Arapahoe Road/I-25 Interchange

Final System Level Feasibility Study

Submitted by

DAVID EVANS AND ASSOCIATES INC.

On Behalf of

Arapahoe County
Colorado's First

Submitted to

Taking Care To Get You There
DOT
DEPARTMENT OF TRANSPORTATION

In Association with

City of Centennial

GREENWOOD VILLAGE COLORADO

June 2008

Arapahoe Road/I-25 Interchange
System Level Feasibility Study

Submitted to

Colorado Department of Transportation

On Behalf of

Arapahoe County
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In Association with

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Table of Contents

Appendices

Table of Figures

List of Tables

1. Introduction

This report documents the information required for the I-25 and Arapahoe Road Interchange System Feasibility Study, in compliance with the Colorado Department of Transportation (CDOT) Policy Directive 1601 Interchange Approval Process. This document will be used by CDOT to evaluate the interchange improvements request.

1.1. Project Location

A partial cloverleaf interchange currently exists at Arapahoe Road and I-25, in the growing southeast I-25 corridor. Arapahoe Road (SH 88) is located in the southern portion of the Denver Tech Center and serves as a key east-west regional roadway connection. I-25 runs north-south through the study area, extending north through Denver and Fort Collins and south through Colorado Springs. A diamond interchange exists approximately 1 mile north of Arapahoe Road at Orchard Road, and approximately 1 mile south of Arapahoe Road at Dry Creek Road. RTD's Southeast Corridor LRT line extends along the west side of I-25 crossing over Arapahoe Road and the southbound interchange ramps. The project location is illustrated in **Figure 1**.

Figure 1. Project Location

1.2. Purpose for Project

The need for interchange improvements at Arapahoe Road and I-25 has grown substantially since the 1980's. These needs are based on the analysis and findings documented in separate documents prepared as part of the Arapahoe Road Corridor Study, including the *Existing Transportation Conditions Report* (May 2006), the *Land Use and Socioeconomic Data Report* (July 2006), the *Revised Final Travel Forecast Summary* (April 2007), *Revised Final Environmental Overview* (April 2007), *Final Alternatives Development and Analysis Report (June 2007),* and *Final Corridor Report* (November 2007).

The goals of this project are to:

- Relieve existing and future congestion along Arapahoe Road and at the I-25/Arapahoe Road interchange
- Enhance regional mobility and local accessibility
- Improve the operations and safety of Arapahoe Road, which is operating at over capacity, and I-25, which is compromised by ramp backups on the mainline freeway

1.2.1. Mobility and Congestion

Traffic volumes have increased substantially since the mid 1980's when the last significant improvements were made to the Arapahoe Road corridor and I-25 Interchange. Highly congested conditions have historically existed for five to six hours per day, creating significant queues and delays for travelers using the interchange. Throughout the day, delays along Arapahoe Road within the interchange area have created queues along the Southbound I-25 off-ramp that back up onto I-25, affecting interstate operations and safety.

Although recent signal timing modifications have improved the progression of ramp traffic through the interchange and reduced queues along the Southbound I-25 off-ramp, significant queuing continues along Arapahoe Road at the Boston/Clinton and Yosemite Street intersections for traffic entering the interchange area. Also, the interchange continues to operate at peak capacity with the slightest increase in volume or any traffic incident creating gridlock conditions on Arapahoe Road and the freeway ramps.

Existing traffic volumes at the interchange create operating conditions characterized by restricted movements and backups. Overall level of service for the interchange area intersections are classified as LOS D, E, and F (over 80 seconds of average delay per vehicle) during the AM and PM peak hours, representing potential gridlock conditions. Specific movements that currently exhibit operational problems include the southbound left turn at the Southbound I-25 off-ramp and the PM peak queues at the northbound ramp terminal intersection. The westbound through movement at the Boston/Clinton Street intersection experiences substantial delays from drivers maneuvering into the right lanes to access I-25.

Operation forecasts with 2030 traffic from projected regional growth degrade to a high level of congestion. The Northbound I-25 mainline is projected to operate at LOS F in the AM peak period while the Southbound I-25 mainline is projected to operate at LOS F in the PM peak period. During the AM peak hour, both ramp terminal intersections are projected to operate at LOS F and the Yosemite Street intersection is expected to operate at LOS E. During the PM

peak hour, the Yosemite Street, Northbound I-25 Ramp, and Boston/Clinton Street intersections are all projected to operate at LOS F. Therefore, without roadway improvements, in the year 2030 drivers will experience significantly more congestion surrounding the Arapahoe/I-25 interchange area.

1.2.2. Safety

The Arapahoe/I-25 interchange experiences the highest crash rate among the interchanges in the southeast corridor. During the last three years for which data are available, 128 crashes occurred within the interchange area, representing an economic cost of more than $1.6 million. Even at the slow speeds within the interchange, over 20 percent of these crashes involved injuries. Most crashes within the interchange area are rear-end collisions resulting from congestion and queues of vehicles at the ramps and signalized intersections. Travel flow is interrupted and becomes dangerous as congestion creates unexpected or sudden stops.

Although recent signal timing modifications have improved the typical peak hour operations, the current interchange configuration operates at peak capacity and any slight increase in traffic volumes or incident causes vehicles on the Southbound I-25 off-ramp to back up onto the interstate, creating hazardous conditions on I-25, the ramp and Arapahoe Road.

Poor operations at the I-25 interchange and intersections along Arapahoe Road currently cause delays for emergency vehicles, resulting in longer response time for incidents on Arapahoe Road and I-25. The retrofit design of Arapahoe Road under the I-25 and light rail bridges does not provide any area for vehicle breakdown outside of the travel lanes.

Research conducted by FHWA, the Insurance Institute for Highway Safety, and the National Highway and Traffic Safety Administration has concluded that as LOS worsens (or congestion increases), the total crash rate and the severity rate tends to increase. Based on recent CDOT statewide research (Kononov and others, 2008), it is expected that future growth in traffic and increases in congestion on I-25 will result in an increase of about 67 percent in the fatal/injury crash rate and an increase of approximately 8 percent in the rate of total crashes. Additionally, this research indicates that differences in vehicle speeds, such as a vehicle entering or exiting the mainline traffic stream from or to a ramp, is correlated to increases in crash and severity rates.

Projected 2030 operations at both the freeway off-ramp terminal intersections are LOS F during the AM and/or PM peak hours, resulting in long and unpredictable queues. During peak hour

operations, vehicles attempting to exit I-25 will need to abruptly slow down and come to a complete stop due to queues extending from the signals onto the I-25 freeway mainline. This leads to the risk of increased crash and severity rates in the future on the I-25 mainline.

1.3. Project History

The need for an efficient interchange at I-25 and Arapahoe Road has been identified and studied in previous projects. The following sections give the status of the interchange project in previous and concurrent planning studies.

1.3.1. Initial Construction and Subsequent Improvements

The Arapahoe Road/I-25 Interchange was constructed in conjunction with the initial I-25 "Valley Highway" in the late 1950's. The initial interchange configuration was a simple diamond interchange. As area development occurred through the 1970's, interchange modifications were needed to increase interchange capacity. In the mid 1980's, the cloverleaf loop ramps were constructed in the northwest and southeast quadrants to serve the heavy left-turning movements onto the freeway. Approach lanes on Arapahoe Road to the new loop ramps were constructed by removing the slope paving under the I-25 bridge. The construction of vertical walls beneath the bridge abutments allowed for the loop ramp approach lanes to be constructed between the bridge piers and the abutment walls. This retrofit interchange has now been in operation for over 25 years.

1.3.2. Arapahoe Road Interchange Transportation Analysis for Southeast Corridor Project

This 1999 report of the potential transportation impacts of the Southeast Corridor LRT project in the area of the Arapahoe Road/I-25 Interchange provided technical documentation of the transportation analyses completed for the Southeast Corridor Environmental Impact Statement. This report documented poor levels of service at the majority of intersections within the interchange area. It was noted that the 2020 Regional Transportation Plan proposed improvements to the interchange, but these improvements would not be made as part of the Southeast Corridor LRT project (eventually known as T-REX). It should be noted that the lack of improvements at the Arapahoe/I-25 interchange with the T-REX project was based solely on the limitations of funding, not a lack of need for capacity improvements. Because improvements to this interchange were included in the Regional Transportation Plan, it was believed that the improvements could be achieved in the future as a separate project with Transportation Improvement Program (TIP) funding.

1.3.3. T-REX

Construction occurred at the I-25/Arapahoe Road Interchange during the Transportation Expansion (T-REX) project and, although needs for improvements at the interchange were recognized, no capacity improvements were made to address the operations of the interchange due to funding limitations. In conjunction with the construction of the RTD Southeast Light Rail line, more lanes were added on I-25 and the southbound exit ramp at Arapahoe Road was modified to accommodate the LRT bridge piers, which made the operations of the exit ramp worse by introducing sight distance restrictions. The I-25 bridge was widened and aesthetic

treatments to the bridge façade and landscaping were also completed. A pier for the LRT structure over Arapahoe Road and the southbound ramps was placed in the median dividing the eastbound Arapahoe Road through lanes from the lanes leading to the eastbound to northbound loop ramp. This pier placement was planned to accommodate the future widening of Arapahoe Road with a shift in centerline to the south.

1.3.4. Arapahoe Road Corridor Study

Current and forecasted traffic volumes and increasing traffic congestion along Arapahoe Road between I-25 and Parker Road prompted Arapahoe County to initiate a Corridor Study in 2005 to address regional mobility and local accessibility, and to build consensus on a locally preferred, realistic investment strategy for the timely implementation of recommended transportation improvements within the study area.

An overall improvement plan was developed in conjunction with this study process to address the vision for the Arapahoe Road corridor. This vision statement, developed with input from the Corridor Study's Executive Committee, comprised of local agency elected officials and CDOT, is as follows:

> *"Over the next 20 years and beyond, Arapahoe Road between I-25 and Parker Road will serve as a highly effective arterial corridor that meets the needs of commuters, employers, residents and the communities it serves. Arapahoe Road will provide a balance of improved regional mobility, local accessibility and enhanced safety, with minimal impact on neighborhoods, corridor business and the environment".*

Project objectives to achieve this vision include:

- Collaborating with local jurisdictions and the public to find creative solutions that will consider current transportation plans, comprehensive land use and economic plans.
- Providing roadway and intersection improvements that maintain safe and reliable travel through and within the Arapahoe Road corridor, including improvements on other nearby corridors that could accommodate a portion of regional traffic.
- Expanding mobility opportunities, including transit, bicycle and infrastructure facilities.
- Accommodating or supporting previous transportation and infrastructure improvements.
- Enhancing the corridor image, design character and identity of places within the project corridor.
- Avoiding or minimizing community or environmental impacts resulting from the recommended improvements.

1.4. Regional Planning Context

DRCOG, as the designated Metropolitan Planning Organization (MPO) for the Denver area, is responsible for developing a regional transportation plan that defines the integrated, multimodal, metropolitan transportation system. The Metro Vision Plan represents the preferred regional development and transportation plan, unconstrained by the region's ability to fund improvements. DRCOG also developed the Regional Transportation Plan (RTP), which is

a fiscally-constrained regional transportation plan that includes those transportation facilities identified in Metro Vision that can be provided through the horizon year based on reasonably expected revenues. The current Metro Vision Plan and RTP, which were adopted by the DRCOG in January 2008, are for the horizon year of 2035. However, the forecasts and analyses used for this study are based on the 2030 Regional Transportation Plan because the study began before the release of the current RTP. All of the planning context, land use, and travel forecast information cited in this report are from the 2030 RTP. It is believed the land use and travel forecasts within the new 2035 RTP would not change the recommendations in this report and would only reinforce the need for interchange improvements at I-25 and Arapahoe Road.

1.4.1. Regional Growth Forecasts

DRCOG forecasts a 47% population growth, from 2.64 million in 2005 to 3.88 million in 2030, for the Denver Metropolitan Region. Employment opportunities are expected to increase to 2.36 million by 2030, which is a 51% increase from 2005.

The relative locations of new households and employment between 2005 and 2030 are shown in **Figures 2 and 3**, respectively. New households will be distributed throughout the region. They are expected to form along the edge of the currently developed area as well as at redevelopment sites and urban centers within the City and County of Denver, the freestanding communities, and several inner ring suburbs. New employment sites will be concentrated in several urban centers and corridors oriented along freeways and transit lines. This reflects the historical trend of employers locating near key transit and highway corridors.

Note that the area surrounding the Arapahoe/I-25 interchange contains many new employment sites. These employment forecasts reinforce the need to evaluate and implement improvements to the transportation system to serve the businesses within the study area.

1.4.2. 2030 Regional Transportation Plan

The 2030 Regional Transportation Plan represents the fiscally-constrained transportation plan for the region, based on a prioritization of the elements identified in the 2030 Metro Vision. DRCOG recognizes a commitment to the preferred plan for the region, but considering reasonably expected revenues, all elements of Metro Vision are not affordable.

Figure 4 illustrates the 2030 RTP Fiscally Constrained Roadway System Improvements. The plan includes the following improvements that will directly affect the study area:

- New interchange at Arapahoe Road and Parker Road
- Widening of Arapahoe Road from I-25 to Potomac Street
- Reconstruction of I-25/Arapahoe Road interchange

As part of CDOT Policy Directive 1601, it is necessary for the proposed improvements to be included in the constrained plan. The reconstruction of the Arapahoe/I-25 interchange is included in the current fiscally-constrained plan. The 2030 RTP is currently being updated to the 2035 plan, which does not include as many projects as contained in the 2030 RTP. The draft 2035 RTP does include the I-25/Arapahoe Road interchange improvements.

Figure 2. Location of New Households 2005-2030

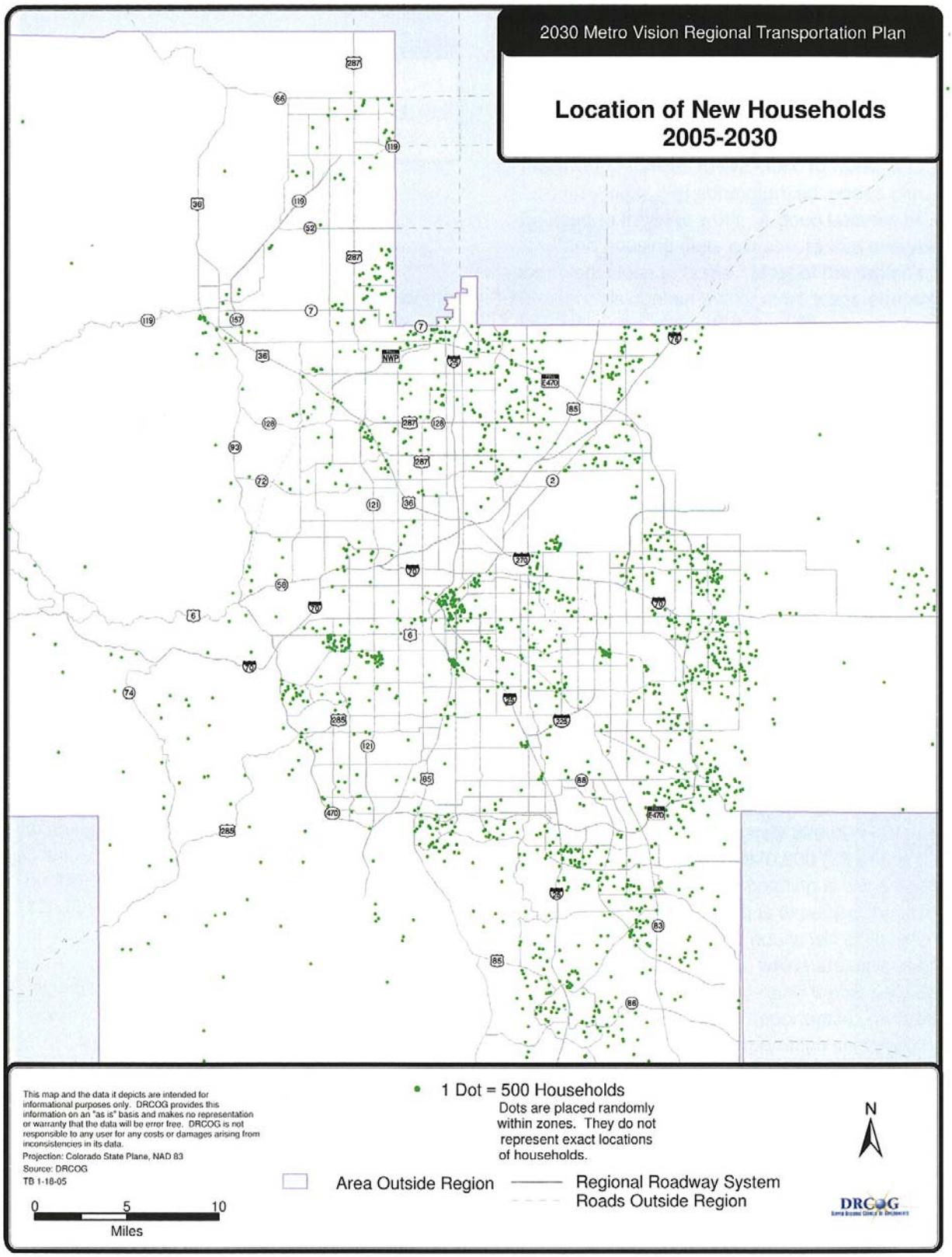


Figure 3. Location of New Employment 2005-2030

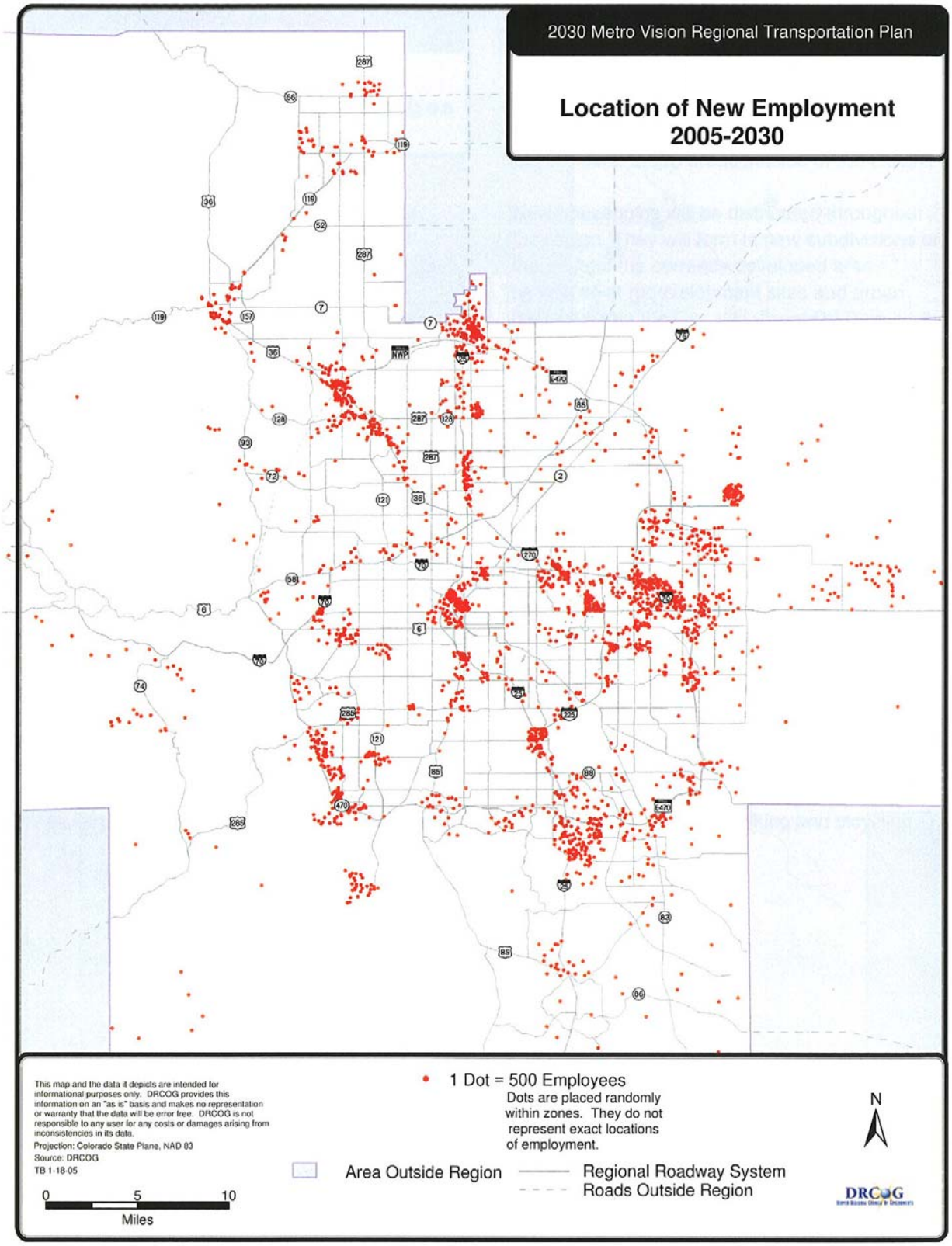
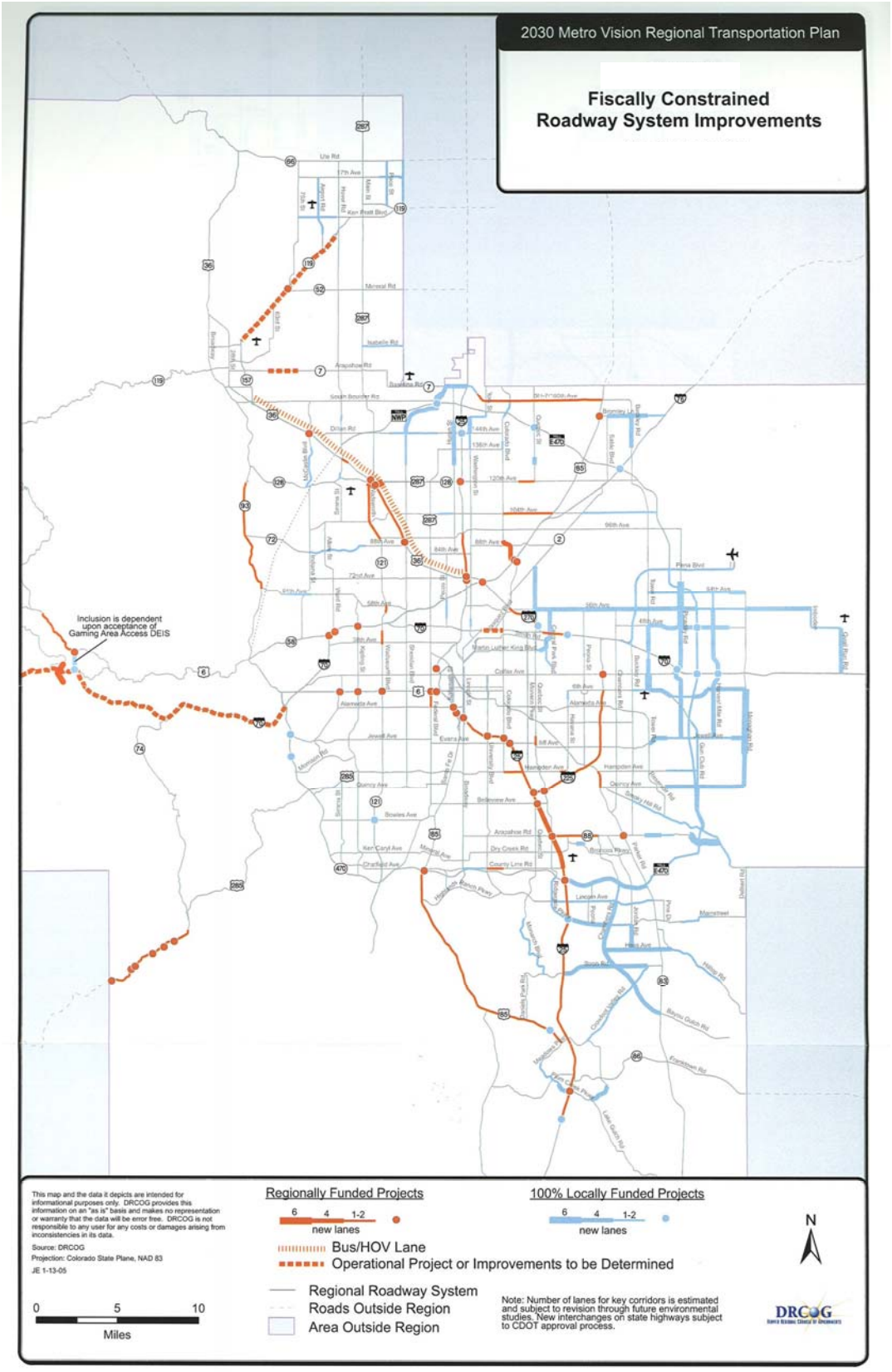


Figure 4. 2030 RTP Fiscally Constrained Roadway System Improvements



1.4.3. Local Plans

The Arapahoe/I-25 interchange reconstruction is consistent with the local communities' long-range plans. The interchange improvements are identified in the transportation plans of Arapahoe County, Greenwood Village, and Centennial. Planned land uses surrounding the interchange include mostly commercial redevelopment. To support the local redevelopment plans, the interchange improvements should be planned to handle increased levels of traffic.

1.5. Submittal Requirements for Interchange Approval Process

The Colorado Department of Transportation (CDOT) Policy Directive 1601B (PD 1601B) requires that all requests for new interchanges and improvements to existing interchanges on major state highways be reviewed and evaluated in a consistent manner through the use of established guidelines. These guidelines provide general direction regarding the content and format of information to be provided to CDOT and the Colorado Transportation Commission for its review during the interchange approval process. The documents that must be provided for the interchange approval include the System Level Feasibility Study, the appropriate environmental documentation of any other impacts and consequences of the interchange, preliminary design, and an Intergovernmental Agreement documenting funding and maintenance responsibilities.

The System Feasibility Study (SFS) is the first study required through the 1601 process. The SFS examines general traffic impacts of the new interchange within the context of existing and planned regional and local transportation facilities. The SFS details any benefits derived from the proposed improvement for the study area roadways and adjacent interchanges.

The environmental documentation is completed after the SFS and generally in conjunction with or after the preliminary design, to analyze the physical, social and environmental impacts associated with the proposed improvements.

The preliminary design of the interchange determines the precise location and extent of traffic impacts to the state transportation system. This design identifies all necessary improvements to the interchange and surrounding road system (state and local) to accommodate anticipated traffic. Preliminary engineering plans at a 20 – 30% design level of detail are provided.

An Intergovernmental Agreement (IGA) will also be necessary for this project. The City of Centennial, Greenwood Village, Arapahoe County and CDOT will need to document any funding and maintenance agreements, and identify any desired construction phasing.

This report presents only the System Feasibility Study for the Arapahoe Road and I-25 Interchange in compliance with CDOT Policy Directive 1601 Interchange Approval Process.

1.5.1. Public Involvement Process

Potential improvements to the Arapahoe/I-25 interchange were discussed within the public involvement process for the Arapahoe Road Corridor Study.

The study held four public meetings, to introduce the project and discuss corridor travel conditions and the need for improvement, to present the range of implementation options, to

present alternatives and preliminary analysis, and discuss the recommended improvements. The Arapahoe/I-25 interchange analysis and improvements were included in the presentation at each public meeting.

In an effort to gain as much community input as possible, the study utilized many methods of advertising and outreach. Each meeting was preceded by a news release, which was sent to local newspapers and television stations as well as local jurisdictions' Public Involvement Officers for inclusion in their community bulletins and newsletters. Also, a newsletter was mailed and e-mailed to businesses and residents in the area surrounding the corridor prior to each public meeting. Input was solicited at the public meetings and community members were also able to submit comments via the project website (www.arapahoecorridor.com) throughout the course of the study.

A Community Resource Panel (CRP) was formed to advise the project team of the concerns of various groups of stakeholders in the area. The CRP was divided into four separate focus groups, including representatives from:

- Homeowners' Associations and Neighborhood Associations
- Emergency Providers
- Bicycle and Trails groups
- Businesses, Metro Districts and Chambers of Commerce

The project team worked with the CRP to identify project needs, review proposed improvement alternatives, discuss likely impacts of improvements and possible mitigation or resolution techniques, and provide input on project implementation and phasing. The Business, Metro Districts and Chambers of Commerce CRP were particularly interested in the improvements planned for the Arapahoe/I-25 interchange area. Comments received at public and CRP meetings were posted on the website along with answers to frequently asked questions.

1.5.2. Agency Coordination

A series of meetings were also held with local agency representatives that comprised the corridor study's Technical Advisory Committee (TAC). The committee met approximately every two months throughout the 18-month study to provide technical input and review of plans and documents. Specific meetings were held with representatives of the City of Centennial and the City of Greenwood Village to discuss possible future redevelopment plans for the area surrounding the I-25 interchange.

2. Existing Conditions

2.1. Study Area

The study area is located along Interstate 25 (I-25) between the Dry Creek Road and Orchard Road interchanges. Arapahoe Road is State Highway 88 (SH 88) within the I-25 interchange area. The Arapahoe Road/I-25 interchange includes six ramp junctions with the current partial cloverleaf configuration. Arterial intersection operations were examined along Arapahoe Road through the interchange area from Yosemite Street to Boston Street/Clinton Street. The study area is located in Arapahoe County and includes the cities of Greenwood Village and Centennial. In addition, system-level transportation forecasts and plans were examined in a larger regional level as they relate to the traffic operations along I-25 and Arapahoe Road.

2.2. Existing Land Use

The Arapahoe Road/I-25 interchange is surrounded with office and commercial development, and includes portions of commercial and office areas in Greenwood Village and the Denver Technological Center. Today, big box retail uses such as Target, Home Depot and Lowe's occupy the majority of land near the I-25 interchange. Other land near the interchange is occupied by smaller scale retail and commercial uses and sections of office-park development. Southwest and northeast of the interchange predominantly single family residential development exists. The interchange provides access to several close major regional destinations, including:

- The Arapahoe at Village Center Light Rail Station is located northeast of the interchange at the intersection of Caley Avenue and Yosemite Street and provides access to downtown Denver and other regional destinations. This new station built with the T-REX project is contributing to the intensification of adjacent office and retail employment, and future higher density residential use in Transit Oriented Development (TOD) near the station location.
- The Southeast Business Corridor, a major employment center for the Denver metropolitan region, surrounds the interchange. The Arapahoe Road interchange is one of five interchanges along I-25 (County Line, Dry Creek, Arapahoe, Orchard, Belleview) that serves as primary access to the employment area.
- Centennial Airport, located about two miles southeast of the interchange, is the second busiest general aviation airport in the United States. Over 2,000 jobs are supported by this airport.
- Coors Amphitheatre, located about one mile northwest of the interchange along Greenwood Plaza Boulevard, is a regional concert venue with a seating capacity of approximately 17,000.
- Over 1,700 hotel rooms are located within a half-mile of the interchange.

2.3. Existing Roadway Network

The existing Arapahoe Road/I-25 interchange is a partial cloverleaf configuration in which the westbound to southbound and the eastbound to northbound movements through the interchange are accommodated via loop ramps. Below I-25, Arapahoe Road provides only two through lanes in each direction between the bridge piers, plus lanes north and south of the bridge piers to accommodate traffic bound traffic for the loop ramps. Upon approaching I-25, drivers must pay close attention to the specific lane they are traveling since the outside through lane in each direction forces traffic onto the ramps entering I-25.

Through the I-25 interchange, traffic signals are spaced every 600 to 900 feet. Four traffic signals comprise the I-25 interchange complex including Yosemite Street at the west end, the southbound off-ramp intersection, the northbound off-ramp intersection, and the Clinton Street/Boston Street intersection. One-quarter mile is provided from the Clinton Street/Boston Street to Dayton Street signalized intersection to the east of the interchange.

The traffic signals through the interchange area and along the Arapahoe corridor are coordinated by time of day via a central computer system. The signal cycle lengths are 120 seconds during the AM and PM peak periods and 100 seconds during the rest of the day, including the noon peak period.

I-25 – This is a major interstate highway facility through the Denver Metropolitan area and Colorado. Near Arapahoe Road, I-25 provides five through lanes in each direction following completion of recent improvements as part of the T-REX transportation expansion project.

Arapahoe Road (SH 88) –Arapahoe Road is a major regional arterial extending east-west through the southeast Denver Metropolitan area from Broadway to Smokey Hill Road east of E-470. It is a state highway (SH 88) between I-25 and Parker Road (SH 83). The roadway consists of three lanes of traffic east and west of I-25, with only two lanes in each direction carried through the interchange.

Havana Street – Located about one mile east of the Arapahoe/I-25 interchange, Havana Street is a six-lane facility extending south and curving into Dry Creek Road. The Dry Creek/I-25 interchange serves as a convenient southern alternate connection to I-25 for the study area.

Peakview Avenue - This is a two-lane east-west facility located north of and within one-quarter mile of Arapahoe Road. Its western terminal is at Yosemite Street where it "dead ends"

into commercial development near I-25. From here, the road extends east one mile to Havana Street where it curves south and intersects with Arapahoe Road (as Havana Street) part of Greenwood Village's "Serpentine Road".

Orchard Road – One mile north of Arapahoe Road is the parallel facility of Orchard Road. This roadway has an interchange with I-25 and extends east 2.5 miles to Peoria Street. This is a four-lane arterial roadway just east of I-25 that transitions to a two-lane road east of DTC Boulevard and then to a two-lane residential collector street east of Dayton Street.

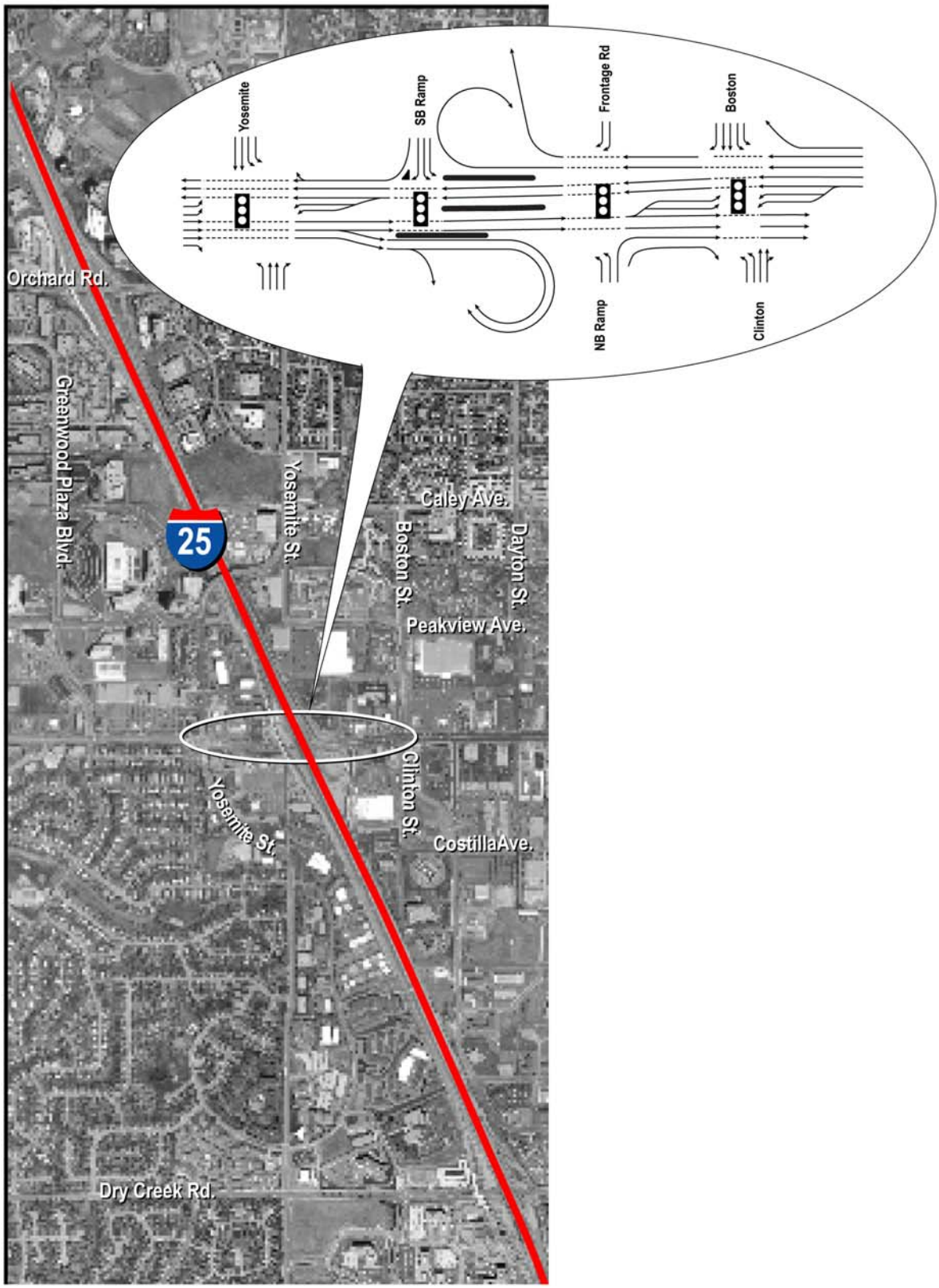
Yosemite Street – This is a major north-south four-lane arterial roadway that intersects Arapahoe Road immediately west of I-25. This facility extends south through the Park Meadows retail area and continues south to Lincoln Avenue in Douglas County. North of Arapahoe Road, the roadway crosses over I-25, provides access to the Arapahoe at Village Center Light Rail Station, and becomes DTC Boulevard within the Denver Tech Center. This road interchanges with I-225 nearly three miles north of Arapahoe Road.

Boston/Clinton Street – This north-south roadway, immediately east of I-25, provides access to a variety of facilities within the study area. North of Arapahoe Road, Boston Street has four travel lanes up to Caley Avenue, one-half mile north of Arapahoe Road. This segment provides access to adjacent businesses but also serves as the prime connection to Yosemite Street (via Caley Avenue) as part of Greenwood Village's "Serpentine Road". South of Arapahoe Road, Clinton Street also provides access to nearby businesses in the form of an I-25 Frontage Road. It extends two miles south and terminates at County Line Road (as Inverness Drive West).

Costilla Avenue – About one-quarter mile south of Arapahoe Road is Costilla Avenue, which parallels Arapahoe Road as a collector roadway east of the interchange, beginning at Clinton Street. East of Havana Street the road becomes Briarwood Avenue, which extends one-half mile east to Lima Street. This road is discontinuous between Lima and Peoria Streets, then is reestablished east of Peoria Street and extends as far east as Jordan Road. The roadway cross-section varies from two lanes to four lanes.

Figure 5 depicts the surrounding area roadway network and the existing lane configuration at intersections in the study area.

Figure 5. Existing Roadway Network & Intersection Lane Configuration



2.4. Existing Traffic Volumes

Traffic count data within the interchange area were collected for the Arapahoe Road Corridor Study during January 2006. The traffic count data are included in **Appendix A**.

Historic traffic volumes within the interchange area were obtained from Arapahoe County and CDOT. As shown in **Table 1**, there was an effect on the traffic volumes from 2001 to 2002 within the I-25 area from the commencement of the T-REX construction and the volumes on Arapahoe Road east of I-25 decreased over ten percent before rebounding somewhat in 2003. There has been substantial growth in traffic traveling on I-25 and Arapahoe Road through the interchange area in the last two years.

Table 1. Arapahoe Road/I-25 Historic Traffic Volumes

Roadway	Location	2001	2002	2003	2004	2005	2006	2007
I-25	S of Arapahoe Rd	130,600	130,300	130,400	-	-	153,100	172,000
	N of Arapahoe Rd	158,900	158,800	158,800	-	-	179,500	194,600
Arapahoe Road	E of I-25	64,200	55,800	60,000	59,600	56,800	-	69,600

Source: CDOT Crash Rate Books 2001-2003, CDOT Traffic Data Website, and Arapahoe Road Corridor Study traffic counts

As shown in **Figure 6**, the daily traffic volumes on Arapahoe Road immediately east of the I-25 interchange are distributed almost equally in the eastbound and westbound directions throughout the day. The noon peak period traffic volumes at this location are generally as high as the traffic volumes experienced during the typical AM and PM commuting periods, which creates lunch hour traffic congestion surrounding the retail and eating establishments around the interchange.

