FEDERAL BOULEVARD
ENVIRONMENTAL ASSESSMENT | 7th Ave - Howard Pl.

AIR QUALITY TECHNICAL MEMORANDUM

FOR THE

Federal Boulevard Improvements between West 7th Avenue and West Howard Place Environmental Assessment

Prepared for

CITY AND COUNTY OF DENVER

COLORADO DEPARTMENT OF TRANSPORTATION

FEDERAL HIGHWAY ADMINISTRATION

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ACRONYMS

ADA	Americans with Disability Act
APCD	Air Pollution and Control Division
AM	Morning
APEN	Air Pollution Emission Notice
AASHTO	American Association of State Highway and Transportation
CAA	Clean Air Act
CCD	City and County of Denver
CDPHE	Colorado Department of Public Health and Environment
CDOT	Colorado Department of Transportation
CO	Carbon Monoxide
CO_2	Carbon Dioxide
EA	Environmental Assessment
FHWA	Federal Highway Administration
FHU	Felsburg Holt and Ullevig
FTA	Federal Transit Administration
GHGs	Greenhouse Gases
LOS	Level of Service
LRT	Light Rail Transit
MMT	Million Metric Tons
MOA	Memorandum of Agreement
MS4	Municipal Separate Storm Sewer System
MSATs	Mobile Source Air Toxics
NAAQS	National Ambient Air Quality Standards
NO_2	Nitrogen Dioxide
NO_X	Nitrogen Oxide
O_3	Ozone
PEL	Planning and Environmental Linkages
PM	Evening
PM_{10}	Particulate Matter 10 micrometer in diameter and smaller
$PM_{2.5}$	Particulate Matter 2.5 micrometer in diameter and smaller
PPM	Parts Per Million
RAQC	Denver Regional Air Quality Council
RTD	Regional Transportation District
RTP	Regional Transportation Plan
SIP	State Implementation Plan
SO_2	Sulfur Dioxide
TIP	Transportation Improvement Program
ug/m^3	Micrograms per Cubic Meter
U.S.	United States
USEPA	United States Environmental Protection Agency
VMT	Vehicle Miles Traveled
VOCs	Volatile Organic Compounds

INTRODUCTION

This Technical Memorandum has been prepared in support of the *Federal Boulevard Improvements Environmental Assessment* (EA). The general project area extends from West 7th Avenue to West Howard Place along Federal Boulevard ("Project Area", Figure 1). This Memorandum evaluates the effects of the Federal Boulevard Improvement Project (Proposed Action) and the No-Action Alternative with respect to air quality. The Study Area used in this assessment is the modeled intersection of West 8th Avenue and Federal Boulevard as it is the most congested intersection and is therefore the worst case scenario ("Study Area", Figure 2).

Figure 1. EA Project Area

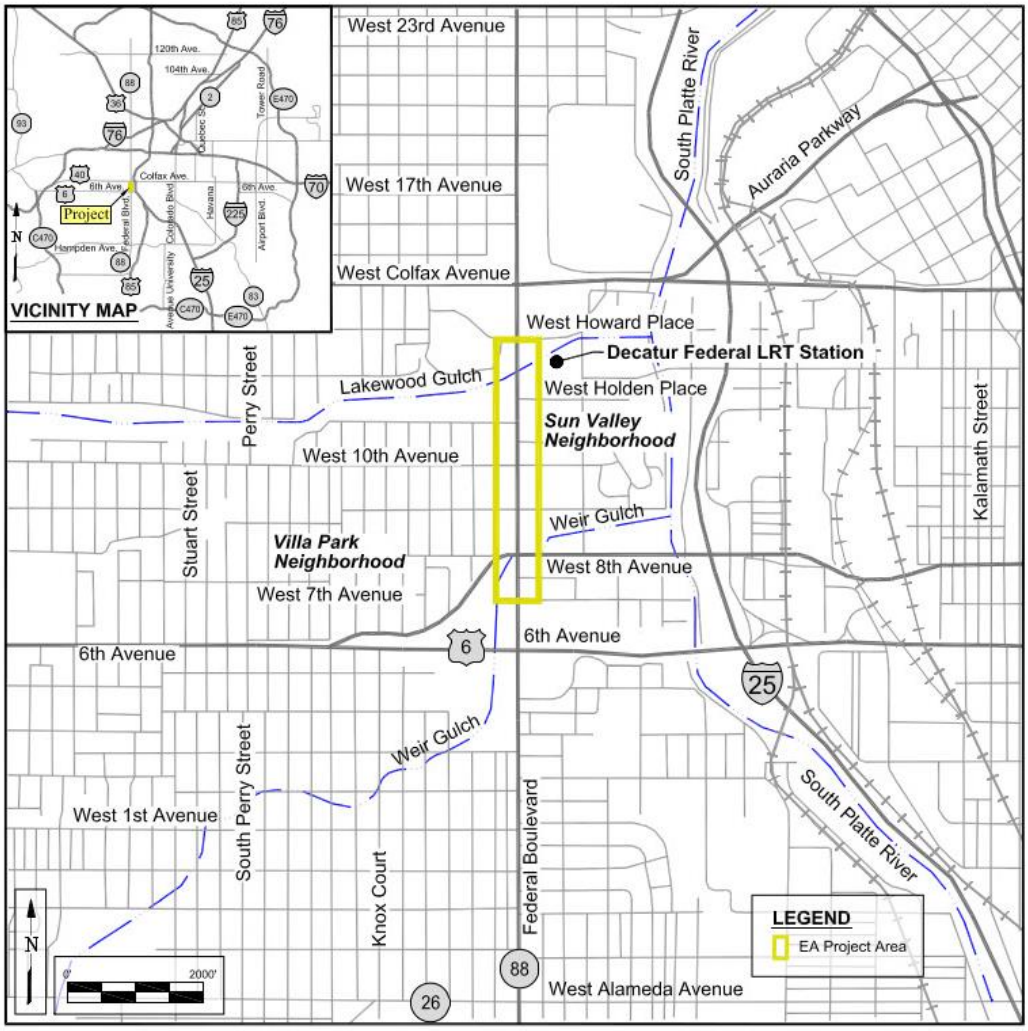


Figure 2. Air Quality Study Area

Federal and Local Regulations and Policies

National air quality policies are regulated by the *Federal Clean Air Act of 1970* (CAA). As required by the CAA, the United States Environmental Protection Agency (USEPA) established National Ambient Air Quality Standards (NAAQS) for seven criteria air pollutants (USEPA, 2014a). In addition to ozone (O_3), carbon monoxide (CO), and particulate matter 10 micrometers in diameter and smaller (PM_{10}), the criteria pollutants include particulate matter 2.5 micrometers in diameter and smaller ($PM_{2.5}$), sulfur dioxide (SO_2), nitrogen dioxide (NO_2), and lead (Table 1). The NAAQS represent levels that allow for avoidance of specific adverse health and welfare effects associated with each pollutant. The Colorado Department of Public Health and Environment (CDPHE) has adopted these NAAQS; there are no ambient air quality standards specific to the State of Colorado.

The USEPA has delegated authority to the CDPHE to administer many of the requirements of the CAA. Within the CDPHE, the Air Pollution Control Division (APCD) oversees air quality policies. The State Implementation Plan (SIP) establishes emission limits for different categories of polluters, including motor vehicles (CDPHE, 2014a). In order to achieve the emission reductions necessary for compliance, Metropolitan Planning Organizations are required to demonstrate that transportation plans and programs stay within these limits. This is done through the transportation conformity process through a Memorandum of Agreement (MOA) with the APCD and the Colorado Department of Transportation (CDOT).

If the level of any pollutant in an area exceeds the NAAQS, then the area is designated by USEPA as a nonattainment area for that pollutant. The geographic boundaries of nonattainment areas are determined by the USEPA in consultation with the CDPHE. Nonattainment areas are required to prepare implementation plans for attaining the standard for each pollutant. Once an area has attained the NAAQS, a maintenance plan must be prepared to ensure that the standard will be met. After the maintenance plan is approved by the USEPA, the area is re-designated as an attainment/maintenance area.

Table 1. USEPA National Ambient Air Quality Standards

Pollutant	Averaging Time	NAAQS[1]	
		µg/m³	ppm
Ozone (O_3)	8 hour	--	0.075[2]
Carbon Monoxide (CO)	1 hour	--	35
	8 hour	--	9
Sulfur Dioxide (SO_2)	3 hour	--	0.5
Nitrogen Dioxide (NO_2)	1 hour	--	0.100
	Annual	--	0.053
Particulate Matter (PM_{10})	24 hour	150	--
Particulate Matter ($PM_{2.5}$)	Annual	12	--
	24 hour	35	--
Lead (Pb)	Rolling 3-Month Average	0.15	--

Notes:
[1] Source: USEPA, 2014a
[2] Reflects the 2008 standard
NAAQS National Ambient Air Quality Standards
µg/m³ micrograms per cubic meter
ppm parts per million

The seven criteria pollutants have been identified as key air quality pollutants and have specific adverse health and welfare effects associated with each pollutant. A brief description of the seven criteria pollutants is discussed below:

Ground-level ozone. Ozone is a pollutant created by the chemical reaction of volatile organic compounds (VOCs) and nitrogen oxides (NOx) in the presence of sunlight. The O_3 molecule is formed through this chemical transformation, which typically occurs downwind from the VOC and NOx emission sources. Health effects include breathing problems, reduced lung function, asthma, irritated eyes, stuffy nose, and reduced resistance to colds and other infections, and acceleration of the aging of lung tissue. Ozone also damages plants, trees, rubber products, fabrics, and other materials. In general, O_3 is considered a regional issue rather than a localized street or intersection concern; therefore, an individual highway project will typically have little or no effect on regional O_3 concentrations. However, O_3 has been a concern in the Denver region in the past and the City and County of Denver's (CCD) is currently a nonattainment area for this pollutant.

