Oakridge-Westfir $PM_{2.5}$ Updated Attainment Plan

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EXECUTIVE SUMMARY

The Oakridge community in Lane County, Oregon, has steadily improved air quality over the past 25 years. This Oakridge-Westfir $PM_{2.5}$ Updated Attainment Plan outlines the work by the community from 2014-2016 to complete the attainment of current national health standards adopted in 2006 (24-hour) and 2012 (annual), and to ensure continued attainment of those standards in future years.

Oakridge is a forest-oriented community (population 3,240 as of July 2015) in a valley of the Middle Fork Willamette River in the foothills of the Cascade Mountains about 45 miles southeast of Eugene-Springfield. Many of the homes are heated by wood as the primary or secondary heat source, or even sole source in some cases. As a result, the major contributor to the historical particulate air pollution has been home wood heating, especially on stagnant winter days when temperature inversions form over the small valley.

The Lane Regional Air Protection Agency (LRAPA) has been monitoring in Oakridge for inhalable particulate matter (PM_{10} – particles 10 microns and smaller) since 1988 and for respirable particulate matter ($PM_{2.5}$ – particles 2.5 microns and smaller) since 1999.

The U.S. Environmental Protection Agency (EPA) designated Oakridge as a moderate PM_{10} nonattainment area in 1994. The Oakridge PM_{10} attainment strategy was adopted by the City of Oakridge, LRAPA, and the Oregon Environmental Quality Commission (EQC) in 1996 and submitted to EPA as part of the State Implementation Plan (SIP). EPA approved the plan in 1999. The Oakridge PM_{10} strategy focused primarily on control of residential wood combustion. The attainment strategy was successful in achieving the PM_{10} standards in Oakridge on schedule. In 2001, EPA published a finding of attainment for the Oakridge PM_{10} area.

The 1996 Oakridge PM_{10} attainment plan was successful in not only meeting the PM_{10} standards on schedule, but also meeting the initial national $PM_{2.5}$ standard of 65 micrograms per cubic meter ($\mu g/m^3$) adopted by EPA in 1997. Therefore, a separate Oakridge $PM_{2.5}$ strategy was not required at that time. In 1997, EPA adopted an annual average $PM_{2.5}$ standard of 15 $\mu g/m^3$, and tightened that annual standard to 12 $\mu g/m^3$ in 2012. The Oakridge area has met the 12 $\mu g/m^3$ annual average PM_{10} standard since 2006 as a by-product of the strategies to meet the 24-hour PM_{10} and $PM_{2.5}$ standards.

However, subsequent national health studies supported a more protective 24-hour national $PM_{2.5}$ health standard, and EPA adopted the 35 $\mu g/m^3$ standard in 2006. Between 2006 and 2011, $PM_{2.5}$ concentrations in Oakridge on worst winter days continually violated the new 24-hour national health standard.

In 2012, the City of Oakridge, LRAPA, and Oregon EQC developed and submitted to the EPA a $PM_{2.5}$ SIP submittal. This past plan identified the dominant source of $PM_{2.5}$ in Oakridge on the problem winter days as residential wood combustion (RWC) in woodstoves and fireplaces. This

was determined by $PM_{2.5}$ emission inventories, chemical speciation of particulate filter samples, and diurnal $PM_{2.5}$ concentration fluctuations. Therefore, the strategies in the 2012 $PM_{2.5}$ SIP submittal focused primarily on RWC emission reductions, as did the previous PM_{10} strategy.

The abovementioned strategies included: woodstove change outs; a mandatory curtailment program; removal of uncertified woodstoves at the time of home sale; and a 40% opacity limit on residential chimneys. However, these strategies proved to be not enough to reach the attainment status. Colder than normal winters with inclement weather conditions proved to be a real challenge that ramped up the use of wood heating in Oakridge. Limitations on woodstove change out requirements prevented many rentals from benefiting from the program. A lack of dedicated code enforcement officer and not enough EPA method 9 smoke reading trained police officers led to limited enforcement and education of the curtailment program. Furthermore, the absence of a dedicated workgroup also made communication between LRAPA and the City more challenging.

Conditions were slowly improving but by October 2014, it became clear that the standards would likely not be met by the Clean Air Act deadline.

The particulate concentrations measured in Oakridge for the calendar year 2015 and the three-year period 2013-2015 were the lowest measured in the 25 years of monitoring in Oakridge. However, the 3-year 98^{th} percentile value of 37 $\mu g/m^3$ did not meet the 35 $\mu g/m^3$ national $PM_{2.5}$ standard by December 31, 2015 as required by the federal Clean Air Act. Therefore, the City of Oakridge and LRAPA triggered the contingency plan portion of the 2012 $PM_{2.5}$ SIP submittal and initiated monthly meetings with the other Oakridge stakeholders. These meetings sought to revisit the past plan's strategies and implement the triggered contingency measures to ensure attainment of standards as soon as possible.

The federal Clean Air Act gives the EPA Administrator discretionary authority to grant a 1-year extension to the attainment date for moderate nonattainment areas such as Oakridge. Two criteria are required to be met: first, the community must have implemented all of the control strategies promised in the previous attainment plan; second, the 98^{th} percentile $PM_{2.5}$ concentration in the community in the extension year has to be less than or equal to the 35 $\mu g/m^3$ standard. In Oakridge, the community implemented all of the control strategies promised in the 2012 attainment plan. In addition, their 98^{th} percentile $PM_{2.5}$ concentration in 2015 was 28.9 $\mu g/m^3$, which is less than the 35 $\mu g/m^3$ standard. Therefore, on December 14, 2015, the City of Oakridge, LRAPA, and the Oregon Department of Environmental Quality (ODEQ) jointly requested and was granted a 1-year attainment date extension to December 31, 2016.

Oakridge and LRAPA are confident that the strategies currently being implemented will be adequate to fully meet the national 24-hour $PM_{2.5}$ health standards by December 31, 2016, and in subsequent years. To illustrate, the 1999-2015 $PM_{2.5}$ trends indicate:

- Worst-day $PM_{2.5}$ concentrations (i.e., the 98^{th} percentile design values) in Oakridge improved an average 1.5 $\mu g/m^3$ per year compared to an average annual improvement

of 0.8 µg/m^3 at the non-Oakridge monitoring sites (i.e., areas not affected by the Oakridge-specific strategies) in Lane County.

- Using the worst-day $PM_{2.5}$ concentrations at the non-Oakridge sites as a reference, it appears that meteorological conditions in 2012-2014 and 2013-2015 were more adverse than average (and similarly, the conditions in 2009-2011 and 2010-2012 were better than average).
- Annual average $PM_{2.5}$ concentrations in Oakridge improved an average 0.4 µg/m^3 per year compared to an average annual improvement of 0.2 µg/m^3 at the non-Oakridge monitoring sites in Lane County.
- In Oakridge, most of the improvement in the $PM_{2.5}$ annual average was in November-February (0.6 µg/m^3 per year improvement in the seasonal average) when the RWC strategies were most effective, compared to 0.2 µg/m^3 per year improvement the rest of the year (March-October) when the RWC strategies were less applicable.

On May 18, 2016, EPA proposed approval of the 1-year extension of the Oakridge attainment date to meet the 24-hour $PM_{2.5}$ standard from December 31, 2015 to December 31, 2016 on the basis that the Clean Air Act criteria for such an extension had been met. On July 18, 2016, EPA finalized its extension decision effective August 17, 2016.

This Oakridge-Westfir $PM_{2.5}$ Updated Attainment Plan includes contingency strategies to be implemented if standards are not achieved on schedule, quantitative milestones to be achieved during implementation of the attainment plan, and the process for determining reasonable further progress in future years. The Oakridge $PM_{2.5}$ concentrations measured thus far in 2016 are similar to the record low Oakridge $PM_{2.5}$ concentrations measured in 2015, further strengthening our confidence that the 24-hour $PM_{2.5}$ health standards will be fully achieved by December 31, 2016. During 2016, the City of Oakridge and LRAPA intend to document the adequacy of the new aggressive control measures implemented since October 2014 and to record the additional air quality data needed to demonstrate full attainment of $PM_{2.5}$ standards.

INTRODUCTION

Background

This plan addresses the 24-hour and the annual ambient air quality standards for $PM_{2.5}$ as adopted by the EPA after consultation with the Clean Air Scientific Advisory Committee (CASAC), a group of non-EPA scientists and medical professionals established by Congress.

In 1997, EPA adopted a daily (24-hr) $PM_{2.5}$ standard of 65 $\mu g/m^3$ and an annual $PM_{2.5}$ standard of 15 $\mu g/m^3$. However, subsequent national health studies supported more protective $PM_{2.5}$ health standards, and EPA adopted a 35 $\mu g/m^3$ 24-hour $PM_{2.5}$ standard in 2006 and a 12 $\mu g/m^3$annual $PM_{2.5}$ standard in 2012.

Areas in violation of either of the $PM_{2.5}$ standards (based on the most recent three years of federal reference monitoring data) are designated as a "nonattainment area" by the EPA. Oakridge, Oregon, has been designated as nonattainment for the daily $PM_{2.5}$ standard. The Lane Regional Air Protection Agency (LRAPA) and the City of Oakridge must develop an attainment plan that will bring air quality in Oakridge into compliance with the standard for approval by the Oregon Environmental Quality Commission (EQC) and EPA. The initial attainment plan was prepared and submitted to EPA in December 2012 but the 24-hour $PM_{2.5}$ standard was not achieved by December 31, 2015 as required by the federal Clean Air Act, so a 1-year extension request was submitted on December 14, 2015.

What is $PM_{2.5}$?

Particulate matter (PM) is the general term used for a mixture of solid particles or liquid droplets found in the air. Some particles are large or dark enough to be seen as soot or smoke. Others are so small they can be detected only with an electron microscope. These particles come in a wide range of sizes ("fine" or "respirable" particles are less than 2.5 micrometers in diameter and coarser-sized particles are larger than 2.5 micrometers), and originate from many different sources. Fine particles ($PM_{2.5}$) generally result from fuel combustion from residential fireplaces and woodstoves, pile and forest burning, industrial facilities, and motor vehicles. Coarse particles (PM_{10} and larger) are generally emitted from sources such as vehicles traveling on paved and unpaved roads, materials handling, and wood products operations, as well as wind-blown dust.

These particles can accumulate in the respiratory system and are associated with numerous negative health effects. Fine particles are most closely associated with such health effects as increased hospital admissions and emergency room visits for heart and lung disease, increased respiratory symptoms and disease, decreased lung function and premature death. Sensitive groups that are at greatest risk include the elderly, pregnant women, individuals with cardiopulmonary disease such as asthma, and children.

National Ambient Air Quality Standards for $PM_{2.5}$

EPA has established National Ambient Air Quality Standards (NAAQS) for $PM_{2.5}$ at 35 micrograms per cubic meter ($\mu g/m^3$) for a daily (24-hour) standard and 12 $\mu g/m^3$ as an annual standard. Any value monitored above these levels, as defined by federal rules and guidance, is

considered an exceedance. EPA uses the 98th percentile of the 24-hr $PM_{2.5}$ within any given year and averages it over three calendar years. An exceedance of the average 98th percentile over three years greater than 35 µg/m^3 is considered a violation. An exceedance of the annual standard averaged over three years becomes a violation of the annual standard. If an area violates either standard, EPA designates it as a nonattainment area. This plan includes a demonstration of continuing attainment with both standards in Oakridge.

Purpose of Attainment Plan

This document provides a pathway for continued improvement to reduce particulate emissions and to return the Oakridge Nonattainment Area to attainment for $PM_{2.5}$ (state classification will be "maintenance") by achieving the more protective national health standards adopted in 2006 and 2012. It is a plan to ensure Oakridge meets the 24-hour and annual National Ambient Air Quality Standards for $PM_{2.5}$ and maintains the annual standard for $PM_{2.5}$. This document complies with the applicable 1990 Federal Clean Air Act requirements and EPA guidance and policies. The attainment plan provides strategies to meet the $PM_{2.5}$ standards by 2016 and provides contingency measures should Oakridge not meet the deadline. To demonstrate "attainment" requires the collection of representative monitoring data using approved measuring instruments and procedures, with adequate quality assurance. EPA will review the plan to determine if it is approvable and publish its findings in the Federal Register. Redesignation back to attainment is possible only after Oakridge meets the standards for three consecutive years and a maintenance plan is drafted, adopted by the LRAPA Board of Directors, the EQC and approved by EPA.

Oakridge Area Description

Oakridge lies in an alluvial plain in the foothills at the southern end of the Willamette River valley. The city is in Lane County, Oregon, approximately 45 miles east-southeast of Eugene, and 28 miles west of Willamette Pass, a summit of the Cascade Mountain Range. The city limits of present-day Oakridge include the historic City of Oakridge and, directly west, the area formerly known as Willamette City. Figure 1 shows the location of Oakridge in Lane County.