Figure 6. Weekday Hourly Traffic Volumes

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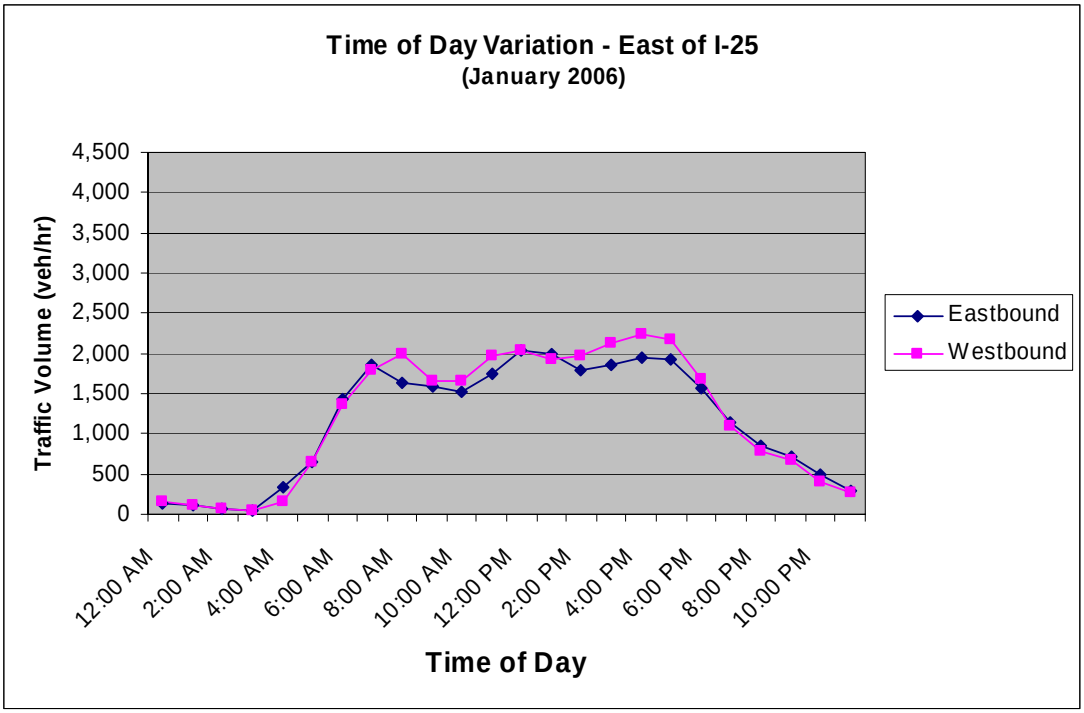


2.5. Existing Operational Analysis

Operational analysis was completed utilizing methods outlined in the latest Highway Capacity Manual (HCM 2000). Intersection operations were analyzed using Synchro software. Freeway segment and merge/diverge analysis was completed with Highway Capacity Software (HCS+).

Level of Service (LOS) is a measure of the quality of traffic flow and level of congestion on a roadway or intersection, measured on a scale from A to F. For signalized intersections, LOS is defined by the average control delay per vehicle. LOS A indicates very low control delay, averaging less than ten seconds per vehicle. LOS F indicates highly congested conditions with control delay in excess of 80 seconds per vehicle at the intersection. LOS D or better is often viewed as the realistic optimal operation for peak hour level of service in urbanized areas.

For basic freeway sections, level of service is defined by the maximum allowable density. LOS A describes free-flow operations where vehicles are almost completely unimpeded in their ability to maneuver within the traffic stream. LOS F indicates breakdowns in vehicular flow caused by traffic incidents or points of recurring congestion. The ramp merge and diverge level of service analysis is based on the density in the ramp influence area, defined as 1500 feet downstream (or upstream) from the physical merge (or diverge) point. LOS A represents unrestricted operations and LOS F represents unstable operation in which queues are formed on the freeway and ramps and continue to grow as approaching demand flows exceed the discharge capacity of the downstream freeway.

CDOT recently collected new peak hour turning movement volumes within the interchange area for a signal timing and short-term improvements project. These recent traffic volumes were compared with the volumes previously collected for this project and the movements to the Northbound I-25 entrance ramp and from the Southbound I-25 off ramp were substantially higher, while the movements from the Northbound I-25 off ramp were substantially lower. All other movements at the interchange intersections remained generally consistent. The traffic volumes for this project were updated only for the movements to and from the ramps that showed large differences.

The existing lane configurations, balanced peak hour traffic volumes, and current signal timings were used to analyze the LOS at each interchange area intersection, ramp merge/diverge, and freeway segment during the AM and PM peak hours. The freeway and ramp operations are based on the current lane configuration of I-25, which consists of five general purpose travel lanes in each direction with outside auxiliary lanes between interchanges.

The existing peak hour traffic volumes and results of the peak hour analyses are illustrated in **Figure 7** and summarized in **Table 2**. To simplify the illustration, the freeway segment and merge/diverge LOSs shown in the figure are for the peak hour in the peak direction (northbound during the morning peak hour and southbound during the evening peak hour). Output reports for the existing operational analysis are provided in **Appendix B**.

The intersections at Yosemite Street and the Southbound I-25 off ramp were calculated to operate at LOS D or LOS E during the peak hours analyzed based on HCM methodology. Highway Capacity Manual methods are the preferred standard methodology for traffic operations analysis. However, the HCM methodology for signalized intersections does not take into account the interaction of closely-spaced intersections, such as within this interchange

area. It should be noted that while the level of service for the Southbound I-25 exit ramp and Arapahoe Road intersection is shown to be LOS E and LOS D during the morning and evening peak hours, the queues along the Southbound I-25 off ramp occasionally back up from the signalized intersection onto the freeway mainline, a distance of approximately 1000 feet. These queues are due to the capacity constraints for through traffic along Arapahoe Road. The traffic queues at the downstream intersections on Arapahoe Road (at Yosemite Street or at Boston/Clinton Street), back up through the ramp intersections during some signal cycles during the peak hours, even with the recent signal timing improvements.

Table 2. Arapahoe Road/I-25 Existing Peak Hour Level of Service (LOS)

Roadway / Intersection	Control / Facility Type	LOS	
		AM Peak Hour	PM Peak Hour
Yosemite St/Arapahoe Rd	Signalized Intersection	D	D
SB I-25 Exit Ramp/Arapahoe Rd	Signalized Intersection	E	D
NB I-25 Exit Ramp/Arapahoe Rd	Signalized Intersection	C	B
Boston St/Clinton St/Arapahoe Rd	Signalized Intersection	E	E
SB I-25, North of Arapahoe Rd	Freeway Segment	C	D
SB I-25, South of Arapahoe Rd	Freeway Segment	B	D
NB I-25, South of Arapahoe Rd	Freeway Segment	C	B
NB I-25, North of Arapahoe Rd	Freeway Segment	D	C
SB I-25 Exit Ramp	Ramp Diverge	A	A
SB I-25 Loop Ramp	Ramp Merge	B	C
SB I-25 Entrance Ramp	Ramp Merge	B	F
NB I-25 Exit Ramp	Ramp Diverge	A	A
NB I-25 Loop Ramp	Ramp Merge	A	A
NB I-25 Entrance Ramp	Ramp Merge	F	C

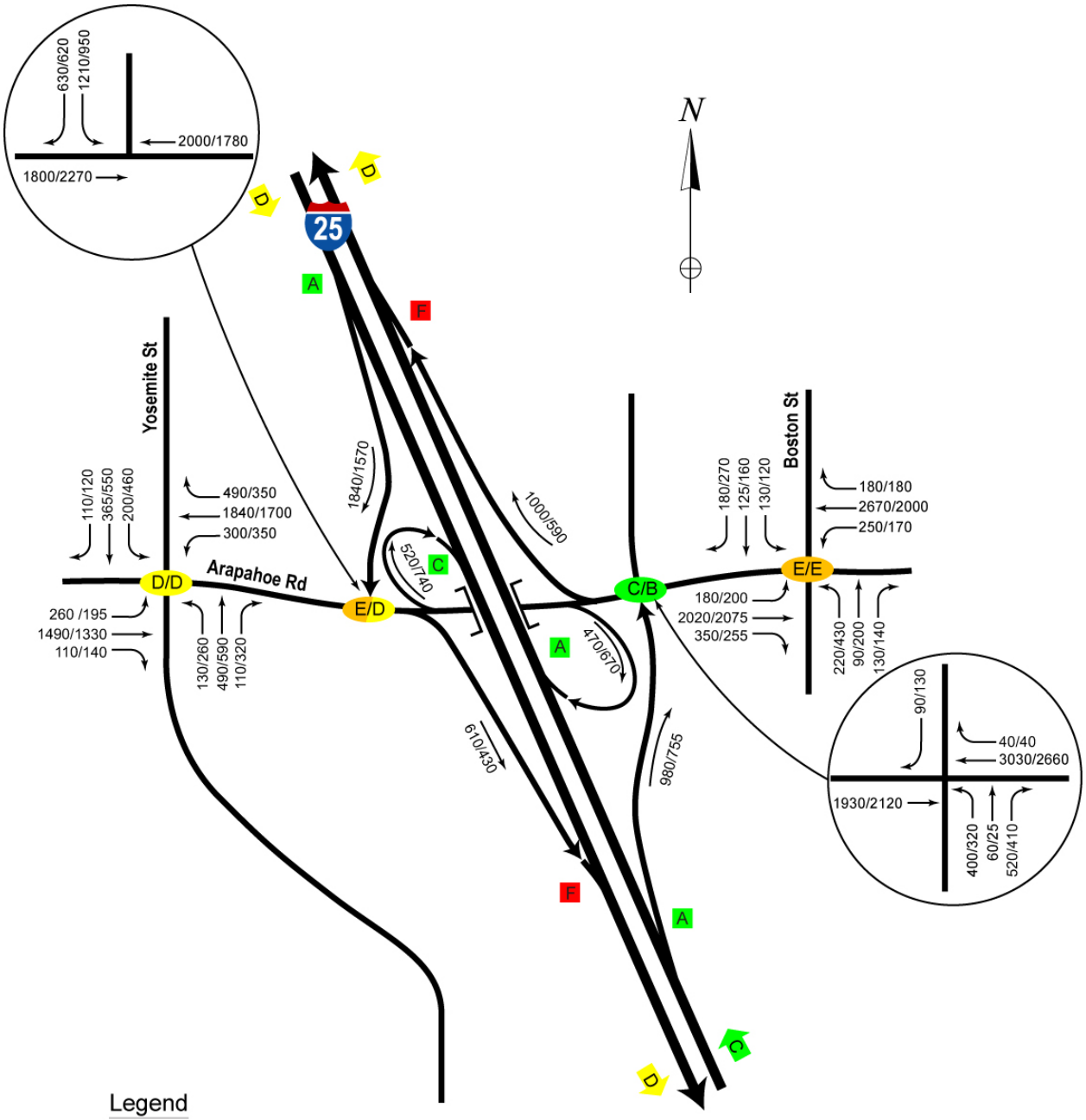
Source: Highway Capacity Manual analysis by David Evans and Associates, Inc.

The Northbound I-25 off-ramp terminal intersection operates at LOS C during the AM peak hour and LOS B during the PM peak hour. The Arapahoe Road and Boston Street/Clinton Street intersection operates at LOS E during the AM and PM peak hours. Due to the large amount of traffic bound for the Northbound and Southbound I-25 on ramps, much of the traffic traveling through these intersections is in the two right westbound lanes on Arapahoe. The outside lane is added at the Boston Street/Clinton Street intersection and the right lane on Arapahoe Road often backs up through the Dayton Street signal, located approximately a quarter mile east of Boston Street/Clinton Street.

The recent T-REX improvements have reduced congestion on the I-25 freeway. The freeway segments and merge/diverges operate at LOS D or better during the peak hours, except the diamond entrance ramp merges, which operate at LOS F due to heavy freeway volumes.

All four I-25 on ramps are controlled with ramp meters during the AM and PM peak hours. Although queues do not consistently back up to Arapahoe Road, the queues do fully utilize the ramps for storage.

Figure 7. Existing Peak Hour Traffic and Level of Service



Notes:

- Levels of Service based on Highway Capacity Manual (HCM) methodology
- Ramp and freeway design hour shown is NB in the AM peak hour and SB in the PM peak hour

2.6. Interim Improvements Operational Analysis

An interim operational improvements project is being planned for the Arapahoe Road/I-25 interchange, currently in the final design process by CDOT. The improvements are being funded through "TREX contingency funds". The improvements within the interchange area will include:

- An additional eastbound and westbound through lane on Arapahoe Road through the ramp intersections on the outside of the existing bridge piers and barriers that will tie into the outside lanes approaching the Yosemite Street and Boston/Clinton Street intersections
- A westbound right turn lane under the bridge from the new through lane outside the bridge piers and barrier to the Southbound I-25 loop ramp (This right turn lane will begin just west of the existing lanes leading to the Northbound I-25 entrance ramp)
- A free-flow southbound right turn lane from the Southbound I-25 exit ramp that will drop as a westbound right turn lane at Yosemite Street
- Modifications to the barrier median on the east leg of the Southbound I-25 exit ramp intersection to provide more room for truck traffic turning left from the exit ramp onto eastbound Arapahoe Road
- Additional advanced signage with overhead sign structures on Arapahoe Road east and west of the interchange

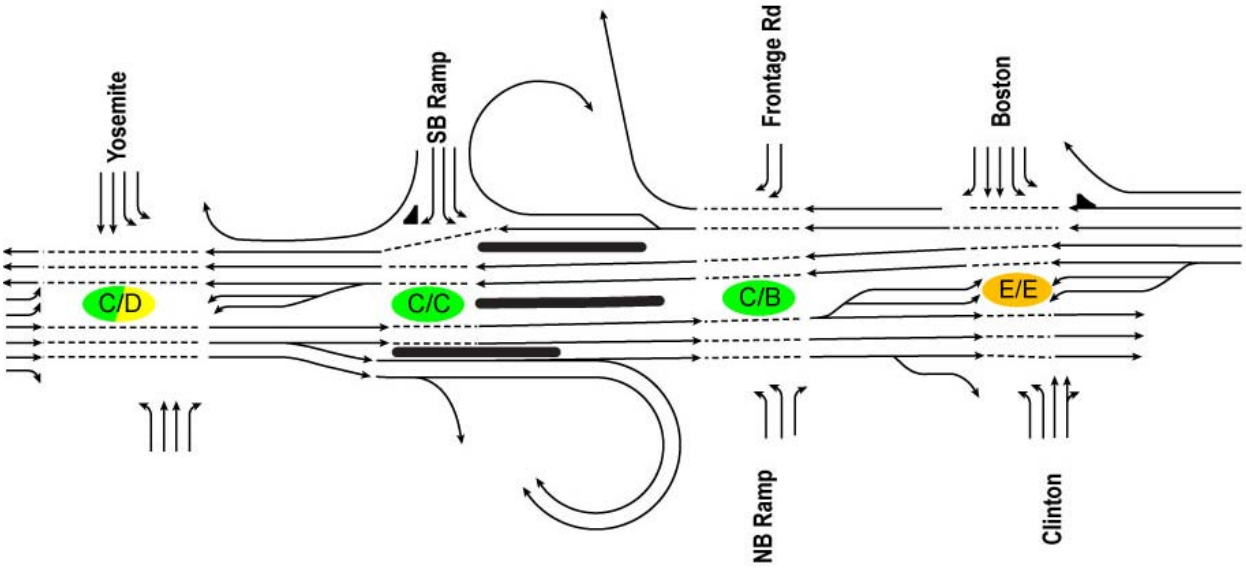
The lane configurations of the interchange intersections with the interim improvements are illustrated in **Figure 8**. The proposed interim improvements were analyzed with the balanced peak hour traffic volumes and optimized signal timings. The results of the peak hour analyses are summarized in **Table 3**. These results show that the interim improvements will provide a benefit to the interchange traffic operations in the short term, particularly at the Southbound I-25 exit ramp and Yosemite Street intersections.

Table 3. Arapahoe Road/I-25 Interim Improvements Peak Hour Level of Service (LOS)

Roadway / Intersection	Control / Facility Type	LOS	
		AM Peak Hour	PM Peak Hour
Yosemite St/Arapahoe Rd	Signalized Intersection	C	D
SB I-25 Exit Ramp/Arapahoe Rd	Signalized Intersection	C	C
NB I-25 Exit Ramp/Arapahoe Rd	Signalized Intersection	C	B
Boston St/Clinton St/Arapahoe Rd	Signalized Intersection	E	E

Source: Highway Capacity Manual analysis by David Evans and Associates, Inc.

Figure 8. Interim Interchange Improvements and Peak Hour Level of Service



2.7. Crash History

Crash data along Arapahoe Road were obtained from CDOT for 2001-2003 (the latest data available at the beginning of this study). Rates and summaries were calculated for the I-25 interchange. The crash rates are summarized in **Table 4**.

Table 4. Arapahoe/I-25 Interchange Crash Rates

	PDO	Injury	Fatal	Total
Arapahoe/I-25 Interchange Crash Rates	0.85	0.17	0.00	1.02

Source: CDOT Detailed Crash Summary Reports

Note: Property Damage Only (PDO) and Injury rates reported per Million Vehicle Miles Traveled (MVMT) and Fatal rate reported per 100 Million Vehicle Miles Traveled (100 MVMT)

The severity of crashes is summarized in **Table 5**. Due to the slow speeds experienced through the interchange with recurring traffic congestion, the percentage of crashes involving injuries within the interchange area (20%) is lower than the percentage of injury crashes at typical three and four-legged intersections within Colorado (27-31%).

Table 5. Arapahoe/I-25 Interchange Crashes Severity

	Crash Severity						
	Property Damage Only (PDO)		Injury		Fatal		Total
	Number	Percent	Number	Percent	Number	Percent	
Arapahoe/I-25 Interchange Crashes	101	79%	27	21%	0	0%	128

Source: CDOT Detailed Crash Summary Reports

Most crashes (46 percent) were rear end crashes, which is consistent with the number of signalized intersections in the area and the recurring congestion. About 25 percent of the crashes were broadside crashes and about 20 percent of the crashes were side swipe same direction. There were no crashes in the interchange area involving pedestrians and bicyclists during the years studied.

2.8. Engineering Opportunities and Constraints

The current Arapahoe/I-25 interchange does not have adequate capacity to accommodate traffic volumes today or into the future. Arapahoe Road currently contains three lanes approaching the interchange in each direction, but only two lanes are carried eastbound and westbound through the interchange, which severely limits the capacity of the interchange.

The location of the light rail bridge recently constructed with the Transportation Expansion (T-REX) project along the west side of I-25 highly constrains the options for the interchange, particularly the Southbound I-25 exit and entrance ramps and the potential modification of the Arapahoe Road horizontal alignment. A pier for the LRT structure over Arapahoe Road was placed in the median dividing the eastbound Arapahoe Road through lanes from the lanes leading to the eastbound to northbound loop ramp. This pier placement was planned to accommodate future widening of Arapahoe Road with a shift in centerline to the south. However, the existing I-25 bridge over Arapahoe Road, widened for additional lanes on I-25 with the T-REX project, cannot accommodate widening Arapahoe Road.

An abutment for the LRT structure straddles the Southbound I-25 exit ramp at Arapahoe Road. This straddle bent has reduced the sight distance for vehicles exiting the freeway and approaching the signal at Arapahoe Road, which has hindered the ramp operations. The bent also greatly limits the options for improving the Southbound I-25 off-ramp layout without reconstructing the LRT bridge.

2.9. Local and Property Access

The existing roadways within the interchange area are shown in **Figure 9**. West of I-25, right turn only intersections exist along both the north and south sides of Arapahoe Road between I-25 and Yosemite Street. The South Yosemite Court right turn only intersection on the north side serves commercial development (primarily fast-food restaurants) in the northwest quadrant of the interchange. South Yosemite Court extends north in a curvilinear alignment from Arapahoe Road to South Yosemite Circle, which intersects with South Yosemite Street at a signalized intersection, and further to an unsignalized intersection with South Yosemite Street.

The South Xanthia Court right turn only intersection along the south side of Arapahoe Road west of I-25 extends south to an unsignalized intersection with South Yosemite Street. The roadway serves the commercial development (primarily sit-down restaurants and auto service centers) in the southwest quadrant of the interchange. Further south along South Yosemite Street, additional access is provided to the southwest quadrant commercial development, including two private driveways to the Southgate Shopping Center, and South Yosemite Court which serves office development near I-25.

East of I-25, only one access exists between I-25 and the South Boston Street/Clinton Street intersection. This access is located along the north side of Arapahoe Road opposite the Northbound I-25 off-ramp. Northbound off-ramp traffic can travel straight north to this access road, but southbound traffic is restricted to right turn only movements. No left turns are permitted from eastbound Arapahoe Road into this access road. The road extends north in a curvilinear alignment to East Southtech Drive, and provides access to hotels and big box development in the northeast quadrant of the interchange.

2.10. Alternate Transportation Modes

2.10.1. Transit

The existing transit services in the vicinity of the Arapahoe/I-25 interchange were detailed in the *Existing Transportation Conditions Report* (May 2006) prepared in conjunction with the Arapahoe Road Corridor Study. Nearby transit services and facilities are focused on the Arapahoe at Village Center park-n-Ride, located north of the interchange at Caley Avenue and Yosemite Street, and the Arapahoe LRT Station. The station platform is on the west side of I-25 and is served by a pedestrian bridge over the interstate leading to the park-n-Ride on the east side.

Arapahoe Crosstown (Route 66) is the east-west local bus route that serves destinations along Arapahoe Road. It runs from the LRT/Littleton Downtown Station (along the Southwest LRT Corridor) east along Arapahoe Road to Parker Road, and south on school days to the Pinery park-n-Ride. In the vicinity of the I-25/Arapahoe interchange, the route uses Yosemite Street north of Arapahoe Road to transfer passengers at the Arapahoe LRT Station, then Caley Avenue to Boston Street to continue east on Arapahoe Road. Therefore, the buses turn at the Yosemite Street and Boston/Clinton Street intersections and do not travel through the ramp intersections within the interchange area.

Other routes in the interchange vicinity include Route 465 – South Yosemite, Route 727 – DTC Boulevard, Route 169 L – Buckley/Tower/DIA, and the Arapahoe call-n-Ride (Route 1409).

These routes use Yosemite Street, Clinton Street, Boston Street and Caley Avenue in the vicinity of the I-25/Arapahoe interchange.

None of the existing transit routes serving the area travel directly through the Arapahoe/I-25 interchange, but rather travel around the interchange to efficiently access the Arapahoe LRT Station and Arapahoe at Village Center park-n-Ride.

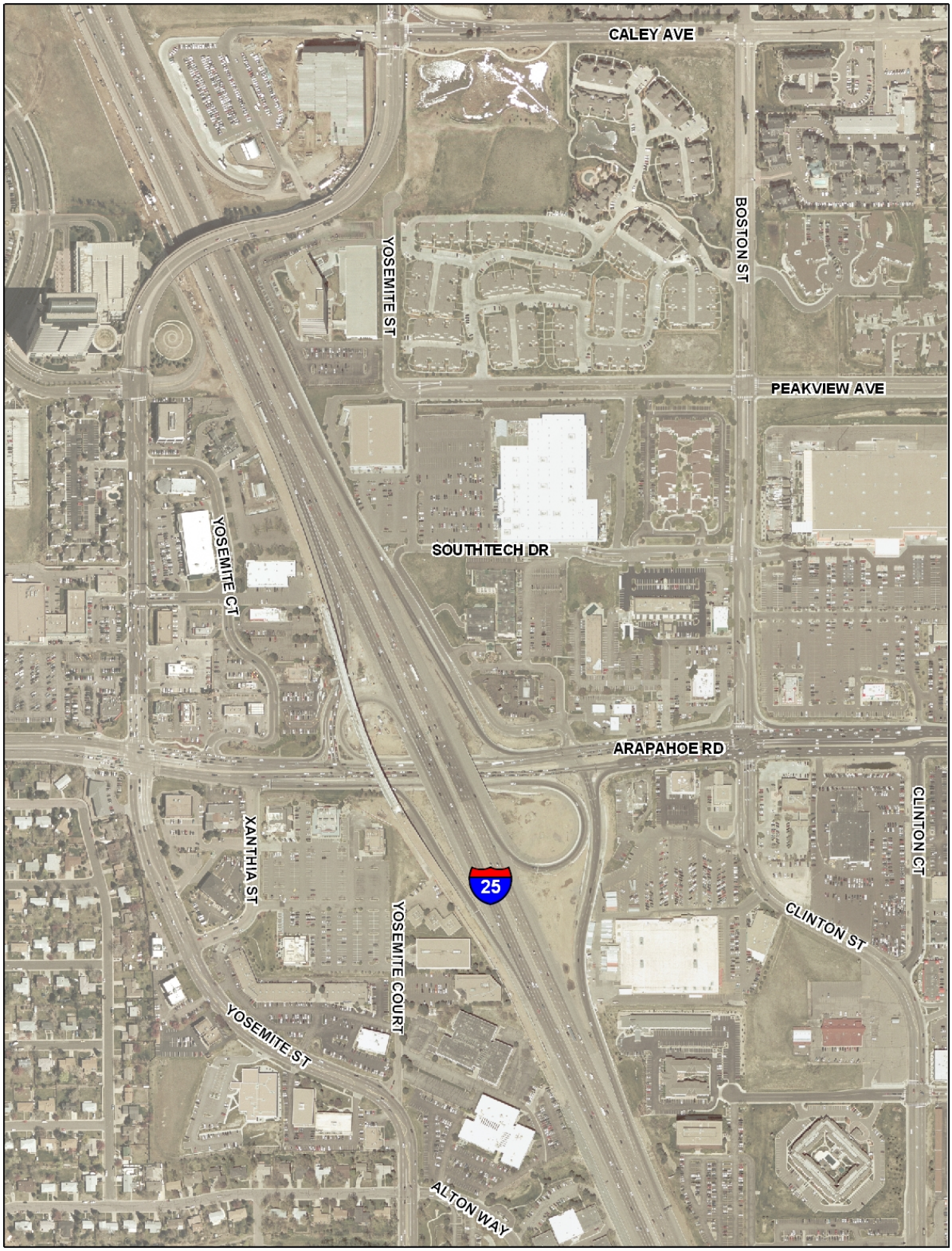
2.10.2. Pedestrians and Bicyclists

Pedestrian and bicycle conditions in the vicinity of the Arapahoe/I-25 interchange were summarized in the Arapahoe Road Corridor Study *Existing Transportation Conditions Report* (May 2006). Also, in conjunction with that study, Community Resource Panel meetings with area bicycle advocates were held to gain information on existing bicyclist activities and concerns.

Although sidewalks exist along Arapahoe Road through the interchange, little pedestrian activity has been observed. Pedestrians must negotiate through the high traffic volume area and cross the free-flowing traffic movements of the loop ramps in the northwest and southeast quadrants of the interchange. In order to facilitate the peak hour signal timing through the interchange area, the pedestrian timing to cross Arapahoe Road at the Northbound I-25 off-ramp was recently removed. Due to the existing barrier to separate Eastbound Arapahoe traffic bound for I-25, there is also no pedestrian crosswalk across Arapahoe Road at the Southbound I-25 off-ramp.

Separate bike lanes or widening of general purpose lanes do not exist along Arapahoe Road through the confined, retrofit interchange area. In discussion with area bicycle advocates, bicyclists currently choose to avoid the Arapahoe Road corridor and the Arapahoe/I-25 interchange and instead use Yosemite Street and the Yosemite Street overpass of I-25 to negotiate around the interchange area.

Figure 9. Existing Interchange Area



3. Environmental Issues

3.1. Environmental Overview

An environmental overview was conducted as part of the Arapahoe Road Corridor Study to identify the potential environmental issues that may influence the type, locations or design of the alternatives forwarded for further evaluation in this study and in future environmental evaluation processes under the National Environmental Policy Act (NEPA).

In the environmental overview report, each resource is described in terms of existing conditions, the potential impacts from a range of possible alternatives and the potential mitigation or Best Management Practices that could reduce or eliminate impacts. The major findings of the analysis within the Arapahoe/I-25 interchange area are discussed below.

Air Quality: Motor vehicles are a major source of air pollutants in the interchange area, particularly those pollutants that have been problematic for the larger Denver metropolitan area. Pollutant hot-spots can exist around a congested intersection. There are local changes that could be used individually or collectively to reduce local pollutant emissions, such as signal timing or the number of driving lanes. For the range of speeds within the Arapahoe/I-25 interchange area, any changes that will reduce vehicle idling time or increase average vehicle speeds will reduce pollutant emissions from mobile sources.

Improvements to the Arapahoe/I-25 interchange were included in the DRCOG 2030 Regional Transportation Plan (RTP), which was subject to air quality conformity analysis. During the future NEPA process for this project, carbon monoxide hot-spot analysis will be conducted as required.

Hazardous Materials: Several potential hazardous material sites were identified within the general area of the interchange area. Most of these sites are outside of the impact area of the interchange configuration options. The sites include automotive service stations, storage units, and commercial facilities.

Contributors of potential contamination within the general interchange area include:

- 9138 E. Arapahoe Road (east of interchange) – Gasoline station with open liquid petroleum gas tank.
- 9301 E. Arapahoe Road (east of interchange) – Automobile dealership and service with an UST and a closed LUST (November 1991).
- 9171 E. Arapahoe Road (east of interchange) – Gasoline station with seven USTs and one active LUST (1990).
- 6767 S. Clinton Street (southeast of interchange) – Commercial facility with no violations.
- 9250 E. Costilla Avenue (southeast of interchange) – Industrial/commercial facility with backup diesel generator.
- 9600 E. Costilla Avenue (southeast of interchange) – Storage units with potential for methamphetamine lab activity. No such activity reported.

- 6802 S. Yosemite Street (southwest quadrant of interchange) – Gasoline station with three open gasoline Underground Storage Tanks (USTs) and one closed Leaking Underground Storage Tank (LUST) (March 2001).
- 6900 S. Yosemite Street (southwest quadrant of interchange) – Commercial facility with no violations.
- 6770 S. Yosemite Street (southwest quadrant of interchange) – Automotive station with vehicle maintenance bays. Unknown material handling and disposal practices. Potential materials include: fuel, motor oils, hydraulic fluids, degreasers, paints, and solvents. No reported soil and groundwater contamination.

There are two leaking underground storage tank (LUST) sites within 100 feet of right-of-way in the interchange study area. One of these sites is still active and one site has been closed and clean-up has been completed. The active LUST site is located along Arapahoe Road east of the interchange and west of Boston Street (9171 East Arapahoe Road).

Historic and Archaeological Resources: Historic and archeological resources are tangible remains of past human activity and include sites, buildings, structures, districts, features and artifacts at least 45 years old. To warrant consideration of impacts in a federally-assisted or sponsored transportation project, historic and archeological resources must be listed on, or meet the eligibility criteria established for, the National Register of Historic Places (NRHP). A file search, literature review, aerial photo review, and reconnaissance "windshield" survey revealed no previously recorded significant historic or prehistoric resources within the Arapahoe/I-25 interchange area.

Environmental Justice: U.S. Census data (year 2000) was evaluated to better understand the potential impacts of a future project to minority and/or low-income populations and as a basis for outreach methods to those populations during a future NEPA process. The Census block south of Peakview Avenue and north of Dry Creek Road, between I-25 and Havana Street has minority populations higher than the county they are located within (Arapahoe or Douglas County) and a higher percentage of individuals living in poverty compared to the county percentage.

During the future NEPA process for this project, data on low-income and minority populations will be updated and the extent to which any populations may be affected will be identified. The interchange improvements will be designed to avoid impacts to these populations to the extent feasible. If impacts to these populations cannot be avoided, mitigation measures will be identified to reduce impacts and coordination with affected groups will be conducted to identify the best means for reducing such impacts.

Section 4(f)/6(f) Resources: No potential Section 4(f)/6(f) resources were identified within the study area near or adjacent to the interchange roadways that could be improved as part of this project.

Biological Resources: Existing data on wildlife, wetlands and special status species that are known to occur or may potentially occur within the interchange area were collected from a variety of data sources including Arapahoe County, the USFWS county list of federally listed species, and the Colorado Division of Wildlife (CDOW) list of state listed species and species of

concern. A visual survey of wildlife and special status species habitat and potential wetland areas was also conducted.

A small area of wetland vegetation was identified in the southeast quadrant of the interchange between the existing Target and hotel sites west of the Clinton Street and Costilla Avenue intersection. The majority of the Arapahoe Road corridor is occupied with noxious weeds, including diffuse knapweed and leafy spurge.

Any necessary wildlife surveys may be conducted during the environmental documentation for the project in accordance with CDOW survey protocol. A weed management plan is warranted to prevent the spread of noxious weeds within the study area.

Water Resources: The Study Area is located within the Cherry Creek Watershed. This watershed is nearly fully developed in the northern reaches and transitions southward to a more sparse development including farmsteads, open land and large lot residential areas. Cherry Creek is a right bank tributary to the South Platte River and is located within Denver, Arapahoe, Douglas and El Paso Counties. Cherry Creek Reservoir is located northwest of the interchange area and is a major water feature within the watershed. The reservoir is the main attraction for Cherry Creek State Park and is used extensively for boating and fishing. It provides a habitat for a diverse variety of animal species and vegetation. All of the drainages along Arapahoe Road east of the interchange are within the Cherry Creek Basin and all are tributary to Cherry Creek Reservoir. The area is controlled by the Cherry Creek Basin Water Quality Authority (CCBWQA). The CCBWQA has requirements for projects such as transportation improvements to improve the water quality within the basin. Phosphorus loads are a primary concern; storm runoff transports most of the phosphorus within the watershed. Stormwater issues include stormwater runoff control on construction sites and post-construction stormwater management.

The Arapahoe/I-25 interchange is in the Urban Drainage District which administers the floodplain modifications for Federal Emergency Management Agency (FEMA) designated floodplains. The Arapahoe County Stormwater Authority and local city floodplain administrators conduct the initial review for proposed floodplain impacts and determine if Urban Drainage and FEMA coordination is necessary. Any improvement of a drainage structure that lies within a FEMA administered floodplain will probably require this coordination.

Noise: Traffic volumes are likely to increase in the future within the Arapahoe/I-25 interchange area even without the proposed project, and this would likely increase the traffic noise to neighboring properties. The current land uses adjacent to the interchange area are generally Category B (homes, hotels, parks, etc.) and Category C (commercial). Category B is the most noise sensitive and there are several Category B properties within 500 feet of the proposed interchange construction area. There are approximately 45 homes west of the Arapahoe Road/Yosemite Street intersection and about 20 homes located near the Yosemite Street/Alton Way intersection. There are three hotels in the southwest quadrant of the interchange and one hotel in the northeast quadrant of the interchange.

Any changes to study area roads that would increase traffic volumes or move the roads closer to any current receivers would also likely increase the traffic noise at the receivers. Whether any of these changes would cause a traffic noise impact according to CDOT criteria would need to be assessed through a more thorough noise analysis during the future NEPA process for this project.

Geology and Paleontological Resources: The Arapahoe/I-25 interchange area contains the Louviers Alluvium geologic unit. The paleontological sensitivity of this geologic unit was evaluated using the Potential Fossil Yield Classification system and identified as a Class 2 unit. Class 2 units are sedimentary geologic units that are not likely to contain vertebrate fossils or scientifically significant invertebrate (or plant) fossils. Ground-disturbing activities are not likely to require mitigation.

3.2. Environmental Clearance Streamlining

The Arapahoe Road Corridor Study was conducted following FHWA/FTA guidance regarding the integration of transportation planning and the NEPA process, which encourages the use of planning studies to provide information for incorporation into NEPA documents. The goal of this early integrated planning effort is to streamline subsequent alternatives analysis during the NEPA clearance work for individual projects, such as the Arapahoe/I-25 interchange improvements.

Although the Arapahoe Road Corridor Study is a planning study and does not yet include NEPA clearance, the following steps were taken to streamline the future NEPA process:

- Developing a vision statement and objectives that readily translate to a project Purpose and Need,
- Conducting evaluation and documentation of a broad range of alternatives and the screening process to narrow preferred alternatives,
- Identifying logical termini for the study corridor, and identifying segments with independent utility for potential future NEPA clearances within fiscally constrained budgets,
- Including public and agency input during the study process,
- Conducting an environmental overview of resources potentially affected by the range of options, and
- Requesting concurrence by the Executive Committee at key decision points that mesh with those of the NEPA process:
  - Vision statement and objectives,
  - Range of alternatives,
  - Major screening criteria, and
  - Identification of a recommended option.

These steps were documented in various formats (meeting notes, public meeting materials, project memos and reports) that may be included as background reference as the transportation planning process transitions into NEPA clearance projects.

4. Future Conditions

4.1. Forecasting Approach

Traffic forecasts for the interchange were developed with the Arapahoe Road Corridor Study. The 2030 Denver Regional Council of Governments' (DRCOG's) regional travel demand forecasting model, Version 94, was used as a basis for developing year 2030 forecasts for the corridor study. This version of the regional model incorporates DRCOG's recent improvements to several aspects of the modeling process, including the forecasting of traffic on tollways. The travel forecast methodology and results are documented in the *Arapahoe Road Corridor Study Revised Final Travel Forecasts Summary* (April 2007).

The regional model includes the fiscally-constrained 2030 Regional Transportation Plan (RTP) as its basis. The planned interchange at Arapahoe Road/Parker Road is included in the 2030 RTP and it has been included in the baseline Arapahoe Road corridor modeling. The other major improvement to the Arapahoe Road corridor roadway network included in the 2030 RTP is widening to eight lanes between I-25 and Potomac Street. This widening was not included in the baseline modeling, since it represents an alternative analyzed in the corridor study.

The DRCOG Traffic Analysis Zone (TAZ) zonal structure was imposed over the study area, defining the 112 TAZs within the boundaries of the Arapahoe Road land use study area.

Due to the complexity of real-world driver behavior and individual roadway characteristics, travel demand forecasting models cannot be expected to result in precise representations of traffic volumes on each roadway. A common technique used to improve the reliability of travel demand forecasts is referred to as post-processing adjustment. This technique uses comparisons of the base year (2005) model's predicted traffic volumes versus actual traffic counts (which are documented in the *Arapahoe Road Corridor Study Existing Transportation Conditions Report*). These comparisons provide estimations of the error associated with the model's representation of travel conditions. The model-produced forecasts are then adjusted to account for the errors found in the model to provide more reliable forecasts. This post-processing adjustment process, as prescribed in the Transportation Research Board's publication *NCHRP 255*, was applied to the Arapahoe Road Corridor traffic forecasts.

4.2. Land Use

The I-25 interchange area has developed and will continue to develop in a high density land use pattern because of the regional access offered by I-25. The relatively recent construction of the Southeast Corridor Light Rail will contribute to further higher density development and redevelopment, with the potential for a significant amount of high density residential and commercial mixed use development influenced by light rail transit. Current development plans for the area include:

- The Greenwood Village Center is a 2 million square foot development planned north of the interchange that will include 1,600 new homes, over 350 hotel rooms, shopping, entertainment and open space, serving as a downtown core of the city.

- A 1.1 million square foot redevelopment project called Streets at Southglenn will convert the Southglenn Mall, located about 3.5 miles west of the interchange along Arapahoe Road, into an urban neighborhood with new homes and retail expansion.
- Centennial is planning a mixed use community called the Centennial City Center. This will be located along Arapahoe Road about three miles east of the interchange in a main street configuration with 200,000 square feet of retail and 600 new homes.

4.3. 2030 Roadway Network

The roadway network from the Arapahoe Road Corridor Study 2030 No Build model included the following roadway network improvements within the study area over existing conditions:

- New interchange at Arapahoe Road and Parker Road

The DRCOG 2030 model network includes the widening of Arapahoe Road from I-25 to Potomac Street. This improvement was removed to create the 2030 No Build model roadway network for the Arapahoe Road Corridor Study and this I-25 Interchange System Level Feasibility Study. The 2030 general roadway network within the study area used for the traffic forecasts is shown in **Figure 10**. The 2030 No Build analysis also included the interim lane configuration improvements, as described in Section 2.6 of this report, which are planned for construction within the interchange area within the next couple of years.

4.4. 2030 No Build Traffic Forecasts

No Build 2030 traffic forecasts from the modeling and adjustment process are shown in **Figure 11**. Significant traffic growth is expected on the roadways surrounding the Arapahoe/I-25 interchange, even without the widening of Arapahoe Road to eight lanes from I-25 to Potomac Street. The following is a summary of forecasted traffic volume growth on the corridor and surrounding roadway system:

- **I-25**: I-25 volumes are forecast to increase by more than 50 percent by 2030, to reach levels of approximately 270,000 to 290,000 in the vicinity of Arapahoe Road.
- **Arapahoe Road**: West of the interchange, traffic volumes on Arapahoe Road are expected to increase almost 40 percent over existing levels while traffic volumes are expected in increase about 20 percent east of the interchange.
- **Boston Street/Clinton Street**: Traffic projections on Boston Street/Clinton Street are expected to increase about 10 percent north of Arapahoe Road and increase approximately 20 percent over existing levels south of Arapahoe Road.
- **Yosemite Street**: Traffic volumes on Yosemite Street are expected to increase approximately 50 percent north of Arapahoe Road and about 60 percent south of Arapahoe Road.

Figure 10. 2030 Roadway Network

4.5. 2030 No Build Operational Analysis

To conduct traffic operational analysis of 2030 conditions, turning movement forecasts were developed using a combination of data from existing traffic counts, forecasted daily traffic, and forecasted peak hour traffic. Intersection, freeway segment, and ramp merge/diverge levels of service analyses were performed using the 2030 No Build traffic projections and roadway network. **Figure 11** shows the AM and PM peak hour traffic forecasts and **Figure 12** illustrates the Levels of Service (LOS) calculated for the Arapahoe/I-25 interchange area. Analysis worksheets are included in **Appendix C**.

