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3.0 TRANSPORTATION

INTRODUCTION

The first part of this chapter describes existing and future conditions of the transportation system. The second part presents evaluations of the transportation performance of the No Action Alternative and the four build alternatives. Transportation performance evaluations are organized according to the four principal project needs that are included in the Purpose and Need chapter. Traffic forecasts presented and used for performance evaluations are Year 2030 forecasts and are based upon the DRCOG 2030 regional travel demand forecasting model.

3.1 *EXISTING AND FUTURE CONDITIONS*

This section discusses the existing and future conditions as they relate to transportation. It includes discussions of the transportation network, existing traffic volumes, roadway capacity analysis, and demographic forecasts.

3.1.1 TRANSPORTATION NETWORK

The existing transportation network in the study area includes the roadway network, pedestrian/bicycle facilities, transit routes, railroads, and aviation facilities.

3.1.1.1 ROADWAY NETWORK

The study area is generally defined by SH 93 on the west, Wadsworth Boulevard (SH 121) on the east, US 6 on the south, and US 36 and Northwest Parkway on the north (see **Figure 3.1-1**). Major roadways in the study area fall into the three general categories described in this section: National Highway System, other US and state highways, and other local government arterial streets.

NATIONAL HIGHWAY SYSTEM

FHWA has designated a National Highway System consisting of roads between and within urbanized areas that form the backbone of the nation's roadways. The routes designated as part of the National Highway System are identified. The US Congress designated these routes for the critical and efficient movement of goods and people. Connectivity with these facilities is important to increase effectiveness of this system. The roads within the study area that are designated as parts of the National Highway System are listed here with their current number of through lanes (see **Figure 3.1-1**).

- Interstate 70 (I-70)–six lanes
- US Highway 6 (US 6)–four to six lanes
- US Highway 36 (US 36)–four lanes
- State Highway 93 (SH 93)–two to three lanes
- State Highway 121 (SH 121 or Wadsworth Boulevard)–four to six lanes
- Northwest Parkway–four lanes
- C-470–four lanes

OTHER US AND STATE HIGHWAYS

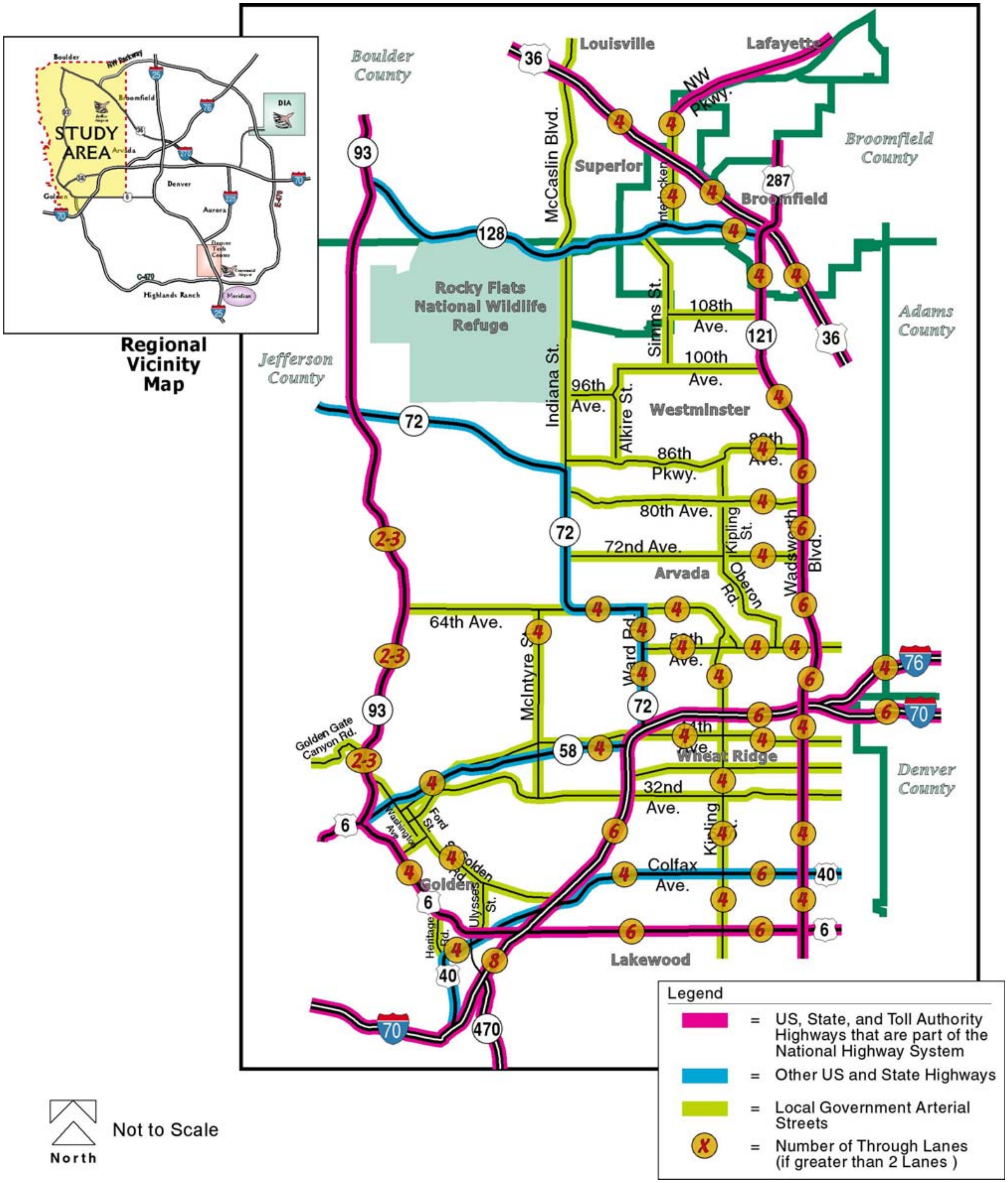
One US highway and three state highway routes within the study area are not part of the National Highway System:

- US Highway 40 (US 40 or Colfax Avenue)–four lanes
- State Highway 58 (SH 58)–four lanes
- State Highway 72 (SH 72)–two- and four-lane portions of Ward Road, 64th Avenue, Indiana Street, and the east-west SH 72 segment between SH 93 and Indiana Street
- State Highway 128 (SH 128)–two lanes

OTHER LOCAL GOVERNMENT ARTERIAL STREETS

There are numerous principal and minor arterial streets maintained by counties or municipalities (see **Figure 3.1-1**).

Figure 3.1-1 Major Roadways in the Study Area



Sources: *Federal Highway Administration, www.fhwa.dot.gov/hep10/nhs/maps/co/co_colorado.pdf (accessed: January, 2005). Denver Regional Council of Governments 2030 Metro Vision Regional Transportation Plan, 2004.*

3.1.1.2 Pedestrian/Bicycle Mobility

There are presently pedestrian and bicycle facilities throughout the study area. There is an existing bicycle/pedestrian trail along the east side of US 6 from C-470 to 19th Street, much of which is within the existing CDOT right-of-way. There are also trail segments located near 64th Avenue. There are existing bicycle/pedestrian trails along either side of Interlocken Loop between SH 128 and US 36. Pedestrian and bicycle mobility was included in the development of the build alternatives (see **Chapter 2**).

3.1.1.3 Transit Routes

The Denver RTD operates a network of regional, express, and local bus routes that serve the study area (see **Figure 3.1-2**). Regional bus route G travels SH 93 along the western edge of the study area. Additional north-south bus connections are provided via routes 76 (Wadsworth), 100 (Kipling), and east-west routes include 72 (72nd Avenue), 52 (52nd-Pearl), and CC (SH 72). There are twelve park-n-Ride facilities in and around the study area, including six in the US 36 corridor.

The RTD is currently implementing the FasTracks plan, a twelve-year comprehensive plan to build and operate high-speed rail lines and expand and improve bus service and park-n-Ride facilities throughout the region. The FasTracks plan includes two light rail corridors that will connect downtown Denver with the study area: the West Corridor, which will terminate at the Jefferson County Government Center at US 6/Johnson Road in Golden, and the Gold Line, which will terminate at I-70/SH 58 in Wheat Ridge. Two other rapid transit corridors are included in the US 36 corridor, with specific characteristics of those corridors being refined through the US 36 EIS process. Additionally, suburb-to-suburb bus service enhancements are planned along SH 93 from Golden to Boulder, as well as routes using SH 72, Wadsworth Boulevard, Kipling Street, and other study area streets.

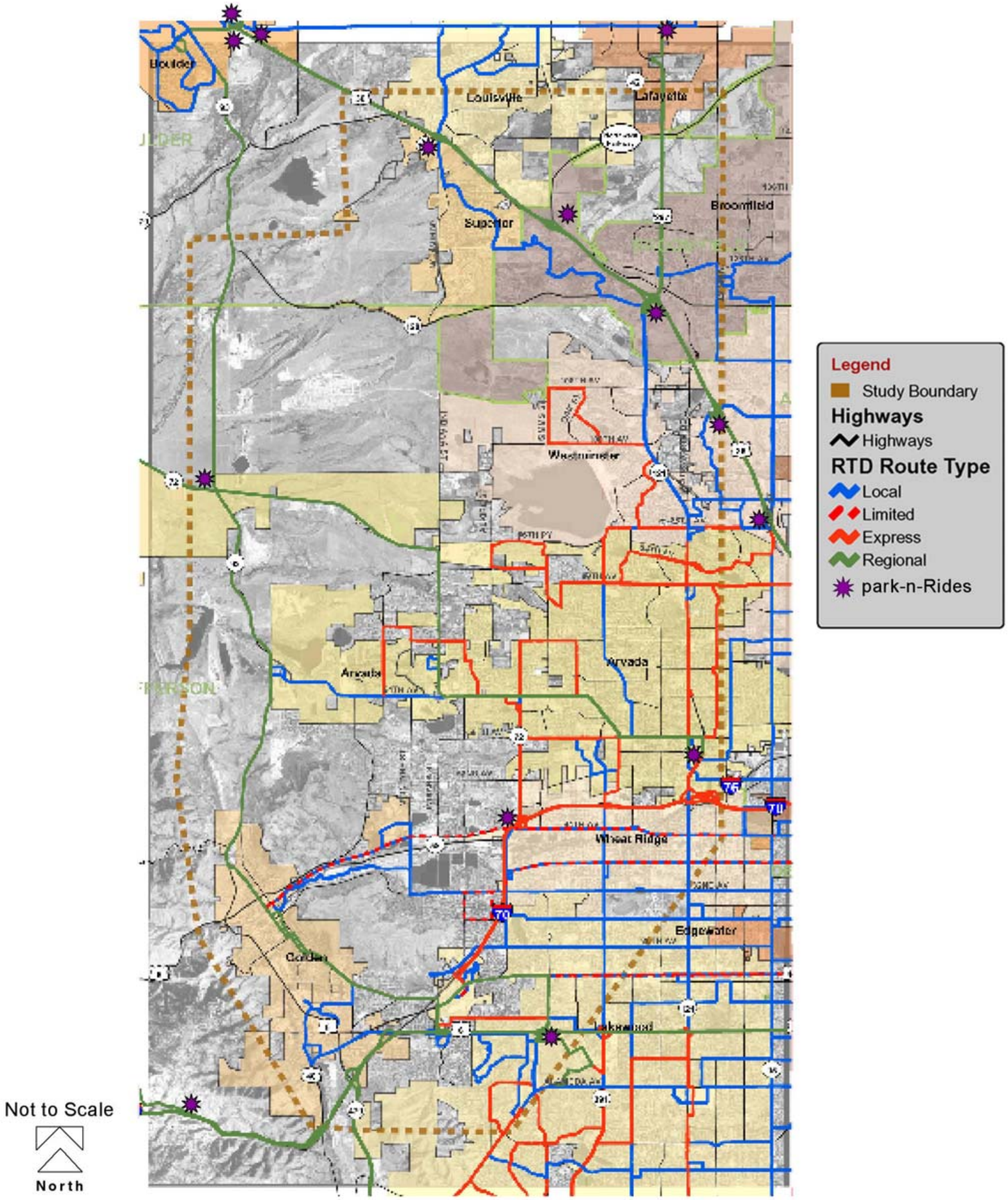
3.1.1.4 Rail

The Union Pacific Railroad currently operates an east-west line along the south side of SH 72. This line crosses beneath SH 93 and over Indiana Street. The Burlington Northern Santa Fe Railroad operates another east-west line located farther south, extending along SH 58. This line has its western terminus in Golden and crosses SH 58, Table Mountain Parkway, McIntyre Street and Ward Road (SH 72) at grade.

3.1.1.5 Aviation

The Rocky Mountain Metropolitan Airport (formerly the Jefferson County Airport) is a corporate/general aviation airport located southwest of the SH 128/Wadsworth Boulevard intersection. According to the Jeffco Airport Master Plan Update, prepared in 2000, the number of annual aircraft operations is forecast to increase from 164,000 in 1998 to approximately 241,000 in 2020.

Figure 3.1-2 Existing RTD Transit System



Source: RTD Geographic Information System Files, January 2005.

3.1.2 Existing Traffic Volumes

Traffic volume and vehicle classification data were collected to summarize existing levels of vehicle activity and the types of vehicles using the major corridors within the study area. This section provides a summary of the data in four categories:

- Historic growth patterns
- Daily traffic volumes
- Vehicle turning movements
- Vehicle classification

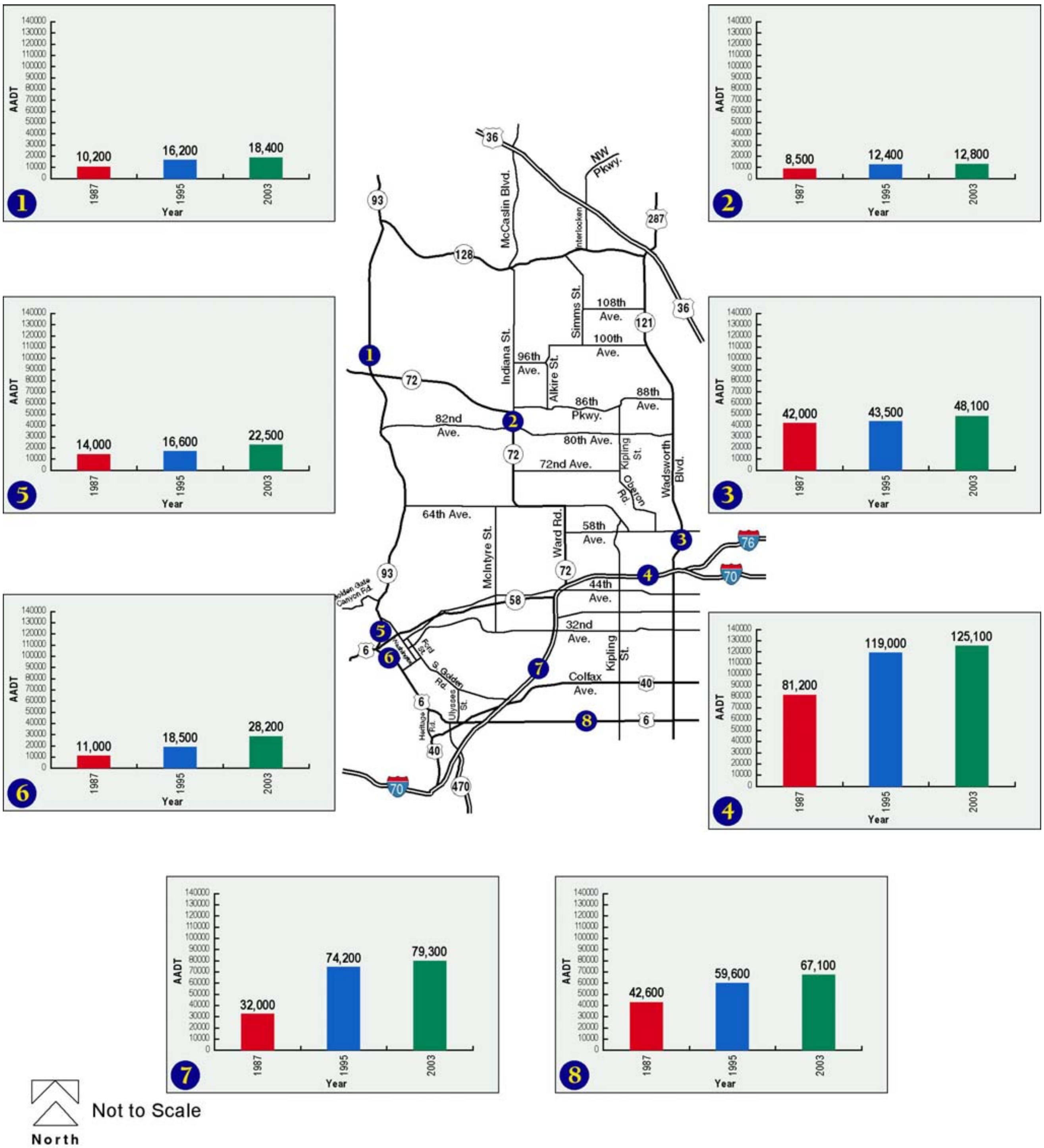
3.1.2.1 Historic Growth Patterns

Historic Average Annual Daily Traffic (AADT) volume data were obtained from CDOT along several of the state highways in the study area (CDOT, 2004). AADT means the total recorded traffic volume over the course of a full year divided by 365, including both weekdays and weekends. Volume data from 1987, 1995, and 2003 provide a view of traffic growth trends on the regional and inter-regional road system over a 16-year period (see **Figure 3.1-3**).

Data show that, with one exception, all roads measured have seen 50 percent or greater growth in traffic volumes over the 16-year period. Two locations, SH 93 south of SH 58 and I-70 west of SH 58, have seen more than a doubling of traffic volumes in that period. The one exception to the sharp growth trends is Wadsworth Boulevard north of I-70, which experienced relatively modest growth, from 42,000 vehicles per day in 1987 to 48,100 in 2003. The slow growth on Wadsworth Boulevard can be explained by the facts that much of the Wadsworth commercial corridor was fully developed in the 1980s and there are constraints on the ability of the existing Wadsworth Boulevard to efficiently accommodate additional traffic.

Several roadways in the study area experienced sharp growth rates between 1987 and 1995, with growth tapering off between 1995 and 2003. State Highway 93 traffic volumes grew at an annual rate of approximately six percent between 1987 and 1995, then slowed to approximately two percent between 1995 and 2003. Similarly, along SH 72, the growth rate changed from approximately five percent to less than one percent. Growth rates along I-70 north of Colfax Avenue dropped from approximately 11 percent to 1 percent. These decreasing growth rates reflect that these facilities have been carrying levels of traffic at or near their capacity for the past ten years and are not capable of acceptably accommodating much additional travel demand without widening or area roadway network improvements.

Figure 3.1-3 State Highway Traffic Volume History



Source: Compiled by FHU, 2005.

3.1.2.2 DAILY TRAFFIC VOLUMES

Daily traffic volumes were recorded along numerous corridor roadways or were compiled from available data from several sources. In contrast to the historic AADT volumes, all daily traffic volumes related to typical weekdays, except for those identified as being recorded on a Saturday or Sunday. Traffic volumes were collected from CDOT, the Northwest Parkway Public Highway Authority, and the US 36 EIS project. Additional traffic volumes were recorded during May 2004 to fill identified gaps (see **Figure 3.1-4**).

Weekday AM and PM peak hours are typically the most congested periods on urbanized area roads, and thus weekday volume data are generally used to assess levels of congestion or levels of service. Since some study area roadways carry substantial volumes of recreation-oriented traffic, Saturday and Sunday traffic counts were performed. Comparison of weekend traffic to weekday traffic volumes confirmed that weekday volumes are higher on study area roads; therefore, evaluation of typical weekday AM and PM peak periods is appropriate for this study.

Volume data show that the fully access-controlled freeway facilities of the National Highway System carry the largest volumes of traffic, including I-70, US 36, US 6 east of C-470, and C-470, with weekday traffic volumes ranging from 57,000 vehicles on I-70 west of C-470 to 136,000 vehicles on I-70 near Wadsworth Boulevard.

Among surface arterial streets the highest daily traffic volumes are found on Wadsworth Boulevard (more than 50,000 vehicles per day), US 6 west of its transition between a freeway and regional arterial (more than 40,000 vehicles per day), and Ward Road north of I-70 (37,000 vehicles per day).

3.1.2.3 VEHICLE TURNING MOVEMENTS

Weekday vehicle turning movements at intersections and interchange ramp terminals were recorded during both the AM and PM peak hours of vehicle activity. These vehicle counts were used to evaluate levels of service on the roadway system. Between 8 percent and 11 percent of total daily traffic volumes were found to occur in the peak hours on various study area roadways. Detailed information regarding these peak hour turning movements is provided (see **Northwest Corridor Supporting Technical Document-Transportation Analysis and Traffic Safety**).

3.1.2.4 VEHICLE CLASSIFICATIONS

Information was collected on the types of vehicles using the highways in the study area, including SH 93, US 6, SH 128, and SH 121 (see **Table 3.1-1**). Total truck percentages range from 6 percent to more than 10 percent of the vehicle mix, showing that substantial volumes of freight movements occur through the study area's regional and inter-regional road system. These vehicle classification data were also used in the levels of service analysis, as the presence of heavy vehicles in the traffic stream affects travel speeds and vehicle acceleration and deceleration.

