Appendix 1: Emission Inventory

Oakridge-Westfir $PM_{2.5}$ Nonattainment Area Emission Inventory and Forecast for 2008 Base Year and 2015 Attainment Year

(including updated on-road emissions using MOVES2014a)

November 2016

Lane Regional Air Protection Agency
1010 Main Street
Springfield, Oregon 97477

Background

The 1990 Clean Air Act contains provisions on the required development of emission inventories for designated areas that failed or have failed in the past to meet the National Ambient Air Quality Standards (NAAQS). The Oakridge-Westfir Nonattainment Area (NAA) is a designated NAAQS $PM_{2.5}$ nonattainment area. This emission inventory is provided as a part of the State of Oregon revisions to its State Implementation Plan (SIP) to formulate a strategy to maintain the NAAQS.

The principal components for development and documentation for the 2014 Attainment Plan emission inventories have been addressed in this document, which includes stationary permitted point sources, stationary area (non-permitted) sources, non-road mobile sources (railroads), on-road mobile sources, and emissions summaries. Inventory years include a base year of 2008 and the 2015 attainment deadline year. The geographic boundary for each inventory is the Oakridge-Westfir NAA, as defined by the NAA boundary.

In this document the terms *annual*, *typical season day*, and *worst-case day* emissions are used to categorize the estimated emissions for a particular time period. The annual emissions are a total amount of emissions for the source category that occurred throughout the year, represented in tons per year (tpy). The typical season day emissions represent an average daily emission value occurring from November 1st through the end of February. This four-month time period is considered to be the PM season, and is when the PM standard is usually violated. The worst-case day emissions are the highest daily emissions estimated for the PM season, and represent a day during the PM season when emissions generating activity is at its highest. For emission inventory purposes, the worst-case day is equivalent to the 98th-percentile design value (DV) day. Typical season day and worst-case day emissions are represented in pounds per day (lbs/day).

The 2008 National Emission Inventory (NEI) for Lane County was used as the starting point for calculating both $PM_{2.5}$ emissions and $PM_{2.5}$ precursor emissions for the Oakridge-Westfir $PM_{2.5}$ nonattainment area. The Lane County portion of the 2008 NEI was summarized in Appendix D-5 of the 2012 Oakridge-Westfir $PM_{2.5}$ Attainment Plan, including emissions of $PM_{2.5}$, NOx, SO2, VOC and NH3. The initial Oakridge-Westfir emissions were estimated by applying appropriate emission allocation factors (e.g., relative population, housing, vehicle miles of travel, land area, etc.) to the Lane County $PM_{2.5}$ and precursor emission categories. The significant (and insignificant) source categories during the winter $PM_{2.5}$ problem season were identified in Appendix D-5 of the 2012 Oakridge-Westfir $PM_{2.5}$ Attainment Plan.

The 2011 and 2014 NEIs were released subsequent to the submittal of the 2012 Oakridge-Westfir $PM_{2.5}$ Attainment Plan. LRAPA has summarized and compared the Lane County and Oakridge portions of the 2008 NEI, the 2011 NEI and the 2014 NEI. The comparison of the 2008-2011-2014 NEIs indicates that the anthropogenic precursor emissions are decreasing significantly over time. The next NEI (2017) will probably not be available until late 2018, but based on the 2008-2014 trends, LRAPA expects the 2015-2017 precursor emissions to be even lower than the 2014 precursor emissions.

Secondary particulate is an overall very minor contributor to the Oakridge $PM_{2.5}$ air pollution concentrations on worst winter days as summarized in both the 2012 and 2016 Oakridge-Westfir Attainment Plans. For example, as outlined in Table 6 of the 2016 Plan, sulfates contribute only 1.1% and nitrates contribute only 0.4% on the top 25% high $PM_{2.5}$ concentration days. Rather, the major $PM_{2.5}$ contributor is organic carbon (88%), primarily from residential wood combustion.

Parameter	Sulfate	Nitrate	OC	EC	Water	NH3	OPP
Percent	1.1	0.4	88.4	7.6	1.4	0.03	1.1
ug/m3	0.43	0.16	34.46	2.95	0.54	0.01	0.44

Table 1 (from 2016 Plan): Contribution by speciated components, based on results of SANDWICH analysis for the top 25% high concentration winter (October-March) days.

Each of the precursor groups in Table 6 was determined to be below the EPA Region 10 insignificance threshold of 1.3 ug/m3:

- Nitrate + ammonia = 0.16 ug/m3 + 0.01 ug/m3 = 0.17 ug/m3 < 1.3 ug/m3.
- Sulfate = 0.43 ug/m3 < 1.3 ug/m3.

Therefore, the LRAPA emission inventory analysis focused in most detail on the significant $PM_{2.5}$ particulate sources during the winter season in Oakridge-Westfir, notably residential woodburning emissions from woodstoves, fireplaces and pellet stoves.

Executive Summary

This emission inventory consists of emission estimates from sources that emit $PM_{2.5}$ within the Oakridge-Westfir 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 the following table.

	-- 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 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. Residential wood-heating 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 the following figure.

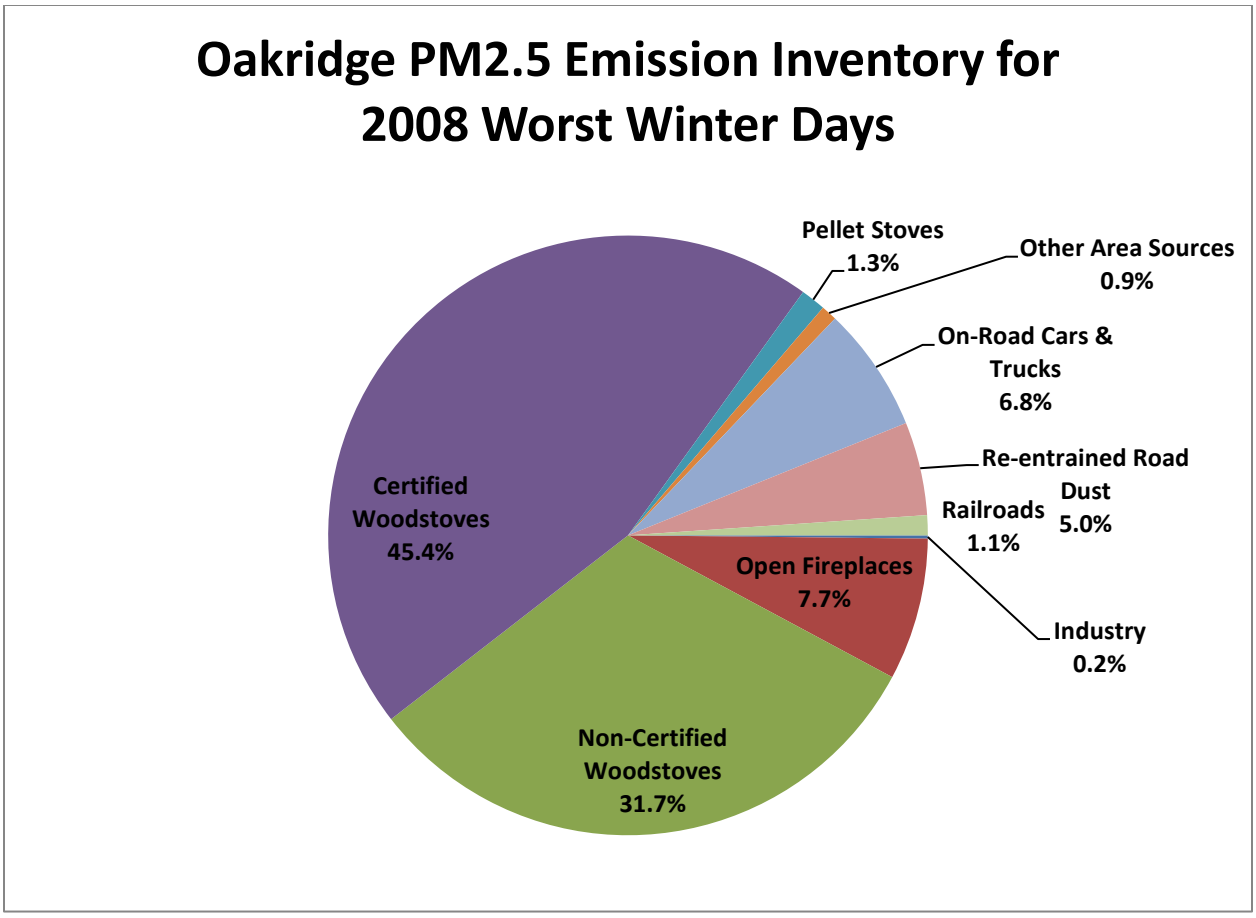

Figure 1: **Oakridge $PM_{2.5}$ Emission Inventory for 2008 Worst Winter Days**

Residential Wood Combustion

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 Nonroad Sources

Road dust and tailpipe emissions of $PM_{2.5}$ from motor vehicles were initially calculated by Lane Council of Governments (LCOG) transportation staff by applying emission factors from the EPA MOVES 2010b computer program to total vehicle miles traveled in the nonattainment area. Estimated vehicle miles traveled are from previous transportation modeling by LCOG for the Oregon Department of Transportation. The on-road mobile source emissions were updated by the Oregon Department of Environmental Quality (DEQ) in 2016 using MOVES 2014a. 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 the Oakridge-Westfir area are two minor aggregate industry sources (rock crusher and concrete batch plant) operated by Oakridge Sand & Gravel.