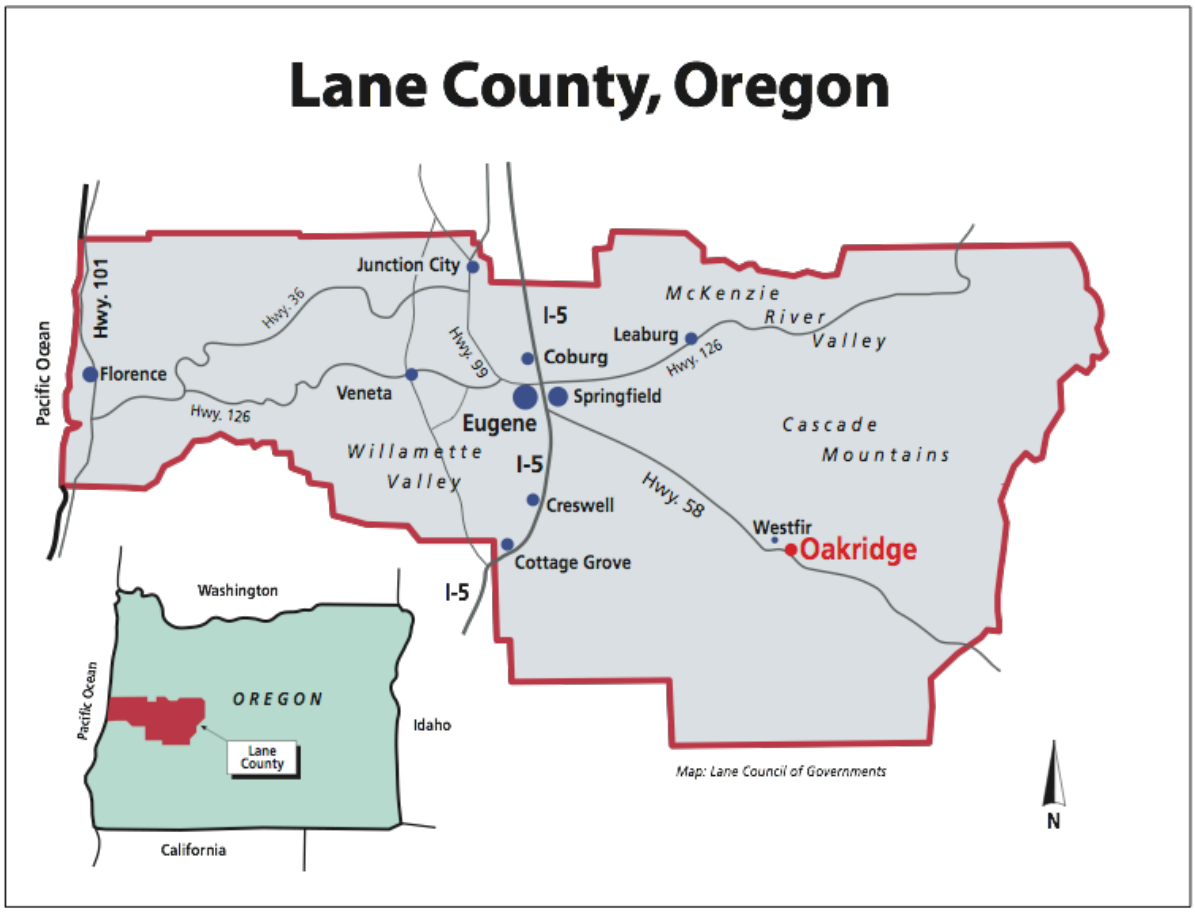

Figure 1: Oakridge Location in Lane County and Oregon.

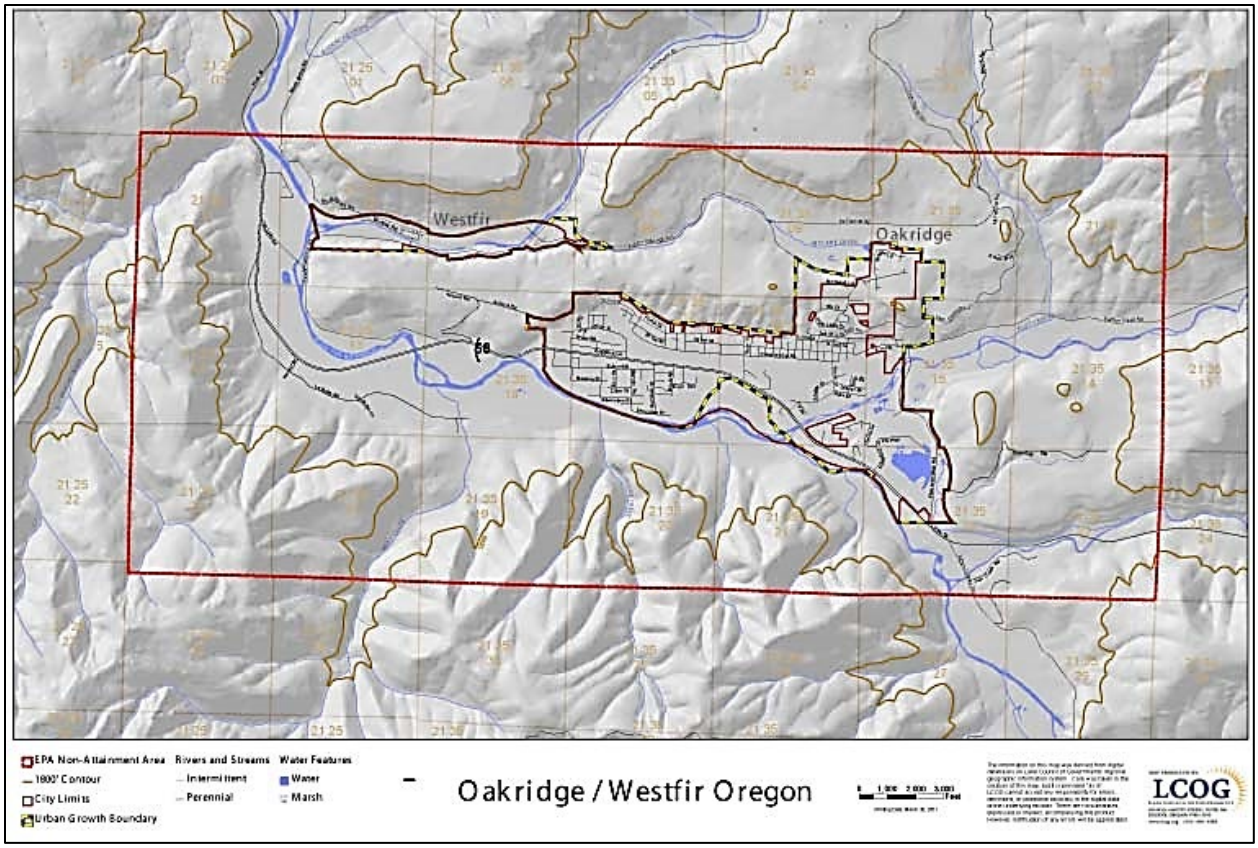

Figure 2: Nonattainment Area Boundary map.

The area of applicability for this attainment plan includes an area that contains the City of Oakridge and the small town of Westfir. Figure 2 shows the Oakridge non-attainment area.

The City of Oakridge is situated in a valley oriented east to west, where the middle fork of the Willamette River flows. Elevation of the area ranges from 1100 feet at the lower (west) end to 1600 feet with areas of densest population situated between 1100 feet and 1200 feet. Mountains rise on the north and south sides to 1700 feet and 1600 feet, respectively.

Westfir is a very small (population 255 as of July 2015) isolated rural mountain community that is located along the north fork of the Willamette River about 1 mile NW of Oakridge. Its elevation is about the same as Oakridge and it is surrounded by the same high mountains. Westfir and Oakridge are in opposite steep sided river valleys separated by a 400-foot ridge. The Westfir valley is very narrow, only about 1/4 mile across at its widest point, while the Oakridge valley is about 1 mile across at its widest point.

Air Quality Monitoring

The Oakridge air monitoring station (Site Code WAC, AQS #410392013) has been located at the Willamette Activity Center (WAC) in the southwest portion of the city of Oakridge since 1989. Saturation monitoring studies in 1991 and 1994 (PM_{10}) and 2002-2003 ($PM_{2.5}$) demonstrated the monitor is located in the area of maximum emissions and PM concentrations. The WAC station is part of the SLAMS (State and Local Air Monitoring Stations) network and meets all siting requirements and criteria for the monitoring objective of maximum population exposure at the neighborhood spatial scale.

The WAC sampling method for $PM_{2.5}$ is the filter-based Federal Reference Method (FRM) operating on an every-3rd-day schedule. Other parameters measured at the WAC station include:

- PM_{10} (filter-based FRM on an every-6th-day operating schedule),
- $PM_{2.5}$ with Federal Equivalent Method (continuous beta attenuation),
- Nephelometer (continuous optical backscatter),
- Wind Speed and Direction (continuous propeller/vane),
- Temperature (continuous thermistor at 2 meters and 10 meters height),
- Barometric Pressure (continuous electronic barometer), and
- Solar Radiation (continuous pyranometer).

Additional details, photos, and maps are included in the annual LRAPA Ambient Air Monitoring Network Plan; Figures 3a and 3b are taken from that Network Plan.

Figure 3a: Oakridge WAC Air Monitoring Station.

Figure 3b: WAC Station Location.

Quality-assured data is submitted quarterly by LRAPA to ODEQ and EPA within 60 days of the end of each calendar quarter.

History of Efforts to Address Particulate Matter in Oakridge

The air quality in Oakridge has steadily improved over the past 25 years with comprehensive strategies to reduce the measured concentrations of particulate matter and to address the adoption of progressively more protective national air quality health standards.

The Oakridge Urban Growth Boundary (UGB) was designated nonattainment for PM_{10} and classified as moderate by EPA on January 20, 1994. LRAPA submitted a draft Oakridge PM_{10} attainment plan to EPA Region 10 for stringency review during early 1996. The Oakridge PM_{10} attainment plan was adopted by the LRAPA Board of Directors at a hearing on August 13, 1996. The Oakridge PM_{10} attainment plan was subsequently adopted by the EQC on December 9, 1996, and submitted to EPA. EPA approved the plan on March 15, 1999 (64 FR 12751). The plan relied on control strategies needed to assure attainment of the PM_{10} National Ambient Air Quality Standards (NAAQS). The strategy focused on control of RWC and road dust. Additional reductions were provided by statewide efforts to reduce slash burning smoke.

These control measures were approved by EPA, effective May 14, 1999:

- Accelerated Woodstove Replacement Program through grants and loans (1993-1994); Aggressive Voluntary Residential Wood Burning Curtailment (1996);
- Letter of Agreement from ODOT , July 29, 1996, Use of Anti-icing Chemicals in the City of Oakridge; and
- Road Paving Program (1991-1995).

EPA also approved these contingency measures on March 15, 1999 (64 FR 12751), but the Oakridge area achieved the PM_{10} standards on schedule without triggering the contingency measures:

- City Ordinance 815, Mandatory Wood Heating Curtailment Program, adopted August 15, 1996; and
- OAR 340-262-0310 Removal and Destruction of Uncertified stove upon Sale of Home.

The Oakridge PM_{10} strategies were successful in achieving the PM_{10} standards on schedule. On July 26, 2001, EPA published a finding of attainment for the Oakridge PM_{10} area (66 FR 38947). The Oakridge PM_{10} data for 1988-2014 is outlined in Figure 4.

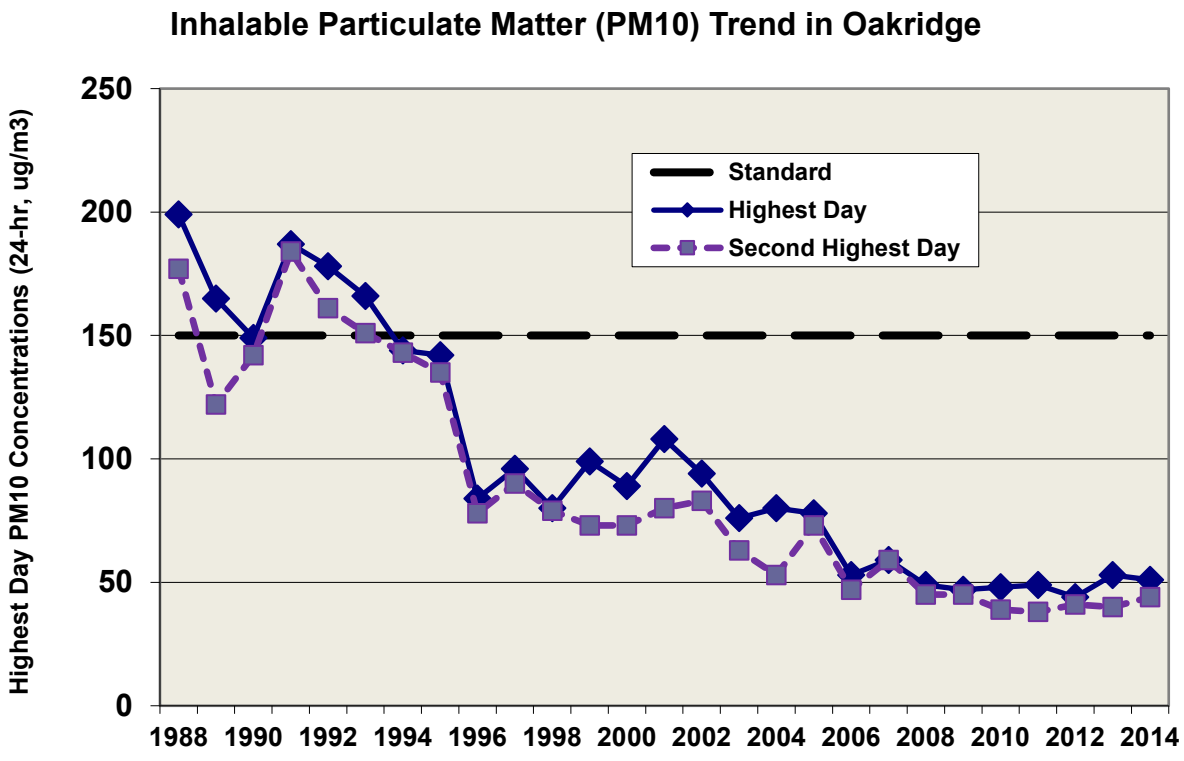

Figure 4: PM_{10} Trend at the Oakridge WAC Monitoring Station.

