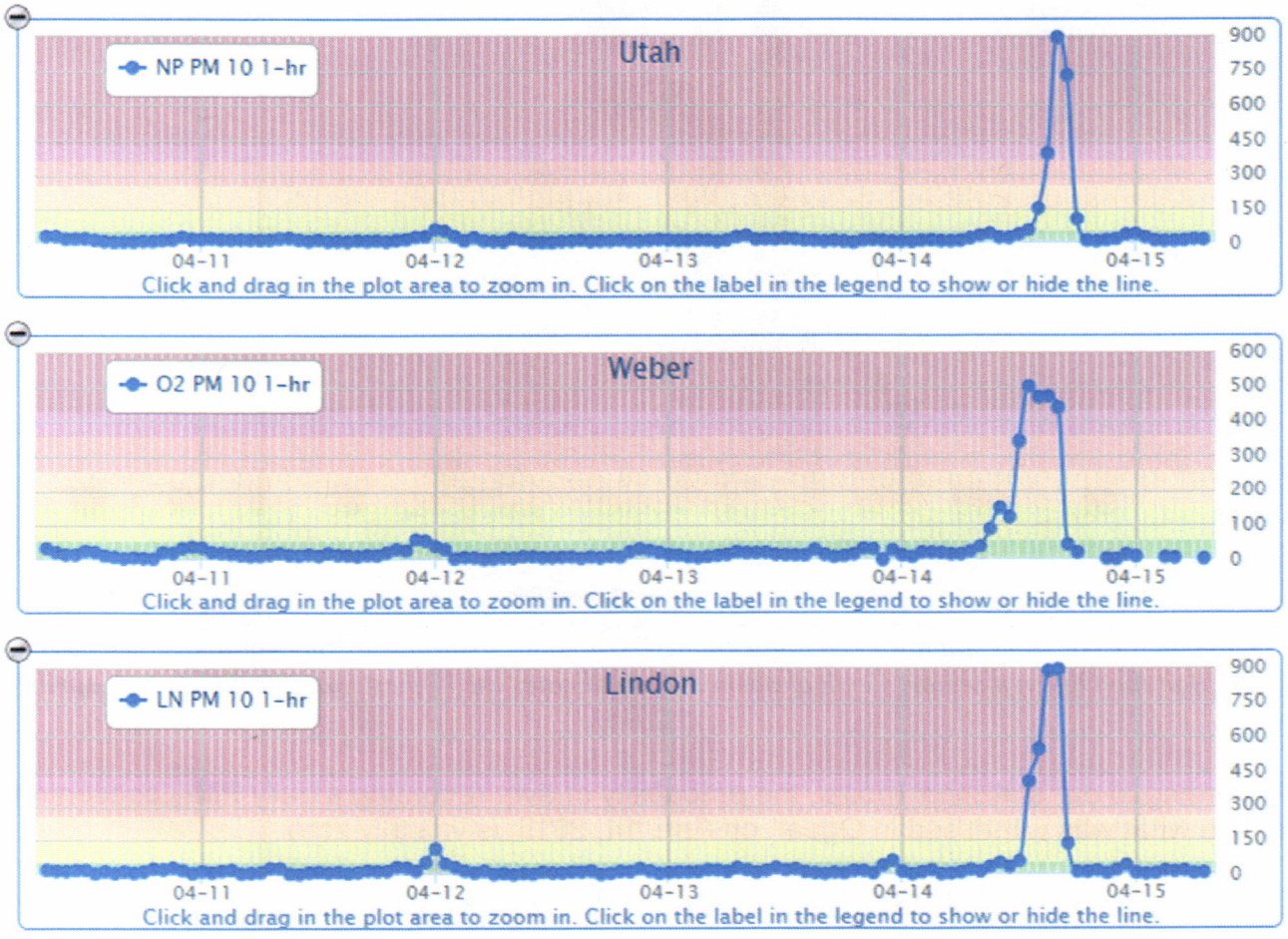
$$P(z > 4.077) = P\left(PM_{10,April} > 332\mu g/m^3\right) = 5.22 * 10^{-6}$$

These results demonstrate that the PM_{10} concentrations observed on April 14, 2015 at Lindon and Ogden are highly anomalous. From a statistical perspective, it seems reasonable to conclude an exceptional event occurred on April 14, 2015 that had no anthropogenic basis.