Attainment Year Emission Inventory (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 VMT through 2015 were used to estimate 2015 emissions. LRAPA took credit for RWC emissions reductions as a result of the woodstove replacement and heat pump installation projects implemented during 2009-2014 that reduced the number of non-certified woodstoves accounted for in the 2008 emission inventory.

The attainment year emission inventory is based on the 2008 emissions inventory, estimated growth rates and the emission reduction strategies that have recently been put into effect. The emission reduction strategies primarily include the continued implementation (with specific strengthening revisions in some cases) of the existing control measures that have been effective in achieving the PM_{10} standards and the initial (1997) $PM_{2.5}$ standards on schedule. The key ongoing control strategies, which were in place prior to 2008, include:

- City ordinance to curtail burning during stagnant weather periods;
- City ordinance requiring the removal of a non-certified wood stoves upon sale of a home;
- City ordinance prohibiting the use of a non-certified wood stove in a residence; and
- Partnering in additional change-out programs to encourage removal of non-certified woodstoves.

The RWC emission reduction credits in the proposed $PM_{2.5}$ Attainment Plan are conservative. The calculated credits are based on:

- New woodstoves installed after 2008 are EPA certified Phase II equivalent, based on the Oakridge ordinances and the Oregon HeatSmart law;
- Existing uncertified woodstove replacements since 2008 are based on the 79 units documented by LRAPA-administered financial incentive programs;
- Lane Electric Cooperative installed additional heat pumps in the Oakridge area during 2012-2015: 15 in 2012, 15 in 2013, 22 in 2014 (and an additional 36 in 2015 considered in the calculation of 2016 emissions); and
- The strengthened mandatory curtailment program during air pollution episodes forecasts a 25% reduction in wood burning on red advisory days by December 31, 2014 and a 30% reduction by December 31, 2015.

There are several other RWC strategies in the proposed $PM_{2.5}$ Attainment Plan but no specific credits were taken for those strategies.

The 2015 emission inventory is summarized in the following table.

	-- 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%	3.7%
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	22%	21%
Residential Wood Combustion: Certified Woodstove/Insert[2]	243.2	200.7	52%	51%
Pellet Stoves	7.3	8.0	1%	2%
All Other Stationary Area Sources	47.4	4.7	10%	1%
On-Road Sources				
On-Road: Exhaust, Brake, Tire	17.6	22.2	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	**481**	**397**		

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

Table 2: **2015 Estimated Typical Season Day and Worst-Case Day $PM_{2.5}$ Emissions.**

Comparison of 2008 to 2015 Emissions

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 in 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 2009-2014, and decreased due to improvements in the programs for curtailment during stagnant air episodes.

To review, the key long-term permanent 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 2005-2011. In addition, the combined emission reduction of these programs will more than offset the growth in population and housing between 2008 and 2015, with a net RWC emission reduction of about 35 lb/day on typical season days and 38 lb/day 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 below the 35 $\mu g/m^3$ $PM_{2.5}$ standard on worst-case days.

Contingency Planning

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 2014-2016 (i.e., reduced from 39.5 $\mu g/m^3$ in the 2006-2010 baseline period to 35 $\mu g/m^3$ by the 2014-2016 attainment date). Therefore, the RFP requirement in Oakridge would equal about one $\mu g/m^3$ of further reduction.

The contingency measures for stronger enforcement on more red advisory days beginning in 2015 (and reflected in the 2016 emission inventory) 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.

Introduction

Purpose of the Report

The $PM_{2.5}$ Nonattainment Area State Implementation Plan (SIP) emissions inventory for Oakridge-Westfir has been developed in response to requirements specified in the Clean Air Act Amendments of 1990 and in conformance to 40 CFR §51.1002(c).

The 1990 Clean Air Act contains provisions on the required development of emission inventories for designated areas that failed or have failed in the past to meet the National Ambient Air Quality Standards (NAAQS). The Oakridge-Westfir Nonattainment Area (NAA) is a designated NAAQS $PM_{2.5}$ nonattainment area. This emission inventory is provided as a part of the State of Oregon revisions to its State Implementation Plan (SIP) to formulate a strategy to maintain the NAAQS.

The U.S. Environmental Protection Agency (EPA) adopted revisions to the National Ambient Air Quality Standards (NAAQS) for $PM_{2.5}$ in September 2006. $PM_{2.5}$ is fine particulate matter two and a half microns and less in diameter.

On October 8, 2009, the Environmental Protection Agency (EPA) issued final area non-attainment designations for the 24-hour national air quality standards for fine particulate matter ($PM_{2.5}$). Oakridge was designated a non-attainment area in Oregon. Under the Clean Air Act, an area that violates the federal standards is designated as "nonattainment" and must adopt a plan with emission reduction measures to bring the area back into compliance. The area designated as non-attainment for $PM_{2.5}$ contains Oakridge, the small town of Westfir and surrounding area.

This document fulfills the EPA requirements for preparing the 2008 Base Year and 2014 Attainment Year emission inventories, as specified in the provisions of the 1990 CAAA, and EPA guidance documents. The purpose of this report is to establish baseline emissions for the Oakridge-Westfir NAA in 2008 and project emissions to 2014. These emissions are then used to determine whether the area will reach attainment by 2014. This determination is documented in the Oakridge $PM_{2.5}$ Attainment Plan, of which this is an appendix.

The principal components for development and documentation for the 2014 Attainment Plan emission inventories have been addressed in this document, which includes stationary permitted point sources, stationary area (non-permitted) sources, non-road mobile sources (railroads), on-road mobile sources, and emissions summaries. Inventory years include a base year of 2008 and the 2014 attainment deadline year. The geographic boundary for each inventory is the Oakridge-Westfir NAA, as defined by the NAA boundary.

Description of Inventory and Area Covered

The 2008 Base Year emission inventory and 2014 Attainment Year emission forecast cover $PM_{2.5}$ emissions for the Oakridge-Westfir NAA. Emissions are reported as annual, typical season day, and worst-case day. Typical season day emissions are the daily rate of emissions for the four-month PM season, defined as the period from the beginning of January through the end of February and beginning of November through the end of December. Worst-case day emissions represent the highest ambient $PM_{2.5}$ accumulations on a single day during the four-month PM season. Annual emissions are reported as tons per year (tpy), whereas typical season and worst-case day emissions are reported as lbs per day.

Oakridge, Oregon 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, the summit of the Cascade Mountain Range. The city limits of present-day Oakridge includes the historic City of Oakridge and, directly west, the area formerly known as Willamette City. Figure 2 shows the location of Oakridge in Lane County.

