I-70 Mountain Corridor PEIS Climate and Air Quality Technical Report

August 2010

This page intentionally left blank.

Table of Contents

List of Figures

List of Tables

Section 1. Introduction and Background

This Climate and Air Quality Technical Report supports the information presented in **Chapter 3, Section 3.1, Climate and Air Quality**, and **Chapter 4, Cumulative Impacts**, of the I-70 Mountain Corridor Programmatic Environmental Impact Statement (PEIS). It describes the regulations related to air quality, the affected environment, the potential impacts of all alternatives under consideration, and mitigation.

Over the past decade, since the I-70 Mountain Corridor PEIS was initiated, a number of changes have occurred in air quality regulations and monitoring, and this report presents current (2010) information. Additionally, as the study progressed, the Colorado Department of Transportation (CDOT) updated its design year projections to the current 2035 timeframe. This report reflects air emissions based on that 2035 baseline (and traffic projections). Year 2000 traffic volumes are used as the baseline for the travel demand modeling. The 2000 data remains valid for model calibration as no major changes in travel behavior or transportation infrastructure have occurred since 2000. The Corridor serves the same market of users with the same I-70 highway infrastructure as was in place in 2000. In comparisons between existing and future emissions, therefore, 2000 and 2035 are reported.

1.1 Overview of Issues, Regulations, and Coordination

The Air Pollution Control Division (APCD) of the Colorado Department of Public Health and Environment (CDPHE) is responsible for air quality monitoring within the state. The primary pollutant of concern along the I-70 Mountain Corridor is particulate matter. Particulate matter less than 10 microns (PM_{10}) is the only pollutant monitored in the project area west of Jefferson County. In the mountain areas, APCD determined that airflow patterns and wind speed tend to disperse pollutants sufficiently so that pollutant concentrations meet National Ambient Air Quality Standards (NAAQS). Ozone is monitored in Jefferson County. Carbon monoxide (CO) is monitored only in central Denver as APCD discontinued monitoring of CO in Jefferson County in 2006.

1.2 National Ambient Air Quality Standards

The Environmental Protection Agency has established NAAQS for six criteria pollutants to protect the public from the health effects associated with air pollution, as follows:

- Carbon monoxide
- Ozone
- Nitrogen dioxide (NO_2)
- Sulfur dioxide (SO_2)
- Particulate matter
  - Less than 10 microns (PM_{10})
  - Less than 2.5 microns ($PM_{2.5}$)
- Lead (Pb)

The Environmental Protection Agency designates geographic areas that violate NAAQS for a pollutant as a nonattainment area for that pollutant. Most of the Corridor meets NAAQS, with the exception of the east end of the Corridor in Jefferson County, which, along with the rest of the Denver metropolitan area, exceeds air quality standards for ozone.

The Environmental Protection Agency is revising the 8-hour ozone standard and is considering a range between 0.060 and 0.070 parts per million (ppm). Jefferson County is not likely to meet the new standard, and other portions of the Corridor may not attain the new standard, depending on the final level set by the

Environmental Protection Agency. Colorado is evaluating the new ozone standard, determining what areas may violate the standard, and identifying what additional ozone control measures may be needed throughout the state. **Table 1** presents current NAAQS for criteria pollutants.

Table 1. NAAQS Criteria for Pollutants

Pollutant/Averaging Time	Primary Standard	Secondary Standard
Particulate Matter Less Than 10 Microns (PM_{10})		
24-hour	150 micrograms per cubic meter ($\mu g/m^3$)	Same as Primary
Particulate Matter Less Than 2.5 Microns ($PM_{2.5}$)		
Annual (Arithmetic Mean)	15.0 $\mu g/m^3$	Same as Primary
24-hour	35 $\mu g/m^3$	Same as Primary
Sulfur Dioxide (SO_2)		
Annual (Arithmetic Mean)	0.03 ppm	Same as Primary
24-hour	0.14 ppm	Same as Primary
3-hour		1,300 $\mu g/m^3$ (0.5 ppm)
1-hour	75 ppb	None
Nitrogen Dioxide (NO_2)		
Annual (Arithmetic Mean)	100 $\mu g/m^3$ (0.053 ppm)	Same as Primary
1 hour	188 $\mu g/m^3$ (100 parts per billion [ppb])	
Ozone		
8-hour (2008 standard)	0.075 ppm	Same as Primary
8-hour (2010 standard) (will be finalized in August 2010)	Between 0.060 and 0.070 ppm	
1-hour (applies only in limited areas)	0.12 ppm	Same as Primary
Carbon Monoxide (CO)		
8-hour	10 mg/m^3 (9 ppm)	None
1-hour	40 mg/m^3 (35 ppm)	None
Lead (Pb)		
Rolling 3-month average	0.15 $\mu g/m^3$	Same as Primary
Quarterly average	1.5 $\mu g/m^3$	Same as Primary

Source: Environmental Protection Agency, 2010.

1.3 Ozone

1.3.1 Regional Air Quality Council

Governor Bill Ritter designated the Regional Air Quality Council as the lead air quality planning agency for the Denver metropolitan area. The Regional Air Quality Council's primary task is to prepare state implementation plans (SIP) for compliance with federal air quality standards. The Regional Air Quality Council addresses emissions of ozone precursors (chemicals that contribute to the formation of ozone) and greenhouse gases through discussions with the Denver Regional Council of Governments (DRCOG), CDOT, CDPHE, transportation organizations, local governments, the private sector, and the public (State of Colorado, 2009).

1.3.2 Ozone Attainment and Nonattainment Areas

Based on its review of the air quality criteria for ozone- related photochemical oxidants and NAAQS for ozone, the Environmental Protection Agency revised the primary and secondary NAAQS for ozone in March 2008 to provide for the protection of public health and welfare. For the primary standard for ozone, the Environmental Protection Agency revised the level of the 8-hour standard from 0.08 ppm to 0.075 ppm. The secondary standard for ozone is identical to the revised primary standard.

The Environmental Protection Agency declared the Denver metropolitan and North Front Range areas (including Jefferson County in the Corridor) a “nonattainment” area for the federal 8-hour ozone standard on November 20, 2007. Since the new standard reduces the level, the area remains in nonattainment under the new, lower standard.

The Environmental Protection Agency recommends nine criteria, or “factors,” to help with attainment/nonattainment determinations and, if necessary, to help determine the appropriate size of a nonattainment area. States must submit an analysis of these nine factors, along with a proposed nonattainment boundary, for any areas that are not meeting the federal standard (CDPHE, 2009). The nine factors to address are:

1. Air quality data
2. Emissions data
3. Population density and degree of urbanization (Colorado Recommended 8-hour Ozone Designations, Page 8 of 70, Technical Support Document)
4. Traffic and commuting patterns
5. Growth rates and patterns
6. Meteorology
7. Geography/topography
8. Jurisdictional boundaries
9. Level of control of emission sources

The Denver metropolitan and North Front Range 8-hour nonattainment areas for the 0.08 ppm standard geographically includes parts of Weld and Larimer counties and the entirety of Arapahoe, Adams, Broomfield, Denver, Jefferson, and Douglas counties. The Air Pollution Control Division conducted the nine factor analysis to determine if this boundary remained appropriate for the revised ozone standard. The analysis confirmed the boundaries of the nonattainment area should not change and recommends that the geographic area shown in **Figure 1** continue to be designated as nonattainment for the 0.075 ppm 8-hour ozone standard. This large area encompasses the region’s:

1. Urbanized area,
2. Traffic and commuting patterns, and
3. Industrial and commercial activities.

A decision on the re-designation boundary is pending from the Environmental Protection Agency.

Within the Corridor, the recommended nonattainment area includes Jefferson County but does not include Clear Creek or Summit counties. The Air Pollution Control Division conducted a passive ozone study during summer 2007 in the North Front Range area. Samples collected over a period of 48 hours during July and August in attainment and nonattainment areas included one near Idaho Springs in Clear Creek County. Although not directly comparable to the NAAQS, these data compare reasonably well to the 48-hour averages for the same periods from a collocated continuous analyzer. The 48-hour averages from the Clear Creek location were lower than the 48-hour averages from all the continuous analyzers, except the CAMP analyzer in downtown Denver. These data indicate that Clear Creek County is not likely to have ozone concentrations above the NAAQS (CDPHE, 2009). Based on the subsequent analysis of the nine factors, the APCD did not include Clear Creek County in the presumptive ozone nonattainment area because:

- The precursor emissions are low (approximately 4,000 tons per year [tpy] of oxides of nitrogen [NO_x] and volatile organic compounds [VOC] combined),
- Population is sparse (approximately 14,600), and
- The extent of ozone transport into the area is unknown.

In January 2010, the Environmental Protection Agency re-evaluated the 8-hour ozone standard to better reflect scientific data relating ozone levels to health risks and recommends revising the standard from 0.075 ppm to a lower range between 0.060 ppm and 0.070 ppm. Depending on the level of the final standard, CDPHE may need to expand the existing nonattainment boundary or add new nonattainment areas.

Figure 1. Denver Metropolitan and North Front Range Existing (2007) and Recommended (2008) 8-hour Ozone Nonattainment Areas

Source: CDPHE, 2009

1.4 Mobile Source Air Toxics

Most air toxics originate from human-made sources, including:

- On-road mobile sources
- Non-road mobile sources (such as airplanes)
- Area sources (such as dry cleaners)
- Stationary sources (for example, factories or refineries)

On September 30, 2009, FHWA released updated interim guidance on when and how to analyze mobile source air toxics (MSATs) in National Environmental Policy Act (NEPA) documents for highway projects (FHWA, 2009). The interim guidance reflects the current list of priority MSATs.

1.4.1 Background

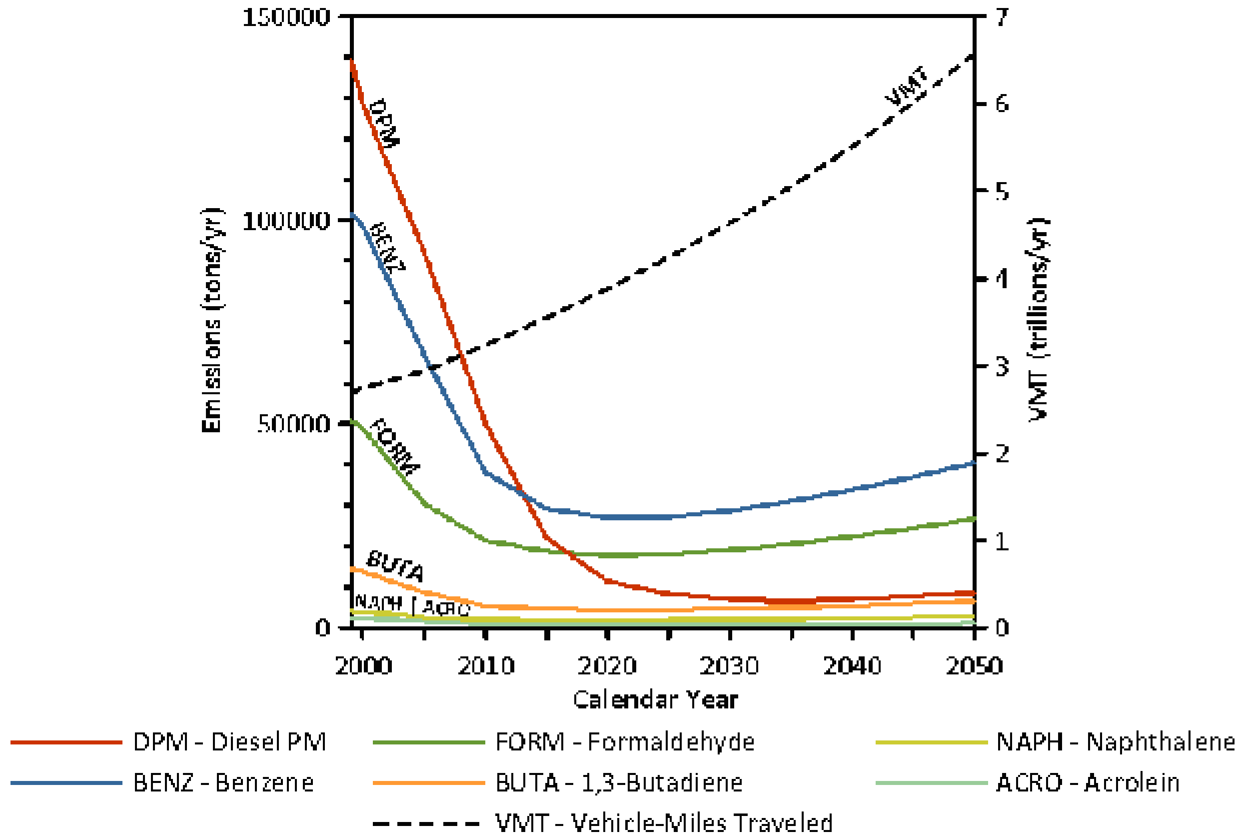
Controlling air toxic emissions became a national priority with the passage of the Clean Air Act Amendments of 1990, whereby Congress mandated that the Environmental Protection Agency regulate 188 air toxics, also known as hazardous air pollutants. The Environmental Protection Agency assessed this expansive list in their latest rule on the *Control of Hazardous Air Pollutants from Mobile Sources* (Federal Register, Vol. 72, No. 37, page 8430, February 26, 2007) and identified a group of 93 compounds emitted from mobile sources that are listed in their Integrated Risk Information System (IRIS) (URL: http://www.epa.gov/ncea/iris/index.html). In addition, the Environmental Protection Agency identified seven compounds with noteworthy contributions from mobile sources that are among the national and regional-scale cancer risk drivers from their 1999 National Air Toxics Assessment (URL: http://www.epa.gov/ttn/atw/nata1999/):

