4.12 AIR QUALITY

Summary

Air quality impacts may result from the construction and operation of any of the proposed United States Highway 36 (US 36) corridor Final Environmental Impact Statement (FEIS) packages. Temporary impacts are expected from construction activities, while impacts associated with the operation of a proposed package would affect air quality over the life of the project.

Temporary impacts to air quality would result from equipment emissions during site preparation and project construction activities such as clearing, grading, excavating, and demolition. These activities would involve the use of heavy-duty off-road diesel- and gasoline-powered equipment that would generate emissions of air pollutants; namely oxides of nitrogen (NO_x), carbon monoxide (CO), particulate matter less than 10 microns in diameter (PM_{10}), particulate matter less than 2.5 microns in diameter ($PM_{2.5}$), oxides of sulfur, and volatile organic compounds (VOC). In addition, fugitive dust (PM_{10}) would be generated from earth-moving activities such as grading and excavating and from travel on temporary unpaved roads.

Permanent impacts to air quality associated with the operation of a US 36 build package would primarily result from emissions from motor vehicles. Local and regional air quality would be impacted in varying degrees, depending on the net change in regional vehicle miles traveled (VMT), and the potential traffic congestion caused or eased by each package.

The construction and operation of any of the proposed US 36 corridor FEIS packages would not cause any new violations nor worsen existing violations of the NAAQS.

The air quality impact analysis of the build packages for the US 36 Corridor Project indicates that the build packages are not expected to cause any new violations of any standard, increase frequency or severity of any existing violation, or delay timely attainment of the National Ambient Air Quality Standards (NAAQS). Both regional and project-level air quality conformity has been demonstrated by this project. Appendix B, Consultation and Coordination, contains a letter from the Colorado Air Quality Control Commission supporting regional air quality determination, and a letter from the Colorado Department of Public Health and Environment (CDPHE) concurring with the project-level air quality conformity analysis.

Affected Environment

Description of Governing Regulations

The regulatory structure for air quality planning in Colorado includes federal, state, regional, and local agencies.

The regulatory structure for air quality planning in Colorado includes federal, state, regional, and local agencies. These agencies either have regulatory authority or are responsible for the development and implementation of programs and plans designed to reduce air pollution levels, including emissions from transportation sources.

National air quality policies are regulated through the Federal Clean Air Act. Pursuant to this Act, the U.S. Environmental Protection Agency (USEPA) has established NAAQS for the following air pollutants (termed “criteria” pollutants): CO, ozone (O_3), nitrogen dioxide, sulfur dioxide (SO_2), PM_{10}, $PM_{2.5}$, and lead. The NAAQS represent safe levels that allow for avoidance of specific adverse health and welfare effects associated with each pollutant, and ambient air quality standards are summarized in Table 4.12-1, National Ambient Air Quality Standards.

The Colorado Air Pollution Control Division (APCD) oversees Colorado air quality policies and is responsible for preparing and submitting the State Implementation Plan (SIP) to the USEPA.

Table 4.12-1: National Ambient Air Quality Standards

Pollutant	Averaging Time	National Standards	
		Primary	Secondary
O_3	8-hour[1] 1-hour[2]	0.075 ppm[3] (147 µg/m^3) –	0.075 ppm (147 µg/m^3) –
CO	8-hour[3] 1-hour[3]	9 ppm (10,000 µg/m^3) 35 ppm (40,000 µg/m^3)	– –
NO_2	Annual arithmetic mean	0.053 ppm (100 µg/m^3)	0.053 ppm (100 µg/m^3)
SO_2	Annual arithmetic mean 24-hour[3] 3-hour[3]	0.03 ppm (80 µg/m^3) 0.14 ppm (365 µg/m^3) –	– – 0.5 ppm (1,300 µg/m^3)
PM_{10}	Annual arithmetic mean[4] 24-hour[5]	– 150 µg/m^3	– 150 µg/m^3
$PM_{2.5}$	Annual arithmetic mean[6] 24-hour[7]	15 µg/m^3 35 µg/m^3	15 µg/m^3 –

Source: USEPA, 2009.
Notes:
[1] To attain this standard, the 3-year average of the fourth-highest daily maximum 8-hour average O_3 concentrations measured at each monitor over each year must not exceed 0.075 ppm.
[2] In November 2008, the U.S. Environmental Protection Agency revoked the 1-hour O_3 standard of 0.12 ppm for the Denver metropolitan area.
[3] Not to be exceeded more than once per calendar year.
[4] Due to a lack of evidence linking health problems to long-term exposure to coarse particle pollution, the U.S. Environmental Protection Agency revoked the annual respirable PM_{10} National Ambient Air Quality Standards in 2006 (effective December 17, 2006).
[5] Not to be exceeded more than once per year on average over 3 years.
[6] To attain this standard, the 3-year average of the weighted annual mean respirable $PM_{2.5}$ concentrations from single or multiple community-oriented monitors must not exceed 15 µg/m^3.
[7] To attain this standard, the 3-year average of the 98th percentile of 24-hour concentrations at each population-oriented monitor within an area must not exceed 35 µg/m^3 (effective December 17, 2006).

– = not applicable
µg/m^3 = micrograms per cubic meter
CO = carbon monoxide
NO_2 = nitrogen dioxide
O_3 = ozone
PM_{10} = particulate matter less than 10 microns in diameter
$PM_{2.5}$ = particulate matter less than 2.5 microns in diameter
ppm = parts per million
SO_2 = sulfur dioxide

The Federal Highway Administration (FHWA) and the Federal Transit Administration (FTA) require projects to comply with the conformity provision of the Federal Clean Air Act and the USEPA transportation air quality conformity regulations (40 Code of Federal Regulations [CFR] 51 Subpart T and 40 CFR 93 Subpart A).

The following sections of 40 CFR 93 Subpart A are the conformity criteria that apply to the FEIS packages:

§93.110 – The conformity determination must be based on the latest planning assumptions.

§93.111 – The conformity determination must be based on the latest emissions model.

§93.112 – Conformity must be determined according to the interagency consultation procedures in §93.105 (a)(2) and (e) and the requirements of 23 CFR Part 450 and in the applicable implementation plan, and according to the public involvement procedures established in compliance with 23 CFR Part 450.

§93.114 – There must be a currently conforming transportation plan and currently conforming Transportation Improvement Program (TIP) at the time of project approval.

§93.115 – The project must come from a conforming transportation plan and TIP.

§93.116 – The project must not cause or contribute to any new localized CO or PM_{10} violations in CO and PM_{10} nonattainment and maintenance areas.

§93.117 – The project must comply with PM_{10} control measures in the implementation plan.

§93.118 – The transportation plan and TIP must be consistent with the motor vehicle emissions budget in the implementation plan submittal.

In addition, 23 CFR 450 requires that the Regional Transportation Plan (RTP) and TIP be fiscally constrained. Before the Record of Decision (ROD) can be signed and project advanced, the project must be included in a fiscally constrained, air quality conforming RTP.

Description of Existing Conditions

The concentration of a pollutant in the atmosphere depends on the amount of pollutant released, the nature of the source, and the ability of the atmosphere to transport and disperse the pollutant. The main determinants of transport and dispersion are wind, atmospheric stability or turbulence, topography, and the existence of inversion layers. The Denver metropolitan area is located in the South Platte River drainage area, with mountains located to the west and relatively high terrain to the south and north. Under certain meteorological conditions, the local topography has the tendency to trap pollutants resulting in elevated ambient concentrations. The pollutants can be trapped under strong inversions that inhibit dispersion and cause poor air quality. Certain photo-chemically active pollutants, such as NO_x and VOCs, react under the presence of sunlight and can cause elevated levels of ground level O_3. Warm temperatures accelerate the creation of ground level O_3 and can exacerbate conditions of poor air quality.

The Denver metropolitan area is in attainment/maintenance for PM_{10} and CO, and effective November 2007, is designated nonattainment for the 8-hour O_3 standard. It is currently in attainment for the remaining criteria pollutants.

The Regional Air Quality Council (RAQC), in cooperation with the state of Colorado, has proposed a SIP to be submitted to USEPA in mid-2009 to demonstrate compliance with the O_3 NAAQS (8-hour average less than 0.08 parts per million) by the end of 2010. In addition, in March 2008 the USEPA revised the 8-hour O_3 standard from 0.08 parts per million to 0.075 parts per million. A revised SIP for the new standard must be submitted to USEPA in 2013.

Pollutants of Primary Concern

When assessing the impacts of transportation projects, the pollutants of primary concern are CO, O_3, and PM_{10}.

When assessing the impacts of transportation projects, the pollutants of primary concern for the Denver metropolitan area are CO, O_3, and PM_{10}. A transportation project can affect regional air quality when emissions of O_3 precursors (NO_x and VOCs) from traffic are greater if the project is implemented than if not. Because the region is designated as an attainment/maintenance area by federal standards for CO or PM_{10}, and designated nonattainment for O_3, the project is subject to federal conformity requirements. While regional conformity requirements apply for all three pollutants, no project-level analysis requirements apply for O_3 due to the fact that it is formed downwind of the source of the precursor emissions and therefore a pollutant of regional concern. Conversely, CO and PM_{10} concentrations can accumulate near areas of heavy traffic congestion where average vehicle speeds are low. Therefore, emissions of CO and PM_{10} are evaluated for localized or “hot-spot” impacts, and the project must be analyzed for project level conformity. The impacts of these two pollutants are addressed later in this section.

