I-76 & Bridge Street INTERCHANGE

Air Quality

Technical Report

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List of acronyms and abbreviations

Act	Clean Air Act of 1970
APCD	Air Pollution Control Division
Brighton	City of Brighton
CDOT	Colorado Department of Transportation
CDPHE	Colorado Department of Public Health and Environment
CFR	Code of Federal Regulations
CO	Carbon monoxide
DRCOG	Denver Regional Council of Governments
EA	Environmental Assessment
EPA	U.S. Environmental Protection Agency
FHWA	Federal Highway Administration
FTA	Federal Transit Administration
LOS	Level of service
MOA	Memorandum of Agreement
MPO	Metropolitan Planning Organization
MSAT	Mobile source air toxic
NAAQS	National Ambient Air Quality Standards
NO_2	Nitrogen dioxide
NOx	Nitrogen oxides
O_3	Ozone
$PM_{2.5}$	Particulate matter 2.5 micrometers in diameter and smaller
PM_{10}	Particulate matter 10 micrometers in diameter and smaller
ROW	Right of way
RTP	Regional Transportation Plan
SIP	State Implementation Plan
SLS	System-Level Study
SO_2	Sulfur dioxide
STIP	Statewide Transportation Improvement Plan
TIP	Transportation Improvement Program
VMT	Vehicle miles traveled/vehicle miles of travel
VOC	Volatile organic compound

1. Introduction

The I-76 and Bridge Street Interchange Environmental Assessment (EA) is a joint effort between the City of Brighton (Brighton), the Federal Highway Administration (FHWA), and the Colorado Department of Transportation (CDOT). This EA will identify potential impacts of the proposed interchange on the built and natural environment.

1.1 Air Quality

A qualitative analysis of potential impacts to air quality for the No-Action Alternative and the three Action Alternatives under evaluation was conducted as part of the I-76 and Bridge Street Interchange Environmental Assessment. Exhibit 1-1 shows the location of the project. Although transportation projects can impact air quality during both the construction phase and the maintenance and operation phase of a project, air quality is primarily affected by increased traffic volumes and vehicle congestion.

1.2 No-Action Alternative

The No-Action Alternative serves as the baseline against which Action Alternatives were compared. For the purposes of this study, the No-Action Alternative is defined as the existing facilities within the project area. Under the No-Action Alternative, no further improvements—aside from ongoing operations and maintenance—would be made to the Bridge Street overpass at I-76.

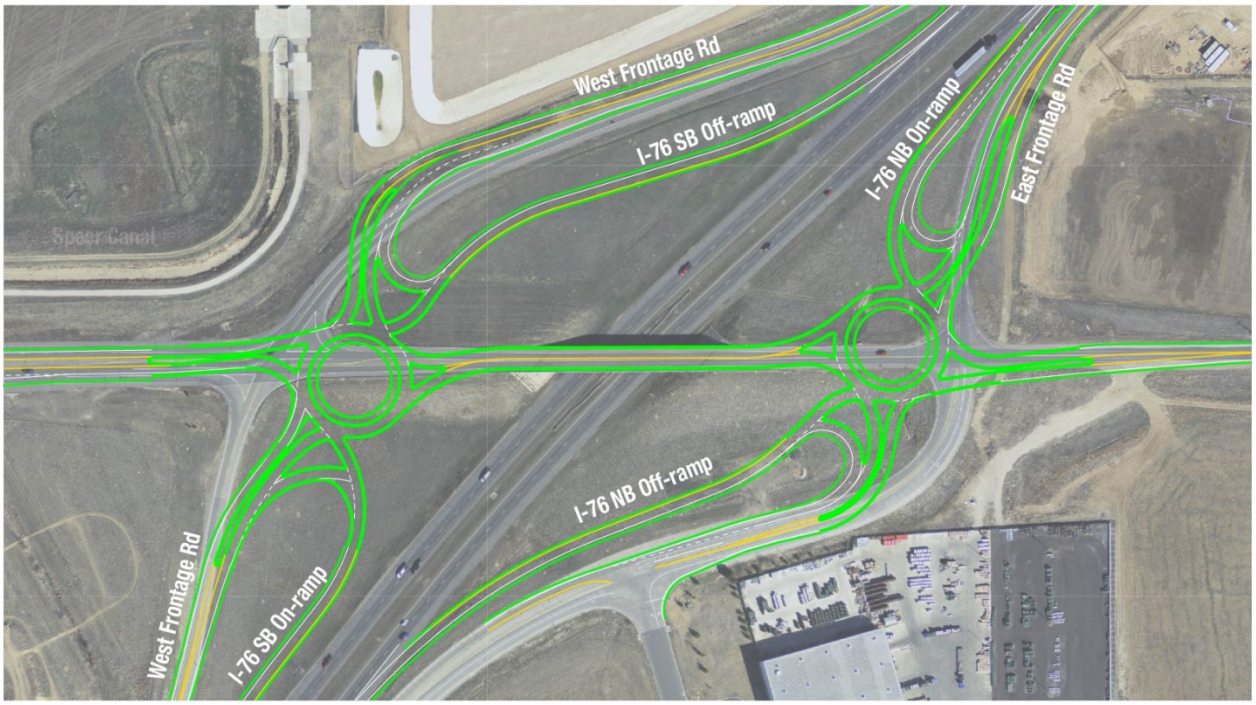
Exhibit 1-1 Project Location Map

1.3 Preferred Alternative: Two-Roundabout Interchange Design

The Preferred Alternative for this EA is the Two-Roundabout Interchange. This alternative combines the frontage roads and ramp terminals to make one 6-legged roundabout on both the east and west sides of I-76 (see Exhibit 1-2). This alternative meets the project Purpose and Need. It preserves the existing bridge, can be designed within the existing right of way (ROW), and avoids impacts to the Speer Canal to the northwest of the interchange. This alternative is expected to operate at Level of Service (LOS) B in the year 2035.

