Air Quality Report

Columbia River Gorge Air Study and Strategy

September 2011

State of Oregon
Department of
Environmental
Quality

Oregon Department of Environmental Quality
Southwest Clean Air Agency

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Executive Summary

Introduction

This Columbia River Gorge Strategy brings together a regional approach and plan that includes emission reduction strategies to drive continued visibility improvements in the future and help guard against long-term visibility degradation from current levels.

Recommendation

The Oregon Department of Environmental Quality and Southwest Clean Air Agency recommend that the Gorge Commission approve our key strategy of using requirements of the federal Regional Haze Program as the vehicle and framework for improving visibility in the Gorge. The Regional Haze Program, required by the Clean Air Act, has already been successful in achieving significant reductions in haze causing pollution, and will continue to be the primary means of addressing haze reduction across the Pacific Northwest in the years to come. The agencies recommend specifically tracking Gorge air quality each time the Regional Haze Plan is updated to ensure that the regional strategies continue to benefit air quality in the Scenic Area.

Background

In 2000, the Columbia River Gorge Commission, which has responsibility under the Scenic Area Management Plan to protect natural, scenic, cultural, and recreational resources in the Gorge asked the Oregon Department of Environmental Quality and Southwest Clean Air Agency (together, "air agencies") to develop and implement a regional air quality strategy to carry out the purposes of the National Scenic Area Act.

The main air quality concern in the Gorge is visibility impairment, or haze pollution. There are also concerns about the effects of air pollution on important natural and cultural resources. Visibility impairment can occur at relatively low levels of air pollution.

Visibility Study Findings

In 2007 the Gorge visibility study conducted by the air agencies determined that visibility conditions in the Gorge are remaining constant and are expected to improve somewhat in the coming years despite regional growth pressures. The study identified the PGE Boardman coal-fired power plant as the most significant individual contributor to haze in the Gorge. Additional studies, conducted by the U.S. Forest Service, Dr. Dan Jaffe and Dr. Kent Norville, also looked at visibility, air quality trends, and acid deposition in the Gorge and concluded that PGE Boardman is a key contributor.

Visibility conditions in the Gorge are remaining constant and are expected to improve somewhat in the coming years despite regional growth pressures.

Both the Gorge visibility study and other studies come to the same conclusion – that PGE Boardman is a key contributor to haze in the Gorge.

The Gorge visibility study also identified other local and regional emission sources such as natural sources (trees, forest fires), and mobile (on-road and non-road) sources as contributing to Gorge haze. The study determined there are many different sources from all over the region that are contributing to haze pollution. Some haze pollutants are generated locally, but a large fraction of haze pollution comes from regional sources as far away as Canada and beyond. Haze impacts in the Gorge occur in both summer and winter, with winter haze levels generally being highest. Emissions from the Portland area also contribute to summertime haze in the western Gorge, but the "Portland plume" is not a primary contributor to haze in the wintertime. It is one of many regional sources affecting the Gorge and the wilderness areas of Mt. Hood and Mt. Adams. A summary of the study's key findings can be found at www.deq.state.or.us/aq/gorgeair/docs/FinalScienceSummaryReport.pdf.

Strategy

The air agencies have identified the haze-contributing sources in the Gorge and developed this strategy document to address the impact of these emission sources. After reviewing many options the agencies determined that to achieve visibility improvement in the Gorge and across the region, the most effective approach to mitigate and improve haze conditions in the Gorge is through implementation of the federally-mandated Regional Haze Program. The federal Regional Haze Program requires:

- Visibility improvement in designated national parks and wilderness areas (known as Class I areas);
- 5-year progress check-ins and milestones;
- Actions such as adoption of stringent emissions controls for sources such as PGE Boardman.

The horizon for this Regional Haze Program extends out to 2064. Adopting this program as the strategy to improve visibility in the Gorge provides milestones, benchmarks and the legal framework that would otherwise not exist for taking action to improve visibility in the region and in the Gorge.

Tying visibility improvement in the Gorge to the regional haze program provides an on-going regulatory framework for haze reduction and checkpoints for the Gorge strategy through a coordinated visibility improvement effort across multiple states.

While the Gorge is not classified as a Class I area it is closely located between two Class I areas (Mt. Hood and Mt. Adams) and will benefit from Oregon's and Washington's Regional Haze Programs. The goal for visibility in the Gorge is continued improvement, the same approach used in the

federal Regional Haze Program. Due to the mix of urban and rural activities in the Gorge, longer term visibility improvement cannot be expected to reach "natural conditions" as is the case for pristine wilderness areas and national parks. However, visibility improvement in the Gorge can be expected to mirror the visibility improvement in Mt. Hood and Mt. Adams that will be achieved by emission reduction strategies adopted through the regional haze plans.

Additionally, under the federal states must develop and update regional haze plans every five years to reduce haze pollution over the long term. DEQ adopted its Regional Haze Plan in 2009, and revised the plan in December 2010 (Appendix C). Oregon's plan included commitments to review visibility trends in the Gorge as part of future regional haze plan updates. Washington adopted its Regional Haze Plan in December 2010 (Appendix D). The next installment of the Regional Haze Plan for Washington and Oregon is expected to occur sometime in 2013-2015, and as part of this update the agencies will ensure progress in the Gorge continues as expected.

The Gorge strategy identifies controllable sources of haze in the Gorge and the proposed strategies to address these emissions. For example, the PGE Boardman plant was identified as a major contributor to haze in the Gorge. DEQ's revised 2010 Regional Haze Plan included rules for the PGE Boardman coal-fired power plant. The plan and subsequent revisions requires the installation of stringent emission controls at a cost of $75 million dollars between now and 2018, as well as permanent closure of the Boardman coal-fired boiler no later than Dec. 31, 2020. These requirements will result in reducing haze forming emissions by 48 percent in the 2011 to 2019 timeframe and eliminating these pollutants completely after closure. In addition, the plan requires emission reductions at several other major industrial sources affecting visibility in the Gorge. Based primarily on DEQ's regional haze analysis, and in part on the Gorge visibility study, the Oregon Environmental Quality Commission adopted these emission control requirements for the PGE Boardman plant in June 2009 and December 2010.

Additional reductions will be made in Washington as part of the Washington Regional Haze Plan. Several large sources in southern Washington will have emission reductions and in the long-term, the TransAlta coal fired power plant near Centralia, Washington will be shut down starting in 2025. This will provide additional long term reduction in emissions.

Other sources from inside and outside the region that affect the Gorge include: natural sources such as wildfires; non-road sources such as marine engines, construction equipment, and locomotives; on-road sources such as motor vehicles; and combustion sources such as residential heating. The air agencies are implementing a number of regulatory and voluntary strategies that will reduce emissions from these sources in the Gorge. These strategies include: requiring vehicles to meet low emission standards (in both Washington and Oregon); a program to retrofit diesel engines; federal requirements mandating the use of ultra-low sulfur fuel for diesel engines; and a smoke management program to keep prescribed fire smoke out of the Gorge. The air agencies conclude that visibility improvement can be accomplished through the cumulative effect of many

different state and federal emission reduction strategies in place now or adopted for near-term implementation.

When Oregon and Washington next update their Regional Haze Plans (expected 2013-2015),if the air agencies find that Gorge haze levels are increasing rather than decreasing as expected, the air agencies will investigate the reasons and will consult with the Gorge Commission to discuss possible remedies. The primary focus of these regional haze plans is on visibility improvement; however this haze reduction work will also have general benefits for public health, as well as reducing acid deposition that can threaten other important natural and cultural resources.

Tribal Coordination

The state air agencies, federal EPA and USFS worked with and received input from the Yakama Nation and the Confederated Tribes of the Umatilla Indian Reservation on the Gorge visibility strategy. The state air agencies also reached out to other Gorge-area Tribes, including the Confederated Tribes of Warm Springs and the Nez Perce Tribe to invite them to provide input and inform them of developments regarding the Gorge project. Discussions focused on the tribal nations' environmental concerns from both a holistic perspective and from a scientific perspective. The relationship has been beneficial in developing the Gorge strategy and shaping agencies approach to visibility improvement in the Gorge. One of the key components to that discussion was the impact of PGE Boardman emissions on the Gorge and valued tribal resources. The tribal perspective was very important as DEQ shaped its Boardman BART proposal.

Conclusion

The air agencies have developed a strategy for reducing haze-forming pollution in the Columbia River Gorge and, in combination with the associated Gorge visibility study, have completed the charge given them by the Gorge Commission. The Gorge visibility study provides a comprehensive understanding of the local and regional emission sources that influence scenic resources in the Gorge. The Gorge visibility strategy establishes mandates, benchmarks and timelines to improve visibility across the region through the federal Regional Haze Program. In addition, this strategy document also describes the many other state and federal emission reduction strategies to reduce haze pollution across the Pacific Northwest. This strategy document provides a look into the likely future of haze trends in the Scenic Area, and a path forward for continued visibility improvement over time.

Acknowledgements

The Oregon Department of Environmental Quality and the Southwest Clean Air Agency wish to express its gratitude to the Columbia River Gorge Commission and staff, Gorge stakeholders and tribal nations who participated in the Gorge project and contributed to our efforts. In particular, DEQ wishes to thank the Southwest Clean Air Agency, who led the visibility study effort in coordination with the many national experts and air quality scientists who contributed to the study's design, critique, and conclusions. DEQ and SWCAA also wish to thank the Washington Department of Ecology for its early participation. We hope those with an interest in Gorge air quality will follow and engage in the on-going Regional Haze Programs in Oregon and Washington.

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Table of Contents

Figures

Tables

Appendices

I. Introduction

The Columbia River Gorge strategy summarizes the emission reduction strategies that, taken together, will help guard against long-term visibility degradation from current levels and drive continued visibility improvements in the future. The Oregon Department of Environmental Quality and Southwest Clean Air Agency (together, "air agencies") recommend that the Gorge Commission approve our key strategy of using the federal Regional Haze Program as the primary framework for improving visibility in the Gorge.

II. Background

A. What is Haze?

Haze is air pollution that reduces visibility. Generally, the higher the concentration of the pollutants, the more visibility is impaired. Visibility impairment can occur at relatively low levels of air pollution that do not pose a risk to public health, but can nevertheless degrade scenic vistas during certain times of the year. This is why air quality in the Columbia Gorge can meet all air quality health standards, but levels of visibility impairment can still exist. These visibility impairing pollutants can also, in high enough concentrations, potentially harm sensitive ecosystems and other resources.

The air pollutant primarily responsible for haze is particulate matter. Particulate matter can be released as primary particles from fire or dust or as secondary particles that are chemically formed in the atmosphere from precursor gases. The major precursor gases are sulfur dioxide, oxides of nitrogen, ammonia and volatile organic compounds.

Particulate matter can be further broken down to distinct particle species in the atmosphere: ammonium sulfate, ammonium nitrate, organic compounds, elemental carbon, and coarse particulate matter. Air monitoring on bad visibility days shows the main pollutants affecting the Gorge are organic carbon, nitrates, and sulfates. Sulfates and nitrates are secondary particles chemically formed in the atmosphere from precursor gases such as sulfur oxides and oxides of nitrogen, which are products of fossil fuel combustion such as that from coal burning power plants, automobiles, and industrial boilers. The presence of ammonia also plays a key role in the formation of sulfates and nitrates. Sources typically associated with ammonia emissions include livestock farming, application of fertilizer, and the decomposition of manure. For the most part, organic carbon comes from sources that emit wood smoke directly into the atmosphere such as wildfires and residential woodstoves. Another pollutant of concern is elemental carbon, a byproduct of fossil-fuel combustion. All of these pollutants have the ability to affect visibility by scattering or absorbing light.

Air monitoring on bad visibility days shows the main pollutants affecting the Gorge are organic carbon, nitrates, and sulfates.

B. Columbia River Gorge Commission and the Charge to Address Air Quality in the Gorge

In November 1986, Congress recognized the significance of the Columbia River Gorge when it passed the Columbia River Gorge National Scenic Area Act. The Scenic Area Act called for the creation of the Columbia River Gorge Commission and for the preparation of a National Scenic Area Management Plan. The Gorge Commission has responsibility under the Scenic Area Management Plan to protect and enhance natural, scenic, cultural, and recreational resources in the Columbia River Gorge.

The Gorge Commission has responsibility under the Scenic Area Management Plan to protect natural, scenic, cultural, and recreational resources in the Columbia River Gorge.

In May 2000, the Gorge Commission approved an air quality amendment to the National Scenic Area Management Plan. The amendment language states:

> *"Air quality shall be protected and enhanced, consistent with the purposes of the Scenic Area Act. The States of Oregon and Washington shall: (1) continue to monitor air pollution and visibility levels in the Gorge; (2) conduct an analysis of monitoring and emissions data to identify all sources, both inside and outside the Scenic Area that significantly contribute to air pollution. Based on this analysis, the States shall develop and implement a regional air quality strategy to carry out the purposes of the Scenic Area Act, with the U.S. Forest Service, the Southwest Air Pollution Control Authority [now the Southwest Clean Air Agency] and in consultation with affected stakeholders. The States and the Forest Service together shall provide annual reports to the Commission on progress made regarding implementation of this policy."*[1]

C. Gorge Air Quality Project

In 2001, the air agencies and the Washington Department of Ecology developed an approach to study and protect air quality in the Gorge with a focus on visibility and the emission sources that contribute to haze in the Scenic Area. After a lengthy public process and Gorge Commission approval, the 2001 Gorge study work plan encompassed two elements: the development of a bi-state air quality advisory committee to lead a strategy development process; and a technical study to assess the causes of visibility impairment and to identify the emission sources that contribute to haze in the Scenic Area.

In 2003, budget cutbacks forced the study and process to be redesigned. Resource reductions at the state level resulted in the Washington Department of Ecology dropping

[1] Management plan amendment language adopted by the Columbia River Gorge Commission on May 9, 2000. SMA Natural Resources Policy 12 [pages I-3-32 and I-3-33]

out of the Gorge project and its statewide visibility protection program. DEQ and SWCAA had to abandon efforts for a bi-state air quality advisory committee and the technical study was scaled back. As a result, the scope and funding for the Gorge project did not allow for an exhaustive evaluation of all possible air pollution effects on scenic, cultural, natural, and recreational resources. Although the redesigned technical study does not provide answers to all possible questions about air quality in the Gorge, it still provides insight on the emission sources that contribute to haze. Because similar pollutants affect both visibility and acid deposition, visibility was selected as a surrogate of air quality in general. The air agencies developed an addendum to the work plan and the Gorge Commission approved the changes in August 2003.

Monitoring for the technical study began in 2004 as the agencies collected and analyzed monitoring data, began developing an emissions inventory for the region, and used chemical analysis and computer model simulations to investigate the causes of haze. By 2007, the agencies completed a draft study and produced the "Columbia River Gorge Air Quality Study - Science Summary Report" that compiled all the integrated data and analyzed the monitoring, emissions and meteorological data, along with modeling results designed to identify sources, both inside and outside the Scenic Area.

The air agencies hosted "Gorge Science Day," in September 2007 to discuss the scientific results documented in the science summary report and the findings of other studies related to visibility, acid deposition and air quality trends in the Gorge. Both the public and national scientific experts commented, discussed, and provided feedback on the studies. The agencies incorporated changes and finalized the science summary report[2].

In 2008, the air agencies presented a draft air quality strategy for public review. The draft strategy addressed visibility in the Gorge based in part on the findings from the technical studies reviewed on "science day" and the results found in the science summary report.

At the time DEQ and SWCAA presented the draft strategy, Oregon DEQ was also evaluating the PGE Boardman coal-fired power plant for emission controls under the federal Regional Haze Plan. Based primarily on DEQ's regional haze analysis, and in part on the Gorge visibility study, the Oregon Environmental Quality Commission in December 2010 adopted stringent emission controls and a timeframe for closing the PGE Boardman plant no later than 2020.[3] This action taken under the Regional Haze Plan was incorporated into the Gorge visibility strategy.

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[2] http://www.deq.state.or.us/aq/gorgeair/docs/FinalScienceSummaryReport.pdf

[3] For more information on the emission controls adopted for PGE Boardman, see Section IV.A.2.

III. Gorge Air Quality Project Goal

A. What is the Air Quality Goal for Visibility in the Gorge?

The National Scenic Area Act does not establish or mandate a specific air quality standard or numeric goal for the Gorge. Instead, its charge is to "protect and enhance" the scenic, natural, cultural, and recreational resources of the Gorge[4]. Nevertheless, the air agencies have established an air quality goal for the Gorge. The goal for visibility in the Gorge is continued improvement using the same approach used in the federal Regional Haze Program. The federal Regional Haze Program requires states to incrementally improve visibility in wilderness areas with the ultimate improvement goal of reaching natural conditions by 2064.

The goal for visibility in the Gorge is continued improvement.

Due to the mix of urban and rural activities in the Gorge, long-term visibility improvement cannot be expected to reach "natural conditions" as is the objective for pristine wilderness areas and national parks. However, visibility improvement in the Gorge can be expected to mirror the visibility improvement in Mt. Hood and Mt. Adams that will be achieved by emission reduction strategies adopted through the federal Regional Haze Plan.

Why not set a more prescriptive or numeric goal for the Gorge?

The air agencies have thought carefully about this question and are persuaded by four main points:

- The goal of continued improvement ties into the purposes of the National Scenic Area Act to protect and enhance. Continued improvement will reduce impairment and ensure air quality will not degrade.

- Neither the Clean Air Act nor the National Scenic Area Act require or envision setting a specific, legally binding visibility goal or standard for the Columbia River Gorge National Scenic Area. There are widely divergent and strongly held opinions among Gorge area stakeholders regarding what defines an appropriate goal. The agencies are concerned that attempting to set a prescribed air quality goal or standard for the Gorge at this time would lead to a very long and divisive debate among Gorge area interests and could in fact become an obstacle to achieving the goals of the Gorge strategy.

