State Implementation Plan Revision
Adoption of Regional Haze Strategies in Oregon

Oregon Regional Haze Plan
for Implementing
Section 308 (40CFR 51.308)
of the Regional Haze Rule

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Oregon DEQ Information and Documents

Available at the DEQ Regional Haze website:
http://www.deq.state.or.us/aq/haze/index.htm
See other documentation in the Appendices Section of this document

Applicable Western Regional Air Partnership (WRAP) Reports and Documents

Available at the WRAP website:
http://www.wrapair.org/
or at the WRAP TSS website:
http://vista.cira.colostate.edu/tss/

Other Reference

1. EPA's Regional Haze Regulations (64 Federal Register 35714), July 1, 1999.
2. EPA's Regional Haze Regulations and Guidelines for Best Available Retrofit Technology (BART) Determinations: Final Rule (70 Federal Register 39104), July 6, 2005.

ACKNOWLEDGEMENTS AND SUMMARY

Acknowledgements

This document comprises the State of Oregon's State Implementation Plan submittal to EPA under Section 308 of the Regional Haze Rule (40 CFR 51.308). Adoption of the Oregon Section 308 Regional Haze Plan (herein referred to as the Oregon Regional Haze Plan) amends the State of Oregon Clean Air Act Implementation Plan, OAR 340-200-0040. See Appendix H for the complete citation of this rule. Other appendices at the end of this document provide additional information related to the strategies, including Oregon administrative rules associated with this plan, reference material (technical analysis and reports) prepared by the WRAP, and other documentation.

Executive Summary

Regional haze is air pollution that travels long distances and reduces visibility in scenic areas. The haze that affects visibility in Oregon comes from motor vehicles, power plants, industrial and manufacturing processes, forestry, agricultural and other open burning, as well as natural sources such as wildfire and windblown dust. The federal Clean Air Act contains requirements to protect and improve visibility in national parks and wilderness areas in the country. In 1977 Congress designated certain national parks and wilderness areas as "Class 1 areas," where

visibility was identified as an important value. Currently there are 156 Class 1 areas in the country. Oregon has 12 Class 1 areas, including Crater Lake National Park and 11 wilderness areas.

To address the problem of regional haze the Environmental Protection Agency (EPA) adopted the *Regional Haze Rule* in 1999. This rule requires states to adopt regional haze plans to incrementally improve visibility in all Class 1 areas, including Oregon, over the next 60 years. It focuses on improving Class 1 area visibility on the haziest days (the worst 20 percent) and ensuring no degradation on the clearest days (the best 20 percent). The first regional haze plan must include "Reasonable Progress Goals" (RPG) for each Class I area, for the year 2018, also known as the "2018 milestone year". RPGs are interim goals that represent incremental visibility improvements, based on a calculation of a "uniform rate of progress" (URP). The first regional haze plan describes the progress anticipated in reaching the 2018 URP milestone for each Class I area, for the 20 percent worst and best days, based on projections of emission reductions and visibility improvements from regional haze control strategies during this first planning period.

Best Available Retrofit Technology (BART) is a key part of the federal Regional Haze Rule, and the central focus of regional haze plans that states are developing. It applies to certain older industrial facilities that began operating before 1977 when federal Prevention of Significant Deterioration (PSD) rules were adopted to protect visibility in Class I areas when permitting new industrial facilities. Under BART, these older facilities must now evaluate their visibility impact in Class I areas, and if found to be significant, conduct an evaluation of new pollution controls, and install them within five years.

This document is Oregon's Regional Haze Plan to meet this federal rule. The highlights of the plan are as follows:

- History and regulatory background of the Regional Haze Rule, and geographical description of each of Oregon's 12 Class I Areas.   See Chapters 1 through 5.

- A comprehensive review and technical assessment of visibility conditions in each of Oregon's 12 Class I areas, showing major pollutants and source categories in Oregon and other states causing haze, and a projection of visibility by a required "milestone" date of 2018. See Chapters 6 through 9.

- DEQ's evaluation of ten "BART-eligible" sources, and proposal to require retrofit controls on the power plant, and reduce emissions at four other facilities to below the visibility impact level considered to be significant. See Chapter 10.

- "Reasonable Progress Goals" established by DEQ for Oregon's 12 Class I area, which show improvements in visibility for the haziest or worst days (but less than the first URP milestone for 2018) and no visibility degradation for the clearest or best days. See Chapter 11.

- A "Long-Term Strategy" that describes what actions DEQ will take to address major sources of haze over the next 10 years, and commitments for future plan updates and revisions.

- Summary of the efforts by DEQ to consult and coordinate with other States, Tribes, and Federal Land Managers on the regional haze strategies contained in this plan. See Chapter 13.

The major elements of this plan are the BART evaluation, Reasonable Progress Goals, and the Long-Term Strategy.

Best Available Retrofit Technology evaluation

The primary result of the BART evaluation in Chapter 10 was the outcome of the BART determination for the PGE Boardman coal-fired power plant. DEQ evaluated 10 BART-eligible sources, and found that the PGE Boardman plant had by far the greatest visibility impact in Oregon's Class I areas, and in several of Washington's Class I areas as well. As a result, DEQ adopted BART requirements for the PGE Boardman plant that contain a 2020 closure date for the plant, at the request of PGE. Prior to this date, PGE would install BART controls, and meet emission limits in 2011, 2014, and 2018, that will reduce total emissions by 48%. After 2020, all emissions from the plant, or approximately 25,500 tons per year of primarily sulfur dioxide (SO_2) and nitrogen oxide (NO_x), would be eliminated. Both the emission reductions from the interim BART controls and from plant closure would provide significant visibility benefits to 14 Class I areas impacted by the Boardman plant, including the Columbia Gorge National Scenic Area. In addition, the complete elimination of all emissions after 2020 would greatly contribute to meeting regional haze "reasonable progress" requirements (see below). For a full description of DEQ's BART determination, see Chapter 10.

Also as part of the BART evaluation, DEQ found four other BART-eligible sources that had visibility impacts that we just over the "significance" level used for the modeling protocol for BART sources. DEQ determined these sources could take a federally enforceable permit limit to lower their emissions below the significance level. Sources that take an enforceable permit limit are not subject to further evaluation for BART controls, however as BART-eligible sources, they can be re-evaluated as part of a more comprehensive review of industrial emissions under the reasonable progress requirements for making visibility improvements. This re-evaluation of all BART-eligible sources is part of the Long-Term Strategy described below.

Reasonable Progress Goals

In establishing RPGs for each Class I area, DEQ relied upon emission projections and regional modeling work conducted by the Western Regional Air Partnership (WRAP). The WRAP *Technical Support System* or TSS website provided considerable technical information in determining the RPGs, and is referenced in the Appendices section of the plan. The RPGs described in Chapter 11 represent future visibility conditions in Oregon's Class I areas in 2018, based on the URP calculated for each Class I area (see Chapter 6) that represents a "presumptive goal" for the first regional haze plan. In cases where the RPGs do not meet the

URP goal for 2018, States are required to explain the reasons for the slower progress, additional controls that were considered for this first plan, and what future actions that will be taken to ensure the 60-year objective of the Regional Haze Rule will be met.

While the RPGs for Oregon's Class I areas meet the requirement for no degradation of the clearest or best days, they do show a slower rate of progress for the haziest or worst visibility days, and do not meet the 2018 URP milestones in most areas. The reasons for this, as described in Chapter 11, are summarized below:

- DEQ's analysis of emissions data, source apportionment, and modeling results strongly supports the finding that the contribution of natural sources, such as wildfire and windblown dust, is the primary reason for slower progress in achieving the 2018 milestone in Oregon's Class I areas.

- Similar to the contribution of natural sources, DEQ believes marine vessel emissions are also affecting progress in making visibility improvements. These emissions are estimated to be currently half of the statewide SO_2 emissions and one-third the statewide NO_x emissions. This contribution to visibility impairment is significant, especially in Western Oregon Class I areas. Current DEQ authority to regulate offshore shipping emissions is limited. The plan identifies future work that is needed to address this significant source of emissions.

- DEQ's analysis of projected visibility improvements from sulfate and nitrate impacts in Oregon Class I areas shows about a 20 percent reduction in these pollutants by the 2018 milestone. Given the strong association of these pollutant species to anthropogenic sources, DEQ believes this is a more realistic indicator of reasonable progress. If natural sources are excluded, this 20 percent reduction in sulfates and nitrates corresponds to the same percent reduction that is represented by the 2018 milestone.

- Mobile sources (mostly cars and trucks) are the largest anthropogenic source of emissions in Oregon. By 2018 more than half of these emissions are projected to decrease due to numerous federal emission standards that are already "on the books", as well as programs in Oregon that will reduce these emissions. DEQ believes this major reduction supports the demonstration that RPGs are reasonable based on the considerable progress being made reducing this large source of emissions.

- DEQ conducted a "Four-Factor Analysis" as required under the Regional Haze rule to evaluate other large sources of emissions (non-BART sources) that could be reduced or controlled to improve visibility by 2018. Using this analysis DEQ did not find any controls that were reasonable to pursue at this time. However, as noted above, the BART controls for the PGE Boardman power plant will result in a 48% reduction in emissions prior to 2018, followed by the complete elimination all emissions after 2020. Overall, this represents a total emission reduction of approximately 25,500 tons per year. Although not a direct result of the four-factor analysis, this does represent a "greater than BART" emission reduction that is significant, and will provide noticeable visibility improvements in 14 different Class I areas. Based on the preliminary information obtained from the

four-factor analysis, DEQ has proposed in the Long-Term Strategy of the plan to further evaluate non-BART industrial sources for possible new controls in the next five years to make additional visibility improvements by 2018.

Long-Term Strategy

Chapter 12 of this plan is the Long-Term Strategy, which describes on-going rules and programs that are expected to provide visibility improvements, and identifies new measures that DEQ has committed to evaluate by the next plan update in 2013. The two primary commitments are to evaluate possible visibility improvements from non-BART industrial sources not included in the BART review, and Class I area smoke impacts from forestry burning. These represent the two greatest areas where potentially significant visibility benefits could be realized.

The evaluation of non-BART sources will include a re-evaluation of the BART-eligible sources. Starting in 2009, DEQ will develop a comprehensive guidance document through a stakeholder process for evaluating visibility impacts from non-BART industrial sources. A DEQ report will be prepared by 2013 that summarizes (1) the development of this guidance; (2) results of applying the guidance to non-BART sources and BART-eligible sources; (3) any potential new controls for sources, (4) proposed rulemaking needed and schedule for adopting new rules, (5) estimated timeline for installing any new controls; and (6) estimate of the expected visibility benefits.

The evaluation of forestry burning will consist of an analysis of smoke impacts from forestry burning on visibility, for the haziest or worst days at each Class I area in Oregon. Where this burning it is found to cause significant visibility impacts, DEQ plans to work with state forestry and federal land managers to identify new smoke management controls to protect visibility.

Other new measures in the Long-Term Strategy included an evaluation of the contribution from residential open burning and rangeland burning, and further assessment on the contribution of marine vessels and possible regulatory actions that could be taken.

Columbia River Gorge National Scenic Area Visibility

The Columbia River Gorge National Scenic Area was created by Congress in 1986. While it was not designated as a Class I area, it will receive significant visibility benefit under the Oregon Regional Haze Plan due to its' proximity to nearby Class I areas, such as Mt. Hood Wilderness in Oregon. The Gorge was included with other Class I areas in the visibility modeling analysis of BART sources, and the requirement for five-year updates to Oregon Regional Haze Plan will include similar analysis and tracking of visibility improvements for the Gorge.

The National Scenic Area Act of 1986 requires the protection and enhancement of the scenic, natural, cultural, and recreational resources of the Gorge, while at the same time supporting the local economy. The Columbia River Gorge Commission (CRGC) has responsibility to administer the National Scenic Area Act. In 2001, the CRGC determined that in order to

protect air quality in the Gorge, the CRGC would rely on Oregon DEQ and the Washington Southwest Clean Air Agency to develop an air quality strategy for the Scenic Area. The state agencies studied air quality and visibility and the emission sources that contribute to haze in the Gorge. Because many of the same problems that affected haze in the Gorge are the same problems that affect haze across the western region, much of the visibility efforts under the regional haze program will ultimately benefit the Gorge. Therefore, as part of the federally mandated five-year regional haze plan update, DEQ will track visibility conditions in the area and provide a separate follow up with the CRGC to provide a progress report on conditions in the Gorge. See Section 1.6.2 of this plan for more information.

CHAPTER 1: INTRODUCTION

1.1 Overview of Visibility and Regional Haze

Good visibility is essential to the enjoyment of national parks and scenic areas. Visibility impairment occurs as a result of the scattering and absorption of light by particles and gases in the atmosphere. This affects the clarity and color of what we see. Without the effects of air pollution, natural visual range is approximately 140 miles in the West and 90 miles in the East. However, over the years, air pollution in many parts of the United States has significantly reduced the range that people can see. In the West, the current range is 35-90 miles, and in the East, only 15-25 miles.

Regional haze is air pollution that is transported long distances and reduces visibility in national parks and wilderness areas. The pollutants that create this haze are sulfates, nitrates, organic carbon, elemental carbon, and soil dust. Human-caused haze sources include industry, motor vehicles, agricultural and forestry burning, and windblown dust from roads and farming practices.

The federal Regional Raze Rule requires states to improve visibility over the next 60 years in 156 national parks and wilderness areas in the country. In 1977, Congress designated all wilderness areas over 5,000 acres and all national parks over 6,000 acres as "mandatory federal Class I areas" (or "Class I areas" for short). These Class I areas receive special visibility protection under the Clean Air Act. Figure 1.1-1 shows the Class I areas located in Oregon and Northwest.

Figure 1.1-1 Class I Areas in Pacific Northwest

1.2 Oregon Class I Areas

Oregon has 12 specially designated Class I areas, including Crater Lake National Park and 11 wilderness areas. These areas are listed in Table 1.2-1, and are the focus of this Regional Haze Plan. A description of each Class I area is provided in Chapter 3 of this report.

Table 1.2-1 Oregon Class I Areas

Class I Area	Acreage
Mt. Hood Wilderness	47,160
Mt. Jefferson Wilderness	107,008
Mt. Washington Wilderness	52,516
Three Sisters Wilderness	285,202
Diamond Peak Wilderness	52,337
Crater Lake	183,315
Mountain Lakes Wilderness	23,071
Gearhart Mtn. Wilderness	22,809
Kalmiopsis Wilderness	179,700
Strawberry Mtn. Wilderness	69,350
Eagle Cap Wilderness	360,275
Hells Canyon Wilderness	131,133*

* Oregon portion only. Total acreage is 214,944

1.3 Background on the Regional Haze Rule

In 1977, Congress amended the Clean Air Act to include provisions to protect the scenic vistas of the nation's national parks and wilderness areas. In these amendments, Congress declared as a national visibility goal:

> *The prevention of any future, and the remedying of any existing impairment of visibility in mandatory class I Federal areas which impairment results from man-made air pollution.* (Section 169A)

To address this goal, in 1980 EPA adopted regulations to address "reasonably attributable visibility impairment", or visibility impairment caused by one or a small group of man-made sources generally located in close proximity to a specific Class I area. These became known as EPA's "Phase I" visibility rules. At that time, EPA deferred adopting provisions to specifically address regional haze, because they lacked the needed scientific information and research needed to understand the long-range transport and formation of regional haze.

In response to EPA's Phase I visibility rules, the Department adopted the Oregon Visibility Protection Plan in October 1986 (see Section 1.5.2). The 1990 amendments to the Clean Air Act established requirements to study regional haze. They gave EPA the authority to establish visibility transport commissions and promulgate regulations to address regional haze. The 1990 amendments also established a visibility transport commission to investigate and report on regional haze visibility impairment in the Grand Canyon National Park and nearby Class I

areas. A summary of the work of the Grand Canyon Visibility Transport Commission is provided in Section 1.5.4.

1.4 Summary of the Regional Haze Rule

To address the problem of long range transport of regional haze and to meet the national goal of reducing man-made visibility impairment in all Class I areas, EPA adopted "Phase II" visibility rules in 1999, to be known as the Regional Haze Rules. These rules can be found in 40 Code of Federal Regulations, Volume 64, July 1, 1999, pages 35714-35774.

The objective of the rules was to improve visibility over the next 60 years (by 2064) in all 156 Class I areas in the country. The rules require States to adopt a regional haze State Implementation Plan (SIP) that focuses on improving the haziest days (the worst 20%) and protecting the clearest days (the best 20%). Each SIP will provide a comprehensive analysis of natural and human-caused sources of haze in each Class I area, and contain strategies to control sources and reduce emissions that contribute to haze. The SIP must also address the transport of haze across state boundaries.

The Regional Haze Rule provides two paths for adopting regional haze SIPs. The submittal of this regional haze SIP meets the "Section 308" requirements in 40 CFR 51.308. The other part of the rule is "Section 309" (40 CFR 51.309), and is an option for nine western states - Arizona, California, Colorado, Idaho, Nevada, New Mexico, Oregon, Utah, and Wyoming. These states can choose to follow Section 309 and adopt specific regional haze strategies related for the 16 Class I areas of the Colorado Plateau, based on recommendations developed by the Grand Canyon Visibility Transport Commission (see Section 1.5.4 below). Section 309 applies only until 2018, after which Section 308. Since Oregon's 12 Class I areas are not part of the 16 Colorado Plateau Class I areas, Oregon choose not submit a Section 309 plan for this SIP submittal.[1]

Two of the primary components of the Regional Haze Rule are requirements to address Best Available Retrofit Technology (BART) and demonstrate "reasonable progress" in improving visibility by a 2018 milestone for each Class I area. The BART requirements address certain larger industrial sources that began operation before the adoption of the 1977 Prevention of Significant Deterioration Rules (see Section 1.5.1). Chapter 10 of this Plan describes the BART review and evaluation in detail. The demonstration of reasonable progress requires setting goals for the 20% worst and best days in each Class I area, based on an evaluation of how BART and other regional haze strategies will reduce emissions and improve or protect visibility. Chapter 11 of this Plan describes the Reasonable Progress Demonstration in detail.

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[1] In 2003, Oregon did submit to EPA a Section 309 Regional Haze Plan, to primarily address the contribution of Oregon emissions to visibility impacts in the Colorado Plateau. This plan, along with other 4 other state plans submitted under Section 309, were disapproved by EPA due to a lawsuit regarding the BART requirements in Section 309. [For more information see *Center for Energy and Economic Development v. EPA*, no. 03-1222, (D.C. Cir. Feb. 18, 2005)("*CEED* v. EPA").] The four states chose to resubmit their 309 plans. The Department decided not to resubmit the plan, due to the optional nature of Section 309, the fact that Oregon is only a minor contributor to visibility impacts in the Colorado Plateau, and that a Section 308 plan is required in 2008 regardless under the Regional Haze Rule.

The Regional Haze Rule is in addition to "Phase I" visibility rules adopted by EPA in 1980. The Department developed the Oregon Visibility Protection Plan in 1986, in response to EPA's Phase I rules, as described in Section 1.5.2 below.

Additional information on the Regional Haze Rule can be found on the Department's website, at http://www.deq.state.or.us/aq/haze/index.htm.

1.5 Other Programs to Address Visibility Impairment

1.5.1 Prevention of Significant Deterioration for New Sources

The 1977 Clean Air Act Amendments established Prevention of Significant Deterioration (PSD) requirements, which protect air quality (and visibility) from air pollution from new major industrial sources, and major modifications of existing sources. Included in the PSD rules were requirements to protect visibility in national parks, national wilderness areas, national monuments and national seashores. The PSD program sets specific increments or limits on the maximum allowable increase in air pollution in certain airsheds, and a preconstruction permit review process for new or modifying major sources that allows for careful consideration of control technology, consultation with FLMs on visibility impacts and public participation in permitting decisions.

1.5.2 Phase I Visibility Rules – the Oregon Visibility Protection Plan

In response to EPA's Phase I visibility rules, the Department adopted the Oregon Visibility Protection Plan in October 1986. This visibility plan contains short and long-term strategies for making reasonable progress toward the national goal, related to addressing reasonably attributable impairment in the state's Class I areas through visibility monitoring and control strategies. This plan incorporates PSD requirements for visibility protection from new or modified major stationary sources, and if necessary, applying BART to existing stationary sources if certified as causing reasonably attributable visibility impairment. The plan includes (a) the mitigation of visibility impairment within the Mt. Hood and Central Oregon Cascade wilderness areas through short and long-term control strategies for forest prescribed burning and Willamette Valley agricultural field burning, and (b) mitigation of impairment in the Eagle Cap Wilderness and Central Oregon Cascades resulting from agricultural field burning.

1.5.3 Best Available Retrofit Technology (BART)

Under Section 169A(b)(A) of the Clean Air Act, Congress established Best Available Retrofit Technology (BART) requirements for major stationary sources in operation within a 15-year period before adoption of the 1977 PSD rules. Under EPA's "Phase I" visibility rules, BART could be required for sources that were certified by the Federal Land Manager as causing reasonably attributable visibility impairment in a Class I area. Under EPA's "Phase II" regional haze rules, new BART rules were included that automatically triggered a review process for all pre-1977 sources. The review process included criteria for determine BART eligibility, modeling of visibility impacts, and evaluating the need for controls. (The BART review process is described in detail in Chapter 10 of this Plan.) In evaluating controls, the BART rules

require taking into consideration the costs of compliance, the energy and non-air quality environmental impacts of compliance, any existing pollution control technology in use at the source, the remaining useful life of the source, and the degree of improvement in visibility which may reasonably be anticipated to result from the use of such technology.

1.5.4 The Grand Canyon Visibility Transport Commission

The 1990 Clean Air Act Amendments created the Grand Canyon Visibility Transport Commission (GCVTC). The GCVTC was given the charge to assess the currently available scientific information pertaining to adverse impacts on visibility from potential growth in the region, identify clean air corridors, and recommend long-range strategies for addressing regional haze for Class I areas on the Colorado Plateau. The GCVTC completed significant technical analyses and developed recommendations to improve visibility in the 16 Class I areas on the Colorado Plateau. These 16 Class I areas are as follows: Arches National Park, Black Canyon of the Gunnison Wilderness, Bryce Canyon National Park, Canyonlands National Park, Capital Reef National Park, Flat Tops Wilderness, Grand Canyon National Park, Maroon Bells Wilderness, Mesa Verde National Park, Mt. Baldy Wilderness, Petrified Forest National Park, San Pedro Parks Wilderness, Sycamore Canyon Wilderness, Weminuche Wilderness, West Elk Wilderness, Zion National Park.

The GCVTC found that visibility impairment on the Colorado Plateau was caused by a wide variety of sources and pollutants. A comprehensive strategy was needed to address all of the causes of regional haze. The GCVTC submitted these recommendations to EPA in a report dated June 1996 for consideration in rule development. These recommendations were:

Air Pollution Prevention. Air pollution prevention and reduction of per capita pollution was a high priority for the Commission. The Commission recommended policies based on energy conservation, increased energy efficiency and promotion of the use of renewable resources for energy production.

Clean Air Corridors. Clean air corridors are geographic areas that provide a source of clean air to the 16 Class I areas of the Colorado Plateau. For these areas, the Commission primarily recommended careful tracking of emissions growth that may affect air quality in these corridors, and ultimately the 16 Class I areas.

Stationary Sources. For stationary sources, the Commission recommended closely monitoring the impacts of current requirements under the Clean Air Act and ongoing studies. It also recommended regional targets for SO_2 emissions from stationary sources, starting in 2000. If these targets are exceeded, a regional cap and market-based emission trading program should be implemented.

Areas In and Near Parks. The Commission's research and modeling showed that a host of sources adjacent to parks and wilderness areas, including large urban areas, have significant visibility impacts. However, the Commission lacked sufficient data regarding the visibility impacts of emissions from some areas in and near parks and wilderness areas. In general, the models used by the Commission were not readily applicable to such areas. Pending further

studies of these areas, the Commission recommended that local, state, tribal, federal, and private parties cooperatively develop strategies, expand data collection, and improve modeling for reducing or preventing visibility impairment in areas within and adjacent to parks and wilderness areas.

Mobile Sources. The Commission recognized that mobile source emissions are projected to decrease through about 2005 due to improved control technologies. The Commission recommended capping emissions at the lowest level achieved and establishing a regional emissions budget, and also endorsed national strategies aimed at further reducing tailpipe emissions, including the so-called 49-state low emission vehicle, or 49-state LEV.

Road Dust. The Commission's technical assessment indicated that road dust is a large contributor to visibility impairment on the Colorado Plateau. As such, it requires urgent attention. However, due to considerable skepticism regarding the modeled contribution of road dust to visibility impairment, the Commission recommended further study in order to resolve the uncertainties regarding both near-field and distant effects of road dust, prior to taking remedial action. Since this emissions source is potentially such a significant contributor, the Commission felt that it deserved high priority attention and, if warranted, additional emissions management actions.

Emissions from Mexico. Mexican sources are also shown to be significant contributors, particularly of SO_2 emissions. However, data gaps and jurisdictional issues made this a difficult issue for the Commission to address directly. The Commission recommendations called for continued bi-national collaboration to work on this problem, as well as additional efforts to complete emissions inventories and increase monitoring capacities. These matters should receive high priority for regional and national action.

Fire. The Commission recognized that fire plays a significant role in visibility on the Plateau. In fact, land managers propose aggressive prescribed fire programs aimed at correcting the buildup of biomass due to decades of fire suppression. Therefore, prescribed fire and wildfire levels are projected to increase significantly during the studied period. The Commission recommended the implementation of programs to minimize emissions and visibility impacts from prescribed fire, as well as to educate the public.

Future Regional Coordinating Entity. Finally, the Commission believed there was a need for an entity like the Commission to oversee, promote, and support many of the recommendations in their report. To support that entity, the Commission developed a set of recommendations addressing the future administrative, technical and funding needs of the Commission or a new regional entity. The Commission strongly urged the EPA and Congress to provide funding for these vital functions and give them a priority reflective of the national importance of the Class I areas on the Colorado Plateau.

1.5.5 The Western Regional Air Partnership

The GCVTC recognized the need for a long-term organization to address the policy and technical studies needed to address regional haze. The Western Regional Air Partnership

(WRAP) was formed in September 1997 as the successor organization to the GCVTC. The WRAP is made up of western states, tribes and federal agencies. The states are Alaska, Arizona, California, Colorado, Idaho, Montana, New Mexico, North Dakota, Oregon, South Dakota, Utah, Washington, and Wyoming. The WRAP is assisting these states by developing the policy and technical work products needed for their regional haze SIPs. The WRAP established stakeholder-based technical and policy oversight committees to assist in managing the development of regional haze work products. See Section 4.1 of this plan for more information on the WRAP. See also WRAP web site at http://www.wrapair.org.

1.6 Purpose of this Document

The Oregon Regional Haze Plan has been prepared to meet the requirements of the Federal Regional Haze Rule, Section 40 CFR, Part 51, Section 308. It contains strategies and elements related to each requirement of this federal rule. The appendices (citation) at the end of this document provide additional information related to the strategies, including citations of new Oregon administrative rules associated with this plan, and the reference material (technical analysis and reports) prepared by the WRAP.

Relation to the WRAP's Regional Technical Support System (TSS)

The WRAP's Technical Support System (TSS) was the source for the majority of key technical information and data used in the Oregon Regional Haze Plan. The WRAP TSS can be found at http://vista.cira.colostate.edu/tss/. See Chapter 12, Section 12.2, for more information on specific WRAP reports and project. Appendix C has additional information on the WRAP TSS.

1.6.1 Mandatory Federal Class I Areas Addressed in this SIP

The Regional Haze Rule under 40 CFR 51.308 requires states to address visibility protection for regional haze in Oregon's Class I Areas. These areas are listed under Section 1.2, and as depicted in Figure 1.2-1.

1.6.2 Columbia River Gorge National Scenic Area

As mentioned earlier, the Regional Haze Rule is applicable to federal Class I areas only. While the Columbia River Gorge National Scenic Area is not a Class I area, it was designated a National Scenic Area by Congress in 1986. The National Scenic Area Act of 1986 requires the protection and enhancement of the scenic, natural, cultural, and recreational resources of the Gorge, while at the same time supporting the local economy.

The Columbia River Gorge Commission (CRGC) has responsibility to administer the National Scenic Area Act. As part of an amendment to the National Scenic Area Management Plan, the CRGC recognized that a Class I designation is not appropriate for the Gorge. However, the CRGC did recognize that air quality degradation can jeopardize those resources, and that in order to protect air quality in the Gorge, the CRGC would rely on state air quality agencies to develop an air quality strategy for the Scenic Area.

Oregon DEQ and the Washington Southwest Clean Air Agency (SWCAA) have been working with the CRGC since 2001 to study air quality and visibility in the Gorge, and the emission sources that contribute to haze in the Gorge. The study also included a projection of future visibility conditions in the Scenic Area. The study results identified that haze in the Gorge was caused by many different sources and haze reduction would need to result from the cumulative effect of numerous emission reduction activities.

Because many of the same problems that affected haze in the Gorge are the same problems that affect haze across the western region, much of the visibility efforts under the regional haze program will ultimately benefit the Gorge. The Columbia River Gorge Scenic Area is situated between two Class I areas (Mt. Hood and Mt. Adams) and the Gorge will benefit from Oregon and Washington's long term regional haze process. Although the Gorge is not a Class I area and will not be expected to be on the same reasonable progress glide path as the Class I areas, visibility in the Gorge can be measured against the nearby Class I areas. This comparison will allow DEQ to track the Gorge's progress for continued visibility improvement.

Additionally, as part of the federally mandated five-year regional haze plan update, DEQ will include in these updates a description of visibility benefits to the Gorge, as the result of the effort to make reasonable progress in improving Class I area visibility over the next 60 years. Once this Regional Haze Plan SIP is submitted to EPA, DEQ will follow up with the CRGC to provide a progress report on conditions in the Gorge. DEQ will identify whether Gorge visibility conditions are showing continued improvement, similar to but not on the same glide path as conditions in the Class I areas. If visibility in the Gorge is not improving or showing a downward trend, then DEQ will reassess its Gorge strategy and potentially identify new strategies to ensure continued visibility improvement in the Gorge.

CHAPTER 2: OREGON REGIONAL HAZE SIP DEVELOPMENT AND CONSULTATION PROCESS

The Oregon Regional Haze Plan was developed through a process of consultation with other States, Tribes, state and federal natural resource agencies, EPA, and major stakeholders and the general public. The following is a brief summary of the consultation requirements under the Regional Haze Rule. Chapters 13 and Appendix G contains a full description of the consultation process identified below, in developing the Oregon Regional Haze Plan.

2.1 Federal Land Manager Consultation

The Regional Haze Rule requires consultation between the State and FLMs related to development and implementation of regional haze plans. States need to provide FLMs and opportunity to comment at least 60 days prior to holding a public hearing on a proposed plan or plan revision. This includes commenting on the State's assessment of visibility impairment in each Class I area, and providing recommendations on the reasonable progress goals and visibility control strategies the State has proposed. States also need to provide the FLM an opportunity to comment on the five-year progress reports and other developing programs that may contribute to Class I visibility impairment.

2.2 State Consultation

Also required under the Regional Haze Rule is state-to-state consultation to develop coordinated regional haze strategies. Regional haze by definition is the long-range transport of air pollution, and as such includes identifying interstate transport issues. This requirement directs States to address emissions that are "reasonably anticipated to contribute to visibility impairment" and any Class I area in another State or States.

2.3 Tribal Consultation

Although tribal consultation is not required under the Regional Haze Rule, the Department views this as an important part of the consultation process, and actively pursued this during the development of the regional haze plan. Like the State consultation process above, consultation with Tribes involved reviewing major emission sources and regional haze strategies to address visibility issues.

CHAPTER 3: INTRODUCTION TO OREGON CLASS I AREAS

This chapter provides a map and description of the size, elevation, location, and other features of Oregon's 12 Class I areas.

Figure 3-1 Map of Oregon Class I Areas
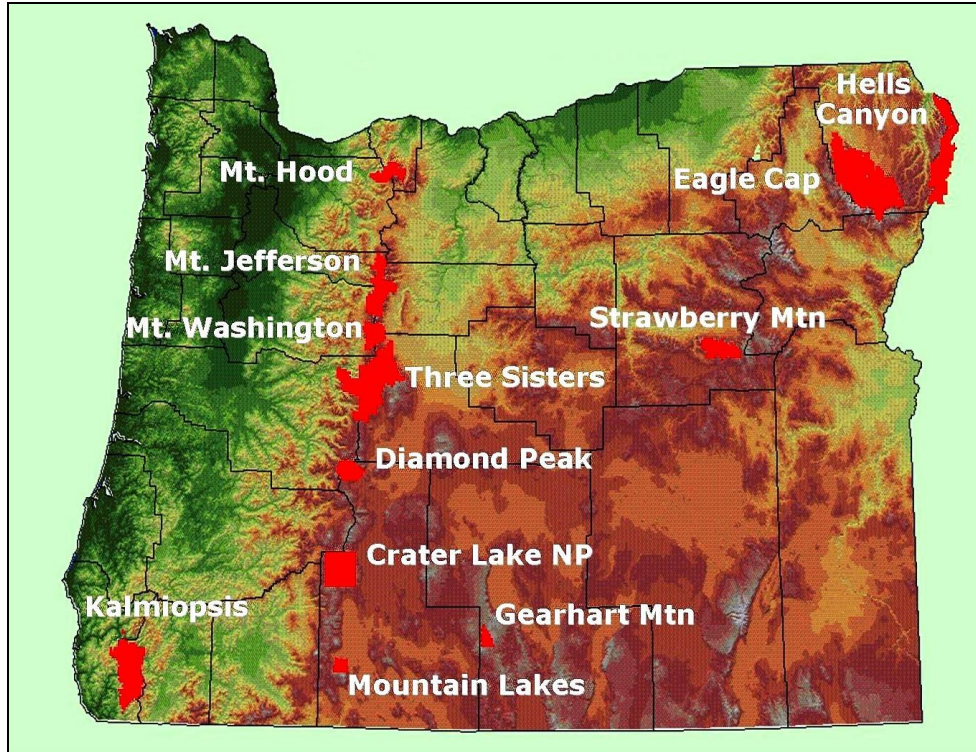
3.1 Mt. Hood Wilderness Area

Figure 3.1-1 presents a map of the Mt Hood Wilderness, which spans 47,160 acres on the slopes of Mt Hood in the northern Oregon Cascades. Wilderness elevations range from 3,426 m (11,237 ft) on the summit of Mt Hood down to almost 600 m (2,000 ft) at the western boundary. It is almost adjacent to the Portland Oregon metropolitan area; the westernmost boundary is about 20 km east of the Portland Oregon suburb of Sandy and 40 km from the heavily populated metropolitan center, elevation 100 m (300 ft). Visitation to the Mt. Hood Wilderness Area is approximately 50,000 visitors a year, primarily between May and October. Most visitors come from the Portland/Vancouver area that has a population of approximately 2 million.

Figure 3.1-1 Map of Mt. Hood Wilderness Area
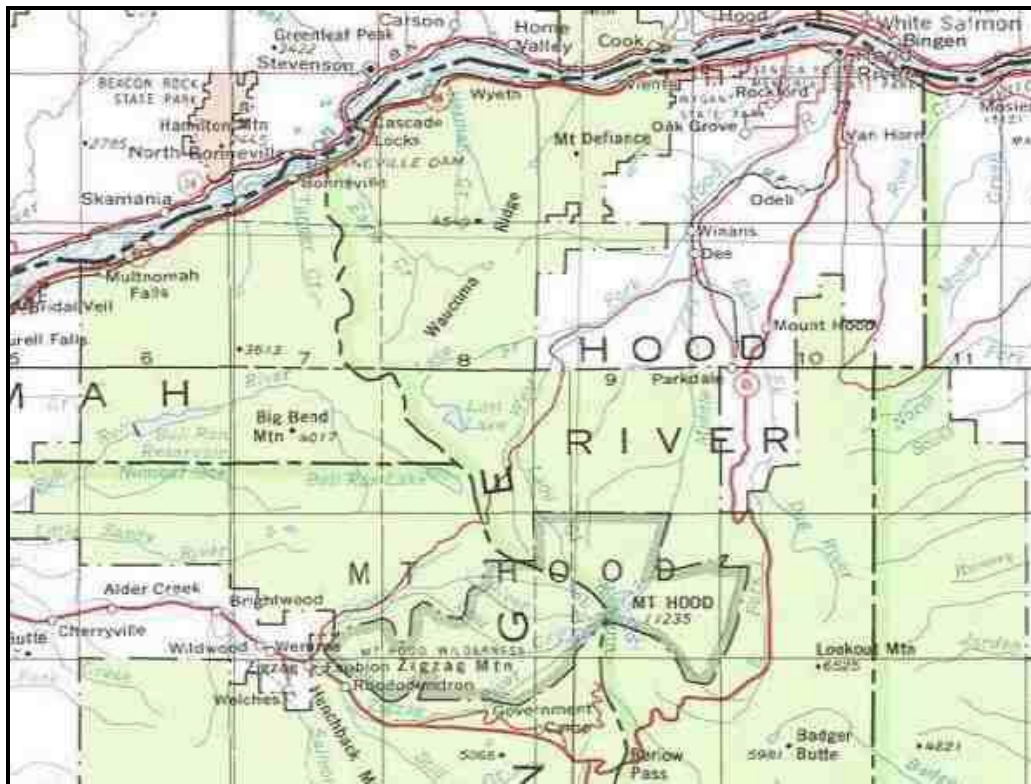
3.2 Mt. Jefferson Wilderness Area

Figure 3.2-1 presents a map of the Mt. Jefferson Wilderness Area, which occupies 107,008 acres on the crest of the Cascade Range in central Oregon. Its southern boundary is a few km north of the northern boundary of the Mt Washington Wilderness and it extends 40 to 50 km north along the Cascade crest. West of the crest, it consists primarily of the eastern side of the North Santiam River headwaters basin that connects to the Willamette Valley source region near Salem Oregon, 100 km (60 mi) to the west. East of the crest it occupies the western slopes of the Metolius River drainage that connects eastern slopes with Deschutes River in eastern Oregon. The highest Wilderness elevation is 3,200 m (10,497 ft) at the summit of Mt Jefferson in the northern part of the Wilderness. Lowest Wilderness elevations are near 1,000 m (3,000 ft) along the western boundary in the North Santiam headwaters basin and along the eastern boundary in the Metolius River basin.

Figure 3.2-1 Map of Mt. Jefferson Wilderness Area
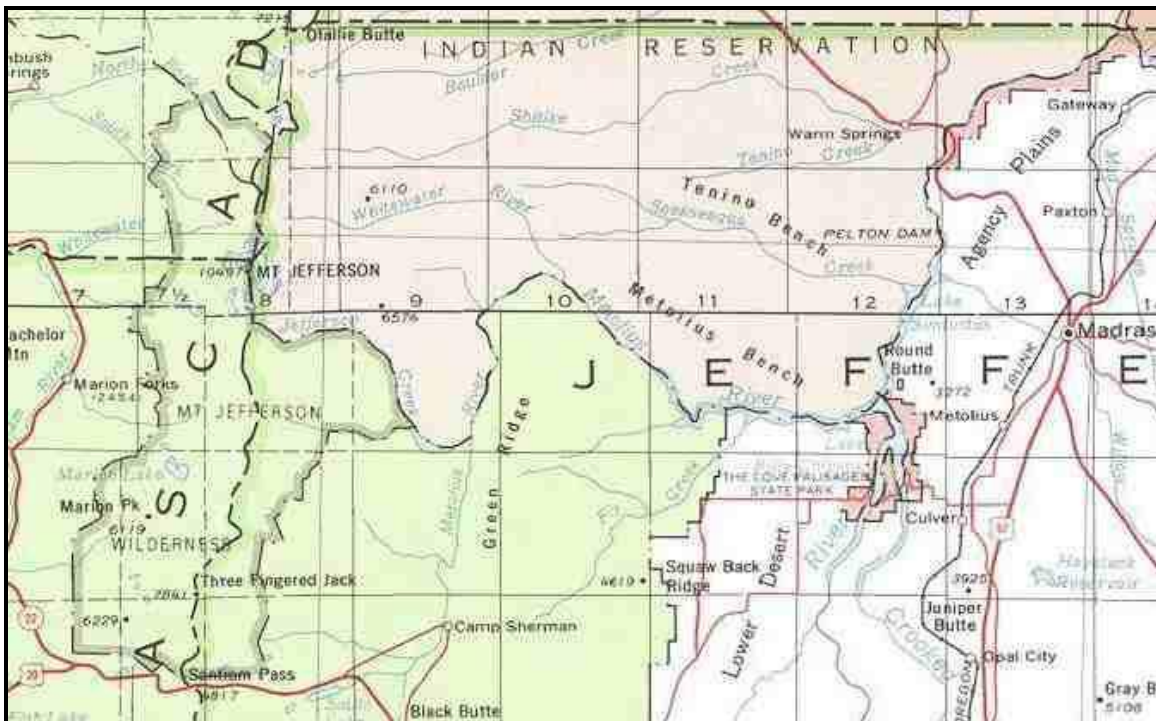
3.3 Mt. Washington Wilderness Area

Figure 3.3-1 presents a map of the Mt. Washington Wilderness Area, which occupies 52,516 acres on the crest of the Cascade Range in central Oregon. Like the Three Sisters Wilderness that it borders to the south, it includes headwaters tributaries of the McKenzie River that flow west into the Willamette Valley near Eugene and connect the Wilderness with that source region. On the east side eastern slopes of the Cascades descend to the Deschutes River near Bend. The highest Wilderness elevation is 2,376 m (7,794 ft) at the summit of Mt Washington. Lowest elevations are near 900 m (3,000 ft) in the upper headwaters basin of the McKenzie River.

Figure 3.3-1 Map of Mt. Washington Wilderness Area
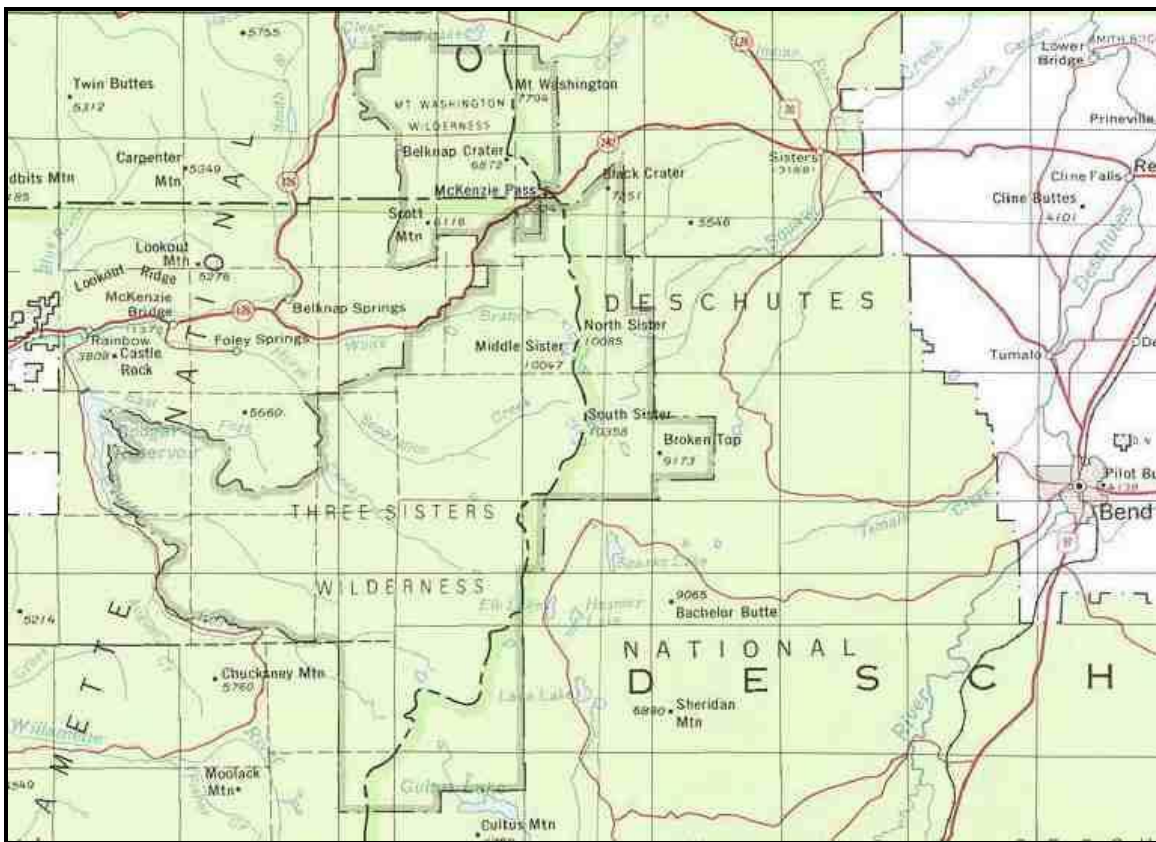
3.4 Three Sisters Wilderness Area

Figure 3.4-1 presents a map of the Three Sisters Wilderness Area, which consists of 285,202 acres abreast the crest of the Cascade Range in central Oregon. It includes headwaters tributaries of the McKenzie River that flow west into the Willamette Valley near Eugene and connect the Wilderness with that source region. On the east side streams flow east to the Deschutes River near Bend. The highest crest elevation is 3,158 m (10,358 ft) at the summit of the South Sister. Lowest elevations are near 600 m (2,000 ft) where the South Fork of the McKenzie River exits the Wilderness on the west boundary. This is about 500 m (1,600 ft) above the Willamette Valley at Eugene 70 km (40 mi) west.

Figure 3.4-1 Map of Three Sisters Wilderness Area
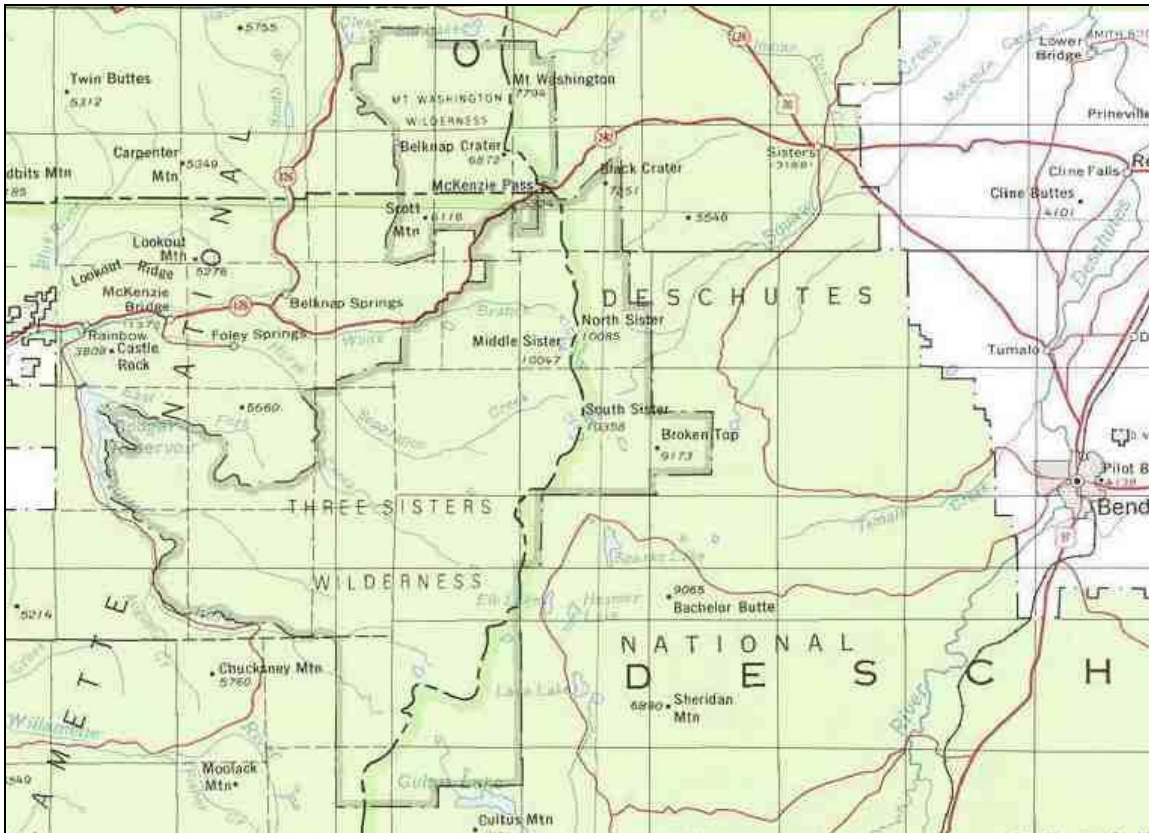
3.5 Diamond Peak Wilderness Area

Figure 3.5-1 presents a map of the 52,337 acre Diamond Peak Wilderness Area, which straddles the Cascade Range 50 km (30 mi) north of Crater Lake National Park. The highest crest elevation in the Wilderness is 2,666 m (8,744 ft) at Diamond Peak, which is also the highest summit in this region of the Cascade Range. Lowest elevations are near 1,450 m (5,000 ft) where streams exit the Wilderness on the west side. On the east side the Wilderness is bordered by mountain lakes with elevations from 1,459 m to 1,693 m (4,786 to 5,553 ft). The area includes headwaters of the Middle Fork of the Willamette River that flows to the Willamette Valley near Eugene, elevation 100 m (300 ft) and 90 km (60 mi) distant. Wilderness elevations are thus some 1,400 m (4,600 ft) above the Willamette Valley floor. East of the Cascade crest, streams flow to the Deschutes River in eastern Oregon.

Figure 3.5-1 Map of Diamond Peak Wilderness Area
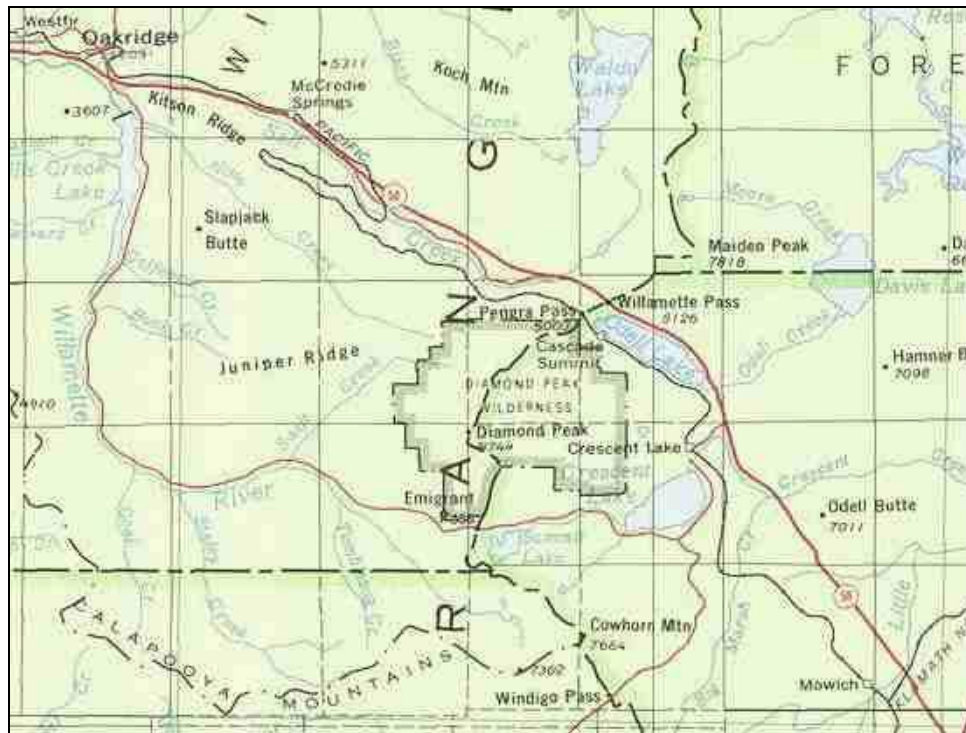
3.6 Crater Lake National Park

Figure 3.6-1 presents a map of Crater Lake National Park, the only national park in Oregon. The park was established on May 22, 1902, and now consists of 183,315 acres. It is located in southwestern Oregon on the crest of the Cascade Mountain range, 100 miles east of the Pacific Ocean. Rim elevations range from about 900 to 1,873 ft above lake level. The highest park elevation is 8,929 ft at the peak of Mt. Scott, in the eastern Park area. The National Park includes headwaters of the Rogue River that flows southwest towards the Medford/Grants Pass area, and Sun Creek/Wood River that flows southeast to the Klamath Falls area.

Figure 3.6-1 Map of Crater Lake NP
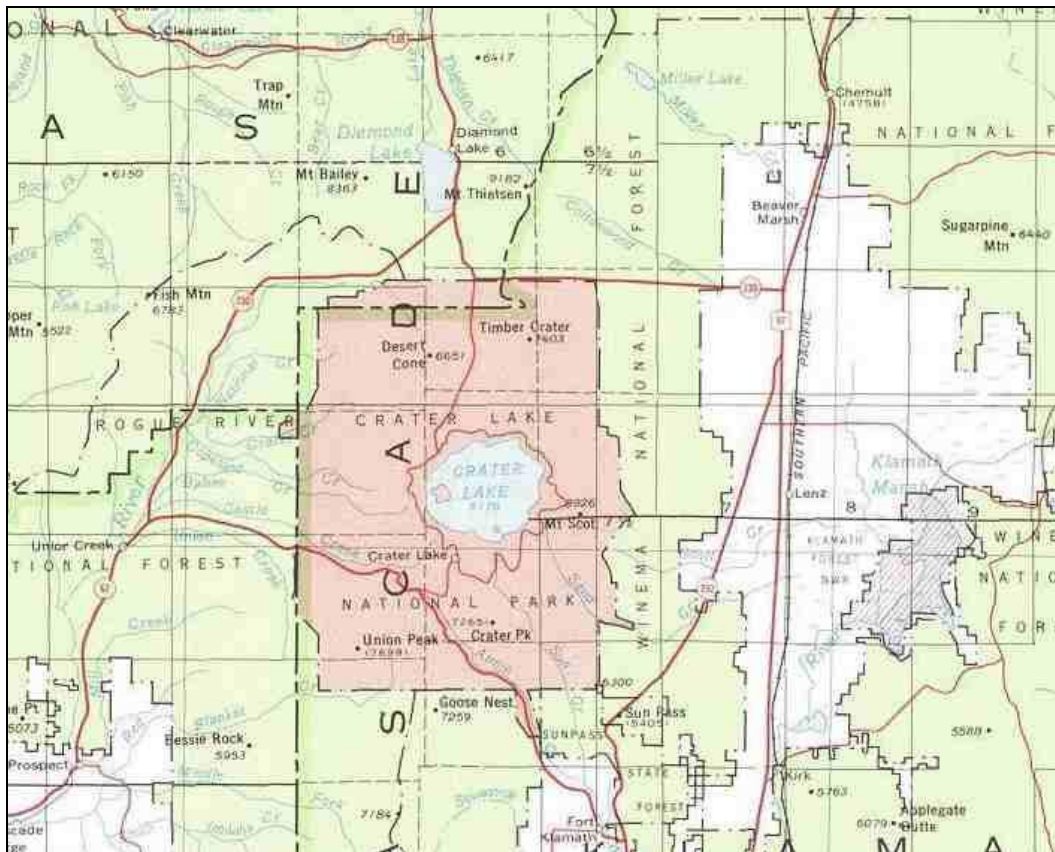
3.7 Mountain Lakes Wilderness Area

Figure 3.7-1 presents a map of the Mountain Lakes Wilderness Area, which is a relatively small Class 1 Area in southern Oregon of 23,071 acres, 50 km (30 mi) south of Crater Lake National Park. It consists of several peaks with a highest elevation of 2,502 m (8,208 ft) at the crest of Aspen Butte. Lowest elevations are near 1,500 m (5,000 ft). Primary drainages are Varney Creek and Moss Creek that flow into the Upper Klamath Lake, 3 km northeast of the Wilderness boundary.

Figure 3.7-1 Map of Mountain Lakes Wilderness Area

3.8 Gearhart Mountain Wilderness Area

Figure 3.8-1 presents a map of the Gearhart Mountain Wilderness Area, which comprises 22,809 acres on the flanks of Gearhart Mountain in south central Oregon, primarily the northern slope and eastern drainages of Gearhart Mountain, the dominant topographic feature. Elevations range from near 5,900 ft at the North Fork of the Sprague River in the northern Wilderness to 8,364 ft at the summit of Gearhart Mountain.

Figure 3.8-1 Map of Gearhart Mountain Wilderness Area
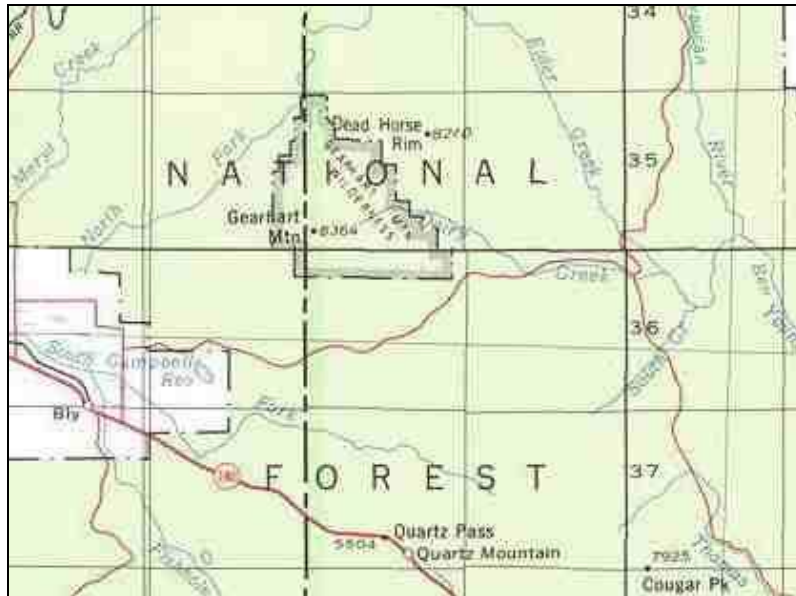
3.9 Kalmiopsis Wilderness Area

Figure 3.9-1 presents a map of the Kalmiopsis Wilderness Area, which currently spans a total of 179,700 acres and is managed by the U.S. Forest Service. The Kalmiopsis Wilderness is located in the Klamath Mountains of southwestern Oregon, part of the coastal temperate rainforest zone that lies between the Pacific Ocean and the east side of the coast ranges in northwestern U.S. and Canada. Its western boundary is 20 to 25 km (12 to 15 mi) from the coast. Its easternmost extent is about 40 km (25 mi) from the coast. Elevations range from about 300 m (900 ft) on the western boundary where the Chetco River exits the Wilderness towards the Pacific Ocean 25 to 30 miles further west, to 1,554 m (5,098 ft) on Pearsoll Peak on the eastern Wilderness boundary. Terrain is steep canyons and long broad ridges. The Wilderness is mostly west of the general crest of the coast range, thus exposed to precipitation caused by lifting of eastward moving maritime air, primarily during the winter. Precipitation ranges from 150 to 350 cm (60 to 140 in) annually, depending on elevation.

Figure 3.9-1 Map of Kalmiopsis Wilderness Area

3.10 Strawberry Mountain Wilderness Area

Figure 3.10-1 presents a map of the Strawberry Mountain Wilderness Area, which consists of 69,350 acres in eastern Oregon, just east of John Day. The Wilderness comprises most of the Strawberry Mountain Range. Terrain is rugged, with elevations ranging from 1,220 m (4,000 ft) to 2,755 m (9,038 ft) at the summit of Strawberry Mountain. It borders the upper John Day River valley to the north.

Figure 3.10-1 Map of Strawberry Mountain Wilderness Area

3.11 Eagle Cap Wilderness Area

Figure 3.11-1 presents a map of the Eagle Cap Wilderness Area, which comprises 360,275 acres in northeastern Oregon. Terrain is characterized by bare peaks and ridges and U-shaped glaciated valleys. Elevations range from 5,000 ft in lower valleys to near 10,000 ft at the highest mountain summits. The Lostine and Minam Rivers flow north from the center of the Wilderness towards Pendleton and the Columbia, 130 km northwest.

Figure 3.11-1 Map of Eagle Cap Wilderness Area
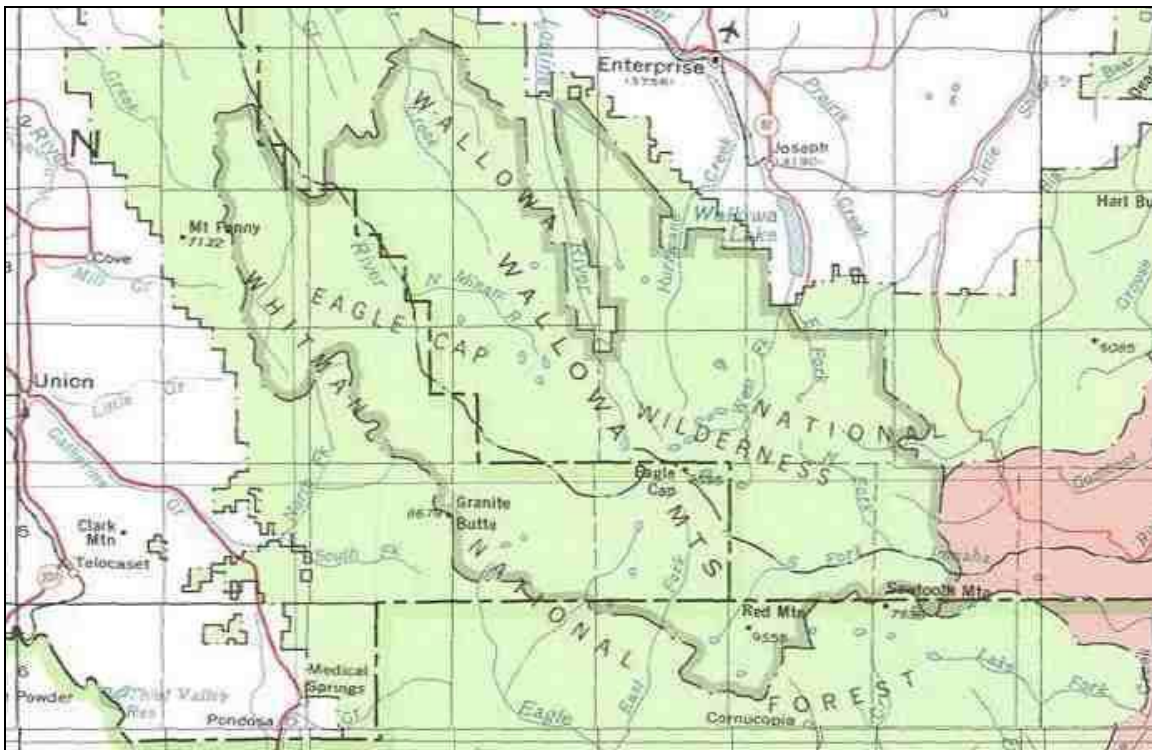
3.12 Hells Canyon Wilderness Area

Figure 3.12-1 a presents a map of the Hells Canyon Wilderness Area, which consists of 214,944 acres, and is located on the Oregon-Idaho border. The Snake River divides the wilderness, with 131,133 acres in Oregon, and 83,811 acres are in Idaho. It is managed by the Bureau of Land Management and the Forest Service. The Snake River canyon is the deepest river gorge in North America. The higher terrain is located on the Oregon side. Popular Oregon-side viewpoints are McGraw, Hat Point, and Somers Point.

Figure 3.12-1 Map of Hells Canyon Wilderness Area
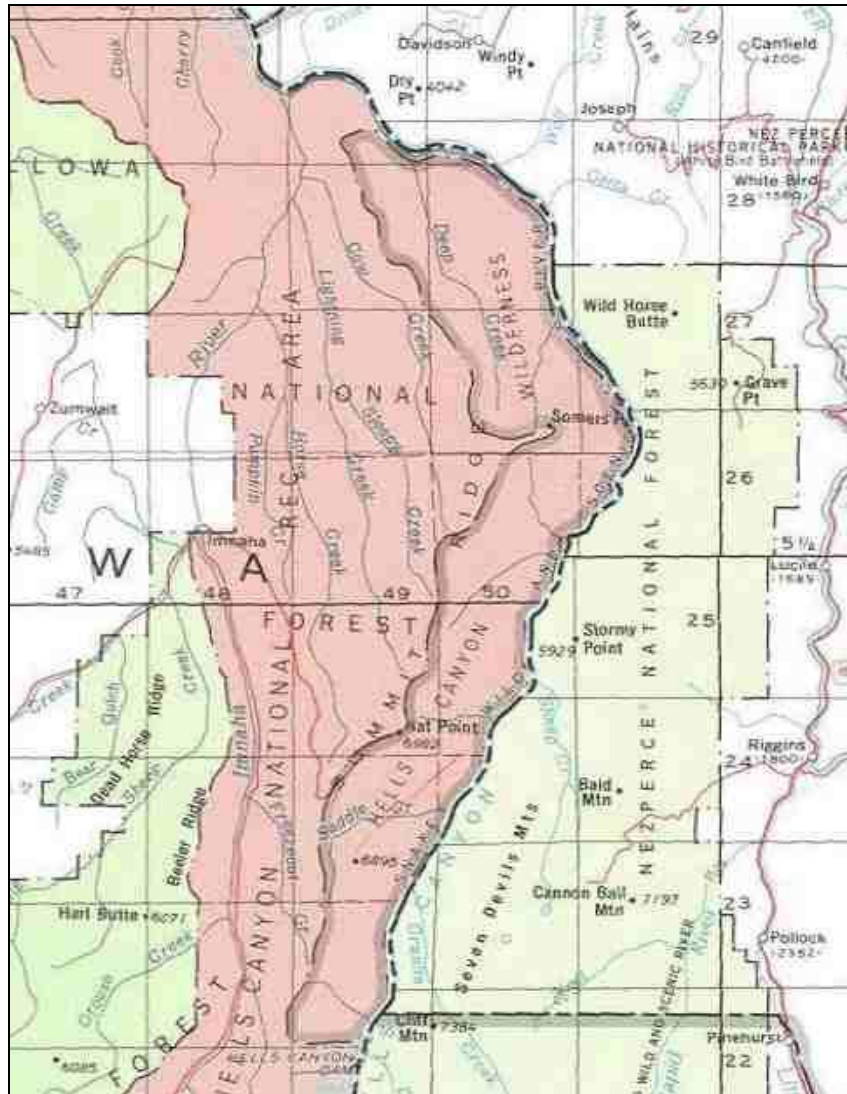
CHAPTER 4: TECHNICAL INFORMATION AND DATA RELIED UPON IN THIS PLAN

This chapter describes the information relied upon by the Department in developing this regional haze plan. The first part of this chapter describes the Western Air Regional Partnership (WRAP) organization and work products relied upon by the Department. The second part describes the IMPROVE monitoring data and network that is used throughout the country by states in measuring Class I area visibility.

4.1 The WRAP and Technical Support

As described in Section 1.5.5 of this plan, the WRAP is a voluntary organization of western states, tribes and federal agencies. It was formed in 1997 as the successor to the Grand Canyon Visibility Transport Commission. It is a regional planning organization that provides assistance to western states like Oregon in the preparation of regional haze plans. The WRAP is also implementing regional planning processes to improve visibility in all Western Class I areas by providing the technical and policy tools needed by states and tribes to implement the federal regional haze rule. The WRAP is administered jointly by the Western Governors' Association (WGA) and the National Tribal Environmental Council (NTEC).

The WRAP is made up of western states, tribes and federal agencies. The states are Alaska, Arizona, California, Colorado, Idaho, Montana, New Mexico, North Dakota, Oregon, South Dakota, Utah, Washington, and Wyoming. Tribal board members include Campo Band of Kumeyaay Indians, Confederated Salish and Kootenai Tribes, Cortina Indian Rancheria, Hopi Tribe, Hualapai Nation of the Grand Canyon, Native Village of Shungnak, Nez Perce Tribe, Northern Cheyenne Tribe, Pueblo of Acoma, Pueblo of San Felipe, and Shoshone-Bannock Tribes of Fort Hall. Representatives of other tribes participate on WRAP forums and committees. Participation is encouraged throughout the Western states and tribes. Federal participants are the Department of the Interior (National Park Service and Fish & Wildlife Service,) the Department of Agriculture (Forest Service), and the Environmental Protection Agency.

4.1.1 WRAP Committee's and Workgroups

1. Initiatives Oversight Committee
The Initiatives Oversight Committee is responsible for establishing and overseeing the work of forums that develop policies and programs to improve and protect our air quality. IOC forums are:

The Air Pollution Prevention Forum
The Air Pollution Prevention Forum is tasked with developing energy conservation initiatives and programs to expand the use of renewable energy sources. They are working to find, and encourage use of, energy sources that minimize air pollution.

The Economic Analysis Forum

This Forum assists with studies to evaluate the economic effects of air quality programs being developed by the WRAP to diminish haze throughout the West.

The Forum on Emissions In/Near Class 1 Areas
This Forum is looking at pollution sources in and near federally mandated Class 1 areas to determine their impact on visibility in those areas. The group also will address mitigation and outreach options.

The Mobile Sources Forum
This Forum addresses the impact of motor vehicles and other mobile sources of pollution. For example, the Forum developed a plan presented to the WRAP, suggesting a revision of U.S. Environmental Protection Agency rules regarding the production of low-sulfur fuel by small refineries. The Forum also recommended reforms for off-road emissions and diesel fuel.

2. Technical Oversight Committee
The Technical Oversight Committee's tasks are to identify and manage technical issues and to establish and oversee the work of forums and work groups that are developing and analyzing, scientific information related to air quality planning in the West. TOC forums and work groups include:

The Air Quality Modeling Forum
This Forum identifies, evaluates the performance of, and applies mathematical air quality models, which can be used to quantify the benefits of various air quality programs for reducing haze in the western United States.

The Ambient Monitoring and Reporting Forum
This Forum oversees the collection, use, and reporting of ambient air quality and meteorological monitoring data as needed to further the WRAP's overall goals.

The Emissions Forum
This Forum is developing the first comprehensive inventory of haze-causing air emissions in the West, including a comprehensive emissions tracking and forecasting system. The forum also monitors trends in actual emissions and forecasts emissions reductions anticipated from current regulations and alternative control strategies.

Attribution of Haze Work Group
This Work Group is preparing guidance for states and tribes regarding both the types of pollution emitters and the regions in which pollutants contribute to visibility impairment in national parks and other Class 1 wilderness areas. Three state and three tribal representatives form the work group along with all members of the Technical Oversight Committee and one representative each from the Initiatives Oversight Committee, the technical and joint forums and the Tribal Data Development Work Group.

The Tribal Data Development Work Group
This Work Group is identifying gaps in air quality data for tribal lands and working with tribes to collect that data. While some tribes have adequate staff and equipment for such an undertaking, many lack the manpower and technical resources to accomplish the work on their own. This Work Group is providing help by both enhancing the tribes' ability to collect the necessary data and establishing an organized way to standardize and catalogue the information for subsequent analysis.

3. WRAP Working Committees and Forums

Implementation Work Group
The purpose of this work group is to bring together state and tribal staff involved in the development of regional haze plans, to meet the requirements of the Regional Haze Rule. This work group discusses the major strategies associated with state and tribal regional haze plans, issues associated with plan development and rule interpretation, and coordination and consultation between states, tribes, EPA, and the FLMs on these topics. State representatives on this work group are the primary regional haze plan writers.

Joint Technical and Policy Forums
Joint Forums address both technical issues and policy. Both the TOC and the IOC have oversight.

The Dust Emissions Joint Forum
This Forum is seeking first to improve the methods for estimating dust emissions and their inputs in air quality models. The Forum also is examining the extent of dust impacts and strategies to reduce dust emissions.

The Fire Emissions Joint Forum (FEJF)
The Grand Canyon Commission confirmed that forest fires contribute significantly to visibility problems and that the use of prescribed fire is expected to increase as a forest management tool. The Fire Emissions Joint Forum is developing measures to reduce the effects of prescribed fires and is examining emissions from all kinds of fire, whether ignited naturally or by humans. The Forum is considering public health and nuisance effects as well as visibility impacts. It will develop a tracking system for fire emissions and management techniques to minimize emissions. This Forum is working to coordinate with and gain the full cooperation of federal, tribal, state, and local agencies as well as private landowners, forest managers, and the agriculture community.

The Stationary Sources Joint Forum
The Stationary Sources Joint Forum, formerly the Market Trading Forum, developed the details of an emissions trading program to achieve cost-effective reductions from industrial sources of sulfur dioxide. The Forum first set emission milestones for sulfur dioxide between now and 2018 and then designed a trading program to be triggered if these emission targets are exceeded. The Forum is now examining other industrial source emissions, such as oxides of nitrogen and particulate matter, and is assisting WRAP members in compliance with the stationary source provisions of the regional haze rule.

4.1.2 WRAP TSS

The primary purpose of the TSS is to provide key summary analytical results and methods documentation for the required technical elements of the Regional Haze Rule, to support the preparation, completion, evaluation, and implementation of the regional haze implementation plans to improve visibility in Class I areas. The TSS provides technical results prepared using a regional approach, to include summaries and analysis of the comprehensive datasets used to identify the sources and regions contributing to regional haze in the Western Regional Air Partnership (WRAP) region.

The secondary purpose of the TSS is to be the one-stop-shop for access, visualization, analysis, and retrieval of the technical data and regional analytical results prepared by WRAP Forums and Workgroups in support of regional haze planning in the West. The TSS specifically summarizes results and consolidates information about air quality monitoring, meteorological and receptor modeling data analyses, emissions inventories and models, and gridded air quality/visibility regional modeling simulations. These copious and diverse data are integrated for application to air quality planning purposes by prioritizing and refining key information and results into explanatory tools.

Additional information on the TSS is provided in Appendix C.

4.2 IMPROVE Monitoring

4.2.1 Background on IMPROVE Monitoring

In the mid-1980's, the Interagency Monitoring of PROtected Visual Environments (IMPROVE) program was established to measure visibility impairment in mandatory Class I Federal areas throughout the United States. The monitoring sites are operated and maintained through a formal cooperative relationship between the EPA, National Park Service, U.S. Fish and Wildlife Service, Bureau of Land Management, and U.S. Forest Service. In 1991, several additional organizations joined the effort: State and Territorial Air Pollution Program Administrators and the Association of Local Air Pollution Control Officials, Western States Air Resources Council, Mid-Atlantic Regional Air Management Association, and Northeast States for Coordinated Air Use Management.

The objectives of the IMPROVE program include establishing the current visibility and aerosol conditions in mandatory Class I federal areas; identifying the chemical species and emission sources responsible for existing human-made visibility impairment; documenting long-term trends for assessing progress towards the national visibility goals; and support the requirements of the Regional Haze Rule by providing regional haze monitoring representing all visibility-protected federal Class I areas where practical.

Figure 4.2.1-1 shows a typical IMPROVE site, and Figure 4.2.1-2 shows the four separate modules used for sampling the different pollutant species.

Figure 4.2.1-1 Picture of an IMPROVE Monitoring Site

The IMPROVE sampler consists of four separate modules for measuring regional haze.

Figure 4.2.1-2 IMPROVE Sampler Modules
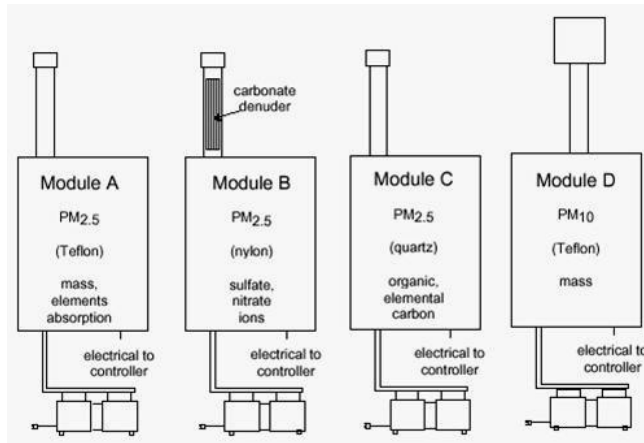
The data collected at the IMPROVE monitoring sites are used by land managers, industry planners, scientists, public interest groups, and air quality regulators to better understand and protect the visual air quality resource in Class I areas. Most importantly, the IMPROVE Program scientifically documents the visual air quality of their wilderness areas and national parks.

4.2.2 Formula for Reconstructed Light Extinction

The IMPROVE program has developed methods for estimating light extinction from speciated aerosol and relative humidity data. The three most common metrics used to describe visibility impairment are:

- **Extinction (b_{ext})** – Extinction is a measure of the fraction of light lost per unit length along a sight path due to scattering and absorption by gases and particles, expressed in inverse Megameters (Mm^{-1}). This metric is useful for representing the contribution of each aerosol species to visibility impairment and can be practically thought of as the units of light lost in a million meter distance.