Particulate matter. Particulate matter is a complex mixture of very small particles and liquid droplets classified as either inhalable coarse-sized particles. Particulate matter includes: diesel tailpipe emissions; road, brake, and tire dust; and dust due to construction activities. Health effects include nose and throat irritation, lung damage, and bronchitis. PM_{10} has been a concern in the Denver region in the past, but the region is currently in attainment/maintenance for this pollutant. The Denver nonattainment area was

redesignated to attainment/maintenance status in September 2002 (USEPA, 2002) and has maintained the NAAQS since that time.

Carbon monoxide. Carbon monoxide is a colorless, odorless gas emitted directly from vehicle tailpipes as a product of combustion. Because of this, CO tends to concentrate at intersections with high vehicle delays and poor level of service (LOS). Carbon monoxide reduces the ability of blood to bring oxygen to body cells and tissues. High concentrations of CO may be particularly hazardous to people who have heart or circulatory problems and people who have damaged lungs or breathing passages. In severe cases, CO poisoning can cause death. Carbon monoxide has been a concern in the Denver region in the past, but the region was redesignated to an attainment/maintenance area for this pollutant in December 2001 (USEPA, 2001) and has maintained the NAAQS since that time.

Nitrogen dioxide. Nitrogen dioxide is a highly reactive gas that is emitted during the combustion process. Health effects include lung damage and illnesses of the respiratory system. Nitrogen dioxide has not been and is not currently an issue in the Denver region or the State of Colorado.

Sulfur dioxide. Sulfur dioxide is one of a group of highly reactive gases emitted during the combustion process. Sulfur dioxide causes breathing problems and lung damage. The Denver region has not had exceedances of the SO_2 standard, nor has any location within Colorado. Sulfur dioxide is not considered a transportation-related criteria pollutant.

Lead. Lead is a metal found naturally in the environment. It is used in manufacturing and historically was added to gasoline to reduce engine knocking, boost octane ratings, and decrease wear and tear on engine components. Lead poisoning causes serious health effects, including seizures, high blood pressure, learning disabilities, behavioral disorders, and central nervous system problems. Lead has been phased out of paint and automotive fuels. Lead is not a pollutant of concern in the Denver region.

Conformity Determination Process

The Federal Highway Administration (FHWA) and the Federal Transit Administration (FTA) control the Federal funding of highway and transit projects and activities. Therefore, Federal funding can only be approved for projects that comply with the conformity provision of the CAA and the USEPA transportation air quality conformity regulations (40 CFR 51 Subpart T and 40 CFR 93 Subpart A). This means that the project must be included in a conforming Transportation Improvement Program (TIP) and the Regional Transportation Plan (RTP). The project design concept must be sufficiently defined to determine emissions at the time of the conformity determination. The design concept and scope of the project that was in place at the time of the TIP (TIP Identification Number 2012-111) and RTP conformity findings must be maintained through implementation.

If a project is located in a nonattainment or attainment/maintenance area for one or more criteria pollutants, then a conformity determination must be made. The conformity regulations require that all transportation plans, TIPs, and transportation projects will not

cause or contribute to any new violation of any standard, increase the frequency or severity of existing violations of any standard, or delay timely attainment of any standard or any required interim emissions reductions (CDOT, 2014).

As the first step in a conformity determination for a transportation project in the State of Colorado, the CDOT Environmental Programs Branch air quality specialist and the APCD determine which roadways and signalized intersections will require a LOS analysis. This typically includes the signalized intersections that will be constructed, reconstructed, or modified as part of the project. Additionally, if the project could result in increased traffic at nearby intersections, those intersections may also need to be evaluated. A LOS analysis is completed for each intersection in the project area based upon all project alternatives under evaluation, including the No-Action Alternative. The LOS analysis assesses each intersection based upon the average wait time per vehicle and assigns a letter "grade" to each intersection for the morning (AM) and evening (PM) peak hour periods.

An additional analysis, "Hot Spot Modeling", is required for intersections forecasted to have a LOS of D or worse after project implementation. Hot spot modeling is a method of calculating the CO concentrations along roadways and near intersections. The purpose of hot spot modeling is to evaluate whether a project could cause, or contribute to, a violation of the CO NAAQS.

Hot spot modeling is also required for particulate matter. Projects of air quality concern are certain highway and transit projects that involve significant levels of diesel vehicle traffic, or any other project that is identified in a $PM_{2.5}$ or PM_{10} SIP as a localized air quality concern. Pursuant to 40 CFR 93.123(b)(2), particulate matter hot spot analyses are required for projects of air quality concern within non-attainment or attainment/maintenance areas.

Pollutants of Concern

When assessing the impacts of transportation projects, the main pollutants of concern for the Denver metropolitan area are CO and PM_{10}. The Denver metropolitan area is currently designated as an attainment/maintenance area for these pollutants. Carbon monoxide and PM_{10} concentrations can accumulate near areas of heavy traffic congestion where average vehicle speeds are low. Carbon monoxide is the main focus of this report. Ozone and mobile source air toxics (MSAT) are two more pollutants of concern which are discussed below. Vehicle exhaust also includes emissions of $PM_{2.5}$ and SO_2; however, these two compounds are not pollutants of concern in the Denver metropolitan area. Greenhouse gases (GHGs), while not an exposure issue, also are of interest due to climate change concerns and are discussed further in this technical memorandum.

Ozone

The Denver metropolitan area is currently considered to be in non-attainment for O_3. As previously discussed, this pollutant is not directly emitted by motor vehicles. However, the reaction of two other motor vehicle emissions, NOx and VOCs, contribute to O_3 formation. Ozone is created by the reaction of NOx and VOCs on hot summer days. This

reaction takes place over several hours, which allows for mixing and dispersion in the atmosphere; therefore, O_3 is generally a regional, rather than localized, pollutant. A transportation project can negatively affect regional air quality if vehicle emissions of O_3 precursors (NOx and VOCs) increase as a result of the project.

In March 2008, the USEPA established a new, more stringent standard for O_3 based upon a review of the most recent health effects information. The new standard is 0.075 parts per million (ppm) averaged over an eight-hour period. As with the 1997 standard, a violation of the standard occurs when the three-year average of the fourth maximum values at a monitor station exceeds the Federal standard. In September 2008, CDPHE created an Ozone Action Plan, which would bring the region back into attainment by November 2010 in the Denver/North Front Range area (CDPHE, 2008). The overall plan includes elements that were incorporated into the Federally-enforceable SIP, elements that are included as State-only enforceable measurements, and elements that needed further evaluation prior to a possible SIP amendment in the future (CDPHE, 2008).

Mobile Source Air Toxics

In addition to the criteria air pollutants for which there are NAAQS, the USEPA also regulates air toxics. Most air toxics originate from human-made sources, including on-road mobile sources, non-road mobile sources (i.e., trains), area sources (i.e., dry cleaners), and stationary sources (i.e., factories or refineries).

The MSATs are a subset of the 188 air toxics defined by the CAA, and 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.

The USEPA is the lead Federal agency for administering the CAA and has certain responsibilities regarding the health effects of MSATs. The USEPA issued a *Final Rule on Controlling Emissions of Hazardous Air Pollutants from Mobile Sources* (40 CFR 80 and 86). This rule was issued under the authority of Section 202 of the CAA. In this rule, the USEPA examined the impacts of existing and newly promulgated mobile source control programs, including reformulated gasoline program, national low emission vehicle standards, Tier 2 motor vehicle emissions standards and gasoline sulfur control requirements, proposed heavy duty engine and vehicle standards, and on-highway diesel fuel sulfur control requirements.

PEL STUDY SUMMARY

A Planning and Environmental Linkages Study (PEL) Study was prepared for the project in October 2009 by Felsburg Holt and Ullevig (FHU, 2009a). In addition, an *Air Quality Impact Analysis* was prepared as a supporting document to the PEL Study (FHU, 2009b). Project-related air pollutants were evaluated through air-quality analysis. Regional conformity

for the Proposed Action identified in the PEL Study was demonstrated by inclusion in the 2035 RTP (DRCOG, 2011).

Based upon the project description, location, and observations made within study area, defined as part of the PEL Study, the following was concluded:

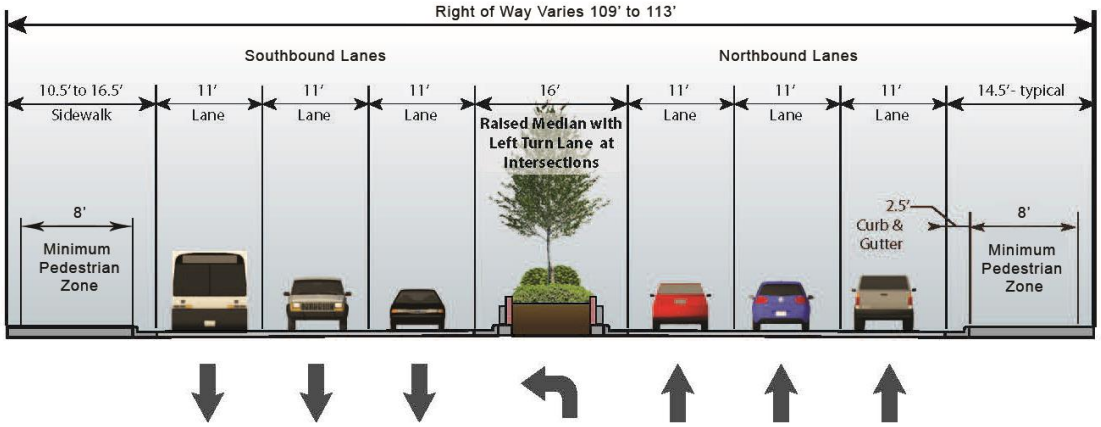
- Future emissions from vehicles would be minimized through several Federal regulations (i.e., emission standards) and regional controls (i.e., street-sanding regulations). The Denver metropolitan area maintenance plans that are already in place for CO and PM_{10} will serve to avoid and minimize pollutant emissions from vehicles. Due to cleaner vehicles, future daily air-pollutant levels for most pollutants are predicted to be lower than current levels, even with more vehicles on the roads. Total particulate-matter levels may increase in the future because of more vehicles on the roads, but the preliminary analysis indicated that these concentrations would meet the appropriate NAAQS. Standard emission-minimization measures for construction activities would be recommended.
- The proposed action identified in the PEL Study would be found not to cause violations of health-based air quality standards or other relevant evaluation criteria through the air quality analysis.
- Standard emission-minimization measures for construction activities would be recommended should the Proposed Action be implemented. Neighboring areas could be exposed to construction-related emissions and particular attention would be given to minimizing total emissions near sensitive areas, such as homes. To address the temporary elevated air emissions that could be experienced during construction, standard construction mitigation measures should be incorporated into construction contracts. These include following best management practices and relevant CDOT construction specifications.

