Missoula County Year 2013 Air Pollution Trends Report

May 12, 2014

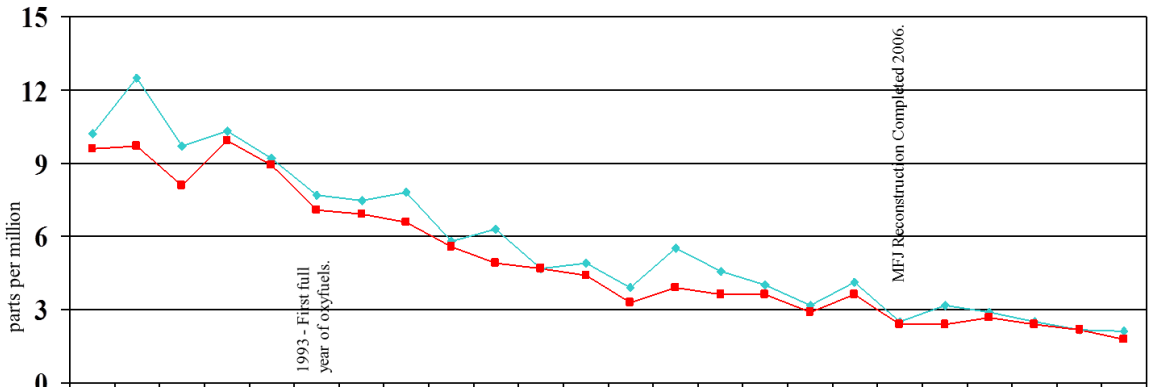
Carbon Monoxide - Missoula

Missoula last exceeded the 8-hour carbon monoxide (CO) National Ambient Air Quality Standard (NAAQS) in 1991. Because of federal tailpipe standards and fleet turnover, ambient levels of CO have declined drastically over the last decades to the point where maximum CO levels for a winter season are around one third the NAAQS. Consequently, Missoula discontinued monitoring for CO on March 31, 2011.

Graph 1. Missoula Carbon Monoxide Levels

1988-2011 Malfunction Junction

1st and 2nd Highest 8-Hour Average



	88	89	90	91	92	93	94	95	96	97	98	99	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
1st	10.2	12.5	9.7	10.3	9.2	7.7	7.5	7.8	5.8	6.3	4.7	4.9	3.9	5.5	4.6	4	3.2	4.1	2.5	3.2	2.9	2.5	2.2	2.1
2nd	9.6	9.7	8.1	9.9	8.9	7.1	6.9	6.6	5.6	4.9	4.7	4.4	3.3	3.9	3.6	3.6	2.9	3.6	2.4	2.4	2.7	2.4	2.2	1.8

Federal 8-Hour Average Standard = 9 parts per million, not to be exceeded more than once per calendar year. Carbon monoxide monitoring at Brooks, South and Russell (Malfunction Junction) ended March 31, 2011.

A winter 2005-2006 Reserve Street CO study found CO levels to be well below the 8-hour standard and comparable to the Brooks-South Russell intersection. Study results are available at http://www.co.missoula.mt.us/airquality/MissoulasAir/AirStudies.htm. This study made it clear that CO levels throughout Missoula are well below the NAAQS.

In 2005 the State of Montana requested that Missoula be re-classified as an attainmnent area for CO. In 2007, Missoula was designated an attainment area for CO in "46158 - 46161 Federal Register / Vol. 72, No. 159 / Friday, August 17, 2007 / Rules and Regulations."

PM_{10} - Missoula

The 24-hour PM_{10} NAAQS was last exceeded in Missoula in 1989. Even with increased vehicle traffic and population in the Missoula Valley, PM_{10} concentrations over the last several years have been stable and well below the NAAQS. Several factors that help limit PM_{10} concentrations include the woodstove removal program, the use of deicer in place of street sand on many streets, prompt street sweeping in the spring and regulations that require most new vehicle use areas be paved inside the Air Stagnation Zone. Because of Missoula's mountain valley topography and growing population, ways to limit and reduce air pollution in the valley will continue to be important if we wish to maintain and improve on the air quality gains made in the past.