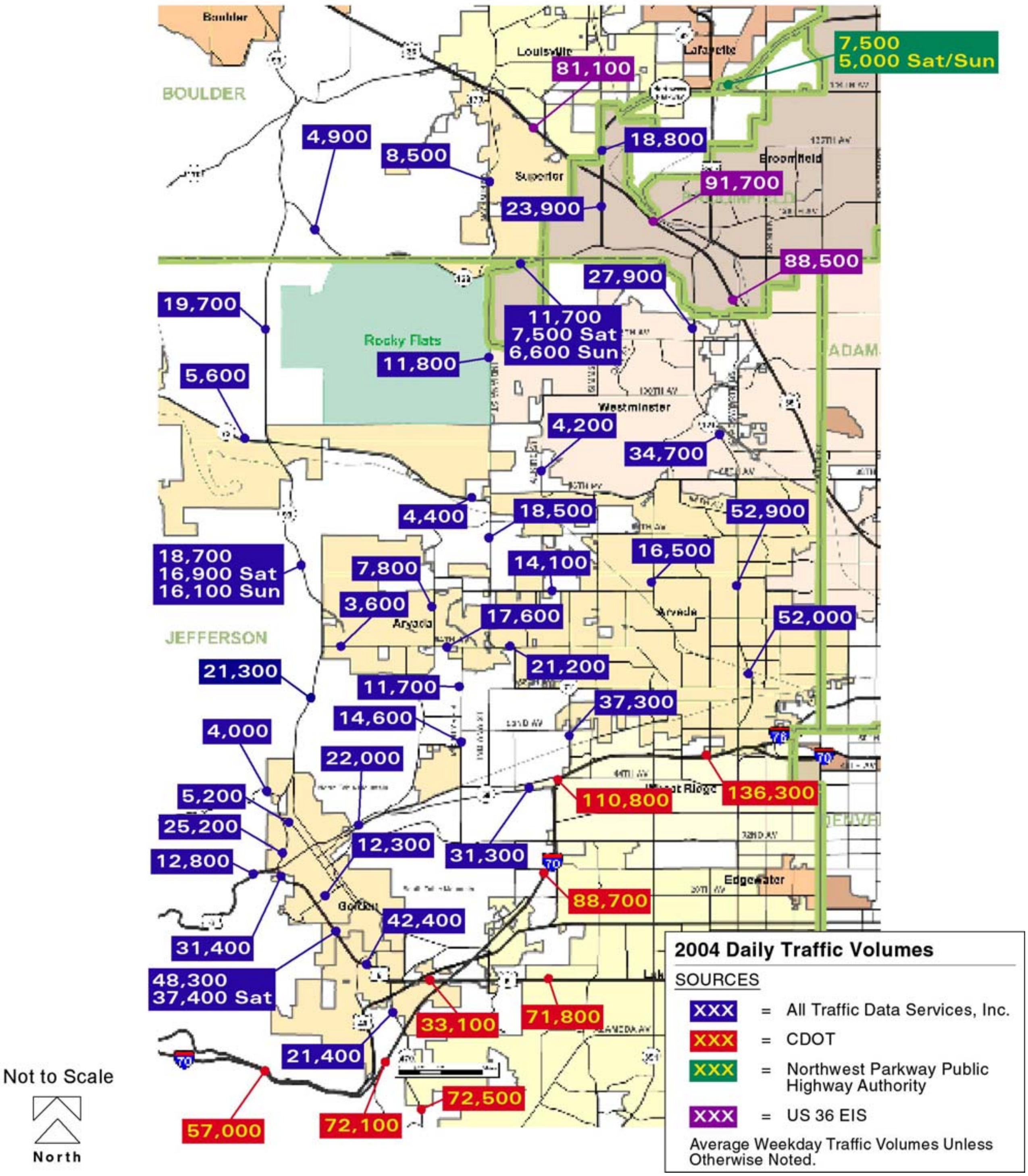
Table 3.1-1 Vehicle Classification

Location	Vehicle Type (Percentage)				
	Passenger Cars	Single-Unit Trucks	Multi-Axle Trucks	Other	Total
SH 93 North of 64th Avenue	87.5	9.7	1.1	1.7	100
US 6 South of 19th Street	90.5	5.5	2.8	1.2	100
SH 128 East of Indiana Street	92.6	4.7	1.3	1.4	100
SH 121 (Wadsworth Blvd.) North of 92nd Avenue	91.8	2.5	4.2	1.5	100

Source: Compiled by All Traffic Data Services, Inc. May 2004.

Northwest Corridor
A TRANSPORTATION ENVIRONMENTAL STUDY

Figure 3.1-4 Current Daily Traffic Volumes



3.1.3 Capacity Analysis

This section discusses the methodology and the existing levels of service for the study area.

3.1.3.1 Methodology

Analysis of traffic operations in the study area used methods documented in the *Highway Capacity Manual* (HCM) (Transportation Research Board, 2000). The analysis result is a level-of-service (LOS) rating, which is a qualitative assessment of the traffic flow for a given roadway facility. Level of service is described by letter designations ranging from A to F, with LOS A representing essentially uninterrupted flow, and LOS F representing a breakdown of traffic flow with excessive congestion and delay.

For analysis of a signalized intersection, a LOS rating is calculated for an intersection as a whole. Level of service analysis of an unsignalized intersection yields a LOS rating for each critical vehicle movement. The Synchro© software analysis package and methodology (Albeck and Husch, 2003) was utilized to calculate LOS ratings for signalized and unsignalized intersections throughout the study area. According to the software documentation, Synchro's© HCM signalized analysis provides a full implementation of the HCM (Transportation Research Board, 2000) Signalized Operations method. However, the Synchro© implementation does calculate the effects of signal progression and actuated signal green times differently than the HCM.

A LOS rating may also be calculated for mainline, merge, diverge, or weaving sections along a major freeway. Freeway levels of service were calculated using Highway Capacity Software.

3.1.3.2 Existing Level of Service

Level of service analyses were conducted for both the AM and PM peak hours of vehicle travel, and the peak hour with the poorer LOS is documented (see **Figure 3.1-5**). LOS calculations were prepared for each of the thirty-three intersections where vehicle turning movements were recorded, using the existing traffic volumes, intersection geometry, and signal timing.

Two of the thirty-three intersections are currently stop sign controlled (82nd Avenue/SH 93, and SH 93/56th Avenue), and both exhibit peak hour LOS F for their critical movement. No signalized intersections currently exhibit peak hour LOS F.

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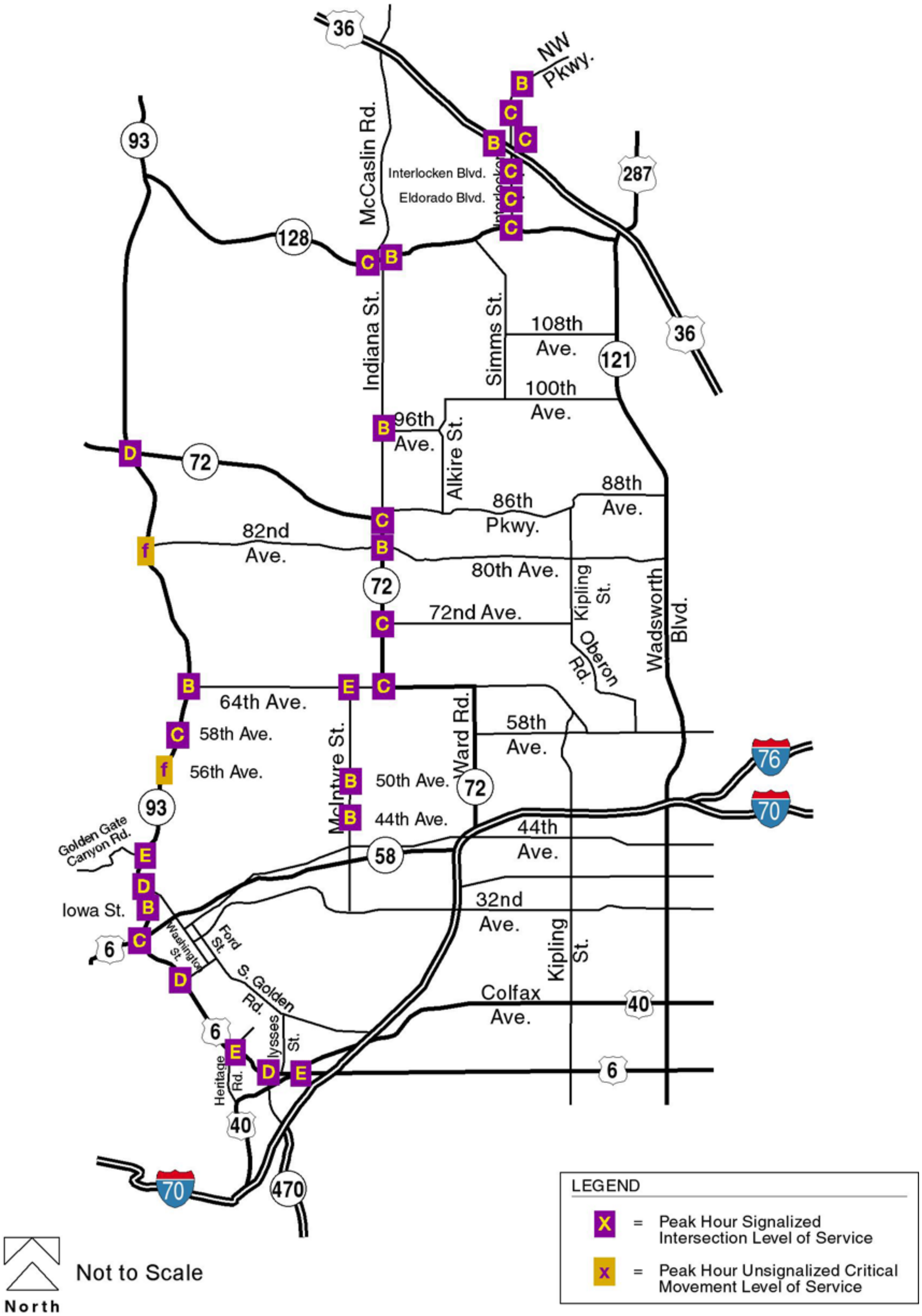
A TRANSPORTATION ENVIRONMENTAL STUDY

Figure 3.1-5 Intersection Levels of Service—Existing Conditions



3.1.4 DEMOGRAPHIC FORECASTS

DRCOG, as the Metropolitan Planning Organization for the Denver area, prepares demographic forecasts that are used as input into the regional travel demand forecasting model. DRCOG's demographic estimates and forecasts were used as a basis for the Northwest Corridor travel demand forecasts. These demographic forecasts are based on DRCOG's modeling of land use with the fiscally constrained RTP in place. Two important assumptions associated with the RTP should be noted. First, the RTP *does not* include a high-speed, north-south freeway or tollway connection in the study area. Second, the RTP *does* include RTD's FasTracks system of regional rapid transit corridors.

DRCOG has developed a regional system of transportation analysis zones (TAZs) to compile demographic data and to use as a foundation for regional travel modeling. A demographic study area to examine demographic data was defined by South Boulder Road on the north, Sheridan Boulevard on the east, US 6 and I-70 on the south, and TAZ boundaries that extend west of SH 93 on the west (see **Figure 3.1-6**).

Forecasts show a demographic study area increase of 26 percent in households and 42 percent in employment between 2005 and 2030 (see **Table 3.1-2**). DRCOG's forecasts for the entire Denver region project over a 50 percent increase in households and a 51 percent increase in employment over the same 25-year time frame. The study area has been allocated 6.3% of the forecasted regional growth in households and almost 10% of the forecasted regional growth in employment. The forecasted increase in inter-regional and regional travel demand in the northwest part of Denver flow directly from the projected study area and regional growth in households and employment.

Figure 3.1-6 Demographic Study Area

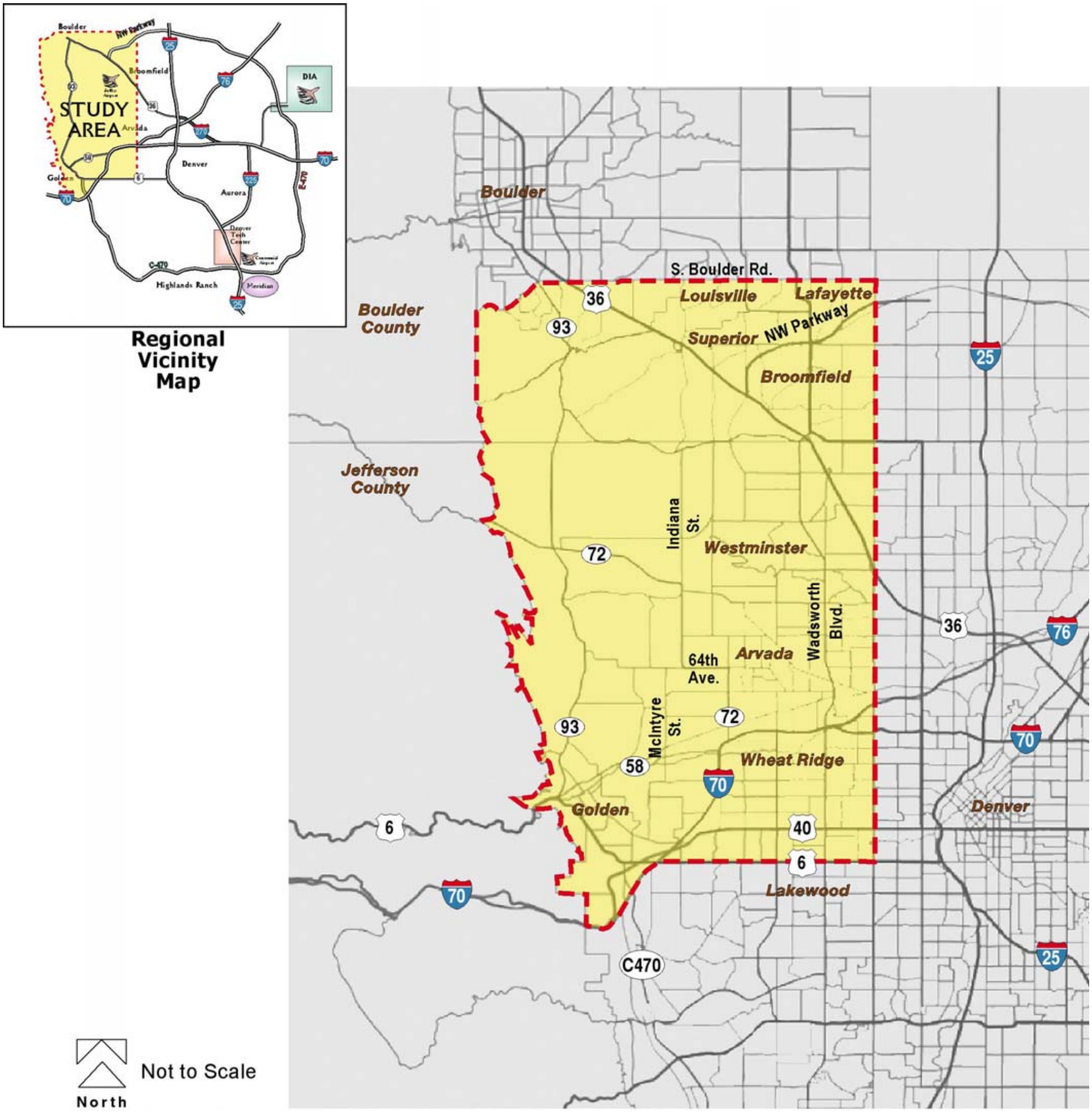


Table 3.1-2 Demographic Data and Forecasts

Area	2005		2030		2005 to 2030 Growth (%)	
	Households	Employment	Households	Employment	Households	Employment
Demographic Study Area	134,915	163,279	170,343	231,906	26.3	42.0
DRCOG Region	1,046,308	1,374,595	1,606,314	2,078,284	53.5	51.2

Source: DRCOG Compass Regional Travel Model Version 93 Modified, 2005a.

3.2 TRANSPORTATION PERFORMANCE EVALUATIONS

This section describes the transportation performance evaluations of the four build alternatives compared with the No Action Alternative. The section is organized around the four principal project needs included in **Chapter 1**:

- System Connectivity/Functionality
- Travel Demand/Capacity
- Travel Reliability
- Modal Interrelationships

3.2.1 SYSTEM CONNECTIVITY/FUNCTIONALITY

The System Connectivity/Functionality need is defined in **Chapter 1** as follows:

> *Enhance the corridor's inter-regional and regional system for a more direct, well-connected, and functional roadway system.*

Connectivity and functionality are key attributes of a roadway system that effectively serves the regional and inter-regional travel demand in the Northwest Corridor, from the vicinity of US 36 and the Northwest Parkway on the north to the vicinity of SH 58, I-70 and C-470 on the south. Connectivity refers to the directness and clarity of the system for regional and inter-regional travelers between the northern and southern ends of the Northwest Corridor. Functionality refers to the capability of the roadway system to provide service that is well suited to the longer distance trip demands for the regional and inter-regional roadway system. These system attributes are established through the regional planning process for the area's transportation system.

3.2.1.1 NO ACTION ALTERNATIVE

Deficiencies in the No Action Alternative with respect to System Connectivity/Functionality are described (see **Chapter 1**). With the No Action Alternative, there are three roadway corridors that provide paths between the northern and southern ends of the study area: SH 93, the Indiana Street/McIntyre Street/Ward Road corridor, and Wadsworth Boulevard. As described in the following sections, each of these routes has connectivity and functionality constraints that limit its ability to efficiently serve the regional and inter-regional travel demands in and through the Northwest Corridor.

SH 93 Route

System Connectivity afforded by SH 93 is limited on the north. While SH 93 provides a direct route into the City of Boulder on the north, it does not provide a direct route to the vicinity of US 36 and Northwest Parkway in the City and County of Broomfield. Traveling between SH 93 and the US 36/Interlocken Loop/Northwest Parkway interchange requires right angle turns using east-west surface arterial routes including SH 128 or SH 72. In addition, the use of SH 128 requires substantial out-of-direction travel around the west side of the Rocky Flats National Wildlife Refuge. Travel paths that include SH 72 require multiple turns, including SH 93/SH 72, SH 72/Indiana Street, Indiana Street/SH 128, and SH 128/Interlocken Loop intersections.

The SH 93 route does not provide functionality that is compatible with the regional and inter-regional functions delineated in the project's Purpose and Need. SH 93, and other east-west and north-south links that complete the path between the northern and southern ends of the corridor, are classified in the RTP as principal or minor arterials. Substantial portions of the paths are comprised of roads with relatively low design speeds that provide substantial local access functions for adjacent land uses. These characteristics are in contrast to the higher speed, limited access facilities, including US 36, the Northwest Parkway, I-70, and C-470, which form the surrounding regional and inter-regional roadway system. The local access functions of streets in the SH 93 route are in conflict with the ability of these same roads to efficiently serve the regional and inter-regional functions through the corridor.

Indiana Street/McIntyre Street and Indiana Street/Ward Road Routes

The Indiana Street/McIntyre Street route provides poor system connectivity throughout the corridor. On the northern end, connecting between Indiana Street and US 36 requires right-angle turns at the intersections of Indiana Street/SH 128 and SH 128/Interlocken Loop. In the middle of the corridor, Indiana Street and McIntyre Street are discontinuous at 64th Avenue, requiring turns at each street's intersection with 64th Avenue to continue north-south on the corridor. At the south end, the arterial street route ends at the McIntyre Street interchange with SH 58. This requires regional drivers wishing to access C-470 or I-70 to navigate turning movements through the McIntyre Street/SH 58 and SH 58/I-70 interchanges, traveling out of direction. An alternative route using Ward Road to connect between 64th Avenue and I-70 has better connectivity to I-70 but requires a longer out-of-direction component on 64th Avenue to connect between Indiana Street and Ward Road.

Neither the Indiana Street/McIntyre Street nor the Indiana Street/Ward Road route provide functionality that is compatible with the regional and inter-regional functions delineated in the project's Purpose and Need. These streets and other links completing the routes between the north and south ends of the corridor are classified in the RTP as principal or minor arterials. These streets have relatively low design speeds and provide substantial local access functions for adjacent land uses. These characteristics are in contrast to the higher speed, limited access facilities that form the surrounding regional and inter-regional roadway system, and their local access functions are in conflict with the ability of these same roads to efficiently serve the regional and inter-regional functions through the corridor.

Wadsworth Boulevard Route

Wadsworth Boulevard provides the most direct path between US 36 and I-70 with the No Action Alternative. Its deficiencies as a regional and inter-regional route lie primary in its functionality. In the approximately ten-mile length of Wadsworth Boulevard between US 36 and I-70, drivers making regional trips through the corridor encounter dozens of signalized intersections with major and minor cross-streets and commercial driveways. The signal timing necessary to accommodate heavy turning movements and the substantial peak period congestion at many of these intersections makes Wadsworth Boulevard an inefficient route for regional and inter-regional travel between the northern and southern ends of the study corridor.

3.2.1.2 FREEWAY ALTERNATIVE

The Freeway Alternative would create a direct connection between US 36 and the Northwest Parkway on the north and I-70 and C-470 on the south. Once accessing the Freeway Alternative from the north, the south, or anywhere within the study area, drivers could follow the route in either direction and connect directly to the surrounding regional and inter-regional roadway system at appropriate interchanges.

The Freeway Alternative would provide its users with a limited access, high-speed connection that is compatible with the functionality of the US 36 freeway and Northwest Parkway tollway facilities on the north and the I-70 and C-470 freeway facilities on the south.

3.2.1.3 TOLLWAY ALTERNATIVE

The Tollway Alternative would create a direct connection between US 36 and the Northwest Parkway on the north and I-70 and C-470 on the south. Once accessing the Tollway Alternative from the north, the south, or anywhere within the study area, drivers could follow the route in either direction and connect directly to the surrounding regional and inter-regional roadway system.

