Cache Valley Idaho
$PM_{2.5}$ Nonattainment Area
State Implementation Plan Amendment

State of Idaho
Department of Environmental Quality

October 2014

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State Implementation Plan Amendment

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Acronyms, Abbreviations, and Symbols

$\mu g/m^3$	micrograms per cubic meter
ADT	average daily traffic
ATR	automatic traffic counters
BMP	best management practice
CAA	Clean Air Act
CFR	Code of Federal Regulations
CMAQ	community multiscale air quality model
CO	carbon monoxide
CVNAA	Cache Valley nonattainment area
DEQ	Idaho Department of Environmental Quality
DSL	deep stable layer
DV	design value
EPA	US Environmental Protection Agency
FR	Federal Register
HDD	heating degree days
IDAPA	Idaho Administrative Procedures Act
MATS	Model Attainment Test Software
MOVES	motor vehicle emission simulator
NAA	nonattainment area
NAAQS	National Ambient Air Quality Standards
NH_3	ammonia
NO_x	nitrogen oxides
PBR	permit by rule
PM	particulate matter
$PM_{2.5}$	particulate matter under 2.5 microns in size
PM_{10}	particulate matter under 10 microns in size

RWC	residential wood combustion
SIP	state implementation plan
SO_2	sulfur dioxide
tpd	tons per day
tpy	tons per year
UDAQ	Utah Division of Air Quality
VOC	volatile organic compounds
VMT	vehicle miles traveled

1 Introduction

The purpose of this amendment is to revise the *Cache Valley Idaho $PM_{2.5}$ Nonattainment Area State Implementation Plan* (DEQ 2012) to address the Clean Air Act (CAA) Title I, Part D, Subpart 4 requirements. In amending the state implementation plan (SIP), the following changes occurred:

- Revised model attainment test
- Revised attainment date
- Shifted model base year to 2010
- Added emissions reductions through additional woodstove change outs
- Strengthened the existing road sanding agreements
- Provided a voluntary control measure: permit by rule (PBR) for dairies, IDAPA 58.01.01.760–764, prescribing best management practices (BMPs) to control ammonia (NH_3) and volatile organic compounds (VOCs).

This amendment demonstrates that the Cache Valley 2012 particulate matter 2.5 ($PM_{2.5}$) SIP satisfies federal $PM_{2.5}$ SIP requirements under CAA, Title I, Part D, Subpart 4, attaining the standard by 2015.

Background

The Idaho Department of Environmental Quality (DEQ) completed a $PM_{2.5}$ SIP for the Idaho side of Cache Valley, which is part of the Cache Valley nonattainment area (CVNAA) (Logan UT-ID NAA), and submitted it to the US Environmental Protection Agency (EPA) in December 2012. This plan satisfied requirements from EPA's 2007 Fine Particle Implementation Rule, which was grounded in the CAA, Title I, Part D, Subpart 1.

On January 4, 2013, the District of Columbia Circuit Court found that EPA incorrectly interpreted the CAA when determining how to implement the National Ambient Air Quality Standards (NAAQS) for $PM_{2.5}$. The court ruling held that the EPA should have implemented the $PM_{2.5}$ NAAQS based on both CAA, Title I, Part D "Plan Requirements for Nonattainment Areas," Subpart 1 "Nonattainment Areas in General" and Subpart 4 "Additional Provisions for Particulate Matter Nonattainment." Therefore, as of January 4, 2013, Subpart 4 also applies.

Under CAA Subpart 4, nonattainment areas (NAAs) for particulate matter may carry the classification of either moderate or serious. Subpart 4 address the attainment dates and planning provisions for both moderate and serious particulate matter NAAs. The Logan UT-ID NAA is classified as a moderate $PM_{2.5}$ NAA.

Since its submission in December 2012, EPA acted on two portions of the Cache Valley, Idaho, $PM_{2.5}$ SIP (DEQ 2012). In March 2014, EPA issued a Federal Register (FR) notice finalizing a limited approval of $PM_{2.5}$ control measures contained in the December 2012 submittal because incorporation of these measures strengthen the Idaho SIP and reduce sources of $PM_{2.5}$ emissions in Franklin County that contribute to violations of the 2006 $PM_{2.5}$ standard on the Idaho side of the Logan UT-ID NAA (79 FR 16201 [March 25, 2014]). In July 2014, EPA issued an FR notice

approving the baseline emissions inventory contained in DEQ's submittal as meeting the requirement to submit a comprehensive, accurate, and current inventory of direct $PM_{2.5}$ and $PM_{2.5}$ precursor emissions in Franklin County (79 FR 41904 [July 18, 2014]).

The amendment addressing Subpart 4 is required to be submitted by December 31, 2014, and demonstrate attainment by December 31, 2015.

For additional information, refer to the *Cache Valley Idaho $PM_{2.5}$ Nonattainment Area State Implementation Plan*" (DEQ 2012), which is available at *www.deq.idaho.gov/media/930589-cache_valley_pm2_5_nonattainment_state_implementation_plan_1212.pdf.* The SIP appendices are available at *www.deq.idaho.gov/media/930593-cache-valley-pm2-5-sip-appendices-1212.pdf.*

2 Air Quality Data

$PM_{2.5}$ standards are based on averaging air quality measurements both annually and on a 24-hour basis. The 24-hour standard is designed to provide an appropriate level of protection from short-term exposures to $PM_{2.5}$. The 24-hour standard for $PM_{2.5}$ is met whenever the 3-year average of the annual 98th percentile of values at designated monitoring sites in an area is less than or equal to 35 micrograms per cubic meter ($\mu g/m^3$). The analysis of the $PM_{2.5}$ data for the monitoring sites across the valley show violations of the 24-hour $PM_{2.5}$ NAAQS on both the Utah and Idaho sides of the CVNAA.

2.1 Idaho and Utah Summary

Figure 1 details the 98th percentile monitoring data for the Franklin County, Idaho, air quality monitor from 2004 through 2013. The 2010 data should not be considered representative of the area; due to upgrades to the Franklin sewage lagoons, the area was without power for a considerable portion of the year. During 2010, none of the quarters for data collection met EPA criteria for data completeness. Figure 2 details the 98th percentile monitoring data for the Cache County, Utah air quality monitor.

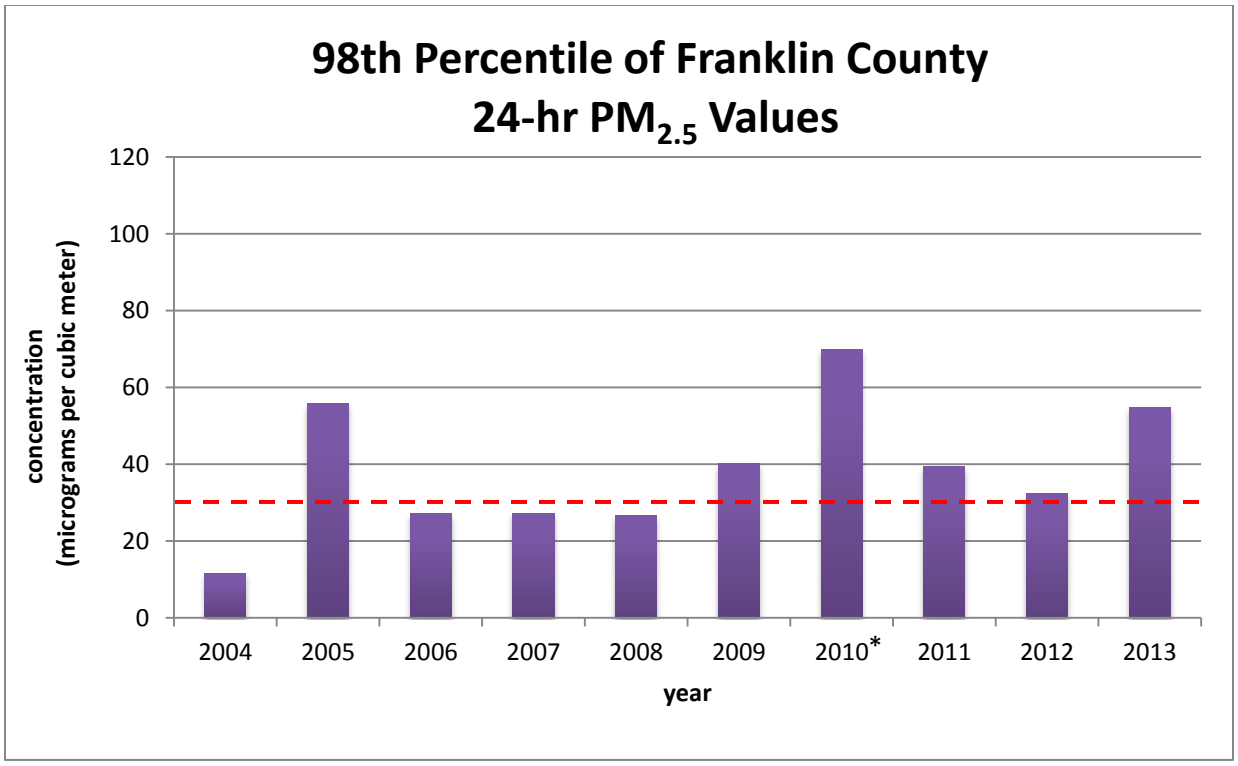

Figure 1. The 98th percentile of Franklin County, Idaho, 24-hour $PM_{2.5}$ values from 2004–2013.

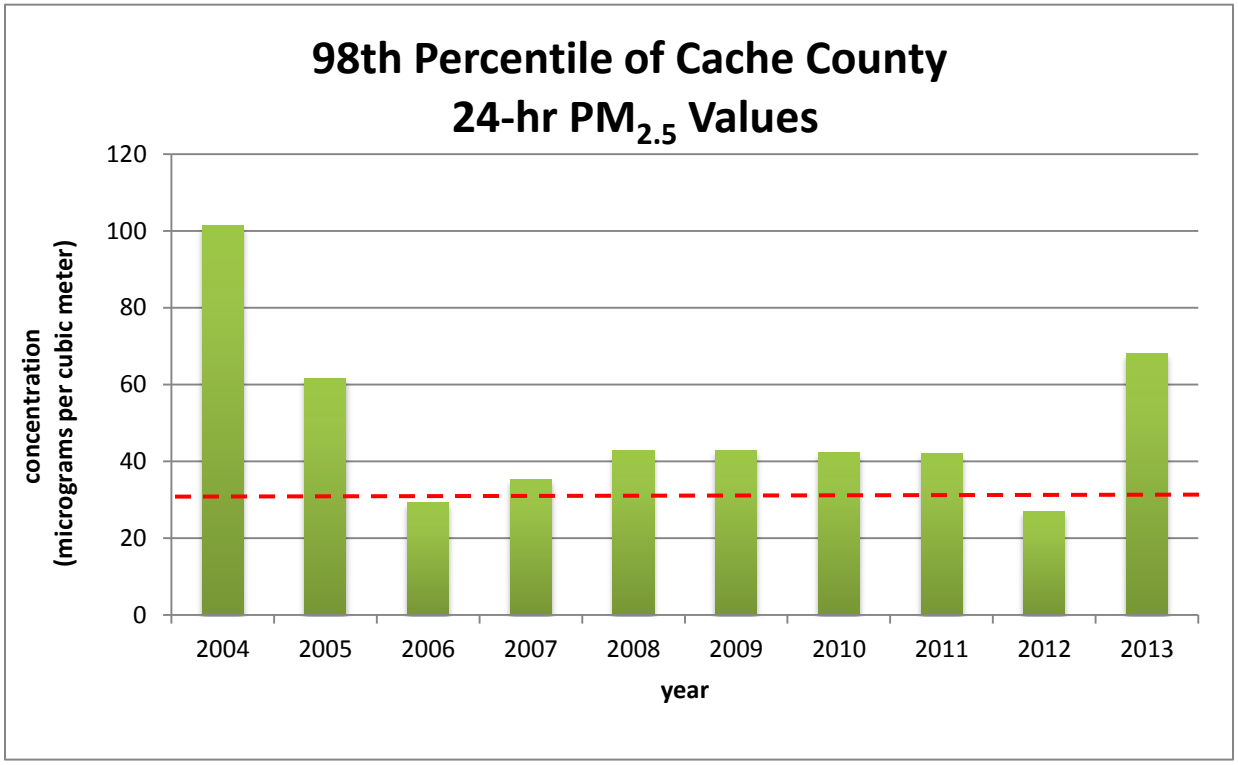

Figure 2. The 98th percentile of Cache County, Utah, 24-hour $PM_{2.5}$ values from 2004–2013.

2.2 Design Value Determination—24-Hour Standard

Design values are the metrics that are compared to the NAAQS to determine compliance. For the 24-hour standard, the design value is the 3-year average of annual 98th percentile, 24-hour average values. The 24-hour $PM_{2.5}$ NAAQS is met when the design value is less than or equal to 35 µg/m^3.

EPA recommends an average of three such 3-year averages that straddle the baseline inventory be used to calculate the monitored baseline value. The year 2010 represents the baseline inventory. Therefore, the 3-year running average of 98th percentile values collected from 2008–2010 would be averaged together with the 3-year averages from 2009–2011 and 2010–2012 to arrive at the site-specific monitored baseline design value.

For this SIP, the baseline design value concentration for the Utah side of Cache Valley is 40.7 µg/m^3. The SIP demonstration will be based on the Utah design value because it is the highest in the CVNAA. The 24-hour $PM_{2.5}$ design values for the Cache County (Logan) monitor are shown in Figure 3.

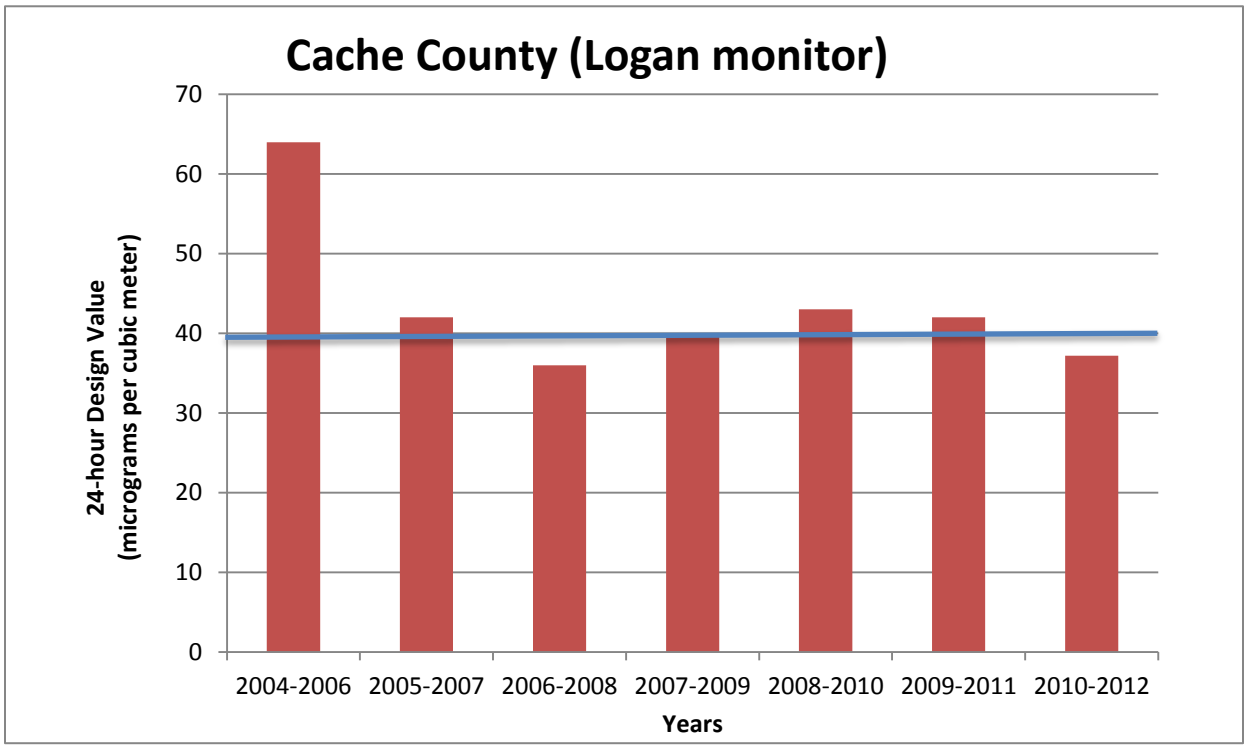

Figure 3. Cache County (Logan monitor) running 24-hour $PM_{2.5}$ design values.