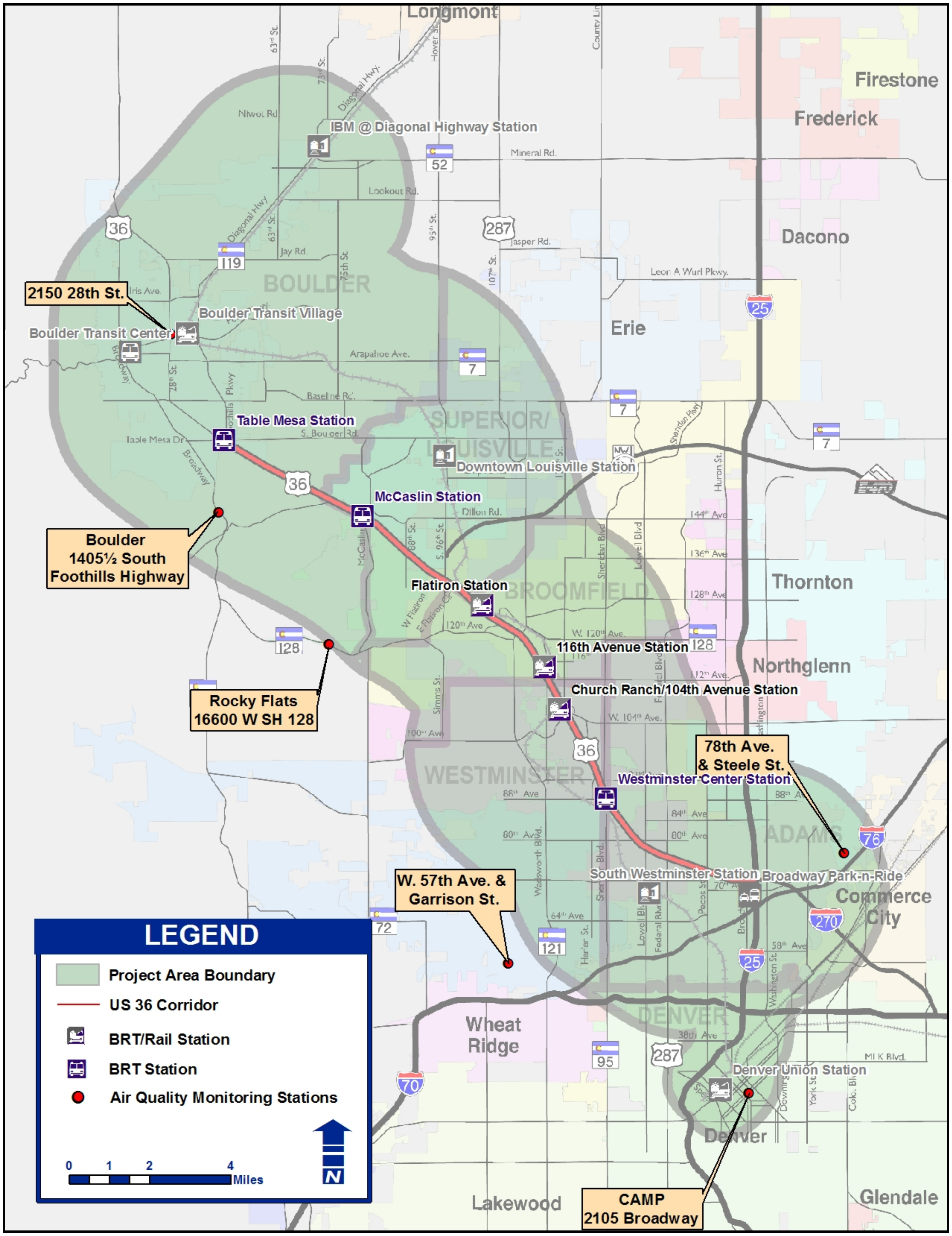
NO_x, SO_2, and $PM_{2.5}$ can be emitted from combustion sources, including on-road vehicles and non-road equipment. The Denver metropolitan area is currently designated as attainment for these three pollutants. In the past few years, the $PM_{2.5}$ annual concentrations and the 3-year average of the 98^{th} percentile 24-hour concentrations did not exceed NAAQS in the project area. Therefore, $PM_{2.5}$ was not considered as a pollutant of primary concern for this project. Detailed analyses of $PM_{2.5}$ were not included in this report. Similarly, the project area is classified as attainment for NO_x and SO_2 NAAQS; therefore, no detailed analyses were performed.

Air Quality Monitoring Data

The APCD operates a network of ambient air quality monitoring stations within the Denver/Boulder area. Figure 4.12-1, Location of Colorado Air Pollution Control Division Monitoring Stations Within/Near the Project Area, shows the locations of the monitoring stations within the study corridor. Table 4.12-2, Summary of Ambient Monitoring Concentrations within the Study Area, lists the maximum CO, O_3, PM_{10}, and $PM_{2.5}$ concentrations measured from 2004 through 2008 for monitoring stations in the area, and displays the NAAQS for comparison. These data indicate that the air quality in the study area meets the NAAQS for CO and PM_{10}. There were some incidents when the maximum 24-hour concentrations of $PM_{2.5}$ were measured higher than the NAAQS of 35 micrograms per cubic meter. To attain the 24-hour $PM_{2.5}$ NAAQS, the 3-year average of the 98^{th} percentile of 24-hour $PM_{2.5}$ concentrations at each monitor within the area must not exceed 35 micrograms per cubic meter. The calculated 3-year average of the 98^{th} percentile of 24-hour $PM_{2.5}$ concentration did not exceed the 35 micrograms per cubic meter NAAQS in the project area; therefore, the area is currently in attainment for $PM_{2.5}$.

Several monitors in the Denver metropolitan area (Boulder, Welby, Arvada, and Denver) have measured violations of the new 8-hour O_3 standard. An O_3 exceedance is derived from the 3-year average of the fourth maximum 8-hour O_3 concentrations. In this case, 8-hour O_3 data have recently exceeded NAAQS.

Figure 4.12-1: Location of Colorado Air Pollution Control Division Monitoring Stations Within/Near the Project Area



Source: US 36 Mobility Partnership, 2009.

Note: The 116th Avenue Rail Station is not a part of the 2004 FasTracks Program. Additional stations were added in the early planning stages of the US 36 Environmental Impact Statement. Exact rail station locations and additional stations may be reconsidered in the U.S. Army Corps of Engineers/Regional Transportation District Northwest Rail Environmental Assessment/Environmental Evaluation.

Table 4.12-2: Summary of Ambient Monitoring Concentrations within the Study Area

Monitoring Station	Pollutant	Averaging Time	2004	2005	2006	2007	2008
NAAQS	CO (ppm)	1-hour[1] 8-hour[1]	35.0 9.0	35.0 9.0	35.0 9.0	35.0 9.0	35.0 9.0
Boulder – 2150 28th Street	CO (ppm)	1-hour (2nd max.) 8-hour (2nd max.)	4.5 2.5	3.2 1.9	N/A N/A	N/A N/A	N/A N/A
Arvada – West 57th Avenue and Garrison Street	CO (ppm)	1-hour (2nd max.) 8-hour (2nd max.)	3.7 2.6	3.6 2.0	3.5 2.0	N/A N/A	N/A N/A
Welby – 78th Avenue and Steele Street, Adams County	CO (ppm)	1-hour (2nd max.) 8-hour (2nd max.)	4.0 2.8	3.3 2.2	3.8 2.5	3.0 2.1	3.1 1.7
CAMP – 2105 Broadway, Denver	CO (ppm)	1-hour (2nd max.) 8-hour (2nd max.)	8.7 4.1	4.3 2.5	4.6 3.1	5.9 2.8	7.0 2.3
NAAQS	O_3 (ppm)	1-hour[2] 8-hour[3]	– 0.075	– 0.075	– 0.075	– 0.075	– 0.075
Boulder – 1405½ South Foothills Highway	O_3 (ppm)	1-hour (max.) 8-hour (4th max.)	0.08 0.068	0.100 0.076	0.099 0.083	0.095 0.079	0.093 0.074
Arvada – West 57th Avenue and Garrison Street	O_3 (ppm)	1-hour (max.) 8-hour (4th max.)	0.086 0.065	0.099 0.078	0.099 0.082	0.095 0.079	0.093 0.074
Welby – 78th Avenue and Steele Street, Adams County	O_3 (ppm)	1-hour (max.) 8-hour (4th max.)	0.078 0.066	0.090 0.073	0.089 0.069	0.098 0.070	0.100 0.076
CAMP – 2105 Broadway, Denver	O_3 (ppm)	1-hour (max.) 8-hour (4th max.)[4]	N/A N/A	0.072 0.051	0.085 0.062	0.084 0.057	N/A N/A
Rocky Flats North – 16600 West State Highway 128	O_3 (ppm)	1-hour (max.) 8-hour (4th max.)[4]	0.086 0.073	0.099 0.077	0.104 0.090	0.108 0.090	0.088 0.079
NAAQS	PM_{10} (µg/m³)	Annual Mean[4] 24-hour[5]	(50.0) 150.0	(50.0) 150.0	(50.0) 150.0	(50.0) 150.0	(50.0) 150.0
Boulder – 2440 Pearl Street	PM_{10}[6] (µg/m³)	Annual Arith. Mean 24-hour (2nd max.)	19 33	20 38	17 34	22 59	21 46
Welby – 78th Avenue and Steele Street, Adams County	PM_{10}[6] (µg/m³)	Annual Arith. Mean 24-hour (2nd max.)	30 95	32 66	28 82	30 73	27 63
CAMP – 2105 Broadway, Denver	PM_{10}[6] (µg/m³)	Annual Arith. Mean 24-hour (2nd max.)	30 69	28 68	29 61	28 67	30 56
NAAQS	$PM_{2.5}$ (µg/m³)	Annual Mean 24-hour[7]	15 35	15 35	15 35	15 35	15 35
CAMP – 2105 Broadway, Denver	$PM_{2.5}$[6], (µg/m³)	Annual Arith. Mean 24-hour (98th percentile)	9.36 22.9	9.82 29.4	8.90 24.3	10.73 37.2	7.90 19.4
Boulder – 2440 Pearl Street	PM_{10}[6] (µg/m³)	Annual Arith. Mean 24-hour (2nd max.)	6.72 18.7	6.97 18.4	6.72 15.7	7.40 25.0	6.49 17.1

Source: USEPA, 2009.
Notes:
[1] Not to be exceeded more than once per calendar year.
[2] The standard is attained when the expected number of days per calendar year with maximum hourly average concentrations above 0.12 ppm is less than 1.
[3] To attain this standard, the 3-year average of the fourth-highest daily maximum 8-hour average O_3 concentrations measured at each monitor over each year must not exceed 0.08 ppm.
[4] The U.S. Environmental Protection Agency revoked the annual respirable PM_{10} NAAQS in 2006 (effective December 17, 2006).
[5] Not to be exceeded more than once per year on average over 3 years. The standard has been revoked. The data presented here are for information purposes only.
[6] If a monitoring station has more than one monitor for a pollutant, the highest reading among the monitors was used.
[7] The $PM_{2.5}$ 24-hour standard is attained when 98 percent of the daily concentrations, averaged over 3 years, is equal to or less than the standard.

µg/m³ = micrograms per cubic meter
arith. = arithmetic
CO = carbon monoxide
max. = maximum
N/A = data not available
NAAQS = National Ambient Air Quality Standards
O_3 = ozone
PM_{10} = particulate matter less than 10 microns in diameter
$PM_{2.5}$ = particulate matter less than 2.5 microns in diameter
ppm = parts per million

Impact Analysis

Air quality impacts were evaluated for Package 1 (No Action) and two build packages (Package 2 and Package 4) in the Draft Environmental Impact Statement (DEIS). Through public comments received after the publication of the DEIS, it was apparent that there was overwhelming agency and community support for a hybrid alternative. In late 2007, a Preferred Alternative Committee was formed and developed the Combined Alternative Package. The Combined Alternative Package contains characteristics of both Package 2 and Package 4. The Combined Alternative Package would have fewer lanes which in turn reduces environmental impacts and cost while maximizing the transportation benefits. This effort resulted in the Combined Alternative Package being identified as the Preferred Alternative and evaluated in this FEIS.

Corridor Emission Estimates

Methodology

Total emissions within the project corridor for NO_x, CO, VOC, and PM_{10} were estimated for each package. These emission estimates were based on the expected traffic levels for each package for the year 2035. An estimate of the emissions for the baseline year 2005 was added for further comparison.

Total emissions within the project corridor for criteria air pollutants of concern were estimated for each package.

The VMT for Package 1 and the Combined Alternative Package (Preferred Alternative) in 2035 were obtained from the travel demand forecasting completed for the FEIS. Corridor vehicle emissions for Package 1 and the Combined Alternative Package (Preferred Alternative) in year 2035 were modeled by the Colorado APCD using a link-based motor vehicle emissions modeling system within MOBILE6.2. The modeling system was used to generate the on-road mobile source emissions of the Denver Regional Council of Governments (DRCOG) Network. The motor vehicle emissions model estimates link-level emissions using the output from the DRCOG Travel Demand Model. The Travel Demand Model provides VMT or volume for multi-hour periods, and the emission model uses temporal allocation factors and VMT mix fractions to estimate hourly emissions for each vehicle class for each roadway type and speed.