- **Visual Range (VR)** – Visual range is the greatest distance a large black object can be seen on the horizon, expressed in kilometers (km) or miles (mi).

- **Deciview (dv)** – This is the metric used for tracking regional haze in the RHR. The deciview index, was designed to be linear with respect to human perception of visibility. A one deciview change is approximately equivalent to a 10% change in extinction, whether visibility is good or poor. A one deciview change in visibility is generally considered to be the minimum change the average person can detect with the naked eye. See Section 5.3 for additional information.

The IMPROVE network estimates light extinction based upon the measured mass of various contributing aerosol species. EPA's 2003 guidance for calculating light extinction is based on the original protocol defined by the IMPROVE program in 1988. (For further information, see http://vista.cira.colostate.edu/improve/Publications/GuidanceDocs/guidancedocs.htm.) In December 2005, the IMPROVE Steering Committee voted to adopt a revised algorithm for use by IMPROVE as an alternative to the original approach.

The revised algorithm for estimating light extinction is calculated as recommended for use by the IMPROVE steering committee using the following equations:

$$
\begin{aligned}
b_{ext} \approx\ & 2.2 \times f_s(RH) \times \overline{[\text{Small Amm. Sulfate}]} + 4.8 \times f_L(RH) \times \overline{[\text{Large Amm. Sulfate}]} \\
& + 2.4 \times f_s(RH) \times \overline{[\text{Small Amm. Nitrate}]} + 5.1 \times f_L(RH) \times \overline{[\text{Large Amm. Nitrate}]} \\
& + 2.8 \times \overline{[\text{Small POM}]} + 6.1 \times \overline{[\text{Large POM}]} \\
& + 10 \times \overline{[\text{EC}]} \\
& + 1 \times \overline{[\text{Soil}]} \\
& + 1.7 \times f_{ss}(RH) \times \overline{[\text{Sea Salt}]} \\
& + 0.6 \times \overline{[\text{CM}]} \\
& + 0.33 \times \overline{[\text{NO}_2(ppb)]} \\
& + \text{Rayleigh Scattering (Site Specific)}
\end{aligned}
$$

The revised algorithm splits ammonium sulfate, ammonium nitrate, and POM concentrations into small and large size fractions as follows:

$$\text{For } \text{Total} < 20\,\mu g/m^3 \begin{cases} \text{Large} = \dfrac{\text{Total}}{20} \times \text{Total} \\[3mm] \text{Small} = \text{Total} - \text{Large} \end{cases}$$

$$\text{For } \text{Total} \geq 20\,\mu g/m^3, \; \text{Large} = \text{Total}$$

4.3 Oregon IMPROVE Monitoring Network

In Oregon there are six IMPROVE monitors that are listed under the site name in Table 4-3-1. Three are located in the Oregon Cascades, two in Eastern Oregon, and one in the Coast Range. Since there are 12 Class I areas in Oregon, some monitors serve multiple Class I areas. While it is desirable to have one monitor per Class I area, in some cases one monitor can be "representative" of haze conditions in nearby Class I areas. Figure 4-3-1 shows the location of the IMPROVE monitors and the Class I areas covered by each monitor, as indicated by the yellow circles.

Table 4.3-1 Oregon IMPROVE Monitoring Network

Site Code	Class I Area	Sponsor	Elevation MSL	Start Date
MOHO1	Mt. Hood Wilderness	USFS	1531 m (5022 ft)	3/7/2000
THSI1	Mt. Jefferson Wilderness Mt. Washington Wilderness Three Sisters Wilderness	USFS	885 m (2903 ft)	7/24/1993
CRLA1	Crater Lake National Park; Diamond Peak Wilderness Mountain Lakes Wilderness Gearhart Mountain Wilderness	NPS	1996 m (6548 ft)	3/2/1988
KALM1	Kalmiopsis Wilderness	USFS	80 m (262 ft)	3/7/2000
STAR1	Strawberry Mountain Wilderness Eagle Cap Wilderness	USFS	1259 m (4130 ft)	3/7/2000
HECA1	Hells Canyon Wilderness Area	USFS	655 m (2148 ft)	8/1/2000

Figure 4.3-1 Map of Oregon IMPROVE Sites
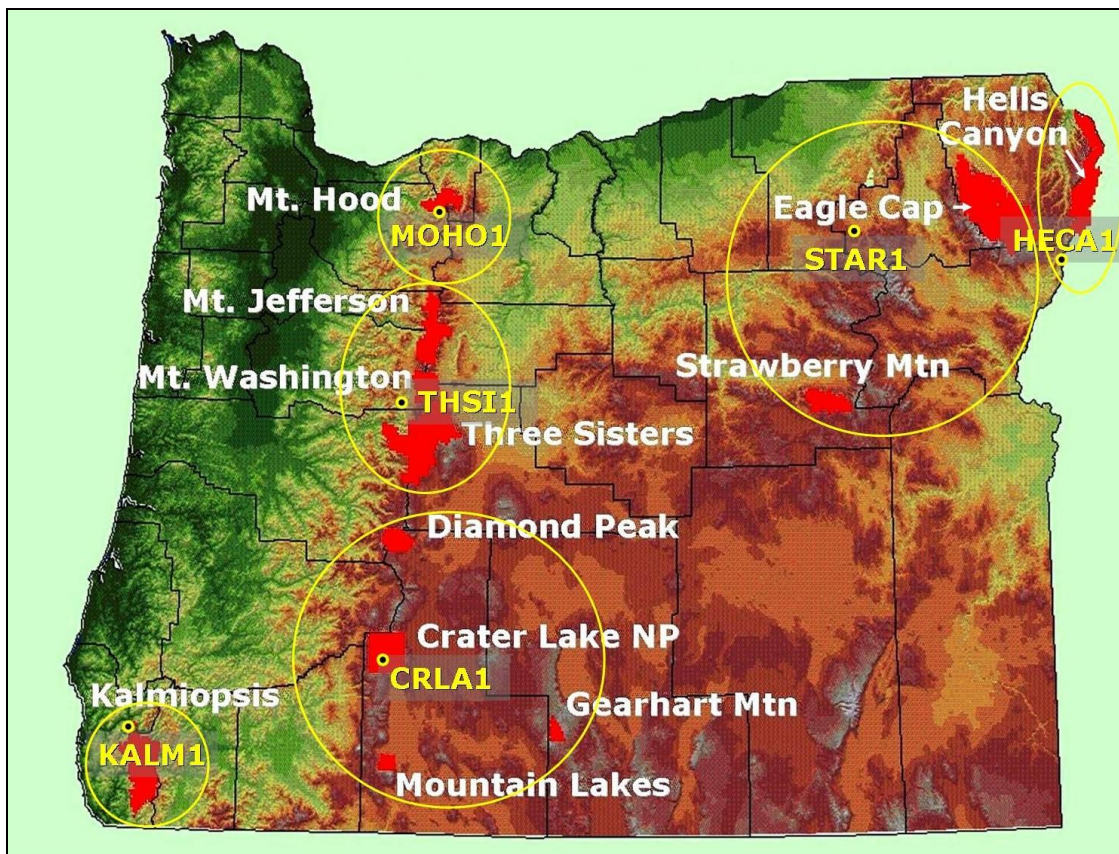
4.3.1 MOHO1

The MOHO1 IMPROVE site is the monitor for the Mt. Hood Wilderness Area. It is located just south of the wilderness boundary near Government Camp, at an elevation of 5,022 feet.

4.3.2 THSI1

The THSI1 IMPROVE site is the monitor for the Mt Washington, Three Sisters, and Mt Jefferson Wilderness Areas. It is located 5 miles to the west of Mt Washington, 12 miles southwest of Mt Jefferson, and 10 miles northwest of Three Sisters, at an elevation of 2,903 feet.

4.3.3 CRLA1

The CRLA1 IMPROVE site is the monitor for Crater Lake National Park, and is used as the representative site for Diamond Peak, Mountain Lakes, and Gearhart Mountain Wilderness Areas. It is located at the Park Headquarters in the park, to the south of the crater rim, at an elevation of 6,548 feet. The CRLA1 site is located 40 miles to the south of Diamond Peak, 35 miles to the north of Mountain Lakes, and 70 miles to the northeast of Gearhart Mountain.

4.3.4 KALM1

The KALM1 IMPROVE site is the monitor for the Kalmiopsis Wilderness Area. It is located 6 miles north of the wilderness boundary near where the Illinois River merges with the Rogue River, at an elevation of 262 feet.

4.3.5 STAR1

The STAR1 IMPROVE site is the representative monitoring site for the Strawberry Mountain and Eagle Cap Wilderness Areas. It is located 60 miles north of the Strawberry Mountain Wilderness, and 40 miles west of the Eagle Cap Wilderness, at an elevation of 4,130 feet.

4.3.6 HECA1

The HECA1 IMPROVE site is the monitor for the Hells Canyon Wilderness Area. It is located 10 miles south of the wilderness boundary, at an elevation of 2,148 feet.

4.4 Oregon Regional Haze Monitoring Commitments

Under Section 51.308(d)(4) of the Regional Haze Rule, the State must submit with the implementation plan a monitoring strategy for measuring, characterizing, and reporting of regional haze visibility impairment that is representative of all mandatory Class I Federal areas within the State. This monitoring strategy must be coordinated with the monitoring strategy required in Section 51.305 for reasonably attributable visibility impairment.

The State of Oregon has committed to continue utilizing the IMPROVE monitoring program to track reasonable progress over time. Also, Oregon will continue to develop and update emission inventories sufficient to allow for the tracking of emission increases or decreases attributable to adopted strategies or other factors such as growth, economic downturn, or voluntary or permit related issues. These monitoring and emissions data will be available for electronic processing in future modeling or other emission tracking processes. Information collected from the monitoring system and emission inventory work will be made available to the public on a periodic basis.

Oregon will rely upon WRAP technical support to meet its commitment to conduct the analyses necessary to meet the requirements of Section 51.308(d)(4).

Oregon will rely on the IMPROVE program to collect and report aerosol monitoring data for long-term reasonable progress tracking as specified in the Regional Haze Rule. Since this rule is a long-term tracking program with an implementation period over 60 years, Oregon expects that the IMPROVE program will provide data based on the following goals:

1) Maintain a stable configuration of the individual monitors and sampling sites, and stability in network operations for the purpose of continuity in tracking reasonable progress trends;
2) Assure sufficient data capture at each site of all visibility-impairing species;

3) Comply with EPA quality control and assurance requirements; and
4) Prepare and disseminate periodic reports on IMPROVE program operations.

Oregon is relying on the IMPROVE program to meet these monitoring operation and data collection goals, with the fundamental assumption that network data collection operations will not change, or if changed, will remain directly comparable to those operated by the IMPROVE program during the 2000-04 baseline period. Technical analyses and reasonable progress goals in this implementation plan for Regional Haze are based on data from these sites. As such, Oregon asks that the IMPROVE program identify potential issues affecting regional haze rule implementation trends and notify the State before changes in the IMPROVE program affecting a regional haze tracking site are made.

Further, Oregon notes that the human resources to operate these monitors are provided by Federal Land Management agencies. Beyond that in-kind contribution, resources for operation and sample analysis of a complete and representative monitoring network of these sites by the IMPROVE program in the WRAP region are a collaborative responsibility of members of the WRAP (EPA, states, tribes, and FLMs) and the IMPROVE program steering committee. Oregon will collaborate with the EPA, FLMs, other states, tribes, and the IMPROVE committee to assure adequate and representative data collection and reporting by the IMPROVE program.

Oregon depends on the following IMPROVE program-operated monitors at the following sites for tracking RHR reasonable progress:

Oregon IMPROVE Monitoring Sites: CRLA1, HECA1, KALM1, MOHO1, STAR1, THSI1	
Oregon Class I Areas covered by this network	Crater Lake NP, OR: Diamond Peak W, OR: Gearhart Mountain W, OR: Mountain Lakes W, OR; Class I Area - Hells Canyon W, ID; Class I Area - Kalmiopsis W, OR; Class I Area - Mount Hood W, OR; Class I Areas - Eagle Cap W, OR: Strawberry Mountain W, OR; Class I Areas - Mount Jefferson W, OR: Mount Washington W, OR: Three Sisters W, OR

Oregon will use data reported by the IMPROVE program as part of the regional technical support analysis tools found at the Visibility Information Exchange Web System (VIEWS) and the Technical Support System (TSS), as well as other analysis tools and efforts sponsored by the WRAP. Oregon will participate in the ongoing regional analysis activities of the WRAP to collectively assess and verify the progress toward reasonable progress goals, also supporting interstate consultation as the rule is implemented, and collaborate with WRAP members (EPA, states, tribes, and FLMs) to ensure the continued operation of these technical support analysis tools and systems. Oregon may conduct additional analyses as needed.

Oregon will depend on the routine timely reporting of haze monitoring data by the IMPROVE program for the reasonable progress tracking sites to the EPA air quality data system, VIEWS, and TSS. Oregon will collaborate with WRAP members (EPA, states, tribes, and FLMs) to ensure the continued operation of these technical support analysis tools and systems.

Oregon has prepared a statewide inventory of emissions that can reasonably be expected to cause or contribute to visibility impairment in Federal Class I Areas. Chapter 8, Section 8.1 of this plan summarizes Oregon emissions by pollutant and source category.

Oregon commits to updating statewide emissions periodically. The updates will be used for state tracking of emission changes, trends, and input into the WRAP's evaluation of whether reasonable progress goals are being achieved and other regional analyses. The inventories will be updated every three years on the same schedule as the every three-year reporting required by EPA's Consolidated Emissions Reporting Rule.

As a member of the WRAP, the state will continue to use the WRAP-sponsored Emissions Data Management System (EDMS) and Fire Emissions Tracking System (FETS) to store and access emission inventory data for the region. Oregon will also depend upon and participate in additional periodic collective emissions inventory efforts by the WRAP. Further, Oregon will continue to depend on and use the capabilities of the WRAP sponsored Regional Modeling Center (RMC) to simulate the air quality impacts of emissions for haze and other related air quality planning purposes. Oregon will collaborate with WRAP members (EPA, states, tribes, and FLMs) to ensure the continued operation of these technical support analysis tools and systems.

Oregon will track data related to regional haze plan implementation for sources for which the state has regulatory authority, and will depend on the IMPROVE program and WRAP-sponsored collection and analysis efforts and data support systems for monitoring and emissions inventory data, respectively. To ensure the availability of data and analyses to report on visibility conditions and progress toward Class I area visibility goals, Oregon will collaborate with WRAP members (EPA, states, tribes, and FLMs) to ensure the continued operation of the IMPROVE program and the WRAP-sponsored technical support analysis tools and systems.

CHAPTER 5: BASIC PLAN ELEMENTS

In order to better understand the information presented in the document, this chapter describes the basic plan elements and key concepts contained in the Oregon Regional Haze Plan.

5.1 Natural Sources of Visibility Impairment

Natural sources of visibility impairment include anything not directly attributed to human-caused emissions of visibility-impairing pollutants. Natural events (e.g. windblown dust, wildfire, volcanic activity, biogenic emissions) also introduce pollutants that contribute to haze in the atmosphere. Specific natural events can lead to high short-term concentrations of visibility-impairing particulate matter and its precursors. Therefore, natural visibility conditions, for the purpose of the Oregon regional haze program, are represented by a long-term average of conditions expected to occur in the absence of emissions normally attributed to human activities. Natural visibility conditions reflect contemporary vegetated landscape, land-use patterns, and meteorological/climatic conditions.

Natural sources, particularly wildfire and windblown dust, can be major contributors to visibility impairment. However, these emissions cannot be realistically controlled or prevented by the states, and therefore the focus of the regional haze strategies in this document are on human-caused (anthropogenic) sources, as described below. While current methods of analysis of monitoring data do not provide a clear distinction between natural and anthropogenic emissions, certain pollutant species, such as sulfur dioxide (SO_2) and nitrogen oxide (NO_x) are more representative of anthropogenic sources, while organic carbon (OC) and coarse particulate matter (PM_{10}) are more representative of natural sources such as wildfire and dust, respectively.

5.2 Human-Caused Sources of Visibility Impairment

Anthropogenic or human-caused sources of visibility impairment include anything directly attributable to human-caused activities that produce emissions of visibility-impairing pollutants. Some examples include industry, transportation, agriculture activities, home heating, and managed outdoor burning. Anthropogenic sources can be local, regional, or international. Efforts to regulate anthropogenic emissions are mostly limited to inside the United States. Emissions from Mexico & Canada, and off-shore marine shipping emissions in the Pacific Ocean, are examples of anthropogenic sources that contribute to visibility impairment in Oregon, but like natural sources, beyond the scope of this planning document.[2]

5.3 Deciview Measurement

Each IMPROVE monitor collects particulate concentration data which are converted into reconstructed light extinction through a complex calculation using the IMPROVE equation (see Technical Support Documents for any Class I area). Reconstructed light extinction (denoted as

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[2] As described in Chapter 9 and elsewhere in this document, international emissions from Canada, as well as offshore marine vessels, are major contributors to regional haze in Oregon.

bext) is expressed in units of inverse megameters (1/Mm or Mm-1). The Regional Haze Rule requires the tracking of visibility conditions in terms of the Haze Index (HI) metric expressed in the deciview (dv) unit (40 CFR 51.308(d)(2)). Generally, a one deciview change in the haze index is considered a humanly perceptible change under ideal conditions, regardless of background visibility conditions. The relationship between extinction (Mm-1), haze index (dv) and visual range (mi) are indicated by the following scale:

Extinction (Mm^{-1})	10	20	30	40	50	70	100	200	300	400	500	700	1000
Deciviews (dv)	0	7	11	14	16	19	23	30	34	37	39	42	46
Visual Range (mi)	250	125	80	60	50	37	25	13	8	6	5	3	2
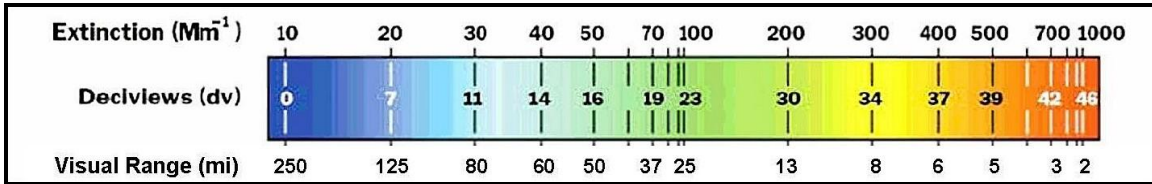
5.4 Baseline and Current Conditions

The Regional Haze Rule requires the calculation of baseline conditions for each Class I area. Baseline conditions are defined as the five year average (annual values for 2000 - 2004) of IMPROVE monitoring data (expressed in deciviews) for the most-impaired (20% worst) days and the least-impaired (20% best) days. For this first regional haze plan submittal, the baseline conditions are the reference point against which visibility improvement is tracked. For future plan progress reports and updates, baseline conditions are used to calculate progress from the beginning of the regional haze program. Current conditions for the best and worst days are calculated from a multiyear average, based on the most recent 5-years of monitored data available. This value will be revised at the time of each periodic plan revision, and will be used to illustrate: (1) The amount of progress made since the last plan revision, and (2) the amount of progress made from the baseline period of the program.

5.5 Natural Conditions

The visibility that would exist under natural conditions (absent any man-made impairment) would vary based on the contribution of natural sources and meteorological conditions on a given day. For that reason, natural conditions, as defined in this document, consists of a level of visibility (in deciviews) for both the most-impaired (20% worst) days and the least-impaired (20 % best) days. Since no visibility monitoring data exists from the pre-manmade impairment period, these estimates of natural conditions are based on EPA guidance on how to estimate natural conditions (EPA Document: *Guidance for Estimate Natural Visibility Conditions under the Regional Haze Rule*).

5.6 Reasonable Progress Goals

For each Class I area the State must establish goals (measured in deciviews) that provide for reasonable progress towards achieving natural visibility conditions. The reasonable progress goals (RPG) are interim goals that represent incremental visibility improvement over time for the most-impaired (20% worst) days and no degradation in visibility for the least-impaired (20% best) days. The first regional haze plan that States must submit to EPA needs to include RPGs for the year 2018, also known as the "2018 milestone year". The State has flexibility in

establishing different RPGs for each Class I area. In establishing the RPG, the State must consider four factors: the costs of compliance; the time necessary for compliance; the energy and non-air quality environmental impacts of compliance; and the remaining useful life of any potentially affected sources. States must demonstrate how these factors were taken into consideration in selecting the goal for each Class I area.

5.7 Uniform Rate of Progress

The uniform rate of progress (URP) is the calculation of the slope of the line between baseline visibility conditions and natural visibility conditions over the 60-year period. For the first regional haze plan, the first benchmark is the deciview level that should be achieved in 2018, as indicated in blue below as the first planning period (Figure 5.7-1). This is 2018 Milestone, and applies to both the 20% worst days and the 20% best days.

Figure 5.7-1 Example of How Uniform Rate of Progress is Determined
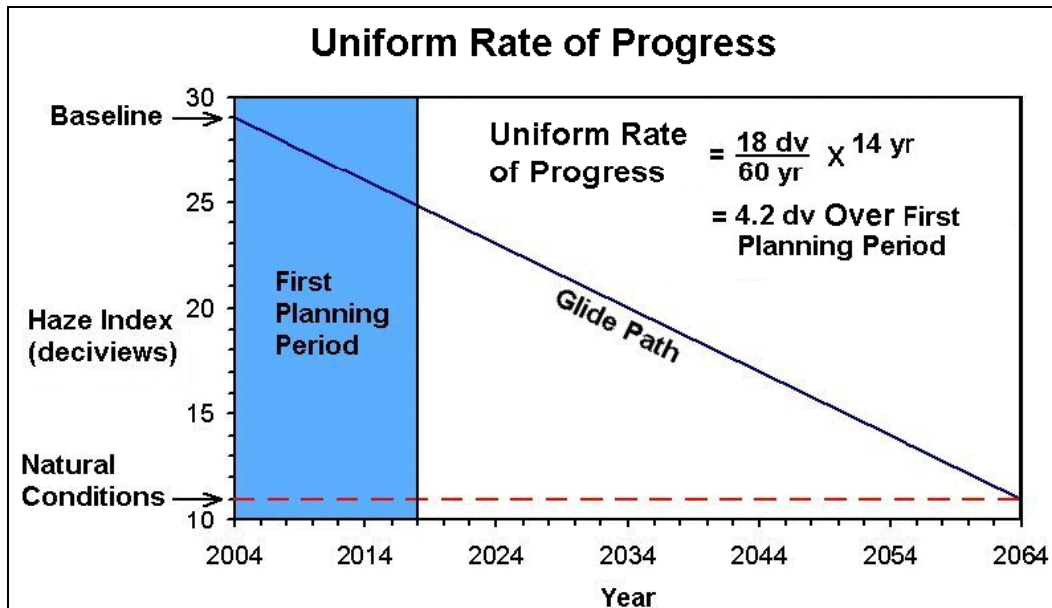
- Compare baseline conditions to natural conditions. The difference between these two represents the amount of progress needed to reach natural visibility conditions. In this example, the State has determined that the baseline for the 20 percent worst days for the Class I area is 29 dv and estimated that natural background is 11 dv, a difference of 18 dv.

- Calculate the annual average visibility improvement needed to reach natural conditions by 2064 by dividing the total amount of improvement needed by 60 years (the period between 2004 and 2064). In this example, this value is 0.3 dv/yr.

- Multiply the annual average visibility improvement needed by the number of years in the first planning period (the period from 2004 until 2018). In this example, this value is 4.2 dv. This is the uniform rate of progress that would be needed during the first planning period to attain natural visibility conditions by 2064.

The URP is not a presumptive target. When establishing RPGs, the State may determine RPGs at greater, lesser or equivalent visibility improvement than the URP. In cases where the RPG results in less improvement in 2018 than the URP, the State must demonstrate why the URP is not achievable, and why the RPGs are "reasonable".

For the 20% worst days, the URP is expressed in deciviews per year (i.e. slope of the glide path) is determined by the following equation:
URP = [Baseline Condition - Natural Condition] / 60 years

The 2018 Progress Goal (i.e. the amount of reduction necessary for the 1st planning period) is determined by multiplying the URP by the number of years in the 1st planning period.
2018 Progress Goal = [Uniform ROP] x [14 years]

The 14 years comprising the 1st planning period includes the 4 years between the baseline and the SIP submittal date plus the standard 10-year planning period.

5.8 Long-Term Strategy

The Regional Haze Rule also requires States to submit a long-term strategy that includes enforceable measures to achieve reasonable progress goals. The long-term strategy must identify all anthropogenic sources inside the State that are affecting Class I areas both inside and outside the State. The first long-term strategy will cover 10 to 15 years, with reassessment and revision of those goals and strategies in 2018 and every 10 years thereafter. At a minimum, the following factors must be considered in developing the long-term strategy:

- Measures to mitigate the impact of construction activities;
- Emission limitations and schedules for compliance to achieve the RPG;
- Source retirement and replacement schedules;
- Smoke management techniques for agricultural and forestry burning, including plans to reduce smoke impacts;
- Enforceability of emission limitations and control measures; and
- The anticipated net affect on visibility due to projected changes in point, area, and mobile source emissions over the period addressed of the long term strategy.

5.9 BART

The RPGs, the long-term strategy, and BART are the three main elements of a Regional Haze Plan. Best Available Retrofit Technology (BART) requirements apply to certain older industrial facilities that began operating before national rules were adopted in 1977 to prevent new facilities from causing visibility impairment. BART applies to facilities built between 1962 and 1977, have potential emissions greater than 250 tons per year, and which fall into one of 26 specific source categories. These facilities must be evaluated to see how much they contribute to regional haze and if retrofitting with controls is feasible and cost effective.

The BART process consists of three-steps: (1) determining BART-eligibility; (2) determining is a source is "subject to BART" by conducting modeling of Class I visibility impacts; and (3) conducting an analysis of BART controls (retrofitting) for those sources subject to BART that contribute to regional haze.

In determining BART controls, the State must take into account several factors, including the existing control technology in place at the source, the costs of compliance, energy and nonair environmental impacts of compliance, remaining useful life of the source, and the degree of visibility improvement that is reasonably anticipated from the use of such technology.

CHAPTER 6: BASELINE AND NATURAL VISIBILITY CONDITIONS, AND UNIFORM RATE OF PROGRESS

States and tribes are required to establish "reasonable progress goals" for each Class I area to improve visibility on the 20% haziest days and to prevent visibility degradation on the 20% clearest days. States are to evaluate their contributions to visibility impairment at Class I areas both within and outside the State and to develop long-term control strategies to reduce emissions of air pollutants that impair visibility. The national goal is to return visibility to natural background levels by 2064. Using the period 2000 to 2004 as the baseline period, the Uniform Rate of Progress (URP) is a linear rate of progress or "glide path" towards natural conditions in 2064. States are to evaluate progress in improving visibility to the 2018 URP planning goal, and every 10 years thereafter.

This chapter describes the URP for each of Oregon's 12 Class I areas. Chapter 7 provides information on monitoring data, sources of visibility impairment, and the emission reductions that will be needed to demonstrate reasonable progress for the 2018 planning goals. Chapter 8 provides information on state and regional emissions sources, and Chapter 9 presents an analysis of significant source contributions and improvements expected by 2018.

Table 6-1 below is a summary of the 20% worst and best days for Oregon's 12 Class I areas, comparing baseline conditions (2000-04) to estimated natural conditions in 2064. For the 20% worst days, the 2018 URP is indicated, and the reduction needed (in deciview) to achieve the URP. Class I areas are grouped by the IMPROVE monitoring site that represents each area.

Sections 6-1 through 6-6 show figures of the URP for each Class I area. Following these figures are photographs of haze conditions for each Class I area. Each photograph lists the deciview level, light extinction measurement, and the viewing distance (standard visual range) in kilometers/miles at the bottom. No images were available for Mountain Lakes Class I area. The photographs visually show the 20% worst and best days for baseline and natural conditions. Where available, these haze conditions were simulated using ARS' WinHaze Visual Air Quality Modeler (Ver. 2.9.6). If images were not available in the WinHaze program, images were assembled using photographs and associated haze condition estimates from archives from the US Forest Service Air Monitoring Program.

Table 6-1 20% Best and Worst Days Baseline, Natural Conditions, and Uniform Rate of Progress Goal for Oregon Class I Areas

Region	Oregon Class I Area	20% Worst Days				20% Best Days	
		2000-04 Baseline (dv)	2018 URP Goal (dv)	2018 Reduction Needed (dv)	2064 Natural Conditions (dv)	2000-04 Baseline (dv)	2064 Natural Conditions (dv)
Northern Cascades	Mt. Hood Wilderness Area	14.9	13.4	1.5	8.4	2.2	0.9
Central Cascades	Mt. Jefferson, Mt. Washington, and Three Sisters Wilderness Areas	15.3	13.8	1.5	8.8	3.0	1.9
Southern Cascades	Crater Lake National Park; Diamond Peak, Mountain Lakes, and Gearhart Mountain Wilderness Areas	13.7	12.3	1.4	7.6	1.7	0.1
Coast Range	Kalmiopsis Wilderness Area	15.5	14.1	1.4	9.4	6.3	3.7
Eastern Oregon	Strawberry Mountain and Eagle Cap Wilderness Areas	18.6	16.3	2.3	8.9	4.5	1.5
Eastern Oregon/ Western Idaho	Hells Canyon Wilderness Area	18.6	16.2	2.4	8.3	5.5	2.5

6.1 Northern Cascades – Mt. Hood Wilderness Area

The Mt. Hood (MOHO1) monitoring site represents the Mt. Hood Wilderness Class I Area in the northern cascades region of Oregon. Figure 6.1-1 shows baseline visibility conditions, the uniform rate of progress, the 2018 planning goal, and estimated 2064 natural conditions for the MOHO1 site.

Figure 6.1-2 is a split image which represents the current worst-day and estimated natural conditions for the Mt. Hood Wilderness Area, and Figure 6.1-3 is an image representing the current best-day visibility conditions for Mt. Hood.

Figure 6.1-1 MOHO1 Uniform Rate of Progress

Mount Hood Wilderness Area
MOHO1 IMPROVE Site (new IMPROVE algorithm)
Uniform Rate of Progress for 20% Best and Worst Visibility Days

Worst Days
Baseline = 14.9 dv

2018 Goal = 13.4 dv
(Reduction Needed = 1.5 dv)

Natural Conditions = 8.4 dv

Best Days
Baseline = 2.2 dv

Total Extinction (dv)
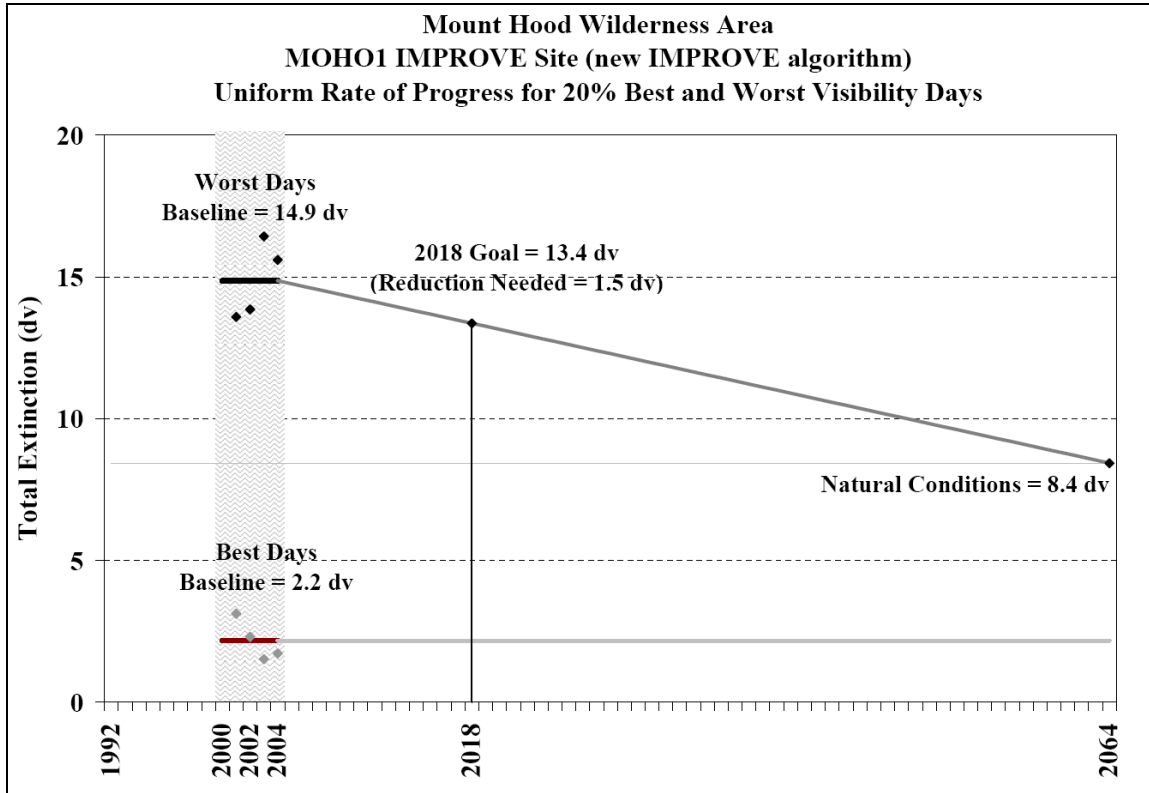
Figure 6.1-2 Mt. Hood Wilderness Area (Hickman Butte vista) Worst Days Baseline and Natural Conditions

2000-04 Worst Days Baseline
Haze Index = 14.9 dV
b_{ext} = 47.5 Mm^{-1}
SVR = 82 km/51 mi

2064 Natural Conditions
Haze Index = 8.4 dV
b_{ext} = 23.9 Mm^{-1}
SVR = 163 km/101 mi
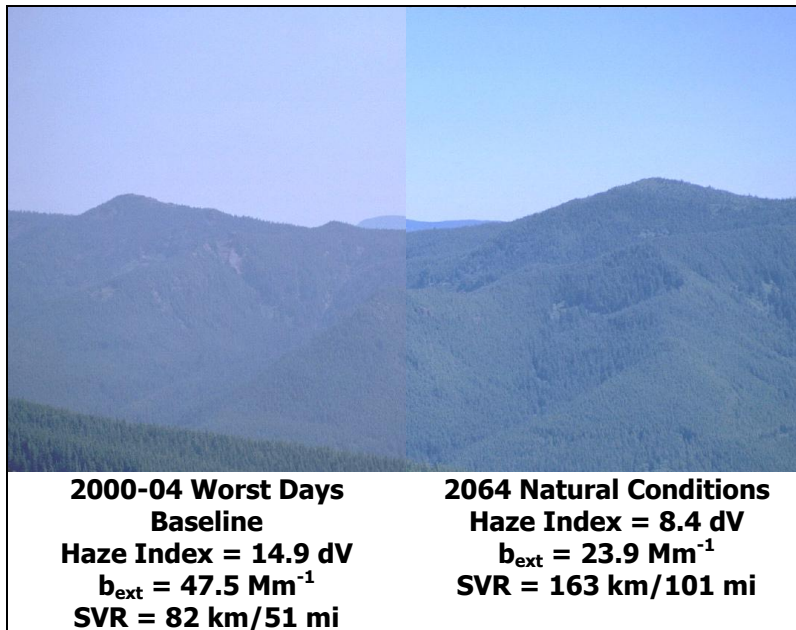
Composite of U.S. Forest Service Air Monitoring Program images

Figure 6.1-3 Mt. Hood Wilderness Area (Hickman Butte vista) Best Days Baseline Conditions

2000-04 Best Days Baseline
Haze Index = 2.2 dV
b_{ext} = 12.5 Mm^{-1}
SVR = 313 km/194 mi
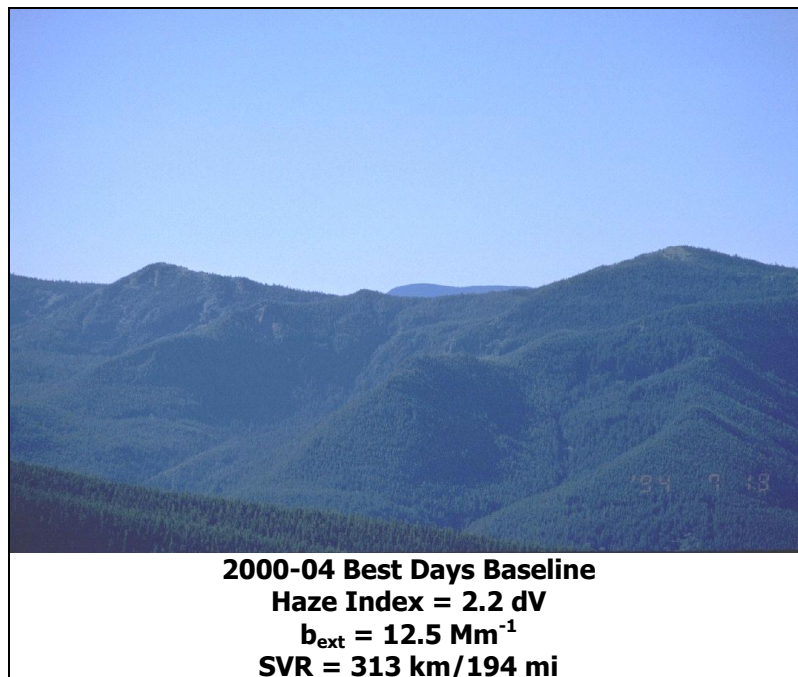
U.S. Forest Service Air Monitoring Program image

6.2 Central Cascades – Mt. Jefferson, Mt. Washington, and Three Sisters Wilderness Areas

The Three Sisters (THSI1) monitoring site represents three Class I areas in the Central Cascades, which include the Mt. Jefferson, Mt. Washington, and Three Sisters Wilderness Areas. Figure 6.2-1 shows the baseline visibility conditions, the uniform rate of progress, the 2018 planning goal, and estimated 2064 natural conditions for the THSI1 site.

Figure 6.2-2 is a split image which represents the current worst-day and estimated natural conditions for the Mt. Jefferson Wilderness Area, and Figure 6.2-3 is an image representing the current best-day visibility conditions for Mt. Jefferson. Figures 6.2-4 and 6.2-5 are similar images for the Mt. Washington Wilderness area, and Figures 6.2-6 and 6.2-7 are images from the Three Sisters Wilderness Area.

Figure 6.2-1 THSI1 Uniform Rate of Progress

Mt. Jefferson, Mt. Washington and Three Sisters Wilderness Areas
THSI1 IMPROVE Site (new IMPROVE algorithm)
Uniform Rate of Progress for 20% Best and Worst Visibility Days

Worst Days
Baseline = 15.3 dv

2018 Goal = 13.8 dv
(Reduction Needed = 1.5 dV)

Natural Conditions = 8.8 dv

Best Days
Baseline = 3.0 dv

Total Extinction (dv) (y-axis: 0, 5, 10, 15, 20)

(x-axis: 1992, 2000, 2002, 2004, 2018, 2064)
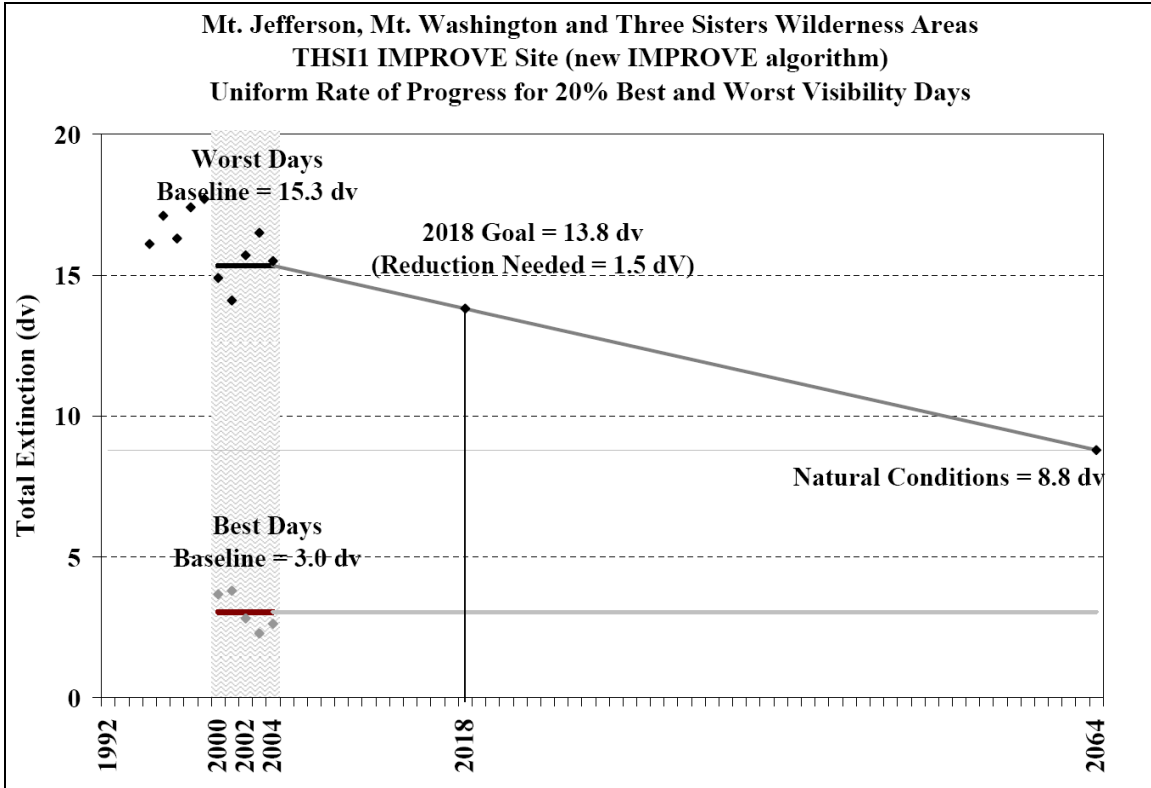
Figure 6.2-2 Mt. Jefferson Wilderness Area (Three Fingered Jack vista) Worst Days Baseline and Natural Conditions

2000-04 Worst Days Baseline
Haze Index = 15.3 dV
b_{ext} = 49.4 Mm^{-1}
SVR = 81 km/50 mi

2064 Natural Conditions
Haze Index = 8.8 dV
b_{ext} = 24.7 Mm^{-1}
SVR = 165 km/103 mi
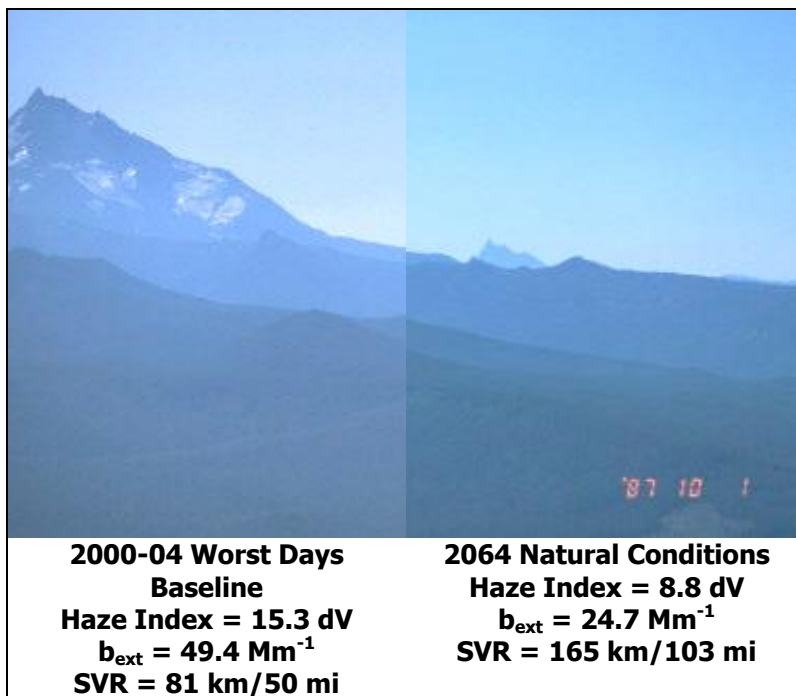
Composite of U.S. Forest Service Air Monitoring Program images

Figure 6.2-3 Mt. Jefferson Wilderness Area (Three Fingered Jack vista) Best Days Baseline Conditions

2000-04 Best Days Baseline
Haze Index = 3 dV
b_{ext} = 13.6 Mm^{-1}
SVR = 310 km/192 mi
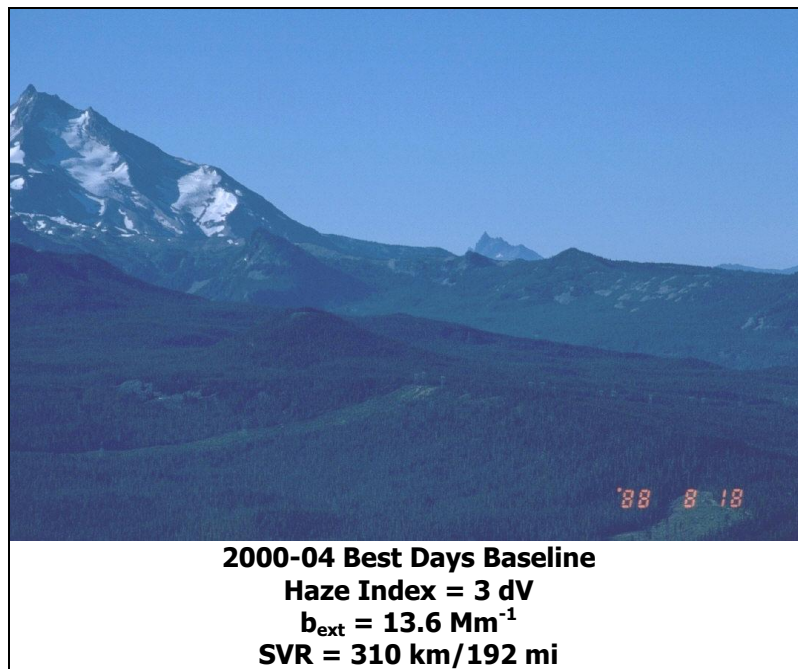
U.S. Forest Service Air Monitoring Program image

Figure 6.2-4 Mt. Washington Wilderness Area (Black Butte vista) Worst Days Baseline and Natural Conditions

2000-04 Worst Days
Baseline
Haze Index = 15.3 dV
b_{ext} = 49.4 Mm^{-1}
SVR = 81 km/50 mi

2064 Natural Conditions
Haze Index = 8.8 dV
b_{ext} = 24.7 Mm^{-1}
SVR = 165 km/103 mi
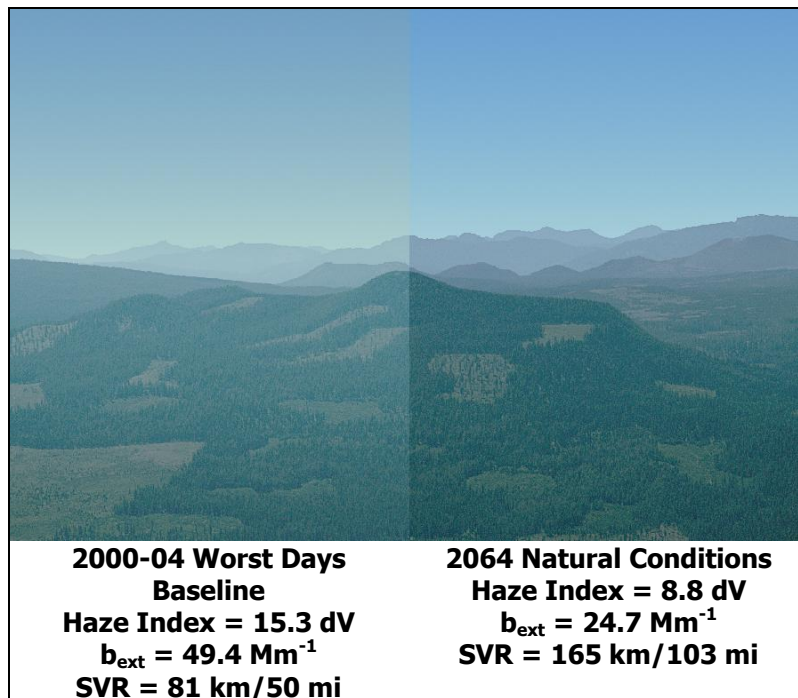
WinHAZE v2.9.6

Figure 6.2-5 Mt. Washington Wilderness Area (Black Butte vista) Best Days Baseline Conditions

2000-04 Best Days Baseline
Haze Index = 3 dV
b_{ext} = 13.6 Mm^{-1}
SVR = 310 km/192 mi
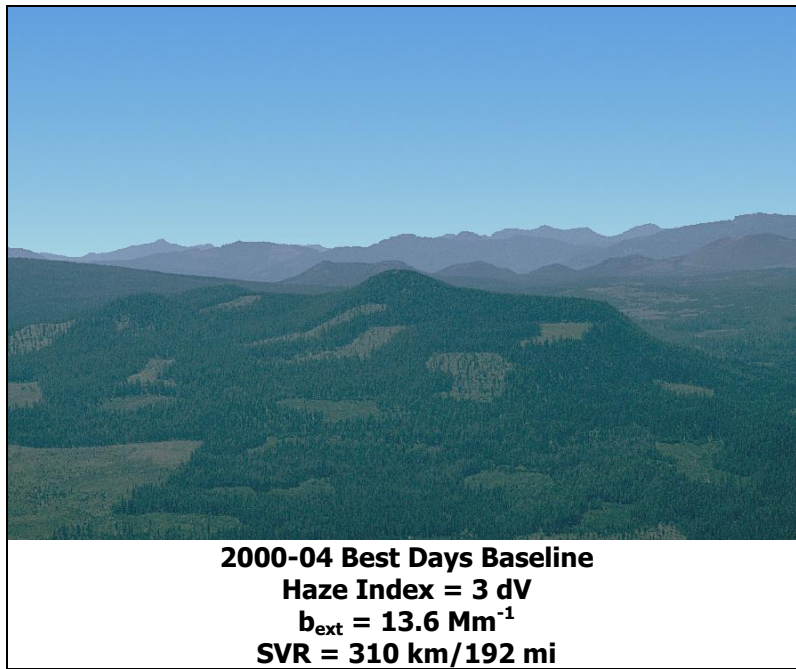
WinHAZE v2.9.6

Figure 6.2-6 Three Sisters Wilderness Area Worst Days Baseline and Natural Conditions

2000-04 Worst Days Baseline
Haze Index = 15.3 dV
b_{ext} = 49.4 Mm^{-1}
SVR = 81 km/50 mi

2064 Natural Conditions
Haze Index = 8.8 dV
b_{ext} = 24.7 Mm^{-1}
SVR = 165 km/103 mi
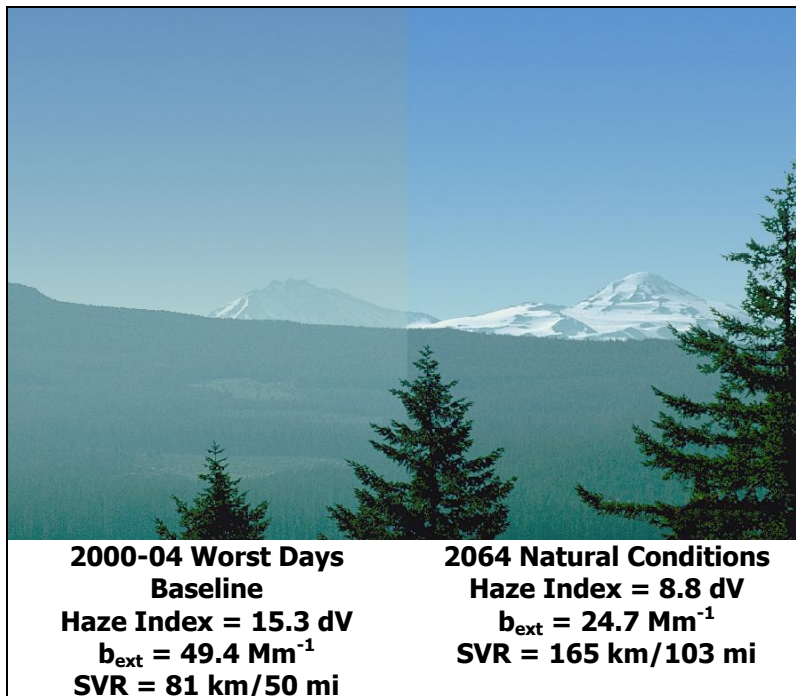
WinHAZE v2.9.6

Figure 6.2-7 Three Sisters Wilderness Area Best Days Baseline Conditions

2000-04 Best Days Baseline
Haze Index = 3 dV
b_{ext} = 13.6 Mm^{-1}
SVR = 310 km/192 mi

WinHAZE v2.9.6
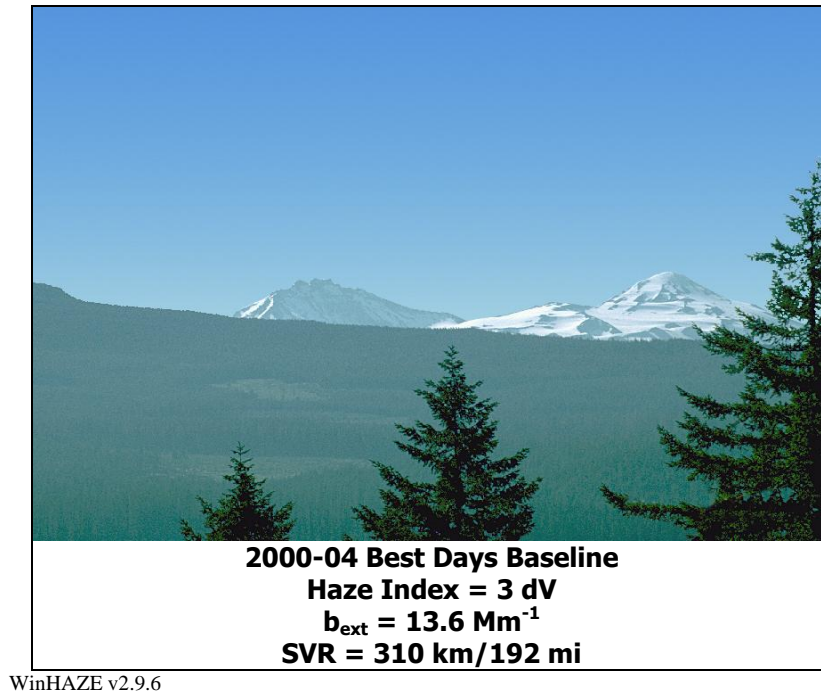
6.3 Southern Cascades – Crater Lake National Park, and Diamond Peak, Mountain Lakes, and Gearhart Mountain Wilderness Areas

The Crater Lake (CRLA1) monitoring site represents four Class I areas in the southern part of Oregon, which include Crater Lake National Park, and Diamond Peak, Mountain Lakes, and Gearhart Mountain Wilderness Areas. Figure 6.3-1 shows the baseline visibility conditions, the uniform rate of progress, the 2018 planning goal, and estimated 2064 natural conditions for the CRLA1 site.

Figure 6.3-2 is a split image which represents the current worst-day and estimated natural conditions for Crater Lake National Park, and Figure 6.3-3 is an image representing the current best-day visibility conditions for Crater Lake. Figures 6.3-4 and 6.3-5 are similar images for the Diamond Peak Wilderness area, and Figures 6.3-6 and 6.3-7 are images from the Gearhart Mountain Wilderness Area. Images for the Mountain Lakes Wilderness Area were not available.

Figure 6.3-1 CRLA1 Uniform Rate of Progress

**Crater Lake National Park
and Diamond Peak, Mountain Lakes and Gearhart Mnt. Wilderness Areas
CRLA1 IMPROVE Site (new IMPROVE algorithm)
Uniform Rate of Progress for 20% Best and Worst Visibility Days**

Worst Days
Baseline = 13.7 dv

2018 Goal = 12.3 dv
(Reduction Needed = 1.4 dv)

Natural Conditions = 7.6 dv

Best Days
Baseline = 1.7 dv

Total Extinction (dv)

1992 2000 2002 2004 2018 2064
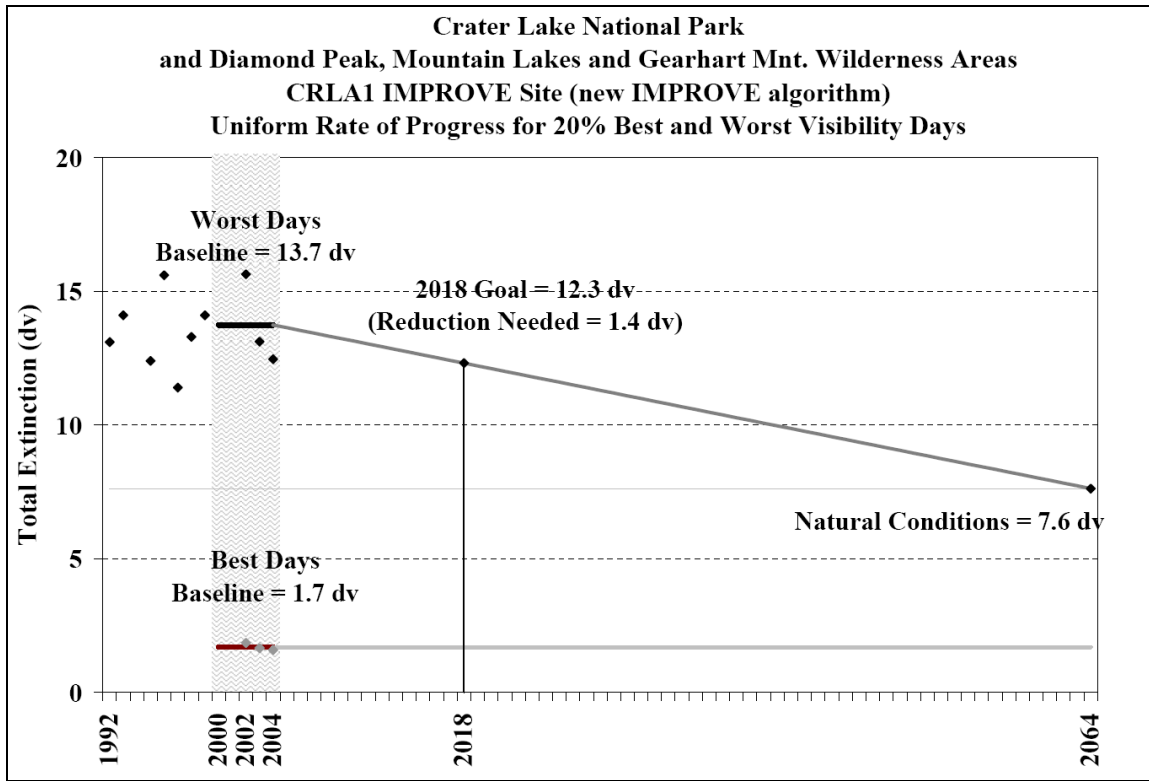
Figure 6.3-2 Crater Lake National Park Worst Days Baseline and Natural Conditions

**2000-04 Worst Days
Baseline
Haze Index = 13.7 dV
b_{ext} = 47.9 Mm^{-1}
SVR = 80 km/50 mi**

**2064 Natural Conditions
Haze Index =7.6 dV
b_{ext} = 23.3 Mm^{-1}
SVR = 161 km/100 mi**
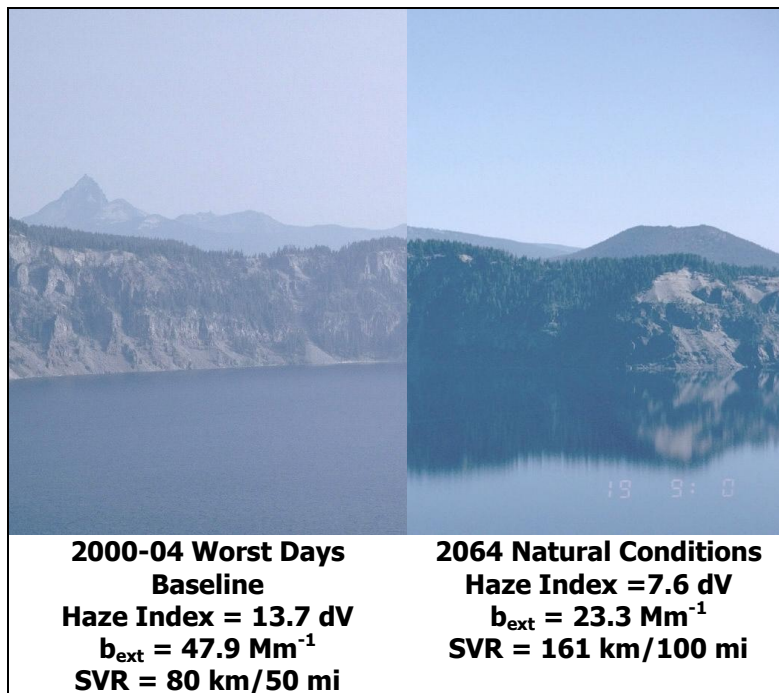
Composite of U.S. Forest Service Air Monitoring Program images

Figure 6.3-3 Crater Lake National Park Best Days Baseline Conditions

2000-04 Best Days Baseline
Haze Index = 1.7 dV
b_{ext} = 11.9 Mm^{-1}
SVR = 303 km/188 mi
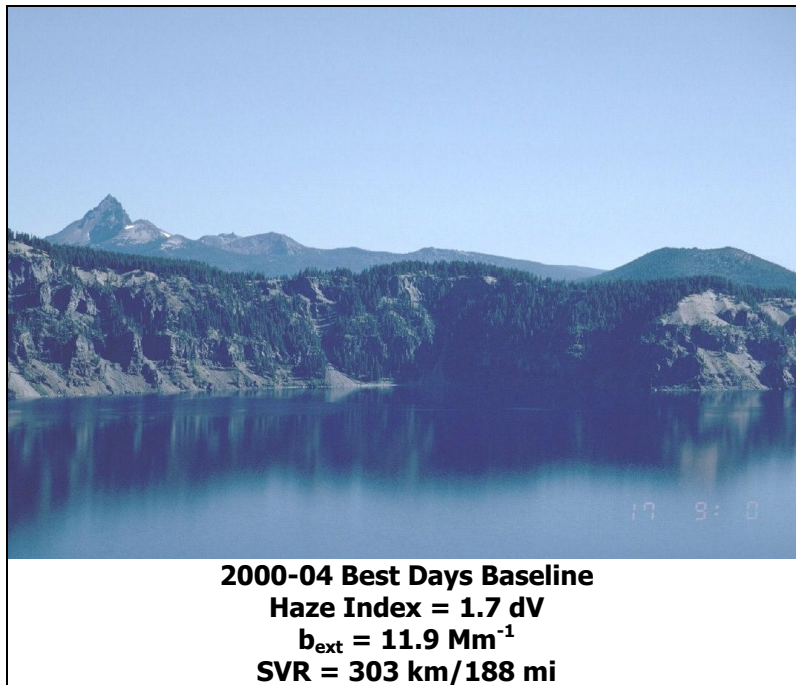
U.S. Forest Service Air Monitoring Program image

Figure 6.3-4 Diamond Peak Wilderness Area (Wolf Mountain Vista) Worst Days Baseline and Natural Conditions

2000-04 Worst Days Baseline
Haze Index = 13.7 dV
b_{ext} = 47.9 Mm^{-1}
SVR = 80 km/50 mi

2064 Natural Conditions
Haze Index =7.6 dV
b_{ext} = 23.3 Mm^{-1}
SVR = 161 km/100 mi
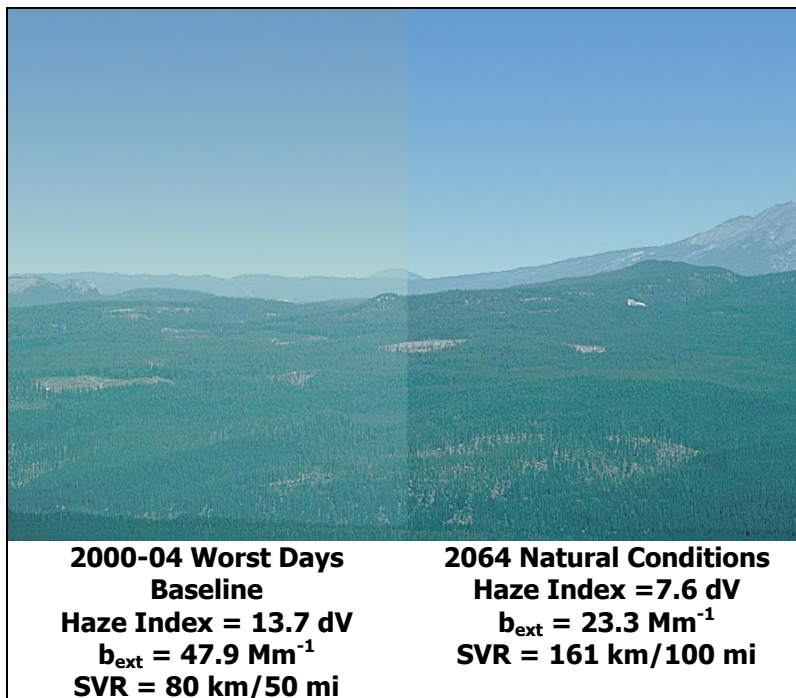
WinHAZE v2.9.6

Figure 6.3-5 Diamond Peak Wilderness Area (Wolf Mountain Vista) Best Days Baseline Conditions

2000-04 Best Days Baseline
Haze Index = 1.7 dV
b_{ext} = 11.9 Mm^{-1}
SVR = 303 km/188 mi
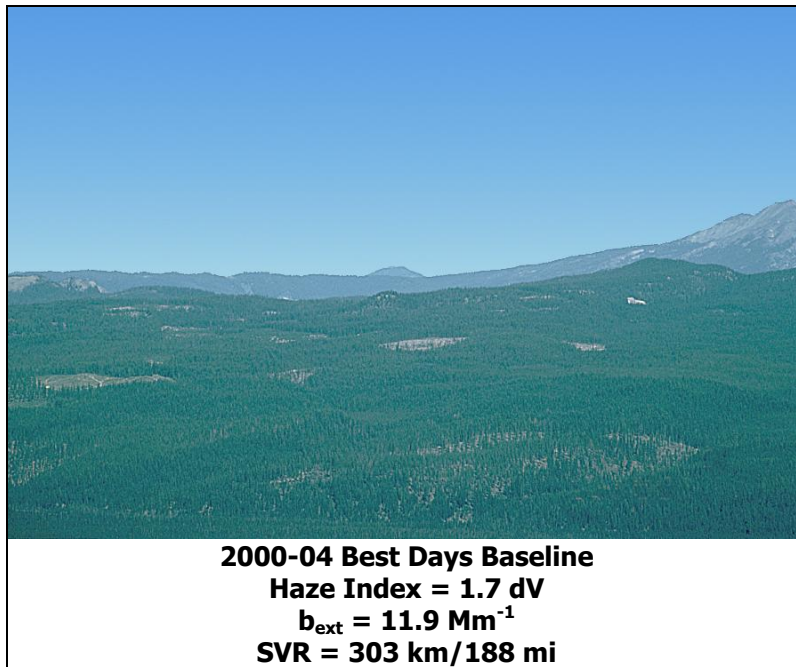
WinHAZE v2.9.6

Figure 6.3-6 Gearhart Mountain Wilderness Area Worst Days Baseline and Natural Conditions

2000-04 Worst Days
Baseline
Haze Index = 13.7 dV
b_{ext} = 47.9 Mm^{-1}
SVR = 80 km/50 mi

2064 Natural Conditions
Haze Index =7.6 dV
b_{ext} = 23.3 Mm^{-1}
SVR = 161 km/100 mi
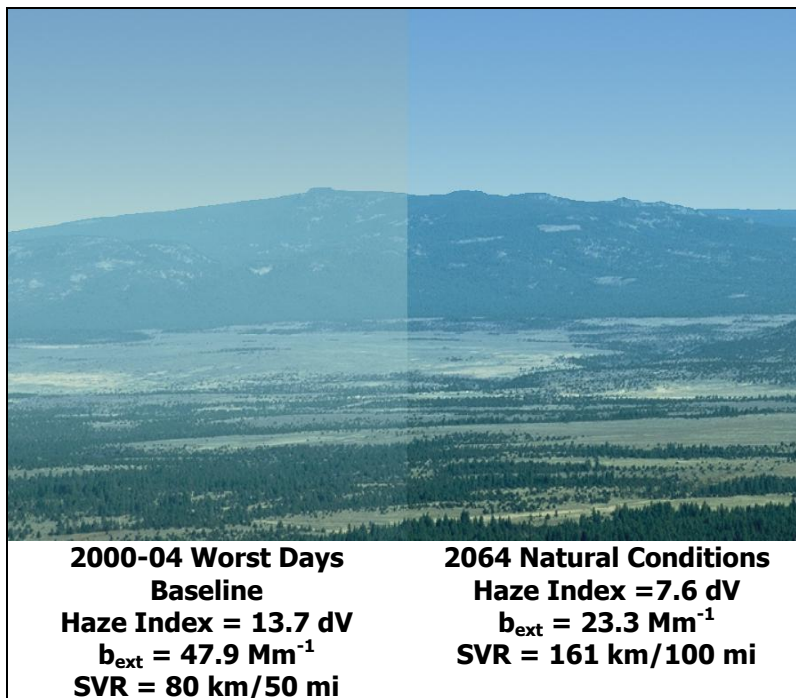
WinHAZE v2.9.6

Figure 6.3-7 Gearhart Mountain Wilderness Area Best Days Baseline Conditions

2000-04 Best Days Baseline
Haze Index = 1.7 dV
b_{ext} = 11.9 Mm^{-1}
SVR = 303 km/188 mi
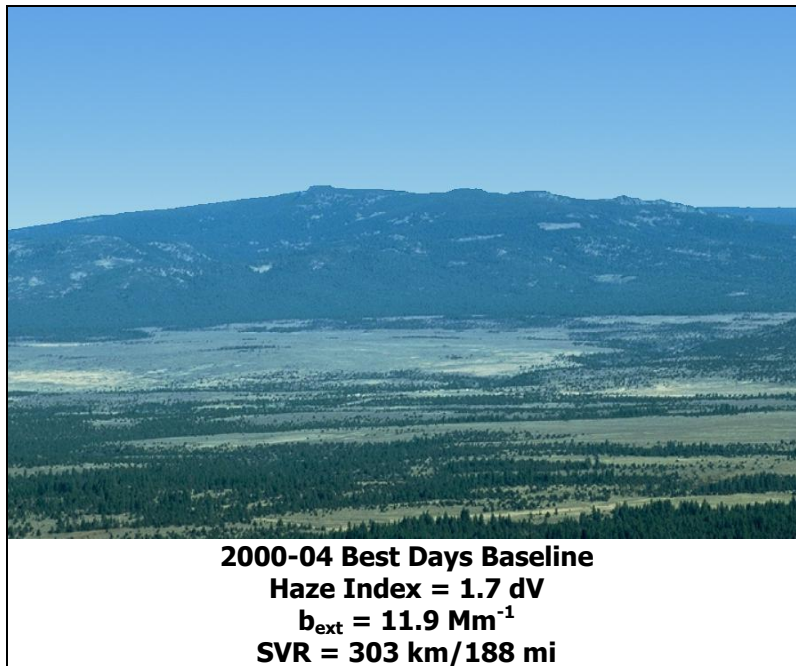
WinHAZE v2.9.6

6.4 Coast Range – Kalmiopsis Wilderness Area

The Kalmiopsis (KALM1) monitoring site represents the Kalmiopsis Wilderness Class I Area in the coastal range of Oregon. Figure 6.4-1 shows baseline visibility conditions, the uniform rate of progress, the 2018 planning goal, and estimated 2064 natural conditions for the KALM1 site.

Figure 6.4-2 is a split image which represents the current worst-day and estimated natural conditions for the Kalmiopsis Wilderness Area, and Figure 6.4-3 is an image representing the current best-day visibility conditions for Kalmiopsis.

Figure 6.4-1 KALM1 Uniform Rate of Progress

Kalmiopsis Wilderness Areas
KALM1 IMPROVE Site (new IMPROVE algorithm)
Uniform Rate of Progress for 20% Best and Worst Visibility Days

Worst Days
Baseline = 15.5 dv

2018 Goal = 14.1 dv
(Reduction Needed = 1.4 dv)

Best Days
Baseline = 6.3 dv

Natural Conditions = 9.4 dv

Total Extinction (dv) (y-axis: 0, 5, 10, 15, 20)

x-axis: 1992, 2000, 2002, 2004, 2018, 2064
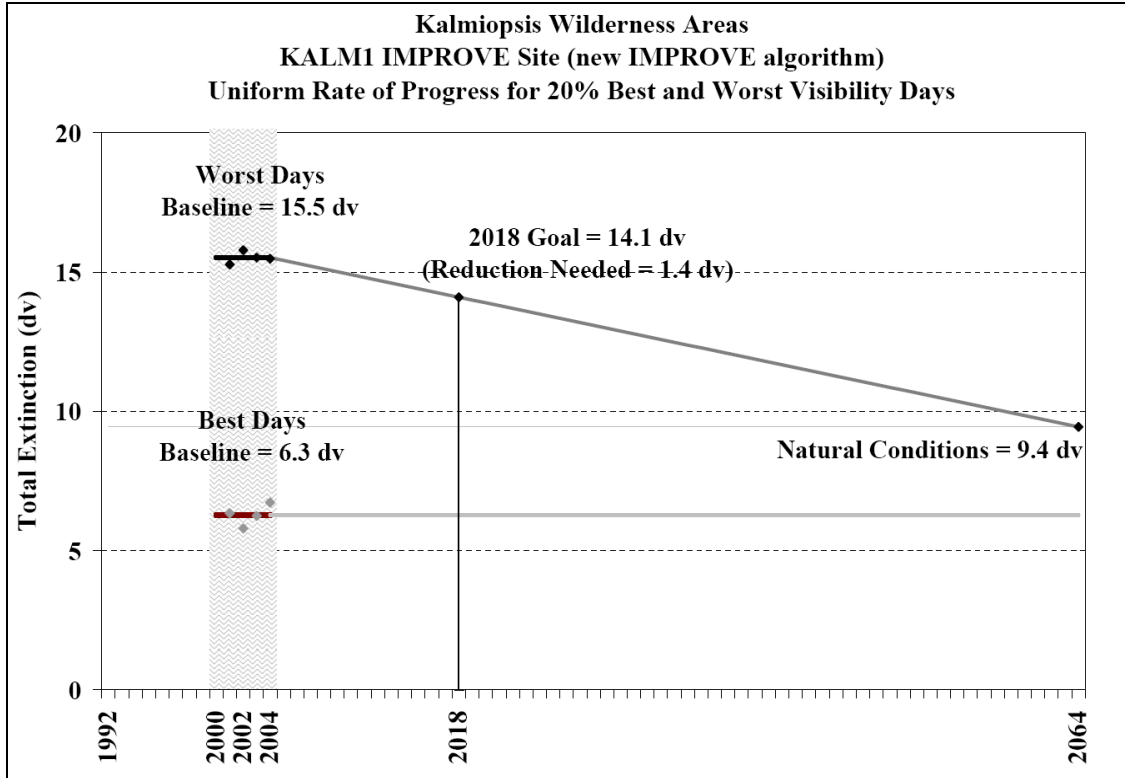
Figure 6.4-2 Kalmiopsis Wilderness Area (Quail Prairie) Worst Days Baseline and Natural Conditions

2000-04 Worst Days Baseline
Haze Index = 15.5 dV
b_{ext} = 48.1 Mm^{-1}
SVR = 85 km/53 mi

2064 Natural Conditions
Haze Index = 9.4 dV
b_{ext} = 26.0 Mm^{-1}
SVR = 163 km/101 mi
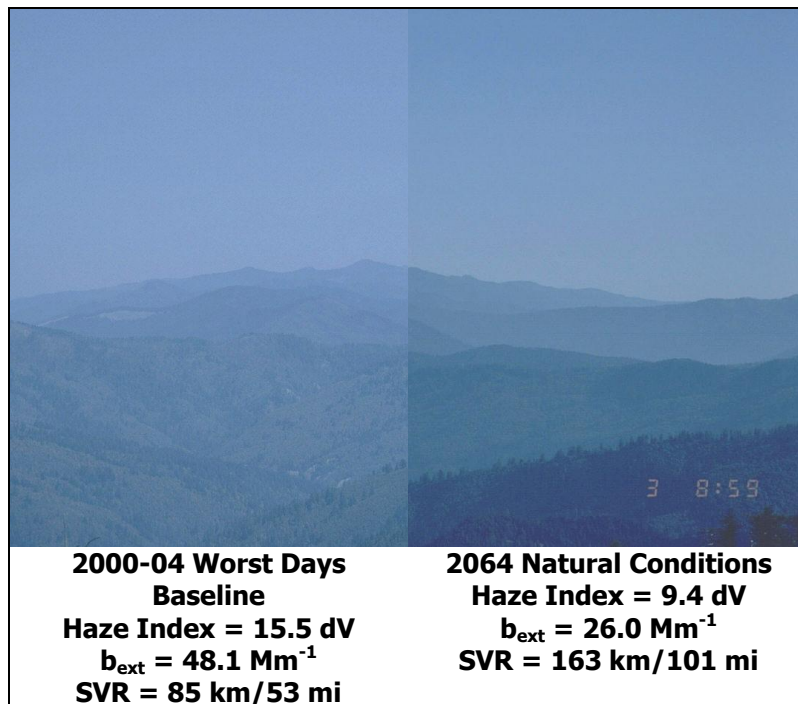
Composite of U.S. Forest Service Air Monitoring Program images

Figure 6.4-3 Kalmiopsis Wilderness Area (Quail Prairie) Best Days Baseline Conditions

**2000-04 Best Days Baseline
Haze Index = 6.3 dV
b_{ext} = 18.8 Mm^{-1}
SVR = 232 km/144 mi**
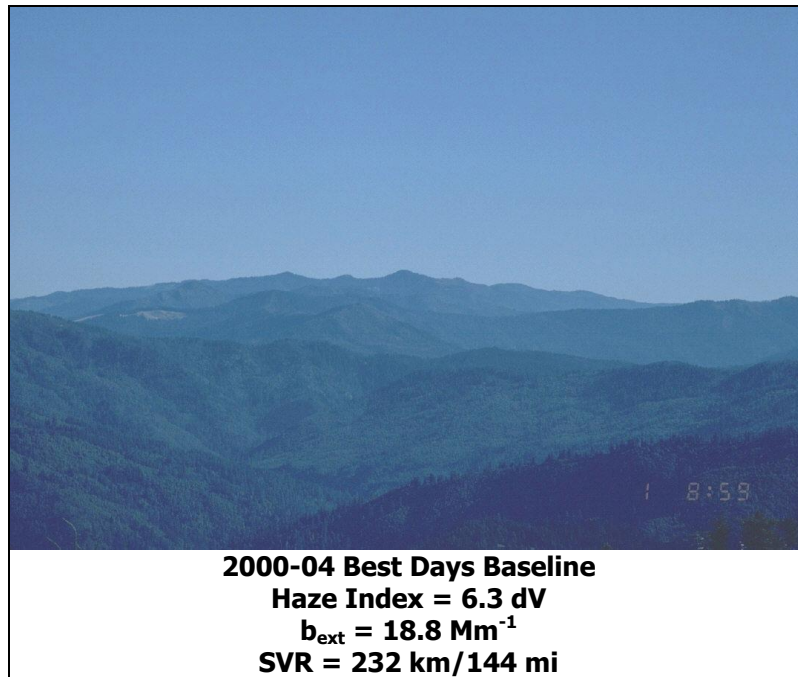
U.S. Forest Service Air Monitoring Program image

6.5 Eastern Oregon – Strawberry Mountain Wilderness and Eagle Cap Wilderness

The Starkey (STAR1) monitoring site represents two Class I areas in the eastern part of Oregon, which include the Strawberry Mountain and Eagle Cap Wilderness Areas. Figure 6.5-1 shows the baseline visibility conditions, the uniform rate of progress, the 2018 planning goal, and estimated 2064 natural conditions for the STAR1 site.