The analysis shows that, even with the interim interchange improvements, three of the four signalized intersections along Arapahoe Road are expected to operate at LOS F during the AM and/or PM peak hours by 2030. The Southbound I-25 off-ramp intersection is expected to operate at LOS E during the AM peak hour. Taking the interactions of the closely-spaced intersections into consideration, the average queue on the southbound exit ramp is expected to reach 900 feet and the maximum queue would extend into the I-25 mainline lanes during the AM peak hour, creating a potentially dangerous situation for freeway and ramp traffic.

The I-25 freeway also degrades significantly from LOS C and LOS D under existing conditions to LOS F in 2030 between the Orchard Road and Dry Creek Road interchanges during peak hours in the peak direction (northbound during the morning peak hour and southbound during the evening peak hour). This high level of freeway congestion would result in failing ramp merge/diverge operations at the Arapahoe Road interchange. With these operational failures on the freeway, the queues from the ramp metering would back up to Arapahoe Road and impact the traffic traveling through the interchange area with only two lanes provided through the interchange ramp intersections.

Table 6. Arapahoe Road/I-25 No Build 2030 Peak Hour Level of Service (LOS)

Roadway / Intersection	Control / Facility Type	LOS	
		AM Peak Hour	PM Peak Hour
Yosemite St/Arapahoe Rd	Signalized Intersection	F	F
SB I-25 Exit Ramp/Arapahoe Rd	Signalized Intersection	E	C
NB I-25 Exit Ramp/Arapahoe Rd	Signalized Intersection	F	D
Boston St/Clinton St/Arapahoe Rd	Signalized Intersection	F	F
SB I-25, North of Arapahoe Rd	Freeway Segment	D	F
SB I-25, South of Arapahoe Rd	Freeway Segment	D	F
NB I-25, South of Arapahoe Rd	Freeway Segment	F	D
NB I-25, North of Arapahoe Rd	Freeway Segment	F	D
SB I-25 Exit Ramp	Ramp Diverge	B	F
SB I-25 Loop Ramp	Ramp Merge	C	F
SB I-25 Entrance Ramp	Ramp Merge	F	F
NB I-25 Exit Ramp	Ramp Diverge	F	A
NB I-25 Loop Ramp	Ramp Merge	F	A
NB I-25 Entrance Ramp	Ramp Merge	F	F

Source: Highway Capacity Manual analysis by David Evans and Associates, Inc.

Figure 11. 2030 No Build Traffic Forecasts

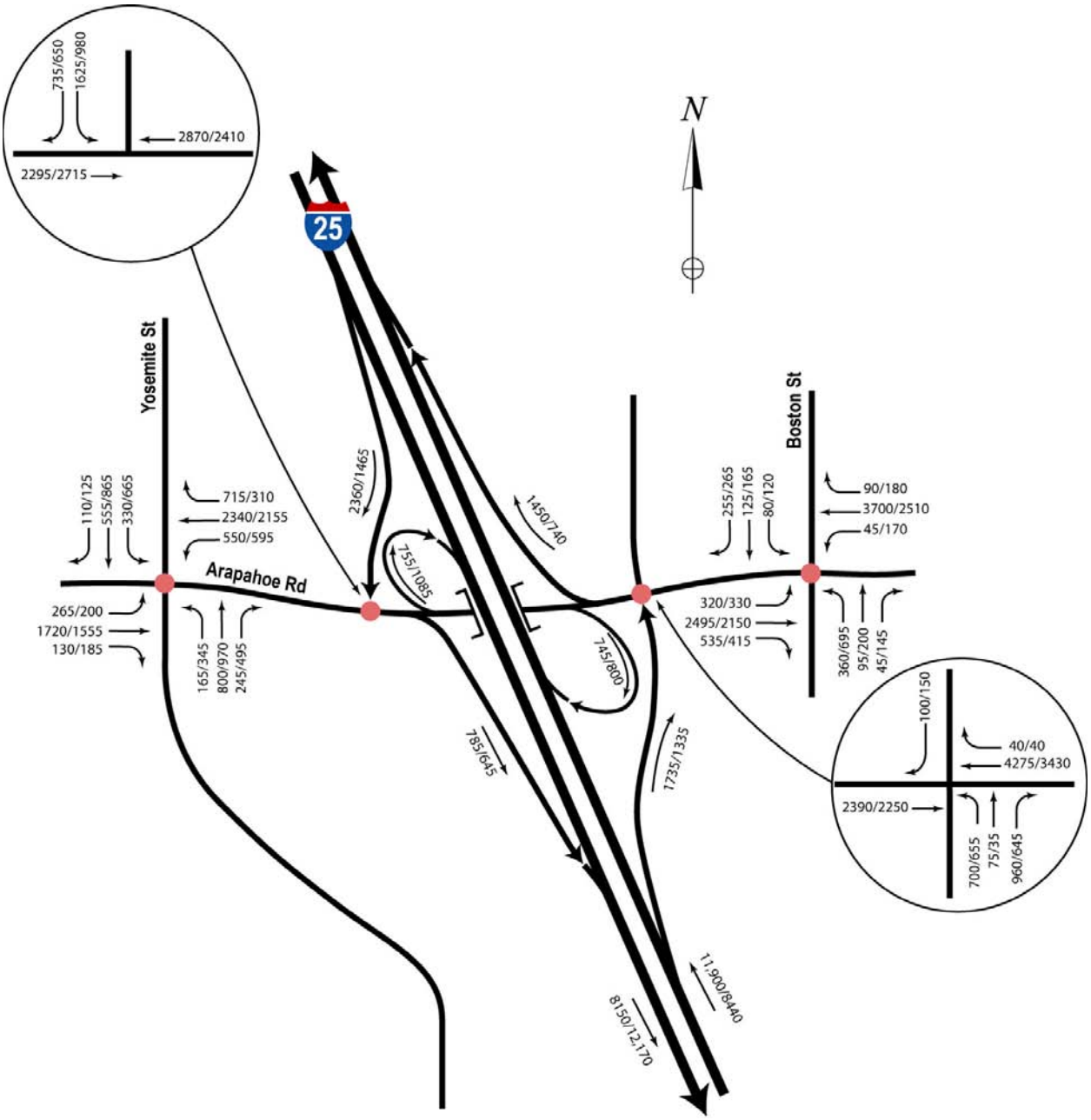
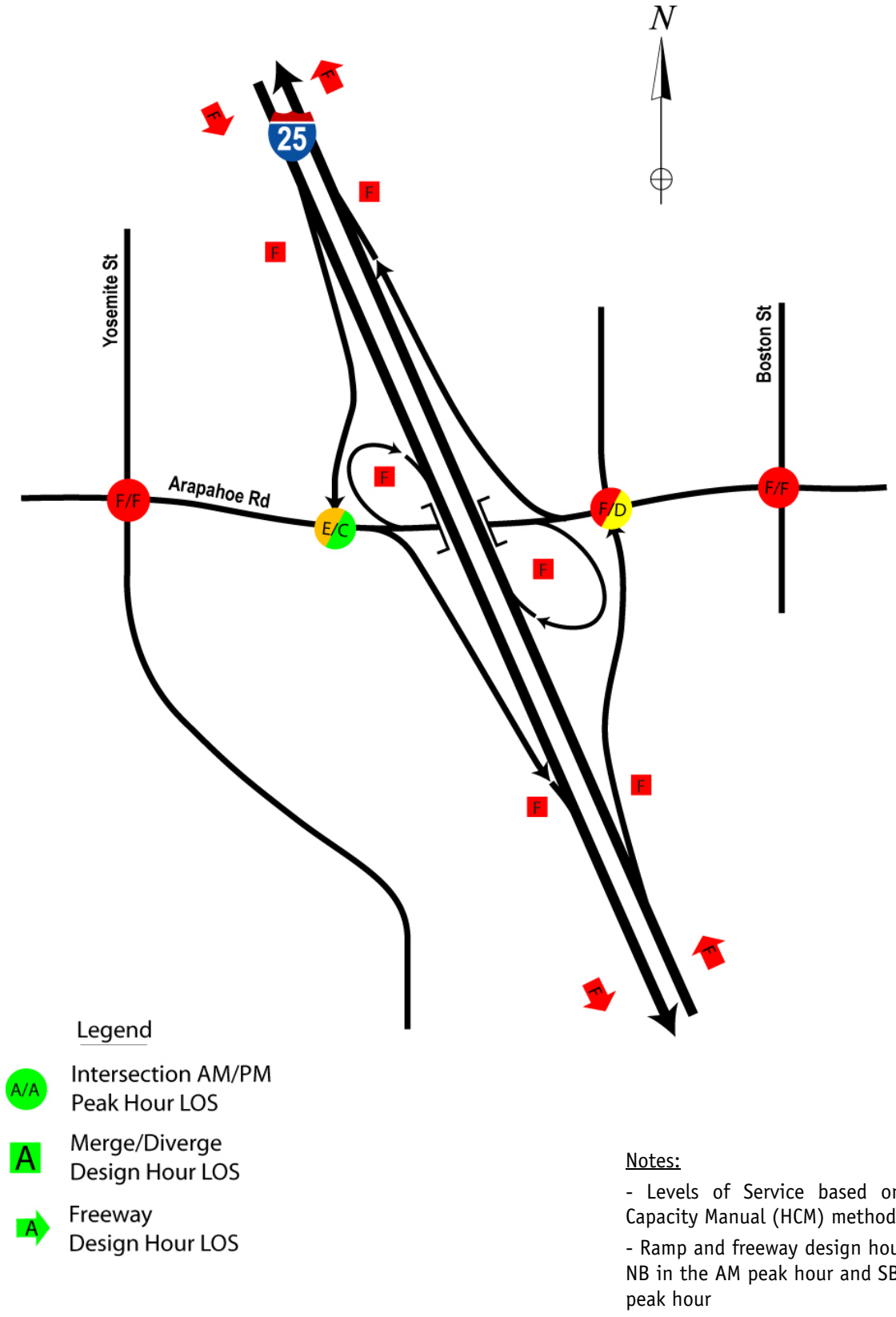


Figure 12. 2030 No Build Peak Hour Level of Service



5. Evaluation of Alternatives

In 2005, Arapahoe County, CDOT, Greenwood Village, and Centennial sponsored the Arapahoe Road Corridor Study, which included the evaluation of initial configuration options for the Arapahoe/I-25 interchange. The corridor study included an extensive task force and public meeting process. The study Technical Advisory Committee (TAC) and Executive Committee (EC) were comprised of engineers, planners, and stakeholder agency representatives that reviewed and guided the study process. The corridor study evaluation effort led to the selection of the interchange alternatives examined in this System Level Feasibility Study report.

5.1. Preliminary Interchange Options

The Arapahoe Road Corridor Study considered a range of options for improvements to the Arapahoe/I-25 interchange. The initial options considered, shown in **Figure 13**, include improvements to the existing cloverleaf type interchange, concepts with improved ramp intersection operations, and three level interchange concepts.

Alternative A - Improved Partial Cloverleaf: Conceptual design options were considered for improving the existing partial cloverleaf interchange design geometry. The concept includes increasing the loop ramp radius for the loop within the NW quadrant. The partial cloverleaf interchange would also include additional east/west travel lanes on Arapahoe Road for a total of six lanes traveling through the interchange.

Alternative B - Single Point Urban: The single point urban interchange option would replace the existing partial cloverleaf interchange and its two signalized ramp intersections with a single three-phase signalized intersection on Arapahoe Road. Due to the substantial width of the intersection, a long, deep clear span structure is required, and relatively long clearance intervals are required at the ramps signalized intersection. The tight ramp configuration would result in excess right-of-way from the current two cloverleaf ramps.

Alternative C - Tight Urban Diamond: The tight urban diamond interchange configuration includes two closely-spaced signalized intersections to serve ramp terminal and Arapahoe Road traffic movements. Due to the proximity of the signalized ramp intersections, signal operations of the two intersections would be operated as one signal with four-phase overlap phasing. Much of the Arapahoe Road left turn storage may be provided outside the signalized intersections, with signal timing developed to minimize the number of vehicles stored between the ramp intersections. This alternative also includes additional east/west travel lanes on Arapahoe Road for a total of six lanes traveling through the interchange.

Alternative D - Directional Ramps: This option consists of directional ramps to/from north I-25 with diamond configuration ramps to/from south I-25. This alternative includes additional east/west travel lanes on Arapahoe Road for a total of six lanes traveling through the interchange. This interchange option would have significant impacts to I-25 lane alignments due to the widening that would be required for shoulder areas for the grade change-related barriers of the flyover/tunnel ramps. (I-25 widening would be all to the east due to the proximity of the light rail bridge to the west.) Tunneling for a curved ramp underpass would be complicated and require storm drainage accommodations. A short weave area would result

for southbound I-25 to eastbound Arapahoe Road traffic prior to the Boston Street/Clinton Street intersection.

Alternative E - Tunnel: With this option, the eastbound to northbound and westbound to southbound ramp movements would be accommodated as tunnels under the interchange. All eastbound and westbound traffic bound for I-25 would be separated from Arapahoe Road west of Yosemite Street and east of Boston Street/Clinton Street, respectively, with local access to the southwest and northeast quadrants crossing over the on ramps. The existing four through lanes on Arapahoe Road would remain without additional widening through the interchange.

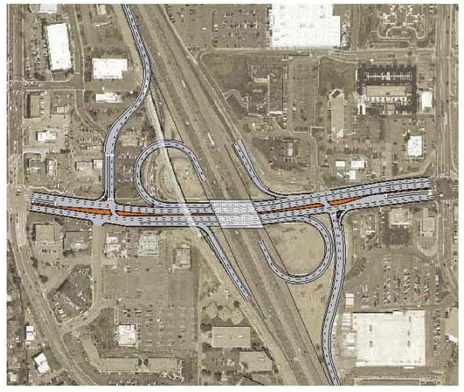
Similar to the directional ramp option, the merge of the westbound to southbound ramp would require additional shoulder area along the southbound on ramp, consequently requiring a shift in the alignment of I-25. The curved tunnel ramps would require complicated construction and drainage accommodations.

Alternative F - Diverging Diamond: A diverging diamond interchange is a form of diamond interchange in which the two directions of traffic on the intersecting arterial roadway cross to the opposite side on both sides of the bridge at the freeway. Simple two-phase traffic signal control of the ramp intersections could improve overall interchange and corridor traffic operations. However, driver expectancy issues may increase the number of crashes within the interchange area. The speed limit on Arapahoe Road would also need to be substantially reduced through the interchange to be consistent with the low design speed of the curving intersection approaches. This alternative includes additional east/west travel lanes on Arapahoe Road for a total of six lanes traveling through the interchange.

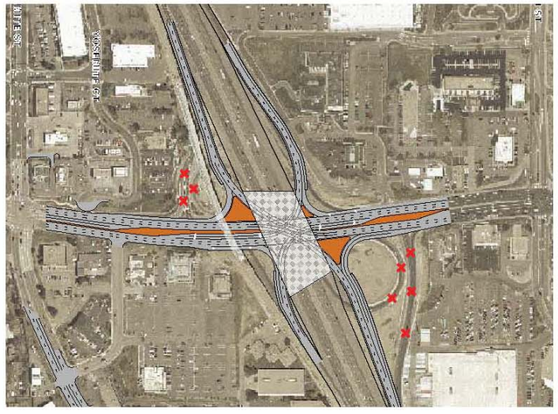
Alternative G - Three Level Diamond: The three level diamond option would include an underpass for east/west Arapahoe Road through traffic under the existing level of Arapahoe Road. The underpass would provide two lanes in each direction for through travel on Arapahoe Road. Ramp intersection movements would occur on the existing level of Arapahoe Road, and I-25 would remain the top level of the interchange. Turn accommodations for ramp traffic bound for the adjacent Yosemite Street and Boston Street/Clinton Street would be made to eliminate weaving traffic movements along Arapahoe Road. The underpass would require complicated construction and drainage accommodations.

Alternative H - Yosemite to Costilla Connection: With this option, the existing interchange configuration and number of lanes remain, but a new underpass of I-25 south of Arapahoe Road would be constructed to connect Yosemite Street and Costilla Avenue. This would provide an alternate route for east/west through traffic to bypass the interchange area along Arapahoe Road. The new five-lane section of Costilla Avenue would begin at a T-intersection with Yosemite Street west of I-25, cross under the freeway south of the Target property, and connect at the existing Costilla Avenue and Clinton Street intersection. The existing section of Costilla Avenue east of Clinton Street would also be improved to meet the existing five-lane section at Fulton Street.

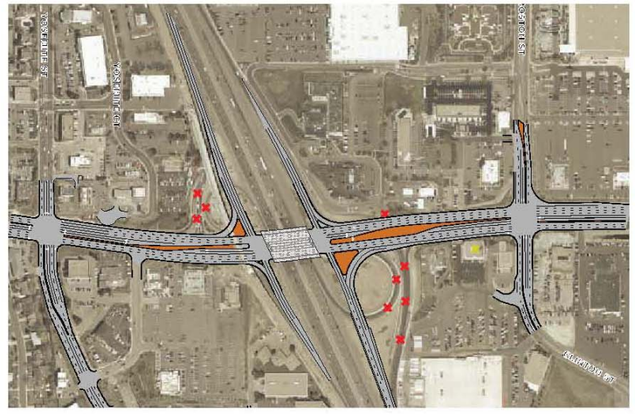
Figure 13. Preliminary Interchange Layouts



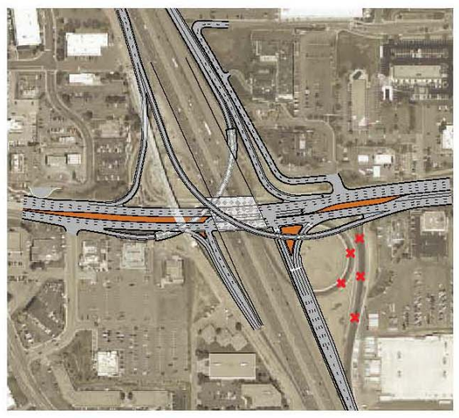
Alt. A - Improved Partial Cloverleaf



Alt. B - Single Point Urban Interchange

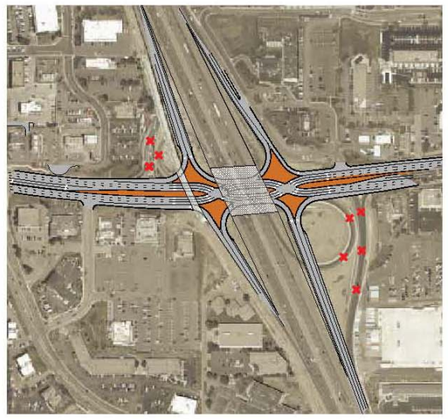


Alt. C - Tight Urban Diamond Interchange

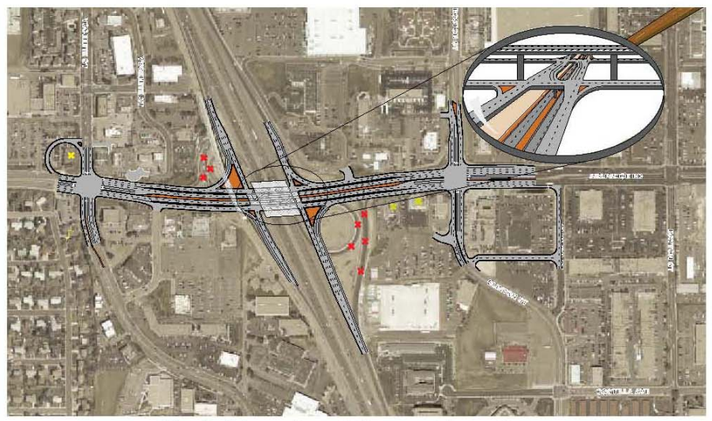


Alt. D - Directional Ramps Interchange

Alt. E - Tunnel Interchange



Alt. F - Diverging Diamond Interchange



Alt. G - Three Level Diamond Interchange

Alt. H - Costilla Connection

5.1.1. Preliminary Evaluation

The seven initial alternatives were evaluated against a wide range of applicable evaluation criteria. These criteria were categorized as:

- Traffic Operations/Level of Service (LOS)
- Safety/Crash Potential
- Access to Adjacent Land Uses
- Constructability/Phasing
- Right-of-Way Requirements
- Existing Business Impacts
- Construction/Implementation Cost

Table 7 provides a summary of the evaluation of preliminary alternatives. This evaluation matrix provides a comparative analysis of the alternatives related to the evaluation criteria.

5.1.2. Traffic Operations/Level of Service

These criteria consider the number of traffic signals within the interchange area (including the signalized intersections at Yosemite Street and Boston Street) and the direct connection for heavy turning movements to/from I-25. It also considers weaving movements or complex operations required to accommodate local movements within the interchange area. The evaluation indicates that the Improved Partial Cloverleaf (Alternative A) and Yosemite and Costilla Connection (Alternative H) would best comply with the project goals related to this criteria. The Single Point Urban interchange would remove a signal from Arapahoe, but limits the capacity of the movements accessing I-25. The Tight Urban Diamond interchange would continue to require Arapahoe Road traffic to travel through four closely-spaced signalized intersections and would limit the capacity of the left turns accessing I-25. The Directional Ramps, Tunnel, Diverging Diamond, and Three Level Diamond alternatives would provide high capacity for certain movements through the interchange, but all would create complicated weaving movements and/or unusual maneuvers that would degrade overall interchange operations.

5.1.3. Safety/Crash Potential

The number of conflict points in the interchange area, potential queuing and weaving conflicts along Arapahoe Road and interstate ramps, and driver expectancy are considered in this evaluation. The Single Point Urban (Alternative B) alternative indicates the best compliance with project safety goals due to one less intersection on Arapahoe Road. The Improved Partial Cloverleaf (Alternative A) also has moderate compliance with the safety goals since increased capacity would reduce the number of congestion-related crashes. The Tight Urban Diamond (Alternative C) would introduce increased left turn conflicts and queuing at the two ramp intersections since left turns would occur at the ramp intersections and the queues would need to be stored on the approaches to the interchange, outside the area between the ramp intersections. Although the Yosemite and Costilla Connection would reduce volumes through

the interchange, the additional intersection on Yosemite introduces additional conflict points. The Directional Ramps, Tunnel, Diverging Diamond and Three Level Diamond alternatives have driver expectancy safety concerns due to the unusual configurations and short distances for lane changes and turning movements between the four interchange area intersections.

5.1.4. Access to Adjacent Land Uses

Access limitations and restrictions resulting from the interchange configuration are considered in this evaluation. Each of the interchange configuration alternatives will impact access to adjacent development areas to some degree. The Yosemite and Costilla Connection (Alternative H) would provide additional access opportunities across I-25 south of the interchange. The Improved Partial Cloverleaf (Alternative A) and Tunnel (Alternative E) configurations provide the potential for signalized access to the southwest quadrant across from the Southbound I-25 off-ramp.

5.1.5. Constructability/Phasing

This criterion considers the accommodation of traffic through the interchange during construction. Each of the interchange configuration alternatives would have some detour and construction impacts to traffic traveling through the area. The Yosemite and Costilla Connection (Alternative H) would have no impact to traffic through the interchange. The greatest impacts would result from alternatives that would be difficult to build in phases and/or would require the realignment of I-25, including the Single Point Urban (Alternative B), Directional Ramps (Alternative D), Tunnel (Alternative E), and Three Level Diamond (Alternative G) alternatives.

5.1.6. Right-of-Way Requirements

Impacts are based on the number of parcels affected. The most right-of-way within the interchange area would be required with the Directional Ramps and Tunnel alternatives and the least amount of right-of-way is required with the Single Point Urban (Alternative B) configuration. The Yosemite and Costilla Connection (Alternative H) would require substantial right-of-way along the new roadway alignment. The Improved Partial Cloverleaf, Tight Urban Diamond, and Diverging Diamond alternatives would require minimal, if any, additional right-of-way outside of the existing interchange footprint.

5.1.7. Existing Business Impacts

Impact to existing businesses within the study area is considered the key differentiating environmental characteristic for this level of screening. Other, more specific, environmental criteria are considered in the next level of alternative assessment.

Impacts are based on the number of existing businesses displaced. No impacts to existing buildings are anticipated with the Improved Partial Cloverleaf (Alternative A), Single Point Urban (Alternative B), Tight Urban Diamond (Alternative C), and Diverging Diamond (Alternative F) configurations. The Yosemite and Costilla Connection (Alternative H) would require major impacts to at least two buildings south of the interchange area.

Table 7. Preliminary Evaluation of Interchange Options

Evaluation Criteria	No Build	Alt. A Improved Partial Cloverleaf	Alt. B Single Point Urban	Alt. C Tight Urban Diamond	Alt. D Directional Ramps	Alt. E Tunnel	Alt. F Diverging Diamond	Alt. G Three Level Diamond	Alt. H Yosemite and Costilla Connection
Traffic Operations / LOS	No improvements to existing congestion or queuing. ●	Four intersections on Arapahoe Rd; No left turns at ramp terminals. Direct connection for EB to NB and WB to SB left turns. ◔	Three intersections on Arapahoe Rd; Limits capacity of EB to NB and WB to SB left turns. ◒	Four intersections on Arapahoe Rd; Limits capacity of EB to NB and WB to SB left turns. ◕	Four intersections on Arapahoe Rd; High capacity for heavy movements to/from north I-25; Weaving movements for SB to EB ramp traffic to Boston St. ◒	Four intersections on Arapahoe Rd; High capacity for movements to I-25; Complicated movements Yosemite & Boston intersections. ◒	Four intersections on Arapahoe Rd; Two-phase ramp terminal operations; Unusual weaving operations along Arapahoe Rd at ramp terminals. ◕	Two intersections for thru traffic on Arapahoe Rd; Weaving at Yosemite & Boston intersections; Complex turning and local movements at Yosemite & Boston intersections. ◒	Four intersections on Arapahoe Rd; New signalized intersection on Yosemite north of Alton Way; About 3,000 vpd removed from Araphoe Rd thru interchange. ◔
Safety / Crash Potential	No changes in crash potential. ●	Arapahoe Rd traffic continues to stop at four intersections; Limits queuing from I-25 on-ramps to outside lanes of Arapahoe. ◔	Single intersection limits conflicting movements; Decreased storage length for I-25 on-ramp queues. ◔	Arapahoe Rd traffic continues to stop at four intersections with increased left turn conflicts. ◒	Arapahoe Rd traffic continues to stop at four intersections; Decreased turn conflicts at ramp terminal intersections: Decreased storage length for SB I-25 on-ramp queues. ◒	Arapahoe Rd traffic continues to stop at four intersections; Decreased conflicts at ramp intersections: Removes Arapahoe queuing from I-25 on-ramps; Weaving issues east & west of interchange. ◒	Critical driver expectancy safety concern with unusual travel lane configuration thru interchange; Short weaving section along Arapahoe Rd between ramp intersections. ◕	Arapahoe Rd thru traffic grade-separated, limiting conflicting movements; Driver expectancy safety concern with movements required at Yosemite & Boston intersections. ◕	Arapahoe Rd traffic continues to stop at four intersections; Decreased volumes on Arapahoe thru interchange decreases conflicts; Increased conflicts on Yosemite and Costilla Ave. ◒
Access to Adjacent Land Uses	Continuing congestion degrades existing access conditions. ○	Closes right-in/right-out access to NW quadrant; Potential for added signalized access to SW quadrant across from SB off-ramp (only with CDOT approval). ◔	Closes right-in/right-out access to NW quadrant and signalized access to NE quadrant. ◔	Closes right-in/right-out access to NW quadrant and signalized access to NE quadrant. ◔	Closes right-in/right-out access to NW quadrant; Replaces signalized access to NE quadrant with unsignalized right-in/right-out access. ◒	Closes right-in/right-out access to SW quadrant; Potential for added signalized access to SW quadrant across from SB off-ramp (only with CDOT approval). ◔	Closes right-in/right-out access to NW quadrant; Replaces signalized access to NE quadrant with unsignalized right-in/right-out access. ◒	Closes right-in/right-out access to NW quadrant; Replaces signalized access to NE quadrant with unsignalized right-in/right-out access; Complex movements to provide access at Yosemite & Boston. ●	Provides additional access opportunities south of interchange with additional traffic on Costilla connection. ○
Constructability / Phasing	No construction impacts. ○	Could be built in phases with minimal impacts to existing Arapahoe alignment during construction. ◔	Difficult to build in phases; Requires detours of Arapahoe and multiple construction phases on I-25. ◕	Difficult to build in phases. ◒	Constructability issues with third level bridges and tunnels; Requires realignment of I-25 ●	Constructability issues with tunnel. ●	Difficult to build in phases. ◒	Constructability issues with lower level for Arapahoe thru traffic; Difficult to build in phases. ◕	Could be built in phases; No impact to Arapahoe interchange during construction. ○
Right-of-Way Requirements	No ROW impacts. ○	Minimal ROW required if loop ramps remain within existing interchange footprint. ◔	Least ROW required than other build alternatives. ○	Minimal, if any, ROW required. ◔	ROW required in all four quadrants for flyover ramps. ●	ROW required in SW and NE quadrants for tunnel approaches. ●	Minimal, if any, ROW required. ◔	ROW required along Arapahoe thru interchange and at Yosemite & Boston intersections for roadways for local circulation. ●	Substantial ROW required along new roadway alignment. ●
Existing Business Impacts	None. ○	No impacts if loop ramps remain within existing interchange footprint. ○	None anticipated. ○	None anticipated. ○	Potential building impacts in SW, NE, and SE quadrants for flyover ramps. ●	Potential for substantial building impacts in SW and NE quadrants for tunnel approaches. ◕	None anticipated. ○	Potential building impacts in SW and SE quadrants with widening required along Arapahoe Rd. ◕	Major impacts to two buildings with substantial impacts to parking for adjacent properties. ●
Construction / Implementation Cost	No construction costs. ○	$50-60 million ◔	$70-80 million ◒	$50-60 million ◔	$120-170 million ●	$120-170 million ●	$40-50 million ◔	$100-140 million ◕	$35-45 million ◔

Legend: ○ High compliance with project goals ◔ Moderate compliance with project goals ◒ Limited compliance with project goals ◕ Little compliance with project goals ● Low level of compliance with project goals

5.1.8. Construction/Implementation Cost

An initial estimate of the range of construction costs was developed. More detailed cost estimates are provided for the detailed alternatives later in this report. The initial estimates indicate that the Directional Ramps, Tunnel, and Three Level Diamond alternatives would be the most expensive. The Improved Partial Cloverleaf (Alternative A), Tight Urban Diamond (Alternative C), Diverging Diamond (Alternative F), and Yosemite and Costilla Connection (Alternative H) alternatives would be the least expensive interchange configurations.

5.2. Preliminary Screening Summary

5.2.1. Alternatives Screened Out

Based on the results of the preliminary alternatives evaluation, the following alternatives are not forwarded for further detailed evaluation. Primary reasons that these alternatives have been screened from further consideration are highlighted below.

- **Alternative C – Tight Urban Diamond**: The diamond interchange ramp intersections with Arapahoe Road would not provide sufficient capacity to accommodate future traffic volumes. The eastbound to northbound and westbound to southbound left turn movements would exceed the capacity of double left turn lanes and queues would extend through the interchange. Limited storage length would be provided between the two ramp intersections. Traffic signal progression along Arapahoe Road would be compromised with the additional left turn phases at the ramp signals. Due to the nature of the construction within existing travel areas, there would be some difficulty with building the interchange ramps and intersections in phases.
- **Alternative D – Directional Ramps**: The locations of the eastbound to northbound and southbound to eastbound ramp merges/diverges along Arapahoe Road would result in complex weaving maneuvers that would be difficult to sign with traffic interactions at the Boston/Clinton and Yosemite Street intersections. The northbound to westbound and westbound to southbound left turns would require the ramp terminals to remain signalized. The westbound to southbound left turn movement would exceed the capacity of double left turn lanes and queues would extend through the northbound ramp intersection. All traffic headed for Southbound I-25 would travel on one diamond ramp, rather than the diamond ramp and loop ramp with the existing type of configuration, which results in decreased storage length for queues from the ramp meter or the I-25 merge.

  The flyover and tunnel ramps would require complicated construction and realignment of the freeway. Due to the nature of the construction within existing travel lanes, it would be difficult to build in phases. New right-of-way would be required in all four quadrants of the interchange with potential business building impacts in the southwest, northeast, and southeast quadrants.
- **Alternative E - Tunnel**: The locations of the I-25 entrance ramp diverges along eastbound and westbound Arapahoe Road would result in complex lane changing maneuvers east and west of the Boston/Clinton and Yosemite Street intersections. The

I-25 exit ramp terminals would remain signalized. The tunnels under Arapahoe Road would require complicated construction. New right-of-way would be required in the southwest and northeast quadrants of the interchange for the approaches to the tunnels with the potential for business building impacts.

- **Alternative F – Diverging Diamond**: The unconventional layout with realigned lanes for drivers to travel on the left side of the roadway creates critical safety concerns related to driver expectancy. The unusual weaving operations surrounding the ramp terminal intersections are inconsistent with a long-term solution for the relatively high non-peak speeds of Arapahoe Road. All traffic headed for Northbound or Southbound I-25 would travel on single diamond ramps, rather than the diamond ramps and loop ramps with the existing type of configuration, which results in decreased storage length for queues from the ramp meters or the I-25 merge. Due to the nature of the construction within existing travel lanes, it would be difficult to build in phases.
- **Alternative G – Three Level Diamond**: The decision point between Arapahoe Road through movements and freeway ramp access movements would be difficult to sign with the short distance and traffic interactions at the Boston/Clinton and Yosemite Street intersections. Providing local access within the interchange area would be complicated with the grade-separation of Arapahoe Road movements. All traffic headed for Northbound or Southbound I-25 would travel on single diamond ramps, rather than the diamond ramps and loop ramps with the existing type of configuration, which results in decreased storage length for queues from the ramp meters or the I-25 merge. New right-of-way would be required along Arapahoe Road. The tunnels under Arapahoe Road would require complicated construction and the nature of the construction within existing travel lanes would make it difficult to build in phases.
- **Alternative H – Yosemite and Costilla Connection:** The travel modeling indicates that the alternate route between Yosemite Street and Clinton Street along Costilla Avenue would decrease traffic traveling along Arapahoe Road through the interchange by 3,000 vehicles per day with most volume reduction expected during the peak hours. Although a benefit to traffic operations at the ramp terminal intersections, the travel forecasts show that the connection would not divert sufficient traffic to eliminate the need for additional capacity improvements within the immediate interchange area. The connection would be best combined with another build alternative to provide the reduction of traffic volumes through the interchange as well as a potential alternate route during the interchange reconstruction.

5.2.2. Alternatives for Further Consideration

Based on the results of the preliminary alternatives evaluation, the Improved Partial Cloverleaf (Alternative A) and Single Point Urban (Alternative B) alternatives are forwarded for more detailed evaluation. The Improved Partial Cloverleaf and Single Point Urban interchange configurations provide the best traffic operations and safety benefits and perform better than the other alternatives in almost all of the preliminary evaluation criteria.

Due to the additional capacity, access, and construction phasing benefits identified for the Yosemite and Costilla Connection in the preliminary evaluation, both alternatives moving

forward into the detailed alternative assessment were modified to include a new underpass of I-25 south of Arapahoe Road connecting Yosemite Street and Costilla Avenue as a means for east/west through traffic to bypass the interchange area. **Table 8** illustrates the comparison of the preliminary alternatives with the evaluation of the modified alternatives, Improved Partial Cloverleaf with Costilla Connection (Modified Alternative A) and Single Point Urban Interchange with Costilla Connection (Modified Alternative B), related to the preliminary evaluation criteria.

The modification to add the Costilla Connection makes the two alternatives even more superior to the other configurations considered in the preliminary evaluation. The reduction in traffic volumes through the interchange resulting from the underpass increases the traffic operations and safety benefits of the improvements. The new roadway connection would provide additional access opportunities across I-25 south of the interchange. The construction of the Costilla Connection would not impact traffic through the interchange. However, phasing the construction of the underpass first would provide a valuable alternate route for traffic during the interchange reconstruction of either the Improved Partial Cloverleaf or Single Point Urban configurations.

Adding the Costilla Connection to the alternatives does add substantial right-of-way, existing business impacts, and costs since it is a new roadway alignment through a developed area. However, the Improved Partial Cloverleaf and Single Point Urban interchange configurations required minimal, if any, right-of-way and existing business impacts, so the modified alternatives still perform better overall than the larger-scale alternatives (Directional Ramps, Tunnel, and Three Level Diamond). The traffic operations, safety, access, and construction phasing benefits of the modified alternatives outweigh the additional right-of-way impacts and construction costs.

The Costilla underpass connection is also an element of the recommended alternative in the Arapahoe Road Corridor Study.

Table 8. Preliminary Evaluation of Modified Interchange Options

Evaluation Criteria	No Build	Alt. A Improved Partial Cloverleaf	Alt. B Single Point Urban	Alt. C Tight Urban Diamond	Alt. D Directional Ramps	Alt. E Tunnel	Alt. F Diverging Diamond	Alt. G Three Level Diamond	Alt. H Yosemite and Costilla Connection	Mod. Alt. A Improved Partial Cloverleaf with Costilla Connection	Mod. Alt. B Single Point Urban with Costilla Connection
Traffic Operations / LOS	●	◔	◒	◕	◒	◒	◕	◒	◔	○	◔
Safety / Crash Potential		◔	◔	◒	◒	◒	◕	◕	◒	◔	◔
Access to Adjacent Land Uses	●	◔	◔	◔	◒	◔	◒	●	○	○	○
Constructability / Phasing	○	◔	◕	◒	●	●	◒	◕	○	◔	◕
Right-of-Way Requirements	○	◔	○	◔	●	●	◔	●	●	●	●
Existing Business Impacts	○	○	○	○	◕	◕	○	◕	●	●	●
Construction / Implementation Cost	No construction costs ○	$50-60 million ◔	$70-80 million ◒	$50-60 million ◔	$120-170 million ●	$120-170 million ●	$40-50 million ◔	$100-140 million ◕	$35-45 million ◔	$85-105 million ◒	$105-125 million ◕

Legend: ○ High compliance with project goals ◔ Moderate Compliance with project goals ◒ Limited Compliance with project goals ◕ Little compliance with project goals ● Low level of compliance with project goals

6. Detailed Alternative Assessment

Based on the preliminary screening of alternatives, the following alternatives are forwarded for more detailed evaluation.

- Modified Alternative A - Improved Partial Cloverleaf with Costilla Connection
- Modified Alternative B - Single Point Urban Interchange with Costilla Connection

6.1. Evaluation Criteria

Criteria were defined in the following areas for evaluation of the detailed interchange alternatives:

- Traffic Operations and Safety Performance –Intersection Levels of Service (LOS), delay, and potential queue lengths for critical movements were quantified for each alternative. Crash potential as a result of conflict points and queuing was also considered.
- Design and Construction – Geometric considerations, constructability issues, and potential construction phasing were considered in this evaluation.
- Environmental Issues – These criteria considered community/business impacts, hazardous materials impacts, water resources, noise impacts, as well as air quality impacts.
- Right-of-Way Requirements – Quantification of the required acres of right-of-way for each alternative was calculated.
- Construction Costs – Costs for construction, contingencies, construction engineering, and construction management are included in this analysis. This analysis excluded the cost for right-of-way acquisition.

6.2. Traffic Operations and Safety Performance

Traffic operations were analyzed for the No Build and two interchange alternatives based on travel forecasts developed for each configuration. **Figures 14 and 15** show the peak hour traffic forecasts for the two build alternatives.

These traffic volumes were developed from the Arapahoe Road Corridor Study traffic forecasts and are based on the DRCOG 2030 model with the addition of the recommended alternative for the Arapahoe Road Corridor Study, which includes the Costilla Avenue connection and improvements to Arapahoe Road, Broncos Parkway, and Easter Avenue, as well as the parallel routes adjacent to Arapahoe Road (Peakview Avenue and Briarwood Avenue).

Relative to the No Build projections, the Arapahoe/I-25 interchange and Arapahoe Road corridor improvements show an additional 2,000 vehicles per day on I-25 north of Arapahoe Road and a decrease of approximately 5,000 vehicles per day on I-25 south of Arapahoe Road. These changes will have little impact on the future congested operations along I-25.