Each roundabout has an outside diameter of 200 feet, including a 12-foot truck apron for truck traffic. To develop approach angles as a traffic-calming technique and to lessen ROW impacts, both roundabouts have been placed off center of the existing Bridge Street center line. Splitter islands are included to slow traffic coming into the roundabouts. The roundabouts are designed with an 18-foot single lane for circulation and exclusive right-turn bypasses for the ramp-to-frontage-road and frontage-road-to-ramp movements. This alternative has the least amount of access points among the Action Alternatives.

Exhibit 1-2 Preferred Alternative: Two-Roundabout Interchange Design

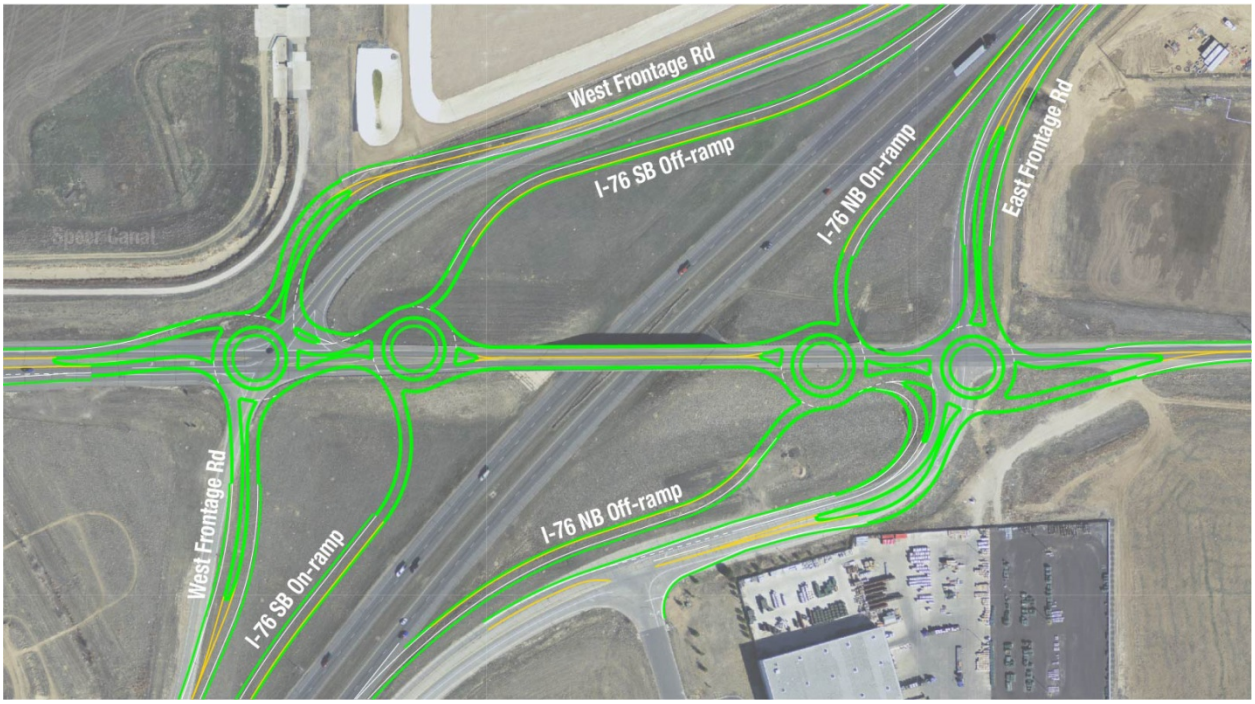


1.4 Alternative 2: Four-Roundabout Interchange Design

Alternative 2 for this EA is the Four-Roundabout Interchange. Exhibit 1-3 shows that this alternative creates two four-legged roundabouts on each side (east and west) of I-76. This alternative meets the project Purpose and Need. It preserves the existing bridge and has minor ROW impacts. This alternative is expected to operate at LOS B in the year 2035.

The two four-legged roundabouts on the east and west side of I-76 allow truck traffic to be separated from residential traffic. Each roundabout has an outside diameter of 110 feet, including a 12-foot truck apron for truck traffic. With each pairing on the west and east sides, the roundabouts have been placed off center of the existing Bridge Street center line slightly to develop approach angles as a traffic-calming technique and to lessen ROW impacts. Splitter islands are included to slow traffic coming into the roundabouts. The roundabouts are designed with an 18-foot single lane for circulation and exclusive right-turn bypasses for the ramp-to-frontage-road and frontage-road-to-ramp movements.