Figure 6.5-2 is a split image which represents the current worst-day and estimated natural conditions for the Strawberry Mountain Wilderness Area, and Figure 6.5-3 is an image representing the current best-day visibility conditions for Strawberry Mountain. Figures 6.5-4 and 6.5-5 are similar images for the Eagle Cap Wilderness area.

Figure 6.5-1 STAR1 Uniform Rate of Progress
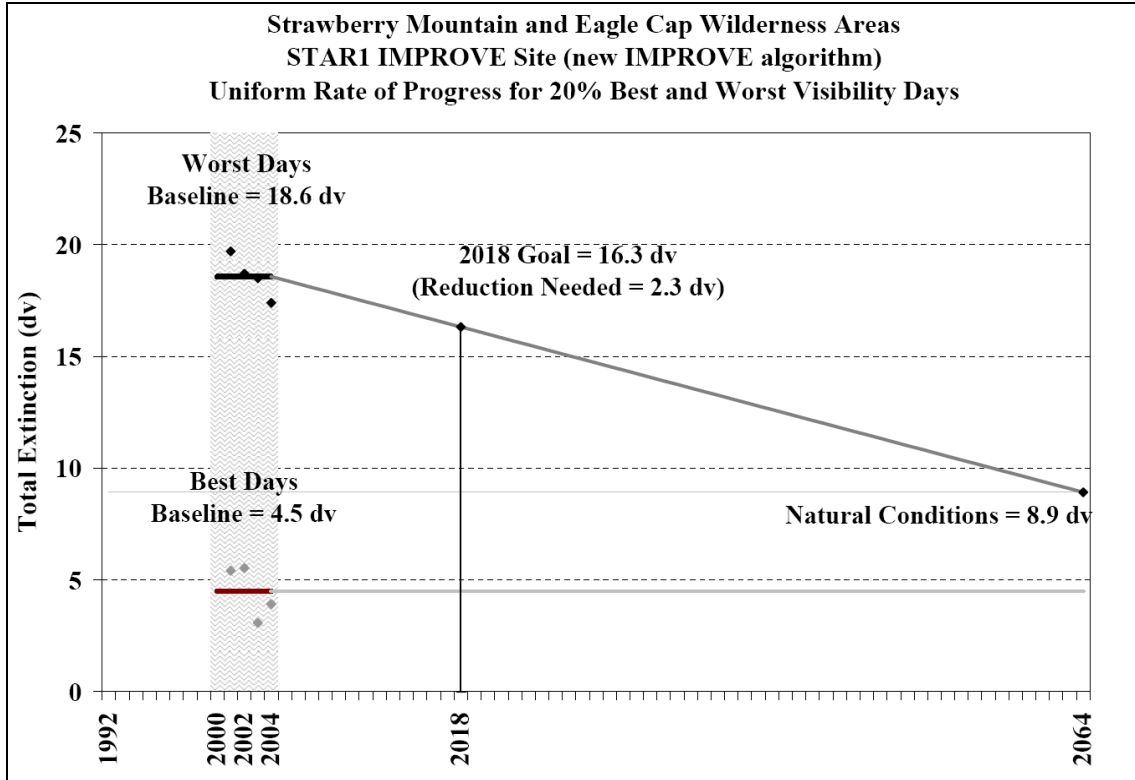
Figure 6.5-2 Strawberry Mountain Wilderness Area (Dixie Butte) Worst Days Baseline and Natural Conditions
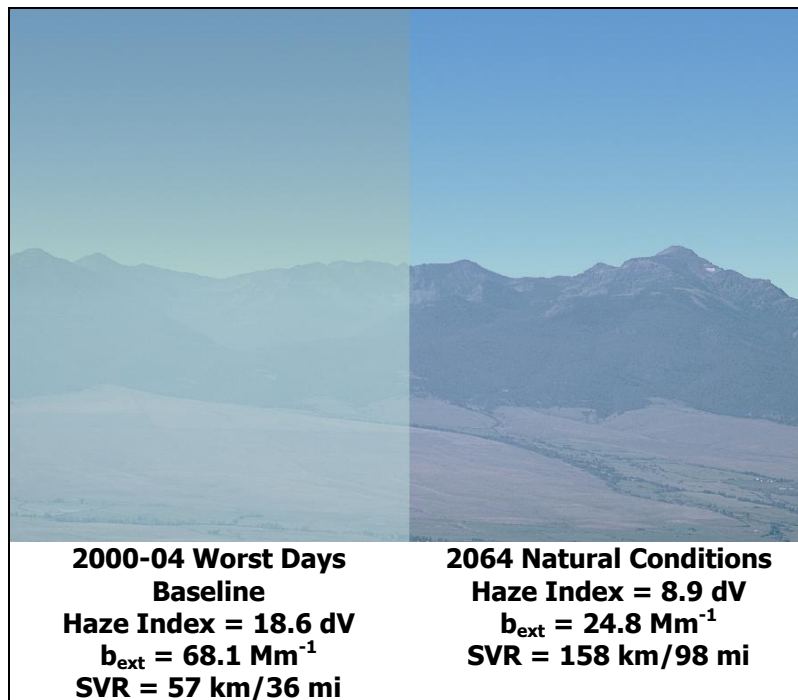
Figure 6.5-3 Strawberry Mountain Wilderness Area (Dixie Butte) Best Days Baseline Conditions

2000-04 Best Days Baseline
Haze Index = 4.5 dV
b_{ext} = 15.9 Mm^{-1}
SVR = 247 km/153 mi
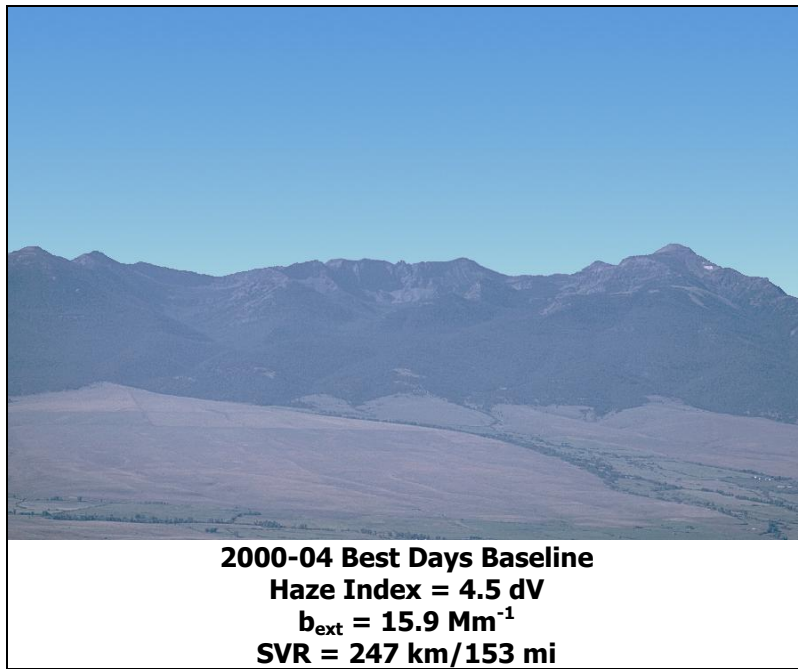
WinHAZE v2.9.6

Figure 6.5-4 Eagle Cap Wilderness Area (Point Prominence) Worst Days Baseline and Natural Conditions

2000-04 Worst Days Baseline	**2064 Natural Conditions**
Haze Index = 18.6 dV	**Haze Index = 8.9 dV**
b_{ext} = 68.1 Mm^{-1}	**b_{ext} = 24.8 Mm^{-1}**
SVR = 57 km/36 mi	**SVR = 158 km/98 mi**
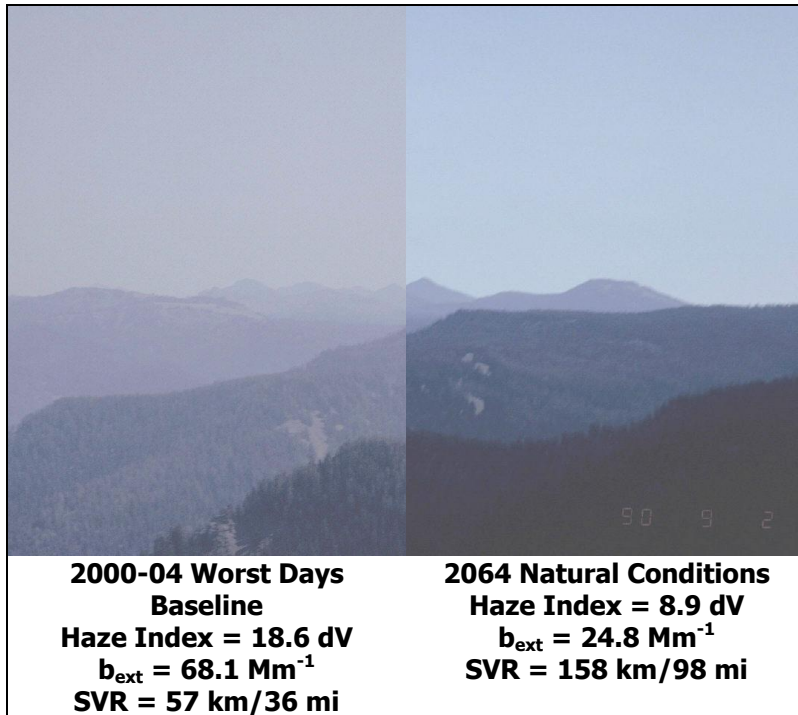
Composite of U.S. Forest Service Air Monitoring Program images

Figure 6.5-5 Eagle Cap Wilderness Area (Point Prominence) Best Days Baseline Conditions

2000-04 Best Days Baseline
Haze Index = 4.5 dV
b_{ext} = 15.9 Mm^{-1}
SVR = 247 km/153 mi
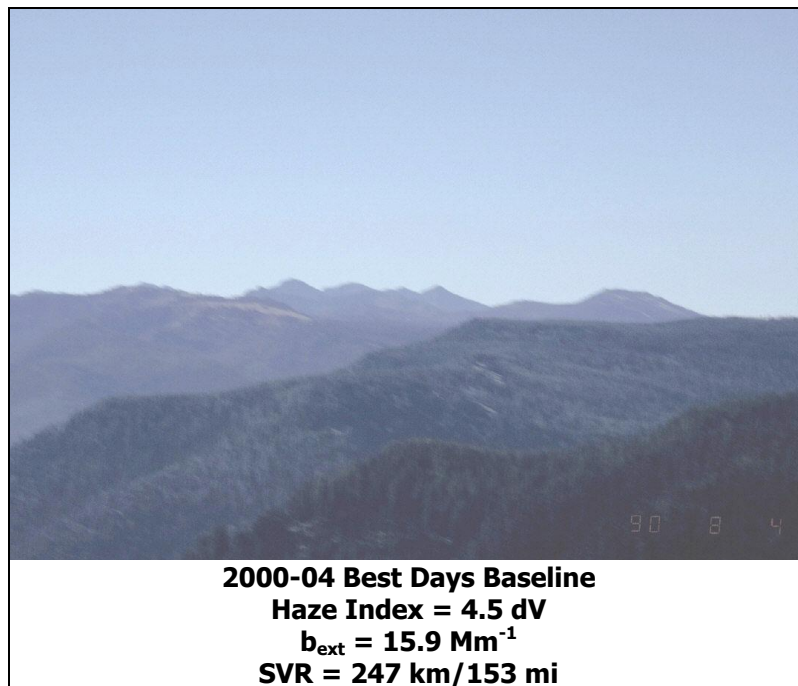
U.S. Forest Service Air Monitoring Program image

6.6 Eastern Oregon/Western Idaho – Hells Canyon Wilderness Area

The Hells Canyon (HECA1) monitoring site represents the Hells Canyon Wilderness Class I Area. Figure 6.6-1 shows baseline visibility conditions, the uniform rate of progress, the 2018 planning goal, and estimated 2064 natural conditions for the MOHO1 site.

Figure 6.6-2 is a split image which represents the current worst-day and estimated natural conditions for the Hells Canyon Wilderness Area, and Figure 6.6-3 is an image representing the current best-day visibility conditions for Mt. Hood.

Figure 6.6-1 HECA1 Uniform Rate of Progress

Hells Canyon Wilderness Area
HECA1 IMPROVE Site (new IMPROVE algorithm)
Uniform Rate of Progress for 20% Best and Worst Visibility Days

Worst Days
Baseline = 18.6 dv

2018 Goal = 16.2 dv
(Reduction Needed = 2.4 dv)

Best Days
Baseline = 5.5 dv

Natural Conditions = 8.3 dv

Total Extinction (dv)
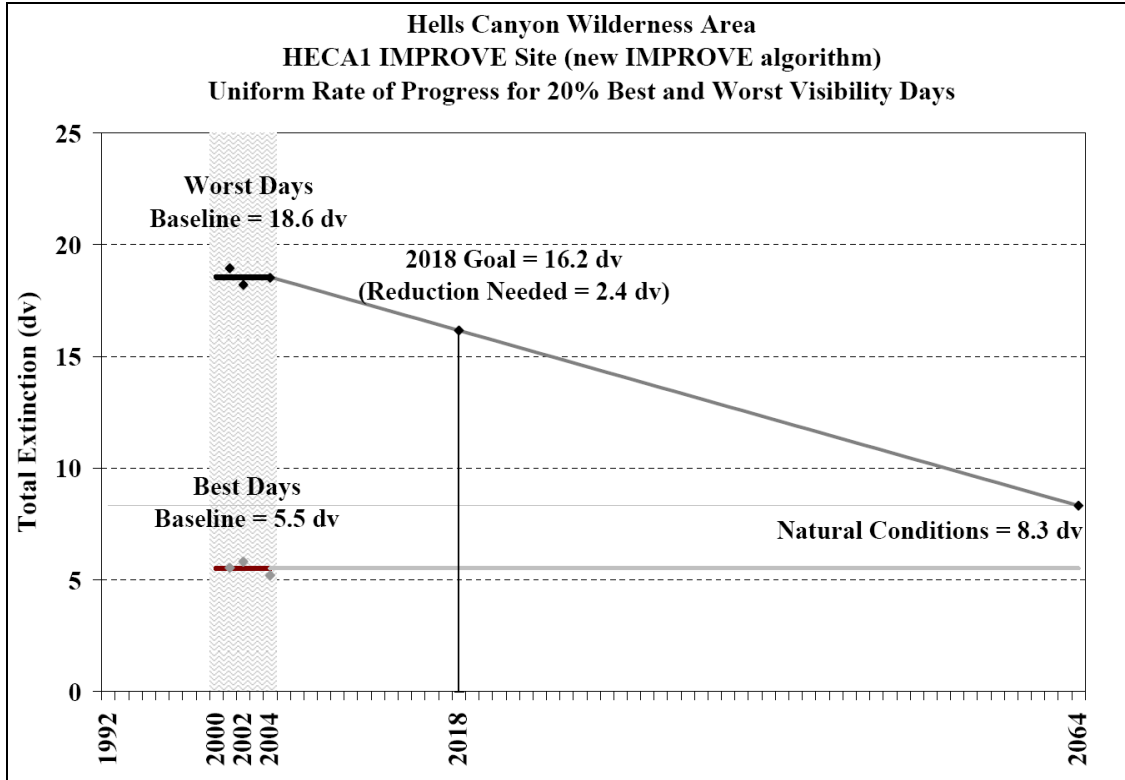
Figure 6.6-2 Hells Canyon Wilderness Area (Mt. Howard) Worst Days Baseline and Natural Conditions

2000-04 Worst Days
Baseline
Haze Index = 18.6 dV
b_{ext} = 69.1 Mm^{-1}
SVR = 57 km/36 mi

2064 Natural Conditions
Haze Index = 8.3 dV
b_{ext} = 23.2 Mm^{-1}
SVR = 176 km/109 mi
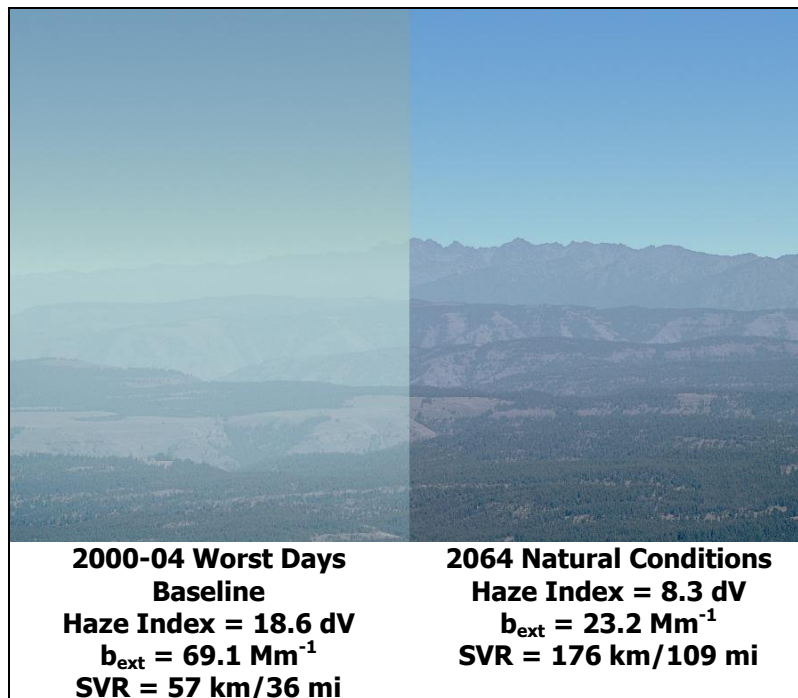
WinHAZE v2.9.6

Figure 6.6-3 Hells Canyon Wilderness Area (Mt. Howard) Best Days Baseline Conditions

2000-04 Best Days Baseline
Haze Index = 5.5 dV
b_{ext} = 17.5 Mm^{-1}
SVR = 238 km/148 mi
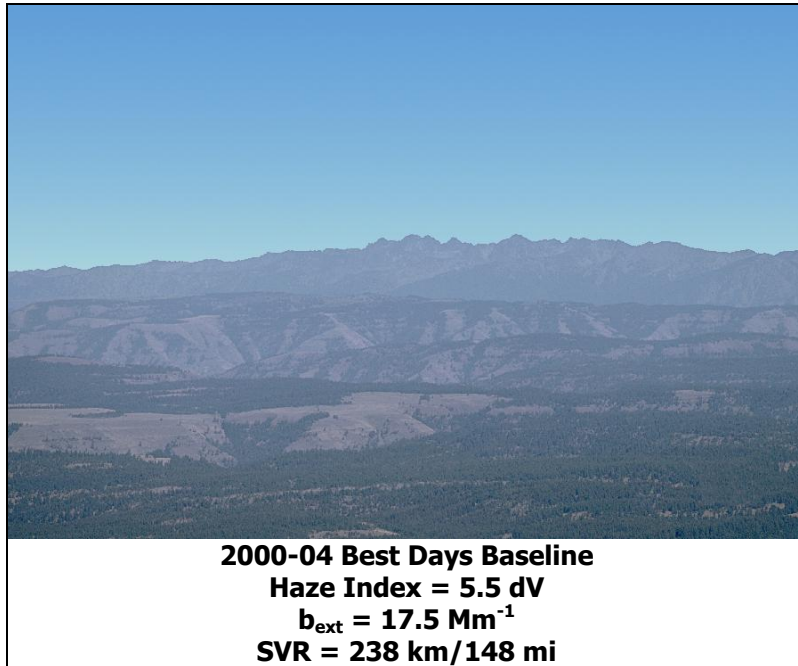
WinHAZE v2.9.6

CHAPTER 7: POLLUTANTS CAUSING VISIBILITY IMPAIRMENT IN OREGON CLASS I AREAS

This chapter provides a summary of regional haze monitoring data from the IMPROVE monitoring sites in Oregon, and the pollutants that are causing visibility impairment in each of Oregon's Class I Areas. Also provided is a summary of the visibility improvement needed from baseline (2000-2004) to the 2018 uniform rate of progress milestone, and to the 2064 natural condition goal.

Figure 7-1 shows Oregon IMPROVE monitoring sites that will be described in this chapter. This map and a description of the IMPROVE network was provided in Chapter 4.

Figure 7-1 Map of Oregon IMPROVE sites
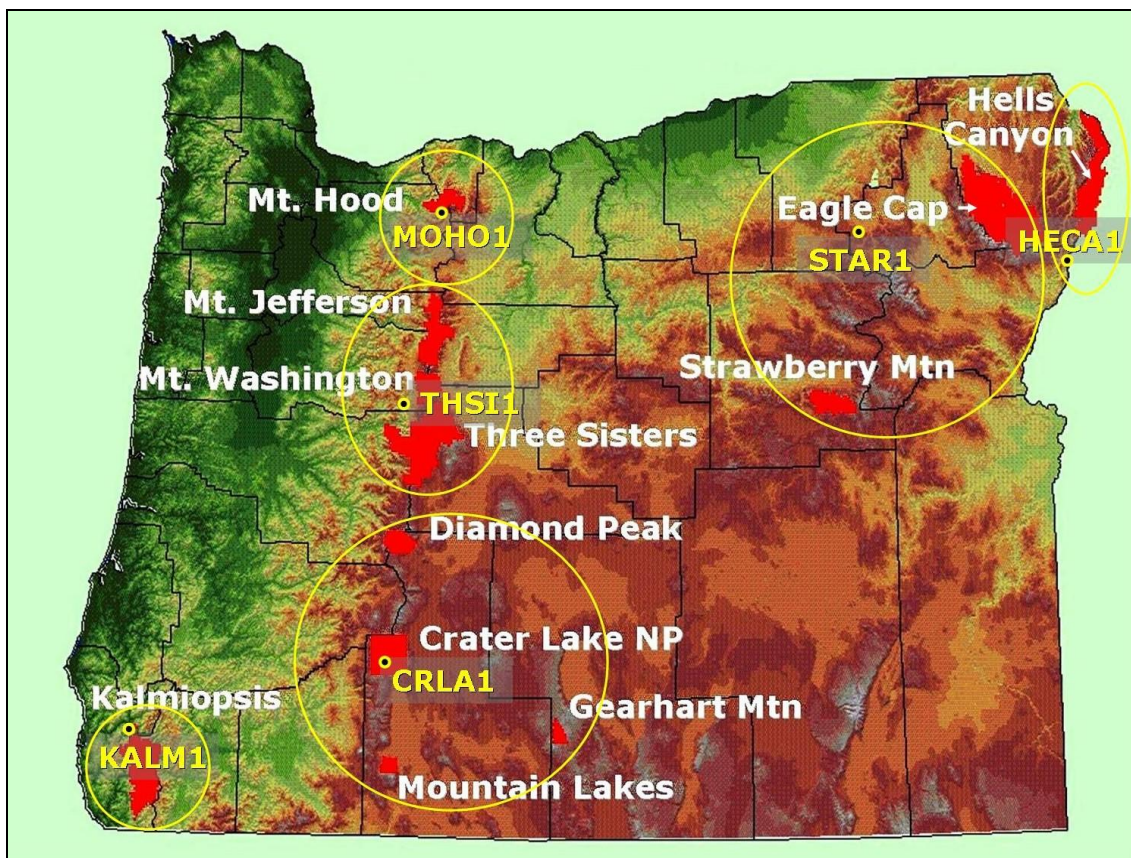
Table 7-1 identifies the different pollutant species that contribute to haze, and their abbreviations, as they appear in the figures in this chapter. References to sulfate and nitrate in this chapter are intended to reflect ammonium sulfate and ammonium nitrate, respectively.

Table 7-1 IMPROVE Monitor Aerosol Composition

	Pollutant	IMPROVE Abbreviation
🟥	Ammonium Nitrate	ammno3f_bext
🟨	Ammonium Sulfate	ammso4f_bext
⬛	EC (Elemental Carbon)	ecf_bext
🟩	OMC (Organic Mass Carbon)	omcf_bext
⬜	CM (Coarse Mass)	cm_bext
🟧	Soil (fine Soil)	soilf_bext
🟦	Sea Salt	seasalt_bext

The figures which follow in this chapter provide information for each Class I area (based on representative IMPROVE monitoring site) for the 20% best and 20% worst days during the baseline period, monthly averages of all monitored days, and the improvement needed by 2018 and 2064.

Figures 7-2 and 7-3 summarize the distribution of pollutant species in Oregon's Class I areas, for the current (2000-04 baseline) 20% best and 20% worst days.

Figure 7-2 Light Extinction by Pollutant Species for Oregon Class I Areas 20% Best Days (2000-2004)
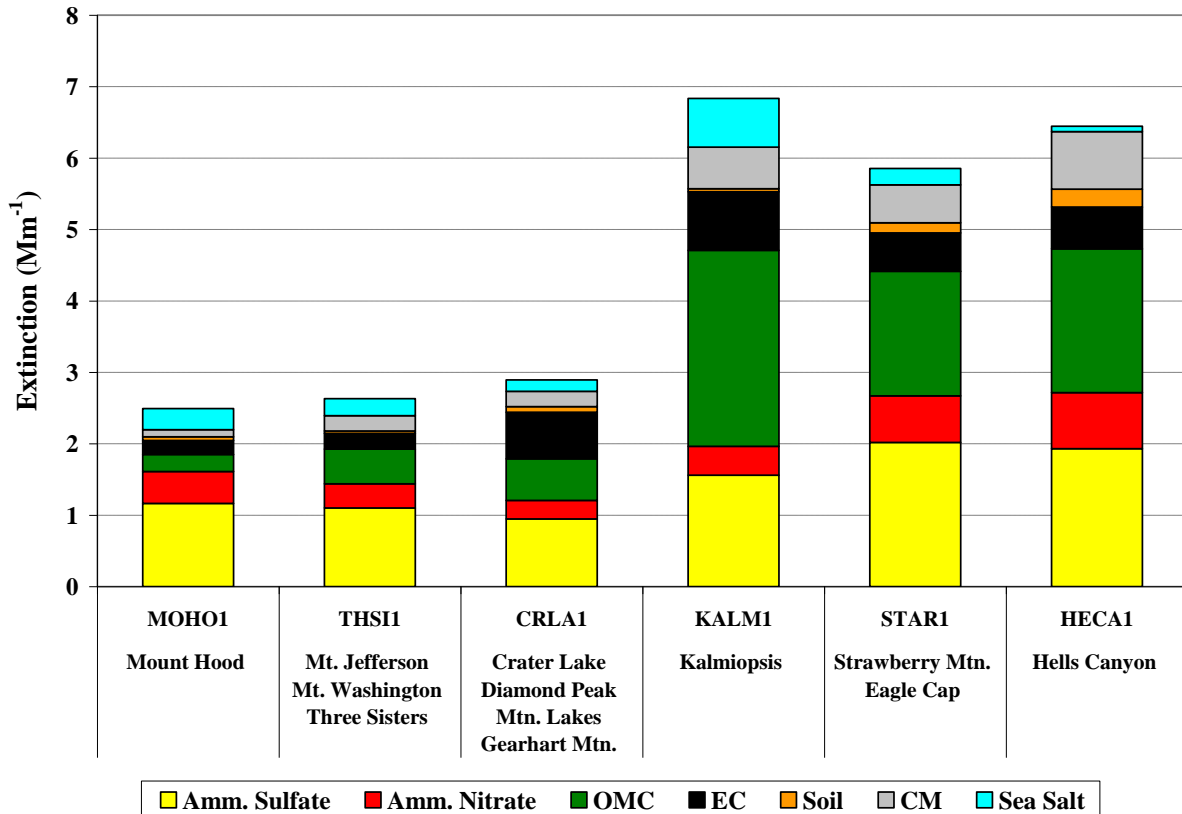
Figure 7-3 Light Extinction by Pollutant Species for Oregon Class I Areas 20% Worst Days (2000-2004)
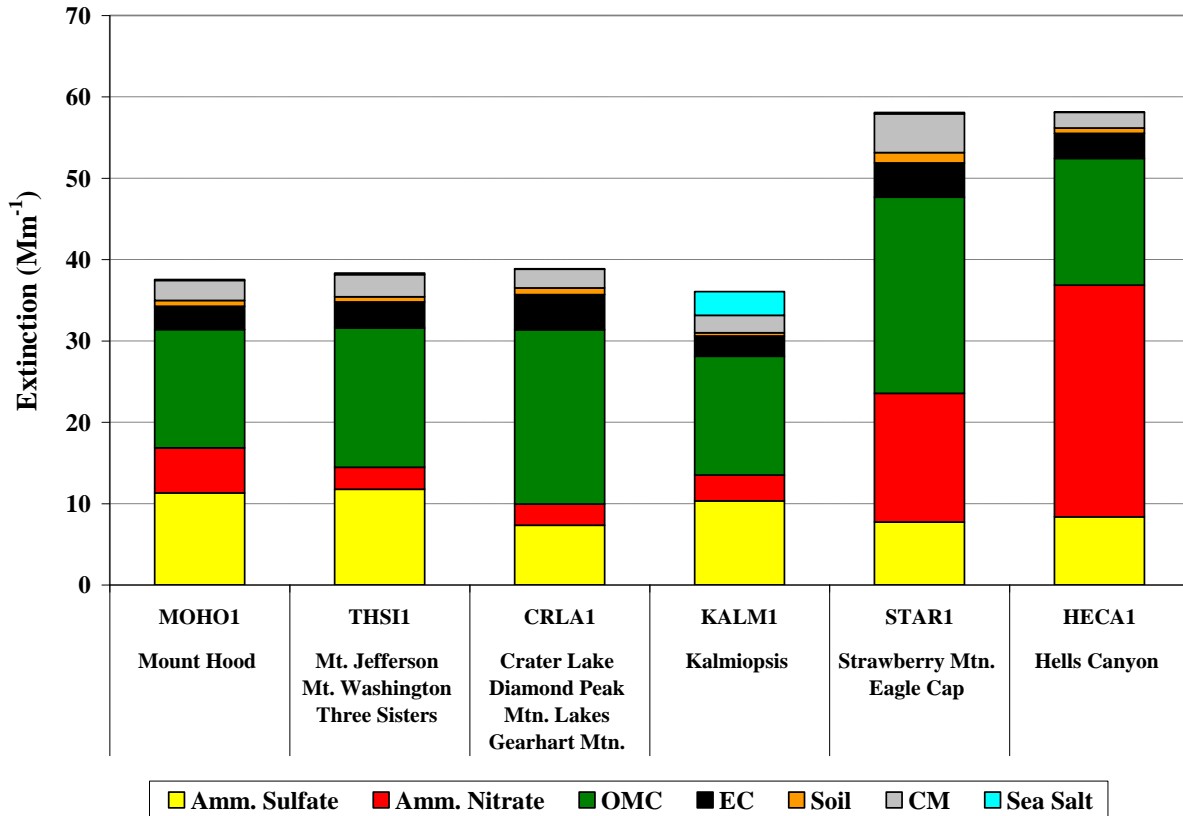
As Figures 7-2 and 7-3 indicate, Oregon's Class I areas are dominated by organic carbon and sulfate on the 20% best days and worst days. On the 20% best days, organic carbon is significant in both the coast range (Kalmiopsis Wilderness) and Eastern Oregon Class I areas. Much of this can be attributed to fire sources. On the 20% worst days, nitrate is significant in Eastern Oregon Class I areas, which accounts for the total extinction levels being higher there than the other Class I areas. Much of this can be attributed to industrial sources, such as the PGE Boardman power plant, which is a major NO_x emissions source in Eastern Oregon. See Sections 7.5 and 7.6 below.

The following sections provide an additional breakdown of the pollutant species that contribute to each Class I area. The first figure in each section shows a simple pie chart of the 20% best and 20% worst days, similar to the bar chart figures above. The second figure in each section shows the pollutant species based on monthly averages for all days (including best or worst) during the baseline period, as an example of the seasonal variation in Class I areas. The third figure in each section takes a closer look at the daily variation during a given year - in this case 2004. The fourth figure in each section shows the improvement needed (shown by reduction in deciview) for each Class I area, from the baseline year to the 2018 milestone, and to 2064 natural conditions.

7.1 Northern Cascades - Mt. Hood Wilderness Area

As Figure 7.1-1 shows, Mt. Hood Wilderness, like other Class I areas in the Cascades, is dominated by sulfate on the best days, and mostly organic carbon on the worst days. In looking at the pollutant species variations, the sulfate levels fluctuate during the year, while the contribution of nitrate is generally more consistent. The sources of sulfate and nitrate vary, and are described further in Chapters 8 and 9. Significant impacts or "spikes" can be seen during the year from organic carbon. These impacts are an indicator of fire sources. During the summer, it is likely these impacts are from wildfire, while during the spring and fall, they are most likely from controlled (anthropogenic) burning. Figure 7.1-4 shows a 1.5 dv reduction is needed to meet the 2018 URP, and 6.5 dv needed by 2064.

Figure 7.1-1 Mt. Hood IMPROVE Site – Average Pollutant Species Contribution to 20% Best and 20% Worst Days Baseline (2000-2004)
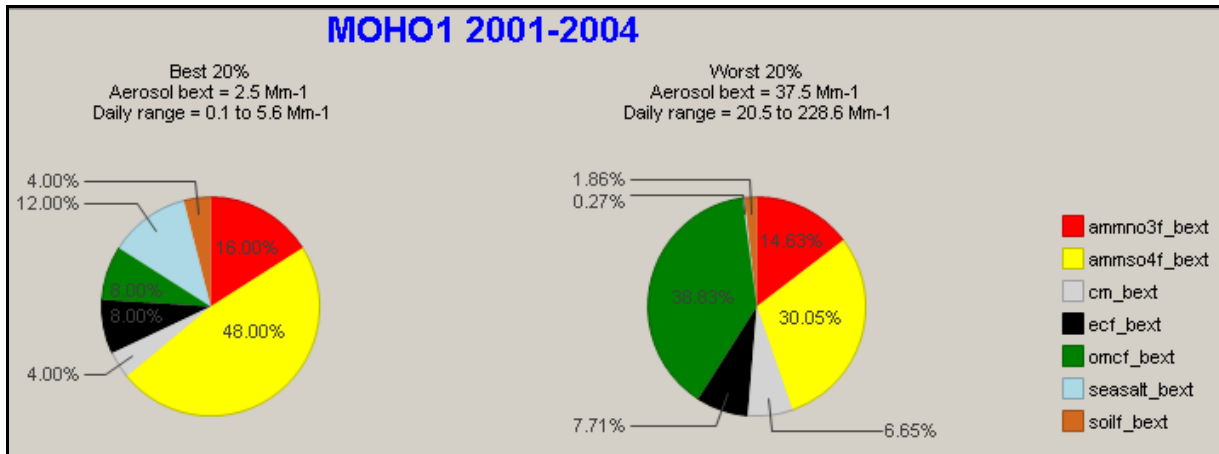
Figure 7.1-2 Mt. Hood IMPROVE Site – Monthly Average Pollutant Species Variation for All Days Sampled During the Baseline Period (2000-2004)
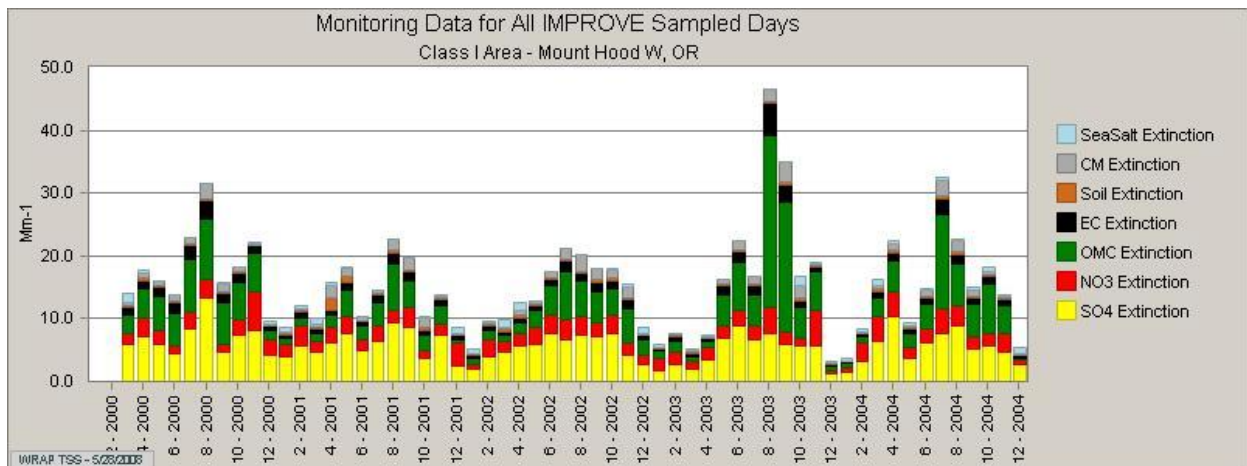
Figure 7.1-3 Mt. Hood IMPROVE Site – Pollutant Species Variation for All Days Sampled in 2004
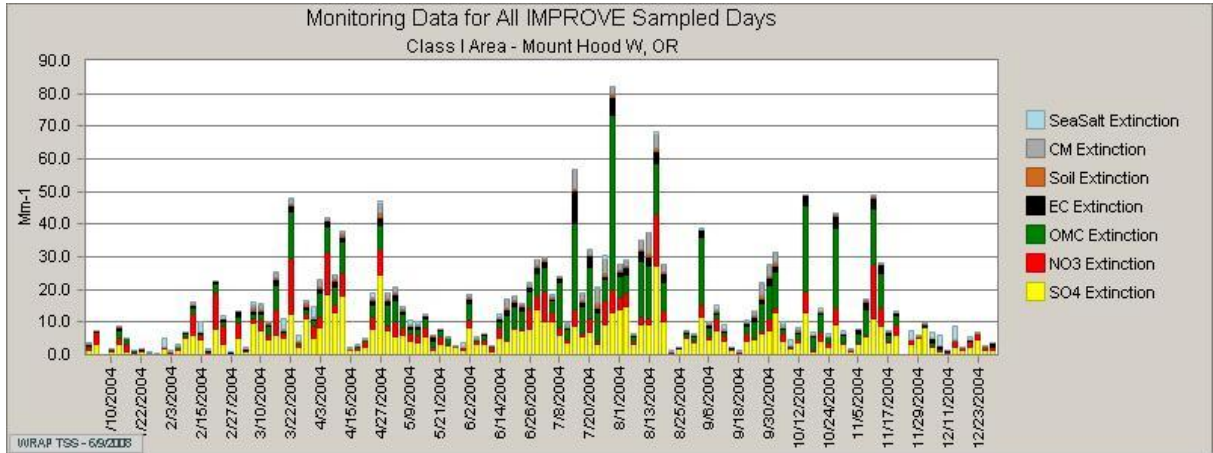
Figure 7.1-4 Mt. Hood IMPROVE Site – Baseline Worst Day Aerosol Composition Compared to Visibility Improvement Needed by 2018 & 2064
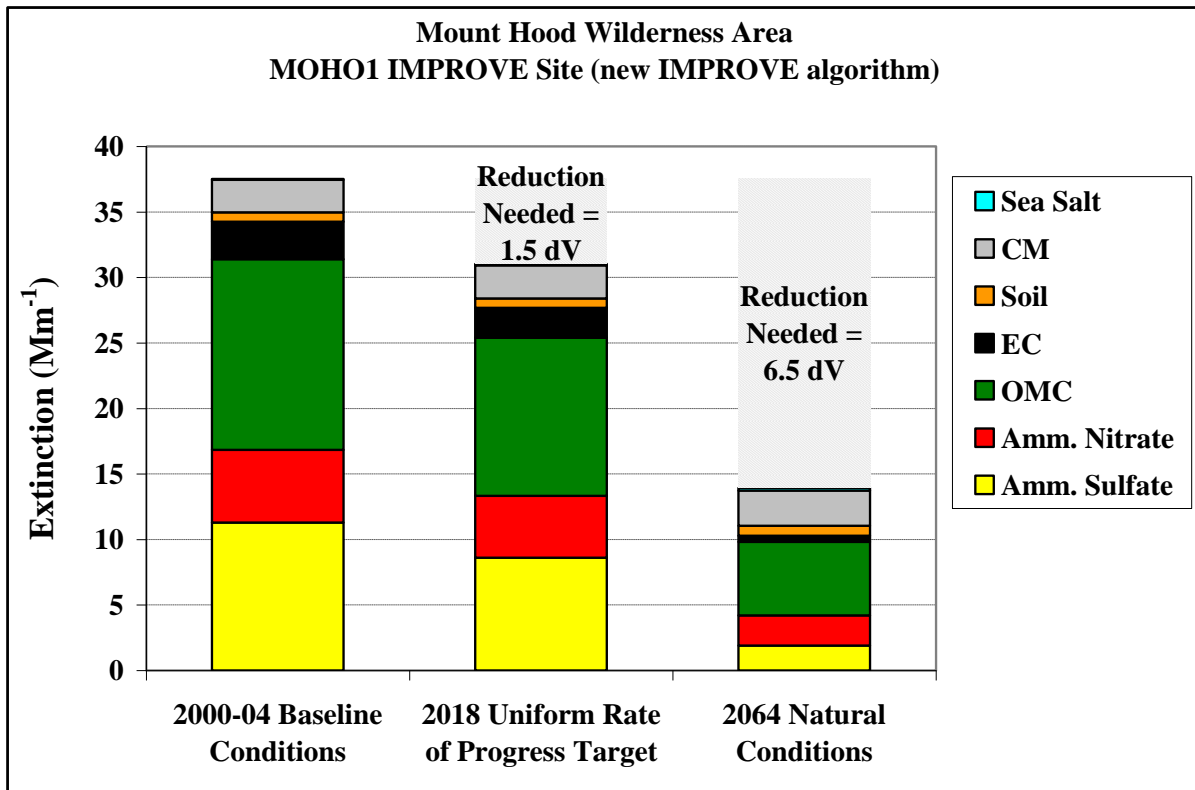
7.2 Central Cascades – Mt. Jefferson Wilderness, Mt. Washington Wilderness, and Three Sisters Wilderness Areas

As Figure 7.2-1 shows, the three Class I areas in the Central Cascades - Mt. Jefferson, Mt. Washington, and Three Sisters Wilderness Areas - are dominated by sulfate on the best days, and organic carbon on the worst days, similar to other Cascade Oregon Class I areas. In looking at the pollutant species variations, the sulfate levels fluctuate during the year, while the contribution of nitrate is generally more consistent. The sources of sulfate and nitrate are described further in Chapters 8 and 9. Figure 7.2-2 shows major spikes or impacts in organic carbon, particularly during the summer. These impacts are an indicator of fire sources. Figure 7.2-3 shows that during 2004, the largest impact from this pollutant species was during the spring, presumably from a controlled, single fire event. Figure 7.2-4 shows a 1.5 dv reduction is needed to meet the 2018 URP, and 6.5 dv needed by 2064.

Figure 7.2-1 Three Sisters IMPROVE Site – Average Aerosol Composition 20% Best and 20%Worst Days Baseline (2000-2004)
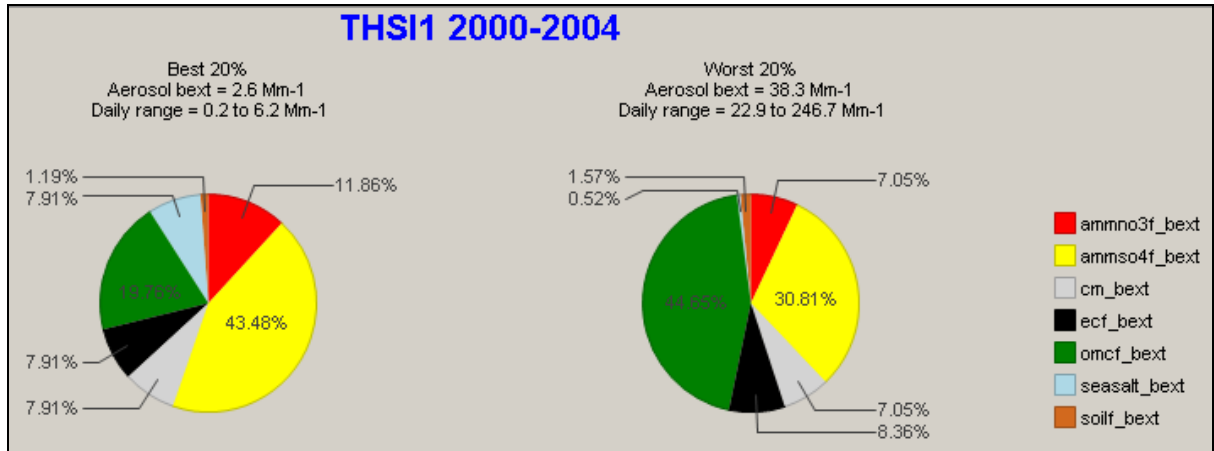
Figure 7.2-2 Three Sisters IMPROVE Site – Monthly Average Pollutant Species Variation for All Days Sampled During the Baseline Period (2000-2004)
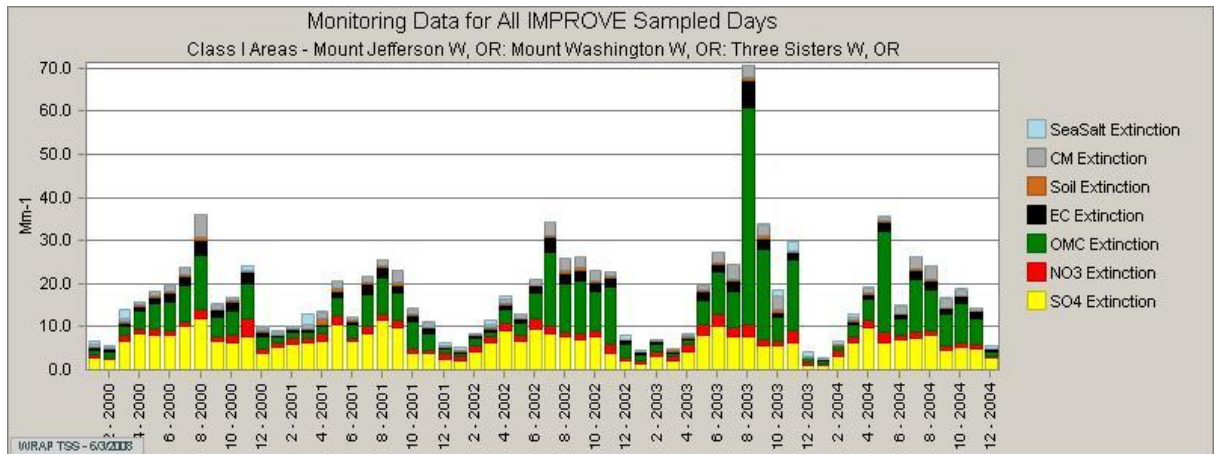
Figure 7.2-3 Three Sisters IMPROVE Site – Pollutant Species Variation for All Days Sampled in 2004
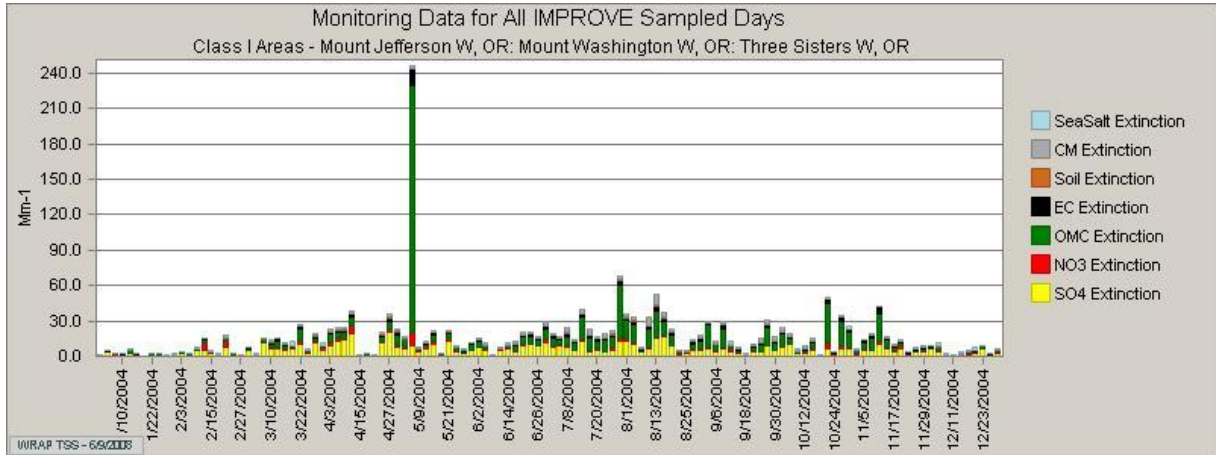
Figure 7.2-4 Three Sisters IMPROVE Site – Baseline Worst Day Aerosol Composition Compared to Visibility Improvement Needed by 2018 & 2064
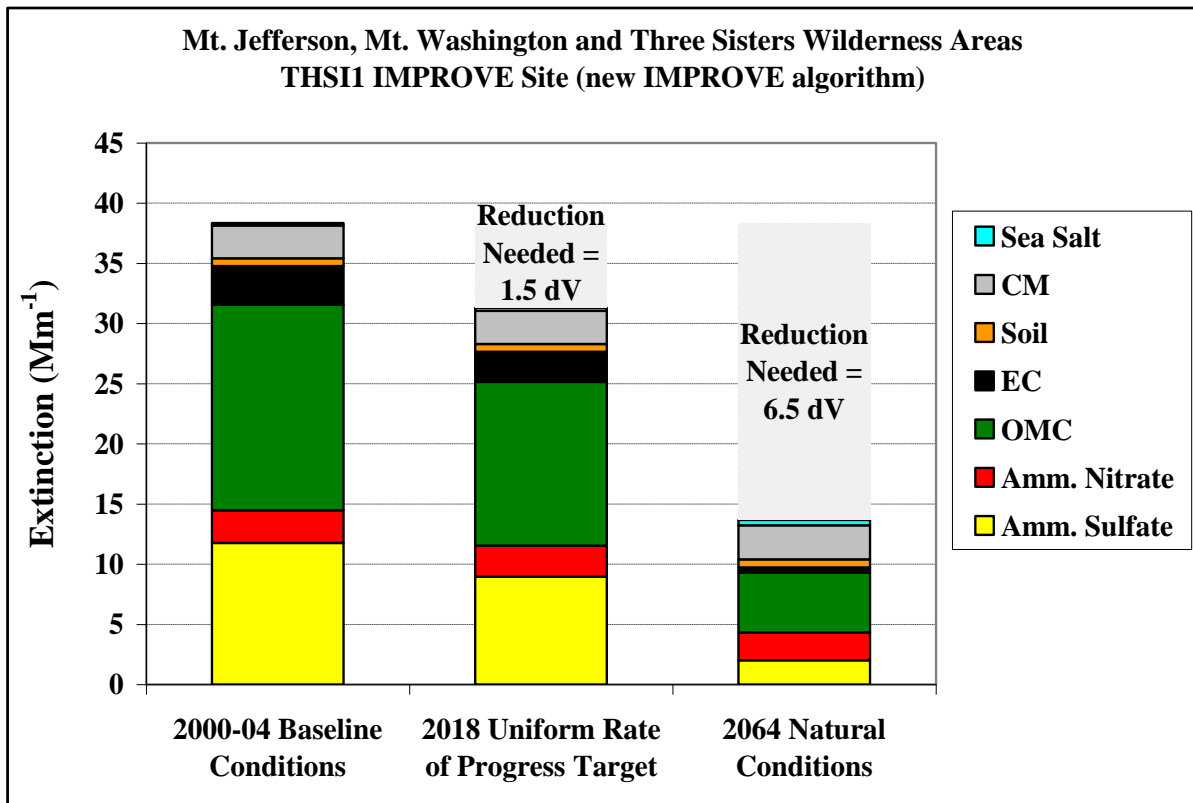
7.3 Southern Cascades – Crater Lake National Park, Mountain Lakes Wilderness, and Gearhart Mountain Wilderness Areas

As Figure 7.3-1 shows, the four Class I areas in the Southern Cascades - Crater Lake National Park, and Diamond Peak, Mountain Lakes, and Gearhart Mountain Wilderness Areas - are dominated by sulfate on the best days, and organic carbon on the worst days, similar to other Cascade Class I areas – however organic carbon is higher than other Cascade Class I areas. This is an indicator of a higher contribution of fire sources. It should be noted that 2002 was one of the highest wildfire years in recent history, as shown by the high impact in Figure 7.3-2. Figure 7.3-3 also shows that for 2004, wildfires were a significant contributor, and that impacts in spring and fall suggest anthropogenic burning. In looking at other pollutants, sulfate levels fluctuate considerably during the year, while the contribution of nitrate is generally consistent. The sources of sulfate and nitrate are described further in Chapters 8 and 9. Figure 7.3-4 shows a 1.4 dv reduction is needed to meet the 2018 URP, and 6.1 dv needed by 2064.

Figure 7.3-1 Crater Lake IMPROVE Site – Average Aerosol Composition 20% Best and 20%Worst Days Baseline (2000-2004)
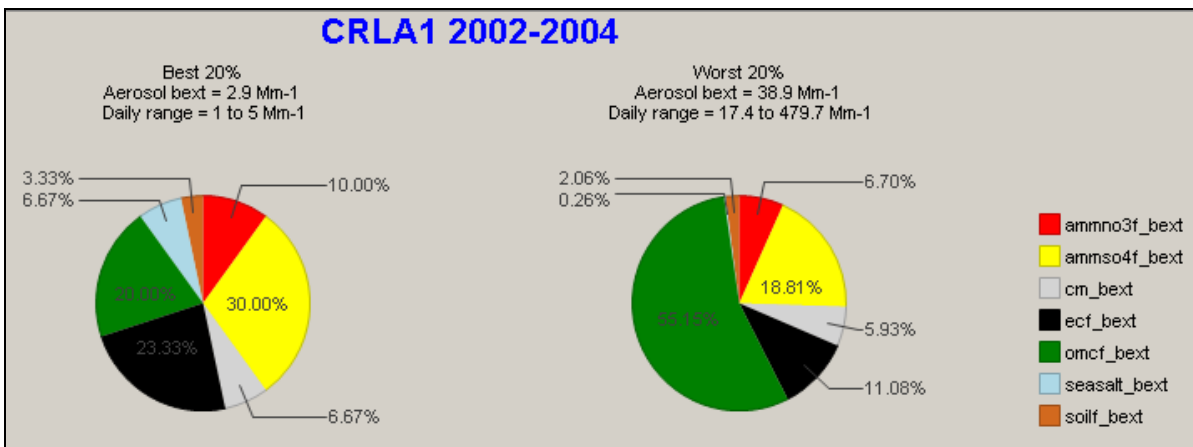
Figure 7.3-2 Crater Lake IMPROVE Site – Monthly Average Pollutant Species Variation for All Days Sampled During the Baseline Period (2000-2004)
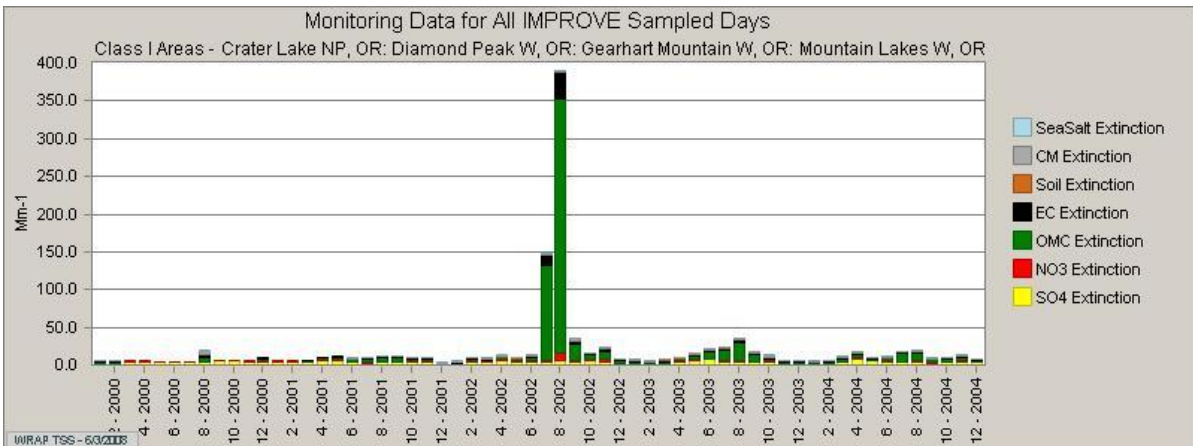
Figure 7.3-3 Crater Lake IMPROVE Site – Pollutant Species Variation for All Days Sampled in 2004
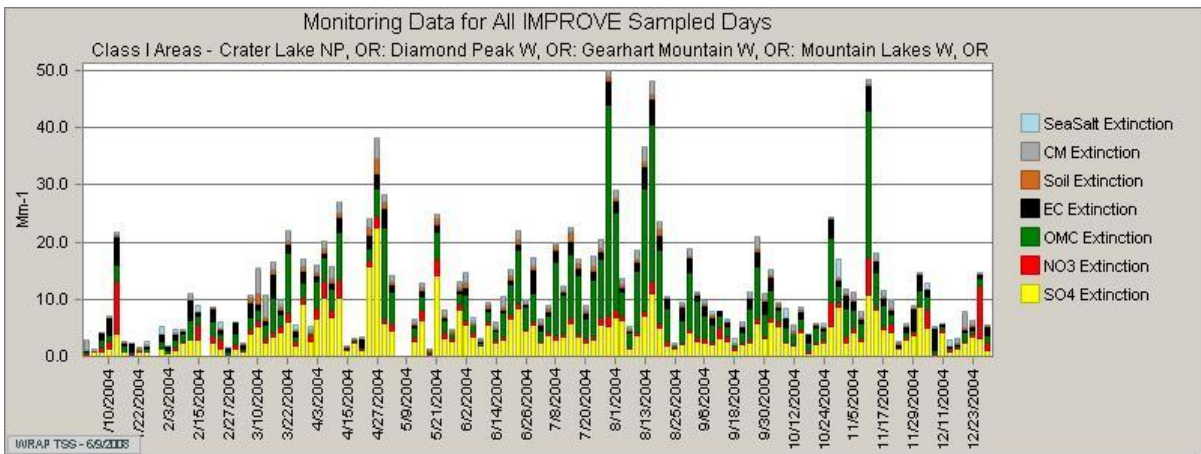
Figure 7.3-4 Crater Lake IMPROVE Site – Baseline Worst Day Aerosol Composition Compared to Visibility Improvement Needed by 2018 & 2064
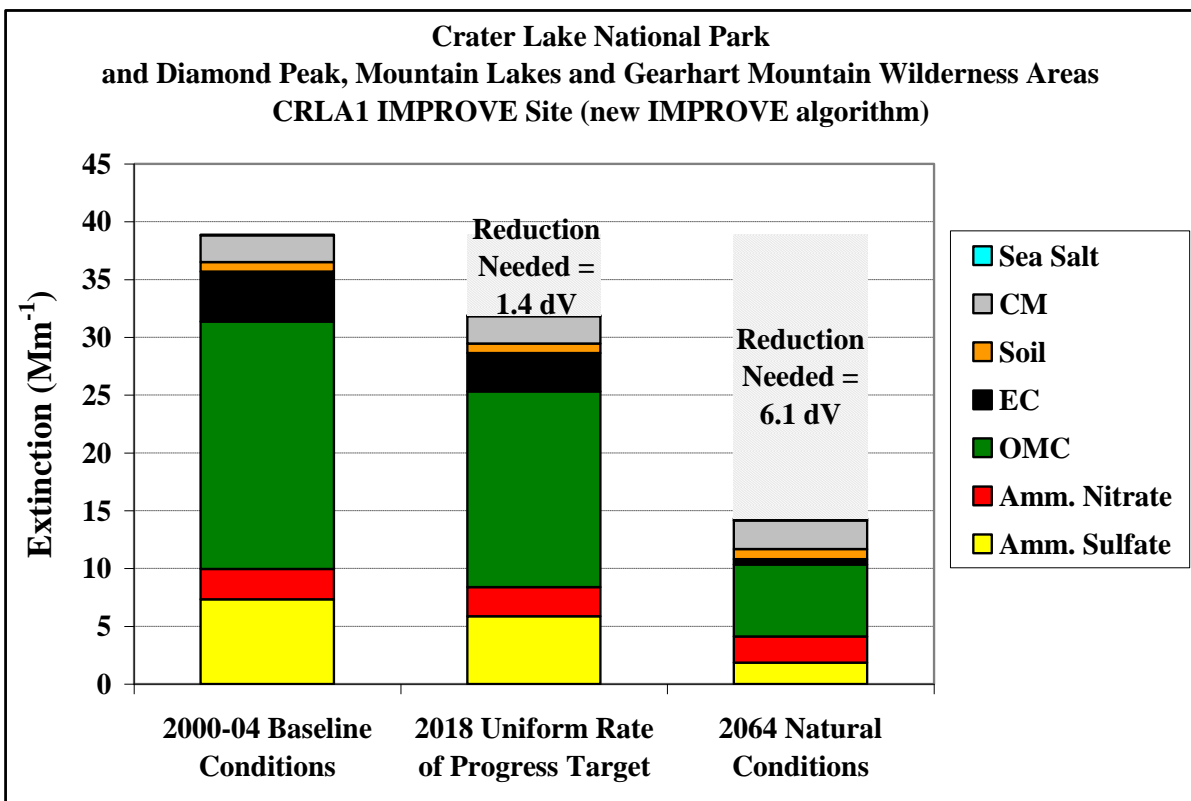
7.4 Coast Range - Kalmiopsis Wilderness Area

As Figure 7.4-1 shows, the Kalmiopsis Wilderness is dominated by organic carbon on both the best and worst days. Sulfate also is a significant contributor on both days. The organic carbon is an indicator of fire sources. The extreme spike or impact shown in Figure 7.4-2 for 2002 reflects one of the worst wildfire years in recent history. Figure 7.4-3 also shows impacts in organic carbon outside of the summer months in 2004, indicating that anthropogenic burning is a contributor year-round. While sulfate is significant, nitrate levels are lower than other Oregon Class I areas. The sources of sulfate and nitrate are described further in Chapters 8 and 9. Figure 7.4-4 shows a 1.4 dv reduction is needed to meet the 2018 URP, and 6.1 dv needed by 2064.

Figure 7.4-1 Kalmiopsis IMPROVE Site – Average Aerosol Composition 20% Best and 20%Worst Days Baseline (2000-2004)
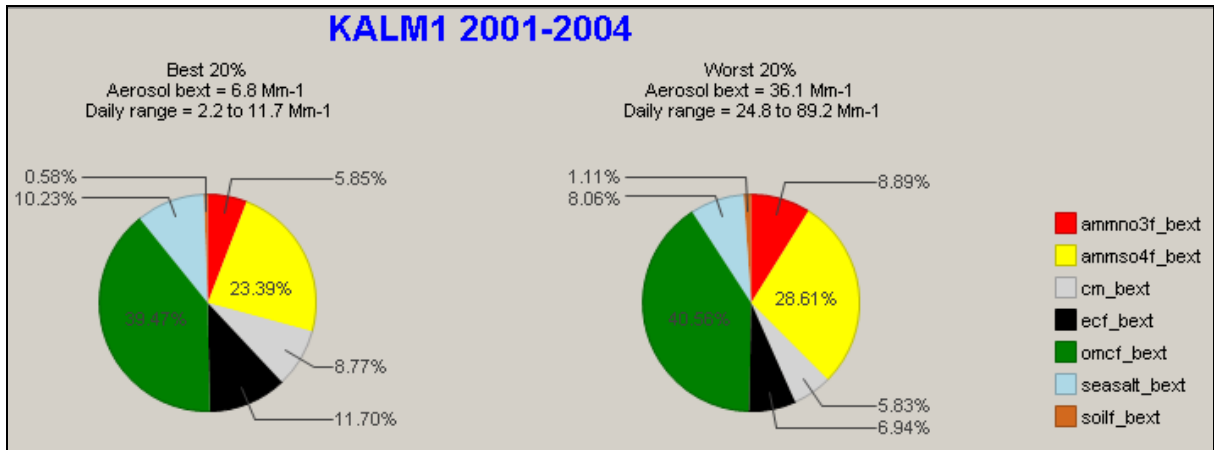
Figure 7.4-2 Kalmiopsis IMPROVE Site – Monthly Average Pollutant Species Variation for All Days Sampled During the Baseline Period (2000-2004)
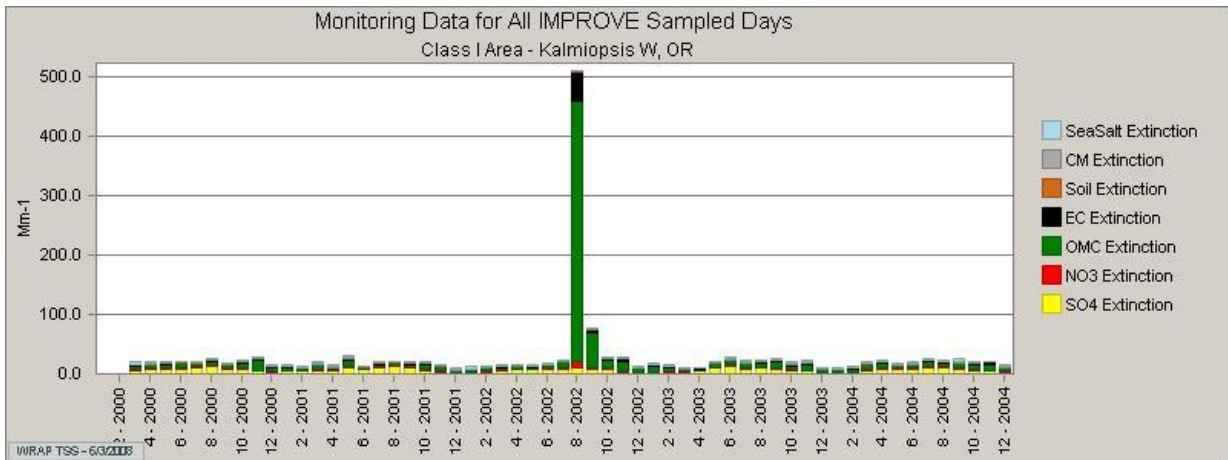
Figure 7.4-3 Kalmiopsis IMPROVE Site – Pollutant Species Variation for All Days Sampled in 2004
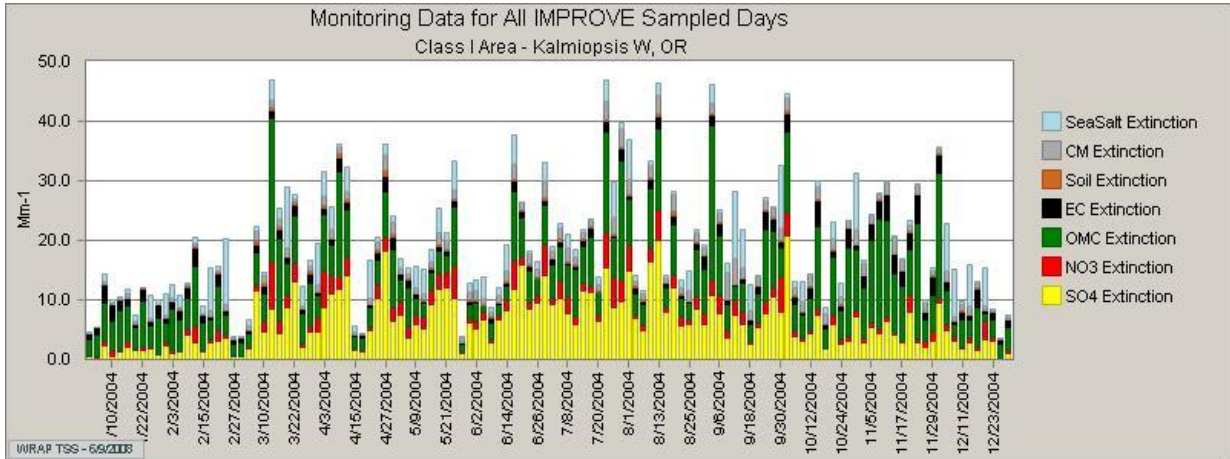
Figure 7.4-4 Kalmiopsis IMPROVE Site – Baseline Worst Day Aerosol Composition Compared to Visibility Improvement Needed by 2018 & 2064
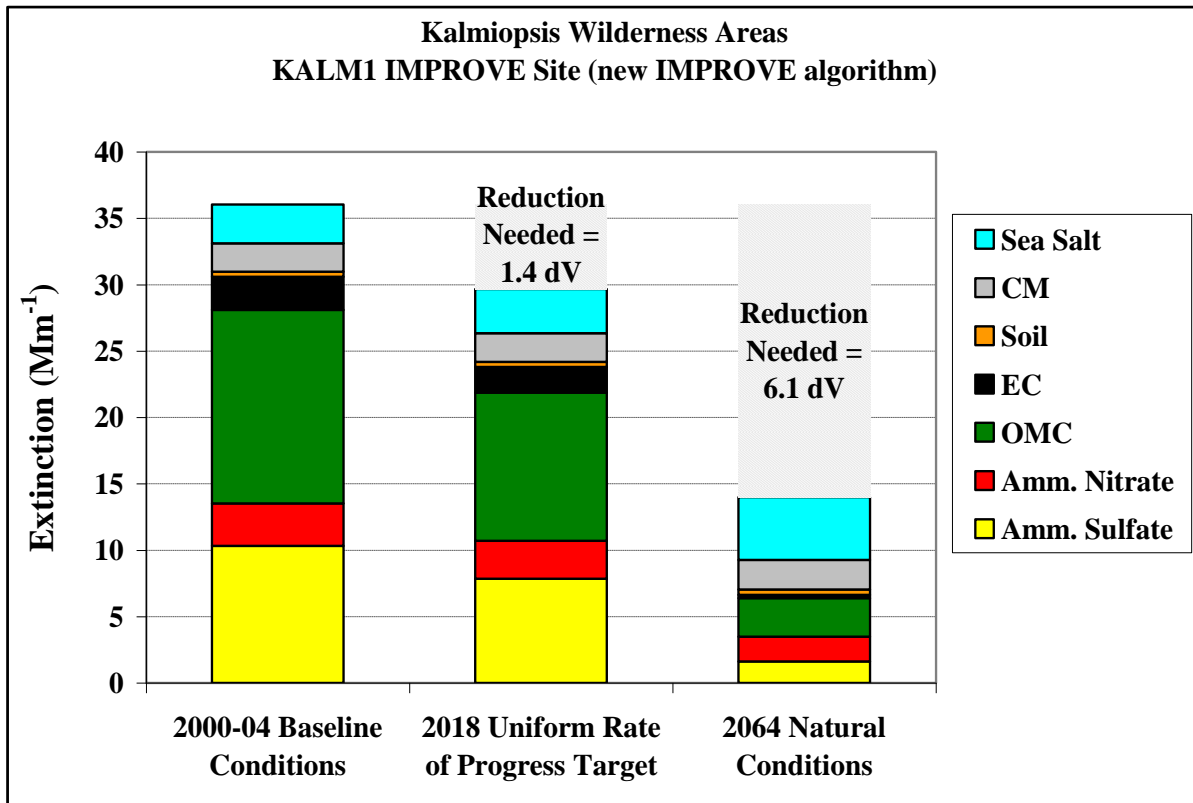
7.5 Eastern Oregon – Strawberry Mountain Wilderness and Eagle Cap Wilderness

As Figure 7.5-1 shows, two Class I areas in Eastern Oregon – the Strawberry Mountain and Eagle Cap Wilderness Areas - are dominated by sulfate on the best days, and organic carbon on the worst days. However, on the best days, organic carbon is also significant, while on the worst days, the contribution of nitrate is much higher than Western Oregon Class I areas. In looking at the pollutant species variations, the organic carbon impacts during the year suggests the same pattern of summer wildfire and anthropogenic burning in spring and fall as other Oregon Class I areas. There is also a pattern of high nitrate impacts during the winter months, which is particularly evident in Figure 7.5-3. Much of this can be attributed to industrial sources, primarily the PGE Boardman power plant, which is a large NO_x emissions source, and has been identified through BART modeling to be a significant contributor to regional haze, as described in Chapter 10.[3] Since these impacts occur in wintertime, this suggests that meteorological conditions play a major role. Cold temperatures and low level inversions likely intensify these impacts, and account for the high impacts noted in early 2004. Figure 7.5-4 shows a 2.3 dv reduction is needed to meet the 2018 URP, and 9.7 dv needed by 2064. The reductions needed here are notably greater than Western Oregon Class I areas.

Figure 7.5-1 Starkey IMPROVE Site – Average Aerosol Composition 20% Best and 20%Worst Days Baseline (2000-2004)

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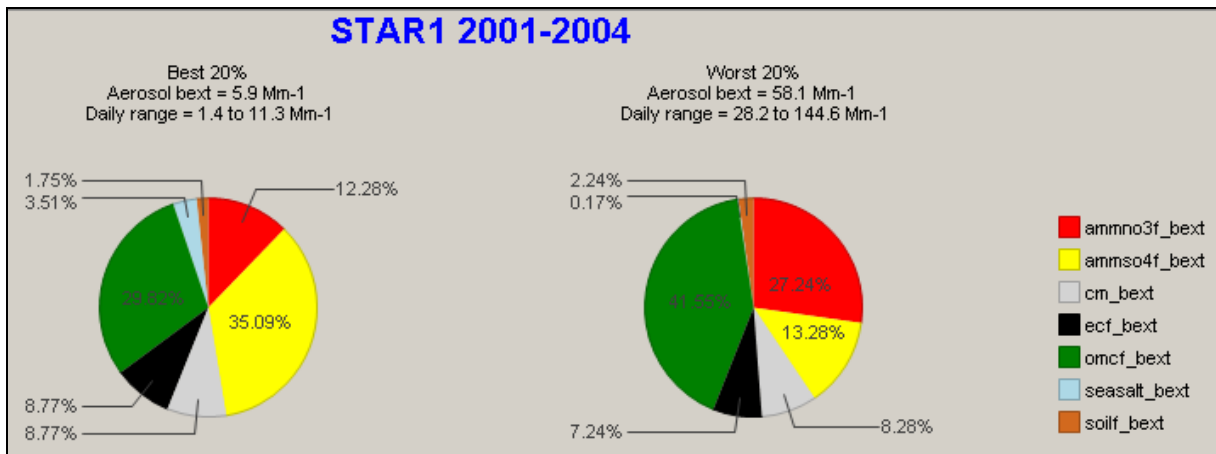
[3] Also described in Chapter 10 is a significant reduction in these nitrate impacts (and sulfate as well) that is expected from the installation of BART controls for the PGE Boardman power plant. See Chapter 10, Section 10.4.2, for further details.