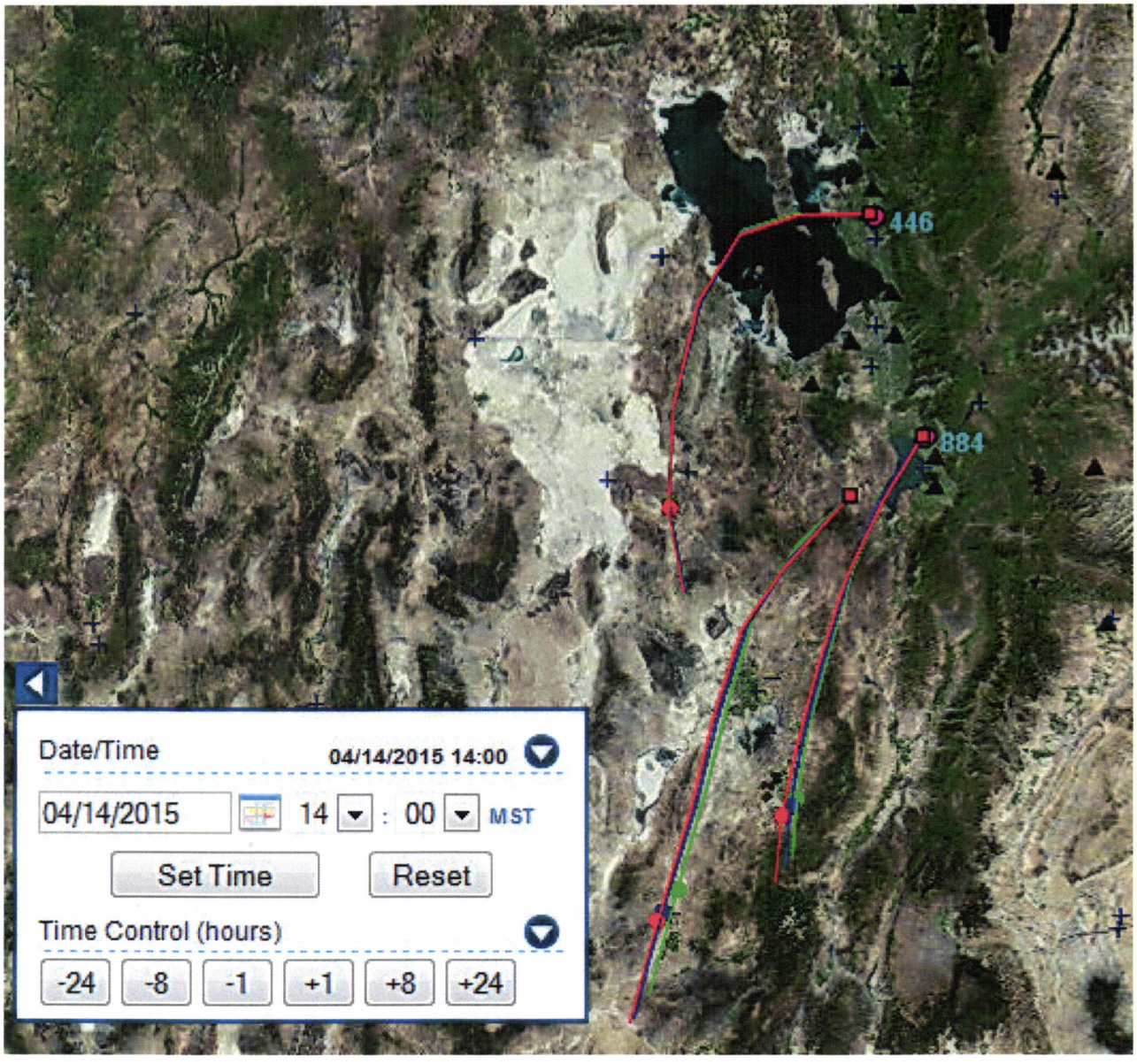
In the absence of historical Herriman data and the fact that the Herriman event value is much greater than that observed value at Lindon, we can comfortably assume that the probability that the Herriman exceedance is due to anthropogenic sources is comparably negligible.

Clear Causal Relationship

Real-time PM_{10} monitors operating before, during and after the event show that PM_{10} levels before the 14th were at normally low levels, as is the case after the storm passage late evening of the 14th. The concentration peaks correspond to the high winds. PM_{10} concentrations plummeted as the cold front brought precipitation and the end of the high winds.



Six hour back trajectories from the height of the storm were plotted for the three monitoring stations. The numerical values shown at the stations are hourly PM_{10} values. Back trajectories were plotted at 10 (green), 50 (blue) and 100 (red) meters. There were no appreciable differences in the trajectory heights. The trajectories at the Lindon and Herriman stations are consistent with the southerly approach of the storm, as projected by the National Weather Service. The winds shifted to the northwest after the cold front passed, as shown by the Ogden station trajectories.