PROPOSED ACTION

The Proposed Action is to add a third northbound lane between West 7th Avenue and West 10th Avenue and a raised median throughout the Project Area to improve mobility and safety (Figure 3). North of West 10th Avenue, the width of the existing three northbound lanes would be brought up to standard (11 feet). The existing southbound lanes would also be brought up to standard width in areas where they are currently substandard. The widening of Federal Boulevard as a part of the Proposed Action will meet AASHTO and CDOT standards.

Note that this Project Area differs from that of the PEL Study as the portion of Federal Boulevard to the south of West 7th Avenue, including the interchange with United States Highway 6 (US 6), is being addressed by the US 6 Bridges Design-Build project. However, the proposed improvements are consistent with the Proposed Action in the PEL Study.

Figure 3. Proposed Action



Access will be limited by controlling left-turns at non-signalized points. In the Proposed Action, the existing signalized crosswalks at the intersections of Federal Boulevard with West 8th Avenue and West 10th Avenue will be upgraded with new traffic and pedestrian signal indications and enhanced concrete crosswalks. Sidewalks on the west and east sides of the street will be brought up to Americans with Disabilities Act (ADA) standards; this will match the existing sections of Federal Boulevard to the north and south.

Access to bus service, which connects to local and regional destinations as well as the greater transit system, including the nearby West Line of RTD's LRT system, will be improved by upgrading the sidewalk to be consistent and compliant with ADA standards. Additionally, connectivity to the Weir Gulch Trail would be enhanced with better signage for the trail, reducing the curvature of the "T" intersection where the trail and sidewalk connect along West 8th Avenue, signage for the Trail, and a wider sidewalk along West 8th Avenue, all of which support the CCD's Bicycle Master Plan (CCD, 2001) and Denver Moves (CCD, 2011). These improvements are anticipated to improve mobility, safety, and enhance multi-modal options within the Project Area.

In summary, the Proposed Action consists of the following elements:

- Federal Boulevard roadway alignment and improvements
  - Widening Federal Boulevard from the ROW boundary on the west side of Federal Boulevard toward the east between West 7th Avenue and approximately West 10th Avenue with an additional 11-foot northbound lane
  - Restriping and widening the three northbound lanes on Federal Boulevard between approximately West 10th Avenue to approximately West Howard Place to be 11 feet wide
  - Restriping and widening the three southbound lanes on Federal Boulevard between approximately West 7th Avenue and West 10th Avenue to be 11 feet wide

- Bicycle and pedestrian improvements
  - Improving the sidewalks on the east side of Federal Boulevard between West 7th Avenue and West 10th Avenue to meet ADA standards and better accommodate pedestrians
  - Standardizing inconsistent sidewalk widths on both the east and west sides of Federal Boulevard with an 8-foot pedestrian zone consisting of either a detached 5-foot sidewalk with a 3-foot buffer or an attached 8-foot sidewalk with ADA-compliant curb ramps and driveway cuts
  - Enhancing access to the Decatur-Federal LRT station through improved multi-modal connectivity by improving the sidewalks throughout the Project Area
  - Upgrading existing pedestrian signals and constructing enhanced concrete crosswalks at the signalized intersections of Federal Boulevard with West 8th Avenue and West 10th Avenue
  - Enhancing bicycle and pedestrian connectivity to the Weir Gulch Trail with better signage, wider sidewalks, and access ramps
  - Enhancing bicycle connectivity to Routes D-10 and D-12 by adding signage in the Project Area that meets CCD and CDOT standards

NO-ACTION ALTERNATIVE

The No-Action Alternative would leave Federal Boulevard as it currently is configured and would not provide any improvements beyond typical maintenance activities. The roadway would remain the same, with 3 southbound and 2 northbound lanes (each 9.5 to 11 feet in width) and a continuous two-way, center, left-turn median between West 7th Avenue and West 10th Avenue (Figure 4). The segment of Federal Boulevard from West 10th Avenue to West Howard Place has three southbound and three northbound lanes, and a continuous two-way left-turn median over Lakewood Gulch (Figure 5). The existing sidewalks along the both sides of Federal Boulevard in the Project Area are either narrow or not well-defined, and the curb ramps at intersections do not meet current ADA or CDOT standards. As part of State Highway 88, normal maintenance of Federal Boulevard would continue to be performed by CDOT. This includes the current direct discharge of stormwater to the nearby gulches.

Figure 4. No-Action Alternative between West 7th Avenue and West 10th Avenue

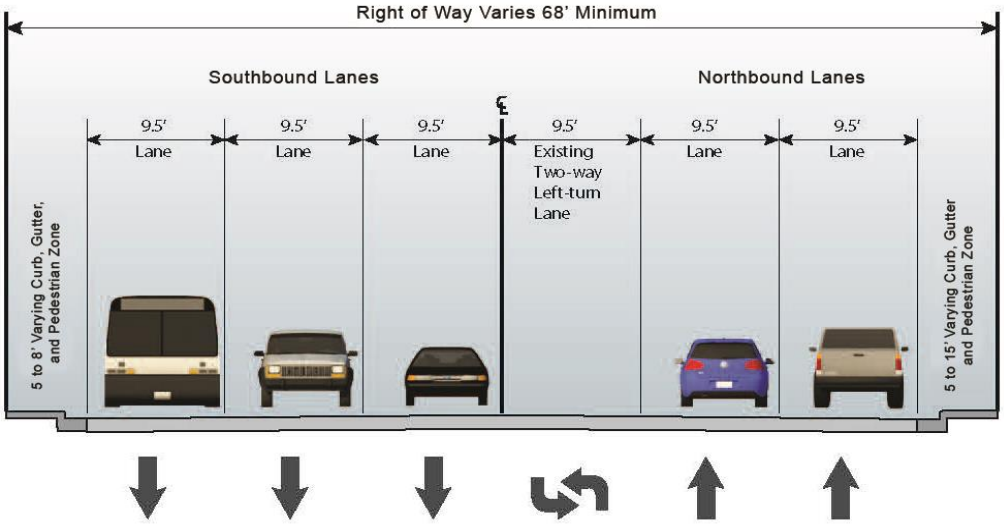
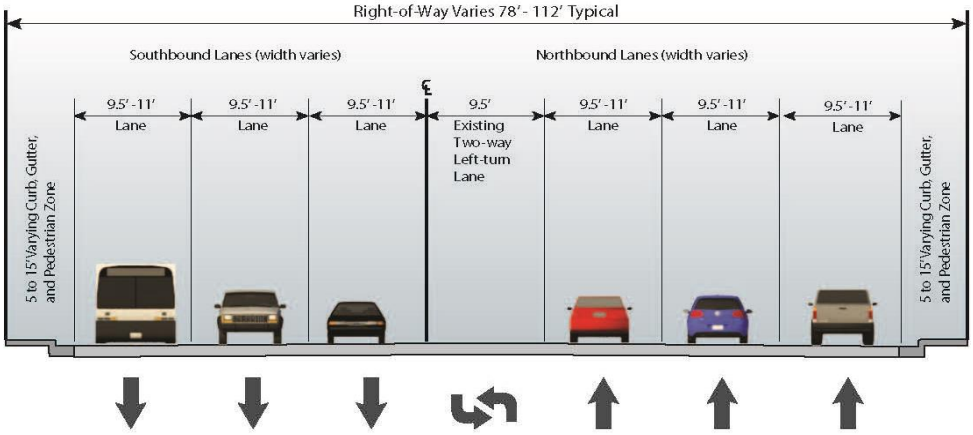


Figure 5. No-Action Alternative between West 10th Avenue and West Howard Place



METHODOLOGY

Carbon Monoxide Hot Spot Analysis

There are three signalized intersections that would be affected as part of the Proposed Action, including the intersections of Federal Boulevard at West 8th Avenue, West 10th Avenue, and West Holden Place (Figure 2). With the implementation of the Proposed Action, the intersections of Federal Boulevard at West 8th Avenue and West 10th Avenue would have a LOS of C or worse during the forecasted year of 2035 (Table 2). At both intersections, the PM peak-hour is projected to have the worst LOS. Based upon the traffic data information and LOS summaries, the intersection of Federal Boulevard and West 8th Avenue demonstrates the worst-case scenario due to the poor LOS and high traffic volumes for both the Proposed Action and No-Action Alternative (Tables 2 and 3).