Figure 7.5-2 Starkey IMPROVE Site – Monthly Average Pollutant Species Variation for All Days Sampled During the Baseline Period (2000-2004)
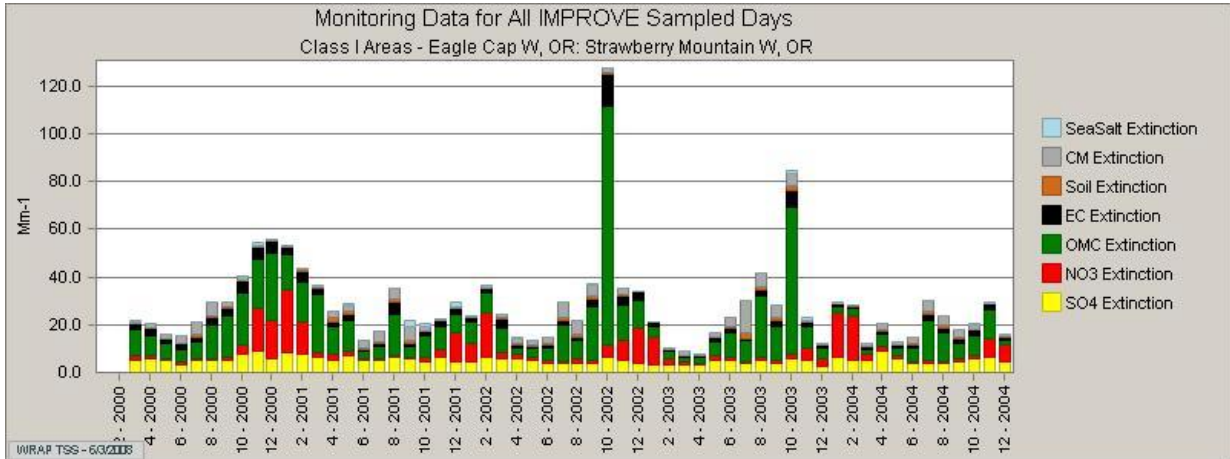
Figure 7.5-3 Starkey IMPROVE Site – Pollutant Species Variation for All Days Sampled in 2004
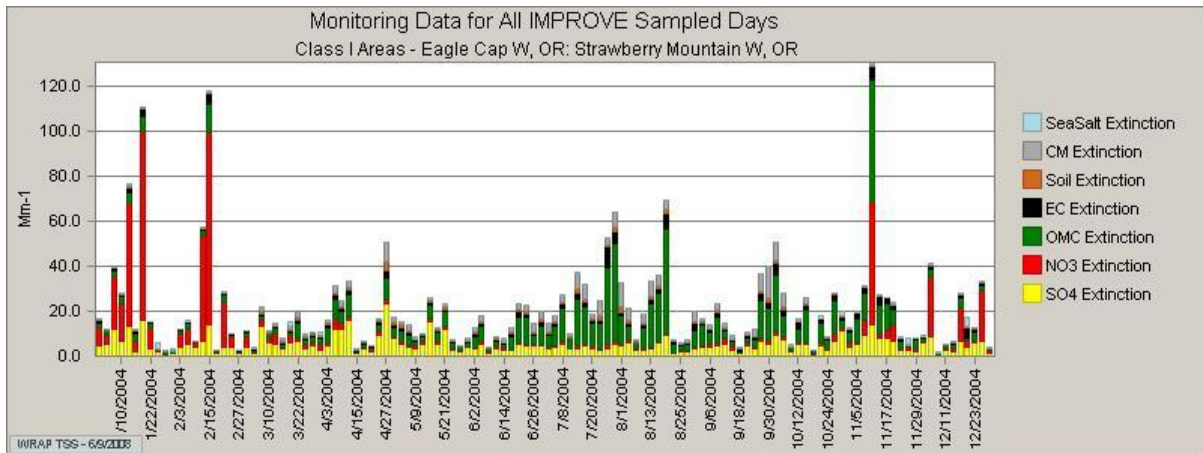
Figure 7.5-4 Starkey IMPROVE Site – Baseline Worst Day Aerosol Composition Compared to Visibility Improvement Needed by 2018 & 2064

Strawberry Mountain and Eagle Cap Wilderness Areas
STAR1 IMPROVE Site (new IMPROVE algorithm)
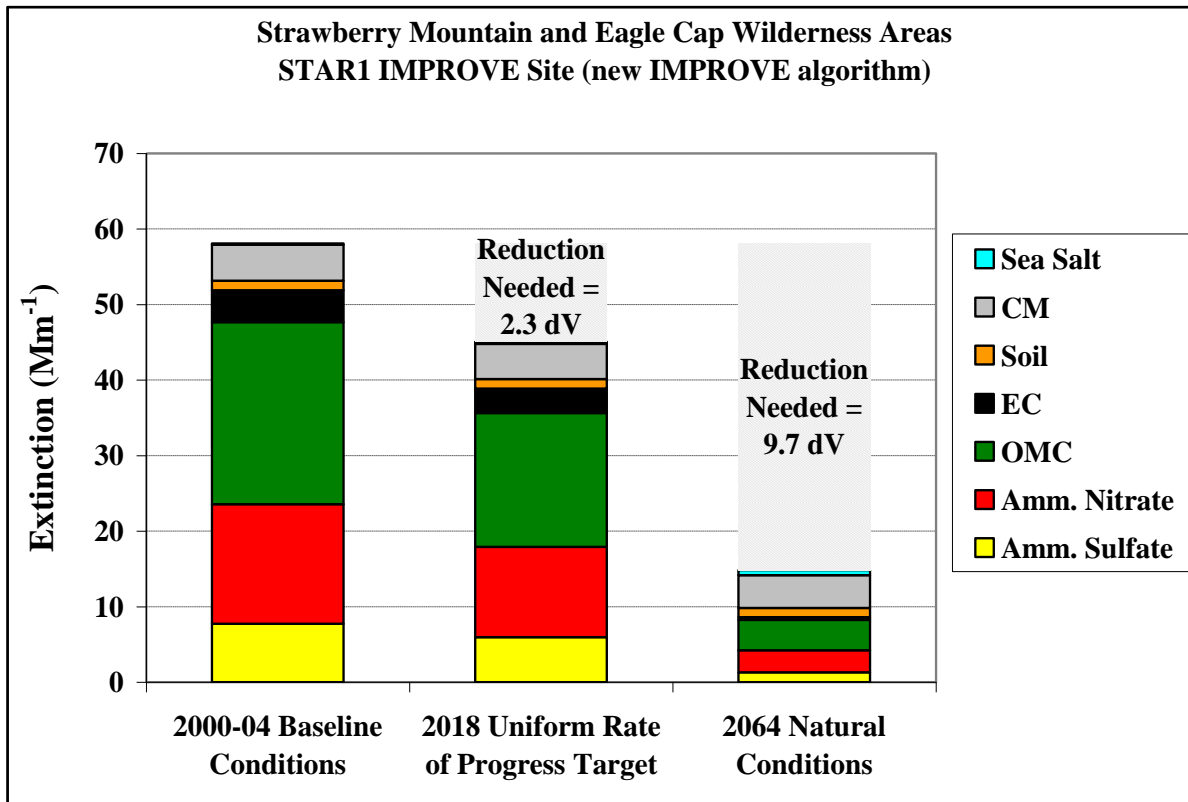
7.6 Eastern Oregon/Western Idaho - Hells Canyon Wilderness Area

As Figure 7.6-1 shows, the Hells Canyon Wilderness Area in Eastern Oregon has a different mix of pollutant species than Western Oregon Class I areas. It is dominated by both organic carbon and sulfate on the best days, and a significant contribution of nitrate (rather than organic carbon) on the worst days. This nitrate contribution is even more pronounced than at Strawberry Mountain and Eagle Cap Wilderness Areas. As Figure 7.6-3 and 7.6-4 show, most of the nitrate impacts appear during the winter months, suggesting meteorological conditions are playing a major role here. It is likely that the topographic features of Hells Canyon, combined with cold temperatures and low level inversions, greatly intensify these impacts during the winter. Again, the PGE Boardman power plant is believed to be the largest contributor, as indicated by the BART modeling and impacts described in Chapter 10.[4] Figure 7.6-4 shows a 2.4 dv reduction is needed to meet the 2018 URP, and 10.3 dv needed by 2064. The reductions needed here are notably greater than Western Oregon Class I areas.

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[4] As noted above in Section 7.5, a significant reduction in these nitrate impacts is expected from the installation of BART controls on the PGE Boardman power plant. See Chapter 10, Section 10.4.2, for further details.

Figure 7.6-1 Hells Canyon IMPROVE Site – Aerosol Composition 20% Best and 20%Worst Days Baseline (2000-2004)
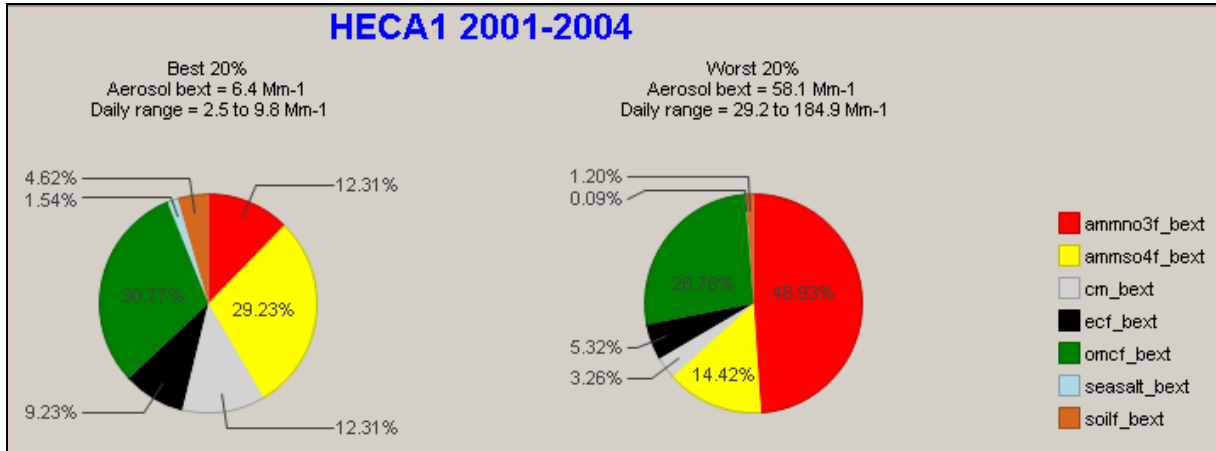
Figure 7.6-2 Hells Canyon IMPROVE Site – Monthly Average Pollutant Species Variation for all days sampled During the Baseline Period (2000-2004)
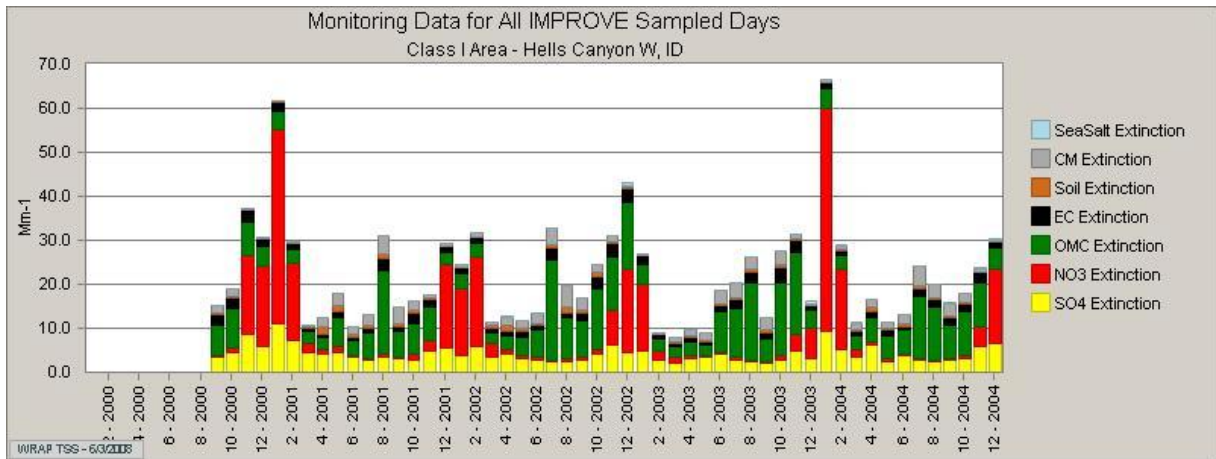
Figure 7.6-3 Hells Canyon IMPROVE Site – Pollutant Species Variation for All Days Sampled in 2004
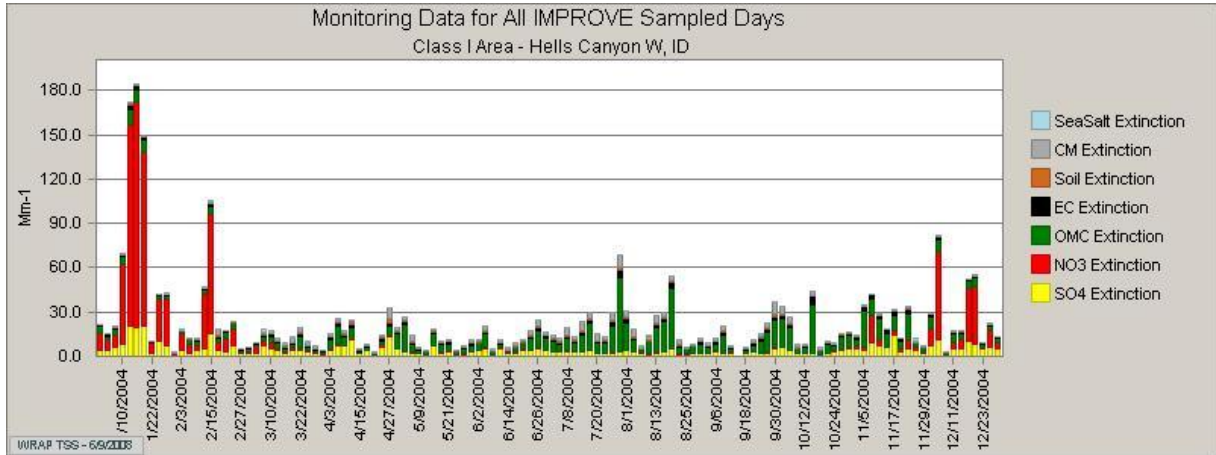
Figure 7.6-4 Hells Canyon IMPROVE Site – Baseline Worst Day Aerosol Composition Compared to Visibility Improvement Needed by 2018 & 2064
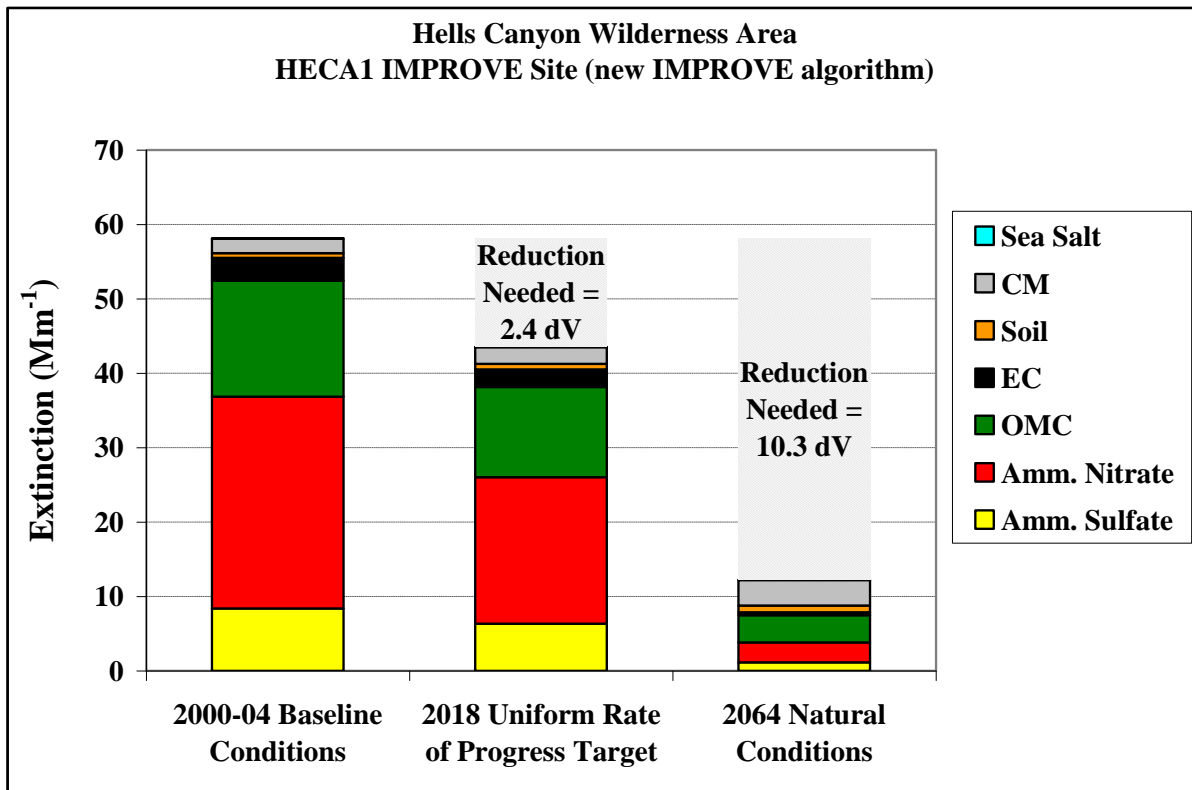
CHAPTER 8: EMISSION SOURCE INVENTORY

Regional haze in Oregon's Class I areas is caused by emission sources both inside and outside the state. Emission inventories are one part of the analysis to evaluate sources that impact visibility. This chapter identifies emission sources in Oregon, and regionally in neighboring States that could be affecting visibility in Oregon's Class I areas. This emissions information focuses on changes between the current 2002 baseline and projected 2018 emission scenarios. Chapter 9 provides a description of the significant emission sources that contribute to visibility impairment in Oregon, based on source apportionment analysis.

Section 8.1 of this chapter describes in-state emissions. Section 8.2 compares Oregon emissions to regional emissions.[5] Appendix A provides a breakdown of Oregon emissions by county. All emissions information is described by pollutant, source category, and 2002 vs. 2018 scenarios.

8.1 Oregon Statewide Emissions

EPA's Regional Haze rules (40 CFR 51.308(d)(4)(v)) requires a statewide emission inventory of pollutants that are reasonably anticipated to cause or contribute to visibility impairment in any mandatory Class I area. The pollutants in this chapter are sulfur dioxide (SO_2), nitrogen oxides (NO_x), volatile organic compounds (VOC), organic carbon (OC), elemental carbon (EC), fine particulate ($PM_{2.5}$), coarse particulate (PM_{10}), and ammonia (NH_3).

It is important to note that each of these pollutants have characteristics that differ in terms of ability to affect visibility. Assuming "one emission unit" of fine particulate ($PM_{2.5}$), for example, the same unit of SO_2 and NO_x (sulfate and nitrate particles) would be about 3 times more effective at impairing visibility, while OC is about 4 times more effective, and EC about 10 times. Conversely, coarse particulate (PM_{10}) is about half as effective as fine. Both VOC and NH_3 affect visibility only after certain chemical reactions occur, and therefore cannot be compared in this manner.

This emissions inventory was obtained from the WRAP Technical Support System (TSS) http://vista.cira.colostate.edu/TSS/Results/Emissions.aspx. The TSS emission scenarios used in this chapter were the "plan 02d" and the "2018 PRP". The plan 02d are emissions from an average of 2000-2004, and reflect the most recent inventory of all the pollutants in the West. This inventory provides a basis for comparison with the future year 2018 projected emissions, as well as to gauge reasonable progress with respect to future year visibility. In the following tables, these emissions are referred to as 2002 emissions. The 2018 PRP represents projected emissions in the year 2018, taking into account growth, "on-the-books" controls and regulations, and the application of regional haze strategies. The year 2018 was selected as it represents the first milestone date for demonstrating reasonable progress (see Chapter 11).

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[5] The county level emissions in Appendix A has been provided for reference purposes, as a further breakdown of the in-state emissions described in Section 8.1 of this chapter. However, no analysis of the county by county trend in emissions was conducted as part of this plan.

The emission tables show the primary source categories for each visibility impairing pollutant. The source categories vary by the type of pollutant. Categories include: point, area, on-road mobile, off-road mobile, oil and gas, anthropogenic fire, natural fire, biogenic, road dust, fugitive dust and windblown dust.[6] Not included as an "in-state" emission source category is offshore marine vessel emissions, which are considered "regional" emissions and discussed in Section 8.2. It should also be noted the projected 2018 emissions for natural fire (wildfires) is based on historical rates of burning and does not take into account increased burning that may occur due to climate change or natural causes.

8.1.1 SO_2 Emissions

The following table shows Oregon SO_2 emissions for baseline and future years.

Table 8.1.1-1 Oregon SO_2 Emission Inventory – 2002 & 2018

Oregon Statewide SO_2 Emissions (tons/year)			
Source Category	Plan02d	Prp18a	Net Change
	2002	2018	
Point	18,493	7,952	-10,541 (-57%)
Area	9,932	8,422	-1,510 (-15%)
On-Road Mobile	3,446	461	-2,985 (-87%)
Off-Road Mobile	6,535	152	-6,383 (-98%)
Anthro Fire	1,586	1,322	-264 (-17%)
Natural Fire	7,328	7,329	0 (0%)
Total	**47,320**	**25,638**	**-21,683 (-46%)**

Sulfur emissions produce sulfate particles in the atmosphere. Ammonium sulfate particles have a significantly greater impact on visibility than other pollutants like dust from unpaved roads due to the physical characteristics causing greater light scattering from the particles. SO_2 emissions come primarily from coal combustion at electrical generation facilities but smaller amounts come from natural gas combustion, mobile sources and even wood combustion. There are no biogenic SO_2 emissions of significance in Oregon. A 46% statewide reduction in SO_2

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[6] The number and types of sources are identified by various methods. For example, major stationary sources report actual annual emission rates to the EPA national emissions database. Oregon collects annual emission data from both major and minor sources and this information is used as input into the emissions inventory. In other cases, such as mobile sources, an EPA mobile source emissions model is used to develop emission projections. Oregon vehicle registration, vehicle miles traveled information and other vehicle data are used to tailor the mobile source data to best represent statewide and area specific emissions. Population, employment and household data are used in other parts of the emissions modeling to characterize emissions from area sources such as home heating. Thus, for each source type, emissions are calculated based on an emission rate and the amount of time the source is operating. Emission rates can be based on actual measurements from the source, or EPA emission factors based on data from tests of similar types of emission sources. In essence all sources go through the same process. The number of sources is identified, emission rates are determined by measurements of those types of sources and the time of operation is determined. By multiplying the emission rate times the hours of operation in a day, a daily emission rate can be calculated.

emissions are expected by 2018 due to planned controls on existing sources, especially on-the-books rules for mobile sources (see Section 11.4.3). Area sources of SO_2 are linked to population growth as the activity factor, which accounts for only a 15% reduction by 2018. A typical area source for SO_2 would be home heating. Not reflected in this table is a reduction of about 7,600 tons per year expected by 2018 from BART SO_2 controls at the PGE Boardman plant (see Chapter 10).

8.1.2 NO_x Emissions

The following table shows Oregon NO_x emissions for 2002 and 2018.

Table 8.1.2-1 Oregon NO_x Emission Inventory – 2002 & 2018

Oregon Statewide NO_X Emissions (tons/year)			
Source Category	**Plan02d**	**Prp18a**	**Net Change**
	2002	**2018**	
Point	26,160	24,947	-1,213 (-5%)
Area	14,740	16,979	2,238 (15%)
On-Road Mobile	111,646	42,143	-69,502 (-62%)
Off-Road Mobile	53,896	32,418	-21,478 (-40%)
Anthro Fire	6,292	5,150	-1,142 (-18%)
Natural Fire	27,397	27,400	3 (0%)
Biogenic	16,527	16,527	0 (0%)
WRAP Area O&G	85	44	-41 (-48%)
Total	**256,744**	**165,609**	**-91,134 (-35%)**

Nitrogen oxides (NO_x) are generated during any combustion process where nitrogen and oxygen from the atmosphere combine together under high temperature to form nitric oxide, and to a lesser nitrogen dioxide and in much smaller amounts other odd oxides of nitrogen. Nitrogen oxides, like sulfur dioxide, react in the atmosphere to form nitrate particles. These particles have a slightly greater impact on visibility than do sulfate particles and are four to eight times more effective at scattering light than mineral dust particles. NO_x emissions in Oregon are expected to decline 35% by 2018, primarily due to significant improvements in mobile sources. Off-road and on-road vehicles NO_x emissions are estimated to decline by more than 90,000 tons per year from the base case emissions total of 257,000 tons per year. Increases in area sources are related to population growth, with an expected 15% increase by 2018. Not reflected in this table is a reduction of about 4,700 tons per year expected by 2018 from BART NO_x controls at the PGE Boardman plant (see Chapter 10).

8.1.3 VOC Emissions

The following table shows Oregon VOC emissions for 2002 and 2018.

Table 8.1.3-1 Oregon VOC Emission Inventory – 2002 & 2018

Oregon Statewide VOC Emissions (tons/year)			
Source Category	**Plan02d**	**Prp18a**	**Net Change**
	2002	**2018**	
Point	28,762	40,639	11,876 (41%)
Area	245,649	334,846	89,197 (36%)
On-Road Mobile	88,784	36,395	-52,389 (-59%)
Off-Road Mobile	39,516	24,963	-14,553 (-37%)
Anthro Fire	9,939	7,354	-2,586 (-26%)
Natural Fire	60,336	60,344	7 (0%)
Biogenic	1,148,266	1,148,266	0 (0%)
WRAP Area O&G	34	14	-20 (-59%)
Total	**1,621,287**	**1,652,820**	**31,533 (2%)**

The dominant source of VOC emissions is biogenic emissions. These emissions comprise 70% of total Oregon VOC emissions. These are natural emissions mostly from forests, but also agricultural crops and urban vegetation. Biogenic emissions are the largest single source of VOCs in the country. Among other sources, automobiles, industrial and commercial facilities, solvent use, and refueling automobiles all contribute to VOC loading in the atmosphere. From a regional haze perspective, there is less concern with VOCs emitted directly to the atmosphere and more with the secondary organic aerosol that VOCs form after condensation and oxidation. Of more significance is the role VOCs play in the photochemical production of ozone in the troposphere. Volatile organic compounds react with NO_x to produce nitrated organic particles that impact visibility in the same series of chemical events that lead to ozone. Thus, strategies to reduce ozone in the atmosphere often lead to visibility improvements. Note that significant VOC reductions from mobile sources are more than offset by increases in area sources, due to primarily population growth. Use of solvents such as in painting, dry cleaning fluid, charcoal lighter fuel, windshield washer fluids, and many home use products show up in the area source category, and are linked to population growth. Overall, total VOC emissions are estimated to increase by 2% in 2018.

8.1.4 Organic Carbon Emissions

The following table shows Oregon Organic Carbon (OC) emissions for 2002 and 2018.

Table 8.1.4-1 Oregon Organic Carbon Emission Inventory – 2002 & 2018

Oregon Statewide Organic Carbon Emissions (tons/year)			
Source Category	**Plan02d**	**Prp18a**	**Net Change**
	2002	**2018**	
Point	1,445	283	-1,163 (-80%)
Area	22,281	23,762	1,481 (7%)
On-Road Mobile	1,009	967	-42 (-4%)
Off-Road Mobile	1,323	844	-479 (-36%)
Anthro Fire	10,937	7,863	-3,074 (-28%)
Natural Fire	81,047	81,054	7 (0%)
Road Dust	95	132	37 (38%)
Fugitive Dust	202	341	138 (68%)
Total	**118,340**	**115,245**	**-3,094 (-3%)**

Organic carbon is primarily the end product of combustion of organic material. Most of these emissions in Oregon are from natural (nonanthropogenic) wildfire, which can fluctuate greatly from year to year. 2002 was an unusually high year for wildfires in Oregon. Another sizable source is anthropogenic fire (human-caused), such as forestry prescribed burning, agricultural field burning, and outdoor residential burning. A variety of area sources contribute, although woodstoves are a significant source. Area sources increase slightly (7%) by 2018, due mostly to population increases. Overall, OC emissions are estimated to decline by 3% by 2018.

8.1.5 Elemental Carbon Emissions

The following table shows Oregon Elemental Carbon (EC) emissions for 2002 and 2018.

Table 8.1.5-1 Oregon Elemental Carbon (EC) Emission Inventory – 2002 & 2018

Oregon Statewide Elemental Carbon Emissions (tons/year)			
Source Category	**Plan02d**	**Prp18a**	**Net Change**
	2002	**2018**	
Point	45	61	17 (38%)
Area	4,121	4,355	234 (6%)
On-Road Mobile	1,166	320	-846 (-73%)
Off-Road Mobile	3,038	1,164	-1,874 (-62%)
Anthro Fire	1,935	1,416	-519 (-27%)
Natural Fire	16,403	16,403	0 (0%)
Road Dust	7	10	3 (38%)
Fugitive Dust	14	23	9 (68%)
Total	**26,728**	**23,752**	**-2,975 (-11%)**

Elemental carbon is the carbon black, or soot, which is a byproduct of incomplete combustion. It is similar to OC, but represents more combustion of fuel producing carbon particulate matter as the end product. Like OC, the primary source is natural fire, and to a lesser degree, anthropogenic fire. Other emissions of note are area and mobile sources. Area EC emissions are estimated to increase by 6% due mostly to population growth, while mobile is estimated to decrease significantly (62-73%) by 2018, as new federal mobile source regulations are being implemented.

8.1.6 PM Fine Emissions

The following table shows Oregon PM fine emissions for 2002 and 2018.

Table 8.1.6-1 Oregon Fine Particulate Matter Emission Inventory – 2002 & 2018

Oregon Statewide Fine Particulate Matter Emissions (tons/year)			
Source Category	**Plan02d**	**Prp18a**	**Net Change**
	2002	**2018**	
Point	5,728	462	-5,266 (-92%)
Area	15,295	17,082	1,787 (12%)
Anthro Fire	1,483	1,007	-475 (-32%)
Natural Fire	6,090	6,093	3 (0%)
Road Dust	1,379	1,909	530 (38%)
Fugitive Dust	3,642	6,157	2,515 (69%)
WB Dust	11,586	11,586	0 (0%)
Total	**45,203**	**44,296**	**-906 (-2%)**

PM fine in the emissions inventory includes soil materials and other non-carbon, non-sulfate and non-nitrate particulate matter less than 2.5 microns in size. The primary sources are area sources (woodstoves), and a variety of sources of dust (agriculture, mining, construction, and

unpaved and paved roads.) Here again, like OC and EC, natural fire is a significant source of PM fine. In terms of mobile sources, direct PM tailpipe emissions are relatively small, and are accounted for in the next table under PM coarse. Overall, PM fine shows a decrease of 2% by 2018. Monitoring at all sites in Oregon indicates PM fine is relatively small part of the visibility problem compared to other pollutants.

Table 8.1.6-2 Oregon Coarse Particulate Matter Emission Inventory – 2002 & 2018

Oregon Statewide Coarse Particulate Matter Emissions (tons/year)			
Source Category	**Plan02d**	**Prp18a**	**Net Change**
	2002	**2018**	
Point	10,211	12,088	1,877 (18%)
Area	3,546	4,206	660 (19%)
On-Road Mobile	618	692	74 (12%)
Anthro Fire	1,282	737	-546 (-43%)
Natural Fire	17,036	17,036	0 (0%)
Road Dust	12,630	17,485	4,855 (38%)
Fugitive Dust	21,369	43,989	22,620 (106%)
WB Dust	104,272	104,272	0 (0%)
Total	**170,964**	**200,505**	**29,541 (17%)**

PM coarse is particulate matter larger than PM fine, generally between 2.5-10 microns in size. Emission sources are similar to PM fine, but involve activities like rock crushing and processing, material transfer, open pit mining and unpaved road emissions. Windblown dust is the dominant source of PM coarse emissions. Coarse mass particles travel shorter distances in the atmosphere than other smaller particles, but can remain in the atmosphere long enough to contribute to regional haze. PM coarse emissions are significantly greater than PM fine in Oregon. Substantial increases in PM coarse are seen in the fugitive dust category. This is due to the fact that construction and emissions from paved and unpaved roads are tied to population growth and vehicle miles traveled. Overall, PM coarse emissions are estimated to increase by 17% in 2018.

8.1.7 Ammonia Emissions

The following table shows Oregon Ammonia (NH_3) emissions for 2002 and 2018.

Table 8.1.7-1 Oregon Ammonia (NH₃) Emission Inventory – 2002 & 2018

Oregon Statewide Coarse Particulate Matter Emissions (tons/year)			
Source Category	**Plan02d**	**Prp18a**	**Net Change**
	2002	**2018**	
Point	919	832	-87 (-9%)
Area	45,591	45,614	23 (0%)
On-Road Mobile	3,263	4,725	1,463 (45%)
Off-Road Mobile	39	51	13 (33%)
Anthro Fire	1,211	849	-361 (-30%)
Natural Fire	6,132	6,133	2 (0%)
Total	**57,154**	**58,206**	**1,052 (2%)**

Emission estimates for NH_3 have a high degree of uncertainty associated with them, based on a high variability in emission factors, wide range of activities, and lack of a uniform emission methodology.[7] However, NH_3 emissions are important in that they react with SO_2 and NO_x to form ammonium sulfate and ammonium nitrate particles, which are very effective in impairing visibility. NH_3 emissions come from agricultural related activities, primarily livestock operations and farming fertilizer applications. These fall under the category of area source emissions, which dominate NH_3 emissions in Oregon. Both area source and natural fire emissions are expected to be unchanged by 2018. As a result, total NH_3 emissions in Oregon are only projected to change by 2%. However, improvements in developing ammonia inventories will be needed in the near future to develop more effective regional haze strategies. As described in Section 8.2.3, improved emission inventory and better understanding of the chemistry in forming ammonium sulfate and ammonium nitrate in areas such as Eastern Oregon is needed.

8.2 Regional Emissions

In order to better understand the relative contribution of in-state vs. out-of-state emissions to regional haze, a comparison of Oregon emissions to regional emissions is provided in the following figures. Section 8.2.1 is a comparison of Oregon to the neighboring states of Washington, Idaho, California and Nevada. Section 8.2.2 is a summary of off-shore emissions from marine vessels, which have been separated from other source categories due to the unique nature of these emissions, their magnitude, and the relatively recent effort to quantify these emissions.

8.2.1 Regional Emissions Comparison to Neighboring States.

The following figures show Oregon emissions in comparison the states which border Oregon. The figures compare baseline to future year emissions (2002 and 2018, respectively) in tons per year. There are eight source categories for each visibility impairing pollutant: point, area, on-

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[7] A separate 2005 NH_3 emission inventory prepared by the Department showed a statewide total of approximately 39,000 tons per year. This highlights the uncertainty associated with estimating NH_3 emissions.

road mobile, off-road mobile, oil and gas, anthropogenic fire, natural fire, biogenic, road dust, fugitive dust and windblown dust.[8] These regional emissions can be found on the WRAP TSS under Emissions Review Tool http://vista.cira.colostate.edu/TSS/Results/HazePlanning.aspx.

Figure 8.2.1-1 SO₂ Emissions – Oregon vs. Regional, 2002 & 2018
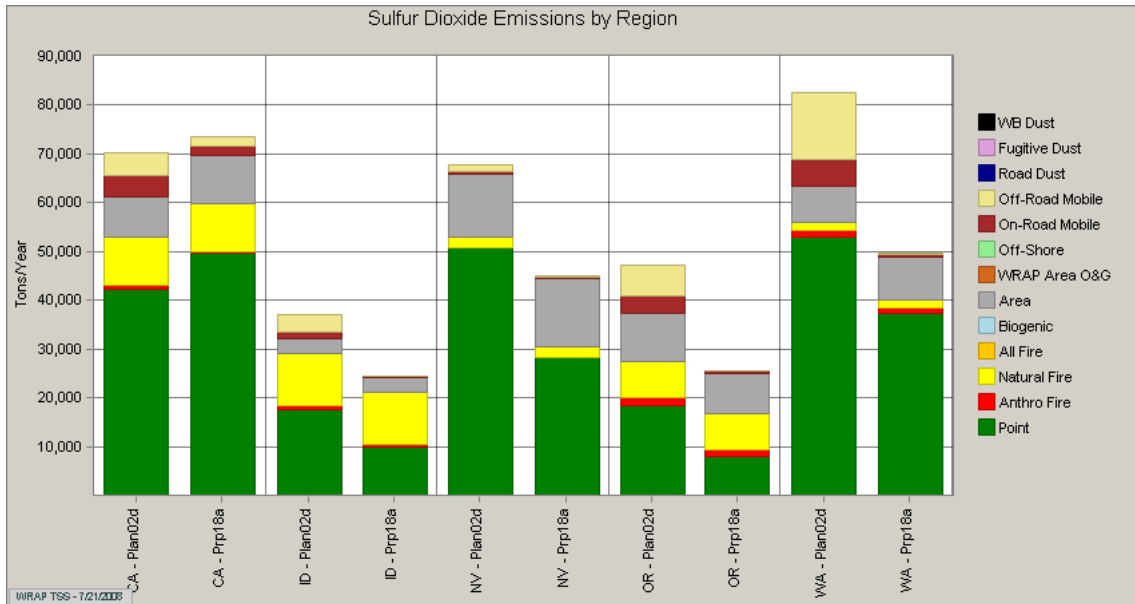
As indicated in Figure 8.2.1-1, Oregon SO₂ emissions are mostly from point sources, followed by area sources and natural fire. Projected emission levels for 2018 show almost a 50% reduction in Oregon, due primarily to large point source and mobile source reductions. Compared to neighboring states, Oregon total SO₂ emissions are considerably less than Washington, Nevada, and California, but more than Idaho.

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[8] The figures in this section are from the WRAP TSS, which include the source category of "Off-Shore" emissions on the right margin. These emissions are not included here, but instead are described separately in Section 8.2.2. WRAP TSS combines all of the off-shore emissions from marine vessels from the Pacific Ocean. Section 8.2.2 provides a breakdown of these off-shore emissions by State (Oregon, Washington, and California). Included is a discussion of how these emissions are estimated, and a general assessment of their potential contribution to regional haze in Oregon Class I areas.

Figure 8.2.1-2 NO$_x$ Emissions – Oregon vs. Regional, 2002 & 2018
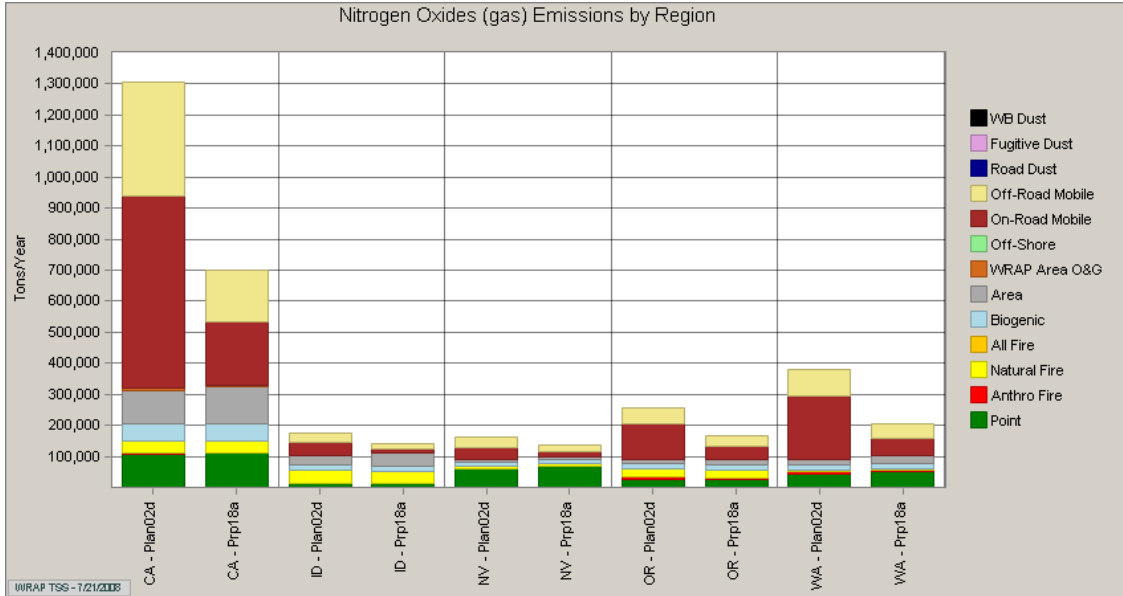
As indicated in Figure 8.2.1-2, Oregon NO$_x$ emissions are primarily from mobile sources, which show about a 50% reduction by 2018. Compared to neighboring states, California NO$_x$ emissions are considerably greater than Oregon and the other states.

Figure 8.2.1-3 VOC Emissions – Oregon vs. Regional, 2002 & 2018
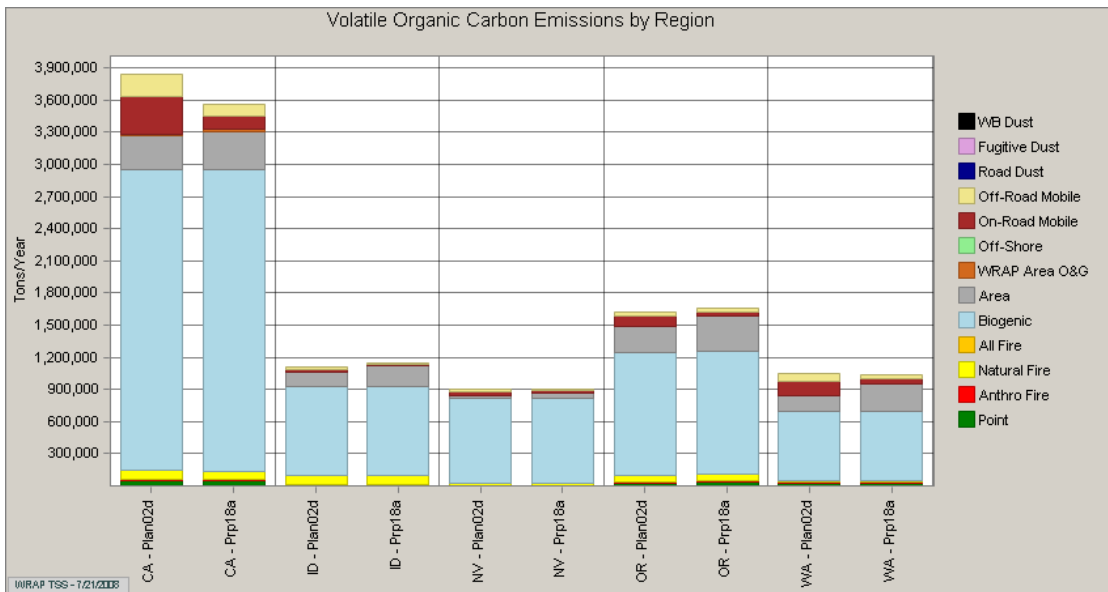
As indicated in Figure 8.2.1-3, VOC emissions are largely from biogenic sources. California's total VOC emissions are about twice that of Oregon.

Figure 8.2.1-4 OC Emissions – Oregon vs. Regional, 2002 & 2018
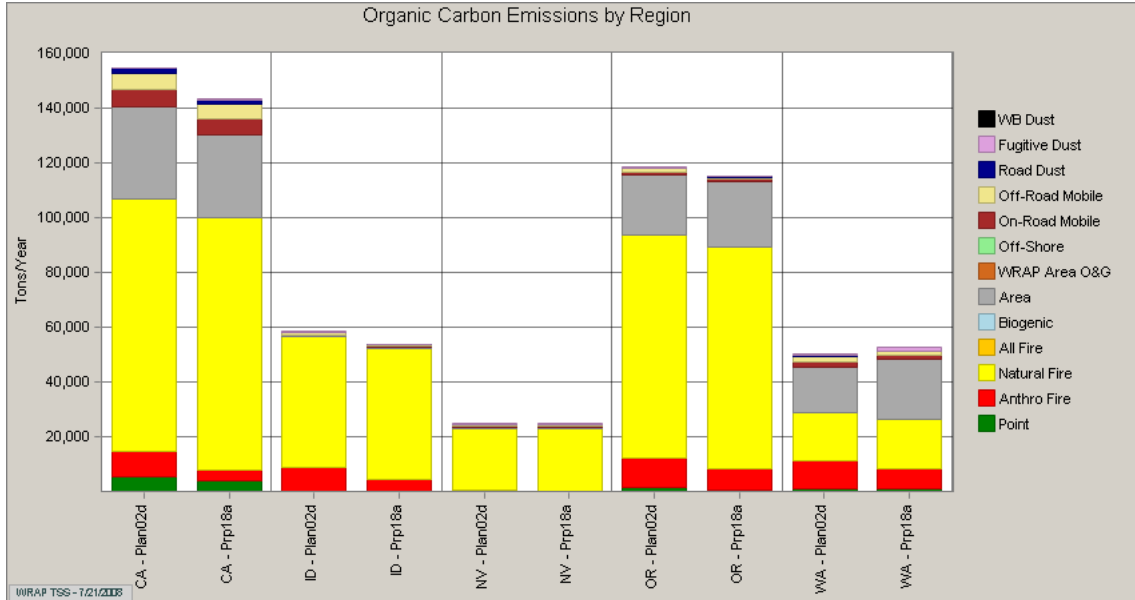
As indicated in Figure 8.2.1-4, Oregon OC emissions are primarily associated with fire sources. Oregon fire emissions are slightly lower than California's fire emissions, but considerably higher than neighboring states. 2002 was a much higher than normal year for wildfires in Oregon.

Figure 8.2.1-5 EC Emissions – Oregon vs. Regional, 2002 & 2018
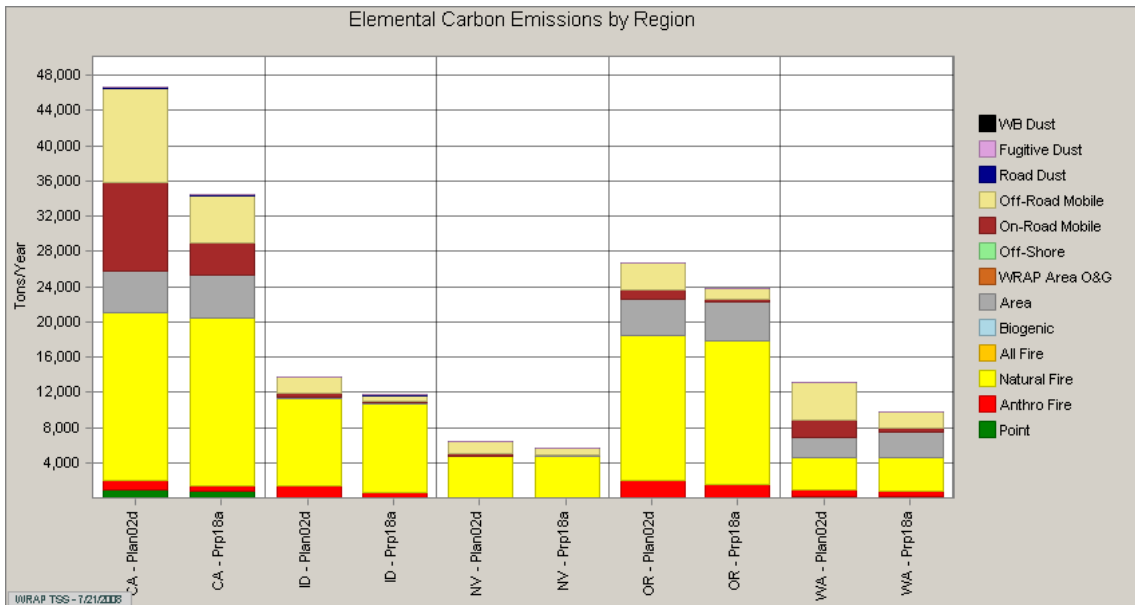
As indicated in Figure 8.2.1-5, Oregon EC emissions are mostly fire related, similar to OC.

Figure 8.2.1-6 PM Fine Emissions – Oregon vs. Regional, 2002 & 2018
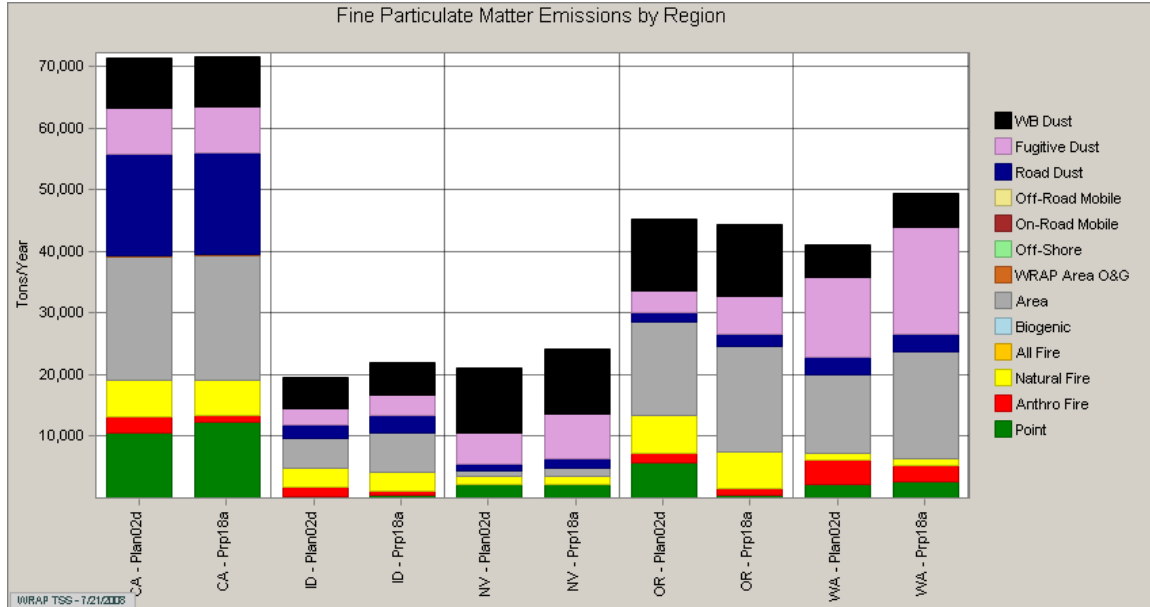
As indicated in Figure 8.2.1-6, Oregon PM Fine emissions are mostly dust and area sources, similar to Washington's. California's total Fine PM emissions are significantly higher.

Figure 8.2.1-7 Coarse PM Emissions – Oregon vs. Regional, 2002 & 2018
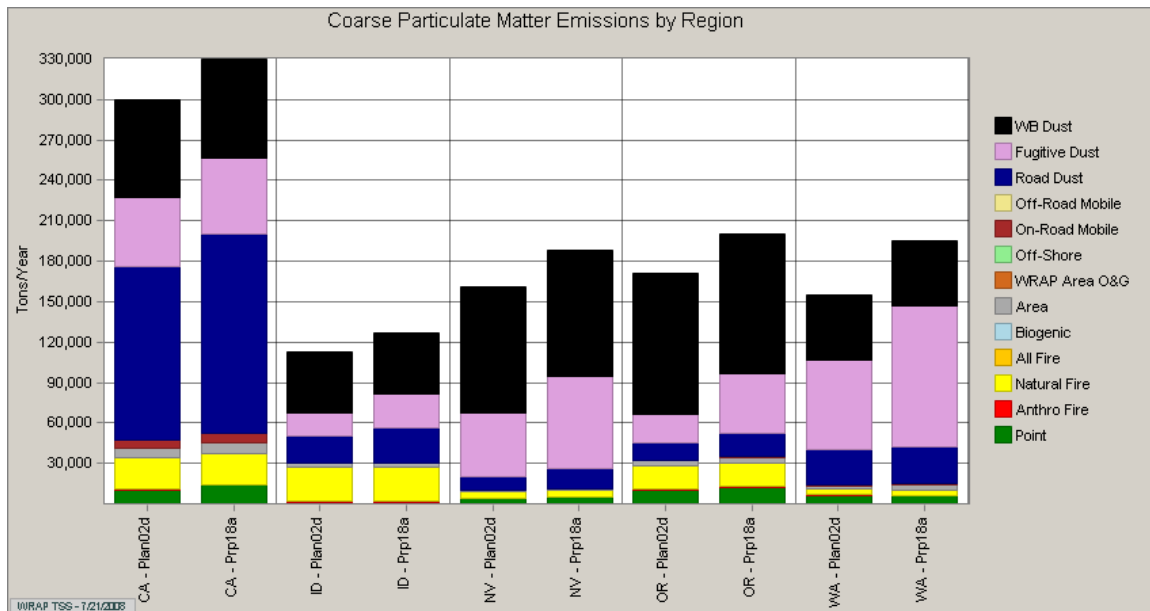
As indicated in Figure 8.2.1-7, Oregon PM coarse emissions are almost exclusively dust related. Again, California's emissions for this pollutant are significantly higher.

Figure 8.2.1-8 Ammonia Emissions – Oregon vs. Regional, 2002 & 2018
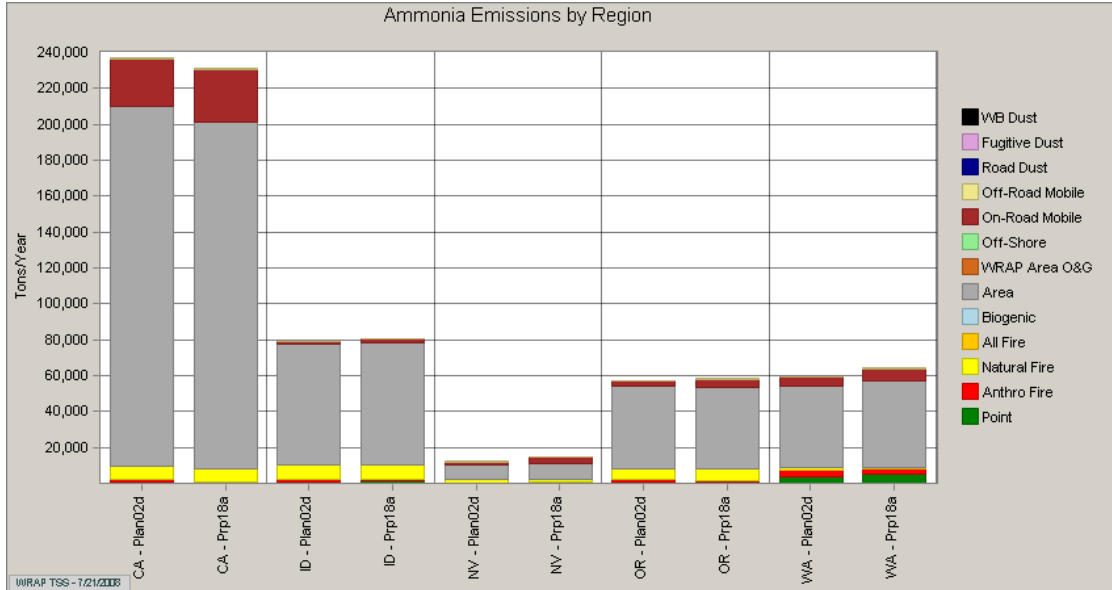
As indicated in Figure 8.2.1-8, Oregon ammonia emissions are almost exclusively from area sources, such as agricultural related activities involving livestock operations and farming fertilizer applications. California ammonia emissions dominate the regional total.

8.2.2 Regional Off-Shore Marine Emissions

Commercial marine shipping (tankers, container and cargo ships, bulk carriers, etc.) is a large source of emissions that is believed to have a significant contribution to regional haze in states like Oregon.[9] Until recently, emission estimates for marine vessels were limited. As part of the CMAQ regional haze modeling work conducted by the Regional Modeling Center (RMC) for the WRAP, efforts were made to update emission estimates for this source category. The RMC compiled information for this purpose through various means, including previous WRAP emission estimates, CARB estimates, EPA emission factors, and other sources.[10] 2002 emissions were estimated for vessels near shore and near ports using port call data, and offshore emissions were generated from ship location data. For purposes of identifying state emissions for marine shipping, the states were defined using latitudes where state borders meet the shore. Table 8.2.2-1 shows the different types of commercial marine vessels and uses.

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[9] As stated in Section 11.4.1, the contribution of this large emissions source to visibility impairment in Oregon Class I areas, particularly those located in Western Oregon, is believed to be a significant factor in affecting the ability to meet the 2018 URP goal.

[10] See WRAP TSS website under "Resources", "Emissions", and "Offshore Emissions" for summary, or go to http://vista.cira.colostate.edu/docs/wrap/emissions/OffshoreEmissions.doc

Table 8.2.2-1 Commercial Marine Vessel Types and Uses

Type	Purpose	Activity Area
Deep draft	Ocean-going large vessels	Ocean Traffic
		Near port
Tow or Push Boats	Barge Freight	River Traffic
		Ocean Traffic
Tugs	Vessel assist and support functions	Near port
Ferries	River or lake ferrying	Regular routes
Other Commercial Vessels	Smaller support or excursion boats	Near dock
Dredges	Dredging projects	Varies
Commercial Fishing	Market fishing	Ocean
Military	Coast Guard and Navy	Ocean & Port

Emissions were estimated for each of these vessel types by the RMC, using methodology that included revising emission factors for different marine engines, updates on port activity, offshore traffic levels, and other factors. Table 8.2.2-2 shows the 2002 emissions for large ocean-going shipping by State and pollutant. Table 8.2.2-3 shows the 2002 emissions for Columbia River vessels, by port.

Table 8.2.2-2 2002 Emissions for Ocean-going Shipping Emissions by State

State	VOC (tons/year)	NO$_x$ (tons/year)	PM10 (tons/year)	SO$_2$ (tons/year)
Oregon (offshore)	1,331	41,113	2,986	23,119
Oregon (near port)	22	736	72	532
Oregon (within shore)	23	1,415	42	212
Washington (offshore)	1,451	44,692	3,247	25,130
Washington (within shore)	277	10,764	763	5,352
Washington (near port)	103	3,467	335	2,483
California (offshore)	4,269	131,930	9,587	74,181
California (coastal zone)*	5,387	111,550	6,042	46,059
Total	12,863	345,667	23,074	177,068

* includes near port

Table 8.2.2-3 2002 Emissions for Columbia River Ocean-going Vessels by Port

Port	VOC (tons/year)	NO_x (tons/year)	PM10 (tons/year)	SO_2 (tons/year)
Port of Astoria, OR	3	146	7	44
Port of Kalama, WA	11	512	31	212
Port of Longview, WA	18	862	51	344
Port of Portland, OR	72	2935	209	1470
Port of Vancouver, WA	21	920	61	423

These emission estimates for both tables show that total emissions for Oregon are 79,955 tons/year, with the majority being NO_x at 48,639 tons/year (61%) and SO_2 emissions at 26,356 tons/year (33%).

Future increases in marine vessel emissions by 2018 are difficult to estimate. The RMC study estimated a possible doubling in emissions by 2018. Other estimates of future growth suggest a more modest 5-6% increase by 2020.[11]

Chapter 9 PSAT and WEP results show offshore marine vessel emissions as a major contributor to Oregon Class I areas, especially for SO_2 and NO_x, in the Kalmiopsis Class I area in the Coast Range, and the seven Class I areas located in the Cascade Mountains. The impact is less for Class I areas in eastern Oregon, based on distance from this source. If compared to emission inventory data in Chapter 8, marine vessel emissions are 56% for SO_2 and 31% for NO_x of the total 2002 statewide emission inventory for these pollutants.

The Department views these emission estimates as having a higher than average level of uncertainty, based on the description by the RMC of revisions made to emission factors, estimates of traffic and activity levels, and other aspects of methodology used for this estimation. The Department expects that further refinement of marine vessel emissions will occur in the future, through efforts by the WRAP, CARB, and other organizations.

Currently, the Department has limited authority in Oregon to regulate offshore shipping emissions. Current state regulations on shipping (340-208-0570) apply only to vessels on the Willamette River and Columbia River in three counties - Clackamas, Columbia, and Multnomah. The rules require each ship meet "visible emissions" standards for particulate matter, and must minimize soot emissions.

On July 24, 2008, the State of California adopted new strict regulations for marine vessels within 24 miles of shore. These regulations, *Adoption of a Proposed Regulation for Fuel Sulfur and Other Operational Requirements for Ocean-Going Vessels Within California Waters and 24 Nautical Miles of the California Baseline (13 CCR, section 2299.1.)*, will require the use of low sulfur marine distillate fuel in auxiliary diesel engines and diesel-electric engines, for both

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[11] West coast growth rate for 2020, from "Regional Commercial Marine Vessel Inventories and Forecasts" presentation, made to California Air Resources Board, Sacramento CA, 26 July 2007, by James Corbett, University of Delaware, and Chengfeng Wang, Air Resources Board.

U.S. and foreign vessels. The regulation will be implemented in two steps. Starting in 2009 with low sulfur fuel, and then in 2012, ultra low sulfur fuel. Using the cleaner fuels required in 2009 will result in immediate emission reductions from ocean-going vessels. Reductions will increase as the fuel sulfur content is progressively lowered through the regulation's phase-in. In 2009 about a 75% percent of the diesel PM, over 80% of SO_2, and 6% of NO_x will be eliminated. In 2012, when the very low sulfur fuel requirement will result in reductions of diesel PM of 15 tons daily, an 83% reduction compared to uncontrolled emissions. SO_2 will be reduced by 140 tons daily, or a 95% reduction, and NO_x will be reduced by 11 tons per day, a 6 percent reduction.

The Department expects that implementation of California's new regulations for marine vessels will have benefits in Oregon, and will include in the next regional haze plan update in 2013 any information on possible visibility benefits in Oregon Class I areas. See Section 12.6.5 of the LTS for future efforts planned by the Department to address marine vessel emissions.

8.2.3 Role of Ammonia Emissions in Visibility Impairment

It is believed that in many areas of the country, ammonia plays a key role in the formation of haze. NH_3 reacts chemically with SO_2 and NO_x to form ammonium sulfates and nitrates, which are very effective in impairing visibility. Sources typically associated with ammonia emissions include livestock farming, application of fertilizer, and the decomposition of manure. The contribution of ammonia to regional haze in Oregon is difficult to estimate. As pointed out in Section 8.1.7, NH_3 emission estimates have a high degree of uncertainty associated with them, based on high variability in emission factors and lack of a uniform emission methodology.

A 2007 visibility study conducted on the Columbia River Gorge National Scenic Area by the Department and the Southwest Clean Air Agency (SWCAA) evaluated several haze-causing pollutants, including NH_3. This study used modeling to simulate the chemical formation and transport, and evaluated a 2004 wintertime episode with some of the highest visibility impairment days. The NH_3 emissions included in the modeling was limited to just regional estimates from dairy farms in Oregon and Washington, as other NH_3 emission information was not available. The study found that the contribution of NH_3 on some days was negligible, and on other days contributed to a 12%-30% reduction in visibility. The study was the first to provide an indication of the role NH_3 can play in contributing to haze impacts in Oregon. It also illustrated the current technical complexity and uncertainties of evaluating NH_3, due in part to limited NH_3 emission inventories. Further information on this study can be found at http://www.deq.state.or.us/aq/gorgeair/.

As mentioned above, one of the sources of NH_3 is animal feeding operations. In January 2008, an Oregon Task Force on Dairies and Air Quality was convened to study emissions from dairy operations and explore options for reducing those emissions. Currently there are 370 permitted dairy operations in Oregon. Of those, 331 of them were milking operations with 116,335 milking cows. Of the 331 permitted dairy operations, 39 were registered as large federal concentrated animal feeding operations (CAFOs), meaning that they had 700 or more dairy milking cows. The Task Force reviewed efforts in other parts of the West to improve NH_3 emission estimates, and reviewed best management practices (BMP) being used. In Idaho, for

example, some BMPs being employed include solid separation of manure, corral harrowing, low pressure irrigation, composting and rapid manure removal from outdoor lots. The Task Force concluded its work in July 2008, providing recommendations that included encouraging voluntary programs to reduce emissions from CAFO, and additional research to identify appropriate BMPs for Oregon. For additional information on the Oregon Dairy Task Force, see http://www.deq.state.or.us/aq/dairy/index.htm.

As described in Chapter 7, ammonium nitrate and ammonium sulfate are major contributors to regional haze throughout Oregon's 12 Class I areas. In addition, Eastern Oregon Class I areas (Strawberry Mountain, Eagle Cap, and Hells Canyon) there is a noticeably high contribution of ammonium nitrate to visibility impairment during the winter months. Cold temperatures and low level inversions likely intensify these impacts. See Sections 7.5 and 7.6. Much of this can be attributed to industrial sources, but primarily the PGE Boardman power plant, a large source of NO_x, and identified through BART modeling as a significant contributor to regional haze. The installation of BART controls for this plant (as described in Chapter 10) is expected to reduce NO_x emissions by about 8,000 tons per year, and SO_2 by about 11,000 tons per year. This should result in significant visibility benefits, and reduce these wintertime nitrate levels, as well as sulfate levels year-round in Eastern Oregon.

The Department recognizes that any reduction in NO_x and SO_2 also needs to include reductions in NH_3, due to the role that chemistry plays in secondary aerosol formation. Any effective strategy in Eastern Oregon, or any region of the state, will need to address the chemical formation and transport, as noted in the 2007 Columbia Gorge study summarized above, and identify measures such as the BMPs for large NH_3 sources like CAFOs, as noted in the work of the Oregon Dairy Task Force.

The Department intends to continue to explore ways to improve NH_3 emission estimates, and options for reducing these emissions in the future, as a part of Oregon's on-going participation in the WRAP, and state efforts such as the Oregon Dairy Task Force. As part of the next progress report in 2013, the Department will provide an update on any new information on NH_3 emissions, BMPs, and related programs.

CHAPTER 9: SOURCE APPORTIONMENT AND REGIONAL HAZE MODELING

9.1 Overview

Visibility impairment occurs when pollutants emitted into the atmosphere scatter and absorb light, thereby creating haze. These pollutants can remain suspended in the atmosphere for long periods and be transported long distances, thereby contributing to regional-scale impacts on visibility in Class I areas. Air quality models offer the opportunity to better understand how these impacts occur, by identifying the sources that contribute to haze, and helping to select the most effective emissions reduction strategies to improve visibility.

Oregon Class I area visibility is affected by a combination of local and regional transport of air pollutants. Chapter 8 provided information on emission inventories, as the first step in identifying significant source categories causing visibility impairment. This chapter describes the results of (1) source apportionment analysis showing the in-state and regional contribution of haze sources, emphasizing the 20% worst visibility days, and (2) regional modeling projections of visibility conditions by the 2018 benchmark or milestone, based on application of the regional haze strategies outlined in this Plan, including BART. The source apportionment information and regional modeling results are the basis for the demonstration of reasonable progress for the 20% worst and best days, described in Chapter 11.

9.1.1 Source Apportionment Analysis – PSAT and WEP

In order to determine the significant sources contributing to haze in Oregon's Class I areas, the Department has relied upon source apportionment analysis techniques provided by the WRAP for this regional haze plan. This information can be found on the WRAP TSS website at http://vista.cira.colostate.edu/TSS/Results/HazePlanning.aspx. There were two techniques used for source apportionment of regional haze. One was the *PM Source Apportionment Technology (PSAT)* tool, used for the attribution of sulfate and nitrate sources only. The other was the *Weighted Emissions Potential (WEP)* tool, used for attribution of sources of sulfate, nitrate, organic carbon, elemental carbon, fine PM, and coarse PM.

PSAT uses the CAMx air quality model to show nitrate-sulfate-ammonia chemistry and apply this chemistry to a system of tracers or "tags" to track the chemical transformations, transport and removal of NO_x and SO_2. Emissions scenarios used for PSAT analysis were the plan02c and base18b. PSAT results were not regenerated for using the more recently updated plan02d and prp18a emissions scenarios because of the time and resources that would have been required. These two pollutants are important because they tend to originate from anthropogenic (human-caused) sources. Therefore the results from this analysis can be useful in determining contributing sources that may be controllable, both in-state and in neighboring states. The PSAT results show contributions or impacts in mass ($\mu g/m^3$), but do not directly represent actual sulfate and nitrate measurements, nor can they accurately be transformed into extinction values.

WEP is a screening tool that helps to identify source regions that have the potential to contribute to haze formation at specific Class I areas. Unlike PSAT, this method does not

account for chemistry or deposition. The WEP combines emissions inventories, wind patterns, and residence time of air mass over each area where emissions occur, to estimate the percent contribution of different pollutants. Like PSAT, the WEP tool compares baseline (2000-04) to 2018, to show the improvement expected by the 2018 URP, for sulfate, nitrate, organic carbon, elemental carbon, fine PM, and coarse PM.

Appendix B of this plan provides additional WEP information in the form of maps which show the location and transport of each haze-causing pollutant and its potential contribution to the 20% worst days at each Class I area. Each map shows a 100 km and 200 km radius circle around the Class I area, with shaded colors representing areas that potentially contribute to the Class I area. For the sake of brevity these maps were made part of the appendix section.

As described in Section 9.2, the Department believes PSAT is a better tool than WEP for identifying the contribution of sulfates and nitrates to Oregon Class I areas, because PSAT does account for chemistry and deposition, and is better at identifying regional contribution of sources from outside the WRAP region (see discussion in Section 9.2). For these reasons, the Department has relied upon the PSAT results as the primary source apportionment tool for sulfates and nitrates, and thus the better tool for identifying anthropogenic sources. The results from the WEP analysis were used by the Department primarily to identify the pollutants more commonly associated with non-anthropogenic (natural) sources. Even though these sources are mostly uncontrollable, it is still important to consider their relative contribution to haze.

As described in Section 9.2 below, the review of PSAT results in this chapter focus on the contribution on sulfates and nitrates, while the WEP results focus on the contribution of organic carbon, elemental carbon, fine PM, and coarse PM.

9.1.2 Regional Haze Modeling – CMAQ

The primary tool relied upon by the Department for modeling regional haze improvements by 2018, and for determining Oregon's Reasonable Progress Goals (see Chapter 11), was the *Community Multi-Scale Air Quality (CMAQ)* model. The CMAQ model was used to estimate 2018 visibility conditions in Oregon and all Western Class I areas, based on application of the regional haze strategies included in this plan, including assumptive controls on BART sources.[12] For a complete description on the CMAQ model operation and the emission inputs used to project 2018 visibility conditions, see Appendix C of this plan.

The modeling was conducted by the Regional Modeling Center (RMC) at the University of California Riverside, under the oversight of the WRAP Modeling Forum. Results can be found on the WRAP TSS website at http://vista.cira.colostate.edu/TSS/Results/HazePlanning.aspx.

The CMAQ model was designed as a "one atmosphere" modeling system to encompass modeling of multiple pollutants and issues, including ozone, PM, visibility, and air toxics. This

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[12] The CMAQ modeling was conducted by the WRAP prior to the completion of Oregon's and other state BART reviews. However, the modeling did include assumptions of BART controls for known BART sources across the West. See Appendix C for more information.

is in contrast to many earlier air quality models that focused on single-pollutants. CMAQ takes into account emissions, advection and dispersion, photochemical transformation, aerosol thermodynamics and phase transfer, aqueous chemistry, and wet and dry deposition of trace species. The model requires inputs of three-dimensional gridded wind, temperature, humidity, cloud/precipitation, and boundary layer parameters. The current version of CMAQ can only utilize output fields from the MM5 meteorological model. MM5 is a state-of-the-science atmosphere model that has proven useful for air quality applications and has been used extensively in past local, state, regional, and national modeling efforts. MM5 has undergone extensive peer-review, with all of its components continually undergoing development and scrutiny by the modeling community.

The RMC developed air quality modeling inputs including annual meteorology and emissions inventories for a 2002 actual emissions base case, a planning case to represent the 2000-04 regional haze baseline period using averages for key emissions categories, and a 2018 base case of projected emissions determined using factors known at the end of 2005. All emission inventories were developed using the Sparse Matrix Operator Kernel Emissions (SMOKE) modeling system. Each of these inventories underwent a number of revisions throughout the development process to arrive at the final versions used in CMAQ modeling. The development of each of these emission scenarios is documented under the emissions inventory sections of the TSS.

The 2018 visibility projections were made using the Plan02c and Base18b CMAQ 36-km modeling results. Projections were made using relative response factors (RRFs), which are defined as the ratio of the future-year modeling results to the current-year modeling results. The calculated RRFs are applied to the baseline observed visibility conditions to project future-year observed visibility.

The CMAQ modeling included emission inputs for the following sources:

- Smoke Management Programs accounted for using Emissions Reduction Techniques applied to 2000-04 average Fire emissions
- New permits and state/EPA consent agreements since 2002 reviewed with each state – through Spring 2007
- Ozone and PM_{10} SIPs in place in the WRAP region
- State Oil and Gas Emissions control programs
- Mobile sources
  - Heavy Duty Diesel (2007) Engine Standard
  - Tier 2 Tailpipe
  - Large Spark Ignition and Recreational Vehicle Rule
  - Nonroad Diesel Rule
- Combustion Turbine and Industrial Boiler/Process Heater/RICE MACT
- Known BART controls in the WRAP region
- Presumptive SO_2 BART for EGU's in the WRAP region

Generally, emissions inputs were prepared by individual states and tribes for point, area, and most dust emissions categories. The following WRAP Forums were relied upon to summarize this data and provide it to the RMC:

- Point Source emissions were obtained from projects commissioned by the Stationary Sources Joint Forum and the Emissions Forum.
- Area Source emissions were obtained from projects commissioned by the Stationary Sources Joint Forum and the Emissions Forum.
- Mobile Source emissions were from projects commissioned by the Emissions Forum.
- Fire (natural and anthropogenic) emissions were from projects commissioned by the Fire Emissions Joint Forum.
- Ammonia, Dust, & Biogenic emissions were from projects were commissioned by the Dust Emissions Joint Forum and the Modeling Forum.
- Emissions from Pacific offshore shipping were from a project conducted by the RMC, as described in Section 8.2.2 of this plan.
- Other emissions from North America were from projects commissioned by the Emissions Forum and the Modeling Forum. The Mexico emissions are from 1999, and were held constant for 2018. Canada emissions are from for 2000 and were held constant for 2018.
- Boundary conditions reaching North America from the rest of the world were from a project commissioned by the VISTAS Regional Planning Organization, on behalf of the five regional planning organizations working on regional haze.

The results from the CMAQ regional modeling analysis is provided and discussed in Section 9.3 of this chapter, and are also discussed determination of Reasonable Progress Goals in Section 11.4.

9.2 Major Source Categories Contributing to Haze in Oregon

Figures in this section show profiles of the relative contribution of in-state vs. out-of-state sources contributing to Oregon's Class I areas, for the 20% worst days, for the baseline (2000-2004) and future year (2018) scenarios, using the PSAT and WEP techniques. This chapter emphasizes the worst-case days, since this is the primary focus and challenge for demonstrating reasonable progress by 2018.[13] The Oregon Class I areas are grouped by general location (based on representative IMPROVE monitoring sites), as in Chapter 6.

As described above, there are several differences between the PSAT and WEP techniques. PSAT focuses on sulfate and nitrate contribution only, taking into account chemistry and deposition. PSAT also estimates the contribution from all regions – the WRAP states, CENRAP states[14] , Canada, Mexico, Pacific offshore (shipping), and "outside the domain"

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[13] The reasonable progress requirement also requires setting goals for the 20% best days, which at a minimum, must show no degradation of visibility from baseline year (2000-2004).   Further discussion of the 20% best days is in the reasonable progress demonstration in Chapter 11.

[14] CENRAP is a regional planning organization similar to the WRAP that is comprised of Nebraska, Kansas, Oklahoma, Texas, Minnesota, Iowa, Missouri, Arkansas, and Louisiana.

(global transport). The WEP does not address sulfate and nitrate chemistry and deposition, and while it does estimate the contribution from Canada and Pacific offshore regions, it does not include other regional contributions.