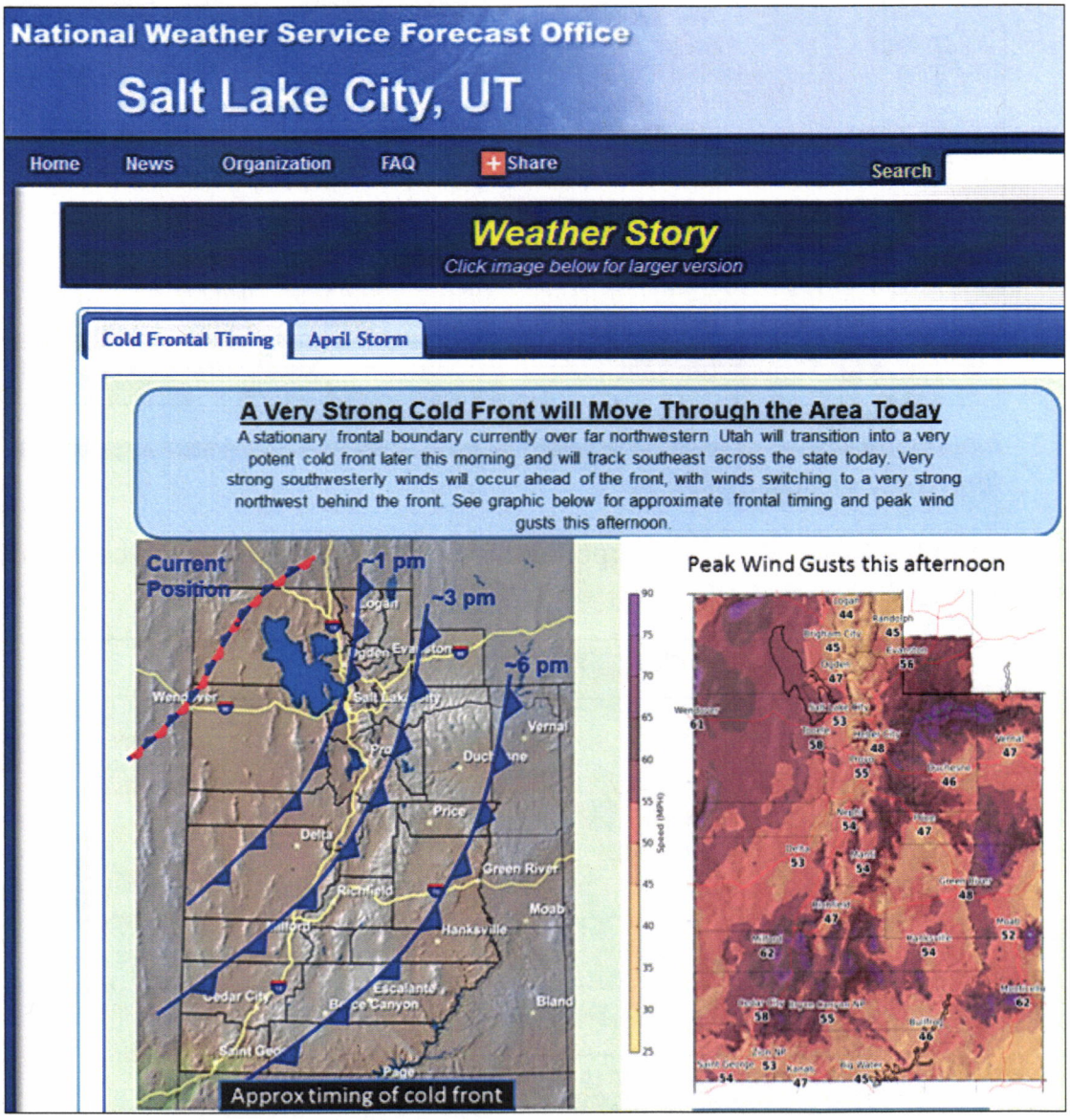
A DAQ staffer was on the shore of the Great Salt Lake at Farmington Bay in the morning of the event. He noted dusting in the dry lake bed as early as 7 a.m. and well established dust clouds by 8:30 a.m., as shown in the picture below.

This photograph was taken from the shore of Farmington Bay, looking directly west towards Antelope Island. Antelope Island is shrouded by the dust haze.