Because Missoula's PM_{10} levels are stable and well below the national standard, work on a PM_{10} Limited Maintenance Plan and request to re-designate Missoula as an attainment area for PM_{10} began in 2013. The Missoula City-County Health Department (Department) with assistance from the Montana Department of Environmental Quality (DEQ) hopes to complete the PM_{10} Limited Maintenance Plan and associated PM_{10} emission inventory sometime in 2014. Once the Limited Maintenance Plan is accepted by the EPA, the State of Montana will request that Missoula be re-designated as attainment for PM_{10}.

$PM_{2.5}$ – Missoula Valley

Missoula began sampling for particulate matter 2.5 microns in diameter or smaller ($PM_{2.5}$) in 1999. The Health Department and Boyd Park were the two SLAMS sites for $PM_{2.5}$ in the Missoula Valley. The $PM_{2.5}$ Boyd Park site was closed in April 2002 because the results were similar to the concentrations found at the Health Department. In 2009 the main $PM_{2.5}$ monitoring site was moved to Boyd Park since that location had capacity for the new continuous monitoring equipment.

In December of 2006, the United States Environmental Protection Agency (EPA) promulgated new standards for $PM_{2.5}$. This new standard lowered the permissible $PM_{2.5}$ 24-hour level from 65 micrograms per cubic meter ($\mu g/m^3$) to 35 $\mu g/m^3$. Based on the daily $PM_{2.5}$ design value of 35.2 $\mu g/m^3$ for the 2005-2007 three year average, Missoula was barely designated as attainment for this new standard. A value of 35.5 $\mu g/m^3$ would have rounded up to 36 $\mu g/m^3$ which would have exceeded the 24-hour $PM_{2.5}$ standard.

Typically, Missoula has values over 35 ug/m^3 a few times each year, generally during the winter months. In fact, all of the $PM_{2.5}$ days over 35 ug/m^3 (with the exception of wildfire smoke episodes) for 2004-2014 occurred in November, December, January or early February. When approved by the Environmental Protection Agency, days impacted by wildfire smoke can be "flagged" and not used to determine compliance with the $PM_{2.5}$ standard. Data in Tables 1-5 were collected using equipment located at the Missoula City-County Health Department, at Boyd Park which is one block from Russell Street and the YMCA, and in Frenchtown near the elementary school.

Tables 2-4 show that Missoula and Frenchtown have been in compliance with the daily $PM_{2.5}$ NAAQS since 2006.

Table 1. Missoula's 24-Hour High $PM_{2.5}$ Values for Boyd Park

2009		2010		2011		2012		2013	
Date	**µg/m³**	**Date**	**µg/m³**	**Date**	**µg/m³**	**Date**	**µg/m³**	**Date**	**µg/m³**
11/28	43.2	**12/25**	39.7	**9/8**[1]	36.6[1]	**9/15**[1]	105.1	**1/18**	40.3
12/10	36.2	**12/26**	37.5	**1/3**	31.5	**9/14**[1]	96.5	**8/23**[1]	38.3
8/30[1]	34.3[1]	**12/24**	36.2	**1/2**	28.9	**9/20**[1]	83.1	**8/22**[1]	36.9
9/5[1]	31.5[1]	**12/22**	35.0	**12/15**	28.6	**9/24**[1]	82.4	**1/22**	36.7
12/22	30.2	**12/21**	30.6	**12/11**	28.3	**9/25**[1]	74.7	**1/23**	32.9

[1]Values were influenced by wildfire smoke and may be flagged and not used to determine compliance in the future.

Table 2. Annual 24-hour $PM_{2.5}$ 98th Percentile Values for Boyd Park and Frenchtown with Wildfire Data Omitted

Location	2009 *u*g/m³	2010 *u*g/m³	2011 *u*g/m³	2012 *u*g/m³	2013 *u*g/m³
Boyd Park	21.4	26.1	26.1	17.3	26.6
Frenchtown	No Data	24.4	23.9	19.7	28.9

Table 3. Missoula's Three Year Running 24-Hour $PM_{2.5}$ Standard Design Values[2] with Wildfire Data Omitted

(Based on three year average of yearly 98th percentile 24-hr values at Health Department)

2003 – 2005 µg/m³	**2004 – 2006 µg/m³**	**2005 – 2007 µg/m³**	**2006 – 2008 µg/m³**	**2007 – 2009 µg/m³**	**2008 – 2010 µg/m³**
39	41	35.2	29.9	25.8	24

[2]24-hour $PM_{2.5}$ Standard Design Values over 35.4 exceed the national ambient air quality standard.