Based on these differences, the figures provided in this section focus on PSAT results for identifying the contribution of sulfates and nitrates (the primary anthropogenic source pollutants) and WEP results for identifying the contribution of organic carbon, elemental carbon, fine PM, and coarse PM (commonly associated with non-anthropogenic sources).

Sections 9.2.1 and 9.2.2 show 20% worst-day PSAT profiles on the contribution of sulfate and nitrate at each IMPROVE monitoring site representing the Class I Areas in Oregon. The pie charts display relative regional contributions to total annual modeled sulfate and nitrate mass at the respective sites. The WRAP contribution is separated from the rest of the pie for easy identification. The remaining pie slices are outside the Western US, for the regions described above.

The PSAT bar charts below the pie charts display source region and source category contributions of sulfate and nitrate mass. There are five source categories listed – point, area, mobile, anthropogenic fires (controlled burning), and natural and biogenic sources (wildfire and windblown dust, mostly). Also included are the estimated contributions outside the modeling domain "OD", and Mexico, Canada, and Pacific offshore "PO" emissions.

Sections 9.2.3 through 9.2.5 present WEP profiles for organic carbon, fine PM, and coarse PM, at Class I Areas in Oregon. It should be noted that WEP information on elemental carbon were not included here, as these profiles show no appreciable differences from organic carbon in terms of source category and general origin.[15]

Unlike the PSAT figures, the WEP figures are bar charts only, and summarize weighted emissions by state and region for 12 source categories – windblown dust, fugitive dust, road dust, off-road mobile, on-road mobile, off-shore, oil and gas, area, biogenic, natural fire, anthropogenic fire, and point. This analysis used more source categories than the PSAT analysis to account for the additional pollutants types, and the more natural origins contributing to these pollutants, including dust and fire sources.

9.2.1 PSAT Regional Contribution to Sulfate on 20% Worst Days.

Figures 9.2.1-1 through 9.2.1-6 in this section show the state and regional contribution of sulfate to the 20% worst days in Oregon Class I areas, for 2002 and 2018, based on PSAT profiles for each IMPROVE monitoring site representing the nearest Class I Areas. The figures below consist of a pie chart that shows the estimated contribution of the major regions - WRAP states, Pacific Offshore, CENRAP, Eastern US, Canada, Mexico, and Outside Domain (global). The bar chart is the WRAP portion (in white), showing Oregon and other Western States.

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[15] Both organic and elemental carbon are a result of combustion, and therefore a strong indicator of fire, both wildfire and anthropogenic. To a lesser extent, area and mobile sources are also contributors. The WEP elemental carbon results for Oregon Class I areas were very similar to organic carbon, and thus not included in this analysis.

It should be noted that in all the figures in this section, the majority of sulfate originates outside the WRAP region. (This is different than the nitrate contribution, which is much higher within the WRAP region – as seen in Section 9.2.2.) The WRAP sulfate contribution is in most cases about one-third of the total. The largest contributor is outside the domain, or "global". Two other sizable contributors of sulfate are Canada and Pacific offshore. Other regions, such as Mexico, Eastern US, and CENRAP states, are negligible.

Also indicated in these figures, the largest contributor of sulfate is generally from point sources. The variation in sulfate contribution is based on the location in the state. For instance, in the most northern Class I area (Mt. Hood), the contribution of sulfate from Canada and Washington is the highest. Similarly, the contribution of Pacific offshore shipping is much higher in Western Oregon than Eastern Oregon.

In terms of comparison of 2002 and 2018, it can be seen that the WRAP portion of the pie chart has a noticeable reduction by 2018. The source categories that account for this reduction are primarily point source and mobile. Implementation of BART requirements, ongoing and new industrial control requirements, source retirements and shutdowns, are all contributing factors to this decrease. To a lesser extent, numerous federal and state "on-the-books" requirements for mobile sources also account for this decrease (see Section 11.4.3).

Figure 9.2.1-1 Northern Cascades – Mt. Hood Wilderness Area PSAT Sulfate
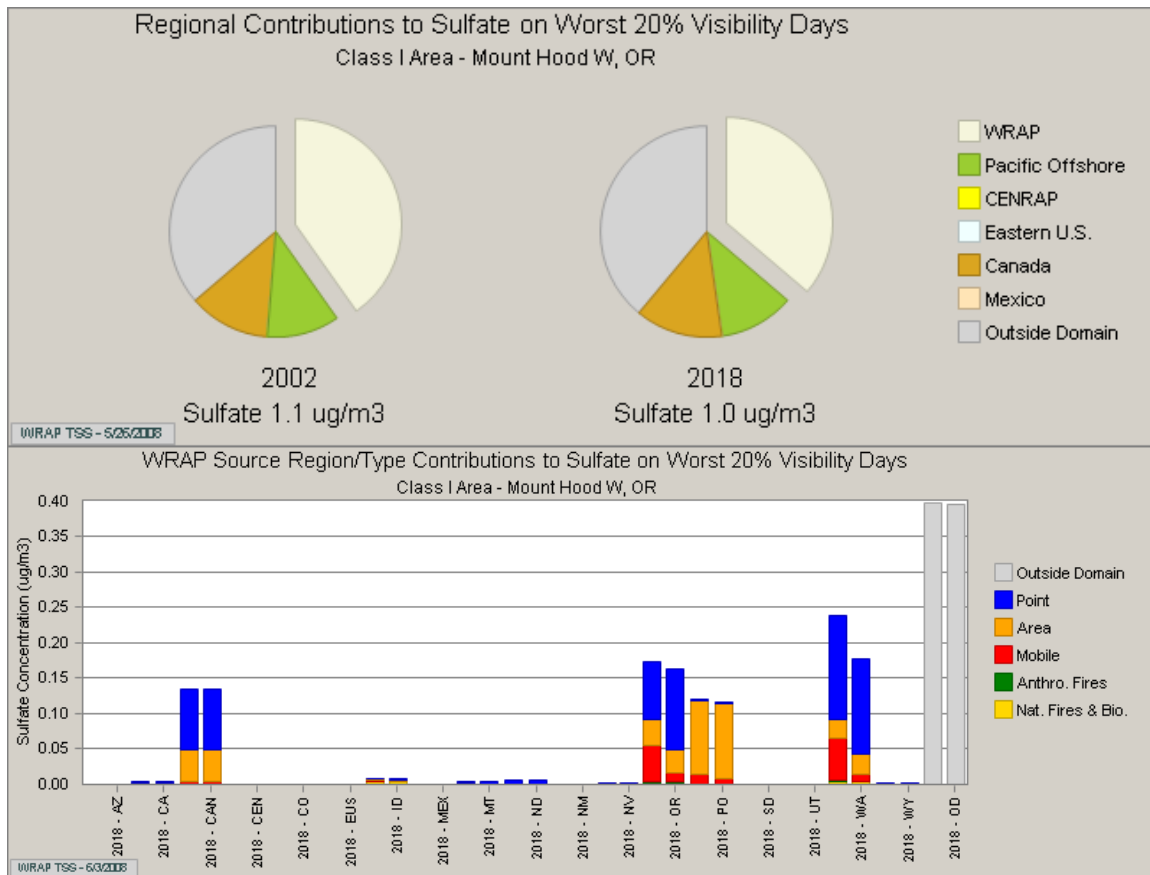
For the 20% of worst days at Mt. Hood, it should be noted that point source sulfate contribution is higher from Washington than Oregon. This is likely due to the proximity of industrial sources across the border in that state. There is also a noticeable contribution from point sources in Canada, and a sizable contribution from Pacific offshore shipping. Area and mobile sources from Oregon and Washington are much less. The mobile source portion is projected to decline significantly by 2018. Roughly one third of the sulfate comes from the area outside the domain.

Figure 9.2.1-2 Central Cascades – Mt. Jefferson Wilderness, Mt. Washington Wilderness, and Three Sisters Wilderness Areas PSAT Sulfate
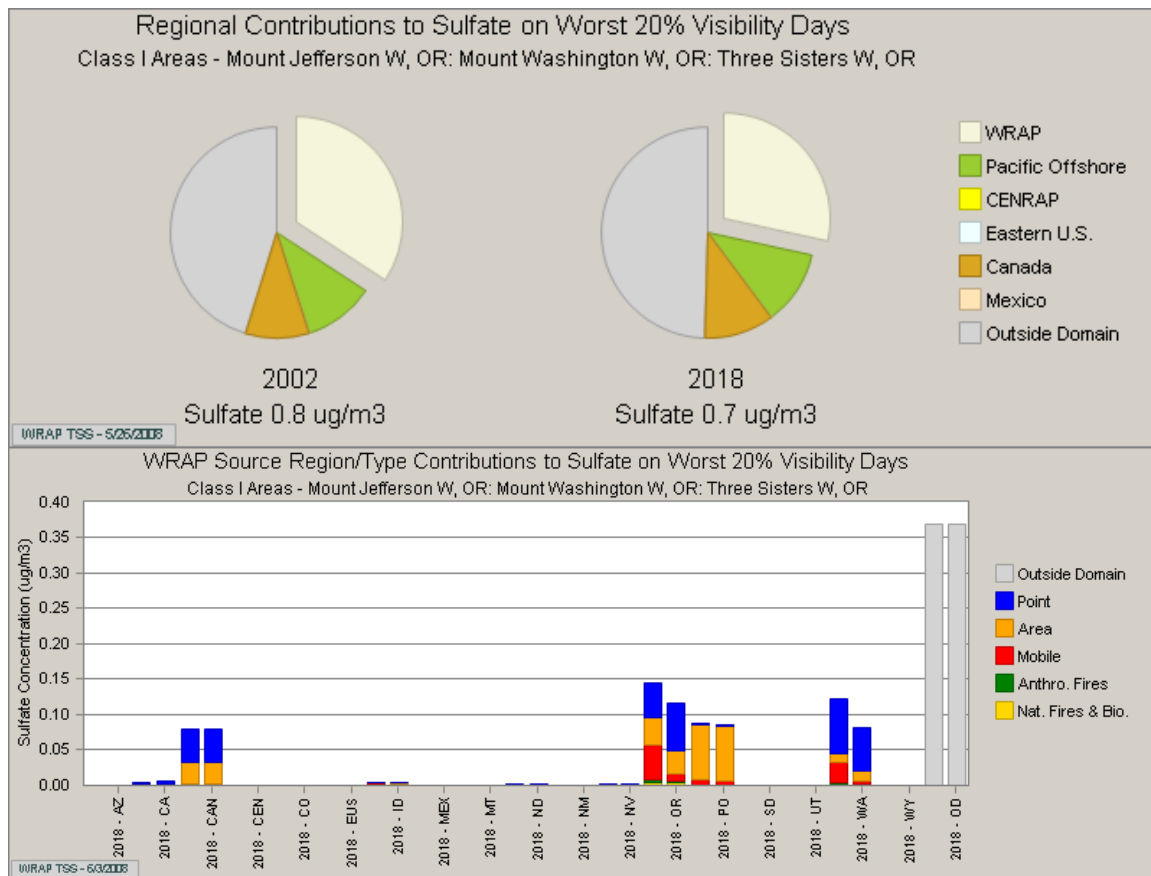
For the 20% of worst days in the Central Cascades, there is a noticeable sulfate contribution from point sources in Oregon and Washington, but much less than Mt. Hood. There is also smaller contribution from Canadian point, but a sizable contribution from Pacific offshore shipping. Mobile sources from Oregon and Washington are smaller contributors. Roughly one half of the sulfate comes from the area outside the domain.

Figure 9.2.1-3 Southern Cascades – Crater Lake National Park, Mountain Lakes Wilderness, and Gearhart Mountain Wilderness Areas PSAT Sulfate
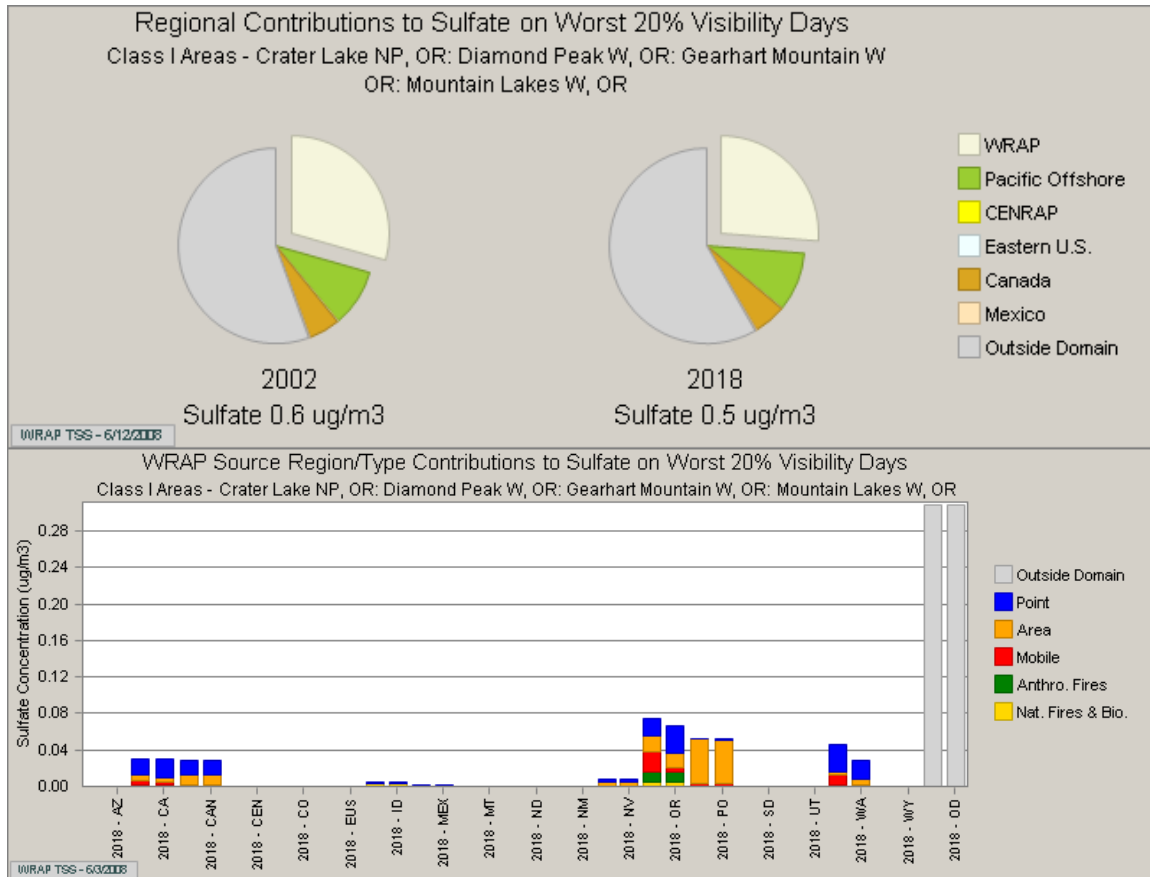
For the 20% of worst days in the Southern Cascades, overall sulfate levels are lower compared to the northern Cascade Oregon Class I areas. Most of the sulfate is from point sources in Oregon, Washington, California, and Canada. Pacific offshore shipping is again a sizeable contributor. Area and mobile sources in Oregon are a small contributor. More than half of the sulfate comes from the area outside the domain.

Figure 9.2.1-4 Coast Range – Kalmiopsis Wilderness Area PSAT Sulfate
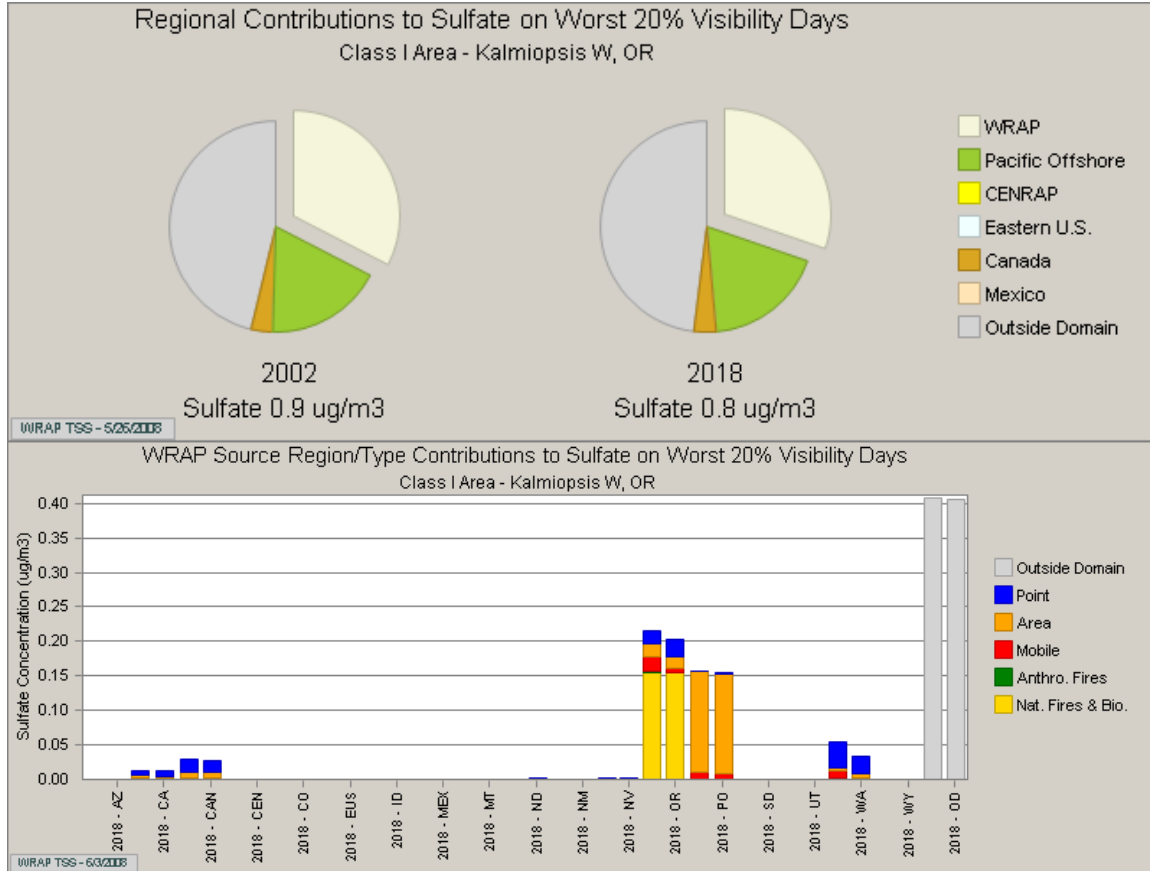
For the 20% of worst days in the Kalmiopsis Wilderness, the point source contribution that is evident in other Oregon Class I areas is much smaller here. There a sizeable sulfate contribution from both natural fire and Pacific offshore shipping. Roughly one half of the sulfate comes from the area outside the domain.

Figure 9.2.1-5 Eastern Oregon – Strawberry Mountain Wilderness and Eagle Cap Wilderness PSAT Sulfate
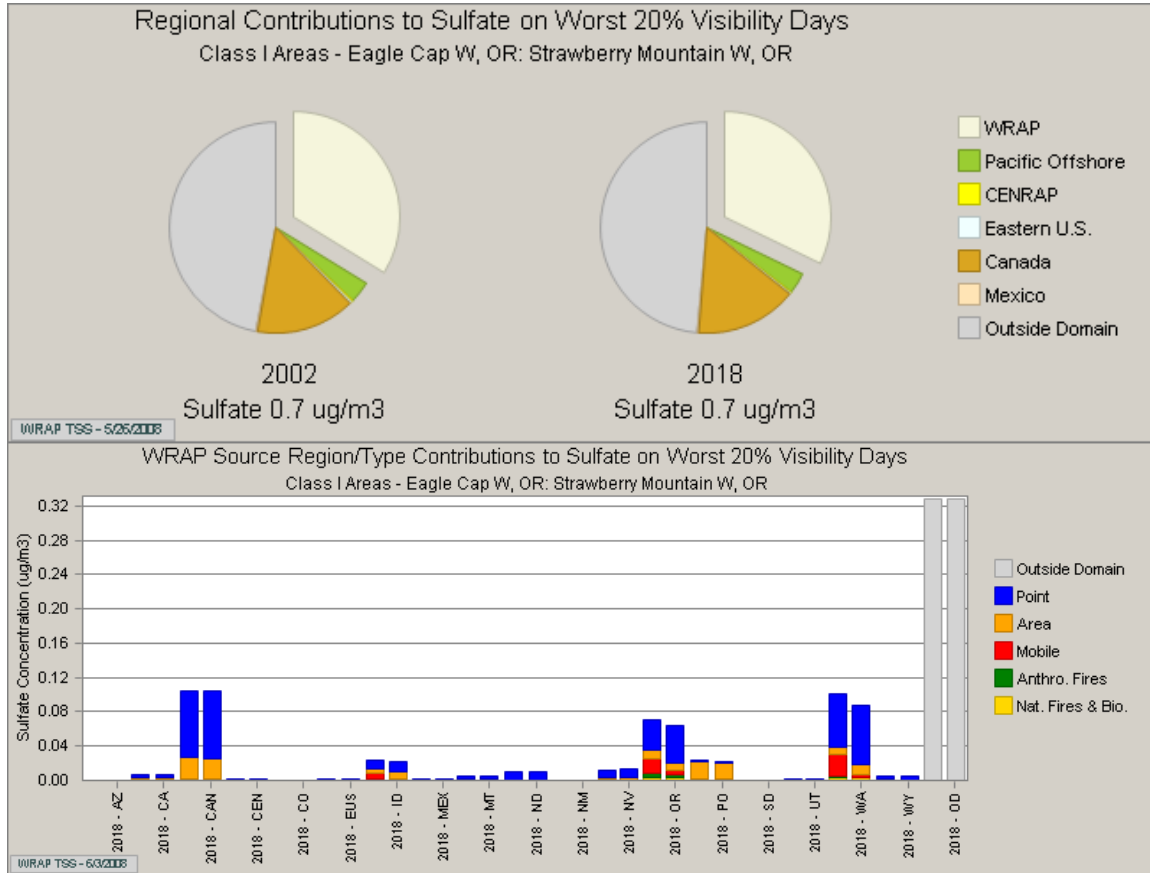
For the 20% of worst days in Strawberry Mountain Wilderness and Eagle Cap Wilderness, overall sulfate levels low, with the largest contribution being point sources from Canada, Washington, and Oregon. Mobile sources have a small impact, as do Pacific offshore shipping. Roughly one half of the sulfate comes from the area outside the domain.

Figure 9.2.1-6 Eastern Oregon/Western Idaho – Hells Canyon Wilderness Area PSAT Sulfate
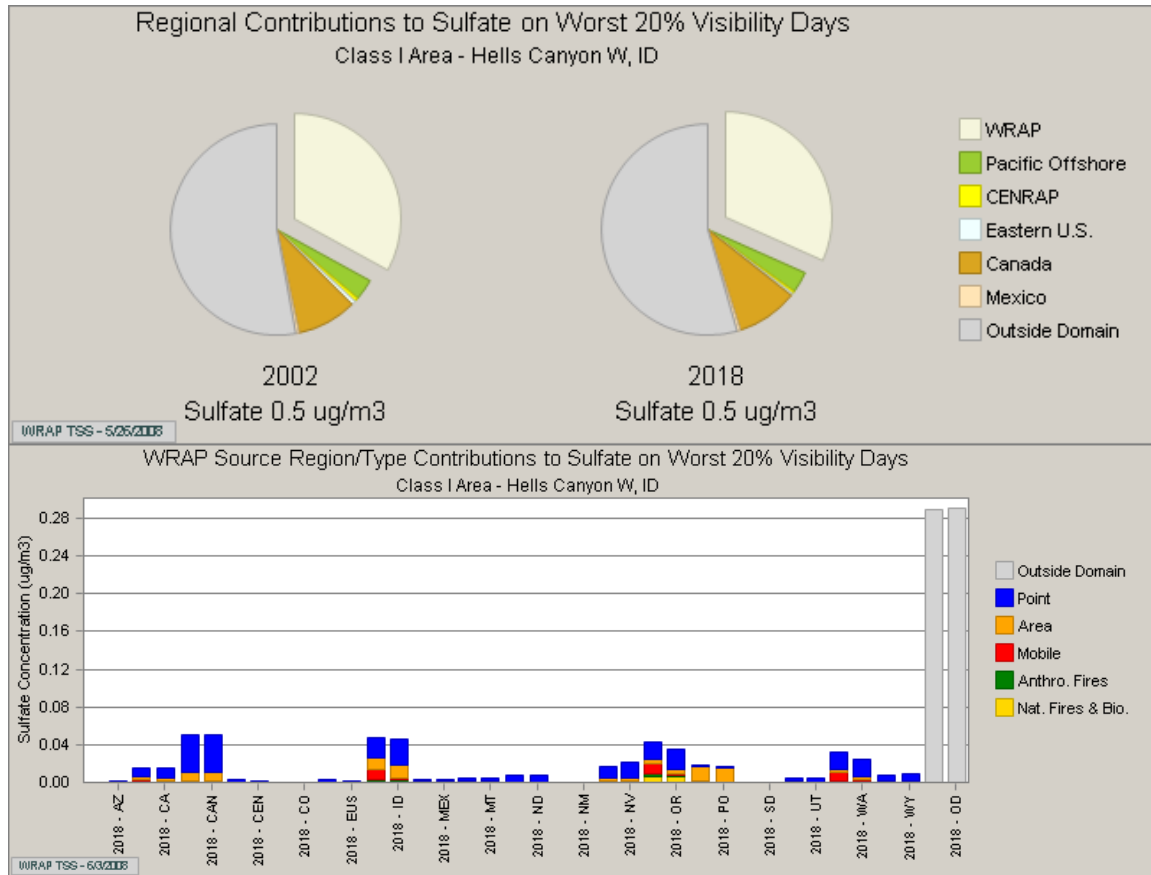
For the 20% of worst days at Hells Canyon Wilderness Area, overall sulfate levels are very low, dominated primary from point sources in Oregon, Washington, Idaho, and Canada. More than half of the sulfate comes from the area outside the domain.

9.2.2 PSAT Regional Contribution to Nitrate on 20% Worst Days.

Figures 9.2.2-1 through 9.2.2-6 in this section show the state and regional contribution of nitrate to the 20% worst days in Oregon Class I areas, for 2002 and 2018, based on PSAT profiles for each IMPROVE monitoring site representing the nearest Class I Areas.

It should be noted that in all the figures in this section, most of the nitrate comes from within the WRAP region. (This is different than the sulfate contribution, which originates outside the WRAP – as seen in Section 9.2.1.) The WRAP nitrate contribution ranges from half to two-thirds of the total. Similar to sulfate, sizable contributions of nitrate are from Pacific offshore (mostly Western Oregon), and to a lesser extent Canada and outside the domain. Other regions, such as Mexico, Eastern US, and CENRAP states, are negligible.

As these figures show, the vast majority of nitrate comes from mobile sources. Unlike sulfate, the contribution from Washington and Canada is much less than the contribution from inside

Oregon. Mobile emissions tend to be more urban-based, and have less long-range transport than sulfate point source emissions. Some contribution from California and Idaho is also evident in the figures below.

In terms of comparison of 2002 and 2018, it can be seen that the WRAP portion of the pie chart has a significant drop in nitrate by 2018 (greater than the sulfate reduction by 2018). Most of this can be attributed to the numerous federal and state "on-the-books" requirements for mobile sources (see the description in Section 11.4.3).

Figure 9.2.2-1 Northern Cascades – Mt. Hood Wilderness Area PSAT Nitrate
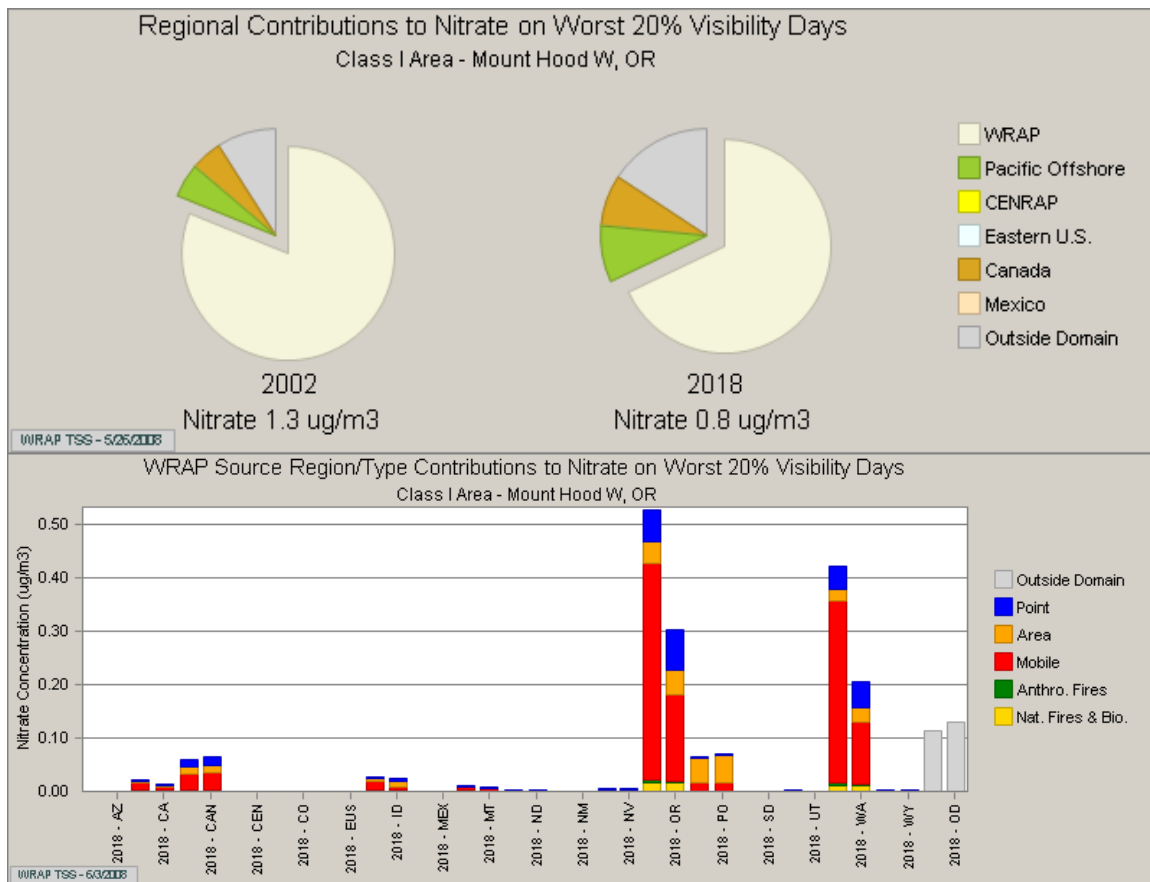
For the 20% of worst days at Mt. Hood, there are sizable nitrate contributions from Oregon and Washington mobile sources. The extent of this contribution from Washington is higher at Mt. Hood than the other Oregon Class I areas. These contributions are projected to decline significantly by 2018. Smaller contributions of nitrate come from Oregon and Washington point sources, Canadian mobile sources, and Pacific offshore emissions.

Figure 9.2.2-2 Central Cascades – Mt. Jefferson Wilderness, Mt. Washington Wilderness, and Three Sisters Wilderness Areas PSAT Nitrate
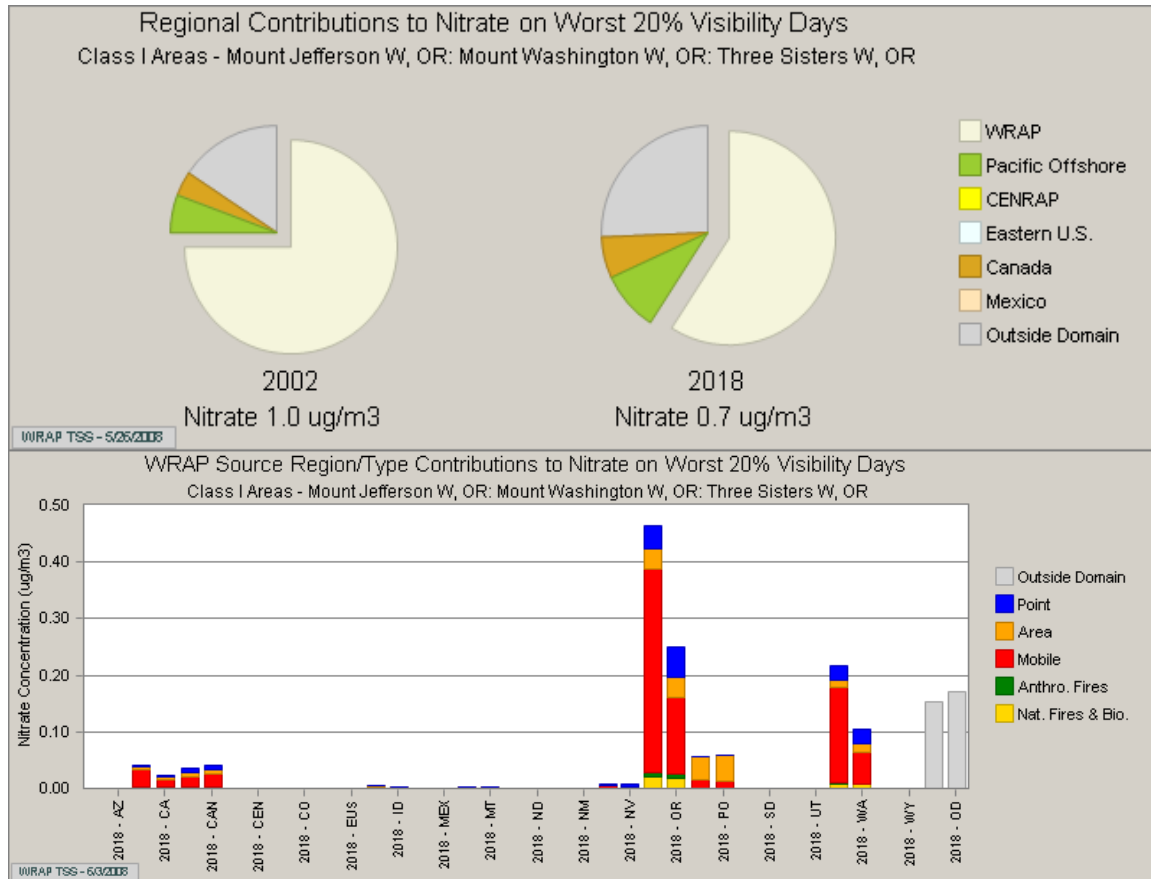
Similar to Mt. Hood, for the 20% of worst days, there are sizable nitrate contributions from Oregon mobile sources, with the Washington contribution much less here than at Mt. Hood. Both of these contributions are projected to decline significantly by 2018. Much smaller nitrate contributions come from Oregon and Washington point sources, Canadian mobile sources, and Pacific offshore emissions.

Figure 9.2.2-3 Southern Cascades – Crater Lake National Park, Mountain Lakes Wilderness, and Gearhart Mountain Wilderness Areas PSAT Nitrate
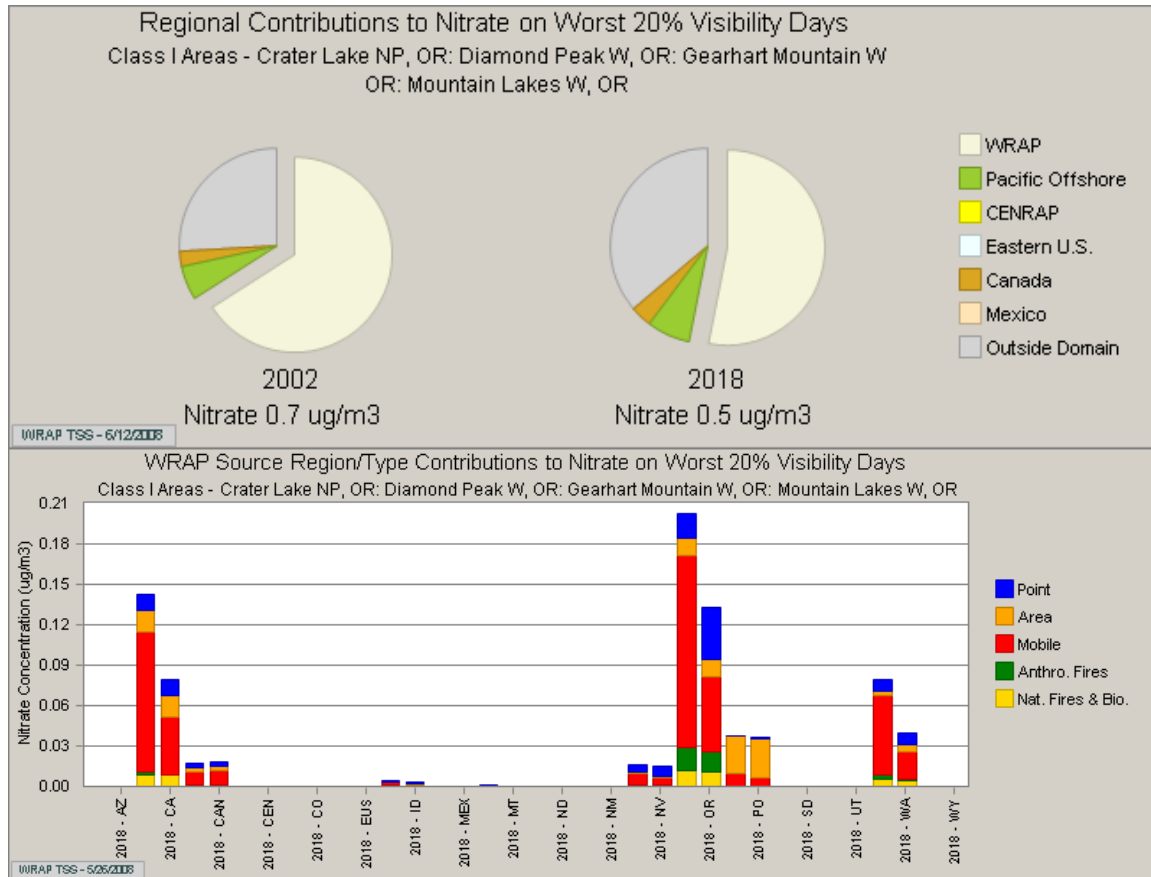
For the 20% of worst days in the Southern Cascades, there are sizable nitrate contributions from Oregon mobile sources, while even less from Washington. However, a sizeable contribution from California mobile sources can now be seen. These contributions are all projected to decline significantly by 2018. Point source contributions from California and Washington are relatively small.

Figure 9.2.2-4 Coast Range – Kalmiopsis Wilderness Area PSAT Nitrate
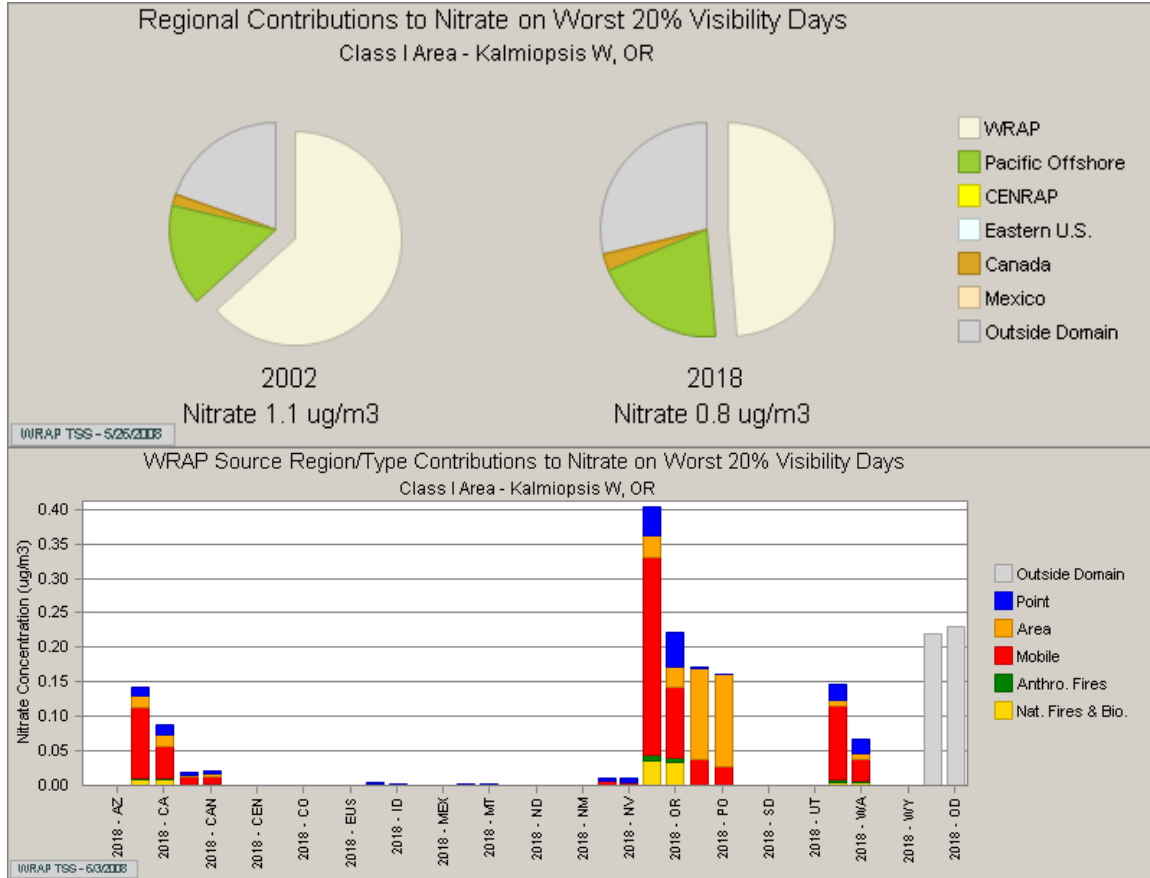
For the 20% of worst days in the Kalmiopsis Wilderness Area, the vast majority of nitrate comes from Oregon mobile sources, and much less from Washington and California. All are projected to decline significantly by 2018. There is a sizable nitrate contribution from Pacific offshore shipping, due primarily to the close proximity of the Kalmiopsis to the ocean. Other contributions from point sources are relatively small.

Figure 9.2.2-5 Eastern Oregon – Strawberry Mountain Wilderness and Eagle Cap Wilderness Figure PSAT Nitrate
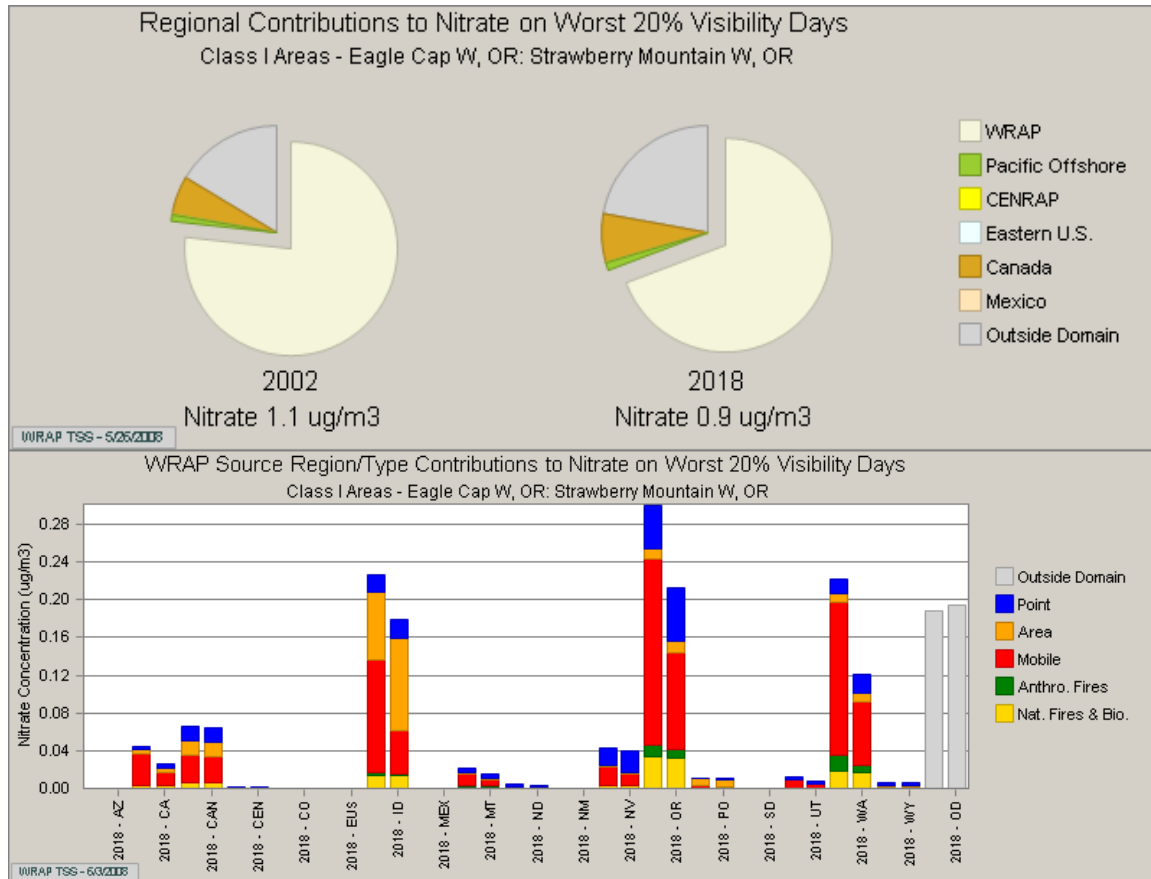
For the 20% of worst days in Strawberry Mountain Wilderness and Eagle Cap Wilderness, there are sizable nitrate contributions from Oregon, Washington, and Idaho mobile sources. All are projected to decline significantly by 2018. The Idaho area source contribution is sizeable.[16] Oregon point source contribution here is slightly higher than other Oregon Class I areas. This may be due to the emissions from the PGE Boardman power plant.[17]

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[16] The Department is unsure on the cause of this, and suspects this relatively high contribution may be due to emission inventory overestimation of area source emissions in Western Idaho.

[17] The projection for 2108 does not reflect the application of BART controls for PGE Boardman. This information was not available at the time these projections were made.

Figure 9.2.2-6 Eastern Oregon/Western Idaho – Hells Canyon Wilderness Area PSAT Nitrate
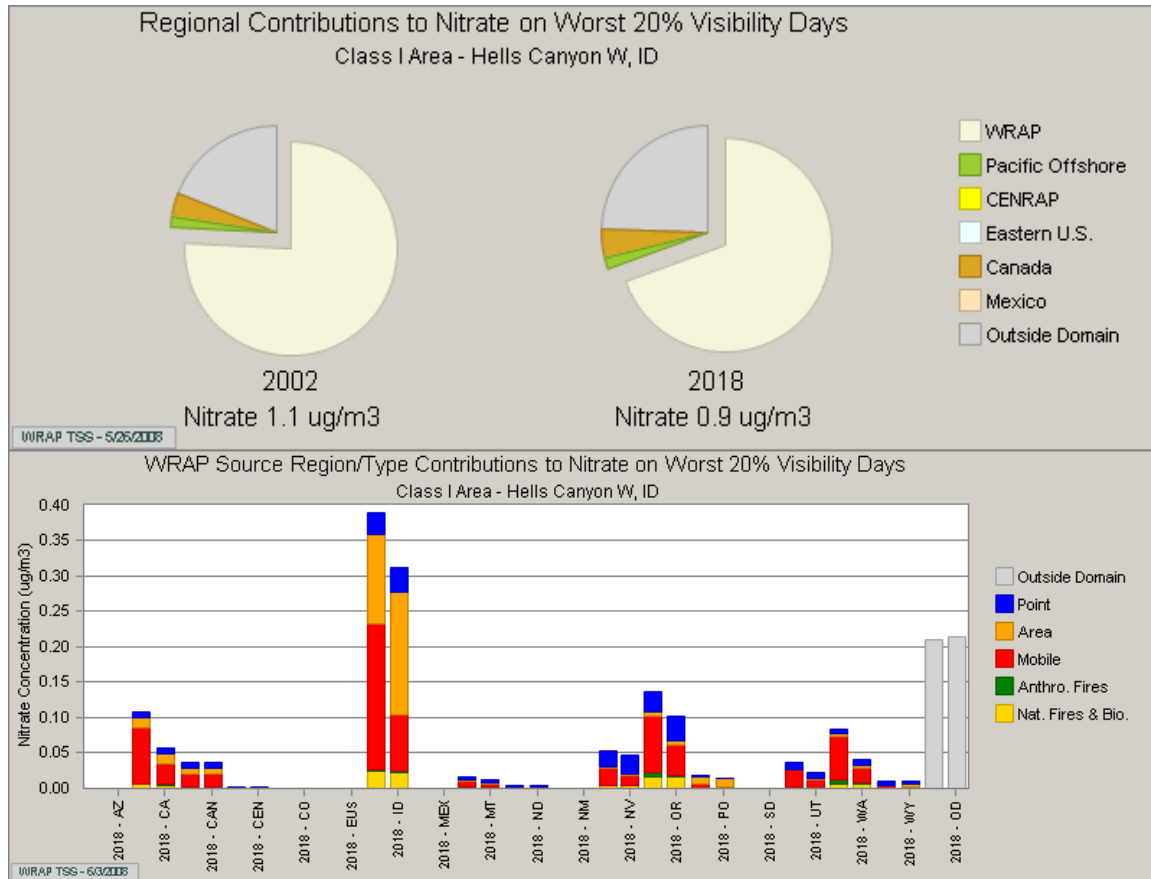
For the 20% of worst days in Hells Canyon Wilderness, there are significant nitrate contributions from Idaho mobile and area sources.[18] Oregon, Washington, and California mobile source contributions can be seen, and to a much smaller extent, Nevada, Utah and Canada. All mobile sources emissions are projected to decline significantly by 2018.

9.2.3 WEP Potential Contribution to OC on 20% Worst Days.

Figures 9.2.3-1 through 9.2.3-6 in this section show the contribution of organic carbon to the 20% worst days in Oregon Class I areas, for 2002 and 2018, based on WEP profile for each IMPROVE monitoring site representing the nearest Class I Areas.

In general, the figures below primarily reflect the contribution of fire sources – mostly natural fire (wildfire) and to a lesser degree, anthropogenic or controlled burning (forestry, agricultural, and residential burning). Area source organic carbon is from woodstoves and other urban

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[18] On the area source contribution, as noted in the previous figure for Strawberry and Eagle Cap, the Department suspects this may be attributable to emission inventory overestimation. Also, the exact cause of relatively high mobile source contribution from Idaho is uncertain.

related sources. Area source contributions of organic carbon are the highest at Mt. Hood Class I area, due to the proximity and size of the Portland-Vancouver urban area.

In terms of comparison of 2002 and 2018, the figures do not show any reduction in future years. For fire sources, future wildfire emissions are generally held constant. For area sources, this is primarily a function of population growth.

Figure 9.2.3-1 Northern Cascades – Mt. Hood Wilderness Area
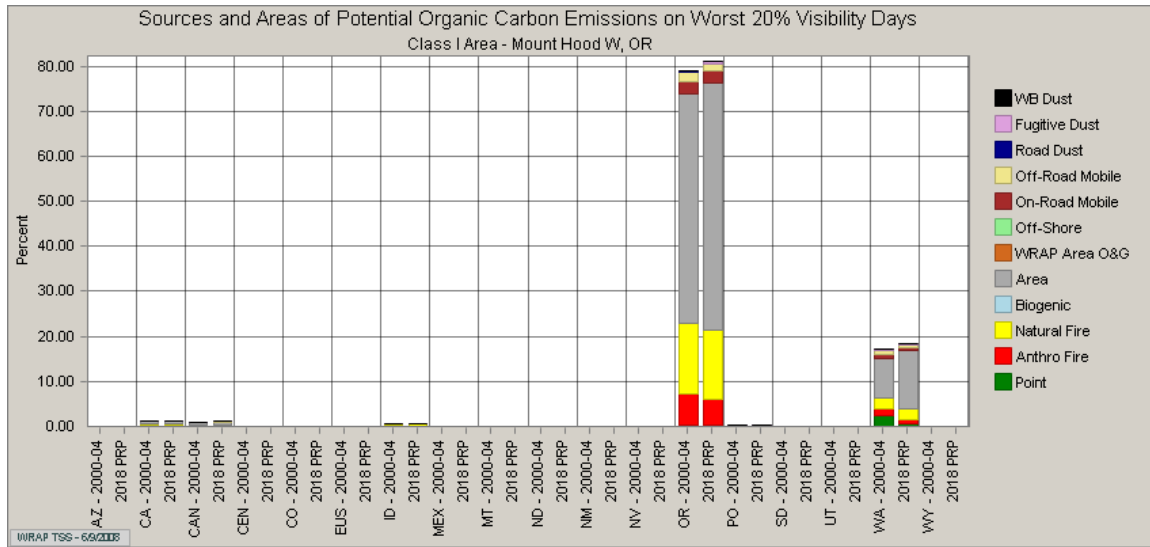
For the 20% of worst visibility days at Mt. Hood, there is a sizable organic carbon contribution from Oregon area sources, and to a smaller extent, fire sources. A much small contribution from these sources in Washington can be seen.

Figure 9.2.3-2 Central Cascades – Mt. Jefferson Wilderness, Mt. Washington Wilderness, and Three Sisters Wilderness Areas
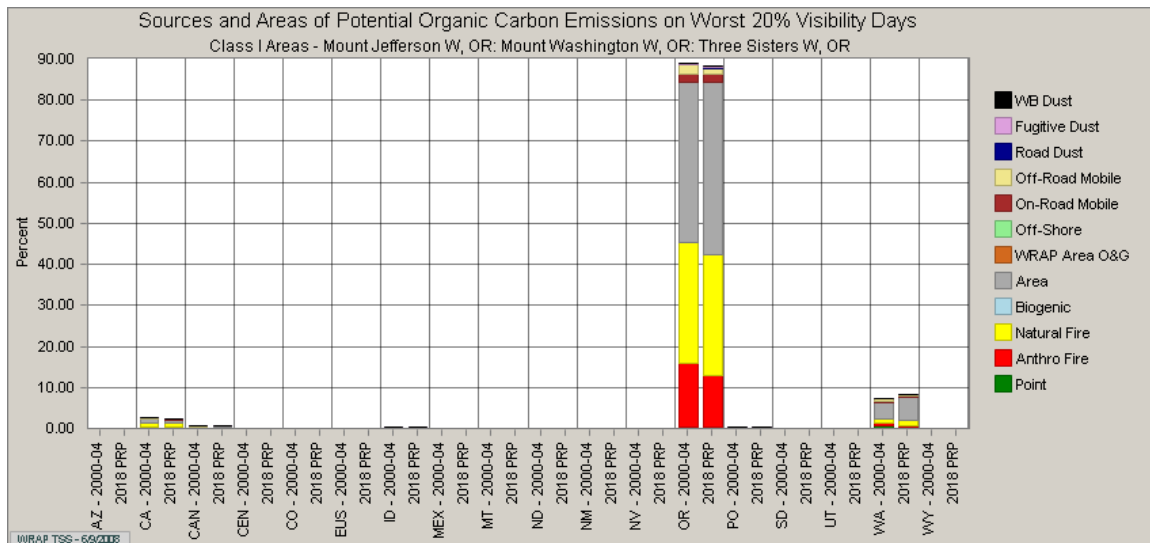
For the 20% of worst visibility days in the Central Cascades, there are sizable organic carbon contributions from Oregon area and fire sources. Washington is negligible.

Figure 9.2.3-3 Southern Cascades – Crater Lake National Park, Mountain Lakes Wilderness, and Gearhart Mountain Wilderness Areas
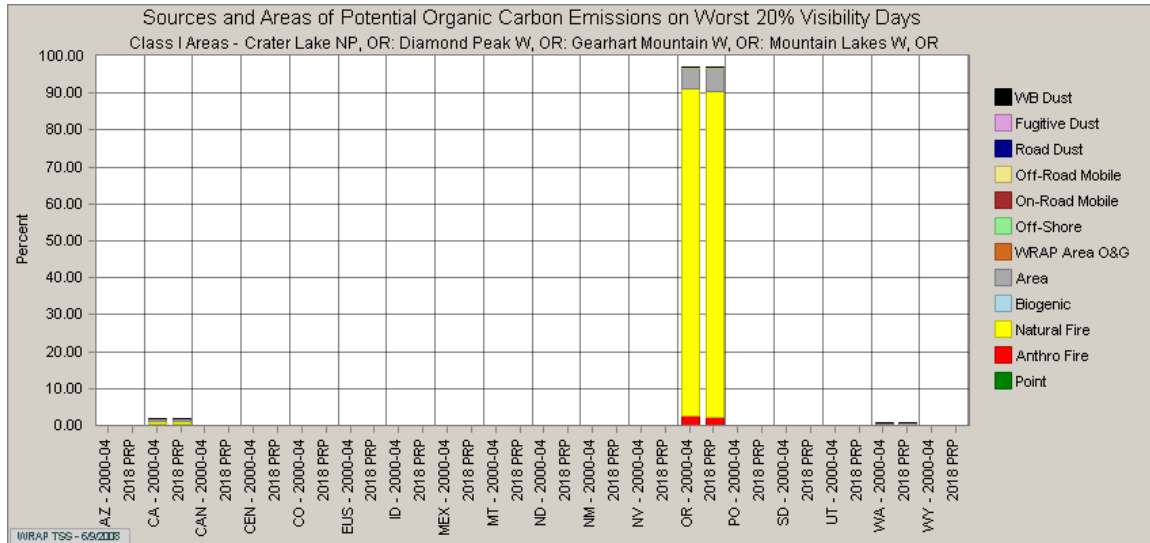
For the 20% of worst visibility days in the Southern Cascades, this figure shows a sizable organic carbon contribution from natural fire (see Figure 9.2.3-4 also). Although wildfire is a major contributor in Southern Cascade Class I areas, the year 2002 was an abnormally high wildfire year in this part of the state, and therefore an extreme case.[19]

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[19] See Figure 9.2.3-4 description also, and footnote. Note that the projection for 2018 is shown as being equal to 2002. This is believed to be a function of the WEP forecasting technique of holding future wildfire levels constant. In this case it is very unlikely 2018 wildfire levels will be as high as 2002.

Figure 9.2.3-4 Coast Range – Kalmiopsis Wilderness Area

Sources and Areas of Potential Organic Carbon Emissions on Worst 20% Visibility Days
Class I Area - Kalmiopsis W, OR
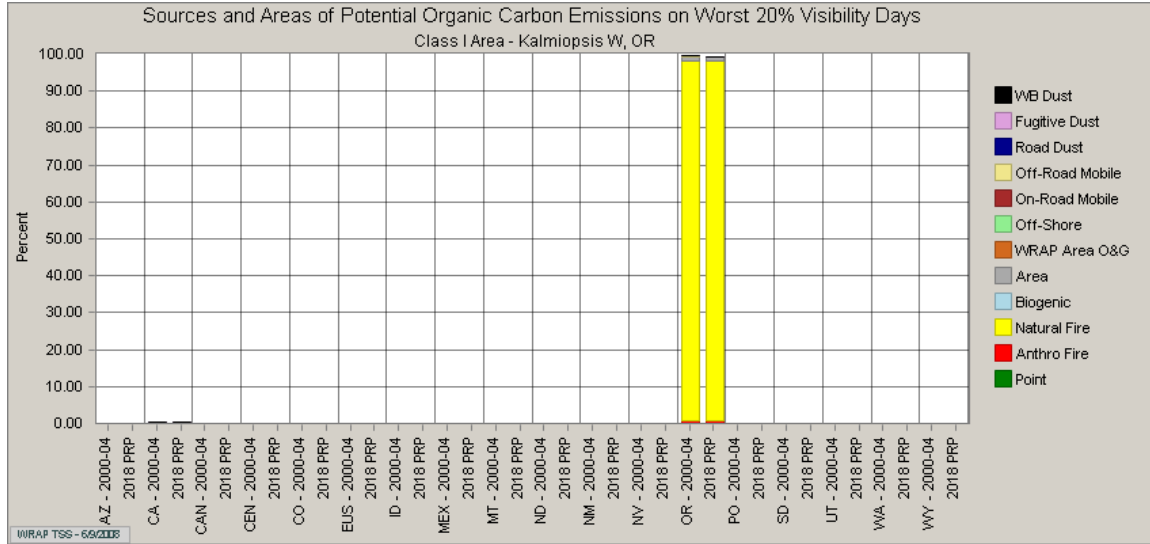
For the 20% of worst visibility days in the Kalmiopsis Wilderness, this figure is similar to the Southern Cascades above in showing a major contribution from natural fire. Although wildfire is a major contributor in the Kalmiopsis Wilderness, the year 2002 was an abnormally high wildfire year in this part of the state, and is therefore an extreme case.[20]

Figure 9.2.3-5 Eastern Oregon – Strawberry Mountain Wilderness and Eagle Cap Wilderness

Sources and Areas of Potential Organic Carbon Emissions on Worst 20% Visibility Days
Class I Areas - Eagle Cap W, OR: Strawberry Mountain W, OR

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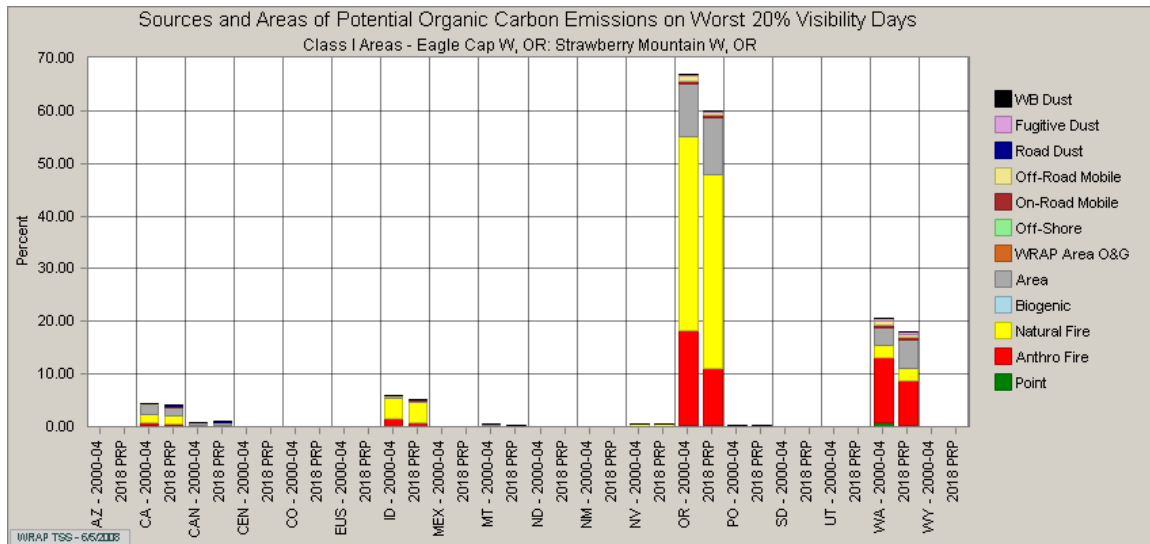
[20] The primary contributor in 2002 was the Biscuit Fire, which was mostly centered in the Kalmiopsis Wilderness Area. This wildfire was the largest in Oregon history, and burned for many weeks. Note that the projection for 2018 is shown as being equal to 2002. This is believed to be a function of the WEP forecasting technique of holding future wildfire levels constant. In this case it is very unlikely 2018 wildfire will be as high as 2002.

For the 20% of worst visibility days in the Strawberry Mountain Wilderness and Eagle Cap Wilderness, there is a large organic carbon contribution from fire, and smaller amount from area sources, in Oregon. Most of the fire contribution is from wildfire. To a much lesser extent, there is a similar contribution from Washington fire and area sources.

Figure 9.2.3-6 Eastern Oregon/Western Idaho – Hells Canyon Wilderness Area
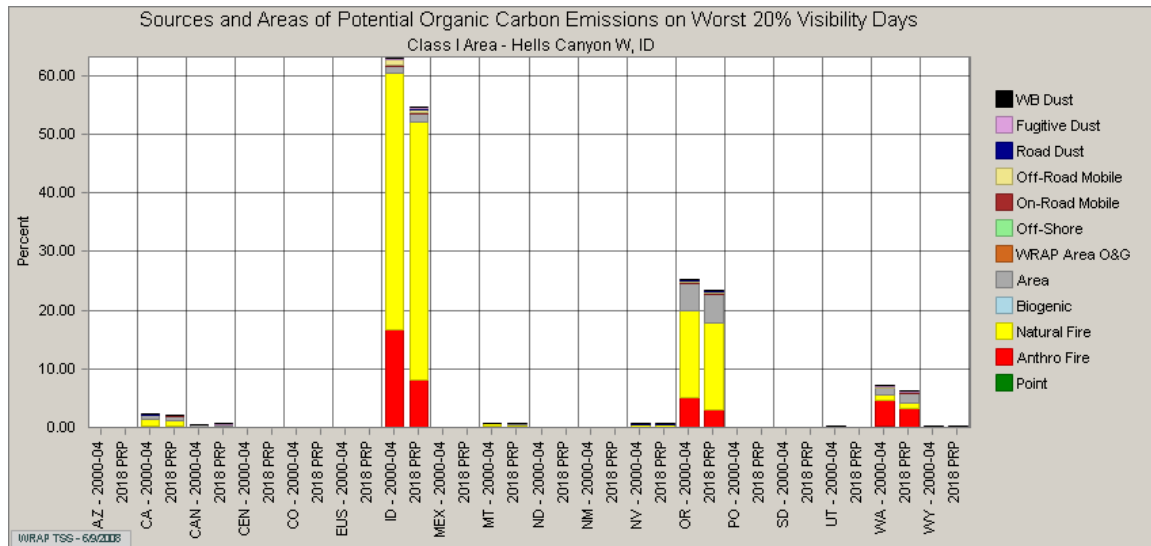
For the 20% of worst visibility days in the Hells Canyon Wilderness, there is a sizable organic carbon contribution from Idaho fire sources, and to a lesser extent, Oregon. Most of this is wildfire. The location of the Hells Canyon Wilderness on the Idaho-Oregon border accounts for the high contribution from Idaho, which can vary year to year from each state.

9.2.4 WEP Potential Contribution to PM Fine on 20% Worst Days.

Figures 9.2.4-1 through 9.2.4-6 in this section show the contribution of PM fine to the 20% worst days in Oregon Class I areas, for 2002 and 2018, based on WEP profile for each IMPROVE monitoring site representing the nearest Class I Areas.

In general, the figures below primarily reflect the contribution of mostly area sources (woodstoves and other urban activities) and a variety of dust sources (agriculture, mining, construction, and unpaved and paved roads.) Like organic carbon, fire is a significant source of PM fine. However, as noted in the prior section, the fire contribution in the Southern Cascade and the Kalmiopsis Class I areas is a result of abnormally high wildfire year in 2002.

In terms of comparison of 2002 and 2018, the figures do not show any reduction in future years, and in some cases show an increase. For both area and dust sources, this is primarily a function of population growth and holding natural dust levels constant.

Figure 9.2.4-1 Northern Cascades – Mt. Hood Wilderness Area
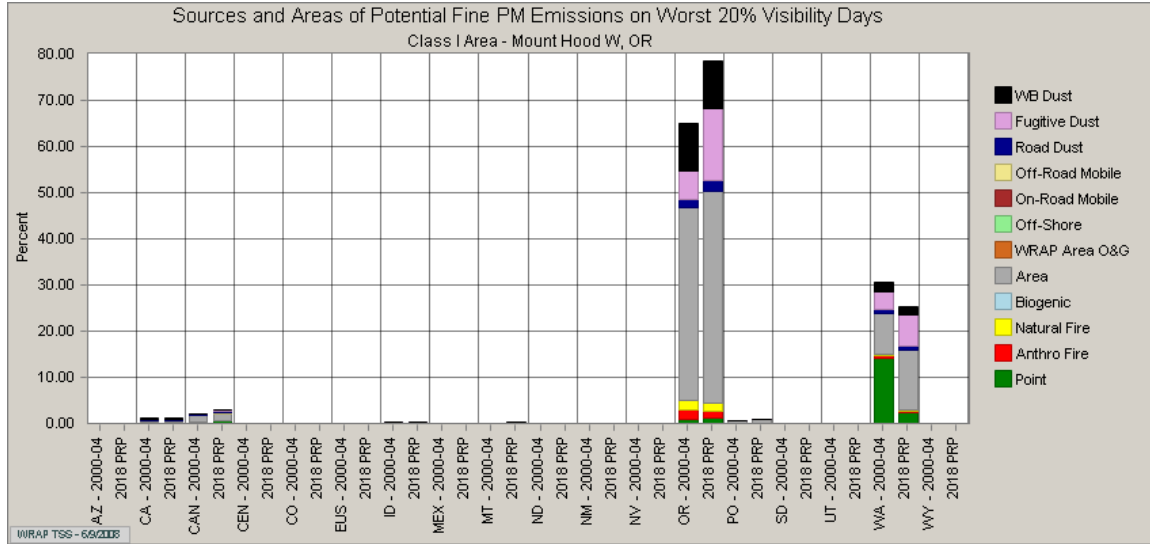
For the 20% of worst visibility days at Mt. Hood, there are sizable fine PM contributions from area and dust sources in Oregon, and to a lesser extent Washington. There is also a noticeable contribution from Washington point sources, however these are projected to decline significantly by 2018 due to on-going implementation of industrial rules.

Figure 9.2.4-2 Central Cascades – Mt. Jefferson Wilderness, Mt. Washington Wilderness, and Three Sisters Wilderness Areas
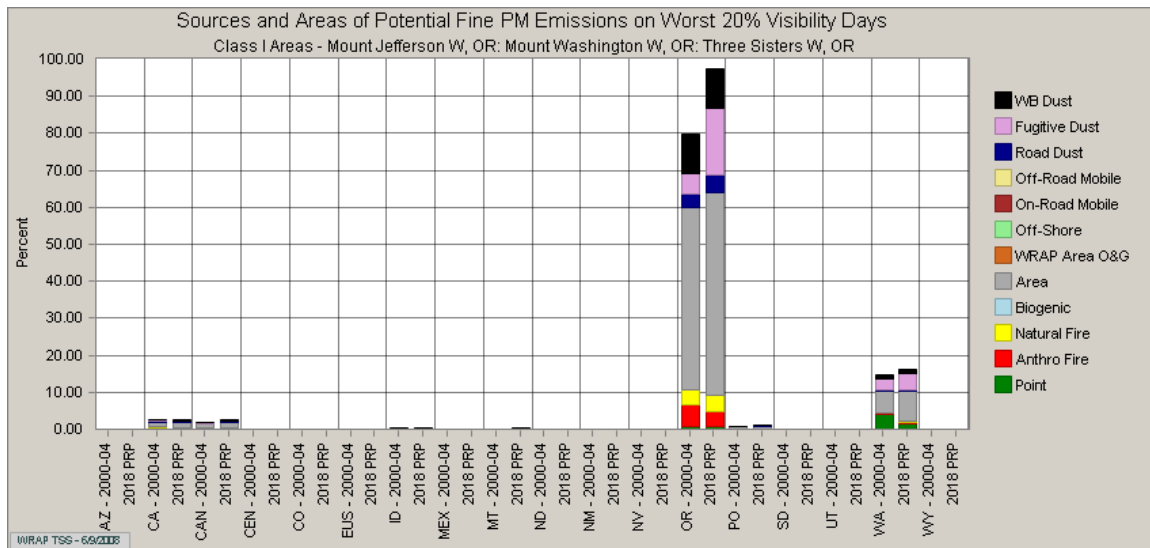
For the 20% of worst visibility days in the Central Cascades, the contribution from fine PM is very similar to Mt. Hood Wilderness above, in terms of area sources and dust, but a much smaller contribution from Washington.

Figure 9.2.4-3 Southern Cascades – Crater Lake National Park, Mountain Lakes Wilderness, and Gearhart Mountain Wilderness Areas
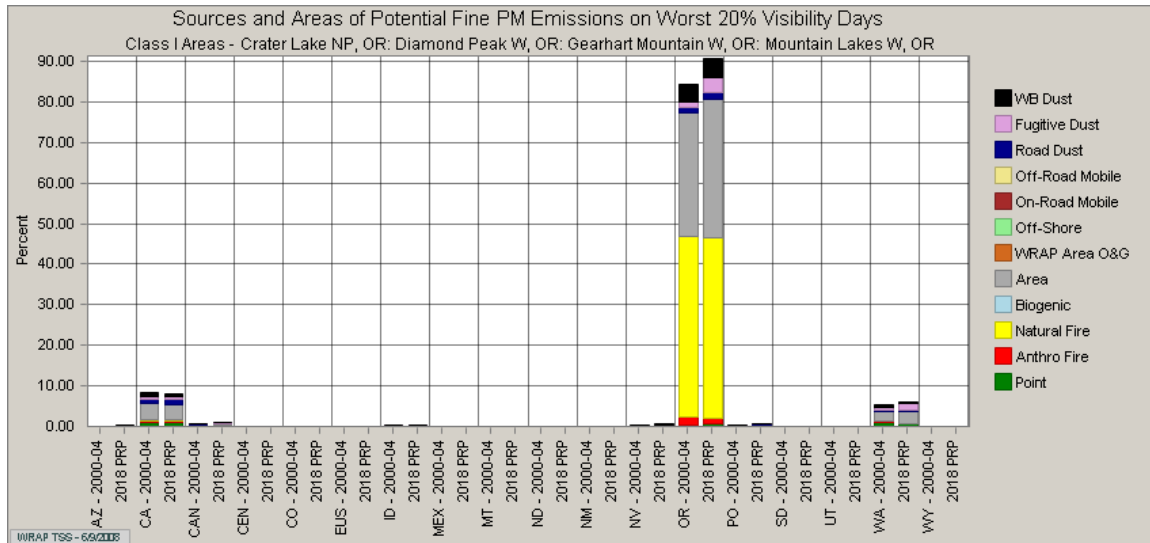
For the 20% of worst visibility days in the Southern Cascades, most of the fine PM contribution in Oregon is from area sources and fire, and to a lesser extent, dust. However, as noted previously, 2002 was an abnormally high wildfire year.

Figure 9.2.4-4 Coast Range – Kalmiopsis Wilderness Area
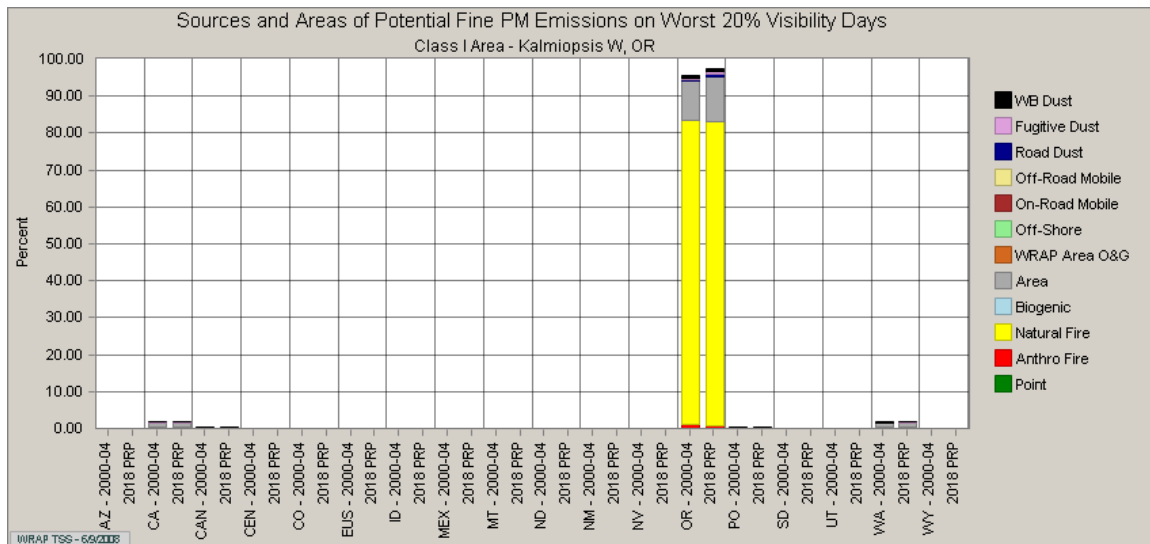
For the 20% of worst visibility days in the Coast Range, the fine PM contribution is dominated by wildfire, which as noted previously, was abnormally high in 2002.