- Acrolein
- Benzene
- 1,3-butadiene
- Diesel particulate matter plus diesel exhaust organic gases (DPM)
- Formaldehyde
- Naphthalene
- Polycyclic organic matter

While FHWA considers these the priority MSATs, the list is subject to change and may be adjusted in consideration of future Environmental Protection Agency rules.

The 2007 Environmental Protection Agency rule mentioned above requires controls that will dramatically decrease MSAT emissions through cleaner fuels and cleaner engines. According to an FHWA analysis using the Environmental Protection Agency's MOBILE6.2 model, even if vehicle activity (vehicle miles traveled) increases by 145 percent as assumed, a combined reduction of 72 percent in the total annual emission rate for the priority MSATs is projected from 1999 to 2050, as shown in **Figure 2**.

Figure 2. National MSAT Emission Trends 1999– 2050 for Vehicles Operating on Roadways Using the Environmental Protection Agency's MOBILE6.2 Model



Notes:

(1) Annual emissions of polycyclic organic matter are projected to be 561 tpy for 1999, decreasing to 373 tpy for 2050.

(2) Trends for specific locations may be different, depending on locally derived information representing vehicle miles traveled, vehicle speeds, vehicle mix, fuels, emission control programs, meteorology, and other factors

Source: Environmental Protection Agency. MOBILE6.2 model run 20 August 2009.

Air toxics analysis is a continuing area of research. While much work has been done to assess the overall health risk of air toxics, many questions remain unanswered. In particular, the tools and techniques for assessing project-specific health outcomes as a result of lifetime MSAT exposure remain limited. These limitations impede the ability to evaluate how the potential health risks posed by MSAT exposure should be factored into project-level decision-making within the context of NEPA.

Nonetheless, air toxics concerns continue to be raised on highway projects during the NEPA process. Even as the science emerges, the public and other agencies expect the lead agencies to address MSAT impacts in our environmental documents. The Federal Highway Administration, Environmental Protection Agency, Health Effects Institute, and others have funded and conducted research studies to try to more clearly define potential risks from MSAT emissions associated with highway projects. The Federal Highway Administration will continue to monitor the developing research in this emerging field.

1.4.2 Coordination

The Denver Regional Council of Governments' 2035 fiscally-constrained, conforming regional transportation plan includes undetermined I-70 improvements in Clear Creek County and western Jefferson County. This project has been coordinated with CDOT and APCD.

1.5 Greenhouse Gases

The issue of global climate change is an important national and global concern that the federal government is addressing in several ways. The transportation sector is the second largest source of total greenhouse gases in the U.S. and the greatest source of carbon dioxide (CO_2) emissions—the predominant greenhouse gas. Transportation greenhouse gas emissions account for 29 percent of all U.S. greenhouse gas emissions (USDOT, 2010). Burning of fossil fuels is the principal human-caused source of carbon emissions and accounts for approximately 80 percent of anthropogenic emissions of carbon worldwide. The combustion of petroleum products, such as motor gasoline, diesel fuel, jet fuel, and residual fuel, accounts of almost all (97.9 percent) of transportation-sector emissions.

Recognizing this concern, FHWA is working with other modal administrations through the U.S. Department of Transportation Center for Climate Change and Environmental Forecasting to develop strategies to reduce transportation's contribution to greenhouse gases—particularly CO_2 emissions—and to assess the risks to transportation systems and services from climate changes. The U.S. Department of Transportation is evaluating four groups of strategies to reduce transportation greenhouse gas emissions:

- Introduce low-carbon fuels
- Increase vehicle fuel economy
- Improve transportation system efficiency (such as lowering speed limits or reducing congestion to improve fuel economy)
- Reduce carbon-intensive travel activity (such as increasing vehicle occupancy)

The federal government is evaluating options to achieve greenhouse gas reductions within these strategies.

Several programs are underway in Colorado to address transportation greenhouse gases. The Governor's Climate Action Plan, adopted in November 2007, includes measures to adopt vehicle CO_2 emissions standards and to reduce vehicle travel through transit, flex time, telecommuting, ridesharing, and broadband communications. The Colorado Department of Transportation's proposed programmatic agreement includes several additional measures, including research into pavement durability and additives to reduce CO_2 associated with construction, expansion of travel demand management efforts, planning assistance to local agencies, and measures to address freight travel efficiency and idling.

The Colorado Department of Transportation also participates in the Planning and Environmental Linkages Partnering Agreement, which was signed in June 2009 and is intended to foster cooperation, coordination, and meaningful environmental analyses among transportation facility providers while providing for Colorado's transportation needs.

Because climate change is a global issue, and the emissions changes due to Action Alternatives are very small compared to global totals, the lead agencies did not calculate the greenhouse gas emissions associated with the alternatives. In addition, because greenhouse gases are directly related to energy use, the changes in greenhouse gas emissions would be similar to the changes in energy consumption presented in the *I-70 Mountain Corridor PEIS Energy Technical Report* (CDOT, August 2010). **Table 2** presents the relationship of current and projected Colorado highway emissions to total global CO_2 emissions. Colorado highway emissions are expected to increase by 4.7 percent between now and 2035 because the benefits of improved fuel economy and wider use of renewable fuels are offset by growth in vehicle miles traveled; the draft 2035 statewide transportation plan predicts that Colorado vehicle miles traveled will double between 2000 and 2035. **Table 2** presents the quantity of emissions and vehicle miles traveled from the Corridor relative to total Colorado emissions and travel activity.

Table 2. Greenhouse Gas Emissions (million metric tons—MMT)

Emissions Source and Location	CO_2 Emissions 2005	Projected CO_2 Emissions 2035	Percent of Global Total Emissions 2005	Percent of Statewide VMT 2005[b]
Global – all emitters	27,700.00[a]	--	--	--
Colorado highways	29.90[c]	31.30	0.108	100.0
Corridor	1.21[d]	1.26[d]	0.004	3.0

[a] *Energy Information Administration, International Energy Outlook 2007*
[b] *Statewide vehicle miles traveled was 47.9 billion in 2005, based on CDOT's* Fact Book 2006–2007, Transportation Facts *(CDOT, 2007)*
[c] *Calculated by FHWA Resource Center.*
[d] *Corridor vehicle miles traveled was 1.5 billion in 2005, and 2.8 billion in 2035 based on the CDOT database (URL: http://www.dot.state.co.us/App_DTD_DataAccess/Traffic/index.cfm?fuseaction=TrafficMain&MenuType=Traffic).*

Key to Abbreviations/Acronyms
CO_2 = carbon dioxide VMT = vehicle miles traveled

1.5.1 Colorado Climate Control Action Plan

Issued in November 2007, the Colorado Climate Control Action Plan states that Colorado's greenhouse gas emissions are steadily climbing and contribute "to a worldwide climate change crisis." The plan goes on to state that Colorado's emissions in 2005 were 35 percent higher than in 1990 (although per capita emissions changed very little over the same period) and "under a business-as-usual scenario, are projected to grow to 81 percent above 1990 levels by the year 2020." The stated goal of the plan is to mobilize Colorado's businesses, governments, and citizens to slow the increase and ultimately to reduce emissions to 20 percent below 2005 levels by 2020. This goal is considered to be achievable (Ritter, 2007). The plan discusses:

- Enacting "bridge strategies" to immediately reduce greenhouse gas emissions while pursuing technologies for cleaner energy;
- Providing leadership to fully develop and implement renewable energy and clean coal technology; and
- Preparing the state to adapt to changes that cannot be avoided.

The plan reports that that transportation sector contributes 23 percent of greenhouse gases in the state in comparison to 26 percent in the U.S. The initial phase of the Colorado Climate Action Plan for transportation focuses on the adoption of greenhouse gas emissions standards for cars and light trucks.

Colorado also joined The Climate Registry, along with 38 other states, the District of Columbia, 3 Canadian Provinces, 1 Mexican State, and 3 Native American tribal nations—to establish a common, North American registry of greenhouse gas emissions. The Climate Registry is developing greenhouse gas reporting protocols and other standards.

The plan recognizes that Coloradans will continue to drive for work, shopping, and mountain recreation but that ways need to be found to reduce the emissions associated with those trips and to reduce the number of trips. Colorado has begun to address this through the Greening of State Government initiative, which proposes to reduce the number of state workers who drive alone to work. The initiative includes providing state employees options such as flex time, telecommuting, and carpooling and vanpooling. Other initiatives include encouraging advances in Colorado's technology sector, statewide broadband access, and transportation options for workers. An important aspect of the transportation sector's contribution to greenhouse gas emissions is the relationship among transportation, land use, and neighborhood design.

Among future action, the Governor will direct CDPHE to update the emissions inventory for the state every five years so that progress, or lack thereof, can help determine further actions required.

1.5.2 Colorado Greening Government Coordinating Council

Executive Order D 005 05 established the Colorado Greening Government Coordinating Council on July 15, 2005 (State of Colorado, 2005). The order directs the Executive Directors of the Governor's Office of Energy Management and Conservation, CDPHE, and Department of Personnel and Administration to establish a Council that includes representatives from each state agency and department. The Council is authorized to develop, implement, and augment programs, plans, and policies that save money, prevent pollution, and conserve natural resources throughout state government management and operations. These include:

- Source and waste reduction
- Energy efficiency
- Water conservation
- Recycling
- Fleet operations
- Environmentally conscious purchasing
- Establishing statewide goals to save money and reduce environmental impacts

The Greening Government Goal is: "By June 30, 2012, the state of Colorado will reduce volumetric petroleum consumption in state fleet vehicles by 25 percent from state fiscal year 2005-2006 baseline. 50 percent of state fleet fuel purchases will be alternative fuels and 20 percent of state fleet diesel vehicles fueled with biodiesel" (State of Colorado, 2009).

The Council reports that pollution control measures have drastically reduced emissions from vehicles in the past 20 years; however, during that same time, the total miles traveled has doubled, resulting in higher levels of air pollutants in many parts of the country. In 2005, the State of Colorado's fleet alone burned more than 4.2 million gallons of fuel in its vehicles, which released 84 million pounds of CO_2 into the atmosphere. The Greening Government Coordinating Council and the Governor's Energy Office provide assistance to move Colorado agencies toward achieving optimal transportation efficiency.

Executive Order D 012 07 Greening of State Government: Detailed Implementation

Executed on April 16, 2007, Executive Order D 012 07 entitled "Greening of State Government: Detailed Implementation" established policies and procedures to achieve the goals and objectives of Executive Order D 011 07 (State of Colorado, 2007). This order provides direction to the Governor's Energy Office, the Colorado Greening Government Coordinating Council, and state departments and agencies for the implementation of Executive Order D 011 07. Executive Order D 011 07 orders the Manager and Council to work with state agencies and departments to reduce overall energy use in all state facilities by 20 percent or more no later than the end of fiscal year 2011. Executive Order D 012 07 directs all state agencies and departments to minimize the public health and environmental impacts associated with agency operations, including employee transportation, and to select products that consider, among other things, a product's impact on resources such as air and water.