Table 2. Level of Service

Study Area Intersection Levels of Service (AM/PM)			
Federal Boulevard and:	**Existing**	**No Action (2035)**	**Proposed Action (2035)**
West 8th Avenue	C/F	**F/F**	**D/F**
West 10th Avenue	B/B	**D/F**	**C/E**
West Holden Place	A/B	A/C	A/B

Data source: FHU, 2009b.

Table 3. Traffic Volumes

Study Area Intersection Traffic Volumes (AM/PM)					
Federal Boulevard and:	**Proposed Action (2035)**				
	Northbound	**Southbound**	**Westbound**	**Eastbound**	**Total**
West 8th Avenue	1870/2166	1775/2480	455/1375	525/215	4625/6236
West 10th Avenue	1905/2255	1775/2495	90/275	330/275	4100/5300

Data source: FHU, 2009b.

Per consultation with CDOT and CDPHE APCD, hot-spot modeling was completed for the intersection of Federal Boulevard and West 8th Avenue to demonstrate air-quality conformity for CO (Figure 2). This is because, based upon the 2035 LOS and traffic volumes, this intersection is considered the worst-case scenario in the Study Area after implementation of the Proposed Action in the year 2035. Air quality at this intersection was evaluated because it could be directly impacted by the Proposed Action, and the intersection had a 2035 PM LOS of F. The Synchro traffic analysis software package was used during the PEL Study and is the source of the LOS used for this EA. Details on the PEL Study LOS analysis are included in Appendix A.

The worst-case scenario at this intersection included the worst delay LOS for the year 2035, traffic volumes for 2035, and emission factors from 2013 as well as all worst-case-meteorological conditions associated with USEPA's CAL3QHC model (see discussion below). In this modeling methodology, if the worse-case scenario passed the CO hot-spot-modeling process, then all other scenarios would most likely pass as well.

Emission Factors

Per CDOT's request, emission factors and background CO concentrations for the year 2013 were obtained from APCD (Appendix B). These emission factors were used in the USEPA's CALQHC model with projected 2035 traffic volumes to signify the worse-case scenario.

Carbon-Monoxide Modeling

The USEPA's CAL3QHC model was used for the hot-spot analysis; this is a computer-based modeling program that predicts CO concentrations from motor vehicles at roadway intersections. The CAL3QHC model accounts for emissions from both moving and idling vehicles. Inputs for the model included projected traffic volumes, motor-vehicle-emission rates calculated using USEPA's Motor Vehicle Emission Simulator model, roadway geometry, traffic-signal timing, and worst-case-meteorological conditions.

Worst-case meteorological conditions included low wind speed (one meter/second) and atmospheric stability class D (defined as neutral based upon the Pasquill stability class and model-default stability class). The CAL3QHC model determines the worst-case wind direction by selecting the wind direction that results in the highest CO concentration at each receptor. Receptors were located in accordance with USEPA guidance and represent worst-case locations for modeling possible violations of Federal CO standards. Per USEPA guidance, receptors were modeled 10 feet from the edge of the outside travel lane on the queue links at the selected intersections.

The CAL3QHC model output is a value for one-hour CO that is not corrected for persistence or altitude. Therefore, the model output must be corrected using site-specific adjustment factors for persistence and altitude. These calculations are described below.

The methodology for this air-quality analysis is consistent with both of the two USEPA guidance manuals related to intersection-hot-spot analysis:

- *Guidelines for Modeling Carbon Monoxide from Roadway Intersections* (USEPA, 1992a).
- *User's Guide to CAL3QHC Version 2.0: A Modeling Methodology for Predicting Pollutant Concentrations near Roadway Intersections* (USEPA, 1992b).

The formulas listed below were used to convert the modeled one-hour CO concentrations (one-hour) and overall eight-hour CO concentrations (eight-hour):

- One-hour Calculations:
  - Modeled one-hour value = model output one-hour value times altitude adjustment factor
  - Overall one-hour CO concentration = modeled one-hour value plus one-hour background CO concentration
- Eight-hour Calculations:
  - Modeled eight-hour value = model output one-hour value times Colorado persistence factor times altitude adjustment factor
  - Overall eight-hour CO concentration = modeled eight-hour value plus eight-hour background CO concentration

The following values were used:

- Colorado persistence factor = 0.57
- Altitude adjustment factor = 1.13
- Background eight-hour CO concentration (provided by APCD) = 3.4 ppm
- Background one-hour CO concentration (provided by APCD) = 5.9 ppm

Therefore, the formulas used are indicated below:

- One-hour Calculations:
  - Modeled one-hour value = modeled one-hour value times 1.13
  - Overall one-hour CO concentration = modeled one-hour value plus background one-hour CO value
- Eight-hour Calculations:
  - Modeled eight-hour value = modeled one-hour value times 0.57 times 1.13
  - Overall eight-hour CO concentration = modeled eight-hour value plus background eight-hour CO value

For each intersection, hot-spot analysis was completed for:

- The Proposed Action, for the year 2035

Per request from CDOT and APCD, the Proposed Action scenario was modeled only for PM traffic counts for 2035, using emission factors from 2013. One model run was completed. Backup information for this analysis is included in Appendix B.

PM_{10}

Per 40 CFR 51.454(d), PM_{10} hot-spot analysis must be performed for projects that are located at sites in which violations have been verified by monitoring as well as at sites that have essentially identical vehicle and roadway emissions and dispersion characteristics (including sites in close proximity to another site where a violation has been monitored). Based upon USEPA guidance, the requirement for a quantitative hot-spot analysis took effect in December 2012 and is applicable to projects that demonstrate the potential to have major air-quality impacts. Per consultation with CDOT and APCD, the potential effects of this project were assessed qualitatively by evaluating the CDPHE Emissions Inventory, weather patterns, and CO hot-spot data. Based upon this qualitative assessment, it was determined that the project would not have a major impact on local and regional air-quality-PM_{10} emissions. Both CDOT and the APCD concurred with this determination on March 5, 2013 (Appendix C). Therefore, the USEPA guidance to complete a quantitative analysis for PM_{10} does not apply.

MSATs

The Proposed Action would not result in any meaningful changes in traffic volumes, vehicle mix, location of the existing facility, or any other factor that could cause an increase in emissions impacts relative to the No-Action Alternative. As such, FHWA guidance supports the conclusion that this Project would generate minimal air-quality impacts for CAA criteria pollutants and has not been linked with any special air-toxics concerns. Consequently, this effort is exempt from a quantitative analysis for air toxics.

Moreover, USEPA regulations for vehicle engines and fuels are expected to cause overall air-toxics emissions to decline substantially over the next 20 years. Even after accounting for a 64 percent increase in vehicle miles traveled (VMT) across the United States (U.S.),

FHWA projects that MSATs will decline in the range of 57 percent to 87 percent from 2000 to 2020, based upon regulations now in effect (FHU, 2009b). This projected decline would both reduce the background level of MSATs and reduce minor MSAT emissions throughout this Project.

A qualitative analysis for the Project was completed to provide a basis for identifying and comparing the potential differences among MSAT emissions, if any, from the Proposed Action and No-Action Alternative. The qualitative assessment was derived in part from a study conducted by FHWA; its report is entitled *A Methodology for Evaluating Mobile Source Air Toxic Emissions among Transportation Project Alternatives* (FHWA, 2014).

EXISTING CONDITIONS

Air-Pollution Sources

Both local and regional sources may contribute to air pollution. The main contributor to air pollution in the project vicinity is traffic. The focus of the project, Federal Boulevard, is a main north-south corridor with moderate to heavy traffic levels. The primary north-south corridor in the Denver metropolitan area is Interstate 25, which is located approximately one-half mile east of the Study Area. Additionally, heavy traffic occurs on US 6, an east-west highway located south of the Study Area. The Study Area is located in the central Denver metropolitan area, and the sources of regional air pollution are mostly east of the Study Area (Figure 1).

Local Setting

The Study Area is near the South Platte River in the central Denver metropolitan area. The elevation of the Study-Area is generally about 5,200 feet above sea level. West of the Study Area is the Front Range of the Rocky Mountains at a much higher elevation, and east of the Study Area is the Great Plains at a much lower elevation (FHU, 2009b).

The coldest month for the Study Area is typically January, with an average daily temperature range of 20° to 48° Fahrenheit. The warmest month is typically July, with an average daily temperature range of 55° to 90° Fahrenheit. Thermal inversions are known to occur in the Study Area during times of low winds. The Study Area generally receives about 19 inches of precipitation annually, with the wettest months generally being May and April. Prevailing winds in the Study Area can be somewhat variable due to local topography, but the prevailing winds near the ground surface tend to come from the south (FHU, 2009b).

Air-Quality Monitoring Stations

The APCD operates a network of ambient air-quality-monitoring stations within the Denver metropolitan area. The results from the air-quality station closest to the Project are summarized in Table 4. Since each station monitors only certain pollutants, stations were selected at increasing distances from the Study Area until all of the pollutants of concern (CO, PM_{10}, and O_3) were covered. The only criteria pollutant that exceeded the

standard at these stations was O_3 in 2010 and 2012 at the 2325 Irving Street Station (Table 4).

Table 4. Results of Air-Quality Monitoring near the Study Area

Monitoring Station	Averaging Time	NAAQS Standard[1]	2010	2011	2012
Carbon Monoxide (ppm)					
2105 Broadway, Denver	1-hour (2nd Max) 8-hour (2nd Max)	35 9	4.0 2.4	3.1 1.8	4.0 2.0
Particulate Matter$_{10}$ (µg/m^3)[2]					
678 South Jason Street, Denver	24-hour (2nd Max)	150	47	45	48
Particulate Matter$_{2.5}$ (µg/m^3)[2]					
678 South Jason Street, Denver	24-hour (2nd Max) Annual Mean	35 15	24.7 7.6	21.5 6.9	17.7 8.2
Ozone (O_3) (ppm)					
2325 Irving Street, Denver	1-hour (Max) 8-hour (4th Max)	0.12 0.075	0.096 **0.082**	0.098 0.075	0.102 **0.077**

Notes:

[1] Source: USEPA, 2014a

[2] If a monitoring station has more than one monitor for a pollutant, the highest reading among the monitors was used.