Figure 9.2.4-5 Eastern Oregon – Strawberry Mountain Wilderness and Eagle Cap Wilderness
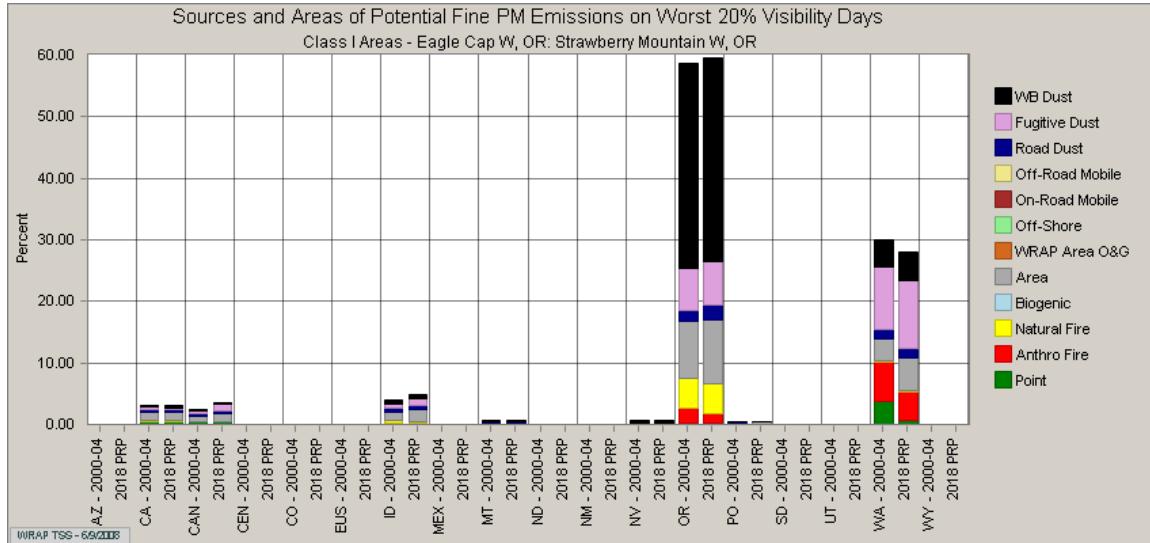
For the 20% of worst visibility days in the Strawberry Mountain Wilderness and Eagle Cap Wilderness, there dominant fine PM contribution in Oregon from dust - mostly windblown dust, and some fugitive and road dust Area and fire sources are also evident in Oregon. The contribution of this mix of source from Washington is about half of the Oregon level.

Figure 9.2.4-6 Eastern Oregon/Western Idaho – Hells Canyon Wilderness Area
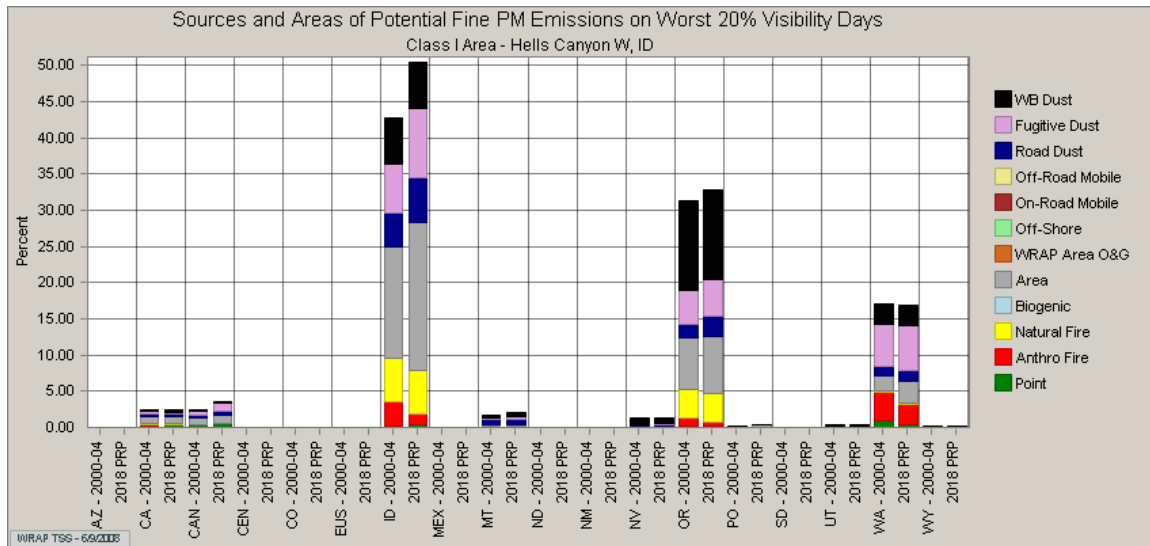
For the 20% of worst visibility days in the Hells Canyon Wilderness, there is a large contribution of fine PM from Idaho area and dust sources, including some fire sources. This mix of sources is evident in Oregon, and to a lesser extent from Washington.

9.2.5 WEP Potential Contribution to PM Coarse on 20% Worst Days.

Figures 9.2.5-1 through 9.2.5-6 in this section show the contribution of PM coarse to the 20% worst days in Oregon Class I areas, for 2002 and 2018, based on WEP profiles for each IMPROVE monitoring site representing the nearest Class I Areas.

The figures below show that compared to PM fine, the profile for PM coarse is dominated by windblown and fugitive dust generated in Oregon. These dust sources are a combination of natural and human activity, such as agriculture, mining, construction, and unpaved and paved roads. Fire is does appear in the figures for Southern Oregon and Kalmiopsis Class I areas, but this is due to abnormally high wildfire for 2002. In terms of comparison of 2002 and 2018, the figures generally show an increase in fugitive dust, which is influence by population growth and holding natural dust levels constant.

Figure 9.2.5-1 Northern Cascades – Mt. Hood Wilderness Area
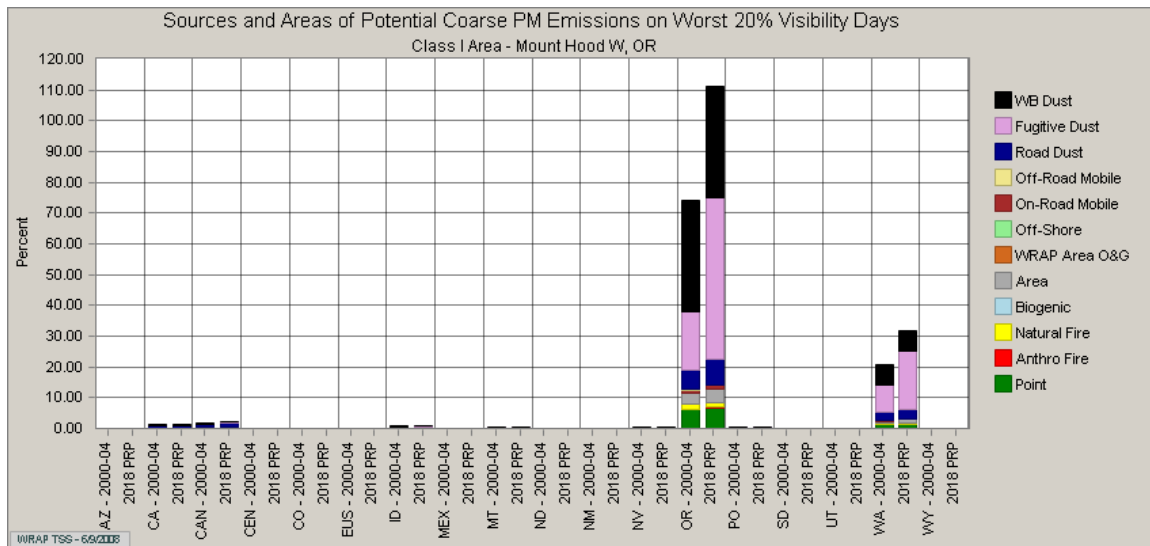
For the 20% of worst visibility days at Mt. Hood, there are sizable course PM contributions from Oregon dust source, with considerable less from Washington.

Figure 9.2.5-2 Central Cascades – Mt. Jefferson Wilderness, Mt. Washington Wilderness, and Three Sisters Wilderness Areas
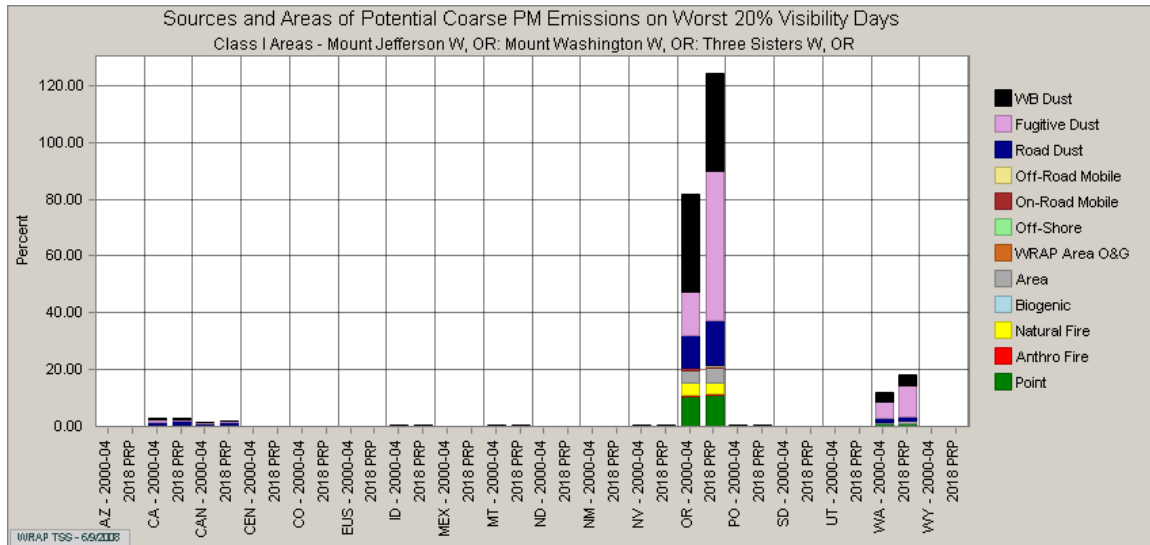
For the 20% of worst visibility days in the Central Cascades, there are sizable course PM contributions from Oregon dust sources, and including some small contribution from Oregon point sources. The contribution from Washington is minimal.

Figure 9.2.5-3 Southern Cascades – Crater Lake National Park, Mountain Lakes Wilderness, and Gearhart Mountain Wilderness Areas
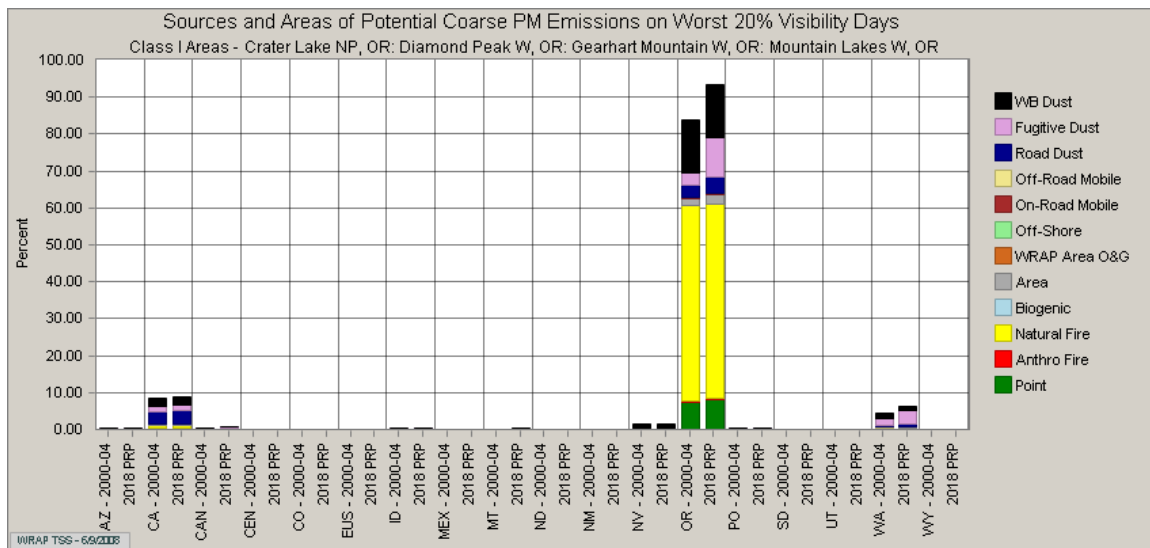
For the 20% of worst visibility days in the Southern Cascades, this profile is heavily influenced by Oregon wildfire in 2002, which was abnormally high. Typically dust would be the primary contributor. This is some small contribution from Oregon point sources evident.

Figure 9.2.5-4 Coast Range – Kalmiopsis Wilderness Area

Sources and Areas of Potential Coarse PM Emissions on Worst 20% Visibility Days
Class I Area - Kalmiopsis W, OR
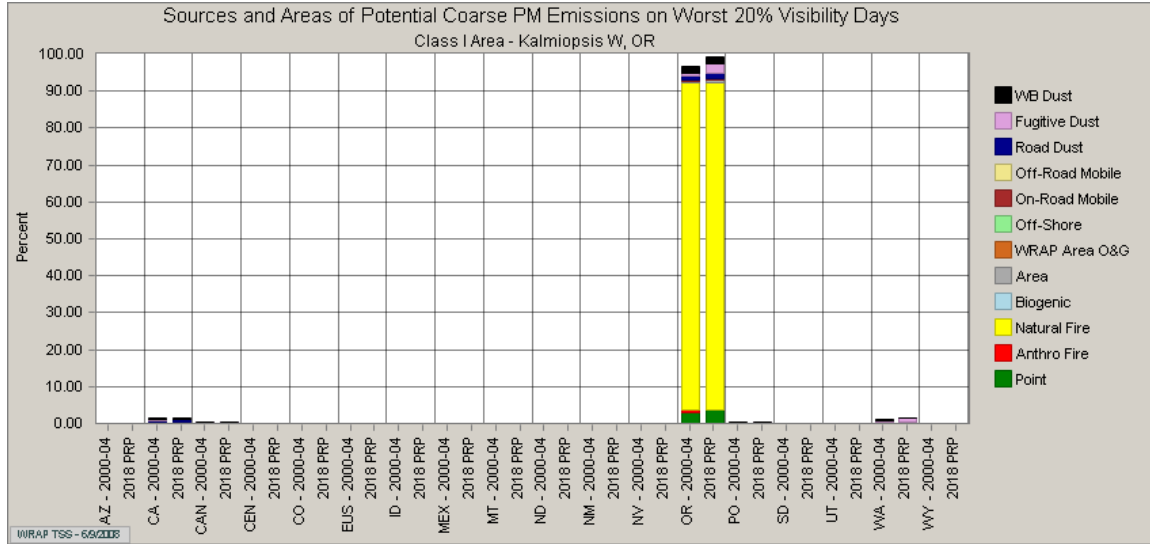
For the 20% of worst visibility days in the Coast Range, this profile is heavily influenced by Oregon wildfire in 2002, which was abnormally high. Typically, dust would be the primary contributor.

Figure 9.2.5-5 Eastern Oregon – Strawberry Mountain Wilderness and Eagle Cap Wilderness
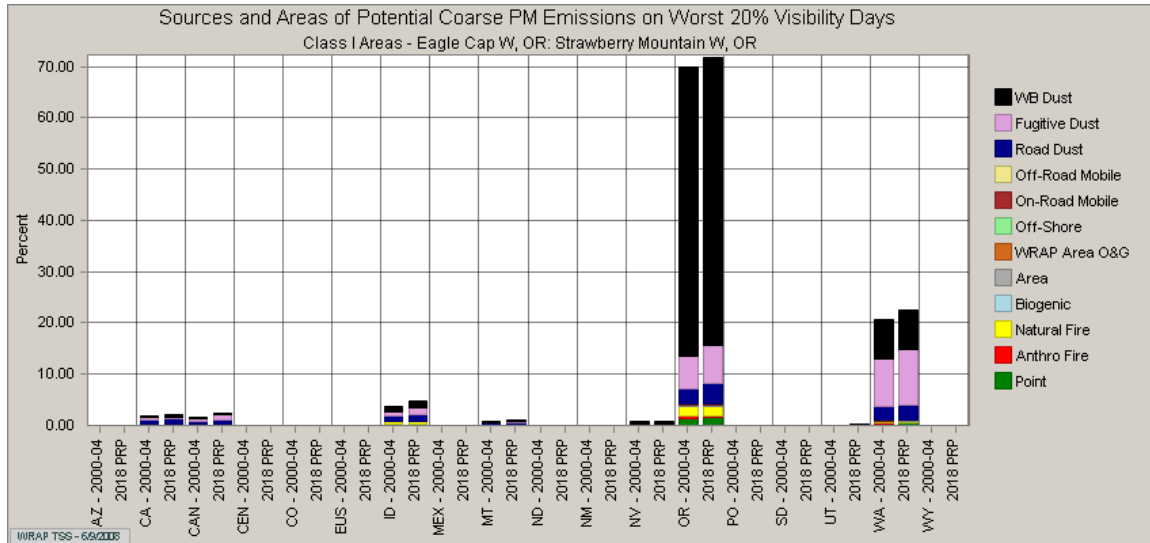
Sources and Areas of Potential Coarse PM Emissions on Worst 20% Visibility Days
Class I Areas - Eagle Cap W, OR: Strawberry Mountain W, OR

For the 20% of worst visibility days in the Strawberry Mountain Wilderness and Eagle Cap Wilderness, windblown dust in Oregon is the dominant contributor of PM coarse. Some dust contribution from Washington is evident.

Figure 9.2.5-6 Eastern Oregon/Western Idaho – Hells Canyon Wilderness Area
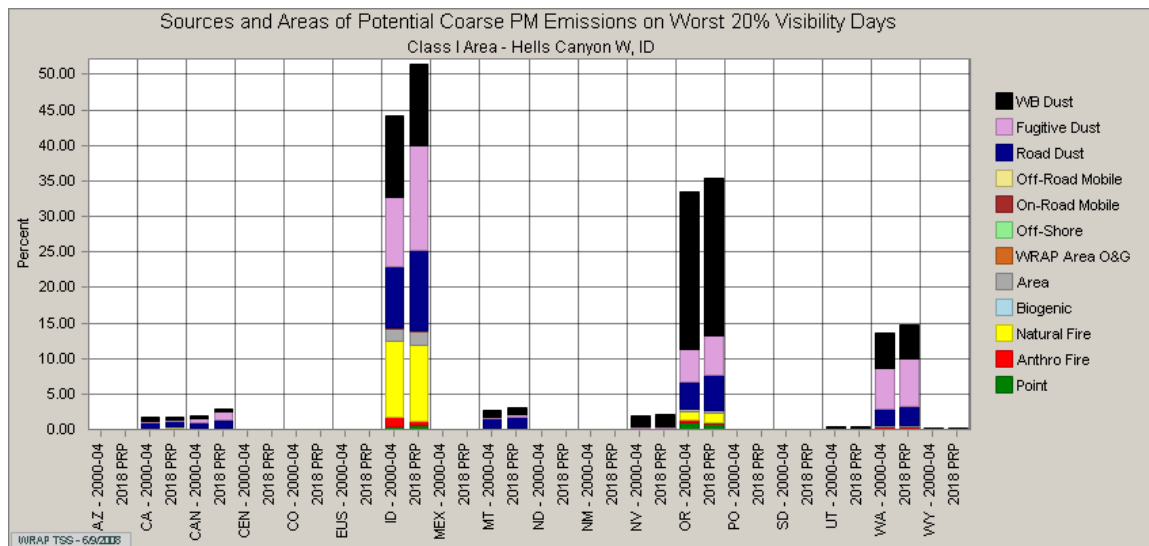
For the 20% of worst visibility days in the Hells Canyon Wilderness, there is a large contribution of coarse PM from Idaho and dust sources – windblown, fugitive, and road. The contribution of windblown dust in Oregon is also considerable. Washington is a small contributor of dust sources.

9.3 CAMQ 2018 Projected Visibility Conditions

This section summarizes the regional haze improvements projected using CMAQ model for Oregon's Class I areas. The CMAQ model was used to estimate 2018 visibility conditions in Oregon and all Western Class I areas, based on emission inputs described in Section 9.1.2 of this chapter. The Department relied upon the results of the CAMQ modeling in establishing the Reasonable Progress Goals described in Section 11.4.

These visibility projections were calculated from modeled results by multiplying a species-specific relative response factor (RRF) with the baseline monitored result, and then converting to extinction and deciview. The RRF is defined as the ratio of future-to-current modeled mass. Chapter 11 details how the 2018 projected visibility conditions were used in selecting the Reasonable Progress Goals. Appendix C contains a detailed summary of the CMAQ modeling conducted by the Regional Modeling Center for the WRAP.

Table 9.3-1 shows the 2018 visibility projections for the 20% worst and best days, compared to the 2018 Uniform Rate of Progress (URP), for Oregon Class I areas (grouped by IMPROVE monitoring site). These 2018 projections are shown in deciview, and in the percent of the URP achieved by 2018 for the 20% worst days (first shaded column). Also indicated is whether the 20% best days for 2018 are projected to be under the 2000-04 baseline (second shaded column).

While the table shows none of Class I areas meet the 2018 URP for the 20% worst days, several are close to this goal (range of 19% to 83%). Section 9.3.1 provides a breakdown by

pollutant species to analyze the cause of this. For the 20% best days, all Class I areas are under the baseline, and thus show no visibility degradation by 2018.

Table 9.3-1 CMAQ Modeling Results for 20% Worst Days and 20% Best Days for Oregon Class I Areas

Region	Oregon Class I Area	20% Worst Days				20% Best Days		
		2000-04 Baseline (dv)	2018 URP Goal (dv)	2018 Projected Visibility (dv)	% of 2018 URP Goal	2000-04 Baseline (dv)	2018 Projected Visibility (dv)	2018 Under Baseline?
Northern Cascades	Mt. Hood Wilderness Area	14.9	13.4	13.8	74%	2.2	2.0	Yes
Central Cascades	Mt. Jefferson, Mt. Washington, and Three Sisters Wilderness Areas	15.3	13.8	14.3	67%	3.0	2.9	Yes
Southern Cascades	Diamond Peak, Mountain Lakes, and Gearhart Mountain Wilderness Areas and Crater Lake National Park	13.7	12.3	13.4	19%	1.8	1.5	Yes
Coast Range	Kalmiospis Wilderness Area	15.5	14.1	15.1	31%	6.3	6.1	Yes
Eastern Oregon	Strawberry Mountain and Eagle Cap Wilderness Areas	18.6	16.3	17.5	50%	4.5	4.1	Yes
Eastern Oregon/ Western Idaho	Hells Canyon Wilderness Area	18.6	16.2	16.6	83%	5.5	4.7	Yes

9.3.1 CMAQ Modeling Breakdown by Pollutant for 20% Worst Days.

As indicated by the 2018 visibility projections using CMAQ modeling, none of the Class I areas meet the URP goal for 2018 for the 20% worst days. In order to determine the cause it is necessary to breakdown these results to identify individual pollutants. The information provided below shows the contribution of each pollutant in extinction (Mm-1) to the deciview level for each Class I areas. As pointed out earlier in this chapter on source apportionment, it is important to note whether the pollutants affecting the modeling are anthropogenic, such as sulfates or nitrates, or the other pollutants that are mostly non-anthropogenic (natural) in origin (OC, EC, and PM). This assessment is important in the determination of reasonable progress, as described in Section 11.4.

Figures 9.3.1-1 to 9.3.1-6 provide a breakdown of individual pollutant contribution (in extinction) by showing the glideslope of each pollutant in each Class I area, from the baseline to 2018, and beyond, for the 20% worst days. Below each figure is a table that shows the 2018 projections for each pollutant, and whether the projection is under the 2018 URP goal, and the percent improvement.

The results of this breakdown by pollutant for each Class I area shows that in general there is much greater improvement in nitrate and sulfate (the more anthropogenic pollutants) than the other pollutants. In all Class I areas except Hells Canyon, nitrate meets or exceeds the 2018 URP goal (Hells Canyon is 90% of the URP). For sulfate, while none of the Class I areas show the 2018 URP being met for this pollutant, the improvement is as high as 74% in the Mt. Hood Class I area, and significant in other Class I areas as well. Conversely, these figures show that organic carbon is the highest contributor to extinction, and projection for 2018 show very little improvement. Much of the organic carbon can be attributed to fire, of which the majority is wildfire, and thus non-anthropogenic in origin. Fine soil and coarse mass are also mostly natural origin (dust), and although relatively small contributors at each Class I area, the 2018 projections for these pollutants also shows little improvement. Overall, the combination of OC, EC, and PM play a significant role in offsetting the improvements from nitrate and sulfate. Further discussion of this is provided in Chapter 11 related to Reasonable Progress Goal demonstration.

Figure 9.3.1-1 Glideslope by Pollutant on 20% Worst Days for Northern Cascades – Mt. Hood Wilderness Area
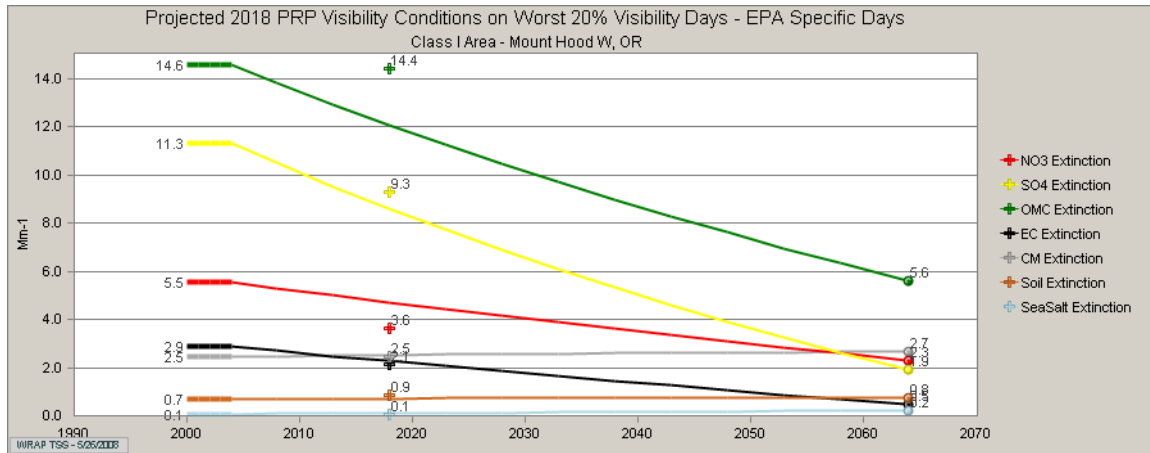
Table 9.3.1-1 Pollutant Breakdown on 20% Worst Days for Northern Cascades – Mt. Hood Wilderness Area

Pollutant	Northern Cascades - Mt. Hood Wilderness Area					
	2000-04 Baseline (Mm-1)	2018 URP Goal (Mm-1)	2018 Projected Visibility (Mm-1)	2064 Natural Conditions (Mm-1)	2018 Under URP Goal?	% of URP Goal
Sulfate	11.3	8.6	9.3	1.9	No	74%
Nitrate	5.5	4.7	3.6	2.3	Yes	>100%
Organic Carbon	14.6	12.1	14.4	5.6	No	6%
Elemental Carbon	2.9	2.3	2.1	0.5	Yes	>100%
Fine Soil	0.7	0.7	0.9	0.8	No	None**
Coarse Material	2.5	2.5	N/A*	2.7	N/A	N/A
Sea Salt	0.1	0.1	N/A*	0.2	N/A	N/A

*Visibility projections are not available due to poor model performance for coarse material and sea salt.
**No progress towards URP goal because projected 2018 values are higher than baseline conditions

Figure 9.3.1-2 Pollutant Breakdown on 20% Worst Days for Central Cascades – Mt. Jefferson Wilderness, Mt. Washington Wilderness, and Three Sisters Wilderness Areas
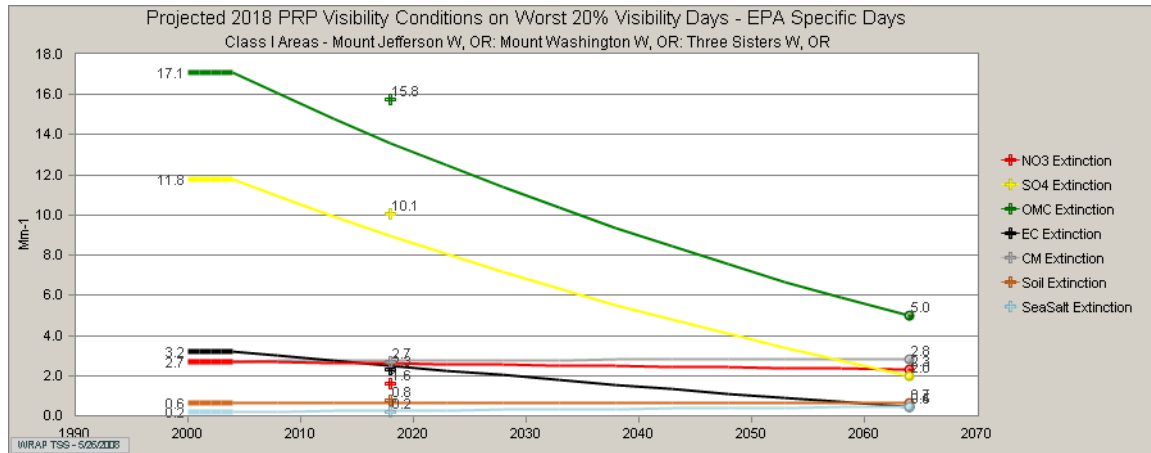
Table 9.3.1-2 Pollutant Breakdown on 20% Worst Days for Central Cascades – Mt. Jefferson Wilderness, Mt. Washington Wilderness, and Three Sisters Wilderness Areas

Pollutant	Central Cascades - Mt. Jefferson, Mt. Washington, and Three Sisters Wilderness Areas					
	2000-04 Baseline (Mm-1)	2018 URP Goal (Mm-1)	2018 Projected Visibility (Mm-1)	2064 Natural Conditions (Mm-1)	2018 Under URP Goal?	% of URP Goal
Sulfate	11.8	9.0	10.1	2.0	No	60%
Nitrate	2.7	2.6	1.6	2.3	Yes	>100%
Organic Carbon	17.1	13.6	15.8	5.0	No	38%
Elemental Carbon	3.2	2.5	2.3	0.4	Yes	>100%
Fine Soil	0.7	0.7	0.8	0.7	No	None**
Coarse Material	2.7	2.8	N/A*	2.8	N/A	N/A
Sea Salt	0.2	0.3	N/A*	0.5	N/A	N/A

*Visibility projections are not available due to poor model performance for coarse material and sea salt.
**No progress towards URP goal because projected 2018 values are higher than baseline conditions

Figure 9.3.1-3 Glideslope by Pollutant on 20% Worst Days for Southern Cascades Region

Projected 2018 PRP Visibility Conditions on Worst 20% Visibility Days - EPA Specific Days
Class I Areas - Crater Lake NP, OR: Diamond Peak W, OR: Gearhart Mountain W, OR: Mountain Lakes W, OR
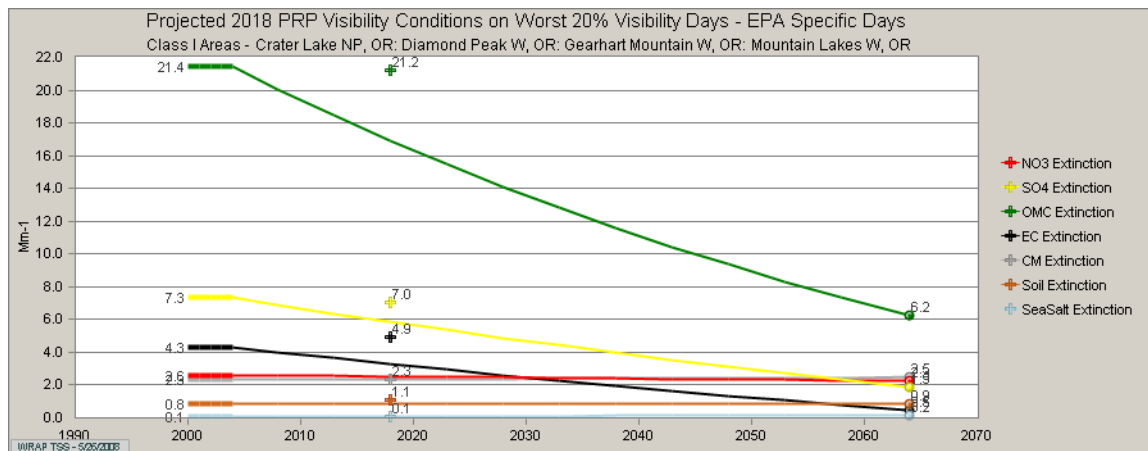
Table 9.3.1-3 Pollutant Breakdown on 20% Worst Days for Southern Cascades Region

Pollutant	Southern Cascades – Crater Lake National Park and Diamond Peak, Mountain Lakes and Gearhart Mountain Wilderness Areas					
	2000-04 Baseline (Mm-1)	2018 URP Goal (Mm-1)	2018 Projected Visibility (Mm-1)	2064 Natural Conditions (Mm-1)	2018 Under URP Goal?	% of URP Goal
Sulfate	7.3	5.9	7.0	1.9	No	20%
Nitrate	2.6	2.5	1.1	2.3	Yes	>100%
Organic Carbon	21.4	16.9	21.2	6.2	No	5%
Elemental Carbon	4.3	3.3	4.9	0.5	No	None**
Fine Soil	0.8	0.8	1.1	0.9	No	None**
Coarse Material	2.3	2.4	N/A*	2.5	N/A	N/A
Sea Salt	0.1	0.1	N/A*	0.2	N/A	N/A

*Visibility projections are not available due to poor model performance for coarse material and sea salt.
**No progress towards URP goal because projected 2018 values are higher than baseline conditions

Figure 9.3.1-4 Glideslope by Pollutant on 20% Worst Days for Coast Range – Kalmiopsis Wilderness Area
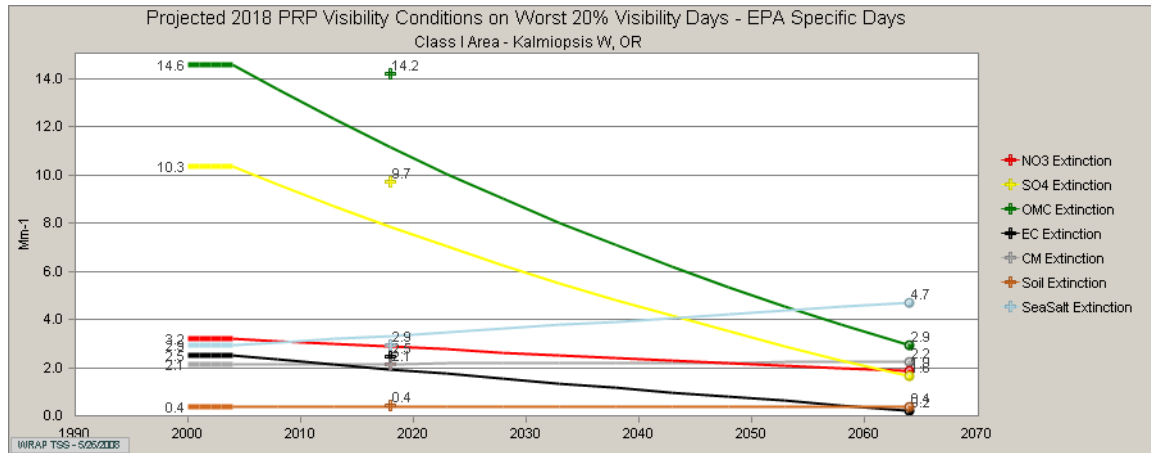
Table 9.3.1-4 Pollutant Breakdown on 20% Worst Days for Coast Range – Kalmiopsis Wilderness Area

Pollutant	Coast Range - Kalmiopsis Wilderness Area					
	2000-04 Baseline (Mm-1)	2018 URP Goal (Mm-1)	2018 Projected Visibility (Mm-1)	2064 Natural Conditions (Mm-1)	2018 Under URP Goal?	% of URP Goal
Sulfate	10.3	7.9	9.7	1.6	No	25%
Nitrate	3.2	2.9	2.1	1.9	Yes	>100%
Organic Carbon	14.6	11.2	14.2	2.9	No	11%
Elemental Carbon	2.5	1.9	2.5	0.2	No	9%
Fine Soil	0.4	0.4	0.4	0.4	Yes	100%
Coarse Material	2.1	2.2	N/A*	2.2	N/A	N/A
Sea Salt	2.9	3.3	N/A*	4.7	N/A	N/A

*Visibility projections are not available due to poor model performance for coarse material and sea salt.
**No progress towards URP goal because projected 2018 values are higher than baseline conditions

Figure 9.3.1-5 Glideslope by Pollutant on 20% Worst Days for Eastern Oregon – Strawberry Mountain Wilderness and Eagle Cap Wilderness Areas
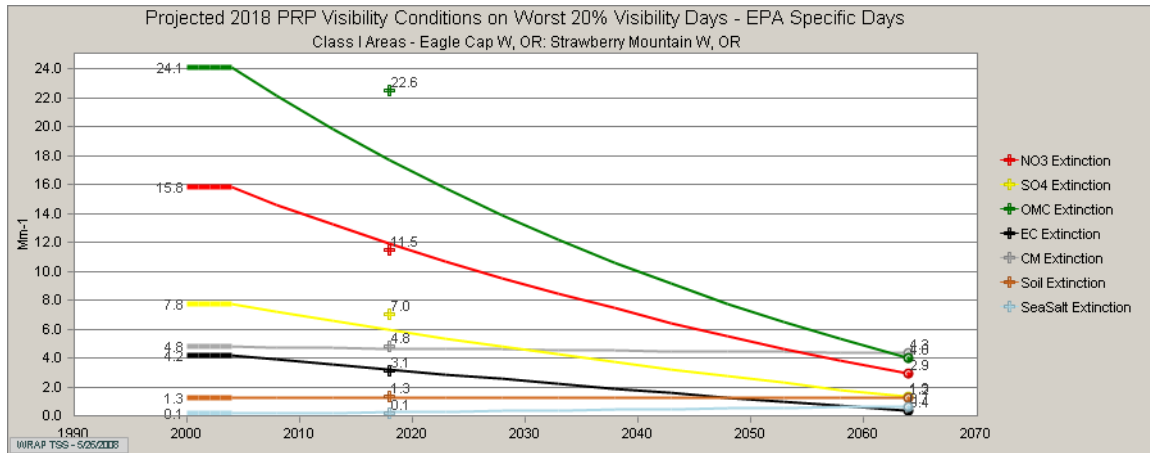
Table 9.3.1-5 Pollutant Breakdown on 20% Worst Days for Eastern Oregon – Strawberry Mountain Wilderness and Eagle Cap Wilderness Areas

Pollutant	Eastern Oregon – Strawberry Mountain and Eagle Cap Wilderness Areas					
	2000-04 Baseline (Mm-1)	2018 URP Goal (Mm-1)	2018 Projected Visibility (Mm-1)	2064 Natural Conditions (Mm-1)	2018 Under URP Goal?	% of URP Goal
Sulfate	7.8	6.0	7.0	1.3	No	40%
Nitrate	15.8	12.0	11.5	2.9	Yes	>100%
Organic Carbon	24.1	17.7	22.6	4.0	No	25%
Elemental Carbon	4.2	3.2	3.1	0.4	Yes	>100%
Fine Soil	1.3	1.3	1.3	1.2	Yes	100%
Coarse Material	4.8	4.7	N/A*	4.3	N/A	N/A
Sea Salt	0.1	0.3	N/A*	0.7	N/A	N/A

*Visibility projections are not available due to poor model performance for coarse material and sea salt.
**No progress towards URP goal because projected 2018 values are higher than baseline conditions.

Figure 9.3.1-6 Glideslope by Pollutant on 20% Worst Days for Eastern Oregon/Western Idaho – Hells Canyon Wilderness Area
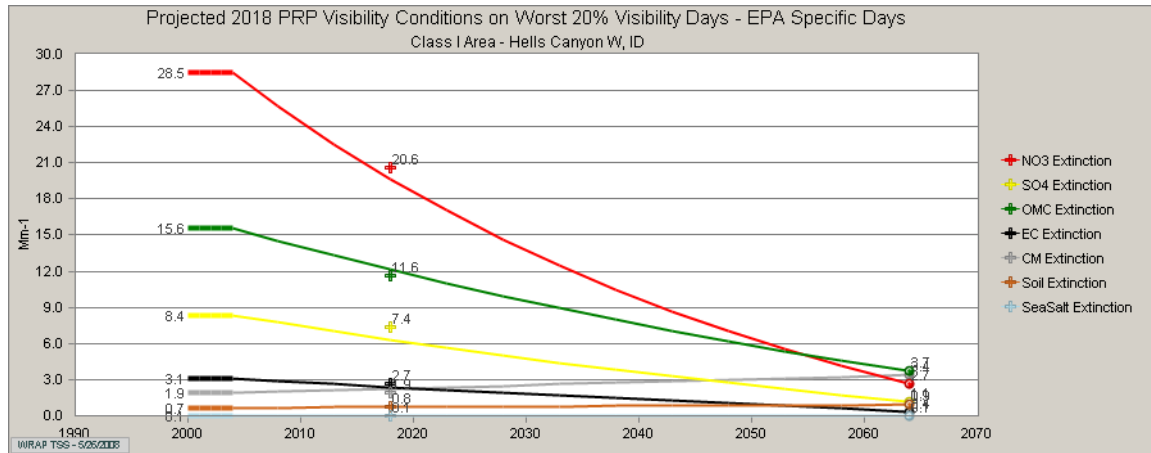
Table 9.3.1-6 Pollutant Breakdown on 20% Worst Days for Eastern Oregon/Western Idaho – Hells Canyon Wilderness Area

Pollutant	Eastern Oregon/Western Idaho – Hells Canyon Wilderness Area					
	2000-04 Baseline (Mm-1)	2018 URP Goal (Mm-1)	2018 Projected Visibility (Mm-1)	2064 Natural Conditions (Mm-1)	2018 Under URP Goal?	% of URP Goal
Sulfate	8.4	6.4	7.4	1.1	No	48%
Nitrate	28.5	19.7	20.6	2.7	No	90%
Organic Carbon	15.6	12.1	11.6	3.7	Yes	>100%
Elemental Carbon	3.1	2.4	2.7	0.4	No	54%
Fine Soil	0.7	0.7	0.8	0.9	No	None**
Coarse Material	1.9	2.3	N/A*	3.4	N/A	N/A
Sea Salt	0.1	0.1	N/A*	0.1	N/A	N/A

*Visibility projections are not available due to poor model performance for coarse material and sea salt.
**No progress towards URP goal because projected 2018 values are higher than baseline conditions

CHAPTER 10: BEST AVAILABLE RETROFIT TECHNOLOGY (BART) EVALUATION

10.1 Overview of BART Process in Oregon

One of the primary requirements of the Regional Haze rule is Section 308(e) on the installation of Best Available Retrofit Technology (BART). The federal definition of BART in 40 CFR 51.301 is as follows:

> **"Best Available Retrofit Technology (BART)** means an emission limitation based on the degree of reduction achievable through the application of the best system of continuous emission reduction for each pollutant which is emitted by an existing stationary facility. The emission limitation must be established, on a case-by-case basis, taking into consideration the technology available, the costs of compliance, the energy and nonair quality environmental impacts of compliance, any pollution control equipment in use or in existence at the source, the remaining useful life of the source, and the degree of improvement in visibility which may reasonably be anticipated to result from the use of such technology."

The BART requirements apply to certain older industrial sources that began operating before federal Prevention of Significant Deterioration (PSD) rules were adopted in 1977 to protect visibility in Class I areas. Both the PSD and BART and rules represent the two primary regulatory tools for protecting visibility and addressing regional haze from industrial sources. The PSD rules apply to new sources and major modifications of existing sources, and require visibility in Class I areas to be protected.[21] The BART rules are essentially a retroactive version of PSD (prior to 1977) for visibility purposes. Under BART, the following sources are subject to review and potential controls if they meet the following criteria: (1) built between 1962 and 1977; (2) have the potential to emit more than 250 tons per year, and (3) fall into one of 26 specific source categories. These sources must be evaluated to see how much they contribute to regional haze and if retrofitting with controls is feasible and cost effective.

The BART process consists of three-steps: (1) determining BART-eligibility; (2) determining is a source is "subject to BART" by conducting modeling of Class I visibility impacts; and (3) conducting an analysis of BART controls (retrofitting) for those sources subject to BART that contribute to regional haze.

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[21] The PSD rules are part of the New Source Review rules, which apply to major new sources and major modifications to existing sources, to protect both visibility and air quality in general. See further description in Section 12.5.1. Both PSD and BART rules require modeling to determine visibility impact, and use similar modeling techniques and a similar threshold for what constitutes is a "significant" visibility impact. Since BART addresses existing sources, the evaluation of controls considers the effectiveness and remaining life of the existing controls, and the cost of replacing them. While both rules may end up evaluating similar types of controls, the criteria and selection of controls for BART is different due to the retrofit factors and visibility improvement that would result.

10.2 Determining Oregon's BART-eligible Sources

In determining BART-eligible sources, Oregon followed Appendix Y of EPA's BART rule, Guidelines for BART Determinations Under the Regional Haze Rule, Part II, How to Identify BART-Eligible Sources (70 FR 39158 to 39161). This guidance consisted of the following criteria:

1. Does the facility contain emissions units[22] which fall into one or more of 26 source categories:
    - Fossil-fuel fired steam electric plants of more than 250 million British thermal units (BTU) per hour heat input
    - Coal cleaning plants (thermal dryers)
    - Kraft pulp mills
    - Portland cement plants
    - Primary zinc smelters
    - Iron and steel mill plants
    - Primary aluminum ore reduction plants
    - Primary copper smelters
    - Municipal incinerators capable of charging more than 250 tons of refuse per day
    - Hydrofluoric, sulfuric, and nitric acid plants
    - Petroleum refineries
    - Lime plants
    - Phosphate rock processing plants
    - Coke oven batteries
    - Sulfur recovery plants
    - Carbon black plants (furnace process)
    - Primary lead smelters
    - Fuel conversion plants
    - Sintering plants
    - Secondary metal production facilities
    - Chemical process plants
    - Fossil-fuel boilers of more than 250 million BTUs per hour heat input.
    - Petroleum storage and transfer facilities with a capacity exceeding 300,000 barrels
    - Taconite ore processing facilities
    - Glass fiber processing plants
    - Charcoal production facilities

2. Did the units "began operation" after August 7, 1962 (defined as "engaged in activity related to the primary design function of the facility").
3. Were the units "in existence" on August 7, 1977 (defined as "the owner or operator has obtained all necessary pre-construction approvals or permits required by Federal, State, or local air pollution emissions and air quality laws or regulations and either has (1) begun, or caused to begin, a continuous program of physical on-site construction of the facility or (2) entered into binding agreements or contractual obligations, which cannot be canceled or modified without substantial loss to the owner or operator, to undertake a program of construction of the facility to be completed in a reasonable time").

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[22] EPA rules (40 CFR 51.166) define *emissions unit* as "any part of a stationary source that emits or has the potential to emit any pollutant".

[Note: Sources that were in operation before August 7, 1962, but were reconstructed during the August 7, 1962 to August 7, 1977 time period are also subject to BART if "the fixed capital cost of the new component exceeds 50 percent of the fixed capital cost of a comparable entirely new source".]

4. Are the potential emissions from these units 250 tons per year or more for sulfur dioxide (SO_2), nitrogen oxides (NO_x), particulate matter (PM_{10}), volatile organic compounds (VOCs), or ammonia (NH_4).[23]

The identification of Oregon BART-eligible sources was initiated by a comprehensive study conducted by the WRAP in 2005. This study, called "Identification of BART-Eligible Sources in the WRAP Region", identified 101 Oregon sources with actual emissions over 100 tpy of any visibility-impairing pollutant, which could be potential BART sources.[24] In this study the WRAP worked with Oregon DEQ staff familiar with Oregon's sources, to review them for the three BART-eligibility criteria, by categorizing as "likely", "potentially" eligible, or "do not know." All of these sources were reviewed by each permit engineer to confirm BART-eligibility. Out of this review 26 sources were identified as needing more in-depth review to determine BART-eligibility. Out of the 26, a total of 10 were found to be eligible. These sources are listed below in Table 10.2-1. The 16 sources found not to be eligible are described in Table 10.2-2.

Table 10.2-1 List of 10 BART-eligible Sources in Oregon

BART-eligible Source	Location	BART Source Category	Nearest Class I Area
1. Amalgamated Sugar	Nyssa, eastern Oregon	SC 22 - fossil fuel boilers >250 MMBtu/hr heat input.	Eagle Cap 80 mi
2. PGE Boardman	Boardman, eastern Oregon	SC 1 - fossil fuel steam fired electric plants.	Mt. Hood 90 mi.
3. Boise Paper Solutions	St. Helens, NW Oregon	SC 3 - kraft pulp mills & 22 ff boilers >250 MMBtu/hr.	Mt. Hood 55 mi.
4. Georgia Pacific, Wauna	Clatskanie, NW Oregon	SC 3 - kraft pulp mills.	Mt. Hood 80 mi.
5. PGE Beaver	Clatskanie, NW Oregon	SC 1 - fossil fuel steam fired electric plants.	Mt. Hood 80 mi.
6. Georgia-Pacific, Toledo	Toledo, western Oregon	SC 3 - kraft pulp mills.	Three Sisters 90 mi.
7. Pope & Talbot	Halsey, western Oregon	SC 3 - kraft pulp mills.	Three Sisters 50 mi.

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[23] EPA's *Guidance for Determining BART Eligibility* allows states the option of excluding VOC and NH4 emissions from the BART process, due to the inability to model these pollutants. Oregon did identify sources for these pollutants, and found one source that did exceed 250 tons for VOC. This source, SFPP Terminals in Eugene, was evaluated, as described in Table 10.3-2, #16, below.

[24] This study can be found on the WRAP website at http://www.wrapair.org/forums/ssjf/bartsources.html.

Source	
8. SP Newsprint	Newberg, NW Oregon	SC 22 - fossil fuel boilers >250 MMBtu/hr heat input.	Mt. Hood 50 mi.
9. International Paper (formally Weyerhaeuser)	Springfield, western Oregon	SC 3 - kraft pulp mills & 22 ff boilers >250 MMBtu/hr.	Three Sisters 40 mi.
10. Kingsford	Springfield, western Oregon	SC 26 - charcoal production facility	Three Sisters 40 mi.

Table 10.2-2 List of Sources Determined not to be BART-eligible

Source	Reasons not BART-eligible
1. Collins Products, Klamath Falls.	Initially thought to have three fossil-fuel boilers. Upon further review found all boilers had been dismantled and scrapped.
2. Northwest Aluminum, The Dalles.	Initial analysis found applicable emission units went into operation prior to August 7, 1962. There was a reconstruction of these units, but this came after 1977, and went through PSD review. The primary aluminum production plant has been permanently shutdown.
3. ESCO, Portland.	Source did not fall under any of the 26 source categories list by EPA for BART. Additionally, no pollutant >250 tpy.
4. Chevron, Portland.	Source thought to meet two of 26 source categories. One category applies to fossil-fuel boilers >250 million BTUs/hr. The other applies to petroleum storage facilities over 300,000 barrels. Upon further review found boilers and storage facilities were far below the applicable capacity. Additionally, no pollutant >250 tpy.
5. Kinder Morgan, Portland.	This source similar to Chevron Portland. Had boilers and storage facilities far below the applicable capacity, and no pollutant >250 tpy.
6. Shore Terminals LLC (Mobil Oil), Portland. .	Upon further review found began operation before 1962, and PTE well below 250 tpy.
7. Oregon Steel Mills, Portland.	Source met source category for Iron and Steel mills. Largest emission unit in existence prior to 1977, but reconstructed after this date. Under EPA guidance on BART-eligibility, a "reconstructed source" after 1977 is not subject to BART if "the fixed capital cost of the new component exceeds 50% of the fixed capital cost of a comparable new source." DEQ review determined the reconstruction of the emission unit exceeded the 50% criteria. Other emission units at the source well under 250 tpy.
8. Wah Chang, Albany.	Primary production activity at this facility did not fall under any of the 26 source categories for BART. Other production activity under 250 tpy.
9. Weyerhaeuser, Albany Paper Mill.	Most of the emission units at this facility started up after 1977. Two emission units that started between 1962-1977 were determined to have emissions under 250 tpy.
10. Roseburg Forest Products, Roseburg.	Source met source category for fossil-fuel boilers. Two boilers had been "derated" to address other regulatory requirements, which reduced boiler capacity to under 250 million BTUs/hr through a federally enforceable permit limit. Source requested similar permit condition for a third boiler. Permit was modified August 8, 2006. Source no longer BART-eligible.
11. Bear Mountain Forest Products, Cascade Locks.	Source does not fall under any of the 26 source categories for BART. Additionally, emissions under 250 tpy.
12. City of Eugene Water Pollution Control Facility.	Boiler under 250 million BTUs/hr, and emissions under 250 tpy.
13. University of Oregon Central Power Station,	Boiler under 250 million BTUs/hr, and emissions under 250 tpy.

	Eugene.	
14.	International Paper, Gardiner.	This facility is shutdown and permit is no longer active.
15.	Reynolds Metals, The Dalles.	This facility is shutdown and permit is no longer active.
16.	SFPP Eugene Gasoline Bulk Terminal.	Source met source category for petroleum storage facilities and had emissions >250 tpy for one pollutant - VOC. Other pollutants were well under 250 tpy. EPA's guidance allows VOC emissions to be excluded from BART due to the difficulty to model visibility impacts from VOCs. DEQ used screening model that conservatively assumed that 50% of the VOC emissions were greater than six carbon atoms and equivalent to organic carbon (OC) for visibility modeling purposes. Results showed visibility impact well under 0.5 deciview. Facility removed from the BART-eligible list.

Figure 10.2-1 below is a map showing the location of the 10 BART-eligible sources in Oregon, indicated in red. The visibility impacts of Oregon's BART-eligible sources and those in neighboring States are described in Section 10.3 below.

Figure 10.2-1 Map of Oregon BART-eligible Sources

10.2.1 Extent of BART-eligible Source Emissions

The first step in the BART process was the identification of the BART-eligible sources. Table 10.2.1-1 shows the actual emissions of these sources compared to all other non-BART sources, and compared to total emissions in Oregon (for SO_2, NO_x, and $PM_{2.5}$, which are the primary haze-causing pollutants of concern). The 10 BART-eligible sources represent about 56% of the industrial emissions, and 4% of all sources in the state (2005 actual emissions). If the PGE Boardman plant is removed from this total, the remaining BART sources represent 18% of the

industry, and 1.3% of the statewide total. The significance of the comparison of BART vs. non-BART source emissions is discussed further in Chapter 12, as part of the Long-Term Strategy to evaluate non-BART sources to identify additional emission reductions from these sources in the future.

Table 10.2.1-1 Oregon BART-eligible Source Emissions (2005 actual, tons/year)

Pollutant	10 BART-eligible sources	9 BART eligible sources, w/o PGE Boardman	Total Industry (non-BART)	Total Statewide (all sources)
SO$_2$	16,223	4,206	3,054	47,447
NO$_x$	12,287	3,974	13,358	233,633
PM$_{10}$	2,339	1,643	7,639	455,666
PM2.5*	878	697	1,264	166,593

* PM2.5 is included in PM10

10.3 Summary of BART Modeling

The next step after determining BART eligibility was to conduct modeling of the 10 Oregon BART sources in order to evaluate Class I area visibility impacts. The results are given in Section 10.3.2, which describes source impacts on Class I areas in Oregon and neighboring States. Section 10.3.3 describes the impacts on Oregon Class I areas from BART sources located outside of Oregon.

Ideally, a full assessment of visibility impacts on Class I areas from any source would show its contribution to total impacts from all sources, and on all days, including the 20% best and worst days as described in the Regional Haze Rule. However, such modeling would be extremely complex, in terms separating out each individual source from the hundreds of emission sources affecting each Class I area at a given time. In constructing the BART program, the Rule and EPA guidance simplified the evaluation of visibility impairment from BART-eligible sources by patterning it after New Source Review, where source impacts are modeled individually relative to an estimated natural background on the 20% best days. Consequently, the BART modeling of the 20% best days is very different from, and serves a different purpose than, the use of monitoring data to determine the 20% best and worst days under the Regional Haze Rule. As a result, the BART modeling is based on individual BART source impacts in order to identify the greatest potential for making visibility improvements. This is consistent with EPA BART modeling guidance and BART modeling conducted by all other states in the country.

The BART modeling was conducted for all BART-eligible emission units, collectively, at each facility. Although EPA's BART guidance does not require the inclusion of non-BART emissions in the BART modeling, for most facilities in Oregon the BART emission units represent most of the plant emissions.

As mentioned above, the visibility impacts identified in the modeling are estimates of the highest impacts from each BART source. This is similar to the approach used for new and

major modified sources under the PSD New Source Review rules, in which the maximum impacts of new major sources are modeled for affected Class I areas. As noted in the description of the regional BART Modeling Protocol below, the Department used the highest plant-wide daily emissions from all BART emission units for each source for the modeling period of 2003-2005.

10.3.1 Description of the Modeling Protocol

The visibility impacts described in the modeling results section use the same deciview (dv) metric as used elsewhere in this plan. The deciview is a measure of visibility, and is equivalent on a logarithmic scale to light extinction. For the BART analysis, sources are evaluated on their contribution to increases in impairment at Class I areas above an estimated natural background. This increase in impairment, or delta dv, can also be expressed as a change in light extinction. For example, a delta dv of 0.5 is equivalent to a 5% increase in light extinction. For the sake of brevity, only "dv" is used here.

As stated in Chapter 5, a 1 dv change is equal to a generally perceptible change in visibility to most people. In EPA's BART modeling guidance, they note that "changes in light extinction of 5 percent [0.5 dv] will evoke a just noticeable change in most landscapes." As a result, EPA identified two thresholds for evaluating individual BART sources: (1) 0.5 dv, which is the limit of perceptible change, and what EPA suggests States can use to identify sources that "contribute" to visibility impairment; and (2) 1.0 dv, which is a perceptible change to most people, and what EPA suggests be used to identify sources that "cause" visibility impairment (see EPA's BART rule, pages 70 FR 39120-21).

For the BART modeling conducted in Oregon, the Department chose 0.5 dv as the visibility threshold. This decision was based on several factors: (1) it equates to the 5% extinction threshold for new sources under the PSD New Source Review rules, (2) it is consistent with the threshold selected by other States in the West (all selected 0.5 dv), (3) it represents the limit of perceptible change, and (4) there was no clear rationale or justification for selecting a lower level.[25]

1. Cumulative Impact Modeling

As suggested by EPA's BART guidance, if multiple BART-eligible sources impact a given Class I area on the same day, then a lower, individual, contribution threshold could be considered. Oregon, in concert with Washington and Idaho, could make an evaluation of multiple-source or cumulative impacts on Class I areas of BART-eligible sources in three states. After a multi-source evaluation, a determination would be made as to which sources, if

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[25] The Department considered lower levels but concluded there was not sufficient justification for selecting a lower level than 0.5 dv. Using a similar threshold to the NSR rules was a significant factor. Also, as a participant in the WRAP, it was important that Oregon use an approach consistent with the other Western states, especially neighboring states of Washington and Idaho, with whom Oregon developed the regional three-state BART Modeling Protocol. Western states (as compared to the Midwest and East) have a similar mix of contributing pollutant species, contributing source categories, BART sources, worst-case days and natural background conditions, and other factors, which support using the same threshold level.

any, are considered to contribute to visibility impairment and subject to BART, and if a lower visibility threshold than 0.5 dv is warranted.

While consideration was given to the option of evaluating cumulative impacts from multiple BART sources, the Department decided not to pursue this path. The Department conferred with other WRAP states to determine if any were considering cumulative impacts for BART purposes, and found no state pursuing this option at the present time. This included the neighboring states of Washington, Idaho, Nevada and California. Not only was consistency with other states a major consideration for the Department, but the lack of any definitive guidance for addressing cumulative impacts from multiple BART sources was also a factor. The Department believes the WRAP regional planning process is the appropriate vehicle for developing the necessary policy and technical guidance for this type of analysis. The Department will continue its participation in the WRAP, and as part of the next Regional Haze Plan update in 2013, will report on any efforts to study and evaluate cumulative impacts, as it relates to BART-eligible sources, and the LTS commitment to evaluate non-BART sources for additional emission reductions and visibility improvements by the 2018 milestone.

2. Oregon-Washington-Idaho BART Modeling Protocol

The modeling conducted was based on the BART Modeling Protocol developed jointly by Oregon DEQ, Idaho DEQ, and Washington Department of Ecology, Federal Land Managers (National Park Service and U.S. Forest Service), and EPA Region 10. It was based on EPA Guidelines for BART Determinations under the Regional Haze Rule (Appendix Y).[26] The CALPUFF model was used to estimate daily visibility impacts above estimated natural conditions at each Class I area from the BART-eligible emission units at each source, based on actual emission over a three year period (2003-2005). This evaluation looked at both the 98th percentile of the three-year period (which is the 22nd highest day), and the 98th percentile of each individual year (which is the 8th highest day). The highest of these 98th percentile values was then compared to the visibility threshold of 0.5 deciview.

The 98th percentile is a frequently used cutoff in modeling where there are measurement limitations, and certain model assumptions and uncertainties involved. The use of the 98th percentile follows EPA's recommended approach for modeling BART sources (see EPA's BART rule, page 70 FR 39121).[27] According to EPA, the use of the 98th percentile is "a more robust approach that does not give undue weight to the extreme tail of the distribution", and that "will effectively capture the sources that contribute to visibility impairment in a Class I area, while minimizing the likelihood that the highest modeled visibility impacts might be caused by unusual meteorology or conservative assumptions in the model". EPA concludes that "if the 98th percentile value from your modeling is less than your contribution threshold, then you may conclude that the source does not contribute to visibility impairment and is not subject to BART."

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[26] See Appendix D-4 for this guidance.
[27] It should also be noted that Federal Land Managers requested that the 98th percentile be used and incorporated into the three-state regional BART protocol.

The BART Modeling Protocol incorporated the use of the 98th percentile, as did the modeling protocols for other states conducting BART modeling across the country. It is important that the same metrics be used for the BART analysis over a wide area, especially for Class I impacts that cross state and regional boundaries.

The emissions used in the modeling reflected the highest emitting day for each facility within the modeling period (2003-2005). They also reflected the facility's steady-state operating conditions during periods of high capacity utilization, which did not include start-up, shutdown, or malfunction emissions.

A copy of the BART Modeling Protocol is provided in Appendix D-5.

Oregon DEQ contacted each BART-eligible source directly to obtain actual emissions and stack parameter information on each BART-eligible emission unit for the modeling. This information was obtained with the assistance of the DEQ permit engineer already assigned to the particular facility. The following is a list of information obtained:

1. Emission Unit Name
2. Geo-location of the Emissions Unit (Latitude - Longitude, or UTM with Zone and Datum)
3. Emission rate - highest 24-hour average actual emissions in the years 2003-2005 (lbs/hour)
4. Stack Base Elevation (meters)
5. Stack Height (meters)
6. Stack Inside Diameter (meters)
7. Exit Velocity (meters/second)
8. Stack Gas Temperature (degrees F, C, or K)
9. Emissions should be quantified for:
   - SO_2
   - H2SO4 (sulfuric acid mist) if available
   - NO_x
   - PM_{10}
   - VOC
10. Speciated PM10 (where available):
    Filterable fraction
    - Elemental carbon (EC)
    - PM Fine ($PM_{2.5}$)
    - PM Course
    Condensable fraction
    - Secondary Organic Aerosol (OC)
    - Inorganic Aerosol (SO_4)
    - Non-SO_4 Inorganic Aerosol

Modeling was conducted for SO_2, NO_x, and PM emissions ($PM_{2.5}$ and/or PM_{10}). EPA guidance allows states the option of excluding VOC emissions from the BART process, due to the inability to easily model this pollutant.[28]

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[28] The Department found a single source that met the BART eligibility criteria for VOC emissions, as indicated in Table 10.2-2. This source (#16 SFPP) was evaluated using a screening model, and found to have impacts well under the 0.5 dv threshold.

Oregon provided each source the opportunity, including the participation in two workshops, to provide feedback on the modeling protocol, participate in the modeling effort, and discuss the results. For some facilities, multiple model runs were conducted either by DEQ or by the consultant to the facility using refined emission rates and stack parameters, and other data, These refined model inputs were based on the availability of recent source test results, continuous emission monitoring (CEMs) data, and other information.

10.3.2 Summary of Oregon BART Modeling Results

Table 10.3.2-1 below shows the results of the CALPUFF modeling conducted on the 10 BART-eligible sources. The far left column of the table shows the Class I areas that were modeled.[29] These are Class I areas in Oregon, Washington, and Idaho that are within 300 kilometers of the individual 10 Oregon BART-eligible sources, in accordance with the distance criteria specified in the BART Modeling Protocol.

The table shows that out of 10 sources that were modeled, five had impacts below the 0.5 dv threshold, and five were over the threshold. The visibility impacts from PGE Boardman facility were considerably higher than any of the other four BART sources over the 0.5 dv threshold. The extent of these impacts is described further in Section 10.4.2, along with the BART control determination for PGE Boardman.

As indicated in Table 10.3.2-1, the five sources under the 0.5 dv threshold are listed as "Exempt", and are shown in the first group. In the next group are four sources listed as "Exempt with FEPL". These are sources that were over the threshold that chose the option of a federally enforceable permit condition (FEPL), as described in Section 10.4.1 below. The last column shows PGE Boardman that was far over the threshold and underwent a BART control determination. The impacts for PGE Boardman in the table reflect the BART controls that have been identified for this facility in Section 10.4.2.

Table 10.3.2-2 shows the modeled impacts for the four BART sources before and after the FEPL. A description of emissions reductions and the FEPL at each source is provided below in Section 10.4.1.

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[29] Note the Columbia River Gorge National Scenic Area is listed, however it is not a Class I area. It was added to the modeling runs as a receptor point, for information purposes only, based on current interest in visibility conditions in the Gorge. Non-Class I areas are not part of BART process, as they are not addressed under EPA's Regional Haze Rule. However, it should be noted that on non-Class I areas like the Gorge that are in close proximity to Class I areas (such as Mt. Hood) receive visibility benefits from the strategies adopted for Class I areas.

Table 10.3.2-1 BART-Eligible Source Modeling Results

22 Best day per three year period (2003-2005)										
	Exempt					Exempt with FEPL				Subject
Class I Area	Boise Paper	GP Toledo	Kingsford	Pope & Talbot	SP Newsprint	GP Wauna	PGE Beaver	Intern'l Paper Springfield	Amalgamated Sugar	PGE Boardman
Alpine Lakes	0.159				0.037	0.263	0.282			2.237
Columbia Gorge	0.478	0.114	0.014	0.221	0.166	0.333	0.359	0.122		3.709
Crater Lake		0.107	0.019	0.199	0.036			0.208		
Craters of the Moon									0.047	
Diamond Peak	0.115	0.125	0.030	0.247	0.061	0.154	0.123	0.278		1.025
Eagle Cap									0.437	2.225
Gearhardt Mt			0.005	0.076				0.059		
Glacier Peak	0.097					0.155	0.158			1.396
Goat Rocks	0.177	0.064	0.006	0.114	0.052	0.236	0.272	0.062		2.420
Hells Canyon									0.282	1.951
Jarbridge									0.059	
Kalmiopsis		0.190	0.023	0.304				0.218		
Lava Beds			0.006					0.076		
Marble Mt			0.012	0.172				0.143		
Mt Adams	0.192	0.083	0.009	0.133	0.062	0.240	0.258	0.085		2.684
Mt Hood	0.367	0.156	0.020	0.299	0.125	0.344	0.357	0.189		4.98
Mt Jefferson	0.234	0.143	0.028	0.296	0.092	0.244	0.243	0.239		3.119
Mountain Lakes		0.080	0.011	0.137				0.125		
Mt Rainier	0.246	0.083	0.007	0.095	0.061	0.356	0.414	0.062		2.020
Mt Washington	0.172	0.136	0.032	0.303	0.075	0.217	0.176	0.279		2.334
North Cascades						0.121	0.136			1.056
Olympic NP	0.224				0.058	0.450	0.412			
Redwood			0.016	0.243				0.176		
Sawtooth									0.078	
Selway-Bitteroot									0.082	
Strawberry Peak									0.349	1.717
Three Sisters	0.185	0.163	0.049	0.396	0.091	0.234	0.195	0.444		2.288
Max dv	**0.367**	**0.190**	**0.049**	**0.396**	**0.125**	**0.450**	**0.414**	**0.444**	**0.437**	**4.98**

A summary of the results of the BART-eligible source modeling is provided below.

1. Exempt Oregon BART-eligible sources based on 2003-2005 Actual Emissions:

- Boise Paper Solutions, St. Helens OR
- Georgia Pacific, Toledo Pulp & Paper Operations, Toledo OR
- Kingsford Manufacturing, Springfield OR
- Pope and Talbot, Halsey OR
- SP Newsprint, Newberg OR

For these sources, the BART modeling showed impacts at all Class I areas less than 0.5 dv, and the facilities are not subject to further BART review. However, as BART-eligible sources, they will be included in the evaluation of non-BART sources described in Section 12.6.1 of the Long-Term Strategy.

2. Exempt BART-eligible sources based on emissions reduced through an FEPL

- Portland General Electric, Beaver Power Plant, Clatskanie OR

- International Paper (formally Weyerhaeuser), Springfield OR
- Georgia Pacific, Wauna Mill, Clatskanie OR
- Amalgamated Sugar, Nyssa OR

BART modeling showed these four sources had impacts over 0.5 dv in at least one Class I area. Table 10.3.2-2 below shows the initial modeling results. By accepting a FEPL, these sources have reduced their visibility impact to below 0.5 dv. See Section 10.4.1 for more details.

Table 10.3.2-2 BART-Eligible Sources with FEPLs

22 Best day per three year period (2003-2005)								
	Visibility Change with FEPL							
	PGE Beaver		Intern'l Paper Springfld		Amalgamated Sugar		GP Wauna	
	Actual		Actual		Actual		Actual	
Class I Area	2003-2005	FEPL	2003-2005	FEPL	2003-2005	FEPL	2003-2005	FEPL
Alpine Lakes	0.400	0.282					0.340	0.263
Columbia Gorge	0.630	0.359	0.436	0.122			0.518	0.333
Crater Lake			0.802	0.208				
Craters of the Moon					0.049	0.047		
Diamond Peak	0.182	0.123	1.002	0.278			0.170	0.154
Eagle Cap					0.457	0.437		
Gearhardt Mt			0.224	0.059				
Glacier Peak	0.234	0.158					0.172	0.155
Goat Rocks	0.433	0.272	0.249	0.062			0.288	0.236
Hells Canyon					0.295	0.282		
Jarbridge					0.062	0.059		
Kalmiopsis			0.731	0.218				
Lava Beds			0.298	0.076				
Marble Mt			0.568	0.143				
Mt Adams	0.416	0.258	0.296	0.085			0.279	0.240
Mt Hood	0.582	0.357	0.656	0.189			0.434	0.344
Mt Jefferson	0.338	0.243	0.855	0.239			0.272	0.244
Mountain Lakes			0.455	0.125				
Mt Rainier	0.655	0.414	0.238	0.062			0.443	0.356
Mt Washington	0.265	0.176	0.981	0.279			0.244	0.217
North Cascades	0.190	0.136					0.138	0.121
Olympic NP	0.679	0.412					0.568	0.450
Redwood			0.676	0.176				
Sawtooth					0.081	0.078		
Selway-Bitteroot					0.086	0.082		
Strawberry Peak					0.365	0.349		
Three Sisters	0.263	0.195	1.457	0.444			0.267	0.234
Max dv	**0.679**	**0.414**	**1.457**	**0.444**	**0.457**	**0.437**	**0.568**	**0.450**
8th Best day per single year								
Eagle Cap					**0.514**	**0.492**		

3. BART-eligible sources subject to BART

- PGE Boardman Power Plant, Boardman OR

BART modeling showed that impacts from this facility were well above 0.5 dv, and the Boardman plant is considered Subject to BART. This source underwent a BART control determination in 2008 and 2010, which is described Section 10.4.2.

10.3.3 Summary of Interstate Modeling Results from BART-eligible sources

As shown in Table 10.3.2-1, PGE Boardman showed impacts in six Class I areas in Washington (Alpine, Glacier Peak, Goat Rocks, Mt. Adams, Mt. Ranier, and North Cascades), and one in the portion of the Hells Canyon Class I area in Western Idaho. Although PGE Beaver and GP Wauna did showed impacts over 0.5 dv in two Washington Class I areas (Olympic and Mt. Ranier), those impacts ended up being under 0.5 dv with the FEPL.

Table 10.3.3-1 below shows the visibility impacts over 0.5 dv in Oregon Class I areas from out-of-state BART-eligible sources. Three BART sources in Washington and one in Idaho had impacts in six Oregon Class I areas (Mt. Hood, Mt. Washington, Mt Jefferson, Three Sisters, Strawberry Mountain, Eagle Cap, and Hells Canyon). The largest impact was from the Trans Alta power plant in Centralia Washington. There were no interstate impacts from BART sources in the states of California and Nevada.

• Washington BART sources impacting Oregon:

1. Weyerhaeuser plant, Longview. This facility is a kraft pulp and paper mill located on the banks of the Columbia River in Longview, Washington. The current mill was constructed in 1948 and expanded in 1956-1957, but it has had many modernizations and upgrades since then. This facility is undergoing a BART control evaluation. As indicated in Table 10.3.3-1, this facility impacts the Mt. Hood Wilderness Area.

2. La Farge, Seattle. This is a cement plant located in the Duwamish Valley in Seattle Washington. The plant produces portland cement using the wet process. 16 of the 18 emission units at the plant are subject to BART. This facility is undergoing a BART control evaluation. As indicated in Table 10.3.3-1, this facility impacts the Mt. Hood Wilderness Area.

3. Trans Alta, Centralia. This is a 702 MW coal-fired power plant located near Centralia Washington. It has 2 tangentially fired pulverized coal units using Powder River sub-bituminous coal for fuel. Controls for SO_2 and PM were recently installed in 2003, and have been determined by EPA to represent a BART level of control. As a result, it is currently undergoing a BART control evaluation only for the NO_x emissions from the plant. As indicated in Table 10.3.3-1, this facility impacts four Oregon Class I areas – Mt. Hood, Mt. Jefferson. Mt. Washington, and Three Sisters.

• Idaho BART sources impacting Oregon:

1. Amalgamated Sugar, Nampa. This is a sugar plant located in SW Idaho. It consists of a boiler rated at 350 million BTUs per hour, classified as a fossil-fuel boiler of more than 250 million BTUs per hour heat input. It was installed in 1969, and was put into service between August 7, 1962 and August 7, 1977. As indicated in Table 10.3.3-1, this facility impacts three Oregon Class I areas – Hells Canyon, Eagle Cap, and Strawberry Mtn.

Table 10.3.3-1 BART source impacts in Oregon from other States

State	BART source impacting Oregon	Oregon Class I Area highest impacted	deciview*
Washington	Weyerhaeuser, Longview	Mt. Hood Wilderness	0.67
	La Farge	Mt. Hood Wilderness	0.62
	Trans Alta, Centralia	Mt. Hood Wilderness	2.83
		Mt. Jefferson Wilderness	1.88
		Mt Washington Wilderness	1.41
		Three Sisters Wilderness	1.53
Idaho	Amalgamated Sugar, Nampa	Hells Canyon Wilderness	0.79
		Eagle Cap Wilderness	1.08
		Strawberry Mtn Wilderness	0.94
California	None		
Nevada	None		

*98th percentile of 3-year baseline (2003-05)

Under BART and Regional Haze Rule, the State where the BART source is located has the responsibility for evaluating BART that source. For this section of the plan, the Department is only providing the preliminary modeling results of neighboring state BART sources. Results of the BART evaluation for the BART sources in Table 10.3.3-1 are not available at this time, but can be obtained by contacting the Washington Department of Ecology and Idaho Department of Environmental Quality.

10.3.4 BART Modeling in the Context of the Regional Haze Rule

The visibility modeling in the BART program is patterned after the type of analysis required of a new or major modified source subject to NSR rules, and following EPA modeling guidelines and FLM FLAG guidance. This analysis is prescriptive on methods, standards, and baseline data, including the definition and determination of natural background. In this context, natural background is defined as the 20% best days as described in "Guidance for Estimating Natural Visibility Conditions under the Regional Haze Rule" (EPA 2003). This natural background is a calculation based on relative humidity and presumed concentration and speciation of particulate at each Class I area. It is not a measured value of visibility impairment as used to determine Reasonable Further Progress. As a result, the BART modeling results cannot be compared directly to visibility conditions on the 20% worst days or 20% best days, as typically used when describing visibility under the Regional Haze Rule.