Exhibit 1-3 Alternative 2: Four-Roundabout Interchange Design

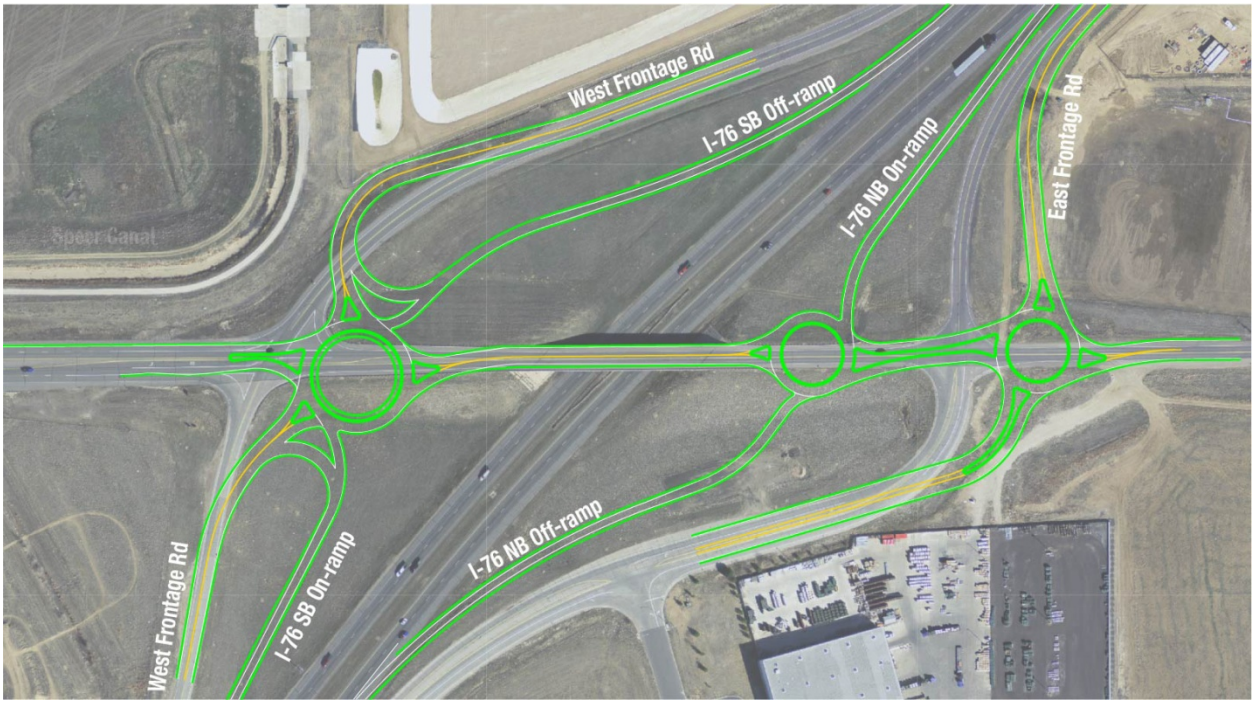


1.5 Alternative 3: Three-Roundabout Interchange Design

This alternative consists of one large roundabout on the west side of I-76 and two smaller roundabouts on the east side of I-76 (see Exhibit 1-4). The West Frontage Road and I-76 westbound ramps are combined into one six-legged roundabout with an outside diameter of 200 feet, including a 12-foot truck apron. The east side combines the eastbound ramp terminal into one four-legged roundabout and the frontage roads into another four-legged roundabout. Each of the smaller roundabouts has an outside diameter of 150 feet, including a 12-foot truck apron. This alternative meets the project Purpose and Need. It preserves the existing bridge and has minor ROW impacts, primarily to the east. The two four-legged roundabouts on the east side of I-76 allow truck traffic to be separated from residential traffic. This alternative is expected to operate at LOS B in the year 2035.

For the pairing on the east side and the single roundabout on the west side, the roundabouts have been placed off center of the existing Bridge Street center line to develop approach angles as a traffic-calming technique. Splitter islands are included to slow traffic coming into the roundabouts. The roundabouts are designed with an 18-foot single lane for circulation and exclusive right turn bypasses for the ramp-to-frontage-road and frontage-road-to-ramp movements.

Exhibit 1-4 Alternative 3: Three-Roundabout Interchange Design



2. Summary of Results

Pursuant to the conformity provisions of the Clean Air Act Amendments of 1990, this project will not cause or contribute to any new violation of any standard, or delay timely attainment of any standard or any required interim emission reduction. This project is examined as part of an Environmental Assessment; it is not considered to be a project that would cause significant regional air quality impacts from either the construction or operational phases of the project, and it meets regional-level air quality conformity requirements. All three of the Action Alternatives under consideration are expected to result in decreased congestion, benefit LOS at local intersections and nearby interchanges, and accommodate the projected increased traffic volumes.

Temporary air quality impacts may result from the construction of the Action Alternatives; impacts associated with the operation of the project would have a small (and generally positive) effect on air quality over the life of the project. Additionally, the project is located in a relatively rural area (see Exhibit 1-1). No sensitive receptors, residences, or crosswalks would be directly impacted as part of the Action Alternatives, so the likelihood of air quality issues is low.