The 1996 Oakridge PM_{10} attainment plan was successful in not only meeting the PM_{10} standards on schedule, but also meeting the initial national $PM_{2.5}$ standards (65 µg/m^3) adopted by EPA in 1997 as shown in Figure 5.

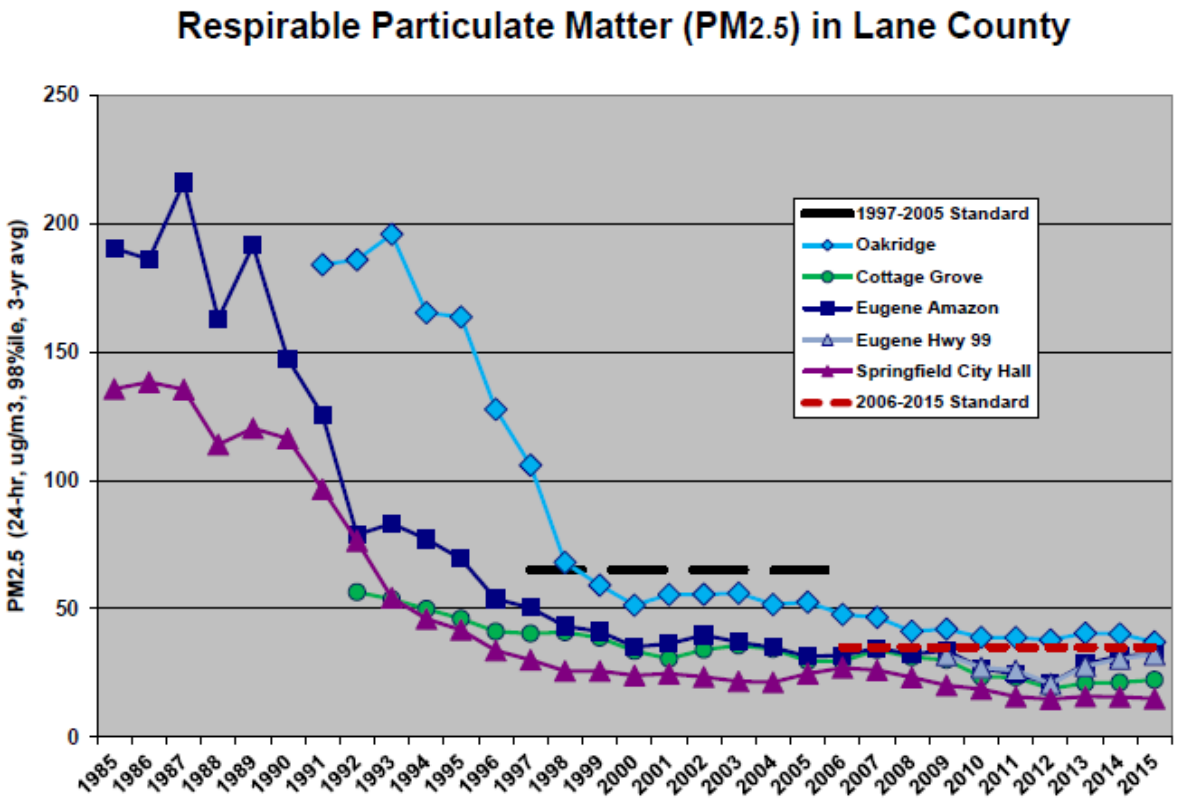

Figure 5: Long-Term $PM_{2.5}$ Trends at the Oakridge and other Lane County Monitoring Stations.

Subsequent national health studies supported a more protective 24-hour national $PM_{2.5}$ health standard, and EPA adopted the 35 µg/m^3 standard in December 2006. Between 2006 and 2011, $PM_{2.5}$ concentrations in Oakridge on worst winter days violated the new 24-hour national health standard. The city of Oakridge, LRAPA, and EQC developed and submitted to the EPA a 2012 $PM_{2.5}$ SIP submittal. The dominant source of $PM_{2.5}$ in Oakridge on the problem winter days was clearly RWC in woodstoves and fireplaces (about 80-88% in the 2008 base year). This is based on $PM_{2.5}$ emission inventories, chemical speciation of particulate filter samples, and diurnal $PM_{2.5}$ concentration fluctuations. Therefore, the new strategies in the 2012 $PM_{2.5}$ SIP submittal focused primarily on RWC emission reductions:

- Woodstove change-out programs;
- Woodstove removal upon sale of home;
- Expanded public education programs;
- Mandatory curtailment program for residential wood burning during periods of air stagnation;
- Enhanced training of police officers on smoke reading for opacity enforcement; and
- Transportation and fuel-related emission reduction programs.

All of these programs are all currently being implemented as committed in the 2012 Oakridge-Westfir $PM_{2.5}$ Attainment Plan. In some cases, the programs are being further strengthened, as discussed under supplemental strategies in the Attainment Plan and Demonstration.

Progress to Meet National Ambient Air Quality Standards (NAAQS)

As mentioned previously, in 2006 and 2012 the EPA revised the $PM_{2.5}$ standards to more accurately reflect the latest health information. EPA revised the 24-hour standard from 65 $\mu g/m^3$ to 35 $\mu g/m^3$ in 2006, and revised the annual standard from 15.0 $\mu g/m^3$ to 12.0 $\mu g/m^3$ in 2012. EPA determines compliance with the $PM_{2.5}$ standards based on averaging air quality measurements both annually and on a 24-hour basis.

Annual $PM_{2.5}$ Standard

The annual standard for $PM_{2.5}$ is met whenever the three-year average of the annual mean $PM_{2.5}$ concentrations for a designated monitor is less than or equal to the standard. Oakridge has met the 1997-2011 annual 15.0 $\mu g/m^3$ standard since $PM_{2.5}$ monitoring started at Willamette Activity Center in 1998, and has met the 2012 annual 12.0 $\mu g/m^3$ standard since 2006. Figure 6 compares the annual average $PM_{2.5}$ in Oakridge to the 1997-2011 and 2012-2016 annual $PM_{2.5}$ standards and to the composite average of the other two long-term monitoring sites (Eugene-Amazon and Springfield-City Hall) in Lane County.

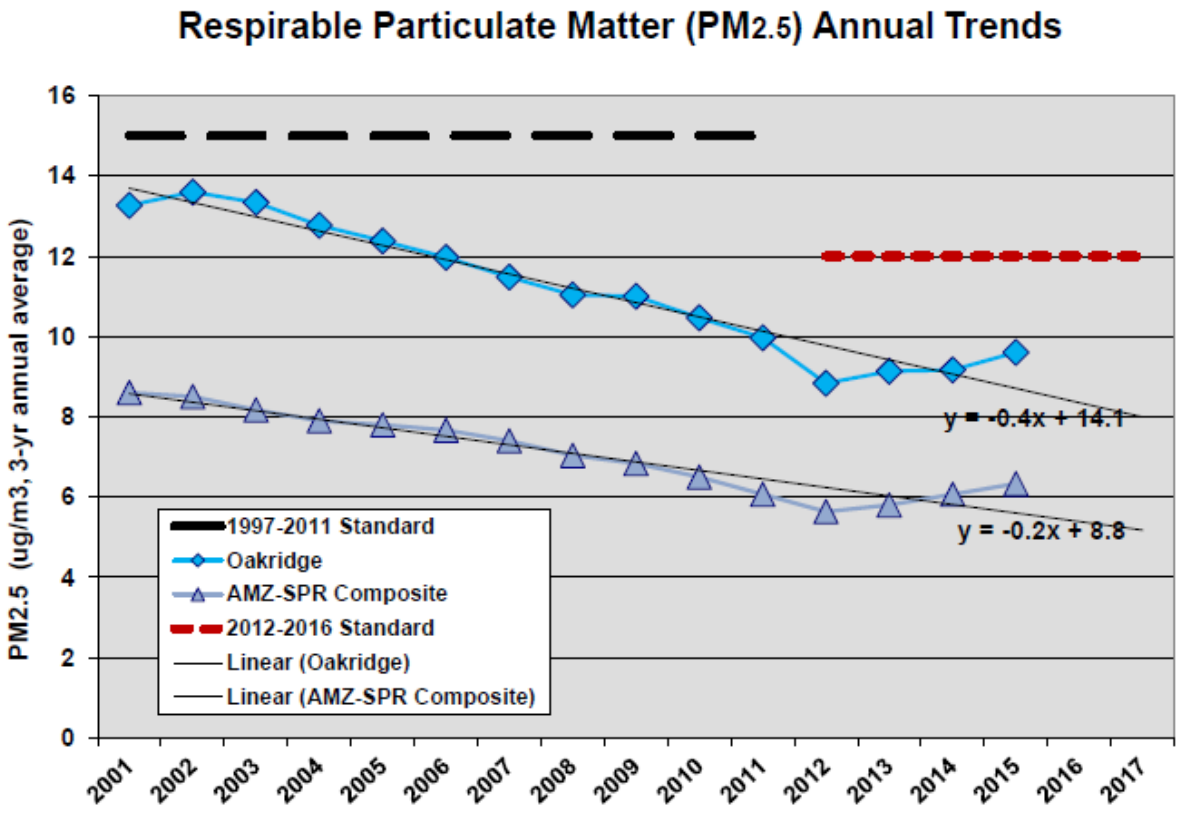

Figure 6: $PM_{2.5}$ Annual Average Trends for Oakridge and Eugene-Springfield.

The trend lines illustrate that the annual average in Oakridge is improving by about 0.4 µg/m^3 per year compared to 0.2 µg/m^3 per year at the composite of the other two long-term Lane County sites. Using the annual $PM_{2.5}$ concentrations at the non-Oakridge sites as a reference, it appears that overall annual average meteorological conditions in 2013-2015 were more adverse than average (and similarly, the conditions in 2010-2012 were better than average). Since all of these monitoring sites are within 40 miles of each other, they would frequently be impacted by the same wildfire events or air stagnation episodes.

24-Hour $PM_{2.5}$ Standard

The 24-hour standard for $PM_{2.5}$ is met whenever the three year average of the annual 98th percentile of values at a monitoring site is less than or equal to 35 µg/m^3. The 98th percentile is a concentration below which 98% of observations fall. This value is used for the 24-hour standard instead of the maximum observation for any given year. By doing so, EPA ensures infrequent peaks are ignored and a more robust value is used for comparison.

From 2001 through 2005, Oakridge was in compliance with the $PM_{2.5}$ standard of 65 µg/m^3. However in 2006, when EPA revised the standard to 35 µg/m^3, Oakridge violated the 24-hour standard. The three year average 98th percentile for the Oakridge monitoring site has continued to violate the 24-hour standard each year since the standard tightened in 2006, but has decreased significantly over the period 2006 - 2015. Figure 7 compares the 98th percentile 24-hour $PM_{2.5}$ in Oakridge to the 1997-2005 and 2006-2016 $PM_{2.5}$ standards and to the composite average of the other two long-term monitoring sites (Eugene-Amazon and Springfield-City Hall) in Lane County.

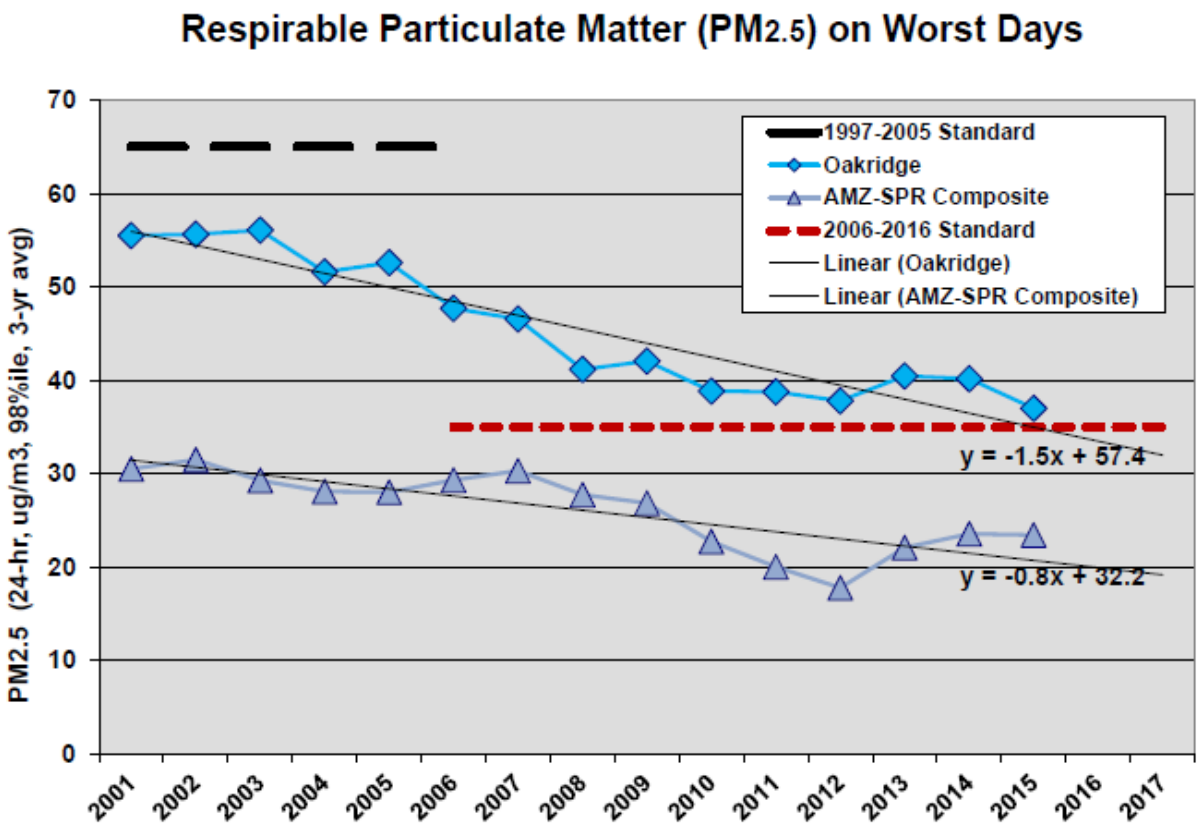

Figure 7: $PM_{2.5}$ Daily 98th Percentile Trends for Oakridge and Eugene-Springfield.