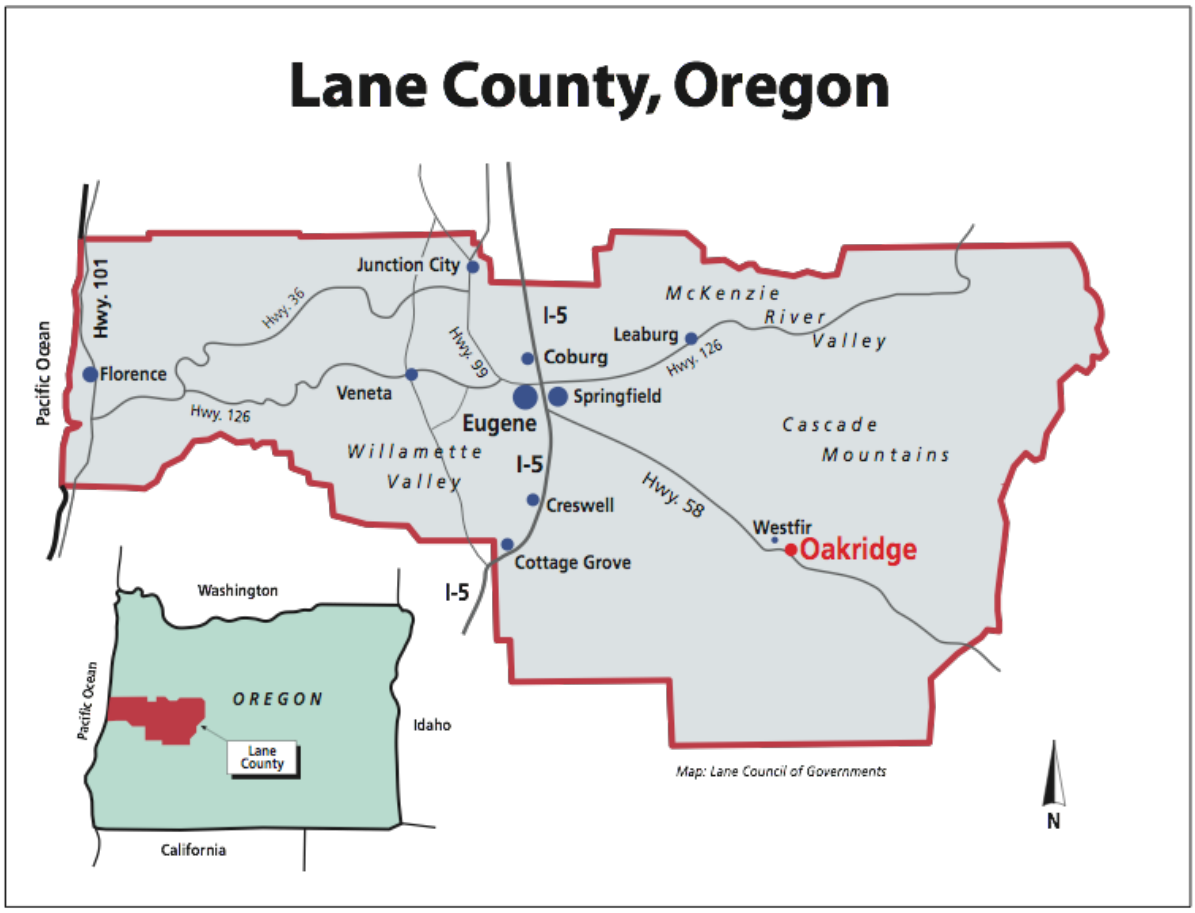

Figure 2: Oakridge Location

The area of applicability for this attainment plan includes an area that contains the City of Oakridge and the small town of Westfir. Figure 3 shows the Oakridge-Westfir non-attainment area.

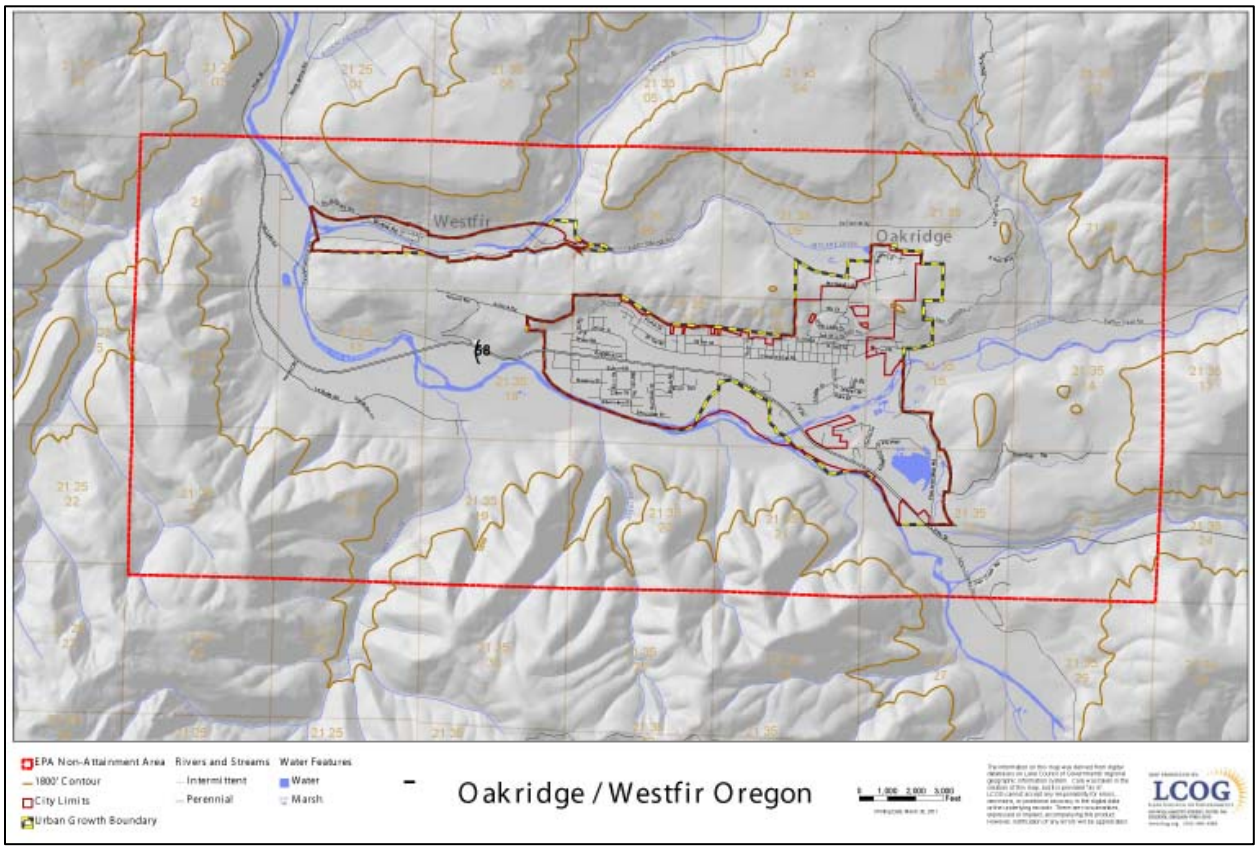

Figure 3: Nonattainment Area

The City of Oakridge is situated in a valley oriented east-west, through which flows the middle fork of the Willamette River. 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 335) 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 separate 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.

Description of Emission Inventory Information Systems

The inventory has been assembled by the staff of the Lane Regional Air Protection Agency (LRAPA) with support from the staffs of the Lane Council of Governments (LCOG) and the Oregon Department of Environmental Quality ODEQ). Permitted point source emissions were drawn from the LRAPA permit source files and ODEQ emission factors. Residential wood combustion (RWC) emissions were calculated from LRAPA wood use surveys and EPA emission factors. Onroad emissions were calculated by LCOG using previous traffic modeling studies and the EPA MOVES emissions model. Railroad emissions were calculated by staff of the Union Pacific Railroad (UPRR) using UPRR data and EPA emissions factors. All other emissions were either modeled or inventoried by LRAPA staff specifically for this project.

Sources Not Inventoried

All significant sources of $PM_{2.5}$ in the Oakridge-Westfir NAA were considered for inclusion in the emission inventory. Sources were omitted for one of the following reasons: (1) point, area, non-road or mobile sources did not emit significant amounts of $PM_{2.5}$ annually or during the winter months; or (2) the activity did not occur within the Oakridge-Westfir NAA. The Lane County portion of the 2008 National Emission Inventory (NEI) was used as the initial base for the initial screening to identify significant source categories of PM, NOx, SO2, VOC and NH3 emissions in the Oakridge-Westfir area. The initial screening of estimated emissions in the Oakridge-Westfir area used relative population, housing, traffic volumes, acreage, industry locations, and other parameters. The Lane County and Oakridge-Westfir emissions of PM, NOx, SO2, VOC and NH3 are summarized in a series of tables by pollutant in Appendix D-5.

Guidance Documents

The inventory was conducted using applicable EPA procedure and guidance documents. Emission factors were taken from the EPA Procedures Document, the *Compilation of Air Pollutant Emission Factors*, hereinafter referred to as AP-42. Localized emission factors were used when documentation existed to support their accuracy. These and other information sources are cited in the text, as appropriate.

Contact Personnel for the Inventory

Merlyn Hough and Max Hueftle of LRAPA performed most of the required source calculations. Josh Roll of the LCOG staff provided the vehicle miles travelled (VMT) and initial onroad emissions calculations using MOVES 2010b; Wes Risher and Gary Beyer of DEQ updated the on-road emissions calculation in 2016 using MOVES 2014a.

Quality Assurance and Quality Control of the Inventory

LRAPA staff consulted with DEQ staff throughout the preparation of these emission inventories. Emissions from each of the categories (e.g., mobile source emission rates per mile) were compared to similar inventories for the Klamath Falls and Tacoma areas. PM emissions were compared to historical emission inventories and trends for the successful 1988-2010 Oakridge and Eugene-Springfield PM_{10} attainment planning and control strategies implementation. The Oakridge emission inventories were consistent with independent chemical speciation work on Oakridge PM filters and Positive Matrix Factorization (PMF) results by EPA Region 10 staff.

Summary of Emissions Data

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 the following table.

	-- 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%
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Stationary Area Sources				
Residential Wood Combustion: Fireplace[2]	38.5	42.3	7%	8%
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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%
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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.
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Table 1: **2008 Estimated Typical Season Day and Worst-Case 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. Residential wood-heating 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 the following figure.