Figure 14. Improved Partial Cloverleaf (Mod. Alt. A) 2030 Traffic Forecasts

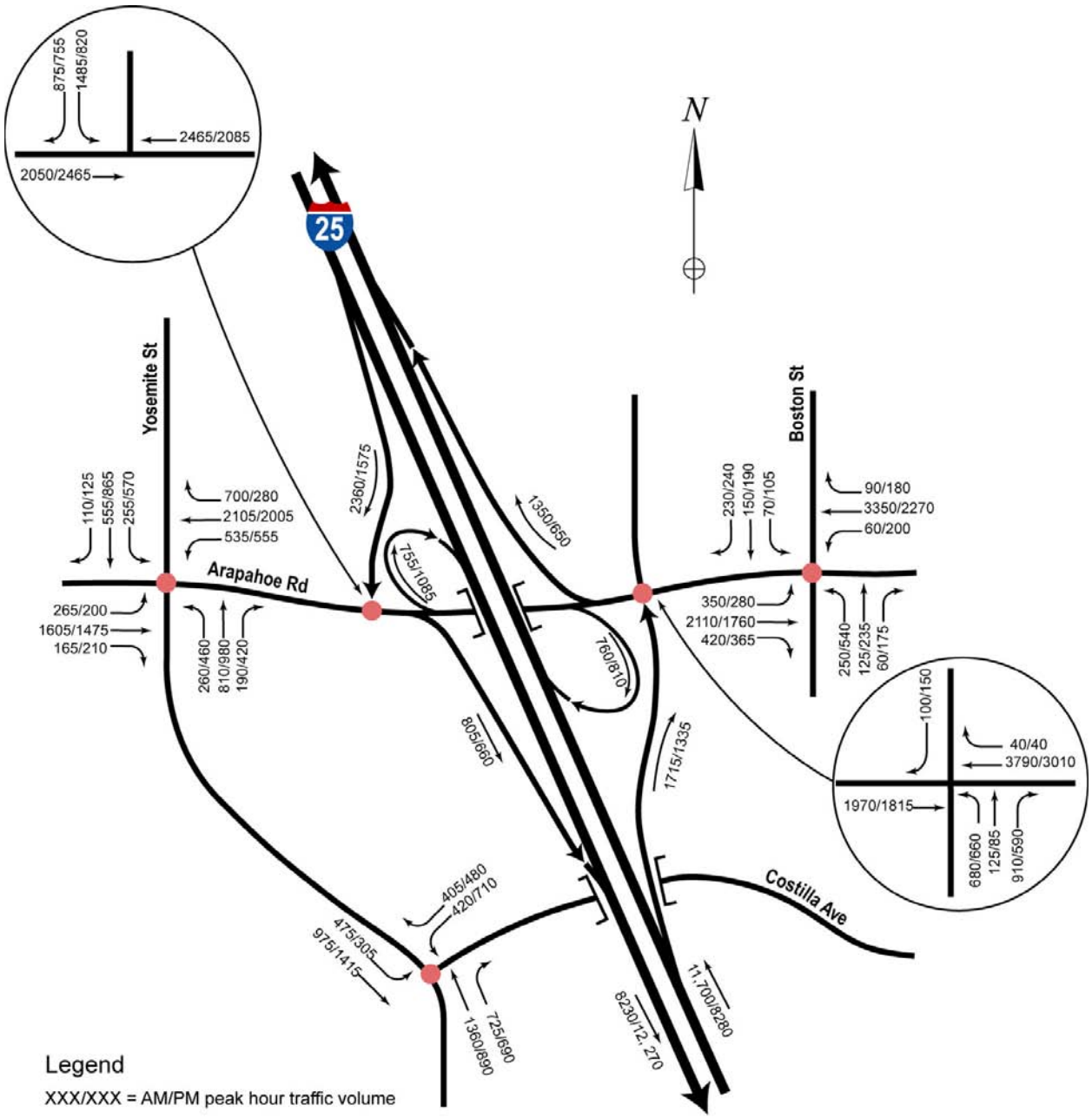
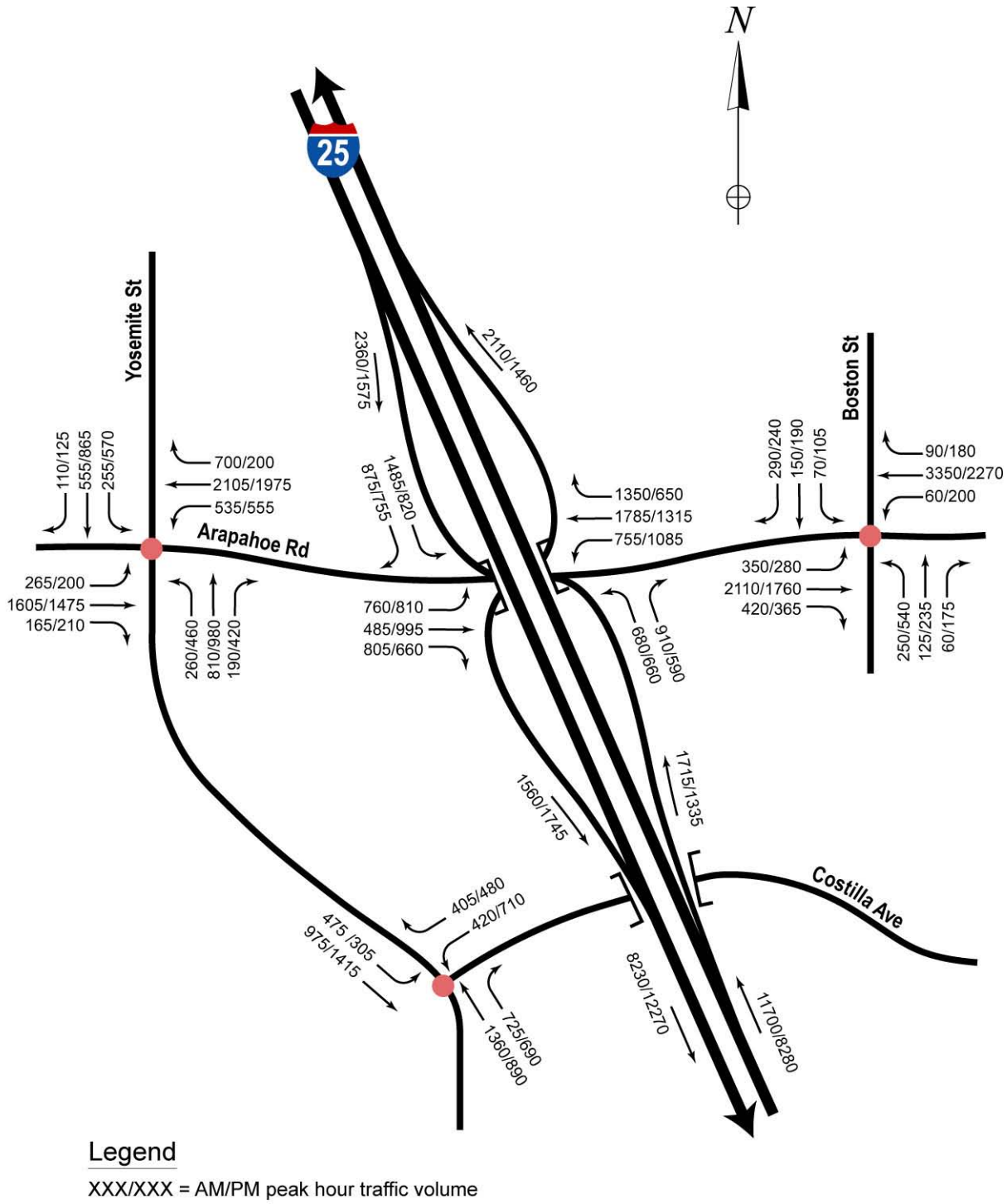


Figure 15. Single Point Urban (Mod. Alt. B) 2030 Traffic Forecasts



As noted with the preliminary alternatives screening, traffic volumes generally decreased on Arapahoe Road through the interchange with the addition of the Costilla Avenue connection. Traffic volumes on Arapahoe Road decreased almost five percent during the peak hours between Yosemite Street and Boston Street/Clinton Street. Daily volume projections on Yosemite Street were also reduced slightly, although the turning movements to the south leg of the Arapahoe Road and Yosemite Street intersection increased during the peak hours with traffic utilizing the Costilla Avenue connection.

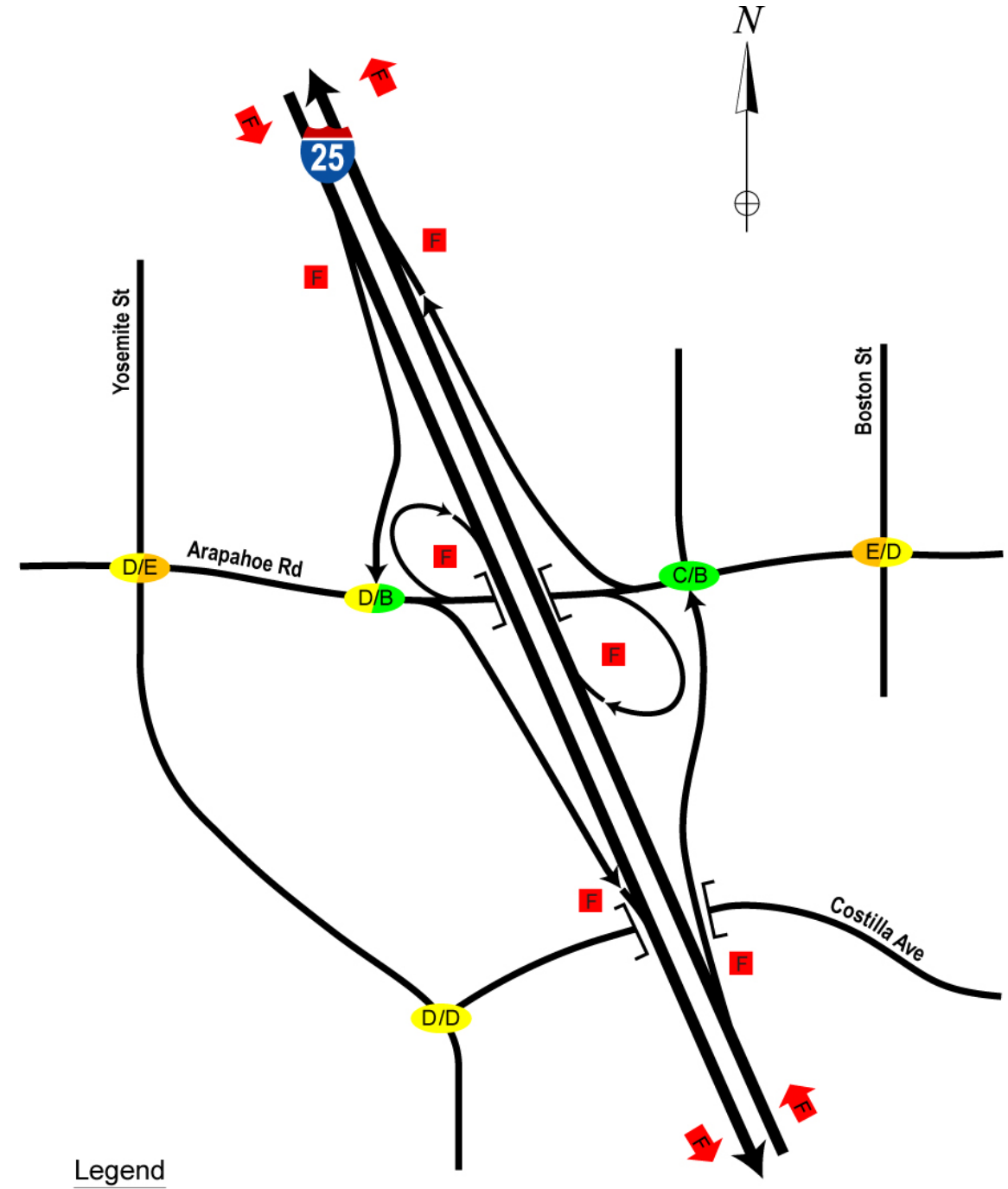
Three key operational parameters distinguish the detailed alternatives: intersection level of services, queue lengths on the freeway ramps and between intersections along Arapahoe Road, and crash potential due to number of conflict points and queuing. The respective measures used to demonstrate the performance level for each parameter are the level of service for each of the intersections along Arapahoe Road, the 95th-percentile queue lengths for the approaches at the ramp terminal intersections, and crash potential measured by the number of conflict points at the ramp terminal intersections and locations of long queues. This information is summarized in **Table 9**. Capacity analysis output is included in **Appendix D**.

Table 9. Traffic Operations and Safety Performance – Evaluation of Alternatives

Alternative	Level of Service	Average Queue Length	Crash Potential	
	AM/PM Peak Hour At Arapahoe Intersections	AM/PM Peak Hour (feet)	Number of Conflict Points at Ramps	Intersection Approaches with Long Queues[1]
No Build	Yosemite: F/F SB Ramp: E/C NB Ramp: F/D Boston/Clinton: F/F	SB Ramp Intersection SB: 900/400 EB: 150/750 WB: 975/525 NB Ramp Intersection NB: 625/350 EB: 475/400 WB: 1375/450	SB Ramp Signal: 5 NB Ramp Signal: 5 Total: 10	NB Exit Ramp SB Exit Ramp NB Entrance Ramp SB Entrance Ramp EB Arapahoe at SB Ramp WB Arapahoe at Boston WB Arapahoe at Yosemite
Improved Partial Cloverleaf with Costilla Connection (Mod. Alt. A)	Yosemite: D/E SB Ramp: D/B NB Ramp: C/B Boston/Clinton: E/D	SB Ramp Intersection SB: 425/325 EB: 175/75 WB: 975/225 NB Ramp Intersection NB: 575/325 EB: 425/250 WB: 200/175	SB Ramp Signal: 5 NB Ramp Signal: 5 Total: 10	NB Entrance Ramp SB Entrance Ramp WB Arapahoe at SB Ramp WB Arapahoe at Yosemite WB Arapahoe at Boston
Single Point Urban with Costilla Connection (Mod. Alt. B)	Yosemite: D/E SB & NB Ramp: D/C Boston/Clinton: E/D	Ramp Intersection NB: 225/250 SB: 775/350 EB: 400/300 WB: 625/375	Ramp Signal: 16 Total: 16	SB Exit Ramp NB Entrance Ramp SB Entrance Ramp WB Arapahoe at Yosemite WB Arapahoe at Boston

[1] Long queues defined as 95th-percentile queue over 700 feet during AM and/or PM peak hour(s)

Figure 16. Improved Partial Cloverleaf (Mod. Alt. A) 2030 Peak Hour Level of Service



Legend

A/A Intersection AM/PM Peak Hour LOS

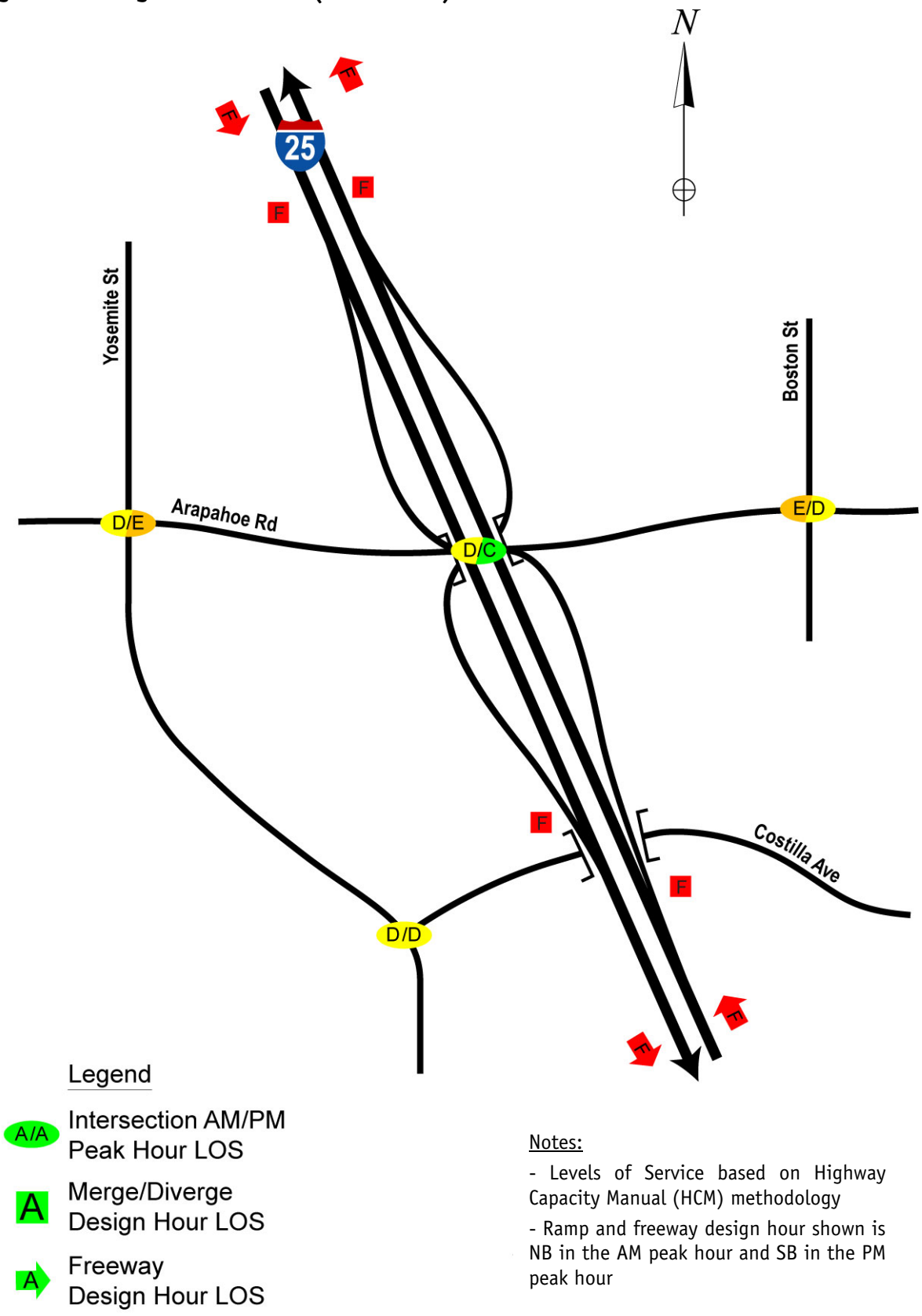
A Merge/Diverge Design Hour LOS

A Freeway Design Hour LOS

Notes:

- Levels of Service based on Highway Capacity Manual (HCM) methodology
- Ramp and freeway design hour shown is NB in the AM peak hour and SB in the PM peak hour

Figure 17. Single Point Urban (Mod. Alt. B) 2030 Peak Hour Level of Service



No Build:
With the increase in traffic volumes expected by 2030, the No Build scenario results in a substantial increase in delay within the interchange area, resulting in more queuing of ramp traffic onto I-25. The No Build operational analysis is described in Section 4.5 of this report. Three of the four interchange area intersections operates at LOS F during the AM and/or PM peak hour. The queues from the entrance ramps to I-25 and through the intersections along Arapahoe Road cause gridlock through the interchange, creating the potential for increased safety problems related to congestion along both Arapahoe Road and I-25. The average queue on the southbound exit ramp is expected to reach 900 feet and the maximum queue would regularly extend into the I-25 mainline lanes during the AM peak hour.

Modified Alt. A – Improved Partial Cloverleaf Interchange with Costilla Connection:
With this alternative, traffic operations along Arapahoe Road improve from LOS F to LOS D at most intersections along Arapahoe Road during the AM and PM peak hours, due to the additional arterial lanes through the interchange. The Arapahoe Road and Boston/Clinton Street intersection operates at LOS E during the AM peak hour and the overall intersection delay is reduced by almost 65 percent from the No Build alternative. Average delay at the Yosemite Street intersection is reduced over 30 percent during the PM peak hour.

Although the Southbound I-25 off ramp essentially remains in the current configuration due to the LRT bridge constraints, the additional southbound left turn lane (for a total of three left turn lanes) and the five-lane cross-section on Arapahoe Road improves the conditions for turning traffic from the ramp. Queues on the Southbound I-25 off-ramp are reduced to an average queue of 425 feet and a maximum queue of 450 feet during the AM peak hour.

Each ramp signal contains five conflict points, which is less than a typical T-intersection since the left turn movements are accommodated with the loop ramps and do not have to cross opposing traffic. The number of conflict points within the interchange area is the same as the No Build scenario.

During the PM peak hour, the queues for traffic entering I-25 extend to Arapahoe Road due to the ramp metering and congestion on I-25. However, because of the loop ramp layout, the ramp back ups are limited to the outside lane along Arapahoe Road and, due to the additional lane through the interchange, through traffic on Arapahoe Road is not blocked. Therefore, the degradation of freeway merging operations has limited impact on traffic traveling on Arapahoe Road through the interchange.

Modified Alt. B - Single Point Urban Interchange with Costilla Connection:
With this alternative, a signalized intersection is eliminated along Arapahoe Road, which increases intersection spacing. Intersection operations are LOS D or better during the AM and PM peak hours, except at Yosemite Street, which operates at LOS E during the PM peak hour, and at Boston/Clinton Street, which operates at LOS E during the AM peak hour. The overall intersection delay at Boston/Clinton Street is reduced by almost 70 percent during the AM peak hour from the No Build alternative. Average delay at the Yosemite Street intersection is reduced almost 35 percent during the PM peak hour.

Queues on the Southbound I-25 off-ramp approaching Arapahoe Road are reduced to an average of 625 feet and a maximum queue of 800 feet during the AM peak hour. A longer cycle length may be required to clear movements through the ramps signal due to the size of

the intersection. This longer cycle length may create longer queuing along the off-ramps and Arapahoe Road, as well as complicate signal progression with the Yosemite Street and Boston/Clinton Street intersections.

Although both ramps are accommodated at one signalized intersection on Arapahoe Road, the higher number of turning movements (including the left turns for the entrance ramps) results in more overall conflict points within the interchange area than the No Build or Improved Partial Cloverleaf with Costilla Connection alternatives. This increases the potential for collisions of two (or more) vehicles.

With this configuration, all traffic headed for I-25 would travel on one diamond ramp, rather than the diamond ramp and loop ramp with the existing type of configuration, which results in decreased storage length for queues from the ramp meters or the I-25 merges. Because of the ramp metering and congestion on I-25 expected during the AM and PM peak hour, the queues on the I-25 entrance ramps extend through the Arapahoe Road signal. Traffic attempting to turn left onto the freeway ramps backs up into the inside through lanes on Arapahoe Road while traffic attempting to turn right onto the ramps backs up into the outside lanes. Therefore, I-25 congestion and ramp metering creates virtual gridlock within the interchange area. Without ramp metering, entrance ramp queues are reduced and the related congestion is avoided. If future traffic volumes cause these types of operational issues with ramp metering, the metering may be limited in use or removed. However, for many years prior to that traffic volume condition, the ramp metering would improve highway operations and safety. Therefore, the management of the ramp metering system at this location would be critical for the operation of this interchange alternative.

6.3. Design and Construction

Conceptual designs were developed for the two build interchange alternatives. Each of the alternatives was designed within the constraints of the existing light rail bridge piers.

Modified Alt. A – Improved Partial Cloverleaf Interchange with Costilla Connection:
This alternative requires reconstruction of the I-25 bridge over Arapahoe Road to accommodate three through lanes on Arapahoe Road, which will result in construction-related impacts to I-25 and Arapahoe Road traffic. Horizontally this interchange layout is identical to the existing interchange with the majority of the work being done to accommodate the widening along Arapahoe Road, a deeper structure depth, and consequently profile grade line changes to both Arapahoe Road and mainline I-25.

The existing interchange was constructed under the T-REX project with variances to limit reconstruction and right-of-way acquisitions. At least two of the six ramps were constructed with variances. The Southbound I-25 loop ramp was constructed with less than a 25-mph minimum radius and the Southbound I-25 entrance ramp was constructed with less than a 50-mph vertical design speed at the gore with mainline I-25. The location of the LRT alignment west of the freeway also reduced the ramp meter lane drop taper from the T-REX project standard of 50:1 to 30:1 at this same location.

Similar issues are created with the design for this alternative, such as reduced design speed at the ramp terminals with Arapahoe Road, reduced horizontal design speed of the Southbound I-25 loop ramp, and the need to raise the grade for Northbound and Southbound I-25 above four

percent for a short distance to accommodate increased structure depths and changes to the Arapahoe Road profile grade line.

The following summarizes design considerations and concerns for this alternative based on the conceptual design (less than ten percent design effort):

- Design will require over 2,000 feet of reconstruction of I-25;
- Design will require design variances for the horizontal design of the loop ramps (less than 25-mph) and vertical design of I-25 (greater than four percent vertical grade);
- Arapahoe Road will need to be raised approximately three feet to accommodate the ramp profiles; and
- Conceptual design is based on an assumed structure depth of five feet and two inches.

The cloverleaf loop ramps in the northwest and southeast quadrants will allow for detention of storm drainage flows within the interchange, simplifying the conveyance of stormwater runoff through the project area. Assuming that two to six feet of depth could be accommodated within the loop ramp areas, a total of 16 acre-feet of detention could be recognized. For an interchange of this configuration and size, 15-20 acre-feet is a feasible range for detention (10-year discharge). In addition to the detention, however, an additional one to five acre-feet of water quality storage is probable for the anticipated contributing runoff area for the interchange. Some or all of this additional area may be accommodated in linear ditches adjacent to mainline I-25 or provided by mechanical treatment systems.

Modified Alt. B - Single Point Urban Interchange with Costilla Connection:
This alternative requires a long, single span bridge structure to accommodate the left turns to and from the ramps at the Arapahoe Road intersection, which would require exceptionally deep structural girders. This bridge design will require lowering Arapahoe Road and raising I-25 to provide adequate vertical clearance, which would result in more complex construction phasing and substantial impacts to I-25 and Arapahoe Road traffic during construction. Lowering Arapahoe Road creates particularly severe phasing issues at existing intersections and access points. Temporary roadways and multiple stages of traffic detours would be required to maintain traffic on both Arapahoe Road and I-25 during bridge construction. Construction of the west side ramps would need to avoid impacts to the existing light rail bridge, which would require creative design solutions. This is particularly critical adjacent to the LRT retaining walls and ballast walls west of I-25.

The following summarizes design considerations and concerns for this alternative based on the conceptual design (less than ten percent design effort):

- Design will require over 4,000 feet of reconstruction of I-25;
- Horizontal or vertical design may require variances; and
- Conceptual design is based on an assumed structure depth of eight feet and four inches.

Like the Improved Partial Cloverleaf with Costilla Connection alternative, available area for detention and water quality storage volume will primarily be handled within or immediately adjacent to the interchange improvements. The primary storage area will be in the southeast

quadrant of the interchange where the existing northbound exit ramp and entrance loop ramp will be removed. This area equates to approximately the same volume as the Improved Partial Cloverleaf with Costilla Connection alternative and will provide adequate storage for detention, but may need additional water quality volume in the form of linear ditches and mechanical cleansers.

6.4. Environmental Issues

The impacts to the human and natural environments with the study area that would result from implementation of each of the final alternatives were evaluated. This evaluation was based on the information provided with the project environmental overview, described in Chapter 3 of this report.

No Build:
The No Build condition would have some negative impact to air quality within the study area due to increasing congestion. No other new environmental impacts are applicable if the project is not constructed.

Modified Alt. A – Improved Partial Cloverleaf Interchange with Costilla Connection:
This interchange alternative would close the right-in/right-out access to the northwest quadrant, located on the north side of Arapahoe Road between the Southbound I-25 ramp and Yosemite Street intersections. Access to the properties would continue to be provided off Yosemite Street. The Costilla Connection south of Arapahoe Road would require major impacts to at least two buildings, an office building west of I-25 and a hotel east of I-25. More specific parking and construction impacts may be assessed during the project environmental documentation.

This interchange alternative would have minor impacts to wetlands within the project area, potentially only in the southeast quadrant of the interchange in the area of construction for the Costilla Avenue connection.

The interchange project would have a minor, yet positive, impact on the air quality of the Southeastern Denver Metropolitan region based on the anticipated decreases in intersection delay and congestion along Arapahoe Road. During the subsequent NEPA process for this project a carbon monoxide hot spot analysis will be conducted, as required.

Recognized environmental conditions related to hazardous materials include potential impacts related to automotive service stations, storage units, and commercial facilities in the southwest quadrant of the interchange, east of the interchange along Arapahoe Road, and along Costilla Avenue east of I-25. Further evaluation of the potential hazardous material sites may be warranted prior to final design of the project. During the subsequent NEPA process for this project a Phase 1 Environmental Site Assessment (ESA) of hazardous materials will be conducted.

Modified Alt. B - Single Point Urban Interchange with Costilla Connection:
This alternative would close the right-in/right-out access to the northwest quadrant and the signalized access to the northeast quadrant of the interchange. Access to the properties in the northwest quadrant would continue to be provided off Yosemite Street and property access for the northeast quadrant would continue to be provided off Boston Street. Similar to the

Improved Partial Cloverleaf with Costilla Connection alternative, the Costilla Connection south of Arapahoe Road would require major impacts to at least two buildings, an office building west of I-25 and a hotel east of I-25. More specific parking and construction impacts may be assessed during the project environmental documentation.

This interchange alternative would have similar impacts to wetlands, air quality, and hazardous materials resources as the Improved Partial Cloverleaf with Costilla Connection alternative.

6.5. Right-of-Way Requirements

The acres of right-of-way required for each build alternative shown below were calculated based on the conceptual design layout of the interchange. The right-of-way for both of the alternatives includes approximately 5.0 acres for the Yosemite to Costilla Connection.

- Improved Partial Cloverleaf with Costilla Connection (Mod. Alt. A): approx. 6.1 acres
- Single Point Urban with Costilla Connection (Mod. Alt. B): approx. 6.8 acres

The larger area of right-of-way needed for the Single Point Urban with Costilla Connection alternative is mostly within the northeast quadrant of the interchange, where the Northbound I-25 entrance ramp curves around and encroaches upon the existing access road and parking areas. With the Improved Partial Cloverleaf with Costilla Connection alternative, this area is not impacted.

These right-of-way estimates do not include total takes of parcels, which may be required for either alternative depending on the final details of access location, parking impacts, and right-of-way negotiations. Both interchange alternatives may also require additional business relocations depending on the final Arapahoe Road alignment. Two commercial buildings (an office and a hotel) would be directly impacted by the Costilla/Yosemite connection.

6.6. Construction Costs

The ranges of construction costs shown below were identified for the two build alternatives based on an initial opinion of probable construction cost, including contingencies, construction engineering, and construction management. The figures for both of the alternatives include $35-45 million for the Yosemite to Costilla Connection. These cost estimates shown were developed in September 2006 and are the cost data provided to DRCOG for development of the Draft 2035 Plan to identify Federal funding for the interchange improvements. These initial estimates do not include right-of-way (see Section 6.5 for right-of-way area requirements).

- Improved Partial Cloverleaf with Costilla Connection (Mod. Alt. A): $85 - 105 million
- Single Point Urban with Costilla Connection (Mod. Alt. B): $105 – 125 million

6.7. Summary of Alternatives Evaluation

A summary matrix of the detailed alternatives evaluation is provided in **Table 10**. The final screening identified concerns associated with the Single Point Urban with Costilla Connection alternative related to the potential for gridlock congestion and queuing on Arapahoe Road

from the ramp metering system and future congestion along the I-25 mainline. There are much larger construction impacts for I-25 related to the long, single span bridge structure as well as concerns with compromising the existing light rail infrastructure in the southwest quadrant of the interchange. The Single Point Urban configuration also requires the closure of the signalized access to the northeast quadrant of the interchange.

The No Build alternative would not provide the capacity necessary to meet the forecasted travel demand at the interchange, resulting in increased traffic congestion, safety concerns, and air quality impacts.

Based on the results of the alternatives evaluation, Modified Alternative 1 - Improved Partial Cloverleaf with Costilla Connection is recommended for further evaluation in the subsequent NEPA process for the interchange improvements. This interchange configuration will provide the necessary transportation facilities and services to adequately accommodate travel demand through and beyond the 2030 planning horizon with minimal impacts to surrounding properties. Most improvements within the immediate interchange area would be generally located within the existing interchange footprint with widening impacts along Arapahoe Road and construction along I-25 for the bridge reconstruction. The majority of project environmental and property impacts would be located along the Costilla/Yosemite alignment.

This analysis concludes that the Improved Partial Cloverleaf with Costilla Connection configuration with improvements along Arapahoe Road will provide the greatest benefit with limited impacts. However, further design analysis may identify limiting design variances and more benefits for shifting I-25. Therefore, these types of design details should continue to be explored during the environmental documentation for the interchange.

Table 10. Detailed Evaluation of Alternatives

Evaluation Criteria	No Build	Mod. Alt. A Improved Partial Cloverleaf with Costilla Connection	Mod. Alt. B Single Point Urban with Costilla Connection
Traffic Operations	See Tables 7 and 8 for details regarding Traffic Operations and Safety Performance		
Design and Construction	Not applicable	- Standard single span bridge - 2000′ of I-25 reconstruction - Construction simplified while maintaining traffic	- Non-standard, deep bridge girders required - 4000′ of I-25 reconstruction - Difficult to construct while maintaining traffic on I-25 - Compromises existing LRT infrastructure
Right-of-Way Requirements	Not applicable	Interchange = 1.1 acres Costilla connection = 5.0 acres Total = approx. 6.1 acres	Interchange = 1.8 acres Costilla connection = 5.0 acres Total = approx. 6.8 acres
Environmental Issues	- As congestion increases, business access will be negatively impacted - As congestion increases, air pollution will increase - No other environmental impacts	- Closes right-in/right-out access to NW quadrant - Positive impact to air quality as traffic operations improved substantially - Minor impacts to wetlands - Potential hazardous material impacts	- Closes right-in/right-out access to NW quadrant and signalized access to NE quadrant - Positive impact to air quality as traffic operations improved substantially - Minor impacts to wetlands - Potential hazardous material impacts
Construction Costs	None	$85 – 105 million	$105 – 125 million
Summary			

Legend:
- High compliance with project goals
- Moderate compliance with project goals
- Limited compliance with project goals
- Little compliance with project goals
- Low level of compliance with project goals

7. Preliminary Recommended Improvements

7.1. Description of Recommended Alternative

Based on the results of the evaluation of alternatives, Modified Alternative A - Improved Partial Cloverleaf with Costilla connection is recommended. This interchange configuration, shown in **Figure 18**, will provide the necessary transportation facilities and services to adequately accommodate travel demand through and beyond the 2030 planning horizon for this study. Components of the conceptual design for the interchange, including local access, major intersection design along Arapahoe Road, and movements to/from I-25, are discussed in this section of the report. Roadway profiles developed for the conceptual design of the Recommended Alternative are included in **Appendix E**.

7.1.1. I-25 Mainline

I-25 will be designed to meet the requirements of the typical section, which includes five twelve-foot through lanes in each direction, ten-foot inside and outside shoulders, a two-foot wide concrete median barrier and twelve-foot acceleration/deceleration lanes, where required. Because the improvements are generally located within the existing interchange footprint, the existing interchange ramp merges and diverges along I-25 will remain in the current locations along I-25 and the existing lane add/drop configurations will not be modified.

7.1.2. I-25 Ramps

The interchange ramps will be designed to accommodate the 2030 traffic volume projections discussed earlier in this report. The entrance ramps will provide one lane access to I-25, narrowing from two lanes at the ramp meter locations. The ramps will include a four-foot left shoulder, a fifteen-foot wide lane, and a minimum six-foot right shoulder. The exit ramps will consist of two lanes, diverging I-25 as a drop lane and an option lane approaching the ramp gore.

7.1.3. Arapahoe Road

Arapahoe Road will be designed to meet the requirements of CDOT and local agency standard specifications. The typical section will match the existing Arapahoe Road section east and west of the interchange, carrying three twelve-foot lanes through the interchange area.

During the Arapahoe Road Corridor Study agency coordination process, the possibility of enhanced local access to the southwest quadrant of the interchange via a roadway constructed directly across from the Southbound I-25 exit ramp was discussed with the local agencies with the Improved Partial Cloverleaf interchange configuration. The local agencies were told that the signal operations, allowable movements, and safety concerns for such an access would need to be studied in detail with traffic projections considering the trip generation of the potential redevelopment within the southwest quadrant area prior to any access approvals. The operation of a south leg at the Southbound I-25 ramp intersection would need to consider interactions with Eastbound Arapahoe Road traffic bound for the I-25 entrance ramps and the closure of the existing right-in/right-out access into the southwest quadrant east of Yosemite

Street. CDOT currently opposes providing this access across from the Southbound I-25 exit ramp and the access is not shown with the Recommended Alternative in Figure 17.

7.1.4. Costilla Avenue Connection

Costilla Avenue from Yosemite Street to Fulton Street will be designed to meet the requirements of the City of Greenwood Village's and Arapahoe County's standard design criteria. The typical section will include eight to ten-foot attached sidewalks, four eleven-foot through travel lanes, three-foot buffers for bikes adjacent to the curb and gutter, and an eleven-foot painted median.

The Yosemite Street/Costilla Avenue intersection, located approximately 300 feet north of the existing Yosemite Street/Alton Way signal, will be designed providing Yosemite Street with the major through movements to avoid queuing impacts at the Yosemite Street/Alton Way intersection. A short length of raised median will be required to accommodate piers for the structures at I-25. The I-25 structures were assumed with two 42-foot spans and structure depths of three feet. A reduced minimum design speed of 35 mph will be required to limit property impacts east of the I-25 underpass.

The north curb line of Costilla Avenue from Clinton Street to Fulton Street will be held through this section with the majority of the widening impacts occurring to the south.

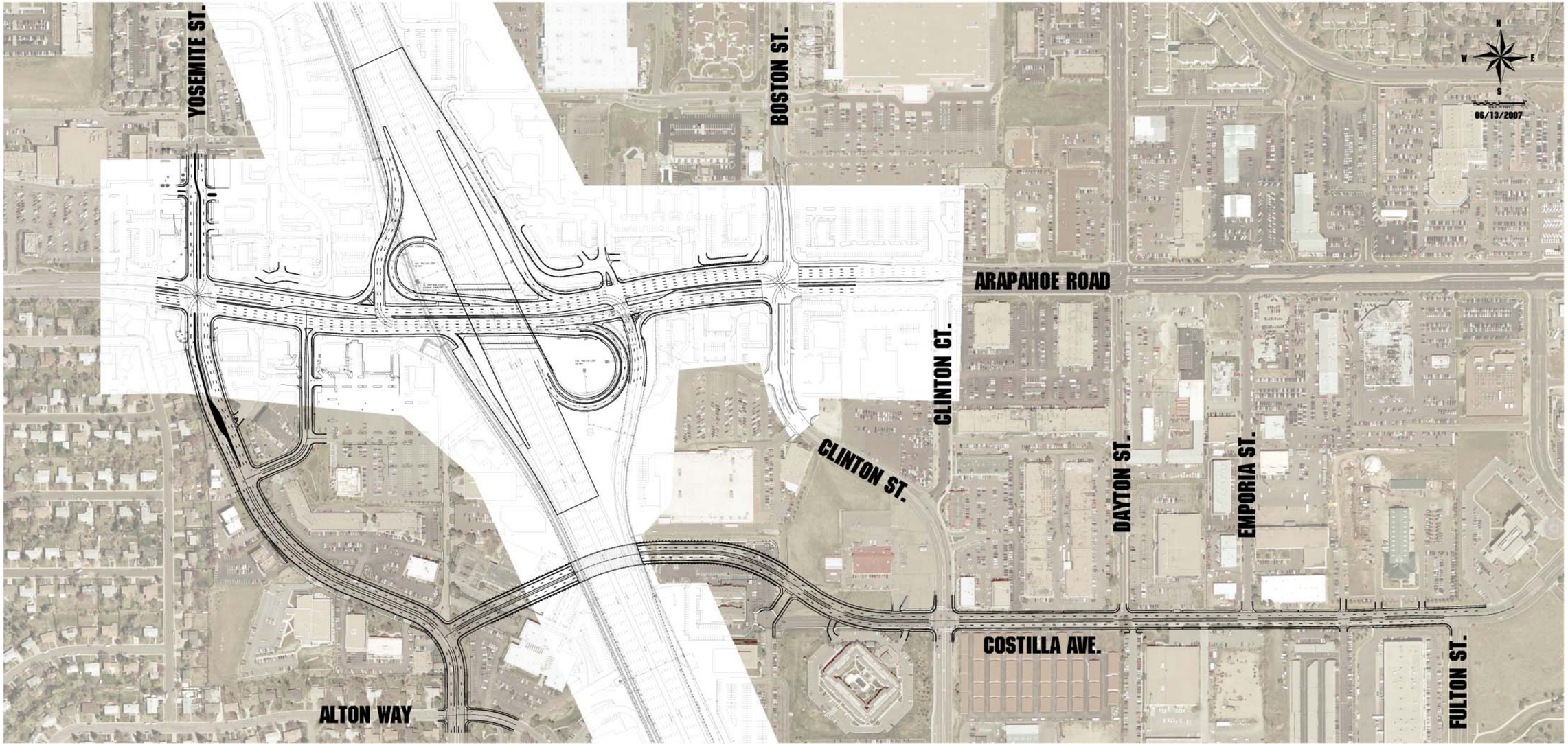
7.2. Alternate Transportation Modes

Alternate mode accommodations to be implemented with the Arapahoe/I-25 interchange improvements will be implemented consistent with the recommended improvements of the Arapahoe Road Corridor Study. These improvements include improved sidewalks along both the north and south sides of Arapahoe Road from Yosemite Street, through the interchange, to the Boston/Clinton Street intersection. Sidewalks will also be constructed along both sides of Costilla Avenue from Yosemite Street to Fulton Street.