- There is no scientific justification for selecting one air quality threshold over another as "the correct" goal for the Gorge. The "natural background" goal prescribed in the federal Clean Air Act for unpopulated, pristine wilderness areas and National Parks does not apply, and in practical terms could not be applied to the Columbia Gorge.

[4] See management plan amendment language adopted by the Columbia River Gorge Commission on May 9, 2000. SMA Natural Resources Policy 12 [pages I-3-32 and I-3-33]

- The air agencies do not have the available funding or staff resources to establish a more prescriptive goal for the Gorge. Faced with a number of other competing priorities such as public health, addressing areas that are in violation of air quality standards, air toxics reduction, and the development of greenhouse gas reduction strategies the agencies must focus on these issues. In addition, a discussion of a prescriptive visibility goal for the Gorge would also require the involvement of the Washington Department of Ecology because of their statewide visibility planning responsibilities.

Tying the goal of visibility improvement over the next decade on a parallel process with the Regional Haze Program goals helps ensure visibility will improve in the Gorge. DEQ and SWCAA will assess improvements in visibility every five years when the Regional Haze Plan is updated. If the improvement trend in the Gorge diverges from the improvement trend in Mt. Hood and Mt. Adams wilderness areas during the next decade, DEQ and SWCAA will conduct additional evaluations to determine if additional separate emission reduction strategies are needed to improve Gorge air quality.

DEQ and SWCAA will assess the improvements in Gorge visibility every five years in conjunction with federal Regional Haze plan updates to determine whether air quality in the Gorge is improving or not.

IV. Gorge Air Quality Strategy

The air agencies have identified sources contributing to haze in the Gorge and developed this strategy document to address these emission sources. After reviewing options, the air agencies have determined that to effectively achieve visibility improvement in the Gorge and across the region, they recommend adopting the federally mandated Regional Haze Program[5] as the Gorge strategy.

The federal Regional Haze Program provides milestones, benchmarks and the legal framework to improve visibility in the Gorge.

Regional haze programs require visibility improvement in national parks and wilderness areas, or Class I areas, including 5-year progress check-ins and milestones, and actions such as adoption of stringent emissions controls for sources such as PGE Boardman. States must improve visibility in Class I areas by reducing pollution to meet reasonable progress goals, as part of a multi-decade process producing continual improvement in visibility over time. This program provides milestones, benchmarks and the legal framework that would otherwise not exist for taking action to improve visibility in the region and in the Gorge.

[5] For more information on the regional haze program, please see Section IV.A.1.

While the Gorge is not classified as a Class I area it is closely located between two Class I areas, Mt. Hood and Mt. Adams, and will benefit from Oregon and Washington's Regional Haze Programs. DEQ and SWCAA now know that the sources contributing to haze in the Gorge are the same sources that contribute to haze across the entire Northwest. Therefore, tying visibility improvement in the Gorge to the Regional Haze Program provides an on-going regulatory framework for haze reduction and checkpoints for the Gorge strategy through a coordinated visibility improvement effort across multiple states. As mentioned earlier, the goal for visibility in the Gorge is continued improvement, the same approach used in the federal Regional Haze Program.

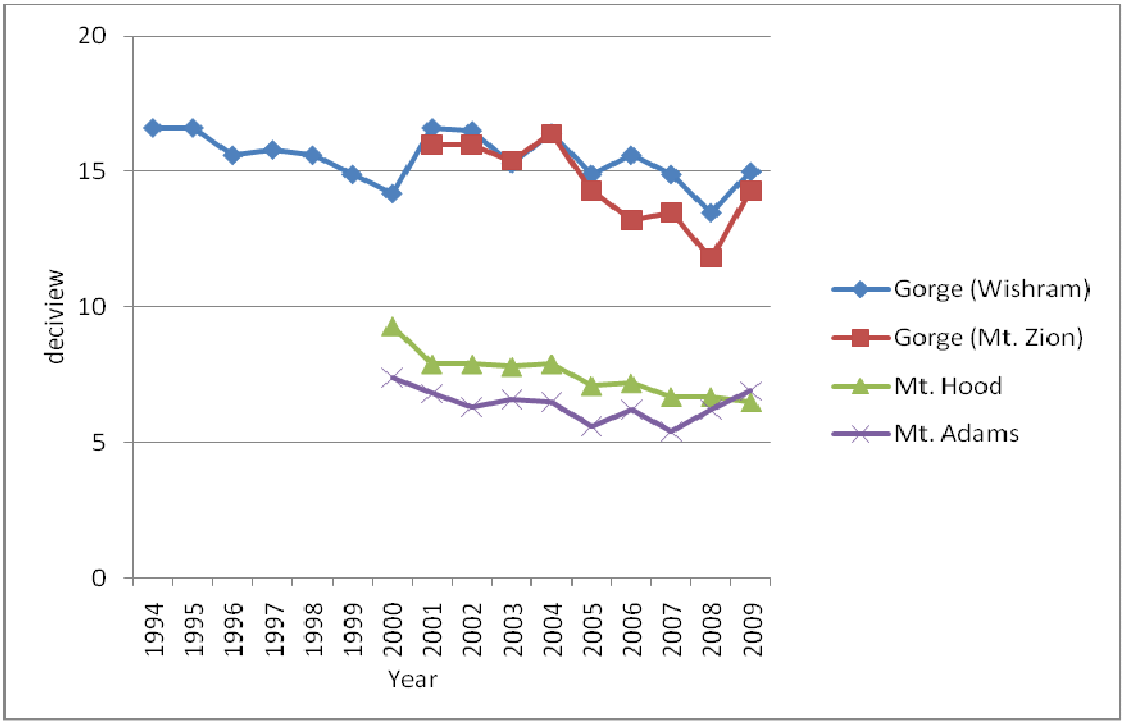
The Gorge strategy for visibility improvement is using the federal Regional Haze program as the primary vehicle and framework for improving visibility in the Gorge.

The Regional Haze Program is a very effective mechanism for achieving significant air quality improvements. For example, Oregon's revised 2010 Regional Haze Plan (Appendix C) contains efforts to address PGE Boardman emissions, identified as the most significant contributor to haze in the Gorge. The revisions ensure the permanent closure of the Boardman coal-fired boiler no later than Dec. 31, 2020. At the same time, the rules reduce haze forming emissions by 48 percent in the 2011 to 2019 timeframe and eliminate these pollutants completely after closure. In addition the haze plan requires emission reductions at several other major industrial sources affecting visibility in the Gorge. Washington adopted its Regional Haze Plan (Appendix D) in January 2011 and it includes similar commitments to review visibility trends in the Gorge for sources located beyond the five county coverage jurisdiction of the Southwest Clean Air Agency for southwest Washington. The plan includes emission reductions for the Weyerhaeuser Longview Mill and the TransAlta Centralia Power Plant. These facilities were shown to contribute to Gorge haze under certain meteorological conditions. Both of the Oregon and Washington Regional Haze Plans allow the air agencies to align efforts to efficiently address haze in both Class I areas and the Gorge.

The federally-mandated Regional Haze Program requires states to develop and update Regional Haze Plans every five years to reduce haze pollution over the long term. Oregon's revised 2010 Regional Haze Plan (Appendix C) includes commitments to review visibility trends in the Gorge as part of future plan updates. The next update of the Regional Haze Plan is anticipated to begin in 2013 at which point DEQ will verify that progress is occurring as expected.

If the air agencies find that Gorge haze levels are increasing rather than decreasing as expected, the air agencies will investigate the reasons and consult with the Gorge Commission to discuss possible remedies. The monitoring trends, as shown in Figure 1, indicates visibility for Class I areas and the Gorge trends are expected to remain constant or steadily improve.

Figure 1: Trends of IMPROVE monitoring data (all days)



The air agencies will focus primarily on trends in man-made emissions to track continued improvement in Gorge visibility. Note that in any given year visibility conditions may be better or worse depending on the influence of natural emission sources such as forest fires. Because visibility varies naturally from year to year, at least three to five years of monitoring data would provide the air agencies with information to observe haze trends. Although the Mt. Zion IMPROVE site was shut down in May 2011 due to resource constraints, continued operation of at least one of Gorge area IMPROVE monitoring sites by the U.S. Forest Service (USFS) is critical to determine whether "continued improvement" is being achieved. If, in the future, funding can be restored to reinstate the Mt. Zion IMPROVE site, it will help provide additional valuable information regarding visibility conditions at both ends of the Gorge.

This Gorge strategy document identifies a host of controllable sources of haze in the Gorge and the strategies that address them, including industrial sources, such as PGE Boardman, non-road sources including marine engines, construction equipment, and locomotives, motor vehicles, and burning. The strategy also discussed natural emission sources such as wildfires, Oregon and Washington have taken steps to address these sources through specific strategies, both regulatory and voluntary, including low emission standards for cars, a program to retrofit diesel engines, federal requirements mandating the use of ultra-low sulfur fuel for diesel engines, and a smoke management program to keep prescribed fire smoke out of the Gorge. These strategies, in combination with emission reduction strategies in already in place will continue to reduce haze-forming emissions and improve visibility.

The air agencies have concluded visibility improvement can be accomplished through the cumulative effect of many different emission reduction efforts. Table 1 summarizes key emission reduction strategies in place now (or adopted for near term implementation) that are reducing air pollution and benefitting the Gorge.

Table 1: Strategies to Address Emission Sources that Contribute to Haze in the Gorge

EMISSION SOURCE CATEGORY CONTRIBUTING TO HAZE	STRATEGIES TO ADDRESS SOURCE OF HAZE
Distant & Regional Sources (including emissions from Canada, overseas)	• **Federal Regional Haze Program -** requires a regional approach by developing and implementing air quality plans to reduce the pollution that causes visibility impairment in national parks and wilderness areas. This is an on-going, multi-decade effort to develop haze reduction strategies and improve visibility.
PGE Boardman (electrical generating units)	• **Federal Regional Haze Program: DEQ Rules for Emission Controls - BART –** requires shutdown of PGE Boardman by December 31, 2010. Reduces haze forming emissions by 48 percent prior to closure at a cost of $75 million, and all emissions after 2020. • **Oregon's Utility Mercury Rule** – reduces mercury emissions by 90%
Non-road Sources – typically diesel engines which include: a. construction equipment b. farming equipment c. locomotive engines d. marine engines	These programs will significantly reduce particulate matter, NOx, and SO_2 emissions: • **Ultra-low Sulfur Diesel Fuel** - new and existing fuel requirements for trucks, locomotives, and marine engines • **Federal Clean Engine Rules** – rules requiring new cleaner diesel engines for non-road sources, including locomotives and marine engines • **Diesel Retrofits for Tugboats and Locomotives** – replacement of three tugboat engines serving the Columbia River Corridor and the retrofitting of locomotive equipment resulting in an annual reduction of 290 tons of NOx and particulate matter • **Maritime Shipping Rules** – rules requiring tankers and cargo ships operating in buffer zones to use low-sulfur fuels to and utilize technologies to reduce NOx and PM emissions • **Bi-State Solutions - Columbia River Regional Diesel Emissions Reduction Project** - a project focused on reducing diesel emissions (ports, tugboats, trucks, rail) in the Columbia River corridor

Area Sources - woodstoves - open burning - auto body refinishing shops - industrial & commercial manufacturing	• **Federal Air Toxics Source Standards** – standards that reduce emissions of hazardous air pollutants and air toxics from 52 emission source categories. • **Oregon's Heat Smart Woodstove Upgrade Initiative** – a program that requires removal of an uncertified woodstove upon home sale • **Woodstove Smoke Reduction Project – Woodstove Changeouts –** rebate program for the change out of an old, uncertified stove
On-Road Vehicles (including motor vehicles)	• **Motor Vehicle Inspection Program in the Portland Metro Area– Fleet Turnover –** identifies high emitting vehicles in need of repair and requires them to be fixed as part of vehicle registration • **Low Emission Vehicle Standards –** requires new vehicles to meet low emission standards, lowering smog forming emissions by 33%. Oregon and Washington adopted these cleaner car standards in 2005 and they will be fully phased in by 2016 • **Ultra-low Sulfur Fuel -** existing fuel requirements for motor vehicles • **Diesel Retrofit on School Buses** • **Diesel Retrofits for Local Government Fleets** • **Low Carbon Fuel Standard** - reduces the average carbon intensity of the mix of transportation fuels used in Oregon by 10 percent over a 10 year period. There are two standards, one for gasoline and its substitutes and one for diesel and its substitutes
Industrial Point Sources - pulp & paper mills - boilers - secondary aluminum plants	• **Federal Regional Haze Program (BART controls) –** requires controls to lower emissions of industrial sources that could be affecting visibility conditions. Future regional haze plans may identify the need for further emission reductions from major industrial sources • **Federal Air Toxics Source Standards -** requires controls to reduce air toxics emissions • **Prevention of Significant Deterioration –** federal program that protects against visibility degradation in the Gorge and Class I areas from new or expanding major industrial facilities

Burning - prescribed forestry - agricultural	• **Smoke Management Program –** a smoke protection program to keep prescribed fire smoke out of the Gorge • **Agricultural Burning** – ban on field burning in the Willamette Valley, reducing regional smoke levels on certain days
Portland/Vancouver-area Emissions	• **Portland Air Toxics Solutions Plan –** a plan to reduce air toxics and other pollutants in Portland. • **Portland and Vancouver Ozone Maintenance Plan –** a federal plan with control measures and reduction programs to keep ozone levels below the federal health standard • **Bi-State Solutions - Columbia River Regional Diesel Emissions Reduction Project** - a project focused on reducing diesel emissions (ports, tugboats, trucks, rail) in the Columbia River corridor
Ammonia • agricultural operations (fertilizer) • dairy operations	• **Oregon's Dairy Task Force Recommendations –** encouraging voluntary programs to reduce emissions from Confined Animal Feeding Operations • **Best Management Practices (BMPs) at Oregon Dairies** – utilizing BMPs at dairies, including adding methane digesters and reusing manure as fertilizer

A. Key Strategy to Address Gorge Visibility – Regional Haze Program

1. What is the Regional Haze Program?

The federal Clean Air Act contains requirements to protect and improve visibility in national parks and wilderness area in the country. In 1977, Congress designated certain national parks and wilderness areas as "Class I areas," where visibility was identified as an important value. Currently there are 156 Class I areas in the United States. Oregon has 12 Class I areas and Washington has eight Class I areas, which include Mt. Hood, Mt. Adams, and Crater Lake National Park. While the Gorge is not classified as a Class I area, the Regional Haze Program is expected to benefit the Columbia Gorge. However, during the development of Oregon's Regional Haze Plan, DEQ considered impacts to the Gorge and tailored some of its actions to specifically address impacts on Gorge air quality (e.g. controls on PGE Boardman).

The federal Regional Haze Program is intended to improve visibility in all Class I areas, including Oregon and Washington. States are required to develop a regional haze plan to ensure that they achieve "reasonable progress" at reaching natural visibility conditions in 60 years, or by 2064. It focuses on improving Class I area visibility on the haziest days -

The federal Regional Haze Program offers a mechanism for stakeholder and Tribal involvement on visibility issues and a public process to share ideas and raise concerns.

the worst 20 percent - and ensuring no degradation on the clearest days - the best 20 percent. This objective of reducing haze across the country will require complex technical analysis covering thousands of different emissions sources, and multi-jurisdictional coordination among states, federal land managers such as the US Forest Service and National Park Service, EPA, Native American tribes, and many other stakeholders. The federal Regional Haze Program also offers a mechanism for stakeholder and Tribal involvement on visibility issues and a public process to share ideas and raise concerns. In developing Oregon's Regional Haze Plan – the Gorge is considered.

The key elements of the federal Regional Haze Program include:

1) **Best Available Retrofit Technology (BART)** for older industrial sources built before 1977, when federal rules were adopted to protect visibility in Class I areas from new industrial sources. Some of these older sources are still uncontrolled and have significant visibility impacts in Class I areas.
2) **A projection of statewide emissions and visibility conditions in 2018,** including a comprehensive review of visibility conditions in each state's Class I areas, showing major pollutants and sources causing haze.
3) **A demonstration of reasonable progress** for the best and worst visibility days, showing how progress is being made to reduce haze by 2018.
4) **A long-term strategy** that describes sources that will be evaluated in the next 10 years to make visibility improvements.

All 50 states are required to submit Regional Haze Plans, and every five years provide updates that show the latest visibility trends, current status in demonstrating reasonable progress, and proposed emission reduction strategies for making incremental progress in haze reduction. Oregon submitted its updated plan to EPA in December 2010. Washington submitted its plan in January 2011 and many of the components in the Washington plan will be similar to the Oregon plan.

2. Best Available Retrofit Technology (BART)

Under BART, states must evaluate pre-1977 major industrial sources to determine which have significant visibility impacts and evaluate the need for retrofitting with new pollution controls. Oregon and Washington evaluated over 100 sources; Oregon found ten sources to be BART-eligible and Washington found 15 sources.

a) Oregon's BART eligible sources

Of the ten Oregon BART-eligible sources, DEQ's visibility modeling analysis showed that the PGE Boardman coal-fired power plant had considerably greater visibility impact than any other BART-eligible source. Four other Oregon sources had visibility impacts just over the significant impact level, while the remaining five did not. A significant impact was defined as 0.5 deciview or greater (to the human eye, 0.5 deciview is a barely

perceptible change in visibility). The Boardman plant was evaluated for BART controls, while the other four sources chose to reduce their emissions by making permanent changes to their operations and reduce emissions by taking enforceable permit limits.

DEQ's visibility modeling analysis showed that the PGE Boardman coal-fired power plant caused considerably greater visibility degradation than any other BART-eligible source.

(1) PGE Boardman

The PGE Boardman plant is a 600-megawatt coal-fired electric generating plant. Originally permitted in 1977, PGE Boardman is Oregon's only coal-fired power plant, and represents approximately 20 percent of PGE's total energy generating capacity. The facility currently emits about 25,000 tons of air pollution per year.