The Tollway Alternative would provide its users with a limited-access, high-speed connection that is compatible with the functionality of the US 36 freeway and Northwest Parkway tollway facilities on the north and the I-70 and C-470 freeway facilities on the south, while still maintaining the existing general purpose lanes.

3.2.1.4 REGIONAL ARTERIAL ALTERNATIVE

The Regional Arterial Alternative would create a continuous connection between US 36 and the Northwest Parkway on the north and I-70 and C-470 on the south. Once accessing the Regional Arterial Alternative from the north, the south, or anywhere within the study area, drivers could follow the route in either direction and connect directly to the surrounding regional and inter-regional roadway system. However, in comparison to the Freeway Alternative, Tollway Alternative, and Combined Alternative (Recommended Alternative), the alignment of the Regional Arterial Alternative is not as direct in the middle portion between SH 93 and Indiana Street.

The major regional arterial design of the Regional Arterial Alternative would provide functionality, including design speed and access-control characteristics, that is more compatible with the regional and inter-regional traffic-carrying project purpose than the No Action Alternative but not as fully compatible as the Freeway Alternative or Tollway Alternative. The signalized intersections on the Regional Arterial Alternative would reduce travel speeds and would be contrary to the uninterrupted travel flow that would be experienced on the existing freeway and tollway facilities to which the alternative would connect.

3.2.1.5 COMBINED ALTERNATIVE (RECOMMENDED ALTERNATIVE)

The Combined Alternative (Recommended Alternative) would create a direct connection between US 36 and the Northwest Parkway on the north and I-70 and C-470 on the south. Once accessing the Combined Alternative (Recommended Alternative) from the north, the south, or anywhere within the study area, drivers could follow the route in either direction and connect directly to the surrounding regional and inter-regional roadway system.

The Combined Alternative (Recommended Alternative) includes two major regional arterial portions along its alignment, including the southern portion (south of 58th Avenue) and the far northern portion (along Interlocken Loop, north of SH 128). These major regional arterial sections of the Combined Alternative (Recommended Alternative) would provide functionality, including design speed and access-control characteristics, that is more compatible with the regional and inter-regional traffic-carrying project purpose than the No Action Alternative and the Regional Arterial Alternative, but not as fully compatible as the Freeway Alternative or Tollway Alternative. The four signalized intersections in the southern portion of the alternative and the five signalized intersections in the northern portion of the alternative would reduce travel speeds and would be contrary to the uninterrupted travel flow that would be experienced on the freeway and tollway facilities to which the alternative would connect.

The Combined Alternative (Recommended Alternative) would also provide an enhanced principal arterial toward the center of the study area for additional network connectivity along the Indiana Street/McIntyre Street corridor.

3.2.1.6 TRAVEL TIME COMPARISON

Another measure of the connectivity and functionality of the alternatives is the time it would take drivers to travel between the northern and southern termini cited in the project's Purpose and Need. Traffic forecasting models were used to forecast the 2030 travel times between Interlocken Loop just south of US 36/Northwest Parkway and C-470 south of I-70 for each alternative. Four travel time forecasts were developed for each alternative, including northbound and southbound movements in the AM and PM peak hours. These travel times were recorded and the times for the four-direction/peak hour combinations were averaged to estimate the time savings associated with the four build alternatives (see **Table 3.2-1**).

Forecasts show that the Freeway Alternative and Tollway Alternative would provide the greatest travel-time savings compared with the No Action Alternative, saving 17.5 minutes and 16.8 minutes respectively, equivalent to a 42 percent savings for the Freeway Alternative and a 44 percent savings for the Tollway Alternative. The Regional Arterial Alternative and Combined Alternative (Recommended Alternative) would also generate substantial time savings, forecasted to be 9.6 minutes and 12.6 minutes respectively, equivalent to 23 percent savings for the Regional Arterial Alternative and a 33 percent savings for the Combined Alternative (Recommended Alternative).

Table 3.2-1 Travel Time Comparisons

Alternative	AM Peak Travel Time (minutes): Travel Time, North-Bound	AM Peak Travel Time (minutes): Travel Time, South-Bound	AM Peak: Difference vs. No Action (Time Saved)*, North-Bound	AM Peak: Difference vs. No Action (Time Saved)*, South-Bound	PM Peak Travel Time (minutes): Travel Time, North-Bound	PM Peak Travel Time (minutes): Travel Time, South-Bound	PM Peak: Difference vs. No Action (Time Saved)*, North-Bound	PM Peak: Difference vs. No Action (Time Saved)*, South-Bound	Average Travel Time AM and PM NB and SB: Average Travel Time	Average Travel Time AM and PM NB and SB: Difference vs. No Action (Time Saved)
No Action Alternative (DRCOG Model)	45.0	39.1	—	—	38.3	43.2	—	—	41.4	—
No Action Alternative (Wilbur Smith Model)	41.4	36.8	—	—	35.4	40.8	—	—	38.6	—
Freeway Alternative (DRCOG Model)	25.0	23.0	20.0	16.1	21.8	26.0	16.5	17.3	24.0	17.5
Tollway Alternative (Wilbur Smith Model)	22.6	20.9	18.8	15.9	20.8	22.9	14.6	17.9	21.8	16.8
Regional Arterial Alternative (DRCOG Model)	33.0	31.0	12.1	8.1	29.8	33.7	8.5	9.5	31.9	9.6
Combined Alternative (Recommended) (Wilbur Smith Model)	27.0	24.6	14.4	12.2	24.6	27.9	10.8	12.9	26.0	12.6

Note: *Travel times for the build alternatives with no tolling component (Freeway Alternative and Regional Arterial Alternative) were determined and compared with the No Action Alternative using the DRCOG Model and travel times for the build alternatives with a tolling component (Tollway Alternative and Combined Alternative) were determined and compared with the No Action Alternative using the Wilbur Smith Model.

Source: DRCOG Compass Regional Travel Model Version 93 Modified, 2005a, and Wilbur Smith Associates (WSA) TRANPLAN® Traffic Model with WSA Tolling Algorithm, converted from DRCOG Compass Regional Travel Model Version 93 Modified, 2005.

3.2.2 TRAVEL DEMAND/CAPACITY

The Travel Demand/Capacity need is defined in **Chapter 1** as follows:

> *Expand and enhance the system capacity to respond to future demand increases and improve inter-regional and regional movements of people, goods, and services.*

Evaluations relative to this project need are of two types: travel demand forecasts and level of service analyses.

3.2.2.1 TRAVEL DEMAND FORECASTS

DRCOG, as the Metropolitan Planning Organization for the Denver metropolitan area, is responsible for development of regional transportation plans and travel demand forecasting models for the metropolitan area. Traffic forecasts for the alternatives development process utilized DRCOG's most current Year 2030 model at the time as a basis, Compass Model Version 93 Modified (DRCOG, 2005a). Version 93 modified of the DRCOG model used Version 4.7 Build 249 of the TransCAD® software (Caliper Corporation, 2004). The model reflects the current adopted year 2030 fiscally constrained Regional Transportation Plan (RTP).

For the three alternatives that do not include tollways (No Action Alternative, Freeway Alternative, and Regional Arterial Alternative), the DRCOG model was used for the entire modeling process. The modeling process included all parameters and procedures prescribed by DRCOG, including feeding congested speeds through the trip distribution step until speed balancing is achieved (DRCOG, 2005b).

A post-processing step was applied to modeled forecasts, using the calibration procedures presented in the *National Cooperative Highway Research Program, Report 255* (NCHRP, 1982) and prescribed by DRCOG. This process uses a comparison between a 2005 base model and existing traffic volumes to develop adjustment factors that can be applied to modeled forecasts. These adjustments were made to all existing roadways for which traffic count volume was available. Adjustments were not made to the alternative roadways themselves, since there are no base year count data for alternative future roadways.

For the two alternatives that include tollways (Tollway Alternative and the Combined Alternative [Recommended Alternative]), a special assignment procedure was used to develop the 2030 forecasts. Wilbur Smith Associates (WSA) utilized the TRANPLAN® equilibrium software, which has been enhanced to include WSA market share traffic diversion routines, specifically designed to emulate motorists' willingness to pay tolls at varying toll levels and congestion conditions. Use of these WSA modeling techniques for alternatives with tollway elements was discussed with DRCOG.

WSA directly converted the Tollway Alternative and Combined Alternative (Recommended Alternative) TransCAD® networks into TRANPLAN® format. The vehicle trip tables from the Freeway Alternative model run were converted and used in the toll assignments for the Tollway Alternative and Combined Alternative (Recommended Alternative) model runs. DRCOG modeling parameters were transferred to the WSA modeling procedure for consistency. A series of traffic assignments were run using the two models to ensure compatibility of results. Minor calibration adjustments were made to the traffic network to bring the WSA model results within 5 to 10 percent of the DRCOG model.

Traffic assignments were run at 2030 levels for the Tollway Alternative and Combined Alternative (Recommended Alternative) under tolled conditions. WSA was able to utilize value-of-time parameters for each traffic zone, which were recently developed for a comprehensive traffic and revenue study for E-470. Estimates of traffic and annual toll revenue for both alternatives were produced for 2030 at per-mile toll rates consistent with those recently estimated to occur by 2030 on E-470.

To estimate the traffic impacts of the toll alternatives on other roadways such as Wadsworth Boulevard and Ward Road, WSA ran a No Action Alternative in TRANPLAN®. These build versus no-build impacts were then applied to the DRCOG-based No Action Alternative forecasts to provide consistency with other non-toll alternatives that were run in the DRCOG modeling platform.

DRCOG is in a continual process of refining its modeling procedures, including procedures to forecast toll diversion and tollway traffic volumes. When model refinements, including refined tollway forecasting procedures, have been incorporated by DRCOG, those procedures will be incorporated to the extent possible in the Northwest Corridor tollway alternatives forecasting for the remainder of the study process.

INDUCED DEMAND

Major transportation facility investments such as the Northwest Corridor build alternatives have the potential to induce additional travel demand within the corridor. One component of induced travel demand can be induced growth and development. As described earlier, the DRCOG demographic forecasts upon which forecasts for this study are based is predicated on the No Action Alternative (see **Section 3.1.4**). The potential for a build alternative to induce additional demographic growth is discussed in the Land Use section of this document (see **Section 4-1**). Evaluation of induced demographic growth potential revealed that implementation of any build alternative would only affect the rate of growth in limited portions of the study area.

Other components of induced demand relate to the attraction of a larger share of the fixed number of trips onto the Northwest Corridor build alternative alignments. These components of induced demand are reflected in the trip distribution and traffic assignments steps in the modeling process.

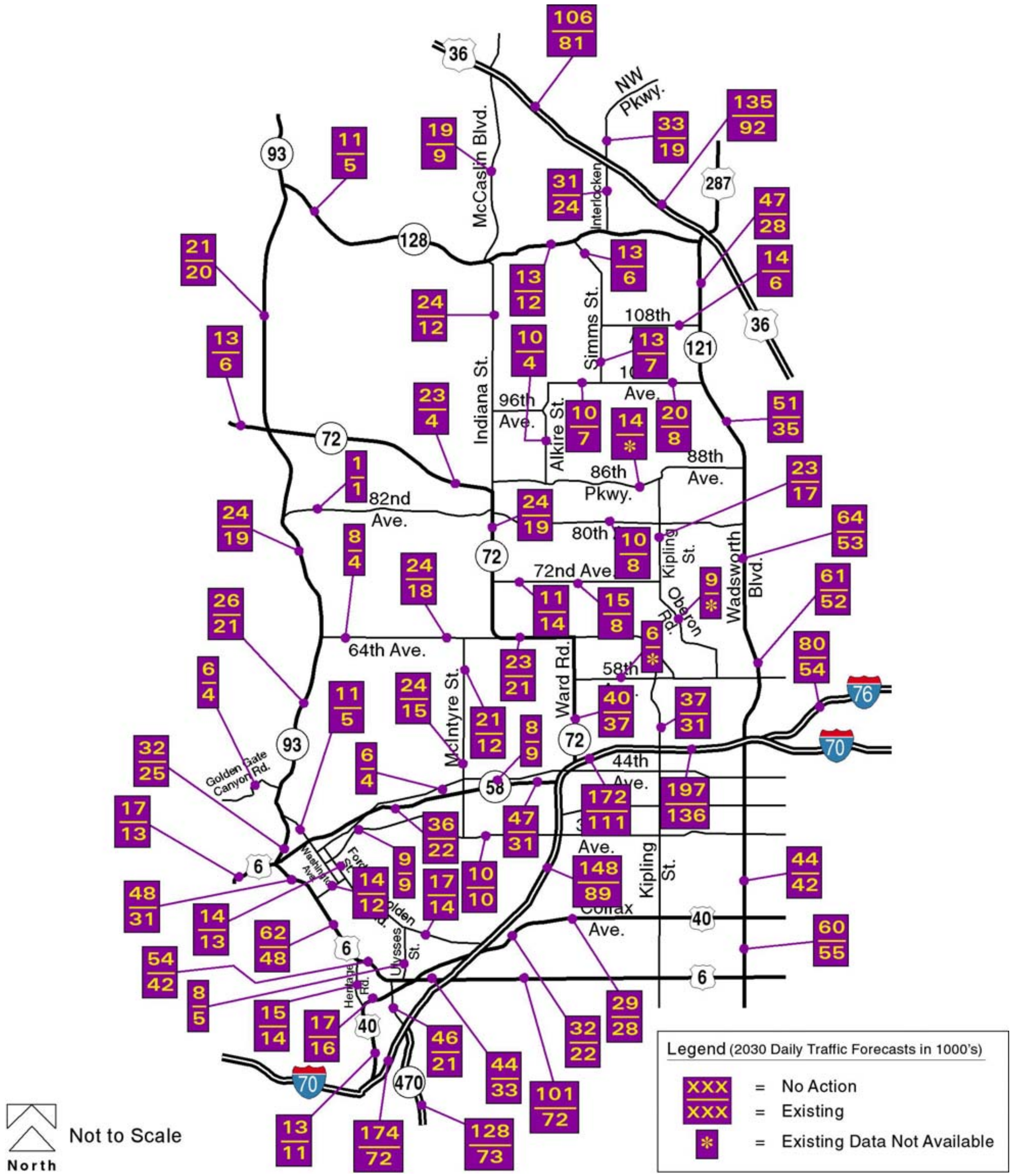
3.2.2.2 NO ACTION ALTERNATIVE TRAFFIC FORECASTS

Using the modeling procedures described in previous sections, traffic forecasts were prepared for the No Action Alternative. 2030 daily traffic volume forecasts for the No Action Alternative were compared with existing daily traffic volumes (see **Figure 3.2-1**). The No Action Alternative includes only existing and committed transportation facilities within the study area. To construct the No Action Alternative network from the DRCOG 2030 model network, certain roadway improvements that are not committed for the short term had to be removed, including the conversion of segments of SH 93, SH72, Indiana Street, and McIntyre Street to four lanes. Outside of the study area, the DRCOG model network was not modified.

Only moderate growth in daily volumes is forecasted between now and 2030 on some roads that are currently near capacity or that access fully developed areas, such as segments of Wadsworth Boulevard and the part of SH 93 north of SH 128. On other roads, such as segments of SH 72 and Indiana Street, adjacent development is forecasted to cause traffic volumes to double or more than double.

Peak hour intersection turning movement forecasts were developed for the No Action Alternative and the build alternatives using the model-generated roadway link forecasts, existing turning movement patterns, and NCHRP 255 balancing procedures, and adjustments to balance through the system. Detailed procedural steps and resulting intersection turning movement volumes are documented (see **Northwest Corridor Supporting Technical Document- Transportation Analysis and Traffic Safety**).

Figure 3.2-1 Traffic Forecast Comparison—2030 No Action Alternative vs. Existing Traffic



3.2.2.3 Build Alternatives Traffic Forecasts

Year 2030 traffic volume forecasts were developed for each of the four build alternatives. Forecasts for each were compared with the 2030 No Action Alternative on major roadways in and surrounding the study area (see **Figure 3.2-2**, **Figure 3.2-3**, **Figure 3.2-4**, and **Figure 3.2-5**). Forecasts on the build alternative alignments themselves are highlighted on these maps.

The Freeway Alternative 2030 daily traffic volume forecasts are the greatest of the alternatives, with forecasts ranging from 108,000 vehicles per day (vpd) at the southern end of the corridor to 29,000 vpd on the northern end, where the Freeway Alternative includes a pass-through section parallel to Interlocken Loop (see **Figure 3.2-2**).

The Tollway Alternative 2030 forecasts range from 39,000 vpd at the southern end to 18,000 vpd at the northern end of the corridor (see **Figure 3.2-3**).

The Regional Arterial Alternative 2030 forecasts range from 78,000 vpd in the southern part of the corridor to 22,000 vpd along the SH 128 portion of the alignment toward the northern end of the corridor (see **Figure 3.2-4**).

The Combined Alternative (Recommended Alternative) 2030 forecasts range from 69,000 vpd in the southern part of the corridor to 46,000 vpd along Interlocken Loop (see **Figure 3.2-5**). The principal arterial portion of this alternative along Indiana Street and McIntyre Street is forecast to carry between 30,000 vpd and 41,000 vpd.

Daily forecasts for the alternatives were compared across three screenlines measuring north-south travel (see **Figure 3.2-6**). Screenlines are imaginary lines drawn across an area used to measure traffic (north-south traffic in this case) along a number of parallel roadways. Year 2030 daily traffic forecasts were recorded for each of the major study area roads that cross these screenlines, and then the forecasted traffic volumes across these screenlines were totaled (see **Table 3.2-2**). To show the effects of the build alternatives on roadways beyond the study area, the screenline through the middle of the corridor (between 80th Avenue and 72nd Avenue) was extended to the east to include Sheridan Boulevard, Federal Boulevard, Pecos Street, and I-25.

These comparisons show that all build alternatives would add to the total traffic across screenlines, but reduce traffic forecasts on individual parallel roads. On average, the No Action Alternative would accommodate 26,000 fewer north-south vehicle trips per day through the southern portion of the study area and 30,000 fewer through the northern portion of the study area. Of the alternatives, the Freeway Alternative provides the greatest reduction for the other roads and adds the highest increment to the screenline totals.

The middle screenline can provide an illustration of the effects of the Freeway Alternative and other alternatives. Compared with the No Action Alternative, the Freeway Alternative would increase the total north-south travel across the middle screenline by an estimated 45,000 vpd from 533,000 with No Action to 578,000 with the Freeway Alternative. The freeway alignment would carry a forecasted 56,000 vpd. The Freeway Alternative would reduce traffic volumes on the other parallel facilities by a total of 11,000 vpd, yielding the total screenline addition of 45,000 vpd.

The Tollway Alternative would add 28,000 vpd to the No Action middle screenline total, accommodating 30,000 vpd along the tollway alignment itself. The Regional Arterial Alternative is projected to convey 40,000 vpd along its alignment, with a total middle screenline traffic volume of 17,000 vpd greater than the No Action Alternative. The Combined Alternative (Recommended Alternative) would add 31,000 vpd to the middle screenline, accommodating 23,000 vpd along its alignment.

The higher travel demand forecasted to occur with the Freeway Alternative indicates that this alternative represents the most attractive build alternative for vehicles traveling north-south through the study area. The other build alternatives are less attractive options and are less effective in expanding the capability of the system to move people, goods, and services.