3 Meteorological Discussion

The 2012 Cache Valley UT-ID SIP was projected to achieve compliance with the $PM_{2.5}$ 24-hour NAAQS by the end of 2014. Projected emissions levels and the number of measured exceedances were trending downward, as indicated in Figure 4 (UDAQ 2014) and the attainment plan appeared to be on track. In 2013, especially in January, the number of exceedances

increased dramatically. DEQ analyzed the January–February stagnation episodes in an effort to determine whether this was due to suddenly increasing emissions or strictly an unusual weather pattern.

The DEQ analysis, provided in Appendix A, found the following:

- An unusually strong and persistent high-pressure system occurred in 2013 producing the coldest January in over 62 years.
- Baseline source activity related to population and traffic remained approximately flat from the SIP baseline year, 2010 through 2013.
- The cold temperatures alone probably exacerbated the emissions by increasing heating loads and vehicle emission rates (but not source activity).
- The $PM_{2.5}$ concentrations in Cache Valley and other locations in the northwest such as Boise, Idaho, reached extreme levels as a result not so much of the strength of the inversion, but its persistence, or more specifically the number of consecutive days when the lower stable layer (< 500 meters) did not break up in the afternoon, allowing $PM_{2.5}$ and its precursors to accumulate from day to day.

The duration of the January accumulation period was longer than any in at least the past decade. As a result of this analysis, DEQ concluded that the increased exceedances resulted solely from this extreme meteorological event.

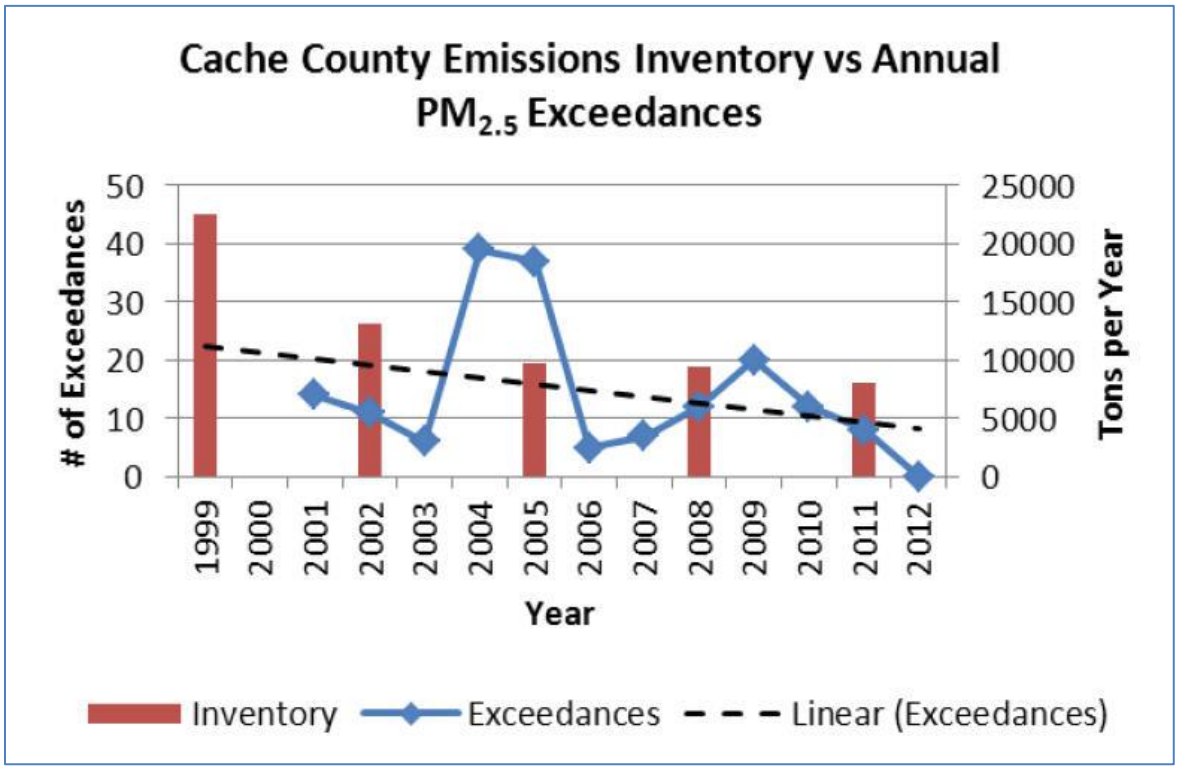

Figure 4. Cache County, Utah, emissions inventory and annual exceedances (UDAQ 2014).

4 Emissions and Attainment Year Inventories

A detailed emissions inventory using the best information available was prepared for the Cache Valley airshed to assess direct $PM_{2.5}$ emissions as well as emissions of precursors to secondary $PM_{2.5}$ formation. In July 2014, EPA issued an FR notice approving the baseline emissions inventory contained in DEQ's submittal as meeting the requirement to submit a comprehensive, accurate, and current inventory of direct $PM_{2.5}$ and $PM_{2.5}$ precursor emissions in Franklin County (79 FR 41904 [July 18, 2014]).

Table 1 lists total daily winter emissions (for both Utah and Idaho) for the 2010 base year as well as the 2015 attainment year. The attainment year totals include projections concerning growth in population, vehicle miles traveled, and the economy. The totals also include the effects of emissions control strategies that are either already promulgated or were required as part of the Utah SIP.

Table 1. Cache Valley emissions inventory (tons per day) for the 2010 base year and 2015 attainment year for $PM_{2.5}$, NO_x, VOC, NH_3, and SO_2; emissions shown are for Utah and Idaho.

	NA-Area	Source Category	PM2.5	NOX	VOC	NH3	SO2
2010	Logan, UT-ID						
Sum of Emissions (tpd)		Area Sources	0.54	1.63	4.16	4.31	0.26
		Mobile Sources	0.37	6.48	4.99	0.12	0.04
		NonRoad	0.13	1.15	2.28	0.00	0.02
		Point Sources	0.00	0.02	0.63	0.00	0.00
		Total	1.05	9.28	12.06	4.43	0.32
2015	Logan, UT-ID						
Sum of Emissions (tpd)		Area Sources	0.40	1.59	3.75	4.08	0.27
		Mobile Sources	0.28	4.49	3.35	0.10	0.03
		NonRoad	0.10	0.81	1.77	0.00	0.01
		Point Sources	0.00	0.00	0.00	0.00	0.00
		Total	0.79	6.89	8.87	4.19	0.31

Notes: particulate matter 2.5 ($PM_{2.5}$); nitrogen oxides (NO_x); volatile organic compounds (VOC); ammonia (NH_3); sulfur dioxide (SO_2); tons per day (tpd).

5 Modeled Attainment Test and Attainment Date

The Utah Division of Air Quality (UDAQ) used the Model Attainment Test Software (MATS) for the modeled attainment test at grid cells near monitors. MATS results for future year modeling at the Logan monitor site are presented in Figure 5. The future year design value is presented for 2015, the attainment year, along with the MATS future year design values for modeling simulation that include control strategies. For comparison purposes, the monitored design value is also presented for the base year, 2010. Table 2 presents the same information in tabular form and also includes data from the monitoring location in Franklin, Idaho.

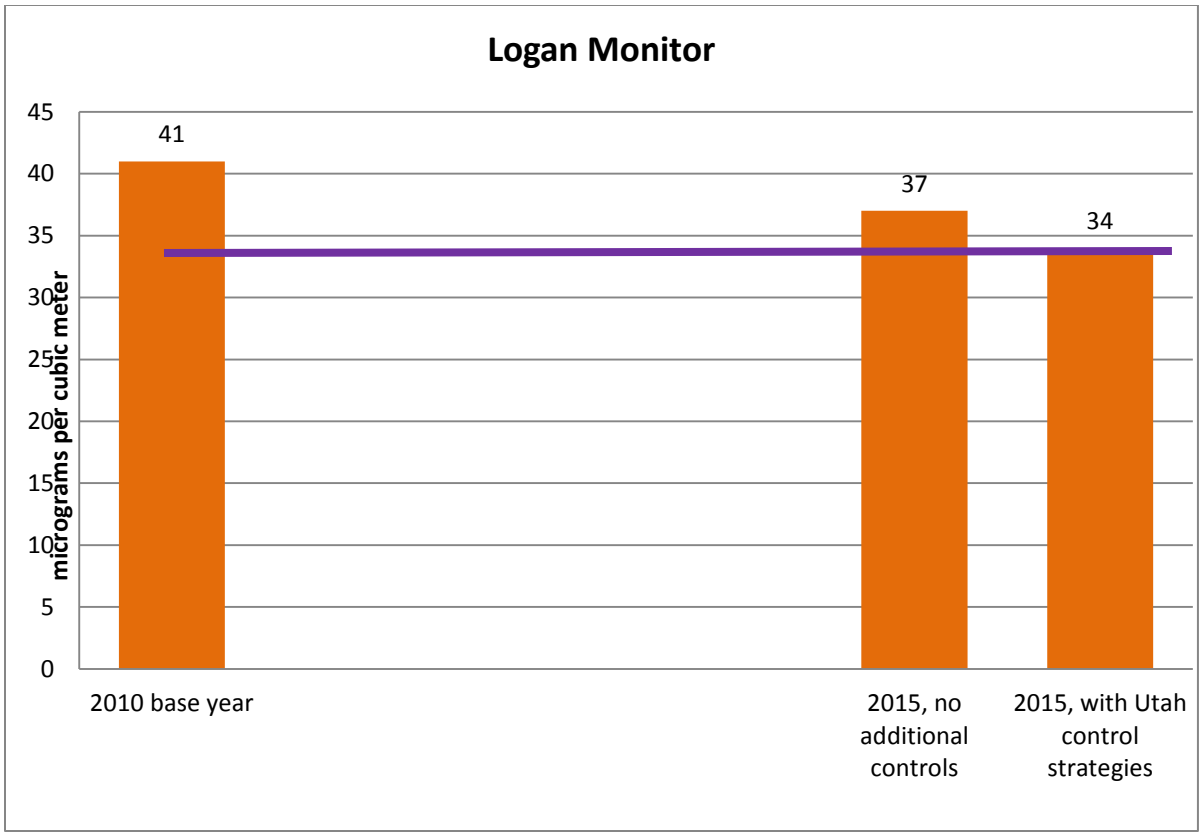

Figure 5. Model results for the Cache Valley nonattainment area, Logan monitor.

Table 2. Modeled concentrations for the Cache Valley nonattainment area.

	2010	2015	
	Observed ($\mu g/m^3$)	**Business-As-Usual ($\mu g/m^3$)**	**Control Basket ($\mu g/m^3$)**
Logan	41	37	34
Franklin	39	34	32

The attainment date for this moderate $PM_{2.5}$ NAA is December 31, 2015. As shown in the modeled attainment test, the emissions reductions achievable in 2015 allow for a demonstration that the CVNAA can attain the 24-hour $PM_{2.5}$ NAAQS by the attainment date.

6 Control Strategies

The overall strategy for improving air quality throughout the Cache Valley consists of many different components across the multistate NAA. Collectively, these components are responsible for reducing $PM_{2.5}$ emissions in the CVNAA and have contributed to the demonstration of attainment with the NAAQS by December 31, 2015. Both sides of the Cache Valley (Utah and Idaho) dealt separately with various control measures, due to both jurisdictional authority and differences in the emissions inventory. Details concerning the control measures used on the Utah side of the Cache Valley are found in the $PM_{2.5}$ SIP and technical support document developed

by UDAQ (2014). The following subsections deal directly with any updates to the existing controls and applicability to CAA, Subpart 4.

6.1 Reasonably Available Control Measures

Reasonably available control measures, which refers to measures of any type that may be applicable to a wide range of sources (mobile, area, or stationary), was addressed in the original SIP submission with road sanding agreements and residential wood combustion ordinances. The original road sanding agreements lacked a measure of enforceability. This amendment contains updated road sanding agreements (Appendix B), which are now tied to the IDAPA rules and have a new measure of enforceability.

6.2 Reasonably Available Control Technology

Reasonably available control technology refers to measures specifically designed for stationary sources. In developing the emissions inventories underlying the SIP, the criteria of 40 CFR 51 for air emissions reporting requirements was used to establish a 100 tons per year (tpy) threshold for identifying stationary point sources. For the CVNAA, there are no point sources with the potential to emit 100 tpy of $PM_{2.5}$ or any $PM_{2.5}$ plan precursor.

6.3 Additional Emissions Reductions (Woodstove Change Out)

DEQ has operated three woodstove change-out programs on the Idaho side of the CVNAA (2006–2007, 2011–2012, and 2013–2014), changing out a total of 209 uncertified residential wood combustion devices. The original SIP submission claimed credit for the first two change outs (152 woodstoves). DEQ is claiming credit for the additional 57 woodstoves, as well as an additional 39 uncertified woodstoves that were recycled in accordance with Idaho's Alternative Energy Device tax deduction. This program allows Idaho citizens to deduct all, or most, of the cost to acquire and install a certified appliance (wood/pellet/gas). Table 3 lists the emissions reductions due to all of the woodstove change outs. Supporting documentation is found in Appendix C. In addition to reductions in particulate matter, the woodstove change-out program has also led to the reduction in air toxics, such as formaldehyde, Acrolein, and benzo(a)pyrene, which are generated as by-products of combustion.

Table 3. Emissions reductions due to the woodstove change outs.

Pollutant	Old Woodstove to Certified Wood or Gas Stove (tpy)	Old Woodstove to Pellet Stove (tpy)	Total (tpy)
CO	46.64	15.72	62.36
SO_2	0.05	0.01	0.06
NO_X	0.45	0.02	0.47
VOC	14.79	3.79	18.57
$PM_{2.5}$ primary	6.00	2.04	8.04
PM_{10} primary	6.00	2.04	8.04

Notes: tons per year (tpy), carbon monoxide (CO), sulfur dioxide (SO_2), nitrogen oxides (NO_x), volatile organic compounds (VOC), particulate matter ($PM_{2.5,\ 10}$).

6.4 Voluntary Measure—Dairy Rule

DEQ has added an additional voluntary control measure to this SIP amendment to address the control of ammonia emissions in Idaho. Rules for the control of ammonia from dairy farms, IDAPA 58.01.01.760–764, sets forth BMPs for dairy farms of a certain size licensed by the Idaho State Department of Agriculture through a PBR. The PBR applies to dairy farms with a capacity to produce 100 or more tons of ammonia emissions per year. Dairy farms with fewer than the specified number of animal units or mature cows may opt into the PBR program as well.

These rules derived from negotiations amongst the dairy industry, Idaho Department of Agriculture, Idaho Conservation League, and DEQ as part of a settlement of a lawsuit. The stakeholders agreed these rules would not be submitted to EPA for SIP approval. These rules are considered "State Only" rules and are not enforceable by the federal government.

The capacity to produce is based on the number of animal units or mature cows and the type of manure collection system. It requires dairy farms above specified threshold numbers of cows or animal units to register with DEQ and to implement industry BMPs to control ammonia emissions. The BMPs also have the added benefit of controlling VOC emissions. The rules prescribe various BMPs to control ammonia emissions, such as installing certain types of waste storage and treatment systems, implementing composting practices, and exporting manure. A point value is assigned to each BMP. Dairy farms must employ BMPs totaling 27 points.

While model runs have shown that significant reductions in the NH_3 inventories have little to no effect on predicted $PM_{2.5}$ concentrations, it was determined that VOCs do play a role in the secondary aerosol formation. This amendment provides for a voluntary control measure: PBR for dairies, IDAPA 58.01.01.760–765, prescribing BMPs to control NH_3 and VOCs. The reduction in NH_3 will likely have no effect on the $PM_{2.5}$ formation, but the reduction in VOC is an added benefit that will help to reduce $PM_{2.5}$ secondary aerosol formation.

7 Conclusion

This SIP amendment demonstrates that the Logan, UT-ID NAA will achieve attainment with the 24-hour $PM_{2.5}$ NAAQS by December 2015. Utah and Idaho have worked cooperatively with each other, EPA, and citizens to develop control strategies in keeping with the inventories on both sides of the valley. The State of Idaho will continue to monitor $PM_{2.5}$ concentrations in Franklin County. If exceedances occur, Idaho will determine the cause(s) and adjust the appropriate control measures to ensure prompt corrective action is taken.

This plan fulfills the requirements of the CAA as they pertain to SIPs. DEQ requests that EPA approve this attainment plan in accordance with CAA Section 110 and Subpart 4.

8 References

DEQ (Idaho Department of Environmental Quality). 2012. *Cache Valley $PM_{2.5}$ Nonattainment Area State Implementation Plan.* Pocatello, ID: DEQ.

FR (Federal Register). 2014. "Revision to the Idaho State Implementation Plan: Approval of Fine Particulate Matter Control Measures; Franklin County." 79 FR 16201.