DEQ's visibility modeling analysis shows that sulfur dioxide (SO_2) and nitrogen oxide (NOx) emissions from this facility can travel more than 200 miles, significantly degrading visibility in 14 Class I areas in Oregon, Washington, and Idaho.[6] The modeling analysis also shows these emissions significantly degrade visibility in the Columbia River Gorge National Scenic Area and contribute to acid deposition, which can threaten important Native American cultural resources such as ancient rock images. DEQ's modeling analysis shows that the highest visibility degradation occurs at the Mt. Hood Class I Area (5 deciview), with the Columbia River Gorge having an impact of 3.7 deciview.

DEQ adopted rules in 2009 that utilized a two-phased approach to reduce total emissions 81 percent, or about 21,000 tons per year, and reduce peak visibility impacts in the 14 Class I areas by an average of 83 percent. The rule also anticipated PGE would operate Boardman until at least 2040 and likely beyond. The 2009 Regional Haze Plan contained a provision allowing PGE to submit a formal request to DEQ for a rule change if the company wanted to close the plant earlier.

In 2010, PGE subsequently submitted proposals to revise the 2009 rule, based on PGE's desire to close the plant by 2020. After much deliberation between DEQ and PGE, including the opening of two public comment periods to review several options that meet the BART requirement, DEQ adopted the following rules in December 2010:

- Permanent closure of the Boardman coal-fired boiler no later than December 31, 2010
- Low nitrogen oxide (NOx) burners with overfire air to meet BART requirements
- Dry sorbent injection controls for sulfur dioxide (SO2) to meet BART requirements, including more stringent limits from 2018-2020

In all, these controls will reduce haze forming emissions by 48 percent prior to closure,

[6] DEQ's modeling analysis is discussed in more detail in Appendix A

and all emissions after 2020. In addition, they significantly improve visibility in 14 Class I wilderness areas in Oregon and Washington, and in the Columbia River Gorge National Scenic Area.

(2) Other Oregon BART sources

As mentioned above, there were four BART-eligible sources that had much smaller visibility impacts than PGE Boardman, yet were still over the significant impact level. These sources opted to take a federally enforceable permit limit to permanently lower their emissions to below the 0.5 deciview significant impact level. Sources that take these enforceable limits are not subject to further evaluation for BART controls; however, as with other emission sources, they will be re-evaluated in the future for reasonable progress purposes, as part of the long-term strategy. The air quality permits for these four sources have been modified to meet these emission limits.

- **PGE Beaver power plant** is a 558 megawatt electric generating plant located in Clatskanie, Oregon. PGE Beaver is reducing its emissions by using a cleaner ultra-low sulfur diesel fuel blend as a backup fuel in its steam gas turbines, and by limiting the amount of ultra-low sulfur diesel fuel it can burn in any given day. PGE currently burns a low-sulfur (500 parts per million-ppm) fuel oil and will be transitioning to an ultra-low-sulfur (15 ppm) fuel oil in the near future. Overall, this action will result in reductions of 522 tons/yr of SO_2, 1,830 tons/yr of NOx, and 616 tons/yr of particulate matter.
- **International Paper (formerly Weyerhaeuser)** is a containerboard plant located in Springfield, Oregon. The plant will soon begin work on repairs that will reduce its emissions, and show compliance through operational limits and monitoring. In the interim, limits on both operation and oil use will apply, especially during periods of inspection and maintenance of damaged equipment when emissions can vary.
- **Georgia Pacific, Wauna Mill** is a pulp and paper manufacturing plant located near Clatskanie, Oregon. The mill is reducing its emissions by taking a permit limit based on permanently reducing oil usage, reconfiguring an emission control system to eliminate an incinerator in late 2010 and applying production limits before and after the incinerator is eliminated.
- **Amalgamated Sugar** is a sugar beet processing plant located in Nyssa, Oregon, near the Idaho border, which is currently closed. Since its air quality permit is still active, this facility will have an emission limit added to its current permit, which becomes effective if the facility resumes operation in the future.

Through these permit modifications these sources will have emissions reductions that contribute to visibility improvement in the Columbia Gorge. DEQ's BART modeling shows PGE Beaver and GP Wauna, had visibility impacts just over the significant impact level (above 0.5 deciview), in the Columbia Gorge. Through these permit modifications,

the emissions reductions achieved results in visibility improvement from 0.18 deciview to 0.31 deciview[7] providing a small yet measurable visibility benefit.

b) BART eligible sources in Washington

Washington identified 15 BART-eligible sources and required the sources to perform modeling to determine if they were subject to the BART requirements. Seven sources were determined to be subject to BART (over the eligible 0.5 deciview threshold). Washington completed its BART process and the level of control (permit modification or BART controls) on these seven facilities by January 2011. Due to the location of these BART-eligible sources, there are some impacts to the Gorge and any reductions would result in reduced regional pollution. The Washington Department of Ecology's modeling shows that three BART-eligible sources, TransAlta with 2.3 deciviews, Weyerhaueser with 0.7 deciviews and LaFarge Cement with 0.5 deciviews have visibility impacts on the Gorge. The Washington Department of Ecology determined the following facilities are subject to BART controls:

1. **TransAlta Centralia Power Plant** (Centralia, WA) is a two-unit coal fired power plant rated at 702.5 MW per unit. In April 2011, the Washington Legislature approved a bill to phase out TransAlta starting in 2020 and completely close the facility by 2025. One of the two coal-fired boilers will be shut down by Dec. 31, 2020, and the other boiler by Dec. 31, 2025.

   In 2013, TransAlta will install additional air pollution control technology to further reduce emissions of nitrogen oxides at the plant. This will reduce permitted levels of NOx by about 10 percent. The SO_2 control is provided by wet limestone, forced oxidation scrubber system providing in excess of 95% control of SO_2. The plant SO_2 emission limit is 10,000 tons per year and currently emits at less that 2,500 to 3,500 tons SO_2 per year. Particulate matter control is provided by series electrostatic precipitators followed by the wet scrubbers.

2. **Weyerhaeuser** (Longview, WA) is an integrated pulp and paper facility. The Kraft recovery furnace and one power boiler are subject to BART at this facility. Weyerhaeuser recently upgraded combustion controls on the recovery furnace and power boiler and installed new particulate control equipment on the power boiler. BART for this facility has been proposed to be the emission controls currently installed and operated.

3. **Lafarge Cement** (Tacoma, WA) is a wet process cement kiln cement plant. The cement kiln is the primary unit at the plant subject to BART. BART for this facility is the installation of SNCR for NOx control and dry sorbent injection for SO2 control. NOx emissions are predicted to be reduced by 869 tons/year and SO2 emissions by 143 tons/year.

[7] http://www.deq.state.or.us/aq/haze/docs/May09/ORRegHazeplan1.pdf

4. **Port Townsend Paper Company** (Port Townsend, WA) is a Kraft pulp mill. The Kraft recovery furnace, one power boiler and the lime kiln at this facility are subject to BART. BART for this facility has been proposed to be the emission controls currently installed and operated.

5. **Tesoro** (Anacortes, WA) is a petroleum refinery. A number of process heaters and other combustion equipment at the refinery are subject to BART. A major SO_2 unit at the plant had a wet scrubber system to reduce its SO_2 emissions in the last three years. For most process heaters and other equipment, BART is proposed to be the current burners and emission controls installed. On one process heater, low NOx burners are proposed to be installed as BART, on another the use of high sulfur fuel oil is to be curtailed. NOx emissions predicted to be reduced by 62 tons/year due to the burner change and SO2 by 35 tons/year due to the curtailment in fuel oil usage.

6. **BP Cherry Point Refinery** (Anacortes, WA) is a petroleum refinery. A number of process heaters and other combustion equipment at the refinery are subject to BART. Most of the BART eligible units at this refinery have been subject to NOx emission reduction projects resulting from an EPA National Consent Decree. Two refinery gas boilers were replaced after the BART modeling baseline period. These two new boilers are proposed to be accepted as BART emission reductions. For all other BART eligible units BART is proposed to be the current burners and other emission controls installed.

7. **Intalco** (Ferndale, WA) is a primary aluminum plant owned and operated by Alcoa. This plant is essentially all subject to BART. BART for this facility has been proposed to be the emission controls currently installed and operated.

c) BART eligible sources in Idaho

The Idaho Department of Environmental Quality submitted its Regional Haze Plan in October 2010, and in the plan it identified seven sources as BART eligible. After conducting modeling to determine which of the sources were over the 0.5 deciview threshold, the Idaho DEQ identified only two sources, Amalgamated Sugar (located in Nampa, ID), and Monsanto P4 Production (located in Soda Springs, ID) as being over the eligible threshold. Idaho DEQ is requiring additional NOx and SOx controls at the Amalgamated Sugar facility to meet BART requirements, and the current controls already in place at the Monsanto facility meet the BART requirements. Although the location of these facilities, in SW and SE Idaho respectively, will likely have a small to negligible individual impact on the Gorge, any reductions would still result in reduced regional pollution.

In summary, as indicated in the Gorge Science Summary report, some of the contributing sources to Gorge haze was from electrical generating units on the eastern side of the Gorge, Portland area sources (including paper mills) on the western side of the Gorge,

and impacts from sources outside the region such as Idaho. The emissions reductions obtained from the BART sources will result in cleaner air in Class I areas and potentially benefit the Gorge.

3. Reasonable Progress Goal and Long Term Strategy

In addition to the BART requirements, a state must establish goals, measured in deciviews that provide for reasonable progress towards achieving natural visibility conditions in Class I areas. The Regional Haze Plan must show reasonable progress in meeting a 2018 benchmark or "milestone" as the first step in achieving natural conditions by 2064. The reasonable progress goals are interim goals that represent incremental visibility improvement over time for the most-impaired, or 20 percent worst days and no degradation in visibility for the least-impaired, or 20 percent best days.

The reasonable progress goals represent incremental visibility improvement over time for the most-impaired days and no degradation in visibility for the least-impaired days.

Preliminary results indicate that Oregon and Washington are not meeting the Regional Haze Program's reasonable progress goals for the 20 percent worst days. However, Oregon and Washington are meeting the objective of no degradation for the 20 percent best days. The primary contributor to the slower rate of progress for the worst days in Oregon and Washington are natural sources such as wildfire and windblown dust. Other sizable contributors include the long-range transport of air pollution from beyond the Northwest, and emissions from commercial offshore shipping. Future plan updates every five years will continue to identify the natural source contribution, and show progress in implementing the existing long-term haze strategies to reduce emissions from sources that are controllable. A comprehensive plan revision is required in 2018, and every ten years after that, which must include an analysis of visibility trends, evaluation of the effectiveness of the long-term strategies and whether revisions to the reasonable progress goals are needed.

One of the key elements for the five-year update in 2013-2015 for Oregon and Washington will be an evaluation of the contribution of large industrial sources not subject to the BART requirements. This "non-BART" evaluation will be similar to the BART process in identifying whether these sources are contributing to visibility impairment (over 0.5 deciview) and if retrofitting with new controls is needed. While this evaluation addresses only Class I areas, the proximity of the Columbia Gorge to nearby Class I areas is expected to provide similar visibility benefits to the Gorge.

In addition to this non-BART evaluation, another analysis for the 2013-2015 plan update in Oregon will identify the contribution of forestry burning to Class I area visibility impairment. One possible outcome of this analysis could be the adoption of special smoke management measures to protect nearby Class I areas from major smoke impacts. This could again provide some visibility benefits to the Gorge. This would be in addition to the current protection of the Gorge as a "smoke sensitive receptor area", which was

adopted by the Oregon Department of Forestry in 2008 as part of their Smoke Management Program, to keep Oregon forestry burning smoke out of the Gorge. Washington has similar smoke protection requirements for the Gorge as well.

Oregon's next update will also readdress other sources of haze, such as the contribution of commercial offshore shipping, for which few regulations have been developed, and outdoor residential burning which may also be contributing to the worse days. Oregon also intends to review ammonia sources in order to determine potential visibility improvements. As Oregon prepares the next plan update, it will work closely with EPA, federal land managers, appropriate stakeholders and tribal nations in conducting these evaluations, and also in evaluating the impacts in the Columbia River Gorge.

With regards to Washington, most of the haze contribution comes from area, point and mobile sources of sulfate and nitrate from inside and outside the region. As part of its Regional Haze Plan, Washington has evaluated point sources that contribute to Class I areas in the region. Emission reductions will be made to several facilities in Washington but will result in less improvement due to the additional distance from the Gorge. Washington also has programs very similar to Oregon in many categories including offshore shipping, clean fuels, engine updates, woodstove standards, smoke management, outdoor burning, and new federal standards for area sources.

Overall these interim goals and the long term strategy help establish a benchmark by which the states can achieve visibility improvement, at definable milestones. While it does not directly translate to a specific goal for the Gorge, it does help establish measures by which the Gorge can continue to see progress.

B. Other Strategies to Address Gorge Visibility

There are many actions being undertaken by state and federal agencies to address haze, including both regulatory and voluntary programs, currently underway or that soon will be implemented and drive continued improvement. As mentioned previously, the Gorge visibility study identified the emission source categories contributing to haze in the Gorge, including PGE Boardman, natural sources (trees, forest fires), and mobile (on-road and non-road) sources. The study also determined there are many different sources from all over the region that are causing haze problems in the Gorge. Some haze pollutants are generated locally, but a large fraction of haze pollution comes from regional sources as far away as Canada and beyond. The following strategies are identified as additional measures focusing to address these emission sources that have been identified to cause haze.

The Gorge visibility study identified the emission source categories contributing to haze in the Gorge, including PGE Boardman, natural sources (forest fires), and mobile (on-road and non-road) sources, area sources, and the "Portland plume."

1. Distant and Regional Sources

The air agencies' study identified regional and distant sources as being large contributors to haze. The federal Regional Haze Program provides a framework for a larger, collective effort on behalf of states to address haze coming from the surrounding area.

2. PGE Boardman

a) Oregon's Utility Mercury Rule

To reduce mercury emissions from coal-fired power plants in Oregon, DEQ adopted a utility mercury rule in 2006. Mercury emissions, including those from burning coal, can eventually reach water bodies and accumulate in fish tissue, which is the main way humans are exposed to mercury. Several of Oregon's rivers, lakes and reservoirs currently have fish advisories because of high mercury content.

The rule limits mercury emissions for new plants and mandates installation of mercury control technology for the PGE Boardman coal fired power plant, Oregon's only existing coal-fired power plant. The PGE Boardman facility is expected to reduce mercury emissions by 90 percent by July 1, 2012. Mercury emissions from the Boardman plant currently range from 137 to 281 pounds per year. DEQ estimates that mercury emissions from the Boardman plant will range from 18 to 35 pounds per year after installing controls.

DEQ's mercury rules are some of the most stringent in the nation. The required mercury emission reductions will provide greater protection from mercury deposition and bioaccumulation in fish, particularly for subsistence and recreational fishers in the Columbia River Basin.

3. Non-road Sources

The air agencies' science study identified diesel emissions, which contain particulate matter, NOx and SO_2 from non-road sources as a leading contributor to haze. Non-road sources are typically non-road vehicles and engines including farm and construction machinery, lawn and garden equipment, marine vessels, locomotives, and aircraft. Strategies and actions to address diesel emissions from these sources include reducing emissions from non-road equipment such as cargo-handling equipment, trains, tugboats, and local government construction fleets.

a) Columbia River Clean Diesel Project

In 2006, the air agencies contracted with the National Policy Consensus Center located at Portland State University to explore implementation options to reduce emissions in the Gorge. The center designs consensus-based decision-making systems that help communities develop sustainable and collaborative projects to address community-based problems.

NPCC recommended that the air agencies focus on small emission reduction project teams to help achieve air emission reductions from sources within the Gorge. The air agencies decided that a bi-state effort would be most effective to help identify and target emission reductions using a collaborative approach with a diverse group of stakeholders.

The air agencies identified reduction of diesel emissions from on-road and off-road vehicles as such an effort and formed a project group, co-convened by the governors of Washington and Oregon, to focus on managing diesel emissions of freight transport in the Columbia River area.

The project, called the Columbia River Clean Diesel Project began in October 2008. Air agencies, industry participants, and regulators met for several months to identify opportunities for new non-regulatory diesel emission reduction projects.

Meeting participants included:

- BNSF Railway
- Cascade Sierra Solutions
- Oregon Department of Environmental Quality
- Oregon Trucking Association
- Port of Portland
- Port of Vancouver
- Ports America
- Shaver Transportation Company
- Southwest Clean Air Agency
- Tidewater
- Union Pacific
- Washington Department of Ecology

During the course of these meetings, funding through the 2009 federal stimulus money became available. The Port of Vancouver, Ports America and Kinder Morgan applied for the Washington state portion of the stimulus money to help install emission reduction retrofits on diesel handling equipment. Ports America and Kinder Morgan are both terminal operators at the Port of Vancouver. Their proposal resulted in an award of $380,000 to install about 86 emission reduction retrofits and one engine rebuild. Each retrofit is expected to reduce particle emissions by 25 percent to 60 percent per diesel engine.