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Figure 3.2-2 Traffic Forecast Comparison—2030 No Action Alternative vs. Freeway Alternative

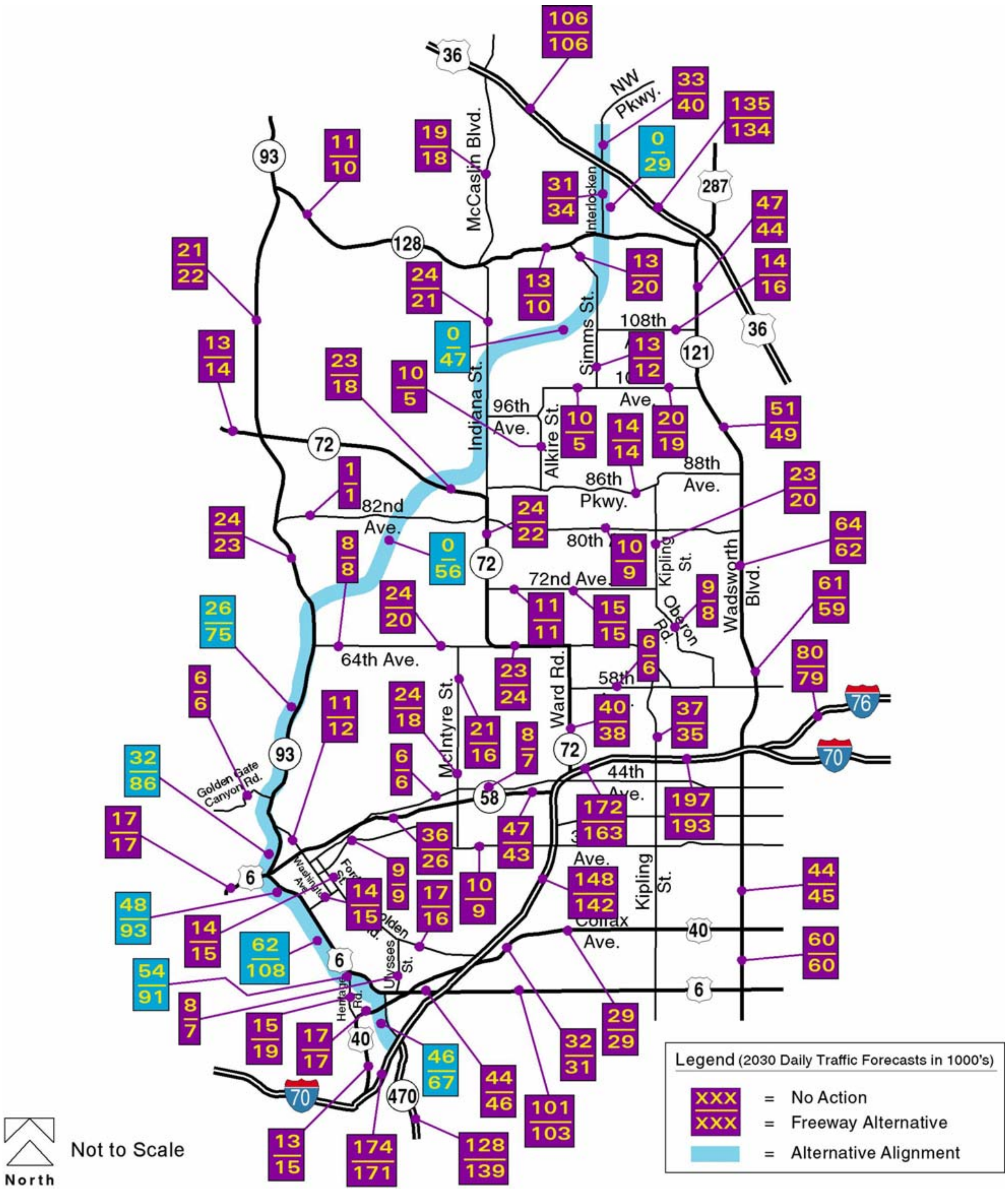


Figure 3.2-3 Traffic Forecast Comparison—2030 No Action Alternative vs. Tollway Alternative

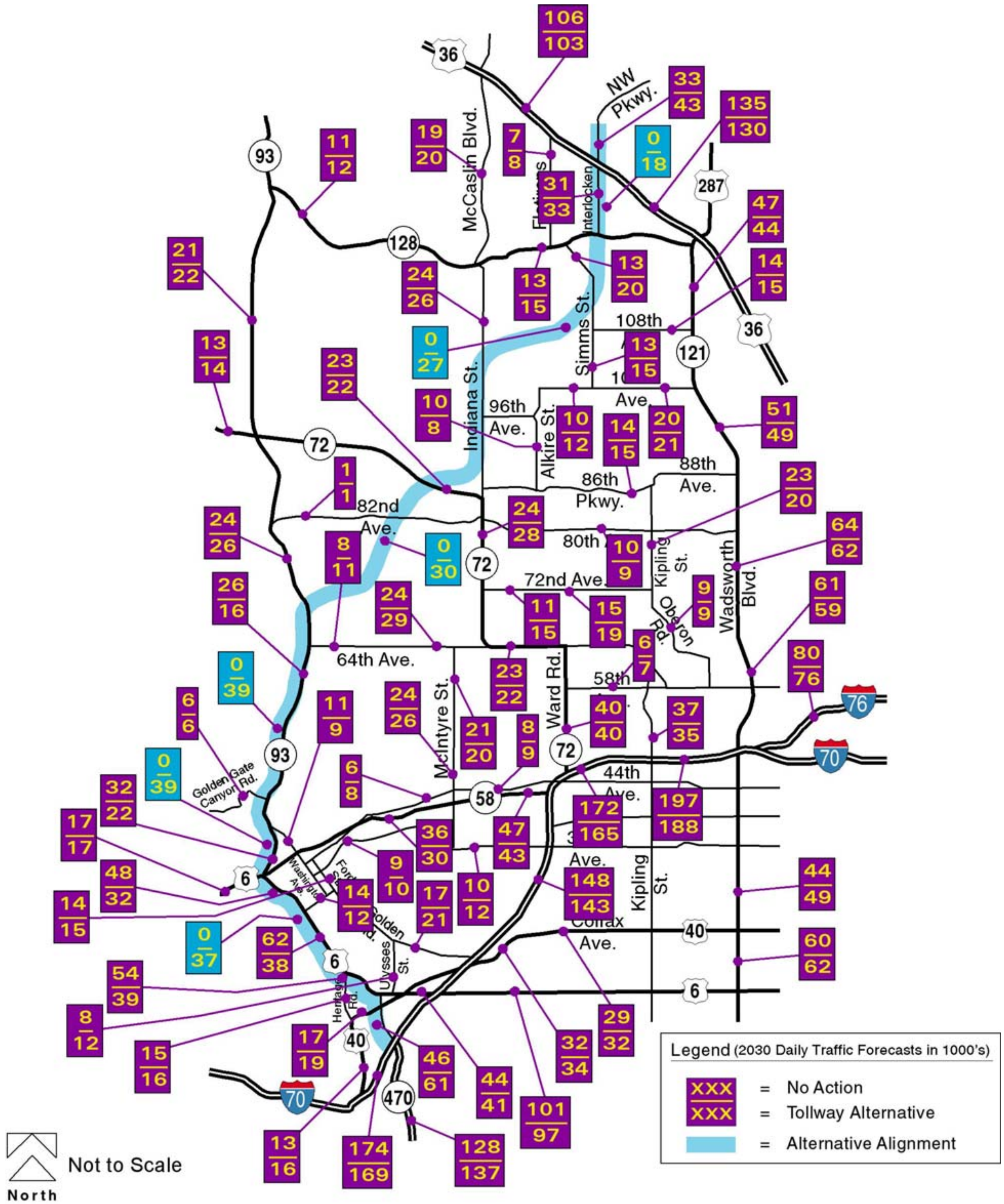


Figure 3.2-4 Traffic Forecast Comparison—2030 No Action Alternative vs. Regional Arterial Alternative

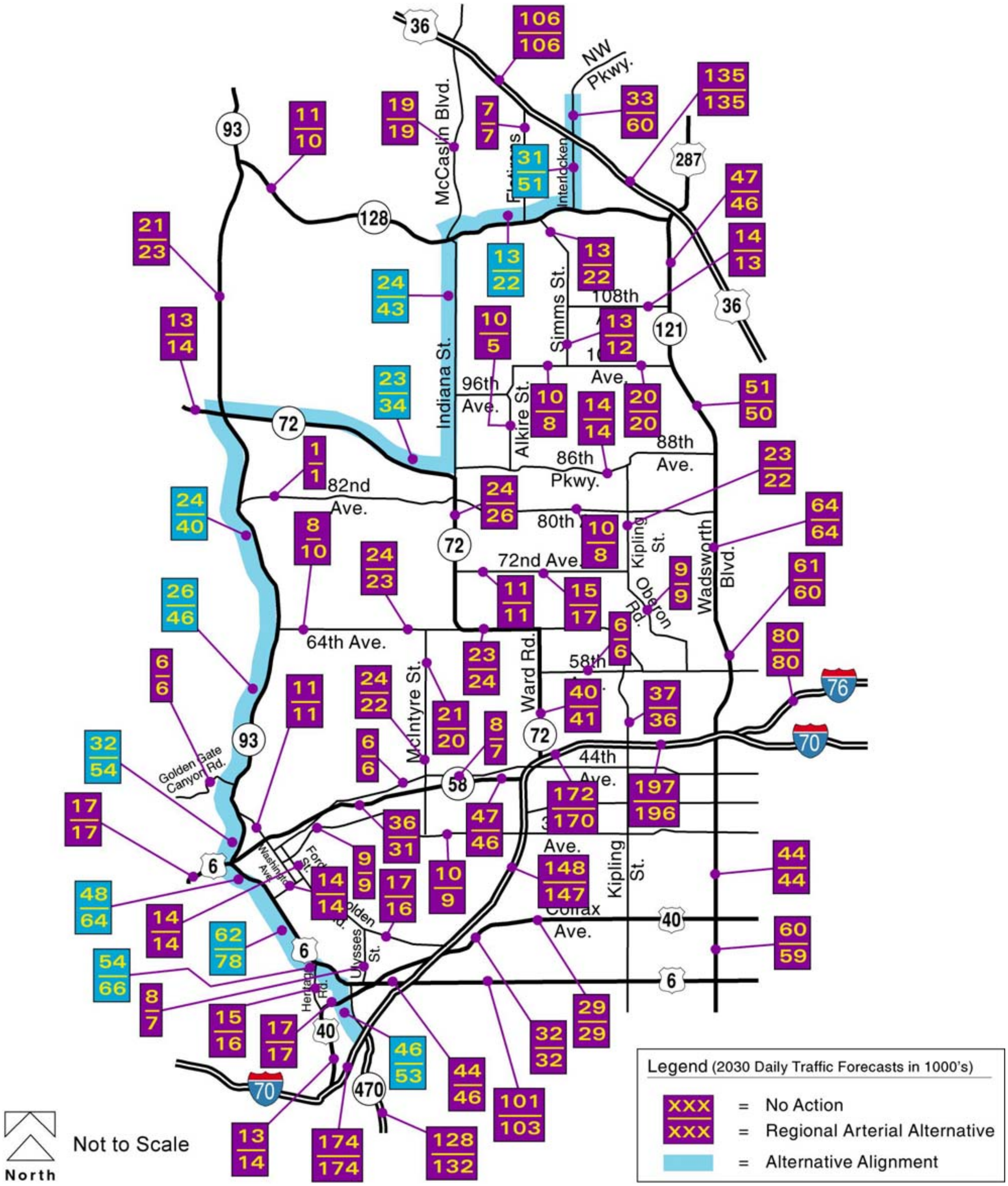


Figure 3.2-5 Traffic Forecast Comparison—2030 No Action Alternative vs. Combined Alternative (Recommended Alternative)

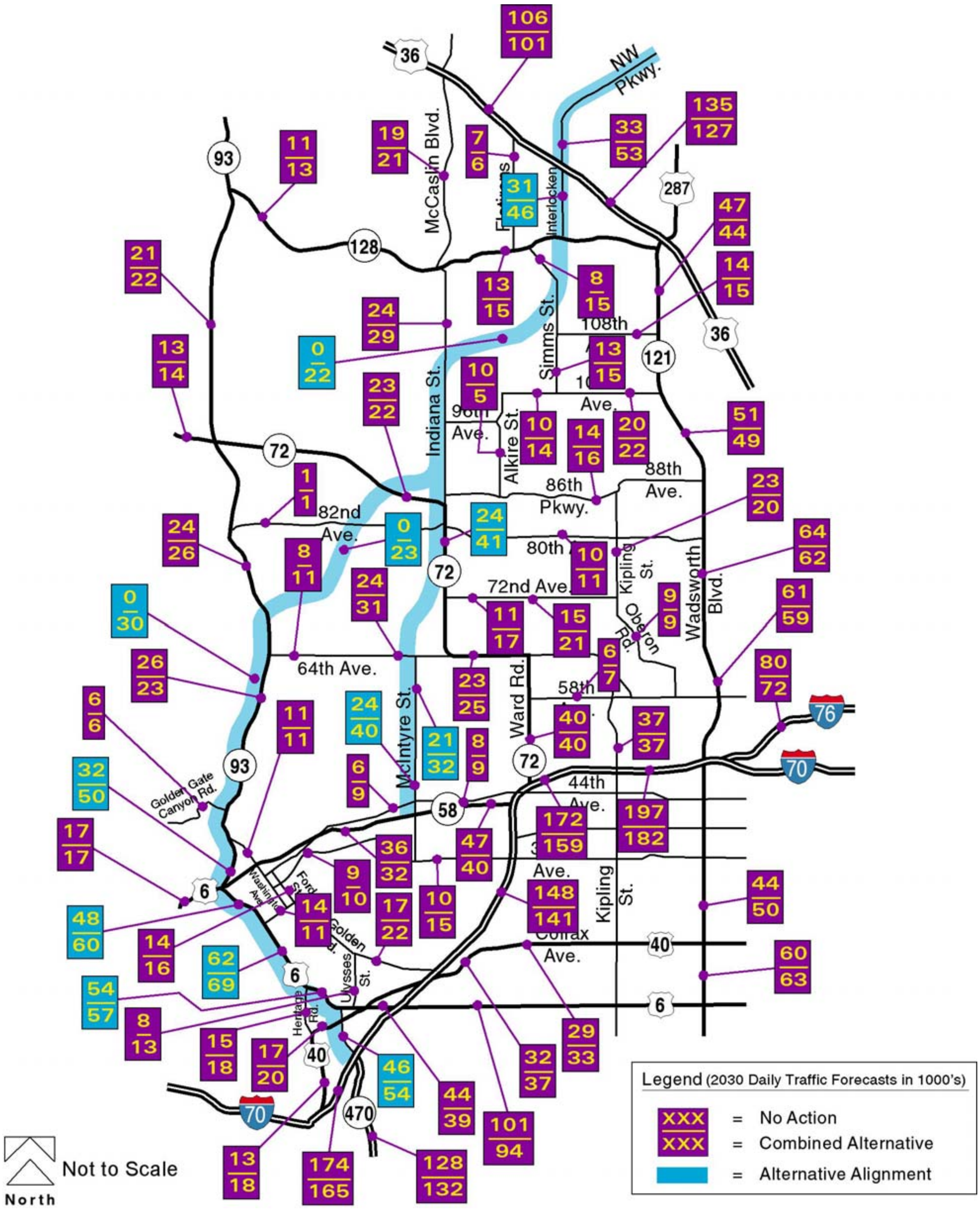


Figure 3.2-6 Screenline Locations

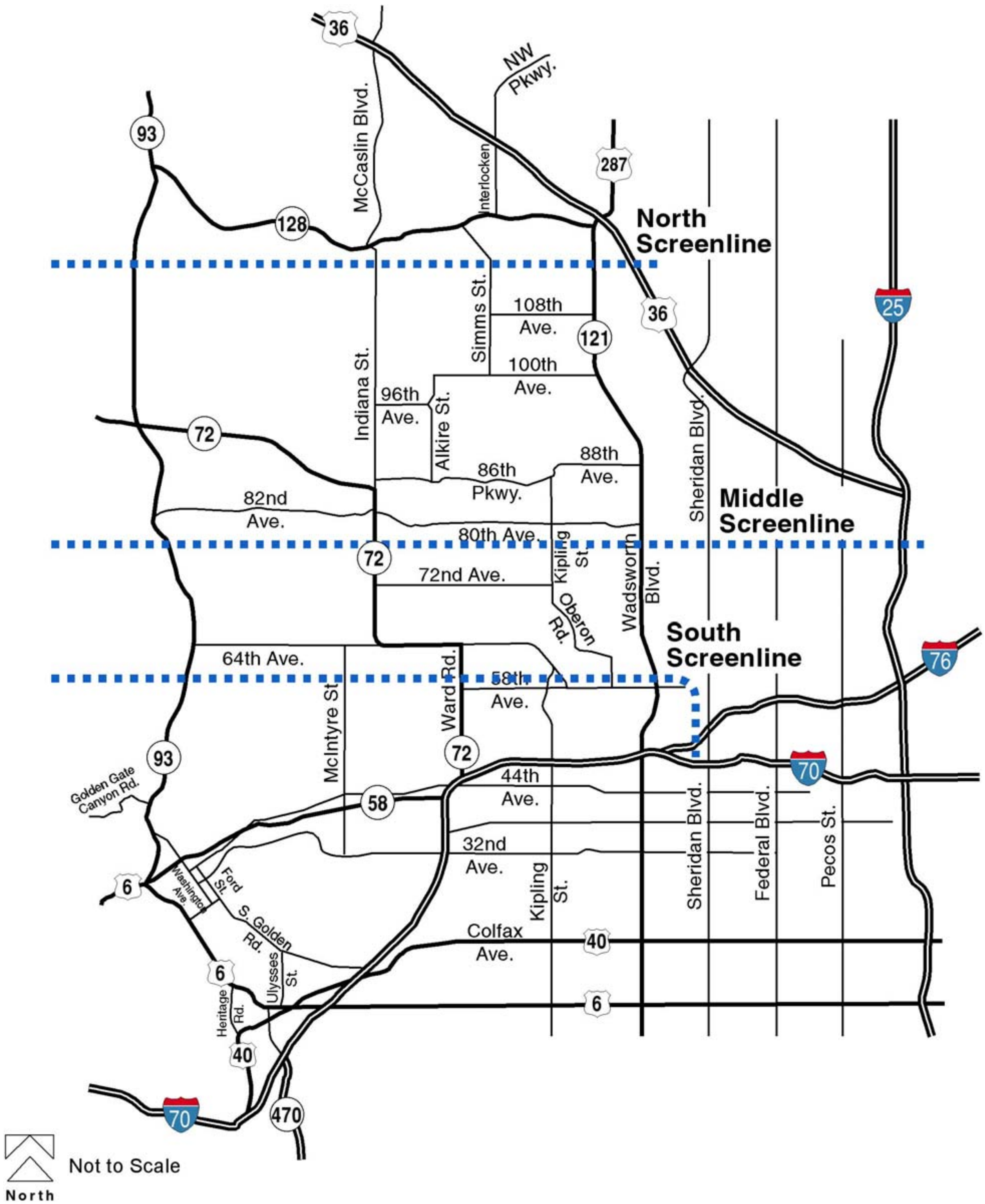


Table 3.2-2 Traffic Forecast Comparisons

2030 Daily Traffic Forecasts						
Screenline	**Road**	**No Action Alternative**	**Freeway Alternative**	**Tollway Alternative**	**Regional Arterial Alternative**	**Combined Alternative (Recommend)**
North Screenline (South of SH 128)	SH 93[1]	21,000	22,000	22,000	23,000	22,000
	Indiana Street[1]	24,000	21,000	26,000	N/A	29,000
	Alternative Roadway[2]	N/A	47,000	27,000	43,000	22,000
	Simms Street[1]	8,000	15,000	14,000	17,000	17,000
	Wadsworth Boulevard[1]	47,000	44,000	44,000	46,000	44,000
	US 36[2]	168,000	166,000	158,000	167,000	154,000
	Screenline Total	**268,000**	**315,000**	**291,000**	**296,000**	**288,000**
Middle Screenline (South of SH 72 – 86th Parkway – 88th Avenue)	SH 93[1]	24,000	23,000	26,000	N/A	26,000
	Alternative Roadway[2]	N/A	56,000	30,000	40,000	23,000
	Indiana Street[1]	24,000	22,000	28,000	26,000	41,000
	Kipling Street[1]	23,000	20,000	20,000	22,000	20,000
	Wadsworth Boulevard[1]	64,000	62,000	62,000	64,000	62,000
	Sheridan Boulevard[2]	46,000	45,000	44,000	46,000	45,000
	Federal Boulevard[2]	66,000	65,000	63,000	65,000	64,000
	Pecos Street[2]	46,000	45,000	45,000	46,000	45,000
	I-25[2]	240,000	240,000	243,000	241,000	238,000
	Screenline Total	**533,000**	**578,000**	**561,000**	**550,000**	**564,000**
South Screenline (South of 64th Avenue)	SH 93[2]	26,000	N/A	16,000	N/A	23,000
	Alternative Roadway[2]	N/A	75,000	39,000	46,000	30,000
	McIntyre Street[1]	21,000	16,000	20,000	20,000	32,000
	Ward Road[1]	40,000	38,000	40,000	41,000	40,000
	Kipling Street[1]	37,000	35,000	35,000	36,000	37,000
	Wadsworth Boulevard[1]	61,000	59,000	59,000	60,000	59,000
	I-76[1]	80,000	79,000	76,000	80,000	72,000
	Screenline Total	**265,000**	**302,000**	**285,000**	**283,000**	**293,000**
Total of 3 Screenlines	**Grand Total**	**1,066,000**	**1,195,000**	**1,137,000**	**1,129,000**	**1,145,000**

Notes: [1]Forecast using post-processing adjustments.
[2]Forecast based on unadjusted model volume.
N/A indicates the listed roadway would not exist with that alternative.

Source: *DRCOG Compass Regional Travel Model Version 93 Modified, 2005a, and Wilbur Smith Associates (WSA) TRANPLAN® Traffic Model with WSA Tolling Algorithm, converted from DRCOG Compass Regional Travel Model Version 93 Modified, 2005.*

3.2.2.4 LEVEL OF SERVICE ANALYSES

2030 NO ACTION ALTERNATIVE

As with the existing conditions operational assessment, analysis of forecasted 2030 traffic operations in the study area utilized methods documented in the HCM. The LOS results for the No Action Alternative are depicted graphically (see **Figure 3.2-7**).

Analysis of projected 2030 traffic conditions at the surface street intersections reflects a general pattern of worsened operational conditions (see **Table 3.2-3**). Of the 28 analyzed intersections, twelve of the signalized intersections and both of the unsignalized intersections are expected to operate at LOS F during either the AM or PM peak hour. The table summarizes the 2030 No Action Alternative signalized intersection results along with existing conditions. The average intersection delay calculated by the HCM methodology is shown in parentheses for those intersections shown to operate at LOS F.

An average intersection delay in excess of 80 seconds per vehicle results in LOS F. Several intersections are anticipated to operate well above 80 seconds of delay. For example, an average delay of 130 seconds per vehicle is anticipated during the PM peak hour at the intersection of SH 93 and SH 72.