FR (Federal Register). 2014. "Approval and Promulgation of Implementation Plans; Idaho Franklin County Portion of the Logan Nonattainment Area; Fine Particulate Matter Emissions Inventory." 79 FR 41904.

IDAPA. 2014."Rules for the Control of Air Pollution in Idaho." Idaho Administrative Code IDAPA 58.01.01.

US Congress. 1970. Clean Air Act. 42 USC § 7401 et seq.

UDAQ (Utah Division of Air Quality). 2014. *$PM_{2.5}$ State Implementation Plan, Weight of Evidence in the Model Attainment Test*. Salt Lake City, UT: UDAQ.

Appendix A. Meteorological Discussion of the January 2013 Stagnation Episode

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Meteorological Discussion of the January 2013 Stagnation Episode

1 Introduction

The 2012 Cache Valley Utah-Idaho state implementation plan (SIP) demonstrated that a number of control measures should bring the 24-hour averaged particulate matter 2.5 ($PM_{2.5}$) design value (DV) concentration under 35 micrograms per cubic meter (µg/m^3) and thereby into compliance with the National Ambient Air Quality Standard (NAAQS) by 2015 (DEQ 2012). Emissions were projected to decline and by 2012, there were no exceedances recorded in either Franklin or Cache Counties. However, in 2013, there were numerous exceedances, and the 98th percentile values were 68 µg/m^3 in Cache County and 55 µg/m^3 in Franklin County. An unusually persistent series of cold temperatures occurred in January–February 2013, resulting in a sharp increase in the DV, defined as the 95th percentile 24-hour concentration value averaged over 3 years.

The purpose of this analysis is to show that the 2013 increase in $PM_{2.5}$, particularly in January, resulted from an extreme weather pattern and does not represent a sudden reversal of the downward trending emissions rates produced by source control measures as demonstrated in the SIP. To be clear, stagnation events cannot be excluded under the Exceptional Events Rule and such a demonstration is not proposed here, nevertheless, it is of value to understand that the increased 2013 $PM_{2.5}$ was strictly the result of an extreme meteorological phenomenon and does not indicate that sources are increasing or that the SIP control measures are not working.

The analyses in the following sections will show that:

Section 2. An unusually strong and persistent high pressure ridge remained in place for most of January leading to a very long period of cold air pooling and temperature inversions that persisted throughout each afternoon.

Section 3. Baseline source activity, at least for the major categories related to population and traffic, did not suddenly increase in January 2013.

Section 4. While emissions activity (related to population and traffic) itself did not increase, and wood-burning curtailment was in effect for 20 days in January 2013, the coldest January in 62 years probably led to higher than normal home heating emissions and vehicle emission, which contributed to the $PM_{2.5}$ buildup.

Section 5. While the inversion conditions were strong, the unusually high $PM_{2.5}$ levels resulted primarily from the duration of the event, or more specifically to the number of days that the low-level inversions persisted in the afternoon without breakup. This caused a consistent day-to-day accumulation of $PM_{2.5}$ concentrations around 13 µg/m^3 per day. The duration of the continuous low stable layer (LSL) period was the longest in at least the past 10 years.

2 Unusually Strong and Persistent High Pressure System Affected the Region

While no strong direct relationship exists between $PM_{2.5}$ levels and the strength of an upper level ridge pattern, the weather characteristics typical to a long-duration upper level ridge event typically enhance $PM_{2.5}$ levels. Large-scale synoptic (O: 1,000 kilometer) blocking patterns can be identified by viewing upper level atmospheric observational data as shown in Figure 1. Additional 500 millibar (mb) charts for the most severe inversion days are shown in Attachment A. Blocking patterns—events that limit the zonal motion of passing waves through the atmosphere—are identified in the analysis below at the 500 mb level, which typically occurs at an elevation of 18,000 feet. The two meteorological parameters investigated are the 500 mb heights (the altitude at which 500 mb of pressure occurs) and the 500 mb temperature.

Characteristically, the high pressure blocking patterns that occurred in the month of January 2013 have warmer than normal temperatures and higher than normal heights. Both of these attributes occurred during the period of interest. Again, it must be stressed that while the values of these meteorological parameters share no significant direct relationship to $PM_{2.5}$ levels, the weather associated with high pressure blocking patterns can cause increased levels of $PM_{2.5}$ with increasing duration of blocking patterns.

Upper air radiosonde profiles from weather balloons for Salt Lake City, Utah, and Boise, Idaho, were obtained to investigate the January 2013 stagnation period in comparison to the 30-year climatology period of 1981–2010. Data presented in Table 1 and Table 2 verify that the 500 mb heights were at a statistically significantly higher altitude than climatology (1981–2010) for southern Idaho and northern Utah. Boise data during the time periods of January 1–6, 2013, January 15–21, 2013, and January 15–26, 2013, were each statistically different than the climatological comparison period (Table 1). T-tests (computed with $\alpha = 0.05$) are shown, such that any T-test value less than 0.05 indicates that the heights and temperatures are statistically different than the 30-year climatological record of 500 mb heights and temperature. As a result, Boise $PM_{2.5}$ concentrations reached their three highest wintertime values since before 1999 on January 19, 22, and 25. This is further indication of the regional nature of the event and that it did not result from any local change in source activity.

Furthermore, published literature has suggested that the heights experienced in the eastern Pacific Ocean and Pacific Northwest were higher than any recorded levels, further promoting the regional scale of this particular wintertime event; in fact, Swain et al. (2014) note that the large-scale meteorological pattern over the northeastern Pacific led to observationally unprecedented geopotential heights (an altitude referenced to sea level) over a broad region and noted that this pattern was nicknamed the “Ridiculously Resilient Ridge.” Funk et al. (2014), Swain et al. (2014), and Wang and Schubert (2014) all note the role of increasing global temperatures and the increase in frequency of such highly anomalous ridge events over the eastern Pacific and Pacific Northwest in the future. Finally, while noted for the relationship between geopotential height and precipitation, the probability of an event with such high anomalies was determined to be less than 1 in 126 years (with confidence > 95%). Although this relationship was discerned with precipitation in mind, it serves to indicate the general strength and anomalous nature of the January 2013 event.

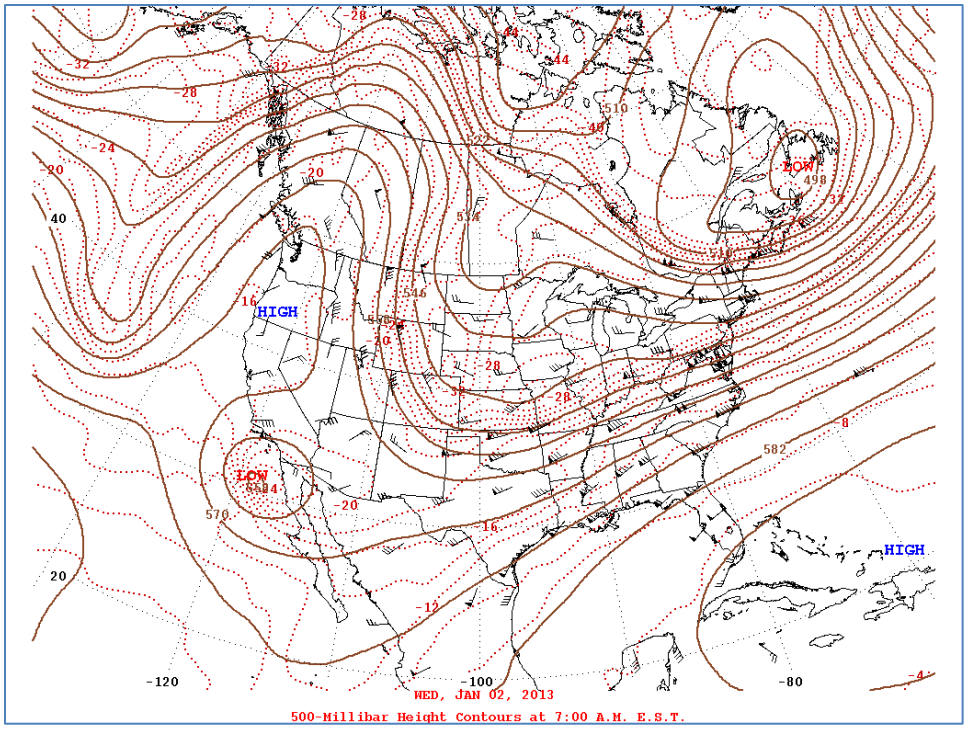

Figure 1. The 500 mb height contours for January 2, 2013, showing a Rex block high pressure ridge over the Pacific Northwest.

Table 1. Paired T-test values and anomalies for periods of interest for Boise, Idaho.[a]

Boise	α=0.05	α=0.05	Height Anomaly (m)	Temperature Anomaly (°C)
Date	T-test Value-Height	T-test Value-Temp (°C)		
Entire month[b]	0.26005	0.23740	29.26	29.26
January 1–6	0.00708	0.00335	91.02	3.63
January 15–21	0.00008	0.00027	155.90	4.78
January 15–26	<0.00001	<0.00001	137.99	5.10

a. Compared to 1981–2010 climatology.

b. January 30, 2013, values are averaged from January 29 and 31.

In Salt Lake City, the time periods of January 15–21, 2013, and January 15–26, 2013, are also significantly different than climatology for those dates (Table 2). One can see that the 500 mb heights were typically 90–150 meters higher than climatology at Boise and Salt Lake City for those time periods. As is typical with ridge patterns, the 500 mb temperature (°C) was also higher than climatology over the same times with the same events being statistically significant for Boise and Salt Lake City as with the 500 mb height. The 500 mb temperature anomalies varied from 3.5 °C to 5.1 °C higher than climatology. It is important to note that the data do not indicate the relative intensity or strength of the corresponding high or low pressure systems as the data are single-point values from two locations.

Table 2. Paired T-test values and anomalies for periods of interest for Salt Lake City, Utah.

Salt Lake City	α=0.05	α=0.05	Height Anomaly (meters)	Temperature Anomaly (°C)
Date	T-test Value-Height	T-test Value-Temp (°C)		
Entire month	0.90839	0.99719	2.94	0.00
January 1–6	0.39089	0.23215	30.60	1.41
January 15–21	0.01859	0.00958	101.28	3.55
January 15–26	0.00021	0.00007	111.05	4.56

Note: Compared to 1981–2010 climatology.

3 Major Sources of $PM_{2.5}$ and Precursor Emissions Did Not Increase in 2013

When ambient concentrations of a pollutant increase, one must consider two contributing factors: (1) sources are increasing, or (2) weather is causing the pollutants to be more concentrated over more days. To evaluate the first factor, DEQ considered the largest source categories of $PM_{2.5}$ and its precursors that cause increased $PM_{2.5}$ formation in the Cache Valley atmosphere—area sources such as home heating and traffic. Both traffic and home heating, including residential wood combustion, are major sources of $PM_{2.5}$ and $PM_{2.5}$ precursors: nitrogen oxides (NOx) and volatile organic compounds (VOCs). (Ammonia is a $PM_{2.5}$ precursor but is believed to be so abundant that moderate changes in ammonia levels have little effect in the Cache Valley wintertime atmosphere.) Population and traffic counts were selected to represent the source activity for home heating and other area sources, and for traffic. The changes from 2010, the baseline year of the Utah Division of Air Quality (UDAQ) SIP, and 2013 are shown in Table 3.

3.1 Traffic

Traffic counts for the four automatic traffic counters (ATRs) in Cache Valley on main roads and with a record back to 2004 were obtained from the Utah Department of Transportation (UDOT 2014). A sum of the January weekday average daily traffic (ADT) counts at three primary ATRs in Cache County with a continuous record back to 2004, as well as the ATR on State Road 91 at the Idaho-Utah border, is shown in Figure 2 for the period from 2004 to 2013. The traffic sum in 2013 is within 1% of the values in 2004 and represents a 2.7% decrease from 2010 (Table 3). Thus both the traffic activity (or vehicle miles traveled [VMT]) in Cache County, Utah, and that entering Cache County from Franklin County, Idaho, is generally flat and is clearly decreasing from 2010 to 2013. This finding only relates to VMT or traffic activity, however, it should be noted that vehicle emission rates (per VMT) are declining every year as a result of new car emission standards, and the inspection and maintenance program will begin to lower emission rates as well.

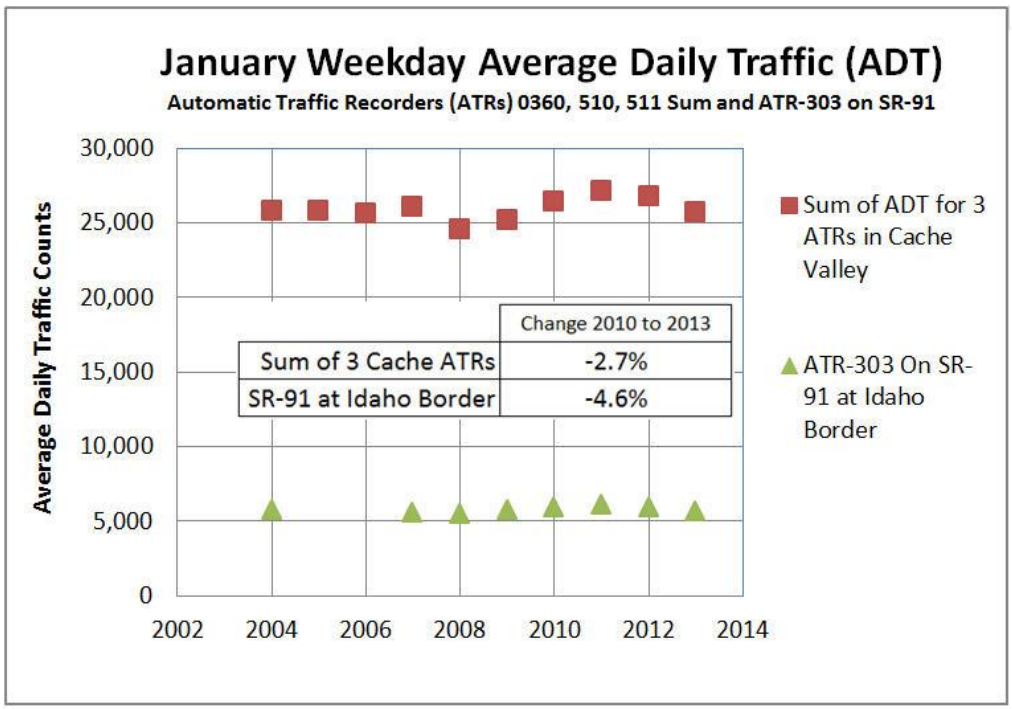

Figure 2. Weekday average daily traffic counts summed for 3 ATRs (363, 510, 511) in Cache County, and one ATR (303) on State Road-91 at the Utah-Idaho border showing a flat 10-year trend and slight reduction from the 2010 SIP baseline year to 2013.

3.2 Population

As shown in Table 3, the population in Cache County, Utah, grew only 3.8% from April 2010 to July 2013, while Franklin County, Idaho, grew only 0.5% (US Census Bureau 2014). Population represents a surrogate for most area sources, including wintertime home heating sources, a major contributor of NOx, VOCs, and $PM_{2.5}$. Thus, we must conclude that the area source categories that vary with population, including residential wood combustion, other combustion home heating sources, residential outdoor burning, and consumer uses of VOC-containing products like solvents and paints do not appear to account for any significant increase in air pollution during January–February 2013. If the source activities cannot explain the increase in $PM_{2.5}$ for this period, we must look to the weather to see if an explanation of the high pollution levels can be found.

Table 3. Changes from 2010 to 2013 in area source activity, represented by population and traffic for Cache County, Utah, and Franklin County, Idaho, from 2010 to 2013.

	Cache County, Utah	Franklin County, Idaho
Population	3.80%	0.50%
Traffic	-2.7%	-4.6%

4 Unusually Cold Temperatures Exacerbated Heating and Vehicle Emissions

The discussion about source activity levels in section 3 demonstrates that changes in the population and traffic activity levels were minor suggesting that residential home heating and traffic emissions alone could not explain the very large increase in concentration. In addition, mandatory curtailment burn bans were in effect on 20 of the inversion episode days in January 2013, which should have lowered residential wood combustion and residential open burning activities significantly. Nevertheless, the cold temperatures alone probably enhanced emissions from heating and vehicles and may have negated some of the emission-lowering benefits of the burn bans.

As a corollary to the extremely cold temperatures in Cache Valley during January 2013, the heating degree days (HDD) in January 2013 were the highest of any January in the previous 62 years. The mean HDDs in Logan (WRCC 2014) are shown in Figure 3 along with their 95% confidence intervals, minimum and maximum values, and the 2013 values (green circles). Since residential wood combustion (and all other types of home heating) increase with increasing heat load and heat load is a direct function of HDD, any residential heating emissions not subject to, or compliant with the burn bans would have been at the highest January loads and emissions level since before 1951, with a heating load (HDD) 28% higher than the 62-year mean for January.