Not Reasonably Controllable or Preventable & Natural Event

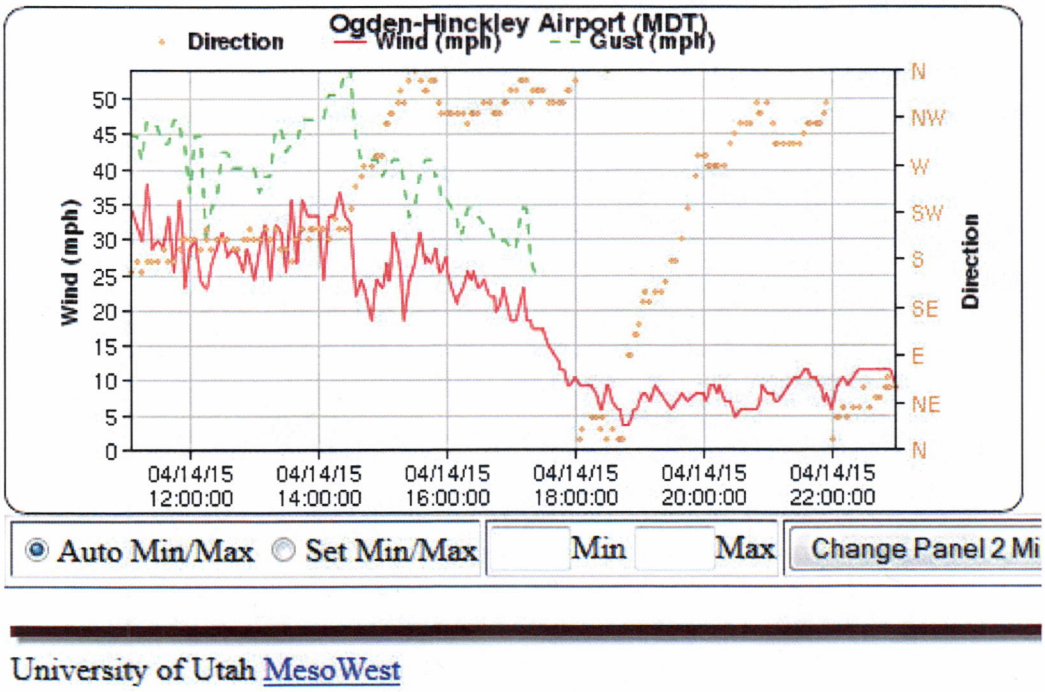
Rapidly developed cold fronts produce strong winds and dramatic temperature gradients over the Intermountain West. This seasonal spring occurrence creates the potential for wind eroded surface soils in the Utah and Nevada deserts. Soil particles are susceptible to erosion when rapid heating releases its adhesion to the strata and surface wind velocities are sufficient to suspend them into the air mass.

The National Weather Service forcasted a strong cold front would produce strong southerly winds in the morning hours, then transition to strong northwest winds later in the day.

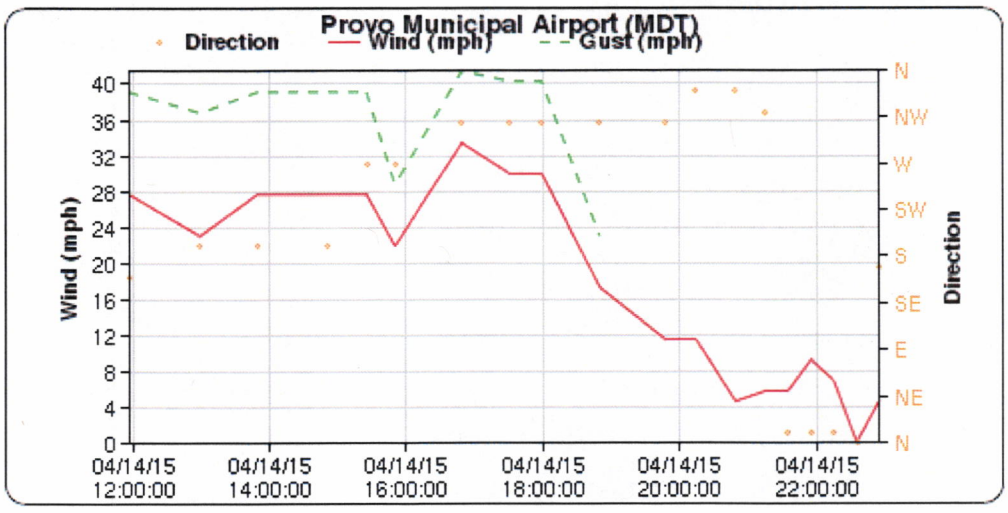


The wind direction shift forecasted by the National Weather Service is evident in the metrological data for the Ogden-Hinckley and Provo Municipal Airports.