3. Affected Environment

Construction of a new interchange at I-76 and Bridge Street is included in the conforming Statewide Transportation Improvement Plan (STIP), the 2012–2017 Denver Regional Council of Governments (DRCOG) Transportation Improvement Program (TIP), and the 2035 DRCOG Regional Transportation Plan (RTP), and is subject to CDOT oversight, as well as state and federal air quality compliance. The project is in an attainment/maintenance area for carbon monoxide (CO) and for particulate matter 10 micrometers in diameter and smaller (PM_{10}). Consideration of particulate matter 2.5 micrometers in diameter and smaller ($PM_{2.5}$) also is included in this technical report since it is a component of diesel exhaust, which would be associated with the equipment used during the construction phase of this project. Mitigation during construction activities to reduce particulate matter is discussed further in this report. Additionally, the project is in a nonattainment area for ozone (O_3).

Due to the status of these three pollutants in the Denver metropolitan area, and the fact that there is CDOT oversight, this project is subject to a conformity analysis. The project has state oversight because it has federal funding and is located on an interstate. Since this project is not considered a project that would cause significant regional air quality impacts, this technical report focuses in the following sections on an overall qualitative analysis of the regional criteria pollutants.

3.1 Regulatory Environment

3.1.1 Federal and State

National air quality policies are regulated through the federal Clean Air Act of 1970 (Act). As required by the Act, the U.S. Environmental Protection Agency (EPA) established National Ambient Air Quality Standards (NAAQS) for seven criteria air pollutants. In addition to O_3, CO, and PM_{10}, the criteria pollutants are $PM_{2.5}$, sulfur dioxide (SO_2), nitrogen dioxide (NO_2), and lead (Pb) (see Exhibit 3-1). The NAAQS represent thresholds based on specific adverse health and welfare effects associated with each pollutant. The Colorado Department of Public Health and Environment (CDPHE) has adopted the NAAQS; there are no ambient air quality standards specific to Colorado.

Exhibit 3-1 National Ambient Air Quality Standards

Pollutant	Averaging Time[1]	NAAQS	
		µg/m^3	ppm
Ozone (O_3)	8-Hour	—	0.0751
Carbon Monoxide (CO)	1-Hour 8-Hour	—	35 9
Sulfur Dioxide (SO_2)	3-Hour	—	0.5
Nitrogen Dioxide (NO_2)	Annual	—	0.053
Particulate Matter (PM_{10}) 5	24-Hour	150	—
Particulate Matter ($PM_{2.5}$)	24-Hour Annual	35 12	— —
Lead (Pb)	Rolling 3-Month Average	0.15	—

Source: EPA, 2013
Notes: [1]The 2008 standard
NAAQS = National Ambient Air Quality Standards
µg/m^3 = micrograms per cubic meter
ppm = parts per million

The EPA has delegated authority to the CDPHE to administer many of the requirements of the Act, including compliance with the NAAQS. 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, to avoid exceedances of the NAAQS. To comply with the SIP, Metropolitan Planning Organizations (MPOs) are required to demonstrate that transportation plans and programs keep emissions within these limits. This is done through the transportation conformity process per a Memorandum of Agreement (MOA) with the APCD and CDOT (CDOT, 1995).

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

3.1.2 CDOT Clearance Process

If the 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, transportation improvement programs, and transportation projects ensure that transportation activities 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, 2013).

The 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 Act and the EPA transportation air quality conformity regulations (40 Code of Federal Regulations [CFR] 51 Subpart T, and 40 CFR 93 Subpart A). This means that the project must be included in a conforming TIP and RTP. The project design concept must be sufficiently defined to assess 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 and RTP conformity findings must be maintained throughout implementation.

As the first step in a conformity determination, the CDOT Environmental Programs Branch air quality specialist and the APCD determine which roadways and signalized intersections will require an 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 also may need to be evaluated. An LOS analysis is completed for each intersection based on all project alternatives, including the No-Action Alternative. The LOS analysis assesses each intersection based on the average wait time per vehicle and assigns a letter "grade" to each intersection for the AM and PM peak-hour periods.

An additional analysis, "Hotspot Modeling," is required for intersections with LOS of D or worse after project implementation. Hotspot modeling is a method of calculating the carbon monoxide concentrations along roadways and near intersections. The purpose of hotspot modeling is to evaluate whether a project could cause, or contribute to, a violation of the CO NAAQS.

Hotspot modeling also is 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 hotspot analyses are required for projects of air quality concern within non-attainment or attainment/ maintenance areas.

3.1.3 Pollutants of Concern

When assessing the impacts of transportation projects, the two main pollutants of concern for the Denver metropolitan area—which includes Brighton—are CO and PM_{10}. The Denver area is designated as an attainment/maintenance area for these two pollutants. CO and PM_{10} concentrations can accumulate near areas of heavy traffic congestion where average vehicle speeds are low. Ozone and mobile source air toxics (MSATs) are two more pollutants of concern and also 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 area.

Carbon Monoxide

The Denver area is currently considered to be in attainment/maintenance for CO. Per CDOT and FHWA guidance, quantitative hotspot modeling is required for intersections affected by the project that demonstrate an LOS of D or worse after project implementation.

For the purpose of this project, the LOS for the No-Action Alternative and all three Action Alternatives was examined in the I-76 and Bridge Street Interchange System-Level Study (SLS) (Atkins, 2013). The results of the SLS show that for the No-Action Alternative and any of the Action Alternatives, all signalized intersections in the project area would operate at LOS C or better during both the AM (morning) and PM (evening) peak-hour traffic in the year 2035 (Appendix A). The EPA modeling guidance states that intersections operating at LOS C or better are not likely to cause a violation of the federal 8-hour average CO standard. Therefore, hotspot modeling is not required and all of the alternatives are considered to meet regional-level air quality conformity requirements. Additionally, the nearby signalized intersection of Bridge Street and 50th Avenue would operate at LOS C or better during both the morning and evening peak-hour traffic in the year 2035 for the Action Alternatives (Appendix A). Therefore, it is not anticipated that this project would have a negative impact on surrounding signalized intersections.