The trend lines illustrate that the 98th percentile in Oakridge is improving by about 1.5 µg/m^3 per year compared to 0.8 µg/m^3 per year at the composite of the other two long-term Lane County sites. Using the worst-day $PM_{2.5}$ concentrations at the non-Oakridge sites as a reference, it appears that meteorological conditions in 2012-2014 and 2013-2015 were more adverse than average (and similarly, the conditions in 2009-2011 and 2010-2012 were better than average). Since all of these monitoring sites are within 40 miles of each other, they would frequently be impacted by the same air stagnation episodes. Wildfire impacts would not be a factor during November-February when the worst-day $PM_{2.5}$ concentrations are measured.

The $PM_{2.5}$ concentrations measured in Oakridge for the calendar year 2015 (28.9 µg/m^3) and the three-year period 2013-2015 (37 µg/m^3) were the lowest measured since $PM_{2.5}$ monitoring began in Oakridge, but the 3-year 98th percentile value of 37 µg/m^3 did not meet the 35 µg/m^3 national $PM_{2.5}$ standard by December 31, 2015 as required by the federal Clean Air Act.

Image 1: EPA and LRAPA Staff at the monitoring station.

Additional Monitoring

In addition to the Oakridge monitoring, investigative monitoring was done during 2009-2010 in the Westfir area to determine $PM_{2.5}$ concentrations there in comparison to the Willamette Activity Center monitor. The results of that investigation were reported in the 2012 Oakridge-Westfir $PM_{2.5}$ Attainment Plan. Westfir $PM_{2.5}$ concentrations were consistently and substantially lower than in Oakridge, supporting the revision of the nonattainment area to the Oakridge Urban Growth Boundary, as was done in the successful 1996 PM_{10} Oakridge Attainment Plan, in order to most effectively focus the limited financial, monitoring and staff resources. This Westfir investigation was augmented by separate LRAPA and ODEQ documentation and analysis to EPA.

ATTAINMENT PLAN AND DEMONSTRATION

Emission Inventory

An emission inventory consists of emission estimates from sources that emit $PM_{2.5}$ within the Oakridge nonattainment area boundary. The emissions inventory data is essential in developing the attainment demonstration, as it helps identify the sources contributing to the air quality problem and the emission reduction strategies, once implemented, that reduce pollution levels below the standard. Sources of $PM_{2.5}$ in Oakridge include minor industry, on-road mobile sources (e.g., car and truck exhaust, road dust), railroads, and area sources (e.g., outdoor burning, woodstoves, and fireplaces).

Base Year Emission Inventory (2008)

The base year emission inventory is used as the starting point for the attainment demonstration. This inventory includes sources in the nonattainment area during the 2008 baseline year.

The 2008 emission inventory is summarized in Table 1 and Figure 8. The calculation procedures are included in Appendix D of the 2012 Oakridge-Westfir $PM_{2.5}$ Attainment Plan, except for the on-road emissions which were updated during 2016 using the MOVES 2014a model. See Appendix 1 for details of the MOVES 2014a modeling results. The MOVES 2014a results were very similar to the previous MOVES 2010 modeling results for the 2008 base year.

	-- lbs/per day --		Percent of Total NAA Emissions	
	Typical Season Day	Worst-Case Day	Typical Season Day	Worst-Case Day
Permitted Point Sources[1]				
Oakridge Sand & Gravel: Rock crushing operation	0.4	0.8	0.1%	0.1%
Oakridge Sand & Gravel: Cement plant	0.1	0.1	0.0%	0.0%
Stationary Area Sources				
Residential Wood Combustion: Fireplace[2]	38.5	42.3	7%	8%
Residential Wood Combustion: Non-Certified Woodstove/Insert[2]	158.9	174.8	30%	32%
Residential Wood Combustion: Certified Woodstove/Insert[2]	228.0	250.8	43%	45%
Pellet Stoves	6.7	7.4	1%	1%
All Other Stationary Area Sources	47.4	4.7	9%	1%
On-Road Sources				
On-Road: Exhaust, Brake, Tire	29.3	36.9	5%	7%
Re-Entrained Road Dust	12.1	27.8	2%	5%
Nonroad Sources				
Union Pacific Railroad	6.0	6.0	1%	1%
Total, All Sources, lbs/day	**527**	**552**		

(1) Worst-case day = Peak month production/20 workdays.
(2) Worst-case day = Peak Heating Degree Day

Table 1: 2008 Estimated Typical Season Day and Worst-Case Design-Day $PM_{2.5}$ Emissions.

The emissions inventory on worst winter days is of most interest since the $PM_{2.5}$ concentrations measured in Oakridge do not meet the current 24-hour $PM_{2.5}$ standard and the peak $PM_{2.5}$ concentrations occur on cold, stagnant days during the November-February wood-heating season. RWC emissions (from certified and non-certified woodstoves, fireplaces, and pellet stoves) account for about 86% of the emissions on worst winter days, as illustrated in Figure 8.

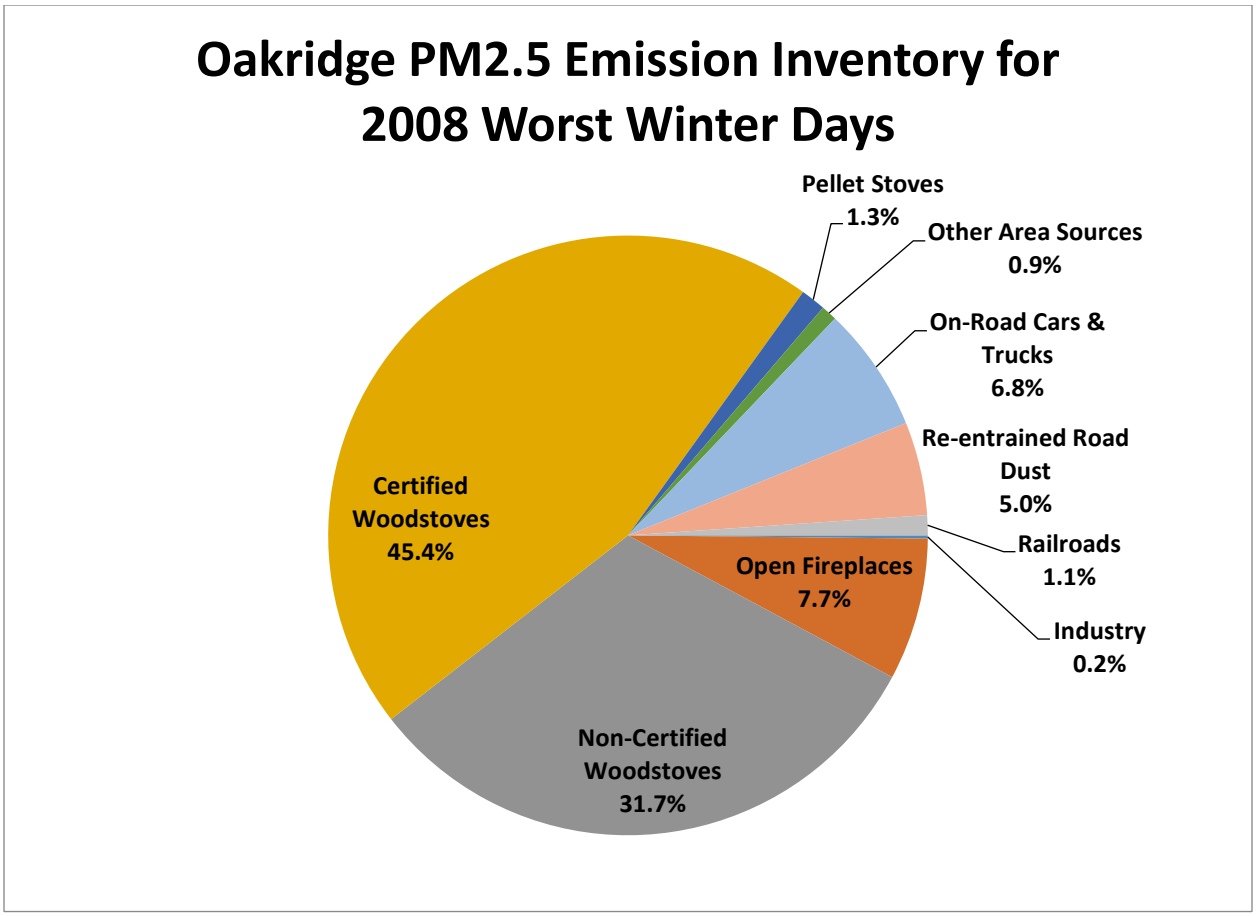

Figure 8: Oakridge $PM_{2.5}$ Emission Inventory for 2008 Worst Winter Days.

Residential Wood Combustion

RWC is a common way to heat homes in Oregon. To estimate emissions from wood burning, LRAPA conducted a survey for the 2009-2010 heating season in Oakridge-Westfir. The survey provided LRAPA with information on how many homes use various types of wood-heating devices, the amount of wood burned, and other information on wood-heating practices.

Mobile and Non-road Sources

Road dust and tailpipe emissions of $PM_{2.5}$ from motor vehicles were calculated by Lane Council of Governments (LCOG) transportation staff by applying emission factors from the EPA MOVES computer program to total vehicle miles traveled in the nonattainment area. Motor vehicle emissions were updated by ODEQ technical services staff in 2016 using the EPA MOVES2014 program. Estimated vehicle miles traveled are from previous transportation modeling by LCOG for the Oregon Department of Transportation. Emissions from railroads were provided by Union Pacific Railroad staff using the EPA NONROAD2008a emissions protocol.

Industrial Point Sources

LRAPA maintains data on industrial point source emissions in Lane County. The only operating industrial point sources within Oakridge-Westfir area are two minor aggregate industry sources operated by Oakridge Sand & Gravel.

Attainment Year Emission Inventory () 2013-2015

The attainment year inventory is an estimation of emissions for the year that the area is expected to have attained the $PM_{2.5}$ standard. It includes projected emissions for the attainment year based on a number of different factors. Growth rates for population, employment, and vehicle miles traveled through 2015 were used to estimate 2014-2016 emissions. LRAPA took credit for emissions reductions as a result of the woodstove replacement project implemented during 2009-2012 that reduced the number of non-certified woodstoves accounted for in the 2008 emission inventory.

The attainment year emission inventory is projected from: the 2008 base-year emissions inventory; estimated growth rates between the 2008 base year and the 2015 attainment year; and the emission reduction strategies that have been implemented during 2009-2014.

The emission reduction strategies include: the continued implementation of control measures that were effective in achieving the PM_{10} standards and the initial (1997) $PM_{2.5}$ standards on schedule; additional and strengthened control measures developed during 2009-2012; the contingency plan triggered in October 2014; and new emission reduction programs developed in 2015.

The critical air pollution control strategies in Oakridge have been of three types: Ongoing, Long-Term, and Short-Term. Ongoing strategies have included education on cleaner-burning practices such as improved firewood seasoning, use of smaller-hotter fires, avoiding the excessive dampering of the woodstove, etc. Long-term strategies have included replacement of older woodstoves with cleaner burning units (newer certified woodstove, pellet stoves, ductless heat pumps, etc.) and overall housing upgrades including weatherization. The key short-term strategy is the green-yellow-red home wood heating advisory program with mandatory curtailment of wood burning during stagnant air episodes.

Details of the ongoing control strategies, strengthened control strategies, and contingency measures were described in the 2012 Oakridge-Westfir $PM_{2.5}$ Attainment Plan and the essential elements are reviewed here.

The dominant source of $PM_{2.5}$ in Oakridge on the problem winter days was clearly RWC in woodstoves and fireplaces, based on $PM_{2.5}$ emission inventories, chemical speciation of particulate filter samples, and diurnal $PM_{2.5}$ concentration fluctuations. Therefore, the new strategies in the 2012 $PM_{2.5}$ SIP submittal focused primarily on RWC emission reductions:

- Woodstove change-out programs;
- Woodstove removal upon sale of home;
- Expanded public education programs;
- Mandatory curtailment program for residential wood burning during periods of air stagnation;
- Enhanced training of police officers on smoke reading for opacity enforcement; and
- Transportation and fuel-related emission reduction programs.