Figure 3.2-7 2030 Intersection Levels of Service—No Action Alternative

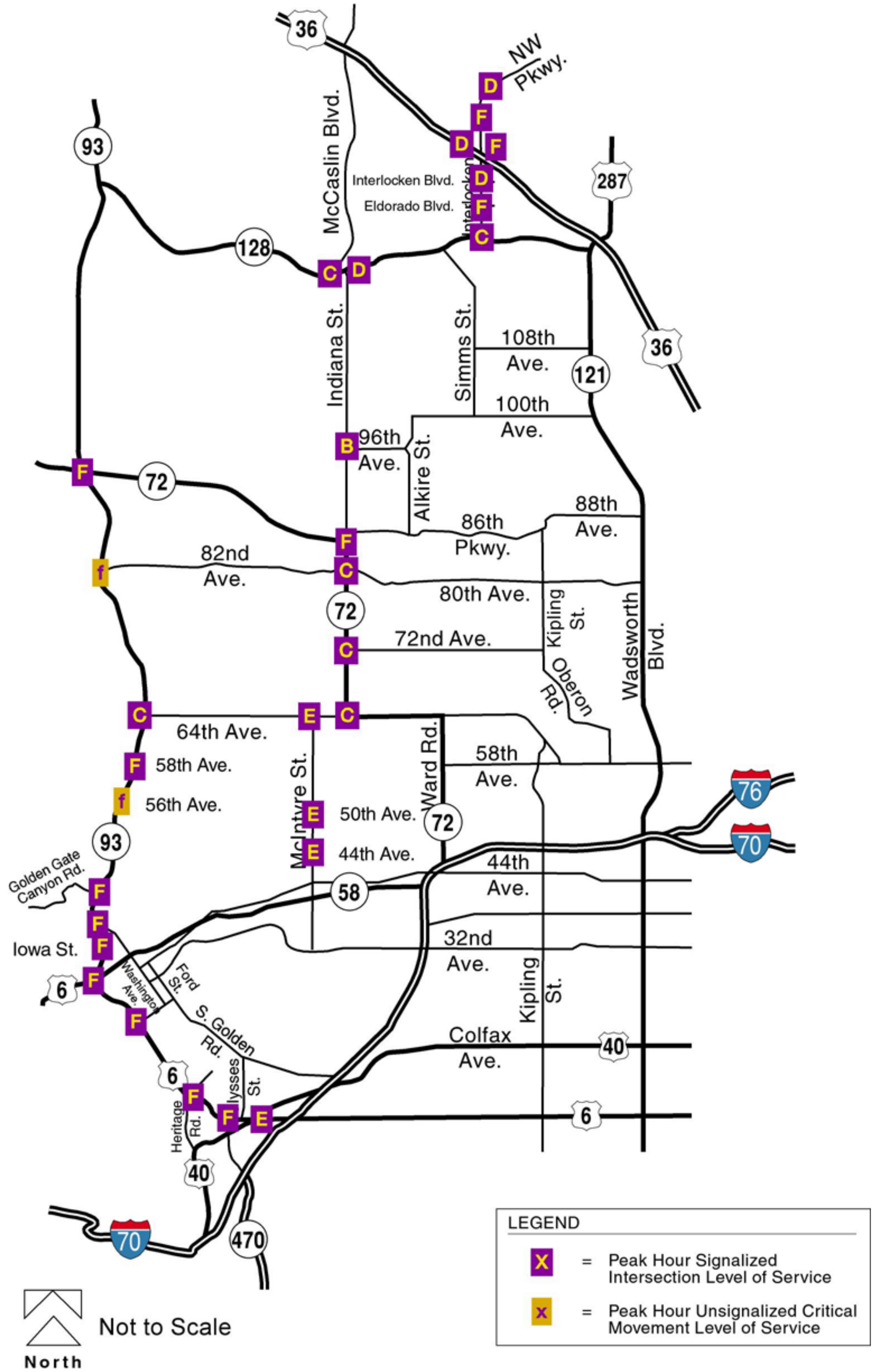


Table 3.2-3 Existing and 2030 No Action Alternative Intersection Levels of Service

Intersection	Level of Service (Average Delay per Vehicle in Seconds for LOS F Intersections)	
	Existing	2030 No Action
	Critical Peak Hour Level of Service	
96th Street/Tape Drive	C	**F**
96th Street/Northwest Parkway	B	D
96th Street/WB US 36 Ramps	C	**F(117)**
96th Street/EB US 36 Ramps	B	D
Interlocken Loop/Interlocken Boulevard	C	D
Interlocken Loop/Eldorado Boulevard	C	**F (90)**
Interlocken Loop/SH 128	C	C
McCaslin Boulevard/SH 128	C	C
Indiana Street/SH 128	B	D
Indiana Street/96th Avenue	B	B
SH 93/SH 72	D	**F (130)**
Indiana Street/SH 72	C	**F(98)**
SH 93/82nd Avenue	**f**	**f**
Indiana Street/80th Avenue	B	C
Indiana Street/72nd Avenue	C	C
SH 93/64th Avenue	B	C
McIntyre Street/64th Avenue	E	E
Indiana Street/64th Avenue	C	C
SH 93/58th Avenue	C	**F (193)**
SH 93/56th Avenue	**f**	**f**
McIntyre Street/50th Avenue	B	E
McIntyre Street/ 44th Avenue	B	E
Golden Gate Canyon Road/SH 93	E	**F (279)**
Washington Avenue/SH 93	D	**F (291)**
Iowa Street/SH 93	B	**F (97)**
SH 58/SH 93	C	**F (106)**
US 6/19th Street	D	**F (118)**
US 6/Heritage Road	E	**F (127)**
US 6/Johnson Road	D	**F (112)**
US 6/Colfax Avenue	E	E

Notes: Unsignalized intersection LOS depicted by lowercase letters references critical intersection movement.
LOS F locations are highlighted in orange.

Source: Compiled by FHU, 2006.

FREEWAY ALTERNATIVE

Freeway Analysis

The Freeway Alternative would create a freeway connecting the Northwest Parkway on the north to C-470 on the south. This alternative includes 10 new interchanges that would link it to the surface street network. Freeway sections along the alternative include an assortment of ramp merge, diverge, weaving, and mainline sections. The Freeway Alternative would provide six through travel lanes between C-470 and the exit to SH 93 and four lanes north of that point connecting to the Northwest Parkway.

Mainline segments throughout the study area are anticipated to operate in the LOS C through E range during peak hours (see **Figure 3.2-8**). Ramp merge and diverge junctions are expected to operate at similar levels. The southbound off ramp to 19th Street is expected to operate at LOS F during peak hours along with the northbound off ramp to SH 128.

Surface Street Intersections

The AM and PM peak hour LOS were determined at each intersection with the Freeway Alternative (see **Figure 3.2-9**). There were 33 signalized intersections and one unsignalized intersection analyzed for this alternative. Nearly all surface street interchange ramp terminal intersections are expected to operate at LOS D or better during peak hours. The one exception, the ramp terminal intersection at the SH 58 interchange with the Freeway Alternative, is anticipated to operate at LOS E during the PM peak hour. Of the 34 analyzed intersections, seven are projected to operate at LOS F during either the AM or PM peak hour. Therefore, in comparison with the No Action Alternative, implementation of the Freeway Alternative would reduce from 15 to seven the number of surface street intersections operating at LOS F.

Figure 3.2-8 2030 Mainline and Ramp Levels of Service and Selected Peak Hour Volumes—Freeway Alternative

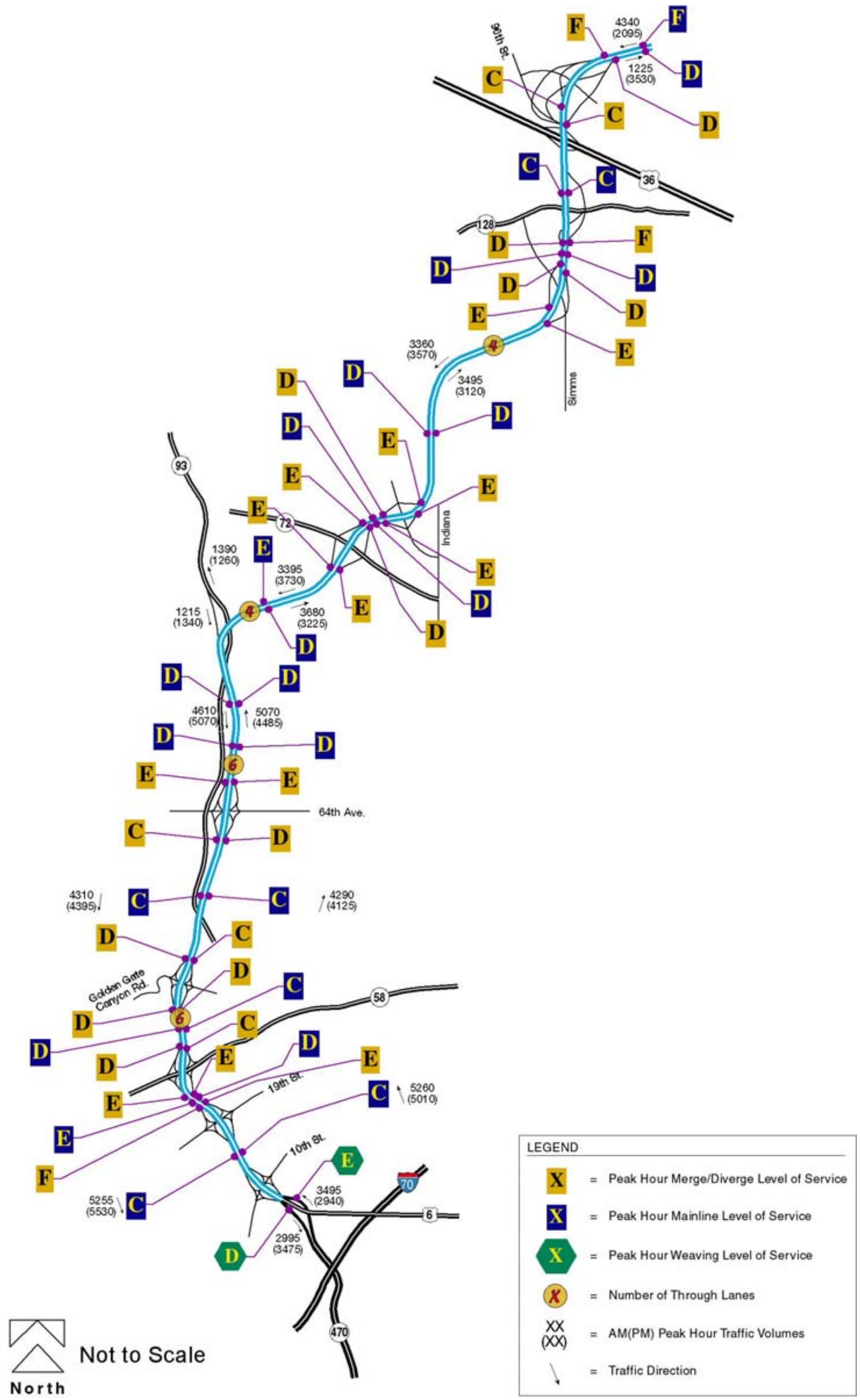
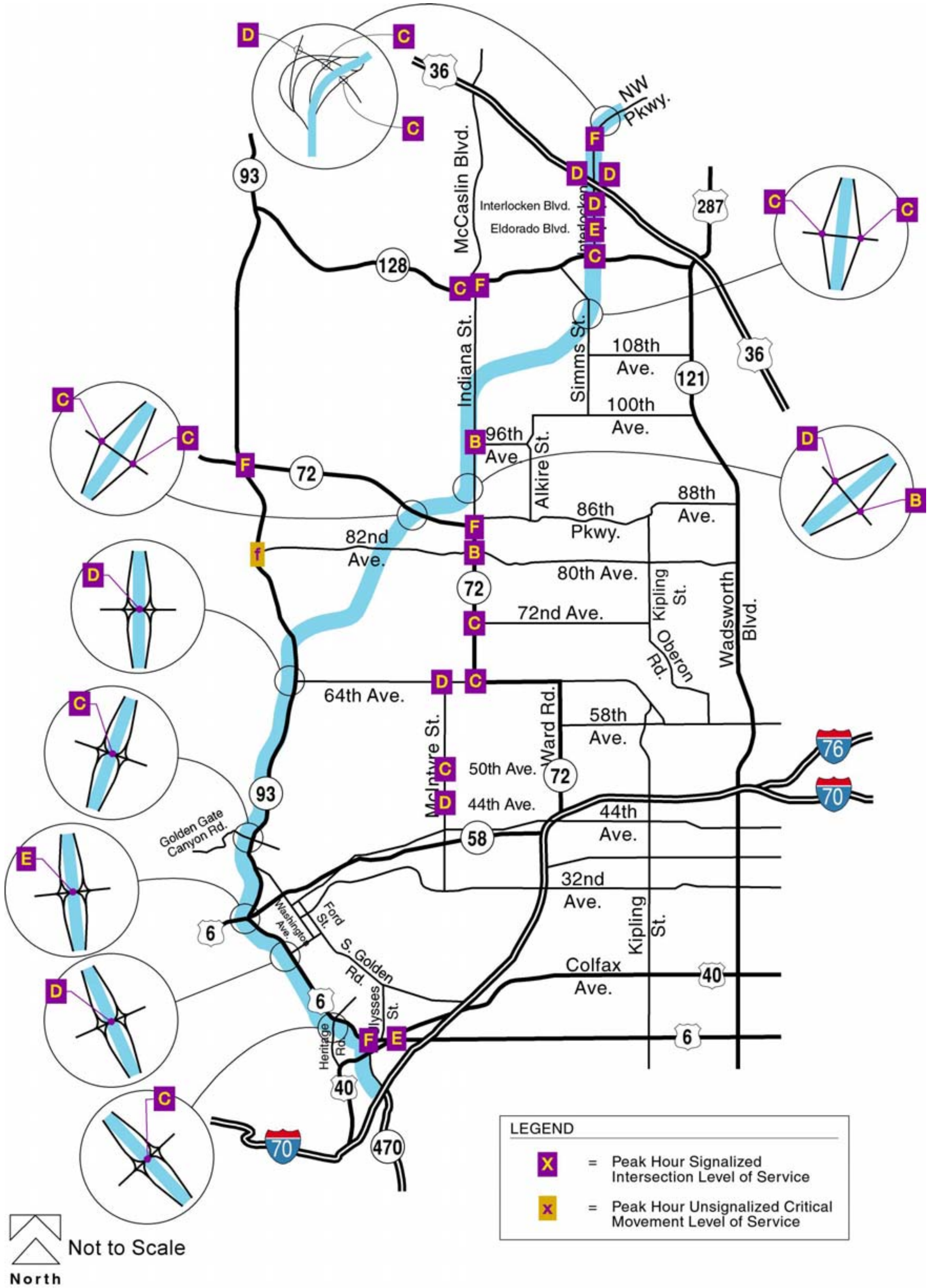


Figure 3.2-9 2030 Intersection Levels of Service—Freeway Alternative



TOLLWAY ALTERNATIVE

Tollway Analysis

The Tollway Alternative would introduce four tollway lanes along US 6/SH 93 from C-470 to north of SH 58. North of SH 58, the tollway lanes would split from the existing SH 93 alignment and follow an alignment similar to the Freeway Alternative to the Northwest Parkway connection. Four-lane mainline sections along the Tollway Alternative are expected to operate at LOS C or better throughout the study area, and merge/diverge ramp junctions would operate at similar levels. LOS was determined for the tollway sections (see **Figure 3.2-10**).

Surface Street Intersections

There were 37 signalized intersections and two unsignalized intersections analyzed for the Tollway Alternative. Of the 39 analyzed intersections, 11 are projected to operate at LOS F during the AM or PM peak hour (see **Figure 3.2-11**). Relative to the No Action Alternative, the Tollway Alternative would relieve LOS F conditions at the intersections of SH 93 with Washington Avenue and Iowa Street. Several at-grade intersections along US 6 and SH 93 that would operate at LOS F in the No Action Alternative would remain at LOS F with implementation of the Tollway Alternative, including Heritage Road, 19th Street, SH 58, Golden Gate Canyon Road, and 58th Avenue. In comparison with the No Action alternative, the Tollway Alternative would reduce LOS F intersections from 15 to 11.

Figure 3.2-10 2030 Mainline and Ramp Levels of Service and Selected Peak Hour Volumes—Tollway Alternative

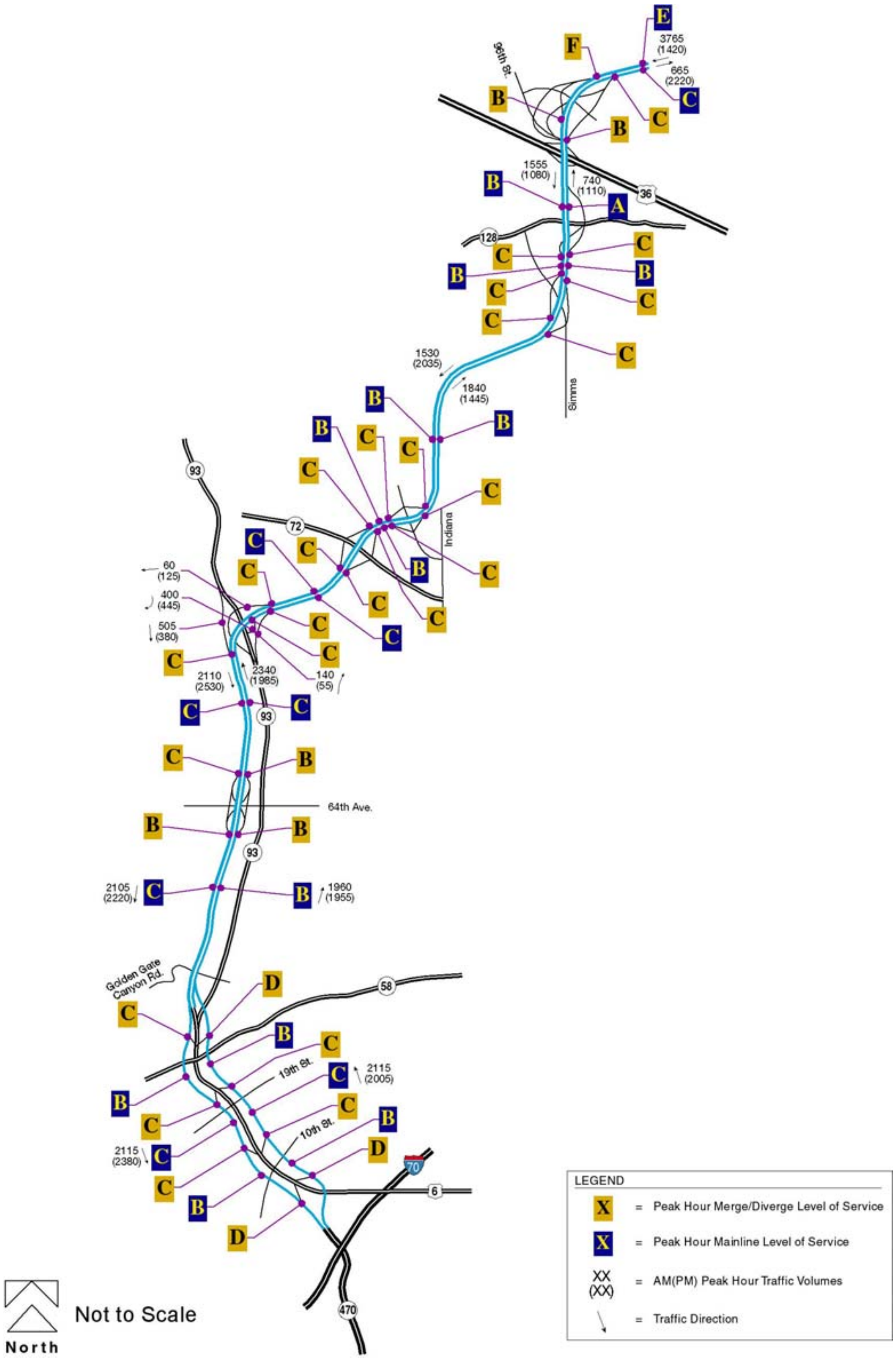


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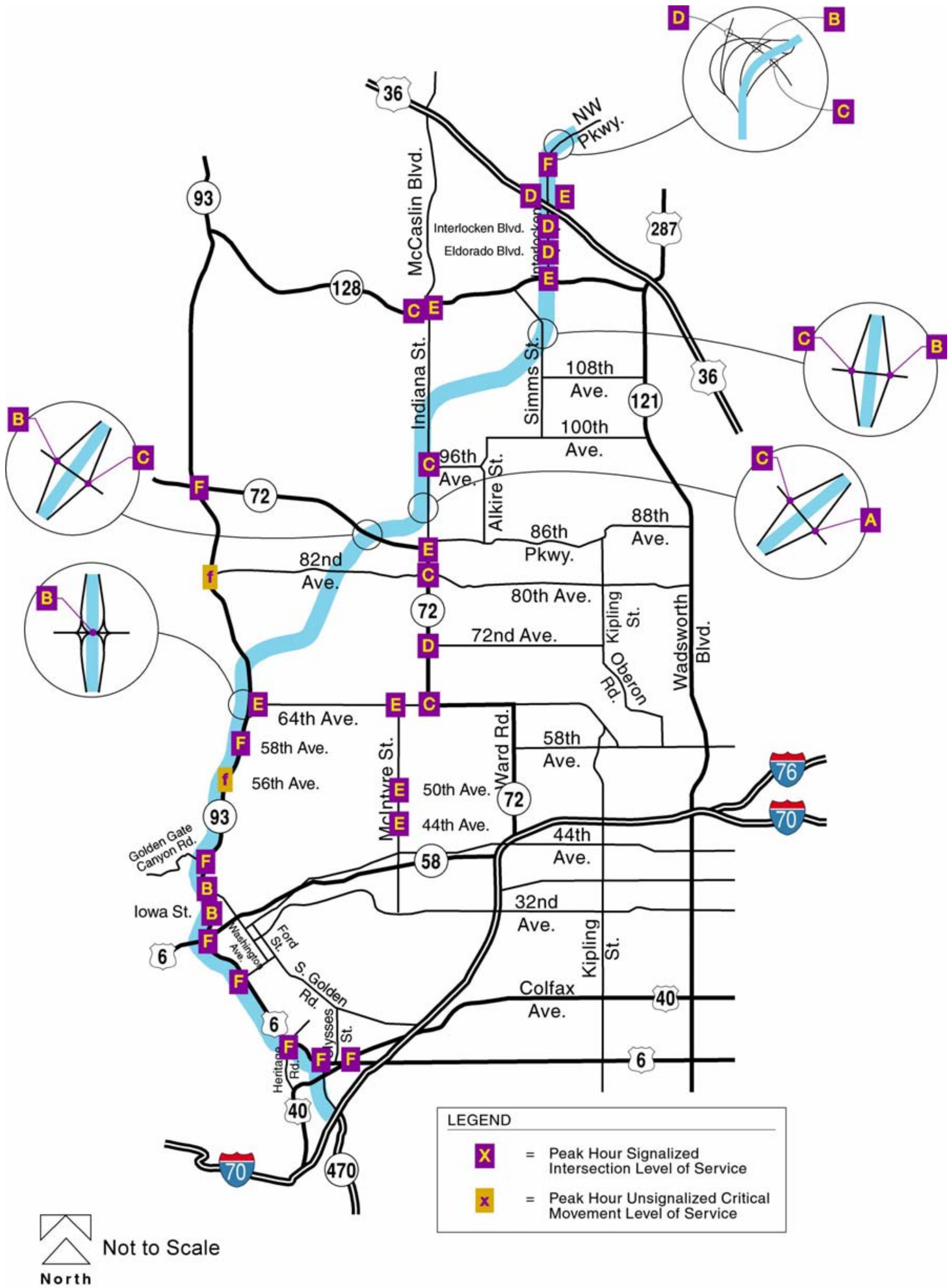
Figure 3.2-11 2030 Intersection Levels of Service—Tollway Alternative