Particulate Matter

Per 40 CFR 51.454(d), a PM_{10} quantitative hotspot analysis must be performed for projects that are located at sites where violations have been identified by air quality monitoring, and at sites that have essentially identical vehicle and roadway emissions and dispersion characteristics. Nationally, PM_{10} levels have been decreasing over the past 30 years (CDPHE, 2010). However, the overall levels of this pollutant in the northern Front Range have been fairly constant since 1997 (CDPHE, 2010).

The project area is within the attainment area for PM_{10}, but there have been no recent exceedances of NAAQS at the nearest air quality monitoring stations. According to the CDPHE Emission Inventories for

Adams County, the major sources of particulate matter in the project area are construction, road dust, and agricultural tilling (see Exhibit 3-2).

Exhibit 3-2 Adams County PM_{10} Emissions for 2008

County	Three Highest Emission Categories Tons per Year (Percent of Total Tons/Year)			Total Tons of PM_{10}/Year
	Construction	Road Dust	Agricultural Tilling	
Adams	5,828 (30%)	4,933 (26%)	4,497 (23%)	19,205

Source: CDPHE, 2013

The requirement for a quantitative hotspot analysis took effect in December 2012 and is applicable to projects that demonstrate the potential to have major air quality impacts. Although this project has the potential to affect vehicle fleet mix within the project area, it would not have a significant increase in the number of diesel vehicles. Therefore, the project is below the PM_{10} regulatory threshold for conducting a PM_{10} hotspot assessment. The potential effects of this project were assessed qualitatively by evaluating the CDPHE Emissions Inventory. Based on this qualitative assessment, it was determined that this project would not have a major impact on local and regional air quality PM_{10} emissions. Therefore, the EPA guidance to complete a quantitative analysis for PM_{10} does not apply.

Ozone

The Denver area is currently in non-attainment for O_3 because 2007 O_3 levels exceeded the EPA 8-hour standard. This pollutant is not directly emitted by motor vehicles. However, the reaction of two pollutants found in motor vehicle emissions, nitrogen oxides (NOx) and volatile organic compounds (VOCs), contribute to O_3 formation. Ozone is created by the reaction of NOx and VOCs, primarily 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 EPA established a more stringent standard for O_3 based on a review of the most recent health-effects information. The March 2008 standard is 0.075 parts per million (ppm) averaged over an 8-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 intended to bring the Denver/North Front Range area back into attainment by November 2010 (CDPHE, 2008). The overall plan included elements that were part of the federally enforceable SIP, elements that are included as state-only enforceable measurements in state regulation, and elements that needed further evaluation prior to a possible SIP amendment in the future (CDPHE, 2008). The Ozone Action Plan did not bring the Denver/North Front Range area into attainment by November 2010.

In July 2012, the Denver area and the North Front Range were classified as a “marginal” O_3 nonattainment area by the EPA. The marginal nonattainment designation does not currently impose any new planning requirements on Colorado; however, the nonattainment areas must meet the standard before 2015 or new requirements may be imposed.

Mobile Source Air Toxics

In addition to the criteria air pollutants, for which there are NAAQS, the EPA also regulates air toxics, including MSATs, which are a subset of the 188 air toxics defined by the Clean Air Act. Most air toxics originate from human-made sources, including on-road mobile sources, non-road mobile sources (such as trains), area sources (such as dry cleaners), and point sources (such as factories or refineries). Some toxic compounds present in fuel 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.

Studies have reported that proximity to roadways is related to adverse health outcomes, particularly respiratory problems. Much of this research is not specific to MSATs, but instead includes the full spectrum of both criteria and other pollutants. The validity of these studies cannot be evaluated at this time, but—more importantly—these studies do not provide information that would be useful to alleviate the uncertainties associated with the studies and enable a more comprehensive evaluation of the health impacts specific to this project. Because of the uncertainties associated with the studies, a quantitative assessment of the effects of air toxic emissions impacts on human health cannot be made at the project level.

4. Impact Analysis

For each alternative examined in the EA, the amount of MSATs emitted would be proportional to the vehicle miles traveled, or vehicle miles of travel (VMT), assuming that other variables—such as fleet mix—are the same for each alternative. The VMT estimated for each of the Action Alternatives is slightly higher than that for the No-Action Alternative because the interchange may attract trips from alternative routes nearby. This increase in VMT means MSATs under any of the three Action Alternatives would probably be higher than the No-Action Alternative in the project area. There also could be localized differences in MSATs from indirect effects of the project, such as associated access traffic, emissions of evaporative MSATs (e.g., benzene) from parked cars, and emissions of diesel particulate matter from delivery trucks. The indirect localized differences in MSATs are not expected to be measurable in the project area and, therefore, would not impact project-level MSAT emissions. Traffic volumes at other nearby interchanges could be reduced due to a shift in travel patterns to use the proposed interchange; this would result in a decrease in emissions at those locations.