Bicycle accommodations will be focused on the new Costilla Avenue crossing of I-25. Bicycle advocates input during the Arapahoe Road Corridor Study indicated a desire to utilize roadways parallel to rather than along Arapahoe Road itself. Widened outside travel lanes as described above will ultimately connect with bicycle improvements along Briarwood Avenue resulting in a parallel bike route from Yosemite to Jordan Road.

Expanded fixed route local transit services recommended in conjunction with the Arapahoe Road Corridor Study will utilize the Yosemite to Costilla connection under I-25 to serve locations south of the interchange, avoiding the interchange itself as existing routes do today via the Yosemite Street overpass.

Figure 18. Preliminary Recommended Interchange Alternative



7.3. Preliminary Funding Package

7.3.1. Preliminary Cost of Recommended Improvement

The costs for the Arapahoe/I-25 interchange improvements, based on the limited conceptual design completed to date, are estimated to be:

Construction cost estimate: $53.7 million

Design cost estimate: $8.1 million

Utilities cost estimate: $1.5 million

NEPA Documentation: $1.0 million (funded through current TIP)

Construction Management: $11.3 million

Total: $75.6 million (not including right of way)

All costs are based on 2006 dollars and do not include maintenance or financing costs. An estimate of probable cost for the recommended improvement is included in **Appendix F**.

Right of way costs for the project will be comprised of three components: full parcel takes (including buildings and businesses), partial parcel takes which may diminish the total value of the property, and partial takes which will not diminish the value of the property. Due to the complexity of determining property and building values, right of way costs are difficult to estimate. At this time, the right of way costs are conceptually estimated to be in the range of $15 to 30 million.

7.3.2. Proposed Funding Plan

The reconstruction of the Arapahoe/I-25 interchange has long been viewed by the surrounding local governments and the Denver Regional Council of Governments (DRCOG) as an integral part of the Regional Transportation Plan (see Section 1.5). The 2030 RTP was recently updated to the 2035 plan, which does not include as many projects as contained in the 2030 RTP due to fiscal constraints. This project was part of the 2030 fiscally constrained plan and is included in the new 2035 fiscally-constrained RTP. Therefore, the proposed interchange improvements are eligible for funding in the competitive process of the Transportation Improvement Program (TIP) for allocation of funds under the metropolitan allocation of the Surface Transportation Program (STP-Metro). The DRCOG 2035 fiscally-constrained plan includes $83 million for this project, which is a combination of local and federal/state funding.

Due to the inherent regional benefits of the project, Arapahoe County will continue to pursue the TIP process for funding a portion of the cost of this project. This feasibility study and other coordination required to initiate the project are being completed as part of the Arapahoe Road Corridor Study. Arapahoe County has obtained current TIP funding for the environmental clearance coordination and documentation for the Arapahoe/I-25 interchange reconstruction ($1 million). The County will pursue additional TIP funding for portions of the design, right of way acquisition, construction, and construction management efforts. Earmarked funding will also be pursued after the Arapahoe Road/Parker Road interchange is fully funded.

Maintenance costs and agreements on maintenance issues within the interchange area will be negotiated between CDOT and the surrounding communities with a separate Intergovernmental Agreement.

7.4. Project Support

Support for long-term improvements at the Arapahoe/I-25 Interchange has been received from each of the agencies represented as part of the Arapahoe Road Corridor Study. A letter of support from CDOT Region 6 Transportation Director Randy Jensen (dated October 25, 2007) notes that "...CDOT supports evaluating the needs at I-25/Arapahoe Road Interchange as the next priority project along the Corridor...". The City of Greenwood Village adopted a Resolution on October 15, 2007 in support of the Corridor Study recommendations, including the Arapahoe/I-25 interchange improvements.

Formal endorsements and letters of support are also soon expected from the City of Centennial, the City of Aurora, and Arapahoe County.

Appendix A

Existing Traffic Count Data

All Traffic Data Services, Inc.
9660 W 44th Ave
Wheat Ridge, CO 80033
www.alltrafficdata.net

ARAPAHOE E/O BOSTON
Site Code: 3
Station ID: 3

Start Time	11-Jan-06 Wed	EB
12:00 AM		142
01:00		112
02:00		71
03:00		42
04:00		325
05:00		657
06:00		1423
07:00		**1857**
08:00		1645
09:00		1598
10:00		1530
11:00		1737
12:00 PM		**2036**
01:00		2000
02:00		1802
03:00		1860
04:00		1941
05:00		1920
06:00		1571
07:00		1152
08:00		851
09:00		710
10:00		499
11:00		287
Total		27768
AM Peak		07:00
Vol.		1857
PM Peak		12:00
Vol.		2036
Total		27768
ADT	Not Calculated	

All Traffic Data Services, Inc.
9660 W 44th Ave
Wheat Ridge, CO 80033
www.alltrafficdata.net

ARAPAHOE RD E/O BOSTON
Site Code: 4
Station ID: 4

Start Time	11-Jan-06 Wed	WB
12:00 AM		154
01:00		106
02:00		68
03:00		52
04:00		163
05:00		654
06:00		1365
07:00		1784
08:00		**1998**
09:00		1654
10:00		1652
11:00		1968
12:00 PM		2037
01:00		1924
02:00		1964
03:00		2132
04:00		**2245**
05:00		2182
06:00		1674
07:00		1090
08:00		790
09:00		672
10:00		414
11:00		277
Total		29019
AM Peak		08:00
Vol.		1998
PM Peak		16:00
Vol.		2245
Total		29019
ADT	Not Calculated	

All Traffic Data Services, Inc.
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Site Code: 1
Station ID: 1
WB TO SB LOOP RAMP

Start Time	11-Jan-0 Wed	WB
12:00 AM		50
01:00		28
02:00		16
03:00		28
04:00		46
05:00		134
06:00		298
07:00		414
08:00		**491**
09:00		408
10:00		374
11:00		469
12:00 PM		563
01:00		512
02:00		509
03:00		644
04:00		692
05:00		**743**
06:00		617
07:00		418
08:00		340
09:00		242
10:00		180
11:00		89
Total		8305
AM Peak		08:00
Vol.		491
PM Peak		17:00
Vol.		743
Grand Total		8305
ADT		Not Calculated

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Site Code: 2
Station ID: 2
EB TO NB LOOP RAMP

Start Time	11-Jan-0 Wed	EB
12:00 AM		56
01:00		32
02:00		24
03:00		28
04:00		58
05:00		206
06:00		464
07:00		488
08:00		513
09:00		446
10:00		428
11:00		**586**
12:00 PM		584
01:00		562
02:00		**600**
03:00		596
04:00		506
05:00		524
06:00		425
07:00		358
08:00		276
09:00		257
10:00		212
11:00		94
Total		8323
AM Peak		11:00
Vol.		586
PM Peak		14:00
Vol.		600
Grand Total		8323
ADT		Not Calculated

All Traffic Data Services, Inc
9660 W 44th Ave
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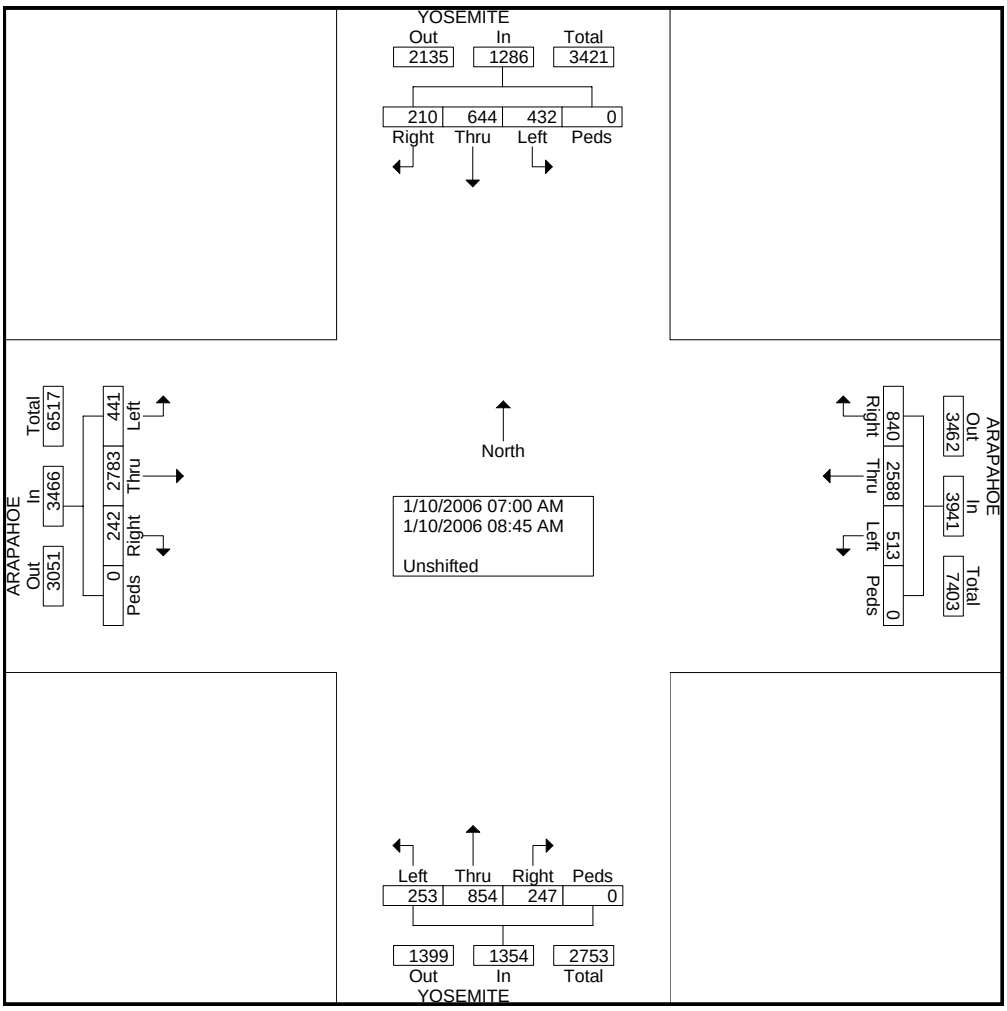
File Name : YOSEMITE&ARAPAHOEAM
Site Code : 00000000
Start Date : 1/10/2006
Page No : 1

Groups Printed- Unshifted

	YOSEMITE Southbound				ARAPAHOE Westbound				YOSEMITE Northbound				ARAPAHOE Eastbound				
Start Time	Left	Thru	Right	Peds	Left	Thru	Right	Peds	Left	Thru	Right	Peds	Left	Thru	Right	Peds	Int. Total
Factor	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	
07:00 AM	38	41	16	0	41	266	97	0	12	59	16	0	39	325	21	0	971
07:15 AM	60	81	21	0	66	246	93	0	30	109	14	0	54	349	38	0	1161
07:30 AM	40	78	36	0	54	358	98	0	25	132	18	0	62	400	21	0	1322
07:45 AM	65	104	22	0	78	351	138	0	29	144	23	0	83	350	28	0	1415
Total	203	304	95	0	239	1221	426	0	96	444	71	0	238	1424	108	0	4869
08:00 AM	46	89	21	0	72	399	128	0	40	128	28	0	47	388	28	0	1414
08:15 AM	50	92	28	0	65	315	98	0	33	85	37	0	67	354	30	0	1254
08:30 AM	63	75	19	0	66	337	101	0	43	80	31	0	50	323	25	0	1213
08:45 AM	70	84	47	0	71	316	87	0	41	117	80	0	39	294	51	0	1297
Total	229	340	115	0	274	1367	414	0	157	410	176	0	203	1359	134	0	5178
Grand Total	432	644	210	0	513	2588	840	0	253	854	247	0	441	2783	242	0	10047
Apprch %	33.6	50.1	16.3	0	13	65.7	21.3	0	18.7	63.1	18.2	0	12.7	80.3	7	0	
Total %	4.3	6.4	2.1	0	5.1	25.8	8.4	0	2.5	8.5	2.5	0	4.4	27.7	2.4	0	



All Traffic Data Services, Inc
9660 W 44th Ave
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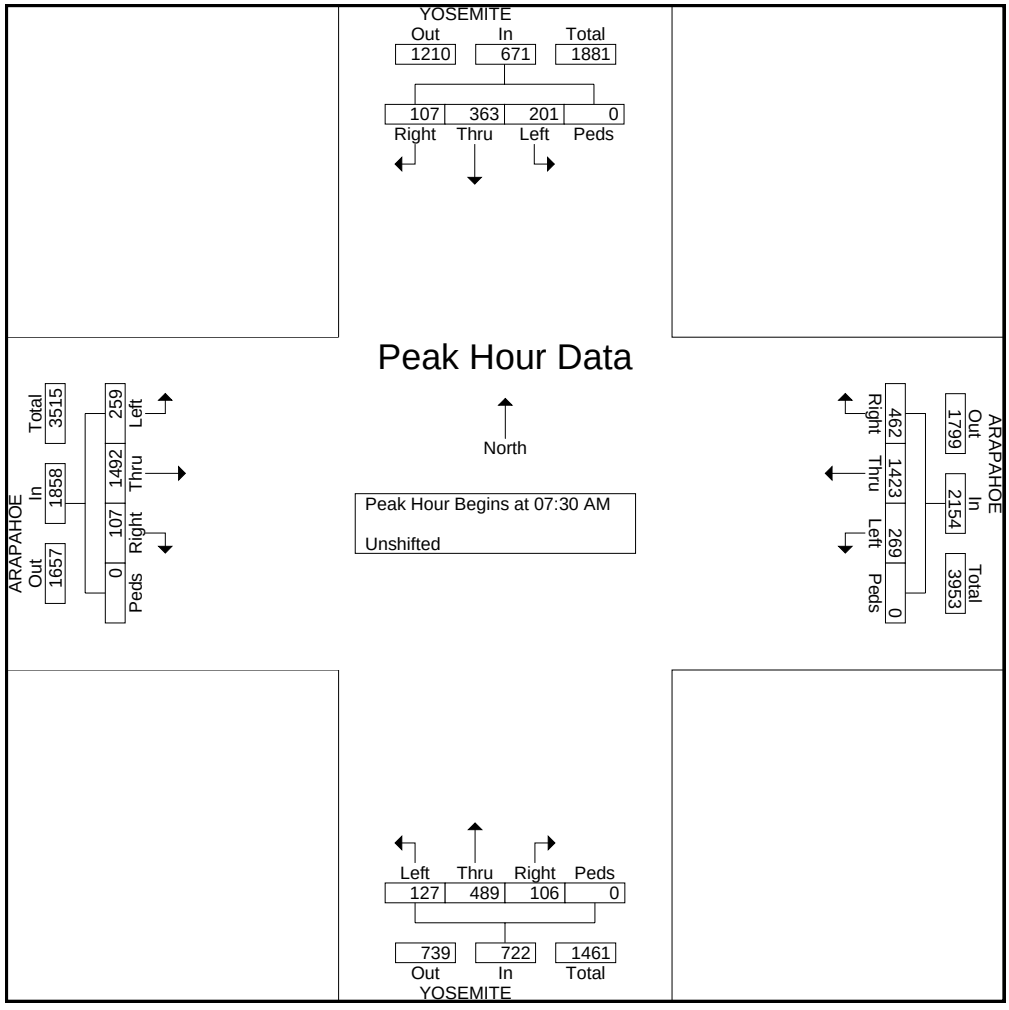
File Name : YOSEMITE&ARAPAHOEAM
Site Code : 00000000
Start Date : 1/10/2006
Page No : 2

	YOSEMITE Southbound					ARAPAHOE Westbound					YOSEMITE Northbound					ARAPAHOE Eastbound					
Start Time	Left	Thru	Right	Peds	App. Total	Left	Thru	Right	Peds	App. Total	Left	Thru	Right	Peds	App. Total	Left	Thru	Right	Peds	App. Total	Int. Total
Peak Hour Analysis From 07:00 AM to 08:45 AM - Peak 1 of 1																					
Peak Hour for Entire Intersection Begins at 07:30 AM																					
07:30 AM	40	78	**36**	0	154	54	358	98	0	510	25	132	18	0	175	62	**400**	21	0	**483**	1322
07:45 AM	**65**	**104**	22	0	**191**	**78**	351	**138**	0	567	29	**144**	23	0	**196**	**83**	350	28	0	461	**1415**
08:00 AM	46	89	21	0	156	72	**399**	128	0	**599**	**40**	128	28	0	196	47	388	28	0	463	1414
08:15 AM	50	92	28	0	170	65	315	98	0	478	33	85	**37**	0	155	67	354	**30**	0	451	1254
Total Volume	201	363	107	0	671	269	1423	462	0	2154	127	489	106	0	722	259	1492	107	0	1858	5405
% App. Total	30	54.1	15.9	0		12.5	66.1	21.4	0		17.6	67.7	14.7	0		13.9	80.3	5.8	0		
PHF	.773	.873	.743	.000	.878	.862	.892	.837	.000	.899	.794	.849	.716	.000	.921	.780	.933	.892	.000	.962	.955



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9660 W 44th Ave
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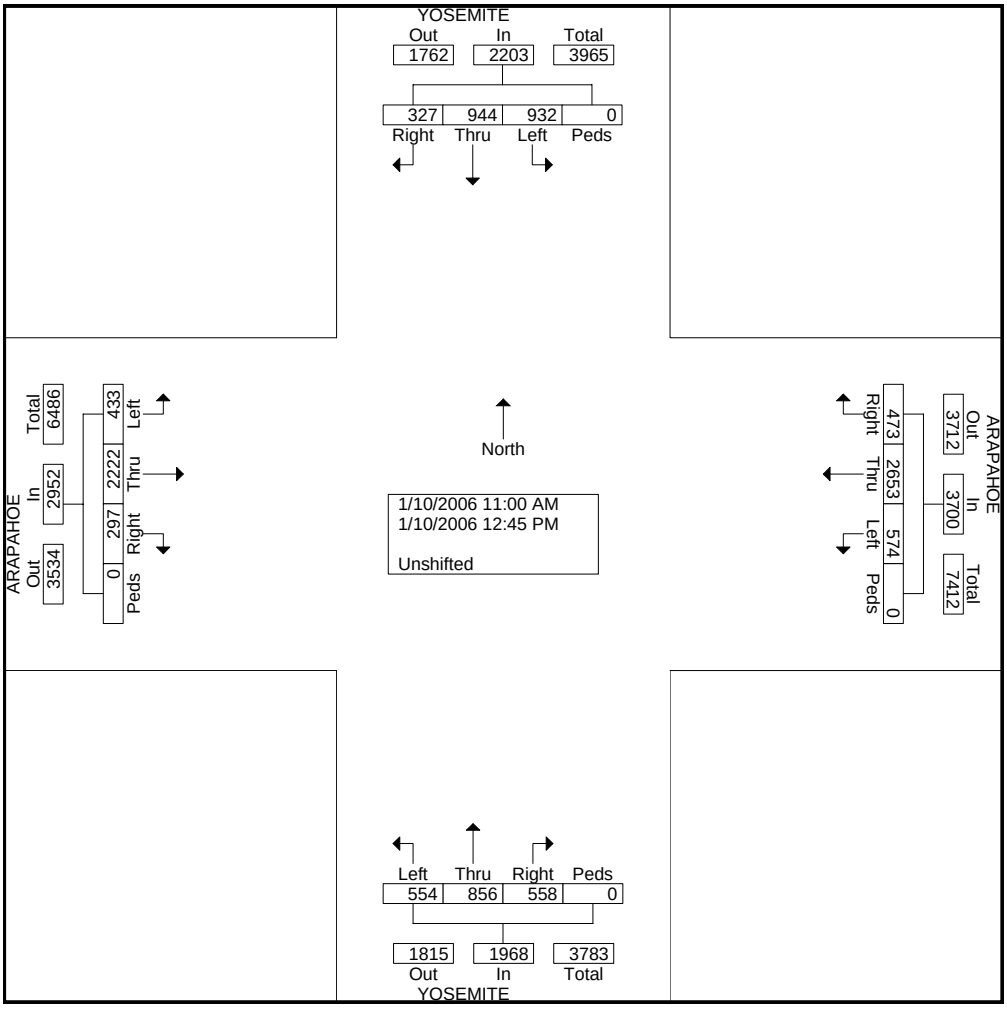
File Name : YOSEMITE&ARAPAHOENOON
Site Code : 00000000
Start Date : 1/10/2006
Page No : 1

Groups Printed- Unshifted

	YOSEMITE Southbound				ARAPAHOE Westbound				YOSEMITE Northbound				ARAPAHOE Eastbound				
Start Time	Left	Thru	Right	Peds	Left	Thru	Right	Peds	Left	Thru	Right	Peds	Left	Thru	Right	Peds	Int. Total
Factor	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	
11:00 AM	72	70	32	0	65	274	34	0	47	67	37	0	32	242	30	0	1002
11:15 AM	111	114	32	0	64	356	52	0	79	86	75	0	39	265	37	0	1310
11:30 AM	127	130	49	0	70	358	56	0	76	87	75	0	57	277	48	0	1410
11:45 AM	123	142	44	0	86	354	71	0	70	116	85	0	57	275	37	0	1460
Total	433	456	157	0	285	1342	213	0	272	356	272	0	185	1059	152	0	5182
12:00 PM	134	126	46	0	70	334	76	0	72	106	92	0	56	305	36	0	1453
12:15 PM	130	120	47	0	76	346	69	0	68	136	70	0	73	294	28	0	1457
12:30 PM	124	117	51	0	65	329	48	0	84	136	53	0	60	305	42	0	1414
12:45 PM	111	125	26	0	78	302	67	0	58	122	71	0	59	259	39	0	1317
Total	499	488	170	0	289	1311	260	0	282	500	286	0	248	1163	145	0	5641
Grand Total	932	944	327	0	574	2653	473	0	554	856	558	0	433	2222	297	0	10823
Apprch %	42.3	42.9	14.8	0	15.5	71.7	12.8	0	28.2	43.5	28.4	0	14.7	75.3	10.1	0	
Total %	8.6	8.7	3	0	5.3	24.5	4.4	0	5.1	7.9	5.2	0	4	20.5	2.7	0	



All Traffic Data Services, Inc
9660 W 44th Ave
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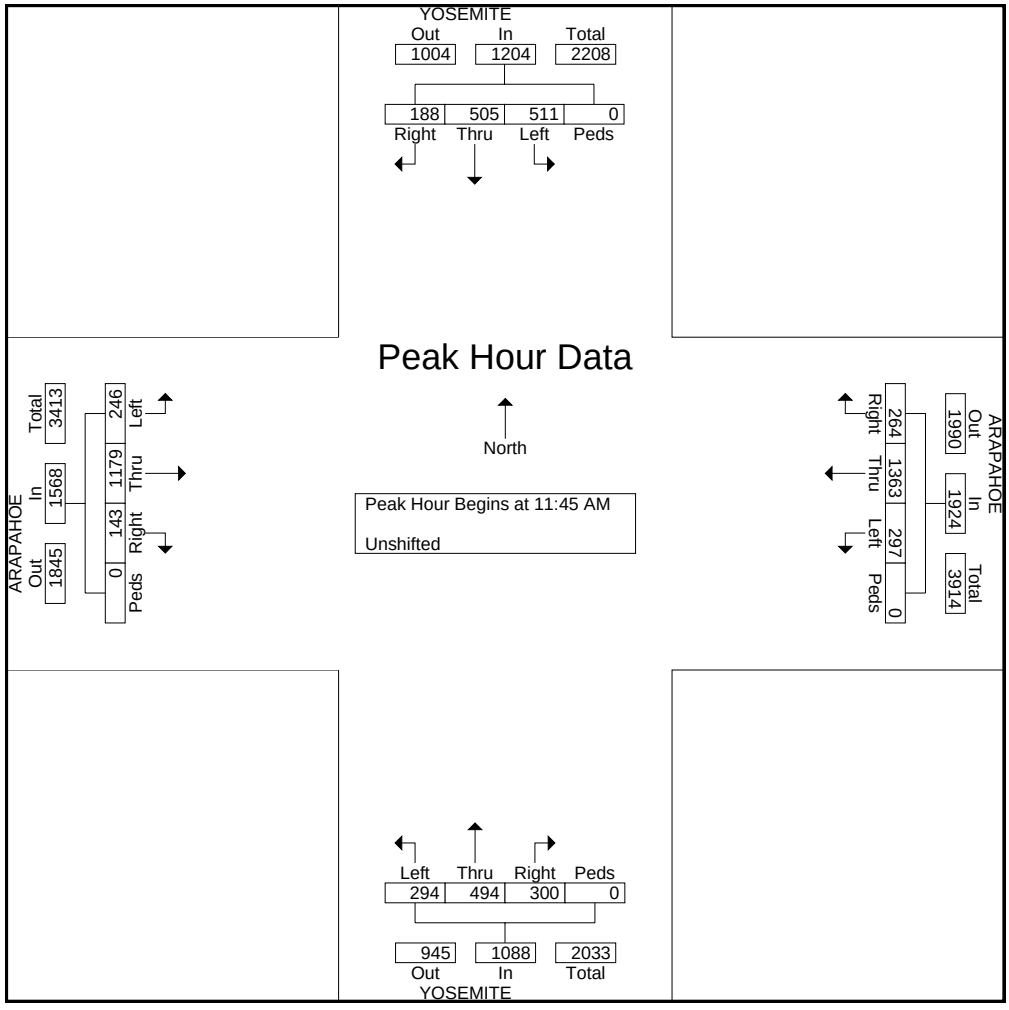
File Name : YOSEMITE&ARAPAHOENOON
Site Code : 00000000
Start Date : 1/10/2006
Page No : 2

	YOSEMITE Southbound					ARAPAHOE Westbound					YOSEMITE Northbound					ARAPAHOE Eastbound					
Start Time	Left	Thru	Right	Peds	App. Total	Left	Thru	Right	Peds	App. Total	Left	Thru	Right	Peds	App. Total	Left	Thru	Right	Peds	App. Total	Int. Total
Peak Hour Analysis From 11:00 AM to 12:45 PM - Peak 1 of 1																					
Peak Hour for Entire Intersection Begins at 11:45 AM																					
11:45 AM	123	**142**	44	0	**309**	**86**	**354**	71	0	**511**	70	116	85	0	271	57	275	37	0	369	**1460**
12:00 PM	**134**	126	46	0	306	70	334	**76**	0	480	72	106	**92**	0	270	56	**305**	36	0	397	1453
12:15 PM	130	120	47	0	297	76	346	69	0	491	68	**136**	70	0	**274**	**73**	294	28	0	395	1457
12:30 PM	124	117	**51**	0	292	65	329	48	0	442	**84**	136	53	0	273	60	305	**42**	0	**407**	1414
Total Volume	511	505	188	0	1204	297	1363	264	0	1924	294	494	300	0	1088	246	1179	143	0	1568	5784
% App. Total	42.4	41.9	15.6	0		15.4	70.8	13.7	0		27	45.4	27.6	0		15.7	75.2	9.1	0		
PHF	.953	.889	.922	.000	.974	.863	.963	.868	.000	.941	.875	.908	.815	.000	.993	.842	.966	.851	.000	.963	.990



All Traffic Data Services, Inc
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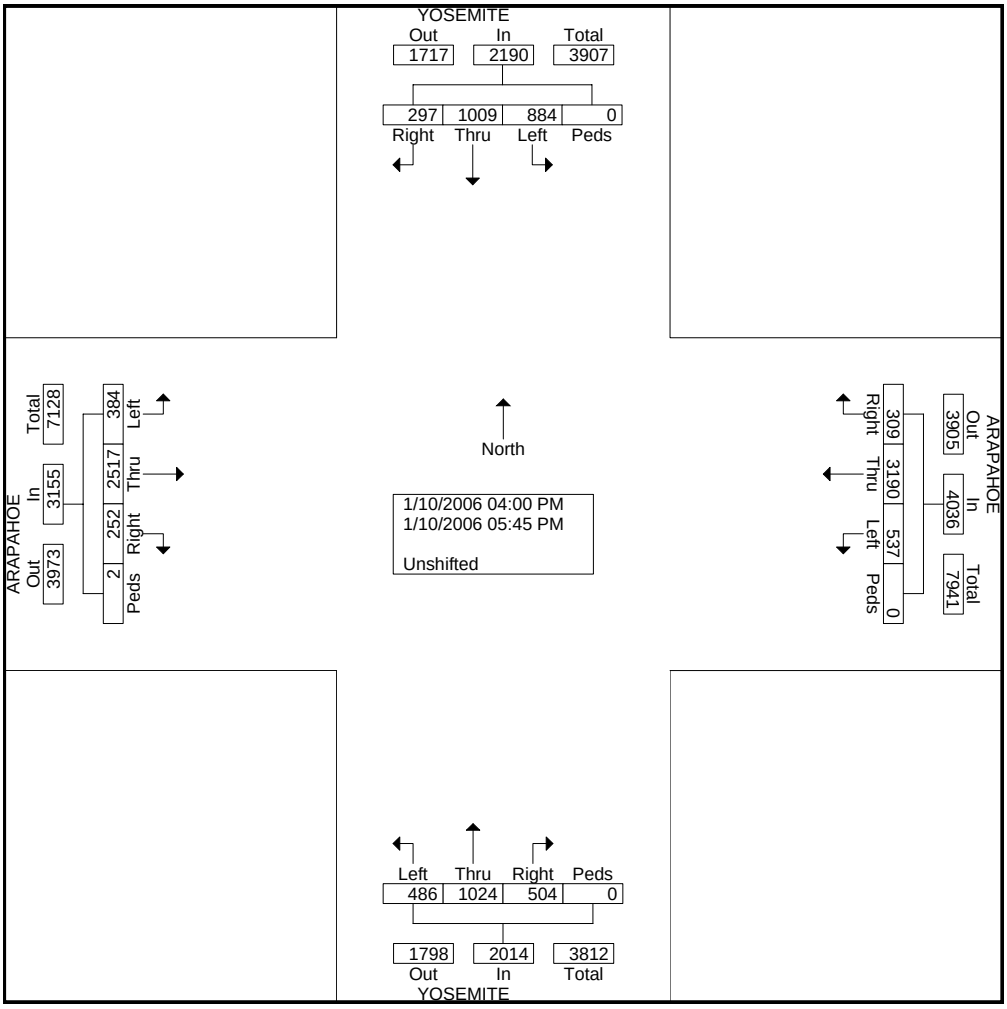
File Name : YOSEMITE&ARAPAHOEPM
Site Code : 00000000
Start Date : 1/10/2006
Page No : 1

Groups Printed- Unshifted

	YOSEMITE Southbound				ARAPAHOE Westbound				YOSEMITE Northbound				ARAPAHOE Eastbound				
Start Time	Left	Thru	Right	Peds	Left	Thru	Right	Peds	Left	Thru	Right	Peds	Left	Thru	Right	Peds	Int. Total
Factor	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	
04:00 PM	114	70	38	0	55	388	48	0	66	96	56	0	46	279	29	0	1285
04:15 PM	77	121	46	0	80	398	38	0	40	144	55	0	61	299	31	0	1390
04:30 PM	116	114	34	0	67	418	20	0	63	139	78	0	41	280	44	0	1414
04:45 PM	108	134	39	0	92	439	42	0	66	131	75	0	46	336	29	0	1537
Total	415	439	157	0	294	1643	148	0	235	510	264	0	194	1194	133	0	5626
05:00 PM	115	139	22	0	52	393	39	0	65	158	88	0	49	402	33	0	1555
05:15 PM	117	161	26	0	66	434	44	0	68	166	75	0	59	309	30	2	1557
05:30 PM	126	140	39	0	60	382	41	0	68	100	41	0	36	331	34	0	1398
05:45 PM	111	130	53	0	65	338	37	0	50	90	36	0	46	281	22	0	1259
Total	469	570	140	0	243	1547	161	0	251	514	240	0	190	1323	119	2	5769
Grand Total	884	1009	297	0	537	3190	309	0	486	1024	504	0	384	2517	252	2	11395
Apprch %	40.4	46.1	13.6	0	13.3	79	7.7	0	24.1	50.8	25	0	12.2	79.8	8	0.1	
Total %	7.8	8.9	2.6	0	4.7	28	2.7	0	4.3	9	4.4	0	3.4	22.1	2.2	0	



All Traffic Data Services, Inc
9660 W 44th Ave
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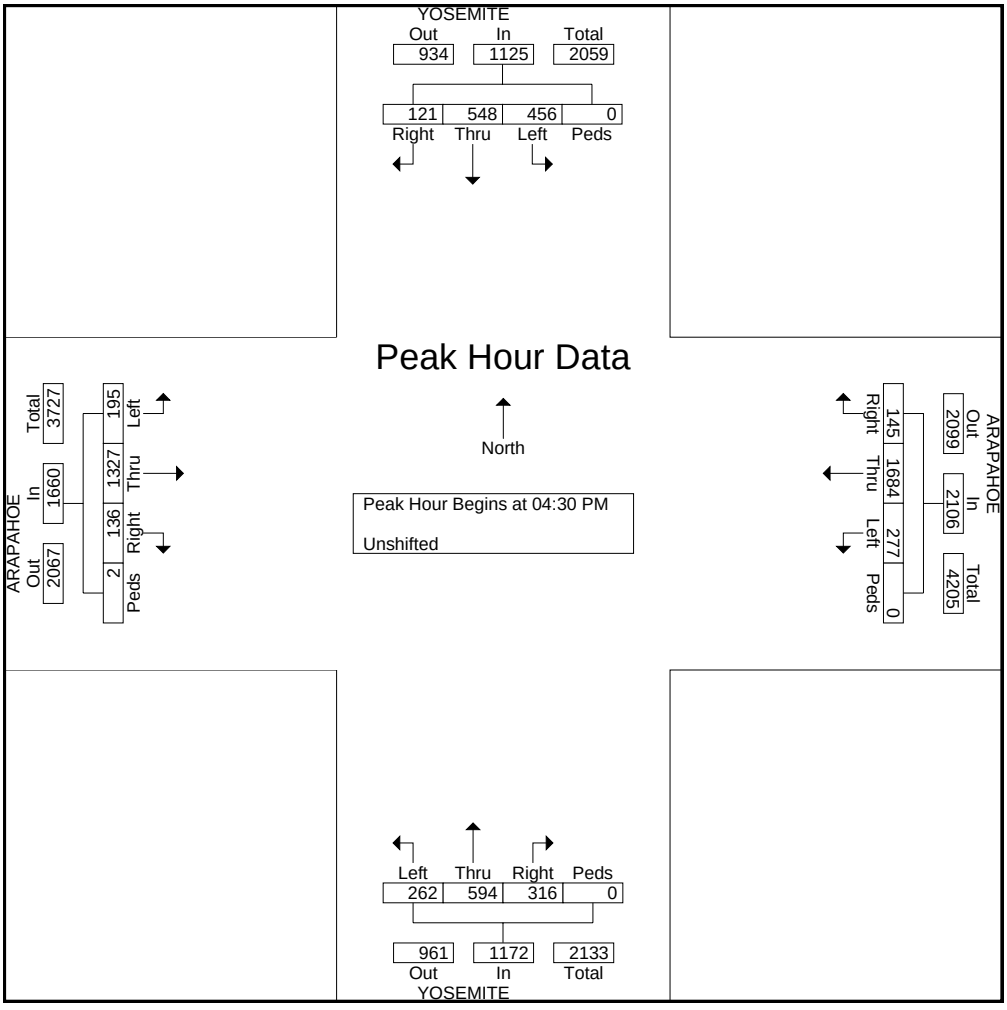
File Name : YOSEMITE&ARAPAHOEPM
Site Code : 00000000
Start Date : 1/10/2006
Page No : 2

	YOSEMITE Southbound					ARAPAHOE Westbound					YOSEMITE Northbound					ARAPAHOE Eastbound					
Start Time	Left	Thru	Right	Peds	App. Total	Left	Thru	Right	Peds	App. Total	Left	Thru	Right	Peds	App. Total	Left	Thru	Right	Peds	App. Total	Int. Total
Peak Hour Analysis From 04:00 PM to 05:45 PM - Peak 1 of 1																					
Peak Hour for Entire Intersection Begins at 04:30 PM																					
04:30 PM	116	114	34	0	264	67	418	20	0	505	63	139	78	0	280	41	280	**44**	0	365	1414
04:45 PM	108	134	**39**	0	281	**92**	**439**	42	0	**573**	66	131	75	0	272	46	336	29	0	411	1537
05:00 PM	115	139	22	0	276	52	393	39	0	484	65	158	**88**	0	**311**	49	**402**	33	0	**484**	1555
05:15 PM	**117**	**161**	26	0	**304**	66	434	**44**	0	544	**68**	**166**	75	0	309	**59**	309	30	**2**	400	**1557**
Total Volume	456	548	121	0	1125	277	1684	145	0	2106	262	594	316	0	1172	195	1327	136	2	1660	6063
% App. Total	40.5	48.7	10.8	0		13.2	80	6.9	0		22.4	50.7	27	0		11.7	79.9	8.2	0.1		
PHF	.974	.851	.776	.000	.925	.753	.959	.824	.000	.919	.963	.895	.898	.000	.942	.826	.825	.773	.250	.857	.974



All Traffic Data Services, Inc
9660 W 44th Ave
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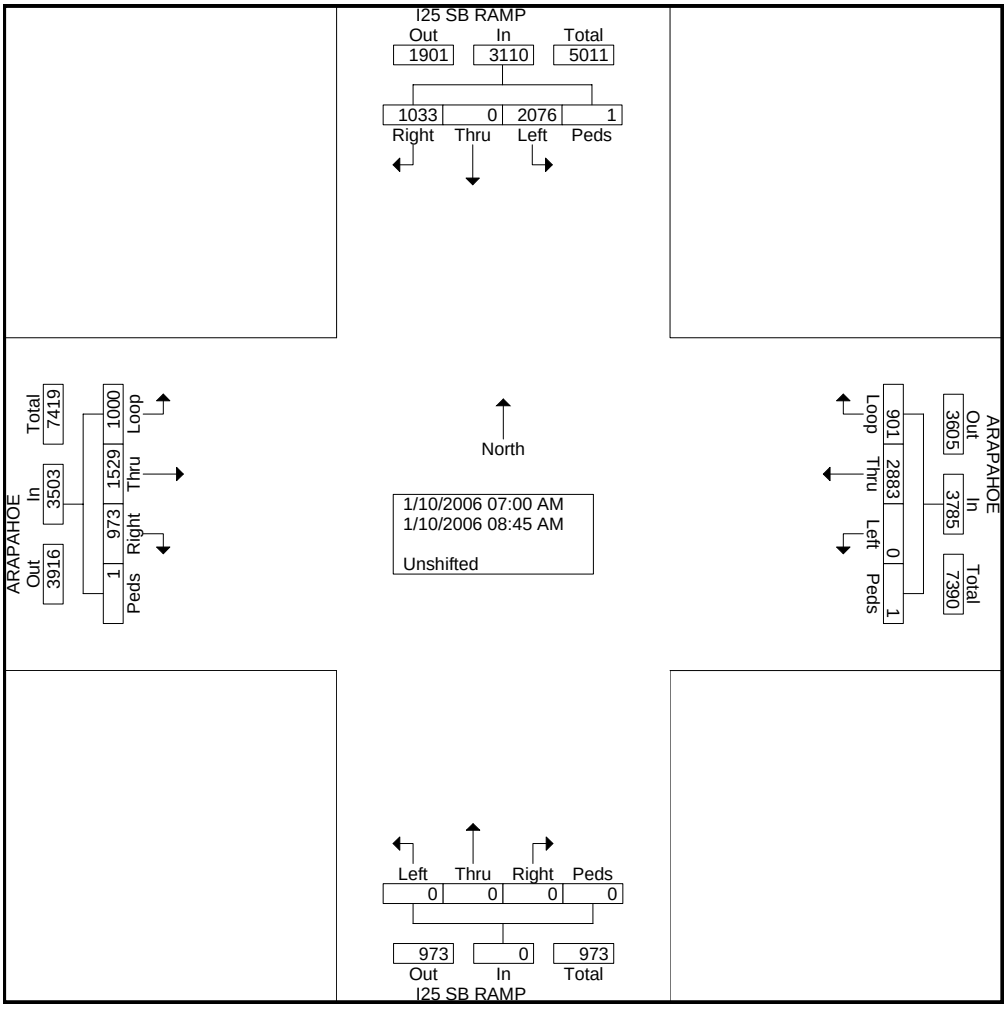
File Name : SBRAMP&ARAPAHOEAM
Site Code : 00000000
Start Date : 1/10/2006
Page No : 1