REGIONAL ARTERIAL ALTERNATIVE

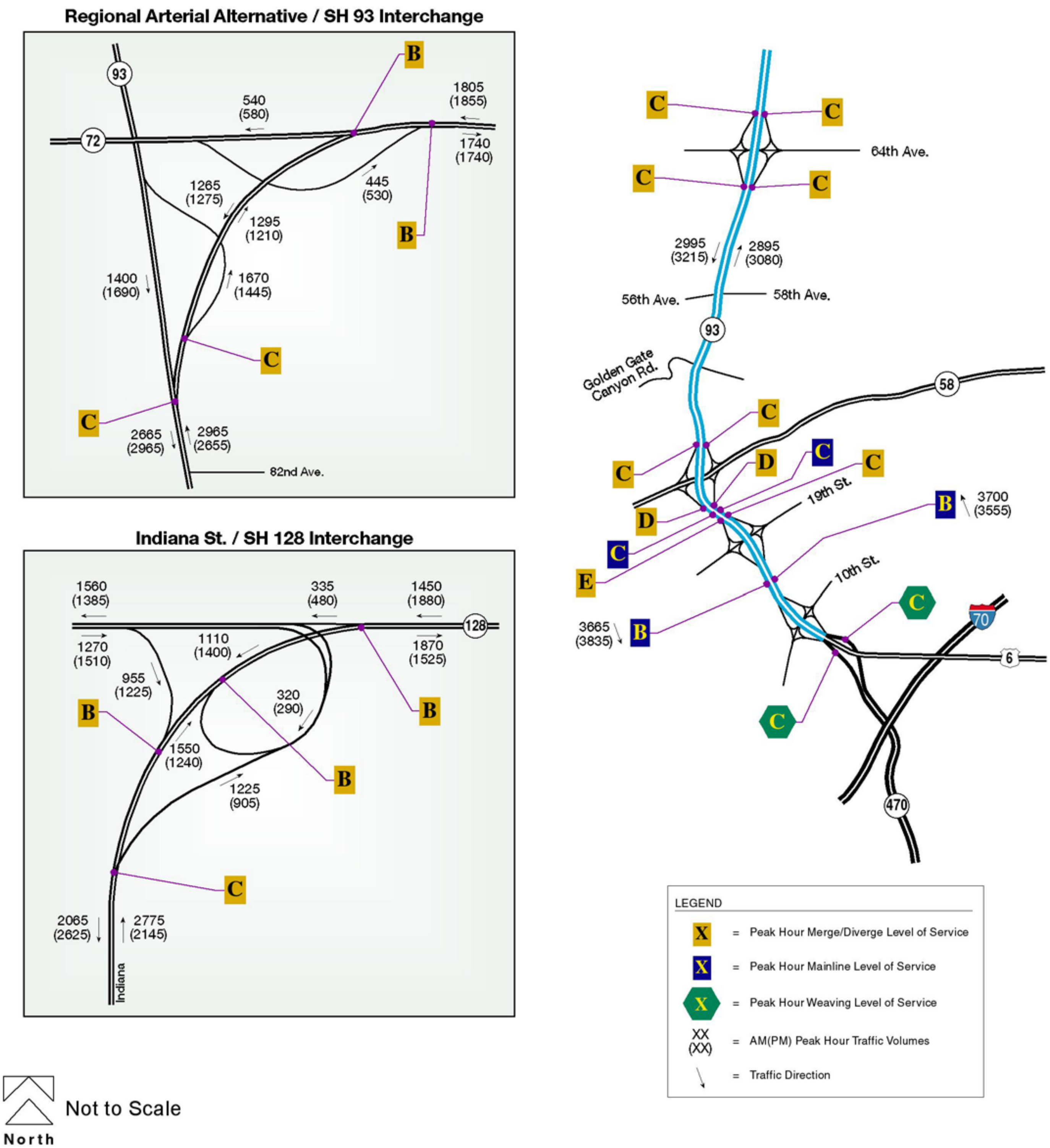
Freeway Analysis

Because the Regional Arterial Alternative consists primarily of enhancements to existing arterial roadways, freeway-type analyses were limited to the section between C-470 and SH 58 and three interchanges located farther north along the alternative alignment (64th Parkway, SH 93, and SH 128). All mainline, merge, diverge, and weaving sections are projected to operate at LOS C or better during peak hours (see **Figure 3.2-12**).

Surface Street Intersections

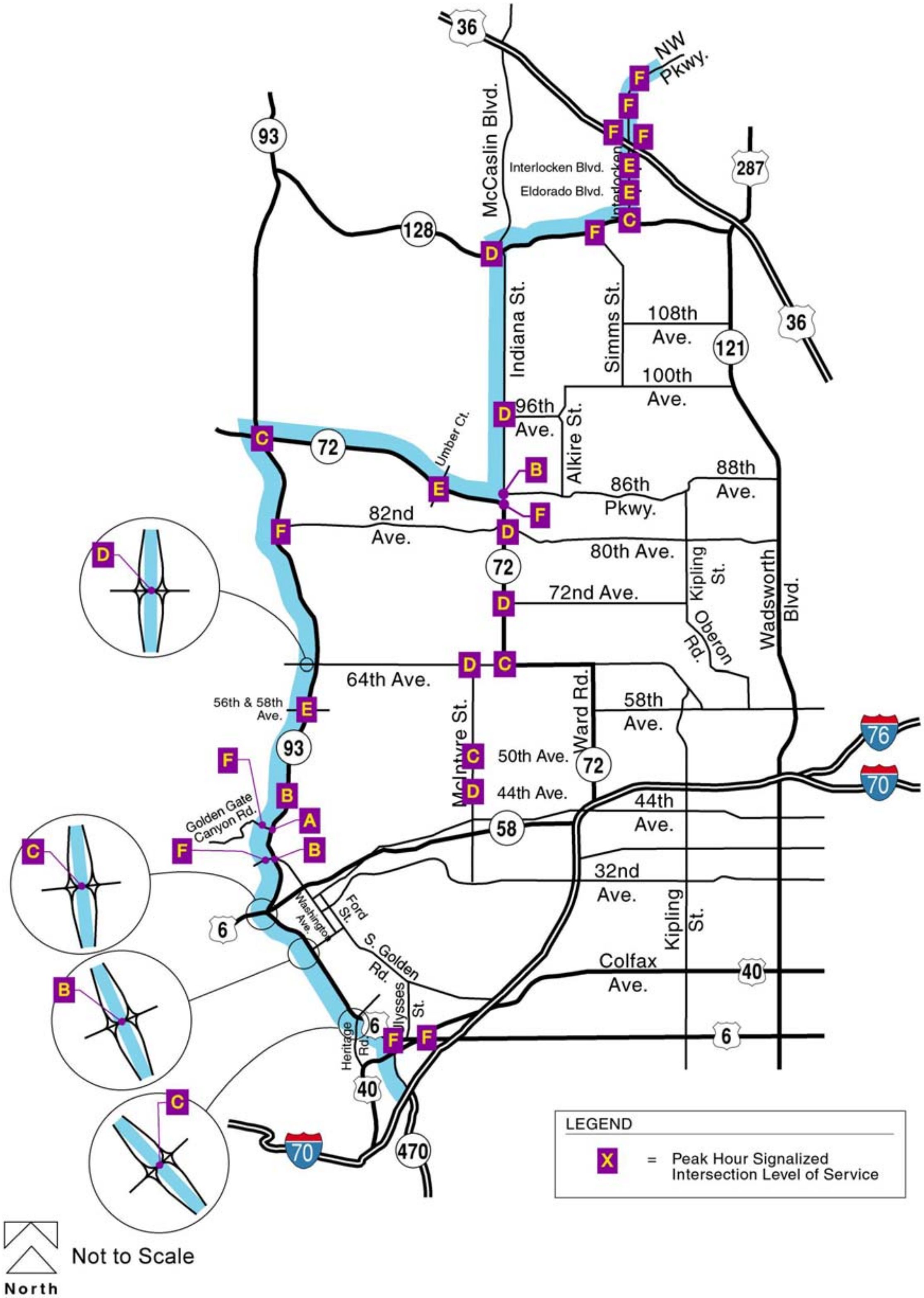
There were 33 intersections analyzed for the Regional Arterial Alternative. Of these, eleven were found to operate at LOS F during either peak hour, including the at-grade intersections on the Regional Arterial Alternative alignment at 82nd Avenue, Golden Gate Canyon Road, and Washington Avenue (see **Figure 3.2-13**). The locations of these intersections reveal congested segments of the Regional Arterial Alternative alignment, particularly between SH 58 and 82nd Avenue. In comparison with the No Action Alternative, the Regional Arterial Alternative would reduce LOS F intersections from 15 to 11.

Figure 3.2-12 2030 Mainline and Ramp Levels of Service and Selected Peak Hour Volumes—Regional Arterial Alternative



Note: Regional Arterial Alternative interchange locations only. See **Figure 2.4-16** for Regional Arterial Alternative configuration.

Figure 3.2-13 2030 Intersection Levels of Service—Regional Arterial Alternative



COMBINED ALTERNATIVE (RECOMMENDED ALTERNATIVE)

Tollway Analysis

All tollway mainline, weave, and merge/diverge sections of the Combined Alternative (Recommended Alternative) are anticipated to operate at LOS C or better during peak hours, with the exception of ramp merge and diverge movements along US 6 between the SH 58 and 19th Street interchanges. These sections would operate at LOS E or D (see **Figure 3.2-14**).

Surface Street Intersections

There were 39 intersections analyzed for the Combined Alternative (Recommended Alternative). Of these, seven were found to operate at LOS F during either peak hour (see **Figure 3.2-15**). Analyzed intersections along the Indiana Street and McIntyre Street portions of the alternative would operate at LOS E or better, with the exception of the Indiana Street "tee" type intersection located north of SH 72 and the Indiana Street/96th Avenue intersection. In comparison with the No Action Alternative, the Combined Alternative (Recommended Alternative) would reduce the number of LOS F intersections from 15 to seven.

Figure 3.2-14 2030 Mainline and Ramp Levels of Service and Selected Peak Hour Volumes—Combined Alternative (Recommended Alternative)

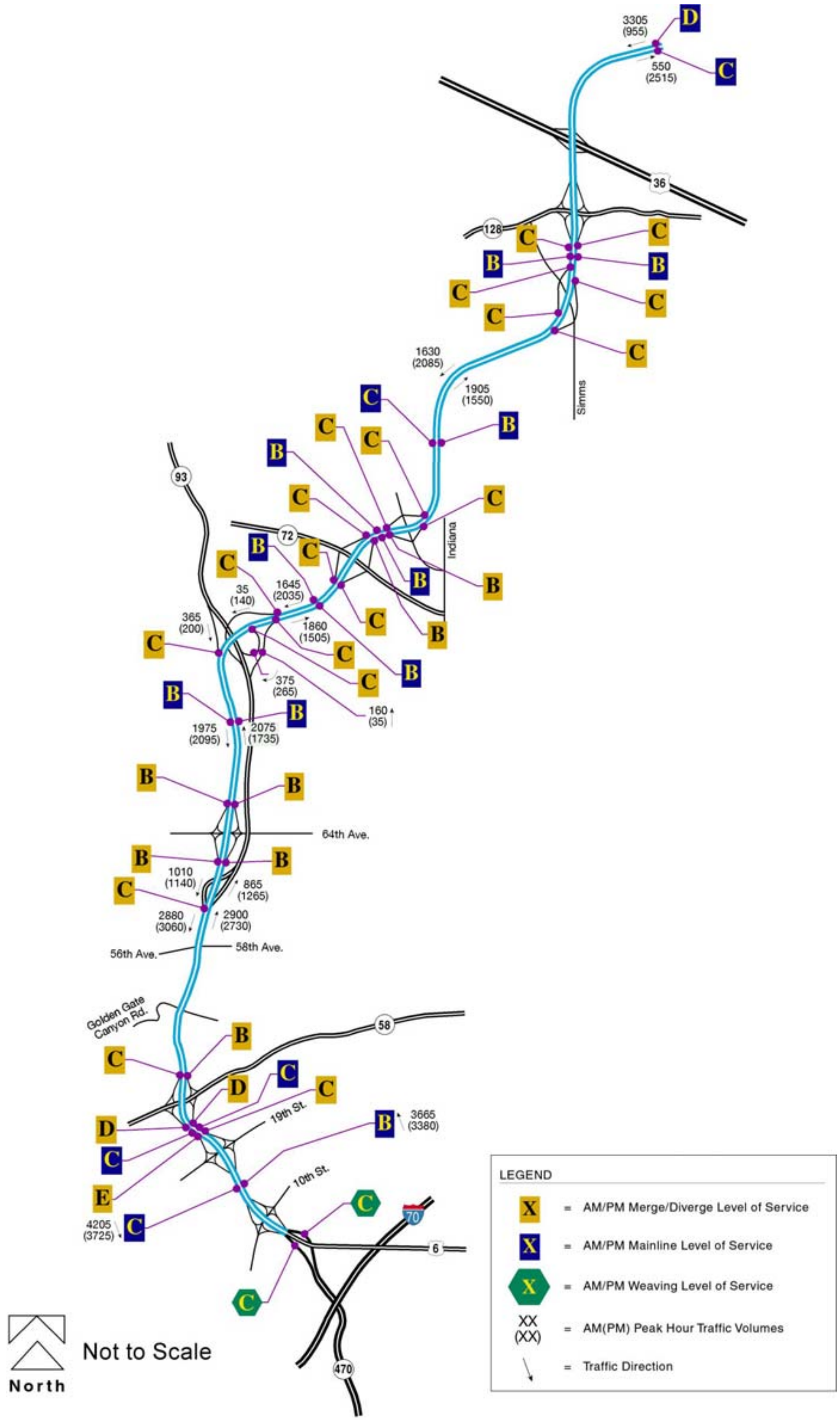
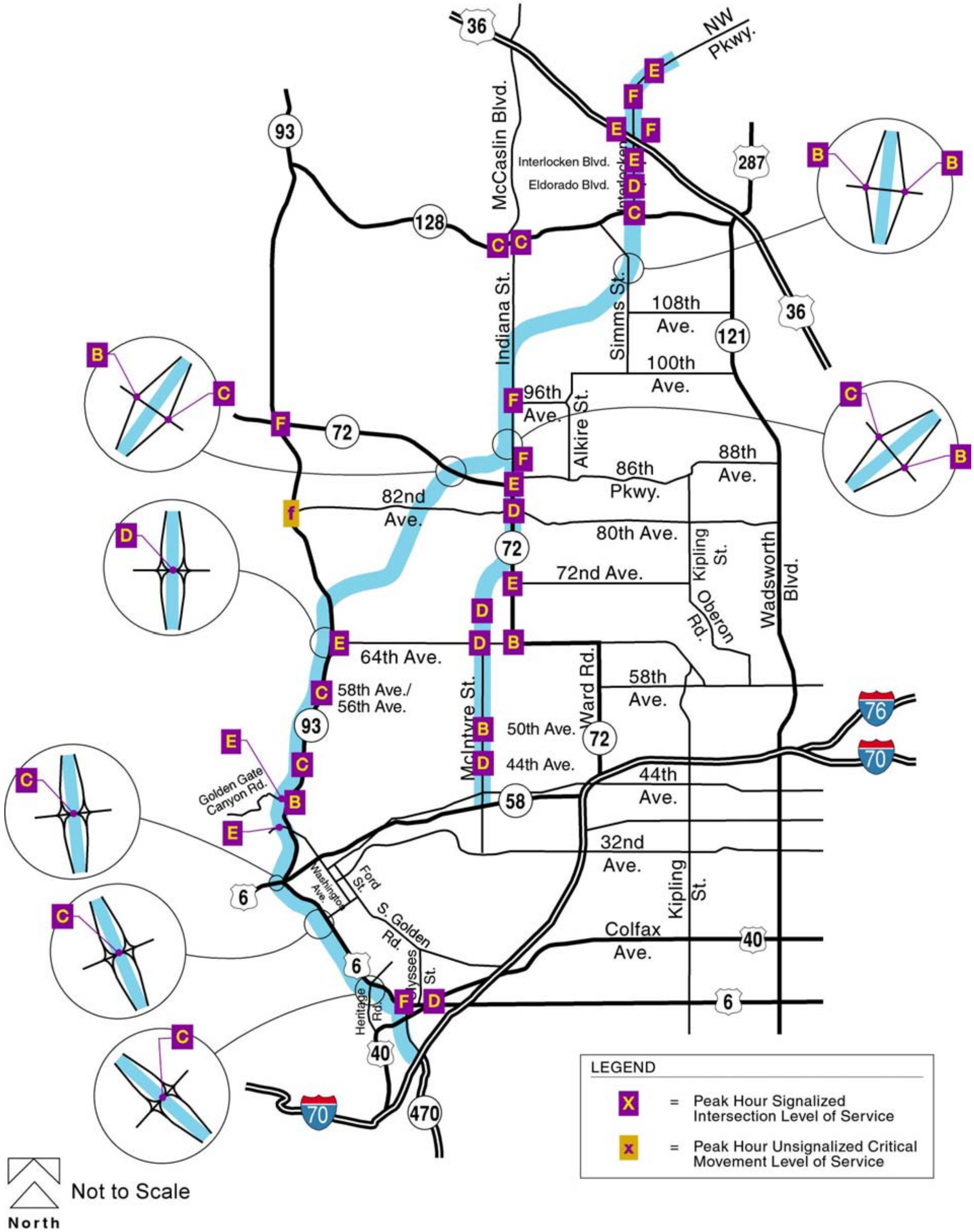


Figure 3.2-15 2030 Intersection Levels of Service—Combined Alternative (Recommended Alternative)



3.2.2.5 LEVEL-OF-SERVICE SUMMARY

FREEWAY OPERATIONS COMPARISON

The freeway and tollway sections of each of the build alternatives generally would operate at acceptable levels of service. Due to its higher volume forecasts, a few specific ramp merge, ramp diverge, or weaving areas have been identified as operating at poorer levels of service in the 2030 peak hours. Refinements to the Freeway Alternative that add auxiliary lanes at these locations could improve levels of service.

INTERSECTION OPERATIONS COMPARISON

The results of the operational analyses of surface street intersections were summarized (see **Table 3.2-4**). Locations projected to operate at LOS F are shown highlighted in orange. The highlighted cells within the table allow for some qualitative operational comparisons between alternatives. A comparison indicates that the Freeway Alternative exhibits the fewest LOS F results of all of the alternatives.

A number of intersections that would operate at LOS F with the No Action Alternative would be improved by all or most of the build alternatives (by adding lanes or constructing grade separations). These intersections include the SH 93 intersections with SH 72, 58th Avenue, Washington Avenue, and SH 58. The cells highlighted in green indicate locations where operations have improved over the No Action Alternative by at least one letter LOS or, where still LOS F, have reduced delay by at least 30 seconds. The Freeway Alternative and Combined Alternative (Recommended Alternative) show the greatest surface street delay reduction compared to the No Action Alternative.

The Regional Arterial Alternative and Combined Alternative (Recommended Alternative) accommodate traffic through at-grade intersections, while the Freeway Alternative and Tollway Alternative exhibit more limited access and grade-separated interchanges. The following examples highlight locations where the Regional Arterial Alternative and Combined Alternative (Recommended Alternative) show congested intersection conditions while the Freeway Alternative and Tollway Alternative provide grade-separated structures and/or interchanges that would improve operations:

- The 96th Street/US 36 interchange, where the Freeway Alternative and Tollway Alternative accommodate the regional north-south through movements with a bridge over US 36.
- The intersection of SH 93 with Golden Gate Canyon Road would operate at LOS F with construction of the Regional Arterial Alternative. With the access-controlled Freeway Alternative, the interchange at Golden Gate Canyon Road would replace this congested intersection with a single-point urban interchange operating at LOS C.