Table 4. Missoula and Frenchtown Three Year Running 24-Hour $PM_{2.5}$ Standard Design Values[2] With Wildfire Data Omitted

(Three year average of yearly 98th percentile 24-hr values at Boyd Park, Missoula and Frenchtown)

Location	**2009 – 2011 µg/m³**	**2010 – 2012 µg/m³**	**2011 – 2013 µg/m³**
Boyd Park	25	23	23
Frenchtown	Insufficient Data	23	24

[2]24-hour $PM_{2.5}$ Standard Design Values over 35.4 exceed the national ambient air quality standard.

Table 5 list the annual averages for Missoula and Frenchtown. The annual average standard is based on the mean of three consecutive years. The 2011-2013 three-year running annual average, with wildfire date included, of 9.2 *u*g/m³ for Missoula and 10.8 *u*g/m³ for Frenchtown is below the NAAQS Annual Standard of 12 *u*g/m³. With wildfire data omitted, the 2011-2013 three running annual average for Missoula and Frenchtown is 7.6 *u*g/m³ and 9.5 *u*g/m³ respectively.

Table 5. Missoula Boyd Park and Frenchtown Annual Averages With Wildfire Data

($PM_{2.5}$ annual standard is based on three year running average and the standard is 12 *u*g/m³)

Location	2009 *u*g/m³	2010 *u*g/m³	2011 *u*g/m³	2012 *u*g/m³	2013 *u*g/m³
Boyd Park	7.1	7.1	8.62	10.75	8.26
Frenchtown	No Data	9.60	10.5	12.36	9.77

For the 2009-2010 winter a Bitterroot Valley and Missoula Valley saturation study was done to determine the distribution and movement of $PM_{2.5}$ through these connected valleys. The Bitterroot Valley and Missoula Valley air sheds were found to only partially influence each other. Generally, air quality in the Bitterroot Valley had higher $PM_{2.5}$ concentrations near communities such as Hamilton or Stevensville with lower $PM_{2.5}$ levels between the communities. Compared to the Bitterroot Valley communities, $PM_{2.5}$ levels were lower in Missoula Valley where more woodstove rules have been enacted.

$PM_{2.5}$ – Seeley Lake

Introduction

Seeley Lake is a small, mountain valley community located north of Missoula in Missoula County, Montana. As is common in rural, forested areas, many residents rely on woodstoves to heat their homes.[3] The Seeley Lake valley, like all valleys in western Montana, is prone to frequent winter temperature inversions that have the potential to trap wood stove smoke near the ground where it poses a threat to human health.

The Department and the Montana DEQ first started measuring fine particulate concentrations in Seeley Lake in 2005. Between 2005 and 2009, 24-hour $PM_{2.5}$ concentrations greater than the daily 2006 National Ambient Air Quality Standard (NAAQS) of 35 $\mu g/m^3$ were measured at the Seeley Lake Fire Hall.

Because the daily $PM_{2.5}$ standard was exceeded between 2005 and 2009 at the fire station monitoring location, a permanent $PM_{2.5}$ monitor for Seeley Lake that met EPA siting criteria was needed. The fire station location was a temporary special project site that did not meet EPA siteing criteria. In 2009 a new continuous $PM_{2.5}$ monitor that met EPA siteing criteria was installed at the Seeley Lake Elementary School fields. The elementary school $PM_{2.5}$ Beta Attenuated Monitor (BAM) is located next to residential areas where many homes are heated with wood-burning appliances. The BAM reports hourly data and provides near-real time air quality information to the Department and the public.

Data collection at the School site started in mid-November 2009. Within a month and half, 19 days had daily $PM_{2.5}$ averages greater than the 24-hour NAAQS of 35 $\mu g/m^3$. Between January 1 and March 18, 2010, 21 days exceeded the $PM_{2.5}$ 24-hour NAAQS. For the 2010-2011 winter (November-March), 53 days with $PM_{2.5}$ concentrations greater than 35 $\mu g/m^3$ were measured and for the 2011-2012 winter season, 57 days with $PM_{2.5}$ concentrations greater than 35 $\mu g/m^3$ were measured.

3 2010 Census reported 45.5% of Seeley Lake homes heat with wood. Propane was the second most commonly used fuel at 30.7%.