Specific to transportation, the order includes a section entitled "Greening of State Fleet Management." This section directs all state departments and agencies to achieve, by June 30, 2012, a 25 percent volumetric reduction in petroleum consumed by state vehicles measured against a fiscal year 2005–2006 baseline. This directive includes vehicles managed by CDOT. The order suggests restricting the purchase of four-wheel drive sport utility vehicles, except where necessary, giving priority to replacement of pre-1996 light duty vehicles that have a city fuel efficiency rating of less than 25 miles per gallon, acquiring hybrid gas/electric high efficiency vehicles, alternative and flex fuel vehicles, and other fuel-efficient/ low-emission vehicles whenever practicable. Annual reporting of fuel-use reduction is required. The Greening Council must also develop an education plan for state employees that includes the labeling of state-owned flexible-fuel vehicles and providing information about the location of flex-fuel stations to increase the use of ethanol blended and bio-diesel fuels. State agencies are required to use, when available, a minimum of a 20 percent bio-diesel blend for diesel-burning vehicles and to reach a goal using alternative fuels at least 50 percent of the time.

As part of this process, the Greening Council must work to evaluate the state fleet, develop suggestions regarding how to increase average fuel efficiency and the use of alternative fuels in state vehicles, and present the results of this study to the Governor. When traveling, state employees must use mass-transit whenever feasible.

Executive Order D 004 08, Reducing Greenhouse Gases in Colorado

Signed by the Governor on April 22, 2008, Executive Order D 004 08 prescribes specific goals for reducing and reporting greenhouse gas emissions statewide and specifically identifies the transportation sector as an area to be addressed as part of the Governor's Greening Government Initiative (State of Colorado, 2008). In addition to directing CDPHE to develop and implement a process for identifying and evaluating the benefits and impediments to measures that would reduce greenhouse gas tailpipe emissions from cars and light trucks, CDPHE is to present a comprehensive proposal for reducing new greenhouse gas emissions from the state's transportation sector within 24 months of the executive order's signing.

1.6 Visibility

Haze is caused by the emission of SO_2, NO_x, and particulate matter into the atmosphere that either scatters or absorbs light. The resulting decrease in visibility is measured by a haze metric (or index), known as a deciview. A deciview is a small but noticeable change in haziness that is especially pronounced when viewing scenes in national parks and wilderness areas (EPA, 1999). Visibility impairment is the result of both natural (windblown dust, wildfires, volcanic activity, and biogenic emissions) and anthropogenic (human induced) activities (transportation, agricultural activities, mining, and fuel combustion).

One of the primary objectives of the 1977 Clean Air Act amendments was to establish federal standards for point and nonpoint source pollutants. Section 169A of the Clean Air Act declared, as a national goal, preventing future and remedying existing impairment of visibility in mandatory Class I areas (select federal national parks and wilderness areas) from anthropogenic air pollution. Class I areas are granted special protection from the effects of air pollution in the 1977 amendments to the Clean Air Act. The federal visibility protection regulations outlined two phases to both identify and remedy visual impairments. The goal was to restore visibility to its "natural conditions" in Class I areas by year 2064. Phase I of the visibility program, referred to as Reasonably Attributable Visibility Impairment, establishes the method of determining visibility impacts from individual or small groups of sources. Phase II of the visibility program addresses the effects of regional haze, which are a decrease in visual range, clarity, color, and ability to discern texture and details in Class I areas (CDPHE, 2007).

Section 169B was added to the Clean Air Act amendments of 1990 to address regional haze. The key goals of the Regional Haze program are to:

- Improve visibility for the most impaired days, and
- Ensure no degradation in visibility for the least impaired days.

On July 1, 1999, the Environmental Protection Agency promulgated final regulations (40 CFR Part 51 Subpart P – Visibility Protection 51.300 – 309) that require each state to submit a SIP to address regional haze. The regulations require each state's SIP to:

1. Include a monitoring strategy
2. Address existing impairment from major stationary facilities (Reasonably Attributable Visibility Impairment)
3. Prevent future impairment from proposed facilities
4. Address Best Available Retrofit Technology (BART) for certain stationary sources
5. Consider other major sources of visibility impairment
6. Calculate baseline, current, and natural visibility conditions
7. Consult with the Federal Land Managers in the development or change to the SIP
8. Develop a long-term strategy to address issues facing the state
9. Set and achieve reasonable progress goals for each Class I area
10. Review the SIP every five years

The federal visibility regulations require each state to identify facilities that are subject to BART analyses and implementation. Facilities subject to BART are those that hinder visibility in Class I areas. Air Quality Control Commission Regulations modified 40 CFR 51, Appendix Y by adopting Regulation No. 3, Part E on March 16, 2006. The provisions of the regulation apply to existing stationary facilities subject to BART analysis and implementation by the Environmental Protection Agency. The amendments are designed to prevent air quality deterioration in areas that exceed national standards and improve air quality in nonattainment areas. The amendments establish Class I, II, and III Areas where particulate matter and SO_2 emissions are restricted. Mandatory Class I federal lands include all national wilderness areas greater than 500 acres. Air quality and visibility (deemed an important value of an area) are protected in Class I areas and are regulated via SIPs.

The Air Quality Control Commission established emission limitations by taking the following factors into account:

- Available technology
- Costs of compliance
- Energy and non-air quality environmental impacts of compliance
- Any pollution control equipment in use or in existence at the source or unit
- Remaining useful life of the source or unit
- Degree of improvement in visibility that may reasonably be anticipated as a result of the technology used

Because of the various factors considered, the Air Quality Control Commission establishes emission limitations case by case.

After BART-eligible facilities have been identified, the feasibility of implementing BART designed for that specific facility must be analyzed and implemented. Discretion is left to the states to determine the best approach to comply with the federal guidelines. This rule requires facilities subject to BART to file an application for a construction permit as the mechanism for submitting its BART analysis and proposal, and for seeking a Division determination of BART for the source. Existing permitting procedures are used wherever possible to streamline BART implementation.

For those facilities determined to be subject to BART, the following analyses are to be performed:

- Identify all available retrofit control technologies
- Eliminate technically infeasible options
- Evaluate control effectiveness of remaining control technologies
- Evaluate impacts and document the results
- Evaluate visibility impacts (EPA, 1999)

The analysis of available technology must include Best Available Control Technology, Lowest Achievable Emission Rate, New Source Performance Standards, Pollution Prevention, and other widely used retrofit control technologies—including those still being developed and licensed. Technologies with lower efficiencies may be considered; however, the control effectiveness of any technology must be evaluated based on the highest removal efficiency available for the technology. If existing controls are currently being used, the analysis must include enhanced efficiency of these controls.

According to the Environmental Protection Agency guidelines governing the analysis, the visibility impacts of each technology must be evaluated using approved models. If a technology is deemed technically infeasible, it must be demonstrated that the technology is not available or that it would not be fully operational due to specific physical or chemical characteristics. Secondary impacts such as implementation costs, energy consumption of the technology under evaluation, and waste products such as hazardous waste and wastewater are also considered. Other factors taken into account in BART determinations include socioeconomic factors such as impacts on the local economy and unemployment resulting from low coal sales.

Facilities that generate 750 megawatts or greater will meet the Environmental Protection Agency presumptive limits (thereby meeting BART-analysis requirements) whereas smaller plants need to include the presumptive limits as part of their BART analysis. If supported by the BART analysis, APCD may establish a BART limit higher than the Environmental Protection Agency presumptive limits.

Colorado adopted a Phase 1 visibility SIP to address the Prevention of Significant Deterioration permitting, source specific haze, and plume bright aspects of visibility in 1987. The Air Quality Control Commission subsequently updated the SIP in November 2004. Colorado's Air Quality Control Commission approved a state-only BART regulation (Regulation 3 Part E) that became effective in May 2006. The provisions of this regulation required all BART-subject facilities to submit an application for a BART determination by August 1, 2006. Colorado's BART Rule is based on the Environmental Protection Agency's BART Rule and provides the same assumption that electric generating units of greater than 750 megawatt capacity can meet the presumptive limits established by the Environmental Protection Agency. These presumptive limits are used as guidelines for smaller electric utilities subject to Colorado's BART Rule.

As outlined in Colorado's SIP, Colorado's BART Rule includes the following major provisions in addition to the presumptive limits (CDPHE, 2007):

1. Visibility impairing pollutants include SO_2, NO_x, and particulate matter.
2. Visibility impact levels are established for determining whether a given source causes or contributes to visibility impairment. The causation threshold is 1.0 deciview and the contribution threshold is 0.5 deciview. Individual sources are exempt from BART if the 98th percentile daily

change in visibility, as compared against natural background conditions, is less than 0.5 deciview at all Class I federal areas for each year modeled and for the entire multiyear modeling period.

3. Procedures for evaluating case-by-case BART considering the factors the Environmental Protection Agency discusses in 40 CFR 51, Appendix Y, including consideration of all technically feasible technologies.
4. A provision that Colorado cannot require the use of post-combustion NO_x controls as BART for sources subject to Colorado's BART program. This provision, based on the Environmental Protection Agency BART Rule preamble, states that the presumptive levels are based on fuel and boiler types. The preamble also notes that selective catalytic reduction, a common post combustion NO_x control technology, should be required only for cyclone boilers and sources that already use it on a seasonal basis for ozone purposes. The Environmental Protection Agency's conclusion was based on extensive national studies of cost-effective control technologies for hundreds of electrical generating units, and specifically included all BART-subject electric generating units in Colorado.
5. Consideration of economic impacts associated with use of Colorado coal at BART sources. This provision was included to address the fact that some Colorado sub-bituminous coal contains much different characteristics than the sub-bituminous coal that was used to establish the presumptive NO_x limits.
6. Language allowing for BART alternatives to be used in situations where a result that is better than BART will be achieved. The alternative allows sources within the same source category to be grouped together in the same airshed.
7. Requirements for public participation in the BART determinations.
8. Provision that the installation of regional haze BART controls exempts a source from additional BART controls for regional haze but does not exempt a source from additional controls or emission reductions that may be necessary to make reasonable progress under the regional haze SIP.

Colorado is setting emission limits for those sources subject to BART and must be in compliance by July 1, 2014. Colorado's SIP specifies those programs, regulations, processes, and controls needed to ensure that the goals outlined in the U.S. Environmental Protection Agency regulations and the Clean Air Act for 2018 and 2064 are met. Colorado's regulated pollutants are SO_2, NO_x, VOCs, primary organic aerosol, elemental carbon, $PM_{2.5}$, coarse particulates ($PM_{2.5}$ to PM_{10}), and ammonia (NH_3). For each emission type, emissions are calculated based on an emission rate and the amount of time the source is operating (CDPHE, 2007).

According to CDPHE, "The Commission elected to assume that all BART-eligible sources are subject to BART, but require the Division to perform modeling to determine whether BART-eligible sources will cause or contribute to visibility impairment in any Class I Area" (CDPHE, 2006).

To continue working toward meeting the 1999 regional haze rule (40 CFR 51.300) for protecting the visibility in national parks and wilderness areas, the Air Quality Control Commission held public hearings on the state's proposal for a regional haze SIP in 2007 and 2008. At the December 2007 public hearing, the commission approved all chapters of the plan, except Chapter 8, and bifurcated the hearing to continue discussion on Chapter 8 in January 2008. The legislature approved the portion of the plan approved by the commission, which was then transmitted to the Environmental Protection Agency in June 2008. During the January rulemaking hearing, the commission vacated the proceedings and ordered the division to convene a stakeholder process to address requirements related to "reasonable progress." During four stakeholder meetings, the division and stakeholders developed extensive technical materials, which resulted in a full discussion about whether and how the division will propose a regulation to establish reasonable progress pollution controls for noteworthy sources and reasonable progress visibility goals. This process was put on hold in April 2008. When the ozone SIP is complete, work will continue on this phase of the regional haze SIP (CDPHE, 2007).