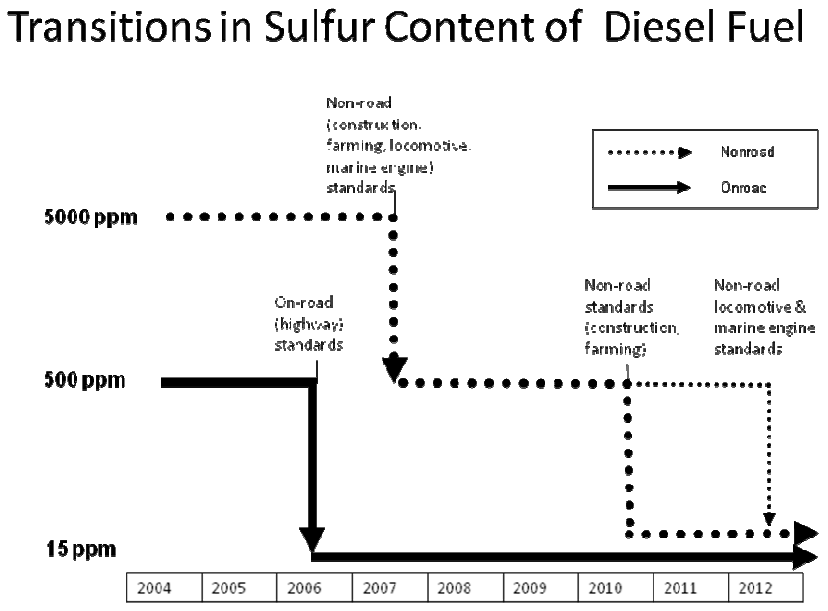
In addition to the emissions reductions generated by these grants, the project group also signed a Declaration of Cooperation in July 2009 that outlines the commitments of the various participants to achieve future diesel emission reductions. The group is also tasked with exploring funding options for existing emission reduction proposals, identifying specific technology or operational options for cargo handling or similar equipment, and identifying any additional opportunities for emission reductions. Following the close of the air agency supported project period, the group decided to continue meeting to identify further collaboration opportunities to reduce diesel emissions from freight movement

activity along the Columbia River corridor.

b) Ultra-Low Sulfur Diesel Fuel Requirements

Diesel engines and vehicles with advanced emissions control devices make it possible to use ultra-low sulfur diesel fuel, which is a cleaner technology resulting in significantly improved air quality. Diesel fuel intended for locomotive, marine, 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 5,000 ppm). The standard of 15 ppm sulfur diesel fuel applies in 2010 to all farming and construction engines and equipment. Locomotive and marine diesel fuel will be required to meet the ultra-low sulfur diesel fuel standard beginning in 2012, resulting in further reductions of diesel emissions. Subsequent reductions in sulfur will result in reductions of sulfur dioxide and ultimately to reductions in sulfate, another pollutant that contributes to haze. Figure 2 provides a graph showing the transitions in sulfur content of diesel fuel over the next few years.

Figure 2: Transitions in Sulfur Content of Diesel Fuel



These diesel fuel requirements not only reduce emissions of sulfur compounds (blamed for acid rain), but also emissions of oxides of nitrogen and particulate matter, which are components of haze forming pollutants.

c) Federal Clean Engine Rules

Non-road engines

EPA has promulgated a comprehensive rule to reduce emissions from non-road diesel engines. The new emission standards apply to diesel engines used in most construction, agricultural, industrial, and airport equipment. Engine manufacturers will produce engines with advanced emission-control technologies similar to those upcoming for highway trucks and buses. The standards took effect for new engines beginning in 2008 and will be fully phased in for most engines by 2014. Pollution from these engines will decrease by more than 90 percent, resulting in annual reductions of 738,000 tons of NOx and 120,000 tons of particulate matter when fully implemented across the United States.

Locomotives and marine engines

Locomotive and marine diesel engines contribute to air pollution in many cities and towns throughout the Gorge. EPA anticipates that over the next few decades, these engines may account for an even greater share of overall emissions as emission control programs take effect for cars and trucks and other non-road emissions sources. EPA's locomotive and marine diesel rule passed in 2008 will result in particulate matter reductions of about 90 percent and NOx reductions of about 80 percent from engines meeting these standards, compared to engines meeting the current standards. By 2030 this program will reduce national annual emissions of NOx by about 800,000 tons and particulate matter emissions by 27,000 tons across the United States and those emission reductions will continue to grow beyond 2030 as fleet turnover is completed.

Closely linked to these engine provisions are new fuel requirements (mentioned above) that will decrease the allowable levels of sulfur in fuel used in non-road diesel engines, locomotives, and marine vessels by more than 99 percent. These fuel improvements will create immediate and significant environmental and public health benefits and will enable the use of new, high-efficiency emission-control devices on non-road engines.

d) Diesel Retrofits for Tugboats & Locomotives

Tugboats

The Columbia River is the largest inland waterway system west of the Mississippi River, routinely served by tugboats that operate between Portland, Oregon and Pasco, Washington. In 2007 Tidewater Barge Line replaced one of its engines, at a cost of $1 million, which resulted in a substantial reduction of NOx emissions.

Recognizing the affect of emissions reductions in the Gorge from tugboat retrofitting, DEQ worked with Tidewater and Shaver Transportation Company the following year to replace tugboat engines on three towboats that operate in the Gorge. The engines were built in the late 1960s to early 1970s, well before any advancement in diesel engine efficiency. Through the retrofitting, which cost $2.5 million, DEQ estimates an annual reduction of about 280 tons of NOx and an undetermined amount of particulate pollution

reduction. These environmental benefits are significant for the cost. DEQ estimated achieving equivalent results from heavy duty diesel trucks and found that it would require retrofitting 370 trucks at a cost of over $5 million.

Additional repowers have been completed on at least three more towboats that are operated by Shaver and Tidewater through the Columbia Gorge. Additionally other operators on the river, learning about these earlier opportunities, became interested in being engaged in engine repowers on their vessels. In 2009 Oregon DEQ applied for and received a federal grant to repower engines on one upriver towboat and four pilot launch boats, the latter operating in the lower Columbia River. Upgrading the engines on the tow boat would reduce particulate emissions by 60.4 tons and nitrogen oxides by 607.2 tons over the life of the project.

In the air agencies' strategy to address diesel emissions in the Gorge, tugboat retrofitting provides an efficient, targeted effort to reduce significant pollutant emissions that contribute to visibility impairment. DEQ will continue to identify future opportunities for tugboat retrofits, seek additional funding, and obtain additional emissions reductions.

Locomotives

Rail also serves an important function in the Gorge, carrying freight from Portland/Vancouver to eastern parts of Oregon and Washington. While the federal government regulates railroads and interstate transport, Oregon and Washington have been working with railroads to seek local efforts to reduce rail emissions. In 2004, SWCAA worked with Burlington Northern and Santa Fe Railway Company, the U.S. Environmental Protection Agency and Kim Hotstart Manufacturing Company to install three retrofit devices on diesel switchyard locomotive engines in Vancouver's switchyard. These devices keep critical fluids warm and flowing, allowing the locomotive engines to be shut down when not performing work and then quickly restart when needed. Reductions from the retrofits have reduced NO_x and particulate matter by 9 tons a year and saved over 47,000 gallons of fuel a year.

e) Future Regulation: Diesel Emissions - Maritime Shipping

Air pollution from ocean going ships was one of the more significant emission source categories identified to influence visibility in western Class-I areas and the Gorge. Air pollution from ships is expected to become more significant as controls on other mobile sources take effect and as port traffic increases. Ocean-going vessels, which are primarily foreign-owned and operated, dock at more than 100 U.S. ports, including ports located in and around the Gorge. The International Maritime Organization approved the formation of an emission control area around the North American continent that would impose a 230-mile buffer zone around the coastline that could provide air quality benefits as far inland as Kansas. The emission control area standards will impose stricter standards on oil tankers and cargo ships that operate in emission control areas. Ships would be required to use fuel with no more than 1,000 parts per million sulfur beginning in 2015 (reducing sulfur in fuel by 98 percent), and new ships would have to use advanced emission control technologies beginning in 2016 to reduce nitrogen oxide emissions by

80 percent and particulate matter emissions by 85 percent. Allowing for lead time this regulation will take effect beginning in August 2012 and help reduce regional emissions from major ports in Seattle, Portland-Vancouver, Astoria, and Newport. Nationally, the overall cost of the North American ECA is estimated at $3.2 billion in 2020, while its benefits are expected to include preventing as many as 14,000 premature deaths and relieving respiratory symptoms for nearly five million people each year in the U.S. and Canada. The monetized health-related benefits are estimated to be as much as $110 billion in the U.S. in 2020.

f) Future Project: Non-road Engines

Currently, the state of California program regulates non-road engines by setting retrofitting standards for non-road heavy-duty diesel fueled vehicles greater than 14,000 pounds. The regulation requires fleets to install exhaust retrofits that capture pollutants before they are emitted to the air, and to accelerate replacements to vehicles with cleaner engines. Oregon and Washington are looking into the feasibility of such a program and are considering whether to seek legislative authority to adopt a program comparable to the California program. If the states were to proceed, it would prevent dirty engines from California from being dumped in Oregon and Washington and create a regional corridor of clean diesel engines along the West Coast.

4. Area Sources

Area sources can include groups of numerous small point sources, such as dry cleaners or other small sources that do not individually emit significant amounts of pollutants, but when the emissions from all of these small sources are combined, can be a source of emissions in the Gorge. Area sources can include emissions from woodstoves, outdoor burning, paint and solvent use, and small, non-permitted point sources, such as dry cleaners, auto body refinishing shops, fast food restaurants. For example, emissions from uncertified woodstoves can emit up to 70 percent more fine particulate than certified woodstoves. Some of the strategies included below focus on changing out older, polluting stoves with newer, more efficient devices, greatly improving health conditions and seasonal haze. Other strategies focus on federal regulatory efforts to reduce emissions from the various categories of non-permitted sources.

a) Woodstove Smoke Reduction Project in Washington

In the fall of 2007, SWCAA enhanced the annual rebate program it has been offering to Washington citizens to encourage the removal of old, high-polluting woodstoves and replacing them with cleaner-burning home-heating devices. Upon written confirmation to SWCAA that an old uncertified woodstove has been destroyed, Washington residents became eligible for the following rebates: $250 rebate if a new Washington-certified woodstove had been purchased; $300 if a new Washington-certified pellet stove had been purchased; and $400 if the resident has converted to natural gas or propane instead of wood-burning. Residents of Skamania County also qualify for an additional $100 Gorge rebate on a replacement unit to further reduce air emissions in the Columbia River Gorge

National Scenic Area. SWCAA replaced 27 stoves, two of which were in Skamania County.

In 2008, SWCAA also received a $260,000 grant to replace uncertified stoves in the Vancouver area. SWCAA took a two-tiered approach to the woodstove rebate program. The first tier offered a $1,500 voucher to any resident who had an uncertified woodstove/woodstove insert and burned more than a cord of wood a year. The second tier offered a $3,000 voucher for low-income residents who had an uncertified stove. Through this program SWCAA assisted in changing out 150 old uncertified woodstoves and replacing them with 141 new certified stoves, six natural gas/propane units and three electric heating units.

b) Oregon's Heat Smart Woodstove Upgrade Program and Oregon Tax Credits

In 2009, the Oregon Legislature authorized the establishment of "Heat Smart," a program designed to accelerate the turnover of older, uncertified stoves. The law requires homeowners to remove uncertified woodstoves upon home sale. The legislation also establishes a funding framework for local communities to set up change out programs. This program went into effect starting August 1, 2010.

In addition to removing and replacing uncertified woodstoves, the Oregon Department of Energy currently provides a $300 tax credit towards the purchase of a new, premium efficiency residential wood or pellet stove. This program provides incentives for obtaining the cleanest and highest efficiency devices to reduce the amount of particulate matter pollution and air toxics into the air. By reducing the emissions from woodstoves, it would provide additional air quality benefits and improve visibility in the Gorge.

c) Federal Air Toxics Source Standards

EPA has promulgated air toxics standards for area sources, including gas stations, dry cleaning shops, auto body refinishing, cement plants, and commercial, industrial, and institutional boilers which are currently in effect or about to go into effect over the next few years. These standards, referred to as National Emission Standards for Hazardous Air Pollutants, regulate hazardous air pollutants, often referred to as air toxics. Sources subject to these standards are required to use control technologies to reduce the amount of air toxics released. Though emissions from individual sources are often relatively small, collectively these emissions can be of concern - particularly where large numbers of sources are located in heavily-populated areas. There are currently 52 area source categories in Oregon and Washington that are subject to these air toxics standards (with approximately 2,540 affected sources in Oregon). Many of these sources are located in metropolitan areas, including the Portland-Vancouver area and in other communities along the Gorge. While air toxics are not directly related to visibility impairment, these standards to address air toxics will result in a significant reduction in air pollution and improve public health throughout Oregon, including the Gorge.

d) Future Project: Additional Wood Smoke Reduction Efforts

DEQ hopes to pursue a number of wood smoke reduction efforts, including woodstove change-outs throughout the state and in local Gorge communities. To do this, DEQ is exploring options to secure funding to provide rebates, or work with local organizations and communities to establish low-interest loans, including seeking stimulus funds for woodstove change-outs and home weatherization programs. DEQ also plans to work with stakeholders to explore other avenues for change-out funding options.

e) Future Regulation: Emission Standard for Woodstoves

Current federal regulations only target a limited universe of wood burning sources, via the new source performance standards for residential wood heaters. The standards have not been revised since 1992 and wood heat technology has advanced significantly since the existing standards were phased in almost twenty years ago. EPA has indicated that it plans to lower the emission standard and include a larger class of wood burning devices, including exempt stoves. Washington has already established the most stringent emission standard for devices sold in Washington. Oregon also has authority to establish more stringent standards for woodstoves, if EPA does not act within the next few years. This would guarantee woodstoves sold in the Pacific NW and in the Gorge would have to meet these more stringent emission standards. Improved standards for woodstoves would help reduce particulate emissions by ensuring only the cleanest burning devices are allowed to be sold, installed and used in homes.

5. On-Road Motor Vehicle Emissions

The air agencies also identified on-road mobile sources as another emission source contributing to haze formation in the Gorge. Vehicle emissions from Portland and the region accounted for up to 16 percent of haze in the Gorge. Haze forming pollutants, including CO, NOx, and volatile organic compounds from motor vehicles, and diesel particulate matter emissions from on-road highway vehicles all contribute to air pollution in the Gorge. The air agencies have identified and undertaken a number of strategies and actions to address emissions from these sources, including the requirement that all new motor vehicles must meet stringent low emission vehicle regulations, diesel retrofits for school buses and on-road private and public vehicle fleets.

a) California Low Emission Vehicles in Oregon and Washington

In 2005 and 2006, Washington and Oregon adopted regulations requiring that vehicles sold must meet the California low-emission vehicle standards. These standard decrease emissions that cause ground-level ozone (an air pollutant formed by a chemical reaction of volatile organic compounds and NOx), promote zero-emission vehicles and reduce greenhouse gases. The regulations apply only to new cars and trucks, beginning with the

2009 model year. When the rules take full effect in model year 2016 they will reduce greenhouse gas emissions 30 percent, substantially improve fuel efficiency, and lower smog-forming emissions from 12 percent to 33 percent by 2020. California intends to strengthen greenhouse gas standards beginning in 2017 to obtain 45 percent greater reductions by 2020. California standards will help reduce haze impairment in the Gorge.

b) Motor Vehicle Inspection and Maintenance Program

Vehicle inspection and maintenance programs help improve air quality by identifying high-emitting vehicles in need of repair and requiring them to be fixed as a prerequisite to vehicle registration within certain areas. Vehicle exhaust emissions can contribute to Gorge haze because it includes NOx, one of the precursors to haze-forming pollutants such as nitrates. All new passenger cars and trucks sold in the U.S. today must meet stringent pollution standards, but they remain low-polluters only if the emission controls and the engine are both functioning properly. In the Portland/Vancouver area, the vehicle inspection program requires periodic emissions performance checks and repairs for those vehicles that fail emissions tests, and it ensures that vehicle exhaust emissions remain low.

c) Ultra-Low Sulfur Diesel Fuel Requirements

Beginning in 2006, EPA mandated new standards in highway diesel fuel, known as ultra-low sulfur diesel. This regulation dropped the sulfur content of diesel fuel from 500 ppm to 15 ppm. Ultra-low sulfur diesel fuel enables the use of cleaner technology diesel engines and vehicles with advanced emissions control devices, resulting in significantly improved air quality. Subsequent reductions in sulfur will result in reductions of SO_2 and to reductions in sulfate, another pollutant that contributes to haze.

d) Diesel Retrofits for Vehicle Fleets (Local Government, Private Sector)

To further address highway diesel emissions, Washington and Oregon are also pursuing a regional effort to conduct diesel retrofits of local government and private fleets. In Washington, the Southwest Clean Air Agency, in partnership with the Department of Ecology, reduced diesel emissions on motor vehicles in the public sector as well as for private fleets by the installation of diesel oxidation catalysts and diesel multistage filters. Many cities and counties near the Gorge will benefit from these retrofit installations, including Vancouver, Stevenson, Clark County, and Cowlitz County. To date, the Southwest Clean Air Agency facilitated the installation of diesel emission reduction retrofit devices on over 100 government fleet vehicles and over 80 private fleet vehicles.

Many Oregon communities near the Gorge applied for and received a total of $3.5 million in 2009 federal stimulus money to retrofit or repower their diesel fleets and buses. The city of Portland and Multnomah County received over $2.1 million in federal stimulus funds to retrofit or repower their diesel fleets. Public fleets, both on-road and off-road engines, in the Portland metropolitan area will be retrofitted with best available emission control technology for the engine, which will result in reductions of diesel

particulate matter emissions by 25 percent or more. These devices will use catalyzed diesel particulate filters, partial flow filters, or diesel oxidation catalysts, depending on the engine model year and engine type. The remaining federal stimulus money ($1.4 million) will be used to retrofit public fleets in Milwaukie, Lake Oswego, and Washington County, and Tri-Met buses. These diesel engines will be retrofitted in 2010. The diesel retrofits are all part of a regional effort to reduce emissions in Oregon and Washington, with benefits to the Columbia River Gorge.

e) Diesel Retrofit on School Buses in SW Washington and Oregon

The majority of school buses currently used in Oregon and Washington are diesel buses. Evidence indicates that levels of diesel particulate matter inside buses are higher than outside air due to self-pollution. These buses present unacceptable pollutant exposures to school children through in-cabin exposure to diesel emissions, in addition to contributing to haze in the Gorge. Since the Washington State School Bus Retrofit Program was funded by the Washington State Legislature in 2004, the Southwest Clean Air Agency has distributed $1.7 million to have diesel emission reduction retrofits installed on many diesel school buses. This emission reduction program resulted in more than 650 school buses in southwest Washington being installed with diesel oxidation catalysts, 350 of these school buses also receiving the installation of closed crankcase ventilation systems to capture emissions that could go inside the school bus, and an additional 50 school buses being installed with diesel multi-stage filters. Retrofitted school buses in southwest Washington now emit 30 percent to 70 percent less air pollution in the form of fine diesel particles coming out of the exhaust pipe.