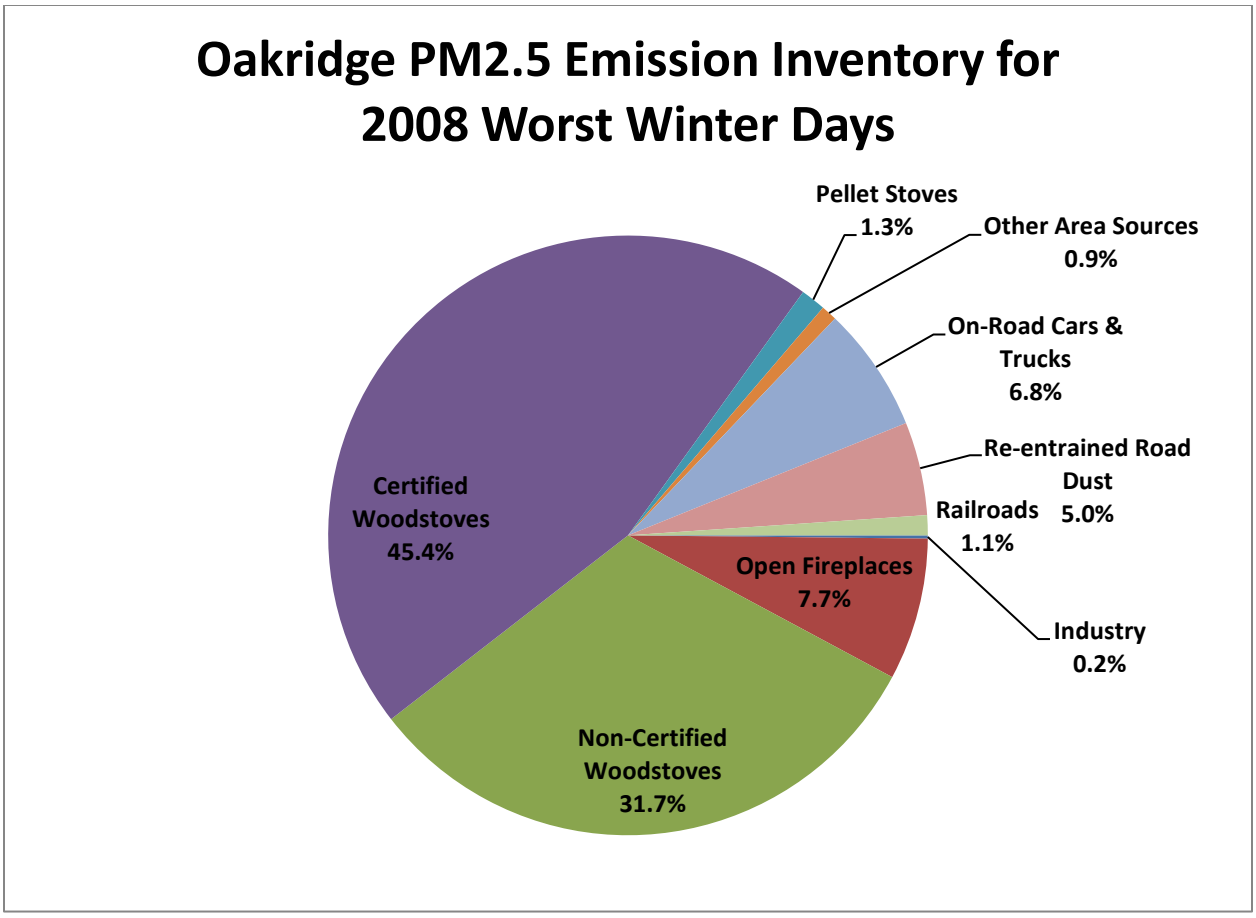

Figure 1: **Oakridge $PM_{2.5}$ Emission Inventory for 2008 Worst Winter Days**

Industrial Point Sources

LRAPA maintains data on industrial point source emissions in Lane County. 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 and future year emission inventories. 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 technologies installed on these sources are the standards for the industry and meet RACT requirements. The rock crusher has water-spray controls and the concrete plant has baghouse controls. Actual production rates, maximum production capacities, actual emissions, and maximum potential emissions are summarized in Appendix D-1. Emission factors are based on the ODEQ Emission Factors for Asphalt and Aggregate

Industries (AQ-EF06) which are derived from EPA AP-42. A copy of AQ-EF06 was included in Appendix D-1 of the 2012 Oakridge-Westfir $PM_{2.5}$ Attainment Plan.

The typical season day emissions for these two facilities during the base year were based on average actual production rates and calculated emissions during the months of November-February in recent years (2008-2011). The worst-case day emissions for these two facilities during the base year on based on actual production rates and calculated emissions during the highest production month during November-February in recent years (2008-2011); for the rock crusher, the peak winter month was January 2011; for the ready-mix concrete plant, the peak winter month was November 2009.

[The future year (2015) emissions for these two facilities are based on the maximum allowable production rates identified in the facility permit applications and the LRAPA-issued permits. The typical season day emissions are based on the annual maximum production capacity and the worst-day emissions are based on the daily maximum production capacity. The rock crusher has a production capacity of 3,600 tons per day (potential $PM_{2.5}$ emissions of 4 lb/day) and 300,000 tons per year (potential $PM_{2.5}$ emissions of 360 lb/year). The ready-mix concrete plant has a production capacity of 480 cubic yards per day (potential $PM_{2.5}$ emissions of 14 lb/day) and 30,000 cubic yards per year (potential $PM_{2.5}$ emissions of 90 lb/year).]

Residential Wood Combustion

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. The Oakridge wood use is summarized in the following table.

Woodburning Device	Base Year Wood Fuel Use Survey (Households)	Base Year Wood Fuel Use (tons/HH)	Base Year Wood Fuel Use (tons/year)
Oakridge NAA			
21-04-008-100 Fireplace without Insert	123	1.6	195.6
21-04-008-320 Certified Non-Cat Wood-Stove	256	3.0	770.6
21-04-008-330 Certified Cat Wood-Stove	64	3.0	192.6
21-04-008-310 Conv Wood Stove	111	3.0	334.1
21-04-008-230 Fireplace Insert Cert Catalyst	28	3.0	84.3
21-04-008-220 Fireplace Insert Cert Non-Cat	112	3.0	337.1
21-04-008-210 Fireplace Insert Conv.	96	3.0	289.0
21-04-008-400 Exempt Pellet Stove	228	1.2	264.5
21-04-008-510 Central Furnace	0	0.0	0.0
Total	1,018		2,468

Table 1a: **Oakridge Base Year Residential Wood Use Survey Results.**

The survey report, data, and additional RWC emission calculation details are included at the end of Appendix D-2 of the 2012 Oakridge-Westfir $PM_{2.5}$ Attainment Plan in a series of tables of RWC 2008 emissions of $PM_{2.5}$ (and NOx, SO2, VOC and NH3).

Other Area Sources

The only other area source category with potential significant emissions is backyard burning. Backyard burning is banned in Lane County for fire safety reasons during the June-September fire season and is banned in Oakridge for air quality reasons during November-February. There are 1,756 households in the Oakridge-Westfir nonattainment area. The LRAPA survey indicates that 28% of the households (about 492 households) burn yard debris (weighted average of 3 cubic yards per household) during the Fall and Spring months. The yard debris is a mix of leaves and brush with an estimated average density of 312.5 pounds per cubic yard using conversion factors (250-375 lb/yard) from OAR 340-097-0110. AP-42 emission factors are 17-38 lb/ton, or an average of 27.5 lb/ton. The total amount of yard debris burned is calculated to be 230.6 tons per year with $PM_{2.5}$ emissions of 3.2 tons per year. Typical season days emissions

are estimated to be 47.4 lb/day on the approximately 135 days per year during the Spring and Fall burning seasons . Although backyard burning is banned during November-February, LRAPA and Oakridge occasionally receive complaints of backyard burning on banned days, so backyard burning emissions are conservatively estimated at 10% (4.7 lb/day) on worst-case days during November-February.

Mobile and Nonroad 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 2010b computer program to total vehicle miles traveled in the nonattainment area. Estimated vehicle miles traveled are from previous transportation modeling by LCOG for the Oregon Department of Transportation. A copy of the LCOG report was included as Appendix D-3 of the 2012 Oakridge-Westfir $PM_{2.5}$ Attainment Plan.

Since the 2012 on-road modeling was completed, EPA developed MOVES2014 as a major revision of the mobile source emission model to replace MOVES2010 and its minor revisions (MOVES2010a and MOVES2010b). MOVES2014 incorporates the effects of three new emission control programs associated with regulations promulgated since the release of MOVES2010b:

- Tier 3 emission standards that phase in beginning in 2017 for cars, light-duty trucks, medium-duty passenger vehicles, and some heavy-duty trucks, and Tier 3 fuel standards that require lower sulfur gasoline beginning in 2017
- Heavy-duty engine and vehicle greenhouse gas (GHG) regulations that phase in during model years 2014-2018.
- The second phase of light-duty vehicle GHG regulations that phase in for model years 2017-2025 cars and light trucks.