Corridor emissions were calculated on a link-by-link basis using MOBILE6.2 model emission factors and corresponding VMT. Vehicle speeds were obtained from the Metropolitan Planning Organization transportation networks. The ambient temperatures for the regional emissions analysis were derived from the meteorological modeling performed for the attainment demonstration for a typical O_3 episode period. The motor vehicle mix was obtained from the Colorado Department of Transportation (CDOT) automated traffic counters.

Emissions for Package 1 and the Combined Alternative Package (Preferred Alternative) in 2035 were estimated for both summer and winter months using corridor-specific roadway settings and vehicle distributions. The worst-case emissions of each pollutant were used in the analysis. Detailed emission modeling files for the Combined Alternative Package (Preferred Alternative) and Package 1 in 2035 are provided in the *Air Quality Technical Report Addendum* (CH2M Hill 2009).

Emissions from Package 2 and Package 4 were adjusted to 2035 values for full disclosure and comparison among packages. Trend analyses were applied to VMT of these two packages to reconcile 2035 modeling. The emission adjustments also took into account the changes of speeds between year 2030 and 2035 for Package 2 and Package 4. Details of the emission estimates for Package 2 and Package 4 are in *Air Quality Technical Report Addendum* (CH2M Hill 2009).

Impact Analysis

Table 4.12-3, Peak-hour Corridor-wide Vehicle Miles Traveled and Emission Inventory Estimates, presents the estimated peak hourly VMT and emissions for each package. Table 4.12-4, Daily Corridor-wide Vehicle Miles Traveled and Emission Inventory Estimates, presents the estimated daily VMT and emissions for each package.

Table 4.12-3: Peak-hour[1] Corridor-wide Vehicle Miles Traveled and Emission Inventory Estimates

Parameter	Year 2005	Package 1 (2035)	Package 2 (2035)[2]	Package 4 (2035)[2]	Combined Alternative Package (Preferred Alternative) (2035)
VMT: Total Corridor Wide	1,073,540	1,393,441	1,443,036	1,457,695	1,489,741
Emissions: VOC (lb/hr)	3,434	1,370	1,382	1,402	1,388
Emissions: CO (lb/hr)	47,959	33,398	34,135	34,556	34,471
Emissions: NO_x (lb/hr)	4,326	708	723	733	733
Emissions: PM_{10} (lb/hr)	110	104	108	109	108

Source: US 36 Mobility Partnership, 2006 and 2009.
Notes:
[1]Peak-hour emissions represent the worst-case of morning and afternoon peak-hour emissions.
[2]VMT and emissions of Package 2 and Package 4 in 2035 were estimated by applying adjustment factors to the 2030 data, taking into account the VMT growth rate and vehicle speed change between 2030 and 2035. See the *Air Quality Technical Report Addendum* (CH2M Hill 2009) for details.

CO = carbon monoxide
lb/hr = pound(s) per hour
NO_x = oxides of nitrogen
PM_{10} = particulate matter less than 10 microns in diameter
VMT = vehicle miles traveled
VOC = volatile organic compound

Table 4.12-4: Daily Corridor-wide Vehicle Miles Traveled and Emission Inventory Estimates

Parameter	Year 2005	Package 1 (2035)	Package 2 (2035)[1]	Package 4 (2035)[1]	Combined Alternative Package (Preferred Alternative) (2035)
VMT: Total Automobile/ Truck/BRT for US 36	12,105,100	16,186,920	16,589,894	16,796,701	16,567,130
Emissions: VOC (lb/day)	38,734	13,215	13,408	13,575	13,473
Emissions: CO (lb/day)	541,040	379,153	388,154	392,959	388,152
Emissions: NO_x (lb/day)	48,248	8,353	8,536	8,643	8,619
Emissions: PM_{10} (lb/day)	1,219	1,240	1,271	1,287	1,272

Source: US 36 Mobility Partnership, 2006 and 2009.
Notes:
[1]VMT and emissions of Package 2 and Package 4 in 2035 were estimated by applying adjustment factors to the 2030 data, taking into account the VMT growth rate and vehicle speed change between 2030 and 2035. See the *Air Quality Technical Report Addendum* (CH2M Hill 2009) for details.

BRT = bus rapid transit
CO = carbon monoxide
lb/day = pound(s) per hour
NO_x = oxides of nitrogen
PM_{10} = particulate matter less than 10 microns in diameter
US 36 = United States Highway 36
VMT = vehicle miles traveled
VOC = volatile organic compound

Within the project corridor, the build packages would produce slightly higher pollutant emissions than Package 1 in 2035 due to the increased VMT on US 36 with the build packages. Package 4 would produce the greatest VMT and emissions increase above Package 1 2035 levels. Daily and peak-hour emissions of VOC, CO, and NO_x for the build packages in 2035 are much lower than those in the baseline year 2005, which is attributed to the addition of newer vehicles with tighter emission controls, cleaner fuels, and more stringent emission restrictions in future years.

The daily PM_{10} emissions in 2035 presented in Table 4.12-4, Daily Corridor-wide Vehicle Miles Traveled and Emission Inventory Estimates are slightly higher than 2005. Note that the APCD has refined their modeling approaches over time. The VMT estimated for the build packages in 2035 is about 34 to 38 percent higher than the 2005 VMT. However, vehicle PM_{10} emission factors are expected to be reduced at a faster rate than the estimated VMT increase on US 36; therefore, the slight increase of the PM_{10} emissions are likely due to the different modeling approaches used for 2005 and 2035 emission estimates (see the Methodology subsection).

Regional Emission Estimates

Methodology

For comparison, total emissions within the entire Denver metropolitan area for VOC, NO_x, CO, and PM_{10} were estimated for each package. As with the corridor-wide emission estimates, the region-wide estimates for Package 1 and the Combined Alternative Package (Preferred Alternative) were based on the expected traffic levels for each package for the year 2035, the expected mix of vehicles, and emission factors for each vehicle type. Total daily emissions were estimated for each package for the regional analysis.

For Package 1 and the Combined Alternative Package (Preferred Alternative), vehicle emissions were modeled for year 2035 using traffic model outputs and Denver-specific vehicle fleet information and roadway settings in 2035 — using the same methodologies as the 2035 corridor emission modeling. Regional emissions of Package 2 and Package 4 were estimated by applying VMT and speed adjustment factors to the 2035 Package 1 emissions.

Impact Analysis

Table 4.12-5, Daily Region-wide Vehicle Miles Traveled and Emission Inventory Estimates, presents the estimated daily emissions for the region.

Table 4.12-5: Daily Region-wide Vehicle Miles Traveled and Emission Inventory Estimates

Parameter	Year 2005	Package 1 (2035)	Package 2 (2035)[1]	Package 4 (2035)[1]	Combined Alternative Package (Preferred Alternative) (2035)
VMT: Total Automobile/Truck	61,813,300	113,244,870	113,463,909	113,907,582	113,605,913
Emissions: VOC (lb/day)	197,409	93,680	93,620	93,986	94,956
Emissions: CO (lb/day)	2,768,912	2,694,573	2,699,081	2,710,106	2,698,663
Emissions: NO_x (lb/day)	244,493	58,776	58,890	59,120	59,388
Emissions: PM_{10} (lb/day)	6,124	8,626	8,643	8,676	8,681

Source: US 36 Mobility Partnership, 2009.

Notes:

[1]VMT and emissions of Package 2 and Package 4 in 2035 were estimated by applying adjustment factors to the 2030 data, taking into account the VMT growth rate and vehicle speed change between 2030 and 2035. See the *Air Quality Technical Report Addendum* (CH2M Hill 2009) for details.

CO = carbon monoxide
lb/day = pound(s) per day
NO_x = oxides of nitrogen
PM_{10} = particulate matter less than 10 microns in diameter
VMT = vehicle miles traveled
VOC = volatile organic compound

Within the entire Denver metropolitan area, daily emissions of the criteria pollutants that would occur with implementation of the build packages are estimated to be higher than Package 1 in 2035 due to the increased regional VMT. Estimated emissions of VOC, CO, and NO_x emissions of the build packages in 2035 indicate substantial reductions of these pollutants when compared to year 2005, due to greater control efficiencies of these pollutants in the future. The regional PM_{10} emissions estimated for the project are higher in 2035 compared to 2005, which may be due to the greater VMT growth rate than the PM_{10} emission reduction rate between 2005 and 2035.

Project-Level Carbon Monoxide Impacts

Methodology

Project-level CO hot-spot analysis is required to demonstrate conformity because the project area is in a maintenance area for CO. Localized CO effects were assessed by estimating the maximum ambient CO concentrations near the affected intersections assumed to have the greatest potential effect during operation of the build packages. The predicted worst-case CO concentrations of the build packages were compared to the NAAQS to determine if the project would cause any new violation or worsen the existing violation of the standards.

CO hot-spot analyses were conducted for Package 2, Package 4, and the Combined Alternative Package (Preferred Alternative) in this FEIS based on the worst-case scenario of 2005 emission factors and worst-case 2035 traffic conditions.

The following two worst-case intersections for Package 2 and Package 4 were identified in the DEIS based on the 2030 traffic information at the affected intersections:

- Wadsworth Parkway/120th Avenue in Broomfield.
- Foothills Parkway/Arapahoe Road in Boulder.

Detailed traffic modeling was not conducted for these two packages for the year of 2035. The traffic volumes and turning movements of Package 2 and Package 4 used in this analysis were estimated according to the local traffic growth rates anticipated between 2030 and 2035.

For the Combined Alternative Package (Preferred Alternative), a screening analysis was first performed to identify the worst intersections within the study area that were predicted to be affected in 2035. For the purposes of this analysis, the “worst” intersections are identified in terms of intersection level of service (LOS), traffic delay, and traffic volume. Only signalized intersections with a deficient LOS of D, E, or F were subjected to the screening. Intersections were chosen to be representative of: a) the highest overall traffic volume intersection operating at a deficient LOS and traffic delay, and b) the worst LOS and highest peak-hour traffic delay, high traffic volume intersection in the US 36 corridor. Details of the screening process can be found in the *US 36 Corridor Air Quality Technical Report Addendum* (CH2M Hill 2009).

Based on the screening analysis, the following intersections were analyzed quantitatively in a hot-spot analysis to determine localized CO impacts:

- 92nd Avenue and Sheridan Boulevard
- 80th Avenue and Federal Boulevard

The two worst-case intersections for Package 1 were identified in order to compare modeled CO concentrations across packages in 2035. Based on delay and volume, the intersection of Dillon Road and McCaslin Boulevard was the worst-case. Model results from this intersection will be discussed in the ROD (which is further discussed in Chapter 8, Phased Project Implementation). Model results for the other worst-case intersection, 80th Avenue and Federal Boulevard, are provided below.

Emission factors in grams per mile were provided by APCD in August 2009. Emission factors were estimated for each vehicle speed evaluated in the analysis using USEPA's MOBILE6.2 model. To be conservative, the highest estimated emission factors for 2005 were used to generate a worst-case CO emission scenario for each intersection to ensure that no interim years between project opening and design year (2035) would have a greater impact. The USEPA CAL3QHC dispersion model was used to calculate the ambient concentrations of CO at the selected worst-case intersections. A persistence factor of 0.57 was used to estimate the 8-hour concentrations from the 1-hour concentrations as instructed by CDOT. The MOBILE6.2 model accounts for high altitude in emission factor calculations. All high-altitude considerations are represented within the emission factors used for hot-spot modeling.