In addition to monitoring $PM_{2.5}$ concentrations, Department staff performed several visual smoke assessments in Seeley Lake during the winter of 2009-2010. They observed the thickest smoke near the elementary school and in the neighborhoods immediately south and north of the elementary school site. Visual observations by Missoula City-County Health Department staff in Seeley Lake frequently identified opacity readings of 90-100% from woodstoves. Smoke levels appeared less dense in other parts of the community, including the high school, golf course, intersection of Boy Scout Road and Hwy 83 and the intersection of Morrell Creek Road and Hwy 83 north of the elementary school site.

Chemical mass balance studies in western Montana have shown that woodstoves are the primary source of winter $PM_{2.5}$ air pollution[4]. Based on these chemical mass balance studies and visual observations, wood stoves have the most persistent negative impact on public health in Seeley Lake. The Seeley Lake Community Council, citizens of Seeley Lake, and the Missoula City-County Health Department are looking at ways to reduce wood smoke pollution in the Seeley Lake area. A "How You Burn Makes a Difference" pamphlet has been widely distributed in Seeley Lake through the school system and with the local newspaper, The Pathfinder.

To reduce smoke emissions from wood stoves, solutions will need to take into account several factors.

1. Natural gas is not available for home heating in the Seeley Lake area. More expensive sources of fuel for heat, such as propane and electricity, are available.
2. Wood is readily available in this forested area and often the cheapest choice of fuel for space heating.
3. Many Seeley Lake residents would have a financially difficult time changing from wood to a different heating fuel or different heating appliance.
4. While a switch to all pellet stove heat would solve the winter air quality pollution problem, there is widespread resistance in Seeley Lake to using a manufactured pellet fuel that costs money when wood is cheap and readily available. Many people prefer using wood stoves, which they are familiar with. They also feel wood stoves are less complicated and more reliable than pellet stoves and that a wood stove will work even during a power outage.
5. Replacing most of the old wood stoves with cleaner and more efficient wood stoves is only be part of the solution. To reduce smoke pollution below the daily $PM_{2.5}$ standard near the Seeley Lake Elementary School where the concentration of wood stoves is the highest, an on-going educational effort on how to burn cleanly and the use of dry fuel will also be needed.

To get Seeley Lake smoke pollution levels in compliance with the daily $PM_{2.5}$ national ambient air quality standard, wood burning methods will need to change. Eventually, the community will need to have expectations that wood chimney emissions should be barely visible and 100% opacity is not acceptable.

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4 Ward, T.J., Lange, T., 2010. The impact of wood smoke on ambient PM2.5 in northern Rocky Mountain valley communities. Environmental Pollution 158 (2010) 723–729.

Seeley Lake Winter 2010-2011 $PM_{2.5}$ Saturation Study

To analyze the distribution of $PM_{2.5}$ throughout the Seeley Lake Community, a $PM_{2.5}$ saturation study was performed from October 1, 2010, through March 31, 2011. Table 6 shows the number of days $PM_{2.5}$ concentrations exceeded the 24-hour NAAQS of 35 µg/m^3 at each site. The permanent monitor at the School exceeded the 24-hour $PM_{2.5}$ standard 50 times, more than any other location.

Table 6. Number of Days with 24-Hour $PM_{2.5}$ Values > 35 µg/m^3 by Site for 2010-2011 Saturation Study

	Forest Service	Barn	Airport	Boy Scout Rd.	Dogtown South of Pyramid	Juniper & Alder	School
October	0	0	0	0	No Data*	0	0
November	1	1	0	3	5	8	8
December	1	1	1	3	7	9	19
January	0	0	0	1	1	9	13
February	0	0	0	0	2	6	7
March	0	0	0	0	0	2	3
Total	**2**	**2**	**1**	**7**	**15**	**34**	**50**