1.7 Nitrogen Deposition

When determining BART limits, factors that affect NO_x emissions are part of the BART analysis for both large and small facilities. Such factors include types of combustion-control equipment in use, boiler design, the differences between boiler types, and ranks of coal (that is, bituminous, sub-bituminous, and lignite). These factors result in great variation in NO_x emissions among coal-fired power plants.

During combustion, NO_x forms when nitrogen and oxygen from the atmosphere react to form nitric oxide, nitrogen dioxide, and other oxides of nitrogen, which, in turn, react in the atmosphere to form nitrate particles. Nitrate particles decrease visibility to a greater extent than sulfate particles and scatter light four to eight times more effectively than dust particles. Nitrogen emissions are associated with the following environmental effects: increasing ground-level ozone, acid rain and resulting acidification of land and aquatic ecosystems, forest damage, and regional haze (Srivastava et. al, 2005).

In Colorado, NO_x emissions from all sources are expected to decrease by 28 percent between 2002 and 2018, as shown in **Table 3**. This decrease largely results from technological improvements in vehicular emission controls, which accounted for 204,330 tpy (or approximately 50 percent) of all NO_x emissions in 2002 and are estimated to decrease to 86,053 tpy (or 30 percent) by 2018 (CDPHE, 2007). A projected increase in area source NO_x emissions from 11,645 tpy to 16,360 tpy results from population increases. **Table 3** provides the source category for all NO_x emissions for 2002 and 2018 (estimated).

Table 3. Colorado Nitrogen Oxides Emission Inventory: 2002 and 2018

Source Category	Statewide NO_x		
	2002 (tpy)	2018 (tpy)	Net Percent Change
Point	117,869	112,241	(5)
Area	11,645	16,360	40
On-Road Mobile	141,883	45,249	(68)
Off-Road Mobile	62,447	40,804	(35)
Oil and Gas	23,351	27,993	20
Road Dust	1	0	(100)
Fugitive Dust	13	17	29
Anthropogenic Fire	520	408	(21)
Natural Fire	9,377	9,377	0
Biogenic	37,349	37,349	0
TOTAL	**404,455**	**289,799**	**(28)**

Source: CDPHE, 2007.

Key to Abbreviations/Acronyms
NOx = oxides of nitrogen   tpy = tons per year

Monitoring data show nitrogen deposition rates range from 4 to 8 kilograms of nitrogen per hectare per year at high-elevation sites in the Colorado Front Range. Deposition rates are lower west of the Continental Divide because there are fewer sources of nitrogen emissions. Also, westerly winds prevent nitrogen-enriched air masses originating along the heavily urbanized Front Range from crossing the divide (Fenn et. al, 2003). Nitrogen deposition is not a regulated air pollutant.

Section 2. Affected Environment

The following sections describe the air quality conditions in each county (from west to east through the Corridor). As noted in **Section 5**, the entire Corridor is in attainment of all NAAQS except for Jefferson County, which is currently within the Denver metropolitan and North Front Range nonattainment areas for 8-hour ozone and an attainment/maintenance (formerly nonattainment) area for CO, PM_{10}, and the 1-hour ozone standards. The Air Pollution Control Division maintains several air quality monitoring stations in the Corridor, as listed in **Table 4**. Four monitors for ozone are located in Jefferson County, and one PM_{10} monitor is located in Summit County. These are the only active monitors in the Corridor.

Table 4. Monitoring Stations and Pollutants Monitored Within the Corridor

County	Station Site	Pb	CO	SO_2	Ozone	PM_{10}	NO_2	Met[a]
Garfield[b]	Glenwood Springs	--	--	--	--	Discontinued in 2007	--	--
Eagle	Vail	--	--	--	--	Discontinued in 2001	--	--
Summit	Breckenridge, 501 N. Park Avenue	--	--	--	--	X	--	--
Clear Creek	No stations	--	--	--	--	--	--	--
Jefferson (Rocky Flats)	Golden 16600 W. Hwy. 128	--	--	--	X	--	--	--
Jefferson (Arvada)	Arvada, 9101 W. 57th Avenue		Discontinued in 2006		X	--	--	X
Jefferson (Welch)	Lakewood, 12400 West SH 285	--	--	--	X	--	--	X
Jefferson (NREL)	Golden, 2054 Quaker Street	--	--	--	X	--	--	--

Source: CDPHE, 2009
[a] Meteorological measurements: wind speed, wind direction, temperature, relative humidity, and standard deviation of horizontal wind direction.
[b] Targeted monitoring of MSATs at select oil and gas sites in Garfield County has been underway since 2007.

Key to Abbreviations/Acronyms
X = monitored -- = not monitored CO = carbon monoxide NO_2 = nitrogen dioxide
Pb = lead PM_{10} = particulate matter less than 10 microns SO_2 = sulfur dioxide

2.1 Garfield County

2.1.1 Climate and Air Quality Conditions

The dry climate in Garfield County contributes to PM_{10} emissions from windblown dust. Woodburning and re-entrained dust from highway and street sanding also contribute to PM_{10} emissions during the winter. Oil and gas drilling activities in the county also cause dust emissions from travel on miles of dirt roads and other ground disturbance associated with drilling operations.

The oil and gas industry is the largest source category (nearly half) of human-caused ozone precursor emissions in the state. On the Western Slope, a substantial amount of oil and gas development is taking place in Garfield County, where approximately 4,000 natural gas wells and associated infrastructure were completed as of mid-2006, with well development continuing at a pace of approximately 1,000 new wells per year. Surrounding oil and gas development (such as in the Piceance Basin of eastern Utah) transports emissions to the county. In recent years, the Air Quality Control Commission has acted to address the impact of emissions from the oil and gas industry (CDPHE, 2008).

Garfield County has generally experienced steady growth over the past three decades and is currently growing rapidly as the recreation/retirement and the natural gas industries have expanded. Full scale, commercial oil shale development—if it occurs—could ultimately have a substantial effect on Garfield County's economic base and land development. Population growth is shifting westward toward the New Castle, Silt, Rifle, and Parachute areas in response to recent employment opportunities brought to the area by gas development and the rising cost of homes in Glenwood Springs and Carbondale, areas that are approaching their buildout capacities (Garfield County, 2007). The economic development patterns and population increases directly relate to the number of vehicle miles traveled (and associated air emissions) in the county.

Controlled and uncontrolled burns are also a substantial source of air pollution in the Western Slope region. Garfield County Public Health continues to work with local fire authorities to develop and distribute educational materials to residents about trash burning, agricultural open burning, and smoke management (CDPHE, 2008).

2.1.2 Monitoring

The Air Pollution Control Division no longer monitors air quality within the project area. Monitors are currently located in Parachute for PM_{10} and in Rifle for PM_{10}, $PM_{2.5}$, ozone, and meteorological data (CDPHE, 2009). Both of these cities are far west of the project.

As noted in **Table 4**, the Glenwood Springs monitor, which is within the I-70 Mountain Corridor, was discontinued in 2007. Between 1986 and 2006 when it operated, the PM_{10} monitoring station in Glenwood Springs did not record any exceedances of either the 24-hour or annual average PM_{10} standards.

Garfield County completed a two-year air quality study in 2007, which investigated the ambient air quality impacts of increased oil and gas drilling in the county. Although no violations of NAAQS were observed, CDPHE follow-up tests suggest a potential for benzene violations at oil and gas sites. These and other studies prompted APCD to enhance the 2008–2009 air quality monitoring program. Garfield County Public Health received an Environmental Protection Agency Regional Geographic Initiatives Grant in 2007 to conduct targeted air monitoring of active drilling and well completion sites in partnership with several oil and gas companies. Garfield County continues to fund air toxics monitoring and sampling in the most active oil and gas areas to better understand emissions and exposure risks (CDPHE, 2008).

No NO_2, SO_2, or lead monitors are located in the County (or Corridor).

2.2 Eagle County

2.2.1 Climate and Air Quality Conditions

The dry climate in Eagle County contributes to PM_{10} emissions from windblown dust. Woodburning and re-entrained dust from highway and street sanding also contribute to PM_{10} emissions during the winter. Windblown dust from sand and gravel mining and construction activities is also a source of PM_{10} emissions. Controlled and uncontrolled burns are also a substantial source of air pollution in the Western Slope region. Eagle County has hired a wildfire mitigation specialist to work with local fire districts to better manage air quality impacts (CDPHE, 2008).

To improve air quality in Eagle County, an ad-hoc Air Quality Forum—made up of representatives of the gravel and gypsum mining industries and local governments—is developing industry standards of operation, Best Available Demonstrated Technologies, and lobbying local governments to take regulatory actions to control emissions. The County has also initiated a number of actions under the ECO Green Initiative program to reduce greenhouse gas emissions (CDPHE, 2008).

2.2.2 Monitoring

Monitoring conducted in Vail for PM_{10} between 1993 and 2001 showed no exceedances of the 24-hour or annual average PM_{10} standards. The Air Pollution Control Division discontinued PM_{10} monitoring in Vail in 2001.

No NO_2, SO_2, or lead monitors are located in the County (or Corridor).

2.2.3 Class I Areas

The Eagles Nest Wilderness Area, within the White River National Forest, is the only Class I area in the vicinity of the Corridor. Data provided by the U.S. Forest Service explain that "air quality on the White River National Forest is affected by land management and development activities both on and off the forest. Collectively, these activities can reduce visibility, emit gaseous and particulate pollutants, and contribute to acidic deposition." Monitoring of air quality-related indicators in 2002 showed "very-good-to-excellent air quality in the wilderness areas managed by the forest" (USFS, 2002). The Fiscal Year 2006 Monitoring Evaluation Report for the White River National Forest showed that 10 sites had been monitored for air quality with the goal of minimizing the amount and impact of air pollutants produced from land management activities (USFS, 2006). No degradation in visibility was reported. The median Standard Visual Range of more than 140 miles for the Eagles Nest Wilderness Area is among the best in the U.S. (USFS, 2002).

According to the U.S. Forest Service, localized air pollution from development of ski areas, continued growth in Western Slope communities, vehicular exhaust and re-entrained road dust (PM_{10}) associated with increased traffic, and smoke from prescribed burns to reduce fuel accumulation continue to affect air quality.

2.3 Summit County

2.3.1 Climate and Air Quality Conditions

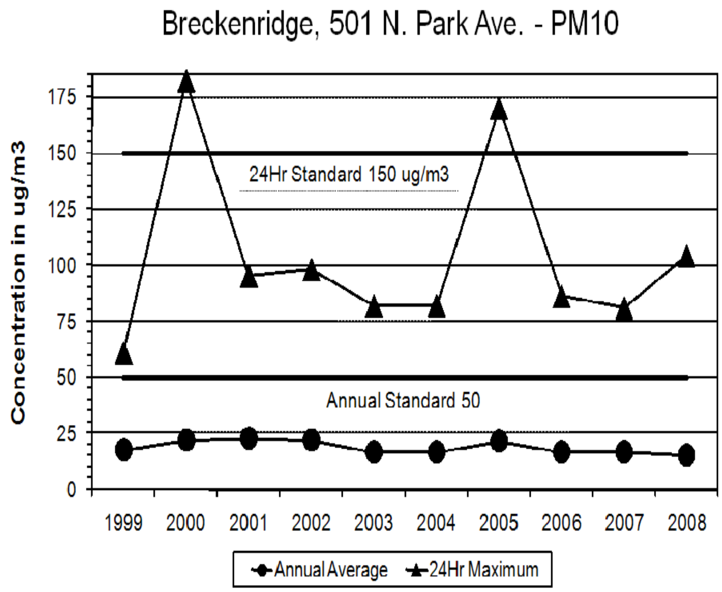
The dry climate in Summit County contributes to the PM_{10} emissions from the windblown dust. Re-entrained dust from highway and street sanding also contribute to PM_{10} emissions in the winter. Other sources of fugitive dust are sand and gravel mining and construction. Woodburning is a smaller contributor to PM_{10} emissions because of restrictions on fireplaces and woodburning stoves in Summit County. Controlled and uncontrolled burns are also a substantial source of air pollution in the Western Slope region (CDPHE, 2008).

The Environment Element of the Countywide Comprehensive Plan includes strategies for preservation of air quality. The Transportation Element of the plan provides policy direction and places emphasis on the coordination of different transportation components and promotion of alternatives to automobile use (Summit County, 2009).