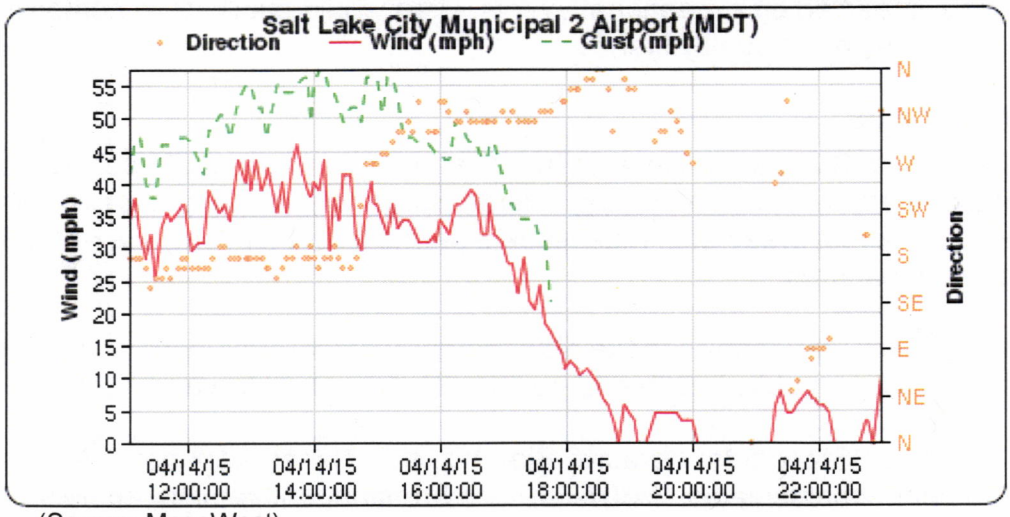
Wind speeds at the Ogden-Hinckley Airport were between 18 and 37 mph during the height of the event, with gusting winds up to 55 mph.



Wind speeds at the Provo Municipal Airport at the height of the event were between 28 and 33 mph, with gusts up to 40 mph.



(Source: MesoWest)



(Source: MesoWest)

Wind speeds at the Salt Lake City Municipal Airport at the height of the event were between 26 and 46 mph, with gusts up to 57.5 mph.

These wind speeds exceed the EPA default sustained wind threshold of 25 mph for winds to entrain dust.

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). This system of control techniques for fugitive dust has been in place since 1992, when the current Utah PM_{10} SIP was developed and has been significantly revised in 2013. The SIP program requires control measures for both specific and general PM_{10} 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 two administrative rules that control fugitive dust throughout the state. Taken together, R307-205 and R307-309 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's 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 SIPs have been successful as evidenced by the fact that, excluding data impacted by exceptional events, Utah would easily be in compliance with the PM_{10} national ambient air quality 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 their local fire authority 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 practices and emission standards to control particulates. R307-306, 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.

Agricultural Sources

The back trajectory from the Lindon monitoring station indicates that the storm path may have traversed agricultural lands. 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). EPA recognizes the value of this program in controlling fugitive dust by determining that this program is BACM for agricultural tilling (EPA-450/2-92-004, page 1-10).

The Farm Bill legislation created and reauthorized two 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 reserves. 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 and 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 of these NRCS programs 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;
- Using NRCS "costs shares" on conservation practices with local farmers to prevent soil erosion; and
- Working 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.

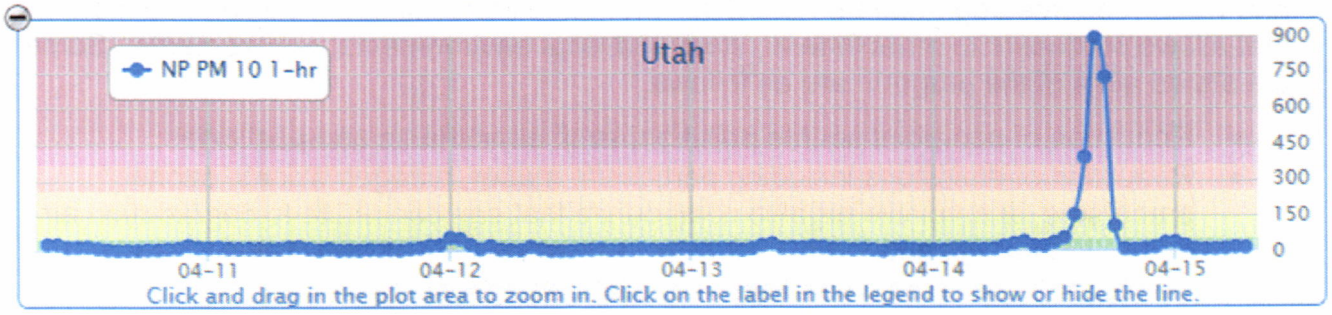
Mr. David Brown, State Conservationist with the USDA, has provided confirmation that, "most of Utah dryland farmers are currently participating in USDA programs and have conservation plans that include dealing with erosion concerns." The fact that these farmers have approved conservation plans is important because DAQ uses the same mechanism under R307-309 (mandatory fugitive dust plan) to assure that reasonable controls are being applied.