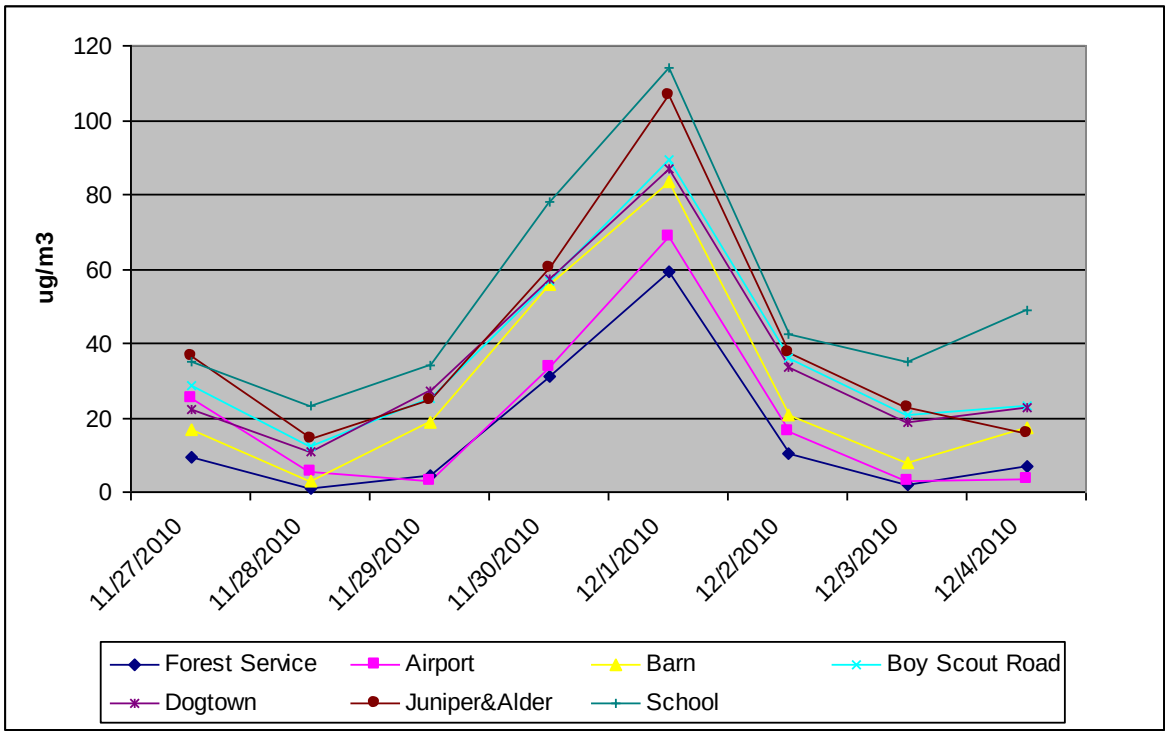
* There is no October data for location south of Pyramid Mountain Lumber because the monitor was not set up until November.

All the residential sites on the valley floor (Boy Scout Road, DogTown, Juniper & Alder and the School) had multiple days with $PM_{2.5}$ averages greater than 35 µg/m^3. While $PM_{2.5}$ values rose and fell together throughout the study area, the residential sites had consistently greater $PM_{2.5}$ concentrations.

The study results show that high $PM_{2.5}$ concentrations in the winter are a residential neighborhood affect and the regional air quality is typically good. The hourly data indicates that air pollution clears out most afternoons in the Seeley air shed; this prevents the multi-day $PM_{2.5}$ buildup which can create valley wide high $PM_{2.5}$ concentrations common in many valleys of western Montana. In fact, the north and south sites at the Forest Service and the Barn had no daily $PM_{2.5}$ concentrations over the 24-hour NAAQS from residential wood stove burning. But on November 30 and December 1, outdoor burning caused $PM_{2.5}$ to greatly exceed the 24-hour NAAQS at all the sites.

On November 30, 2010, outdoor burning was closed below 4800 feet in the Seeley Lake area because of poor dispersion conditions. Even with the outdoor burning closure, several people in the Seeley Lake Valley floor chose to burn on November 30, the last day of the outdoor burning season. Graph 2 shows that the illegal burns caused elevated levels of $PM_{2.5}$ at every study monitoring site for November 30 and December 1. Smoke ($PM_{2.5}$) from the fires was trapped in the valley through December 1.

Graph 2. Illegal Outdoor Burn Impacts
November 30, 2012



With outdoor burning closed, the Forest Service, Airport and Barn sites had levels of $PM_{2.5}$ below 35 µg/m^3 throughout the winter, while the sites in the residential zones frequently had $PM_{2.5}$ concentrations over 35 µg/m^3. Based on the $PM_{2.5}$ data and outdoor burning information, it is clear that the November 30 and December 1 high $PM_{2.5}$ concentrations were primarily caused by outdoor burning.