In addition to the effect of temperature on heating load, colder temperatures also influence vehicle emissions. The motor vehicle emission simulator (MOVES) temperature sensitivity graphs shown in Figure 4 (Choi 2010) indicate that $PM_{2.5}$ emissions as well as $PM_{2.5}$ precursor emissions of VOC and NOx all increase as temperatures drop from the the 62-year average January temperature (24.0^{o}F) to the 2013 mean January temperature (14.4^{o}F), an approximately 10-degree departure from normal mean monthly temperatures for January. The emission increases are not large, but all species except the $PM_{2.5}$ from diesel vehicles are shown to trend upward as the temperature drops from 24°F to 14°F. To be clear, source activities related to population and traffic are flat or declining, but the purely meteorological influence of colder temperatures causes higher emissions at the same time that the persistent inversion traps pollutants through the afternoon, causing many consecutive days of accumulation.

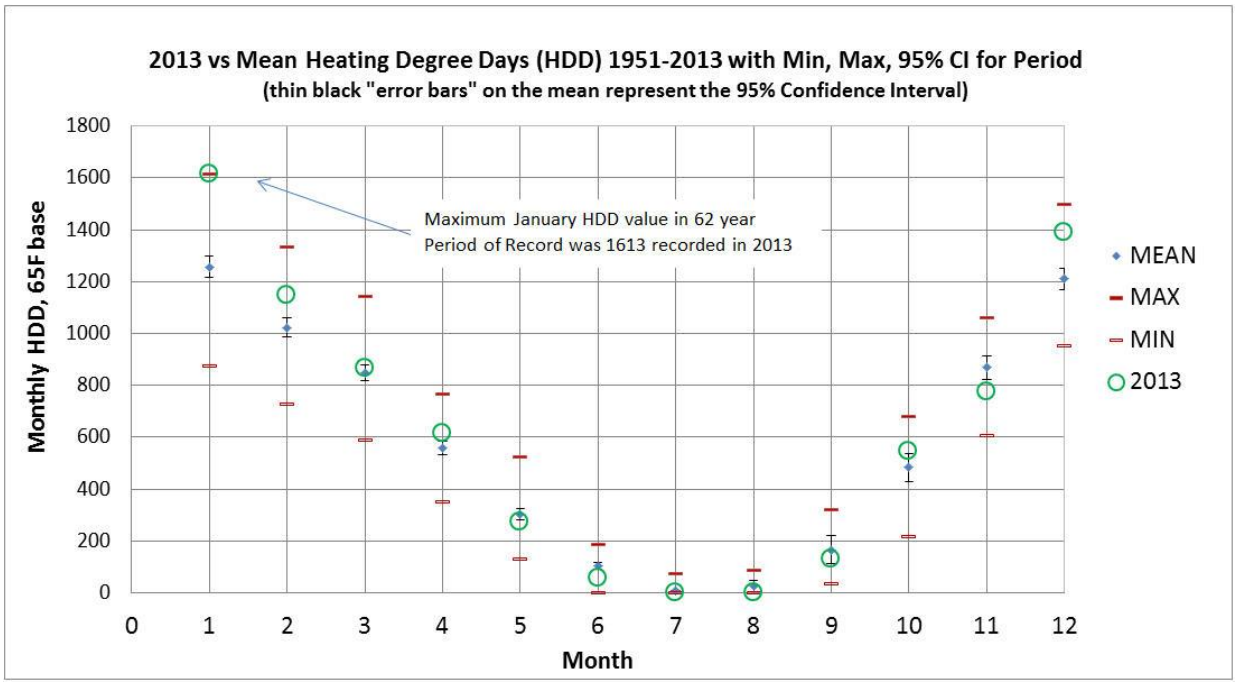

Figure 3. Logan, Utah, heating degree days in 2013 versus 1951–2013 period of record (WRCC 2014).

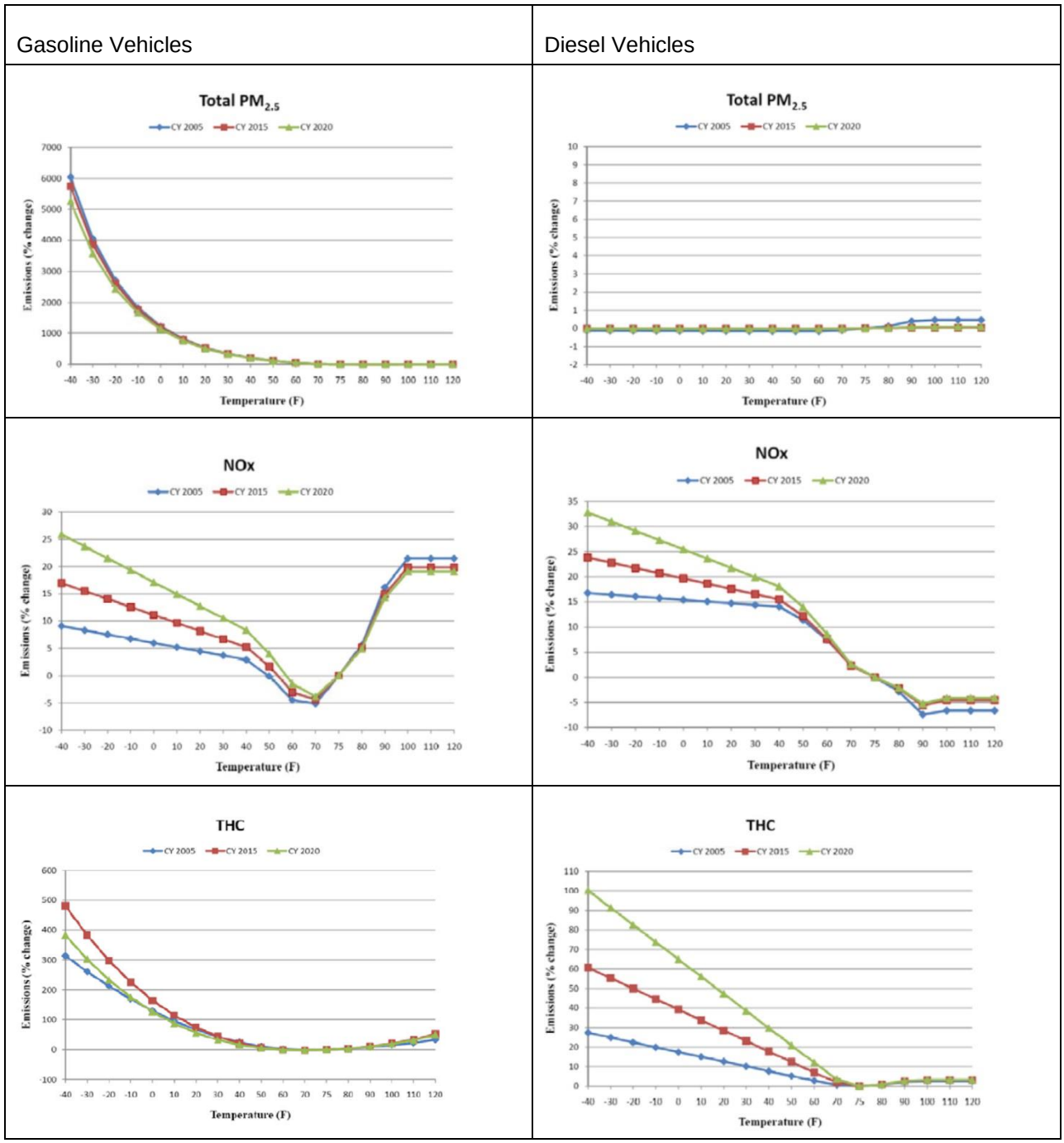

Figure 4. Temperature sensitivity for gasoline and diesel vehicles in the MOVES2010b model (Choi 2010).

5 Why Franklin County, Idaho, $PM_{2.5}$ Was Higher in 2013

The previous sections have shown that an extremely persistent high pressure system predominated in January 2013; source activity for major sources declined or remained flat throughout the month; and cold air by itself can contribute to increased emissions. The following analysis demonstrates that the key factor in producing extreme $PM_{2.5}$ levels is not so much the strength or depth of the inversion, but rather the number of consecutive days that the afternoon lower stable layer persists without breakup, and that 2013 had the longest such period in the last decade.

5.1 Assumptions

1. Maximum 24-hour $PM_{2.5}$ concentration increase rate (µg/m^3 per day) in a strong stagnation episode is more or less constant assuming the constant emissions.
2. Maximum 24-hour $PM_{2.5}$ concentration increase rate (µg/m^3 per day) in a strong stagnation episode is positively correlated with emission level.
3. A deep stable layer (DSL) with a thickness of 500 meters above ground level or more (12Z soundings) indicates a stagnation condition. A deep stable layer is defined as a condition in which 65% of the layer from 0 to 1,500 meters is stable.
4. A low stable layer (LSL) of 50 meters or more above ground level (in the lowest 500 meters, 0Z soundings) between two consecutive DSL days indicates a continuous DSL episode in which the $PM_{2.5}$ concentration on one day will accumulate in the next day with a roughly constant rate.
5. The maximum $PM_{2.5}$ elevation in a severe stagnation episode can be conceptually estimated by Equation 1:

   C = R (mixing height, emission rate) x N **Equation 1. Conceptual model.**

   where:

   R (a function of mixing height and emission rate) is the concentration increase rate that can be estimated using the data from most recent episode.

   N is the number of days in the first stage (increasing $PM_{2.5}$ stage) of the episode, which should be continuous without breakup, i.e., a LSL exists at 0Z, the afternoon sounding between any two consecutive DSL days.

6. There could be brief breakups or relief during an episode, therefore, the above estimation is for the maximum level and the actual level is usually lower.
7. There could be exceptional situations in which the $PM_{2.5}$ level may increase extremely fast, such as 50 µg/m^3 per day or more. This kind of extreme situation is not considered in this study.

5.2 Conceptual Model

While the $PM_{2.5}$ formation and concentrations depend on complicated emission and weather patterns, experience has shown that pollutant levels could be estimated by relatively simple box models. During severe stagnation episodes, both vertical and horizontal dispersion are limited. In

the deep valleys, inversions establish early before dusk, and mixing height in afternoon may never reach the level that allows pollutants to disperse; as a result, pollutants will persistently increase for days. The conventional dispersion models and photochemistry models often fail to properly simulate this situation due to the lack of accurate meteorological information near the surface. An example of community multiscale air quality (CMAQ) modeling results are shown in Figure 5 (UDAQ 2014). It can be seen that the $PM_{2.5}$ levels constantly increase at a linear rate during the episodes; the highest concentration is roughly proportional to the number of the days of the episode, as suggested in Equation 1. While the R in Equation 1 depends on the mixing height and emission rate, it is observed that R remains nearly constant over several episodes. The number of days without afternoon LSL breakup (N) is also relatively easy to predict from large-scale weather forecasting.

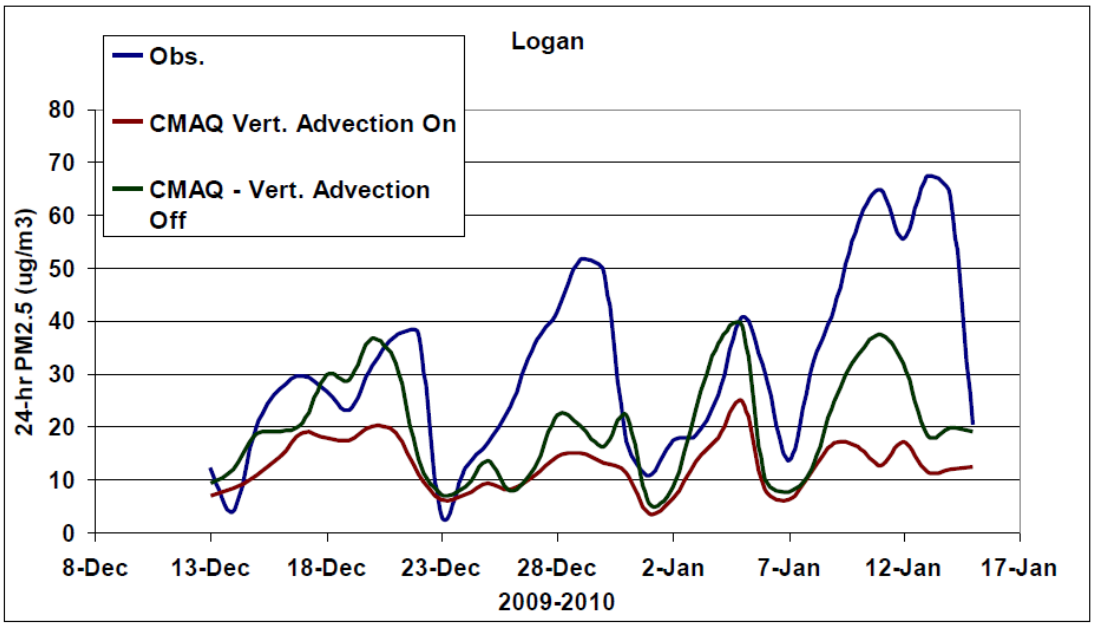

Figure 1.8: 24-hr $PM_{2.5}$ time series - Logan monitoring site.

Figure 5. Examples of $PM_{2.5}$ episodes in which $PM_{2.5}$ concentrations accumulated at a nearly constant rate.

Based on this consideration, R can be determined using the data from the most recent severe stagnation episodes and the number of days of an episode. N is the only parameter needed to estimate the potential maximum $PM_{2.5}$ level. The longer the episode duration, the higher the potential maximum $PM_{2.5}$ level could be.

While the duration of episodes can be forecasted using the DSL method (Wolyn and McKee 1968), and the DSL method was found to be applicable to the Boise, Idaho, airshed, the atmospheric stability with respect to trapping inversions in the Cache Valley is better defined using an LSL scheme because it is found that DSL thickness could vary in a great range, which results in uncertainties in determining the effect on the polluted layer. In other words, the layer above 500 meters may be deeply stable, but if the lower stable layer below 500 meters still breaks up in the afternoon, the accumulation is interrupted and $PM_{2.5}$ levels drop or stop

accumulating. Figure 6 and Figure 7 clearly show that the $PM_{2.5}$ events are defined by the existence of LSL.

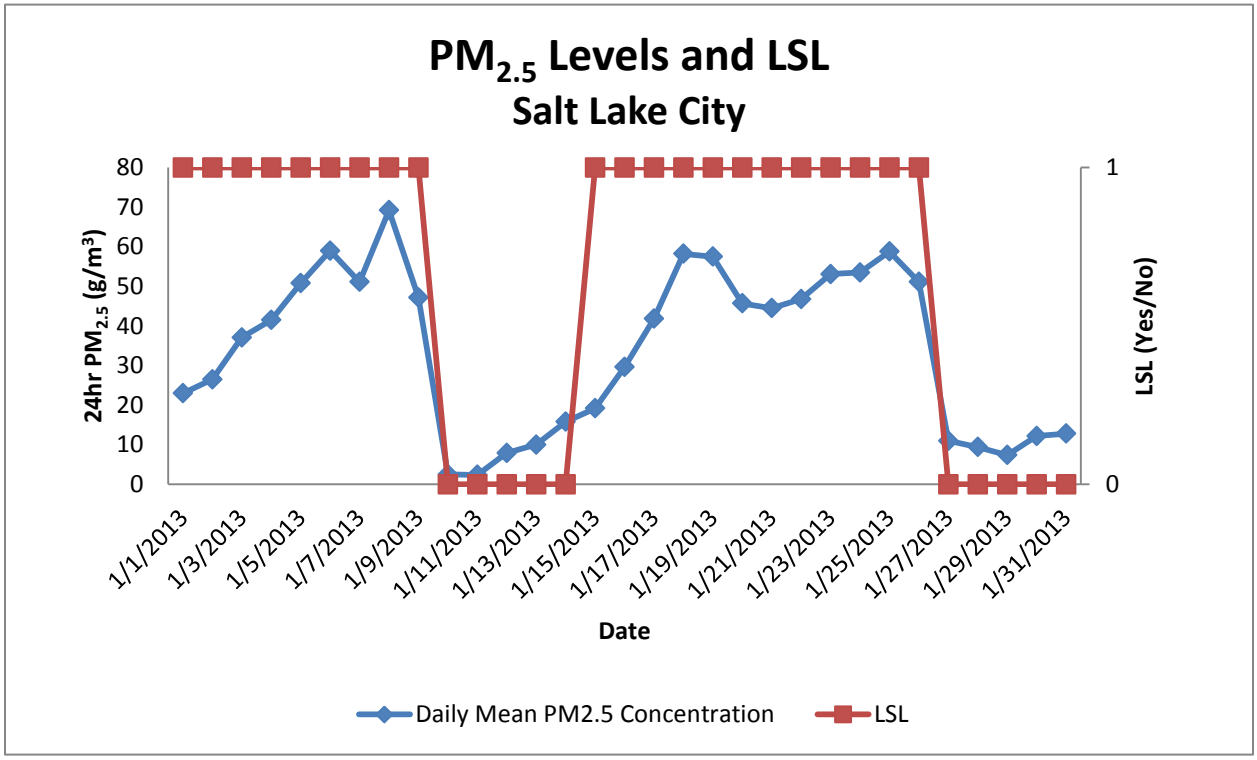

Figure 6. Salt Lake City, Utah, $PM_{2.5}$ events defined by lower stable layer. $PM_{2.5}$ and lower stable layer data are both from Salt Lake City.