These programs are all currently being implemented and further strengthened as outlined below under the Extension Request and Supplemental Strategies section

Wood Stove Change-out Program: The Warm Homes wood stove change-out program continued into 2009. Funding from EPA helped replace 11 uncertified wood stoves with new heating devices. In October 2010, LRAPA received funds from the American Recovery and Reinvestment Act. LRAPA used the funding to conduct another round of wood stove change-outs in Oakridge and Westfir. The program offered two-tier funding for qualified residents within the non-attainment boundary designated by EPA. Residents who qualified as low income based on Housing and Urban Development's (HUD) income guidelines received a full rebate of up to $5,000 to pay for a ductless heat pump, certified wood stove, or pellet stove. All other qualified applicants received a rebate of up to $2,000 based on emission reductions. The program ended in December 2011. LRAPA provided rebates to replace 79 stoves. Wood heat was most popular; 56 new wood stoves were installed, 10 pellet stoves, and 13 electric ductless systems.

Oakridge Wood Stove Change-out Programs		
Years	2009	2010-11
# of Stoves	11	79

Table 2: Oakridge Wood Change-out Programs (2009/2010-11)

Due to the effectiveness of this strategy in the past, LRAPA will continue pursuing funds for more woodstove change-outs within the nonattainment area. Implementation of this strategy may provide substantial reductions in $PM_{2.5}$ in the future. LRAPA did not apply any emission credit for this strategy to the 2013-2015 inventory,. In the most recent round of wood stove change-outs during 2010-2011, 75% of the participants qualified as low-income. The poor economy in Oakridge makes it essential any future change-out incentives include grants to cover the full cost of replacement for low income individuals and substantial incentives to residents who are not "low income".

Heat Smart: Stove Removal upon Sale of Home: In 2010, a statewide requirement mandating the removal of an uncertified stove at the time of home sale went into effect. This statewide rule closely mirrored the existing requirement in the Oakridge ordinance. Under the rule, all uncertified devices that are on the property being sold (including residences, shops, garages, and outbuildings) must be removed at the time of home sale. The Oregon Heat Smart law requires DEQ to confirm residences where owners removed or changed-out uncertified woodstoves upon home sale. DEQ currently administers the Heat Smart program and tracks submittals of all uncertified removals at the time of home sale. These submittals can be used to estimate the level of compliance in Oakridge and identify any need for additional education or follow-up. DEQ has established in rules, penalties for noncompliance and hopes to conduct periodic enforcement sweeps throughout the state. LRAPA is responsible for Heat Smart implementation in Lane County.

Public Education: LRAPA has maintained a vigorous public education program in Oakridge. In 2009 -2011, the program expanded to reach a wider audience. In 2010, LRAPA produced a television commercial to promote compliance with home wood heating advisories and clean burning practices. The commercial has run every fall on three major television networks; all are available to Oakridge viewers. Radio ads targeting open burning and home wood heating have aired on a network of radio stations in Lane County since 2009. Almost all stations are available in Oakridge.

Articles in the weekly newspaper, the Dead Mountain Echo, serving the Oakridge area have been submitted by LRAPA staff periodically to keep the public informed about poor air quality, LRAPA programs, and other topics related to wood smoke. Display advertisements and fliers inserted into the paper are also used to promote high profile projects, the Warm Homes program being an example. People have also received fliers and articles from LRAPA through the city's water bill mailing list and Lane Electric Co-op's Ruralite magazine.

Every spring, the US Forest Service hosts outdoor school in Oakridge for middle school students. LRAPA attends annually with educational material, presentations, and experiments centered on air quality problems specific to Oakridge.

LRAPA's Public Affairs department has also done several targeted presentations in Oakridge in recent years to publicize the Warm Home Program, elaborate on attainment goals at town hall meetings, and information sessions at the Oakridge Public Library.

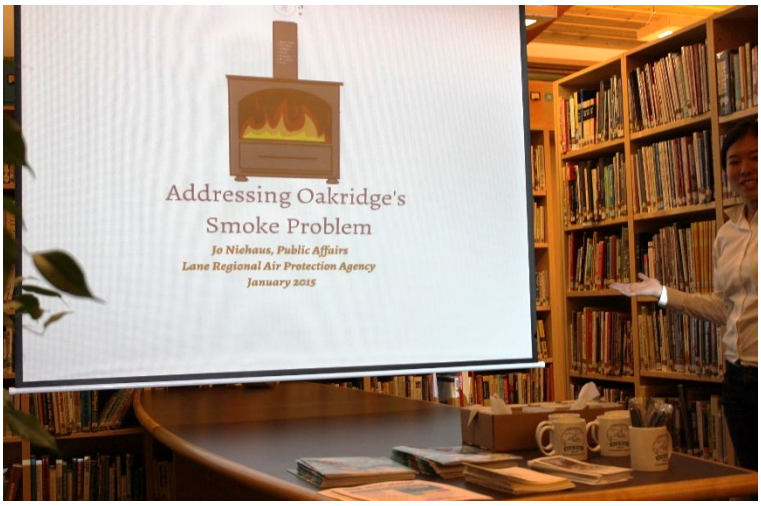

Image 2: Informational session at Oakridge Public Library.

In addition, LRAPA's Public Affairs department has increased access to information about the daily home wood heating advisories and information about burn bans. Residents can find out the daily advisory through an automated phone line, 541-736-HEAT, or go online to the LRAPA website, www.lrapa.org. In 2015, LRAPA activated direct text message and e-mail alerts for burn bans. If people choose to receive messages directly, they can opt in to the LRAPA alert program.

Transportation and Fuel-Related Emissions: Federal, state, and local transportation regulations and programs recently implemented will reduce mobile and non-road emissions. These include:

- Federal regulations requiring:
  - Reduced sulfur content of gasoline and diesel
  - Increased fuel economy
- Oregon regulations requiring:
  - Low emissions vehicles beginning with model year 2009 and newer
  - Renewable fuel standard for biodiesel – 5%
- Local programs:
  - Implementing diesel retrofits of school buses

Enforcement of Oakridge Ordinance: Oakridge Ordinance #889 (subsequently updated and expanded with Oakridge Air Pollution Control Ordinance #914) allowed the City to impose a penalty not greater than $500 upon anyone who violates City Code related to the use of a solid fuel heating device. Each day's violation will incur additional fines. The City of Oakridge has enforcement authority of the ordinance. LRAPA has worked with the Oakridge Police Department to train and strengthen enforcement on yellow and red advisory days. LRAPA has provided a series of door hangers that can be left at a residence with an excessively smoky chimney if personal contact is unable to be made. The door hangers include language from the City Ordinance, including potential fines for a violation.

2012 Contingency Strategies: The following contingency strategies were adopted to fully meet the air quality standards, when it became clear that the strengthened ongoing strategies described above would not be sufficient to attain the $PM_{2.5}$ standards by 2014:

- Stricter opacity limit on all green or yellow advisory days, revising the previous 40% opacity limit in the city ordinance to a more restrictive 20% limit, as has been done in some other northwest communities. A 20% opacity limit on green and yellow advisory days to help reduce emissions with the goal of avoiding red advisories when no visible emissions are allowed.
- Stricter green-yellow-red advisory program, with more yellow and red advisory days each winter.
- Further restrictions on city woodstove curtailment exemptions (for sole source, economic hardship).

Triggering of Contingency Plan: The particulate concentrations measured in Oakridge for the calendar year 2015 and the three-year period 2013-2015 were the lowest measured in the 25 years of monitoring in Oakridge. However, the 3-year 98^{th} percentile value of 37 $\mu g/m^3$ did not meet the 35 $\mu g/m^3$ national $PM_{2.5}$ standard by December 31, 2015 as required by the federal Clean Air Act. In October 2014, when it became clear that the standards would likely not be met by the Clean Air Act deadline, the City of Oakridge and LRAPA immediately triggered the contingency strategies portion of the 2012 $PM_{2.5}$ SIP submittal to ensure attainment of standards as soon as possible.

Extension Request and Supplemental Strategies: The federal Clean Air Act gives the EPA Administrator discretionary authority to grant a 1-year extension to the attainment date for moderate nonattainment areas such as Oakridge. Two criteria are required to be met: first, the community must have implemented all of the control strategies promised in the 2012 attainment plan; and second, the 98^{th} percentile $PM_{2.5}$ concentration in the community in 2015 had to be less than or equal to the 35 $\mu g/m^3$ standard. In Oakridge, the community has implemented all of the control strategies promised in the 2012 attainment plan, and the 98^{th} percentile $PM_{2.5}$ concentration in 2015 was 28.9 $\mu g/m^3$ which is less than the 35 $\mu g/m^3$ standard. Therefore, on December 14, 2015, the City of Oakridge, LRAPA, and the Oregon Department of Environmental Quality (ODEQ) jointly requested that the EPA Administrator grant a 1-year attainment date extension to December 31, 2016.

The extension would allow the City of Oakridge and LRAPA to determine the adequacy of the new aggressive control measures implemented since October 2014 to achieve attainment of standards. The supplemental strategies currently being implemented, in addition to those in the 2012 Oakridge-Westfir $PM_{2.5}$ Attainment Plan, include:

1. The City of Oakridge adopted an expanded Air Pollution Control Ordinance (#914) on October 15, 2015, which tightens the exemption process, reaffirms the 20% opacity limits on woodstove emissions, prohibits unseasoned (>20% moisture) firewood, and clarifies other requirements.
2. The City of Oakridge, with LRAPA financial assistance, hired a code enforcement officer effective November 2015, to focus on air pollution control under Ordinance #914 during the winter months. The code enforcement officer has been trained and is currently implementing Oakridge air pollution control ordinances with the assistance of LRAPA field compliance officers. The code enforcement officer and LRAPA field compliance officers have teamed up for over 40 visitations per month to residences with visible smoke during the peak RWC season (November 2015 – February 2016).
3. The City of Oakridge, with LRAPA financial assistance, sponsored a smoke school in November 2015 in Oakridge for police, fire, and public works staff to get certified to document stack opacity readings.
4. LRAPA extended the daily home wood heating advisory from four months (November-February) to eight months (October-May), effective October 1, 2015.
5. Lane Electric Cooperative (LEC) has continued to provide financial assistance for heat pump installations in the Oakridge area since the submittal of the 2012 Oakridge-Westfir $PM_{2.5}$ Attainment Plan: 15 installations in 2012, 15 in 2013, 22 in 2014, and 36 in 2015. LEC enhanced its financial assistance and incentives for ductless heat pumps effective October 20, 2015. The number of heat pump installations in 2016 is expected to exceed the record number in 2015. The November 2015 Lane Electric Ruralite Magazine included a Winter Wood Heating article for Oakridge prepared by LRAPA.
6. Firewood seasoning programs and other strategies continue to be pursued under the stakeholder collaborative. The Community Firewood Program was developed by the Southern Willamette Forest Collaborative to provide affordable seasoned firewood (consistent with the requirements of Oakridge City Ordinance #914 described above) to Oakridge and Westfir residents. The seasoned firewood was sold at discounted prices for elderly, disabled, and low-income participants in the Oakridge home wood heating exemption program. The initial 60 cords of firewood were delivered to a covered storage area, split, moisture tested, and made available for sale on December 11, 2015, by the Collaborative with the assistance of Inbound LLC. Details and updates on this program and the Collaborative are available from: http://southwillamette.wix.com/swfc , and https://www.facebook.com/swfcollaborative.

On May 18, 2016, EPA proposed approval of the 1-year extension of the Oakridge attainment date to meet the 24-hour $PM_{2.5}$ standard from December 31, 2015 to December 31, 2016 (81

FR 31202) on the basis that the CAA criteria for such an extension had been met. On July 18, 2016, EPA finalized its extension decision (81 FR 46612) effective August 17, 2016.

Image 3: Oakridge Community Firewood Program.

Economic Factors

The economy in Oakridge has shifted from logging-based industries to a more recreation-oriented model. The decline in the harvesting and processing of timber has left Oakridge with no industrial employer or businesses that support the lumber industry. In the 1990s, the population in Oakridge declined sharply as jobs disappeared. Current census figures in Table 3 show only minimal growth between 2000 and 2015, with Oakridge increasing from 3,172 to 3,240, and Westfir decreasing from 280 to 255, over the 15-year period (for a combined 0.1% per year growth rate). Within the civilian labor force, 16% were unemployed in 2010 and 21.7% of all families had incomes below the poverty level. The low cost of living has attracted low-income and unemployed people to Oakridge.

2015 PSU Certified Population Estimates for Lane County and Its Cities

	2000	2014	2015	2014-2015 Numerical Change	2014-2015 Percent Change	2000 - 2015 Annual Average Growth Rate
Oregon	3,421,399	3,962,710	4,013,845	51,135	1.3%	1.1%
Lane County	322,959	358,805	362,150	3,345	0.9%	0.8%
Eugene	137,893	160,775	163,400	2,625	1.6%	1.1%
Springfield	52,864	60,065	60,135	70	0.1%	0.9%
Cottage Grove	8,445	9,840	9,875	35	0.4%	1.0%
Florence	7,263	8,565	8,620	55	0.6%	1.1%
Junction City	4,721	5,620	5,870	250	4.4%	1.5%
Creswell	3,579	5,075	5,125	50	1.0%	2.4%
Veneta	2,762	4,690	4,700	10	0.2%	3.6%
Oakridge	3,172	3,220	3,240	20	0.6%	0.1%
Dunes City	1,241	1,315	1,315	0	0.0%	0.4%
Lowell	880	1,060	1,065	5	0.5%	1.3%
Coburg	969	1,045	1,055	10	1.0%	0.6%
Westfir	280	255	255	0	0.0%	-0.6%
Incorporated (within city limits)	224,069	261,525	264,655	3,130	1.2%	1.1%
Unincorporated	98,890	97,280	97,495	215	0.2%	-0.1%

Data for 2000 are from the decennial Census, and are as of April 1st.
Other annual estimates are from the Population Research Center at Portland State University, and are as of July 1 each year.