2.3.2 Monitoring

A PM_{10} monitor is located in Breckenridge. As shown in **Figure 3**, air quality data for the Breckenridge site have been relatively constant when measured over an annual average, keeping slightly over or under 22 $\mu g/m^3$ annual averages, although violations of the 24-hour standard were recorded in 2000 and 2005.

Figure 3. Historical Comparisons of PM_{10} at Breckenridge Monitoring Station



Source: CDPHE, 2009

No NO_2, SO_2, or lead monitors are located in the County (or Corridor).

2.4 Clear Creek County

2.4.1 Climate and Air Quality Conditions

The dry climate in Clear Creek County contributes to PM_{10} emissions from windblown dust. Re-entrained dust from highway and street sanding also contribute to PM_{10} emissions in the winter. Windblown dust from mine tailings is also a source of PM_{10} emissions. Woodburning is a smaller contributor to PM_{10} emissions; Clear Creek County does not have woodburning restrictions.

2.4.2 Monitoring

The Air Pollution Control Division does not maintain any permanent air quality monitors in Clear Creek County. As noted in **Section 1.3.2**, APCD collected ozone samples in 2007 and determined that Clear Creek County is not likely to have high ozone concentrations and should not be included in the Denver metropolitan and North Front Range updated ozone nonattainment areas.

No NO_2, SO_2, or lead monitors are located in the County (or Corridor).

2.5 Jefferson County

2.5.1 Climate and Air Quality Conditions

Jefferson County is part of the Denver Air Basin and Monitoring Region (Central Front Range Region). Along with the rest of the Denver metropolitan area, Jefferson County is a maintenance area for CO and particulate matter due to past violations of NAAQS, although the area is currently in attainment for these pollutants. The Denver metropolitan region, including Jefferson County, is a nonattainment area for ozone. The dry climate in Jefferson County contributes to PM_{10} emissions from windblown dust. Re-entrained dust from highway and street sanding also contribute to PM_{10} emissions in the County during the winter.

Woodburning is a small contributor to PM_{10} emissions due top restrictions on fireplaces, woodburning stoves, and use of woodburning devices are in place. Jefferson County also regulates air pollution sources from large-scale manufacturing plants to unpaved roads.

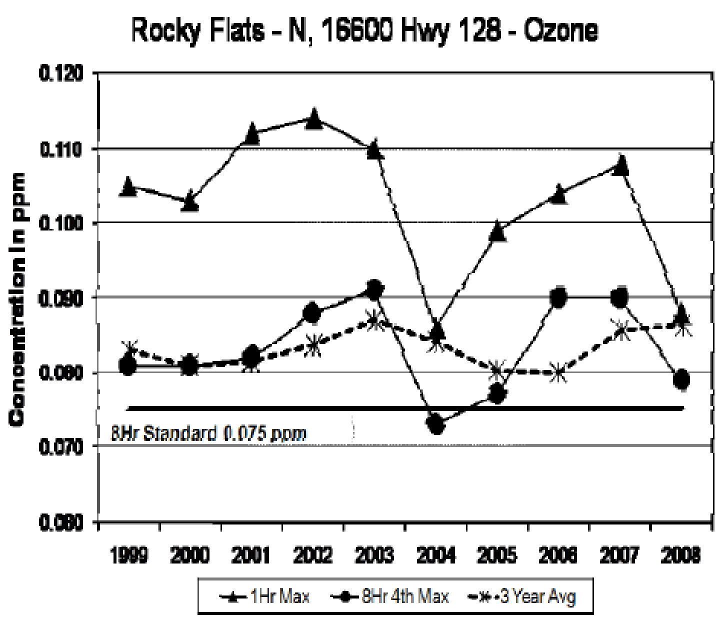
2.5.2 Monitoring

In Colorado, carbon monoxide monitoring is performed only in portions of the Denver metropolitan area, and the CO standard was last violated in 1995. Carbon monoxide monitoring was discontinued in Jefferson County in 2006. The most recent revised CO maintenance plan for Denver, approved by the Air Quality Control Commission on December 15, 2005, established the emissions budget at 1,635 tons per day (tpd) through 2020, and 1,600 tpd for 2021 and beyond. On May 3, 2007, the Environmental Protection Agency found the revised CO budget of 1,600 tpd adequate for use in conformity determinations for 2021 and beyond. The Environmental Protection Agency's approval of the revised Denver CO Maintenance Plan became effective October 16, 2007 (DRCOG, 2008).

No NO_2 monitoring is currently performed in Jefferson County because new monitors in Denver and Adams counties replaced the NO_2 monitors at Rocky Flats (CDPHE, 2009). No SO_2 monitoring stations are within the project area. The Denver metropolitan area is in attainment of SO_2 standards. Lead is not monitored in the project area.

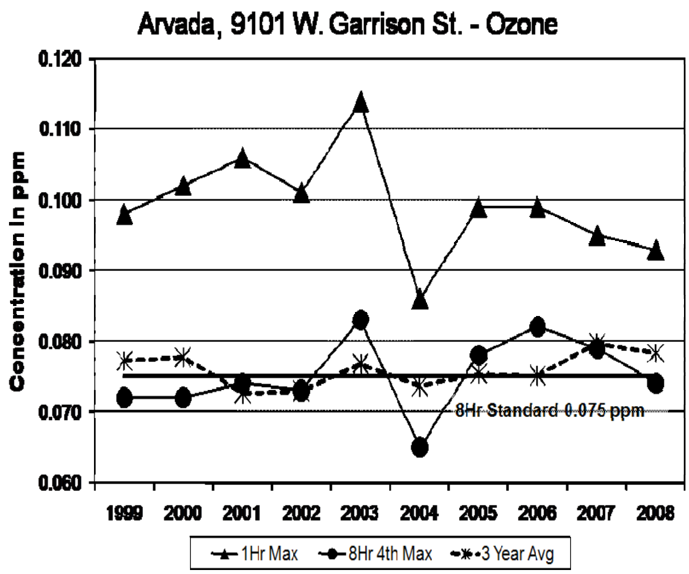
The only pollutant monitored in Jefferson County is ozone. Ozone monitoring within the project area is conducted at Rocky Flats, Arvada, Golden (NREL), and Welch. **Figure 4 through Figure 7** provide graphs of the ozone trends at these stations (see **Table 4**). Note that for all stations, 2003 is considered to be abnormally high due to climatic conditions that summer. Over the past several years, the Denver metropolitan area has recorded multiple exceedances of the ozone standard, and in 2007 became a nonattainment area for the 8-hour ozone standard. The nonattainment status is partially related to a stricter standard imposed by the Environmental Protection Agency in 2008. As noted previously, the current (2010) proposal to further reduce the ozone standard could result in new or expanded nonattainment areas throughout the state.

Figure 4. Historical Comparisons of 1-hour Ozone and 8-hour Ozone at the Rocky Flats Monitoring Station



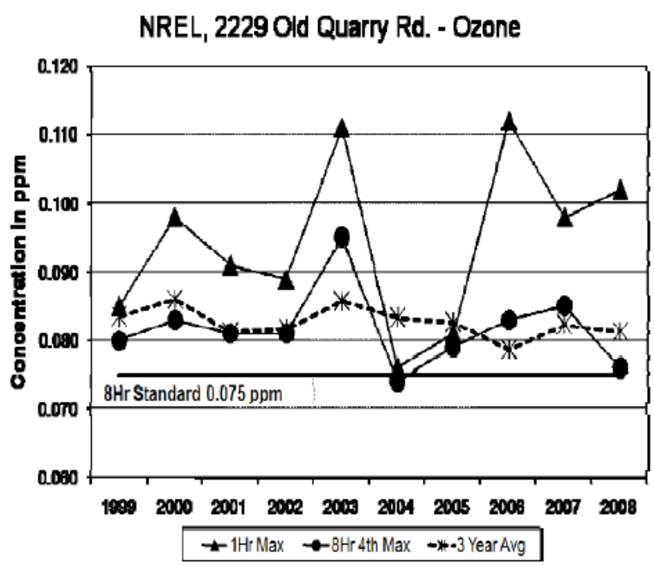
Source: CDPHE, 2009

Figure 5. Historical Comparisons of 1-hour Ozone and 8-hour Ozone at the Arvada Monitoring Station



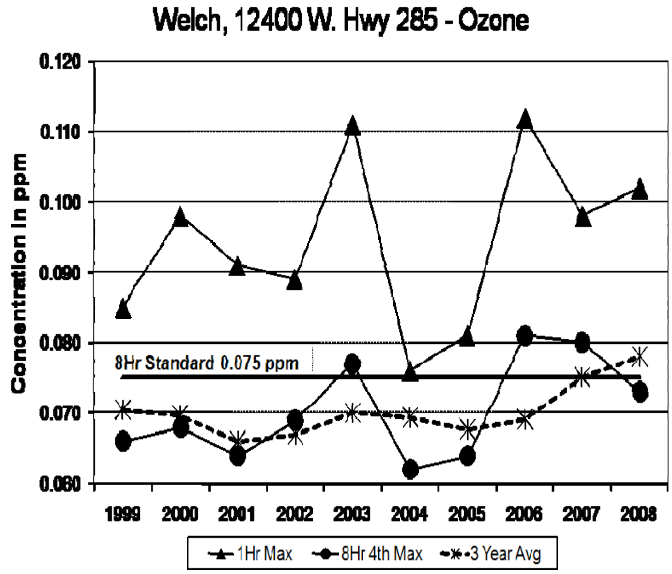
Source: CDPHE, 2009

Figure 6. Historical Comparisons of 1-hour Ozone and 8-hour Ozone at the Golden (NREL) Monitoring Station



Source: CDPHE, 2009

Figure 7. Historical Comparisons of 1-hour Ozone and 8-hour Ozone at Welch Monitoring Station



Source: CDPHE, 2009

Section 3. Environmental Consequences

To compare the air quality impacts among the alternatives, the lead agencies calculated emissions of various pollutants for each alternative. Emissions of criteria pollutants and MSATs are directly related to vehicle miles traveled in the Corridor. Therefore, alternatives with higher vehicle miles traveled generally have higher total daily emissions. As a reference for the emissions calculations presented in the following sections, **Table 5** presents a comparison of vehicle miles traveled by alternative. The 2035 Baseline (estimated by APCD) shows the highest percentage increase in vehicle miles traveled because it represents demand and does not factor congestion-related suppressed trips or mode shifts that occur with Transit alternatives. In contrast, the No Action Alternative factors in congestion-related suppressed trips. Therefore, No Action vehicle miles traveled, and associated pollutant emissions, are lower than the 2035 Baseline in **Table 5, Table** 6**, and Table** 7. Despite the substantial increase in vehicle miles traveled for all alternatives (when compared with current levels) shown in **Table 5**, emissions of criteria and toxic pollutants are projected to be less in 2035 than current day emissions, even though traffic volumes are higher. Future emissions are assumed to be lower as older, higher-polluting vehicles are replaced by newer, low-polluting vehicles and strict regulatory controls continue to be effective in reducing emissions. Ozone concentrations are considered a regional pollutant and are, therefore, not directly related to vehicle miles traveled.

Table 5. Comparison of Daily Vehicle Miles Traveled in the I-70 Mountain Corridor by Alternative (Year 2035)

Alternative	Automobile VMT	Heavy-duty Vehicle VMT (Truck, Bus, and Rail)	Total VMT	Percent Increase from Current
Year 2008 Current[1]	6,085,077	752,088	6,837,166	0
Year 2035 Baseline	9,310,168	1,150,695	10,460,863	53
No Action	8,261,907	1,021,135	9,283,042	36
Minimal Action	7,541,878	932,142	8,474,021	24
Rail with IMC	7,743,354	957,044	8,700,398	27
AGS	7,541,878	932,142	8,474,021	24
Dual-Mode Bus in Guideway	7,614,435	941,110	8,555,545	25
Diesel Bus in Guideway	7,710,822	953,023	8,663,845	27
Six-Lane Highway (55 and 65 mph)	9,145,262	1,130,313	10,275,576	50
Reversible/HOV/HOT Lanes	9,217,222	1,139,207	10,356,429	51
Combination Six-Lane Highway with Rail and IMC	8,851,222	1,093,971	9,945,194	45
Combination Six-Lane Highway with AGS	8,698,266	1,075,067	9,773,333	43
Combination Six-Lane Highway with Dual-Mode Bus in Guideway	8,821,329	1,090,277	9,911,605	45
Combination Six-Lane Highway with Diesel Bus in Guideway	8,886,333	1,098,311	9,984,644	46
Preferred Alternative[2]	7,849,800 to 8,698,266	970,200 to 1,075,067	8,820,000 – to9,773,333	29 to 43

[1] Estimated from CDOT traffic database (URL: http://www.dot.state.co.us/App_DTD_DataAccess/Traffic/index.cfm?fuseaction=TrafficMain&MenuType=Traffic).