Also, BART modeling is carried out individually for each source. Including all other contributing sources in the modeling (i.e., non-BART permitted industrial sources, mobile sources (such as motor vehicles, rail, boat traffic), area sources (non-permitted small sources including outdoor burning, etc.) would mask the contribution to visibility impairment from a single BART source. The primary purpose of BART in its regulatory context is to assess the individual contribution, and to determine the level of emission controls that may be necessary to reduce impacts. Although the broad goal is to reduce haze, the end result of BART is a

source-specific analysis with possible source-specific permit conditions and controls to reduce emissions.

This means that the visibility improvements from the BART process, as described in Section 10.5, are based on the improvement from an individual BART source. However, the results of the CMAQ modeling undertaken by WRAP, as discussed in Chapter 9, provides a regional picture that incorporates not only the estimated emissions reductions from BART sources in Oregon, and regionally across the West, but also includes emissions from non-BART permitted sources, mobile sources, and area sources including fires.

10.4 Summary of Oregon BART Control Determination Process

10.4.1 Option to take a Federally Enforceable Permit Limit

EPA guidance allows BART-eligible sources to adopt a federally enforceable permit limit (FEPL) to permanently lower emissions to below the 0.5 dv threshold level.[30] A modeling analysis is needed to demonstrate that the permit limit will achieve this level. Sources that take a FEPL remain BART-eligible, but are no longer "subject to BART", which removes the source from having to conduct a BART control determination.

Sources that pursue this option tend to be sources which modeled just over the 0.5 dv threshold, and are willing to make a permanent reduction to lower their visibility impact to under this level. There are several advantages to the FEPL option, when compared to the BART control determination. First, this option requires making actual emission reductions to lower visibility impacts below the 0.5 dv threshold. The BART determination process does not guarantee emission reductions, as it is possible the determination could result in no controls (for technical or economic reasons). Second, by reducing visibility impairment below the 0.5 dv threshold, the impact is below the human "perceptibility" level. The BART determination process has no requirement to achieve this level (although greater reductions and more visibility improvement could be an outcome). Third, this option in most cases will result in visibility improvement in a shorter period of time than the 5 years allowed under BART.

The FEPL applies to the BART-eligible emission units, and must be quantifiable and enforceable, such that compliance can be determined by the State in the same manner as any other enforceable permit condition. BART-eligible sources that take a FEPL must have their air quality permit modified by the time the regional haze SIP is submitted to EPA.

In Oregon there were four BART-eligible sources that chose to adopt a FEPL. Table 10.3.2-2 shows the visibility impacts of these sources with and without the FEPL. As explained above, each of these sources will be undergoing a permit modification to include the conditions of the FEPL. These permit modifications go through a separate public review and adoption process, and will completed prior to submittal of the Oregon Regional Haze Plan to EPA in 2009.

The following is a summary of each source FEPL:

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[30] EPA Guidance document entitled "BART Exemption Q&A" from August 24, 2006.

1. PGE Beaver Power Plant

This is a 558 megawatt electrical generating plant located in Clatskanie Oregon. The BART visibility modeling conducted for this facility showed an impact on three Class I areas over the 0.5 dv contribution threshold, with the highest impact 0.68 dv at Olympic National Park in Washington. As a result of this FEPL, the facility will reduce its emissions by using a cleaner ultra-low sulfur diesel (ULSD) fuel blend as a backup fuel in its steam gas turbines. DEQ will also impose a limit on the amount of ULSD that can be burned in any given day. The result will ensure the visibility impact remains under the 0.5 dv level.

2. Georgia Pacific Wauna Mill

This is a pulp and paper manufacturing plant located in Clatskanie Oregon. The BART visibility modeling conducted for this facility showed an impact at one Class I area over the 0.5 dv contribution threshold, Olympic National Park in Washington, at 0.57 dv. As a result of this FEPL, the mill will reduce its emissions by taking a permit limit based on (1) permanently reducing use of oil, (2) reconfiguring an emission control system to eliminate an incinerator later in 2009; and (3) production limits, that apply before (an interim limit) and after elimination of the incinerator. This permit limit will ensure the visibility impact remains under the 0.5 dv level.

3. International Paper (formally Weyerhaeuser) Plant

This is a containerboard plant located in Springfield Oregon. The BART visibility modeling conducted for this facility showed an impact on nine Class I areas over the 0.5 dv contribution threshold, with the highest impact 1.45 dv at the Three Sisters Wilderness Area. As a result of this FEPL, the plant will reduce its emissions by accepting limits on fuel usage and operation, and meeting a combined SO2 and NO_x emission limit formula. The plant is also making repairs to one of its' BART units that will result in even lower emission levels and thus ensure the visibility impact is well under the 0.5 dv level.

4. Amalgamated Sugar Plant

This is a sugar beet processing plant located in Nyssa, in eastern Oregon, near the Idaho border. This plant is currently shutdown, and has no identified date to resume operations. However, since their air quality permit is still valid, BART modeling was conducted for the plant, and an impact of 0.514 dv was identified at one Class I area, the Eagle Cap Wilderness (based on single year, 8th highest day, as indicated in Table 10.3.2-2). The facility is taking an FEPL in the event it resumes operation in the future. The FEPL will consist of an emission limit on a boiler, which will ensure this visibility impact is under the 0.5 dv level.

10.4.2 Summary of BART Control Determination for PGE Boardman plant

Under EPA's BART rules and guidance, BART-eligible sources that are determined to contribute to visibility impairment, and do not take the FEPL option, must undergo a BART control determination analysis. In conducting this analysis, Oregon followed Appendix Y of EPA's BART rule, <u>Guidelines for BART Determinations Under the Regional Haze Rule - Part IV. The BART Determination: Analysis of BART Options (70 FR 39164 to 39172)</u>. This guidance can be found in Appendix D-4. The guidance describes a five-step process for determining the appropriate control technology for BART-eligible sources. The five criteria are as follows:

- Cost of compliance;
- Energy and non-air quality environmental impacts of compliance;
- Any existing pollution control technology in use at the source;
- The remaining useful life of the source, and
- The degree of improvement in visibility which may reasonably be anticipated to result from the use of such technology

Upon completion of this evaluation, the controls determined to represent BART must be installed and in operation as expeditiously as possible, but no later than 5 years after EPA approval of the State's regional haze plan.

The summary below is from the report <u>DEQ's 2008 BART Report for the Boardman Power Plant</u>, which can be found in Appendix D-1 of this plan. A second BART report and visibility analysis was prepared in 2010 for PGE Boardman, and can also be found in Appendix D-6 and D-7 of this plan. See the discussion in Section 5 below.

1. PGE Boardman BART Background

As a result of the BART process conducted by Oregon, one BART-eligible source was found to be subject to the BART control determination process. This facility is the PGE Boardman electric generating plant located in northeastern Oregon, about 150 miles east of Portland. Table 10.4.2-1 provides an overview of this facility. This facility is Oregon's largest electrical generating facility that serves approximately 814,000 industrial, commercial and residential customers in 52 Oregon cities.

Table 10.4.2-1 Overview of the PGE Boardman Plant

Item	Description
Plant description	Permitted in 1977, began operation 1980, 617 Megawatt electric steam plant, coal burning, Foster-Wheeler dry bottom, opposed-wall firing boiler
Emissions (tons per year)	Permitted - SO_2: 30,450, NO_x: 12,687, PM: 1,056 Actual (2007) - SO_2: 14,902, NO_x: 10,349, PM: 417
BART-eligibility	SC1 fossil fuel steam electric plant >250 MMBtu/hr, went into operation 1962-1977, emissions over 250 tpy,

Existing Emission Controls	SO$_2$: low-sulfur, sub-bituminous coal (~0.3% by weight)
	NO$_x$: Low NO$_x$ burner, overfire air (1st generation)
	PM: cold-side electrostatic precipitator.
BART Modeling summary	Highest impact 4.60 dv (22nd highest day). A total of 14 Class I areas impacted over 0.5 dv threshold.

2. PGE Boardman BART Modeling Summary

As shown in Table 10.3.2-1 on page 143, the PGE Boardman power plant had considerably higher visibility impacts than any other BART-eligible source, impacting 14 Class I areas over the 0.5 dv threshold, with the highest impact of 5.0 dv at the Mt. Hood Wilderness Area. Compared to the other four sources that initially modeled over the threshold, PGE Boardman accounted for 52% of the Class I impacts over 0.5 dv, with an average impact of 2.2 dv, compared to the combined average of the other four sources of 0.78 dv.

Figure 10.4.2-1 shows a map of the 14 Class I areas impacted by PGE Boardman, within the 300 km radius used in the modeling, in accordance with the BART Modeling Protocol described in 10.3.1.

Figure 10.4.2-1 Map of 14 Class I Areas Impacted by PGE Boardman
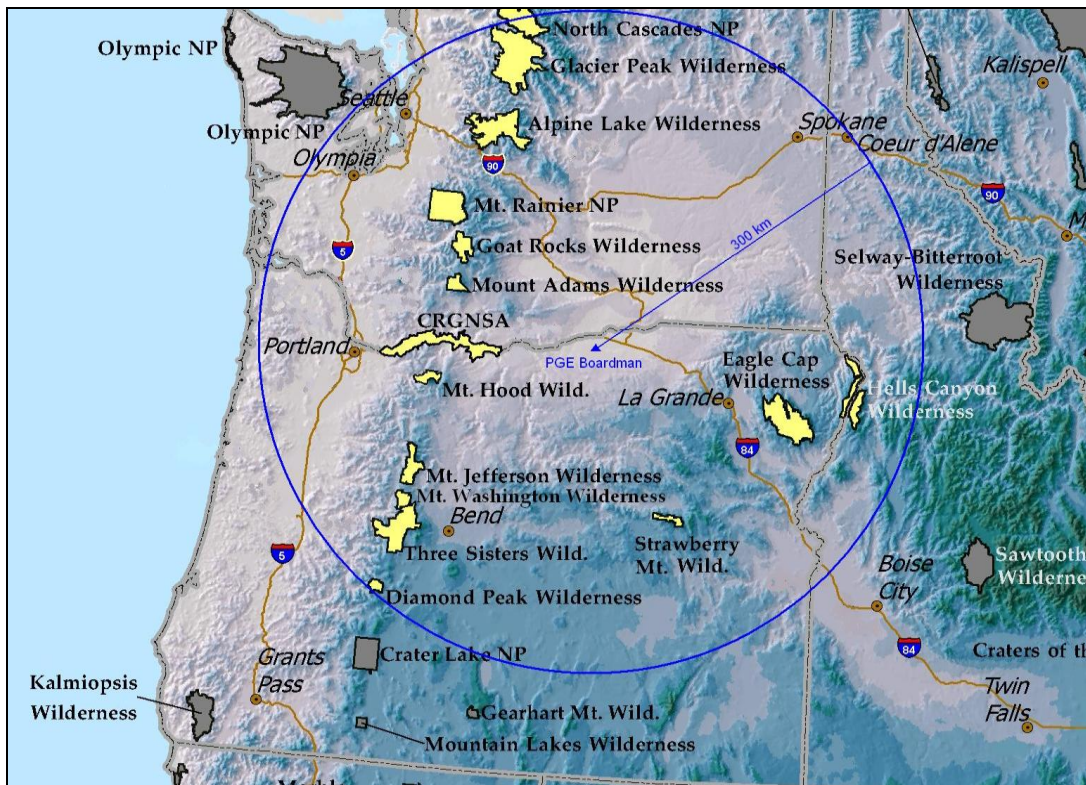
Table 10.4.2-2 identifies each of the 14 Class I areas impacted in Oregon, Washington, and Idaho, and the highest impact (in deciview) based on the 98th percentile during the 2003-05 baseline. Included in the modeling was the Columbia River Gorge National Scenic Area and

Crater Lake National Park. The Columbia Gorge was added to the modeling as a receptor point, for information purposes only, based on current interest in visibility conditions in the Gorge. Crater Lake National Park was outside the 300 km radius identified in the modeling protocol, but was also included for information purposes.

Table 10.4.2-2 Summary of Class I Area Visibility Impacts from PGE Boardman Plant

Class I Areas Affected	Highest Impact (dv)*
Oregon Class I Area	
Mt. Hood Wilderness	4.98
Mt. Jefferson Wilderness	3.12
Three Sisters Wilderness	2.29
Mt. Washington Wilderness	2.33
Eagle Cap Wilderness	2.23
Hells Canyon Wilderness	1.95
Strawberry Mountain Wilderness	1.72
Diamond Peak Wilderness	1.03
Washington Class I Area	
Mt. Adams Wilderness	2.68
Goat Rocks Wilderness	2.42
Alpine Lakes Wilderness	2.24
Mt. Rainer National Park	2.02
Glacier Peak Wilderness	1.40
North Cascades National Park	1.06
Idaho Class I Area	
Hells Canyon (Idaho portion)	1.95
National Scenic Areas (non-Class I)	
Columbia River Gorge (NSA)	3.71
Beyond 300 km (outside blue circle)	
Crater Lake National Park	1.06

*in deciview, 98th percentile of 3-year baseline (2003-05)

3. PGE Boardman's 2007 BART Analysis Report

After completion of the modeling results, DEQ informed PGE Boardman that the facility was "subject to BART". As required under the BART rule, PGE Boardman prepared a BART control analysis report which was submitted to DEQ on November 2, 2007, and identified the controls in Table 10.4.2-3 below as BART.[31]

Table 10.4.2-3 BART Proposal by PGE

Pollutant	Control Technology	Emission Rate

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[31] "Portland General Electric Boardman Plant, Best Available Retrofit Technology (BART) Analysis, November 2, 2007".

Sulfur dioxide	Semi-dry flue gas desulfurization	0.12 lb/mmBtu
Nitrogen oxides	New low-NO$_x$ burners with modified overfire air system and selective non-catalytic reduction	0.23 lb/mmBtu
Particulate matter	Pulse jet fabric filter	0.012 lb/mmBtu

4. DEQ's 2008 BART Control Determination for PGE Boardman

DEQ followed EPA's *Appendix Y guidance for BART control determinations*, in selecting BART on a pollutant by pollutant basis, taking into consideration the cost, the energy and non-air environmental impacts, the remaining useful life, and the modeled visibility impacts. Table 10.4.2-4 shows the range of controls that were evaluated for the PGE Boardman plant.

Table 10.4.2-4 Summary of Control Options Evaluated for PGE Boardman

Pollutant	Controls Evaluated
SO$_2$	• Semi-dry flue gas desulfurization (SDFGD) • Wet flue gas desulfurization (WFGD)
NO$_x$	• Overfire air system operation • Upgraded low NO$_x$ burners • Selective Non-Catalytic Reduction (SNCR) • Upgraded Low NO$_x$ Burners (LNB) with Overfire Air (OFA) • Upgraded LNB with OFA and SNCR • New LNB with Modified OFA • SNCR/SCR hybrid (cascade) • Selective Catalytic Reduction (SCR)
PM	(co-benefit of SO$_2$ controls): • Pulse jet fabric filter (PJFF) • Wet ESP

DEQ identified a two-step process for installing controls at the PGE Boardman plant. Phase 1 required the installation of new low NO$_x$ burners with modified over fire air system for NO$_x$ controls, semi-dry gas flue gas desulfurization for SO$_2$ controls, and pulse jet fabric filter for PM controls. Phase 1 would reduce these emissions by about 66 percent by 2014, at a cost of about $280 million, and meet the minimum requirements for BART. Phase 2 added more stringent controls for NO$_x$ by requiring Selective Catalytic Reduction (SCR), that would reduce emissions by about 81 percent by 2017, at an additional cost of $191 million. Phase 2 was in addition to BART, to achieve greater visibility improvements and address reasonable progress in Oregon's Class I areas, and address visibility and acid deposition concerns in the Columbia River Gorge National Scenic Area (not a Class I area).

This two-phased approach was adopted into DEQ rules in 2009, but subsequently revised in 2010, as described below in Section 6.

DEQ conducted a second BART determination in 2010, based on a proposal from PGE to close the Boardman plant in 2020. This necessitated re-evaluating BART controls for this facility,

based on a shorter remaining useful life of the plant. Further information on DEQ's 2008 BART control determination and emissions limits that were identified can be found in Appendix D-1. DEQ's 2010 BART determination is described below.

5. DEQ's 2010 BART Control Determination for PGE Boardman

In 2010 DEQ conducted a second BART determination for the PGE Boardman plant, in response to an early closure of the plant proposed by PGE. This was followed by DEQ adopting rule changes to reflect this early shutdown, consisted with the BART regulations. See Section 6 for further information on the 2010 rulemaking.

PGE submitted a revised BART analysis based on a proposal to close the plant by December 2020.[32] PGE proposed an alternative to BART that consisted of installing the same Phase 1 NO_x controls (i.e., low- NO_x burners with overfire air system) and reducing SO_2 emissions by burning low-sulfur coal, in combination with the 2020 closure. The proposal rejected the Phase 1 SDFGD SO_2 controls and the Phase 2 SCR NO_x controls as no longer cost effective under a 2020 shutdown, based on a much shorter life of the plant (10 years). However, this proposal was not supported by DEQ, and instead DEQ conducted another BART determination for the plant, examining a much wider range of pollution control options that would meet BART, under an early closure.

In DEQ's 2010 BART determination, three different emission reduction options were identified that each met BART, and contained separate early closure date options. This approach was taken to allow PGE to choose the most cost-effective closure option, or choose not to close and continue to be subject to the Phase 1 and 2 controls described above. Each option reflected different combinations of pollution control requirements and costs, and would be federally enforceable.

The following summarizes the three emission reduction options:

Option 1- 2020 shutdown. Required the same Phase 1 controls for NO_x in 2011 and SO_2 in 2014, but not the Phase 2 SCR controls in 2017. Installing the SDFGD controls for SO_2 in 2014 was determined by DEQ to be cost-effective with a 2020 shutdown date. DEQ determined installing the SCR controls in 2017 would not be cost effective if the plant were to close in three years (2020). The estimated cost of Option 1 was approximately $320 million.

Option 2 - 2018 shutdown. Required the same NO_x controls in 2011, but would use dry sorbent injection (DSI) controls in lieu of SDFGD controls in 2014. Similar to Option 1, no Phase 2 SCR controls would be required for NO_x. The DSI controls cost considerably less than the SDFGD controls, and provide half of the SO_2 emission reduction. DEQ's rationale for pairing DSI with a 2018 closure date was as follows:

- In the period 2019-2020, SDFGD controls for SO_2 are cost effective and would be required as BART. 2018 is the first year where these controls are no longer cost

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[32] See PGE's BART Report, Revision 3: Boardman 2020 Alternative. Copy on file with DEQ.

effective, and under the BART evaluation process, can be replaced by a less stringent BART technology (in this case, DSI).

- An earlier closure date than 2018 may also be cost effective for DSI, but DEQ believes a 2018 closure date, in combination with DSI controls meets BART and would provide a reasonable timeframe for PGE to develop replacement power options. In their proposal, PGE indicated 2020 is necessary to develop replacement power to serve their customers.

- While the DSI controls are less effective in reducing emissions than SDFGD, a 2018 closure date would result in all emissions being eliminated two years sooner than SDFGD with a 2020 closure date. This makes Option 2 very comparable to Option 1 from an overall emission reduction and visibility improvement standpoint.

- The estimated cost of this option is approximately $103 million.

Option 3 - 2015/2016 shutdown. Required the same NO_x controls in 2011, but no substantive new pollution controls for SO_2. The Clean Air Act requires BART controls to be installed no later than 5 years from the time EPA approves the regional haze plan. This option would allow PGE to close the Boardman plant by the BART deadline in lieu of installing BART controls for SO_2. This option established a shutdown date by 2015 or 2016, or five years from the date EPA approves the Oregon's 2009 Regional Haze Plan, at an estimated cost of approximately $36 million.

Further information on DEQ's 2010 BART control determination and the three options above, including more description of the selection of DSI as BART, see DEQ's 2020 BART Report for the PGE Boardman Plant in Appendix D-7.

PGE's BART III 2020 plan. In response to DEQ's three options, PGE proposed an alternative to Options 1 and 2. This proposal included the same controls and costs as Option 2, but would allow the plant to run until 2020, instead of 2018. PGE also proposed a "pilot study" for the DSI controls to confirm they could meet the required emission limit without negatively impacting mercury controls or increasing particulate emissions, to the point where expensive additional particulate controls would be required.

New PGE proposal for 2020 closure and rule adoption. After completing the 2010 BART evaluation, DEQ received another closure proposal from PGE that contained a commitment to permanently close the Boardman plant in 2020, and thereby eliminate the need for the Phase 1 and Phase 2 controls adopted in 2009. Similar to PGE's BART III plan and DEQ's Option 2, this new proposal included DSI controls, but would establish a lower SO_2 emission limit for the last two years, or from 2018 to 2020. There would also be the same pilot study for DSI as under PGE's previous proposal. The 2020 closure date would be a federally enforceable requirement in the rules.

As a result of this new proposal for an early closure, DEQ conducted additional analysis of BART controls under this approach. This analysis can be found in Appendix D-7 DEQ's addendum to the 2010 BART Report for the PGE Boardman Plant.

Table 10.4.2-5 below summarizes this new proposal and the BART controls and costs associated with it. These BART controls associated with a firm 2020 closure date were adopted as DEQ's BART rules in late 2010. These rules also included an optional earlier closure date of 2015-16, as proposed in DEQ's Option 3, to provide PGE with an earlier closure date if they should want it. Table 10.4.2-5 shows the 2010 rules with 2020 closure date in comparison to the 2009 Phase 1 and Phase 2 controls, and DEQ's Option 2 and Option 3.

Table 10.4.2-5 DEQ BART Controls Comparison for PGE Boardman

Option	Controls/Installation Date			Capital Cost (million $)	Emission reduction tons/year (+percent)
	2011 (NO_x)	2014 (SO_2)	2018 (NO_x)		
2009 Rules (no closure)	LNB/MOFA	Semi-dry Scrubber	SCR	$497.6	20,800 (81%)
Option 2 (2018)	LNB/MOFA	DSI 0.40 lb/mmBtu	-	$102.6	9,900 (39%)
Option 3 (2015-16)	LNB/MOFA	-	-	$35.7	4,800 (19%)
2010 Rules w/2020 closure	LNB/MOFA	DSI-1* 0.40 lb/mmBtu	DSI-2* 0.30 lb/mmBtu	$102.6	12,400 (48%)

   * Subject to pilot study evaluation

   Notes:
   LNB/MOFA = Low NO_x burners with modified overfire air system.
   SNCR = Selective Non-Catalytic Reduction system.
   Semi-dry Scrubber, also known as semi-dry flue gas desulfurization system.
   DSI = Dry Sorbent Injection
   SCR = Selective Catalytic Reduction.

As noted in this table, the 2009 rules would achieve an 81% emission reduction by 2018, but would continue to allow the plant to emit about 4,700 tons of air pollution per year. The 2010 rules achieve a 48% reduction by 2020, and then eliminate all emissions after this date. For additional information on emission reductions and visibility improvements under the 2010 rules, see Section 10.5 below.

The DSI pilot study. The 2010 rules contain two dates where a pilot study would be conducted to confirm the feasibility of DSI controls, prior to the compliance dates in 2014 and 2018. PGE raised concerns about possibility that DSI could negatively impact the mercury controls scheduled to be installed in 2011 as required by other DEQ rules. PGE was also concerned that due to the sorbent injection process, the resulting particulate emissions may trigger DEQ's Prevention of Significant Deterioration (PSD) rules by causing an increase in $PM_{2.5}$ emissions greater than the significant emission rate (10 tons/yr). If that occurred, PGE would be required

to install best available control technology and conduct an air quality impact analysis to ensure the increase does not exceed the PSD increment or ambient air quality standards for $PM_{2.5}$. DEQ cannot determine what will be required until accurate emission estimates are available. However, it is possible that the existing electrostatic precipitator at the Boardman plant may satisfy the best available control technology requirement. The pilot studies will evaluate commercially available sorbents, injection zones, and ESP collection efficiency. If it is determined that the DSI system would negatively impact the mercury controls or require a fabric filter, PGE may propose an alternative limit that will be established in the permit. The alternative limit must be the lowest achievable emissions limit without negatively impacting the mercury controls or requiring a fabric filter, but may not exceed 0.55 lb/mmBtu in order to achieve at least 0.5 dv improvement in the Mt. Hood wilderness area.

Repowering the PGE Boardman plant. The 2010 rules will require the PGE Boardman Foster-Wheeler boiler to cease burning coal in 2020. The rules do not prevent the plant owners from applying for a new permit to construct a new power plant at the Boardman site, or from repowering the existing Boardman boiler using an alternative fuel. Any new facility, or the repowering of the existing coal-boiler, would need to be permitted by DEQ as a new facility without relying on the emission reductions from the existing plant and in compliance with all applicable state and federal rules, such as Prevention of Significant Deterioration requirements, and therefore subject to modern air pollution controls and air quality impact analysis.

6. 2010 BART Rule Changes subject to EPA approval

As noted above, the rules changes adopted in 2010 would replace the 2009 rules, which allowed the continued operation of the Boardman plant, under the Phase 1 and 2 control requirements. The 2020 rule changes are subject to approval by EPA. The 2009 rules would remain in force if these rule changes are not approved, however this is not expected.

10.5 Emission Reductions and Visibility Improvements Achieved from BART Process

As described in Section 10.3.4, the modeling conducted for BART sources cannot be compared directly to visibility conditions on the 20% worst days or 20% best days, as contained in this regional haze plan. The visibility improvements from the BART process can only be shown by each individual source. The CMAQ modeling, described in Section 9.3.1, is a large regional scale model for showing visibility improvements expected under this regional haze plan. This modeling included assumptions of BART reductions for known BART sources across the West. However, it does not contain the results of the BART process, due to this modeling work being conducted prior to the completion of Oregon's and other states' BART reviews.

The visibility improvements described below reflect the controls identified for PGE Boardman in Section 10.4.2. For further information, see DEQ's 2010 BART report and addendum for the PGE Boardman Plant, in Appendix D-6 and D-7.

10.5.1 PGE Boardman 2020 Closure and Visibility Improvement

Table 10.5.1-1 below summarizes the emission reductions and visibility benefits from the BART controls associated with the 2020 closure for PGE Boardman. Overall, this would eliminate a total of approximately 25,500 tons of air pollution per year and provide significant visibility benefits, and additionally reduce acid deposition, toxic air contaminants, and mercury emissions, including about four million tons of greenhouse gas emissions. Prior to closure, PGE Boardman emissions would be reduced by about 19 percent in 2011, 39 percent in 2014, and up to 48 percent in 2018. The corresponding improvement in visibility at the highest impacted Class I area – the Mt. Hood Wilderness Area, would be 1.45 dv in 2011, 2.41 dv in 2014, and 2.75 dv in 2018. Upon closure in 2020, the total visibility improvement would be 4.98 dv, which is the baseline impact from the Boardman plant.

Table 10.5.1-1 Emission Reductions and Visibility Benefits from BART and 2020 Closure for PGE Boardman

BART control technology	Compliance Date	Emission reduction in tons/year and percent	Mt. Hood Visibility Impacts (dv*)	Visibility Improvement (dv*)
Baseline	----	---	4.98	---
LNB/MOFA	7/1/11	4,800 (19%)	3.54	1.44
+ DSI-1 *	7/1/14	9,950 (39%)	2.57	2.41
+ DSI-2 *	7/1/18	12,400 (48%)	2.23	2.75
+ Plant Closure	12/31/20	25,500 (100%)	none	4.98

* Subject to pilot study evaluation
Notes:
Baseline = visibility impact with no controls
LNB/MOFA = Low NO_x burners with modified overfire air system.
adds DSI 1 = Dry Sorbent Injection @ 0.40 lb/mmBTU SO_2 emission limit
adds DSI 2 = Dry Sorbent Injection @ 0.30 lb/mmBTU SO_2 emission limit.

Table 10.5.1-2 shows the visibility improvement at each of the 14 Class I areas from the BART controls associated with the 2020 closure for PGE Boardman. Reflected in this table is the installation of Low- NO_x burners in 2011 and DSI controls in 2014. DSI-1 is the visibility improvement in 2014, followed by DSI-2 which is the visibility improvement in 2018 under a lower SO_2 emission limit. Option 3 is the visibility improvement by 2015/16 with Low-NO_x burners, and is provided for informational purposes, if PGE chooses this option. It should be noted that after closure, the highest visibility impact shown in the first column would be zero.

Table 10.5.1-2 Summary of Class I Area Visibility Improvements from BART and 2020 Closure, including DEQ Option 3, for PGE Boardman

Class I Areas Affected	Highest Impact (dv*)	+ DSI-1 2014* (dv)	+ DSI-2 2018* (dv)	DEQ Option 3 (dv)
Oregon Class I Area				
Mt. Hood Wilderness	4.98	2.41	2.75	1.45
Mt. Jefferson Wilderness	3.12	1.59	1.76	0.76
Three Sisters Wilderness	2.29	1.17	1.29	0.67
Mt. Washington Wilderness	2.33	1.23	1.36	0.62
Eagle Cap Wilderness	2.23	1.13	1.80	0.61
Hells Canyon Wilderness	1.95	1.02	1.12	0.52
Strawberry Mountain Wilderness	1.72	0.90	1.03	0.44
Diamond Peak Wilderness	1.03	0.56	0.60	0.27
Washington Class I Area				
Mt. Adams Wilderness	2.68	1.38	1.51	0.79
Goat Rocks Wilderness	2.42	1.26	1.39	0.72
Alpine Lakes Wilderness	2.24	1.17	1.30	0.67
Mt. Rainer National Park	2.02	1.05	1.14	0.54
Glacier Peak Wilderness	1.40	0.74	0.82	0.39
North Cascades National Park	1.06	0.57	0.63	0.31
Idaho Class I Area				
Hells Canyon (Idaho portion)	1.95	1.02	1.12	0.52

* Subject to pilot study evaluation

Notes:
- Both DSI controls include Low-NO_x burner with modified overfire air.
- + DSI 1 = Dry Sorbent Injection @ 0.40 lb/mmBTU SO_2 emission limit.
- + DSI 2 = Dry Sorbent Injection @ 0.30 lb/mmBTU SO_2 emission limit.
- DEQ Option 3 is 2015/16 closure with just LNB/MOFA controls.

Not reflected in Table 10.5.1-2 is the visibility improvement in the number of days where impacts from PGE Boardman would be over 0.5 or 1 deciview. Comparing the highest impact to the DSI-2 emission limit in 2018, the total number of visibility impact days in all 14 Class I areas from PGE Boardman would be 58% less on days over 0.5 dv, and 76% less on days over 1 dv.

10.5.2 FEPL Source Visibility Improvements

The four BART-eligible sources described in Section 10.4.1 are taking a federally enforceable permit limit to reduce their visibility impact to below the 0.5 dv level that represents a significant visibility impact. Most of the FEPL sources had modeled impacts just over the 0.5 dv contribution threshold, and therefore needed relatively small reductions to get under that

threshold. While modeling was used to determine the emission level needed to get under the threshold, no additional modeling was conducted to estimate the total visibility improvement from the FEPL sources. Overall, it is believed to be very small.

10.6 Oregon's BART rule

Included in the adoption of this Regional Haze Plan is Oregon's BART rule, OAR 340-223-0010 through 340-223-0080. This rule is based largely on EPA's BART rule and related Appendix Y, which includes requirements for BART-eligible sources in the state, including PGE Boardman, and FEPL sources. The Oregon BART rules were adopted in 2009, and then revised in 2010 to reflect an early 2020 closure date, and an optional 2015-16 closure date if chosen by PGE. These rules can be found in Appendix E.

CHAPTER 11: REASONABLE PROGRESS GOAL DEMONSTRATION

11.1 Overview

The Regional Haze Rule sets a 60 year timeline for states to improve visibility within Class I areas from the baseline (2000-2004) conditions to natural conditions (2064). Additionally, States are required to show "reasonable progress" over this time period in making incremental improvements, with 2018 as the first benchmark or milestone year.

The rule requires the State establish a Reasonable Progress Goal (RPG) for each Class I area that identifies the visibility improvement for the most-impaired (20% worst) days, and ensures no degradation in visibility for the least-impaired (20% best) days. The State has flexibility in establishing different RPGs for each Class I area.

As described in Chapter 5, in order to set the RPG, the State first calculates the Uniform Rate of Progress (URP) for each Class I area. The URP is simply a straight line (also known as the "glide slope") between current (baseline) conditions and natural conditions over the 60-year period. Along the glide slope, the URP for 2018 needs to be identified, as this is the first planning period (2018 milestone year) that needs to be met when establishing the RPG. The URP for each Oregon Class I area is shown in Chapter 6.

In selecting RPGs, the State must consider the 2018 URP and the emission reductions projected from all regional haze control strategies. The 2018 URP is not a presumptive target. When establishing RPGs, the State may determine RPGs at greater, lesser or equivalent visibility improvement than the URP. In cases where the RPG results in less improvement in 2018 than the URP, the State must demonstrate why the URP is not achievable, and why the RPGs are "reasonable".

A key step in establishing the RPGs is the four-factor analysis: the costs of compliance; the time necessary for compliance; the energy and non-air quality environmental impacts of compliance; and the remaining useful life of any potentially affected sources. States must demonstrate how these factors were taken into consideration in selecting the goal for each Class I area.[33] In cases where the RPGs show a slower rate of visibility improvement than the 2018 URP milestone, the State can still demonstrate reasonable progress, by showing it evaluated additional measures using the four-factor analysis, and other justification and documentation.

11.2 Steps in Demonstrating Reasonable Progress

The following steps were followed in setting the RPGs for each of Oregon's Class I areas:

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[33] In addition to these four factors, other factors can be used, as appropriate, to evaluate the need to control source categories which are not well characterized by the four factors.

1. Compare Baseline to Natural conditions

For each Class I area, identify baseline (2000-2004) visibility and natural conditions in 2064, for the 20% worst and best days. See Chapter 6.

2. Identify the Uniform Rate of Progress (URP)

For each Class I area, calculate the URP glide path from baseline to 2064, including the 2018 planning milestone, for the 20% worst days. Show the URP glide path in both total deciview and by pollutant in deciview. Next, identify the improvement needed by 2018 and 2064, respectively. See Chapter 6.

3. Identify contributing pollutant species

For each Class I area, identify the pollutant species that are contributing to visibility impairment on the current (baseline) 20% worst and 20% best days. See Chapter 7.

4. Identify major emission sources within the State and trends

Using the WRAP Emission Inventory for 2002 and 2018, describe statewide emissions by source category and pollutant, and identify projected emission trends from current (2002) to the 2018 planning milestone. See Chapter 8.

5. Analyze the larger source categories contributing to impairment

For each Class I area, determine the relative contribution of anthropogenic and nonanthropogenic sources in Oregon and neighboring states to the 20% worst and best days, using monitoring data, source apportionment and modeling results, comparing baseline (2000-04) to 2018 "on-the-books" emissions reductions expected. Review these results by pollutant. See Chapter 9.

6. Document the emission reductions from BART

Describe the results of the BART process, and identify the emission reductions that will be achieved from BART and other mechanisms. See Chapter 10, Section 10.5.

7. Identify projected visibility change in 2018 from "on-the-books" controls and BART

For each Class I area, determine the visibility improvement expected in 2018 from on-the-books controls and BART, using the WRAP CMAQ modeling results, for the 20% worst and best days. Identify the extent of visibility improvement related to the 2018 URP milestone, in total deciview and in extinction by pollutant. See Chapter 9.

8. Identify sources or source categories that are major contributors and apply the 4-statutory factor analysis

As a result of the analysis under step 5 above, for each Class I area, determine key pollutant species and source categories that have the greatest impact on visibility in Oregon Class I areas, to be analyzed using the 4-factor analysis. See Section 11.3 below.

9. Describe the results of the 4-factor analysis.

Section 11.3 below describes the results of the 4-factor analysis.

10. Set the Reasonable Progress Goals (RPG) based on steps 7, 8, and 9

Set the RPG for each Class I area in deciview, based on the improvement in 2018 for the 20% worst and best days, from on-the-books controls, BART, and the results of the 4-factor analysis on major source categories. See Section 11.4 below.

11. Compare RPG to the 2018 URP milestone. Provide an affirmative demonstration that reasonable progress is being made based on pollutant trends, emission reductions, and improvements expected under the Long-Term Strategy.

For each Class I area, compare the RPG developed in step 10 to the 2018 URP milestone. Provide an affirmative demonstration that reasonable progress is being made based on pollutant trends, emission reductions from major anthropogenic source categories, and on-the-books controls. Describe the results of the 4-factor analysis in step 9 above, and how future actions identified in the Long-Term Strategy are expected to improve visibility in the next 10 years to the 2018 milestone, and beyond.

11.3 Summary of Four-Factor Analysis

Section 308(d)(1)(i)(A) of the Regional Haze Rule requires that states consider the following factors and demonstrate how they were taken into consideration in selecting the reasonable progress goals:

- costs of compliance
- time necessary for compliance
- energy and non-air quality environmental impacts of compliance, and
- remaining useful life of any potentially affected sources.

In conducting this four-factor analysis, EPA guidance indicates that States have "considerable flexibility" in how these factors are taken into consideration, in terms of what sources or source categories should be included in the analysis, and what additional control measures are reasonable.[34]

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[34] EPA "Guidance for Setting Reasonable Progress Goals Under the Regional Haze Program", June 2007.

11.3.1 Rationale and Scope of the Four-Factor Analysis

The Department looked at key pollutants and certain source categories and the magnitude of their emissions in applying the four factors. Based on the flexibility in how to apply the statutory factors, the following rationale was used in defining the scope of this analysis:

1. Focus on 20% worst days

Since the Regional Haze rule primarily focuses on demonstrating reasonable progress for the 20% worst days, the four-factor analysis in this section addresses only the worst days. It is a reasonable assumption that emission reductions benefiting the worst days also benefits the best days. Moreover, the CMAQ modeling projections in Chapter 9 and reasonable progress demonstration in this chapter both indicate that the 20% best days are maintained for all Oregon Class I areas, and in most cases are under the 2018 URP (see Table 9.3-1 and 11.4-1).

2. Focus on anthropogenic sources

Since the purpose of this analysis is to evaluate certain sources or source categories for potential controls, the four-factor analysis in this section addresses only anthropogenic sources, on the assumption that the focus should be on sources that are "controllable". Although nonanthropogenic sources such as wildfire and dust are major contributors to regional haze, the Department does not believe this analysis is applicable to these sources.[35] In considering which anthropogenic sources or source categories to apply the statutory factors, Department considered point, area, mobile, and fire (controlled burning).

For mobile sources, there are major emissions reductions projected by 2018, based on numerous "on-the-books" federal and state regulations, as described in detail in Section 11.4.3, and in Section 12.5.1 as part of on-going implementation under the LTS. There are also significant visibility improvements projected by 2018 due to these reductions, as Chapter 9 PSAT results indicate. Based on the above findings, the Department did not believe applying the four-factor analysis to mobile sources was needed.[36]

For fire sources, forestry and agricultural burning are large anthropogenic sources. As described in detail in Section 12.5.5, both of these activities are controlled under state-run smoke management programs which meet most of the Enhanced Smoke Management Program (ESMP) requirements, and as such represent an advanced level of smoke management. Both of these activities are also addressed under the Oregon Phase I Visibility program. In Section 12.6.2 of the LTS, the Department has identified future efforts to evaluate new methods of protecting Class I areas from forestry burning. Based on current controls and future efforts, the

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[35] This reference to dust is to "natural" sources of dust, and not road dust, agricultural farming practices, and other anthropogenic activities.

[36] As noted in Section 12.5.1, Oregon has adopted state programs to reduce mobile source emissions, in addition to the federal regulations, and will be implementing these programs in upcoming years. It is possible new programs may be adopted as well. Given this state level effort, the Department did not believe applying the four statutory factors would be productive or necessary.

Department did not believe applying the four-factor analysis to forestry and agricultural burning was needed.[37]

As a result of the above consideration, the Department elected to focus the four-factor analysis on point and area sources only. Further refinement of this approach is provided below.

3. Focus on SO_2 and NO_x pollutants

Although there are six visibility-impairing pollutants, SO_2 and NO_x (i.e., sulfate and nitrate) are typically associated with anthropogenic sources. As noted in Chapter 8, sulfates and nitrates are about three times more effective at impairing visibility than $PM_{2.5}$. Since a large component of particulate (both fine and course) is associated with nonanthropogenic sources, such as wildfire and natural windblown dust, this pollutant was not included in the analysis.[38]

11.3.2 Identification of Point and Area Sources for the Four-Factor Analysis

The Department believes the focus on point and area sources of SO_2 and NO_x for applying the four-factor analysis is consistent with EPA guidance, in terms of flexibility to consider which major source categories are "reasonable" to evaluate for the first planning period of the regional haze plan.

As described in Chapter 8 and 9, it is important to note that there are significant reductions projected in 2018 in SO_2 and NO_x emissions and impacts from point and area sources. This trend was a consideration in the four-factor analysis, in terms of what source categories the Department considered for this analysis. Large reductions in SO_2 and NO_x emissions were also used as supporting evidence in the demonstration that the reasonable progress goals selected for Oregon were "reasonable", as described in Section 11.4.2.

The first step in the four-factor analysis is to identify the sulfate and nitrate contribution within Oregon. Table 11.3.2-1 below shows the modeled sulfate and nitrate impacts on the 20% worst days in 2018, based on PSAT modeling results, at each Oregon Class I area. This table shows that the range of the Oregon portion on the worst days is from 4-20% for sulfate, and 10-30% for nitrate, which is relatively small compared to sources outside the state. The year 2018 is used here to show projected contribution, in order to assess what further emission reductions would be beneficial in achieving reasonable progress.

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[37] The Department also questioned the appropriateness or usefulness of applying the four-factor analysis to sources such as prescribed burning, as the factors do not lend themselves well to this type of source.

[38] The Department recognizes that by focusing on source categories of SO_2 and NOx, this is excluding some point and area sources of PM. The Department does not intend to evaluate all pollutants and all anthropogenic sources in this first Regional Haze Plan. However, it should be noted that under the evaluation of non-BART sources in the LTS of this plan, PM point sources will be included, along with SO_2 and NOx.

Table 11.3.2-1 Oregon Share of Modeled Sulfate and Nitrate in 2018 - 20% Worst Days

Region	Oregon Class I Area	Sulfate			Nitrate		
		2018 Total Sulfate (µg/m3)	2018 Oregon Sulfate (µg/m3)	2018 Oregon Sulfate Share (%)	2018 Total Nitrate (µg/m3)	2018 Oregon Nitrate (µg/m3)	2018 Oregon Nitrate Share (%)
Northern Cascades	Mt. Hood Wilderness Area	1.02	0.16	16%	0.83	0.30	30%
Central Cascades	Mt. Jefferson, Mt. Washington, and Three Sisters Wilderness Areas	0.75	0.12	12%	0.66	0.25	25%
Southern Cascades	Diamond Peak, Mountain Lakes, and Gearhart Mountain Wilderness Areas and Crater Lake National Park	0.53	0.07	7%	0.51	0.13	13%
Coast Range	Kalmiospis Wilderness Area	0.84	0.20	20%	0.81	0.22	22%
Eastern Oregon	Strawberry Mountain and Eagle Cap Wilderness Areas	0.68	0.06	6%	0.88	0.21	21%
Eastern Oregon/ Western Idaho	Hells Canyon Wilderness Area	0.53	0.04	4%	0.88	0.10	10%

The next step in the analysis is to identify the larger point and area source categories in Oregon. Table 11.3.2-2 below identifies SO_2 and NO_x point and area source categories in Oregon, based on their projected emissions in 2018, as identified in Chapter 8 (the PRP18a emission inventory). These categories are External Combustion Boilers, Industrial Processes, Internal Combustion Engines, Stationary Fuel Combustion, and Waste Disposal. The table shows the tons per year of each, as the extent of the contribution. Excluded from these sources categories are Oregon sources already evaluated under BART (see Chapter 10).

Table 11.3.2-2 Oregon Largest Source Categories

Pollutant	Type	Source Category	Extent of Contribution
SO$_2$	Point	External Combustion Boilers	858 tons/year
	Point	Industrial Processes	377 tons/year
	Area	Stationary Source Fuel Combustion	5,699 tons/year
	Area	Misc. (Agriculture Orchard Heaters)	2,243 tons/year
NO$_x$	Point	External Combustion Boilers	4,995 tons/year
	Point	Industrial Processes	3,639 tons/year
	Point	Internal Combustion Engines	3,688 tons/year
	Area	Stationary Source Fuel Combustion	13,454 tons/year
	Area	Waste Disposal, Treatment, and Recovery	2,881 tons/year

11.3.3 The Four-Factor Analysis

Starting with the larger source categories (SSC1), the Department identified the applicable subcategories (SCC3 and SCC6), and the list of individual sources (SCC8) that fall under these categories. The Department included all sources over 50 tons per year. BART-eligible sources were not included. The individual sources listed are only for illustrative purposes, and do not represent sources determined to be "significant" contributors to Class I visibility impairment. Only the source categories (SCC1) are being evaluated here.[39]

In conducting the four-factor analysis, the Department relied on information from EPA's AirControlNET website, which is a control technology analysis tool EPA developed to support its analyses of air pollution policies and regulations. The tool provides data on emission sources, potential pollution control measures and emission reductions, and the costs of implementing those controls. AirControlNET is a relational database system in which control technologies are linked to sources in EPA's emissions inventories.[40] The system contains a database of control measure applicability, efficiency, and cost information for reducing the emissions contributing to ambient concentrations of ozone, PM$_{10}$, PM$_{2.5}$, SO$_2$, NO$_x$, as well as visibility impairment (regional haze) from point, area, and mobile sources.

Following the discussion below are conclusions from the four-factor analysis in Section 11.3.4.

1. External Combustion Boilers

This source category consists of point sources with emissions totaling 858 tpy of SO$_2$ and 4,995 of NO$_x$. Included here are mostly industrial boilers that burn wood waste, oil, and natural gas. The largest subcategory of sources is industrial boilers burning wood/bark waste (SCC6). The

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[39] It should also be noted that the individual sources listed do not necessary represent those which will be part of the non-BART source evaluation described in the LTS section. The official list of non-BART sources will be identified at a future time, after a review and updated inventory of these sources and their emissions is completed.

[40] For the purpose of this four-factor analysis, the Department relied upon the accuracy of EPA's emission inventory in AirControlNET, and did not compare it to our own emissions inventory.

two tables below list the individual SO$_2$ and NO$_x$ sources that comprise this category, and are provided for illustrative purposes, and is not intended to identify sources subject to additional controls.

2018b SO2 Point Sources				
SCC1	SCC3	SCC6	SCC8	TPY
External Combustion Boilers	Industrial	Wood/Bark Waste	Smurfit Newsprint Corporation	516
		Residual Oil	West Linn Paper Company	270
		Process Gas	Chevron Products Company	72
			Total External Combustion Boilers	858

2018b NOx Point Sources				
SCC1	SCC3	SCC6	SCC8	TPY
External Combustion Boilers	Industrial	Wood/Bark Waste	Biomass One, L.P.	205
			Co-Gen Co. LLC	162
			Co-Gen II	177
			Columbia Forest Products, Inc.	61
			Crown Pacific Limited Partnership	106
			Jeld-Wen, Inc.	61
			Kinzua Resources, Pilot Rock Sawmill	63
			McKenzie Forest Products, LLC	176
			Pacific Wood Laminates, Inc.	53
			Roseburg Forest Products Co.	1,059
			SierraPine, A California Limited Partner	210
			Smurfit Newsprint Corporation	802
			Stimson Lumber Company	104
			Tillamook Lumber Company	69
			Willamette Industries, Vaughn	72
			Blue Heron Paper Company	291
			Smurfit Newsprint Corporation	108
		Natural Gas	Tillamook Lumber	58
			West Linn Paper Company	362
	Electric Generation	Wood/Bark Waste	Covanta Marion, Inc.	391
		Solid Waste	Northwest Pipeline Corp.	404
	Commercial/Institutional	Natural Gas	Total External Combustion Boilers	4,995

Based on the review of the above SO$_2$ and NO$_x$ subcategories, the Department is focusing the four-factor analysis on the NO$_x$ industrial boilers of wood waste, as this represents the majority of sources (16), and a total 3,672 tpy, or 63% of the External Combustion Boiler source category for both pollutants.

Cost of Compliance

NO$_x$ controls for industrial boilers of wood or bark waste consist of the following. *Over-fire Air Systems* involve air that is introduced high in the boiler in order to achieve staged combustion. *Selective Non-Catalytic Reduction* is an add-on control technology that allows ammonia to react with NO$_x$ without the need for a catalyst to form water and molecular hydrogen. *Selective Catalytic Reduction* is similar an add-on control technology that allows ammonia to react with NO$_x$ and form N2 and water. The SCR catalyst enables this reaction to occur at lower temperatures than SNCR. However, SCR controls for wood burning can be problematic, as trace elements such as Na and K in the wood has been shown to foul catalysts. So this option is likely infeasible. The cost and other information on these control options are listed below.

Table 11.3.3-1 Summary of NO$_x$ Control Options for External Combustion Boilers (Industrial Wood/Bark Waste)

Control Option	Control Efficiency	Cost Effectiveness ($/ton)
Overfire Air (OFA) Systems	30% or more	$500-$1,500
Selective Non-catalytic reduction (SNCR)	20-30%	$1,500-$10,000
Selective Catalytic Reduction (SCR)	80-90%	not cost effective*

* based on information above of catalyst failure from wood combustion

Time Necessary for Compliance

Overall time for compliance is expected to be 4-5 years. Up to 2 years would be required to develop and adopt rules necessary to require these controls. Typical timeframe for installing these NO$_x$ controls would be 2-3 years after rule adoption.

Energy and Non-Air Quality Environmental Impacts of Compliance

These controls do not have significant energy impacts. There are environmental impacts associated with SNCR and SCR in terms of ammonia emissions, also known as "ammonia slip". Ammonia slip can be greater with SNCR than SCR, due to the former being less efficient in removing NO$_x$. With SCR there is the need for disposal of spent catalyst. The catalysts used in SCR must be replaced every 2-5 years. Catalysts contain heavy metals that are hazardous wastes.

Remaining Useful Life of Affected Sources

It is difficult to estimate the remaining life of any potentially affected sources. Remaining useful life is specific to the facility for which controls are considered.

2. **Stationary Source Fuel Combustion**

This source category consists of area sources, with emissions totaling 5,699 tpy of SO$_2$ and 13,354 tpy of NO$_x$. Included here are industrial, commercial, and residential sources that burn distillate and residual oil, natural gas, and other fuels. The two tables below list the SO$_2$ and NO$_x$ emissions.

2018b SO2 Area Sources				
SCC1	SCC3	SCC6	SCC8	TPY
Stationary Source Fuel Combustion	Industrial	Distillate Oil		1,800
		Residual Oil		449
		Kerosene		60
	Commercial/Institutional	Distillate Oil		1,376
		Residual Oil		398
		Kerosene		63
	Residential	Distillate Oil		753
		Wood		642
		Kerosene		160
			Total Stationary Source Fuel Combustion	5,699

2018b NOx Area Sources				
SCC1	SCC3	SCC6	SCC8	TPY
Stationary Source Fuel Combustion	Residential	Wood		4,470
		Natural Gas		2,172
		Distillate Oil		318
		Liquified Petroleum Gas		206
		Kerosene		68
	Industrial	Natural Gas		2,654
		Liquified Petroleum Gas		674
		Distillate Oil		445
		Residual Oil		90
	Commercial/Institutional	Natural Gas		1,536
		Distillate Oil		642
		Residual Oil		80
			Total Stationary Source Fuel Combustion	13,354

The largest subcategory listed above is residential wood and natural gas combustion (6,642 tpy of NO_x, combined). These represent the woodstoves and home heating devices found throughout Oregon. The Department's residential woodheating rules in OAR 340, Division 262, require that only certified woodstoves can be sold in the state. Certified woodstoves can reduce emissions by 70%. These rules also authorize woodstove curtailment programs in any city that is designated in nonattainment with the PM national ambient air quality standard. The woodstove curtailment programs in these communities have been very effective in reducing pollution levels during the winter months. As a result of current state requirements and programs for residential wood heating, the Department is not including this subcategory in the four-factor analysis. Similarly, the low emissions generated by natural gas home heating devices do not warrant this analysis either.

The remaining sizeable subcategories above are industrial and commercial/institutional combustion, involving mostly natural gas and distillate oil. These emissions are believed to come from smaller generators and engines. As such, these emission estimates are somewhat uncertain. The control options available for those burning natural gas are very limited, since this fuel already produces very low emissions, and any post-combustion controls are not realistic from a cost standpoint. For those burning distillate oil, fuel switching to lower sulfur fuel (<1%) is an option, but not likely to produce any significant reduction in emissions, and any post-combustion controls are not cost realistic.

As a result of close review of this source category, the Department does not believe the four-factor analysis is appropriate, and would not yield any useful results.

3. Industrial Processes

This source category consists of SO_2 and NO_x point sources, with emissions totaling 377 tpy of SO_2 and 3,639 tpy of NO_x. Included here are kraft pulping, glass and cement plants, and steel manufacturing sources. The two tables below list the individual SO_2 and NO_x sources that comprise this category, and are provided for illustrative purposes, and is not intended to identify sources subject to additional controls.

2018b SO2 Point Sources				
SCC1	SCC3	SCC6	SCC8	TPY
Industrial Processes	Mineral Products	Glass Manufacture	Owens-Brockway Glass Container Inc	180
		Cement Manufacturing (Dry)	Ash Grove Cement Company	63
	Secondary Metal Production	Steel Foundries	Cascade Steel Rolling Mills, Inc.	72
	Primary Metal Production	Steel Manufacturing	Oregon Steel Mills, Inc.	63
			Total Industrial Processes	377
2018b NOx Point Sources				
SCC1	SCC3	SCC6	SCC8	TPY
Industrial Processes	Pulp/Paper and Wood Products	Plywood Operations	Timber Products Co.	68
	Mineral Products	Cement Manufacturing (Dry)	Ash Grove Cement Company	2,290
		Glass Manufacture	Owens-Brockway Glass Container Inc.	605
	Secondary Metal Production	Steel Foundries	Cascade Steel Rolling Mills, Inc.	373
	Primary Metal Production	Steel Manufacturing	Oregon Steel Mills, Inc.	303
			Total Industrial Processes	3,639

The only sizable subcategory above is SCC6 for cement manufacturing, which represents 2,290 tpy of NO$_x$, or 57% of the Industrial Processes category. These emissions will be focus of the four-factor analysis for this source category. The SO$_2$ emissions from cement manufacturing are low (63 tpy) and therefore not included in the analysis.

Cost of Compliance

There are several options for NO$_x$ controls for dry process cement manufacturing plants. *Low NO$_x$ Burners* reduce the amount of NO$_x$ formed in the flame. *Mid-Kiln Firing* is a form of secondary combustion where a portion of the fuel is fired in a location other than the burning zone. This reduces thermal NO$_x$ generation because the temperature in the secondary combustion zone is lower. *Selective Non-Catalytic Reduction* is an add-on control technology that allows ammonia to react with NO$_x$ without the need for a catalyst to form water and molecular hydrogen. *Selective Catalytic Reduction* is an add-on control technology that allows ammonia to react with NO$_x$ and form N2 and water. The SCR catalyst enables this reaction to occur at lower temperatures than SNCR. Cost and other information on these control options are listed below.

Table 11.3.3-2 Summary of NO$_x$ Control Options for Cement Manufacturing

Control Option	Control Efficiency	Cost Effectiveness ($/ton)
Mid-Kiln Firing	25%	$500-$750
Low NO$_x$ Burners	25%	$300-$600
Selective Non-Catalytic Reduction (SNCR)	50%	$700-$1,000
Selective Catalytic Reduction (SCR)	80%	$2,000-$5,000

Time Necessary for Compliance

Overall time for compliance is expected to be 4-5 years. Up to 2 years would be required to develop and adopt rules necessary to require these controls. Typical timeframe for installing these NO$_x$ controls would be 2-3 years after the rule was adopted.

Energy and Non-Air Quality Environmental Impacts of Compliance

These controls do not have significant energy impacts. There are environmental impacts associated with SNCR and SCR in terms of ammonia emissions, also known as "ammonia slip". Ammonia slip can be greater with SNCR than SCR, due to the former being less efficient in removing NO_x. With SCR there is the need for disposal of spent catalyst. The catalysts used in SCR must be replaced every 2-5 years. Catalysts contain heavy metals that are hazardous wastes.

Remaining Useful Life of the Source

It is difficult to estimate the remaining life of any potentially affected sources. Remaining useful life is specific to the facility for which controls are considered.

4. Waste Disposal, Treatment, and Recovery

This source category consists of NO_x area sources with emissions totaling 2,881 tpy. Included here are residential open burning, municipal landfills, and on-site incineration at commercial and industrial facilities.

2018b NOx Area Sources				
SCC1	SCC3	SCC6	SCC8	TPY
Waste Disposal, Treatment & Recovery	Open Burning	Residential	Household Waste	1,498
		All Categories	Land Clearing Debris	731
	Landfills	Municipal		419
	On-site Incineration	Commercial/Institutional		159
		Industrial		73
			Total Industrial Processes	2,881

The largest source within this category is residential open burning, which like agricultural and forestry burning, is not suitable for applying the four-factor analysis. Instead, as described in Chapter 12, Section 12.6.3, the Department will conduct an evaluation of residential open burning to determine the extent of the contribution to visibility impairment, and the need for emission reductions, as part of the LTS of this plan. For the remainder of the emissions in this source category, the Department does not consider them to be sizeable enough to warrant the four-factor analysis.

5. Misc. (Agriculture Orchard Heaters)

This source category consists of SO_2 area sources with emissions totaling 2,243 tpy. This category represents agricultural orchard heaters, burning diesel fuel.

2018b SO2 Area Sources				
SCC1	SCC3	SCC6	SCC8	TPY
Miscellaneous Area Sources	Agriculture Production - Crops	Orchard Heaters	Diesel	2,243
			Total Industrial Processes	2,243

While the emissions in this source category (2,243 of SO_2) are not insignificant, the Department does not believe this type of source – orchard heaters – is appropriate for a four-factor analysis for several reasons. First, the Department's confidence in the emissions estimate

from orchard heaters is very low. Second, these heaters are used intermittently, during period of cold temperatures, to prevent frost damage, and for selected crops in diverse regions of the state. The probability that the intermittent use and spatial distribution of this source is a sizeable contributor to Class I area impairment is extremely low. Third, few control options are available. The Department was unable to find any information from EPA's AirControlNET nor other sources that could provide relevant information for completing a four-factor analysis.

6. Internal Combustion Engines

This source category consists of NO_x point sources with emissions totaling 3,688 tpy. Included here are electric generation and industrial engines burning natural gas. The table below lists the individual NO_x sources that comprise this category, and is provided for illustrative purposes, and is not intended to identify sources subject to additional controls.

2018b NOx Point Sources				
SCC1	SCC3	SCC6	SCC8	TPY
Internal Combustion Engines	Electric Generation	Natural Gas	Future Natural Gas EGU (Klamath Gene	887
			Future Natural Gas EGU (PGE Port We	1,153
			Hermiston Generating Company, L.P. ar	143
			Hermiston Power Plant	314
			Klamath Cogeneration Project	141
			Klamath Energy LLC	136
			Northwest Pipeline Corporation	245
	Industrial	Natural Gas	Gas Transmission Northwest Corporatio	669
			Total Industrial Processes	3,688

This source category consists of two types of engines: 1) natural gas fired reciprocating internal combustion engines, and 2) natural gas fires turbines that are either compressor, combustor, or power turbine. Emissions vary from engine to engine, model to model, and mode of operation. EPA's AirControlNET had no information on controls for this source category. Other information on this source category could not be found that would allow a four-factor analysis without a major investment of resources, and an exhaustive facility by facility review to evaluate each unit, which is beyond the scope and effort required in this first Regional Haze SIP. Given the relative low emissions represented by this source category, and the unknown level of contribution to visibility impairment, no further analysis was conducted.

11.3.4 Conclusions from the Four-Factor Analysis

Based on the four-factor analysis above, the Department concluded it is not reasonable to require controls for these source categories at this time. This analysis did provide useful information on possible control options and general costs, which will be included in a more in-depth analysis of additional control measures as described in Section 12.6.1 for the LTS. The Department will be developing guidance for conducting a comprehensive review of individual non-BART stationary sources over the next five years, to identify any additional emission reductions that could improve Class I area visibility by the 2018 milestone. Included in this review will be possible controls identified for non-BART sources, and schedule for implementation.

11.3.5 Identification of Additional Emission Reductions

Although the Department is not requiring any additional emission reductions based on the four-factor analysis, it should be noted that the BART requirements adopted for the PGE Boardman plant contain a 2020 closure date. Prior to this date, PGE would install BART controls and reduce total emissions by 48%. After 2020, all emissions from the plant, or approximately 25,500 tons per year of primarily SO_2 and NO_x would be eliminated. This will provide significant visibility benefits to the 14 Class I areas impacted by the Boardman plant (see description of visibility improvements in Section 10.5.1). In addition, the complete elimination of all emissions after 2020 greatly contribute to meeting the regional haze reasonable progress goals described below.

11.4 Determination of Reasonable Progress Goals for Oregon's Class I Areas.

Under Section 308(d)(1) of the Regional Haze Rule, States must "establish goals (expressed in deciviews) that provide for reasonable progress towards achieving natural visibility conditions" for each Class I area of the State. These RPGs are interim goals that must provide for incremental visibility improvement for the most impaired visibility days, and ensure no degradation for the least impaired visibility days. The RPGs for the first planning period are goals for the year 2018. Based on the steps outlined in Section 11.2, the Department has established RPGs for each of Oregon's 12 Class I areas, as described below.

The RPGs identified in Table 11.4-1 are based on the Department's evaluation and consideration of: (1) the results of the CMAQ modeling described in Section 9.3, which includes on-the-books controls and other emission inputs (see Appendix C for list of CMAQ model emission inputs), (2) the results of the 4-factor analysis described in Section 11.3.3, (3) the BART review described in Chapter 10.[41] Information on the additional emission reductions from the BART controls associated with the 2020 closure for PGE Boardman were not available at the time of this determination of RPGs, but will be evaluated as part of the next plan update in 2013. See Section 12.7.

As shown in Table 11.4-1, the RPGs for the 20% best days not only show no degradation of visibility, but in all cases show a slight improvement over baseline conditions by 2018. The Department attributes this to the numerous "on-the-books" controls accounted for in the CMAQ modeling, and significant reductions in mobile sources emissions, as described in Section 11.4.3. The Department believes the list of measures it has included in the Long-Term Strategy of this plan will continue to ensure no degradation is achieved in the future.

For the 20% worst days, Table 11.4-1 shows that the RPGs are short of the 2018 URP goal for each Class I area (grouped according to region). Section 11.4.1 provides an affirmative demonstration why the RPGs for the 20% worst days is justified.

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[41] As noted in Chapter 9, the CMAQ modeling conducted by the WRAP was prior to the completion of Oregon's and other state BART reviews, and was therefore based on "presumptive BART" for SO_2 controls on EGUs and other known BART sources in the West. See Appendix C for more information.

Table 11.4-1 Reasonable Progress Goals for 20% Worst Days and 20% Best Days for Oregon Class I Areas

Region	Oregon Class I Area	20% Worst Days			20% Best Days	
		Baseline Condition (dv)	2018 Uniform Progress Goal (dv)	2018 Reasonable Progress Goal (dv)	Baseline Condition (dv)	2018 Reasonable Progress Goal (dv)
Northern Cascades	Mt. Hood Wilderness Area	14.9	13.4	13.8	2.2	2.0
Central Cascades	Mt. Jefferson, Mt. Washington, and Three Sisters Wilderness Areas	15.3	13.8	14.3	3.0	2.9
Southern Cascades	Diamond Peak, Mountain Lakes, and Gearhart Mountain Wilderness Areas and Crater Lake National Park	13.7	12.3	13.4	1.8	1.5
Coast Range	Kalmiospis Wilderness Area	15.5	14.1	15.1	6.3	6.1
Eastern Oregon	Strawberry Mountain and Eagle Cap Wilderness Areas	18.6	16.3	17.5	4.5	4.1
Eastern Oregon/ Western Idaho	Hells Canyon Wilderness Area	18.6	16.2	16.6	5.5	4.7

11.4.1 Affirmative Demonstration the RPGs for 20% Worst Days

EPA guidance indicates that "States may establish a RPG that provides for greater, lesser, or equivalent visibility improvement as that described by the glidepath".[42] The 2018 RPGs identified in Table 11.4-1 for 20% worst days show an improvement in visibility, although less than the 2018 URP goal. However, under the Regional Haze Rule, a State can still demonstrate reasonable progress, using the four-factor analysis in Section 11.3, and other evidence and documentation. As a result, the Department believes the RPGs are justified and "reasonable", based on the following factors that support of this demonstration:

1. Findings from the four-factor analysis. This analysis was conducted as required under Section 308 (d)(1)(i)(A). Based on the general level of this review of major source categories, the Department determined it was not reasonable to control additional source categories and has identified a schedule for a more in-depth evaluation of individual sources and additional control measures as part of the LTS of this plan. This evaluation

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[42] EPA "Guidance for Setting Reasonable Progress Goals Under the Regional Haze Program", June 2007.

will be completed by the next SIP submittal in 2013, and will contain a timetable for installation of controls for subject sources. See Chapter 12.

2. <u>Additional significant emissions reductions from the 2020 closure of PGE Boardman</u>. While the four-factor analysis did not identify any additional emission reductions for this first plan, the BART requirements adopted for the PGE Boardman plant contain a 2020 closure date that will eliminate approximately 25,500 tons of primarily SO_2 and NO_x per year. There are significant visibility benefits expected from this reduction, as described in Section 10.5.1.

3. <u>Evidence that natural sources affect ability to meet the 2018 URP goal</u>. The analysis in Chapters 8 and 9 of this plan of emissions data, source apportionment, and modeling results strongly supports the finding that the contribution of natural or nonanthropogenic sources, such as natural wildfire and windblown dust, and the pollutants associated with these sources (OC, EC, $PM_{2.5}$, Coarse PM and Soil) is the primary reason for not achieving the 2018 URP for Oregon's Class I areas. The CMAQ modeling results in Chapter 9 show considerably less reduction by 2018 in these pollutants, in contrast to significant reductions in SO_2 and NO_x, commonly associated with anthropogenic sources.

4. <u>Evidence that offshore marine shipping emissions affect ability to meet the 2018 URP goal</u>. Similar to natural sources of wildfire and dust mentioned above, marine vessel emissions are likely a significant factor affecting the ability to meet the 2018 URP goal. Chapter 9 PSAT and WEP results show this source category (offshore emissions) as a major contributor to Oregon Class I areas, especially for SO_2 and NO_x, in the Kalmiopsis Class I area in the Coast Range, and the seven Class I areas located in the Cascade Mountains. If compared to emission inventory data in Chapter 8, marine vessel emissions are 56% for SO_2 and 31% for NO_x of the total 2002 statewide emission inventory for these pollutants. (It should be noted that in Tables 11.4.2-2 and 11.4.2-3 below, this contribution of SO_2 and NO_x from marine vessels was included in the CMAQ modeling projections for 2018. The higher contribution of SO_2 from marine vessels is what likely accounts for the smaller improvement in SO_2 than in NO_x by 2018, as indicated in these tables. Otherwise, both SO_2 and NO_x improvements would be even greater.) See Section 12.6.5 of the LTS for future efforts planned by the Department to address marine vessel emissions.

5. <u>Reductions in anthropogenic sources equal to or greater than 2018 URP goals as a means of showing "reasonable progress"</u>. Given the strong correlation of SO_2 and NO_x emissions to anthropogenic sources, trends in these pollutants by 2018 can be factored into the determination of reasonable progress, in contrast to the contribution of nonanthropogenic sources. The analysis in Section 11.4-2 below shows the significant reductions in SO_2 and NO_x by 2018. As shown in Chapter 6 related 2018 URP "glideslope" for each Class I area, the total reduction in deciview from baseline to the 2018 URP is approximately 20%. The tables in Section 11.4.2 show that 2018 WEP emission projections for NO_x and SO_2 far exceed a 20% reduction, while projected CMAQ modeling far exceeds 20% for NO_x, and up to 16% for SO_2 by 2018. The

combination of these improvements due to emission reductions from anthropogenic sources adds to the demonstration of reasonable progress. See Section 11.4-2 below.

6. <u>Major reductions in mobile source emissions</u>. As the largest anthropogenic source category for SO_2 and NO_x, mobile sources show a considerable reduction in emissions by 2018. Although these reductions are primarily achieved through federal regulations already "on the books", the Department believes this further supports the demonstration of reasonable progress. See Section 11.4.3 below.

The Department expects that there will be additional visibility improvements by 2018 based on new strategies identified in the Long-Term Strategy. As described in Chapter 12, the LTS will evaluate emission reductions from non-BART sources, possible new smoke management controls for prescribed burning, and other measures. See Section 11.4.4 below.

11.4.2 20% Reduction in Emissions from Anthropogenic Sources

Chapter 6 shows the URP glideslope for each Oregon Class I area. In general, the improvement needed from the 2000-04 baseline to the 2018 URP for the worst case days is approximately 20 percent in total deciview. Although Oregon's Class I areas are not projected to meet the 2018 URP, most of this can be attributed to nonanthropogenic sources, such as natural wildfire and windblown dust. The Department believes that in determining "reasonable" progress, it is important to distinguish between anthropogenic (controllable) versus nonanthropogenic (uncontrollable) emission sources. The results of the WEP apportionment and the CMAQ regional modeling in Chapter 9 show that in looking at individual pollutants, there are significant projected reductions in SO_2 and NO_x by 2018, which represent mostly anthropogenic sources.

Table 11.4.2-1 below summarizes the projected emission reductions in SO_2 and NO_x, in comparison to the other pollutants, based on the WEP results described in Chapter 9.[43] This table shows the projected reductions in 2018 for SO_2 and NO_x average 39% and 40%, respectively. This is considerably greater than the 20% reduction represented by the 2018 URP. This is one factor that supports the demonstration that the 2018 RPGs are "reasonable".

Most of these reductions can be attributed to considerable mobile source reductions described in Section 11.4.3, emissions reduction from BART in Oregon and neighboring states in the next five years, and the SO_2 regional milestones and backstop trading program under Section 309 of the Regional Haze Rule.[44] The numerous ongoing Oregon air pollution control programs and regulations listed in the LTS in Chapter are expected to contribute to this reduction, although this cannot be quantified at this time.

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[43] The WEP results were used instead of PSAT in order to compare the results of all pollutants. While WEP does not take into account chemical reactions of SO_2 and NOx, it is still a valuable screening tool for identifying the potential contribution of pollutant species to haze formation in Class I areas.

[44] This program involves four Western States (Arizona, New Mexico, Utah and Wyoming) and requires SO_2 regional milestones be met out to the year 2018. These milestones require significant reductions in SO_2 be achieved by 2018 that are "better than BART". Meeting the milestones is determined by annual emissions reporting by major industrial SO_2 sources in the four states. If the milestones are exceeded, a backstop trading program would then require emission allocations for these sources in the four states involved.

Table 11.4.2-1 WEP Projected Emission Contributions of Individual Pollutants by 2018 URP as an Indicator of "Reasonable" Progress.

Region	Oregon Class I Area	20% Worst Days Baseline to 2018 Change in Anthropogenic* Upwind Weighted Emission (WEP Analysis)					
		SO$_2$	NO$_x$	OC	EC	PM Fine	PM Coarse
Northern Cascades	Mt. Hood Wilderness Area	-46%	-48%	4%	-26%	11%	91%
Central Cascades	Mt. Jefferson, Mt. Washington, and Three Sisters Wilderness Areas	-44%	-46%	1%	-28%	24%	88%
Southern Cascades	Diamond Peak, Mountain Lakes, and Gearhart Mountain Wilderness Areas and Crater Lake National Park	-33%	-41%	-2%	-24%	15%	46%
Coast Range	Kalmiopsis Wilderness Area	-33%	-40%	-6%	-24%	14%	38%
Eastern Oregon	Strawberry Mountain and Eagle Cap Wilderness Areas	-39%	-38%	-19%	-37%	2%	19%
Eastern Oregon/ Western Idaho	Hells Canyon Wilderness Area	-37%	-28%	-30%	-42%	16%	27%

*Anthropogenic emissions exclude natural fires, biogenic emissions and windblown dust.

Table 11.4.2-2 shows sulfate and Table 11.4.2-3 shows nitrate projected reductions for the 20% worst days based on CMAQ modeling. These tables were taken from Section 9.3.1 CMAQ projections for 2018 and discussion of the breakdown by pollutant for each Class I area, as identified in Tables 9.3.1-1 to 9.3.1-6.

The visibility improvement (i.e., reduction in extinction) for SO$_2$ ranges from 4% to 16%, while for NO$_x$ ranges from 28% to 58%.[45] If this reduction in SO$_2$ and NO$_x$ were combined, the overall improvement would exceed 20%.

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[45] The Department believes the lower reduction in SO$_2$ is likely the result of the contribution of offshore marine vessel emissions, which is slightly greater for SO$_2$ than NOx, as discussed above in Section 11.4.1.

Table 11.4.2-2 CMAQ Projected Reduction in Ammonium Sulfate by 2018 URP as an Indicator of "Reasonable" Progress.

Oregon Class I Area	20% Worst Days 2018 Reduction in Ammonium Sulfate Extinction				
	2000-04 Baseline (Mm-1)	2018 URP Goal (Mm-1)	2018 Projected Visibility (Mm-1)	% of URP Goal	Total % Change by 2018
Mt. Hood Wilderness Area	11.3	8.6	9.3	74%	-18%
Mt. Jefferson, Mt. Washington, and Three Sisters Wilderness Areas	11.8	9.0	10.1	60%	-14%
Diamond Peak, Mountain Lakes, and Gearhart Mountain Wilderness Areas and Crater Lake National Park	7.3	5.9	7.0	20%	-4%
Kalmiospis Wilderness Area	10.3	7.9	9.7	25%	-6%
Strawberry Mountain and Eagle Cap Wilderness Areas	7.8	6.0	7.0	40%	-9%
Hells Canyon Wilderness Area	8.4	6.4	7.4	48%	-11%

Table 11.4.2-3 CMAQ Projected Reduction in Ammonium Nitrate by 2018 URP as an Indicator of "Reasonable" Progress.

Oregon Class I Area	20% Worst Days 2018 Reduction in Ammonium Nitrate Extinction				
	2000-04 Baseline (Mm-1)	2018 URP Goal (Mm-1)	2018 Projected Visibility (Mm-1)	% of URP Goal	Total % Change by 2018
Mt. Hood Wilderness Area	5.5	4.7	3.6	>100%	-34%
Mt. Jefferson, Mt. Washington, and Three Sisters Wilderness Areas	2.7	2.6	1.6	>100%	-40%
Diamond Peak, Mountain Lakes, and Gearhart Mountain Wilderness Areas and Crater Lake National Park	2.6	2.5	1.1	>100%	-58%
Kalmiospis Wilderness Area	3.2	2.9	2.1	>100%	-33%
Strawberry Mountain and Eagle Cap Wilderness Areas	15.8	12.0	11.5	>100%	-27%
Hells Canyon Wilderness Area	28.5	19.7	20.6	90%	-28%

11.4.3 Major Reductions in Mobile Source Emissions by 2018

As the largest anthropogenic source category, the Department believes that the trend in mobile source emission reductions from 2002 to 2018 is another factor in support the demonstration of reasonable progress. As shown by the emission inventory information in Chapter 8, mobile source annual emissions show a considerable decrease in Oregon from 2002 (plan02d) to 2018 (prp18a), and represent the greatest emission reductions of any single source category. This can be seen in the statewide emissions in Section 8.1, and the regional level emissions in Section 8.2. The greatest reduction is in NO_x emissions, followed by VOC, and to a lesser extent SO_2. Table 11.4.3-1 shows this reduction in tons per year and percent reduction at the statewide level, from the baseline of 2002 to projected level in 2018.