Table 3: Population Estimates for Oakridge, Westfir and other cities in Lane County in 2000-2015.

The recreation industry has picked up in Oakridge, with mountain biking being very popular. A hostel, brew pub, and other small businesses have opened to support the visitors attracted to the area. Despite the recent business growth, few jobs have been created. Population and employment in Oakridge are expected to increase only modestly over the next 20 years. The population estimate for the year 2025 is 4,000. Any new employment has been assigned to the potential development of the Oakridge Industrial Park.

Growth Rates

Growth is expected to be low in the Oakridge-Westfir area through 2016. Population, housing, and employment forecasts are expected to increase gradually. VMT growth is based on the previous transportation modeling by LCOG in the Highway 58 corridor.

The 2015 emission inventory is summarized in Table 4. The calculation procedures are included in Appendix D of the 2012 Oakridge-Westfir $PM_{2.5}$ Attainment Plan, except for minor updates to the on-road emissions using MOVES 2014a and to the residential wood combustion emissions due to 2012-2014 heat pump installations by Lane Electric Cooperative and non-certified woodstove removals under the HeatSmart requirements (see Appendix 1).

	-- lbs/per day --		Percent of Total NAA Emissions	
	Typical Season Day	Worst-Case Day	Typical Season Day	Worst-Case Day
Permitted Point Sources[1]				
Oakridge Sand & Gravel: Rock crushing operation	1.7	4.0	0.4%	1.1%
Oakridge Sand & Gravel: Cement plant	4.3	14.0	0.9%	3.5%
Stationary Area Sources				
Residential Wood Combustion: Fireplace[2]	38.5	31.7	8%	8%
Residential Wood Combustion: Non-Certified Woodstove/Insert[2]	108.4	89.4	23%	23%
Residential Wood Combustion: Certified Woodstove/Insert[2]	243.2	200.7	51%	51%
Pellet Stoves	7.3	8.0	2%	2%
All Other Stationary Area Sources	47.4	4.7	10%	1%
On-Road Sources				
On-Road: Exhaust, Brake, Tire	17.6	22.2	4%	6%
Re-Entrained Road Dust	7.1	16.3	1%	4%
Nonroad Sources				
Union Pacific Railroad	6.0	6.0	1%	1%
Total, All Sources, lbs/day	**481**	**397**		

(1) Worst-case day = Permitted hourly (x24) operating capacity
(2) Worst-case day = Peak Heating Degree Day

Table 4: 2015 Estimated Typical Season Day and Worst-Case Day $PM_{2.5}$ Emissions.

Comparison of 2008 to 2013-2015Emissions

The emission inventory shows an overall decrease in emissions for the attainment year (2015) based on the effectiveness of the emission control strategies.

The differences in the 2008 and 2015 emission inventories are the combination of increases due to growth factors and decreases due to emission control strategies. For example, motor vehicle emissions decreased overall due to progressively cleaner gasoline and diesel fuels and motor vehicles, but part of the emissions decrease was offset by gradual growth in traffic volumes. Industry emissions were conservatively increased to reflect operation at maximum capacity in2013-2015, but both industrial sources are minor so this did not have a major effect on the 2015 inventory. The most significant category is residential wood-heating; emissions were increased to reflect population growth during 2008-2015, decreased due to non-certified woodstove replacements with cleaner burning units during 2009-2015, and decreased due to improvements in the programs for mandatory curtailment during stagnant air episodes.

Attainment Strategies – Emission Reduction Analysis

This section describes strategies currently in place or those to be implemented to achieve compliance with the 24-hour $PM_{2.5}$ standard. These strategies are expected to improve air quality and meet the $PM_{2.5}$ standard by the required 2015 attainment date.

RACT and RACM. The attainment strategies are required to meet Reasonably Available Control Technologies (RACT) for significant industrial sources and Reasonably Available Control Measures (RACM) for significant area source categories such as residential wood combustion.

The two existing industrial sources in the Oakridge-Westfir area are minor industrial sources of $PM_{2.5}$ emissions. The facilities are a portable rock crusher and a ready-mix concrete plant owned and operated by Oakridge Sand & Gravel.

These two minor sources together emit less than one ton per year of $PM_{2.5}$ emissions and contribute less than 1% to the base year emission inventory. These two minor sources are well below the LRAPA significant emission rate (SER) for $PM_{2.5}$ of 10 tons per year.

The air pollution control technology installed on these sources are the standard for the industry and meet RACT requirements. The rock crusher has water-spray controls and the concrete plant has baghouse controls.

Even the elimination of the emissions from these two sources would not significantly affect progress to meet the $PM_{2.5}$ standard. For example, the worst-day $PM_{2.5}$ concentrations need to be reduced by about one microgram per cubic meter ($\mu g/m^3$) per year in order to meet the $PM_{2.5}$ standard by 2015 (i.e., reduced from 39.5 $\mu g/m^3$ in the 2006-2010 baseline period to 35 $\mu g/m^3$ by the 2015 attainment date). The modeled impact of these two sources if operated at maximum permitted production rates in 2015 is much less than one $\mu g/m^3$, or much less than the annual progress required by 2015. Further, both of these sources consistently operate well below maximum production rates, especially during the winter months when $PM_{2.5}$ concentrations are a problem.

For the Oakridge nonattainment area, the main source of emissions is wood smoke from residential wood combustion, and RACM is applicable to this emission category. The RWC emission control strategies were determined by LRAPA in the 2012 Oakridge-Westfir $PM_{2.5}$ Attainment Plan to be consistent with the RACM requirements for residential wood combustion (EPA-450/2-89-015), and with the addition of the 2015 Oakridge Air Pollution Control Ordinance #914, including a 20% opacity limit and a prohibition on burning of unseasoned firewood (>20% moisture), the RWC emission control strategies significantly exceed the RACM requirements.

The RACT / RACM analysis took into account direct $PM_{2.5}$ and the precursors NO_x and SO_2 as required by the 2007 implementation rule. Preliminary analysis of the airshed found very little contribution of local sources to secondary sulfate and nitrate relative to direct $PM_{2.5}$. Since the total local emissions of NO_x and SO_2 are not a major factor in ambient $PM_{2.5}$ at the violating monitor, it was a reasonable hypothesis that small changes in that total NO_x and SO_2 emission budget would be a very minor factor in $PM_{2.5}$ in Oakridge relative to primary $PM_{2.5}$ emissions. Thus the attainment model was simplified to not take attainment credit for emission changes in $PM_{2.5}$ nitrate and sulfate precursors. LRAPA is confident that direct $PM_{2.5}$ is the cause of (and solution to) $PM_{2.5}$ nonattainment and that there is little opportunity for reducing $PM_{2.5}$ through emission reductions of NO_x and SO_2.

Estimated Reductions and Credits for Future Strategies

The emission changes between 2008 and 2014 are due to the combination of increases due to growth factors and decreases due to emission control strategies.

The most significant category is residential wood-heating; emissions were increased in the 2014 inventory to reflect population growth during 2008-2014, decreased due to non-certified woodstove replacements with cleaner burning units during 2010-2012, and decreased due to 2012-2015 improvements in the programs for curtailment during stagnant air episodes. The emission decrease due to woodstove replacements was based on the actual number of woodstove replacements documented after the 2008 baseline year.

Most of the improvement in the $PM_{2.5}$ annual average in Oakridge was in November-February (0.6 µg/m^3 per year improvement in the seasonal average) when the RWC strategies were most effective, compared to 0.2 µg/m^3 per year improvement the rest of the year (March-October) when the RWC strategies were less applicable. This is illustrated in Figure 9.

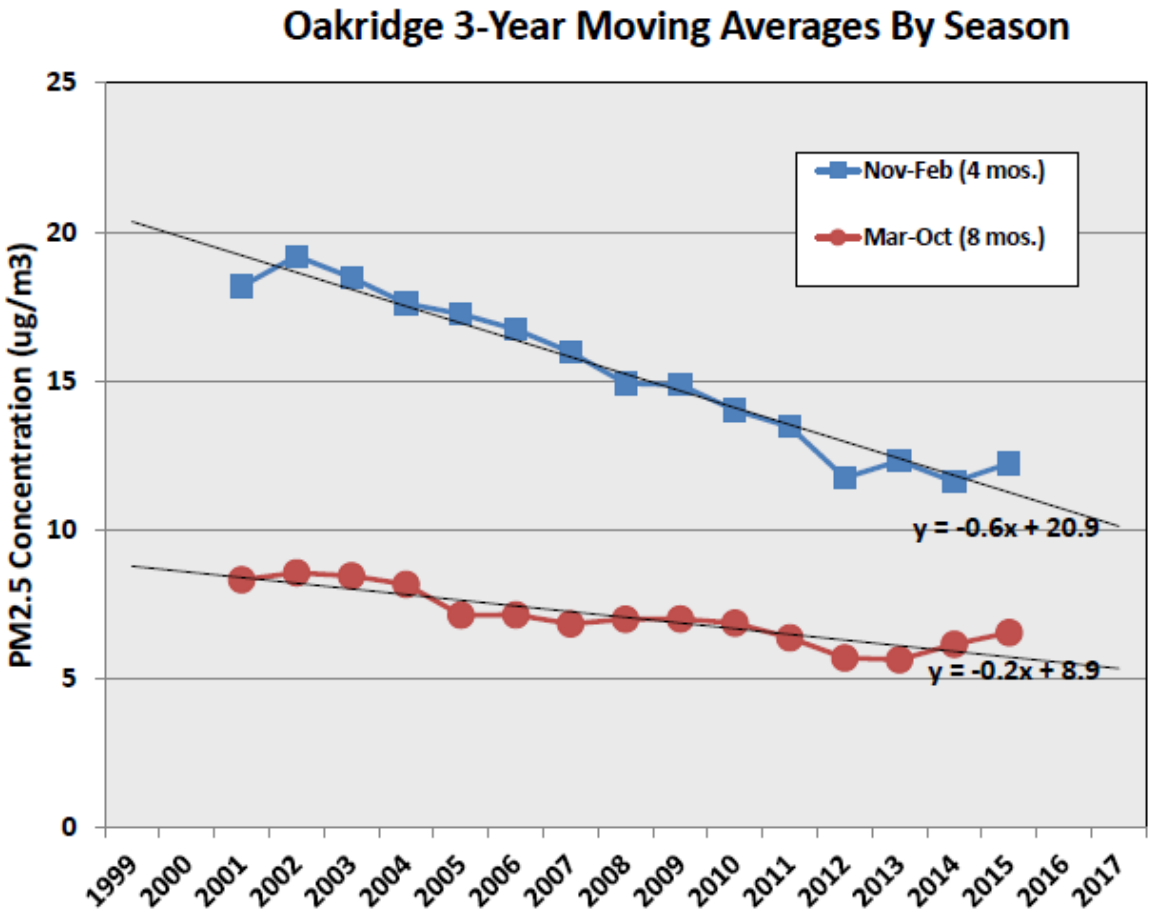

Figure 9: $PM_{2.5}$ Seasonal Trends for Oakridge.

The emission decrease for the more effective woodstove curtailment program is conservatively estimated at a 30% emission reduction on worst winter days as a result of enforcement of the existing city ordinances during stagnant air episodes subsequent to the 2006-2010 baseline period; mandatory curtailment programs in Oregon have historically documented reductions of 50% or more.

Traffic volumes are projected to gradually increase in future years but motor vehicle emissions are calculated to decrease overall due to progressively cleaner gasoline and diesel fuels and motor vehicles. Industry emissions were conservatively increased in the inventory to reflect operation at maximum capacity in 2014, but both industrial sources are minor so this did not have a major effect on the 2014 emission inventory.

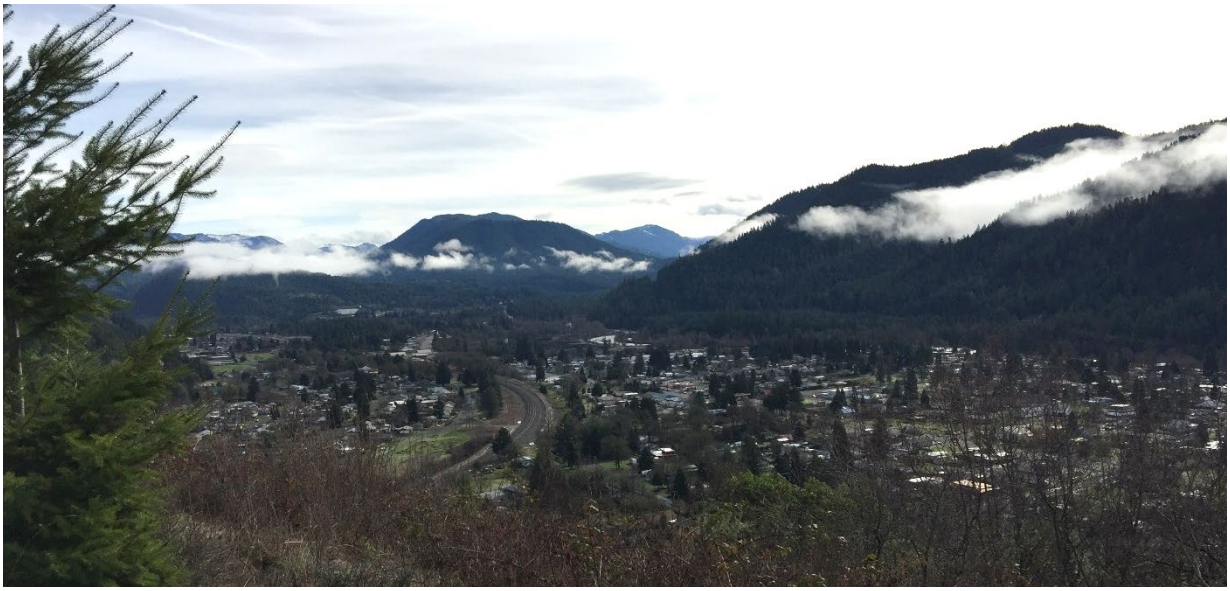

Image 4: Oakridge showing Highway 58 running through the middle.