The Oregon program to retrofit school buses began installation of retrofits in 2009. Over 15 school districts throughout Oregon have installed closed crankcase ventilation systems, or partial flow filters on school buses. School districts in the Portland metro area and the coastal area along the Columbia Gorge River (Astoria, Nappa) underwent retrofitting of approximately 135 buses. These buses have reduced their particulate emissions by 50 to 60 percent.

The new equipment will reduce diesel fumes that build up inside the buses, further protect schoolchildren and reduce visibility-impairing emissions in the region. Washington and Oregon plan to continue the program as long as available funding permits.

f) Future Regulation: Low Carbon Fuel Standard

In 2009, Oregon passed legislation authorizing the Environmental Quality Commission, DEQ's governing board, to adopt a low carbon fuel standard that would reduce lifecycle greenhouse gas emissions from gasoline and diesel by 10 percent by 2020. The bill sets a performance standard for emissions from transportation fuels, without mandating the use of any specific fuel. While the focus of this initiative is on greenhouse gases, battery-electric vehicles and plug-in hybrid electric vehicles could be an effective way to meet the low carbon fuel standard target. If the standard serves to boost the use of electric

vehicles, it will also reduce the number of internal combustion vehicles and the pollution they generate. Reducing the number of gasoline vehicles on the road also results in fewer emissions of NOx and particulate matter, all pollutants that can contribute to haze formation.

The state of Washington has also studied how a low carbon fuel program would work as part of its overall climate change strategy for the state. Many components of their program would be similar to Oregon's approach of reducing greenhouse gas emissions from gasoline and diesel.

6. Industrial Point Sources

Emissions from industrial point sources (besides PGE Boardman) are also identified as contributing to haze in the Gorge. These "point sources" include electrical generating units, pulp and paper mills, secondary aluminum production plants, and other industrial sources. The following lists federal regulatory programs and strategies in place to address these emissions.

a) Federal Regional Haze Program

The federal Regional Haze Program requires controls to address haze from Best Available Retrofit Technology (BART)-eligible sources. In the five-year update, Oregon and Washington will identify all industrial sources not subject to BART requirements that could be affecting Class I areas across the region, which could include boilers and glass, cement, and steel manufacturing plants. In addition, the sources identified as BART-eligible but were not subject to BART controls (due to the fact they modeled under the visibility impact threshold) will be reviewed again to see if any increases in emissions has occurred.

b) Federal Air Toxics Source Standards for Oregon and Washington

As noted earlier, EPA has many air toxics standards for major sources, including pulp and paper mills and electrical generating units which are currently in effect or about to go into effect over the next few years.

Standards affecting pulp and paper mills and major surface coating operations are already in effect. EPA will continue to issue new standards and update existing standards that could include additional sources subject to air toxics regulations. A full listing of the air toxics source standards is available in Appendix B. In addition to reducing air toxic emissions, these standards may reduce emissions of sulfur dioxide, oxides of nitrogen, volatile organic compounds, and other pollutants that contribute to haze. Overall, these standards will have a beneficial effect on visibility in the Gorge.

c) Prevention of Significant Deterioration (PSD) requirements

The "prevention of significant deterioration" is a federal permitting program to help protect against visibility degradation that could be caused by proposed new or expanding federal major industrial facilities. The program requires proposed new or expanding major sources to undergo an air quality analysis of visibility impacts in wilderness areas and national parks, as well as to evaluate potential adverse impacts on other ecosystem values, such as vegetation, lakes, soils, and visibility. Under Oregon's and Washington's program, proposed major sources also have to evaluate their potential impacts on the Gorge. While the program does not reduce emissions from existing industrial facilities, it helps manage and limit the growth of future emissions from proposed new or expanding major industry.

7. Burning – Agricultural & Forestry

The Gorge Science Summary Report indicated that natural emissions, such as forest fires and other burning emissions from prescribed and agricultural burning were major contributors to haze in the Gorge. While emissions from forest fires are harder to control because they do not occur in the same area and vary from year-to-year, the air agencies are identifying strategies to address controllable sources of burning.

a) Smoke Management in Oregon and Washington

The Oregon Department of Forestry smoke management program currently provides smoke protection for designated urban areas, or smoke sensitive receptor areas. This effort requires more intensive smoke management when burning upwind of such an area, in order to avoid any smoke intrusion into the area. ODF in consultation with DEQ revised the Oregon Smoke Management Plan to designate the entire Gorge Scenic Area as an urban- and visibility-protected area. The plan includes mandatory measures to protect the Gorge when burning inside or upwind of the Gorge. As a result, it will be a high priority for forest agencies to keep prescribed fire smoke out of the Gorge. This provision offers stricter protections than for Class I areas, which has only voluntary provisions to prevent prescribed burning smoke from getting into these areas. Future strategy discussions will include conversations with the Washington Department of Ecology to establish a reciprocal agreement.

b) Agricultural Burning Plan

The majority of agricultural burning in Oregon is associated with grass seed and wheat burning. Smoke from agricultural burning can be a significant health issue for people sensitive to the pollutants found in smoke. Other pollutants found in field burning, such as carbon monoxide, and carcinogenic compounds like polycyclic aromatic hydrocarbons, benzene, aldehydes and metals, have the potential to cause health problems depending on the level and duration of exposure and have visibility impacts in areas such as the Columbia River Gorge.

To address issues of public health and impacts from smoke, the 2009 Oregon Legislature passed a bill eliminating most field burning in the Willamette Valley by 2010. Limited burning of certain fire-dependent grass species (15,000 acres) will still be allowed; however other types of burning such as propane flaming and stack burning will be significantly reduced and eventually eliminated by 2013. Overall it will reduce the frequency and magnitude of smoke intrusions in the Willamette Valley. A secondary benefit from this legislation will be reductions in long-range transport of smoke outside the valley, in areas such as the Gorge, where field burning smoke may have contributed to haze levels and visibility reduction.

8. Portland-Vancouver Area Emissions

The air agencies' visibility study indicated that during the summertime, when winds are blowing from the west, emissions from the Portland-Vancouver area contribute to haze in the Gorge. The Portland-Vancouver emissions consist of a variety of sources, including contributions from motor vehicles, non-road sources, area sources, as well as air toxics.

a) Portland and Vancouver Air Toxics Solutions Plans

The EQC adopted ambient benchmarks for 51 air toxics in Oregon. The benchmarks are set at levels protective of human health over a lifetime of exposure, and are based on recommendations of DEQ's Air Toxics Science Advisory Committee. To address the concern of air toxics in Oregon, the DEQ adopted an innovative state program to reduce risk from air toxics in Oregon. The goal of the program is to fill in the gaps in the federal air toxics program, which has primarily focused on reducing air toxics emissions from larger industrial facilities. The program is designed to address risk from source categories and individual sources that are not otherwise regulated by federal standards including developing an area-wide plan to reduce risk from point, area and mobile sources commensurate with their contribution to the problem. Information about the Portland air toxics strategy can be found on DEQ's web site:
http://www.deq.state.or.us/aq/toxics/pats.htm

In 2008, DEQ announced the Portland region as Oregon's first air toxics geographic area. DEQ has determined that within the Portland region, which includes sections of Multnomah, Washington and Clackamas counties, at least ten air toxics are above the health benchmarks, and three of these are more than ten times above the benchmarks.

This DEQ project is named "Portland Air Toxics Solutions." Beginning in 2009, DEQ began working with a broad group of partners and an advisory committee to develop and implement an air toxics emission reduction plan. This plan could include both mandatory and voluntary air toxics reduction measures needed to reduce risk, including the identification of sources that contribute air toxics to the Portland airshed. These efforts will be focused on reducing air toxics, but may have additional co-benefits in reducing particulate, ozone precursors and greenhouse gases, many of which are haze-forming pollutants that could affect the Gorge.

In Washington, air toxic emission reductions are being achieved through its New Source Review (NSR) program. Since the early 1990s, all new sources of air pollution location in southwest Washington and existing sources making modifications have had their emissions screened to determine that toxic air pollutant emissions from a list of approximately 400 compounds are within acceptable source impact levels. This rigorous scrutiny of toxic air pollutant emissions will continue into the future.

b) Portland and Vancouver ozone maintenance plans

In March 2008, EPA strengthened the national ambient air quality standard for ground-level ozone, the primary component of smog. Scientific evidence indicates that adverse health effects occur particularly in those with respiratory illnesses following exposure to ozone at levels below the current standard. In addition, new scientific evidence shows that repeated exposure to low levels of ozone damages vegetation, trees and crops, leading to increased susceptibility to disease, damaged foliage, and reduced crop yields. The Portland-Vancouver area violated the ozone standard back in 1978, but was brought into compliance by 1982. The ozone standard was exceeded again in the early 1990s which resulted in the Department of Environmental Quality and Southwest Clean Air Agency implementing attainment plans that improved air quality by the mid-1990s. The air agencies then implemented EPA approved maintenance plans that insured the ozone standard would be maintained for successive 10-year time periods covering 1997-2006 and 2007-2016. The successful ozone maintenance plan program measures include a motor vehicle inspection program, voluntary parking ratio rules, alternative commute programs in the Portland area, and implementation of standards for industrial and area sources to control volatile organic compound emissions. These strategies have reduced Portland/Vancouver's "pollution plume" and has benefited the Gorge.

In January 2010, EPA proposed to tighten the ozone standard, based on available health studies, and will finalize the revised rule by fall 2011. If needed, DEQ and SWCAA will develop additional ozone reduction strategies and programs to meet any revised ozone standard in order to protect public health. DEQ and SWCAA expect that such strategies would benefit the Columbia Gorge.

c) Future project: Transportation Greenhouse Gas Reductions – Portland metro area

In 2009, the Oregon Legislature passed House Bill 2186 and House Bill 2001 which contain requirements for the Oregon Department of Land Conservation Department, the Oregon Department of Transportation, and local Metropolitan planning organizations to develop planning scenarios to reduce greenhouse gases from transportation. House Bill 2186 sets up a process to develop recommendations for legislation that could require similar "scenario planning" of all six Oregon metropolitan planning organizations including Portland. House Bill 2001 includes requirements for DLCD to establish rules to set targets for greenhouse gas reductions for the Portland metro area. These measures could result in reductions of overall travel, greenhouse gases and related air pollution.

9. Ammonia

Ammonia emissions from sources like agricultural operations could contribute to visibility degradation. Ammonia plays a key role in the formation of small sulfate and nitrate particles leading to haze pollution. Currently, the state of the science for estimating ammonia emissions from various sources has a relatively high degree of uncertainty. EPA is developing more accurate ammonia estimation methods to be available in the next few years. While further research is needed to better quantify ammonia emissions, it is clear that regional ammonia plays an important role in haze formation; therefore it is desirable to take some initial actions now to reduce ammonia emissions as the science for estimating ammonia becomes more certain.

a) Oregon's Dairy Task Force Recommendations

Oregon Senate Bill 235 in 2007 created the Dairy Air Quality Task Force to study the air emissions from Oregon dairy operations, evaluate options for reducing those emissions, and to make findings and recommendations concerning air emissions from dairy operations. The task force provided recommendations that included encouraging voluntary programs to reduce emissions from confined animal feeding operations and additional research to identify appropriate best management practices for Oregon. The task force also recommended that the Oregon Department of Agriculture, DEQ, and the Oregon Department of Human Services adopt rules to implement the proposed Oregon Dairy Air Emissions Program. The program would start as a voluntary program, and move into a state mandatory program pursuant to the recommended conditions and schedule. The task force also recommended that DEQ and ODA, in consultation with DHS, should convene a Dairy Air Advisory Committee to advise and make recommendations. For additional information on the Oregon Dairy Task Force, see http://www.deq.state.or.us/aq/dairy/index.htm.

DEQ's implementation of the Dairy Task Force's recommendations was dependent on receiving funding allocations for this program. Unfortunately, this funding was not provided by the Oregon Legislature. In the meantime, the Oregon dairy industry has identified voluntary BMPs being utilized by various dairy operations in Oregon.

b) BMPs at Threemile Canyon Farm (TMCF)

Threemile Canyon Farm, a dairy operation and agricultural farm located in eastern Oregon, is a facility that has 41,000 dairy cows and is continuously addressing its air emissions by applying new technologies and adaptively managing its dairies with best management practices (BMPs). In particular, ammonia produced in large amounts during the decomposition of organic forms of nitrogen present in animal waste is being addressed in a systematic way. It is estimated that a diary of Threemile Canyon Farms' size, using new technologies and BMPs might release in the range of 12,000 – 16,000 tons per year of ammonia emissions. To address ammonia emissions, Threemile Canyon Farms currently uses manure from the dairy as fertilizer and compost for its agricultural crops. The facility also recently built a free-standing methane digester on the farm to

extract methane gas from dairy manure to produce fuel.

Threemile Canyon Farms' waste management system currently stores its manure slurry water in a lined lagoon prior to pumping it onto its crops as fertilizer. Before the slurry mixture enters this lagoon, it travels through a newly build enclosed digester structure. This facility is lined with waste tires as an expanded surface area for bacteria from the manure to grow on and to produce gas. The lagoon is covered and gas is extracted from the interface between the surface of the lagoon and the bottom of the cover. For now, this gas is returned to Threemile to be used to heat manure going into the digester and any excess gas is flared. Threemile Canyon Farms hopes to utilize the excess gas to heat hot water for sanitation purposes in the milk parlors, if production justifies an investment in a boiler and would further reduce fossil farm use on the farm property.

Another BMP utilized by Threemile Canyon Farm to reduce ammonia emissions is to limit the storage period time of the manure liquids in lagoons. In general, the longer manure liquids are stored in lagoons, the more anaerobic the lagoons become which results in more emissions of ammonia. The general practice in the industry is to store manure for long periods and empty the lagoons once or twice a year. During the growing season, the average storage period at Threemile Canyon Farms is less than 25 days in the lagoons. Overall, these processes will help reduce ammonia and methane emissions from the farm and improve visibility in the Gorge.

C. Other Air Quality Issues of Concern

1. Public Health

Monitoring data collected by the state air agencies in the Gorge shows that air quality in the Gorge meets all federal air quality health standards.

While the charge of the Gorge strategy is to address visibility conditions in the Gorge, ensuring that air quality is maintained at safe public health levels is important. Visibility impairing pollutants such as nitrogen dioxide, sulfur dioxide, and particulate matter are all common air pollutants for which EPA has established federal health standards. Monitoring data collected by the state air agencies in the Gorge shows that air quality in the Gorge meets all federal air quality health standards. In fact, air quality levels that protect human health have been maintained in the Gorge for the past several decades. Nevertheless, protecting public health will always be a vital part of the Gorge's air quality strategy and the air agencies will continue to ensure that air quality health standards continue to be met in the Gorge and across the state.

a) Particulate Matter ($PM_{2.5}$)

In 2006, EPA adopted revisions to the national ambient air quality standards for particulate matter. EPA lowered the standard from 65 ug/m^3 to 35 ug/m^3 due to scientific studies showing an association between exposure to particulate matter and significant

health problems, at much lower levels. Such health problems include aggravated asthma, chronic bronchitis, reduced lung function, irregular heartbeat, heart attack, and premature death in people with heart or lung disease. There are three communities in Oregon that are in violation of the standard, Klamath Falls, Lakeview, and Oakridge, and in Washington, the Tacoma area is in violation. These areas must take measures to reduce particulate matter pollution. Besides these communities, Oregon and Washington will be working with other communities across the state, including the Gorge communities, to ensure they stay below the standard and adequately protect public health.

b) Ozone

In March 2008, EPA strengthened the national ambient air quality standard for ground-level ozone, the primary component of smog. EPA lowered the standard from 0.80 ppm to 0.75 ppm based on scientific evidence indicating that adverse public health effects occur following exposure to ozone at levels below the older standard, particularly in those with respiratory illnesses. There are currently no areas in Oregon or Southwest Washington that are in violation of the current ozone standard. In January 2010, EPA proposed to again tighten the ozone standard, based on available health studies, and will finalize the revised rule by fall 2011. If needed, DEQ and SWCAA will develop additional ozone reduction strategies and programs to meet any revised ozone standard in order to protect public health. DEQ and SWCAA expect that such strategies would benefit the Columbia Gorge.

2. Ecological Effects

During the course of completing the technical study, the air agencies also learned of concerns relating to ecological effects and cultural resources. For example, the U.S. Forest Service conducted studies that looked at fog water chemistry, ozone injury to vegetation, and potential impact to lichen ecosystems. The Gorge area tribes began looking into the effects of air pollution on Native American rock images.

Studying lichen compositions helps provide a first glimpse of potential ecological effects from air pollution. Excess nitrogen deposition can alter plant composition and productivity as well as soil chemistry. The air agencies believe this is a very important area of investigation, and more research should be conducted by the U.S. Forest Service to better understand the risks faced by Gorge and Class I area ecosystems. For example, different ecosystem types across the nation have different resiliencies to air pollution. It is currently unclear just how resilient or vulnerable Gorge and local Class I wilderness areas are to nitrogen or acid deposition. In addition, more complete information would be helpful on the regional nitrogen and acidic deposition trends. Recent studies seem to suggest that trends in sulfur and nitrogen deposition levels remain steady or are slowly increasing in the Gorge. As the USFS continues with its study, the air agencies look forward to being apprised of final study results and discussing findings with federal land managers, elected officials or other stakeholders as well as tribal nations.

Because pollutants that impair visibility in the Gorge are the same that can affect broader

ecosystem issues in the Gorge, the air agencies believe that the strategies set forward in this document to reduce haze pollution would both, directly and indirectly, benefit all the valued resources that must be protected under the Scenic Area Act.