High daily $PM_{2.5}$ readings in Seeley Lake are caused by wildfires, outdoor burning and residential wood smoke. Since western Montana has a naturally occurring wildfire regime, it is impossible to totally eliminate smoke events from wildfires. The November 30th, 2010, outdoor burning smoke episode shows that an active outdoor burn program, with an education and enforcement component on appropriate burn times, will need to continue if severe impacts from outdoor burning are to be eliminated.

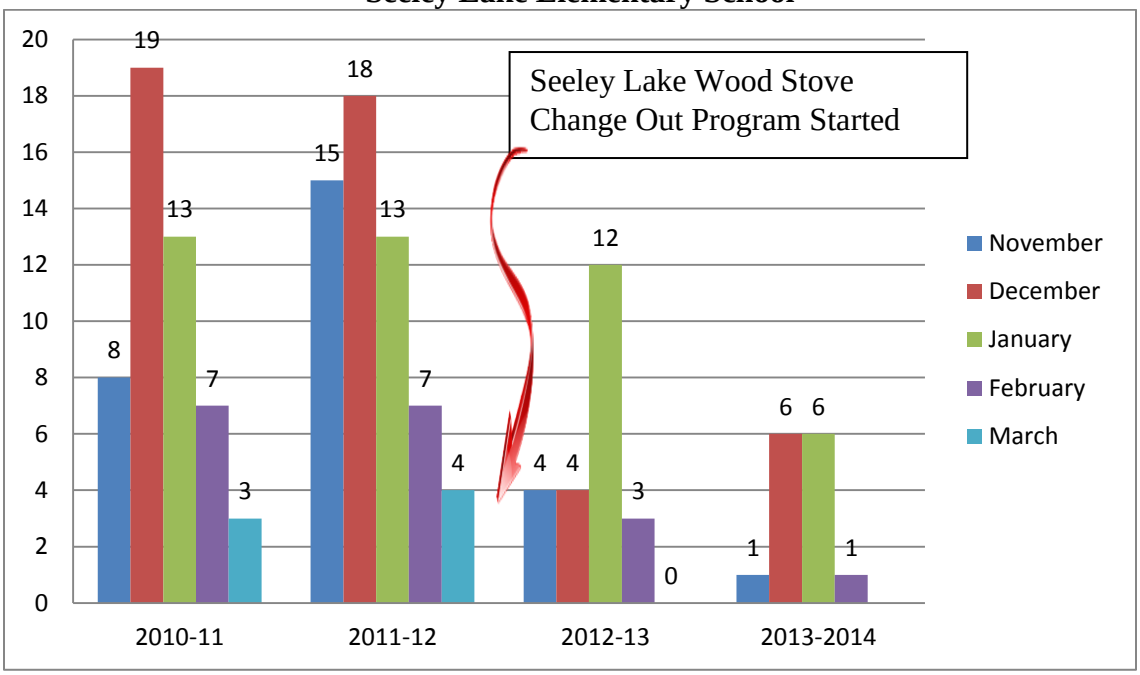
Seeley Lake Wood Stove Change Out Program: 2012 - 2014

In 2012 Missoula County received a grant from the United States Forest Service through Glacierland RC&D to remove older wood burning appliances in Seeley Lake and replace them with efficient cleaner burning EPA certified wood stoves and pellet stoves. By November 1, 2012, a total of 59 stove replacement permits had been awarded for the neighborhoods next to the Seeley Lake Elementary School. By December 31, 2013, 164

older appliances had been changed out for new EPA certified wood and pellet stoves through out the Seeley Lake Community.

Graphs 3 and 4 show that each winter month and the winter seasons as a whole have greatly improved air quality since the wood stove change out program started. Based on visual observations, most parts of the community now appear to meet the 24-hour $PM_{2.5}$ standard. However, the high concentration of stoves in the School neighborhood makes that specific area in need of further improvements.

Graph 3: Number of 24-Hour $PM_{2.5}$ Values Over 35 µg/m^3 by Month at the Seeley Lake Elementary School



In Graph 3 you can see that the month of January, 2013, had several days over 35 µg/m^3. A strong high pressure ridge with very stagnant dispersion conditions affected all of western Montana for over a week that January. The last winter with this strong and long lasting of a high pressure ridge that created very poor dispersion was the winter of 2004-2005. That the 2013 January was not significantly worse than the 2011 and 2012 Januarys was a great sign that the wood stove change out program was improving air quality in Seeley Lake. January 2014 had only 6 days over 35 µg/m^3; the fewest January days over the standard since monitoring started at the school.