Because the estimated VMTs under each of the three Action Alternatives are nearly the same, varying by less than two percent, it is expected there would be no appreciable difference in overall MSAT emissions among the three Action Alternatives. Additionally, for any of the alternatives, emissions are virtually certain to be lower than present levels in the design year as a result of EPA's national control programs that are projected to reduce annual MSAT emissions by more than 80 percent from 2010 to 2050. Local conditions may differ from these national projections in terms of fleet mix and turnover, VMT growth rates, and local control measures. However, the magnitude of the EPA-projected reductions is so great (even after accounting for VMT growth) that MSAT emissions in the project area are likely to be lower in the future than they are today. Future truck percentages are expected to remain the same as those measured during existing conditions (Atkins, 2013). Therefore, particulate matter impacts for additional truck traffic are not expected to occur from any alternative.

The addition of travel lanes as part of the project alternatives will have the effect of moving some traffic closer to the nearby residential community southwest of the project area (see Exhibit 1-1); therefore, under each alternative, there may be localized areas where ambient concentrations of MSATs would be higher under certain alternatives than others. The localized differences in MSAT concentrations would likely be most pronounced along the new/expanded roadway sections that would be built at I-76 and Bridge Street, under any of the Action Alternatives. However, the magnitude and the duration of these potential increases cannot be reliably quantified due to incomplete or unavailable information in forecasting project-specific MSATs health impacts. Further, under any of the alternatives, including the No-Action Alternative, overall future MSATs are expected to be substantially lower than today due to implementation of EPA's vehicle and fuel regulations.

5. Mitigation

Although motor vehicle emissions in the project area may increase, they are not expected to result in an exceedance of the NAAQS; therefore, no air quality mitigation is necessary. However, since the construction of the project will require submittal of an Air Pollution Emission Notice and Application for Construction

Permit from the APCD, preparation of a Fugitive Dust Control Plan will be required. Adherence to this plan will reduce air pollution resulting from construction activities.

Construction phase air quality impacts (fugitive road dust and engine exhaust emissions) will be controlled by implementing the following measures, as applicable:

- Wetting exposed soils and soil piles for dust suppression
- Covering trucks hauling soil and other fine materials
- Stabilizing and covering stockpile areas
- Re-vegetating exposed areas
- Minimizing off-site tracking of mud and debris by washing construction equipment and temporary stabilization
- Limiting vehicle speed of construction-related equipment when off road
- Prohibiting unnecessary idling of construction equipment
- Using low-sulfur fuel
- Locating diesel engines and motors as far away as possible from residential areas
- Locating staging areas as far away as possible from residential areas
- Requiring heavy construction equipment to use the cleanest available engines or to be retrofitted with diesel particulate control technology
- Using alternatives for diesel engines and/or diesel fuels (such as biodiesel, liquefied natural gas, compressed natural gas, fuel cells, or electric engines) when possible
- Installing engine pre-heater devices to eliminate unnecessary idling during winter time construction
- Prohibiting tampering with equipment to increase horsepower or to defeat the effectiveness of emission control devices
- Requiring construction vehicle engines to be properly tuned and maintained
- Using construction vehicles and equipment with the minimum practical engine size for the intended job

6. Conclusions

This project is being evaluated as an EA; it is not considered to be a project that would cause significant regional air quality impacts and it meets regional-level air quality conformity requirements. All of the Action Alternatives are expected to result in decreased congestion, operate at LOS C or better during both the AM and PM peak periods, and are anticipated to be able to accommodate projected increased traffic volumes. All three of the Action Alternatives under consideration also are expected to result in decreased congestion and benefit LOS at local intersections and nearby interchanges. Based on the qualitative analysis of CO and PM_{10} data, no exceedances of the NAAQS are expected as a result of this project. The project is located in a relatively rural area (see Exhibit 1-1). No sensitive receptors, residences, or crosswalks would be directly impacted as part of the Action Alternatives; therefore, the likelihood of air quality issues is low.

7. References

Atkins, 2013. I-76 and Bridge Street System Level Study. Atkins North America, Inc., Denver, Colorado. September 2013.