Groups Printed- Unshifted

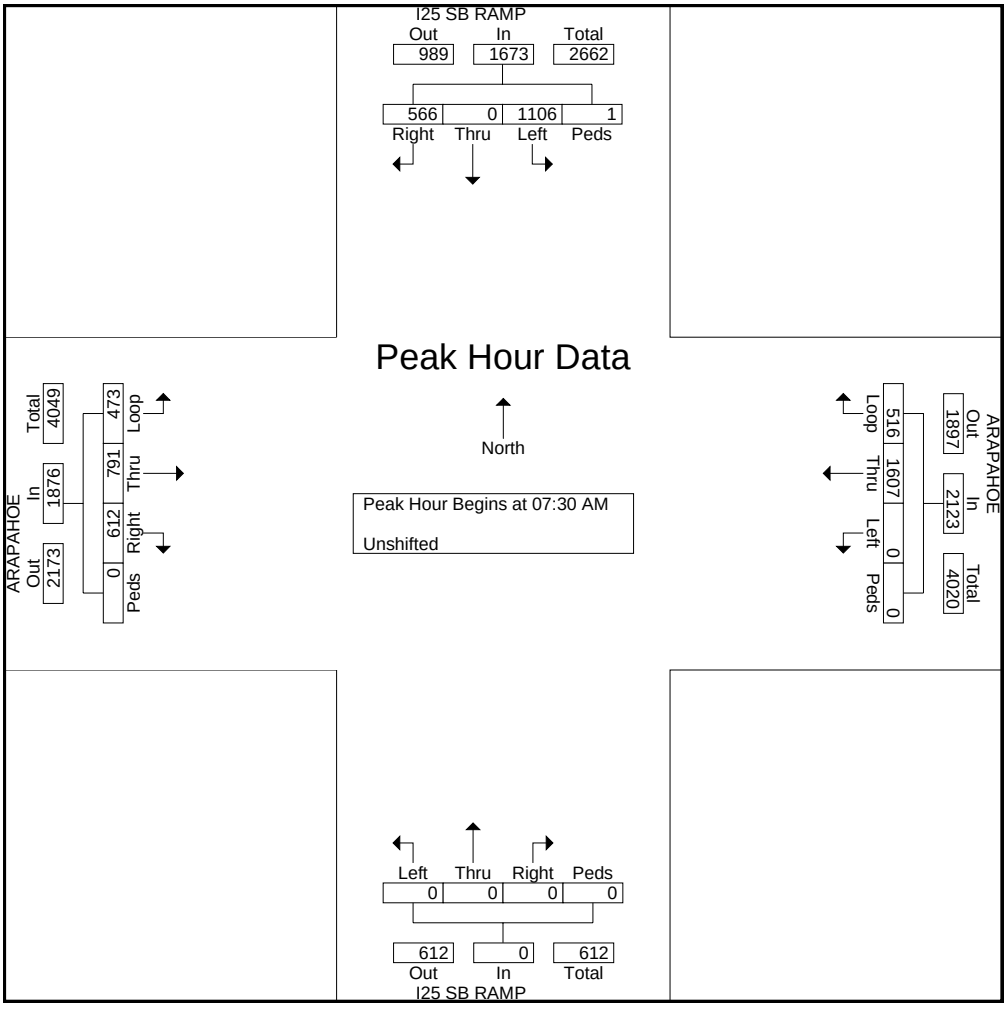
	I25 SB RAMP Southbound				ARAPAHOE Westbound				I25 SB RAMP Northbound				ARAPAHOE Eastbound				
Start Time	Left	Thru	Right	Peds	Left	Thru	Loop	Peds	Left	Thru	Right	Peds	Loop	Thru	Right	Peds	Int. Total
Factor	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	
07:00 AM	254	0	94	0	0	299	70	0	0	0	0	0	158	153	100	0	1128
07:15 AM	265	0	80	0	0	312	88	1	0	0	0	0	122	188	148	1	1205
07:30 AM	284	0	95	0	0	400	128	0	0	0	0	0	106	192	189	0	1394
07:45 AM	273	0	142	0	0	394	124	0	0	0	0	0	99	187	215	0	1434
Total	1076	0	411	0	0	1405	410	1	0	0	0	0	485	720	652	1	5161
08:00 AM	296	0	174	0	0	401	142	0	0	0	0	0	128	210	124	0	1475
08:15 AM	253	0	155	1	0	412	122	0	0	0	0	0	140	202	84	0	1369
08:30 AM	251	0	131	0	0	364	121	0	0	0	0	0	126	197	63	0	1253
08:45 AM	200	0	162	0	0	301	106	0	0	0	0	0	121	200	50	0	1140
Total	1000	0	622	1	0	1478	491	0	0	0	0	0	515	809	321	0	5237
Grand Total	2076	0	1033	1	0	2883	901	1	0	0	0	0	1000	1529	973	1	10398
Apprch %	66.8	0	33.2	0	0	76.2	23.8	0	0	0	0	0	28.5	43.6	27.8	0	
Total %	20	0	9.9	0	0	27.7	8.7	0	0	0	0	0	9.6	14.7	9.4	0	



All Traffic Data Services, Inc
9660 W 44th Ave
Wheat Ridge, CO 80033
www.alltrafficdata.net

File Name : SBRAMP&ARAPAHOEAM
Site Code : 00000000
Start Date : 1/10/2006
Page No : 2

	I25 SB RAMP Southbound					ARAPAHOE Westbound					I25 SB RAMP Northbound					ARAPAHOE Eastbound					
Start Time	Left	Thru	Right	Peds	App. Total	Left	Thru	Loop	Peds	App. Total	Left	Thru	Right	Peds	App. Total	Loop	Thru	Right	Peds	App. Total	Int. Total
Peak Hour Analysis From 07:00 AM to 08:45 AM - Peak 1 of 1																					
Peak Hour for Entire Intersection Begins at 07:30 AM																					
07:30 AM	284	0	95	0	379	0	400	128	0	528	0	0	0	0	0	106	192	189	0	487	1394
07:45 AM	273	0	142	0	415	0	394	124	0	518	0	0	0	0	0	99	187	**215**	0	**501**	1434
08:00 AM	**296**	0	**174**	0	**470**	0	401	**142**	0	**543**	0	0	0	0	0	128	**210**	124	0	462	**1475**
08:15 AM	253	0	155	**1**	409	0	**412**	122	0	534	0	0	0	0	0	**140**	202	84	0	426	1369
Total Volume	1106	0	566	1	1673	0	1607	516	0	2123	0	0	0	0	0	473	791	612	0	1876	5672
% App. Total	66.1	0	33.8	0.1		0	75.7	24.3	0		0	0	0	0		25.2	42.2	32.6	0		
PHF	.934	.000	.813	.250	.890	.000	.975	.908	.000	.977	.000	.000	.000	.000	.000	.845	.942	.712	.000	.936	.961

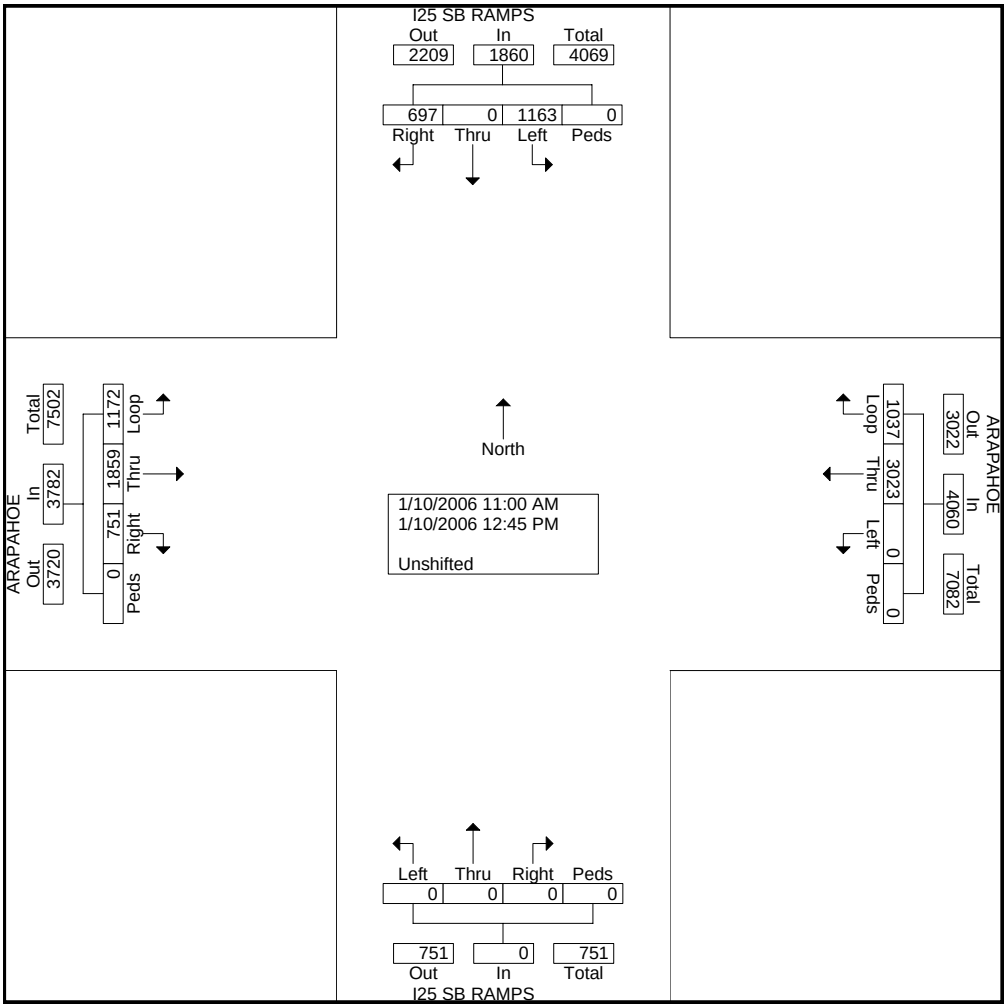


All Traffic Data Services, Inc
9660 W 44th Ave
Wheat Ridge, CO 80033
www.alltrafficdata.net

File Name : SBRAMP&ARAPAHOENOON
Site Code : 00000000
Start Date : 1/10/2006
Page No : 1

Groups Printed- Unshifted

	I25 SB RAMPS Southbound				ARAPAHOE Westbound				I25 SB RAMPS Northbound				ARAPAHOE Eastbound				
Start Time	Left	Thru	Right	Peds	Left	Thru	Loop	Peds	Left	Thru	Right	Peds	Loop	Thru	Right	Peds	Int. Total
11:00 AM	154	0	75	0	0	340	90	0	0	0	0	0	156	222	54	0	1091
11:15 AM	155	0	77	0	0	364	126	0	0	0	0	0	140	228	70	0	1160
11:30 AM	164	0	95	0	0	398	136	0	0	0	0	0	156	261	55	0	1265
11:45 AM	139	0	85	0	0	380	117	0	0	0	0	0	134	237	109	0	1201
Total	612	0	332	0	0	1482	469	0	0	0	0	0	586	948	288	0	4717
12:00 PM	124	0	91	0	0	381	127	0	0	0	0	0	126	253	129	0	1231
12:15 PM	144	0	90	0	0	448	132	0	0	0	0	0	160	218	124	0	1316
12:30 PM	135	0	100	0	0	380	152	0	0	0	0	0	146	225	117	0	1255
12:45 PM	148	0	84	0	0	332	157	0	0	0	0	0	154	215	93	0	1183
Total	551	0	365	0	0	1541	568	0	0	0	0	0	586	911	463	0	4985
Grand Total	1163	0	697	0	0	3023	1037	0	0	0	0	0	1172	1859	751	0	9702
Apprch %	62.5	0	37.5	0	0	74.5	25.5	0	0	0	0	0	31	49.2	19.9	0	
Total %	12	0	7.2	0	0	31.2	10.7	0	0	0	0	0	12.1	19.2	7.7	0	



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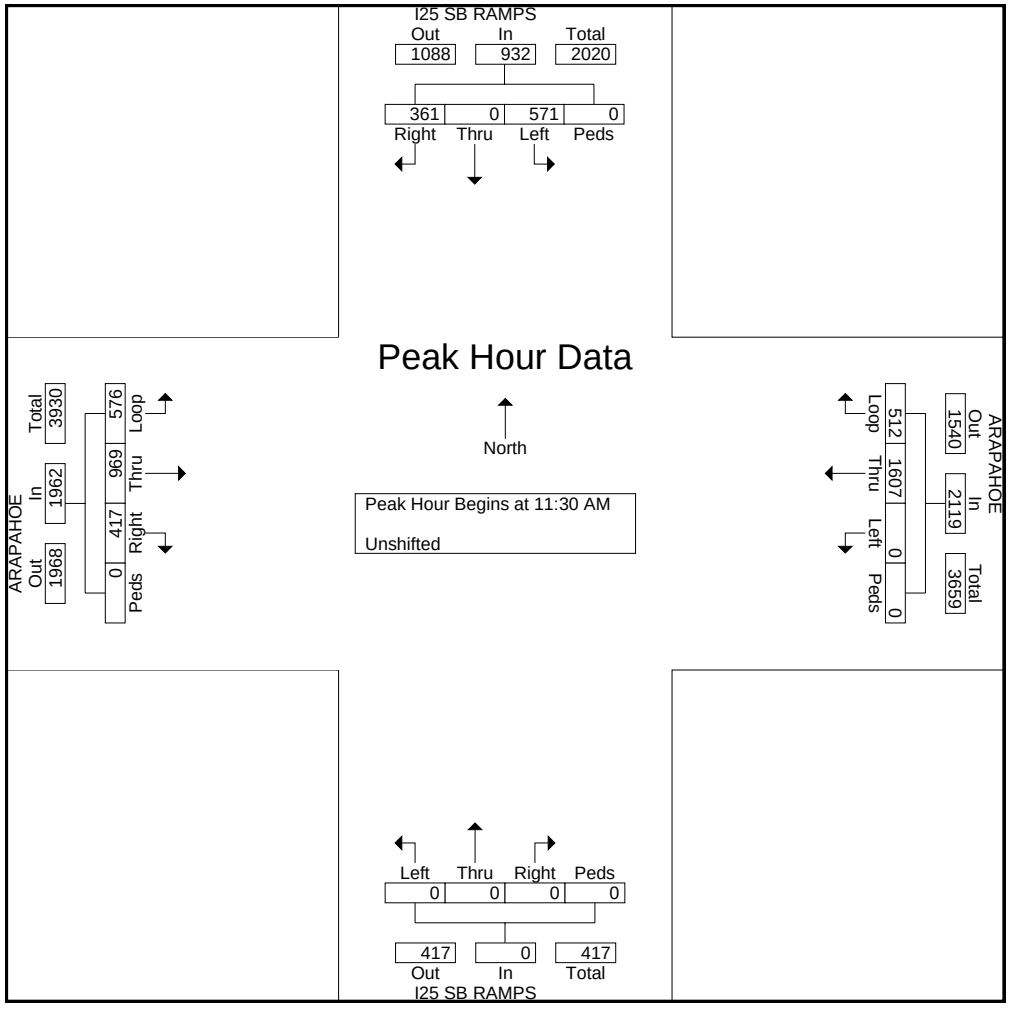
File Name : SBRAMP&ARAPAHOENOON
Site Code : 00000000
Start Date : 1/10/2006
Page No : 2

	I25 SB RAMPS Southbound					ARAPAHOE Westbound					I25 SB RAMPS Northbound					ARAPAHOE Eastbound					
Start Time	Left	Thru	Right	Peds	App. Total	Left	Thru	Loop	Peds	App. Total	Left	Thru	Right	Peds	App. Total	Loop	Thru	Right	Peds	App. Total	Int. Total
Peak Hour Analysis From 11:00 AM to 12:45 PM - Peak 1 of 1																					
Peak Hour for Entire Intersection Begins at 11:30 AM																					
11:30 AM	**164**	0	**95**	0	**259**	0	398	**136**	0	534	0	0	0	0	0	156	**261**	55	0	472	1265
11:45 AM	139	0	85	0	224	0	380	117	0	497	0	0	0	0	0	134	237	109	0	480	1201
12:00 PM	124	0	91	0	215	0	381	127	0	508	0	0	0	0	0	126	253	**129**	0	**508**	1231
12:15 PM	144	0	90	0	234	0	**448**	132	0	**580**	0	0	0	0	0	**160**	218	124	0	502	**1316**
Total Volume	571	0	361	0	932	0	1607	512	0	2119	0	0	0	0	0	576	969	417	0	1962	5013
% App. Total	61.3	0	38.7	0		0	75.8	24.2	0		0	0	0	0		29.4	49.4	21.3	0		
PHF	.870	.000	.950	.000	.900	.000	.897	.941	.000	.913	.000	.000	.000	.000	.000	.900	.928	.808	.000	.966	.952



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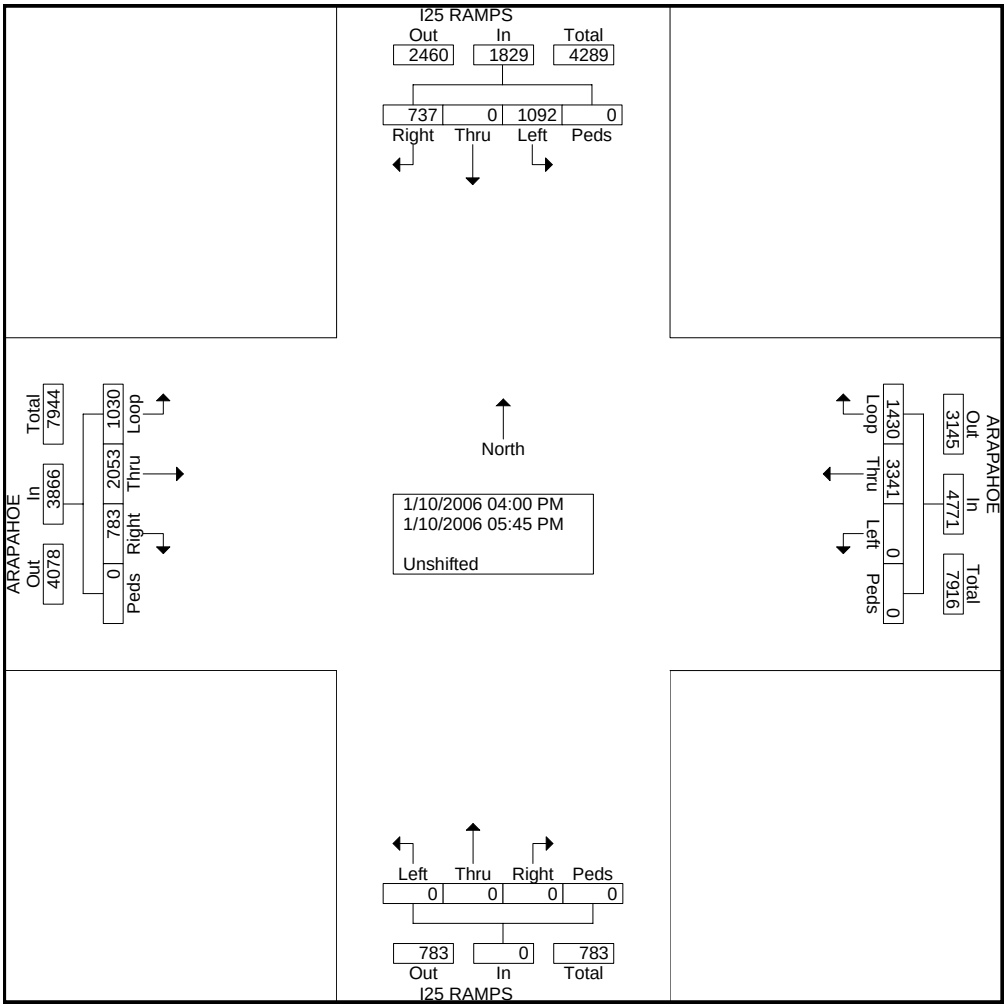
File Name : SBRAMP&ARAPAHOEPM
Site Code : 00000000
Start Date : 1/10/2006
Page No : 1

Groups Printed- Unshifted

	I25 RAMPS Southbound				ARAPAHOE Westbound				I25 RAMPS Northbound				ARAPAHOE Eastbound				
Start Time	Left	Thru	Right	Peds	Left	Thru	Loop	Peds	Left	Thru	Right	Peds	Loop	Thru	Right	Peds	Int. Total
04:00 PM	138	0	76	0	0	395	205	0	0	0	0	0	139	268	56	0	1277
04:15 PM	125	0	89	0	0	409	159	0	0	0	0	0	114	272	102	0	1270
04:30 PM	128	0	74	0	0	440	164	0	0	0	0	0	132	249	98	0	1285
04:45 PM	131	0	91	0	0	396	161	0	0	0	0	0	124	239	96	0	1238
Total	522	0	330	0	0	1640	689	0	0	0	0	0	509	1028	352	0	5070
05:00 PM	166	0	103	0	0	366	192	0	0	0	0	0	171	295	81	0	1374
05:15 PM	159	0	115	0	0	466	198	0	0	0	0	0	143	264	101	0	1446
05:30 PM	125	0	98	0	0	400	186	0	0	0	0	0	125	207	128	0	1269
05:45 PM	120	0	91	0	0	469	165	0	0	0	0	0	82	259	121	0	1307
Total	570	0	407	0	0	1701	741	0	0	0	0	0	521	1025	431	0	5396
Grand Total	1092	0	737	0	0	3341	1430	0	0	0	0	0	1030	2053	783	0	10466
Apprch %	59.7	0	40.3	0	0	70	30	0	0	0	0	0	26.6	53.1	20.3	0	
Total %	10.4	0	7	0	0	31.9	13.7	0	0	0	0	0	9.8	19.6	7.5	0	



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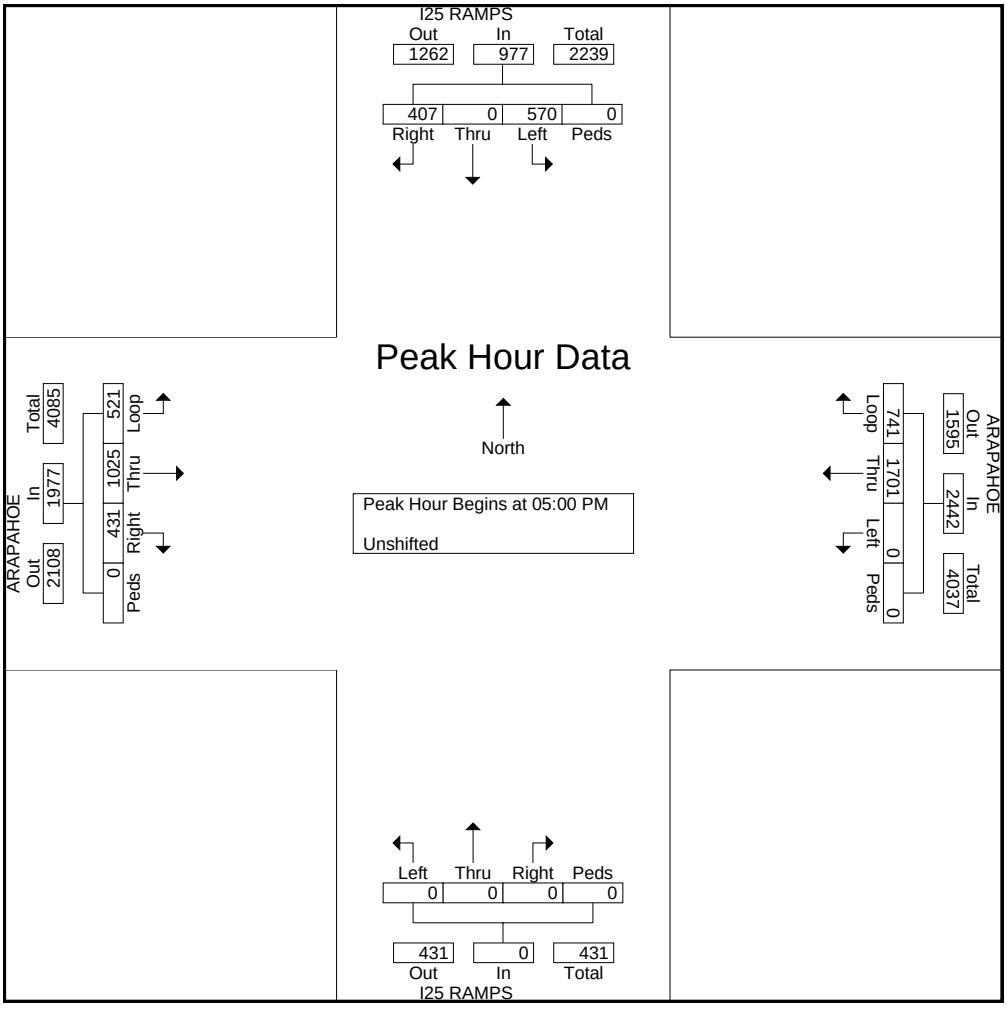
File Name : SBRAMP&ARAPAHOEPM
Site Code : 00000000
Start Date : 1/10/2006
Page No : 2

	I25 RAMPS Southbound					ARAPAHOE Westbound					I25 RAMPS Northbound					ARAPAHOE Eastbound					
Start Time	Left	Thru	Right	Peds	App. Total	Left	Thru	Loop	Peds	App. Total	Left	Thru	Right	Peds	App. Total	Loop	Thru	Right	Peds	App. Total	Int. Total
Peak Hour Analysis From 04:00 PM to 05:45 PM - Peak 1 of 1																					
Peak Hour for Entire Intersection Begins at 05:00 PM																					
05:00 PM	**166**	0	103	0	269	0	366	192	0	558	0	0	0	0	0	**171**	**295**	81	0	**547**	1374
05:15 PM	159	0	**115**	0	**274**	0	466	**198**	0	**664**	0	0	0	0	0	143	264	101	0	508	**1446**
05:30 PM	125	0	98	0	223	0	400	186	0	586	0	0	0	0	0	125	207	**128**	0	460	1269
05:45 PM	120	0	91	0	211	0	**469**	165	0	634	0	0	0	0	0	82	259	121	0	462	1307
Total Volume	570	0	407	0	977	0	1701	741	0	2442	0	0	0	0	0	521	1025	431	0	1977	5396
% App. Total	58.3	0	41.7	0		0	69.7	30.3	0		0	0	0	0		26.4	51.8	21.8	0		
PHF	.858	.000	.885	.000	.891	.000	.907	.936	.000	.919	.000	.000	.000	.000	.000	.762	.869	.842	.000	.904	.933



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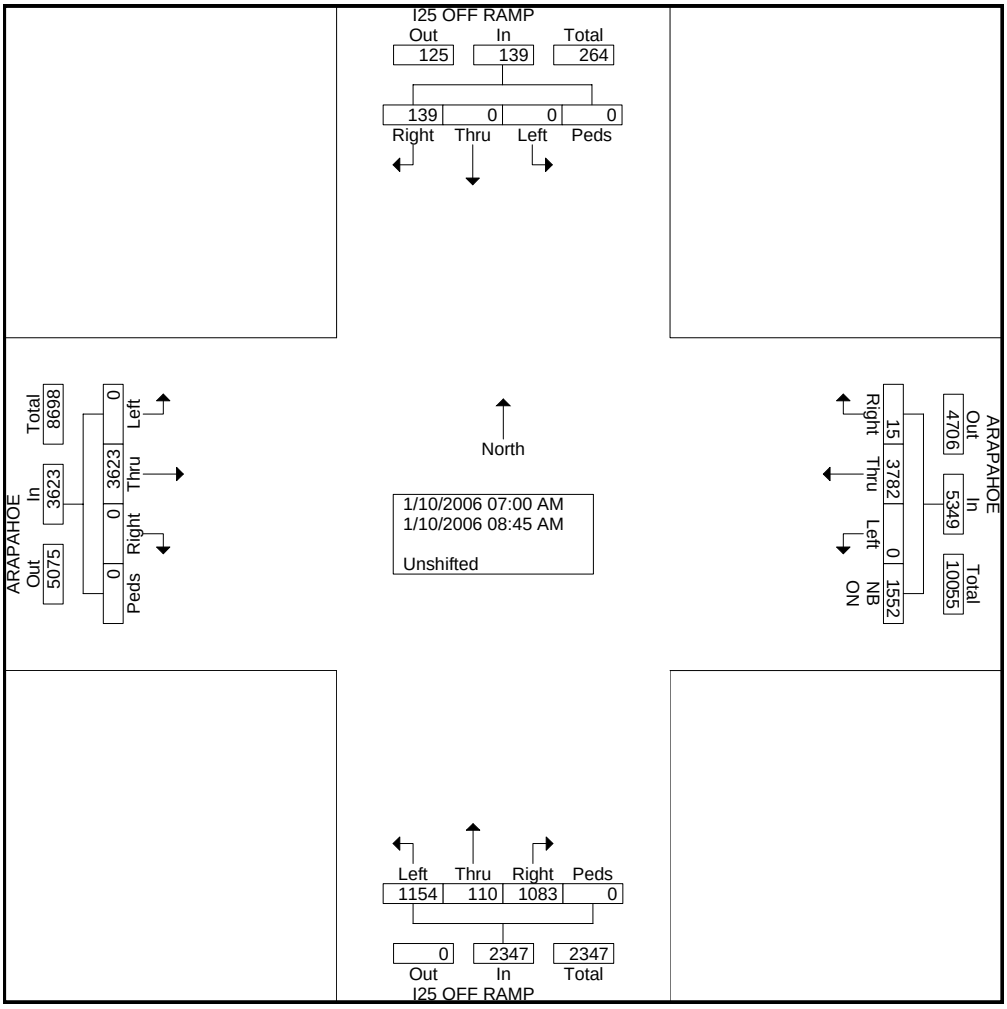
File Name : NBRAMP&ARAPAHOEAM
Site Code : 00000000
Start Date : 1/10/2006
Page No : 1

Groups Printed- Unshifted

	I25 OFF RAMP Southbound				ARAPAHOE Westbound				I25 OFF RAMP Northbound				ARAPAHOE Eastbound				
Start Time	Left	Thru	Right	Peds	Left	Thru	Right	NB ON	Left	Thru	Right	Peds	Left	Thru	Right	Peds	Int. Total
Factor	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	
07:00 AM	0	0	8	0	0	369	2	207	114	8	104	0	0	441	0	0	1253
07:15 AM	0	0	9	0	0	400	1	188	95	7	119	0	0	458	0	0	1277
07:30 AM	0	0	23	0	0	526	1	148	139	15	171	0	0	478	0	0	1501
07:45 AM	0	0	22	0	0	518	1	249	192	25	203	0	0	483	0	0	1693
Total	0	0	62	0	0	1813	5	792	540	55	597	0	0	1860	0	0	5724
08:00 AM	0	0	12	0	0	543	5	138	171	8	112	0	0	451	0	0	1440
08:15 AM	0	0	20	0	0	534	1	170	159	11	131	0	0	439	0	0	1465
08:30 AM	0	0	14	0	0	485	3	161	149	19	125	0	0	441	0	0	1397
08:45 AM	0	0	31	0	0	407	1	291	135	17	118	0	0	432	0	0	1432
Total	0	0	77	0	0	1969	10	760	614	55	486	0	0	1763	0	0	5734
Grand Total	0	0	139	0	0	3782	15	1552	1154	110	1083	0	0	3623	0	0	11458
Apprch %	0	0	100	0	0	70.7	0.3	29	49.2	4.7	46.1	0	0	100	0	0	
Total %	0	0	1.2	0	0	33	0.1	13.5	10.1	1	9.5	0	0	31.6	0	0	



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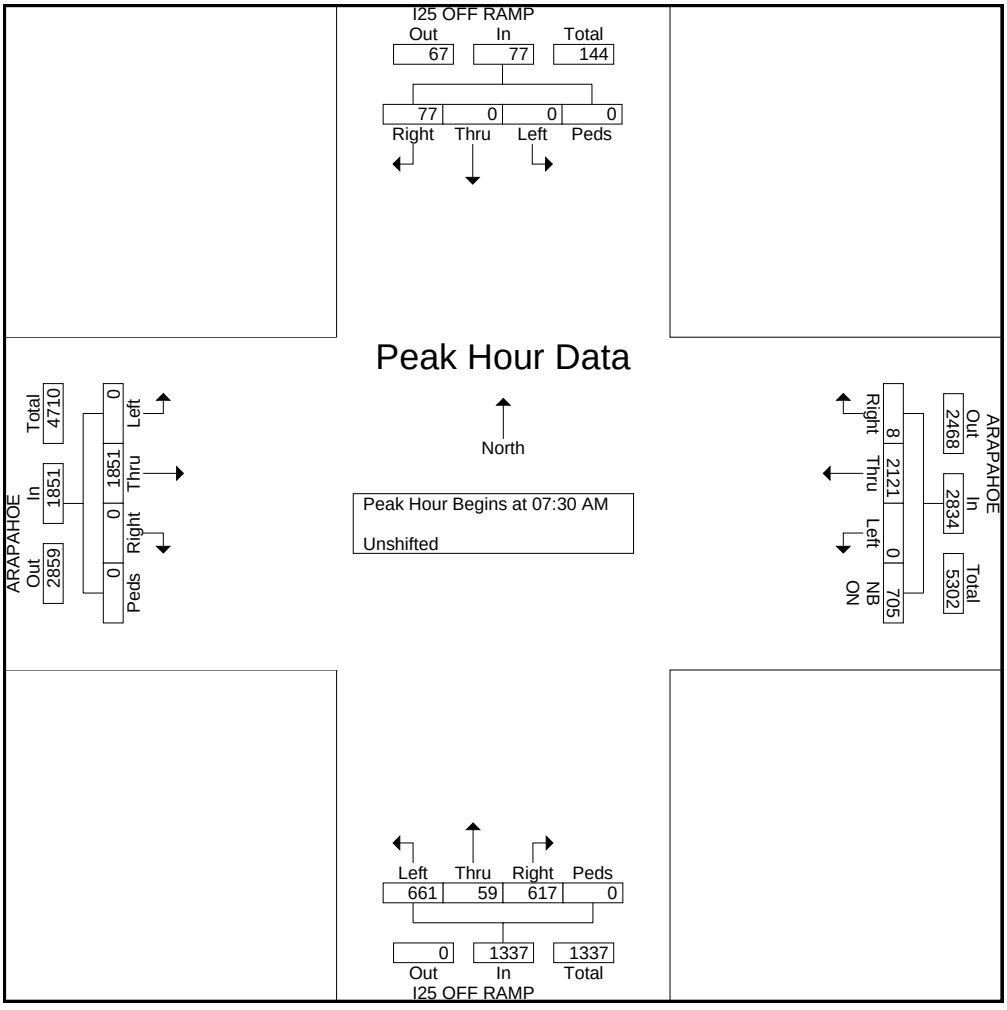
File Name : NBRAMP&ARAPAHOEAM
Site Code : 00000000
Start Date : 1/10/2006
Page No : 2

	I25 OFF RAMP Southbound					ARAPAHOE Westbound					I25 OFF RAMP Northbound					ARAPAHOE Eastbound					
Start Time	Left	Thru	Right	Peds	App. Total	Left	Thru	Right	NB ON	App. Total	Left	Thru	Right	Peds	App. Total	Left	Thru	Right	Peds	App. Total	Int. Total
Peak Hour Analysis From 07:00 AM to 08:45 AM - Peak 1 of 1																					
Peak Hour for Entire Intersection Begins at 07:30 AM																					
07:30 AM	0	0	**23**	0	**23**	0	526	1	148	675	139	15	171	0	325	0	478	0	0	478	1501
07:45 AM	0	0	22	0	22	0	518	1	**249**	**768**	**192**	**25**	**203**	0	**420**	0	**483**	0	0	**483**	**1693**
08:00 AM	0	0	12	0	12	0	**543**	**5**	138	686	171	8	112	0	291	0	451	0	0	451	1440
08:15 AM	0	0	20	0	20	0	534	1	170	705	159	11	131	0	301	0	439	0	0	439	1465
Total Volume	0	0	77	0	77	0	2121	8	705	2834	661	59	617	0	1337	0	1851	0	0	1851	6099
% App. Total	0	0	100	0		0	74.8	0.3	24.9		49.4	4.4	46.1	0		0	100	0	0		
PHF	.000	.000	.837	.000	.837	.000	.977	.400	.708	.923	.861	.590	.760	.000	.796	.000	.958	.000	.000	.958	.901



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9660 W 44th Ave
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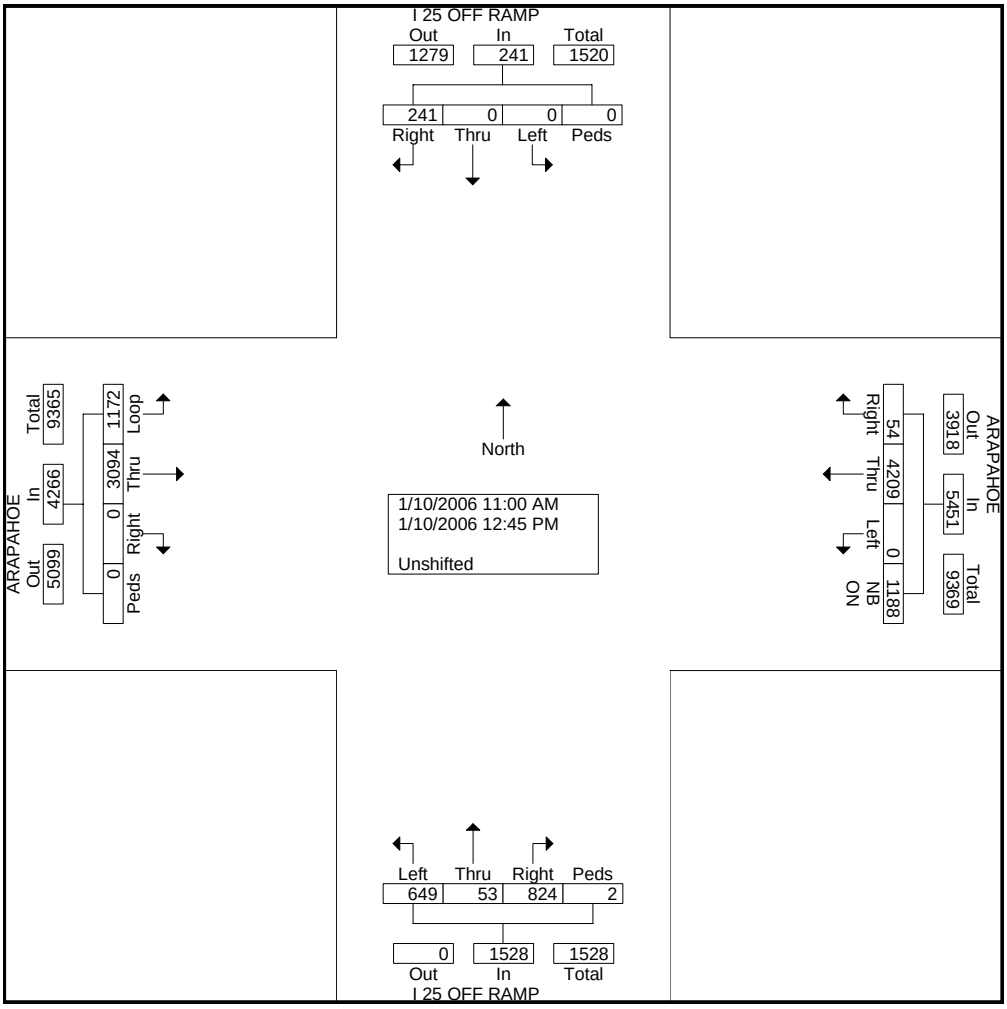
File Name : NBRAMP&ARAPAHOENOON
Site Code : 00000000
Start Date : 1/10/2006
Page No : 1

Groups Printed- Unshifted

	I 25 OFF RAMP Southbound				ARAPAHOE Westbound				I 25 OFF RAMP Northbound				ARAPAHOE Eastbound				
Start Time	Left	Thru	Right	Peds	Left	Thru	Right	NB ON	Left	Thru	Right	Peds	Loop	Thru	Right	Peds	Int. Total
Factor	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	
11:00 AM	0	0	23	0	0	585	6	213	85	8	86	0	156	353	0	0	1515
11:15 AM	0	0	23	0	0	510	5	141	81	3	81	0	140	381	0	0	1365
11:30 AM	0	0	27	0	0	521	5	122	74	6	119	1	156	416	0	0	1447
11:45 AM	0	0	28	0	0	532	4	159	107	4	131	0	134	382	0	0	1481
Total	0	0	101	0	0	2148	20	635	347	21	417	1	586	1532	0	0	5808
12:00 PM	0	0	38	0	0	513	10	141	98	7	80	1	126	396	0	0	1410
12:15 PM	0	0	18	0	0	418	13	97	67	11	95	0	160	350	0	0	1229
12:30 PM	0	0	34	0	0	548	4	115	65	5	99	0	146	393	0	0	1409
12:45 PM	0	0	50	0	0	582	7	200	72	9	133	0	154	423	0	0	1630
Total	0	0	140	0	0	2061	34	553	302	32	407	1	586	1562	0	0	5678
Grand Total	0	0	241	0	0	4209	54	1188	649	53	824	2	1172	3094	0	0	11486
Apprch %	0	0	100	0	0	77.2	1	21.8	42.5	3.5	53.9	0.1	27.5	72.5	0	0	
Total %	0	0	2.1	0	0	36.6	0.5	10.3	5.7	0.5	7.2	0	10.2	26.9	0	0	