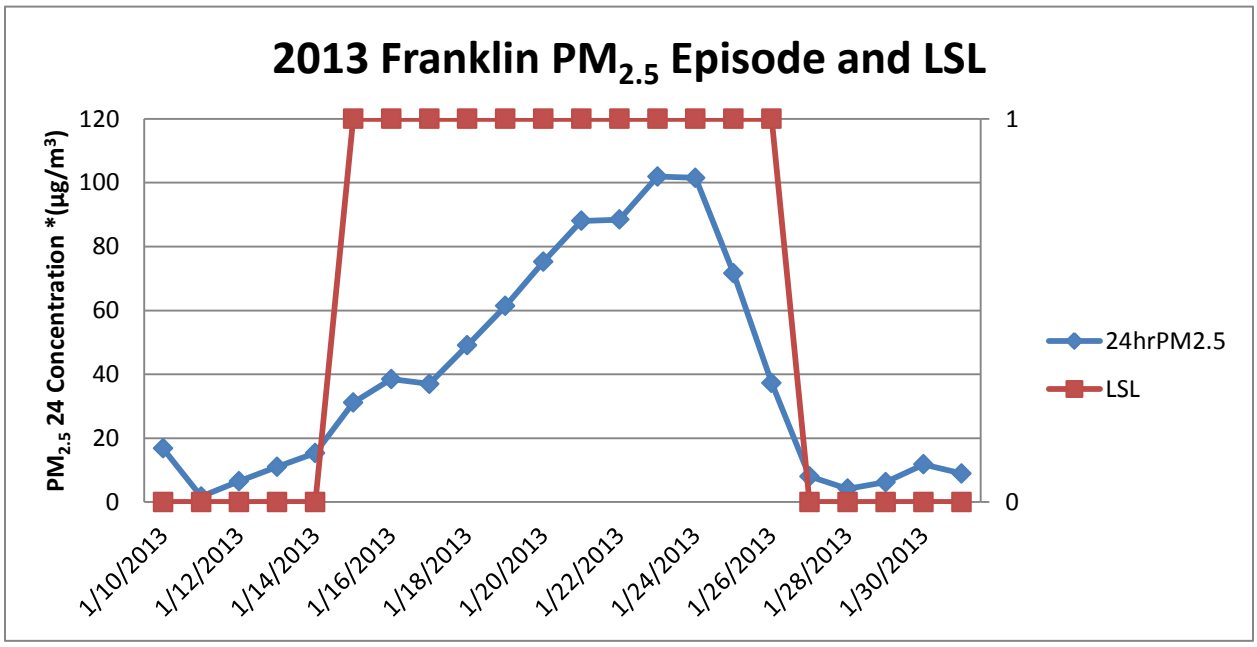

Figure 7. Franklin, Idaho, 2013 episode defined by lower stable layer. $PM_{2.5}$ data are from Franklin County, Idaho, and lower stable layer data are from Salt Lake City, Utah, upper air soundings.

Data Analysis

Two major $PM_{2.5}$ events occurred in the past decade, early 2005 and early 2013, as shown in Figure 8 and Figure 9, respectively. The events in 2005 were shorter with the longest one about 7–8 days. The valid LSL data are not available for 2005; however, it could be determined from the incomplete data that the 2005 episodes were much shorter and milder.

From Figure 8, the R value estimated from the first event is about 18.7 µg/m^3 per day, and the R value estimated from the linear portion in the main episode in Figure 9, is about 13.7 µg/m^3 per day. The episode during in 2013 is much longer than that in 2005, therefore the highest $PM_{2.5}$ concentration in 2013 was much higher than in 2005, while the R value is lower in 2013 probably reflecting lower emissions.

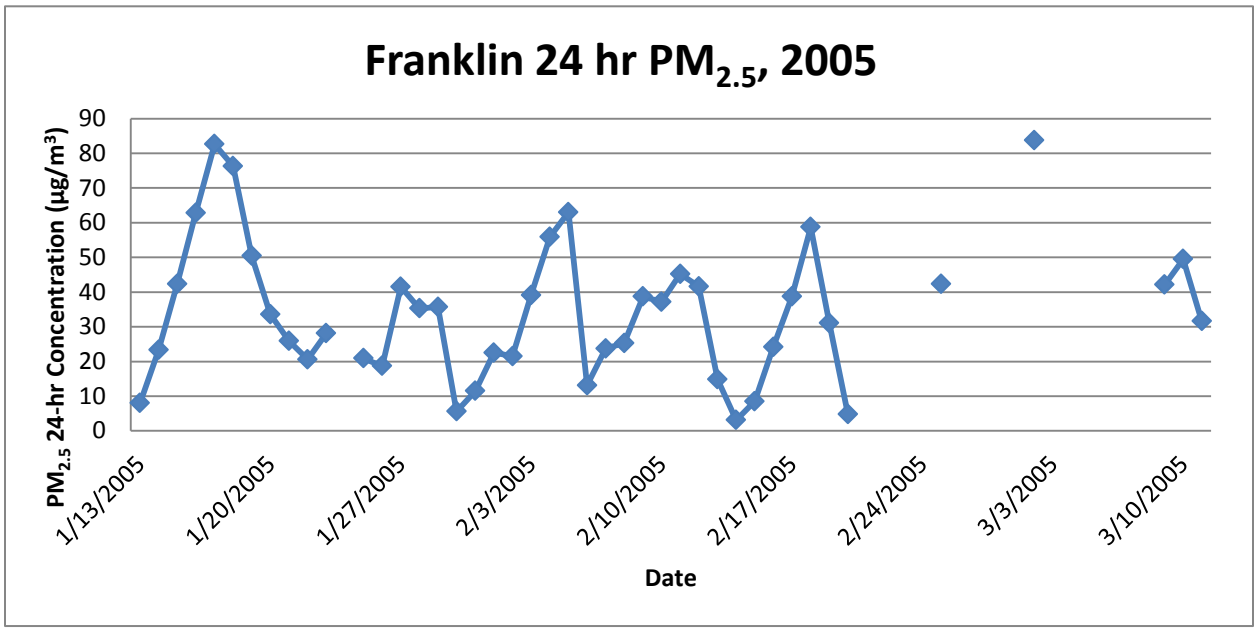

Figure 8. $PM_{2.5}$ events in Franklin, Idaho, early 2005.

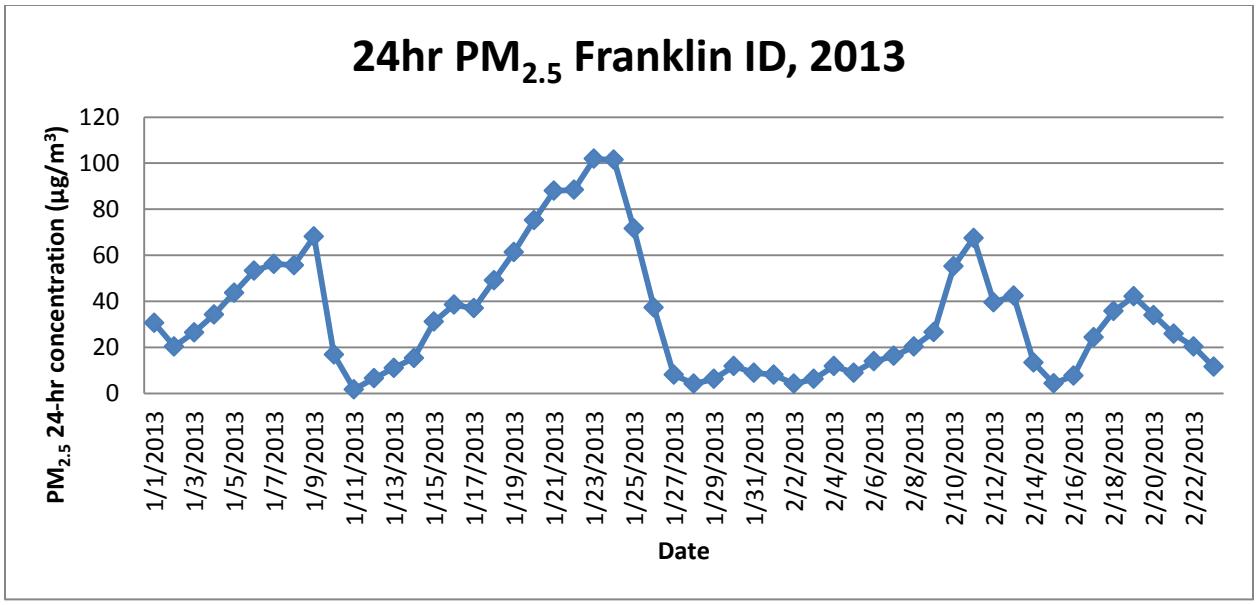

Figure 9. $PM_{2.5}$ events in Franklin County, Idaho, early 2013.

The skew-T diagrams for 2013 and 2005 show that the stable system is much stronger in 2013, while the mixing heights in afternoon were similar (Figure 10 and Figure 11). The lower R value in 2013 can be partially explained by the reduced emission rate since 2005. The emission rate in 2013 is about 80% of emissions in 2005 (UDAQ 2014), and the R value is about 70% in 2013 compared to 2005. This supports the theory that R varies with emissions and suggests emissions are lower in 2013, in agreement with the emission inventory (UDAQ 2014).

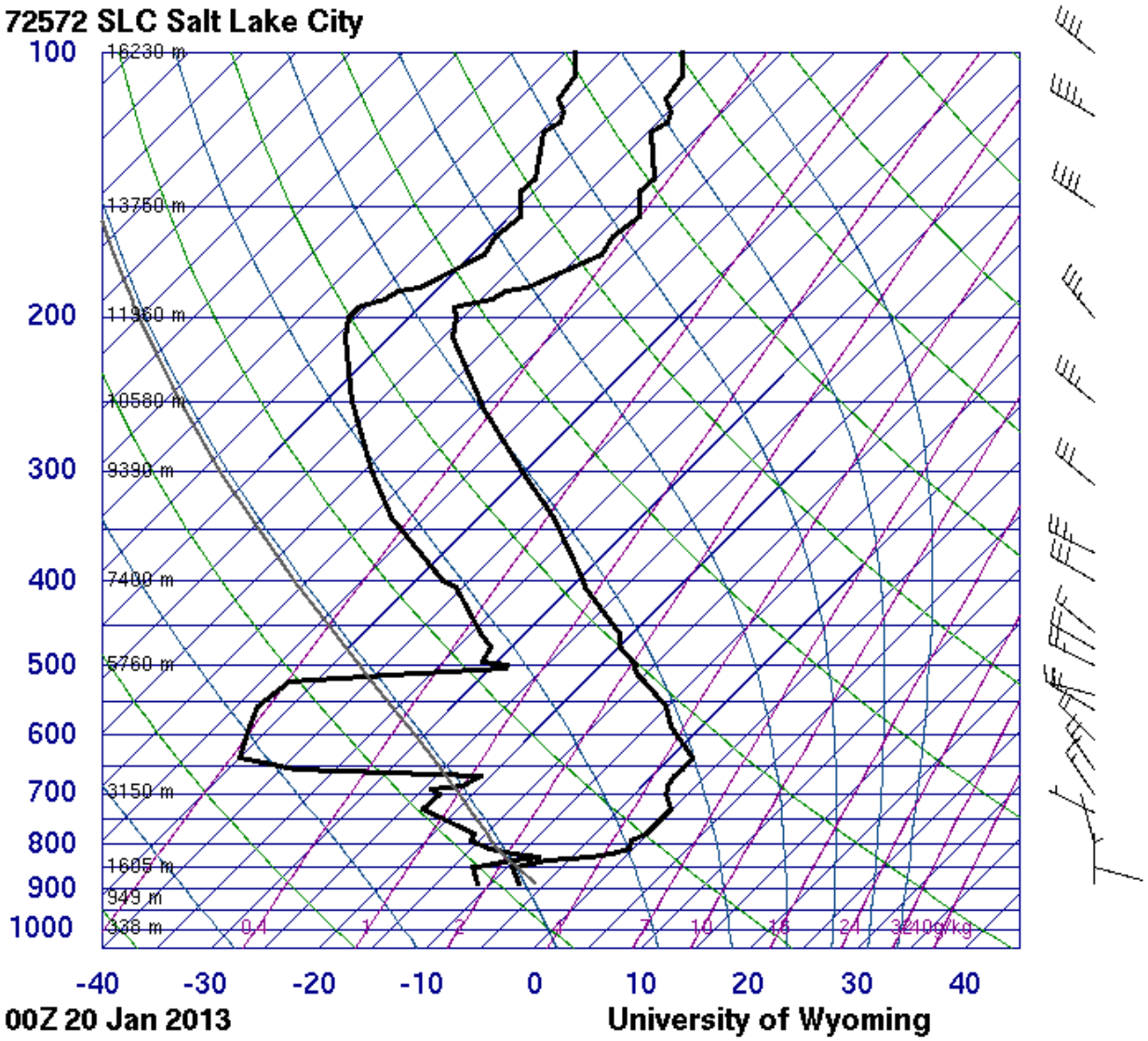

Figure 10. A skew-T diagram in a typical day in 2013 episode.

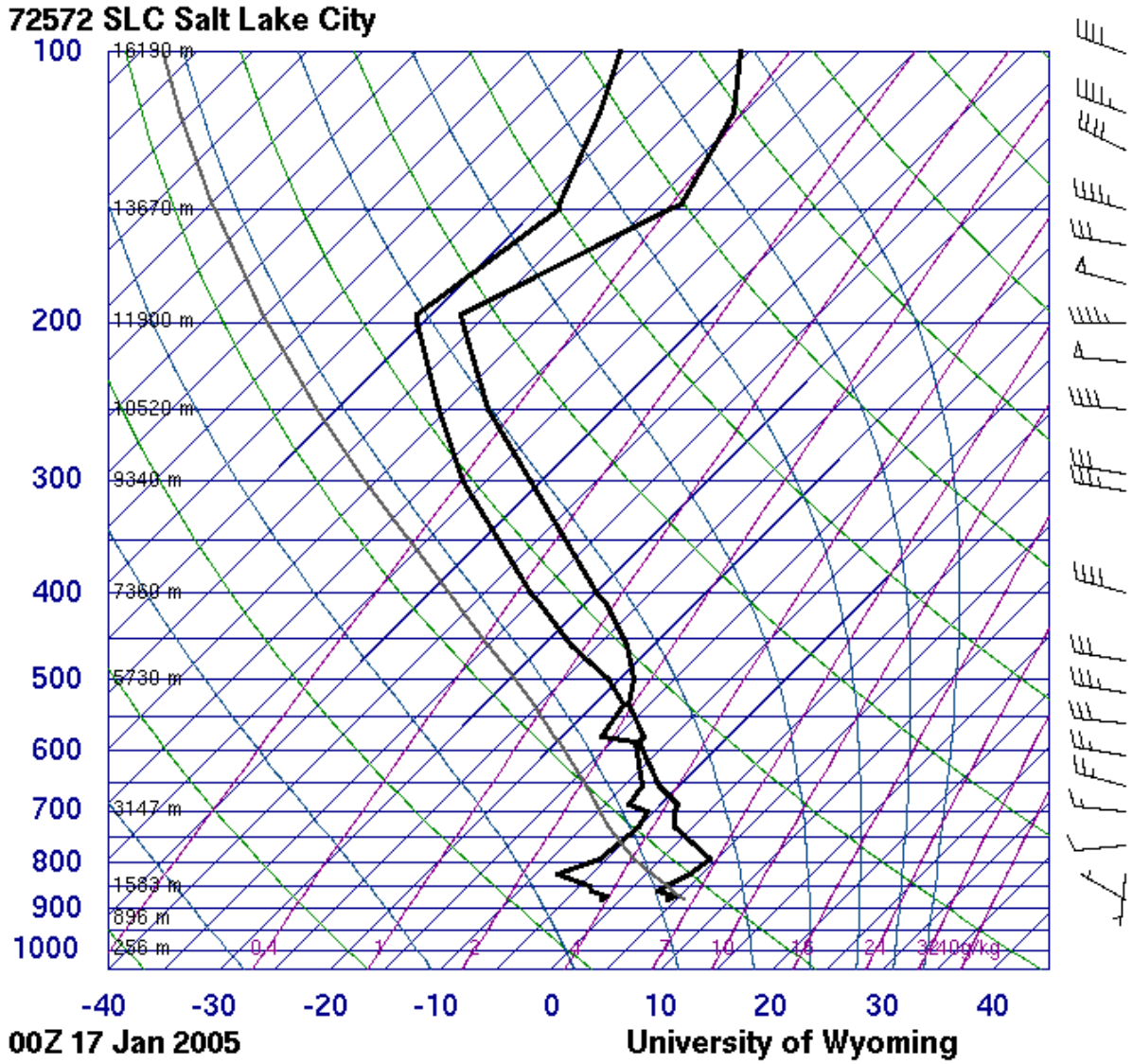

Figure 11. A skew-T diagram in a typical day in 2005 episode.