Attainment Demonstration

The attainment demonstration shows how Oakridge will meet the $PM_{2.5}$ standard by 2013-2015 through the implementation of control measures listed above. LRAPA used a "proportional rollback/rollforward analysis" or rollback model to conduct the analysis. The goal of this section is to demonstrate that future concentrations are less than the NAAQS at the Willamette Activity Center monitor and other unmonitored parts of the designated nonattainment area.

Baseline Design Value

The demonstration starts with estimating the baseline design value, or baseline concentration, for $PM_{2.5}$. The baseline design value is a statistic, expressed as a concentration that describes the $PM_{2.5}$ levels at the Willamette Activity Center monitor relative to the NAAQS. The procedure for its calculation is presented in Appendix N to 40 CFR 50, "Interpretation of the National Ambient Air Quality Standards for Particulate Matter" and "EPA Guidance on the Use of Models and Other Analyses for Demonstrating Attainment of Air Quality Goals for O_3, $PM_{2.5}$, and

Regional Haze". $PM_{2.5}$ measurements from 2006 to 2010 are used to calculate the design value of 39.5 µg/m^3 (see Table 5). Detailed methods on the baseline design value calculation are in Appendix G of the 2012 Oakridge-Westfir $PM_{2.5}$ Attainment Plan.

Year	$PM_{2.5}$ (µg/m^3)
2006	38.6
2007	42.7
2008	38.7
2009	41.3
2010	33.0
Baseline DV	**39.5**

Table 5: Annual $PM_{2.5}$ values used to calculate baseline design value.

Background on Precursors

Speciated $PM_{2.5}$ samples were collected at Willamette Activity Center for the period July 2009-2011. The samples showed the dominance of organic and elemental carbon, with secondary inorganic aerosol nitrate and sulfate comprising relatively minor concentrations of total $PM_{2.5}$. Concern had been expressed about the role of secondary organic aerosols (SOAs) as components of total organic carbon, and an additional analysis was conducted by a research scientist at Portland State University (PSU) in collaboration with ODEQ to better understand the magnitude of these aerosols in the Klamath Falls, Oregon air shed. The results of this analysis showed that the contributions from both biogenic and anthropogenic sources to be minor, less than 1% and 3%, respectively, of total design value $PM_{2.5}$. In consultation with EPA, LRAPA chose to adopt these percent contributions as a conservative assumption for the Oakridge NAA demonstration. Because all secondary aerosols were determined to be minor contributors to total $PM_{2.5}$, these components and their concentrations are held constant in the rollback model and assigned a Relative Response Factor (RRF) of 1.0, assuming future year precursor concentrations are constant or declining. The precursor emissions to secondary aerosols, including NO_X, SO_2, ammonia, and biogenic and anthropogenic VOCs, are not used in the attainment demonstration (LRAPA is utilizing a rollback analysis for the attainment demonstration).

In addition to the study of secondary aerosols, a positive matrix factorization (PMF) study based on the speciated data from Willamette Activity Center was conducted by EPA Region 10 to identify likely sources of speciated $PM_{2.5}$. The study showed the importance of residential woodsmoke to the high levels of organic carbon, an estimated 70-75% of total PM concentrations.

The SANDWICH speciation formulation, based on adjusted and corrected Willamette Activity Center speciation data, is used to speciate the FRM measured design value (DV) for use in the rollback model. The SANDWICH is a profile of the DV with which to describe the components that contribute to $PM_{2.5}$ exceedances. This profile is shown in Figure 10, and shows that over

95% of total PM is from organic and elemental carbon with smaller amounts of secondary inorganic aerosols, such as sulfate (1%) and nitrate (0.4%). The SANDWICH analysis, and the PMF study are described in more detail in Appendix E.1 and Appendix E.2. Based on the evidence cited above, the major sources contributing to nonattainment in Oakridge are considered to be those that emit direct emissions of $PM_{2.5}$. As a result, LRAPA has focused its strategies for the attainment demonstration on these sources.

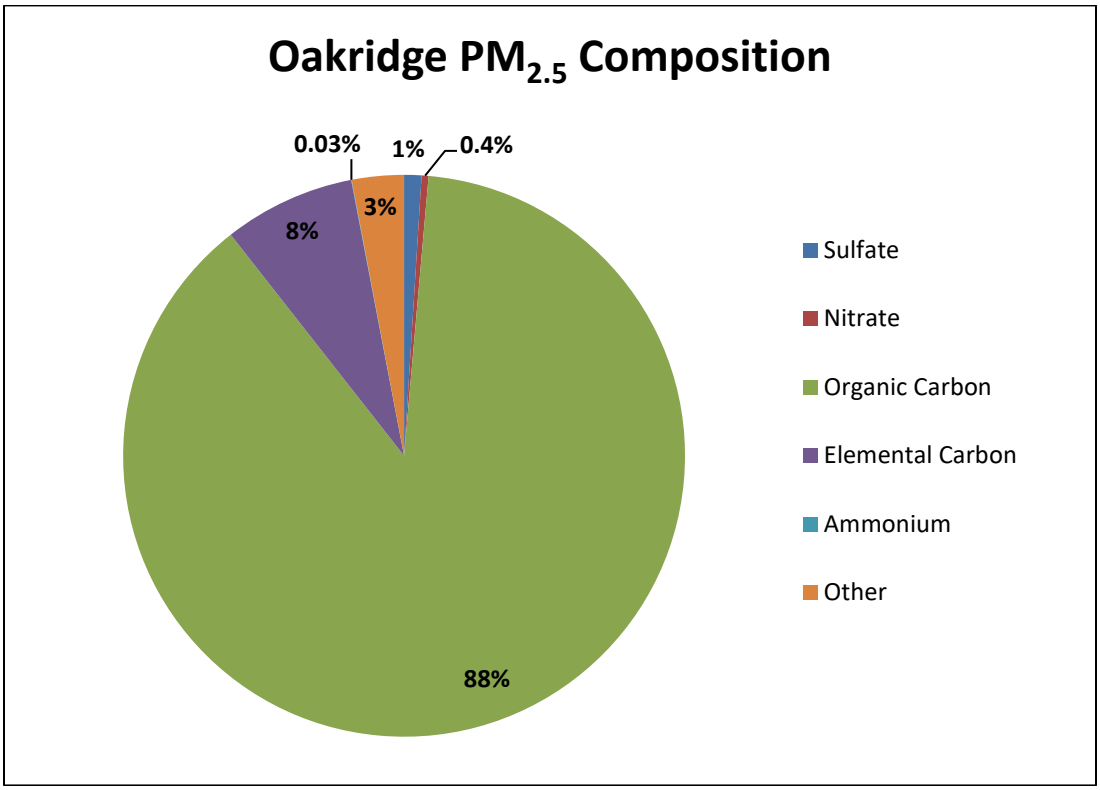

Figure 10: Speciated Components of $PM_{2.5}$ (using SANDWICH analysis).

Speciated Filter Sample Analysis

$PM_{2.5}$ is a mixture and can be divided into major components: mass associated with sulfates, nitrates, ammonium, organic carbon, elemental carbon, particle bound water, and other primary inorganic particulate matter. Percent contribution to the total mass by each of these major components is used to estimate relative contribution by different emission sources.

From July 2009 to 2011, LRAPA conducted $PM_{2.5}$ speciation monitoring at the Willamette Activity Center location. Total $PM_{2.5}$ mass measurements using the FRM are used mainly to determine attainment or nonattainment of the standard. However, to provide information about particular source contribution to that total mass it was necessary to co-locate a speciation sampler that allows the breakdown of the total mass into different chemical species.

The total mass of $PM_{2.5}$ using the FRM sampler is not equal to the simple sum of the measured components from the speciation filter, therefore it is necessary to make adjustments to represent FRM mass. In order to apply the results of the speciated filter analysis to the aerosol mass measurements, EPA Region 10 conducted the Sulfate, Adjusted Nitrate, Derived Water, Inferred Carbonaceous Material Balance Approach (SANDWICH) which is the default method in EPA modeling guidance to define baseline $PM_{2.5}$. The SANDWICH approach uses a combination of speciation measurements and modeled estimates to represent FRM $PM_{2.5}$ measurements. The goal is to reconstruct the measured speciated components so that they add up to the measured FRM $PM_{2.5}$ mass. Table 6 shows the results as percent contribution by a speciated component (sulfates, nitrates, organic carbon (OC), elemental carbon (EC), ammonia (NH_3), and other primary particulate (OPP)). Detailed methods of the SANDWICH analysis are included in Appendix E.1 of the 2012 Oakridge-Westfir $PM_{2.5}$ Attainment Plan.

% Sulfate	% Nitrate	% OC	% EC	% Water	% NH3	% OPP
1.1	0.4	88.4	7.6	1.4	0.03	1.1

Table 6: Contribution by speciated components. Results of SANDWICH analysis for the top 25% high concentration winter (Oct-Mar) days.

Minor $PM_{2.5}$ Components

In addition to the speciated components in Table 7, ODEQ, in partnership with Portland State University, examined contribution by secondary organic aerosols in Klamath Falls, Oregon and found it to be relatively low. Anthropogenic secondary organic aerosols contribute 3% and biogenic 1% to the total measured $PM_{2.5}$ mass. LRAPA chose to adopt these percent contributions as a conservative assumption for the Oakridge NAA demonstration. Secondary organic aerosols and the other minor components sulfate, nitrate, and background EC and OC are assumed to be constant in rollback modeling. More details about this analysis are included in Appendix E.1.

Each source emits a different proportion of OC, EC, and OPP, the three components used to develop a speciated emissions inventory. This proportion, or the speciation profiles, for each source category are taken primarily from EPA SPECIATE 4.2 and 4.3 databases. The following source categories are included in the analysis:

1	Cement Production
2	Sand and gravel mining
3	Fireplace
4	Woodstove Insert Non-Cert
5	Woodstove Insert Cert (Non-Cat)
6	Pellet / Woodstove Cert
7	Ag and open burn
8	Rail
9	Passenger Vehicles - light diesel
10	Trucks - Heavy diesel
11	Passenger Vehicles - gas
12	Vehicle Road Dust

Table 7: Source categories with speciation profiles.

Rollback Model

In evaluating the appropriate modeling analysis of $PM_{2.5}$ for Oakridge, LRAPA considered many different modeling approaches, including rollback and more sophisticated methods such as dispersion modeling. However, both dispersion and receptor are more resource intensive and do not offer substantial improvements in demonstrating attainment under conditions that exist in Oakridge. A rollback model can simulate worst case day conditions when stagnant conditions and slow emissions movement within the nonattainment area occur.

Oakridge is particularly well suited for a rollback demonstration because of a) the relatively small area of the NAA, b) the bowl shape of the local airshed and the presence of inversions and low mixing heights during evening hours when measured particulates are highest, c) the very few types of emissions sources in the NAA, with home wood heating devices dominating the emissions. Based on these considerations, LRAPA has chosen a rollback model for the area.

The rollback model is based on the assumption that there is a direct correlation between emissions of a pollutant and measured concentrations of that pollutant in the same airshed, and that changes in emissions will result in corresponding changes in concentration. This correlation is used to predict future concentrations based on future emissions. The change in concentrations caused by changes in emissions is represented by the Relative Response Factor (RRF). An RRF less than one indicates a reduction in future concentrations, RRF equal to one indicates no change, and RRF larger than one indicates an increase. RRFs are calculated for each speciated component (EC, OC, and OPP) used in the rollback model. Details of the analysis are presented in Appendix H of the 2012 Oakridge-Westfir $PM_{2.5}$ Attainment Plan. The results show a cumulative RRF = 0.696, which indicates a decrease in future concentrations. After the cumulative RRF is applied to the input data for the baseline design value, the results are used to calculate a future 2015 design value of 29.3 $\mu g/m^3$.

Year	Baseline DV $PM_{2.5}$ ($\mu g/m^3$)	Future DV $PM_{2.5}$ ($\mu g/m^3$)
2006	38.6	28.6
2007	42.7	31.6
2008	38.7	28.7
2009	41.3	30.8
2010	33.0	24.5
Design Value	**39.5**	**29.3**

Table 8: Baseline and Future projected design values.

The future ambient concentration levels are below the NAAQS (35 $\mu g/m^3$) for a 24-hour average and the attainment of the standard is demonstrated with the application of the current strategies in place. The current reduction strategies described earlier in this section lower the emissions enough to meet the NAAQS at the Willamette Activity Center monitor.