The modeled CO concentrations were added to background concentrations and compared with NAAQS to determine the CO hot-spot impacts. This methodology sufficiently simulates the worst-case air quality impacts during the interim years from project opening to design year, as the emissions would never be higher than how they have been represented here using 2005 emission factors and 2035 traffic volumes.

Results

Tables 4.12-6 through 4.12-8 summarize the project-level CAL3QHC modeling results for CO for the worst-case scenario of highest expected (2005) emissions in 2035 for all packages. For each package, CO hot-spot modeling was performed for the two poorest operating, highest traffic volume intersections in the US 36 corridor. The concentrations presented in the following tables include background CO concentrations provided by APCD for each intersection. The background concentrations for each intersection are included in the *US 36 Corridor Air Quality Technical Report Addendum* (CH2M Hill 2009).

Table 4.12-6: Package 2 and Package 4 Worst-Case 2035 Maximum Carbon Monoxide Concentrations

Scenario	Concentration (ppm)[1]			
	Wadsworth Parkway and 120th Avenue		Foothills Parkway and Arapahoe Road	
	1-hour	8-hour	1-hour	8-hour
Package 2 (2035)	14.3	7.6	13.8	7.9
Package 4 (2035)	15.5	8.2	13.6	7.8
NAAQS	35	9	35	9

Source: US 36 Mobility Partnership, 2009.

Notes:

[1] Includes background concentrations provided by the Air Pollution Control Division. See the *US 36 Corridor Air Quality Technical Report Addendum* (CH2M Hill 2009) for additional details.

NAAQS = National Ambient Air Quality Standards

ppm = parts per million

Table 4.12-7: Combined Alternative Package (Preferred Alternative) Worst-Case 2035 Maximum Carbon Monoxide Concentrations

Scenario	Concentration (ppm)[1]			
	92nd Avenue and Sheridan Boulevard		80th Avenue and Federal Boulevard	
	1-hour	8-hour	1-hour	8-hour
Combined Alternative Package (Preferred Alternative) 2035	17.1	8.6	12.3	7.0
NAAQS	35	9	35	9

Source: US 36 Mobility Partnership, 2009.

Notes:

[1] Includes background concentrations provided by the Air Pollution Control Division. See the *US 36 Corridor Air Quality Technical Report Addendum* (CH2M Hill 2009) for additional details.

NAAQS = National Ambient Air Quality Standards

ppm = parts per million

Table 4.12-8: Package 1 (No Action) Worst-Case 2035 Maximum Carbon Monoxide Concentrations

Scenario	Concentration (ppm)[1]	
	80th Avenue and Federal Boulevard	
	1-hour	8-hour
Package 1 (2035)	12.9	7.3
NAAQS	35	9

Source: US 36 Mobility Partnership, 2009.

Notes:
[1] Includes background concentrations provided by the Air Pollution Control Division. See the *US 36 Corridor Air Quality Technical Report Addendum* (CH2M Hill 2009) for additional details.
NAAQS = National Ambient Air Quality Standards
ppm = parts per million

The maximum modeled 1-hour and 8-hour CO concentrations are below the NAAQS for all packages. Furthermore, the model results show that the Combined Alternative Package (Preferred Alternative) would improve CO concentrations in the vicinity of 80th Avenue and Federal Boulevard, as compared to Package 1.

Conclusion

Build Packages: Based on the CAL3QHC modeling results for Package 2, Package 4, and the Combined Alternative Package (Preferred Alternative), CO concentrations at the worst-case intersections are predicted to be below the 1-hour and 8-hour NAAQS for all three build packages. Therefore, CO concentrations of the build packages are not expected to exceed the NAAQS in the project area.

Phase 1 of the Combined Alternative Package (Preferred Alternative): The above analysis has demonstrated that the CO concentrations will be below NAAQS when the project is fully implemented. Because the Combined Alternative Package (Preferred Alternative) will be implemented in phases, and currently only Phase 1 of the project is funded, additional analysis was conducted for the intersections. This analysis was done to demonstrate that the CO concentrations before the project build-out will also be in compliance with NAAQS.

Since detailed intersection traffic analysis was not conducted for Phase 1 of the Combined Alternative Package (Preferred Alternative), a comparison of peak-hour ramp and arterial volumes for Phase 1 and the Combined Alternative Package (Preferred Alternative) was conducted to estimate the traffic condition at intersections under Phase 1. Ramp volumes for Phase 1 were found to be less than, or the same as, the forecast volumes for the Combined Alternative Package (Preferred Alternative), and traffic demand on the arterial roadway networks is forecast to increase with the addition of auxiliary lanes to US 36 under the Combined Alternative Package (Preferred Alternative).

Some of the intersections may operate at slightly worse conditions compared to the Combined Package Alternative (Preferred Alternative) before all phases of the project are constructed; however, overall traffic conditions at intersections within the project area are expected to be the same or slightly improve as compared to Package 1.

The Dillon Road and McCaslin Boulevard intersection was modeled as a representative worst-case intersection with the Package 1 2035 traffic volumes and 2005 emission factors. This additional modeling is intended to demonstrate that the worst performing intersection under Package 1 conditions would not produce CO concentrations above the NAAQS. Under Phase 1 conditions, which will be no worse than Package 1, traffic volumes would likewise not cause a violation of the CO NAAQS.

The resulting 8-hour CO concentration, including the background concentration, is 7.8 parts per million, below the NAAQS of 9.0 parts per million. Additional discussions of conformity for Phase 1 will be included in the ROD (further discussed in Chapter 8, Phased Project Implementation).

Project-level PM_{10} Hot-spot Analysis

Unlike modeling CO concentrations, PM_{10} concentrations in the US 36 corridor cannot be calculated because there is no USEPA-approved methodology for calculating PM_{10} concentrations at the project level. Therefore, a qualitative hot-spot analysis was performed for the project following the *Transportation Conformity Guidance for Qualitative Hot-spot Analyses in $PM_{2.5}$ and PM_{10} Nonattainment and Maintenance Areas* (USEPA 2006a). The project-level hot-spot analysis was conducted to assess whether the project would cause or contribute to any new localized PM_{10} violations, or increase the frequency or severity of any existing violations, or delay timely attainment of the PM_{10} NAAQS. As required by the USEPA guidance and according to CDOT's instruction, the PM_{10} hot-spot analysis covers the following elements:

- Description of project.
- Description of type of emissions considered in the analysis.
- Contributing factors, including: air quality; transportation and traffic conditions; built and natural environment; meteorology, climate, and seasonal data; and adopted emission control measures.
- Description of analysis years.
- Description of existing conditions.
- Description of changes resulting from project.
- Description of analysis method chosen.
- Professional judgment of impact.
- Discussion of any mitigation measures.
- Written commitments for mitigation (if needed).
- Conclusion on how project meets 40 CFR 93.116 and 93.123.

Because Colorado has an approved PM_{10} maintenance plan, the March 10, 2006 final conformity rule does not apply to the Denver metropolitan area. Under the 1993 version of the transportation conformity rule (40 CFR Part 93), a PM_{10} hot-spot analysis is required for all non-exempt federal projects in Colorado's PM_{10} maintenance area.

Description of the Project

A description of the US 36 Corridor Project is provided in Chapter 1, Purpose and Need, and Chapter 2, Alternatives Considered.

Description of Type of Emissions Considered in the Analysis

The hot-spot analysis was based on directly emitted emissions from vehicles, including tailpipe, brake wear, and tire wear. Re-entrained road dust was also included in the analysis as required by the USEPA/FHWA guidance.

Construction-related PM_{10} emissions were not included in this hot-spot analysis because these emissions would be considered temporary since construction would last less than 5 years (40 CFR 93.123[c][5]). Secondary PM_{10} emissions would be associated with regional impacts and, therefore, are not included in the hot-spot analysis.

Contributing Factors

Existing and future air quality information was considered in assessing the probability of the project causing or contributing to an air quality violation. There has been no exceedance of the PM_{10} NAAQS measured in the project area for the past 10 years based on the data from three monitoring stations along the US 36 corridor.

Future year air quality was modeled by the CDPHE/APCD in support of the SIP (CDPHE and APCD 2005). The model provides predicted PM_{10} concentrations for a modeling grid that covers the Denver metropolitan area. The modeling results show a trend of PM_{10} concentration increase during the period of 2005 through 2030, mainly due to increased vehicle traffic in future years. However, the PM_{10} concentrations predicted by regional modeling are all below the NAAQS of 150 micrograms per cubic meter in the Denver metropolitan area, including the grids that covers the US 36 Corridor Project.

PM_{10} concentration in the future years will be largely reduced by more stringent vehicle emission standards and better control technologies. The final rule re-designating the Denver metropolitan area from nonattainment to maintenance status for PM_{10} became effective on October 16, 2002. This re-designation also included approval of a maintenance plan for PM_{10} for the Denver metropolitan area. The maintenance plan was updated in 2005 and included a number of strategies to reduce future PM_{10} emissions to demonstrate maintenance for 2002 and beyond. The emission reductions will come mostly from lower tailpipe emissions, better street sanding procedures, utilization of chemical de-icers, and ongoing vehicle inspection/maintenance requirements of the Automobile Inspection and Readjustment Program.

Re-entrained road dust tends to be a larger source of PM_{10} than tailpipe emissions for mobile sources. Street sanding is controlled by Colorado Air Quality Commission Regulation No. 16 and is expected to be the biggest contributor to PM_{10} control for the Denver metropolitan area. The maintenance plan also includes control of PM_{10} emissions from road construction activities. All these control programs would be in place regardless of the implementation of the project, and will improve the air quality in Denver metropolitan area.

Natural environment, local meteorology, and seasonal climate change will also affect the PM_{10} air quality impacts of a project. The Denver metropolitan area is located in the South Platte River drainage area, with mountains located to the west and relatively high terrain to the south and north. High winds are common within the US 36 corridor, often leading to conditions favorable to entrainment of fugitive dust. However, due to the implementation of the PM_{10} control measures, PM_{10} concentrations in the Denver metropolitan area has been in compliance with NAAQS for the past 10 years.

Description of the Analysis Year

The conformity rule and the USEPA/FHWA guidance require the PM_{10} hot-spot analysis in metropolitan nonattainment and maintenance areas to consider the full timeframe of the area's transportation plan. The analysis-year to be examined needs to be the year that the peak emissions from the project are expected. The current adopted transportation plan in the Denver metropolitan area is the DRCOG *2035 Metro Vision Regional Transportation Plan (2035 MVRTP),* as amended (DRCOG 2009a). Therefore, the hot-spot analysis was extended through the year 2035.

To identify the year of peak emissions, both mobile source trends and trends in background ambient concentrations were considered. As a starting point, the mobile source emission inventories from the Colorado PM_{10} maintenance plan were evaluated. These emission inventories are presented in Table 3.1-1, Table 3.4-1, and Table 3.4-3 of the *Technical Support Document for the Colorado SIP for* PM_{10} (CDPHE and APCD 2005). The Colorado PM_{10} maintenance plan presents the emission inventory through 2030 and it shows a trend of increased mobile source emissions, with the highest emissions in 2030. While the tailpipe fraction of the emissions decline due to more stringent emission standards, road dust emissions increase due to increased traffic volumes.