V. Gorge Visibility Technical Studies[8]

Developing a strategy to reduce emissions in the Gorge requires knowing what sources are contributing to haze. The air agencies conducted technical assessments, and reviewed existing visibility studies by DEQ and others to determine current haze conditions in the Gorge.[9] This research provides further insight on visibility conditions and the sources contributing to haze in the Gorge.

A. Source Contribution Studies

The Gorge visibility study looked at all the sources affecting the Gorge during summer and winter high-haze episodes and determined that visibility is not degrading and is expected to improve in the coming years despite regional growth pressures. The study identifies the PGE Boardman coal-fired power plant as the most significant contributor to haze in the Gorge. In addition, there are several other significant emission sources such as natural sources (trees, forest fires), and mobile (on-road and non-road) sources. The study also determined that there are many different sources from all over the region that are contributing to haze problems in the Gorge. Some haze pollutants are generated locally, but a large fraction of haze pollution comes from regional sources as far away as Canada and beyond. Figures 5-8 characterizes the source contributions by east or west end of the Gorge and time of year. Key source categories as shown in the figures below include:

The PGE Boardman coal-fired power plant is identified as one of the most significant contributors to haze in the Gorge in addition to several other emission sources.

- EGUs - Electrical generating units (e.g., power plants)
- Point sources (e.g., major industrial facilities)
- Non-road sources (e.g., marine engines, construction equipment, locomotives)
- Motor vehicles (e.g., cars, trucks)
- Distant sources (e.g., emission sources located outside the region – such as those coming from California, Canada, and beyond)
- Natural sources (e.g., wildfires, volcanoes)
- Other sources (e.g., individual sources that each are less than 1% of the contribution, but are aggregated in the graph)

[8] A detailed description of all the studies referenced in this section is available in Appendix A.

[9] http://www.deq.state.or.us/aq/gorgeair/scienceday.htm

Figure 3: East end of Gorge (Nov 2004)

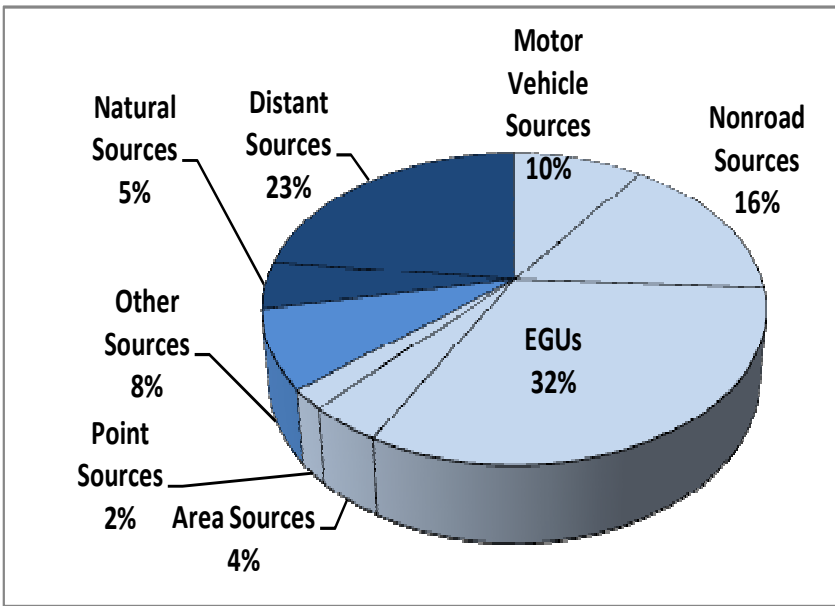


Figure 4: West end of Gorge (Nov 2004)

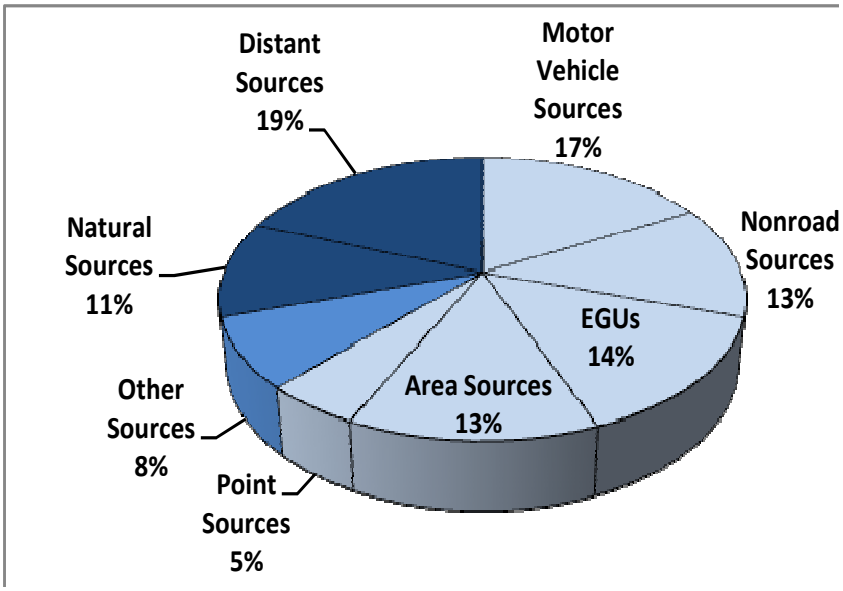


Figure 5: East end of Gorge (Aug 2004)

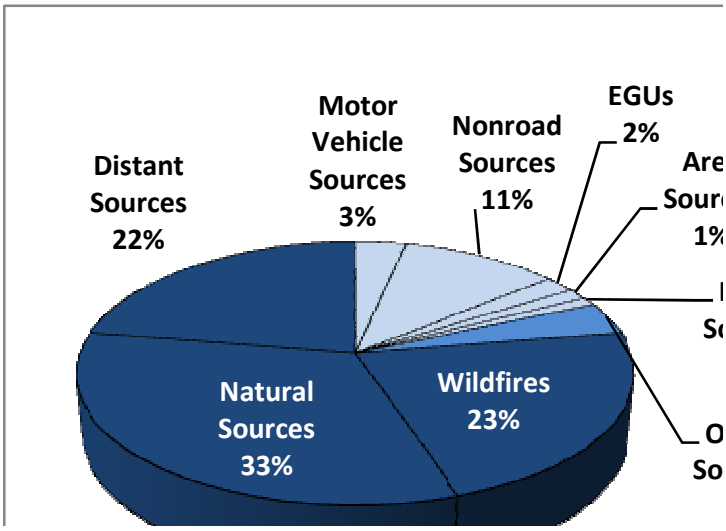
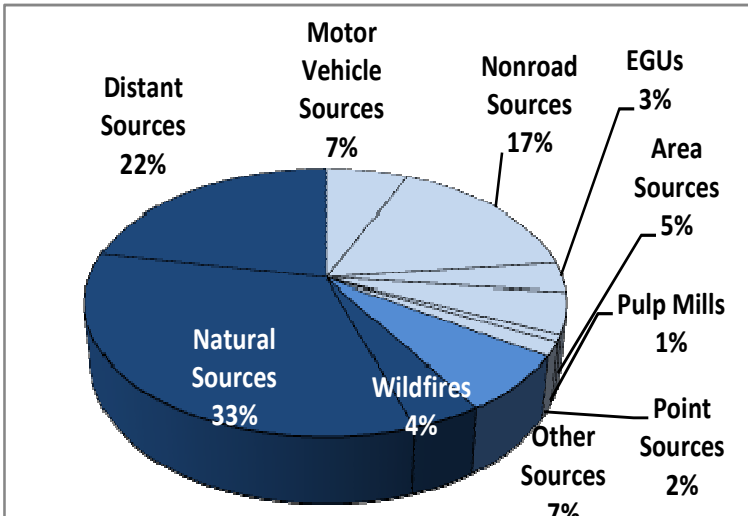


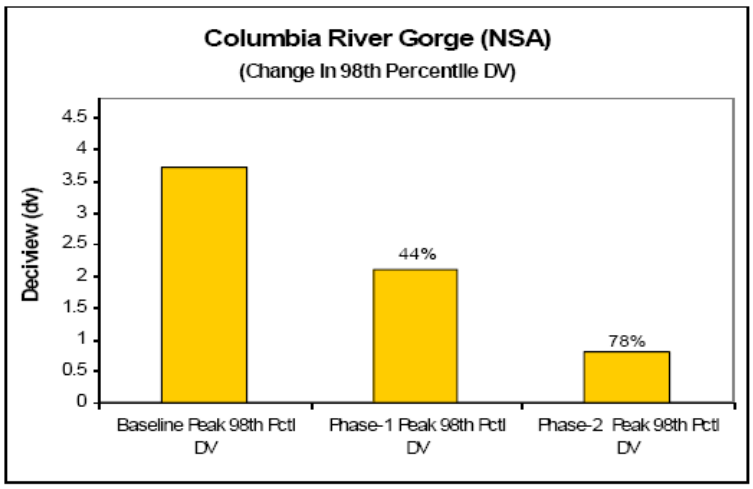
Figure 6: West end of Gorge (Aug 2004)



For a more detailed description of the technical study, and various study components please see Appendix A.

While the Gorge study looked at all the sources contributing to haze in the Gorge, there were additional studies (DEQ, Jaffe) that specifically looked at only one source, PGE Boardman, and its influence on visibility in the Gorge. DEQ's initial BART modeling analysis evaluated the visibility impacts in the Gorge caused by implementing certain BART controls on Boardman, resulting in a 44 percent reduction in visibility impacts in the Gorge from Phase 1 controls. Additional controls or "Phase 2" controls would increase that percentage to a 78 percent reduction of visibility impacts in the Gorge. Figure 9 illustrates the percentage reduction in peak visibility impacts. DEQ's BART controls for NOx and SO_2 would reduce both the number of days of visibility impact and the magnitude of the impacts.

Figure 7: PGE Boardman Peak Visibility Impacts on the Gorge



The Yakama Nation study (conducted by Dr. Dan Jaffe – University of Washington) also analyzed Boardman's influence in the Gorge by reviewing available monitoring data using back trajectory calculations to identify transport and sources of particulate matter and compared the results to the air agencies' Gorge visibility study. Dr. Jaffe concluded Boardman's influence was greater than what was characterized in the Gorge visibility study, contributing up to 55 percent of the particulate matter mass.

The air agencies' Gorge visibility study, DEQ's regional haze/BART study of Boardman, and the Yakama/Jaffe study all evaluated the contribution of the Boardman facility to haze, each from a different perspective. All three studies reached the conclusion that emissions from PGE Boardman have a significant visibility impact on the Columbia Gorge. As described previously, under DEQ's 2010 BART rules for PGE Boardman, the facility will be required to shut down no later than December 31, 2020. At the same time, the rules will reduce haze forming emissions by 48 percent in the 2011 to 2019 timeframe and eliminate these pollutants completely after closure. This action will improve visibility and reduce acid deposition in Oregon and Washington Class I wilderness areas as well as the Columbia Gorge.

The purpose of the Gorge visibility study was to provide a comprehensive look at all emission sources contributing to haze in the Gorge and provide a broad picture of local and regional sources influencing the Gorge in the summer and winter. The Gorge visibility study indicated that haze is caused by many different sources, and while controls on the Boardman power plant will help considerably, there will still be haze events in the Gorge caused by a combination of local and distant sources. The state regional haze planning process will address both local and regional haze sources over time and provide continual, long term visibility improvement.

B. Visibility Trend Studies

A number of studies (Norville, 2006; Jaffe, 2006; ENVIRON, 2007; Geist, 2007)[10] looked at air quality trends in the Gorge. These studies defined historical and future trends using monitoring data. Overall, high haze events occur in the Gorge. These events vary year-to-year and are influenced by local and regional emissions sources as well as local and regional meteorology such as local stagnation and regional and global transport winds. Based on a review of historical data, one trend analysis suggests that current haze levels show a slightly improving or flat trend. Although another analysis suggests that there is no evidence for improvement it is limited to only the worst air quality days. Overall, current monitoring trends show that visibility in the Gorge is not getting worse, but rather holding steady or improving slightly in the face of regional growth. DEQ's projections of future haze trends through 2017 also show an improving trend in visibility.

Overall, current monitoring trends show that visibility in the Gorge is not getting worse, but rather holding steady or improving slightly in the face of regional growth.

C. Acid Deposition Studies[11]

Several U.S. Forest Service studies (Fenn, 2006; Campbell, 2007) in and near the Columbia River Gorge have found elevated levels of acid deposition that raise some concern about the potential for damage to sensitive ecosystems and Native American rock images. For example, sulfur and nitrogen compounds can cause acid deposition and can contribute to acid rain. Emissions of SO_2 and NOx can come from many different sources, including PGE's Boardman power plant.

DEQ conducted a case-study using a computer model to estimate the likely reduction in acid deposition that would occur in the Mt. Hood, the Columbia Gorge, and Mt. Adams areas as a result of the emission controls for the Boardman power plant. This analysis showed that the SO_2 and NOx controls required by DEQ's rules will reduce PGE Boardman's contribution to acid deposition in these areas by about 80 percent through 2020, at which time pollution from the Boardman coal-fired boiler will be permanently eliminated.[12] These controls can help reduce the overall risk to ecosystems and culture resources in wilderness areas as well as the Columbia River Gorge National Scenic Area. In addition, the air agencies support continued research in this area and will be available to discuss new study proposals or any study results with the USFS, tribal nations, or others.

[10] A description of these studies is available in Appendix A.

[11] A more detailed discussion of the available studies is available in Appendix A.

[12] For a full copy of the report, please go to http://www.deq.state.or.us/aq/haze/docs/modelingAnalysis.pdf

VI. Tribal Consultation

The state air agencies, federal EPA and USFS worked with and received input from the Yakama Nation and the Confederated Tribes of the Umatilla Indian Reservation on the Gorge visibility strategy. The state air agencies also reached out to other Gorge-area Tribes, including the Confederated Tribes of Warm Springs and the Nez Perce Tribe to invite them to provide input and inform them of developments regarding the Gorge project. Discussions focused on the tribal nations' environmental concerns from both a holistic perspective and from a scientific perspective. The relationship has been beneficial in developing the Gorge strategy and shaping agencies approach to visibility improvement in the Gorge. One of the key components to that discussion was the impact of PGE Boardman emissions on the Gorge and valued tribal resources. The tribal perspective was very important as DEQ shaped its Boardman BART proposal.

Through conversations with the tribal nations the agencies have a better understanding of important tribal air quality concerns, including the ecological effects to Native American rock images and ecosystem impacts. This ongoing relationship provides additional opportunities to identify ways to address the Tribes' environmental concerns in order to protect the natural resources of the Gorge.

VII. Conclusion

This strategy is based on the air agencies' understanding that both local and regional air pollution sources influence Gorge haze and that reduction of haze can be most effectively achieved though the multi-state regional haze planning process.

The air agencies recommend approving the federal Regional Haze Program as the primary strategy for reducing haze pollution in the Gorge. The Regional Haze Program establishes enforceable mandates, benchmarks and timelines to improve visibility across the region.

This strategy, in combination with the associated Gorge visibility study, completes the charge given by the Gorge Commission. The Gorge visibility study provides a comprehensive understanding of the local and regional emission sources that influence scenic resources in the Gorge. The strategy document also describes the many state and federal emission reduction strategies currently working to reduce haze pollution across the Pacific Northwest, and provides a look into the likely future of haze trends in the Columbia River Gorge National Scenic Area, and a path forward for continued visibility improvement over time.

If the air agencies find that Gorge haze levels are increasing, the air agencies will investigate the reasons and will consult with the Gorge Commission to discuss possible remedies. Much could depend on whether lack of progress is due to manmade sources (which are controllable) versus natural sources, such as wildfires. It is important to note that continued operation of at least one of Gorge area IMPROVE monitoring sites by the U.S. Forest Service (USFS) is critical to determine whether "continued improvement" is

being achieved. If, in the future, funding can be restored to reinstate the Mt. Zion IMPROVE site, it will help provide additional valuable information regarding visibility conditions at both ends of the Gorge and to track haze conditions.

The air agencies are committed to working with all agencies, stakeholders, elected officials, the public, and Native American Tribes as part of the regional haze planning effort, and will be open to reviewing new research conducted by the USFS, Native American Tribes, and others as it is developed.

APPENDIX A

Summary of Gorge Visibility Studies

I. Air Agencies' Gorge Visibility Study

Background

The agencies, led by a technical team of national, state, and local experts, interested stakeholders, and Native American Tribes, undertook a six-year comprehensive study to identify sources of haze and future visibility conditions in the Gorge. The study included air monitoring and the development and application of a meteorological model to simulate conditions in the Gorge and provide visibility results. Reports for each of these components was vetted and commented on through a process of technical meetings and a public forum where scientists and stakeholders could review the reports and provide comments. This study, in conjunction with other visibility studies, helped form the basis for policy decisions recommendations.

Study Components

Beginning in 2003, the air agencies conducted several visibility studies to learn about regional and local emission sources influencing haze levels in the Gorge. The studies used a combination of air monitoring, chemical analysis, and computer model simulations to investigate the causes of haze. They evaluated hundreds of emission source types from in-Gorge sources to sources as far as Seattle and beyond. Scientists explored fundamental questions like: Where is haze pollution coming from? What emission sources are significant contributors to haze levels? What is the expected future trend in visibility looking over the next ten years?

The air agencies' Gorge visibility study looked at all the sources affecting the Gorge during certain times of the year. These specific timeframes were identified in order to best capture hazy conditions in the Gorge focusing on a wintertime and summertime haze event. Rather than focusing on the worst case days and identifying the specific contribution from those days, the study included visibility-impaired days indicative of the most common conditions in the Gorge. The study took a comprehensive look at all the sources that contribute to haze in order to understand where haze is coming from and what is contributing to overall conditions in the Gorge.