[2] The Preferred Alternative is presented as a range because the adaptive management component of the Preferred Alternative allows it to be implemented based on future needs and associated triggers for further action. Chapter 2, Section 2.7 of the I-70 Mountain Corridor PEIS (CDOT, 2010) describes the triggers for implementing components of the Preferred Alternative.

Key to Abbreviations/Acronyms

AGS = Advanced Guideway System
HOT = High-Occupancy Toll
HOV = High-Occupancy Vehicle
IMC = Intermountain Connection
mph = miles per hour
VMT = vehicle miles traveled

Unlike criteria and toxic pollutants, re-entrained dust from winter roadway sanding operations increases as traffic volumes increase. Therefore, re-entrained dust in 2035 is anticipated to be higher than 2000 emissions under all alternatives because 2035 traffic volumes would be higher. Greenhouse gases are also likely to be higher in 2035 than current emissions. The following sections present and discuss emissions by pollutant type.

3.1 Carbon Monoxide

In addition to vehicle miles traveled (see **Table 5**), speed and traffic congestion influence CO emissions. Carbon monoxide emissions are highest at both high, free-flow speeds such as 60 miles per hour (mph) to 70 mph and low, congested speeds such as 15 mph to 20 mph. Congestion in the Corridor is highly variable and depends on the season, day of the week, time of day, and weather conditions. Calculations for total daily CO emissions used average running speeds for four time periods:

- Morning peak
- Midday off-peak
- Afternoon peak
- Evening off-peak periods

Morning and afternoon peak periods represent more congested conditions and, therefore, lower speeds and higher CO emissions. For the I-70 Mountain Corridor, the analysis used wintertime Saturday traffic volumes for the peak periods because typical ski weekend volumes represent the “worst-case” combinations of traffic volumes and emission rates and, therefore, the highest estimate of total daily CO emissions.

For all the alternatives, CO emissions in 2035 are anticipated to be less than current day emissions. As shown in **Table 6**, CO emissions in 2035 for the No Action Alternative are approximately 39 percent lower than present day (baseline) CO emissions in the Corridor. Carbon monoxide emissions in 2035 for the Minimal Action and Transit alternatives are approximately 1 percent to 9 percent lower than those of the No Action Alternative. Because traffic volumes for the Highway and Combination alternatives are higher than those of the No Action Alternative, CO emissions are also higher. Carbon monoxide emissions for the Combination alternatives are approximately 5 percent to 6 percent higher than those of the No Action Alternative, while the Six-Lane Highway (55 or 65 mph) alternatives result in emissions approximately 9 percent higher than those of the No Action Alternative. The Reversible/HOV/HOT Lanes Alternative provides a fourth lane in the peak direction and has the highest CO emissions in 2035 (approximately 10 percent higher than those of the No Action Alternative) as a result of higher traffic volumes during peak hours. In 2035, the Preferred Alternative has CO emissions of 4 percent less to 5 percent more than those of the No Action Alternative. This difference is related to the vehicle miles traveled; the Minimum Program has vehicle miles traveled less than the No Action Alternative, while the Maximum Program, if implemented, has more.

Table 6. Comparison of 2035 Air Quality Impacts Criteria Pollutants by Alternative (tons per day)

Alternative	Particulate Matter Less Than 2.5 Microns ($PM_{2.5}$)	Sulfur Dioxide (SO_2)	Nitrogen Dioxide (NO_X)	Carbon Monoxide (CO)	Nitrogen Content of Emissions	Ammonia (NH_3)	Re-entrained Road Dust
Year 2000	3.99	4.26	16.45	113.79	16.45	NA	49.54
Year 2035 Baseline	0.14	0.11	4.28	76.03	4.28	0.99	104.61
No Action	0.13	0.09	3.87	69.51	3.75	0.88	92.83
Minimal Action	0.13	0.09	3.84	68.98	3.72	0.88	91.90
Rail with IMC	0.12	0.09	3.63	65.21	2.26	0.82	87.00
AGS	0.12	0.09	3.54	63.56	2.19	0.79	84.74
Dual-Mode Bus in Guideway	0.12	0.09	3.56	64.00	1.99	0.81	85.56
Diesel Bus in Guideway	0.11	0.09	3.61	64.82	2.26	0.82	86.64
Six-Lane Highway 55 mph	0.14	0.11	4.25	76.07	2.68	0.99	102.76
Six-Lane Highway 65 mph	0.13	0.11	4.25	76.07	2.68	0.99	102.76
Reversible/HOV/HOT Lanes	0.14	0.11	4.29	76.67	2.69	0.99	103.56
Combination Six-Lane Highway with Rail and IMC	0.14	0.10	4.12	73.82	2.59	0.95	99.45
Combination Six-Lane Highway with AGS	0.13	0.10	4.06	72.88	2.50	0.92	97.73
Combination Six-Lane Highway with Dual-Mode Bus in Guideway	0.14	0.10	4.09	73.15	2.58	0.94	99.12
Combination Six-Lane Highway with Diesel Bus in Guideway	0.14	0.10	4.12	73.61	2.61	0.96	99.85
Preferred Alternative[1]	0.12 to 0.13	0.09 to 0.10	3.68 to 4.06	66.00 to 72.88	2.29 to 2.50	0.83 to 0.92	88.20 to 97.73

[1] The Preferred Alternative is presented as a range because the adaptive management component of the Preferred Alternative allows it to be implemented based on future needs and associated triggers for further action. Chapter 2, Section 2.7 of the I-70 Mountain Corridor PEIS (CDOT, 2010) describes the triggers for implementing components of the Preferred Alternative.

Key to Abbreviations/Acronyms
AGS = Advanced Guideway System HOT = High-Occupancy Toll HOV = High-Occupancy Vehicle
IMC = Intermountain Connection

3.2 Mobile Source Air Toxics

A qualitative analysis provides a basis for identifying and comparing the potential differences among MSAT emissions, if any, from the various alternatives. The qualitative assessment presented below is derived in part from a study conducted by FHWA entitled *A Methodology for Evaluating Mobile Source Air Toxic Emissions Among Transportation Project Alternatives*, found at:
URL: http://www.fhwa.dot.gov/environment/airtoxic/msatcompare/msatemissions.htm.

For each alternative evaluated in the *I-70 Mountain Corridor PEIS* (CDOT, 2010), the amount of MSAT emissions is proportional to the vehicle miles traveled, assuming that other variables such as fleet mix are the same for each alternative. The vehicle miles traveled estimated for each Action Alternative is slightly higher than that for the No Action Alternative because the additional capacity provided by the Action Alternatives increases the efficiency of the roadway and attracts rerouted trips from elsewhere in the transportation network (see **Table 5**). This increase in vehicle miles traveled leads to higher MSAT emissions for the Action Alternatives along the Corridor, along with a corresponding decrease in MSAT emissions along the parallel routes. The emissions increase is offset somewhat by lower MSAT emission rates due to increased speeds. According to the Environmental Protection Agency's MOBILE6.2 emissions model, emissions of all of the priority MSATs, except DPM, decrease as speeds increase. The extent to which these speed-related emissions decreases will offset vehicle miles traveled-related emissions increases cannot be reliably projected due to the inherent deficiencies of technical models.

To allow comparisons of relative quantities of air toxics to be made across scenarios, APCD provided CDOT with emission rates for acetaldehyde, acrolein, benzene, 1,3-butadiene, and formaldehyde for the years 2001, 2015, 2020, 2025, and 2035. The analysis of MSAT emissions in this Technical Report reflects the six priority MSATs in place at the time the analysis was conducted. Tier 2 processes will consider the updated list of MSATs identified subsequently by the Environmental Protection Agency. Emission rates for DPM were also provided for 2005, 2010, 2025, and 2035. Multiplying vehicle miles traveled by the 2035 emission rate for the appropriate MSAT determined corridorwide emissions for the 2035 Baseline travel demand scenario and each alternative. Note that DPM calculations considered vehicle miles traveled only for heavy trucks (that is, combination-units or semis).

Table 7 shows estimated emissions by chemical for a 2035 winter Saturday. Note the Advanced Guideway System, Dual-Mode Bus in Guideway, Preferred Alternative, and Rail with Intermountain Connection alternatives have the lowest quantity for each of the six toxic emissions considered because these alternatives have the least vehicle miles traveled in the Corridor. (As noted, the analysis used the five MSATs considered priority by the Environmental Protection Agency applicable when the modeling was completed. Tier 2 processes will consider the revised list of seven priority MSATs.) (See **Table 5** for estimated vehicle miles traveled under each alternative.) The Reversible/HOV/HOT Lanes and Combination Six-Lane Highway with Rail and Intermountain Connection alternatives have the greatest quantity of each pollutant because of the ability of the alternatives to induce many day recreation trips. A decrease of more than 10 percent in vehicle miles traveled over the No Action Alternative is projected for the Preferred Alternative; this corresponds to lower emissions as well.

Table 7. Comparison of 2035 Winter Saturday Mobile Source Air Toxics Emissions by Alternative (tons per day)

Mobile Air Source Toxic Emissions (for all vehicle types)						
Alternative	**Acetaldehyde**	**Acrolein**	**Benzene**	**1,3-Butadiene**	**Formaldehyde**	**Diesel Particulate Matter**
Year 2035 Baseline	0.0241	0.0031	0.14	0.015	0.062	0.0140
No Action	0.0212	0.0027	0.12	0.014	0.055	0.0124
Minimal Action	0.0210	0.0027	0.12	0.014	0.054	0.0123
Rail with IMC	0.0199	0.0025	0.11	0.013	0.052	0.0116
AGS	0.0194	0.0025	0.11	0.012	0.050	0.0113
Dual-Mode Bus in Guideway	0.0196	0.0025	0.11	0.013	0.051	0.0114
Diesel Bus in Guideway	0.0196	0.0023	0.10	0.012	0.051	0.0105
Six-Lane Highway (55 or 65 mph)	0.0235	0.0030	0.14	0.015	0.061	0.0137
Reversible/HOV/HOT Lanes	0.0237	0.0030	0.14	0.015	0.061	0.0138
Combination Six-Lane Highway with Rail and IMC	0.0227	0.0029	0.13	0.015	0.059	0.0133
Combination Six-Lane Highway with AGS	0.0223	0.0029	0.13	0.014	0.058	0.0131
Combination Six-Lane Highway with Dual-Mode Bus in Guideway	0.0227	0.0029	0.13	0.015	0.059	0.0132
Combination Six-Lane Highway with Diesel Bus in Guideway	0.0229	0.0029	0.13	0.015	0.059	0.0133
Preferred Alternative[1]	0.0202 to 0.0223	0.0026 to 0.0029	0.12 to 0.13	0.013 to 0.014	0.052 to 0.058	0.0118 to 0.0131

[1] The Preferred Alternative is presented as a range because the adaptive management component of the Preferred Alternative allows it to be implemented based on future needs and associated triggers for further action. Chapter 2, Section 2.7 *of the I-70 Mountain Corridor PEIS (CDOT, 2010) describes the triggers for implementing components of the Preferred Alternative.*

Key to Abbreviations/Acronyms

AGS = Advanced Guideway System — HOT = High-Occupancy Toll

HOV = High-Occupancy Vehicle — IMC = Intermountain Connection

Benzene accounts for the greatest mass of air toxics emitted for any alternative. Formaldehyde and acetaldehyde are the next most plentiful emissions, followed by 1,3-butadiene and acrolein. For instance, under the Reversible/HOV/HOT Lanes Alternative, 280 pounds (0.14 tons) of benzene is produced each winter Saturday throughout the Corridor as compared to only 6 pounds (0.0030 tons) of acrolein.