The regional air dispersion modeling results presented in the *Technical Support Document for the Colorado SIP for PM_{10}* (CDPHE and APCD 2005) were used to identify the year with the highest background PM_{10} concentrations. The modeling results show a clear trend of increased concentrations from 2015 through 2030 at the modeling grid inside the project area near the interchange of US 36 and Interstate 25 (I-25).

The maintenance plan does not cover years beyond 2030; however, based on the emissions and modeled PM_{10} concentration trend presented in the PM_{10} maintenance plan, it was assumed that the emission and concentration increase trend will continue through 2035. Because 2035 is expected to be the year with peak emissions and the highest background concentrations, it was selected as the analysis year for the PM_{10} hot-spot analysis.

Description of the Existing Conditions

The VMT for the existing condition (2005) within the US 36 corridor is approximately 12.1 million miles. The location with most traffic volume is near the interchange at US 36 and I-25, with an average daily traffic volume (ADT) of 135,000 vehicles per day.

Five years of ambient PM_{10} data (2004 to 2008) measured near the project area are presented in Table 4.12-2, Summary of Ambient Monitoring Concentrations within the Study Area, and show that there have been no violations of the 24-hour federal PM_{10} standard during that time for the Denver metropolitan area. A violation would be recorded at a particular monitor if more than one measured 24-hour value equals or exceeds NAAQS during a calendar year. Therefore, the highest measured value is disregarded and the next highest value (the “high second-high”) is compared to NAAQS. The second-high 24-hour PM_{10} concentrations measured at the three monitoring stations closest to the project area (Boulder, Welby, and CAMP stations) were at most, 39 percent, 63 percent, and 43 percent, respectively, of the federal 24-hour standard of 150 micrograms per cubic meter. The three monitoring stations have shown fairly stable PM_{10} concentrations over the last few years. The PM_{10} concentrations measured in 2008 at all these stations are lower than those measured in 2007.

For comparison purposes, monitoring data at a location that has similar characteristics with the US 36 project setting and traffic volume were also reviewed. The location of the monitoring station is 1050 South Broadway. This monitoring station is near I-25 in the central South Platte River Valley and has similar characteristics to the US 36 project area. In this area, I-25 carries more than 180,000 vehicles per day. The values listed in Table 4.12-9, Second Highest 24-hour PM_{10} Concentration, are the second highest 24-hour values measured during the year, which is the method required to assess compliance with the NAAQS. As indicated in the table, the measured PM_{10} concentrations at this location were well below the PM_{10} NAAQS of 150 micrograms per cubic meter.

Table 4.12-9: Second Highest 24-hour PM_{10} Concentration

Year	Second Highest 24-hour PM_{10} Concentration (ug/m^3)
2005	54
2004	76
2003	77
2002	67
2001	60
2000	54

Source: US 36 Mobility Partnership, 2009.
Notes:
Monitoring data after 2005 are not available at this station.
PM_{10} = particulate matter less than 10 microns in diameter
ug/m^3 = micrograms per cubic meter

Existing conditions regarding regional air quality, traffic conditions, built and natural environment of the project, meteorology and seasonal climate change of the project area, and the adopted emission control measures are discussed in the Contributing Factors subsection.

Description of Changes Resulting from the Project

Change of VMT: As indicated in Table 4.12-3, Peak-hour Corridor-wide Vehicle Miles Traveled and Emission Inventory Estimates, daily corridor-wide VMT for the build packages would be similar, within 2 to 4 percent of Package 1 VMT, and would increase approximately 34 to 39 percent compared to 2005. The worst-case ADT volumes for the build packages on the US 36 corridor would be between 167,000 to 196,000 in 2035. Because current PM_{10} concentrations monitored in the project area are sufficiently below the NAAQS, the VMT and ADT increase associated with the build packages is unlikely to cause an exceedance of the PM_{10} NAAQS.

Change of LOS: Hot spots of PM_{10} would most likely occur where large volumes of traffic operate under heavily congested conditions. Even though the VMT will increase in future years, the traffic operating conditions on US 36 are expected to improve due to the expanded capacity and efficiency. The projected LOS at affected intersections for the build packages improves or remains the same on US 36 compared to Package 1.

Change of Vehicle Emissions: Overall vehicle emissions, including pipeline, brake wear, and tire wear are shown in Table 4.12-4, Daily Corridor-wide Vehicle Miles Traveled and Emission Inventory Estimates. The daily vehicle emissions of PM_{10} for the build packages are slightly higher (about 2 to 4 percent) than Package 1 in 2035. There is a slight increase (4 to 6 percent) of vehicle PM_{10} exhaust in 2035 from build packages compared to 2005 in the project area.

Change of Re-entrained Dust Emissions: Vehicle re-entrained dust accounted for 40 to 60 percent of the vehicle related PM_{10} emissions in the Denver metropolitan area. According to the emission calculation methodology described in Chapter 13.2.1 of *AP-42, Fifth Edition, Compilation of Air Pollutant Emission Factors* (USEPA 2006b), road re-entrained dust emissions are a function of the road silt content, average weight of vehicles traveled on the road, and VMT. Because the project would not significantly change the vehicle mix of the corridors, the re-entrained road dust emissions would be proportional to the VMT on paved roads. Based on the total VMT data presented in Table 4.12-4, Daily Corridor-wide Vehicle Miles Traveled and Emission Inventory Estimates, daily VMT of build packages are approximately 37 to 39 percent higher compared to 2005. However, fugitive dust emissions are not expected to increase at the same percentage as VMT due to the additional reduction in sand applications and increased road sweeping activities in future years (DRCOG 2009b). VMT for build packages would be about 2 to 4 percent higher than Package 1 in 2035. Therefore, fugitive dust emissions of build packages are expected to be only slightly higher than Package 1, and are not expected to cause an exceedance of the NAAQS.

Description of the Analysis Method Chosen

In lieu of a quantitative methodology, the analysis uses a combination of the two methods outlined in Section 4.1 of the March 2006 USEPA/FHWA guidance, by using the “air quality studies for the proposed project location” as well as the “comparison to another location with similar characteristics.”

The analysis relied on the air dispersion modeling already conducted for the Denver metropolitan PM_{10} maintenance plan to evaluate the potential for the build packages to cause or contribute to violations of the PM_{10} NAAQS. This approach has been used for other projects in the Denver metropolitan area, and involves three technical steps: 1) identify worst-case locations based on traffic volume for the proposed project, 2) review the PM_{10} maintenance plan dispersion modeling to identify similar comparison locations that have similar or even higher traffic volumes, and 3) ensure that the modeled concentrations at these comparison locations in the maintenance plan are below NAAQS. In this case, the regional air dispersion modeling already included the US 36 Corridor Project; therefore, the maintenance plan itself already incorporated the traffic impacts of the project, and no comparison is necessary.

The US 36 Corridor Project was also compared to another location with similar characteristics to demonstrate that the PM_{10} concentration with the build packages would not cause violations of the NAAQS. Details of the evaluation are presented below.

1. Air Quality Studies for the Proposed Project Location

The regional modeling for the PM_{10} maintenance plan for the Denver metropolitan area was conducted by the Colorado APCD with the RAM and ISCST3 models and includes all major point sources, as well as mobile sources and background concentrations (CDPHE and APCD 2005). The maintenance plan shows that none of the modeling grids in the Denver metropolitan area would violate the PM_{10} NAAQS in 2005 through 2030. For the sections of US 36 within the PM_{10} modeling domain, the grid cells containing US 36 with the maximum sixth-highest modeled 24-hour PM_{10} concentrations were selected to represent the worst-case PM_{10} concentrations in the corridor.[1] The top two maximum sixth-highest modeled 24-hour PM_{10} concentration in the US 36 corridor are 149.9 and 139.7 micrograms per cubic meter for the grid cells near the I-25/US 36 interchange in 2030. Both concentrations are lower than the 24-hour PM_{10} NAAQS of 150 micrograms per cubic meter. Currently, no modeling data are available to predict the PM_{10} concentrations in the vicinity of the project beyond 2030.

The US 36 Corridor Project was included in the PM_{10} maintenance plan modeling. Although the build packages of the project went through some changes in the past few years, VMT and LOS are not appreciably different between the packages such that the model would show differences in PM_{10} concentration. Therefore, it is expected that the PM_{10} concentrations predicted by the regional modeling represent the PM_{10} air quality impacts of all the build packages. As a result, the project is not expected to cause exceedance of the NAAQS within the project area.

2. Comparison to another Location with Similar Characteristics

To further demonstrate that the US 36 Corridor Project would not cause violations of the NAAQS, monitoring data from 1050 South Broadway were used as an indication of potential PM_{10} concentration levels due to implementation of the build packages of the US 36 Corridor Project. The station at the 1050 South Broadway location was selected because it is near I-25 in the central South Platte River Valley with similar characteristics to the US 36 Corridor Project area.

The location with the highest traffic volume of the US 36 project is near the interchange of US 36 and I-25. The ADT is 169,000 for Package 2, 188,000 for Package 4, and 196,000 for the Combined Alternative Package (Preferred Alternative) in 2035 at this location. Because I-25 near the South Broadway station carries an ADT of 180,000, similar to the ADT of the build packages in 2035, the PM_{10} concentrations measured at the South Broadway station were used as reference points for estimating the PM_{10} concentration of the build packages. Monitoring data from the South Broadway station are presented in Table 4.12-9, Second Highest 24-hour Concentration, from 1050 South Broadway. There has been no exceedance of NAAQS at the South Broadway station in the past 10 years.

Package 2 and Package 4 have similar ADT in 2035 compared to the I-25 near 1050 South Broadway station. Therefore, it is expected that PM_{10} concentrations for Package 2 and Package 4 in 2035 would be similar to what was monitored at the 1050 South Broadway station, and would be below NAAQS.

The average ADT of the Combined Alternative Package (Preferred Alternative) would be 155,000, which is less than the ADT on I-25 near the South Broadway station; thus, it is not expected to cause PM_{10} to exceed the NAAQS. The worst-case ADT of the Combined Alternative Package (Preferred Alternative) would be at the southern end of the project corridor near the interchange of US 36 and I-25. The

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[1] The PM_{10} regional modeling process used by the Colorado Air Pollution Control District to demonstrate attainment of the 24-hour particulate matter less than 10 microns in diameter (PM_{10}) standard for the PM_{10} maintenance plan is based on 5 years of meteorological data. Therefore, the maximum sixth highest value at each modeled receptor is used to determine if the standard has been met.

Combined Alternative Package (Preferred Alternative) would have slightly higher (less than 10 percent) ADT at the worst-case location in 2035 than the ADT on I-25 at the South Broadway station.

The highest "second-highest" PM_{10} concentration measured at the 1050 South Broadway monitoring station was 77 micrograms per cubic meter in 2003. Because the measured PM_{10} concentrations are so much lower than the NAAQS, the PM_{10} concentration increase is due to the 10 percent traffic volume increase, which is only one of the many sources of PM_{10} emissions, and are unlikely to cause or contribute an exceedance of the NAAQS.