Specifically, the air agencies learned:

- Haze in the Gorge can be characterized by "man-made" emission sources, such as motor vehicles, power plant emissions, and woodstoves, and natural sources, such as forest fires.
- Visibility impairment is typically worse in the winter than it is in the summer, particularly at the eastern end of the Gorge when air stagnation conditions trap and concentrate pollution.
- Winter haze episodes are dominated by easterly winds with the majority of emissions coming from sources east of the Gorge. Winter haze concentrations are

most significant at the east end of the Gorge, less significant at the west end of the Gorge.

- Summer haze episodes are dominated by westerly winds with emissions typically coming from the Portland/Vancouver area and regional sources west of the Gorge. Summer haze concentrations are most significant at the west end of the Gorge, less significant at the east end of the Gorge.
- Natural sources such as wildfires and vegetation, and sources from outside the region (i.e. Canada and overseas) play a large role in Gorge haze, and contribute approximately 20 percent to over 50 percent of total haze depending on the season and location in the Gorge.
- Local sources from the Portland/Vancouver area play a minor to modest role in haze, contributing in the range of 3-20 percent of total haze depending on the day, season, and meteorology. Sources east of the Gorge contribute in the range of 13 - 57 percent of haze, and are most significant in the winter.
- The contribution of ammonia during the winter episodes on some days was negligible, and on other days contributed to a 12-30 percent reduction in visibility.

The air agencies sponsored separate studies with each study clarifying the link to causes of visibility impairment in the Gorge. The three main studies conducted were:

- *Haze Gradient Study*: The Haze Gradient study provided a snapshot of how haze moves into and throughout the Gorge, from both the west and east, and how haze movement relates to wind directions and seasons. The haze gradient study did not identify specific emission source types contributing to haze.
- *CoHaGo Study*: The CoHaGo Study built on the findings from the Haze Gradient Study and tried to estimate individual sources likely to be contributing significantly to haze.
- *CAMx Modeling Study*: The CAMx Modeling Study further identified what sources were contributing to haze and identified specific source regions. The CAMx Modeling Study was conducted for one haze event in the summer and one haze event in the winter. While the source categories and regions are likely representative of most haze events, the actual percent contribution to haze by a single source category may vary. The CAMx study was not able to include the effects of fugitive dust.

Table 1 provides a summary of findings from the three studies describing the different source contributions to haze.

Table 1: Summary of Source Contribution to Haze

Study	**Summer**	**Winter**
Haze Gradient (Mark Green, DRI, 2006 – DEQ & SWCAA sponsored study)	• Summertime episode is cleaner. • Increased haze at the western end of the Gorge from west winds transporting emissions through the Gorge.	• Wintertime haze is worst. • Winds from the east blowing haze into the Gorge.

Causes of Haze in the Gorge (CoHaGo) (Mark Green, DRI, 2006 – DEQ & SWCAA sponsored study)	• Main contributors of haze are estimated to include organic carbon and sulfate: ○ Burning – such as forest fires (organic carbon) ○ Oil combustion and paper mill emissions (sulfate) ○ Portland/Vancouver metro area emissions ○ Dust	• Wintertime haze is worse than the summer. • Caused by haze-forming pollutants such as nitrates, sulfates, and organics. • Contributing sources include: • Sources to the east of the Gorge: ○ Wood burning emissions (organics) ○ Coal fired power plant (sulfates and nitrates) ○ Regional ammonia sources, including nearby confined animal feeding operations (CAFO) (ammonia –contributes to the formation of sulfates and nitrates). • Sources to the west of the Gorge: ○ Pulp and paper ○ Shipping ○ Mobile sources ○ Wildfires ○ Agricultural burning
CAMx Modeling (Chris Emery, ENVIRON, 2007 – DEQ & SWCAA sponsored study)	Emission sources responsible for haze: • Natural sources such as wildfires and vegetation (~33%) • Outside the region - overseas emissions (~22%) • Portland-area emissions (~3% - ~20%)	Emission sources responsible for haze: • Sources east of the Gorge (~13% - 57%) ○ power plants, ○ vehicle emissions ○ residential wood heating ○ ammonia • Emissions from outside the region, including Canada and overseas (~19% - ~23%)

The complete body of research is available from the air agencies, and is also available at the following web site http://www.gorgeair.org.

II. Air Quality Trend Studies

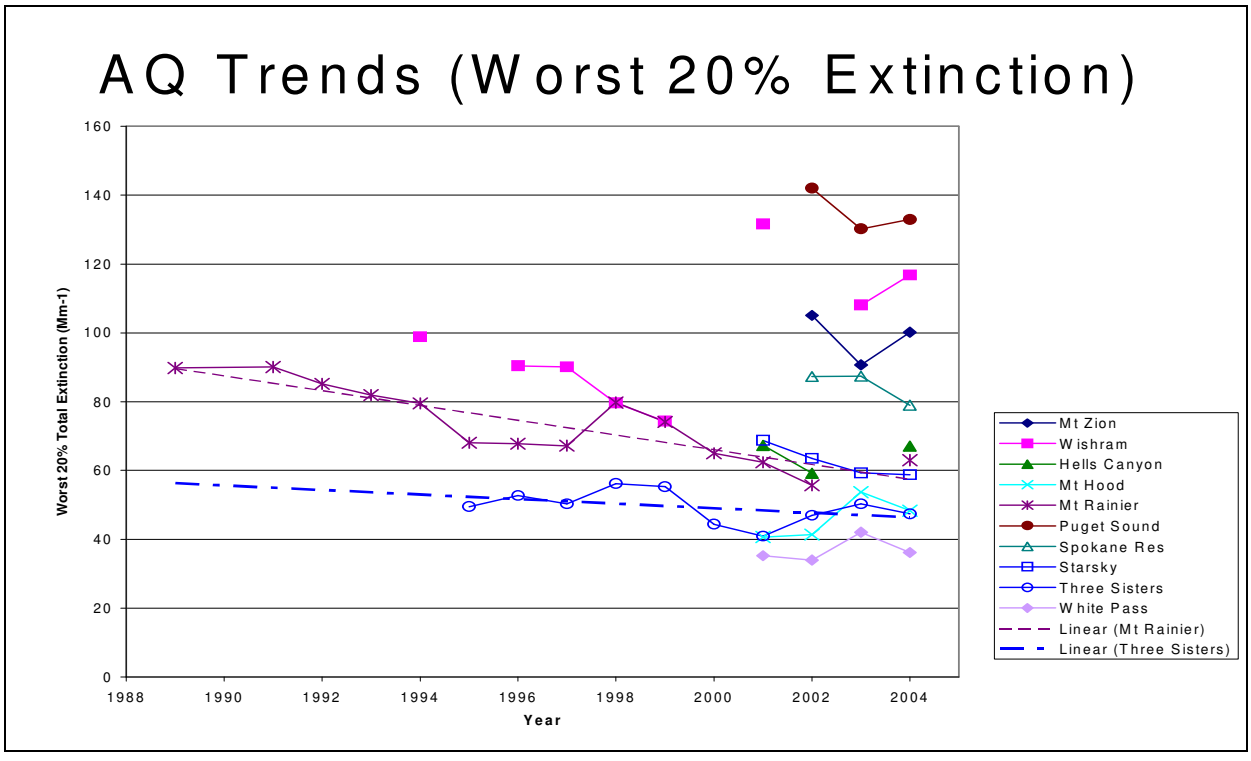
Current Trends

Several independent researchers offered the agencies their analyses of current visibility trends in the Gorge. Highlights of findings are presented below. Historical monitoring data in the Gorge suggests improving trends for some pollutants, like sulfate and lead, but no improvement in other pollutants, like nitrate and ammonium.

Highlights of current monitoring trend analyses are presented below in Figures 1-2. The historical trend data tells a relatively consistent story, although the interpretation of the data can be expressed somewhat differently by various researchers. One trends analysis suggests that current haze levels show a slightly improving or flat trend. Another analysis suggests that there is no significant improving trend, but that the trend is not worsening.

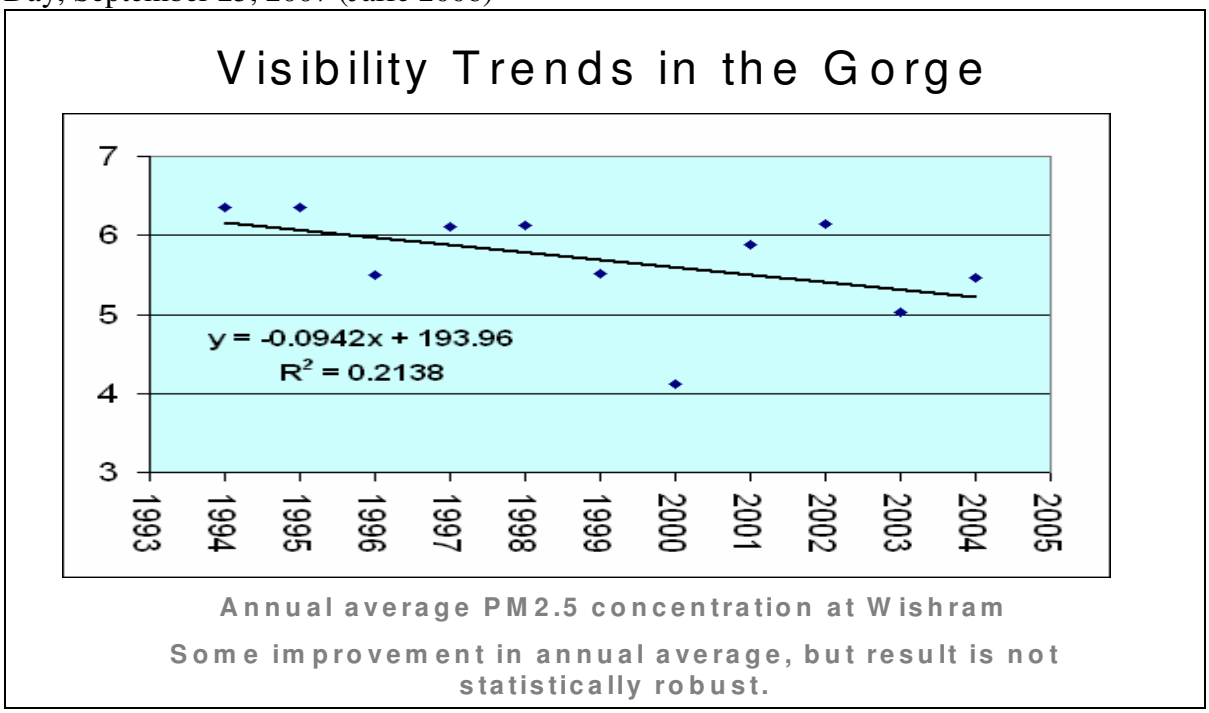
Study	**Findings**
Updated Air Quality Trends For the Columbia River Gorge (Kent Norville, Air Sciences, 2006 - prepared for Klickitat County) **(See Figure 1)**	Historical look at air quality trends: • All long-term (> 7 years) monitoring stations show a downward (improving) trend in air quality. • Shorter-term monitoring stations (3 to 7 years) are either flat or show a downward trend. • No monitoring station shows a long-term upward (worse) trend even though population has increased.

Figure 1: AQ Trends Showing the Worst 20% Visibility Days (Norville, 2006)



Study	Findings
Who is polluting the Columbia River Gorge? (Dan Jaffe, University of Washington, 2006 – prepared for the Yakama Nation) **(See Figure 2)**	Historical look at air quality trends: • No evidence for improving air quality on the worst days or in the fall, when most air quality problems occur in the Gorge.

Figure 2: Who Is Polluting the Columbia Gorge Trends Slide, presented at Gorge Policy Day, September 25, 2007 (Jaffe 2006)



Study	Findings
Air Pollution in the CRGNSA – Detection, Trends, and Ecological Effects (Linda Geiser, USDA Forest Service, Gorge Science Day presentation – Sept 2007.)	• Nitrogen deposition is high in the Gorge. • Sulfur deposition has held steady and remains moderately high in the Gorge. • Lead deposition has decreased dramatically.
National Atmospheric Deposition Program (NADP): Overview of Observations (David Gay, University of Illinois, Gorge Science Day presentation – Sep 2007)	• Looked at wet deposition samples in the Gorge • Slightly higher sulfate and nitrate deposition • Higher ammonium concentration than surrounding area

Future Visibility Trends (to 2018)

One key outcome of the visibility study was an estimation of the future trend in Gorge visibility projected over the next decade, given expected growth and already adopted emission reduction strategies. The air agencies estimated visibility in 2018 for summer and winter haze episodes in the Gorge. The forecast was based on expected emissions changes in the region. Figures 3-5 show the projected future trends in Gorge visibility over the next decade.

Study	Findings
CAMx Modeling Study (Chris Emery, ENVIRON, 2007 – sponsored by DEQ & SWCAA) **(See Figures 3-4)**	Future look at visibility trends: • Little visibility change (1% - 3%) in the summertime (August episode). • Wintertime (November episode) visibility haze levels will improve a small (10%) yet noticeable amount. • Haze levels have held steady and will likely show a small improvement over the next decade, despite population growth.

Figure 3: CAMx Modeling (Emery 2007) Future Visibility Trends: August

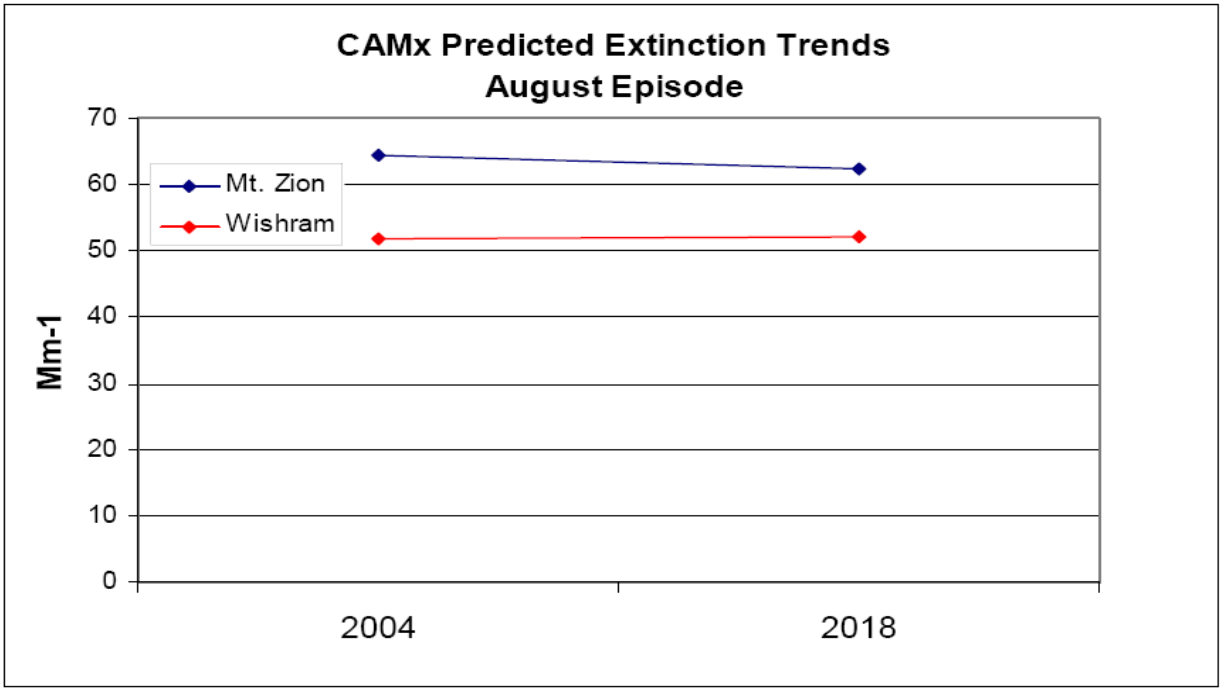
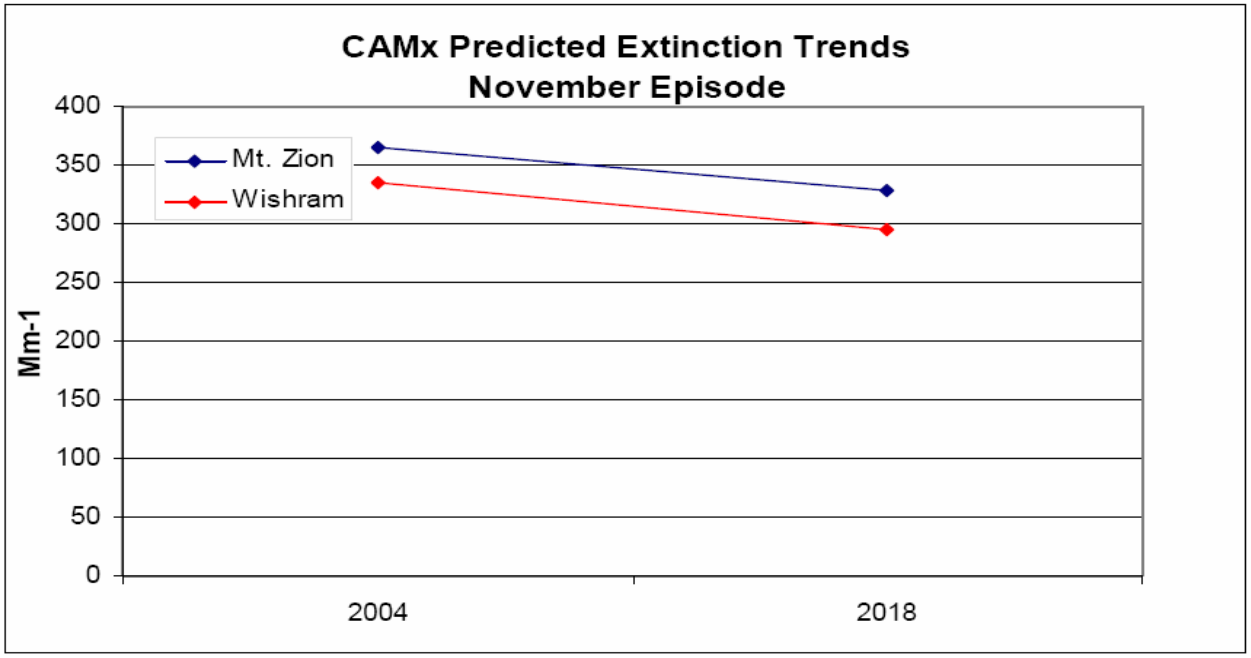