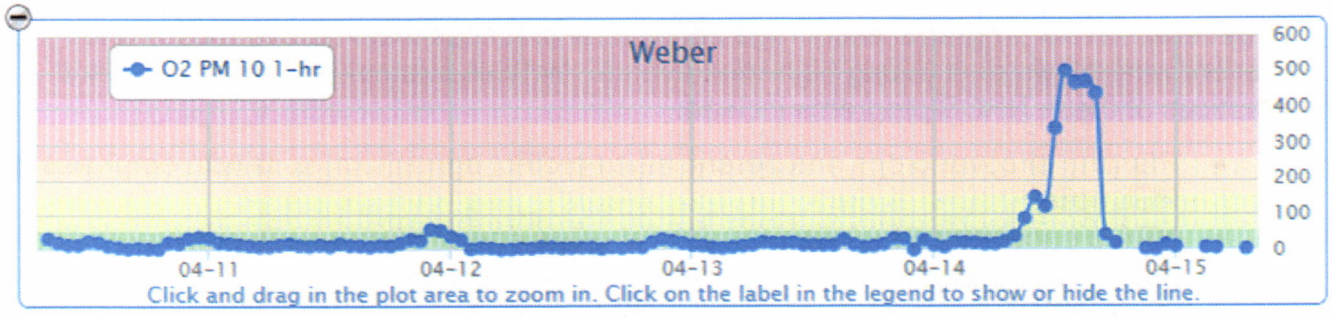
Natural Area Sources

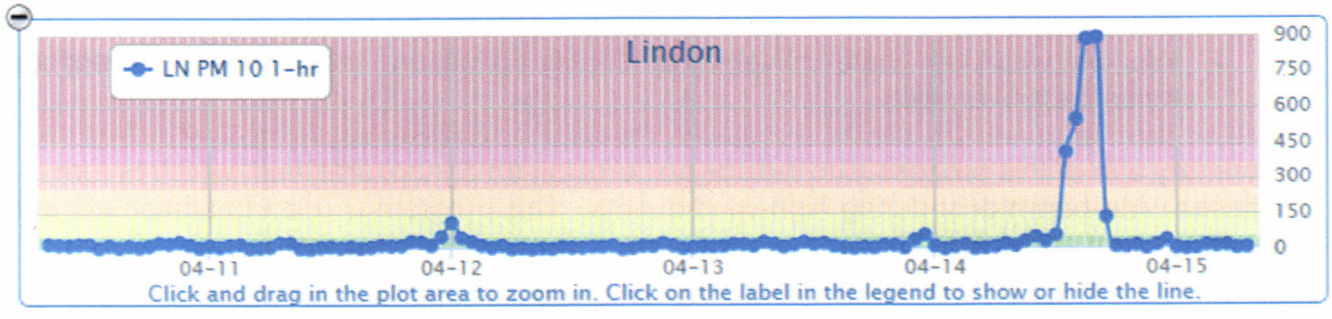
The storm trajectory that impacted the Ogden monitoring station traversed areas of the West Dessert. This dessert region contains dry lake beds (playa) that are remnants of Pleistocene Lake Bonneville. The lake beds have been dry throughout recorded history and are a source of wind-blown dust in dust storms that frequently impact the Wasatch Front.