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Appendices

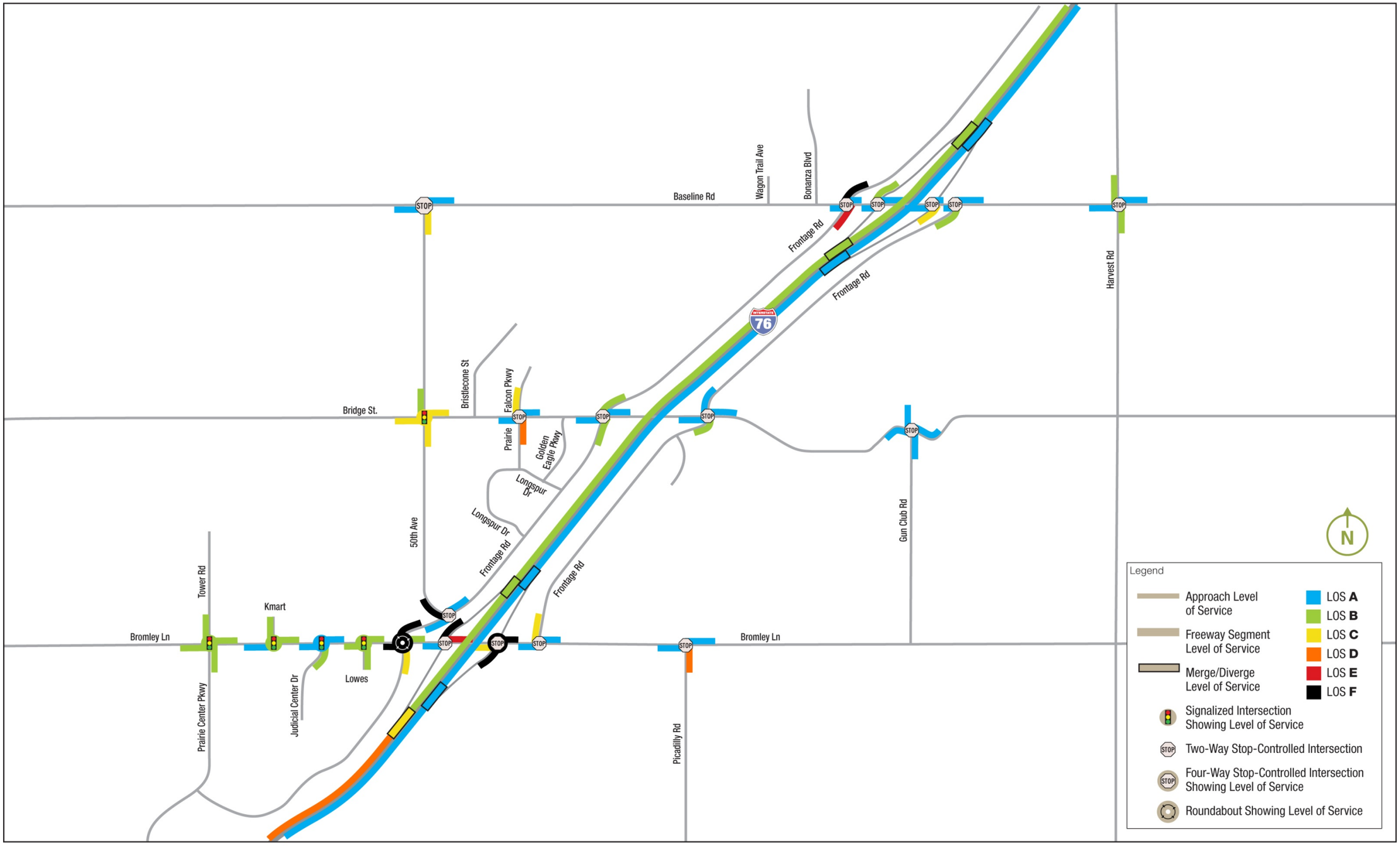
Appendix A: I-76 and Bridge Street Interchange 2035 Conditions