NAAQS: National Ambient Air Quality Standards

µg/m^3: micrograms per cubic meter

Max: Maximum

ppm: parts per million

IMPACT ASSESSMENT

Carbon Monoxide Hot-Spot Analysis Results

One CAL3QHC model run was completed for the intersection with the worst LOS projected for the year 2035 if the Proposed Action was implemented. Based upon the model run, the Federal Boulevard and West 8th Avenue intersection is not expected to exceed the eight-hour or one-hour CO standard (Table 5). The Proposed-Action-model data are presented in Appendix B.

Table 5. Carbon Monoxide Hot Spot Analysis Results (worst-case scenario)

Intersection of Federal Boulevard and:	8-hour Carbon Monoxide (ppm)[1,2]	1-hour Carbon Monoxide (ppm)[3,4]
	Proposed Action	Proposed Action
	PM	PM
West 8th Avenue	4.91	8.68

Notes:
[1] The 8-hour maximum for CO is 9 ppm
[2] Results include a background CO level of 3.4 ppm (provided by APCD)
[3] The 1-hour maximum for CO is 35 ppm
[4] Results include a background CO level of 5.9 ppm (provided by APCD)
PM: Evening rush hours
ppm: parts per million

PM_{10}

The Study Area is in attainment for PM_{10} and there have been no NAAQS exceedances at the nearest air-quality stations (Table 4). According to the online CDPHE Emission Inventories for Denver County, the major sources of particulate matter in the Study Area are construction, road dust, and vehicles (Table 6).

Table 6. Denver County PM_{10} Emissions for 2008

County	Three Highest Emission Categories Tons per Year (Percent of Total Tons/Year)[1]			Total Tons of PM_{10}/Year
	Construction	Road Dust	Vehicles	
Denver	15,725 (76%)	3,026 (15%)	617 (3%)	20,744

Notes:
[1] Source: CDPHE, 2014b

Nationally, PM_{10} levels have been decreasing over the past 30 years (CDPHE, 2010). The overall levels of this pollutant in the Denver metropolitan area have been fairly constant since 1997 (CDPHE, 2010). The greatest impact to PM_{10} as a result of implementation of the Proposed Action is expected to occur during construction. Since this a temporary impact, it is not considered part of the PM_{10} analysis (CDOT, 2010).

Permanent impacts would result from changes in traffic volume and congestion. Since the Proposed Action would add capacity along Federal Boulevard, it is expected to increase total traffic volume and decrease congestion. Lower vehicle emissions due to congestion reduction coupled with minor additional VMT and a percent total VMT increase, traffic-related changes to PM_{10} would be insignificant. This project will not add or contribute to the generation of heavy truck traffic influences.

CONCLUSION AND MITIGATION MEASURES

Consistent with the 2009 PEL Study, air pollutants are not predicted to exceed the NAAQS in the future as a result of implementing the Proposed Action, and mitigation measures for air quality are not necessary for the Project. Project-related air pollutants were

evaluated through air-quality analysis. Regional and local conformity for the Proposed Action has been demonstrated by inclusion in the 2012-2017 TIP (TIP Identification Number 2012-111) and the 2035 RTP (DRCOG, 2011). Future emissions from on-road mobile sources will be minimized globally through several Federal regulations. The Denver area SIPs for CO, O_3, and PM_{10} will serve to avoid and minimize pollutant emissions from project roads.

Standard-emission-minimization measures for construction activities are recommended. Neighboring areas could be exposed to construction-related emissions and particular attention will be given to minimizing total emissions near sensitive areas (e.g., homes). To address the temporary, elevated air emissions that may be experienced during construction, standard construction mitigation measures will be incorporated into construction contracts. These include following best management practices and relevant CDOT construction specifications (Table 7).

Table 7. Mitigation Measures

Resource	Mitigation Measures
Construction-related emissions and dust	• Engines and exhaust systems on equipment will be maintained in good working order. Equipment will be maintained on a regular basis, and will be subject to inspection by the project manager to ensure compliance. • Fugitive dust will be systematically controlled through diligent implementation of CDOT's Standard Specifications for Road and Bridge Construction, particularly Sections 107.24, 209 and 250, and CDPHE-Air Pollution Control Division's (APCD) Air Pollutant Emission Notification, CDPHE-APCD's demolition permit, and fugitive dust control plan requirements. • No excessive idling of inactive equipment or vehicles and compliance with CCD's idling ordinance (5 minutes). • Construction equipment and vehicles will utilize low-sulfur fuel to reduce pollutant emissions.

REQUIRED PERMITS

The construction phase of this project could impact more than 25 acres and/or take longer than six months, which could affect air-quality conditions during construction. Therefore, CCD will need to follow the requirements of filing an Air Pollution Emission Notice (APEN) to fulfill USEPA's concerns regarding air-quality impacts related to transportation projects. Batch plants or other high-generator emission source permits may also be needed, if applicable. Since the construction of the project will require submittal of an APEN and Application for Construction Permit from the CDPHE APCD, preparation of a Fugitive Dust Control Plan will be required. Adherence to this plan will reduce air pollution that results from construction.

STAKEHOLDER COORDINATION

The CCD has continued to provide opportunities for public involvement between the PEL Study in 2009 and initiation of this EA. A public meeting was held in August 14, 2014 prior to the completion of this EA to solicit further comment on and discussion of the Project. A Spanish-speaking translator was present at the open house, and materials were presented in both English and Spanish; Korean translation was available upon request. Stakeholder coordination will continue to take place throughout the Project's development and construction.

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Appendix A LOS Analysis Results

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBU	NBL	NBT	NBR	SBL	SBT
Lane Configurations												
Volume (vph)	70	92	55	596	573	205	40	60	1960	106	39	2298
Ideal Flow (vphpl)	1800	1800	1800	1800	1800	1800	1800	1800	1800	1800	1800	1800
Total Lost time (s)	5.0	5.0		5.0	5.0			5.0	5.0		5.0	5.0
Lane Util. Factor	1.00	0.95		0.97	0.95			1.00	0.91		1.00	0.91
Frpb, ped/bikes	1.00	0.99		1.00	0.99			1.00	1.00		1.00	1.00
Flpb, ped/bikes	1.00	1.00		1.00	1.00			1.00	1.00		1.00	1.00
Frt	1.00	0.94		1.00	0.96			1.00	0.99		1.00	0.99
Flt Protected	0.95	1.00		0.95	1.00			0.95	1.00		0.95	1.00
Satd. Flow (prot)	1621	3017		3144	3084			1602	4448		1589	4404
Flt Permitted	0.95	1.00		0.95	1.00			0.95	1.00		0.95	1.00
Satd. Flow (perm)	1621	3017		3144	3084			1602	4448		1589	4404
Peak-hour factor, PHF	0.93	0.93	0.93	0.93	0.93	0.93	0.92	0.93	0.93	0.93	0.93	0.93
Adj. Flow (vph)	75	99	59	641	616	220	43	65	2108	114	42	2471
RTOR Reduction (vph)	0	16	0	0	35	0	0	0	5	0	0	7
Lane Group Flow (vph)	75	142	0	641	801	0	0	108	2217	0	42	2613
Confl. Peds. (#/hr)	10		10	10		10	10	10		10	10	
Confl. Bikes (#/hr)			5			5				5		
Heavy Vehicles (%)	2%	2%	2%	2%	2%	2%	2%	4%	5%	4%	4%	6%
Bus Blockages (#/hr)	0	0	0	0	0	0	0	0	6	6	0	6
Turn Type	Prot			Prot			Prot	Prot			Prot	
Protected Phases	3	8		7	4		1	1	6		5	2
Permitted Phases												
Actuated Green, G (s)	8.4	14.8		15.0	21.4			8.3	47.0		3.2	41.9
Effective Green, g (s)	8.4	14.8		15.0	21.4			8.3	47.0		3.2	41.9
Actuated g/C Ratio	0.08	0.15		0.15	0.21			0.08	0.47		0.03	0.42
Clearance Time (s)	5.0	5.0		5.0	5.0			5.0	5.0		5.0	5.0
Vehicle Extension (s)	3.0	3.0		3.0	3.0			3.0	3.0		3.0	3.0
Lane Grp Cap (vph)	136	447		472	660			133	2091		51	1845
v/s Ratio Prot	c0.05	0.05		0.20	c0.26			0.07	c0.50		0.03	c0.59
v/s Ratio Perm												
v/c Ratio	0.55	0.32		1.36	1.21			0.81	1.06		0.82	1.42
Uniform Delay, d1	44.0	38.1		42.5	39.3			45.1	26.5		48.1	29.0
Progression Factor	1.00	1.00		1.00	1.00			1.02	0.71		1.03	1.05
Incremental Delay, d2	4.8	0.4		174.5	109.5			22.5	35.2		9.4	187.6
Delay (s)	48.8	38.5		217.0	148.8			68.3	54.2		59.0	218.1
Level of Service	D	D		F	F			E	D		E	F
Approach Delay (s)		41.8			178.4				54.8			215.6
Approach LOS		D			F				D			F

Intersection Summary			
HCM Average Control Delay	145.4	HCM Level of Service	F
HCM Volume to Capacity ratio	1.27		
Actuated Cycle Length (s)	100.0	Sum of lost time (s)	20.0
Intersection Capacity Utilization	100.7%	ICU Level of Service	G
Analysis Period (min)	15		
c Critical Lane Group			