No Exceedance or Violation But For the Event

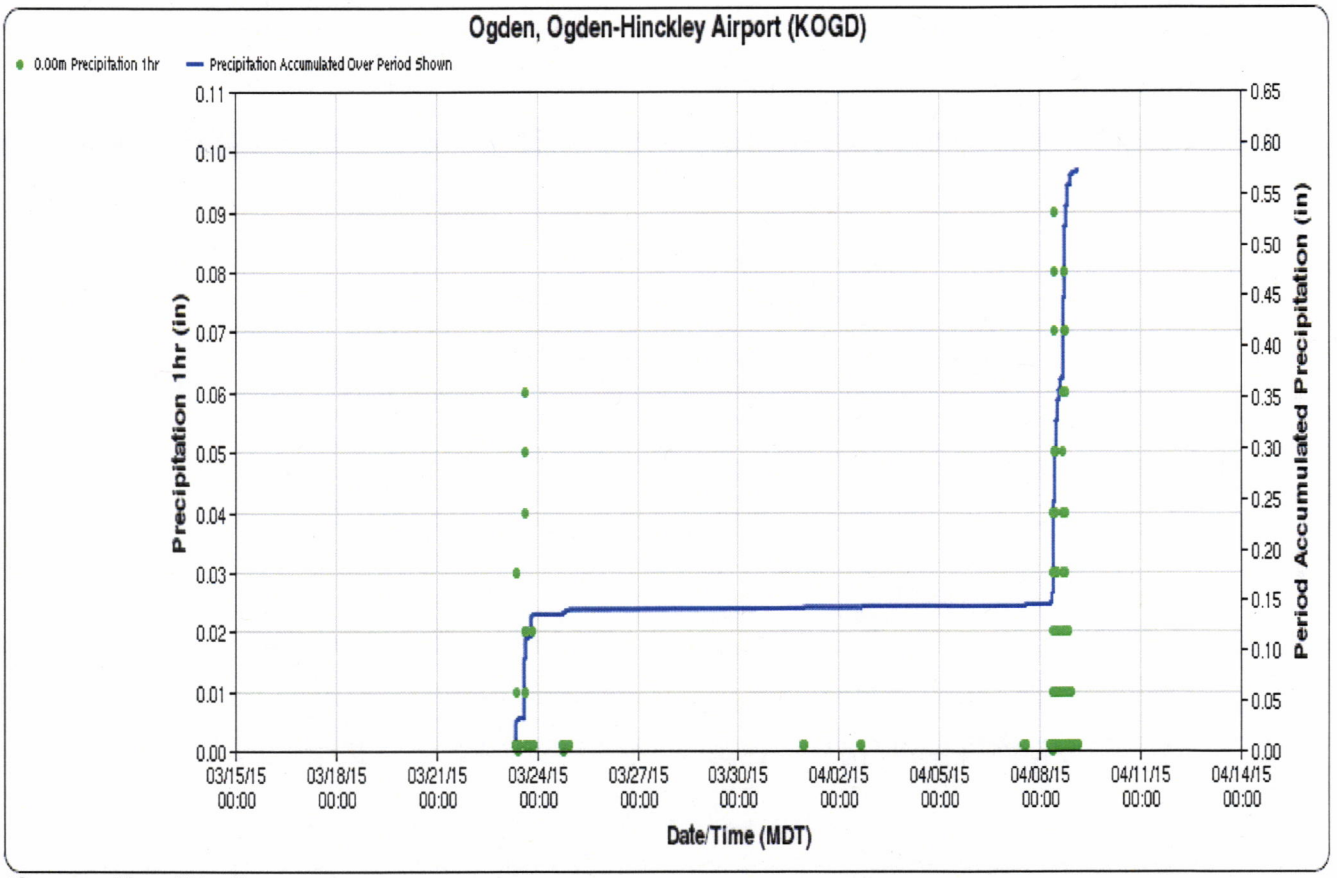
There were no unusual local anthropogenic emissions reported before, during, and after the event. The hourly values for the available monitoring stations show that PM_{10} values were extremely low right up to the storm event (around noon time) and immediately after the storm event (about 4 p.m.).







The absence of snow cover and minimal precipitation did not suppress dust formation during the 30-days preceding the event; therefore, we can surmise that the high winds caused the exceedance.



(Source: MesoWest)

Event Day – April 14, 2015

Reasonable control of anthropogenic sources is evident when we compare PM_{10} levels during normally windy days and during an exceptional event high wind dust storm. This table presents wind speed data for the Ogden-Hinckley Airport from April 1-14, 2015, 24-hr filter results, as well as hourly PM_{10} levels when wind speed was at a minimum of 15 mph.