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9660 W 44th Ave
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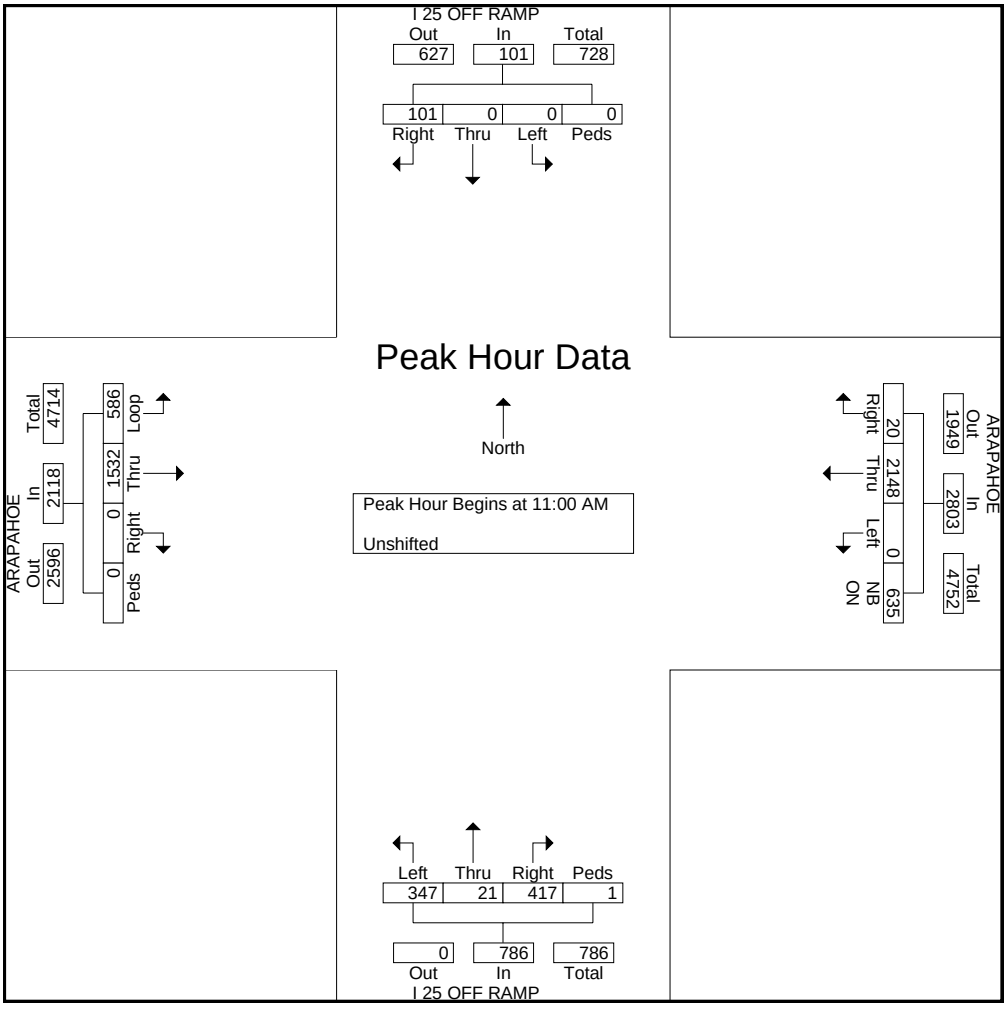
File Name : NBRAMP&ARAPAHOENOON
Site Code : 00000000
Start Date : 1/10/2006
Page No : 2

	I 25 OFF RAMP Southbound					ARAPAHOE Westbound					I 25 OFF RAMP Northbound					ARAPAHOE Eastbound					
Start Time	Left	Thru	Right	Peds	App. Total	Left	Thru	Right	NB ON	App. Total	Left	Thru	Right	Peds	App. Total	Loop	Thru	Right	Peds	App. Total	Int. Total
Peak Hour Analysis From 11:00 AM to 12:45 PM - Peak 1 of 1																					
Peak Hour for Entire Intersection Begins at 11:00 AM																					
11:00 AM	0	0	23	0	23	0	**585**	**6**	**213**	**804**	85	**8**	86	0	179	**156**	353	0	0	509	**1515**
11:15 AM	0	0	23	0	23	0	510	5	141	656	81	3	81	0	165	140	381	0	0	521	1365
11:30 AM	0	0	27	0	27	0	521	5	122	648	74	6	119	**1**	200	156	**416**	0	0	**572**	1447
11:45 AM	0	0	**28**	0	**28**	0	532	4	159	695	**107**	4	**131**	0	**242**	134	382	0	0	516	1481
Total Volume	0	0	101	0	101	0	2148	20	635	2803	347	21	417	1	786	586	1532	0	0	2118	5808
% App. Total	0	0	100	0		0	76.6	0.7	22.7		44.1	2.7	53.1	0.1		27.7	72.3	0	0		
PHF	.000	.000	.902	.000	.902	.000	.918	.833	.745	.872	.811	.656	.796	.250	.812	.939	.921	.000	.000	.926	.958



All Traffic Data Services, Inc
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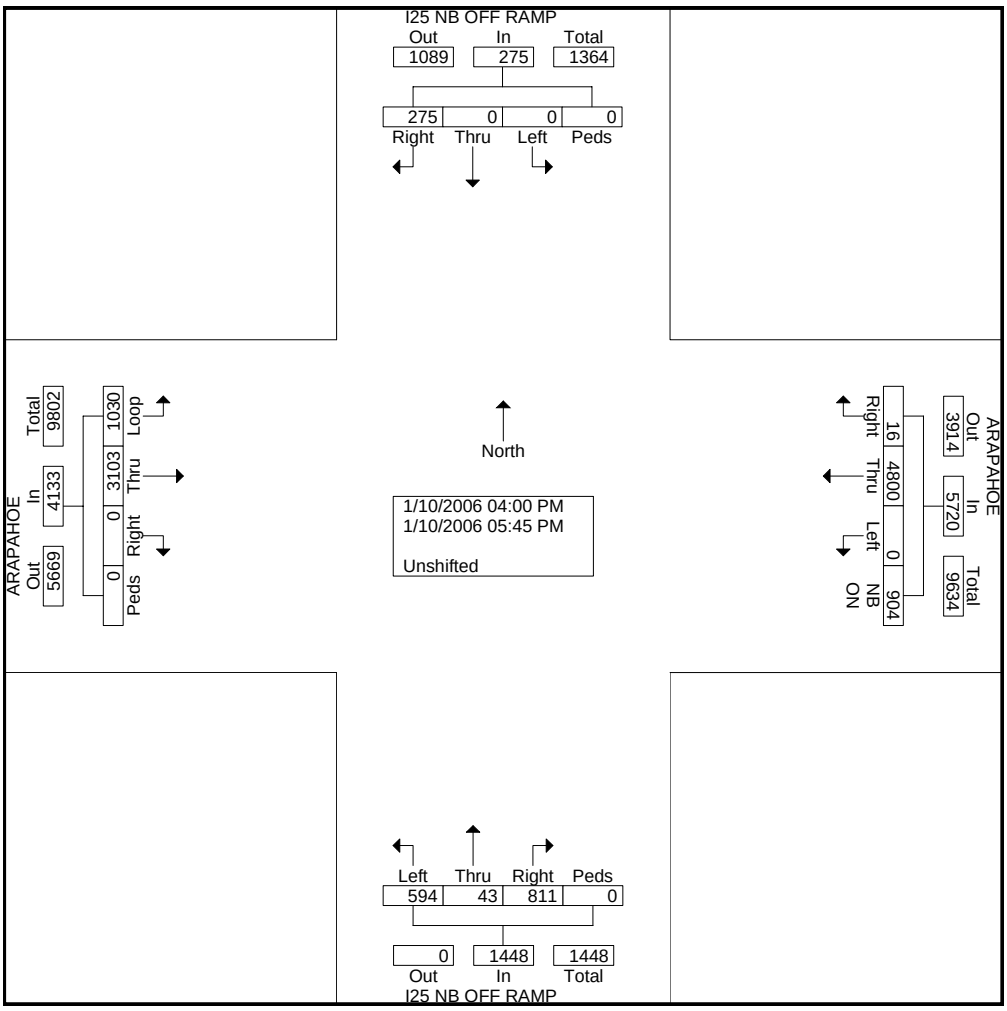
File Name : NBRAMP&ARAPAHOEPM
Site Code : 00000000
Start Date : 1/10/2006
Page No : 1

Groups Printed- Unshifted

	I25 NB OFF RAMP Southbound				ARAPAHOE Westbound				I25 NB OFF RAMP Northbound				ARAPAHOE Eastbound				
Start Time	Left	Thru	Right	Peds	Left	Thru	Right	NB ON	Left	Thru	Right	Peds	Loop	Thru	Right	Peds	Int. Total
Factor	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	
04:00 PM	0	0	40	0	0	612	4	118	66	4	92	0	139	386	0	0	1461
04:15 PM	0	0	21	0	0	580	1	116	83	9	85	0	114	401	0	0	1410
04:30 PM	0	0	31	0	0	624	2	90	68	5	114	0	132	376	0	0	1442
04:45 PM	0	0	33	0	0	660	5	157	78	7	103	0	124	438	0	0	1605
Total	0	0	125	0	0	2476	12	481	295	25	394	0	509	1601	0	0	5918
05:00 PM	0	0	39	0	0	570	1	114	63	4	91	0	171	418	0	0	1471
05:15 PM	0	0	44	0	0	669	0	132	84	7	100	0	143	373	0	0	1552
05:30 PM	0	0	33	0	0	543	0	88	78	4	114	0	125	398	0	0	1383
05:45 PM	0	0	34	0	0	542	3	89	74	3	112	0	82	313	0	0	1252
Total	0	0	150	0	0	2324	4	423	299	18	417	0	521	1502	0	0	5658
Grand Total	0	0	275	0	0	4800	16	904	594	43	811	0	1030	3103	0	0	11576
Apprch %	0	0	100	0	0	83.9	0.3	15.8	41	3	56	0	24.9	75.1	0	0	
Total %	0	0	2.4	0	0	41.5	0.1	7.8	5.1	0.4	7	0	8.9	26.8	0	0	



All Traffic Data Services, Inc
9660 W 44th Ave
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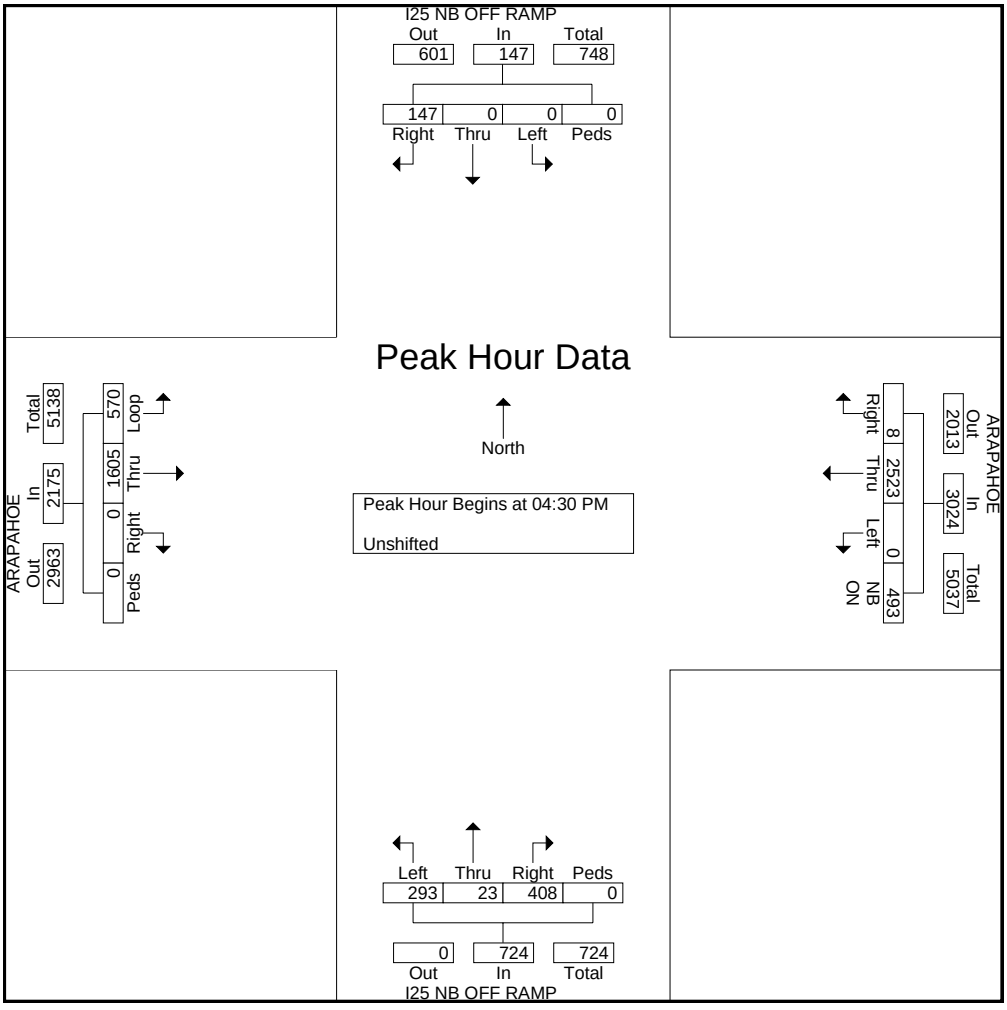
File Name : NBRAMP&ARAPAHOEPM
Site Code : 00000000
Start Date : 1/10/2006
Page No : 2

	I25 NB OFF RAMP Southbound					ARAPAHOE Westbound					I25 NB OFF RAMP Northbound					ARAPAHOE Eastbound					
Start Time	Left	Thru	Right	Peds	App. Total	Left	Thru	Right	NB ON	App. Total	Left	Thru	Right	Peds	App. Total	Loop	Thru	Right	Peds	App. Total	Int. Total
Peak Hour Analysis From 04:00 PM to 05:45 PM - Peak 1 of 1																					
Peak Hour for Entire Intersection Begins at 04:30 PM																					
04:30 PM	0	0	31	0	31	0	624	2	90	716	68	5	**114**	0	187	132	376	0	0	508	1442
04:45 PM	0	0	33	0	33	0	660	**5**	**157**	**822**	78	**7**	103	0	188	124	**438**	0	0	562	**1605**
05:00 PM	0	0	39	0	39	0	570	1	114	685	63	4	91	0	158	**171**	418	0	0	**589**	1471
05:15 PM	0	0	**44**	0	**44**	0	**669**	0	132	801	**84**	7	100	0	**191**	143	373	0	0	516	1552
Total Volume	0	0	147	0	147	0	2523	8	493	3024	293	23	408	0	724	570	1605	0	0	2175	6070
% App. Total	0	0	100	0		0	83.4	0.3	16.3		40.5	3.2	56.4	0		26.2	73.8	0	0		
PHF	.000	.000	.835	.000	.835	.000	.943	.400	.785	.920	.872	.821	.895	.000	.948	.833	.916	.000	.000	.923	.945



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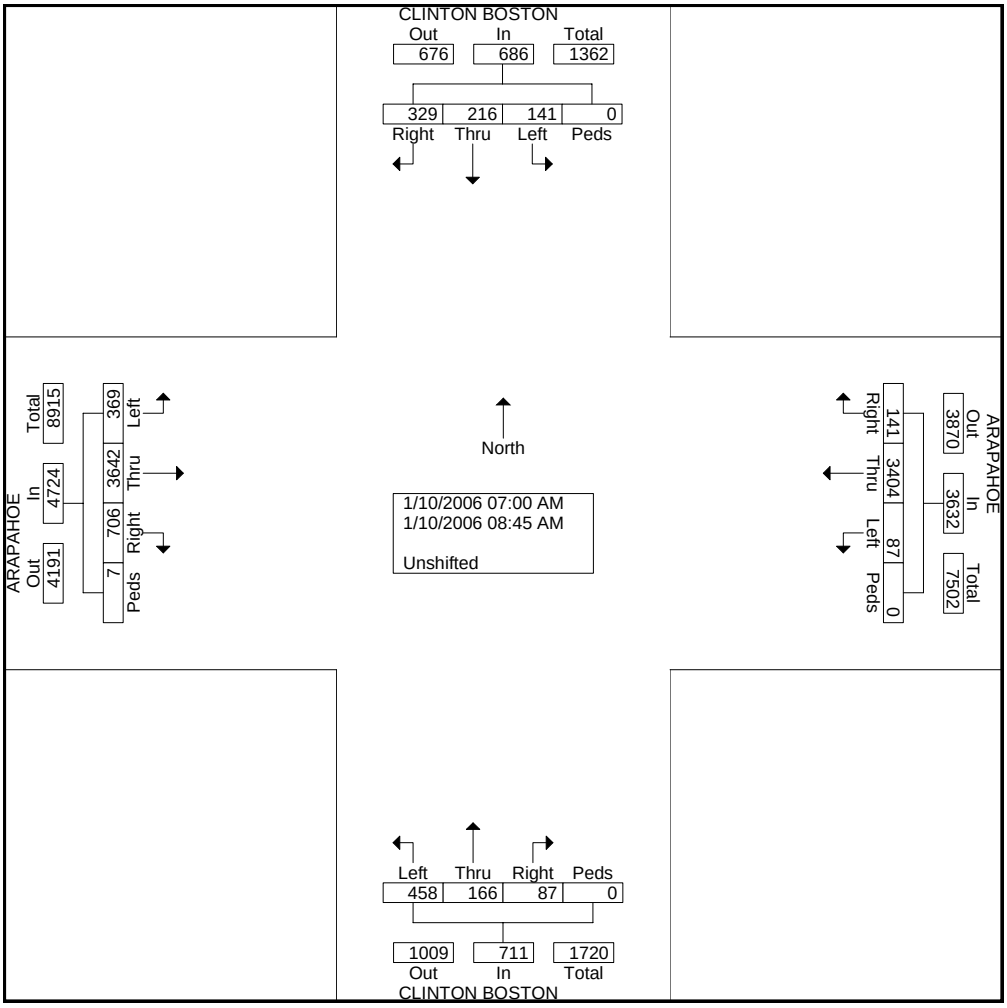
File Name : CLINTON&ARAPAHOEAM
Site Code : 00000000
Start Date : 1/10/2006
Page No : 1

Groups Printed- Unshifted

	CLINTON BOSTON Southbound				ARAPAHOE Westbound				CLINTON BOSTON Northbound				ARAPAHOE Eastbound				
Start Time	Left	Thru	Right	Peds	Left	Thru	Right	Peds	Left	Thru	Right	Peds	Left	Thru	Right	Peds	Int. Total
07:00 AM	7	16	34	0	7	461	10	0	40	7	9	0	24	439	69	0	1123
07:15 AM	14	24	48	0	7	460	17	0	47	20	14	0	21	415	106	7	1200
07:30 AM	18	34	40	0	10	406	27	0	64	24	9	0	41	483	81	0	1237
07:45 AM	20	33	45	0	12	446	20	0	70	24	11	0	53	544	96	0	1374
Total	59	107	167	0	36	1773	74	0	221	75	43	0	139	1881	352	7	4934
08:00 AM	16	26	50	0	11	450	18	0	39	18	10	0	44	479	76	0	1237
08:15 AM	25	32	44	0	9	425	23	0	51	27	10	0	47	438	103	0	1234
08:30 AM	18	25	33	0	16	366	11	0	70	27	11	0	82	458	72	0	1189
08:45 AM	23	26	35	0	15	390	15	0	77	19	13	0	57	386	103	0	1159
Total	82	109	162	0	51	1631	67	0	237	91	44	0	230	1761	354	0	4819
Grand Total	141	216	329	0	87	3404	141	0	458	166	87	0	369	3642	706	7	9753
Apprch %	20.6	31.5	48	0	2.4	93.7	3.9	0	64.4	23.3	12.2	0	7.8	77.1	14.9	0.1	
Total %	1.4	2.2	3.4	0	0.9	34.9	1.4	0	4.7	1.7	0.9	0	3.8	37.3	7.2	0.1	



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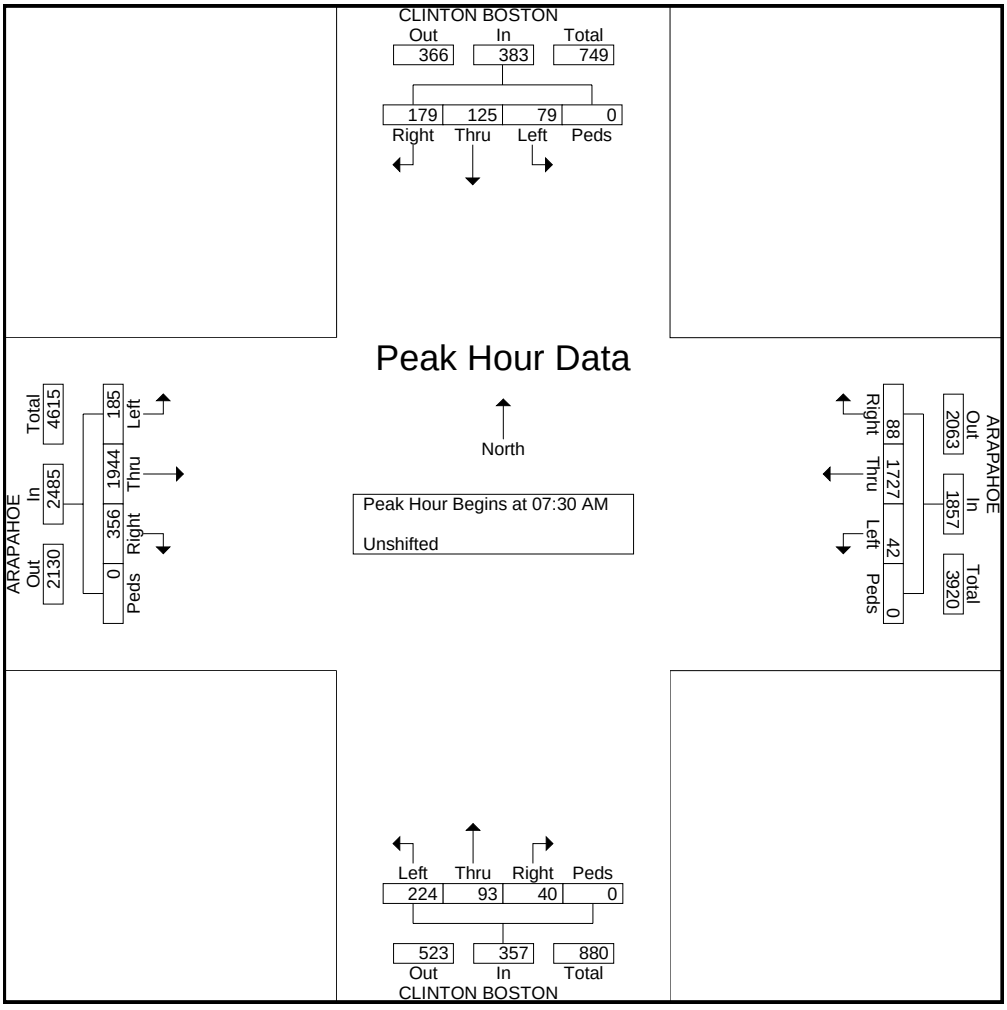
File Name : CLINTON&ARAPAHOEAM
Site Code : 00000000
Start Date : 1/10/2006
Page No : 2

	CLINTON BOSTON Southbound					ARAPAHOE Westbound					CLINTON BOSTON Northbound					ARAPAHOE Eastbound					
Start Time	Left	Thru	Right	Peds	App. Total	Left	Thru	Right	Peds	App. Total	Left	Thru	Right	Peds	App. Total	Left	Thru	Right	Peds	App. Total	Int. Total
Peak Hour Analysis From 07:00 AM to 08:45 AM - Peak 1 of 1																					
Peak Hour for Entire Intersection Begins at 07:30 AM																					
07:30 AM	18	**34**	40	0	92	10	406	**27**	0	443	64	24	9	0	97	41	483	81	0	605	1237
07:45 AM	20	33	45	0	98	**12**	446	20	0	478	**70**	24	**11**	0	**105**	**53**	**544**	96	0	**693**	**1374**
08:00 AM	16	26	**50**	0	92	11	**450**	18	0	**479**	39	18	10	0	67	44	479	76	0	599	1237
08:15 AM	**25**	32	44	0	**101**	9	425	23	0	457	51	**27**	10	0	88	47	438	**103**	0	588	1234
Total Volume	79	125	179	0	383	42	1727	88	0	1857	224	93	40	0	357	185	1944	356	0	2485	5082
% App. Total	20.6	32.6	46.7	0		2.3	93	4.7	0		62.7	26.1	11.2	0		7.4	78.2	14.3	0		
PHF	.790	.919	.895	.000	.948	.875	.959	.815	.000	.969	.800	.861	.909	.000	.850	.873	.893	.864	.000	.896	.925



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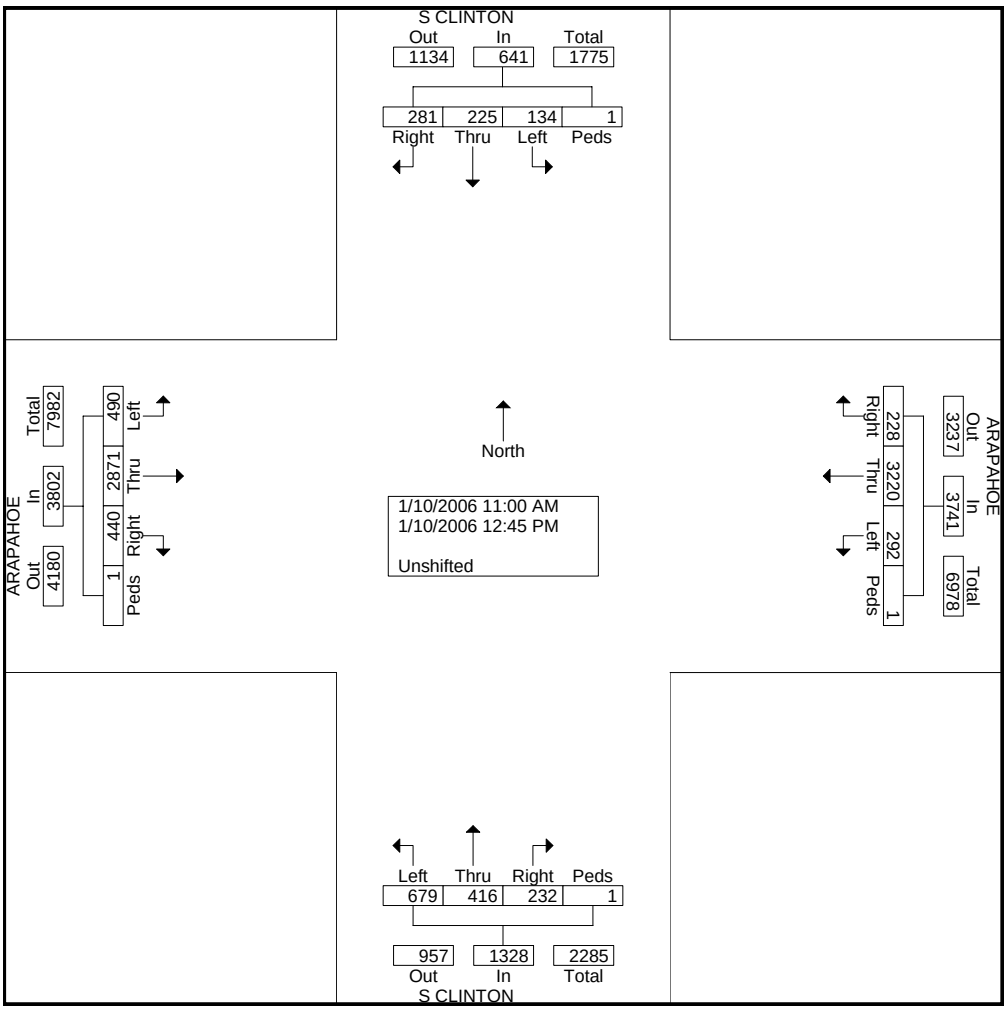
File Name : BOSTON&ARAPAHOENOON
Site Code : 00000000
Start Date : 1/10/2006
Page No : 1

Groups Printed- Unshifted

	S CLINTON Southbound				ARAPAHOE Westbound				S CLINTON Northbound				ARAPAHOE Eastbound				
Start Time	Left	Thru	Right	Peds	Left	Thru	Right	Peds	Left	Thru	Right	Peds	Left	Thru	Right	Peds	Int. Total
Factor	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	
11:00 AM	10	17	22	1	23	400	22	0	66	43	22	1	55	300	38	0	1020
11:15 AM	15	22	38	0	29	427	15	0	82	42	24	0	43	369	43	0	1149
11:30 AM	15	29	33	0	32	399	22	0	63	60	19	0	57	384	55	0	1168
11:45 AM	23	31	32	0	38	387	36	1	104	45	27	0	90	350	52	0	1216
Total	63	99	125	1	122	1613	95	1	315	190	92	1	245	1403	188	0	4553
12:00 PM	21	29	46	0	45	433	42	0	106	52	28	0	106	358	58	0	1324
12:15 PM	22	26	43	0	48	412	41	0	114	63	47	0	43	363	72	0	1294
12:30 PM	14	38	30	0	42	384	29	0	96	67	28	0	51	399	39	0	1217
12:45 PM	14	33	37	0	35	378	21	0	48	44	37	0	45	348	83	1	1124
Total	71	126	156	0	170	1607	133	0	364	226	140	0	245	1468	252	1	4959
Grand Total	134	225	281	1	292	3220	228	1	679	416	232	1	490	2871	440	1	9512
Apprch %	20.9	35.1	43.8	0.2	7.8	86.1	6.1	0	51.1	31.3	17.5	0.1	12.9	75.5	11.6	0	
Total %	1.4	2.4	3	0	3.1	33.9	2.4	0	7.1	4.4	2.4	0	5.2	30.2	4.6	0	



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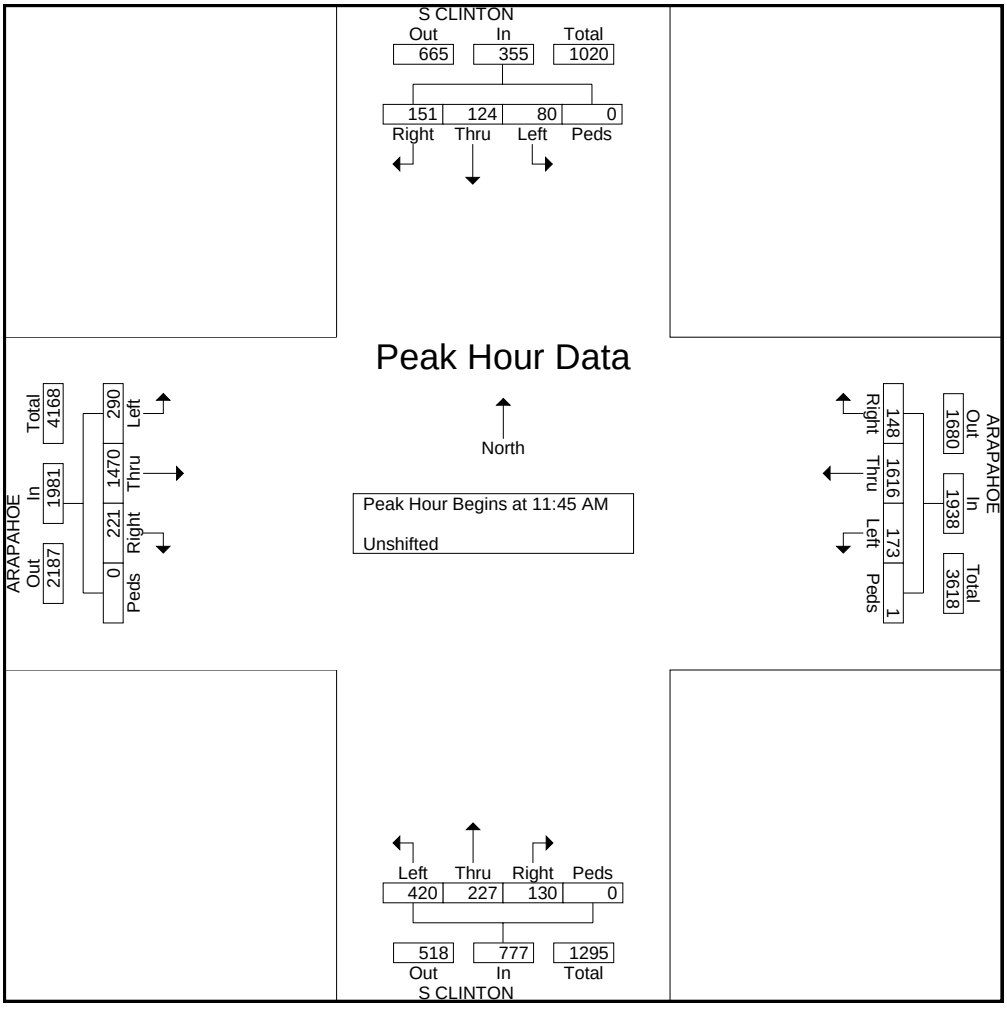
File Name : BOSTON&ARAPAHOENOON
Site Code : 00000000
Start Date : 1/10/2006
Page No : 2

	S CLINTON Southbound					ARAPAHOE Westbound					S CLINTON Northbound					ARAPAHOE Eastbound					
Start Time	Left	Thru	Right	Peds	App. Total	Left	Thru	Right	Peds	App. Total	Left	Thru	Right	Peds	App. Total	Left	Thru	Right	Peds	App. Total	Int. Total
Peak Hour Analysis From 11:00 AM to 12:45 PM - Peak 1 of 1																					
Peak Hour for Entire Intersection Begins at 11:45 AM																					
11:45 AM	**23**	31	32	0	86	38	387	36	**1**	462	104	45	27	0	176	90	350	52	0	492	1216
12:00 PM	21	29	**46**	0	**96**	45	**433**	**42**	0	**520**	106	52	28	0	186	**106**	358	58	0	**522**	**1324**
12:15 PM	22	26	43	0	91	**48**	412	41	0	501	**114**	63	**47**	0	**224**	43	363	**72**	0	478	1294
12:30 PM	14	**38**	30	0	82	42	384	29	0	455	96	**67**	28	0	191	51	**399**	39	0	489	1217
Total Volume	80	124	151	0	355	173	1616	148	1	1938	420	227	130	0	777	290	1470	221	0	1981	5051
% App. Total	22.5	34.9	42.5	0		8.9	83.4	7.6	0.1		54.1	29.2	16.7	0		14.6	74.2	11.2	0		
PHF	.870	.816	.821	.000	.924	.901	.933	.881	.250	.932	.921	.847	.691	.000	.867	.684	.921	.767	.000	.949	.954



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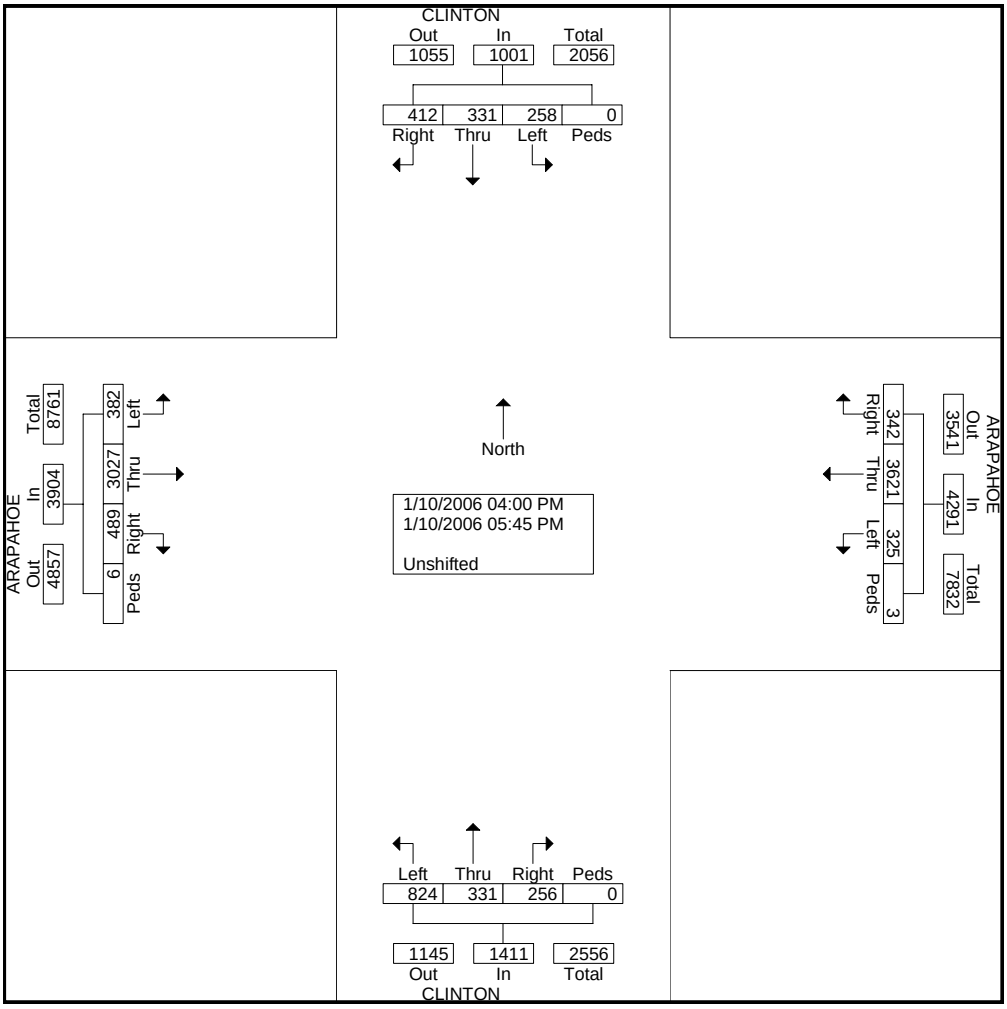
File Name : BOSTON&ARAPAHOEPM
Site Code : 00000000
Start Date : 1/10/2006
Page No : 1

Groups Printed- Unshifted

	CLINTON Southbound				ARAPAHOE Westbound				CLINTON Northbound				ARAPAHOE Eastbound				
Start Time	Left	Thru	Right	Peds	Left	Thru	Right	Peds	Left	Thru	Right	Peds	Left	Thru	Right	Peds	Int. Total
Factor	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	
04:00 PM	27	27	46	0	35	462	48	1	99	23	15	0	49	410	56	0	1298
04:15 PM	34	23	62	0	35	436	33	1	72	45	20	0	47	394	57	0	1259
04:30 PM	26	37	68	0	36	500	36	0	89	40	45	0	49	401	75	0	1402
04:45 PM	32	39	38	0	39	471	37	0	100	33	27	0	50	399	58	6	1329
Total	119	126	214	0	145	1869	154	2	360	141	107	0	195	1604	246	6	5288
05:00 PM	37	43	49	0	43	486	49	0	139	87	40	0	47	412	56	0	1488
05:15 PM	25	45	54	0	49	441	58	1	103	39	30	0	56	372	66	0	1339
05:30 PM	49	69	52	0	60	425	30	0	107	29	34	0	45	318	67	0	1285
05:45 PM	28	48	43	0	28	400	51	0	115	35	45	0	39	321	54	0	1207
Total	139	205	198	0	180	1752	188	1	464	190	149	0	187	1423	243	0	5319
Grand Total	258	331	412	0	325	3621	342	3	824	331	256	0	382	3027	489	6	10607
Apprch %	25.8	33.1	41.2	0	7.6	84.4	8	0.1	58.4	23.5	18.1	0	9.8	77.5	12.5	0.2	
Total %	2.4	3.1	3.9	0	3.1	34.1	3.2	0	7.8	3.1	2.4	0	3.6	28.5	4.6	0.1	