Professional Judgment of Impact

Based on the PM_{10} maintenance plan modeling results and the comparison to another location with similar characteristics to the project, the project is not expected to cause an exceedance of the PM_{10} NAAQS during project operation.

The PM_{10} maintenance plan modeling includes the traffic impacts due to US 36, other new development in the Denver metropolitan area, and changes in regional background concentrations expected over time. The maintenance plan shows that none of the modeling grids in the Denver metropolitan area would violate the PM_{10} NAAQS during the maintenance period, including the grids covering the project area.

Phase 1 of the Combined Alternative Package (Preferred Alternative) is included in the *2008-2013 TIP* (DRCOG 2009b) and the *Fiscally-constrained Element* of the *2035 MVRTP*, as amended (DRCOG 2009a). Other phases of the project will be included in the RTP when funds are available. As discussed previously, the worst-case traffic locations have been evaluated independently from the project phasing to define the worst possible operating conditions that could prevail at any location within the US 36 corridor to the year 2035. The LOS and delay at the worst-case locations of Phase 1 are expected to improve compared to the worst-case intersections analyzed for Package 1 and the project is not expected to cause new violations of PM_{10} NAAQS in any of the interim years before the Combined Alterative Package (Preferred Alternative) is completed.

Evaluation of Both Forms of the Particulate Matter Standard (24-hour and annual)

24-hour PM_{10} Concentration: The maintenance plan shows that PM_{10} concentrations in the project vicinity are predicted to be below the 24-hour PM_{10} standard. Monitoring data at a location with similar characteristics with the project have demonstrated that the 24-hour PM_{10} concentrations are below NAAQS.

Annual PM_{10} Concentration: Denver has not historically had problems with the annual PM_{10} standard. In December 2006, USEPA revoked the annual PM_{10} standard. Annual PM_{10} concentration is no longer a concern.

Discussion of Mitigation Measures

Because the hot-spot analysis does not predict an adverse impact from project operation, no mitigation measures are required. Best management practices (BMPs) will be implemented to reduce air quality effects. Details of the regional PM_{10} control measures are presented in the Mitigation subsection.

Conclusion on How the US 36 Corridor Project Meets 40 CFR 93.116 and 93.123

As discussed above, the US 36 Corridor Project is not anticipated to cause any new or worsen the existing violations of NAAQS. The Denver metropolitan area is currently in attainment of the PM_{10} NAAQS; thus, the project, by definition, will not delay attainment of the NAAQS. Therefore, the project meets the conformity requirements in 40 CFR 93.116 and 93.123 for PM_{10}.

Air Quality Conformity

The project will be implemented in phases when funding becomes available. The following air quality conformity analysis covers the conformity evaluation for scenarios when only Phase 1 of the project is implemented, and when the entire project is fully constructed.

Regional Conformity: The estimated capital costs for each of the build packages exceeds the current available or planned funding contained in the *2035 MVRTP*, as amended (DRCOG 2009a) for the US 36 corridor. To accommodate these funding limitations, the Combined Alternative Package (Preferred Alternative) has been separated into three phases. Details of the components included for each phase are presented in Chapter 8, Phased Project Implementation, of this FEIS.

Only Phase 1 of the Combined Alternative Package (Preferred Alternative) is incorporated into the *Draft 2009 Amendment Cycle 1 DRCOG Conformity Determination (CO, PM_{10}, and 1-hour Ozone) for the Amended Fiscally Constrained 2035 Regional Transportation Plan and the Amended 2008-2013 Transportation Improvement Program* (DRCOG 2009b). Phase 1 consists of the managed lane from Federal Boulevard to east of the Foothills Parkway/Table Mesa Drive interchange; improvements to the Sheridan Boulevard and Wadsworth Parkway interchanges; replacement of four bridges; pavement rehabilitation; shoulder widening; bus rapid transit (BRT) station enhancements; construction of the bikeway; and intelligent transportation system elements related to the managed lane and BRT operations. Other phases of the Combined Alternative Package (Preferred Alternative) will be included in the RTP when funds become available in the future.

Phase 1 of the Combined Alternative Package (Preferred Alternative) meets regional conformity requirements by its inclusion in the fiscally-constrained, conforming *2035 MVRTP*, as amended (DRCOG 2009a) and *2008-2013 TIP* (DRCOG 2009b). Phase 1 of the project satisfies the regional transportation conformity requirements, thus is not expected to cause significant regional air quality impacts.

To demonstrate that this project would not cause significant air quality impacts and would comply with the SIP when it is fully constructed, DRCOG completed a non-fiscally constrained regional model run that included all phases of the Combined Alternative Package (Preferred Alternative). This long-range non-fiscally constrained model was produced to ensure that there would not be any significant regional air quality impacts once all phases of the project are funded and completed. For a complete description of the phasing and funding of the Combined Alternative Package (Preferred Alternative), refer to Chapter 5, Financial Analysis, of this FEIS.

Project Level Conformity: Because the project area is in attainment/maintenance for CO and PM_{10}, a project level conformity analysis was performed for these two pollutants. CO and PM_{10} hot-spot analyses indicated the project would meet the transportation conformity requirements because the build packages would not cause or contribute to any new localized CO or PM_{10} violations, or increase the frequency or severity of any existing violations, or delay timely attainment of the CO or PM_{10} NAAQS.

As indicated in the CO hot-spot analysis discussion, additional CO modeling analysis has been conducted for the intersection at Dillon Road and McCaslin Boulevard for Package 1 in 2035. Because overall traffic conditions within the project area are expected to improve with Phase 1 and the other phases of the Combined Package Alternative (Preferred Alternative), air quality impacts at Dillon Road and McCaslin Boulevard under Package 1 are considered the worst-case during the interim years before the project is completely built. The modeled 1-hour and 8-hour CO concentrations using 2035 traffic volumes and 2005 emission factors are below the NAAQS, indicating that the worst performing intersection outside of Phase 1 would not produce CO concentrations exceeding the NAAQS. Details regarding conformity of Phase 1 will be included in the ROD discussion in Chapter 8, Phased Project Implementation.

Mobile Source Air Toxics

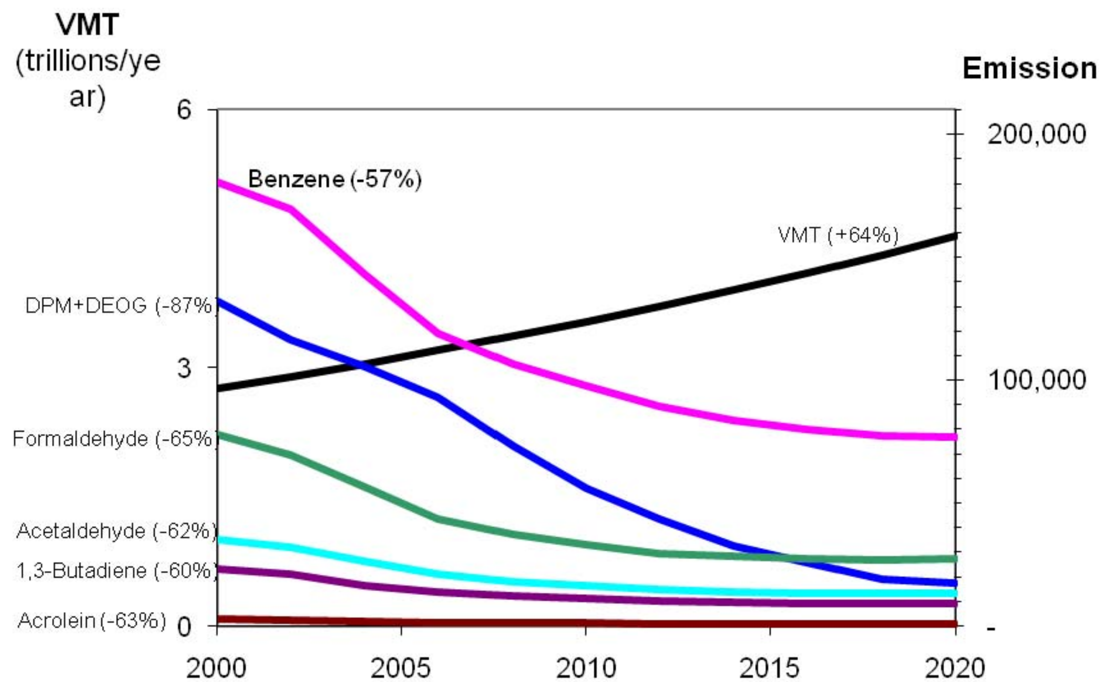
Methodology

In addition to NAAQS, USEPA also regulates air toxics. Most air toxics originate from human-made sources, including on-road mobile sources, non-road mobile sources (e.g., airplanes), area sources (e.g., dry cleaners), and stationary sources (e.g., factories or refineries).

Mobile source air toxics (MSATs) are a subset of the 188 air toxics defined by the Clean Air Act. MSATs are compounds emitted from highway vehicles and non-road equipment. Some toxic compounds are present in fuel and are emitted to the air when the fuel evaporates or passes through the engine unburned. Other toxics are emitted from the incomplete combustion of fuels or as secondary combustion products. Metal air toxics also result from engine wear or from impurities in oil or gasoline (see document No. EPA420-R-00-023, December 2000).

USEPA is the lead federal agency for administering the Clean Air Act and has certain responsibilities regarding the health effects of MSATs (see document No. EPA400-F-92-004, August 1994). More recently, USEPA issued a Final Rule on Controlling Emissions of Hazardous Air Pollutants from Mobile Sources, 66 *Federal Register* 17229 (March 29, 2001). This rule was issued under the authority in Section 202 of the Clean Air Act. In its rule, USEPA examined the impacts of existing and newly promulgated mobile source control programs, including its reformulated gasoline program, its national low emission vehicle standards, its Tier 2 motor vehicle emissions standards and gasoline sulfur control requirements, and its proposed heavy-duty engine and vehicle standards and on-highway diesel fuel sulfur control requirements. Between 2000 and 2020, FHWA projects that even with a 64 percent increase in VMT, these programs will reduce on-highway emissions of benzene, formaldehyde, 1,3-butadiene, and acetaldehyde by 57 to 65 percent, and will reduce on-highway diesel particulate matter emissions by 87 percent, as shown in Figure 4.12-2, U.S. Annual Vehicle Miles Traveled Versus Mobile Source Air Toxic Emissions (2000 to 2020).

Figure 4.12-2: U.S. Annual Vehicle Miles Traveled Versus Mobile Source Air Toxic Emissions (2000 to 2020)



Notes: For on-road mobile sources. Emissions factors were generated using MOBILE6.2. MTBE proportion of market for oxygenates is held constant, at 50%. Gasoline RVP and oxygenate content are held constant. VMT: *Highway Statistics 2000*, Table VM-2 for 2000, analysis assumes annual growth rate of 2.5%. "DPM + DEOG" is based on MOBILE6.2-generated factors for elemental carbon, organic carbon and SO4 from diesel-powered

Source: U.S. 36 Mobility Partnership, 2006.

Summary of Existing Credible Scientific Evidence Relevant to Evaluating the Impacts of Mobile Source Air Toxics

Research into the health impacts of MSATs is ongoing. For different emission types, there are a variety of studies that show that some are either statistically associated with adverse health outcomes through epidemiological studies (frequently based on emissions levels found in occupational settings), or that animals demonstrate adverse health outcomes when exposed to large doses.