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Table 3.2-4 Signalized Intersection Levels-of-Service

	Existing	No Action Alternative	Freeway Alternative	Tollway Alternative	Regional Arterial Alternative	Combined Alternative (Recommended)
	Critical Peak Hour Level-of-Service					
96th Street/Tape Drive	C	**F (88)**	**F (138)**	**F (199)**	**F (119)**	**F (119)**
96th Street/Northwest Parkway	B	D	-	-	**F (84)**	E
96th Street/Northwest Pkwy. Interchange Connection	-	-	D	D	-	-
96th Street/Alternative Ramps	-	-	C/C	C/B	-	-
96th Street/WB US 36 Ramps	C	**F (117)**	**D**	**E**	**F (112)**	**F (99)**
96th Street/EB US 36 Ramps	B	D	**D**	D	**F (164)**	E
Interlocken Loop/Interlocken Blvd.	C	D	D	D	E	E
Interlocken Loop/Eldorado Boulevard	C	**F (90)**	**E**	**D**	**E**	**D**
Interlocken Loop/SH 128	C	C	C	E	C	C
McCaslin Blvd./SH 128	C	C	C	C	D	C
Indiana Street/SH 128	B	D	**F (116)**	E	-	**C**
Alternative/Simms Street	-	-	C/C	B/C	**F (93)**	B/B
Indiana Street/96th Avenue	B	B	B	C	D	**F (161)**
Alternative Ramps/Indiana Street	-	-	B/D	A/C	-	B/C
Indiana Street/Connection to Alternative Interchange	-	-	-	-	-	**F (93)**
Indiana Street/86th Avenue	-	-	-	-	B	-
SH 93/SH 72	D	**F (130)**	**F (107)**	**F (84)**	**C**	**F (92)**
Alternative Ramps/SH 72	-	-	C/C	C/B	-	C/B
SH 72/Umber Court	-	-	-	-	E	-
Indiana Street/SH 72	**C**	**F (98)**	**F (94)**	**E**	**F (125)**	**E**
SH 93/82nd Avenue	**f**	**f**	**f**	**f**	**F (83)**	**f**
Indiana Street/80th Avenue	B	C	**B**	C	D	D
Indiana Street/72nd Avenue	C	C	C	D	D	E
SH 93/64th Avenue	B	C	-	E	-	E
Alternative Ramps/64th Avenue	-	-	D	B	D	D
McIntyre Street/64th Avenue	E	E	**D**	E	**D**	**D**
Alternative/Indiana Street	-	-	-	-	-	D
Indiana Street/64th Avenue	C	C	C	C	C	**B**
SH 93/58th Avenue	C	**F (193)**	-	**F (134)**	**E**	**C**
SH 93/56th Avenue	**F**	**f**	-	**f**	Intersects at 58th	
McIntyre Street/50th Avenue	B	E	**C**	E	**C**	**B**
McIntyre Street/44th Avenue	B	E	**D**	E	**D**	**D**
Alternative/SH 93	-	-	-	-	B	C
Alternative/Golden Gate Canyon Road	-	-	-	-	**F (97)**	E
SH 93/Golden Gate Canyon Road	E	**F (279)**	**C**	**F (167)**	**A**	**B**
Alternative/Washington Avenue	-	-	-	-	**F (98)**	E
Washington Avenue/SH 93	D	**F (291)**	-	**B**	**B**	**-**
Iowa Street/SH 93	B	**F (97)**	-	**B**	-	-
SH 58/SH 93	C	**F (106)**	**E**	**F (148)**	**C**	**C**

	Existing	No Action Alternative	Freeway Alternative	Tollway Alternative	Regional Arterial Alternative	Combined Alternative (Recommended)
	Critical Peak Hour Level-of-Service					
US 6/19th Street	D	**F (118)**	**D**	**F (92)**	**B**	**C**
US 6/Heritage Road	E	**F (127)**	**C**	**F (120)**	**C**	**C**
US 6/Johnson Road	D	**F (112)**	**F (225)**	**F (143)**	**F (355)**	**F (199)**
US 6/Colfax Avenue	E	E	**F (168)**	**F (97)**	**F (260)**	**D**
Total LOS F Signalized Intersections	2	15	7	11	11	7

Notes: Unsignalized LOS are shown by lowercase lettering, signalized LOS by UPPERCASE lettering.

The use of a dash symbol (-) indicates that particular intersection does not exist within the referenced alternative.

"Critical Peak Hour" refers to the poorest LOS result of the AM and PM peak hours.

LOS F locations are highlighted in orange.

The cells highlighted in green indicate locations where operations have improved over the No Action Alternative by at least one letter LOS or, where still LOS F, have reduced delay by at least 30 seconds.

Source: Compiled by FHU, 2006.

3.2.3 Travel Reliability

The Travel Reliability need is defined in **Chapter 1** as follows:

Reduce the variability of travel times and improve driver expectancy.

Evaluations relative to this project need are presented in two parts. The first part includes system level measures, including vehicle miles of travel (VMT), vehicle hours of travel (VHT), and trip types on selected roadway links. The second part provides evaluation of the expected safety performance of the alternatives.

3.2.3.1 System Level Measures

VMT and VHT

Vehicle miles of travel is a measure of the total vehicle travel in a given area. The forecasted 2030 daily VMT was measured for each alternative for the entire Denver regional model area (see **Table 3.2-5**).

A comparison of the build alternatives with the No Action Alternative shows that each of the build alternatives would increase VMT, with one exception. The Tollway Alternative forecasts show a slight (0.1 percent) decrease in VMT compared with the corresponding No Action Alternative, using the WSA Model. The Freeway Alternative is projected to generate the greatest increase in VMT, with a 0.7 percent increase in the entire model area.

Vehicle hours of travel is a measure of the total time spent by vehicles traveling in an area. Decreases in VHT provide an indicator of improved mobility, with less time required to make trips through the area. Each of the build alternatives is forecasted to reduce VHT in the model area. The VHT reductions generally represent small percentage decreases on a regional basis, but that is an expected result given that Northwest Corridor travel represents a relatively small proportion of total regional travel. However, the reductions of more than 10,000 vehicle hours of travel per day represent very substantial savings in the time required for people to accomplish their daily travel.

The Tollway Alternative shows the greatest VHT reduction compared with the No Action Alternative.

Table 3.2-5 Vehicle Miles of Travel and Vehicle Hours of Travel Comparisons

Alternative	Vehicle Miles of Travel*			Vehicle Hours of Travel*		
	Entire Model Area			Entire Model Area		
	VMT	Change versus No Action (Percent)	Change versus No Action (miles)	VHT	% Change versus No Action	Change versus No Action
No Action Alternative (DRCOG Model)	109,925,898	—	—	3,773,776	—	—
No Action Alternative (Wilbur Smith Model)	110,946,157	—	—	3,381,455	—	—
Freeway Alternative (DRCOG Model)	110,701,530	0.7	775,633	3,763,666	-0.3	(10,110)
Tollway Alternative (Wilbur Smith Model)	110,842,155	-0.1	(104,001)	3,219,342	-5.0	(162,113)
Regional Arterial Alternative (DRCOG Model)	110,274,843	0.3	348,945	3,761,990	-0.3	(11,785)
Combined Alternative (**Recommended Alternative**) (Wilbur Smith Model)	110,950,062	0.0	3,906	3,364,677	-0.5	(16,778)

Note: *VMT and VHT for the build alternatives with no tolling component (Freeway Alternative and Regional Arterial Alternative) were determined and compared with the No Action Alternative using the DRCOG Model and VMT and VHT for the build alternatives with a tolling component (Tollway Alternative and Combined Alternative) were determined and compared with the No Action Alternative using the Wilbur Smith Model.

Source: DRCOG Compass Regional Travel Model Version 93 Modified, 2005a, and Wilbur Smith Associates (WSA) TRANPLAN® Traffic Model with WSA Tolling Algorithm, converted from DRCOG Compass Regional Travel Model Version 93 Modified, 2005.

SELECTED LINK TRIP TYPES

Another system-level evaluation measure is the quantification of trip types that use the alternative alignments and other key roadways. Two sets of key roadway links were selected and an "internal" or "local" area was defined surrounding those links (see **Figure 3.2-16**). The traffic forecasting model was used to forecast the proportion of trips on each link that:

- begin and end within the defined local area (internal-internal trips)
- begin or end outside the defined local area (internal-external trips)
- begin and end outside the defined local area (external-external trips)

The internal-internal trips are defined as local trips and the internal-external and external-external trips are defined as regional or inter-regional trips. The distinction between regional and inter-regional trips is that inter-regional trips are those that travel outside the DRCOG model area.

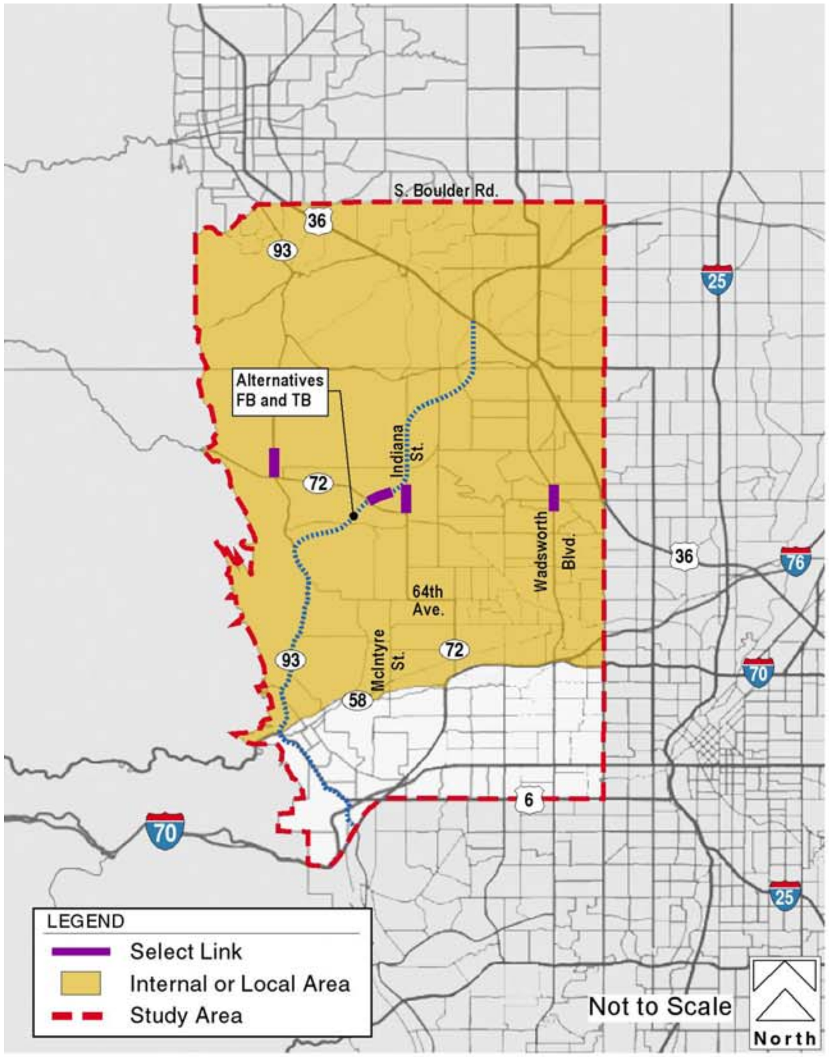
Select link analysis shows that 86 to 89 percent of those trips using the Freeway Alternative, Tollway Alternative, and Combined Alternative (Recommended Alternative) facilities north of SH 72 would be regional or inter-regional in nature (see **Table 3.2-6**). The Regional Arterial Alternative link north of SH 72 would be on Indiana Street, and 65 percent of its trips would be regional. On other study area roadways north of SH 72, for all alternatives, SH 93 would have the largest share of regional traffic.

Select link analysis shows that 86 to 89 percent of trips on SH 93 south of 64th Avenue would be regional or inter-regional in nature for all alternatives (see **Table 3.2-7**). The roadway link on SH 93 at this location would consist of the existing principal arterial with the No Action Alternative; a freeway with the Freeway Alternative; both a tollway and the parallel arterial street with the Tollway Alternative; and a major regional arterial with the Regional Arterial Alternative and Combined Alternative (Recommended Alternative). The regional and inter-regional trip percentages are similar for all alternatives; forecasts show the volume of regional and inter-regional traffic is highest for the Freeway Alternative, with 65,800 regional and inter-regional trips forecasted. SH 93 would have the largest regional and inter-regional proportion of trips and McIntyre Street would have the lowest proportion of the three links evaluated for all alternatives.

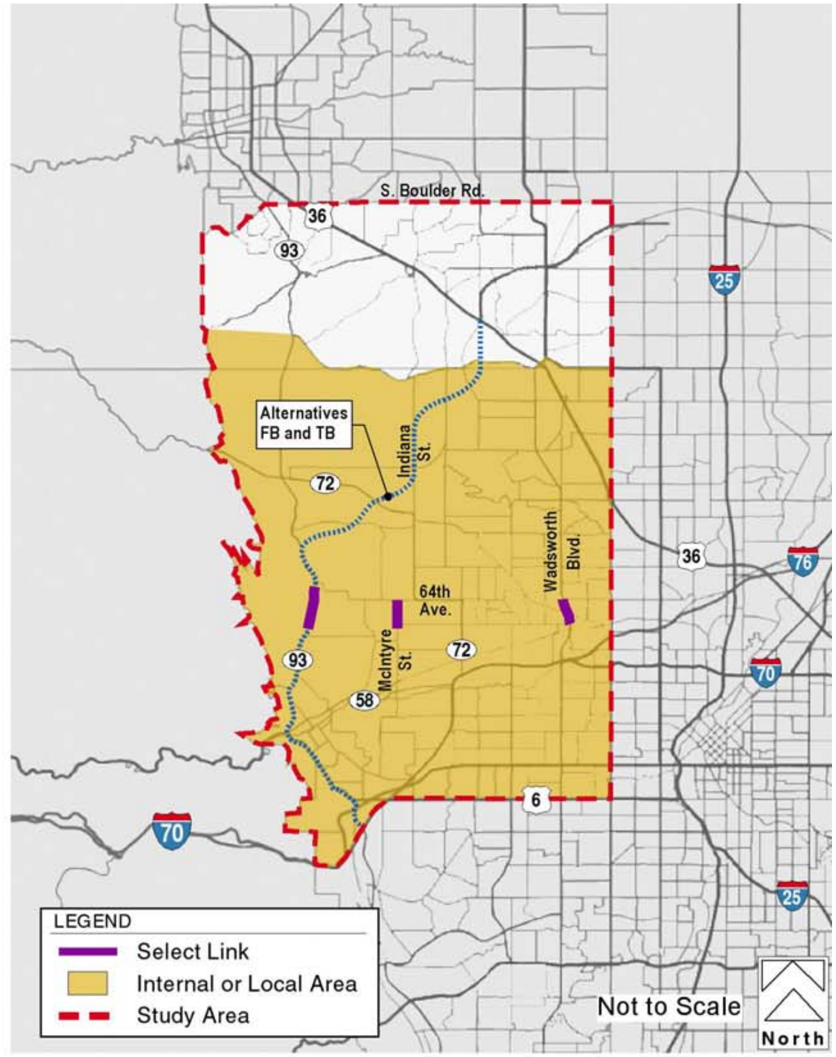
Thus, limited access and high-speed designs of the Freeway Alternative and Tollway Alternative would be most closely targeted to the regional and inter-regional nature of the travel markets, ranking highest relative to the travel time and driver expectancy components of the travel reliability project need. The Regional Arterial Alternative would less closely target the regional travel markets due to reduced travel speeds and the presence of signalized intersections along the Northwest Corridor travel path. The Combined Alternative (Recommended Alternative), with a large part of the alternative being a limited access tollway, would rank higher than the Regional Arterial Alternative, but not as well as the Freeway Alternative and Tollway Alternative. The No Action Alternative would not have facilities that effectively meet travel time and driver expectancy needs for regional and inter-regional travelers.

The Indiana Street/McIntyre Street principal arterial improvements that are part of the Combined Alternative (Recommended Alternative) would bring an additional advantage by improving the ability of Indiana Street and McIntyre Street to accommodate the local trips that comprise a large portion of the travel demand in that part of the corridor.

Figure 3.2-16 Select Link Locations-North and South



North Select Link Locations



South Select Link Locations

Table 3.2-6 Select Link Trip Types-North

	SH 93, North of SH 72				Indiana Street, North of SH 72				New Roadway, North of SH 72				Wadsworth Blvd, North of SH 72			
Alternative	Regional & Inter-regional Trips	Local Trips	Total Trips	Percent Regional & Inter-regional Trips	Regional & Inter-regional Trips	Local Trips	Total Trips	Percent Regional & Inter-regional Trips	Regional & Inter-regional Trips	Local Trips	Total Trips	Percent Regional & Inter-regional Trips	Regional & Inter-regional Trips	Local Trips	Total Trips	Percent Regional & Inter-regional Trips
No Action	16,000	5,000	21,000	76%	14,900	9,100	24,000	62%	N/A	N/A	N/A	N/A	32,800	18,300	51,000	64%
Freeway	18,100	3,900	22,000	82%	13,500	7,500	21,000	64%	41,200	5,800	47,000	88%	30,100	18,900	49,000	61%
Tollway	18,200	3,900	22,000	83%	14,600	11,400	26,000	56%	24,100	2,900	27,000	89%	27,100	21,900	49,000	55%
Regional Arterial	19,100	3,900	23,000	83%	28,000	14,900	43,000	65%	N/A	N/A	N/A	N/A	32,000	18,000	50,000	64%
Combined (Recommended)	18,300	3,800	22,000	83%	17,800	11,200	29,000	61%	23,200	3,700	27,000	86%	27,400	21,600	49,000	56%

Total of All Locations				
Alternatives	Regional & Inter-regional Trips	Local Trips	Total Trips	Percent Regional & Inter-regional Trips
No Action	63,700	32,400	96,000	66%
Freeway	102,900	36,100	139,000	74%
Tollway	84,000	40,100	124,000	68%
Regional Arterial	79,100	36,800	116,000	68%
Combined (Recommended)	86,700	40,300	127,000	68%

Source: DRCOG Compass Regional Travel Model Version 93 Modified, 2005a, and Wilbur Smith Associates (WSA) TRANPLAN® Traffic Model with WSA Tolling Algorithm, converted from DRCOG Compass Regional Travel Model Version 93 Modified, 2005.

Table 3.2-7 Select Link Trip Types-South

Alternative	SH 93, South of 64th Avenue				McIntyre Street, South of 64th Avenue				Wadsworth Blvd, South of 64th Avenue			
	Regional & Inter-regional Trips	Local Trips	Total Trips	Percent Regional & Inter-regional Trips	Regional & Inter-regional Trips	Local Trips	Total Trips	Percent Regional & Inter-regional Trips	Regional & Inter-regional Trips	Local Trips	Total Trips	Percent Regional & Inter-regional Trips
No Action	22,300	3,700	26,000	86%	12,700	8,300	21,000	60%	45,700	15,300	61,000	75%
Freeway	65,800[1]	9,200[1]	75,000[1]	88%[1]	8,500	7,600	16,000	53%	43,000	16,000	59,000	73%
Tollway	48,700[2]	6,300[2]	55,000[2]	89%[2]	9,300	10,600	20,000	47%	39,800	19,300	59,000	67%
Regional Arterial	39,400[1]	6,600[1]	46,000[1]	86%[1]	10,500	9,500	20,000	53%	45,500	14,500	60,000	76%
Combined (Recommended)	46,400[2]	6,600[2]	53,000[2]	88%[2]	17,900	14,000	32,000	56%	40,500	18,500	59,000	69%

Total of All Locations

Alternatives	Regional & Inter-regional Trips	Local Trips	Total Trips	Percent Regional & Inter-regional Trips
No Action	80,700	27,300	108,000	75%
Freeway	117,300	32,800	150,000	78%
Tollway	97,800	36,200	134,000	73%
Regional Arterial	95,400	30,600	126,000	76%
Combined (Recommended)	104,800	39,100	144,000	73%

Note: [1]Figure applies to trip types on the alternative alignment.
[2]Figure includes both trips on the alternative alignment and on the existing parallel road.
Yellow highlights indicate that data include the alternative alignment.

Source: DRCOG Compass Regional Travel Model Version 93 Modified, 2005a, and Wilbur Smith Associates (WSA) TRANPLAN® Traffic Model with WSA Tolling Algorithm, converted from DRCOG Compass Regional Travel Model Version 93 Modified, 2005.

3.2.3.2 SAFETY

Safety performance of alternatives has been used as another indicator of travel reliability, since traffic operations can be greatly influenced by the frequency of traffic accidents and the ability to clear and allow traffic to bypass accidents and incidents.