Movement	SBR
Lane Configurations	
Volume (vph)	139
Ideal Flow (vphpl)	1800
Total Lost time (s)	
Lane Util. Factor	
Frpb, ped/bikes	
Flpb, ped/bikes	
Frt	
Flt Protected	
Satd. Flow (prot)	
Flt Permitted	
Satd. Flow (perm)	
Peak-hour factor, PHF	0.93
Adj. Flow (vph)	149
RTOR Reduction (vph)	0
Lane Group Flow (vph)	0
Confl. Peds. (#/hr)	10
Confl. Bikes (#/hr)	5
Heavy Vehicles (%)	4%
Bus Blockages (#/hr)	6
Turn Type	
Protected Phases	
Permitted Phases	
Actuated Green, G (s)	
Effective Green, g (s)	
Actuated g/C Ratio	
Clearance Time (s)	
Vehicle Extension (s)	
Lane Grp Cap (vph)	
v/s Ratio Prot	
v/s Ratio Perm	
v/c Ratio	
Uniform Delay, d1	
Progression Factor	
Incremental Delay, d2	
Delay (s)	
Level of Service	
Approach Delay (s)	
Approach LOS	

Intersection Summary

Appendix B Hot Spot Analysis Data

Colorado Department of Public Health and Environment
Air Pollution Control Division - Emission Factors

Hour	Street	Side	EF(g/m)	CO Background 2013	ppm	
7	10th	w	8.3114	10th Federal Boulevard	3.362	8-hr
7	8th	e	5.4099		5.969	1-hr
7	8th	w	5.9009			
7	Federal	n	5.9012			
7	Federal	n	5.9003			
7	Federal	n	5.8855			
7	Federal	s	5.8960			
7	Federal	s	5.9012			
7	Federal	s	5.8999			
7	Holden	e	8.3296			
18	10th	e	8.2900			
18	10th	w	8.0474			
18	8th	e	5.3675			
18	8th	w	5.8513			
18	Federal	n	7.0899			
18	Federal	n	7.1742			
18	Federal	n	7.9234			
18	Federal	s	6.5725			
18	Federal	s	7.0899			
18	Federal	s	7.2289			
18	Holden	e	8.0928			

Idle EF

Hour	Speed	2013 g/hr
7	2.5	57.9612
18	2.5	56.7517

JOB: Federal Reconstruction RUN: 2035 Build Alternative

DATE : 3/21/14
TIME : 11:33:40

The MODE flag has been set to C for calculating CO averages.

SITE & METEOROLOGICAL VARIABLES

VS = 0.0 CM/S VD = 0.0 CM/S Z0 = 175. CM
U = 1.0 M/S CLAS = 4 (D) ATIM = 60. MINUTES MIXH = 1000. M AMB = 0.0 PPM

LINK VARIABLES

	LINK DESCRIPTION	*	LINK COORDINATES (FT)				*	LENGTH	BRG	TYPE	VPH	EF	H	W	V/C	QUEUE
		*	X1	Y1	X2	Y2	*	(FT)	(DEG)			(G/MI)	(FT)	(FT)		(VEH)
1.	NBT	*	30.0	-1000.0	30.0	0.0	*	1000.	360.	AG	1960.	7.9	0.0	56.0		
2.	NBD	*	30.0	0.0	30.0	1000.0	*	1000.	360.	AG	1960.	7.9	0.0	56.0		
3.	NBQ	*	30.0	-72.0	30.0	-307.9	*	236.	180.	AG	242.	100.0	0.0	36.0	0.95	12.0
4.	SBT	*	-30.0	1000.0	-30.0	0.0	*	1000.	180.	AG	2298.	7.2	0.0	56.0		
5.	SBD	*	-30.0	0.0	-30.0	-1000.0	*	1000.	180.	AG	2298.	7.2	0.0	56.0		
6.	SBQ	*	-30.0	72.0	-30.0	1980.5	*	1908.	360.	AG	265.	100.0	0.0	36.0	1.26	97.0
7.	EBT	*	-1000.0	-27.0	0.0	-27.0	*	1000.	90.	AG	92.	5.4	0.0	44.0		
8.	EBD	*	0.0	-27.0	1000.0	-27.0	*	1000.	90.	AG	92.	5.4	0.0	44.0		
9.	EBQ	*	-90.0	-27.0	-111.4	-27.0	*	21.	270.	AG	259.	100.0	0.0	24.0	0.26	1.1
10.	WBT	*	1000.0	24.0	0.0	24.0	*	1000.	270.	AG	573.	5.8	0.0	44.0		
11.	WBD	*	0.0	24.0	-1000.0	24.0	*	1000.	270.	AG	573.	5.8	0.0	44.0		
12.	WBQ	*	90.0	24.0	414.0	24.1	*	324.	90.	AG	241.	100.0	0.0	24.0	1.05	16.5
13.	NBR	*	42.0	-72.0	42.0	-102.7	*	31.	180.	AG	81.	100.0	0.0	12.0	0.15	1.6
14.	SBR	*	-42.0	72.0	-42.0	116.1	*	44.	360.	AG	88.	100.0	0.0	12.0	0.23	2.2
15.	EBR	*	-90.0	-33.0	-115.6	-33.0	*	26.	270.	AG	129.	100.0	0.0	12.0	0.31	1.3
16.	WBR	*	90.0	42.0	178.6	42.0	*	89.	90.	AG	120.	100.0	0.0	12.0	0.75	4.5
17.	NBL	*	3.0	-72.0	3.0	-123.2	*	51.	180.	AG	140.	100.0	0.0	12.0	0.94	2.6
18.	SBL	*	-3.0	72.0	-3.0	172.0	*	100.	360.	AG	148.	100.0	0.0	12.0	****	5.1
19.	EBL	*	-90.0	-3.0	-218.0	-3.0	*	128.								

270. AG 140. 100.0 0.0 12.0 1.09 6.5
20. WBL * 90.0 0.0 1512.1 0.0 * 1422.
90. AG 259. 100.0 0.0 24.0 1.69 72.2
♀

JOB: Federal Reconstruction RUN: 2035 Build Alternative

DATE : 3/21/14
TIME : 11:33:40

ADDITIONAL QUEUE LINK PARAMETERS

LINK DESCRIPTION	*	CYCLE LENGTH (SEC)	RED TIME (SEC)	CLEARANCE LOST TIME (SEC)	APPROACH VOL (VPH)	SATURATION FLOW RATE (VPH)	IDLE EM FAC (gm/hr)	SIGNAL TYPE	ARRIVAL RATE
3. NBQ	*	100	53	2.0	1960	1600	56.75	2	3
6. SBQ	*	100	58	2.0	2298	1600	56.75	2	3
9. EBQ	*	100	85	2.0	92	1600	56.75	2	3
12. WBQ	*	100	79	2.0	573	1600	56.75	2	3
13. NBR	*	100	53	2.0	106	1600	56.75	2	3
14. SBR	*	100	58	2.0	139	1600	56.75	2	3
15. EBR	*	100	85	2.0	55	1600	56.75	2	3
16. WBR	*	100	79	2.0	205	1600	56.75	2	3
17. NBL	*	100	92	2.0	60	1600	56.75	2	3
18. SBL	*	100	97	2.0	39	1600	56.75	2	3
19. EBL	*	100	92	2.0	70	1600	56.75	2	3
20. WBL	*	100	85	2.0	596	1600	56.75	2	3

RECEPTOR LOCATIONS

RECEPTOR	*	COORDINATES (FT) X	Y	Z
1. NE1	*	102.0	58.0	5.9
2. NE2	*	112.0	58.0	5.9
3. NE3	*	122.0	58.0	5.9
4. NE4	*	132.0	58.0	5.9
5. NE5	*	142.0	58.0	5.9
6. NE6	*	152.0	58.0	5.9
7. NE7	*	162.0	58.0	5.9
8. NE8	*	172.0	58.0	5.9
9. NE9	*	182.0	58.0	5.9
10. NE10	*	192.0	58.0	5.9
11. NW1	*	-63.0	56.0	5.9

12. NW2	-63.0	66.0	5.9	
13. NW3	-63.0	76.0	5.9	
14. NW3	-63.0	86.0	5.9	
15. NW5	-63.0	96.0	5.9	
16. NW6	-63.0	106.0	5.9	
17. NW7	-63.0	116.0	5.9	
18. NW8	-63.0	126.0	5.9	
19. NW9	-63.0	136.0	5.9	
20. NW10	-63.0	146.0	5.9	
21. SE1	60.0	-78.0	5.9	
22. SE2	60.0	-88.0	5.9	
23. SE3	60.0	-98.0	5.9	
24. SE4	60.0	-108.0	5.9	
25. SE5	60.0	-118.0	5.9	
26. SE6	60.0	-128.0	5.9	
27. SE7	60.0	-138.0	5.9	
28. SE8	60.0	-148.0	5.9	
29. SE9	60.0	-158.0	5.9	
30. SE10	60.0	-168.0	5.9	
31. SW1	-102.0	-51.0	5.9	
32. SW2	-112.0	-51.0	5.9	
33. SW3	-122.0	-51.0	5.9	

♀

DATE : 3/21/14
TIME : 11:33:40

RECEPTOR LOCATIONS

RECEPTOR	COORDINATES (FT) X	Y	Z
34. SW4	-132.0	-51.0	5.9
35. SW5	-142.0	-51.0	5.9
36. SW6	-152.0	-51.0	5.9
37. SW7	-162.0	-51.0	5.9
38. SW8	-172.0	-51.0	5.9
39. SW9	-182.0	-51.0	5.9
40. SW10	-192.0	-51.0	5.9

♀

MODEL RESULTS

REMARKS : In search of the angle corresponding to the maximum concentration, only the first angle, of the angles with same maximum concentrations, is indicated as maximum.