Exposure to toxics has been a focus of a number of USEPA efforts. Most notably, the agency conducted the National Air Toxics Assessment in 1996 to evaluate modeled estimates of human exposure applicable to the county level. While not intended for use as a measure of or benchmark for local exposure, the modeled estimates in the National Air Toxics Assessment database best illustrate the levels of various toxics when aggregated to a national or state level.

The USEPA is in the process of assessing the risks of various kinds of exposures to these pollutants. The USEPA Integrated Risk Information System (IRIS) is a database of human health effects that may result from exposure to various substances found in the environment. The IRIS database is located at http://www.epa.gov/iris. The following toxicity information for the six prioritized MSATs was taken from the IRIS database, *Weight of Evidence Characterization*, summaries. This information is taken verbatim from USEPA's IRIS database and represents the agency's most current evaluations of the potential hazards and toxicology of these chemicals or mixtures.

- **Benzene** is characterized as a known human carcinogen.
- The potential carcinogenicity of **acrolein** cannot be determined because the existing data are inadequate for an assessment of human carcinogenic potential for either the oral or inhalation route of exposure.
- **Formaldehyde** is a probable human carcinogen, based on limited evidence in humans, and sufficient evidence in animals.
- **1,3-Butadiene** is characterized as carcinogenic to humans by inhalation.
- **Acetaldehyde** is a probable human carcinogen based on increased incidence of nasal tumors in male and female rats, and laryngeal tumors in male and female hamsters after inhalation exposure.
- **Diesel exhaust** is likely to be carcinogenic to humans by inhalation from environmental exposures. Diesel exhaust as reviewed in this document is the combination of diesel particulate matter and diesel exhaust organic gases.
- **Diesel exhaust** also represents chronic respiratory effects, possibly the primary non-cancer hazard from MSATs. Prolonged exposure may impair pulmonary function and could produce symptoms, such as cough, phlegm, and chronic bronchitis. Exposure relationships have not been developed from these studies.

There have been other studies that address MSAT health impacts in proximity to roadways. The Health Effects Institute, a non-profit organization funded by USEPA, FHWA, and industry, has undertaken a major series of studies to research near roadway MSAT hot spots, the health implications of the entire mix of mobile source pollutants, and other topics. The final summary of the series is not expected for several years.

Some recent studies have reported that proximity to roadways is related to adverse health outcomes particularly respiratory problems[2]. Much of this research is not specific to MSATs, instead surveying the full spectrum of both criteria and other pollutants. FHWA cannot evaluate the validity of these studies, but more importantly, they do not provide information that would be useful to alleviate the uncertainties listed later in this section. However, these studies would enable us to perform a more comprehensive evaluation of the health impacts specific to this project.

Impact Analysis

Corridor Emission Estimates for Priority Mobile Source Air Toxics

Total emissions within the project corridor for the priority MSATs were estimated for each package. Emissions were estimated for the year 2035. Year 2005 emissions are included to show the effect of "current" VMT levels and the degree of pollution control on the current mix of vehicles. Corridor-wide MSATs emissions were estimated using the same methodology as for criteria pollutants.

Table 4.12-10, Daily Corridor-wide Emission Estimates (Priority Mobile Source Air Toxics), presents the estimated daily MSAT emissions for each package. The estimated emissions for the build packages are higher than Package 1 in 2035, mainly because of increased VMT on US 36.

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[2] The South Coast Air Quality Management District, Multiple Air Toxic Exposure Study-II (2000); Highway Health Hazards, The Sierra Club (2004) summarizing 24 studies on the relationship between health and air quality; National Environmental Policy Act of 1969, *Uncertainty in the Federal Legal Scheme Controlling Air Pollution from Motor Vehicles*, Environmental Law Institute, 35 ELR 10273 (2005) with health studies cited therein.

Table 4.12-10: Daily Corridor-wide Emission Estimates (Priority Mobile Source Air Toxics)

Parameter	Year 2005	Package 1 (2035)	Package 2 (2035)[1]	Package 4 (2035)[1]	Combined Alternative Package (Preferred Alternative) (2035)
Benzene (lb/day)	1,236.1	303.3	310.9	314.7	309.6
1,3-Butadiene (lb/day)	148.9	37.5	38.2	38.6	38.6
Formaldehyde (lb/day)	508.9	163.1	166.0	168.1	169.5
Acetaldehyde (lb/day)	361.4	85.0	85.9	86.8	87.9
Acrolein (lb/day)	23.9	7.5	7.6	7.7	7.8
Diesel Particulate Matter (lb/day)[2]	1,219	1,240	1,271	1,287	1,272

Source: US 36 Mobility Partnership, 2006 and 2009.
Notes:
[1]VMT and emissions of Package 2 and Package 4 in 2035 were estimated by applying adjustment factors to the 2030 data, taking into account the VMT growth rate and vehicle speed change between 2030 and 2035. See the *Air Quality Technical Report Addendum* (CH2M Hill 2009) for details.
[2]Diesel particulate matter emissions included all particulate matter emissions from vehicles, including those powered by diesel, gasoline, and other fuels. These data were used as overly conservative approximations of diesel particulate emissions for the purpose of comparing differences between the packages.
lb/day = pound(s) per day
VMT = vehicle miles traveled

Except diesel particulate matter, year 2005 emissions of the other five MSATs are higher than each of the build packages despite much lower VMT, because of the significantly higher emission factors for the priority MSATs for the current fleet of vehicles. Regardless of the package, these five MSAT emissions are projected to decline markedly in the future. This is directly due to the improved pollution emission performance of a modernizing fleet of all diesel-fueled vehicles, a trend that is anticipated to continue throughout the planning horizon. As discussed in the Pollutants of Primary Concern subsection, the slightly increased PM_{10} emissions over 2005 may be a result of different approaches taken in the emission modeling compared to 2035.

Regional Emission Estimates for Priority Mobile Source Air Toxics

Region-wide MSATs emissions were estimated using the same methodology as for criteria pollutants.

Table 4.12-11, Daily Region-wide Emission Estimates (Priority Mobile Source Air Toxics), summarizes the estimated emissions of each package.

Table 4.12-11: Daily Region-wide Emission Estimates (Priority Mobile Source Air Toxics)

Parameter	Year 2005	Package 1 (2035)	Package 2 (2035)[1]	Package 4 (2035)[1]	Combined Alternative Package (Preferred Alternative) (2035)
Benzene (lb/day)	6,323.5	2,151.5	2,155.6	2,164.1	2,164.0
1,3-Butadiene (lb/day)	760.5	259.5	259.8	260.8	267.2
Formaldehyde (lb/day)	2,592.8	1,094.5	1,096.6	1,100.9	1,138.0
Acetaldehyde (lb/day)	1,846.1	580.2	579.7	582.8	597.0
Acrolein (lb/day)	121.6	50.6	50.6	50.8	52.3
Diesel Particulate Matter (lb/day)[2]	6,124	8,626	8,643	8,676	8,681

Source: US 36 Mobility Partnership, 2006 and 2009.

Notes:

[1]VMT and emissions of Package 2 and Package 4 in 2035 were estimated by applying adjustment factors to the 2030 data, taking into account the VMT growth rate and vehicle speed change between 2030 and 2035. See the *Air Quality Technical Report Addendum* (CH2M Hill 2009) for details.

[2]Diesel particulate matter emissions included all particulate matter emissions from vehicles, including those powered by diesel, gasoline, and other fuels. These data were used as overly conservative approximations of diesel particulate emissions for the purpose of comparing differences between the packages.

lb/day = pound(s) per day
VMT = vehicle miles traveled

Unavailable Information for Project-Specific MSAT Impact Analysis

This FEIS includes a basic analysis of the likely MSAT emission impacts of this project. However, available technical tools do not enable us to predict the project-specific health impacts of the emission changes associated with the packages in this FEIS. Due to these limitations, the following discussion is included in accordance with Council on Environmental Quality regulations (40 CFR 1502.22[b]) regarding incomplete or unavailable information.

Information that is Unavailable or Incomplete

Evaluating the environmental and health impacts from MSATs on a proposed highway project would involve several key elements, including emissions modeling, dispersion modeling in order to estimate ambient concentrations resulting from the estimated emissions, exposure modeling in order to estimate human exposure to the estimated concentrations, and then final determination of health impacts based on the estimated exposure. Each of these steps is encumbered by technical shortcomings or uncertain science that prevents a more complete determination of the MSAT health impacts of this project.

1. **Emissions**: The USEPA tools to estimate MSAT emissions from motor vehicles are not sensitive to key variables determining emissions of MSATs in the context of highway projects. While MOBILE6.2 is used to predict emissions at a regional level, it has limited applicability at the project level. MOBILE6.2 is a trip-based model. Emission factors are projected based on a typical trip of 7.5 miles, and on average speeds for this typical trip. This means that MOBILE6.2 does not have the ability to predict emission factors for a specific vehicle operating condition, at a specific location at a specific time. Because of this limitation, MOBILE6.2 can only approximate the operating speeds and levels of congestion likely to be present on the largest-scale projects, and cannot adequately capture emission effects of smaller projects. For particulate matter, the model results are not sensitive to average trip speed, although the other MSAT emission rates do change with changes in trip speed. Also, the emissions rates used in MOBILE6.2 for both particulate matter and MSATs are based on a limited number of tests of mostly older-technology vehicles. Lastly, in its discussions of particulate matter under the conformity rule, USEPA has identified problems with MOBILE6.2 as an obstacle to quantitative analysis.

   These deficiencies compromise the capability of MOBILE6.2 to estimate MSAT emissions. MOBILE 6.2 is an adequate tool for projecting emissions trends, and performing relative analyses between alternatives for very large projects, but it is not sensitive enough to capture the effects of travel changes tied to smaller projects, or to predict emissions near specific roadside locations.

2. **Dispersion**. The tools to predict how MSATs disperse are also limited. The USEPA's current regulatory models, CALINE3 and CAL3QHC, were developed and validated more than a decade ago for the purpose of predicting episodic concentrations of CO to determine compliance with the NAAQS. The performance of dispersion models is more accurate for predicting maximum concentrations that can occur at some time, at some location within a geographic area. This limitation makes it difficult to predict accurate exposure patterns at specific times at specific highway project locations across an urban area to assess potential health risks. The National Cooperative Highway Research Program is conducting research on best practices in applying models and other technical methods in the analysis of MSATs. This work also will focus on identifying appropriate methods of documenting and communicating MSAT impacts in the National Environmental Policy Act of 1969 process, and to the general public. Along with these general limitations of dispersion models, FHWA is also faced with a lack of monitoring data in most areas for use in establishing project-specific MSAT background concentrations.

3. **Exposure levels and health effects**. Finally, even if emission levels and concentrations of MSATs could be accurately predicted, shortcomings in current techniques for exposure assessment and risk analysis preclude us from reaching meaningful conclusions about project-specific health impacts. Exposure assessments are difficult because it is difficult to accurately calculate annual concentrations of MSATs near roadways, and to determine the portion of a year that people are actually exposed to those concentrations at a specific location. These difficulties are magnified for 70-year cancer assessments, particularly because unsupportable assumptions would have to be made regarding changes in travel patterns and vehicle technology (which affects emissions rates) over a 70-year period. There are also considerable uncertainties associated with the existing estimates of toxicity of the various MSATs, because of factors such as low-dose extrapolation and translation of occupational exposure data to the general population. Because of these shortcomings, any calculated difference in health impacts between packages is likely to be much smaller than the uncertainties associated with calculating the impacts. Consequently, the results of such assessments would not be useful to decision makers, who would need to weigh this information against other project impacts that are better suited for quantitative analysis.