ANALYSIS AND FORECASTING PROCEDURES

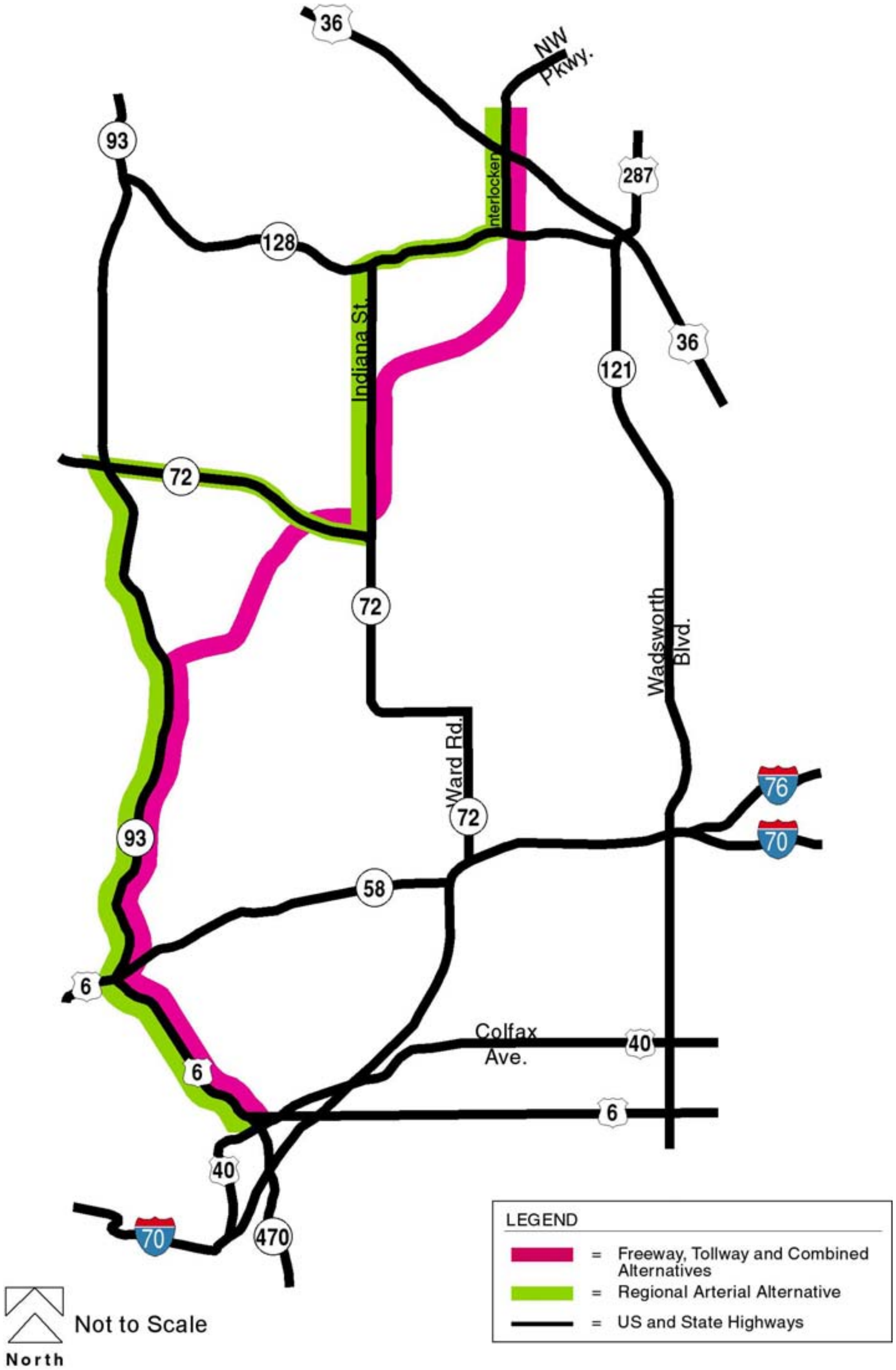
Accident statistics for the most recent available 5-year period (January 1, 1999, through December 31, 2003) were compiled for all state highways in the study area (see **Figure 3.2-17**). Each state highway was reviewed in detail and separated into sections that have different characteristics. Non-state highway (local) arterials were analyzed in a similar manner. CDOT has developed a procedure for determining relative safety for similar facilities with common characteristics. This procedure is known as the Safety Performance Function (SPF) and directly relates accidents per year per mile to the traffic volumes experienced on many types of facilities (Kononov and Allery, 2003; Kononov and Allery, 2004). There are a number of state highway sections for which SPF graphs are available. For example, SPF graphs have been prepared by CDOT for all freeways and many sections of rural, 2-lane state highways. SPF graphs were utilized wherever possible because they represent the most accurate picture of accident experience available for a given type of facility. Current accident experience for a particular state highway section was identified relative to similar facilities statewide. For each appropriate section of each alternative being analyzed, the accident experience of that individual section was predicted based on extending the SPF deviation line to intersect with the appropriate 2030 daily traffic volume. In this manner, yearly totals for property damage only (PDO), injury (INJ), and fatal (FAT) accidents could be determined for each section.

Within the study area, there are a number of state highway sections for which the SPF technique is not applicable. The SPF technique cannot be used for urban arterials because they normally have numerous intersections that skew the analysis. For these facilities, such as SH 121 and US 40, future accident experience was forecasted using recent accident experience as a basis. The annual accident rates for the most recent available 5-year period were determined for each section of the facility, and the average of the 5-year period was used for the analysis. An effort was made to determine if there was a correlation between volume and accident rates, but none was found. Annual VMT were determined for each section of highway based on the 2030 daily traffic volume forecasts for that section. Multiplying VMT by the accident rate results in forecasts of accidents by the three types (PDO, INJ, and FAT) for each section.

The accident experience for local arterials in the study area was analyzed in a similar manner based on annual accident rates. Statewide accident rates (CDOT, 1999-2003) for "Urban Other Principal Arterials" are consistent with local arterial characteristics, and these accident rates were used as a basis for the analyses.

In order to forecast accident experience for the new facilities that are being proposed as an element of each alternative, the most appropriate accident experience for similar facilities was utilized. In the case of the Freeway Alternative and Tollway Alternative, SPF graphs for 4-lane urban freeways were utilized. In the case of the Regional Arterial Alternative (expressway) sections, safety characteristics from US 6 (US 40 to SH 58), SH 157 (Foothills Parkway from US 36 to Iris Avenue in Boulder), and SH 119 (Longmont Diagonal from Iris Avenue to Hover Road in Longmont) were believed to be the most similar facilities on which to base a comparison. Similar analysis procedures (comparing 2030 forecasted daily volumes to either the SPF graph or average accident rate) were utilized to forecast future accident experience for these potential new roadway sections.

Figure 3.2-17 Safety Analysis Interstate and State Highway System



Note: Non-state highway arterial data is analyzed using a rate-based methodology on segments of the following roadways:

58th Avenue	44th Avenue
McIntyre Street	Indiana Street
100th Avenue	Simms Street
South Golden Road	

RESULTS

A series of tabulations were prepared that summarize and compare the expected accident experience for the No Action Alternative and the four build alternatives. A comparison of the five alternatives was developed with each state highway subdivided into the appropriate roadway sections (see **Table 3.2-8**). Section lengths, 2030-weighted average daily volume forecasts for the section, and total annual accidents are shown for each section of each alternative. Totals for length, annual VMT, and accidents are also provided for each alternative, as well as a ratio between annual accidents and annual VMT.

The following is a summary and comparison of accident predictions for the five alternatives:

- Using the measure of number of predicted accidents, the No Action Alternative is expected to have the lowest number of accidents. The Freeway Alternative is predicted to have a somewhat higher number of accidents (less than 2 percent more) compared with the No Action Alternative. The Tollway Alternative is predicted to have slightly more accidents (2.4 percent more) compared with the No Action Alternative. The Regional Arterial Alternative and Combined Alternative (Recommended Alternative) are predicted to have the highest number of accidents, with levels approximately 5 percent greater than the No Action Alternative. These predictions of higher numbers of accidents can be explained by the higher volumes of traffic attracted by the regional and principal arterial segments of the Regional Arterial Alternative and Combined Alternative (Recommended Alternative), since these functional classification streets have relatively high accident rate expectations.
- As measured by the ratio between predicted annual accidents and annual VMT, the Freeway Alternative has the most favorable forecasted accident experience. The Tollway Alternative has the second most favorable forecasted accident experience. This is expected since freeways and tollways have higher design standards and fewer access points, and thus have a better overall safety expectation.
- The Regional Arterial Alternative and Combined Alternative (Recommended Alternative) include improvements to the regional arterial system. Thus, their predicted accident ratios are less favorable than the Freeway Alternative and Tollway Alternative, but more favorable than the No Action Alternative.

Table 3.2-8 Accident Predictions

Highway	Segment	No Action			Freeway Alternative			Regional Arterial Alternative			Tollway Alternative			Combined Alternative (Recommended)		
		Segment Length	2030 AADT[5]	Total	Segment Length	2030 AADT[5]	Total	Segment Length	2030 AADT[5]	Total	Segment Length	2030 AADT[5]	Total	Segment Length	2030 AADT[5]	Total
SH 93/US 6	C-470 to SH 58	3.64	50,800	250	Included in NWC Analysis			Included in NWC Analysis			3.64	35,900	176	Included in NWC Analysis		
	SH 58 to SH 72[1]	8.11	31,100	149	6.44	19,700	59	2.11	800	0	7364	25,500	114	6.25	24,900	69
	SH 72 to SH 128	4.37	26,700	46	4.37	27,500	47	4.61	29,600	53	4.37	28,800	49	4.37	28,500	49
SH 121 (Wadsworth)	US 6 to I-70	3.75	52,400	548	3.75	52,900	553	3.75	52,500	548	3.75	55,900	582	3.75	56,400	588
	I-70 to US 36	8.99	62,200	937	8.99	59,300	894	8.99	61,000	919	8.99	69,300	1,044	8.99	69,500	1,048
I-70	C-470 to Wadsworth	9.55	173,900	1,722	9.55	167,800	1,683	9.55	172,700	1,722	9.55	166,800	1,679	9.52	162,900	1,655
US 6	I-70 to Wadsworth	6.32	126,500	487	6.32	127,200	494	6.32	127,400	495	6.32	120,500	445	6.32	116,100	416
US 36	Interlocken and SH 121 I.C.	5.01	134,800	436	5.01	134,000	434	5.01	134,500	435	5.01	117,700	383	5.01	114,500	370
SH 128	SH 93 to Wadsworth[2]	7.83	16,300	79	7.83	15,100	72	5.83	14,800	47	7.83	17,500	85	7.76	17,700	86
SH 72	I-70 to 86th Parkway	6.13	29,900	222	6.13	28,000	209	6.13	30,900	228	6.13	32,200	235	6.13	38,500	269
	Indiana to SH 93[3]	4.22	21,000	18	4.22	19,100	17	Included in NWC Analysis			4.22	20,200	17	4.22	20,300	17
SH 40	US 6 to Wadsworth	5.69	37,700	557	5.73	37,500	557	5.73	37,600	560	5.73	39,700	593	5.73	41,400	616
SH 58	SH 93 to I-70	5.16	37,900	85	5.16	30,100	68	5.16	30,100	76	5.16	32,700	74	5.15	33,100	74

Highway	Segment	No Action			Freeway Alternative			Regional Arterial Alternative			Tollway Alternative			Combined Alternative (Recommended)		
		Segment Length	2030 AADT[5]	Total	Segment Length	2030 AADT[5]	Total	Segment Length	2030 AADT[5]	Total	Segment Length	2030 AADT[5]	Total	Segment Length	2030 AADT[5]	Total
Northwest Corridor	C-470 to SH 58	No Action			2.80	95,600	162	2.70	69,200	187	2.56	36,600	39	2.17	62,400	128
	SH 58 to 64th Avenue				4.80	77,300	209	4.70	52,300	211	4.73	36,300	72	4.92	37,800	129
	64th Avenue to SH 72[4]				2.95	65,300	101	7.18	39,300	216	3.22	33,700	45	2.64	25,100	27
	SH 72 to SH 36				8.93	44,600	184	8.69	45,000	318	8.96	24,200	54	8.87	29,900	162
Other Non-State Highway Arterials[7]		21.82	21,200	839	21.82	19,100	752	17.67	20,700	658	21.85	21,400	845	21.62	25,400	994
Totals		Length	VMT	**Total**	Length	VMT	**Total**	Length	VMT	**Total**	Length	VMT	**Total**	Length	VMT	**Total**
		100.6	**5,717,300**	**6,375**	**114.8**	**6,443,300**	**6,495**	**104.1**	**6,129,800**	**6,673**	**119.7**	**6,102,400**	**6,531**	**113.4**	**6,043,400**	**6,697**
Calculated Overall Rates[6]				**3.05**			**2.76**			**2.98**			**2.93**			**3.04**

Notes: [1]Segment begins at Washington Avenue for the Freeway Alternative, Regional Arterial Alternative, and Combined Alternative (Recommended Alternative). Segment ends where NW Corridor overlapping section begins for the Regional Arterial Alternative.
[2]The Regional Arterial Alternative excludes the segment overlapping with the NW Corridor.
[3]The Regional Arterial Alternative excludes the segment overlapping with the NW Corridor.
[4]Segment ends at the intersection of SH 72 with Indiana Street for the Regional Arterial Alternative.
[5]Weighted Average by distance for each segment (unadjusted forecasts taken directly from model).
[6]Rates calculated using the following formula: (Number of Accidents) * 1 million vehicles/365 * Weighted AADT * Length – (for FAT rate use 100 million vehicles).
[7]Non-State Highway arterial data analyzed using a rate-based methodology on segments of the following roadways: 58th Avenue, 44th Avenue, McIntyre Street, Indiana Street, 100th Avenue, Simms Street, and South Golden Road.

Sources: Rate Analysis-CDOT Data and CDOT Analysis Procedures; Model Numbers-Accident Predictions.

3.2.4 MODAL INTER-RELATIONSHIPS

The Modal Inter-Relationships need is defined in **Chapter 1** as follows:

> *Expand highway systems to provide enhanced access to transit choices to improve mobility through intermodal connections.*

Alternatives are evaluated relative to their performance for alternative modes including transit, pedestrian and bicycle facilities, freight and rail operations, and congestion management.

TRANSIT

All of the build alternatives would provide the opportunity for enhanced express bus service along their respective alignments. Since RTD does not have plans for a dedicated transit system in the Northwest Corridor, space has not been included within the entire alternative right-of-way footprints to accommodate dedicated transit corridors. The potential option of implementing dedicated transit corridors using space within or adjacent to the corridor is not precluded with any of the build alternatives.

The provision of an interchange for each of the build alternatives at the current US 6/Heritage Road intersection would enhance the connectivity and accessibility to the end-of-line station for the FasTracks West Corridor. The interchange connections to the Northwest Parkway and Interlocken with the Freeway Alternative and Tollway Alternative would better serve travel desires to the FasTracks stations at US 36 and 96th Street.

PEDESTRIAN AND BICYCLE FACILITIES

All of the build alternatives would accommodate existing pedestrian and bicycle facilities by maintaining paths and replacing them, as necessary, where the alignment would encroach.

With the Freeway Alternative, new trails would be added along the north stretch of the new section starting at Washington Avenue on both sides of existing SH 93 and the new west frontage road. There are some existing trails near 64th Parkway. The Freeway Alternative alignment would accommodate new trails along this stretch of the alternative continuing on both sides of the new west frontage road. Between the SH 93 interchange and Interlocken, a new trail would parallel the Freeway Alternative alignment within the new right-of-way.

With the Tollway Alternative, new trails would be added north starting at Washington Avenue along existing SH 93. There are some trails near 64th Parkway. The new alignment would accommodate new trails along this stretch of the alignment continuing along existing SH 93. Between the SH 93 interchange and Interlocken, the trail would parallel the Tollway Alternative alignment within the new right-of-way.

With the Regional Arterial Alternative, a small stretch of new trails would be added from Washington Avenue to where existing SH 93 becomes an independent facility. The trail would then parallel existing SH 93 to where it connects to the regional arterial alignment. There are some trails near 64th Parkway. The new alignment would accommodate new trails along this stretch of the alternative continuing on both sides of the regional arterial alignment from the SH 93 connection to the north section of the study area. The trails would parallel the regional arterial alignment closely with a barrier buffer within the new right-of-way. Bicycle lanes would be added to the urban section.

With the Combined Alternative (Recommended Alternative), a small stretch of new trail would be added from Washington Avenue to where existing SH 93 becomes an independent facility. The trail would then be along existing SH 93. There are some trails near 64th Parkway. The new alignment would accommodate new trails along this stretch of the alternative continuing along existing SH 93. Between the SH 93 interchange and Interlocken, the new trail would parallel the tollway within the new right-of-way. Bicycle lanes would be added to the urban section. There are some trails and sidewalks along small portions of Indiana Street and McIntyre Street. The new principal arterial would accommodate the sidewalk on both sides of the roadway.

FREIGHT AND RAIL OPERATIONS

Each of the build alternatives would serve as designated truck travel routes. Based on existing traffic data, it is estimated that trucks would represent approximately seven percent of overall traffic flow along freeway and tollway segments. Based on this percentage, the Freeway Alternative would conduct up to 7,000 truck trips per day. Truck travel times would be substantially improved with all of the build alternatives, as described in **Section 3.2.1**. As discussed in the description of the existing transportation network, there are currently two east-west rail lines crossing the study area. The alternatives would not change existing crossing conditions where these lines intersect roadways.

CONGESTION MANAGEMENT

Each of the build alternatives would create opportunities for application of congestion management enhancements.

All four build alternatives would allow for enhanced local and express bus service along the alternative alignments. Future express bus transit service with the Regional Arterial Alternative or the regional arterial portion of the Combined Alternative (Recommended Alternative) could be enhanced with preferential bus treatments at signalized intersections.

All four build alternatives would be enhanced with intelligent transportation system (ITS) measures, such as incident management programs and variable message signing.

Traffic flow with the Regional Arterial Alternative and the regional arterial and principal arterial portions of the Combined Alternative (Recommended Alternative) would be enhanced with traffic signal system optimization implemented by appropriate state, regional, and local agencies.

3.3 *SUMMARY OF ALTERNATIVE EVALUATIONS*

Following are summaries of evaluations of the alternatives relative to each of the principal project need statements.

3.3.1 SYSTEM CONNECTIVITY/FUNCTIONALITY

Each of the build alternatives would satisfy the need for enhanced system connectivity by creating a direct route to accommodate regional and inter-regional travel between the northern and southern project termini.

The functionality of the connection would be best with the Freeway Alternative and Tollway Alternative, with fully access-controlled facilities integrating best with surrounding freeway and tollway facilities and by creating the greatest travel time savings compared with the No Action Alternative. The Regional Arterial Alternative and Combined Alternative (Recommended Alternative) would greatly improve functionality compared with the No Action Alternative, but functionality compared with the Freeway Alternative and Tollway Alternative would be constrained by the at-grade intersections present at the southern and northern ends of the corridor. The Freeway Alternative, Tollway Alternative, and Combined Alternative (Recommended Alternative) all rate better than the Regional Arterial Alternative for this measure since they have less out-of-direction travel between SH 93 and Indiana Street.

3.3.2 TRAVEL DEMAND/CAPACITY

The Freeway Alternative would accommodate the most traffic of the four build alternatives with forecasts ranging from 108,000 vpd at the southern end of the corridor to 29,000 vpd on the northern end. The other build alternatives would each accommodate substantially less traffic than the Freeway Alternative, with comparative forecasts among the three alternatives varying at different locations along the corridor.

Traffic forecasts across screenlines that include several major north-south roadways show that each of the build alternatives would increase the total amount of travel on north-south roads in the study area; that is the alternatives would result in drawing some of the regional and inter-regional traffic. The Freeway Alternative would create the greatest increase in north-south travel through the area. At the same time, the build alternatives would focus more travel on the alternative facilities themselves and reduce traffic on other parallel routes.

While all of the build alternatives would improve traffic operations in the area, reducing the number and severity of congested intersections and road segments, intersection congestion would improve most with the Freeway Alternative and the Combined Alternative (Recommended Alternative). The Freeway Alternative and Tollway Alternative would have the best operations among the alternatives due to the access-controlled nature of their alignments. The at-grade intersections that are a part of the Regional Arterial Alternative and the Combined Alternative (Recommended Alternative) could act as system bottlenecks.

3.3.3 Travel Reliability

Each of the build alternatives would create substantial savings in regional hours of travel, with more than 10,000 vehicle hours of travel reduction per day forecast in 2030 for each of the build alternatives compared with the No Action Alternative.

Large percentages of the traffic forecasted to use each of the build alternatives would be regional or inter-regional in nature, meaning trips would begin or end outside of the local area. The Freeway Alternative and Tollway Alternative would provide the best travel times and reliability, and best meet driver expectations for these regional and inter-regional travelers. The Combined Alternative (Recommended Alternative), with its combination of tollway and regional arterial sections, would be the next best alternative for meeting of driver expectations, followed by the Regional Arterial Alternative. The No Action Alternative would not meet driver expectations for regional and inter-regional travelers.

The shift of some travelers from surface arterial streets with potential conflict points at at-grade intersections to access-controlled routes would reduce overall accident rates on study area roads for each of the build alternatives. Forecasted accident rates are least for the Freeway Alternative and Tollway Alternative because these alternatives are the most access-controlled of the build alternatives.

3.3.4 Modal Inter-Relationships

Each of the alternatives would provide a faster and more reliable route to accommodate express bus service and truck movements, with the Freeway Alternative and Tollway Alternative providing the best functionality to support these movements. The provision of an interchange for each of the build alternatives at the current US 6/Heritage Road intersection would enhance the connectivity and accessibility to the end-of-line station for the FasTracks West Corridor. The interchange connections to the Northwest Parkway and Interlocken with the Freeway Alternative, Tollway Alternative, and Combined Alternative (Recommended Alternative) will better serve travel desires to the FasTracks stations at US 36 and 96th Street.

All alternatives have been designed to accommodate pedestrian and bicycle movements.

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