WIND ANGLE RANGE: 10.-360.

WIND * CONCENTRATION
ANGLE * (PPM)
(DEGR)* REC1 REC2 REC3 REC4 REC5 REC6 REC7 REC8 REC9 REC10 REC11 REC12 REC13 REC14 REC15 REC16 REC17 REC18 REC19 REC20

```
------*-------------------------------------------------------------------------------------------
-----------------------------------------
  10.  *   0.2   0.1   0.0   0.0   0.0   0.0   0.0   0.0   0.0   0.0   2.3   2.3
2.2   2.2   2.2   2.2   2.2   2.2   2.2   2.2
  20.  *   0.0   0.0   0.0   0.0   0.0   0.0   0.0   0.0   0.0   0.0   2.3   2.3
2.2   2.2   2.1   2.1   2.1   2.1   2.1   2.1
  30.  *   0.0   0.0   0.0   0.0   0.0   0.0   0.0   0.0   0.0   0.0   2.1   2.2
2.1   2.1   2.0   1.9   1.9   1.9   1.9   1.9
  40.  *   0.0   0.0   0.0   0.0   0.0   0.0   0.0   0.0   0.0   0.0   2.0   2.1
2.0   1.9   1.9   1.8   1.8   1.7   1.7   1.7
  50.  *   0.0   0.0   0.0   0.0   0.0   0.0   0.0   0.0   0.0   0.0   1.6   1.9
2.0   2.0   1.9   1.8   1.7   1.7   1.7   1.6
  60.  *   0.0   0.0   0.0   0.0   0.0   0.0   0.0   0.0   0.0   0.0   1.4   1.7
1.8   1.8   1.8   1.7   1.6   1.5   1.5   1.5
  70.  *   0.0   0.0   0.0   0.0   0.0   0.0   0.0   0.0   0.0   0.0   1.1   1.4
1.8   1.8   1.8   1.7   1.6   1.6   1.5   1.5
  80.  *   0.3   0.2   0.2   0.2   0.2   0.2   0.2   0.2   0.2   0.2   1.2   1.4
1.8   2.0   1.9   1.9   1.8   1.6   1.6   1.5
  90.  *   0.9   0.9   0.9   0.9   0.8   0.8   0.8   0.8   0.8   0.8   1.5   1.6
2.0   2.2   2.1   2.1   2.0   1.9   1.9   1.7
 100.  *   1.5   1.5   1.5   1.5   1.3   1.3   1.2   1.2   1.2   1.2   1.6   1.7
2.1   2.4   2.4   2.4   2.3   2.1   2.0   2.0
 110.  *   1.7   1.7   1.7   1.6   1.6   1.5   1.4   1.3   1.3   1.3   1.4   1.2
1.6   2.0   2.2   2.2   2.4   2.3   2.2   2.2
 120.  *   1.7   1.7   1.6   1.6   1.6   1.5   1.4   1.3   1.3   1.3   1.1   1.3
1.3   1.6   1.9   2.1   2.2   2.1   2.2   2.0
 130.  *   1.6   1.6   1.6   1.5   1.5   1.5   1.4   1.2   1.2   1.2   1.1   1.1
0.8   1.2   1.5   1.8   1.9   2.0   1.9   1.9
 140.  *   1.5   1.5   1.5   1.5   1.5   1.5   1.4   1.3   1.2   1.2   1.0   1.1
1.1   1.1   1.4   1.5   1.8   2.0   1.9   2.0
 150.  *   1.4   1.4   1.4   1.4   1.4   1.4   1.4   1.2   1.1   1.1   1.3   1.2
1.3   1.3   1.4   1.5   1.7   1.8   1.8   1.9
 160.  *   1.3   1.3   1.3   1.3   1.3   1.3   1.3   1.2   1.0   1.0   1.4   1.4
1.4   1.3   1.5   1.6   1.6   1.6   1.9   1.9
 170.  *   1.4   1.4   1.3   1.3   1.3   1.3   1.3   1.2   1.0   1.0   1.4   1.4
1.4   1.5   1.4   1.5   1.5   1.7   1.7   1.7
 180.  *   1.6   1.7   1.7   1.6   1.5   1.5   1.4   1.4   1.2   1.1   1.1   1.1
1.0   1.0   1.0   1.1   1.0   1.0   1.0   1.1
 190.  *   1.7   1.9   2.0   1.8   1.7   1.7   1.7   1.7   1.6   1.2   0.5   0.5
0.5   0.5   0.5   0.5   0.5   0.3   0.3   0.3
 200.  *   1.7   1.8   1.9   2.0   2.0   1.9   1.9   1.9   1.7   1.6   0.4   0.4
0.4   0.4   0.4   0.5   0.3   0.3   0.3   0.2
 210.  *   1.3   1.5   1.7   1.9   1.9   1.9   1.9   1.9   2.0   1.8   0.3   0.3
0.3   0.3   0.2   0.2   0.2   0.1   0.1   0.1
 220.  *   1.0   1.3   1.4   1.7   1.8   1.8   1.9   2.0   2.0   1.9   0.4   0.2
0.2   0.2   0.2   0.2   0.2   0.1   0.1   0.1
 230.  *   0.7   0.9   1.2   1.4   1.6   1.7   1.8   1.9   1.9   1.8   0.3   0.3
0.2   0.2   0.2   0.2   0.2   0.2   0.1   0.0
 240.  *   0.7   0.8   0.8   0.9   1.1   1.2   1.4   1.5   1.5   1.5   0.3   0.2
0.2   0.2   0.2   0.2   0.1   0.1   0.1   0.0
 250.  *   0.8   0.7   0.8   0.9   1.1   1.0   1.2   1.2   1.4   1.3   0.2   0.2
0.2   0.1   0.1   0.1   0.1   0.1   0.1   0.0
 260.  *   0.8   0.8   0.7   0.7   0.8   0.8   0.8   0.9   0.9   1.2   0.2   0.1
0.1   0.1   0.1   0.1   0.1   0.0   0.0   0.0
 270.  *   0.7   0.7   0.6   0.7   0.7   0.7   0.6   0.7   0.8   0.8   0.1   0.1
0.1   0.0   0.0   0.0   0.0   0.0   0.0   0.0
 280.  *   0.8   0.8   0.8   0.7   0.7   0.7   0.7   0.6   0.6   0.6   0.0   0.0
0.0   0.0   0.0   0.0   0.0   0.0   0.0   0.0
 290.  *   0.8   0.8   0.7   0.7   0.7   0.7   0.7   0.6   0.6   0.6   0.0   0.0
0.0   0.0   0.0   0.0   0.0   0.0   0.0   0.0
 300.  *   0.9   0.9   0.9   0.8   0.7   0.7   0.7   0.7   0.7   0.5   0.0   0.0
0.0   0.0   0.0   0.0   0.0   0.0   0.0   0.0
 310.  *   0.9   0.9   0.9   0.8   0.8   0.6   0.6   0.6   0.6   0.6   0.0   0.0
```

```
0.0   0.0   0.0   0.0   0.0   0.0   0.0   0.0
 320.  *   0.9   0.8   0.8   0.8   0.7   0.7   0.7   0.6   0.6   0.6   0.0   0.0
0.0   0.0   0.0   0.0   0.0   0.0   0.0   0.0
 330.  *   1.0   0.8   0.8   0.8   0.8   0.7   0.7   0.7   0.7   0.6   0.0   0.0
0.0   0.0   0.0   0.0   0.0   0.0   0.0   0.0
 340.  *   1.0   0.9   0.8   0.8   0.8   0.7   0.7   0.7   0.7   0.6   0.2   0.2
0.2   0.2   0.2   0.2   0.2   0.2   0.2   0.2
 350.  *   0.9   0.8   0.8   0.6   0.6   0.6   0.5   0.5   0.4   0.4   0.7   0.7
0.7   0.7   0.7   0.7   0.7   0.7   0.7   0.7
 360.  *   0.5   0.5   0.4   0.4   0.2   0.2   0.2   0.2   0.2   0.2   1.5   1.5
1.5   1.5   1.5   1.5   1.5   1.5   1.5   1.5

------*-------------------------------------------------------------------------
----------------------------------------
 MAX   *   1.7   1.9   2.0   2.0   2.0   1.9   1.9   2.0   2.0   1.9   2.3   2.3
2.2   2.4   2.4   2.4   2.4   2.3   2.2   2.2
 DEGR. *  110   190   190   200   200   200   220   220   210   220    10    10
10   100   100   100   110   110    10    10
```

♀

JOB: Federal Reconstruction RUN: 2035 Build Alternative

MODEL RESULTS

REMARKS : In search of the angle corresponding to the maximum concentration, only the first angle, of the angles with same maximum concentrations, is indicated as maximum.