Because the estimated vehicle miles traveled under each Action Alternative is similar, varying by less than 20 percent, it is expected there is no appreciable difference in overall MSAT emissions among the various alternatives. Also, regardless of the alternative chosen, emissions will likely be lower than present levels in the design year as a result of the Environmental Protection Agency's national control programs that are projected to reduce annual MSAT emissions by 72 percent between 1999 and 2050. Local conditions may differ from these national projections in terms of fleet mix and turnover, vehicle miles traveled growth rates, and local control measures. However, the magnitude of the Environmental

Protection Agency-projected reductions is so great (even after accounting for vehicle miles traveled growth) that MSAT emissions in the study area are likely to be lower in the future in nearly all cases.

The additional travel lanes contemplated as part of most of the Action Alternatives have the effect of moving some traffic closer to nearby homes, schools, and businesses; therefore, under each alternative there are localized areas where ambient concentrations of MSATs could be higher under certain Action Alternatives than under the No Action Alternative. The localized increases in MSAT concentrations are likely to be most pronounced along the expanded roadway sections in Clear Creek County between Silverthorne and Idaho Springs and in the Vail Valley. However, the magnitude and the duration of these potential increases compared to the No Action Alternative cannot be reliably quantified due to incomplete or unavailable information in forecasting project-specific MSAT health impacts. In sum, when a highway is widened, the localized level of MSAT emissions for the Action Alternatives could be higher relative to the No Action Alternative but could be offset due to increases in speeds and reductions in congestion (which are associated with lower MSAT emissions). Also, MSATs are lower in other locations when traffic shifts away from them. However, regionally, the Environmental Protection Agency's vehicle and fuel regulations, coupled with fleet turnover, over time cause substantial reductions that, in almost all cases, cause regionwide MSAT levels to be substantially lower than those of today.

3.3 Motor Vehicle Direct Particulate Matter Emissions

The current *Denver PM_{10} Maintenance Plan* (CDPHE, 2005) projects PM_{10} concentrations to 2022 and provides emission inventories for 2010, 2015, 2020, and 2022. The plan documents conformity with the 130 µg/m3 NAAQS for each year. Total projected concentrations range from 135 to 145 µg/m3, which allow for a safety margin to prevent violations of the NAAQS. The plan also establishes a mobile vehicle emissions budget (presented in tons per day) that enables projects to be evaluated against the plan and ensure conformity with the NAAQS. For this study, re-entrained dust, the most prevalent source of PM_{10} emissions, was used for analysis, and the results indicate that violations of the NAAQS would not result from any of the Action Alternatives.

Re-entrained road dust associated with highway sanding (winter only) is the primary source of particulate emissions (PM_{10} and $PM_{2.5}$) from motor vehicles. Other direct vehicle sources of particulate emissions include tailpipe exhaust and brake and tire wear. **Table 6** shows direct vehicle particulate emissions and re-entrained dust emissions for each alternative. Unlike tailpipe emissions, which continue to decrease in the future due to improved engine technologies, re-entrained dust emissions increase as traffic volumes increase. For all alternatives, re-entrained dust (PM_{10}) in 2035 is anticipated to be higher than 2000 emissions because 2035 traffic volumes would be higher. As shown in **Table 6**, re-entrained dust in 2035 for the No Action Alternative is approximately 53 percent higher than present day re-entrained dust in the Corridor. Re-entrained dust (PM_{10}) in 2035 for the Minimal Action and Transit alternatives is approximately 1 percent to 9 percent higher than that of the No Action Alternative. Re-entrained dust (PM_{10}) for the Combination alternatives is approximately 5 percent to 8 percent higher than that of the No Action Alternative, while the Six-Lane Highway (55 or 65 mph) alternatives result in re-entrained dust (PM_{10}) approximately 11 percent higher than that of the No Action Alternative. The Reversible/HOV/HOT Lanes Alternative, which provides a fourth lane in the peak direction, has the highest re-entrained dust (PM_{10}) in 2035 (approximately 12 percent higher than that of the No Action Alternative) as a result of higher traffic volumes during peak hours. In 2035, the Preferred Alternative has re-entrained dust (PM_{10}) emissions ranging from approximately 5 percent lower to 5 percent higher than the No Action Alternative.

Typically, $PM_{2.5}$ emissions result from vehicle exhaust and brake and tire wear. As with other criteria pollutants, $PM_{2.5}$ emissions in 2035 are anticipated to be less than current day emissions under all alternatives. As shown in **Table 6**, $PM_{2.5}$ emissions in 2035 for the No Action Alternative are approximately 97 percent lower than baseline $PM_{2.5}$ emissions in the Corridor. For the Minimal Action and Transit alternatives, $PM_{2.5}$ emissions in 2035 are approximately 0 percent to 15 percent lower than those of the No Action Alternative. Because traffic volumes for the Highway and Combination alternatives are higher than those of the No Action Alternative, $PM_{2.5}$ emissions are also higher. For the Highway and Combination alternatives, $PM_{2.5}$ emissions are approximately 0 percent to 8 percent higher than those of the No Action Alternative, with the Reversible/HOV/HOT Lanes Alternative emissions at the high end of the range. In 2035, the Preferred Alternative has $PM_{2.5}$ emissions within these ranges.

3.4 Visibility

An analysis of visibility impacts of the Action Alternatives compared 2035 emissions of motor vehicle pollutants and re-entrained road dust (PM_{10}) with 2000 emissions. The analysis calculated emissions for $PM_{2.5}$, SO_2, and NO_x. Particulates in tailpipe exhaust (carbon and sulfates), plus brake and tire wear, are included in $PM_{2.5}$ emissions. Sulfur dioxide and nitrogen oxides are gaseous emissions that contribute to secondary particle formation. To determine the relative impacts on visibility of each alternative, a weighted total of gross emissions for each pollutant was calculated based on the light scattering efficiency of each pollutant.

Values in **Table 6** are for the purpose of comparison among alternatives and are not quantitative measures of visibility impairment.

For all alternatives, visibility is expected to improve with reduced emissions due to improvements in engine technologies and stricter regulations. Visibility impacts in 2035 for the No Action Alternative are approximately 33 percent lower than present day visibility impacts in the Corridor. Visibility impacts in 2035 for the Minimal Action and Transit alternatives are approximately 1 percent to 24 percent lower than those of the No Action Alternative. Visibility impacts for the Combination alternatives are approximately 8 percent to 10 percent lower than those of the No Action Alternative, while the Six-Lane Highway (55 or 65 mph) alternatives result in visibility impacts approximately 5 percent lower than those of the No Action Alternative. The Reversible/HOV/HOT Lanes Alternative has approximately 4 percent lower impacts than the No Action Alternative. The visibility impacts of the Preferred Alternative are within these ranges.

Colorado is a member of the Western Regional Air Partnership (WRAP). Although WRAP's primary focus is implementing recommendations from the Grand Canyon Visibility study dealing with regional haze, the organization has also studied other air quality factors affecting visibility, including an assessment of mobile source emissions at several locations along the Corridor (WRAP, 2009). The analysis provides information on air toxic precursors, pollutants that contribute to visibility impacts, and criteria air pollutants. By using state-of-the-art techniques to assess various air quality impact scenarios, the study provides an excellent backdrop and point of reference for air quality impacts along the Corridor. For example, the WRAP inventory of NO_x shows Front Range emissions of mobile source NO_x to be far greater than NO_x emissions west of the Continental Divide along the Corridor. In addition, concentrations of pollutants at Eagles Nest Wilderness Area in the vicinity of the Corridor show mobile source emissions to be less substantial than other sources.

3.5 Nitrogen Deposition

Similar to visibility impacts, the analysis to determine the potential for nitrogen deposition associated with the Action Alternatives compared 2035 emissions of nitrogen with 2000 emissions. Motor vehicle nitrogen oxide emissions were assumed to be nitric oxide because this is the primary form of the many forms of nitrogen oxides first emitted before exhaust gases reach the catalytic converter. Also included is nitrogen from ammonia in vehicle exhaust.

For all alternatives, comparative impacts on nitrogen deposition in 2035 are anticipated to be less than current day impacts because of technological and regulatory controls, even though 2035 traffic volumes would be higher than 2000 volumes. Nitrogen deposition impacts from motor vehicle emissions in 2035 for the No Action Alternative are approximately 62 percent lower than present day nitrogen deposition impacts in the Corridor (see **Table 6**). Nitrogen deposition impacts in 2035 for the Minimal Action Alternative are approximately the same as those of the No Action Alternative, and Transit alternatives are approximately 40 to 47 percent lower than those of the No Action Alternative. Nitrogen deposition impacts for the Combination alternatives are approximately 30 percent to 33 percent lower than those of the No Action Alternative. The Highway alternatives result in nitrogen deposition impacts approximately 28 percent lower than those of the No Action Alternative. The nitrogen deposition impacts of the Preferred Alternative are approximately 38 percent lower than those of the No Action Alternative.

3.6 Cost-Benefit Analysis

The Federal Highway Administration does not typically perform air quality cost-benefit analyses for highway projects. The Environmental Protection Agency, however, performs extensive cost-benefit analyses when it adopts new emissions control regulations. The emission reduction benefits of these regulations are built into the MOBILE6.2 model that FHWA uses for emissions analysis and are reflected in the emissions projections for the Corridor. Because the Environmental Protection Agency already performs a cost-benefit analysis to support its control programs, FHWA does not believe it would be useful to repeat this work in the context of individual highway projects.

The Environmental Protection Agency Office of Transportation and Air Quality website (URL: http://www.epa.gov/otaq) provides more detail on the cost and health benefits of its mobile source emissions controls. In addition, the emissions projections show a substantial decline in emissions of nearly all pollutants in the Corridor, which will presumably lead to health benefits over time. The emissions difference among alternatives is much smaller than the total decline in emissions from 2009 levels. As a result, a cost-benefit analysis comparing the air quality and health costs of the various alternatives would not be particularly useful to decision-makers.

3.7 Greenhouse Gases

The primary greenhouse gases produced by the transportation sector are CO_2, methane (CH_4), nitrous oxide (N_2O), and hydrofluorocarbons (HFC). Carbon dioxide accounts for 95 percent of transportation greenhouse gas emissions in the United States, most (79 percent) related to the combustion of fossil fuels from vehicle engines (USDOT, 2010). Other lifecycle greenhouse gases related to transportation include the manufacture of vehicles, the extraction and refining of fuels, the construction and maintenance of transportation infrastructure, and others (USDOT, 2010). This section presents an analysis of future Corridor on-road greenhouse gas emissions measured by CO_2 production. Greenhouse gas emission estimates for these alternatives are based on the travel demand model projections prepared for this project in 2009 and include vehicle emissions from passenger automobiles, trucks, buses, and rail.

Greenhouse gas emissions are normally presented as the total CO_2 equivalent released and are in this section. Differences in greenhouse gas emissions for each alternative are based on the following assumptions:

- The forecast year is 2035.
- Vehicle miles traveled data are from the travel demand model prepared in 2009 for the Corridor.
- The project area consists of the Corridor transportation network modeled for air quality and travel demand purposes.
- The greenhouse gas emissions are calculated based on the total daily energy consumption estimated for each alternative.
- Carbon dioxide production is used as a surrogate for greenhouse gas emissions in the Corridor analysis.

The analysis calculated greenhouse gas emissions by multiplying the daily vehicle miles traveled and CO_2 production by the following conversion factors, which are based on existing average greenhouse gas emissions by vehicle type:

- Passenger vehicle = 0.0765
- Heavy-duty vehicle, diesel bus, and commuter rail = 0.0788

Emission factors are expected to decrease in the future due to advancements in vehicle and fuel technology and more stringent emissions regulations.

Table 5 presents an estimate of vehicle miles traveled by alternative. **Table 8** below presents a comparison of the CO_2 produced by each alternative, which is measured by vehicle miles traveled. Reductions in vehicle miles traveled result in reduced production of CO_2. The Air Pollution Control Division estimated baseline emissions.