To further improve winter air quality in the school neighborhood, educational efforts on how to burn cleanly need to continue and other strategies such as the use of manufactured fuel as a supplement to regular wood in December and January need to be considered.

Graph 4: Number of 24-Hour $PM_{2.5}$ Values Over 35 µg/m^3 by Winter Season (November – March) at the Seeley Lake Elementary School

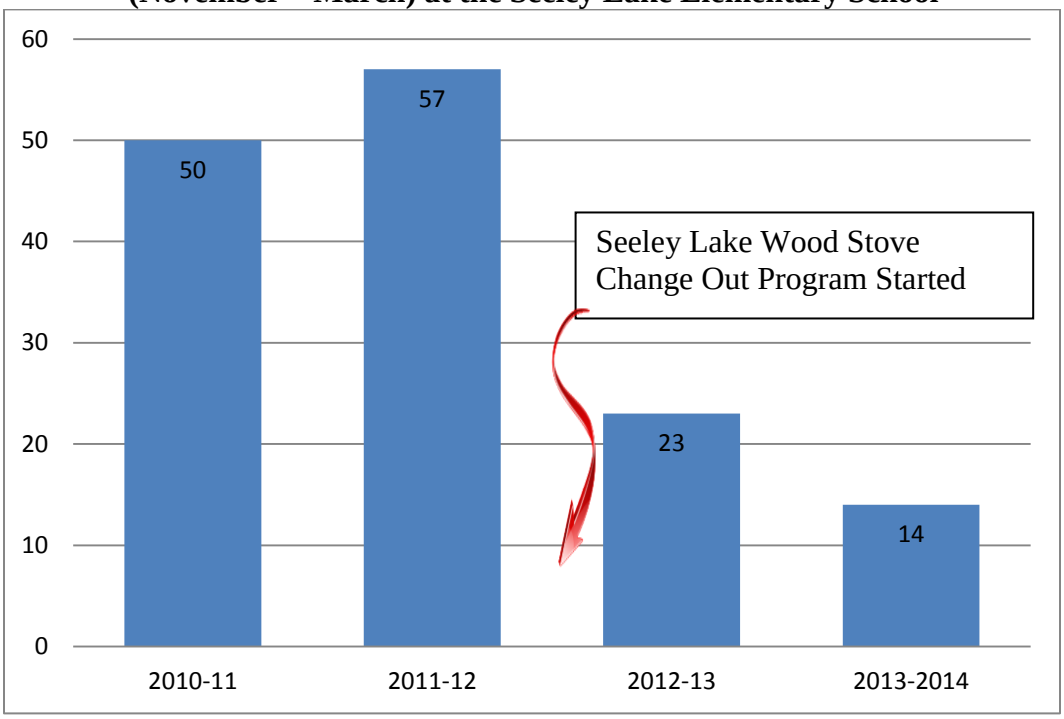


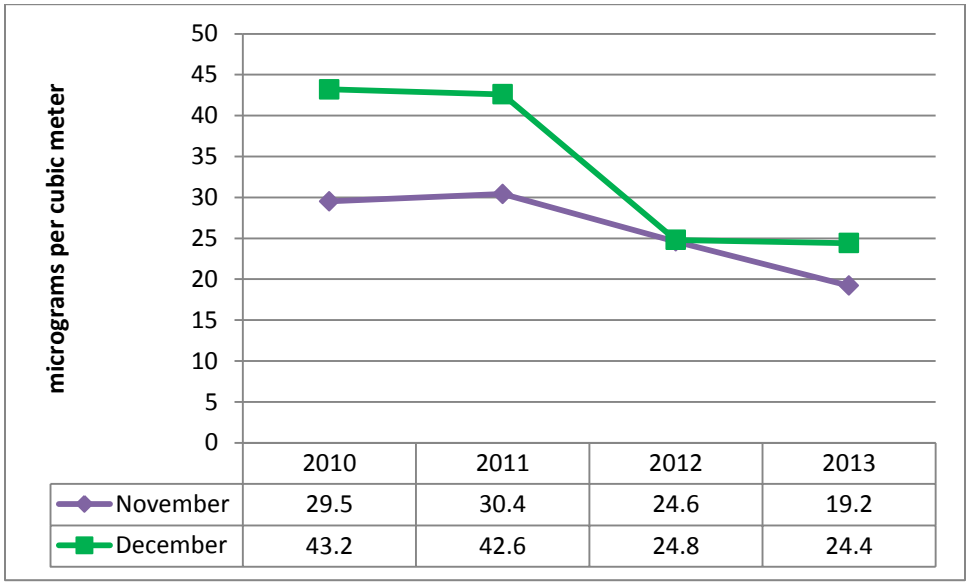
Table 7 below list Seeley Lake's 5 highest $PM_{2.5}$ days for each year. Except for the November 30 and December 1, 2010 outdoor burning impact days, the highest $PM_{2.5}$ values occurred when wood stoves were the primary source of air pollution. The 2013 high value days show that when strong inversions and poor dispersion sets in, Seeley Lake still has daily $PM_{2.5}$ values over the of 35 μg/m^3 standard.