Figure 12 shows the consecutive LSL days of the longest episode in each year in the past decade. The January 2013 episode had the longest LSL event. While it is not the only factor affecting the severity of the pollution episode, it is clear that the meteorological conditions in the 2013 episode made it one of the worst in recent years and are responsible for the sharp upturn in days exceeding the 24-hour $PM_{2.5}$ NAAQS.

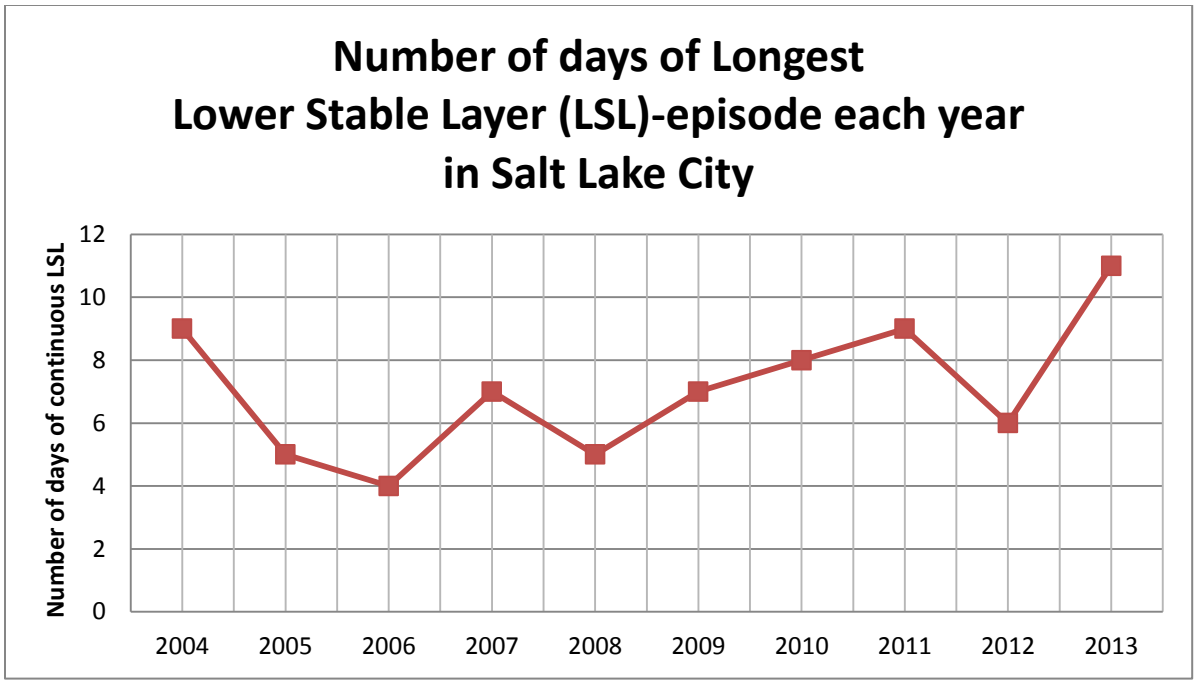

Figure 12. Longest consecutive lower stable layer days in each year; the 2013 event had the longest duration in the past decade.

In conclusion, $PM_{2.5}$ accumulates during severe stagnation events. The accumulation rate depends on the average mixing height and emission rate. The average mixing height in a severe stagnation episode is assumed to be similar; therefore, the accumulation rate is largely dependent on the emission rate only. The stagnation episode in 2013 was the strongest and longest in the past decade, therefore, while the accumulation rate, R, is smaller than 10 years ago due to the reduced emission rate, the maximum $PM_{2.5}$ concentration reached 102 $\mu g/m^3$ due to the longer duration of the episode.

6 References

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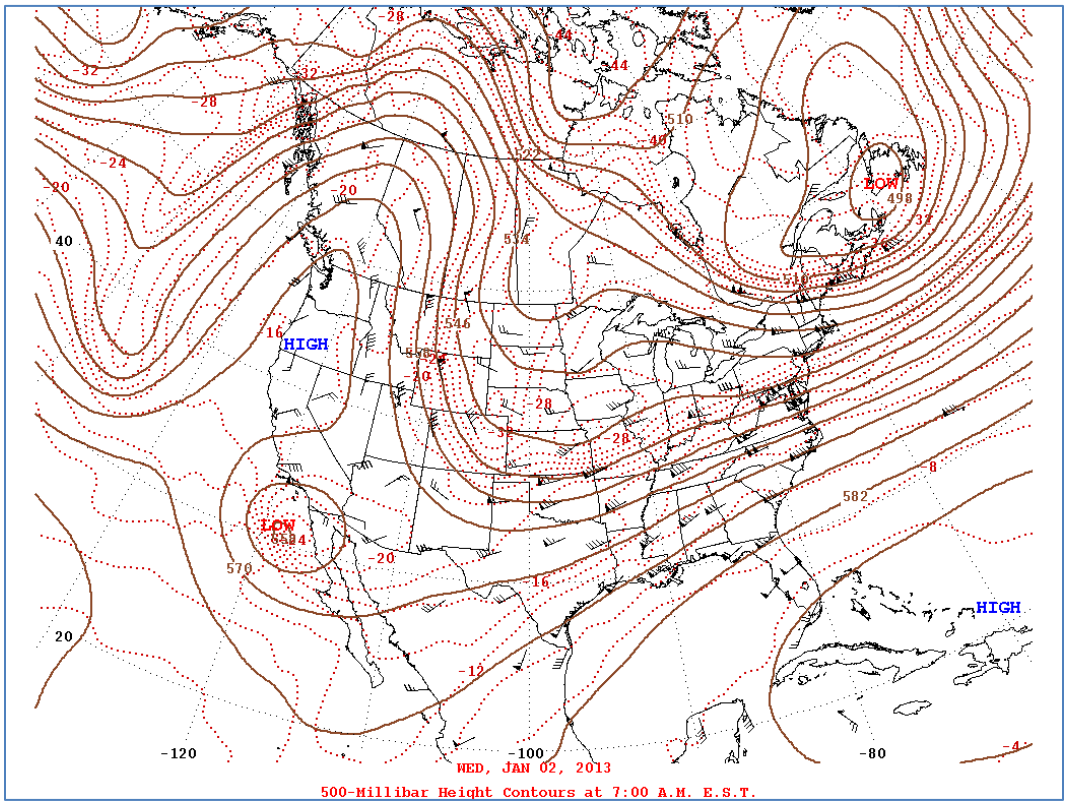
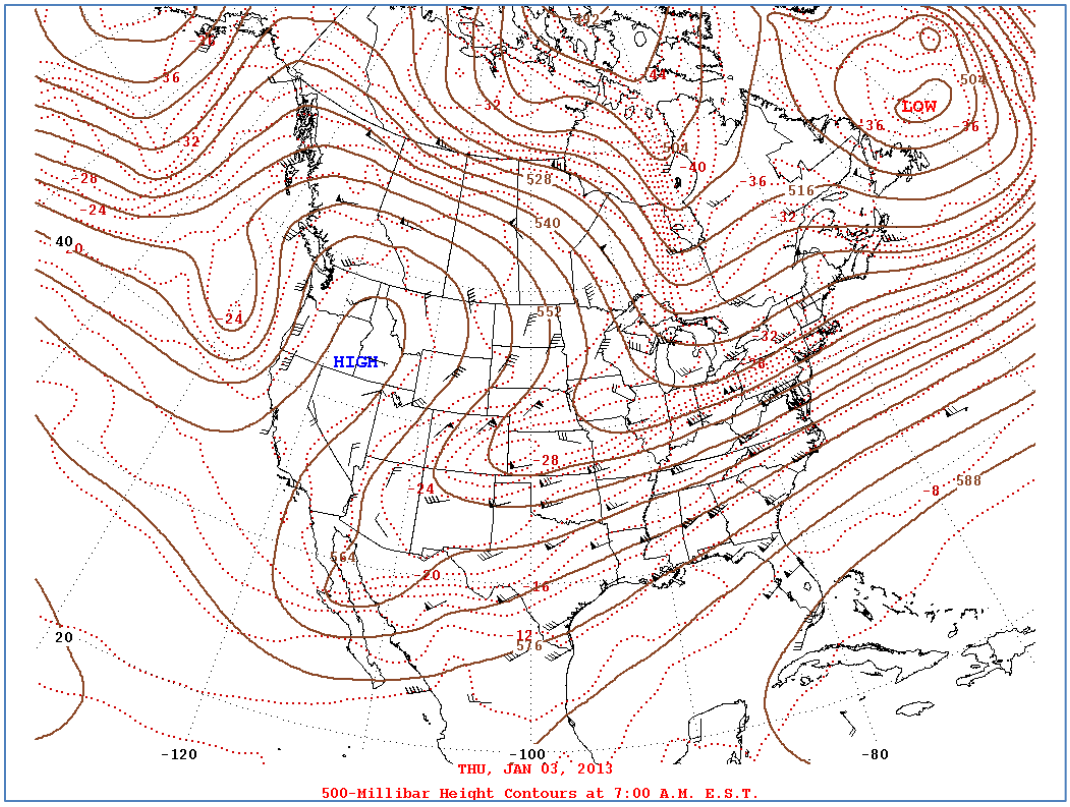
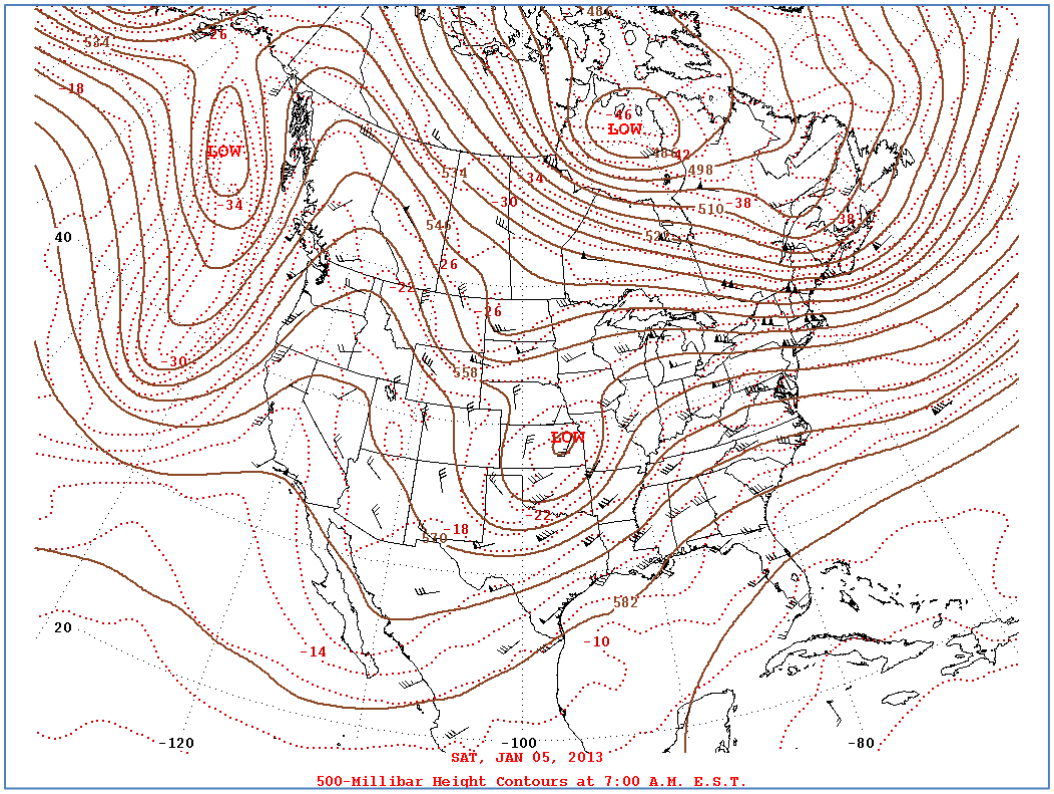
Attachment A



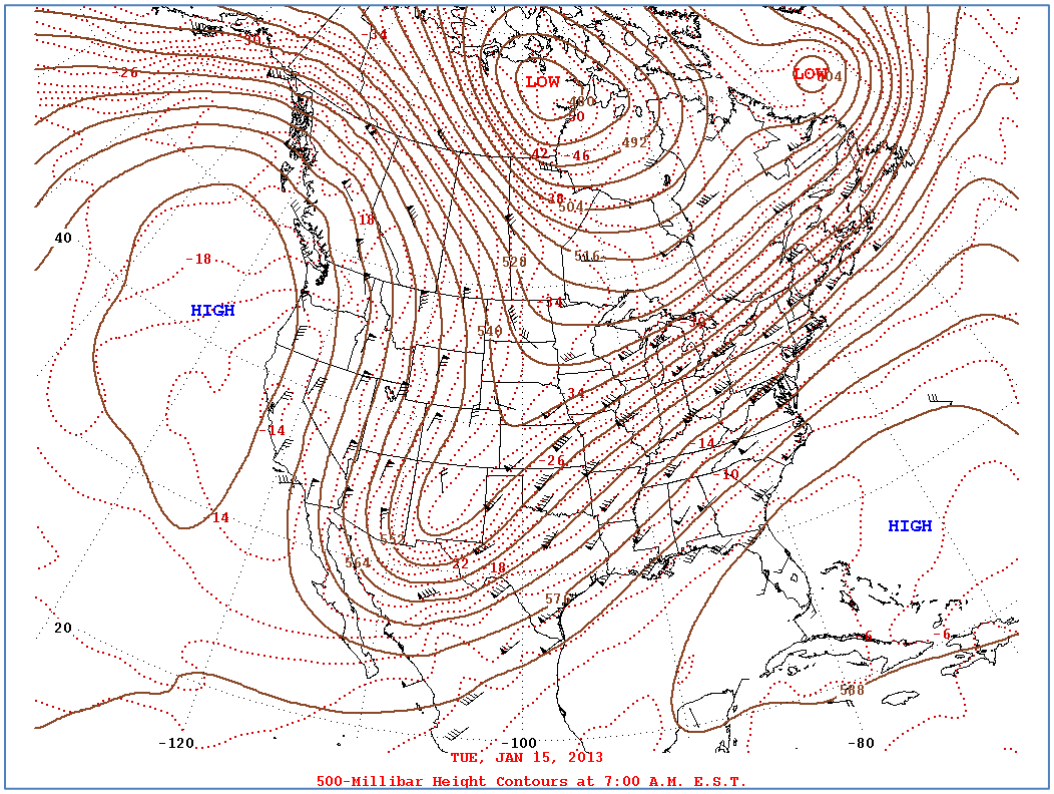
January 2: A Rex block has developed over the Pacific Coast. This forces the air to travel into Canada before entering Idaho. This promotes dry, cold transport into Idaho.