MOVES2014 also includes new and updated emissions data from a wide range of test programs and other sources. The most significant changes in MOVES2014 include new effects of fuel properties such as gasoline sulfur and ethanol, new data on evaporative emissions from fuel leaks and from vehicles parked for multiple days, new analyses of particulate matter (PM) data related to PM speciation and temperature effects on running PM emissions, and new real world in-use emissions for heavy-duty vehicles using data from portable emission monitoring systems. In addition to these and many other updates for emission rates, MOVES2014 also includes substantial new data and updates for default population and activity. These include new vehicle population estimates and sales projections, new vehicle miles travelled (VMT) estimates based on the updated methodology for the Federal Highway Administration's Highway Performance Monitoring System, new national average speed distributions based on global positioning system (GPS) data, new state supplied data from the 2011 National Emission Inventory, and many other population and/or activity related updates.

In general, VOC, NOx, PM, and CO emissions show greater decreases over time compared to MOVES2010b. Differences in total emissions vary by calendar year and location, but in general, VOC and NOx emissions are lower in MOVES2014. PM emissions may be higher in some areas and lower in others.

EPA strongly encouraged LRAPA to use MOVES2014a for the 2015-2016 Supplemental Oakridge Attainment Plan. Oregon DEQ staff agreed to model on-road emissions using MOVES2014a for LRAPA using the inputs and VMT compiled by LCOG in 2012. Wes Risher and Gary Beyer completed this work in July 2016.

Additional details are included in Appendix 1-A, but the key differences between MOVES2010b and MOVES2014a are summarized here. Primary $PM_{2.5}$ Exhaust + Tirewear + Brakewear were modeled for years 2008, 2015 and 2025. Weekdays are labeled 5, and weekend days are labeled 2. Four seasons were modeled separately and labeled 4 (April), 7 (July), 9 (September), and 12 (December).

MOVES 2014a Results by DEQ

Year	Day	4	7	9	12	
2008	5	25.58	28.36	28.16	27.56	
	2	32.57	37.80	34.50	36.87	
2015	5	15.37	17.02	16.92	16.59	
	2	19.61	22.77	20.78	22.23	
2025	5	5.34	6.09	6.04	5.56	
	2	6.72	8.03	7.32	7.34	

MOVES 2010b Results by LCOG

Year	Day	4	7	9	12	
2008	5	22.40	22.70	23.30	27.20	
	2	29.90	32.00	30.00	37.30	
2014	5	13.20	12.80	13.30	16.70	
	2	17.30	17.90	16.90	22.20	
2025	5	6.90	6.00	6.40	9.30	
	2	8.60	7.90	7.80	11.80	

DELTA

Year	Day	4	7	9	12	
2008	5	14.21%	24.94%	20.87%	1.32%	
	2	8.92%	18.12%	15.00%	-1.15%	
2015	5	16.42%	32.98%	27.21%	-0.64%	
	2	13.37%	27.21%	22.99%	0.13%	
2025	5	-22.61%	1.48%	-5.69%	-40.18%	
	2	-21.91%	1.58%	-6.16%	-37.82%	

Emissions from railroads were provided by Union Pacific Railroad staff using the EPA NONROAD2008a emissions protocol. The UPRR report was included as Appendix D-4 of the 2012 Oakridge-Westfir $PM_{2.5}$ Attainment Plan. Fuel consumption information was submitted by UPRR to LRAPA as Confidential Business Information so some of the report is not included in the appendix. Contact LRAPA or UPRR if additional details or calculations are needed for verification.

Other non-road mobile sources were categorized by LRAPA as insignificant in Oakridge-Westfir during the $PM_{2.5}$ winter season as summarized in Appendix D-5 of the 2012 Oakridge-Westfir $PM_{2.5}$ Attainment Plan.

Attainment Year Emission Inventory (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 VMT through 2014 were used to estimate 2014 emissions. LRAPA took credit for RWC 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 based on 2008 emissions inventory, estimated growth rates and the emission reduction strategies that have recently been put into effect. The emission reduction strategies primarily include the continued implementation (with specific strengthening revisions in some cases) of the existing control measures that have been effective in achieving the PM_{10} standards and the initial (1997) $PM_{2.5}$ standards on schedule. The key ongoing control strategies, which were in place prior to 2008, include:

- City ordinance to curtail burning during stagnant weather periods;
- City ordinance requiring the removal of a non-certified wood stoves upon sale of a home;
- City ordinance prohibiting the use of a non-certified wood stove in a residence; and
- Partnering in additional change-out programs to encourage removal of non-certified woodstoves.

The RWC emission reduction credits in the proposed $PM_{2.5}$ Attainment Plan are conservative. The calculated credits are based on:

- New woodstoves installed after 2008 are EPA certified Phase II equivalent, based on the Oakridge ordinances and the Oregon HeatSmart law;
- Existing uncertified woodstove replacements since 2008 are based on the 79 units documented by LRAPA-administered financial incentive programs;
- Lane Electric Cooperative installed additional heat pumps in the Oakridge area during 2012-2015: 15 in 2012, 15 in 2013, 22 in 2014 (and an additional 36 in 2015 considered in the calculation of 2016 emissions); and
- The strengthened mandatory curtailment program during air pollution episodes forecasts a 25% reduction in wood burning on red advisory days by December 31, 2014 and a 30% reduction by December 31, 2015.

There are several other RWC strategies in the proposed $PM_{2.5}$ Attainment Plan but no specific credits were taken for those strategies.

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 1990's, the population in Oakridge declined sharply as jobs disappeared. Current census figures show only modest growth of 1.8% between 2000 and 2010, with the 2015 population at 3,240. 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.

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 to moderate 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 the following table.

	-- 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%	3.7%
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	22%	21%
Residential Wood Combustion: Certified Woodstove/Insert[2]	243.2	200.7	52%	51%
Pellet Stoves	7.3	8.0	1%	2%
All Other Stationary Area Sources	47.4	4.7	10%	1%
On-Road Sources				
On-Road: Exhaust, Brake, Tire	17.6	22.2	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	**481**	**397**		

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

Table 2: **2015 Estimated Typical Season Day and Worst-Case Day $PM_{2.5}$ Emissions.**

Residential wood combustion continues to be the major emission source category in 2015. The Oakridge 2015 wood use, after applying growth factors and woodstove replacements, is summarized in the following table.

Woodburning Device	2015 Wood Fuel Use (Households)	2015 Wood Fuel Use (tons/HH)	2015 Wood Fuel Use (tons/year)
Oakridge NAA			
21-04-008-100 Fireplace without Insert	123	1.6	195.6
21-04-008-320 Certified Non-Cat Wood-Stove	287	3.0	846.9
21-04-008-330 Certified Cat Wood-Stove	62	3.0	183.0
21-04-008-310 Conv Wood Stove	66	3.0	194.8
21-04-008-230 Fireplace Insert Cert Catalyst	27	3.0	79.7
21-04-008-220 Fireplace Insert Cert Non-Cat	125	3.0	368.9
21-04-008-210 Fireplace Insert Conv.	78	3.0	230.2
21-04-008-400 Exempt Pellet Stove	238	1.2	276.1
21-04-008-510 Central Furnace	0	0.0	0.0
Total	1,006		2,375

Table 2a: **Oakridge 2015 Projected Residential Wood Use.**

For example, comparing Tables 1a and 2a, the number of wood burning households and amount of wood burned did not change significantly during 2008-2015, but the number of conventional (uncertified) woodstoves and fireplace inserts decreased due to units replaced with woodstove replacement incentives during 2009-2012 as verified by LRAPA. Additional RWC emission calculation details are included at the end of Appendix D-2 of the 2012 Oakridge-Westfir $PM_{2.5}$ Attainment Plan in a series of tables (Tables 3 through 12) of RWC 2014 emissions of $PM_{2.5}$ (and NOx, SO2, VOC and NH3).

Comparison of 2008 to 2015 Emissions

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 in 2015, but both industrial sources are minor so this did not have a major effect on the 2014 inventory. The future year (2015) emissions for these two facilities are based on the maximum allowable production rates identified in the facility permit applications and the LRAPA-issued permits. The typical season day emissions are based on the annual maximum production capacity and the worst-day emissions are based on the daily maximum production capacity. The rock crusher has a production capacity of 3,600 tons per day (potential $PM_{2.5}$ emissions of 4 lb/day) and 300,000 tons per year (potential $PM_{2.5}$ emissions of 360 lb/year). The ready-mix concrete plant has a production capacity of 480 cubic yards per day (potential $PM_{2.5}$ emissions of 14 lb/day) and 30,000 cubic yards per year (potential $PM_{2.5}$ emissions of 90 lb/year).