Relevance of Unavailable or Incomplete Information to Evaluating Reasonably Foreseeable Adverse Impacts on the Environment

Because of the uncertainties outlined above, a quantitative assessment of the effects of air toxic emission impacts on human health cannot be made at the project level. While available tools do allow us to reasonably predict relative emission changes between alternatives for larger projects, the amount of MSAT emissions from each of the project alternatives, and MSAT concentrations or exposures created by each of the project alternatives, cannot be predicted with enough accuracy to be useful in estimating health impacts. As noted above, the current emissions model is not capable of serving as a meaningful emissions analysis tool at the project level. Therefore, the relevance of the unavailable or incomplete information is that it is not possible to make a determination of whether any of the packages would have "significant adverse impacts on the human environment."

In this document, FHWA has provided a quantitative analysis of MSAT emissions relative to the various packages, and has acknowledged that the project packages may result in increased exposure to MSAT emissions in certain locations, although the concentrations and duration of exposures are uncertain, and because of this uncertainty, the health effects from these emissions cannot be estimated.

Summary of Impact Analyses

Package 1: No Action

Regional air quality is anticipated to improve negligibly over the 25-year planning period with implementation of Package 1.

Package 2: Managed Lanes/Bus Rapid Transit

The regional VMT of Package 2 is comparable to the VMT of Package 1, with a slight increase of less than 0.2 percent. The air quality is expected to change negligibly over Package 1.

Package 4: General-Purpose Lanes, High-Occupancy Vehicle, and Bus Rapid Transit

The effects on regional air quality from Package 4 would be similar to those of Package 2. The air quality impacts due to the slight increase of VMT compared to Package 1 would be minimal.

Combined Alternative Package (Preferred Alternative): Managed Lanes, Auxiliary Lanes, and Bus Rapid Transit

The regional VMT of the Combined Alternative Package (Preferred Alternative) is comparable to the VMT of Package 1. Emission increases due to the VMT change are minimal. The air quality is expected to change negligibly over Package 1.

Construction Impacts

The emissions of PM_{10} during the construction phase of the project were estimated by using an emission factor from the URBEMIS model. This emission factor, which estimates fugitive dust from site grading, was applied to estimates of the maximum number of acres of disturbed ground for each package. For each of the build packages, it was assumed that the area to be disturbed on a daily basis would be less than 10 acres. Therefore, the maximum daily fugitive dust emissions would be 100 pounds per day for the project construction. Other impacts to air quality during construction include emissions from construction vehicles and equipment, emissions from paving and from motor vehicles traveling in the vicinity of the project which may, on occasion, be subject to detours and delays.

Climate Change Cumulative Effects Discussion

The issue of global climate change is an important national and global concern that is being addressed in several ways by the federal government. The transportation sector is the second largest source of total greenhouse gases in the United States (U.S.), and the greatest source of carbon dioxide (CO_2) emissions — the predominant greenhouse gas. In 2004, the transportation sector was responsible for 31 percent of all U.S. CO_2 emissions. The principal anthropogenic (human-made) source of carbon emissions is the combustion of fossil fuels, which account for approximately 80 percent of anthropogenic emissions of carbon worldwide. Almost all (98 percent) of transportation-sector emissions result from the combustion of petroleum products such as gasoline, diesel fuel, and aviation fuel.

Recognizing this concern, FHWA is working nationally 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. At the state level, there are also several programs 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 emission standards and to reduce vehicle travel through transit, flex time, telecommuting, ridesharing, and broadband communications. CDOT issued a policy Directive on Air Quality in May 2009. This Policy Directive was developed with input from a number of agencies, including the CDPHE, USEPA, FHWA, the FTA, the Denver Regional Transportation District, the Denver RAQC. This Policy Directive addresses unregulated MSATS and greenhouse gases produced from Colorado’s state highways, interstates, and construction activities. As a part of CDOT's commitment to addressing MSATs and greenhouse gases, some of CDOT's program-wide activities include:

1. Developing truck routes/restrictions with the goal of limiting truck traffic in proximity to facilities, including schools, with sensitive receptor populations.
2. Continue researching pavement durability opportunities with the goal of reducing the frequency of resurfacing and/or reconstruction projects.
3. Developing air quality educational materials, specific to transportation issues, for citizens, elected officials, and schools.
4. Offering outreach to communities to integrate land use and transportation decisions to reduce growth in VMT, such as smart growth techniques, buffer zones, transit-oriented development, walkable communities, access management plans, etc.
5. Committing to research additional concrete additives that would reduce the demand for cement.
6. Expanding Transportation Demand Management efforts statewide to better utilize the existing transportation mobility network.
7. Continuing to diversify the CDOT fleet by retrofitting diesel vehicles, specifying the types of vehicles and equipment contractors may use, purchasing low-emission vehicles, such as hybrids, and purchasing cleaner burning fuels through bidding incentives where feasible. Incentivizing is the likely vehicle for this.
8. Exploring congestion and/or right-lane only restrictions for motor carriers.
9. Funding truck parking electrification (note: mostly via exploring external grant opportunities).
10. Researching additional ways to improve freight movement and efficiency statewide.
11. Committing to incorporating ultra-low sulfur diesel for non-road equipment statewide before June 2010 – likely using incentives during bidding.
12. Developing a low-VOC emitting tree landscaping specification.

Because climate change is a global issue, and the emissions changes due to project alternatives are very small compared to global totals, corridor-wide greenhouse gas emissions associated with the packages were not calculated. Estimates of regional greenhouse gas emissions are presented in Section 4.19, Energy. Because greenhouse gases are directly related to energy use, the changes in greenhouse gas emissions are similar to the changes in energy consumption. The relationship of current and projected Colorado highway emissions to total global CO_2 emissions is presented in Table 4.12-12, Greenhouse Gas Inventory. Colorado highway emissions are expected to increase by 4.7 percent between now and 2035. The benefits of the fuel economy and renewable fuels programs in the 2007 Energy Bill are offset by growth in VMT; the draft 2035 statewide transportation plan predicts that Colorado VMT will double between 2000 and 2035. Table 4.12-12 also illustrates the size of the project corridor relative to total Colorado travel activity.

Table 4.12-12: Greenhouse Gas Inventory

Global CO_2 Emissions, 2005 (MMT)[1]	Colorado Highway CO_2 Emissions, 2005 (MMT)[2]	Projected Colorado 2035 Highway CO_2 Emissions, (MMT)[2]	Colorado Highway Emissions, % of Global Total (2005)[2]	Project Corridor VMT, % of Statewide VMT (2005)[3]
27,700	29.9	31.3	0.108%	9.1%

Source: US 36 Mobility Partnership, 2009.

Notes:

[1]Energy Information Administration (EIA) International Energy Outlook 2007.

[2]Calculated by Federal Highway Administration Resource Center.

[3]Statewide VMT was 47.9 billion in 2005, based on the Colorado Department of Transportation's *Fact Book 2006–2007, Transportation Facts* (CDOT 2007).

% = percent
CO_2 = carbon dioxide
MMT = million metric tons
VMT = vehicle miles traveled

Mitigation

The air quality analysis does not predict an adverse impact from the project operation; therefore, no mitigation measures are required. However, BMPs will be implemented to reduce air quality effects, particularly during construction. The project construction will exceed 25 acres and last more than 6 months, and therefore an Air Pollutant Emissions Notice and an air permit is required by APCD. Mitigation measures during construction will be covered in the Air Pollutant Emissions Notice submitted to APCD.

Regional and local agency strategies that could be used to reduce criteria pollutant and MSATs emissions include but are not limited to: tailpipe retrofits, closed crankcase filtration systems, clean fuels, engine rebuild and replacement requirements, contract requirements, anti-idling ordinances and legislation, truck stop electrification programs, and aggressive fleet turnover policies. Future emissions from on-road mobile sources will be minimized regionally through programmatic plans outlined in CDOT's *Air Quality Policy Directive 1901*. The purpose of programmatic air quality mitigation is to establish region-wide goals and potential mitigation strategies to reduce air impacts from the roadway network, including US 36.

CDOT will continue sponsorship of Rideshare programs, variable work hour programs, and employee EcoPass distribution to further reduce VMT — reducing criteria pollutants, MSATs, and greenhouse gas emissions on US 36 and other regional roadways.

The Denver metropolitan area maintenance plans for CO, O_3, and PM_{10} will serve to avoid and minimize pollutant emissions from US 36 and other project roads through regional programs and control measures, such as additional transit improvements, and new and improved bike and pedestrian facilities.

The mitigation measures displayed in Table 4.12-13, Mitigation Measures — Air Quality, apply to all of the build packages. All of these mitigation measures would be prepared as part of the Construction Management Plan presented in Section 4.22, Construction-Related Impacts.

Table 4.12-13: Mitigation Measures — Air Quality

Impact	Impact Type	Mitigation Measures
Criteria Pollutants	Construction	• APEN and an air permit is required for projects over 25 acres and that last more than 6 months in length. APEN will cover APCD required mitigation measures for active construction. • CDOT will include language in the construction specifications requiring that all construction equipment to be equipped to burn ultra-low sulfur diesel fuel. • Usage of water or wetting agents to manage dust. • Usage of wind barriers and wind screens to minimize the spread of dust in areas where large amounts of materials are stored. • Usage of a wheel wash station and/or large-diameter cobble apron at egress/ingress areas to minimize dirt being tracked onto public streets. • Usage of vacuum-powered street sweepers to control dirt tracked onto streets. • Coverage of all dump trucks leaving the site. • Coverage of or wetting temporary excavated materials. • Usage of a binding agent for long-term excavated materials. • For winter time construction, engine pre-heater devices will be installed to eliminate unnecessary idling. • Tampering with equipment to increase horsepower or to defeat emissions control devices effectiveness will be prohibited. • Construction vehicle engines will be required to be properly tuned and maintained. • Usage of construction vehicles and equipment with the minimum practical engine size for the intended jobs. • Active grading and parking areas will be watered as required. • Best management practices will be used for stockpiles. • All trucks hauling dirt, sand, or other loose material will be covered or maintain freeboard in accordance with local jurisdiction requirements. • Refer to the CMP in Section 4.22, Construction-Related Impacts.
Visibility/Opacity	Construction	• Refer to the CMP in Section 4.22, Construction-Related Impacts.
Ozone	Construction/ Operations	• Commitment to any appropriate Regional Air Quality Council adopted mitigation measures for ozone.
MSAT	Construction/ Operations	• Truck routes will be restricted to avoid sensitive receptor populations. • Pavement durability will be improved to reduce the frequency of repaving. • Ultra-low sulfur diesel will be used in non-road equipment.

Source: US 36 Mobility Partnership, 2009.

Notes:

APCD = Air Pollution Control Division
APEN = Air Pollutant Emissions Notice
CDOT = Colorado Department of Transportation
CMP = Construction Management Plan
MSAT = mobile source air toxics