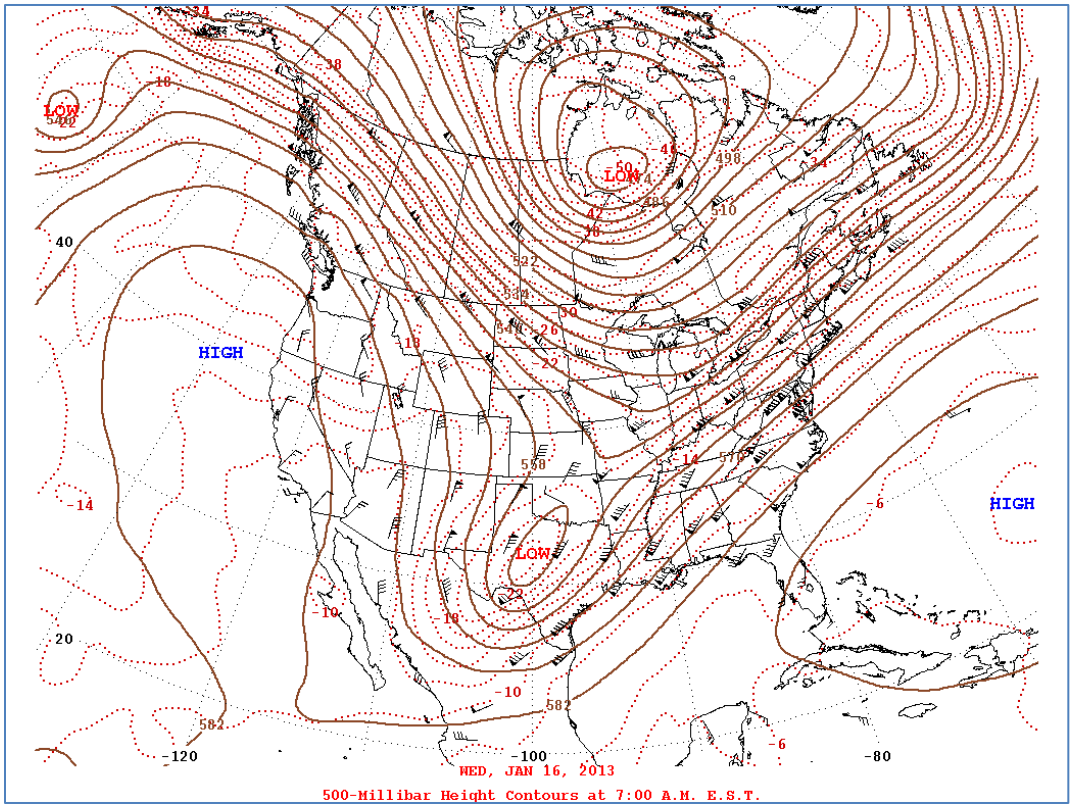


January 3: The low pressure system responsible for the Rex block has devolved into an open wave but is still steering the winds in this same pattern while the high pressure system associated with the Rex block as shifted to the east putting southwestern Idaho directly along the ridge axis. This promotes stagnant, stable weather.



January 5: Again, this ridge is evident with the ridge axis located directly along the Idaho/Oregon border.

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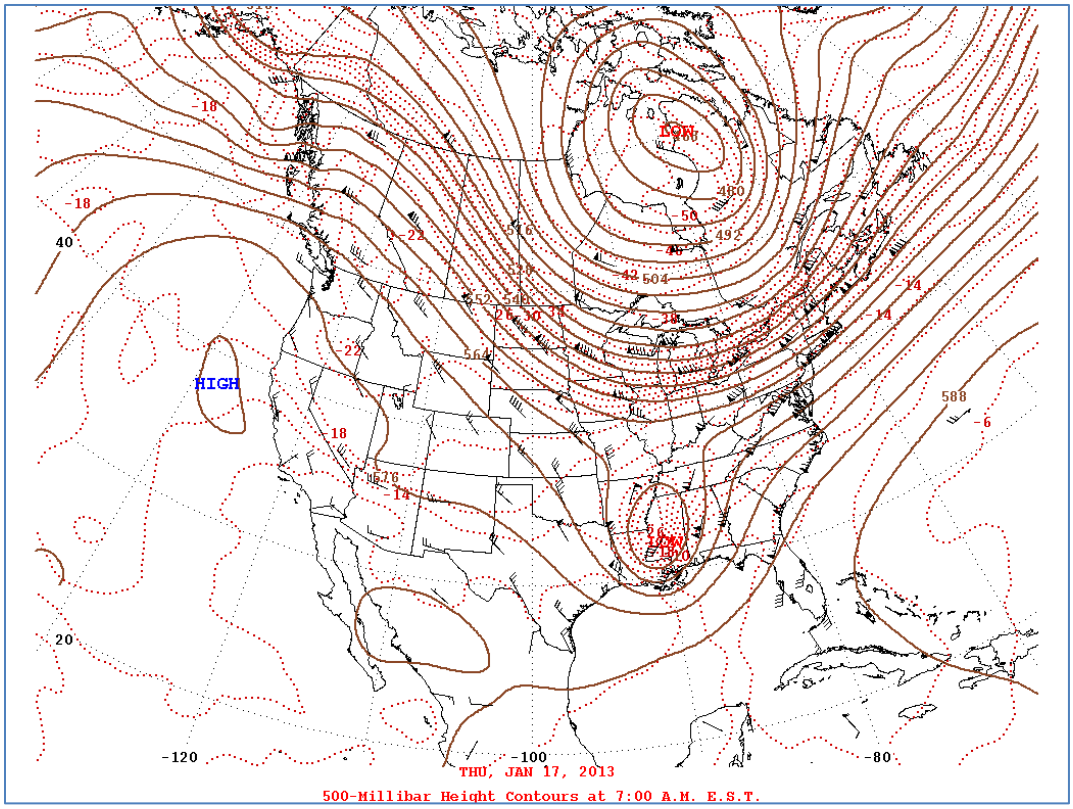
WED, JAN 16, 2013
500-Millibar Height Contours at 7:00 A.M. E.S.T.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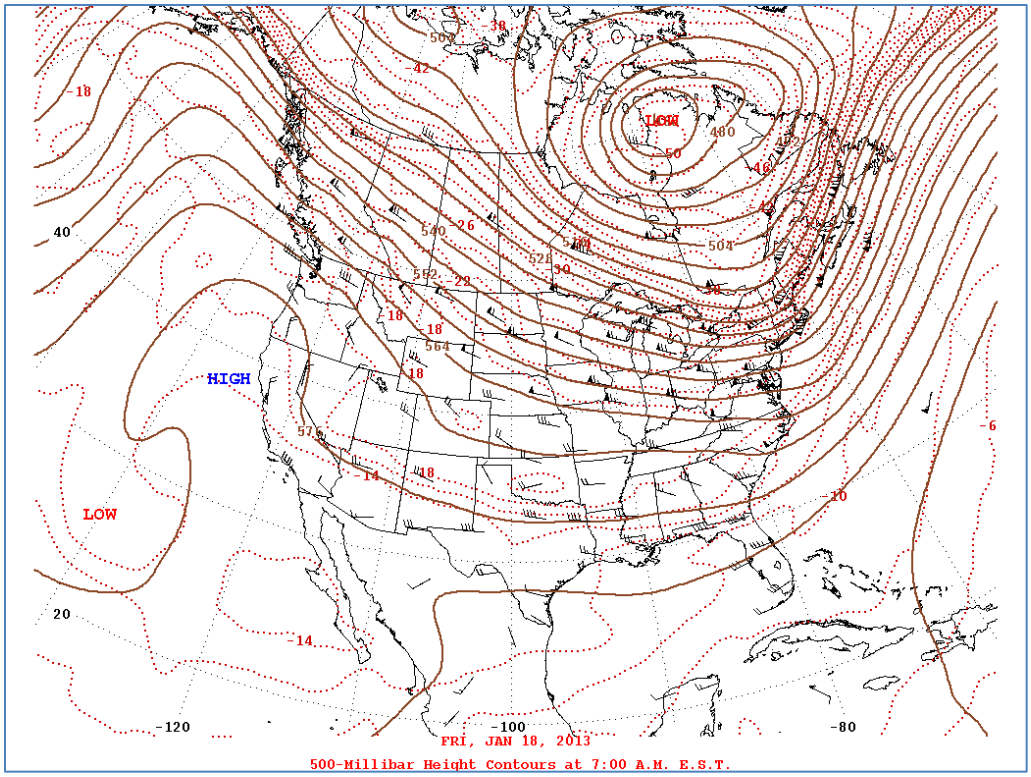
THU, JAN 17, 2013
500-Millibar Height Contours at 7:00 A.M. E.S.T.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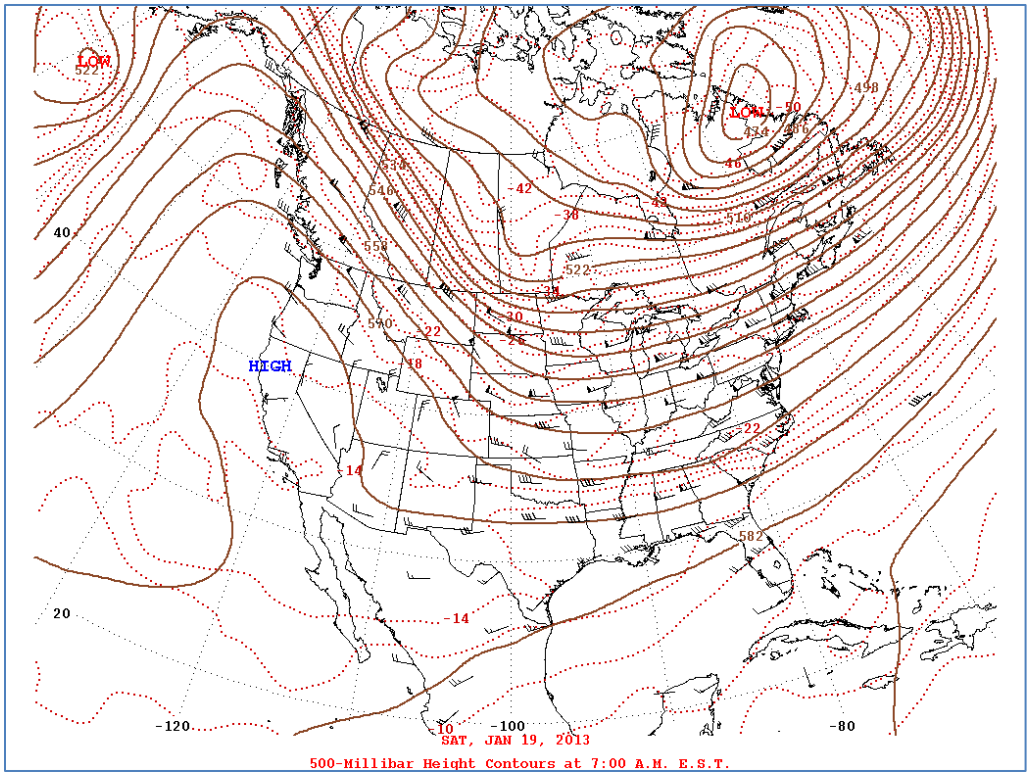
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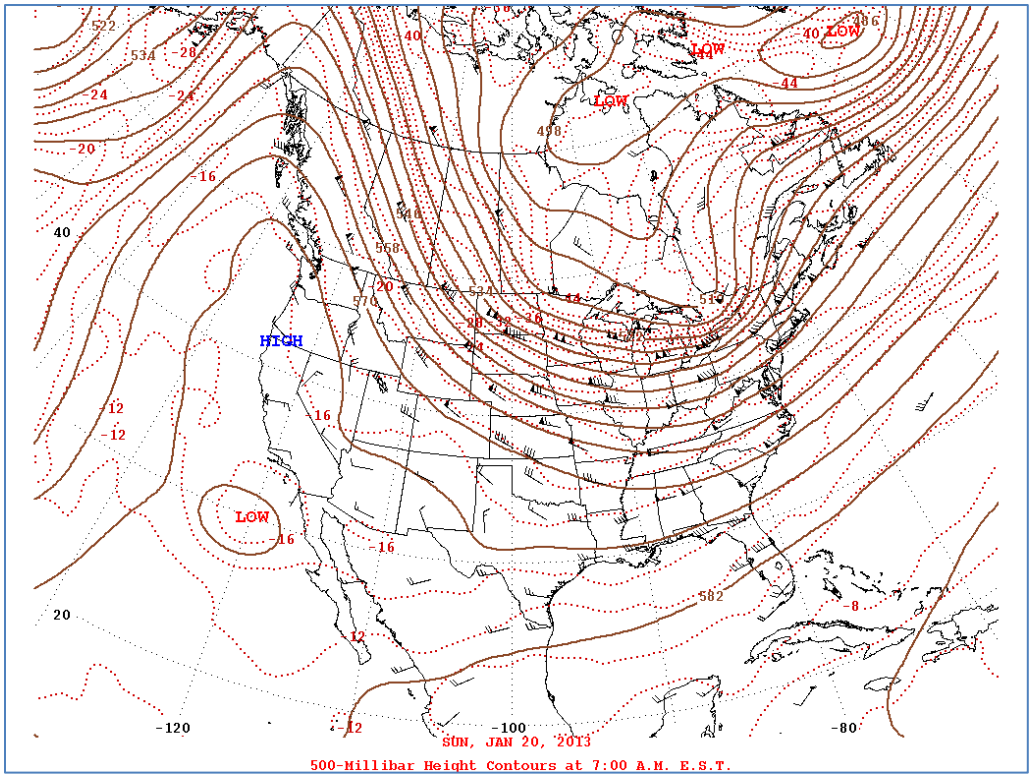
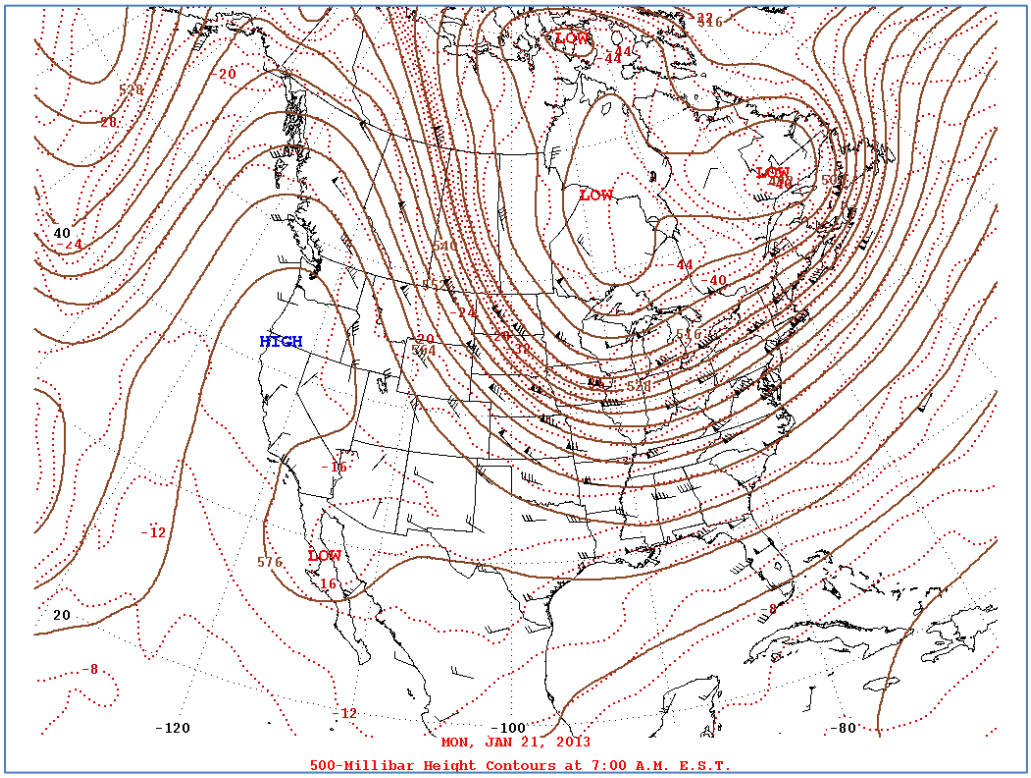
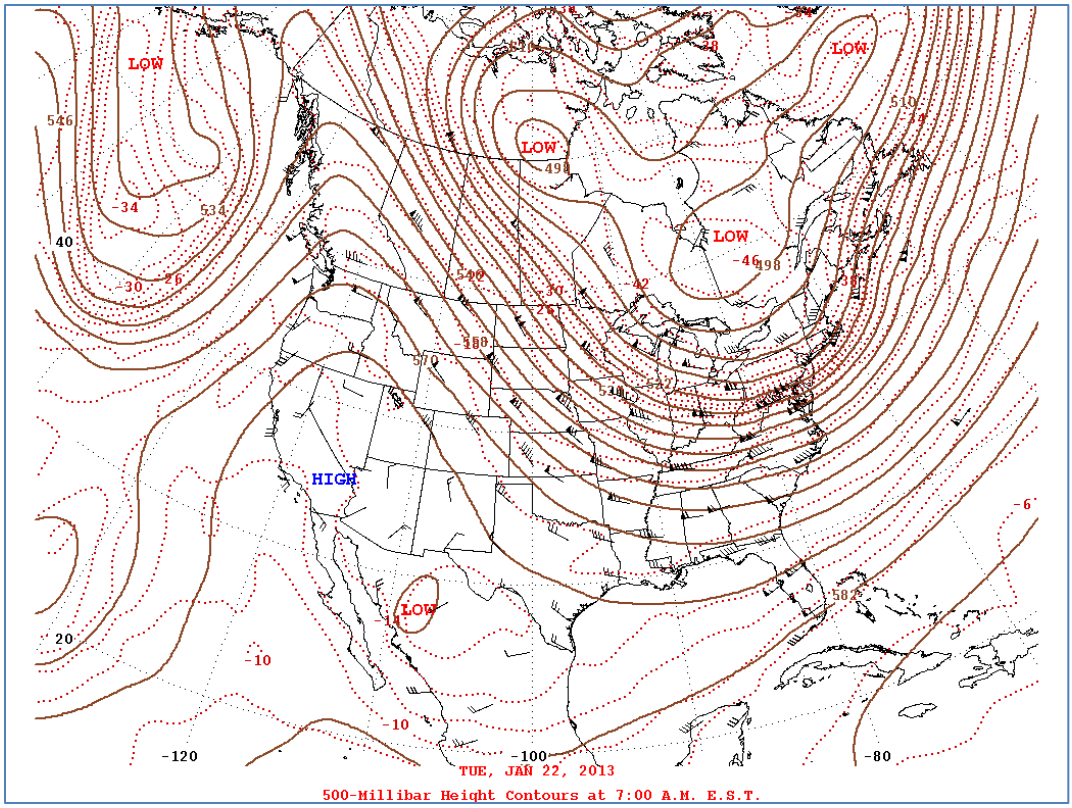