Ogden Airport Wind & Ogden Monitoring Station PM10 Data

PM10 Filter Concentration in ug/m3

	13	11	19	21	24	23	27	13	10	17	6	12	332

Wind Speed in mph & Wind Direction for 14 days // Apr 1, 2015 - Apr 14, 2015

Local Hour of Day	1-Apr	Hourly Values	2-Apr	Hourly Values	3-Apr	4-Apr	Hourly Values	5-Apr	Hourly Values	6-Apr	Hourly Values	7-Apr	Hourly Values	8-Apr	Hourly Values	9-Apr	10-Apr	11-Apr	12-Apr	Hourly Values	13-Apr	14-Apr	Hourly Values
0	29/NW	112	3/N		5/W	9/S		8/W		5/S		7/W		13/S		7/S	7/S	8/S	5/NW		7/S	12/S	
1	17/NW	57	9/N		5/S	9/S		6/W		7/W		5/W		17/S	34	6/S	6/S	9/S	18/NW	3	6/S	13/S	
2	20/NW	33	14/N		7/S	7/S		15/SE	25	3/SW		6/W		16/S	31	0	5/S	12/S	15/N	7	8/S	23/S	21
3	17/NW	21	9/N		8/S	10/S		15/S	27	7/W		6/W		17/S	37	6/S	5/S	9/S	12/N		9/S	21/S	20
4	16/N	14	7/NW		9/S	9/S		10/S		3/NW		6/W		18/S	48	3/SE	5/S	10/S	10/NW		8/S	18/S	16
5	13/N		8/NW		8/S	8/S		9/S		7/NW		7/W		14/S		5/S	6/S	10/S	15/N	2	8/S	21/S	16
6	10/N		9/N		9/S	10/S		6/S		6/S		6/SE		18/S	45	5/S	0	8/S	17/N	5	5/S	23/S	24
7	9/N		7/NW		9/S	10/S		6/S		5/S		-		7/SE		5/S	6/NE	10/S	14/N		5/S	21/S	38
8	10/NW		3/NW		8/S	8/S		8/S		8/W		12/S		3/NW		5/SE	3/S	10/S	12/N		6/S	29/S	88
9	13/N		10/NW		6/SE	8/S		3/S		0		8/S		8/W		5/SE	9/N	9/S	14/N		0	35/S	148
10	14/N		7/NW		0	6/SE		7/W		-		-		5/W		0	6/N	9/SE	7/NW		5/SW	38/S	122
11	10/NW		-		5/S	9/SE		-		-		6/E		12/W		0	-	10/S	-		0	29/S	341
12	-		13/W		0	14/S		8/W		12/NW		16/SE	22	8/SW		3/W	5/W	10/W	-		0	29/S	500
13	-		-		13/SW	16/S	19	-		17/NW	32	9/E		14/SW		3/W	-	9/NW	7/S		8/S	31/S	469
14	8/W		14/NW		8/S	12/W		13/NW		16/N	35	12/SE		14/SW		3/NW	8/W	10/W	-		-	33/SW	471
15	8/W		10/SW		10/SW	12/SW		10/N		22/N	68	7/S		14/SW		5/W	7/W	8/W	13/SW		-	24/N	439
16	10/SW		3/S		8/SW	12/SW		8/N		22/N	35	7/NE		10/S		6/N	-	12/W	6/SE		5/SW	25/NW	43
17	6/W		3/N		10/SW	8/W		14/NW		22/NW	12	7/E		13/S		-	-	10/W	7/SW		3/SW	17/N	20
18	8/W		15/NW	26	-	5/N		10/N		17/NW		7/NW		12/SE		6/N	-	9/NW	7/NW		6/SE	6/NE	-
19	8/SW		14/NW		6/NW	6/N		6/NW		12/N		8/NE		13/S		6/N	5/W	5/NW	3/S		6/SE	7/S	-
20	3/S		8/N		6/N	5/NE		5/N		0		7/NE		8/SE		5/N	3/N	7/NW	5/SE		5/S	7/W	-
21	3/E		9/NW		5/E	3/S		6/NW		7/NW		3/SE		8/S		3/NE	6/S	6/NW	6/E		9/S	10/W	-
22	5/S		6/N		8/S	9/S		5/W		8/NW		8/SE		6/SE		3/S	8/S	14/NW	6/S		12/S	12/NE	-
23	3/N		5/NW		9/S	10/NW		3/SW		5/S		12/SE		8/S		6/S	9/S	12/N	5/S		13/S	7/E	-

University of Utah MesoWest:

Min. wind speed of 15 mph

The yellow highlights represent normal windy conditions. Immediately to the right of the highlighted wind speed, is the correlated hourly PM_{10} level at the Ogden monitoring station. Most of the hourly PM_{10} levels during normal windy conditions are within the good range per the Air Quality Index. Hourly PM_{10} levels when wind speeds were below 15 mph are not included in the table because they are all extremely low (within the AQI good range).

Air Quality Index:

Good	0-50
Moderate	51-100
Unhealthy For Sensitive Group	101-150

But For the Event Summary

A clear and casual relationship and but for the event demonstration has been made based on:

- The cold front produced a storm with high winds and dust clouds that is a natural event;
- PM concentration patterns correspond directly to the storm event winds showing a direct relationship;
- There was no snow cover nor appreciable rainfall prior to the event that would have suppressed wind-blown dust during normally windy days, while PM_{10} level remained low prior to the event;
- Visibility in the valley was impaired by the dust. Both dust and high winds contributed to mobile accidents.

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 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.

The DAQ's Air Monitoring Section (AMS) 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 AMS advisory is calculated for five major pollutants including ground-level ozone, particulate pollution (particulate matter), carbon monoxide, sulfur dioxide, and nitrogen dioxide. To mitigate the effects of pollution for affected groups and reduce pollution levels, the AMS advisory now also makes recommendations to industry and citizens for actions to take on days when concentrations are in the red zone. The outreach program information consolidated in the three-day forecast includes the Summer and Winter Control Programs and Choose Clean Air information.

Public Comment

The documentation was made available for public comment through the Utah Bulletin and on the DAQ web page from February 1 to March 2, 2016. No comments were received.