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 2009-2012, and decreased due to improvements in the programs for curtailment during stagnant air episodes.

In order to illustrate the RWC emission reductions from the key strategies, it is helpful to compare the 2014 emission inventories with (Table 2 above) and without (Table 5 below) the strengthened mandatory curtailment program on worst-case days, and to compare both of these tables to the 2008 emission inventory in Table 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%	0.8%
Oakridge Sand & Gravel: Cement plant	4.3	14.0	0.9%	2.8%
Stationary Area Sources				
Residential Wood Combustion: Fireplace[2]	38.5	42.3	8%	8%
Residential Wood Combustion: Non-Certified Woodstove/Insert[2]	108.4	119.2	23%	24%
Residential Wood Combustion: Certified Woodstove/Insert[2]	243.2	267.6	51%	53%
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%	4%
Re-Entrained Road Dust	7.1	16.3	1%	3%
Nonroad Sources				
Union Pacific Railroad	6.0	6.0	1%	1%
Total, All Sources, lbs/day	**481**	**504**		

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

Table 5: **2015 Estimated Worst-Case Day $PM_{2.5}$ Emissions without Mandatory Curtailment.**

To review, the key long-term permanent 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 2005-2011. In addition, the combined emission reduction of these programs will more than offset the growth in population and housing between 2008 and 2015, with a net RWC emission reduction of about 35 lb/day on typical season days and 38 lb/day on worst-case days (comparing the fireplace, woodstove and pellet stove emissions in Tables 1 and 3).

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 (comparing the fireplace and woodstove emissions in Tables 2 and 3) and reduce future $PM_{2.5}$ concentrations below the 35 $\mu g/m^3$ $PM_{2.5}$ standard on worst-case days.

Contingency Planning

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 2014-2016 (i.e., reduced from 39.5 $\mu g/m^3$ in the 2006-2010 baseline period to 35 $\mu g/m^3$ by the 2014-2016 attainment date). Therefore the RFP requirement in Oakridge would equal about one $\mu g/m^3$ of further reduction.

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 2014-2016 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. 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 an additional reduction of 25 lb/day from 2015 and concentrations on worst case days by an additional reduction of 1.7 $\mu g/m^3$. In addition, RWC emissions in 2016 will be lower due to continued installation of heat pumps by Lane Electric Cooperative (36 in 2015) and continued removal of non-certified woodstoves upon home sale under the Oregon HeatSmart law.

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 3 and Table 4.

	-- 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 3: 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 4: Allocation of emissions and modeled concentrations for base and future year 2016.

Appendix 1-A
On-Road Emission Inventory Update

Oakridge-Westfir $PM_{2.5}$ Nonattainment Area

Lane Regional Air Protection Agency
1010 Main Street
Springfield, Oregon 97477

LRAPA evaluated mobile source emissions of $PM_{2.5}$ and precursors (NOx, SO2, VOC and NH3) for the years 2008, 2015 and 2025 with the assistance of the Oregon Department of Environmental Quality (DEQ). The results of the MOVES2014a model runs are included in the links of the following DEQ-LRAPA transmittal email:

From: RISHER Wes [mailto:wes.risher@state.or.us]
Sent: Thursday, November 03, 2016 11:49 AM
To: Merlyn Hough <merlyn@lrapa.org>; Robbye Lanier <robbye@lrapa.org>
Cc: SWAB Christopher <christopher.swab@state.or.us>; BEYER Gary <gary.beyer@state.or.us>; STOCUM Jeffrey <jeffrey.g.stocum@state.or.us>; LAZAREV Svetlana <svetlana.lazarev@state.or.us>
Subject: Rerun of MOVES modeling for Oakridge-Westfir PM2.5 and additional pollutants (NOx, SO2, VOC and NH3), 2008, 2015 and 2025

Merlyn and Robbye,
We have completed the **rerun** of MOVES2014a onroad modeling and emission estimation for Oakridge-Westfir PM2.5 with the additional pollutants needed (NOx, SO2, VOC and NH3), for the years 2008, 2015 and 2025.

At the links below is an ftp site where you can pull the Excel spreadsheets (Pivot tables), with and without link level data, and the Access databases that has the daily lbs. per day emissions; sizeable files hence the ftp site to provide you a copy. Day 5 is the Weekday and Day 2 is the Weekend. You will likely just need to work with the ResultsWithoutLink but I wanted you to have both sets of results.

ftp://deqftp2.deq.state.or.us\wrisher\Oakridge_rerun_ResultByLink_PIVOT.xlsx
ftp://deqftp2.deq.state.or.us\wrisher\Oakridge_rerun_ResultsByLinkFinalOutput.mdb
ftp://deqftp2.deq.state.or.us\wrisher\Oakridge_rerun_ResultsWithoutLink.accdb
ftp://deqftp2.deq.state.or.us\wrisher\Oakridge_rerun_ResultWithoutLink_PIVOT.xlsx

Regards,
Wes Risher

Wesley Risher
Air Technical Services
Environmental Solutions Division
Oregon Dept. of Environmental Quality
Phone: 503-229-5092
email: risher.wes@state.or.us

LRAPA greatly appreciates the assistance of Wesley Risher, Gary Beyer, Jeffrey Stocum and Christopher Swab of the DEQ staff in running of the MOVES2014a model and the compilation of the results.

DEQ ran MOVES2014a for:

1. Four seasons (April, July, September and December);
2. Weekdays and weekend days;
3. Three years: 2008 base year, 2015 attainment year, and 2025 future year;
4. $PM_{2.5}$ (exhaust, brakewear and tirewear); and
5. $PM_{2.5}$ precursors (NOx, SO2, VOC and NH3).

Mobile source emissions are projected to steadily decrease between 2008 and 2015 as a result of cleaner vehicles and cleaner fuels. EPA has adopted national requirements for progressively more effective pollution control equipment on new cars and trucks and for cleaner gasoline and diesel fuels.

The overall summary table of the results in pounds per day (lb/day) is as follows:

Year	Pollutant Name	April Weekday	April Weekend	July Weekday	July Weekend	September Weekday	September Weekend	December Weekday	December Weekend
2008	Ammonia (NH3)	8.2	11.8	10.9	15.7	10.5	13.8	7.7	12.2
2008	Oxides of Nitrogen (NOx)	722.2	918.3	905.3	1,184.4	866.9	1,049.6	713.0	970.7
2008	Primary Exhaust PM2.5 - Total	24.1	30.7	26.6	35.5	26.5	32.4	26.2	34.9
2008	Primary PM2.5 - Brakewear Particulate	1.0	1.3	1.2	1.6	1.2	1.4	1.0	1.3
2008	Primary PM2.5 - Tirewear Particulate	0.4	0.6	0.5	0.8	0.5	0.7	0.4	0.6
2008	Sulfur Dioxide (SO2)	2.7	3.6	3.7	5.2	3.5	4.5	2.6	3.8
2008	Volatile Organic Compounds	732.2	739.0	756.7	804.8	750.3	759.7	772.7	794.1
	2008 Total	1490.9	1705.3	1704.9	2047.9	1659.4	1862.2	1523.6	1817.7
2015	Ammonia (NH3)	8.0	11.6	10.7	15.5	10.3	13.6	7.6	12.0
2015	Oxides of Nitrogen (NOx)	539.7	671.8	669.7	861.0	642.4	765.6	535.5	711.3
2015	Primary Exhaust PM2.5 - Total	13.8	17.6	15.2	20.3	15.1	18.5	15.1	20.1
2015	Primary PM2.5 - Brakewear Particulate	1.1	1.4	1.3	1.7	1.3	1.5	1.1	1.4
2015	Primary PM2.5 - Tirewear Particulate	0.5	0.6	0.6	0.8	0.6	0.7	0.4	0.7
2015	Sulfur Dioxide (SO2)	2.0	2.8	2.6	3.7	2.5	3.2	2.0	2.9
2015	Volatile Organic Compounds	507.5	508.0	530.7	558.9	523.5	526.4	533.3	543.2
	2015 Total	1072.5	1213.8	1230.7	1461.9	1195.6	1329.6	1094.9	1291.6
2025	Ammonia (NH3)	6.1	8.8	8.1	11.8	7.8	10.3	5.7	9.1
2025	Oxides of Nitrogen (NOx)	154.8	182.6	183.3	225.6	177.8	203.5	155.0	193.1
2025	Primary Exhaust PM2.5 - Total	3.6	4.5	4.0	5.3	4.0	4.8	3.9	5.0
2025	Primary PM2.5 - Brakewear Particulate	1.2	1.5	1.4	1.8	1.4	1.7	1.2	1.6
2025	Primary PM2.5 - Tirewear Particulate	0.5	0.7	0.7	0.9	0.6	0.8	0.5	0.7
2025	Sulfur Dioxide (SO2)	1.0	1.3	1.2	1.7	1.2	1.5	0.9	1.3
2025	Volatile Organic Compounds	170.6	169.5	167.6	175.2	168.2	168.4	182.3	183.2
	2025 Total	337.8	368.9	366.3	422.3	361.0	391.1	349.5	394.0

These results were used to update the 2008 and 2015 emission inventories in the 2016 Updated Oakridge-Westfir $PM_{2.5}$ Attainment Plan as well as the Motor Vehicle Emission Budget in Appendix 4.