WIND ANGLE RANGE: 10.-360.

```
 WIND  * CONCENTRATION
 ANGLE *      (PPM)
 (DEGR)* REC21 REC22 REC23 REC24 REC25 REC26 REC27 REC28 REC29 REC30 REC31 REC32
REC33 REC34 REC35 REC36 REC37 REC38 REC39 REC40

------*-------------------------------------------------------------------------
----------------------------------------
  10.  *   0.7   0.7   0.8   0.8   0.8   0.8   0.8   0.8   0.9   0.9   2.1   2.0
1.6   1.1   1.0   1.0   1.0   0.9   0.9   0.9
  20.  *   0.7   0.7   0.7   0.7   0.7   0.7   0.6   0.5   0.4   0.4   1.9   2.0
1.7   1.3   1.2   1.2   1.1   1.1   0.9   0.9
  30.  *   0.6   0.6   0.6   0.5   0.6   0.5   0.5   0.5   0.5   0.5   1.5   1.9
1.7   1.5   1.2   1.1   1.0   1.0   1.0   1.0
  40.  *   0.7   0.7   0.6   0.5   0.5   0.5   0.5   0.4   0.4   0.4   1.2   1.7
1.6   1.4   1.2   1.1   1.0   0.9   0.9   0.9
  50.  *   0.8   0.7   0.6   0.5   0.5   0.5   0.5   0.5   0.5   0.4   0.7   1.1
1.2   1.3   1.0   1.0   0.9   0.8   0.7   0.8
  60.  *   0.8   0.8   0.6   0.6   0.5   0.5   0.5   0.5   0.4   0.4   0.8   0.9
1.0   1.0   1.0   0.9   0.9   0.6   0.6   0.7
  70.  *   0.8   0.7   0.6   0.5   0.5   0.4   0.4   0.4   0.4   0.4   1.1   1.2
1.3   1.4   1.2   1.0   1.0   0.9   0.8   0.7
  80.  *   0.6   0.5   0.5   0.4   0.4   0.3   0.3   0.3   0.2   0.2   1.2   1.1
1.2   1.1   1.3   1.2   1.2   1.1   1.2   1.2
  90.  *   0.3   0.3   0.2   0.2   0.2   0.2   0.1   0.1   0.1   0.1   1.0   1.0
1.0   1.0   1.0   1.0   1.0   0.9   0.9   0.9
 100.  *   0.1   0.1   0.1   0.1   0.0   0.0   0.0   0.0   0.0   0.0   0.9   0.9
0.7   0.6   0.6   0.6   0.5   0.5   0.5   0.5
 110.  *   0.0   0.0   0.0   0.0   0.0   0.0   0.0   0.0   0.0   0.0   0.8   0.8
0.8   0.7   0.6   0.5   0.5   0.5   0.5   0.5
```

120.	*	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.9	0.8
0.7	0.6	0.6	0.6	0.6	0.5	0.5	0.5						
130.	*	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.8	0.7
0.7	0.7	0.6	0.6	0.6	0.6	0.5	0.5						
140.	*	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.9	0.7
0.7	0.7	0.7	0.6	0.5	0.5	0.5	0.5						
150.	*	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.8	0.7
0.6	0.6	0.6	0.6	0.5	0.5	0.5	0.4						
160.	*	0.2	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.7	0.7
0.6	0.5	0.5	0.5	0.4	0.3	0.3	0.3						
170.	*	0.6	0.6	0.6	0.6	0.6	0.5	0.4	0.4	0.4	0.4	0.6	0.5
0.4	0.4	0.3	0.3	0.3	0.3	0.3	0.2						
180.	*	1.3	1.3	1.3	1.3	1.3	1.3	1.2	1.2	1.1	1.1	0.3	0.3
0.3	0.2	0.1	0.1	0.1	0.1	0.1	0.1						
190.	*	1.8	1.8	1.8	1.8	1.8	1.7	1.7	1.7	1.7	1.7	0.1	0.1
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0						
200.	*	2.1	2.0	2.0	1.8	1.8	1.8	1.8	1.8	1.8	1.8	0.0	0.0
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0						
210.	*	2.0	1.9	1.9	1.9	1.8	1.8	1.8	1.8	1.8	1.8	0.0	0.0
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0						
220.	*	1.8	1.8	1.7	1.7	1.7	1.7	1.7	1.7	1.7	1.7	0.0	0.0
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0						
230.	*	1.8	1.7	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	0.0	0.0
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0						
240.	*	1.8	1.7	1.6	1.5	1.5	1.5	1.5	1.5	1.5	1.5	0.0	0.0
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0						
250.	*	1.6	1.7	1.6	1.5	1.4	1.4	1.4	1.4	1.4	1.4	0.0	0.0
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0						
260.	*	1.7	1.8	1.7	1.6	1.6	1.5	1.5	1.5	1.5	1.5	0.0	0.0
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0						
270.	*	1.6	1.7	1.9	1.6	1.6	1.6	1.5	1.5	1.5	1.5	0.0	0.0
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0						
280.	*	1.5	1.7	1.7	1.7	1.6	1.6	1.6	1.5	1.5	1.5	0.2	0.1
0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1						
290.	*	1.2	1.6	1.8	1.6	1.5	1.4	1.4	1.4	1.4	1.4	0.2	0.2
0.2	0.2	0.2	0.1	0.1	0.1	0.1	0.1						
300.	*	1.2	1.4	1.7	1.7	1.8	1.7	1.7	1.7	1.7	1.6	0.3	0.3
0.2	0.2	0.2	0.2	0.2	0.1	0.1	0.1						
310.	*	0.9	1.1	1.4	1.6	1.6	1.6	1.7	1.7	1.7	1.7	0.5	0.3
0.3	0.3	0.3	0.2	0.2	0.2	0.1	0.1						
320.	*	1.0	1.2	1.3	1.7	1.7	1.8	1.7	1.7	1.7	1.8	0.6	0.3
0.3	0.3	0.3	0.3	0.3	0.2	0.2	0.2						
330.	*	1.2	1.4	1.4	1.6	1.8	1.8	1.9	2.0	2.0	1.9	0.8	0.4
0.3	0.3	0.3	0.3	0.3	0.3	0.2	0.2						
340.	*	1.5	1.6	1.8	1.7	1.8	2.0	2.1	2.1	2.0	2.0	1.0	0.5
0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.2						
350.	*	1.8	1.7	1.6	1.8	2.0	1.8	1.9	1.9	2.0	2.0	1.3	0.9
0.4	0.4	0.4	0.4	0.4	0.4	0.3	0.3						
360.	*	1.2	1.2	1.2	1.2	1.1	1.3	1.3	1.3	1.4	1.4	1.9	1.4
1.0	0.8	0.8	0.6	0.6	0.6	0.6	0.6						

------*--

MAX	*	2.1	2.0	2.0	1.9	2.0	2.0	2.1	2.1	2.0	2.0	2.1	2.0
1.7	1.5	1.3	1.2	1.2	1.1	1.2	1.2						
DEGR.	*	200	200	200	210	350	340	340	340	330	350	10	10
20	30	80	20	80	20	80	80						

THE HIGHEST CONCENTRATION OF 2.40 PPM OCCURRED AT RECEPTOR REC14.

Appendix C Air Quality Methodology Concurrence

Tyler Sparks

From: Tyler Sparks
Sent: Thursday, March 27, 2014 9:09 AM
To: Tyler Sparks
Subject: RE: Air Quality Scoping Concurrence Request for Federal Boulevard Reconstruction Project

---------- Forwarded message ----------
From: **Schlaefer - CDOT, Jill** <jill.schlaefer@state.co.us>
Date: Wednesday, March 5, 2014
Subject: Air Quality Scoping Concurrence Request for Federal Boulevard Reconstruction Project
To: Jordan Rudel - CDOT <jordan.rudel@state.co.us>

Concurrence on Federal Blvd EA air quality methodology.

Jill Schlaefer
Air Quality & Noise Programs
Colorado Department of Transportation
4201 E. Arkansas Av, Denver 80222
(303) 757-9016 Denver office
(303) 514-2987 Cell
jill.schlaefer@state.co.us

---------- Forwarded message ----------
From: **Dileo - CDPHE, Jim** <jim.dileo@state.co.us>
Date: Wed, Mar 5, 2014 at 11:08 AM
Subject: Re: Air Quality Scoping Concurrence Request for Federal Boulevard Reconstruction Project
To: "Schlaefer - CDOT, Jill" <jill.schlaefer@state.co.us>

Jill,

this looks good.

Jim

On Wed, Feb 26, 2014 at 7:37 AM, Schlaefer - CDOT, Jill <jill.schlaefer@state.co.us> wrote:

> Good morning,
>
> CDOT requests your concurrence on the methodology proposed for air quality analysis on the City and County of Denver action: Federal Boulevard Reconstruction Environmental Assessment for widening Federal between 7th Avenue and Howard Place (see attached for more information). The project will add a 3rd northbound travel lane and modify intersections in order to update to current standards. The project lies within the Denver CO and PM10 Maintenance Plan areas and is subject to conformity regulations.
>
> Carbon monoxide screening of major intersections indicates two localities with deficient 2035 level-of-operating service as documented in the attached letter.

Table 1 Level of Service

Study Area Intersection Levels of Service (AM/PM)			
Intersection (Federal Boulevard)	**Existing**	**No Action (2035)**	**Proposed Action (2035)**
West 8th Avenue	C/F	**F/F**	**D/F**
West 10th Avenue	B/B	**D/F**	**C/E**
Holden Place	A/B	A/C	A/B

Source: Federal Boulevard PEL

This project will terminate at the recent US6 & Federal Avenue ROD re-evaluation, where worse-case (2012 emissions rates coupled with 2035 higher traffic volumes), peak hour CO 8-hour hotspot analyses resulted in 6.9 ppm, below the 9 ppm NAAQS. To build on those results, the project proposes one additional CO hotspot at the worst operating intersection (LOS and volumes) on the 0.73mile long widening project - the West 8th Avenue intersection. Because the project will not alter or increase diesel truck patterns or percentages traveling on Federal Boulevard, the project proposes to qualitatively address project related PM and MSAT emissions.

CDOT respectfully requests your concurrence with this air quality analytical methodology for the Federal Boulevard Reconstruction EA to meet 40CFR93 conformity requirements. Due to the previous air quality efforts near this area we thought it to be easier to email the details and concurrence request rather than meet in person, however, that is an option if you have additional questions or need clarification on anything. Thank you.

Jill Schlaefer
Air Quality & Noise Programs
Colorado Department of Transportation
4201 E. Arkansas Av, Denver 80222
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