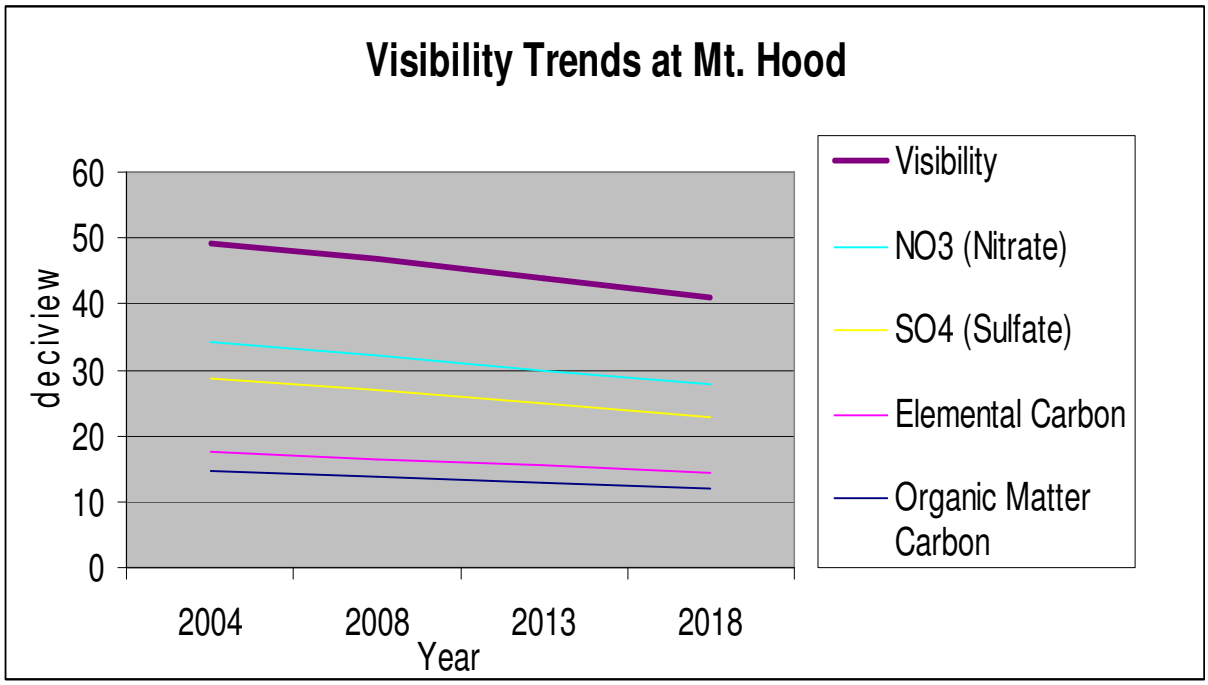
Figure 4: CAMx Modeling (Emery 2007) Future Visibility Trends: November



Study	Findings
Western Regional Air Partnership (WRAP) (Technical Support System-TSS) Haze Reduction Glide Slope Analysis 2008) [13](http://vista.cira.colostate.edu/tss/) **(See Figure 5)** WRAP is a regional organization in the west that helps states in the analysis and preparation of Regional Haze Plan for improving visibility in wilderness areas and national parks.	Future look at visibility trends: • Some visibility improvement. • Sulfate visibility greatly improved. • Nitrate visibility somewhat improved.

[13] The Technical Support System (TSS) has been developed by the Western Regional Air Partnership (WRAP) to provide technical data and analytical results prepared by WRAP Forums and Workgroups. The TSS is a tool to support implementation of Regional Haze plans and to provide a tool to show past and future visibility conditions.

Figure 5: WRAP TSS Visibility Modeling Results for 2018 (2008)



The air agencies conclude that current monitoring trends show that visibility in the Gorge is not getting worse, but rather holding steady or improving slightly in the face of significant regional growth pressure.

III. Ecosystem Studies

During the visibility study the air agencies also considered other studies that examined the ecological effects of air pollution in the Gorge. Given the special historic and cultural value of Native American rock images in the Gorge, the Forest Service funded studies to sample and analyze fog and cloud water chemistry, lichen chemistry, and ozone injury to vegetation for assessing potential risks to culturally significant artifacts and ecosystems in the scenic area.

The studies cited a concern with excess nitrogen. Lichen data shows that the ecosystem is becoming enriched with nitrogen. Additionally, acid fog has been observed in the eastern portion of the Gorge at levels as low as pH 3.7 (for reference, the pH of clean rainwater is typically around 5). The stability of Native American rock images may be at risk due to nitrogen enrichment or acid fog. Ammonia is believed to be the primary cause of excess nitrogen in the eastern Gorge, while fossil fuel combustion is believed to be the primary cause of excess nitrogen in the western Gorge.

The highlights of the findings are presented below. Acid deposition monitoring data shows that ammonium is increasing, while nitrates are steady and sulfates are decreasing.

The ecological studies on lichen show that nitrogen loading is increasing, while sulfur remains steady and lead is decreasing.

Table 2 presents a summary of these studies and their conclusions.

Table 2: Summary of Ecological Effects of Air Pollution in the Columbia River Gorge National Scenic Area

Study	**Findings**
Air Pollution in the CRGNSA – Detection, Trends, and Ecological Effects (Linda Geiser, USDA Forest Service, Gorge Science Day presentation – Sept 2006.)	• Nitrogen deposition is high in the Gorge. • Sulfur deposition has held steady and remains moderately high in the Gorge. • Lead deposition has decreased dramatically.
Atmospheric deposition inputs and effects on lichen chemistry and indicator species in the Columbia River Gorge, USA (USDA Forest Service, Published in Environmental Pollution 146 – June 2006.)	• Nitrogen deposition rates very high, more than double expected • Acidity of the fog and cloud water samples were characterized as extreme (seven day average fog samples as low as pH 3.7) • Impacts of nitrogen deposition well documented for lichen communities
Deposition of Nitrogen and Sulfur in the Columbia River Gorge National Scenic Area (Mark Fenn, USDA Forest Service, Gorge Science Day presentation – Sept 2006.)	• Nitrogen enrichment of ecosystem underway based on lichen data • Acidic fog and precipitation events occur, but no clear evidence of soil acidification in forested areas
Ozone Injury in West Coast Forests: 6 Years of Monitoring (Sally Campbell USDA Forest Service – June 2007)	• Ozone injury was found at one biomonitoring site in Oregon and Washington • Site is unique (Jeffrey Pine at an irrigated site) • Overall, federally managed forests in OR & WA are not being injured by ozone

Tribal Nations of the Gorge area have initiated a study of air pollution effects on rock image stability, based on concerns that air pollution levels could have the potential to impact cultural and natural resources. Rock images may be damaged either directly or indirectly. Direct damage may result from acid rain, acid fog, and soot. Indirect damage may result from accelerated weather caused by lichen growth. Excess nitrogen, which can lead to acid precipitation and increased lichen growth, has been documented to be occurring in the Gorge.

Studying lichen compositions help provide a first glimpse of potential ecological effects from air pollution. Potential sources of nitrogen are associated with agricultural sources from the eastern end of the Gorge, whereas emissions from fossil fuel combustion, such as motor vehicles and industrial processes, contribute nitrogen and sulfur at the west end of the Gorge. Excess nitrogen deposition can alter plant composition and productivity as

well as soil chemistry.

The air agencies note that it is currently unclear at which level nitrogen or acid deposition is harmful to the ecosystem. These studies are a first step in understanding ecological effects in the Gorge, and the results can help inform decision-makers as to the next steps that could be taken to evaluate this issue.

IV. Air Agencies' Gorge Visibility Study - What-If Scenarios

The air agencies tested if reducing emissions from various key source sectors, such as PGE Boardman, motor vehicles, non-road sources, and dairies could improve haze conditions. The agencies used a computer model to evaluate several hypothetical scenarios where the emissions from key regional emission source categories were completely removed from the model in order to evaluate the resulting affect on haze. Actually eliminating these emissions is of course, not possible; however, these hypothetical "what-if" exercises do provide valuable insight and information about what it would take to obtain an immediate and dramatic reduction in haze.

The test-cases included hypothetical scenarios such as removing all emissions from regional cars and trucks; all train emissions in the Gorge; removing emissions from all regional industry; eliminating all regional ammonia, etc.

Table 3 below shows the range of magnitude of visibility changes in "deciviews"[14] (that would result from the test case scenario. Changes in visibility vary significantly depending on location in the Gorge (west end vs. east end), time of year, and the metrology driving haze formation on any given day. The highest values for improvement would typically occur on only a few-days. Average improvement would of course occur more frequently and be less than the maximum improvement. For example, reducing emissions at Boardman might produce a minimum benefit in the summer at the west end of the Gorge when winds are out of the west, but would produce its maximum benefit at the east end of the gorge in the winter when winds are out of the east. Additionally, during the analysis of the "what-if" scenario modeling, the air agencies used the presumptive BART controls through the Regional Haze Program, which were less stringent than the BART controls now mandated by DEQ to meet the regional haze requirements. At that time (of the modeling runs), the agencies assumed 46 percent level of control for NOx and 72 percent level of control for SO_2, as opposed to the now required 84 percent reduction of NOx and 80 percent% reduction of SO_2.

[14] A "deciview" is a measure of visibility. One deciview is equivalent to a perceptible change in visibility (as perceived by an average person). The higher the deciview index, the more visibility is impaired.

Table 3: Agency Test Scenarios for Changes in Haze

Hypothetical Test Scenario (November only)	**Range of Visibility Improvement (min and max values- depending on location in Gorge and time of year)_**
PGE Boardman EGU	0.2 dv to 2 deciviews
On-road (cars and trucks) mobile emissions from the Portland/Vancouver area.	0 deciview to 2.7 deciviews
On-road (cars and trucks) and non-road (construction equipment) mobile emissions in the entire modeling area.	0.75 deciview to 3.9 deciviews
Major point source emissions in the Portland/Vancouver area	0 deciview to 0.2 deciviews
Major point sources inside the Gorge region	0 deciview to 3.4 deciviews
Major point source emissions in the entire modeling area	0.13 deciview to 4.7 deciviews
Regional dairy emissions east of the Gorge	0.01 deciview to 1.6 deciviews
Railroad emissions in the entire modeling area	0.3 deciview to 1.2 deciviews
Residential wood combustion emissions in the entire modeling area	0.2 deciview to 3 deciview
Total Average Haze in August episode	11 deciviews to 12 deciviews
Total Average Haze in November episode	24 deciviews to 28 deciviews

The air agencies' conclusions from the scenario-testing are:

- The "what-if" modeling verifies that many actions are necessary to dramatically improve haze in the Gorge.
    - There are strategies that can help make small but meaningful improvements in visibility and that can collectively drive continued improvement in visibility.
    - For each of the key contributing source categories, there is currently, or will soon be developed, an emission reduction strategy that will lower emissions and help improve visibility over the next several years.
- Obtaining a dramatic reduction in haze - such reducing haze by half - would require actions that are clearly not possible (i.e., eliminating all transportation, industrial, or agricultural operations in the region).
- Specifically, in regard to the Boardman facility, the agencies' "what-if" testing analysis shows that removing all Boardman emissions would help improve visibility, but there would still be haze in the Gorge.

Overall, the air agencies' gorge visibility study and the "what-if" scenarios confirm that obtaining continued improvement in Gorge visibility will require many small contributions in emission reduction from a wide variety of source categories over time.

V. Other Visibility Studies – Effect of PGE Boardman's Emissions on the Gorge

PGE Boardman BART Analysis (Oregon DEQ)

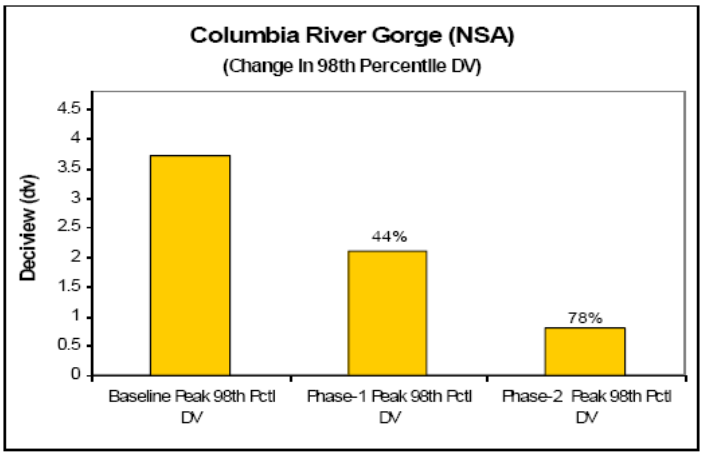
DEQ conducted a modeling analysis to evaluate the visibility impacts caused by NOx, SO_2, and particulate matter emissions from the Boardman plant. This modeling was conducted for 14 Class I areas that were within 300 km of the plant, in accordance with federal guidance, and DEQ's modeling protocol. The Columbia River Gorge was included, even though it is not a designated Class I area. In addition, the Crater Lake National Park Class I area was included for informational purposes, even though it is beyond 300 km. Maximum actual daily emissions from the plant during the 2003-2005 evaluation period were used in the modeling analysis.

The CALPUFF model[15] 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 deciviews.

Based on modeling results, for the Gorge the peak visibility impact was 3.7 deciviews. Figure 6 illustrates the percentage reduction in peak visibility impacts. With the implementation of the BART controls on Boardman, there would be a 44 percent reduction from Phase 1 controls and with Phase 2 controls there would be a 78 percent reduction in visibility impacts.

[15] CALPUFF is an air quality dispersion model that simulates how air pollutants disperse in the atmosphere. A dispersion model is used to estimate or to predict the downwind concentration of air pollutants emitted from sources such as industrial plants and vehicular traffic.

Figure 6: Gorge Visibility Impacts from BART Controls on PGE Boardman



DEQ's BART controls for NOx and SO_2 would reduce the number of days of visibility impact over the visibility threshold of 0.5 deciviews. It is important to note, that even with very stringent controls, the PGE Boardman plant will continue to have some visibility impact in the Columbia River Gorge, although these impacts will be significantly reduced from current levels.

Yakama Nation study (Jaffe study)

The Yakama Nation commissioned a study by Dr. Dan Jaffe, of the University of Washington, to analyze Boardman's influence in the Gorge. The Yakama Nation study (or Jaffe study) analyzed available monitoring data, using back-trajectory calculations to identify transport and sources of particulate matter, and compared the results to the air agencies' Gorge Visibility study. Jaffe concluded Boardman's influence was greater than was characterized in the agencies' Gorge air quality study, contributing up to 55 percent of particulate matter mass. Based on the study's conclusions, it asserts that Boardman is one of the largest contributors to haze during the winter, specifically when winds are blowing from the east. Some of the worst air quality days occur under these conditions.

The Jaffe study also looked at monitoring data during a period when the Boardman power plant was temporarily shut down (November 2005), and compared it to other years in November when there were high particulate matter counts (typically the worst month during the year) and the winds were coming from the east. Jaffe concluded there could be up to a 7.40 micrograms/meters^3 particulate matter contribution from the Boardman plant.

VI. Conclusion

Taken together, the studies that examine the effects of Boardman emissions and other emissions sources indicate that cleaning up Boardman's emissions alone will significantly improve visibility in the Gorge, but not eliminate it altogether. The studies highlight how a coordinated effort to address all emissions contributions to haze in the Gorge may prove most effective.

APPENDIX B

Air Toxics Source Standards

Source Category	In Effect	Source Category	In Effect
Perchloroethylene Dry Cleaning	1993	Auto Body Refinishing	2008
Halogenated Solvent Cleaner	1994	Plastic Parts and Products	2008
Commercial Sterilization Facility	1994	Iron and Steel Foundries	2008
Chromium Electroplating	1995	Gasoline Dispensing	2008
Municipal Waste Combustor	1996	Metal Fabrication and Finishing	2008
Hazardous Waste Incineration	1999	Plating and Polishing	2008
Portland Cement Manufacturing	1999	Nonferrous Foundries	2009
Secondary Aluminum Production	2000	Chemical Manufacturing	2009
Municipal Landfills	2003	Asphalt Processing and Asphalt Roofing Manufacturing	2009
Flexible Polyurethane Foam Production	2007	Paint and Allied Products	2009
Lead Acid Battery Manufacturing	2007	Chemical Preparation	2009
Wood Preserving	2007	Prepared Feeds Materials	2010
Clay Ceramics	2007	Reciprocating Internal Combustion Engines	2010
Stainless and Non-stainless Steel Manufacturing	2007	Boilers	2010
Glass Manufacturing	2007	Brick and Structural Clay Products	2010
Hospital Sterilization	2007	Gold Mine Ore Processing and Production	2011
Paint Stripping Operation	2008		

APPENDIX C

Oregon's Revised 2010 Regional Haze Plan

(Note: Due to the size and length of this document, the air agencies will provide a separate CD copy to the Gorge Commission as part of this submittal)

The Oregon Revised 2010 Regional Haze Plan can also be found at:
http://www.deq.state.or.us/aq/haze/docs/pge/regionalHazePlan.pdf

Appendices for the Oregon Revised 2010 Regional Haze Plan:
http://www.deq.state.or.us/aq/haze/docs/pge/appendices.pdf

APPENDIX D

Washington's Regional Haze Plan

(Note: Due to the size and length of this document, the air agencies will provide a separate CD copy to the Gorge Commission as part of this submittal)

The Washington Regional Haze Plan can also be found at:
http://www.ecy.wa.gov/programs/air/globalwarm_RegHaze/All-in-One.pdf

Appendices for the Washington Regional Haze Plan:
http://www.ecy.wa.gov/programs/air/globalwarm_RegHaze/Appendices_ALL.pdf