Modeled Air Quality Improvements of the Key RWC Strategies

The key long-term permanent residential wood combustion (RWC) strategies have been:

- the woodstove change-out programs replacing uncertified woodstoves with cleaner burning and more efficient home heating units;
- the Oregon and EPA woodstove certification programs requiring any new woodstoves installed since 1986 to be certified woodstoves; and
- the Oakridge ordinance and Oregon Heat Smart law requiring removal of uncertified woodstoves upon home sale.

These programs have been critical to the significant improvement in Oakridge $PM_{2.5}$ concentrations during 2001-2015 as outlined in Figures 6 and 7. In addition, the combined emission reduction of these programs will more than offset the growth in population and housing between 2008 and 2013-2015, with a net RWC emission reduction of about 35 lb/day on typical season days and 38 lb/day on worst-case days and reduce future $PM_{2.5}$ concentrations by 2.6 $\mu g/m^3$ on worst-case days.

The key short-term RWC strategy is a strengthened mandatory curtailment program to reduce fireplace and woodstove emissions by 25% on an average of 20 red days per year (based on the number of days above 30 $\mu g/m^3$ $PM_{2.5}$ during 2005-2011). This will reduce RWC emissions by 107 lb/day and reduce future $PM_{2.5}$ concentrations by 7.1 $\mu g/m^3$ on worst-case days.

Additional details on the modeled air quality improvements due to these emission reductions are included in Appendix H (Rollback Analysis) and Appendix J (Residential Wood Combustion RACM) of the 2012 Oakridge-Westfir $PM_{2.5}$ Attainment Plan.

Unmonitored Area Analysis

The previous section describes the demonstration of attainment at the Willamette Activity Center monitor. In addition, a supplemental analysis was conducted to examine future design values away from the Willamette Activity Center, both within Oakridge and in the neighboring city of Westfir. The unmonitored area analysis is based on a 2002–2003 saturation survey of Oakridge, and the 2009-2010 monitoring of Westfir. These monitoring efforts are described in greater detail in Appendix A of the 2012 Oakridge-Westfir $PM_{2.5}$ Attainment Plan.

The ratio of average concentration at each of these monitors to the average concentration at Willamette Activity Center is applied to the baseline design value at Willamette Activity Center to establish a "baseline" design value for each monitor. The same ratio is then applied to the Willamette Activity Center future design value to estimate a future design value for each site. Since there is currently only one small point source in the emissions inventory for Oakridge, a dispersion modeling exercise to estimate source impacts was deemed unnecessary.

In both monitoring efforts referenced here, the Willamette Activity Center was the location of the highest observed concentration. Base and future design values for all monitored locations were below the NAAQS, indicating that the Willamette Activity Center concentration is the highest in the area. More detail of the unmonitored area analysis is available in Appendix A.

Application of Future Strategies

Including continuing and strengthening current strategies, the rollback model shows that the Oakridge non-attainment area will achieve the standard of 35 µg/m³ by 2015. At 29.3 µg/m³, the future design value includes a buffer for potential variation while still meeting the standard. The actual 24-hour 98th percentile $PM_{2.5}$ concentration recorded during calendar year 2015 was 28.9 µg/m³. The results of the rollback at Willamette Activity Center show a cumulative RRF of 0.70 with current strategies and future strengthening of these strategies recommended by the committee. Table 9 shows the estimated emissions, and proportional concentrations, based on all current attainment strategies implemented prior to 2015:

Source Category	Base Year 2008		Future Year 2015	
	Emissions %	$PM_{2.5}$ µg/m3	Emissions %	$PM_{2.5}$ µg/m3
Residential Wood Combustion	79.6%	31.4	75.6%	22.2
Industry	0.0%	0.0	1.2%	0.3
On-Road Vehicles	8.4%	3.3	6.8%	2.0
Other	2.1%	0.8	2.8%	0.8
Background & Secondary Aerosols	9.9%	3.9	13.6%	4.0
Total	100.0%	**39.5**	100.0%	**29.3**

Table 9: Allocation of emissions and modeled concentrations for base and future year.

Contingency Plan

The attainment plan must contain contingency measures that would be implemented in the event that the Oakridge nonattainment area fails to meet the standard by the Clean Air Act deadline, or measures beyond those necessary to meet standards by the CAA deadline. The contingency measures are designed to correct the violation of the $PM_{2.5}$ standards and be implemented immediately. EPA requires that any contingency measures must equal one-year equivalent of reasonable further progress (RFP).

In Oakridge, the worst-day $PM_{2.5}$ concentrations need to be reduced by about one microgram per cubic meter ($\mu g/m^3$) per year in order to meet the $PM_{2.5}$ standard by 2013-2015(i.e., reduced from 39.5 $\mu g/m^3$ in the 2006-2010 baseline period to 35 $\mu g/m^3$ by the 2013-2015 attainment date). Therefore, the RFP requirement in Oakridge is slightly less than one $\mu g/m^3$ of further reduction.

Supplemental Contingency Plan – Strategies Underway to Further Insure Attainment on Schedule

The Oakridge $PM_{2.5}$ attainment plan includes the following contingency strategies implemented during 2015 to insure full attainment of the $PM_{2.5}$ air quality health standards by 2013-2015 and to maintain compliance with the standards through 2025 and beyond:

- Stricter green-yellow-red advisory program, with more yellow and red advisory days each winter, by reducing the advisory thresholds by 5 $\mu g/m^3$ in the Oakridge Air Pollution Control Ordinance #914; this is projected to increase the average number of potential red advisory days by five days per year.
- Expanded field compliance with a dedicated Oakridge Police Department compliance officer effective November 2015 with assistance of LRAPA field compliance officer.
- Stricter opacity limit, revising the historical 40% opacity limit to the more restrictive 20% limit in the Oakridge Air Pollution Control Ordinance #914.
- Further restrictions on city woodstove curtailment exemptions (for sole source, economic hardship), including inspections of all exempt households to verify whether sole source and to evaluate eligibility for weatherization and ductless heat pump programs beginning in July 2016.

The field compliance improvements in the contingency plan were not made until the second half of 2015, so the curtailment effectiveness during 2015 was estimated at 25% rather than the expected future target of at least 30% effectiveness. As outlined in the earlier section on Attainment Demonstration, a 25% RWC mandatory curtailment program is projected to reduce RWC emissions by 107 lb/day and reduce concentrations on worst-case days by 7.1 $\mu g/m^3$ in 2015. With the more restrictive red advisory criteria and the increased frequency of curtailment enforcement (warnings and citations) during the latter part of 2015 and in 2016, 30% RWC curtailment is projected on worst days in 2016; this will reduce RWC emissions by 132 lb/day (an additional reduction of 25 lb/day from 2015) and concentrations on worst case days by 8.7 $\mu g/m^3$ (an additional reduction of 1.7 $\mu g/m^3$). The 2016 emission inventory is included in Appendix 1.

In summary, the contingency measures for stronger enforcement on more red advisory days are expected to increase the curtailment effectiveness from 25% to 30%, reduce RWC emissions by an additional 25 lb/day, and reduce concentrations on worst case days by an additional 1.7 $\mu g/m^3$; this would more than achieve the one $\mu g/m^3$ target needed to meet the EPA RFP test for contingency plans. The 2016 emission inventory and 2016 impacts are outlined in Table 10 and Table 11.

	-- lbs/per day --		Percent of Total NAA Emissions	
	Typical Season Day	Worst-Case Day	Typical Season Day	Worst-Case Day
Permitted Point Sources[1]				
Oakridge Sand & Gravel: Rock crushing operation	1.7	4.0	0.4%	1.1%
Oakridge Sand & Gravel: Cement plant	4.3	14.0	0.9%	3.8%
Stationary Area Sources				
Residential Wood Combustion: Fireplace[2]	38.5	29.6	8%	8%
Residential Wood Combustion: Non-Certified Woodstove/Insert[2]	109.1	84	23%	23%
Residential Wood Combustion: Certified Woodstove/Insert[2]	237.4	182.8	50%	49%
Pellet Stoves	7.3	8.0	2%	2%
All Other Stationary Area Sources	47.4	4.7	10%	1%
On-Road Sources				
On-Road: Exhaust, Brake, Tire	16.3	20.5	3%	6%
Re-Entrained Road Dust	7.1	16.3	1%	4%
Nonroad Sources				
Union Pacific Railroad	6.0	6.0	1%	2%
Total, All Sources, lbs/day	**475**	**370**		

(1) Worst-case day = Permitted hourly (x24) operating capacity
(2) Worst-case day = Peak Heating Degree Day

Table 10: 2016 Estimated Typical Season Day and Worst-Case Day $PM_{2.5}$ Emissions.

Source Category	Base Year 2008		Future Year 2016	
	Emissions %	$PM_{2.5}$ µg/m3	Emissions %	$PM_{2.5}$ µg/m3
Residential Wood Combustion	79.6%	31.4	74.1%	20.5
Industry	0.0%	0.0	1.2%	0.3
On-Road Vehicles	8.4%	3.3	7.3%	1.9
Other	2.1%	0.8	3.0%	0.8
Background & Secondary Aerosols	9.9%	3.9	14.5%	4.0
Total	100.0%	**39.5**	100.0%	**27.5**

Table 11: Allocation of emissions and modeled concentrations for base and future year 2016.

The highest $PM_{2.5}$ day recorded during the first eight months of 2016 (January-August) was 26.8 µg/m^3 on February 9, 2016. The running 12-month 98th percentile $PM_{2.5}$ concentration for Q3-2015 through Q2-2016 (i.e., July 2015 through June 2016) was 21.7 µg/m^3. This data supports the expectation that the calendar year 2016 $PM_{2.5}$ concentrations will be lower than the 28.9 µg/m^3 98th percentile $PM_{2.5}$ concentration recorded during calendar year 2015, consistent with the modeled 2016 98th percentile $PM_{2.5}$ concentration of 27.5 µg/m^3 in Table 11.

Supplemental Contingency Plan – Conditional Strategies If Needed

The Oakridge $PM_{2.5}$ attainment plan includes the following strategies as contingency strategies to automatically go into effect upon notice by EPA that standards were not fully achieved by December 31, 2016:

- Stricter green-yellow-red daily seasonal advisory program, with more red advisory days each winter, by reducing the red advisory thresholds by 5 µg/m^3 in the Oakridge Air Pollution Control Ordinance; this is projected to increase the average number of potential red advisory days by five additional days per year.
- Prohibition of fireplace use on yellow advisory days (in addition to the existing prohibition on red advisory days).

If the standards are not met by December 31, 2016, the number of red curtailment days would be increased and the frequency of curtailment enforcement (warnings and citations) would be increased accordingly in order to increase the effectiveness of the curtailment to 40% on worst case days. Using these contingency strategies to increase curtailment effectiveness to 40% is expected to reduce RWC emissions by 42 lb/day and reduce $PM_{2.5}$ concentrations by an additional 2.8 µg/m^3 on worst case days. These contingency measures would more than achieve the one µg/m^3 target needed to meet the EPA RFP test.

Quantitative Milestones (QM)

Section 189c of the federal Clean Air Act requires quantitative milestones which demonstrate that continued progress is being made until attainment of standards. The quantitative milestones for Oakridge include:

- Quality-assured air quality data for the previous calendar year, including upload to the EPA Air Quality System (AQS), will be provided within 60 days of the end of each quarter to confirm attainment of health standards in 2013-2015 and future time periods.
- Oakridge air quality data will be compared to other air monitoring stations in Lane County, as illustrated in Figures 6 and 7, by June 30th of each year to evaluate the relative severity of meteorology during each 1-year and 3-year period.
- In addition to the usual comparison of calendar year air quality to the health standards, the most recent 12-months of air quality data will be compared to standards at the end of each winter (i.e., at the end of Q1) by June 30th of each year, since the highest concentrations occur on stagnant winter days.
- The effectiveness of the mandatory curtailment program and other elements of the Oakridge Air Pollution Control Ordinance #914 will be reevaluated by June 30th of each year, including the number of homeowner contacts made by the Oakridge Police Department and LRAPA field compliance staff, and the number of warnings and citations issued under Oakridge Ordinance #914.

This Oakridge attainment plan is projecting attainment by December 31, 2016; therefore, the Quantitative Milestones for 2017 are not expected to apply. If standards are attained in Oakridge by December 31, 2016 as expected, no Quantitative Milestone report is required; if for any reason standards are not attained in Oakridge by December 31, 2016, a Quantitative Milestone report will be submitted to EPA by June 30, 2017 as an initial step toward reassessment of the Oakridge strategies.

Reasonable Further Progress (RFP)

Progress to attain the national $PM_{2.5}$ health standards will be evaluated by June 30th of each year for the previous calendar year and the previous 3-year period. The determination of Reasonable Further Progress will be based on the evaluation of:

- Review of progress to meet the Quantitative Milestones in the previous section.
- Updated emission inventory by June 30th of each year for comparison to the attainment year emission inventory, including review of updated population figures as of July 1st of the previous calendar year, number of ductless heat pumps installed annually in the Oakridge area, number of reported uncertified woodstoves removed annually under the HeatSmart program, and reported industrial production rates and emissions.
- Comparison of the updated emission inventory to the updated seasonal trends of ambient $PM_{2.5}$ air quality data in Figure 9 to ensure consistency with the air monitoring record.

Reasonable Further Progress will be satisfied if the $PM_{2.5}$ health standards are achieved by the EPA Clean Air Act deadline. If standards are attained in Oakridge by December 31, 2016 as expected, no RFP or QM reports are required.

Image 5: Sunny afternoon in Oakridge.

MLH/JN:mlh:rcl (09/26/2016)