Appendix A

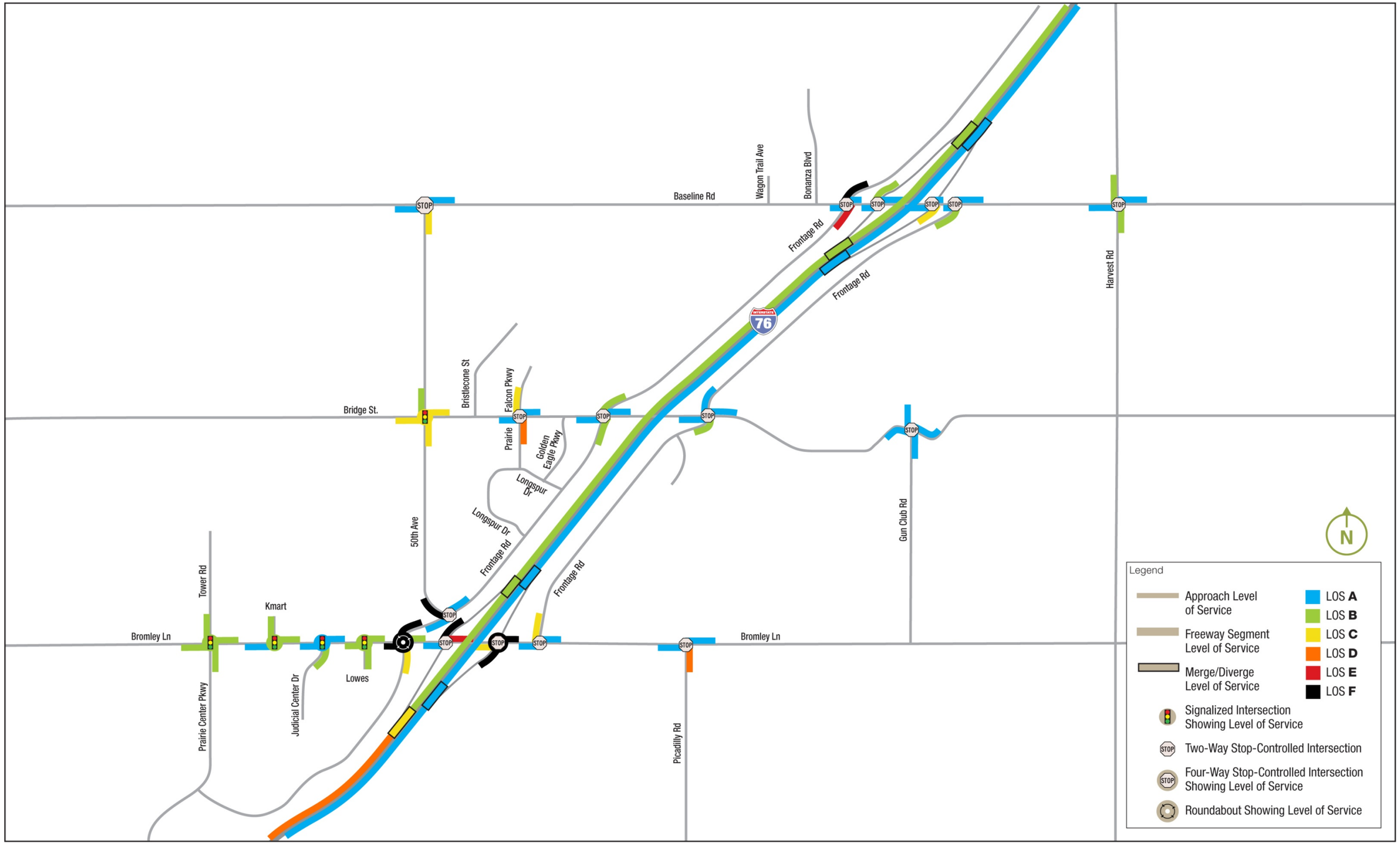
Air Quality Technical Report

I-76 and Bridge Street Interchange
2035 No-Action Alternative and Action Alternatives LOS Conditions

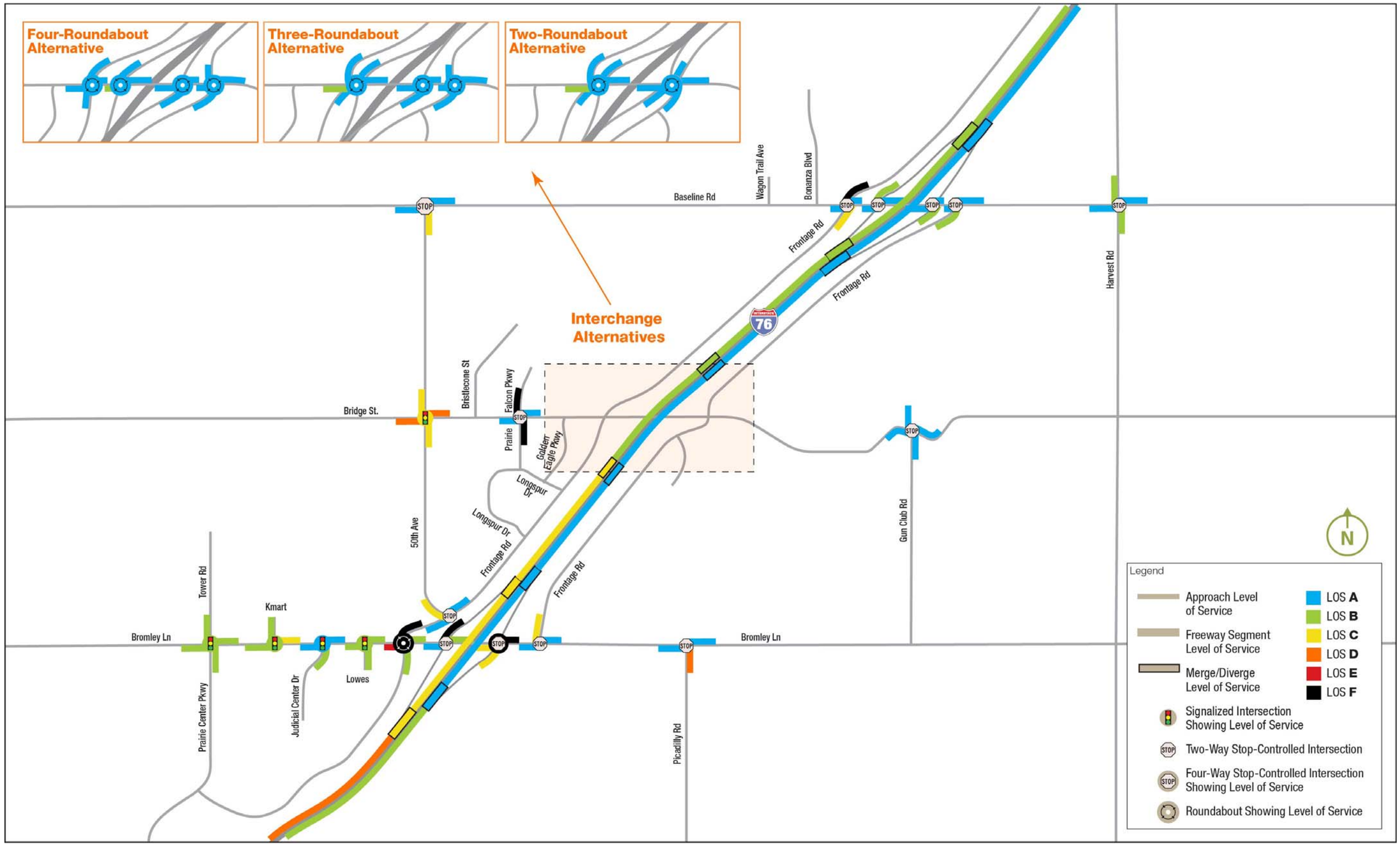
2035 No-Action Alternative AM LOS



2035 No-Action Alternative PM LOS



2035 Action Alternatives AM LOS



2035 Action Alternatives PM LOS