Table 8. Comparison of Corridor Carbon Dioxide Production by Alternative (Year 2035)

Alternative	CO_2 Produced (tons per day)	Difference from Baseline per Day	Percent Difference	Greater than Baseline
Year 2008 Current[1]	436,506	--	--	--
Year 2035 Baseline	671,144	--	--	--
No Action	587,594	(83,550)	(14)	No
Minimal Action	602,407	(68,737)	(11)	No
Rail with IMC	588,828	(82,316)	(14)	No
AGS	585,125	(86,019)	(15)	No
Dual-Mode Bus in Guideway	596,235	(74,909)	(13)	No
Diesel Bus in Guideway	645,613	(25,532)	(4)	No
Six-Lane Highway (55 and 65 mph)	659,191	(11,953)	(2)	No
Reversible/HOV/HOT Lanes	659,191	(11,953)	(2)	No
Six-Lane Highway with Rail and IMC	632,034	(39,111)	(6)	No
Six-Lane with AGS	625,861	(45,283)	(7)	No
Six-Lane with Dual Mode Bus in Guideway	629,565	(41,579)	(7)	No
Six-Lane Highway with Diesel Bus in Guideway	688,818	17,674	3	Yes
Preferred Alternative[2]	623,393 to 625,861	(47,752) to (45,283)	(8) to (7)	No

[1] *Estimated from CDOT traffic database (URL: http://www.dot.state.co.us/App_DTD_DataAccess/Traffic/index.cfm?fuseaction=TrafficMain&MenuType=Traffic).*

[2] *The Preferred Alternative is presented as a range because the adaptive management component of the Preferred Alternative allows it to be implemented based on future needs and associated triggers for further action. Chapter 2, Section 2.7 of the I-70 Mountain Corridor PEIS (CDOT, 2010) describes the triggers for implementing components of the Preferred Alternative.*

Key to Abbreviations/Acronyms
AGS = Advanced Guideway System
CO2 = carbon dioxide
HOT = High-Occupancy Toll
HOV = High-Occupancy Vehicle
IMC = Intermountain Connection
mph = miles per hour

Only the Combination Six-Lane Highway with Diesel Bus in Guideway Alternative has CO_2 production that exceeds the Baseline because of increased vehicle miles traveled and additional diesel engines. The Preferred Alternative reduces CO_2 by 7 percent to 8 percent compared to the 2035 Baseline Alternative. All alternatives result in higher CO_2 emissions compared with current levels. These calculations do not account for broader actions being implemented by the lead agencies and others to control future greenhouse gas emissions (as described in **Section 1.5** of this report).

3.8 Potential Effects on Air Quality in 2050

Emission of traditional air pollutants is related to traffic volumes and congestion. Based on current trends, it is likely that traffic volumes will increase between 2035 and 2050. As new air quality regulations and cleaner car technologies are implemented, the trend of decreasing air pollutant emissions is expected to continue despite the increase in vehicle travel along the Corridor. However, this trend may slow or reverse as technological advances and regulatory controls reach their limits and can no longer offset increased travel miles. If this occurs, air pollutant emissions increases correlate more directly with vehicles miles traveled.

Emissions of greenhouse gases are likely to continue to increase, even as new programs are put in place to control those increases. Controlling greenhouse gas emissions is a national and an international problem that is difficult to address or affect on a project level. **Section 1.5** of this report presents some of the statewide and national efforts to control greenhouse gases. The lead agencies will need to adapt the implementation of the Action Alternatives in accordance with guidance and policies that are expected to continue to evolve into 2050 and beyond.

Section 4. Mitigation

Air quality issues that warrant mitigation include:

- Motor vehicle emissions
- Motor vehicle direct particulate matter emissions including re-entrained dust from highway and street sanding and unpaved roads
- Visibility in and near Class I areas

Because Action Alternatives are not anticipated to cause or result in violations of any NAAQS, mitigation measures for air quality will center on controlling fugitive dust during construction. Mitigation measures for air quality will be developed and refined at Tier 2 processes in the context of a specific project. Mitigation measures that normally apply to construction projects to reduce impacts are specified below. Construction impacts will primarily be mitigated through the implementation of appropriate best management practices. Conceptual techniques for mitigation of impacts could include:

- Control fugitive dust through a fugitive dust control plan, including wetting of disturbed areas
- Use the cleanest fuels available at the time in construction equipment and vehicles to reduce exhaust emissions
- Keep construction equipment well maintained to ensure that exhaust systems are in good working order
- Control blasting and avoid blasting on days with high winds to minimize windblown dust from blasting, particularly near community areas
- Minimize dust from construction in or near tailing areas
- Investigate requirements or incentives for retrofitting construction vehicles and equipment to reduce emissions (e.g., idling equipment)

The lead agencies will develop specific and more detailed mitigation strategies and measures, and develop best management practices specific to each project, during Tier 2 processes. The lead agencies will also adhere to any new laws and regulations that may be in place when Tier 2 processes are underway.

The Project Leadership Team for the PEIS established an Issues Task Force to develop mitigation suggestions. For air quality the following recommendations were made and will be investigated during Tier 2 processes:

- Consider long-term effect of air quality due to increased traffic.
- Support local jurisdiction efforts to develop local and regional data to better inform future air quality measurements and mitigation.
- Optimize air quality through regulatory improvements.
- Use the latest air quality studies and locally collected baseline data in lieu of modeled data.

Additionally, highway maintenance strategies will continue to be explored to minimize the amount of sand used for winter maintenance and to remove the sand from the roadway to minimize re-entrained dust.

Section 5. References

Colorado Department of Public Health and Environment (CDPHE). 2005. *PM_{10} Maintenance Plan for the Denver Metropolitan Area*. Approved by the Colorado Air Quality Control Commission. December 15.

—. 2006. Statement of Basis, Specific Statutory Authority, and Purpose. Regulation No. 3, Part G, Best Available Retrofit Technology. March.

—. 2007. *Colorado visibility and regional haze state implementation plan for the twelve mandatory Class I federal areas in Colorado – Final action by the Air Quality Control Commission*. Colorado Air Pollution Control Division. December 21.

—. 2008. Air Quality Control Commission. 2008. Report to the Public 2007–2008. October 1.

—. 2008. Air Quality Control Commission. December 2008. *Denver Metro Area and North Front Range ozone action plan* including revisions to the State Implementation Plan.

—. 2009. Air Pollution Control Division. Colorado 2008 Air Quality Data Report. August.

—. 2009. State of Colorado *technical support document for recommended 8-hour ozone designations*. March. URL: http://www.cdphe.state.co.us/ap/ozone/OZDesignations.pdf (accessed August 3, 2009).

—. 2009. Air Pollution Control Division. Colorado Annual Monitoring Network Plan 1990–2010. May 29.

Colorado Department of Transportation (CDOT). 2007. *Fact book 2006–2007, transportation facts.*

—. CDOT traffic database. URL: http://www.dot.state.co.us/App_DTD_DataAccess/Traffic/index.cfm?fuseaction=TrafficMain&MenuType=Traffic

—. 2009. Policy Directive on Air Quality 1901. Division of Transportation Development, Environmental Programs Branch. May.

—. 2010. *I-70 Mountain Corridor Programmatic Environmental Impact Statement (PEIS)*.

—. 2010. *I-70 Mountain Corridor PEIS Energy Technical Report*. August.

Denver Regional Council of Governments (DRCOG). 2008. *Conformity of the 2008 Cycle 1 amendments to the fiscally constrained 2035 regional transportation plan and the 2008–2013 transportation improvement program with the state implementation plan for air quality*. August 20.

Environmental Protection Agency (EPA). Integrated Risk Information System (IRIS). URL: http://www.epa.gov/ncea/iris/index.html

—. Office of Transportation and Air Quality. Information on cost and health benefits of mobile source emissions controls. URL: http://www.epa.gov/otaq

—. 1999 National Air Toxics Assessment. URL: http://www.epa.gov/tnn/atw/nata1999

—. 1999. 40 Code of Federal Regulations Part 51, Regional Haze Regulations; Final Rule. July 1.

—. 2002. Health assessment document for diesel exhaust. Office of Research and Development, EPA/600/8-90/057F, May, pp 8-15. URL: http://www.epa.gov/risk/basicinformation.htm#g

—. 2007. Final Rule: Control of hazardous air pollutants from mobile sources. February 26. URL: http://www.epa.gov/otaq/toxics.htm#mobile (accessed August 7, 2009).

—. 2010. National Ambient Air Quality Standards (NAAQS). URL: http://www.epa.gov/air/criteria.html (accessed June 2010).

—. 2010. Office of Air Quality Planning and Standards. *Our Nation's Air: Status and Trends through 2008*. EPA-454/R-09-002. February.

Fenn et al. 2003. Ecological effects of nitrogen deposition in the western United States. Bioscience 53(4):404-420. April 1, 2003.

Federal Highway Administration (FHWA). No date. *A methodology for evaluating mobile source air toxic emissions among transportation project alternatives.* URL: http://www.fhwa.dot.gov/environment/airtoxic/msatcompare/msatemissions.htm

—. 2009. Interim Guidance Update on Mobile Source Air Toxic Analysis in NEPA Documents. September 30. URL: http://www.fhwa.dot.gov./environment/airtoxic/100109guidmem.htm

Health Effects Institute. 2008. *Special report 16 – Mobile-source air toxics: A critical review of the literature on exposure and health effects*. URL: `

Garfield County, Colorado. 2007. *Final report Garfield County socio-economic impact study.* Volume 1: Socio-Economic Study and Projections. BBC Research & Consulting, January 17.

Jefferson County. About Jeffco. URL: http://www.co.jefferson.co.us/aboutjeffco.htm (accessed August 6, 2009).

Ritter, Bill. 2007. *Colorado climate action plan*: *A strategy to address global warming*. November.

Srivastava, R.K., R.E. Hall, S. Khan, K. Culligan, and B.W. Lani. *Nitrogen oxides emission control options for coal-fired electric utility boilers*. Technical Paper, Journal of Air and Waste Management Association. Volume 55:1367-1388. September 2005.

State of Colorado. 2005. Executive order D 005 05 Greening of state government. July 15. URL: http://www.dsireusa.org/documents/Incentives/E.O.%20d00505%20Greening%20of%20the%20State%20Goverment.pdf (accessed June 2009).

—. 2007. Executive order D 012 07 Greening of state government: Detailed implementation. April 16. URL: http://www.colorado.gov/energy/in/uploaded_pdf/ExecutiveOrder-Greening-Government-ImplementationMeasures.pdf (accessed July 2009).

—. 2008. Executive order D 004 08 Reducing greenhouse gas emissions in Colorado. April 22. URL: http://www.colorado.gov/cs/Satellite?blobcol=urldata&blobheader=application%2Fpdf&blobkey=id&blobtable=MungoBlobs&blobwhere=1228626288822&ssbinary=true (accessed July 20, 2009).

—. 2009. Executive order B 002 09 Executive order recreating and reauthorizing the Denver Metropolitan Area Regional Air Quality Council.

—. 2009. Colorado Governor's Energy Office. Greening government. Transportation. URL: http://www.colorado.gov/energy/index.php?/greening/transportation (accessed June 2009).

Summit County.2003. *Countywide comprehensive plan environment element*, November 3. URL: http://www.co.summit.co.us/planning/MasterPlans/documents/EnvironmentElement.pdf (Accessed July 31, 2009).

—. 2009. *Countywide comprehensive plan executive summary*. March 2. URL: http://www.co.summit.co.us/planning/MasterPlans/documents/ExecutiveSummary.pdf (Accessed July 31, 2009.)

United States Forest Service (USFS). 2006. *FY2006 monitoring evaluation report*. White River National Forest. URL: http://ww.fs.fed.us/r2/whiteriver/projects/forest_plan/monitoring-report/WRNF_monitoring_evaluation_report_2006.pdf (accessed August 10, 2009).

—. 2002. *Final environmental impact statement for the White River National Forest and resource management plan* 2002 revision. Volume 1 Part 1, Section 3 Air resources. URL: http://www.fs.fed.us/r2/whiteriver/projects/forest_plan/feis/feis_ch3.pdf (accessed August 7, 2009).

U.S. Department of Transportation (USDOT). 2010. *Transportation's Role in Reducing Greenhouse Gas Emissions, Volume 1: Synthesis Report*. Report to Congress. April.

U.S. Department of Energy. Energy Information Administration. 2007. *International energy outlook*. May.

Western Regional Air Partnership (WRAP). 2009. WRAP Board: Members. URL: http://www.wrapair.org/WRAP/members.html (accessed August 4, 2009).