Earlier MOVES2014a runs specific to $PM_{2.5}$ (not including precursors) are reviewed in the following correspondence.

From: RISHER Wes [mailto:wes.risher@state.or.us]
Sent: Friday, July 15, 2016 2:41 PM
To: Merlyn Hough <merlyn@lrapa.org>; Robbye Lanier <robbye@lrapa.org>
Subject: Completed MOVES modeling for Oakridge-Westfir PM2.5, 2008, 2015 and 2025

Merlyn and Robbye,
We have completed the MOVES2014a onroad modeling and emission estimation for Oakridge-Westfir PM2.5 for the years 2008, 2015 and 2025. At the link below is an ftp site where you can pull the Excel spreadsheet (Pivot table) that has the daily lbs. per day emissions; sizeable file hence the ftp site to provide you a copy. Please confirm that you are able to retrieve the file. Day 5 is the Weekday and Day 2 is the Weekend. Below in Gary's email there is a good comparison of the daily lbs./day values from our modeling analysis and the previous MOVES2010b work that LCOG prepared.

ftp://deqftp2.deq.state.or.us\wrisher\Oakridge_ResultByLink_PIVOT.xlsx

Regards,
Wes Risher

Wesley Risher
Air Technical Services
Environmental Solutions Division
Oregon Dept. of Environmental Quality
Phone: 503-229-5092
email: risher.wes@deq.state.or.us

MOVES 2014a Results by DEQ

Year	Day	4	7	9	12	
2008	5	25.58	28.36	28.16	27.56	
	2	32.57	37.80	34.50	36.87	
2015	5	15.37	17.02	16.92	16.59	
	2	19.61	22.77	20.78	22.23	
2025	5	5.34	6.09	6.04	5.56	
	2	6.72	8.03	7.32	7.34	

MOVES 2010b Results by LCOG

Year	Day	4	7	9	12	
2008	5	22.40	22.70	23.30	27.20	
	2	29.90	32.00	30.00	37.30	
2014	5	13.20	12.80	13.30	16.70	
	2	17.30	17.90	16.90	22.20	
2025	5	6.90	6.00	6.40	9.30	
	2	8.60	7.90	7.80	11.80	

DELTA

Year	Day	4	7	9	12	
2008	5	14.21%	24.94%	20.87%	1.32%	
	2	8.92%	18.12%	15.00%	-1.15%	
2015	5	16.42%	32.98%	27.21%	-0.64%	
	2	13.37%	27.21%	22.99%	0.13%	
2025	5	-22.61%	1.48%	-5.69%	-40.18%	
	2	-21.91%	1.58%	-6.16%	-37.82%	

Gary Beyer
Environmental Engineer
Oregon Department of Environmental Quality
Vehicle Inspection Program
1240 SE12th Avenue
Portland, Oregon 97214
☎: *971-673-1641*
: *503-863-9659*

From: BEYER Gary [mailto:gary.beyer@state.or.us]
Sent: Thursday, September 08, 2016 9:46 AM
To: Merlyn Hough <merlyn@lrapa.org>
Subject: FW: MOST Package has Completed
Importance: High

Hi Merlyn,

The email below is a user notification and a MOVES-MOST run summary.

This should give you an idea of what data is available in the run output database (ResultsByLinkFinalOutput.mdb).

Gary Beyer
Environmental Engineer
Oregon Department of Environmental Quality
Vehicle Inspection Program
1240 SE12th Avenue
Portland, Oregon 97214
☎: *971-673-1641*
: *503-863-9659*
-----Original Message-----
From: BEYER Gary
Sent: Thursday, September 08, 2016 9:43 AM
To: BEYER Gary
Subject: MOST Package has Completed
Importance: High

MOVES - MOST HAS COMPLETED SUCCESSFULLY
Run Time = 2 Hours 37 Secs

Year	Mth	Day	VMT
Base	4	2	91,392 miles
Base	7	2	121,731 miles
Base	9	2	107,160 miles
Base	12	2	94,676 miles
Base	4	5	63,463 miles
Base	7	5	84,189 miles
Base	9	5	81,047 miles
Base	12	5	59,856 miles
Conformity	4	2	107,931 miles
Conformity	7	2	144,041 miles
Conformity	9	2	126,729 miles
Conformity	12	2	111,797 miles
Conformity	4	5	74,889 miles

Conformity	7	5	99,553 miles
Conformity	9	5	95,794 miles
Conformity	12	5	70,612 miles
Future	4	2	97,999 miles
Future	7	2	130,696 miles
Future	9	2	114,999 miles
Future	12	2	101,555 miles
Future	4	5	67,928 miles
Future	7	5	90,259 miles
Future	9	5	86,864 miles
Future	12	5	64,056 miles

==========

User: DEQ\gbeyer
Email: BEYER.Gary@deq.state.or.us
Date: 9/8/2016 7:41:45 AM

SCENARIOS:

Run	Year	Scenario	Mth	Day	Moves Scenario
1	Base	TSD	4	2	2008DEQ_Oakridge_PM25
2	Base	TSD	7	2	2008DEQ_Oakridge_PM25
3	Base	TSD	9	2	2008DEQ_Oakridge_PM25
4	Base	TSD	12	2	2008DEQ_Oakridge_PM25
5	Base	TSD	4	5	2008DEQ_Oakridge_PM25
6	Base	TSD	7	5	2008DEQ_Oakridge_PM25
7	Base	TSD	9	5	2008DEQ_Oakridge_PM25
8	Base	TSD	12	5	2008DEQ_Oakridge_PM25
9	Conform	TSD	4	2	2025DEQ_Oakridge_PM25
10	Conform	TSD	7	2	2025DEQ_Oakridge_PM25
11	Conform	TSD	9	2	2025DEQ_Oakridge_PM25
12	Conform	TSD	12	2	2025DEQ_Oakridge_PM25
13	Conform	TSD	4	5	2025DEQ_Oakridge_PM25
14	Conform	TSD	7	5	2025DEQ_Oakridge_PM25
15	Conform	TSD	9	5	2025DEQ_Oakridge_PM25
16	Conform	TSD	12	5	2025DEQ_Oakridge_PM25
17	Future	TSD	4	2	2015DEQ_Oakridge_PM25
18	Future	TSD	7	2	2015DEQ_Oakridge_PM25
19	Future	TSD	9	2	2015DEQ_Oakridge_PM25
20	Future	TSD	12	2	2015DEQ_Oakridge_PM25
21	Future	TSD	4	5	2015DEQ_Oakridge_PM25
22	Future	TSD	7	5	2015DEQ_Oakridge_PM25
23	Future	TSD	9	5	2015DEQ_Oakridge_PM25
24	Future	TSD	12	5	2015DEQ_Oakridge_PM25

POLLUTANTS:

#	ID	Pollutant Name
1	1	Total Gaseous Hydrocarbons
2	35	Nitrate (NO3)
3	36	Ammonium (NH4)
4	51	Chloride
5	52	Sodium
6	53	Potassium
7	54	Magnesium
8	55	Calcium
9	56	Titanium
10	57	Silicon
11	58	Aluminum
12	59	Iron
13	66	Manganese Compounds
14	91	Total Energy Consumption
15	110	Primary Exhaust PM2.5 - Total
16	111	Organic Carbon
17	112	Elemental Carbon
18	115	Sulfate Particulate
19	116	Primary PM2.5 - Brakewear Particulate
20	117	Primary PM2.5 - Tirewear Particulate
21	118	Composite - NonECPM
22	119	H2O (aerosol)
23	121	CMAQ5.0 Unspeciated (PMOTHR)
24	122	Non-carbon Organic Matter (NCOM)

From: BEYER Gary [mailto:gary.beyer@state.or.us]
Sent: Thursday, September 08, 2016 10:31 AM
To: MATHEWS John <john.mathews@state.or.us>
Cc: FIELDS Brian <brian.fields@state.or.us>; SWAB Christopher <christopher.swab@state.or.us>; STOCUM Jeffrey <jeffrey.g.stocum@state.or.us>; Merlyn Hough <merlyn@lrapa.org>; RISHER Wes <wes.risher@state.or.us>
Subject: MOVES – MOST Process Diagram Ver 16.02

I have attached an updated process diagram for MOVES – MOST.

There are a few minor changes:

- Added contributors to title block
- Added empty table check to fail more gracefully
- Added Canceled by user message to reduce confusion

Let me know if you think I should add any other clarifications.