Table 7. Seeley Lake High Daily $PM_{2.5}$ Values – Elementary School Site

2010		2011		2012		2013	
Date	**µg/m^3**	**Date**	**µg/m^3**	**Date**	**µg/m^3**	**Date**	**µg/m^3**
12/1	114	**12/22**	67.9	**1/24**	67.4	**1/19**	79.3
11/30	78	**12/23**	64	**12/21**	64	**1/21**	65.8
12/24	64	**1/1**	60.5	**1/4**	61.7	**1/22**	62.5
1/7	64	**12/7**	60.3	**12/22**	59.2	**1/16**	60.2
12/11	59.2	**12/11**	59.7	**2/4**	57.2	**1/23**	57

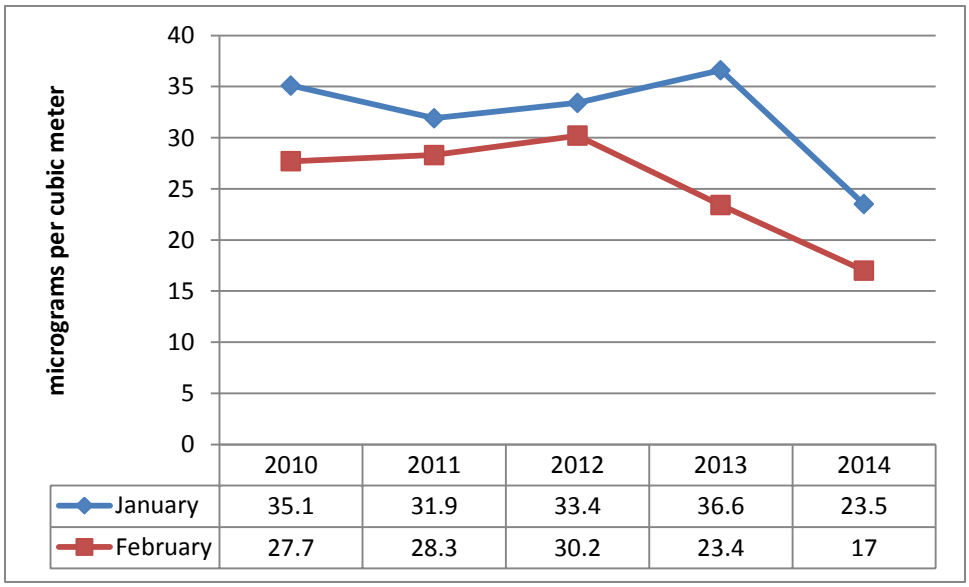
Comparing the monthly average $PM_{2.5}$ values, see Graphs 5 and 6, is another way to gauge the air quality trends. The stove change out program has clearly improved air quality in Seeley Lake.

Graph 5: Average November and December $PM_{2.5}$ Concentrations Seeley Lake Elementary School



	2010	2011	2012	2013
November	29.5	30.4	24.6	19.2
December	43.2	42.6	24.8	24.4

Graph 6: Average January and February $PM_{2.5}$ Concentrations Seeley Lake Elementary School



	2010	2011	2012	2013	2014
January	35.1	31.9	33.4	36.6	23.5
February	27.7	28.3	30.2	23.4	17