January 15–21: Offshore ridge of high pressure is strongly amplified and steering cold, dry, continental Canadian wind into Idaho. This pattern remains for a week. This pattern promotes a consistent northwest wind pattern that is typically quite dry.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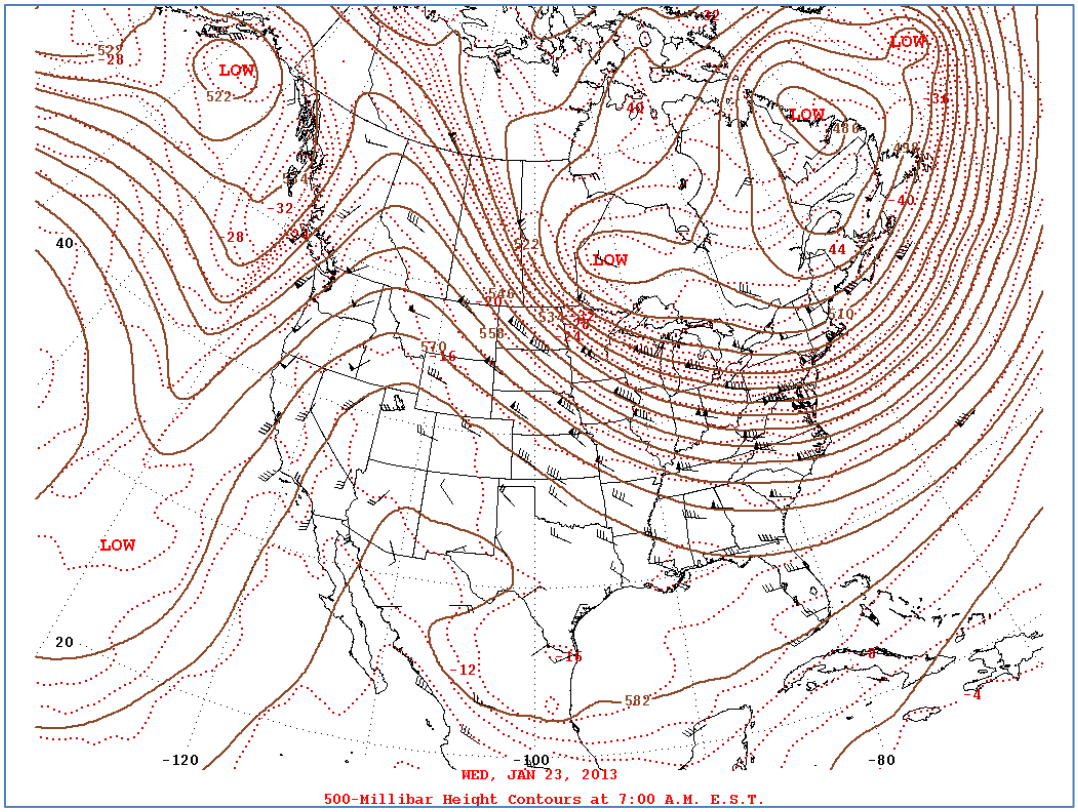
TUE, JAN 22, 2013
500-Millibar Height Contours at 7:00 A.M. E.S.T.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WED, JAN 23, 2013
500-Millibar Height Contours at 7:00 A.M. E.S.T.

January 22–23: This ridge axis shifts to center directly over southwestern Idaho once more. Again, this promotes stagnant winds. The 20,000-foot wind speeds are at 10 miles per hour (mph) near the ridge axis on January 22, while accelerating to 35 mph on January 23. This image also allows the identification of a strong upper level low pressure system in the Gulf of Alaska with an elongated trough that is likely the cause of clearing for this particular stagnation event.

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Appendix B. Updated Road Sanding Agreements

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Franklin County Road Department
561 West Oneida
Preston, Idaho 83263
(208) 852-0610

August 26, 2014

Department of Environmental Quality
444 Hospital Way #300
Pocatello, ID 83201

RE: Letter of Intent-PM $_{2.5}$ Reduction

The Franklin County Particulate Matter ($PM_{2.5}$) Air Quality Improvement Plan identifies wintertime roadway sanding materials as a significant source of $PM_{2.5}$ contribution to our community. The Franklin County Road Department intends to participate in the reduction of airborne $PM_{2.5}$ concentrations from County roads by taking the following action.

1. Anti-Skit Application the Franklin County Road Department has in the past used a ratio of 10 to 1 (10 parts sand to 1 part salt) Sand-Salt mix. Over the last few years we have reduced the ratio of Sand-Salt to 5 to 1. The Franklin County Road Department for the winter of 2012-2013 plans to use a 4 to 1 Sand-Salt ratio mix.

2. Use of Chemical De-icing Agents the Franklin County Road Department will apply prior to and during suitable storms a sodium chloride solution to the high volume roads. This will substantially reduce the amount of sand used to maintain safe roads.

This road sanding agreement ensures compliance with IDAPA 58.01.01.650-651 Rules for the Control of Fugitive Dust. The agreement may be modified by mutual agreement of the parties; all modifications shall be in writing.

Sincerely,

Troy Moser

Troy Moser, Road Supervisor

City of Preston
70 West Oneida • Preston, Idaho 83263
Office 208-852-1817 Fax 208-852-1820

***F. Lee Hendrickson,** Mayor*

***Travis M. Kunz,** Council President*
***Saundra Hubbard,** Councilmember*
***Neal P. Larson,** Councilmember*
***Todd D. Thomas,** Councilmember*

***Jerry C. Larsen,** City Clerk*

August 28, 2014

Department of Environmental Quality
444 Hospital Way #300
Pocatello, ID 83201

RE: $PM_{2.5}$ Reduction

The City Of Preston Particulate Matter ($PM_{2.5}$) Air Quality Improvement Plan identifies wintertime roadway sanding materials as a significant source of $PM_{2.5}$, which contributes to our community. The City Of Preston Public Works Department intends to participate in the reduction of airborne $PM_{2.5}$ concentrations from city streets by taking the following action:

1. In the past, the City of Preston's Anti-Skid application has been a 6 sand to 1 salt ratio. Over the last few years, we have reduced the sand-salt ratio to 5 sand/1 salt. Our plans, for the 2014-2015 winter season is to use a 4 sand to 1 salt ratio mix.

This road sanding agreement ensures compliance with IDAPA 58.01.01.650-651 Rules for the Control of Fugitive Dust. The agreement may be modified by mutual agreement of the parties; all modifications shall be in writing.

Sincerely,

John Balls

John Balls, PWD

IDAHO TRANSPORTATION DEPARTMENT
5151 South 5th Avenue
Pocatello, ID 83204-2202

(208) 239-3300
itd.idaho.gov

September 8, 2014

Melissa Gibbs
Idaho Department of Environmental Quality
444 Hospital Way #300
Pocatello, ID 83201

RE: ROAD SANDING AGREEMENT

Dear Ms. Gibbs:

In compliance with the goals to reduce particulate matter, the Idaho Transportation Department will agree to use straight salt and liquid salt brine prior to and during winter maintenance throughout Franklin County.

However, there may be occasional extenuating circumstances that will warrant discretionary changes based upon climate where anti-skid material may be used. This could include but is not limited to weather conditions and forecasts as well as safety concerns on roadways with specific grade concerns.

This road sanding agreement ensures compliance with IDAPA 58.01.01.650-651 Rules for the Control of Fugitive Dust. The agreement may be modified by mutual agreement of the parties; all modifications shall be in writing.

Sincerely,

Steve Gertonson, P.E.
District Five Operations Engineer

SG/cp:gh

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Appendix C. Woodstove Change Outs

Woodstove Emissions Reductions Calculation Method and Results

Idaho estimated the reduction in emissions due to documented uncertified woodstove change-outs in Franklin County using EPA's Woodstove Calculator.

Specific information regarding the new combustor types was used to develop the calculator inputs.

EPA uses a default value of 3 cords of wood burned per year in Franklin County's climate zone (one).

Idaho also used the defaults for wood density, efficiency of non-certified woodstoves, and the efficiency of certified woodstoves. Emissions factors for woodstoves were updated with data from EPA's 2011 v1 RWC model.

Emissions factors from EPA's 2011 v1 RWC model were used to calculate the emissions reduction benefits for changes to pellet stoves. The results are listed in the Table below and documentation is provided in accompanying worksheets.

Emissions Avoided due to wood stove change-outs in Tons/Yr

Pollutant	Old WS to Cert WS or Gas	Old WS to Pellet	Total TPY
CO	46.64	15.72	62.36
SO2	0.05	0.01	0.06
NOX	0.45	0.02	0.47
VOC	14.79	3.79	18.57
PM2.5-PRI	6.00	2.04	8.04
PM10-PRI	6.00	2.04	8.04

EPA Calculator results for uncertified woodstoves to certified woodstoves or gas

Parameters for Calculation of WS Changeout Benefit	Inputs	Input Description
Cords of Wood Burned per Woodstove =	3	See separate worksheet in this spreadsheet for EPA default values for burnrates
Wood density to convert cords to tons (tons oven dried wood/cord) =	1.02	use state average of wood density, based on oven dried wood. Densities available in this file in a separate v
Number of conventional stoves changed out =	212	
Woodstove % efficiency for conventional WS =	54	Compilation of Emission Factors, AP42, 5th edition
Woodstove % efficiency for certified WS =	68	Compilation of Emission Factors, AP42, 5th edition
Fraction assumed changed out to new Cert WS, remainder to non-wood burning heaters =	0.78	

Directions for use
Input in cell B2 the number of cord burned per woodstove
input in cell B3 the wood density
Input in cell B4 the number of conventional woodstoves being changed out
Input in cell B7 the fraction of of new stoves that are EPA certified
Emissions avoided displayed in box

NEI Pollutant Code	Emission factors (lb/ton)	Conv WS	Certified WS	Reference
CO	CO	230.8	140.8	Section 1.10, Compilation of Emission Factors, AP42
SO2	SO2	0.4	0.4	Section 1.10, Compilation of Emission Factors, AP42
NOX	NOX	2.8	2.28	Section 1.10, Compilation of Emission Factors, AP42
VOC	VOC	53	12	Section 1.10, Compilation of Emission Factors, AP42
PM2.5-PRI	PM2.5-PRI	30.6	19.6	Conv Factor = AP-42; Certified EF = 060704 email fro
PM10-PRI	PM10-PRI	30.6	19.6	Conv Factor = AP-42; Certified EF = 060704 email fro
600	Dioxin teq	4.6E-09	7.9E-10	MARAMA report
106990	1,3-butadiene	0.39	0.175	Section 1.10, Compilation of Emission Factors, AP42
40	16-PAH	0.64	0.3	MARAMA report
75	7-PAH	0.04	0.02	Section 1.10, Compilation of Emission Factors, AP42
75070	Acetaldehyde	0.616	0.632	MARAMA report
107028	Acrolein	0.091	0.0404	Section 1.10, Compilation of Emission Factors, AP42
71432	Benzene	1.938	0.959	Section 1.10, Compilation of Emission Factors, AP42
50000	Formaldehyde	1.45	0.98	Section 1.10, Compilation of Emission Factors, AP42
CH4	Methane	64	28.4	Section 1.10, Compilation of Emission Factors, AP42
91203	Napthalene	0.179	0.14	MARAMA report

Emission Avoided (tons)	
Pollutant	Total Emissions Avoided
CO	46.63541
SO2	0.05
NOX	0.45
VOC	14.79
PM2.5-PRI	6.00
PM10-PRI	6.00
Dioxin teq	1.334E-09
1,3-butadiene	0.0914
16-PAH	0.1474
7-PAH	0.0090
Acetaldehyde	0.0731
Acrolein	0.0214
Benzene	0.4364
Formaldehyde	0.2739
Methane	15.07
Napthalene	0.0300

EPAEmissionCalculator_Woodstoves 092914.xlsx

EPA Calculator results for uncertified woodstoves to pellet stoves

Parameters for Calculation of WS Changeout Benefit	Inputs	Input Description
Tons of Pellets burned per pellet stove =	3.9697	RWC Tool 2011v1 120612
Wood density to convert cords to tons (tons oven dried wood/cord) =	1	No conversion needed
Number of conventional stoves changed out =	36	
Woodstove % efficiency for conventional WS =	54	Compilation of Emission Factors, AP42, 5th edition
Woodstove % efficiency for Pellet Stoves =	80	Conservative average of manufacturer's efficency ratings
Fraction assumed changed out to new Cert WS, remainder to non-wood burning heaters =	1	No fraction needed for Pellet Stoves only

Directions for use
Input in cell B2 the number of cord burned per woodstove
input in cell B3 the wood density
Input in cell B4 the number of conventional woodstoves being changed out
Input in cell B7 the fraction of of new stoves that are EPA certified
Emissions avoided displayed in box

NEI Pollutant Code	Emission factors (lb/ton)	Conv WS	Pellet Stove	Reference
CO	CO	230.8	15.9	Section 1.10, Compilation of Emission Factors, AP42,
SO2	SO2	0.4	0.32	Section 1.10, Compilation of Emission Factors, AP42,
NOX	NOX	2.8	3.8	Section 1.10, Compilation of Emission Factors, AP42,
VOC	VOC	53	0.041	Section 1.10, Compilation of Emission Factors, AP42,
PM2.5-PRI	PM2.5-PRI	30.6	3.06	Conv Factor = AP-42; Certified EF = 060704 email fron
PM10-PRI	PM10-PRI	30.6	3.06	Conv Factor = AP-42; Certified EF = 060704 email fron
600	Dioxin teq	4.6E-09	7.9E-10	MARAMA report
106990	1,3-butadiene	0.39	0.00095	Section 1.10, Compilation of Emission Factors, AP42,
40	16-PAH	0.64	0.3	MARAMA report
75	7-PAH	0.04	0.02	Section 1.10, Compilation of Emission Factors, AP42,
75070	Acetaldehyde	0.616	0.094	MARAMA report
107028	Acrolein	0.091	0.0101	Section 1.10, Compilation of Emission Factors, AP42,
71432	Benzene	1.938	0.0289	Section 1.10, Compilation of Emission Factors, AP42,
50000	Formaldehyde	1.45	0.316	Section 1.10, Compilation of Emission Factors, AP42,
CH4	Methane	64	0.248	Section 1.10, Compilation of Emission Factors, AP42,
91203	Napthalene	0.179	0.423	MARAMA report

RWC Tool 2011v1 120612

Emission Avoided (tons)	
Pollutant	Total Emissions Avoided
CO	15.72484
SO2	0.01
NOX	0.02
VOC	3.79
PM2.5-PRI	2.04
PM10-PRI	2.04
Dioxin teq	2.906E-10
1,3-butadiene	0.0278
16-PAH	0.0313
7-PAH	0.0019
Acetaldehyde	0.0395
Acrolein	0.0060
Benzene	0.1371
Formaldehyde	0.0884
Methane	4.56
Napthalene	-0.0076

EPAEmissionCalculator_Pellet Stoves 092914.xlsx

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Appendix D. Public Involvement

Public Notice

Public Hearing

Public Comment and DEQ Response

DEQ received xxx comments during the public comment period held from xxxxx, through xxxxx. No public comments were submitted during the public hearing that was held on xxxxx. None of the comments received raised substantive issues requiring modification to the proposed state implementation plan.