Regards,

Gary Beyer
Environmental Engineer
Oregon Department of Environmental Quality
Vehicle Inspection Program
1240 SE12th Avenue
Portland, Oregon 97214
☎: *971-673-1641*
: *503-863-9659*

MOVES – MOST
Process Diagram Ver

From: RISHER Wes [mailto:wes.risher@state.or.us]
Sent: Wednesday, July 13, 2016 11:00 AM
To: BEYER Gary <gary.beyer@state.or.us>
Cc: SWAB Christopher <christopher.swab@state.or.us>; Merlyn Hough <merlyn@lrapa.org>
Subject: MOVES2014 and MOVES2014a changes since the version of MOVES2010b

Gary,
Below is a write up I sent to the Portland Medford Multipollutant Analysis Project (PMMAP) team last winter regarding the changes to the MOVES model between the version MOVES2010b and MOVES2014 and MOVES2014a. The onroad mobile estimates for Oakridge that we have been comparing are estimates using the MOVES2010b version of the model. EPA (specifically OTAQ) would not approve the Oakridge-Westfir PM2.5 Attainment Year SIP as the work was not using the most recent version of the MOVES model (MOVES2014a). Outlined below are the three new emission control programs that are now being reflected in the emission rate output from the model beginning in 2017. It appears we are seeing these emission reductions in our future year emission estimates you have prepared. I thought this information would help explain the reductions we are seeing.
Regards,
Wes

From: RISHER Wes
Sent: Friday, February 12, 2016 11:46 AM
To: SWAB Christopher
Cc: DOWNING Kevin; ARMITAGE Sarah; ALLEN Philip; LAZAREV Svetlana; STOCUM Jeffrey
Subject: RE: PMMAP: SMOKE-MOVES

Chris,
Here is what I have found about the MOVES2014 and MOVES2014a changes since the version of MOVES2010b:

MOVES2014 - is a **major new revision** to EPA's mobile source emission model and it replaces MOVES2010 and its minor revisions (MOVES2010a and MOVES2010b).

- MOVES2014 incorporates the effects of three new emission control programs associated with regulations promulgated since the release of MOVES2010b:
    - Tier 3 emission standards that phase in beginning in 2017 for cars, light-duty trucks, medium-duty passenger vehicles, and some heavy-duty trucks, and Tier 3 fuel standards that require lower sulfur gasoline beginning in 2017
    - Heavy-duty engine and vehicle greenhouse gas (GHG) regulations that phase in during model years 2014-2018.
    - The second phase of light-duty vehicle GHG regulations that phase in for model years 2017-2025 cars and light trucks.
- MOVES2014 also includes new and updated emissions data from a wide range of test programs and other sources. The most significant changes in MOVES2014 include new effects of fuel properties such as gasoline sulfur and ethanol, new data on evaporative emissions from fuel leaks and from vehicles parked for multiple days, new analyses of particulate matter (PM) data related to PM speciation and temperature effects on running PM emissions, and new real world in-use emissions for heavy-duty vehicles using data from portable emission monitoring systems. In addition to these and many other updates for emission rates, MOVES2014 also includes substantial new data and updates for default population and activity. These include new vehicle population estimates and sales projections, new vehicle miles travelled (VMT) estimates based on the updated methodology for the Federal Highway Administration's Highway Performance Monitoring System, new national average speed distributions based on global positioning system (GPS) data, new state supplied data from the 2011 National Emission Inventory, and many other population and/or activity related updates.
- Option to map total organic gas (TOG) emissions to chemical species used in air quality transport models.
- MOVES2014 is currently the best tool EPA has for GHG emissions from the transportation sector, and it is a significant improvement over previous versions of MOVES. State and local agencies estimating GHG emissions in the transportation planning process should consider using MOVES2014 for GHG emissions analyses in the future.
- MOVES2014 estimates emissions for mobile source air toxics (MSATs) such as benzene, 1,3-butadiene, formaldehyde, acetaldehyde, acrolein, naphthalene, and ethanol. It is EPA's best available tool for quantifying emissions of these MSATs and is based on data that have been updated since MOVES2010b. State and local agencies, academic institutions, and other interested parties who are interested in analyzing MSAT emissions from transportation projects should consider using MOVES2014 in the future.
- In general, VOC, NOx, PM, and CO emissions show greater decreases over time compared to MOVES2010b. Differences in total emissions vary by calendar year and location, but in general, VOC and NOx emissions are lower in MOVES2014. PM emissions may be higher in some areas and lower in others.

MOVES2014a – **minor update**

- Correct an error in the CB05 and CB6 outputs for CY 2013-2030 (all new work with these outputs should be done with MOVES2014a). Error magnitude varies by chemical species, county and year. All new work with these outputs should be done with MOVES2014a.
- no changes to SMOKE MOVES
- NOx, VOC and CO emissions decrease 0-0.1%
- Total PM2.5 emissions decrease (2-7%) primarily due to correction to brake wear fix

EPA – We encourage state to use MOVES2014a for new onroad SIP and Conformity work, but can complete existing work with MOVES2014.

Based upon my review I strongly feel we need to transition to MOVES2014a from MOVES2010b due to the significant updates for the PMMAP work.
Regards,
Wes

From: SWAB Christopher
Sent: Thursday, February 11, 2016 8:55 AM
To: RISHER Wes
Subject: PMMAP: SMOKE-MOVES

Wes –

The AIRPACT-5 SMOKE-MOVES framework is using MOVES2010b; can you let me know the difference between MOVES2010b and MOVES2014?

Thanks,
Chris

Appendix 1-B

Comparison of 2008-2011-2014 National Emission Inventories for $PM_{2.5}$ Precursors in Lane County and Oakridge Areas

October 2016

Lane Regional Air Protection Agency

The 2008 National Emission Inventory (NEI) for Lane County was used as the starting point for calculating both $PM_{2.5}$ emissions and $PM_{2.5}$ precursor emissions for the Oakridge-Westfir $PM_{2.5}$ nonattainment area. The Lane County portion of the 2008 NEI was summarized in Appendix D-5 of the 2012 Oakridge-Westfir $PM_{2.5}$ Attainment Plan, including emissions of $PM_{2.5}$, NOx, SO2, VOC and NH3. The initial Oakridge-Westfir emissions were estimated by applying appropriate emission allocation factors (e.g., relative population, housing, vehicle miles of travel, land area, etc.) to the Lane County $PM_{2.5}$ and precursor emission cateogries. The significant (and insignificant) source categories during the winter $PM_{2.5}$ problem season were identified in Appendix D-5 of the 2012 Oakridge-Westfir $PM_{2.5}$ Attainment Plan.

The 2011 and 2014 NEIs were released subsequent to the submittal of the 2012 Oakridge-Westfir $PM_{2.5}$ Attainment Plan. LRAPA has summarized and compared the Lane County and Oakridge portions of the 2008 NEI, the 2011 NEI and the 2014 NEI. The comparison of the 2008-2011-2014 NEIs indicates that the anthropogenic precursor emissions are decreasing significantly over time. The next NEI (2017) will probably not be available until late 2018, but based on the 2008-2014 trends, LRAPA expects the 2015-2017 precursor emissions to be even lower than the 2014 precursor emissions.

Secondary particulate is an overall very minor contributor to the Oakridge $PM_{2.5}$ air pollution concentrations on worst winter days as summarized in both the 2012 and 2016 Oakridge-Westfir Attainment Plans. For example, as outlined in Table 6 of the 2016 Plan, sulfates contribute only 1.1% and nitrates contribute only 0.4% on the top 25% high $PM_{2.5}$ concentration days. Rather, the major $PM_{2.5}$ contributor is organic carbon (88%), primarily from residential wood combustion.

Parameter	Sulfate	Nitrate	OC	EC	Water	NH3	OPP
Percent	1.1	0.4	88.4	7.6	1.4	0.03	1.1
ug/m3	0.43	0.16	34.46	2.95	0.54	0.01	0.44

Table 2 (from 2016 Plan): Contribution by speciated components, based on results of SANDWICH analysis for the top 25% high concentration winter (October-March) days.

Each of the precursor groups in Table 6 was determined to be below the EPA Region 10 insignificance threshold of 1.3 ug/m3:

- Nitrate + ammonia = 0.16 ug/m3 + 0.01 ug/m3 = 0.17 ug/m3 < 1.3 ug/m3.
- Sulfate = 0.43 ug/m3 < 1.3 ug/m3.

Therefore, the LRAPA emission inventory analysis focused in most detail on the significant $PM_{2.5}$ particulate sources during the winter season in Oakridge-Westfir, notably residential woodburning emissions from woodstoves, fireplaces and pellet stoves.

Details on the Lane County and Oakridge portions of the 2008, 2011 and 2014 NEIs, as well as graphic comparisons of trends by each precursor category, are included in the attached spreadsheet:

Comparison of 2008 and 2011 and 2014 NEIs for Lane County and Oakridge.xls