Table 11.4.3-1 Mobile Source Emission Reductions in Oregon from 2002 to 2018

Source Category	SO_2	NO_x	VOC
On-Road Mobile	- 2985 tons (87%)	- 69,502 tons (62%)	- 52,389 tons (59%)
Non-Road Mobile	- 6383 tons (98%)	- 21,478 tons (40%)	- 14,553 tons (37%)

The mobile source emission inventory was based on the <u>WRAP Mobile Source Emission Inventories Update.</u> This report estimated all on-road and off-road mobile source emissions for the WRAP region for the 2002 base year, and projections to 2008, 2013, and 2018. It also included emissions from aircraft, locomotives, marine shipping, and road dust. The contractor who conducted the project surveyed state and local air quality planning agencies to obtain the most up-to-date mobile source activity data and control program information. On-road mobile source emissions were estimated with EPA's MOBILE6.2 model. Emissions for most off-road mobile sources were estimated with EPA's Draft NONROAD2004 model. Locomotive emissions were estimated based on locomotive fuel consumption; aircraft emissions were based on aircraft landing and takeoffs and FAA EDMS emission factors; and commercial marine emissions were estimated using a variety of activity data sources and EPA emission factors. For further information, see http://www.wrapair.org/forums/ef/UMSI/index.html

The mobile source emission reductions are based on numerous "on the books" federal mobile source regulations that include the following:

For on-road mobile sources:
- Tier 1 light-duty vehicle standards
- National Low Emission Vehicle (NLEV) standards
- Tier 2 light-duty vehicle standards, with low sulfur gasoline
- Heavy-duty vehicle standards, with low sulfur diesel

For non-road mobile sources and equipment:
- Emission standards for new nonroad spark-ignition engine below 25 hp
- Phase 2 emission standards for new spark-ignition hand-held engine below 25 hp
- Phase 2 emission standards for new spark-ignition nonhand-held engine below 25 hp
- Emission standards for new gasoline spark-ignition marine engines
- Tier 1 and 2 emission standards for new nonroad compression-ignition engines below 50 hp including recreational marine engines
- Tier 2 and Tier 3 standards for new nonroad compression-ignition engines of 50 hp and greater not including recreational marine engines greater than 50 hp
- Tier 4 emission standards for new nonroad compression-ignition engines above 50 hp and reduced nonroad diesel fuel sulfur levels

For example, in 2004 EPA adopted rules the Tier 4 rules for Nonroad Diesel Engines and Fuel, which took effect in 2008. These rules alone are expected to have major visibility benefits in Oregon. Nationally, these rules are estimated to reduce emissions in 3030 from nonroad engines, locomotive engines, and marine engines by 95% for PM2.5, 90% for NO_x, and 99% for SO_2.

The visibility benefits that are projected by 2018 from these reductions can be seen in Chapter 9, in Sections 9.2.1 and 9.2.2, under the PSAT source apportionment results for sulfate and nitrate, on the 20% worst days.

The extent of the mobile source emissions reductions and the visibility improvements that are projected are significant factors in determining that the RPGs identified in this section represent

reasonable progress. It should also be noted that this trend in emission reductions will likely be even greater than expected, due to increasing gasoline prices that are already having the effect of reducing annual vehicle miles traveled across the West, and beyond what was estimated for the emissions inventory cited in this report.

11.4.4 Additional Emission Reductions Expected by 2018 due to the Long-Term Strategy

Under the Long-Term Strategy (LTS) described in Chapter 12, additional emission reductions are expected by 2018 that will result in visibility improvements. Although these new strategies have yet to be implemented, it is reasonable to expect that these visibility improvements will occur and provide greater progress toward the 2018 milestone than the RPGs estimated in this first plan submittal. The key elements of the LTS include an evaluation and possible controls for non-BART sources, new smoke management improvements for prescribed burning, review and possible revision of state open burning regulations, and expected benefits associated with the revised $PM_{2.5}$ National Ambient Air Quality Standard.

11.4.5 Long-Term Strategy "Next Steps" in Analyzing Major Source Categories

As described in the Long-Term Strategy in Chapter 12, the Department will take the results of this four-factor analyses for source categories, and beginning in 2011, conduct further evaluation of these source categories to determine what additional controls are appropriate to achieve further reasonable progress. It is expected this evaluation will be incorporated into the work described in Section 12.6.1 of the LTS that will develop criteria and guidance for evaluating all non-BART sources. Results from this evaluation will be reported in the required 2013 plan update.

CHAPTER 12: LONG-TERM STRATEGY

12.1 Overview of the LTS

The Regional Haze Rule requires States to submit a 10-15 year long-term strategy (LTS) to address regional haze visibility impairment in each Class I areas in the State, and for each Class I area outside the State which may be affected by emissions from the State. The LTS must include enforceable measures necessary to achieve reasonable progress goals, and identify all anthropogenic sources of visibility impairment considered by the State in developing the long-term strategy. Where the State contributes to Class I visibility impairment in other States it must consult with those States and develop coordinated emission management strategies, and demonstrate it has included all measures necessary to obtain its share of the emission reductions. If the State has participated in a regional planning process, the State must include measures needed to achieve its obligations agreed upon through that process.

As required in Section 51.308(d)(3)(v) of the Regional Haze Rule, the State must consider, at a minimum, the following factors: (1) emission reductions due to ongoing air pollution control programs; (2) measures to mitigate the impacts of construction activities; (3) emission limitations and schedules for compliance; (4) source retirement and replacement schedules; (5) smoke management techniques for agricultural and forestry burning; (6) the enforceability of emission limitations and control measures; and (7) the anticipated net effect on visibility over the period of the long-term strategy.

12.2 Overview of the LTS Development Process

As described in Chapter 4, Section 4.1, Oregon is a participant in the WRAP, which was a major source of technical and policy assistance for western States in developing regional strategies for reducing haze. The following is a partial list of the primary WRAP products relied upon by Oregon and other western States in developing the LTS. For a complete list, see the WRAP website at http://www.wrapair.org/:

- **Technical Support System (TSS)** - http://vista.cira.colostate.edu/wraptss/ - this is a project that provides a single, one-stop shop for access, visualization, analysis, and retrieval of the technical data and regional analytical results prepared by WRAP Forums and Workgroups in support of regional haze planning in the West. The TSS specifically summarizes results and consolidates information about air quality monitoring, meteorological and receptor modeling data analyses, emissions inventories and models, and gridded air quality/visibility regional modeling simulations. For more information on the WRAP TSS, see Appendix C.

- **Regional Modeling Center (RMC)** - http://pah.cert.ucr.edu/aqm/308/ - this modeling project conducted by the RMC provides regional scale, three-dimensional regulatory air quality models that simulate the emissions, chemical transformations, and transport of criteria pollutants and fine PM and consequent effects on visibility in Class I areas in the WRAP region and across North America.

- **Visibility Information Exchange Web System (VIEWS)** - http://vista.cira.colostate.edu/views/ - this system provides ongoing access to IMPROVE and other visibility monitoring data, research results, and special studies related to the Regional Haze Rule. Downloads of the IMPROVE data, custom displays of spatial, chemical, and temporal patterns, as well as information about applying monitoring data for regional haze planning are available.

- **Causes of Haze Assessment project (CoHA)** - http://coha.dri.edu/index.html - this project provides detailed analyses of IMPROVE and meteorological monitoring data in the WRAP region. Includes multi-year back trajectory wind plots for each monitored Class I area, trajectory regression analyses' results used in the Phase I AoH project, and extensive descriptive information about the monitoring data and each Class I area.

- **Emissions Data Management System (EDMS)** - http://wrapedms.org/default_login.asp - this project entails an emission inventory and web-based GIS application that provides a consistent, complete, and regional approach to emissions data tracking to meet the requirements for SIP and TIP development, periodic progress reviews, and data updates. The EDMS serves as a central regional emissions inventory database for all types of emissions, and uses associated software to facilitate the data collection efforts for regional modeling, emissions tracking and associated data analyses.

12.3 Summary of all Anthropogenic Sources of Visibility Impairment Considered in Developing the LTS.

Section 51.308(d)(3)(iv) of the Regional Haze Rule requires the identification of "all anthropogenic sources of visibility impairment considered by the State when developing its long-term strategy." Chapter 8 of this Plan describes state and regional emissions, including projections of emission reductions from anthropogenic sources from 2002 to 2018. Chapter 9 of this Plan provides source apportionment results, including projected reductions from anthropogenic sources during the same period. Together, these two chapters show the major anthropogenic sources affecting regional haze in Oregon and in the West. Section 11.3 in Chapter 11 describes the major anthropogenic source categories evaluated through the four-factor analysis.

Based on the analysis in these previous chapters, the anthropogenic sources considered by the Department in developing the LTS are identified in Section 12.5 and Section 12.6 below. Section 12.5 reflects the requirements in Section 308(d)(3)(v) of the Regional Haze Rule that lists specific factors the State must consider. Section 12.6 are major anthropogenic sources that the Department identified in Chapter 11, and will be evaluated by 2013 as possible additional new control measures, as part of the LTS in meeting the reasonable progress goals for Oregon's Class I areas. The "new" sources included in the LTS are as follows:

1. Evaluation of contribution and controls for non-BART sources, and BART update, as described below in Section 12.6.1
2. Evaluation of new smoke management controls for forestry prescribed burning, as described below in Section 12.6.2.

3. Evaluation of emission reductions from residential open burning, as described below in Section 12.6.3.
4. Evaluation of the extent and contribution from Rangeland Burning in SE Oregon, as described in 12.6.4.

12.3 Summary of Interstate Transport and Contribution

Sections 51.308(d)(3)(i) and (ii) of the Regional Haze Rule requires that the LTS address the contribution of interstate transport of haze pollutants between States. Chapter 8 of this plan showed regional emissions by State, while Chapter 9 identified interstate transport of pollutants and larger source categories based on source apportionment results. The Department has analyzed the PSAT and WEP source apportionment findings, focusing on the 20% worst days for primarily impacts from SO_2 and NO_x, typically associated with point, area, and mobile anthropogenic sources. Other pollutants such as OC, EC, PM fine and coarse, were reviewed as well, however, these were assumed to be associated with natural fire and dust sources, and not evaluated any further.[46]

The Department consulted with neighboring States as part of this review, and discussed the need for coordinated strategies to address interstate transport. Based on this consultation, no significant contributions were identified that supported developing new interstate strategies. Both Oregon and neighboring states agreed that the implementation of BART and other existing measures in state regional haze plans were sufficient to address the relatively minor contributions discussed below. This interstate consultation is an on-going process and commitment between States. See Chapter 13 for further information.

12.3.1 Other State Class I Areas Affected by Oregon emissions

The Department reviewed PSAT and WEP source apportionment information on the WRAP TSS website, focusing on the 20% worst day impacts in Class I areas in neighboring States that were the closest to Oregon. The closest Class I areas were as follows: 1) Mt. Ranier National Park and Goat Rocks Wilderness in Washington; 2) Sawtooth Wilderness in Idaho, 3) Jarbridge Wilderness in Nevada, and 4) Lava Beds National Monument and Redwood National Park in California. In none of these examples did the Department find a sizable contribution from Oregon sources. The following summarizes the Department's findings by State. Note all references to PSAT results are based on 20% worst days, and contribution percentages are from WEP results.

<u>Washington</u>

Both Mt. Ranier and Goat Rocks Class I areas were heavily dominated by Washington sources. Contribution from Canadian point sources and Offshore Pacific shipping emissions were sizable for some pollutants, such as SO_2. Based on PSAT results, the Oregon contribution was

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[46] In order to determine the extent of interstate contribution of fire and dust sources that is from anthropogenic sources such as prescribed burning and road dust, an exhaustive study would be required of each of the state Class I areas listed below. Therefore, for the purpose of this review, the Department primarily focused on SO_2 and NOx emission sources.

extremely low for SO_2 and NO_x, in the range of 0.05-0.08 $\mu g/m^3$. The highest impact from any source category from Oregon was SO_2 point sources, which was approximately 8%. Under the WEP projection for 2018, this contribution is expected to drop to about 4%. Additional reductions may occur as the result of BART, as described in Chapter 10, and from evaluation of non-BART industrial sources, described in Section 12.6.1 of the LTS. For all other pollutants, the Oregon contribution was also extremely low.

<u>Idaho</u>

Impacts in the Sawtooth Class I area was dominated by Idaho sources. The Oregon contribution of SO_2 and NO_x was very low, from 0.02-0.05 $\mu g/m^3$, based on PSAT. The largest impact from Oregon was SO_2 point sources, which was less than 10%. Much of this impact can be attributed to the PGE Boardman coal-fired power plant in NE Oregon. As described in Chapter 10, this source will be installing BART controls, which will significantly reduce its emissions, and have corresponding visibility benefits to the Sawtooth Class I area. Other Oregon emissions such as fire and dust were between 10-20%, but these are believed to be mostly natural sources. (Note, the portion of the Hells Canyon Class I area located in Idaho is not addressed here, as the majority of this area is located in Oregon and being addressed under the Oregon Regional Haze Plan. The interstate transport of emissions to Hells Canyon is discussed below in the review of Oregon Class I areas.)

<u>Nevada</u>

Overall the Jarbridge Class I area has very low concentrations of any pollutant. The contribution of SO_2 and NO_x from Oregon is extremely low, from 0.02-0.03 $\mu g/m^3$, based on PSAT. In general, the interstate contribution from Idaho, California, and Pacific Offshore is greater than Oregon. Of SO_2 and NO_x, the highest impact from Oregon is about 5% of all SO_2 point sources. As described above for Sawtooth, this contribution is likely from the PGE Boardman plant, which is installing BART controls and making significant reductions. Like Sawtooth, there is similar contribution of fire and dust sources from Oregon, but these are likely again to be mostly natural sources.

<u>California</u>

The Oregon contribution to Lava Beds and Redwoods Class I areas was very low. For Lava Beds, both SO_2 and NO_x concentrations were low, at 0.03-0.05 $\mu g/m^3$, based on PSAT. About 5% of the impact was from SO_2 point sources. This may be reduced under the evaluation of non-BART industrial sources, described in Section 12.6.1. For Redwoods, the highest contributing sources are fire and Pacific Offshore emissions. However, the Oregon contribution of NO_x mobile source emissions is about 0.22 $\mu g/m^3$. The reason for this is uncertain. By 2018, this is projected to drop to under 0.10 $\mu g/m^3$.

12.3.2 Oregon Class I Areas affected by Other States

The contribution of neighboring States of Washington, Idaho, Nevada and California to Oregon Class I areas is similar in most respects, however, the contribution from Washington and Idaho

into Oregon Class I areas is generally higher as a whole. This may be attributable to the proximity of several of Oregon Class I areas to the state boundary, meteorological factors, and location of certain types of sources. The following summarizes the Department's findings by Oregon Class I area. Note all references to PSAT results are based on 20% worst days, and contribution percentages are from WEP results.

<u>Mt. Hood Class I area.</u>

Mt. Hood is approximately 20 miles from Washington. Based on PSAT results, the contribution of Washington SO_2 and NO_x emissions to Mt. Hood ranges from 0.25-0.40 $\mu g/m^3$. The SO_2 is mostly from point sources (about 20%), and the NO_x is mostly from mobile sources (about 15%). Future projections show a 50% reduction in both of these source impacts at Mt. Hood by 2018. Chapter 10 identified 3 BART sources from Washington that impacted Mt. Hood over the 0.5 dv threshold. These sources will be subject to BART controls. A major reduction in mobile source emissions, as described in Chapter 11, is expected by 2018 from "on-the-books" federal mobile source regulations. This may be augmented by additional mobile source regulations in Washington, similar to those being adopted in Oregon. Also, the LTS section of the Washington regional haze plan is expected to have a similar measure as Oregon's to evaluate non-BART sources in the next 5-10 years to identify additional emission reductions that could benefit visibility at Mt. Hood.

<u>Eagle Cap, Strawberry Mountain, and Hells Canyon Class I areas.</u>

These Class I areas in Eastern Oregon are similar in terms of the contribution from Idaho and Washington sources. Washington contributes more to Eagle Cap and Strawberry Mountain, while Idaho contributes more to Hells Canyon (50% of the contribution to Hells Canyon is from Idaho, and 25-30% is from Oregon). PSAT results show a significantly higher NO_x contribution than SO_2. Idaho SO_2 contribution ranges from 0.03-0.05 $\mu g/m^3$, whereas NO_x is 0.23-0.38 $\mu g/m^3$. For Washington, SO_2 ranges from 0.03-0.10 $\mu g/m^3$, and 0.08-0.22 $\mu g/m^3$ for NO_x. The SO_2 is mostly from point sources, while the NO_x is mostly from mobile and area sources. In both Idaho and Washington, the BART process is expected to lower the SO_2 point source impacts. For the NO_x contribution that is mobile sources, these emissions are projected to decrease significantly by 2018. The area source NO_x is not projected to change much by 2018. The source of these emissions may be farming related. However, these relatively small NO_x emissions will more than be offset by significant NO_x emission reductions from PGE Boardman due to BART controls, as described in Chapter 10. Other emissions, such as from fire and dust sources, are primarily contributed by Idaho and Oregon.

<u>Central and Southern Cascade Class I areas (Mt. Washington, Mt. Jefferson, Three Sisters, Diamond Peak, Crater Lake, Mountain Lakes and Gearhart Mountain).</u>

This grouping of Oregon Class I areas in the central and southern Cascades have a similar pattern of interstate contribution. For SO_2, Washington contribution ranges from 0.05-0.12 $\mu g/m^3$, mostly point sources (about 13%). For NO_x, both Washington and California show a contribution, from 0.08-0.22 $\mu g/m^3$. As with the other NO_x emission sources, these are mostly

mobile source emissions (about 10%), which by 2018 are projected to be reduced by more than half. Fire emissions are almost entirely Oregon based, as are dust emissions.

<u>Kalmiopsis Class I area.</u>

The interstate contribution in this Class I area is very similar to Redwoods in California, as described above. These Class I areas are 30-40 miles apart. The highest contributing sources at both areas are fire and Pacific Offshore emissions. However, mobile source emissions are notable, with the majority originating from Oregon, while California and Washington contribute about 10 $\mu g/m^3$. The reason for this is uncertain. By 2018, this is projected to drop to under 0.05 $\mu g/m^3$.

12.3.3 Estimated International and Global Contribution to Oregon Class I Areas

Although not specifically addressed under the Regional Haze Rule in terms of interstate transport, it is important to identify the contribution to visibility impairment in Oregon from international sources, such as Canada and Mexico, offshore marine shipping in the Pacific Ocean, and "global" sources of haze. As described in Chapter 9, both the PSAT and WEP results show the contribution from both Canada and the Pacific Ocean marine shipping are sizable. Chapter 8 provides an emission inventory for offshore marine emissions. The contribution from Mexico is not significant, based on PSAT and WEP information. Global transport can be assumed to be most of the "outside domain" category identified in the PSAT results for SO_2 and NO_x. However, the extent of the contribution and understanding of global transport is difficult to assess, and will not be addressed in this plan.

In terms of addressing Canadian and Pacific offshore shipping emissions under this LTS, the Department does not have any authority over Canadian sources, and is therefore is not pursuing any new strategy for haze. However, for offshore shipping emissions, the Department believes this could be a possible future strategy, and will conduct further study on the transport and contribution of these sources, through its on-going participation in the WRAP, and in cooperation with the states of California and Washington, which are also impacted by the same offshore sources. The Department will prepare a report for the next Regional Haze Plan submittal in 2013 that addresses this topic, including an assessment of whether regulatory actions are likely in the future to meet other Clean Air Act requirements. This report will include recommendations on what actions Oregon and neighboring states could pursue that could benefit regional haze.

12.4 Summary of Interstate Consultation.

In addition to evaluating interstate transport, the affected States are required to consult with each other under Section 51.308(d)(3)(i), in order to develop coordinated emission management strategies. See Section 13.2 for information on the state-to-state consultation process.

12.5 Technical Documentation

Section 51.308(d)(3)(iii) of the Regional Haze rule requires documentation of the technical basis, including modeling, monitoring and emissions information, on which the State relied upon to determine apportionment of emission reductions needed to achieve progress goals in each Class I area it affects. The State of Oregon relied on exclusively on the technical information and analysis provided by the WRAP, through various projects and studies conducted by contractors, WRAP staff, and incorporated into the WRAP's TSS website. The following references the Chapters in this Plan which describes the technical information and documentation in more detail. Additional information on the TSS can be found in Appendix C of this plan.

Emissions Data

Chapter 8 describes the emission inventory information for state and regional emissions. Section 8.1 summarizes the Oregon statewide emissions, and Section 8.2 regional emissions for other states in the West.

Modeling Techniques

The modeling techniques used are described in Chapter 9. Section 9.1.1 describes on source apportionment analysis using the PM Source Apportionment Technology (PSAT) tool, for the attribution of sulfate and nitrate sources, and the Weighted Emissions Potential (WEP) tool, for the attribution of sources of sulfate, nitrate, organic carbon, elemental carbon, fine PM, and coarse PM. Section 9.1.2 describes the regional haze modeling using the Community Multi-Scale Air Quality (CMAQ) model.

Monitoring Data

Chapter 4 describes the IMPROVE monitoring network and monitoring sites in Oregon. Chapters 6 and 7 provide a summary of monitoring data, trends, and breakdown by pollutant for each of the site locations in Oregon.

12.5 Required Factors for the LTS

Under Section 51.308(d)(3)(v) of the Regional Haze rule, the factors listed below represent the minimum that must be considered by a State in developing the LTS. Section 12.6 identifies additional measures and controls being proposed by Oregon beyond those required for the LTS.

12.5.1 Emission Reductions Due to Ongoing Air Pollution Programs

The following summary describes ongoing programs and regulations in Oregon that directly protect visibility, or can be expected to improve visibility in Oregon Class I areas, by reducing emissions in general. This summary does not attempt to estimate the actual improvements in visibility that will occur, as many of the benefits are secondary to the primary air pollution

objective of these programs/rules, and consequently would extremely difficult to quantify, due to the technical complexity and limitations in current assessment techniques.

1. Prevention of Significant Deterioration/New Source Review Rules

As described in Section 10.1, the two primary regulatory tools for addressing visibility impairment from industrial sources are BART and the Prevention of Significant Deterioration (PSD) New Source Review rules. The PSD rules protect visibility in Class I areas from new industrial sources and major changes to existing sources. Oregon's Air Quality Analysis rules (OAR 340, Division 225) contain requirements for visibility impact assessment and mitigation associated with emissions from new and modified major stationary sources. Specifically, OAR 340-225-0070 references the need for protection of "Air Quality Related Values" (AQRV), which are specific scenic and environmentally related resources that may be adversely affected by a change in air quality. One of these AQRVs is visibility. The primary responsibility of the Department under these rules is visibility protection. Protection of all AQRVs (including visibility) is the primary responsibility of the Federal Land Manager. OAR 340-225-0070 describes mechanisms for visibility impact assessment and review by the Department, as well as impact modeling methods and requirements, the result of which is a demonstration of "no significant impairment of visibility in any Class I area". This modeling is conducted for sources typically out to 300 kilometers from a Class I area. Any new major source or major modification within this distance that is found through modeling to cause significant visibility impairment will not be issued an air quality permit by the Department unless the impact is mitigated. The definition of "significant" impairment for PSD is very similar to the significance level used for BART modeling (see BART Modeling Protocol in Section 10.3.1). For PSD, the significance level is an increase in visibility impairment above natural background of 5% (expressed as visibility extinction). For BART, the significance level is 0.5 deciview. Both represent essentially the same degree of impairment.

2. Reasonably Attributable Visibility Impairment BART

In 1986, the Department adopted Reasonably Attributable Visibility Impairment (RAVI) BART requirements as part of the Oregon Visibility Protection Plan (see below). These BART requirements are different from the BART requirements under EPA's Regional Haze Rule, as described in Chapter 10. While both apply to existing industrial sources, the RAVI BART requirements are triggered by a "certification" by the Federal Land Manager that visibility impairment exists in a federal Class I area. Upon such a certification, the Department would be required to identify and analyze BART for any contributing industrial source. Since the adoption of RAVI BART there has been no formal certification made in Oregon for reasonably attributable impairment.

3. Oregon's Phase I Visibility Protection Program

As described in Section 1.5.2 of this document, EPA's visibility regulations consist of two distinct rules. Phase I rules were adopted in 1980, and address visibility impairment that is "reasonably attributable" to one or small group of sources, in relatively close proximity to a Class I area. Phase II rules were adopted in 1999 to address regional haze visibility impairment

from multiple sources across a broad geographic area. In 1986 the Department adopted the Oregon Visibility Protection Plan (OAR 340-200-0040, Section 5.2) to address EPA's Phase I visibility rules. The Plan contains short and long-term strategies related to addressing reasonably attributable impairment. This includes the RAVI BART requirements and PSD New Source Review rules discussed above for industrial sources, as well as seasonal protection of visibility during the summer months from prescribed forestry burning and agricultural field burning.

The seasonal strategy was developed in order to protect visibility during the summer months, July 1 – September 15, known as the visibility protection period, when approximately 80 percent of the visitation occurs in Oregon's Class I areas. Visibility monitoring at that time focused on visibility conditions in Class I Areas in the Oregon Cascade Mountains. This monitoring showed that during the summer months in the northern and central Cascades, visibility was frequently impaired by smoke or "plume blight" from Willamette Valley agricultural open field burning, forest prescribed burning, and wildfire activity. The Department also determined that there was summer visibility impairment in the Eagle Cap Class I area caused by Union County agricultural open field burning, and that field burning in Jefferson County was contributing to summer visibility impairment in the central Oregon Cascade Class I areas as well.

As a result of this effort the Department adopted into the original plan specific visibility control strategies for these areas. This included smoke management requirements to avoid Class I visibility impacts from Willamette Valley, Jefferson County and Union County open field burning, and from forest prescribed burning in parts of Western Oregon. Special "weekend" restrictions on Willamette Valley field burning were added to prohibit burning activity during most summer weekends. The Jefferson and Union County smoke management programs adopted provisions to avoid any burning upwind of nearby Class I areas. The Oregon Department of Forestry Smoke Management Program was revised to shift prescribed burning in Western Oregon from the summer to the spring and fall, as part of an effort to eliminate burning during the summer. Both the forestry and Willamette Valley smoke management programs have commitments to pursue alternatives to burning through on-going research and development projects, and both use numerous emission reduction techniques when conducting burning during the year. Finally, between 1991 and 1998, Willamette Valley open field burning was reduced under a new state law from 180,000 acres to 40,000, which has resulted in significant visibility benefits, and led to increases in the use of non-burning alternatives, such as straw marketing and less-than-annual burning.

In 2002 the Department made minor revisions to the Visibility Protection Plan that contained several improvements. These improvements and an assessment of the effectiveness of the plan are described in the Department's report "Oregon Visibility Protection Plan Reasonable Progress Report, March 5, 2002."

The Oregon Visibility Protection Plan is can be found in Appendix F.

4. On-going Implementation of State and Federal Mobile Source regulations

As described in Section 11.4.3, mobile source annual emissions show a major decrease in NO_x, SO_2, and VOCs in Oregon from 2002 to 2018, and represent the greatest emission reductions of any single source category. This is from numerous "on the books" federal mobile source regulations (see list in Section 11.4.3). This trend is expected to provide significant visibility benefits. As noted, these emission reductions will likely be even greater than expected, due to increasing gasoline prices that are already reducing annual vehicle miles traveled across the West.

Beginning in 2006, EPA mandated new standards for on-road (highway) diesel fuel, known as ultra-low sulfur diesel (ULSD). This regulation dropped the sulfur content of diesel fuel from 500 ppm to 15 ppm. ULSD fuel enables the use of cleaner technology diesel engines and vehicles with advanced emissions control devices, resulting in significantly lower emissions. Diesel fuel intended for locomotive, marine and non-road (farming and construction) engines and equipment is required to meet the low sulfur diesel fuel maximum specification of 500 ppm sulfur in 2007 (down from 5000 ppm). By 2010, the ULSD fuel standard of 15-ppm sulfur will apply to all non-road diesel fuel. Locomotive and marine diesel fuel will be required to meet the ULSD standard beginning in 2012, resulting in further reductions of diesel emissions. These rules not only reduce SO_2 emissions, but also NO_x and PM.

In 2005, Oregon adopted California's emissions standards for light and medium duty vehicles. The new requirements were adopted as the Oregon Low Emission Vehicle (LEV) Program, and will take effect beginning with 2009 model year vehicles. Although the primary purpose was to reduce greenhouse gas emissions, these rules will also decrease NO_x and PM emissions.

The 2007 the Oregon Legislature authorized a clean diesel program that included funding for a grant/loan program to retrofit existing engines with exhaust controls, repowering nonroad diesels and scrapping older engines. Tax credits were also authorized for retrofitting, repowering and the purchase of 2007 and newer trucks. The Department projects that with no other intervention and relying on normal turnover bringing cleaner engines into the fleet, a 60% reduction in diesel $PM_{2.5}$ by 2018.

The Department operates two motor vehicle inspection/maintenance programs in Oregon. The first program began in the Portland area in 1975. The second program began in the Medford area in 1986. By inspecting exhaust emissions, DEQ identifies high-emitting vehicles that are producing more air pollution than expected. The result of these programs has been significant reductions in air pollution in the both areas, including NO_x and VOCs which contribute to regional haze.

5. On-going Implementation of Programs to meet PM_{10} NAAQS

In Oregon there are seven communities that are either currently or formerly nonattainment areas under the PM_{10} National Ambient Air Quality Standard (NAAQS). The following lists these communities by population size (largest first) and their current PM_{10} designation:

- Eugene-Springfield – Nonattainment Area
- Medford-Ashland – Maintenance Area
- Grants Pass – Maintenance Area
- Klamath Falls – Maintenance Area
- La Grande – Maintenance Area
- Oakridge – Nonattainment Area
- Lakeview – Maintenance Area

The significance of these PM_{10} nonattainment and maintenance areas in terms of regional haze is that each of these areas have made significant reductions in PM_{10} emissions in the last 10 years, by adopting similar strategies to address the primary emission sources in the community. The major contributing sources causing nonattainment in these communities are residential woodstoves, industry, mobile sources, road dust, and outdoor burning. These are the same sources which contribute to visibility impairment in Oregon. As Table 12.5.1-1 shows below, many of these communities are in close proximity to Oregon Class I areas.

Table 12.5.1-1 Proximity of Oregon Class I Areas to PM_{10} Nonattainment/Maintenance Areas

Community	Population	Distance to nearby Class I areas
Eugene-Springfield	205,660	Three Sisters – 35 mi, Mt. Washington and Diamond Peak – 50 mi.
Medford-Ashland	95,390	Mountain Lakes – 30 mi, Crater Lake – 40 mi, Kalmiopsis – 45 mi.
Grants Pass	30,930	Kalmiopsis – 25 mi
Klamath Falls	20,720	Mountain Lakes – 15 mi, Crater Lake – 40 mi, Gearhart Mtn – 45 mi.
La Grande	12,540	Eagle Cap – 20 mi, Hells Canyon – 50 mi.
Oakridge	3,700	Three Sisters and Diamond Peak – 20 mi.+
Lakeview	2,655	Gearhart Mtn – 30 mi.

The Department believes the ongoing PM_{10} reductions in these communities may provide significant benefits to visibility and regional haze.[47] The two most effective emission reduction strategies in these communities are the Department's residential woodheating rules (OAR 340, Division 262) and Major New Source Review (NSR) rules (OAR 340, Division 224). The Department's woodheating rules require woodstove curtailment programs in each of these communities. While some are voluntary and some are mandatory, these programs have been very effective in reducing PM_{10} levels during the heating months. The woodheating rules also specify that only certified woodstoves be sold in the state. These woodstoves can reduce emissions by 70%. The Department's NSR rules apply to new major industrial sources and major modifications, and require the Lowest Achievable Emission Rate (LAER) in

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[47] Quantifying the total emission reductions achieved by the PM10 emission reduction strategies in these communities, as a means to demonstrate actual visibility benefits in nearby Class I areas, is beyond the scope of this document. This would be a difficult and complex undertaking. However, it is reasonable to conclude that the significant PM10 emissions reductions in the larger of these communities has clear secondary benefits in nearby Class I areas in terms of visibility improvements.

nonattainment areas (most stringent controls), and Best Available Control Technology (BACT) controls in maintenance areas.

In addition to the ongoing emission reductions in PM_{10} nonattainment and maintenance areas, the Department will be designating new $PM_{2.5}$ nonattainment areas, which will require adoption of new measures to reduce $PM_{2.5}$ emissions in these communities. These designations have not been made yet, so the communities are not listed.

12.5.2 Measures to Mitigate the Impacts of Construction Activities

In developing this LTS, the Department has considered the impact of construction activities, as a factor in improving visibility in Oregon. Based on general knowledge of construction activity in the state, and without conducting extensive research on the contribution of emissions from construction activities to visibility impairment in Oregon Class I area, the Department believes current state regulations adequately address this topic.

Current rules addressing impacts from construction activities in Oregon are primarily found in the OAR 340, Division 208. OAR 340-208-0110 includes general requirements that set opacity limits for "visible emissions" from any air contaminant source. OAR 340-208-0210 addresses "fugitive emissions" from a variety of sources, and would be the more applicable regulation to construction activities. This regulation requires "reasonable precautions" be taken to prevent particulate matter from becoming airborne from activities such as construction projects. Types of actions to be taken include the use of water or chemicals for control of dust from demolition, construction operations, unpaved roads at construction sites, material stockpiles, and containment of sandblasting or other similar operations. In addition to these rules, the Department's regulations on "Indirect Sources" in OAR 340 Division 254 address minimizing emissions (including visibility impairing pollutants such as NO_x and VOCs) from mobile sources associated with construction of buildings and parking structures.

12.5.3 Emission Limitations and Schedules of Compliance

The implementation of BART, as described in Chapter 10, will contain emission limits and schedules of compliance for those sources either installing BART controls or taking federally enforceable permit limitations. As noted in the Chapter 11, the four-factor analysis did not identify any additional measures that were appropriate for this first Regional Haze plan. As a result, no other emission limitations or schedules of compliance are included in this plan. The evaluation of non-BART sources as part of the LTS is expected to identify additional emission reductions and improve visibility by 2018. To the extent this effort identifies any emission limitations and schedules of compliance, these will be included in the next periodic plan update in 2013.

12.5.4 Source Retirement and Replacement Schedules

Part of this LTS contains an evaluation of non-BART sources, described below in Section 12.6.1. This evaluation will include a review of all existing industrial sources to identify scheduled shutdowns, retirements in upcoming years, or replacement schedules, such as

planned installation of new control equipment to meet other regulations or routine equipment replacement or modernization.

12.5.5   Agricultural and Forestry Smoke Management Techniques

Section 308(d)(3)(iv)(E) of the Regional Haze rule requires the LTS to address smoke management techniques for agricultural and forestry burning. These two sources of air pollution are significant in Oregon. Smoke from agricultural and forestry burning are major contributors to Class I area visibility and regional haze in Oregon and the West. The pollutant species contribution identified in Chapter 7 shows that a significant portion of the 20% worst days in all of Oregon's Class I areas is from organic and elemental carbon, an indicator of fire emissions. Much of this contribution is from wildfires, which fluctuates significantly from year to year. However, there is also a sizable contribution from controlled burning, which is dominated by agricultural and forestry burning.

This section describes current smoke management programs for these sources, and how the advanced techniques used in these programs are expected to provide significant visibility benefits during the period of this LTS. Section 12.6.2 identifies a new LTS measure to evaluate if additional smoke management techniques can be developed for improving Class I area visibility from forestry prescribed burning.

Major Anthropogenic Fire Sources in Oregon

Figure 12.5.5-1 shows the major anthropogenic fire sources in the state. Prescribed forestry burning represents the largest source, at approximately 58% of the total burning in the state. Agricultural burning (including open field burning) is approximately 11%. General Outdoor Open Burning is 16%, and Rangeland Burning is 15%.[48] Since these two fire sources are not specifically mentioned in the Regional Haze Rule, they are not evaluated in this section. Instead, the Department has chosen to address both as additional measures in the LTS, in Section 12.6.3 and 12.6.4, respectively.

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[48] The emissions for rangeland burning are based on rough estimates of acres burned each year. These emissions are 2002 estimates obtained from the WRAP EDMS. The LTS of this plan identifies an evaluation that will be made of rangeland burning to improve emission estimates, track burning, and consider the need for voluntary smoke management controls to protect visibility.

Figure 12.5.5-1 Oregon Anthropogenic Fire Sources

PM10 Emissions tons/year (2005)

- Forestry Burning
- Field & Ag Burning
- General Outdoor Burning
- Rangeland Burning
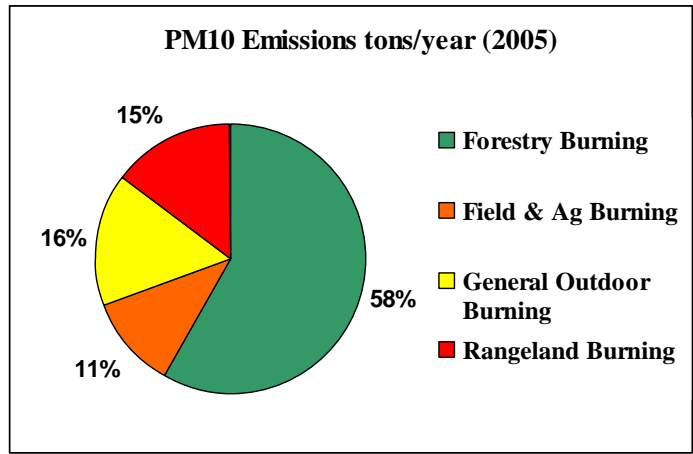
Fire Source	Statewide PM$_{10}$ Emissions tpy (2005)
Forestry Prescribed Burning (public & private lands)	18,518
Open Field Burning & General Agricultural Burning	3,568
General Outdoor Open Burning (residential, construction, demolition, land clearing, etc.)	5,154
Rangeland Burning*	4,654

* 2002 estimate from WRAP EDMS

Forestry Prescribed Burning

As shown above, forestry prescribed burning is the largest anthropogenic fire source in Oregon, at an estimated 18,500 tons per year of PM$_{10}$, based on 2005 emissions. This burning occurs in most areas of the state, except for the remote desert region of southern Oregon, and is controlled under a mandatory smoke management program operated by the Oregon Department of Forestry (ODF). Under state statute ORS 477.013, the State Forester and the Department of Environmental Quality are required to protect air quality through a smoke management plan, which is included in the SIP. ODF smoke management rules are listed in OAR 629-048-0001 to 629-048-0500, 629-043-0043 and 629-043-0041.

On November 2, 2007, ODF adopted revisions to Oregon Smoke Management Plan, as part of a periodic plan review requirement. Numerous changes were made to plan related to protection of air quality. New visibility protection provisions were adopted (629-048-0130) that incorporated references to the Oregon Regional Haze Plan, included the Enhanced Smoke Management Program (ESMP) criteria in Section 309 of the federal Regional Haze Rule, and voluntary measures to protect visibility when burning inside and upwind of any Oregon Class I area, by using best practices, minimizing residual smoke, and avoid significant ground level smoke impacts. The Oregon Smoke Management Rules (OAR 629-048-0001 through 629-048-0500) can be found in Appendix F.

<u>Agricultural Open Field Burning</u>

The majority of agricultural burning in Oregon falls under the category of open field burning. This is burning is associated with mostly grass seed and wheat burning. As shown above, total open field burning estimated emissions in 2005 were 3,500 tons/year of PM_{10}. This burning is concentrated in specific locations during the summer months, with the majority in the Willamette Valley (about 50,000 acres) and smaller amounts in central and eastern Oregon in Jefferson and Union counties (about 10,000 acres combined).

The Willamette Valley burning is controlled under a smoke management program operated by the Oregon Department of Agriculture (ODA). Under state statute ORS 468A.590, ODA is required to conduct a smoke management program for the Willamette Valley. ODA field burning rules are listed in OAR Chapter 603, Division 77, OAR Chapter 837 Division 110, and OAR Chapter 340, Division 264. The rules apply to areas lying between the crest of the Coastal Range and the crest of the Cascade Range (in the counties Benton, Clackamas, Lane, Linn, Marion, Multnomah, Polk, Washington, and Yamhill).

Jefferson and Union county field burning is controlled through smoke management programs established by county ordinance and operated at that level. As described in Section 12.5.1, these country programs have requirements to avoid burning upwind of nearby Class I areas when smoke would impair visibility.

Other agricultural burning takes place in rural areas around the state, although the amount of this burning is not well documented. It is likely that estimates of general outdoor burning, as noted above in Figure 12.5.5-1, may include general agricultural burning as well. Improving estimates of agricultural burning is difficult due to lack of any reliable information on daily burning activity in most areas of the state.

1. Current Phase I Visibility Protection

The primary objective of the smoke management programs mentioned above has been to avoid smoke intrusions into urban areas, and minimize smoke exposure to the public for health reasons. Some protection of visibility from agricultural and forestry burning in Class I areas has been achieved as a result of efforts to conduct burning only under optimum ventilation conditions that achieve maximum smoke dispersion and by the use of emission reduction techniques. There is also some visibility protection provided under the Oregon Visibility Protection Plan, described above in Section 12.5.1. The plan was adopted by the Department to meet EPA Phase I visibility rules, primarily to protect Class I area visibility from nearby burning sources that can cause "plume blight". One of the provisions in the plan prohibits Willamette Valley field burning on weekends between July 1 and September 15, known as the visibility protection period, which is the highest visitation period for Oregon Cascade Class I areas. The plan also incorporates the visibility protection provided by the Prevention of Significant Deterioration rules that apply to new and modified industrial sources. See Section 12.5.1 for further information on current visibility protection measures in the Oregon Visibility Protection Plan.

2. Current Phase II Regional Haze Protection, Section 309 ESMP requirements

Section 309 of the Regional Haze rule contains a requirement to include "Enhanced Smoke Management Programs for Fire". Although this plan addresses Section 308 of the Regional Haze rule, the Department believes the current smoke management programs operated by ODA and ODF meet the Enhanced Smoke Management Program (ESMP) requirements, and therefore represent an advanced level of smoke management. The ESMP elements include: (1) actions to minimize emissions; (2) evaluation of smoke dispersion; (3) alternatives to fire; (4) surveillance and enforcement; and (5) burn authorization. There are 4 additional ESMP elements, however the Department believes these five are the most applicable to regional haze, and highlights these below.

ODF rule 629-048-0130 states that the intent of ODF smoke management program is to "operate in a manner consistent with the Oregon Regional Haze Plan, including the Enhanced Smoke Management Program (ESMP) criteria". The following summarizes how the five ESMP elements listed above met under the ODF and ODA smoke management programs.

(1) Actions to Minimize Fire Emissions

Oregon Department of Forestry Smoke Management Program:

The policy the State Forester is to "minimize emissions from prescribed burning, where appropriate, by encouraging: cost effective utilization of forest residue; alternatives to burning; and alternative burning practices". ODF smoke management rules 629-048-0210 require the use of best burn practices and emission reduction techniques to minimize fire emissions.

Oregon Department of Agriculture Field Burning Program:

Under this program, growers utilize many different techniques which minimize emissions from field burning. Rapid ignition for open burning requires all sides of the field to be ignited as rapidly as practicable in order to maximize plume rise, which shortens burn time and significantly reduces emissions (compared to traditional, slower, headfire burning). Growers must ensure field residue is dry and in good burning condition. Growers may sanitize fields by propane flaming which also significantly reduces emissions. Prior to propane flaming, loose straw is removed from the field and the stubble cut close to the ground to prevent sustained open fire and reduce emissions.

(2) Evaluation of Smoke Dispersion

Oregon Department of Forestry Smoke Management Program:

The ODF program determines appropriate conditions for prescribed burning throughout the state in order to avoid smoke impacts in urban areas identified as Smoke Sensitive Receptor Areas (SSRA). In addition to SSRA protection, burning is conducted in a manner to avoid

or minimize smoke impacts in any populated area. Appropriate conditions are determined based on evaluation of daily weather forecasts and existing air quality. ODF develop forecasts, burning instructions and advisories using national, regional and local weather forecast models and data to determine dispersion conditions. Smoke dispersal conditions are determined for each area of the state, considering factors such as wind direction, wind speed, mixing height, and dispersion index. ODF rule 629-048-0220 describes forecast procedures and smoke dispersion.

Oregon Department of Agriculture Field Burning Program:

This program uses a variety of meteorological tools to evaluate atmospheric conditions. Conventional surface weather reports and rawinsonde observations are used to assess atmospheric conditions. In addition, the program utilizes pilot reports, a vertical sounder, and information from doppler radar. These data are supplemented with strategically located wind monitoring sites. At periodic intervals, program personnel release pilot balloons at different locations in the Willamette Valley which are optically tracked to measure wind speed and direction from the surface to approximately 6000 feet above ground.   A variety of computer models or simulations of the atmosphere are used as well.

(3) Alternatives to Fire

Oregon Department of Forestry Smoke Management Program:

ODF smoke management rule 629-048-0200 "Alternatives to Burning" encourages "practices that will eliminate or significantly reduce the volume of prescribed burning necessary". In this rule forestland managers are encouraged to consult the WRAP document "Non-burning Alternatives to Prescribed Fire on Wildlands in the Western United States". This document is a comprehensive reference manual of alternatives to prescribed fire, that contains an evaluation of non-burning vegetative management options, including a "decision-tree" for considering treatment options, and potential markets and funding sources for utilizing forest materials. It also describes how to develop a successful strategy for vegetation and fuel load management. This document is designed to provide forest landowners and land managers with a comprehensive list of viable options, and decision makers with the tools necessary to develop realistic non-burning strategies.

Oregon Department of Agriculture Field Burning Program:

For agricultural field burning in the Willamette Valley, state law (ORS 468A.555) mandates a research and development program to seek, develop and promote viable alternatives to agricultural field burning. To date these programs have made major strides in finding viable alternatives, such as straw marketing to Japan and other countries, minimum tillage, and less-than-annual burning. A major reduction of 180,000 to 40,000 in the number of acres that can be burned under state law occurred in the 1990's. As a result, there has been a significant increase in the use of alternatives, both in the Willamette Valley and other areas of the state. This high use of alternatives is expected to continue into the future.

(4) Surveillance and Enforcement

Oregon Department of Forestry Smoke Management Program:

ORS 477.515 requires that burning permits be obtained prior to burning. Violation of this statute by any individual may result in a legal citation and fine. Also, it is the policy of the State Forester to "achieve strict compliance with the smoke management plan, directive and instructions", as stated in the Operational Guidance for the Oregon Smoke Management Program, Directive 1-4-1-601. ODF rules 629-048-0500 address enforcement.

Oregon Department of Agriculture Field Burning Program:

The program is built on a foundation of cooperative compliance with rules governing open field burning. This compliance is supported by ODA enforcement rules OAR 603-077-0175. Direct observation by ODA field personnel and others provide information of possible rule violations. ODA staff and director evaluate the factors involved in each case and may assess warnings, notices of noncompliance, and civil penalties.

(5) Burn Authorization

Oregon Department of Forestry Smoke Management Program:

Under the program, the burn authorization process involves the issuance of smoke management forecasts and burning instructions. Burning instructions must be strictly complied with, as described above. Local field personnel then evaluate the burning instructions in coordination with landowners who have burn units that may be in prescription and are ready for burning. A burn might not occur if the local field administrator determines that a burn may not be advisable because of local factors, such as nearby burns being conducted, potential local smoke impacts, or adverse fire conditions. ODF rules 629-048-0230 address burn procedures and authorization.

Oregon Department of Agriculture Field Burning Program:

As previously described, ODA only allows field burning if weather conditions are favorable for avoiding smoke impacts in populated areas. Farmers obtain burn permits in their local fire protection district, and must monitor ODA radio broadcasts and pay close adherence to the burning authorized in these broadcasts. Meteorology varies in the Willamette Valley, and burning is authorized in specific areas as conditions are appropriate. Special field burning zones have been established throughout the Valley. Burning is authorized based on an evaluation of the number of acres that can be burned in a certain zone within an allotted time period. Farmers must burn in accordance with the location, time, and acreage limit specified by ODA. Failure to adhere to this authorization is subject to enforcement action, as described above. ODA rules for burn authorization are addressed in 603-077-0115 and other rule sections.

12.5.6   Enforceability of Oregon's Measures

Section 51.308(d)(3)(v)(F) of the Regional Haze Rule requires States to ensure that emission limitations and control measures used to meet reasonable progress goals are enforceable.

Oregon has ensured that all emission limitations and control measures used to meet reasonable progress goals are enforceable by embodying these in Oregon Administrative Rules, in accordance with Oregon state law, and under OAR 340-200-0040 State of Oregon Clean Air Act Implementation Plan (see Appendix H of this document). The Department has adopted the Oregon Regional Haze Plan into the SIP which ensures that all elements in the plan are enforceable. Oregon BART rules developed for this plan are found in Appendix E.

12.6   Additional Measures in the LTS

This section of the LTS identifies new measures being proposed by the Department for achieving reasonable progress. The sources identified below will be evaluated and fully discussed in the next plan update in 2013. This evaluation will take into account any new relevant monitoring and modeling information related to the contribution of Oregon anthropogenic sources to Class I impairment, new regulations that may benefit regional haze, and any new guidance related to the identifying additional control measures consistent with reasonable progress requirement of the regional haze rule. If additional controls are identified as a result of these evaluations, the 2013 plan update will include an implementation schedule for controls, necessary rulemaking, projected visibility improvements, and revised RPGs for 2018 (if applicable).

12.6.1   Evaluation of Non-BART Sources and BART-eligible Sources

The four-factor analysis in Section 11.3 of the previous chapter evaluated certain non-BART source categories for additional controls. This evaluation was limited to some degree by the lack of any specific guidance for identifying "significant" sources and a process for their evaluation, short of the four statutory factors. However, the four-factor analysis is only the first step in identifying various control options for anthropogenic sources. As described in this section of the LTS, a more comprehensive evaluation will be made of both non-BART sources and large fire sources such as forestry burning, in order to make additional emission reductions by the 2018 and beyond, for achieving reasonable progress.

In order to effectively evaluate non-BART sources for possible controls, an analysis similar to that applied to BART sources is needed. Outside of the four-factor analysis for evaluating controls for "significant" sources, EPA's Regional Haze Rule provides no guidance for addressing non-BART sources, in terms of identifying eligible sources, contribution threshold to visibility impairment, and a process for evaluating the need for controls (retrofitting). Although the Department recognizes that the BART requirements were specifically designed to address stationary sources built before federal PSD rules were adopted, and thus avoiding Class I visibility requirements, the process for evaluating non-BART sources must take into account that these sources did address visibility impacts when permitted, so any re-evaluation of visibility for these sources should, at a minimum, be no a less rigorous a technical evaluation

than for BART sources. For example, using a simple formula like "Quantity over distance" (Q/d) is an example of a less rigorous approach that would not be appropriate as the sole criteria for determining whether a non-BART source, which may have conducted full PSD CALPUFF visibility modeling only a few years earlier, should be evaluated for costly retrofitting.[49]

As such, the first element of this LTS will be the development of guidance for evaluating non-BART sources in Oregon. The Department will develop this guidance through a stakeholder process that includes review by EPA and FLMs. The following factors will be considered in developing this guidance:

1. Date of PSD permit issuance. A list of non-BART sources will be prepared based on the date of the original PSD review. Newer sources are likely to have newer, more state-of-the-art controls and technology. Older sources are more likely candidates for retrofitting with newer controls or other upgrades.
2. Quantity of emissions. A list of non-BART sources emitting SO_2, NO_x, and PM will be prepared and ranked by current emission levels. Both actual and permitted emissions will be identified.
3. Distance to nearby Class I areas. Non-BART sources will be identified by their proximity to nearby Class I areas. Geographic features, such as mountain ranges, will be noted as factors that should be considered along with distance.
4. Cumulative impacts. Consideration will be given to whether the guidance should address cumulative impacts, with preference given to any EPA or WRAP policy or technical assistance in identifying criteria that could be incorporated into the guidance.
5. Option for modeling. Included in this guidance will be the option for any non-BART source to conduct modeling, either screening modeling or advanced modeling. A modeling protocol and visibility threshold value will be developed for this guidance, similar to the BART Modeling Protocol developed for BART sources.
6. Control evaluation similar to BART. This guidance will identify a process for evaluating retrofitting similar to EPA's BART Control Determination Guidance. Included in this approach will be the factors listed above.
7. Planned shutdowns, retirements, and replacement schedules. Included will be a review of all existing industrial sources to identify scheduled shutdowns, retirements in upcoming years, or replacement schedules, such as planned installation of new control equipment to meet other regulations, compliance obligations, or routine equipment replacement/modernization.

Included in this evaluation of non-BART sources will be a review of sources that were identified as BART-eligible (see Chapter 10) and modeled below the visibility impact threshold of 0.5 dv. For those BART-eligible sources which modeled below the threshold and were not "subject to BART", they are still BART-eligible sources. As such under Section 308(e)(3) of the Regional Haze Rule, they are subject to the same reasonable progress requirements in Section 308(d) as other sources. However, given that there is no specific guidance to how to

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[49] The Q/D formula divides the quantity or size of the source (emissions) by the distance, in this case miles to the nearest Class I area, as a means of determining if a source is contributing to visibility in that area. This simplistic approach has been suggested by EPA in lieu of actual modeling for estimating source contribution.

address these sources after the initial BART modeling phase, the Department is proposing to develop such guidance or policy at the same time it will develop similar guidance for evaluating non-BART sources. This guidance will be developed concurrently, and through the same stakeholder process, as that developed for non-BART sources, as described above.

<u>Schedule for Completion and Implementation</u>

Following the completion of guidance for evaluating non-BART and reviewing BART-eligible sources, the Department will use the guidance to conduct the evaluation and review, to be completed by the next scheduled plan update in 2013, in accordance with Section 13.4.2 of this plan. A final report will be included in this update that describes the following:

> (1) identify the process used for developing the guidance, and summary of the guidance document;
> (2) summary of the results of evaluation of non-BART sources and BART-eligible sources;
> (3) summary of how the four-factor analysis in Section 11.4.3 was used as part of the evaluation of non-BART sources;
> (4) identification of any controls to be installed, description of any proposed rulemaking needed and schedule for adopting new rules, and estimated implementation of any new controls
> (5) an estimate of the expected visibility benefits from this LTS element, as part of the overall plan update to report on progress being made towards the 2018 RPGs.

12.6.2   Evaluation of Prescribed Burning Contribution to Haze and Possible Controls

As described in Section 12.5.5, the current Oregon smoke management programs meet the ESMP requirements in Section 309 of the Regional Haze rule. However, there are also other provisions in Section 309 that address the need for state smoke management programs to "evaluate and address the degree of visibility impairment from smoke in their planning and application". Although this plan addresses Section 308, the Department believes these Section 309 requirements for fire and smoke management programs are relevant to this plan, due to the sizable contribution of smoke sources to Oregon's Class I areas. As described in Section 12.5.5, the current smoke management programs for agriculture and forestry burning are advanced programs, a play an important role minimizing visibility impacts from these activities. However, in order to make further achievements in reasonable progress, the Department believes greater efforts are need through smoke management.

Current Oregon smoke management programs have some provisions to "evaluate and address the degree of visibility impairment from smoke". The ODA Willamette Field Burning Program has provisions which prohibit weekend burning upwind of Cascade Class I areas. The Jefferson and Union County field burning programs evaluate conditions on a daily basis upwind of nearby Class I areas to avoid transporting smoke into those areas. The ODF Smoke Management Plan has "visibility objectives" in OAR 629-048-0130 that include voluntary measures to minimize smoke impacts in Class I area during the summer protection period, and

use caution when burning upwind to avoid ground level plume impacts, outside of the summer protection period.

In order to determine if any additional smoke management improvements could be made to improve visibility as part of the LTS, one approach would be to look at IMPROVE monitoring data and pollutant species composition on 20% worst days, and in particular the contribution of OC and EC, as an indicator of vegetative burning. The information provided in Chapter 7 shows the average pollutant species contribution over the 2000-04 baseline period, as well as the annual variation in one year (2004), as an example of the different pollutant species typically found at Oregon Class I area. Table 12.6.2-1 below is an example from the Crater Lake IMPROVE site for 2004, showing the daily variations in pollutant species. The green represents OC, and the black EC. The peaks with a "W" represent the 20% worst case days. Those with a circle around the W are days in the spring and fall months.

Figure 12.6.2-1 Crater Lake IMPROVE Site – Pollutant Species Variation for All Days Sampled in 2004
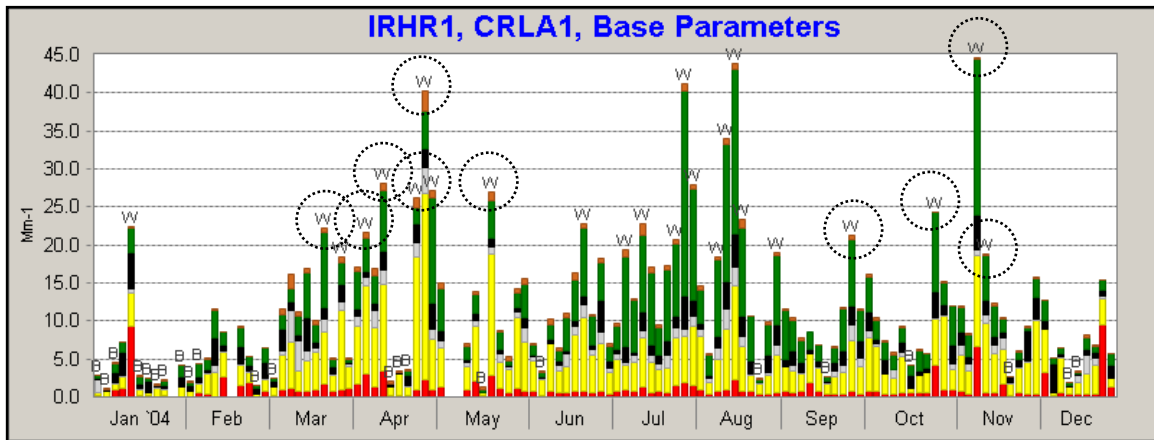
In many ways this is typical of the impacts and variations in Oregon's Class I areas. Many of the 20% worst-case days (W) show a sizable contribution of OC and EC, which has a strong correlation to fire sources. The impacts in the summer months show an even greater contribution of these pollutant species, which is a likely indicator of wildfire. In this case, there could be some smoke contribution from Willamette Valley field burning, although the distance from the Valley to Crater Lake makes it unlikely any contribution would result in a worst day impact. Under the ODF smoke management program, there is little to no burning during the summer months.

However, during the spring and fall months, there is significant forestry burning which occurs in the state. Some of the peaks during these months show a distinct pattern of OC and EC contribution. Given the proximity of forested land around Crater Lake, this is an indication that forestry burning may be a major contributor to these spring and fall worst days. The Department believes further evaluation is needed to determine the extent of this contribution,

and if additional smoke management controls could reduce the impacts on these worst-case days, and provide any substantial improvement in visibility.

The following summarizes the evaluation the Department will conduct to make this assessment of forestry smoke contribution, the type of smoke management controls that would be considered to reduce these impacts, and the schedule for completing these two evaluations by the next regional haze plan update in 2013.

Evaluation Method

As part of this LTS, the Department will evaluate monitoring data at all six IMPROVE sites for 2000-04, identifying the 20% worst-case day impacts in the spring and fall months, as in the example above in Figure 12.6.2-1, that have significant contributions of OC and EC. The general evaluation method will be as follows:

1. Compile a list of worst-case days over this 4 year period, and review ODF accomplished burn records to identify any recorded or observed smoke impacts in the Class I area or areas represented by the IMPROVE site.
2. Review burn records to identify corresponding days when prescribed burning activity was occurring, within a 50 mile radius of each IMPROVE site.
3. On days that impacts and burning match, review meteorological records to identify mixing height, transport wind direction, and other related data, on those days.
4. Compile a list of accomplished burns that correspond to the prevailing winds and mixing height, with a summary of the location, distance to impacted Class I area, estimated tons burned, and times of ignition and completion, if known. (Note - modeling may be included in this step.)
5. Provide a final assessment as to the probably each accomplished burn contributed to the impact, and an estimate of the extent of that impact.

A final report will be prepared that summarizes the overall contribution of prescribed burning to worst-case day impacts at each IMPROVE site. Included in this report will be the Class I area or areas represented by the site, the extent of the contribution from prescribed burning, any recommendations for additional smoke management protections, and the criteria or threshold level used as the basis for the recommendation. This report will be provided to ODF and federal land managers for review and comment.

Additional Smoke Management Protection Assessment

Additional smoke management protection will only be considered based on an affirmative finding from the evaluation described above, and on a case-by-case basis for each Class I area. The purpose of this additional protection would require more intensive management of prescribed burning within a certain distance upwind of an Oregon Class I area, with the objective of avoid any burning that would cause a prolonged smoke intrusion and heavy smoke concentrations, resulting in a 20% worst day impact. This additional protection would rely upon "basic" smoke management techniques, as opposed to adopting more advanced

techniques. Pre-identification of burn units subject to this requirement would be necessary. Other specific provisions may be developed as needed.

The ODF smoke management program currently provides smoke protection for designated urban areas, or SSRAs. This effort requires more intensive smoke management when burning upwind of SSRAs, in order to avoid any smoke intrusion into the SSRA. The additional smoke management protection for Class I areas would be much less restrictive, as the primary objective is not to prevent any smoke, but to avoid major smoke impacts, that could result in a 20% worst day impact.

Identification of the "basic" smoke management techniques to be used for specific Class I areas would need to be determined by the Department in consultation with ODF and federal land managers. One possible approach would be to establish special protection zones of 50 miles around each Class I area. Burning within these zones would be managed to meet to visibility protection objective outlined here. Although this objective reflects the "plume blight" requirements of the Phase I visibility rules, the fact that this protection is directed at reducing the number of 20% worst day impacts is more related to Phase II regional haze, and therefore is being proposed as part of the LTS.

Schedule for Completion and Implementation

The evaluation of forestry burning contribution to Oregon Class I areas and the need for additional smoke management protection, will be conducted in consultation with ODF, federal land managers, and other forest stakeholders. The 2013 update of the Oregon Regional Haze Plan will contain a final report on the results of this effort, and identify a schedule for revisions to the ODF Smoke Management Plan, if additional visibility protection is determined.

12.6.3   Evaluation of the Contribution from General Outdoor Open Burning

As described in Section 12.5.5, general outdoor open burning represents 16% of annual PM_{10} emissions from anthropogenic fire sources, based on 2005 estimates. The Department's Open Burning Rules in OAR Division 264 contain requirements for numerous types outdoor burning, such as domestic, land clearing, construction, demolition, and industrial. This burning occurs mostly year-round, although heaviest in the spring and fall. Each of these types of burning have different regulations to address them in various parts of the State, based primarily on the proximity population centers. These rules were adopted 20-30 years ago, mostly to address nuisance concerns, and have been revised intermittently. To date there has been no evaluation of the extent that general outdoor burning contributes to Class I visibility impairment. Unlike other types of burning, there are many different types of burning that make up this source category, and wide ranges emissions due to fuel type, fuel loading, combustion characteristics, which make difficult to obtain good emission estimates, and ultimately difficult to determine contribution to visibility impairment. However, the Department believes that an evaluation of this source is needed to determine if better emission estimations are possible, and methods for predicting how these emissions are contributing to nearby Class I areas. For the 2013 update to the Regional Haze Plan, the Department will conduct this evaluation and prepare a report with recommendations on the potential benefits to visibility by revising current open burning rules

to minimize impacts on visibility, and a proposed schedule for rule revisions, if supported by the recommendations.

12.6.4   Evaluation of the Contribution from Rangeland Burning

As described in Section 12.5.5, rangeland burning represents 15% of annual PM_{10} emissions from anthropogenic fire sources, and is based on rough estimates. The majority of this burning occurs in the high desert regions in southeastern Oregon, with lesser amounts in Central Oregon. Much of the burning activity is on lands under the authority of the federal Bureau of Land Management. Due to the remote locations and lack of population in the areas where burning historically occurs, there has been little to no regulation of this activity. Information on acres burned is limited, and no smoke management controls have been considered necessary do to the infrequency of reported smoke problems. However, some estimates on the amount of rangeland burning in SE Oregon indicate 200,000-300,000 acres may be burned each year. This raises the possibility that nearby Class I areas are being impacted by this burning during certain times of year. During the 2007 review of the Oregon Department of Forestry's smoke management program, the Department discussed with ODF the need for obtaining better information on the extent of rangeland burning, and smoke management coverage should be extended to that part of the state. For the 2013 update to the Regional Haze Plan, the Department will conduct evaluation on the extent and possible contribution of rangeland burning to Class I visibility impairment, and prepare a report with recommendations for next steps, that may include tracking acres burned and voluntary smoke management measures.

12.6.5   Efforts to Address Offshore Shipping

As described in Chapter 9, both the PSAT and WEP results show offshore marine vessel emissions as a major contributor to Oregon Class I areas, especially in Western Oregon. If compared to emission inventory data in Chapter 8, marine vessel emissions are 56% for SO_2 and 31% for NO_x of the total 2002 statewide emission inventory for these pollutants.

Currently, the Department has limited authority in Oregon to regulate offshore shipping emissions. State regulations on shipping apply only to vessels on the Willamette and Columbia rivers. On July 24, 2008, the State of California adopted new strict regulations for marine vessels within 24 miles of shore. The Department expects that implementation of these new regulations for marine vessels will have benefits in Oregon.

The Department will prepare a report for the next plan update in 2013, that includes any estimates on visibility improvements in Oregon from the California regulations, any new information or studies on the transport and contribution of offshore shipping, any new regulatory actions expected to meet other Clean Air Act requirements, and recommendations on what regulatory actions Oregon could pursue to address this source.

12.7   Projection of the Net Effect on Visibility

The anticipate net effect on visibility from emission reductions by point, area, and mobile sources during the period of the LTS has been estimated by the WRAP, based on monitoring,

emission inventory, and modeling projections. The results of the CMAQ modeling described in Section 9.3 show anthropogenic emission sources declining significantly across the West and in Oregon through 2018. However, overall visibility benefits of these reductions are somewhat offset by emissions from natural sources such as wildfire and dust, and other uncontrollable sources. This includes international sources in Canada and Mexico, global transport of emissions, and offshore shipping in the Pacific Ocean. Despite this, it is clear that visibility improvements will be made due to the control of BART sources, numerous on-the-books regulations such as state and federal mobile source rules, and elements contained in the LTS to address non-BART sources and fire emissions over the next 5-10 years that may provide additional improvements by 2018. The WRAP has also committed to conducting final reasonable progress modeling when all BART results are complete, which will likely reveal additional progress toward the 2018 URP.

As part of the requirement to submit 5-year progress reports in Section 13.4.3 of this plan, the Department will include in the 2013 update any additional visibility improvements expected due to updated CMAQ or other regional modeling information from the WRAP, or other pertinent new information related to the demonstration of reasonable progress in Chapter 11 of this plan. This will include information related to the visibility improvement expected from significant emission reductions from the PGE Boardman plant, under DEQ's BART rules associated with the 2020 closure, as described in Chapter 10, and the extent it can be determined how much the reduction in visibility impact from this plant affects the reasonable progress goals described in Chapter 11.

CHAPTER 13: CONSULTATION AND FUTURE COMMITMENTS

13.1 Federal Land Manager Consultation

Section 308(i) of the Regional Haze Rule requires consultation between the State and FLMs related to development and implementation of regional haze plans. States need to provide FLMs and opportunity to comment at least 60 days prior to holding a public hearing on a proposed plan or plan revision. This includes commenting on the State's assessment of visibility impairment in each Class I area, and providing recommendations on the reasonable progress goals and visibility control strategies the State has proposed. States also need to provide the FLM an opportunity to comment on the five-year progress reports and other developing programs that may contribute to Class I visibility impairment.

Section 51.308(f) of the Regional Haze Rule requires States to submit a plan revision by July 31, 2018 and every ten years thereafter.

Oregon has provided agency contacts to the FLMs as required. In the development of this plan, the FLMs were consulted in accordance with the provisions of 51.308(i)(2). Oregon has provided the FLMs an opportunity for consultation, in person and at least 60 days prior to holding any public hearing on the plan. The first public hearing on the plan is January 6, 2009. The Oregon Regional Haze Plan was made available to the FLMs for review and comment via the Department's regional haze website on November 11, 2008. The FLMs were notified by email and a letter on that date. A copy of the letters is in Appendix G.

In accordance with 40 CFR 51.308(i)(3), Oregon has received comments regarding the plan from the FLMs. These comments on the plan were addressed by the Department. See Appendix G of this plan.

Section 51.308(i)(4) requires procedures for continuing consultation between the State and FLMs on the implementation of the visibility protection program. Oregon will consult with the Federal Land manager(s) on the status of the following implementation items:

1. Implementation of emissions strategies identified in the plan as contributing to achieving improvement in the worst-day visibility.
2. Summary of major new source permits issued.
3. Status of State/Tribe actions to meet commitments for completing any future assessments or rulemakings on sources identified as likely contributors to visibility impairment, but not directly addressed in the most recent plan revision.
4. Any changes to the monitoring strategy or monitoring stations status that may affect tracking of reasonable progress.
5. Work underway for preparing the 5-year review and 10-year revision.
6. Items for FLMs to consider or provide support for in preparation for any visibility plan revisions (based on a 5-year review or the 10-year revision schedule under EPA's RHR).

7. Summary of topics discussion (meetings, emails, other records) covered in ongoing communications between the State/Tribe and FLMs regarding implementation of the visibility program.

The consultation will be coordinated with the designated visibility protection program coordinators for the National Park Service, U. S. Fish and Wildlife Service and the U.S. Forest Service.

Section 51.308(g) requires States to submit a progress report to EPA every 5 years evaluating progress towards the reasonable progress goal established for each Class I area. The first progress report is due 5 years from submittal of this plan, and must be in the form of a SIP revision.

In accordance with Section 51.308(h), at the time of the report submission, Oregon will also submit a determination of the adequacy of its existing Regional Haze SIP revision.

Oregon will continue to coordinate and consult with the FLMs during the development of future progress reports and plan revisions, as well as during the implementation of programs having the potential to contribute to visibility impairment in the mandatory Class I areas.

13.2   State Consultation and Coordination

Section 51.308(d)(3)(i) of the Regional Haze Rule requires States to consult with neighboring States to develop coordinated emission strategies. This requirement applies both where emissions from a State is reasonably anticipated to contribute to visibility impairment in Class I areas outside the State, and where emissions from other States are reasonably anticipated to contribute to Class I visibility impairment inside the State.

As described in Section 12.3 the Long-term Strategy, Oregon reviewed interstate transport of haze pollutants with neighboring States, focusing on source apportionment information to identify visibility impacts in Oregon and neighboring state Class I areas. The states consulted by Oregon were Washington, Idaho, California and Nevada. Section 13.2-1 reviews the consultation process with these States. Additional consultation with these States was through Oregon's participation in the WRAP, and the numerous committees and workgroups described in Section 4.1.2 of this plan.

Of particular note was the WRAP Implementation Work Group (IWG), which consists of state and tribal staff involved in the development of regional haze plans. The state representatives on this work group were the primary regional haze plan writers from the 14 WRAP states. This work group reviewed the major strategies associated with state and tribal regional haze plans, and addressed the issues associated with plan development and rule interpretation, including the primary coordination and consultation that took place between states, tribes, EPA, and the FLMs during the development of the Oregon Regional Haze Plan. The attached link identifies the IWG members http://www.wrapair.org/forums/iwg/members.html. Additional information on IWG work products, projects, and documents, can be found on that website as well.

13.2.1 Summary of State Consultation Process

As described above, the WRAP IWG was one of the primary mechanisms for state-to-state consultation. In addition, the Oregon IWG member and primary author of this plan, Brian Finneran, consulted directly with IWG members from the following neighboring states:

1. Washington – Doug Schneider, Washington Department of Ecology
2. Idaho – Mike Edwards, Idaho Department of Environmental Quality
3. California – Tina Suarez-Murias, California Air Resources Board
4. Nevada – Frank Forsgren, Nevada Division of Environmental Protection*
   (* Nevada is not an official member of the WRAP, but did prepare a regional haze plan.)

Discussions with neighboring States included the review of major contributing sources of air pollution, as documented in numerous WRAP reports and projects, and described in Chapters 7-9, and 12, of this plan. The focus of this review process was interstate transport of emissions, major sources believed to be contributing, and whether any mitigation measures were needed.[50] All the states relied upon similar emission inventories, results from source apportionment studies and BART modeling, review of IMPROVE monitoring data, and existing state smoke management programs, and other information in assessing the extent to which each state contributes to visibility impairment in the other state Class I areas.

Oregon DEQ will continue to coordinate and consult with other States as part of the implementation of the strategies contained in the Oregon Regional Haze Plan, and for future progress reports and plan revisions, as required under the federal Regional Haze Rule.

13.2.2 Consistency with Neighboring State SIPs

As described above, the Oregon Regional Haze Plan was developed with emphasis on consistency with other State plans, through consultation directly with neighboring states and in the WRAP, and the technical tools, policy documents, and other products that were used to develop all of the regional haze plans by Western States.

13.2.3 Oregon and Other State Emission Reductions Obligations

Section 51.308(d)(3)(ii) requires States to demonstrate that its regional haze plan includes all measures necessary to obtain its fair share of emission reductions needed to meet reasonable progress goals. Based on the consultation described above, no major contributions were identified that supported developing new interstate strategies, mitigation measures, or emission reduction obligations. Both Oregon and neighboring states agreed that the implementation of BART and other existing measures in state regional haze plans were sufficient, and that future consultation would address any new strategies or measures needed.

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[50] Significant contributions to haze from international transport (Canada, Mexico, and global) is not addressed here, but is summarized in Chapters 7 and 8.

13.3 Tribal Consultation

Although not required under EPA's Regional Haze Rule, the Department consulted with Tribes in Oregon during the development of this plan. Like the State consultation process above, consultation with Tribes involved reviewing major emission sources and regional haze strategies, both through WRAP activities and direct outreach to Tribes within Oregon.

A letter was sent on March 31, 2008, to Ken Cronin the WRAP Tribal Caucus Coordinator with the National Tribal Environmental Council (NTEC), describing Oregon's interest in obtaining participation from tribes in the development of Oregon's haze plan, and seeking assistance from NTEC contacting Tribes on this matter. A copy of this letter is in Appendix G.

13.4 Commitment to Future 308 Plan Revisions

13.4.1 Comprehensive 10-Year Plan Revisions

Section 51.308(f) of the Regional Haze Rule requires States to revise their regional haze plans and submit a plan revision to EPA by July 31, 2018, and every ten years thereafter. In accordance with the requirements listed in Section 51.308(f) of the federal rule for regional haze, Oregon commits to revising and submitting this regional haze implementation plan by July 31, 2018 and every ten years thereafter.

These plan revisions must evaluate and reassess elements under 40 CFR 51.308(d), taking into account improvements in monitoring data collection and analysis, and control technologies. Elements of the future plans are summarized below.

1) Current Visibility Conditions. Determine current visibility (most recent five year period preceding the required date of the PLAN submittal for which data is available) conditions for the most impaired and least impaired days and determine the actual progress made towards natural conditions.
2) Long Term Strategies. Determine the effectiveness of the long-term strategy for achieving the presumptive goal for the prior SIP period. If the long-term strategy or prior presumptive goal was insufficient to attain natural conditions by 2064, the State/Tribe must look at additional or new control measures that may be adopted considering compliance cost, compliance time, compliance energy and non-air quality environmental impacts, and the affected source remaining useful life.
3) Reasonable Progress Goals.   Affirm or revise the current reasonable progress goal based on assessment of new or updated information, improved technologies, and on-going legislation.
4) Monitoring Strategy. Re-evaluate the adequacy of the existing monitoring strategy. Provide updated information and changes to the monitoring strategy, as well as an updated State/Tribe emissions inventory.

13.4.2   5-Year Progress Reports

In addition, Section 51.308(g) requires periodic reports evaluating progress towards the reasonable progress goals established for each mandatory Class I area.   In accordance with the requirements listed in Section 51.308(g) of the federal rule for regional haze, Oregon commits to submitting a report on reasonable progress to EPA every five years following the initial submittal of the SIP. The report will be in the form of a PLAN revision submitted by December 2013. The reasonable progress report will evaluate the progress made towards the reasonable progress goal for each mandatory Class I area in Oregon. All requirements listed in 51.308(g) shall be addressed in the SIP revision for reasonable progress. At a minimum, the progress reports must contain the following elements:

1. Implementation status of the current SIP measures;
2. Summary of emissions reductions;
3. Assessment of most/least impaired days;
4. Analysis of emission reductions by pollutant;
5. Significant changes in anthropogenic emissions;
6. Assessment of the current SIP sufficiency to meet reasonable progress goals; and
7. Assessment of visibility monitoring strategy.

Section (d)(4)(v) requires periodic updates of the emission inventory. Oregon commits to update the inventory by the next SIP update in 2013.

13.5   Determination of Plan Adequacy

As required by Section 51.308(h) of the Regional Haze Rule, depending on the findings of the five-year progress report required described above in Section 13.4.2, Oregon commits to taking one of the following actions at the same time Oregon submits the 5-year progress report:

1) If Oregon finds that no substantive SIP revisions are required to meet established visibility goals, Oregon shall provide EPA a negative declaration saying that no plan revision is needed;

2) If Oregon finds that the plan is or may be inadequate to ensure reasonable progress due to emissions from outside the State, Oregon shall notify EPA and the other contributing State(s), and initiate efforts through a regional planning process to develop additional strategies in addressing the SIP deficiency;

3) If Oregon finds that the plan is or may be inadequate to ensure reasonable progress due to emissions from another country, Oregon shall notify EPA and provide the available supporting information; or

4) If Oregon finds that the plan is or may be inadequate to ensure reasonable progress due to emissions from within the state, Oregon shall develop additional strategies to address the plan deficiencies and revise the plan within one year from the date that the progress report was due.