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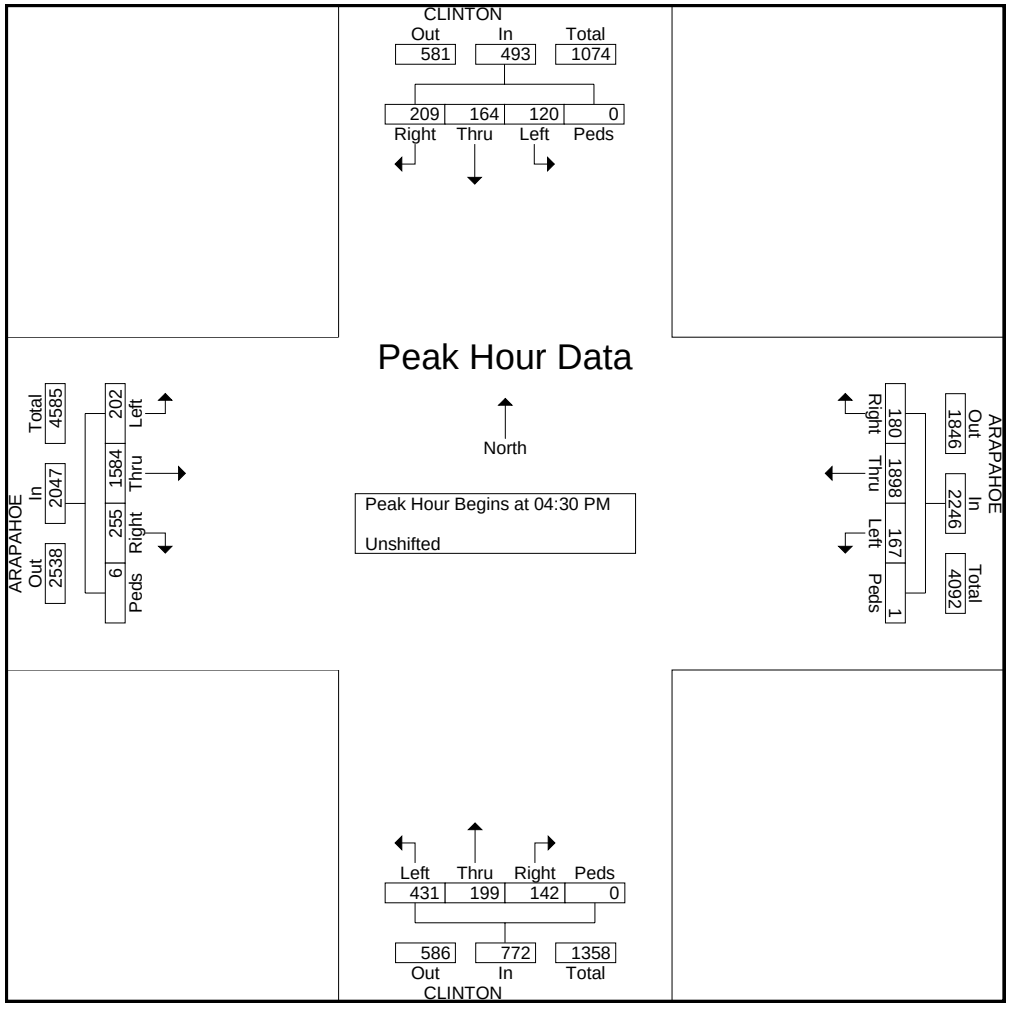
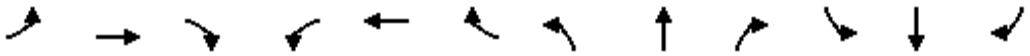
File Name : BOSTON&ARAPAHOEPM
Site Code : 00000000
Start Date : 1/10/2006
Page No : 2

	CLINTON Southbound					ARAPAHOE Westbound					CLINTON Northbound					ARAPAHOE Eastbound					
Start Time	Left	Thru	Right	Peds	App. Total	Left	Thru	Right	Peds	App. Total	Left	Thru	Right	Peds	App. Total	Left	Thru	Right	Peds	App. Total	Int. Total
Peak Hour Analysis From 04:00 PM to 05:45 PM - Peak 1 of 1																					
Peak Hour for Entire Intersection Begins at 04:30 PM																					
04:30 PM	26	37	**68**	0	**131**	36	**500**	36	0	572	89	40	**45**	0	174	49	401	**75**	0	**525**	1402
04:45 PM	32	39	38	0	109	39	471	37	0	547	100	33	27	0	160	50	399	58	**6**	513	1329
05:00 PM	**37**	43	49	0	129	43	486	49	0	**578**	**139**	**87**	40	0	**266**	47	**412**	56	0	515	**1488**
05:15 PM	25	**45**	54	0	124	**49**	441	**58**	**1**	549	103	39	30	0	172	**56**	372	66	0	494	1339
Total Volume	120	164	209	0	493	167	1898	180	1	2246	431	199	142	0	772	202	1584	255	6	2047	5558
% App. Total	24.3	33.3	42.4	0		7.4	84.5	8	0		55.8	25.8	18.4	0		9.9	77.4	12.5	0.3		
PHF	.811	.911	.768	.000	.941	.852	.949	.776	.250	.971	.775	.572	.789	.000	.726	.902	.961	.850	.250	.975	.934



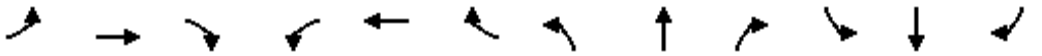
Appendix B

Existing Operational Analysis



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	260	1490	110	300	1840	490	130	490	110	200	365	110
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0	4.0	4.0	4.0		4.0	4.0	4.0	4.0	4.0	
Lane Util. Factor	0.97	0.91	1.00	0.97	0.91		1.00	0.95	1.00	0.97	0.95	
Frt	1.00	1.00	0.85	1.00	0.97		1.00	1.00	0.85	1.00	0.97	
Flt Protected	0.95	1.00	1.00	0.95	1.00		0.95	1.00	1.00	0.95	1.00	
Satd. Flow (prot)	3433	5085	1583	3433	4925		1770	3539	1583	3433	3416	
Flt Permitted	0.95	1.00	1.00	0.95	1.00		0.95	1.00	1.00	0.95	1.00	
Satd. Flow (perm)	3433	5085	1583	3433	4925		1770	3539	1583	3433	3416	
Peak-hour factor, PHF	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
Adj. Flow (vph)	274	1568	116	316	1937	516	137	516	116	211	384	116
RTOR Reduction (vph)	0	0	58	0	39	0	0	0	16	0	24	0
Lane Group Flow (vph)	274	1568	58	316	2414	0	137	516	100	211	476	0
Turn Type	Prot		Perm	Prot			Prot		pm+ov	Prot		
Protected Phases	5	2		1	6		3	8	1	7	4	
Permitted Phases			2						8			
Actuated Green, G (s)	10.9	57.7	57.7	12.0	58.8		9.9	18.0	30.0	10.3	18.4	
Effective Green, g (s)	11.9	59.7	59.7	13.0	60.8		10.9	20.0	32.0	11.3	20.4	
Actuated g/C Ratio	0.10	0.50	0.50	0.11	0.51		0.09	0.17	0.27	0.09	0.17	
Clearance Time (s)	5.0	6.0	6.0	5.0	6.0		5.0	6.0	5.0	5.0	6.0	
Vehicle Extension (s)	2.0	3.0	3.0	2.0	3.0		2.0	2.0	2.0	2.0	2.0	
Lane Grp Cap (vph)	340	2530	788	372	2495		161	590	422	323	581	
v/s Ratio Prot	0.08	0.31		c0.09	c0.49		c0.08	c0.15	0.03	0.06	0.14	
v/s Ratio Perm			0.04						0.04			
v/c Ratio	0.81	0.62	0.07	0.85	0.97		0.85	0.87	0.24	0.65	0.82	
Uniform Delay, d1	52.9	21.9	15.7	52.5	28.6		53.7	48.8	34.4	52.5	48.0	
Progression Factor	1.00	1.00	1.00	1.33	0.70		1.00	1.00	1.00	1.00	1.00	
Incremental Delay, d2	12.3	1.2	0.2	1.7	1.7		31.7	13.2	0.1	3.6	8.4	
Delay (s)	65.2	23.1	15.9	71.6	21.8		85.4	62.0	34.5	56.1	56.4	
Level of Service	E	C	B	E	C		F	E	C	E	E	
Approach Delay (s)		28.5			27.5			62.0			56.3	
Approach LOS		C			C			E			E	

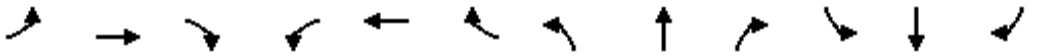
Intersection Summary			
HCM Average Control Delay	35.4	HCM Level of Service	D
HCM Volume to Capacity ratio	0.89		
Actuated Cycle Length (s)	120.0	Sum of lost time (s)	12.0
Intersection Capacity Utilization	88.0%	ICU Level of Service	E
Analysis Period (min)	15		
c Critical Lane Group			



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	0	720	1080	0	2000	0	0	0	0	1210	0	630
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1700	1900	1900
Total Lost time (s)		4.0	6.0		4.0					4.0		4.0
Lane Util. Factor		0.95	0.88		0.95					0.97		0.88
Frt		1.00	0.85		1.00					1.00		0.85
Flt Protected		1.00	1.00		1.00					0.95		1.00
Satd. Flow (prot)		3539	2787		3539					3072		2842
Flt Permitted		1.00	1.00		1.00					0.95		1.00
Satd. Flow (perm)		3539	2787		3539					3072		2842
Peak-hour factor, PHF	0.94	0.94	0.92	0.92	0.94	0.94	0.92	0.92	0.92	0.94	0.92	0.94
Adj. Flow (vph)	0	766	1174	0	2128	0	0	0	0	1287	0	670
RTOR Reduction (vph)	0	0	618	0	0	0	0	0	0	0	0	2
Lane Group Flow (vph)	0	766	556	0	2128	0	0	0	0	1287	0	668
Heavy Vehicles (%)	2%	2%	2%	2%	2%	2%	2%	2%	2%	2%	2%	0%
Turn Type			Perm							Prot		custom
Protected Phases		2			6					4		
Permitted Phases			2									4
Actuated Green, G (s)		56.8	56.8		56.8					52.2		52.2
Effective Green, g (s)		58.8	56.8		58.8					53.2		53.2
Actuated g/C Ratio		0.49	0.47		0.49					0.44		0.44
Clearance Time (s)		6.0	6.0		6.0					5.0		5.0
Vehicle Extension (s)		5.0	5.0		5.0					1.5		1.5
Lane Grp Cap (vph)		1734	1319		1734					1362		1260
v/s Ratio Prot		0.22			c0.60					c0.42		
v/s Ratio Perm			0.20									0.23
v/c Ratio		0.44	0.42		1.23					0.94		0.53
Uniform Delay, d1		19.9	20.8		30.6					32.0		24.3
Progression Factor		0.83	2.42		0.79					1.00		1.00
Incremental Delay, d2		0.7	0.8		105.7					13.2		0.2
Delay (s)		17.2	51.1		129.8					45.2		24.5
Level of Service		B	D		F					D		C
Approach Delay (s)		37.7			129.8			0.0			38.1	
Approach LOS		D			F			A			D	

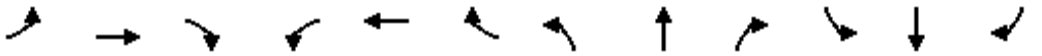
Intersection Summary			
HCM Average Control Delay	70.4	HCM Level of Service	E
HCM Volume to Capacity ratio	1.09		
Actuated Cycle Length (s)	120.0	Sum of lost time (s)	8.0
Intersection Capacity Utilization	100.5%	ICU Level of Service	G
Analysis Period (min)	15		

c Critical Lane Group



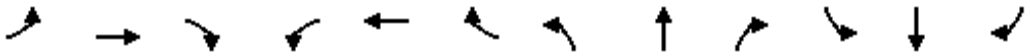
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	0	1930	0	0	3030	40	400	60	620	0	0	90
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)		4.0			4.0		4.0	4.0	5.0			4.0
Lane Util. Factor		0.95			*0.75		0.97	0.95	0.95			0.88
Frt		1.00			1.00		1.00	0.88	0.85			0.85
Flt Protected		1.00			1.00		0.95	1.00	1.00			1.00
Satd. Flow (prot)		3539			5577		3433	1550	1504			2787
Flt Permitted		1.00			1.00		0.95	1.00	1.00			1.00
Satd. Flow (perm)		3539			5577		3433	1550	1504			2787
Peak-hour factor, PHF	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96
Adj. Flow (vph)	0	2010	0	0	3156	42	417	62	646	0	0	94
RTOR Reduction (vph)	0	0	0	0	1	0	0	90	91	0	0	9
Lane Group Flow (vph)	0	2010	0	0	3197	0	417	269	258	0	0	85
Turn Type							Split		Perm			custom
Protected Phases		2			6		8	8				
Permitted Phases									8			4
Actuated Green, G (s)		80.6			80.6		17.0	17.0	17.0			6.4
Effective Green, g (s)		82.6			82.6		18.0	18.0	17.0			7.4
Actuated g/C Ratio		0.69			0.69		0.15	0.15	0.14			0.06
Clearance Time (s)		6.0			6.0		5.0	5.0	5.0			5.0
Vehicle Extension (s)		5.0			5.0		1.5	1.5	1.5			1.5
Lane Grp Cap (vph)		2436			3839		515	233	213			172
v/s Ratio Prot		0.57			c0.57		0.12	c0.17				
v/s Ratio Perm									0.17			c0.03
v/c Ratio		0.83			0.83		0.81	1.15	1.21			0.49
Uniform Delay, d1		13.5			13.7		49.3	51.0	51.5			54.5
Progression Factor		0.80			0.25		1.00	1.00	1.00			1.00
Incremental Delay, d2		2.2			0.2		8.6	106.9	130.4			0.8
Delay (s)		13.0			3.7		58.0	157.9	181.9			55.3
Level of Service		B			A		E	F	F			E
Approach Delay (s)		13.0			3.7			128.3			55.3	
Approach LOS		B			A			F			E	

Intersection Summary			
HCM Average Control Delay	29.2	HCM Level of Service	C
HCM Volume to Capacity ratio	0.86		
Actuated Cycle Length (s)	120.0	Sum of lost time (s)	12.0
Intersection Capacity Utilization	86.4%	ICU Level of Service	E
Analysis Period (min)	15		
c Critical Lane Group			



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	180	2020	350	250	2670	180	220	75	130	130	125	180
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0	3.0	4.0	4.0	4.0	4.0	4.0		4.0	4.0	4.0
Lane Util. Factor	0.97	0.91	1.00	0.97	*0.50	1.00	0.97	0.95		0.97	0.95	1.00
Frt	1.00	1.00	0.85	1.00	1.00	0.85	1.00	0.91		1.00	1.00	0.85
Flt Protected	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00		0.95	1.00	1.00
Satd. Flow (prot)	3433	5085	1583	3433	3725	1583	3433	3203		3433	3539	1583
Flt Permitted	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00		0.95	1.00	1.00
Satd. Flow (perm)	3433	5085	1583	3433	3725	1583	3433	3203		3433	3539	1583
Peak-hour factor, PHF	0.94	0.94	0.94	0.94	0.94	0.94	0.94	0.94	0.94	0.94	0.94	0.94
Adj. Flow (vph)	191	2149	372	266	2840	191	234	80	138	138	133	191
RTOR Reduction (vph)	0	0	27	0	0	40	0	129	0	0	0	115
Lane Group Flow (vph)	191	2149	345	266	2840	151	234	89	0	138	133	76
Turn Type	Prot		pm+ov	Prot		Perm	Prot			Prot		Perm
Protected Phases	5	2	3	1	6		3	8		7	4	
Permitted Phases			2			6						4
Actuated Green, G (s)	8.6	69.7	81.4	9.0	70.1	70.1	11.7	7.0		13.3	8.6	8.6
Effective Green, g (s)	9.6	71.7	85.4	10.0	72.1	72.1	12.7	8.0		14.3	9.6	9.6
Actuated g/C Ratio	0.08	0.60	0.71	0.08	0.60	0.60	0.11	0.07		0.12	0.08	0.08
Clearance Time (s)	5.0	6.0	5.0	5.0	6.0	6.0	5.0	5.0		5.0	5.0	5.0
Vehicle Extension (s)	1.5	5.0	1.5	1.5	5.0	5.0	1.5	1.5		1.5	1.5	1.5
Lane Grp Cap (vph)	275	3038	1127	286	2238	951	363	214		409	283	127
v/s Ratio Prot	0.06	0.42	0.04	c0.08	c0.76		c0.07	0.03		0.04	0.04	
v/s Ratio Perm			0.18			0.10						c0.05
v/c Ratio	0.69	0.71	0.31	0.93	1.27	0.16	0.64	0.42		0.34	0.47	0.60
Uniform Delay, d1	53.8	16.8	6.4	54.7	24.0	10.6	51.5	53.8		48.5	52.8	53.3
Progression Factor	1.13	0.52	0.81	1.00	1.00	1.00	1.00	1.00		1.00	1.00	1.00
Incremental Delay, d2	2.9	0.7	0.0	34.8	124.7	0.4	2.9	0.5		0.2	0.5	5.0
Delay (s)	63.5	9.4	5.2	89.4	148.7	10.9	54.4	54.2		48.7	53.2	58.3
Level of Service	E	A	A	F	F	B	D	D		D	D	E
Approach Delay (s)		12.7			135.9			54.3			54.0	
Approach LOS		B			F			D			D	

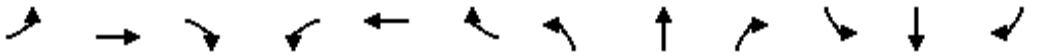
Intersection Summary			
HCM Average Control Delay	76.8	HCM Level of Service	E
HCM Volume to Capacity ratio	1.06		
Actuated Cycle Length (s)	120.0	Sum of lost time (s)	12.0
Intersection Capacity Utilization	69.5%	ICU Level of Service	C
Analysis Period (min)	15		
c Critical Lane Group			



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	260	1490	110	350	1700	350	260	590	320	460	550	120
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0	4.0	4.0	4.0		4.0	4.0	4.0	4.0	4.0	
Lane Util. Factor	0.97	0.91	1.00	0.97	0.91		1.00	0.95	1.00	0.97	0.95	
Frpb, ped/bikes	1.00	1.00	0.99	1.00	1.00		1.00	1.00	1.00	1.00	1.00	
Flpb, ped/bikes	1.00	1.00	1.00	1.00	1.00		1.00	1.00	1.00	1.00	1.00	
Frt	1.00	1.00	0.85	1.00	0.97		1.00	1.00	0.85	1.00	0.97	
Flt Protected	0.95	1.00	1.00	0.95	1.00		0.95	1.00	1.00	0.95	1.00	
Satd. Flow (prot)	3433	5085	1562	3433	4955		1770	3539	1583	3433	3444	
Flt Permitted	0.95	1.00	1.00	0.95	1.00		0.95	1.00	1.00	0.95	1.00	
Satd. Flow (perm)	3433	5085	1562	3433	4955		1770	3539	1583	3433	3444	
Peak-hour factor, PHF	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97
Adj. Flow (vph)	268	1536	113	361	1753	361	268	608	330	474	567	124
RTOR Reduction (vph)	0	0	58	0	26	0	0	0	4	0	16	0
Lane Group Flow (vph)	268	1536	55	361	2088	0	268	608	326	474	675	0
Confl. Peds. (#/hr)	1		1									
Turn Type	Prot		Perm	Prot			Prot		pm+ov	Prot		
Protected Phases	5	2		1	6		3	8	1	7	4	
Permitted Phases			2						8			
Actuated Green, G (s)	9.0	42.2	42.2	15.1	48.3		17.0	23.7	38.8	17.0	23.7	
Effective Green, g (s)	10.0	44.2	44.2	16.1	50.3		18.0	25.7	40.8	18.0	25.7	
Actuated g/C Ratio	0.08	0.37	0.37	0.13	0.42		0.15	0.21	0.34	0.15	0.21	
Clearance Time (s)	5.0	6.0	6.0	5.0	6.0		5.0	6.0	5.0	5.0	6.0	
Vehicle Extension (s)	2.0	3.0	3.0	2.0	3.0		2.0	2.0	2.0	2.0	2.0	
Lane Grp Cap (vph)	286	1873	575	461	2077		266	758	538	515	738	
v/s Ratio Prot	c0.08	0.30		0.11	c0.42		c0.15	0.17	0.08	0.14	c0.20	
v/s Ratio Perm			0.04						0.12			
v/c Ratio	0.94	0.82	0.10	0.78	1.01		1.01	0.80	0.61	0.92	0.92	
Uniform Delay, d1	54.7	34.3	24.8	50.3	34.8		51.0	44.7	32.9	50.3	46.1	
Progression Factor	1.00	1.00	1.00	1.33	0.86		1.00	1.00	1.00	1.00	1.00	
Incremental Delay, d2	36.0	4.2	0.3	3.2	15.5		57.1	5.8	1.3	21.6	15.6	
Delay (s)	90.7	38.5	25.1	70.1	45.3		108.1	50.5	34.2	71.9	61.7	
Level of Service	F	D	C	E	D		F	D	C	E	E	
Approach Delay (s)		45.0			48.9			58.9			65.8	
Approach LOS		D			D			E			E	

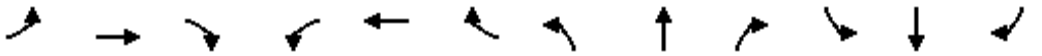
Intersection Summary			
HCM Average Control Delay	52.5	HCM Level of Service	D
HCM Volume to Capacity ratio	0.98		
Actuated Cycle Length (s)	120.0	Sum of lost time (s)	16.0
Intersection Capacity Utilization	94.8%	ICU Level of Service	F
Analysis Period (min)	15		

c Critical Lane Group



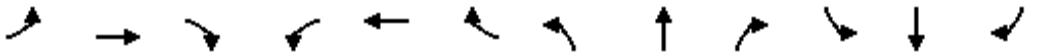
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	0	1170	1100	0	1780	0	0	0	0	950	0	620
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1700	1900	1900
Total Lost time (s)		4.0	6.0		4.0					4.0		4.0
Lane Util. Factor		0.95	0.88		0.95					0.97		0.88
Frt		1.00	0.85		1.00					1.00		0.85
Flt Protected		1.00	1.00		1.00					0.95		1.00
Satd. Flow (prot)		3539	2787		3539					3072		2787
Flt Permitted		1.00	1.00		1.00					0.95		1.00
Satd. Flow (perm)		3539	2787		3539					3072		2787
Peak-hour factor, PHF	0.94	0.94	0.92	0.92	0.94	0.94	0.92	0.92	0.92	0.94	0.92	0.94
Adj. Flow (vph)	0	1245	1196	0	1894	0	0	0	0	1011	0	660
RTOR Reduction (vph)	0	0	519	0	0	0	0	0	0	0	0	14
Lane Group Flow (vph)	0	1245	677	0	1894	0	0	0	0	1011	0	646
Turn Type			Perm							Prot		custom
Protected Phases		2			6					4		
Permitted Phases			2									4
Actuated Green, G (s)		67.9	67.9		67.9					41.1		41.1
Effective Green, g (s)		69.9	67.9		69.9					42.1		42.1
Actuated g/C Ratio		0.58	0.57		0.58					0.35		0.35
Clearance Time (s)		6.0	6.0		6.0					5.0		5.0
Vehicle Extension (s)		5.0	5.0		5.0					1.5		1.5
Lane Grp Cap (vph)		2061	1577		2061					1078		978
v/s Ratio Prot		0.35			c0.54					c0.33		
v/s Ratio Perm			0.24									0.23
v/c Ratio		0.60	0.43		0.92					0.94		0.66
Uniform Delay, d1		16.1	14.9		22.5					37.7		32.9
Progression Factor		1.28	4.77		0.76					1.00		1.00
Incremental Delay, d2		0.8	0.6		6.0					14.5		1.3
Delay (s)		21.4	71.9		23.0					52.2		34.2
Level of Service		C	E		C					D		C
Approach Delay (s)		46.1			23.0			0.0			45.1	
Approach LOS		D			C			A			D	

Intersection Summary			
HCM Average Control Delay	38.6	HCM Level of Service	D
HCM Volume to Capacity ratio	0.93		
Actuated Cycle Length (s)	120.0	Sum of lost time (s)	8.0
Intersection Capacity Utilization	86.2%	ICU Level of Service	E
Analysis Period (min)	15		
c Critical Lane Group			



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	0	2120	0	0	2660	40	320	25	410	0	0	130
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)		4.0			4.0		4.0	4.0	5.0			4.0
Lane Util. Factor		0.95			*0.75		0.97	0.95	0.95			0.88
Frt		1.00			1.00		1.00	0.87	0.85			0.85
Flt Protected		1.00			1.00		0.95	1.00	1.00			1.00
Satd. Flow (prot)		3539			5576		3433	1534	1504			2787
Flt Permitted		1.00			1.00		0.95	1.00	1.00			1.00
Satd. Flow (perm)		3539			5576		3433	1534	1504			2787
Peak-hour factor, PHF	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
Adj. Flow (vph)	0	2232	0	0	2800	42	337	26	432	0	0	137
RTOR Reduction (vph)	0	0	0	0	1	0	0	86	87	0	0	28
Lane Group Flow (vph)	0	2232	0	0	2841	0	337	143	142	0	0	109
Turn Type							Perm		Perm			custom
Protected Phases		2			6			8				
Permitted Phases							8		8			4
Actuated Green, G (s)		81.3			81.3		15.7	15.7	15.7			7.0
Effective Green, g (s)		83.3			83.3		16.7	16.7	15.7			8.0
Actuated g/C Ratio		0.69			0.69		0.14	0.14	0.13			0.07
Clearance Time (s)		6.0			6.0		5.0	5.0	5.0			5.0
Vehicle Extension (s)		5.0			5.0		1.5	1.5	1.5			1.5
Lane Grp Cap (vph)		2457			3871		478	213	197			186
v/s Ratio Prot		c0.63			0.51			0.09				
v/s Ratio Perm							c0.10		0.09			c0.04
v/c Ratio		0.91			0.73		0.71	0.67	0.72			0.59
Uniform Delay, d1		15.2			11.4		49.3	49.0	50.0			54.4
Progression Factor		0.88			0.83		1.00	1.00	1.00			1.00
Incremental Delay, d2		4.3			0.1		3.8	6.4	10.5			3.0
Delay (s)		17.6			9.6		53.1	55.4	60.5			57.4
Level of Service		B			A		D	E	E			E
Approach Delay (s)		17.6			9.6			55.9			57.4	
Approach LOS		B			A			E			E	

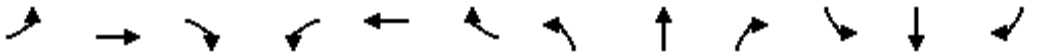
Intersection Summary			
HCM Average Control Delay	19.8	HCM Level of Service	B
HCM Volume to Capacity ratio	0.85		
Actuated Cycle Length (s)	120.0	Sum of lost time (s)	12.0
Intersection Capacity Utilization	83.0%	ICU Level of Service	E
Analysis Period (min)	15		
c Critical Lane Group			



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	200	2075	255	170	2000	180	430	200	140	120	160	270
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0	3.0	4.0	4.0	4.0	4.0	4.0		4.0	4.0	4.0
Lane Util. Factor	0.97	0.91	1.00	0.97	*0.50	1.00	0.97	0.95		0.97	0.95	1.00
Frpb, ped/bikes	1.00	1.00	0.99	1.00	1.00	1.00	1.00	1.00		1.00	1.00	1.00
Flpb, ped/bikes	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00		1.00	1.00	1.00
Frt	1.00	1.00	0.85	1.00	1.00	0.85	1.00	0.94		1.00	1.00	0.85
Flt Protected	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00		0.95	1.00	1.00
Satd. Flow (prot)	3433	5085	1565	3433	3725	1583	3433	3321		3433	3539	1583
Flt Permitted	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00		0.95	1.00	1.00
Satd. Flow (perm)	3433	5085	1565	3433	3725	1583	3433	3321		3433	3539	1583
Peak-hour factor, PHF	0.94	0.94	0.94	0.94	0.94	0.94	0.94	0.94	0.94	0.94	0.94	0.94
Adj. Flow (vph)	213	2207	271	181	2128	191	457	213	149	128	170	287
RTOR Reduction (vph)	0	0	51	0	0	53	0	109	0	0	0	131
Lane Group Flow (vph)	213	2207	220	181	2128	138	457	253	0	128	170	156
Confl. Peds. (#/hr)	3		3									
Turn Type	Prot		pm+ov	Prot		Perm	Prot			Prot		Perm
Protected Phases	5	2	3	1	6		3	8		7	4	
Permitted Phases			2			6						4
Actuated Green, G (s)	11.0	58.7	76.7	9.2	56.9	56.9	18.0	23.0		8.1	13.1	13.1
Effective Green, g (s)	12.0	60.7	80.7	10.2	58.9	58.9	19.0	24.0		9.1	14.1	14.1
Actuated g/C Ratio	0.10	0.51	0.67	0.08	0.49	0.49	0.16	0.20		0.08	0.12	0.12
Clearance Time (s)	5.0	6.0	5.0	5.0	6.0	6.0	5.0	5.0		5.0	5.0	5.0
Vehicle Extension (s)	1.5	5.0	1.5	1.5	5.0	5.0	1.5	1.5		1.5	1.5	1.5
Lane Grp Cap (vph)	343	2572	1052	292	1828	777	544	664		260	416	186
v/s Ratio Prot	c0.06	0.43	0.03	0.05	c0.57		c0.13	0.08		0.04	0.05	
v/s Ratio Perm			0.11			0.09						c0.10
v/c Ratio	0.62	0.86	0.21	0.62	1.16	0.18	0.84	0.38		0.49	0.41	0.84
Uniform Delay, d1	51.8	25.9	7.5	53.0	30.6	17.0	49.0	41.6		53.2	49.1	51.8
Progression Factor	1.21	0.56	0.49	1.00	1.00	1.00	1.00	1.00		1.00	1.00	1.00
Incremental Delay, d2	1.2	1.9	0.0	2.8	80.3	0.5	10.8	0.1		0.5	0.2	25.5
Delay (s)	63.7	16.5	3.7	55.8	110.8	17.5	59.8	41.7		53.8	49.3	77.3
Level of Service	E	B	A	E	F	B	E	D		D	D	E
Approach Delay (s)		18.9			99.7			51.8			64.0	
Approach LOS		B			F			D			E	

Intersection Summary			
HCM Average Control Delay	57.6	HCM Level of Service	E
HCM Volume to Capacity ratio	1.00		
Actuated Cycle Length (s)	120.0	Sum of lost time (s)	16.0
Intersection Capacity Utilization	77.4%	ICU Level of Service	D
Analysis Period (min)	15		

c Critical Lane Group



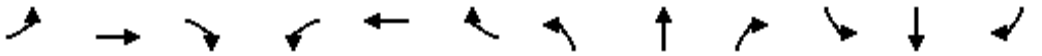
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	260	1490	110	300	1840	490	130	490	110	200	365	110
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0	4.0	4.0	4.0	6.0	4.0	4.0	4.0	4.0	4.0	
Lane Util. Factor	0.97	0.91	1.00	0.97	0.91	1.00	1.00	0.95	1.00	0.97	0.95	
Frt	1.00	1.00	0.85	1.00	1.00	0.85	1.00	1.00	0.85	1.00	0.97	
Flt Protected	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	
Satd. Flow (prot)	3433	5085	1583	3433	5085	1583	1770	3539	1583	3433	3416	
Flt Permitted	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	
Satd. Flow (perm)	3433	5085	1583	3433	5085	1583	1770	3539	1583	3433	3416	
Peak-hour factor, PHF	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
Adj. Flow (vph)	274	1568	116	316	1937	516	137	516	116	211	384	116
RTOR Reduction (vph)	0	0	58	0	0	150	0	0	16	0	24	0
Lane Group Flow (vph)	274	1568	58	316	1937	366	137	516	100	211	476	0
Turn Type	Prot		Perm	Prot		Perm	Prot		pm+ov	Prot		
Protected Phases	5	2		1	6		3	8	1	7	4	
Permitted Phases			2			6			8			
Actuated Green, G (s)	10.9	57.7	57.7	12.0	58.8	58.8	9.9	18.0	30.0	10.3	18.4	
Effective Green, g (s)	11.9	59.7	59.7	13.0	60.8	58.8	10.9	20.0	32.0	11.3	20.4	
Actuated g/C Ratio	0.10	0.50	0.50	0.11	0.51	0.49	0.09	0.17	0.27	0.09	0.17	
Clearance Time (s)	5.0	6.0	6.0	5.0	6.0	6.0	5.0	6.0	5.0	5.0	6.0	
Vehicle Extension (s)	2.0	3.0	3.0	2.0	3.0	3.0	2.0	2.0	2.0	2.0	2.0	
Lane Grp Cap (vph)	340	2530	788	372	2576	776	161	590	422	323	581	
v/s Ratio Prot	0.08	0.31		c0.09	c0.38		c0.08	c0.15	0.03	0.06	0.14	
v/s Ratio Perm			0.04			0.23			0.04			
v/c Ratio	0.81	0.62	0.07	0.85	0.75	0.47	0.85	0.87	0.24	0.65	0.82	
Uniform Delay, d1	52.9	21.9	15.7	52.5	23.6	20.3	53.7	48.8	34.4	52.5	48.0	
Progression Factor	1.00	1.00	1.00	1.43	0.64	0.44	1.00	1.00	1.00	1.00	1.00	
Incremental Delay, d2	12.3	1.2	0.2	9.2	1.3	1.3	31.7	13.2	0.1	3.6	8.4	
Delay (s)	65.2	23.1	15.9	84.5	16.5	10.3	85.4	62.0	34.5	56.1	56.4	
Level of Service	E	C	B	F	B	B	F	E	C	E	E	
Approach Delay (s)		28.5			23.1			62.0			56.3	
Approach LOS		C			C			E			E	

Intersection Summary			
HCM Average Control Delay	33.4	HCM Level of Service	C
HCM Volume to Capacity ratio	0.77		
Actuated Cycle Length (s)	120.0	Sum of lost time (s)	12.0
Intersection Capacity Utilization	77.1%	ICU Level of Service	D
Analysis Period (min)	15		
c Critical Lane Group			

Movement	EBL	EBT	EBR	WBL	WBT	WBR	SBL2	SBL	SBR	NWL	NWR
Lane Configurations											
Volume (vph)	0	720	1080	0	2000	520	1210	0	630	0	0
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1700	1900	1900	1900	1900
Total Lost time (s)		4.0	4.0		4.0	6.0	4.0		4.0		
Lane Util. Factor		0.86	0.86		0.91	1.00	0.97		0.88		
Frt		0.93	0.85		1.00	0.85	1.00		0.85		
Flt Protected		1.00	1.00		1.00	1.00	0.95		1.00		
Satd. Flow (prot)		4493	1362		5085	1583	3072		2842		
Flt Permitted		1.00	1.00		1.00	1.00	0.95		1.00		
Satd. Flow (perm)		4493	1362		5085	1583	3072		2842		
Peak-hour factor, PHF	0.94	0.94	0.92	0.92	0.94	0.94	0.94	0.92	0.94	0.92	0.92
Adj. Flow (vph)	0	766	1174	0	2128	553	1287	0	670	0	0
RTOR Reduction (vph)	0	115	0	0	0	281	0	0	3	0	0
Lane Group Flow (vph)	0	1238	587	0	2128	272	1287	0	667	0	0
Heavy Vehicles (%)	2%	2%	2%	2%	2%	2%	2%	2%	0%	2%	2%
Turn Type			Free			Perm	Prot		custom		
Protected Phases		2			6		4				
Permitted Phases			Free			6			4		
Actuated Green, G (s)		59.0	120.0		59.0	59.0	50.0		50.0		
Effective Green, g (s)		61.0	120.0		61.0	59.0	51.0		51.0		
Actuated g/C Ratio		0.51	1.00		0.51	0.49	0.42		0.42		
Clearance Time (s)		6.0			6.0	6.0	5.0		5.0		
Vehicle Extension (s)		5.0			5.0	5.0	1.5		1.5		
Lane Grp Cap (vph)		2284	1362		2585	778	1306		1208		
v/s Ratio Prot		0.28			c0.42		c0.42				
v/s Ratio Perm			0.43			0.17			0.23		
v/c Ratio		0.54	0.43		0.82	0.35	0.99		0.55		
Uniform Delay, d1		20.0	0.0		24.9	18.7	34.1		25.9		
Progression Factor		0.56	1.00		0.65	0.47	1.00		1.00		
Incremental Delay, d2		0.8	0.8		2.0	0.8	21.2		0.3		
Delay (s)		12.0	0.8		18.1	9.6	55.4		26.2		
Level of Service		B	A		B	A	E		C		
Approach Delay (s)		8.6			16.3			45.4		0.0	
Approach LOS		A			B			D		A	

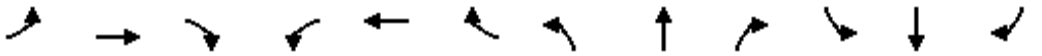
Intersection Summary			
HCM Average Control Delay	22.7	HCM Level of Service	C
HCM Volume to Capacity ratio	0.90		
Actuated Cycle Length (s)	120.0	Sum of lost time (s)	8.0
Intersection Capacity Utilization	83.9%	ICU Level of Service	E
Analysis Period (min)	15		

c Critical Lane Group



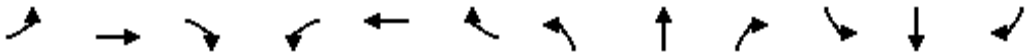
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	0	1930	0	0	3030	40	400	60	620	0	0	90
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)		4.0			4.0		4.0	4.0	5.0			4.0
Lane Util. Factor		0.91			*0.75		0.97	0.95	0.95			0.88
Frt		1.00			1.00		1.00	0.88	0.85			0.85
Flt Protected		1.00			1.00		0.95	1.00	1.00			1.00
Satd. Flow (prot)		5085			5577		3433	1550	1504			2787
Flt Permitted		1.00			1.00		0.95	1.00	1.00			1.00
Satd. Flow (perm)		5085			5577		3433	1550	1504			2787
Peak-hour factor, PHF	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96
Adj. Flow (vph)	0	2010	0	0	3156	42	417	62	646	0	0	94
RTOR Reduction (vph)	0	0	0	0	1	0	0	90	91	0	0	9
Lane Group Flow (vph)	0	2010	0	0	3197	0	417	269	258	0	0	85
Turn Type							Split		Perm			custom
Protected Phases		2			6		8	8				
Permitted Phases									8			4
Actuated Green, G (s)		80.0			80.0		17.0	17.0	17.0			7.0
Effective Green, g (s)		82.0			82.0		18.0	18.0	17.0			8.0
Actuated g/C Ratio		0.68			0.68		0.15	0.15	0.14			0.07
Clearance Time (s)		6.0			6.0		5.0	5.0	5.0			5.0
Vehicle Extension (s)		5.0			5.0		1.5	1.5	1.5			1.5
Lane Grp Cap (vph)		3475			3811		515	233	213			186
v/s Ratio Prot		0.40			c0.57		0.12	c0.17				
v/s Ratio Perm									0.17			c0.03
v/c Ratio		0.58			0.84		0.81	1.15	1.21			0.46
Uniform Delay, d1		9.9			14.1		49.3	51.0	51.5			53.9
Progression Factor		0.80			0.30		1.00	1.00	1.00			1.00
Incremental Delay, d2		0.4			0.2		8.6	106.9	130.4			0.6
Delay (s)		8.3			4.4		58.0	157.9	181.9			54.5
Level of Service		A			A		E	F	F			D
Approach Delay (s)		8.3			4.4			128.3			54.5	
Approach LOS		A			A			F			D	

Intersection Summary			
HCM Average Control Delay	28.1	HCM Level of Service	C
HCM Volume to Capacity ratio	0.86		
Actuated Cycle Length (s)	120.0	Sum of lost time (s)	12.0
Intersection Capacity Utilization	71.8%	ICU Level of Service	C
Analysis Period (min)	15		
c Critical Lane Group			



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	180	2020	350	250	2670	180	220	75	130	130	125	180
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0	3.0	4.0	4.0	4.0	4.0	4.0		4.0	4.0	4.0
Lane Util. Factor	0.97	0.91	1.00	0.97	*0.50	1.00	0.97	0.95		0.97	0.95	1.00
Frt	1.00	1.00	0.85	1.00	1.00	0.85	1.00	0.91		1.00	1.00	0.85
Flt Protected	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00		0.95	1.00	1.00
Satd. Flow (prot)	3433	5085	1583	3433	3725	1583	3433	3203		3433	3539	1583
Flt Permitted	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00		0.95	1.00	1.00
Satd. Flow (perm)	3433	5085	1583	3433	3725	1583	3433	3203		3433	3539	1583
Peak-hour factor, PHF	0.94	0.94	0.94	0.94	0.94	0.94	0.94	0.94	0.94	0.94	0.94	0.94
Adj. Flow (vph)	191	2149	372	266	2840	191	234	80	138	138	133	191
RTOR Reduction (vph)	0	0	27	0	0	40	0	124	0	0	0	115
Lane Group Flow (vph)	191	2149	345	266	2840	151	234	94	0	138	133	76
Turn Type	Prot		pm+ov	Prot		Perm	Prot			Prot		Perm
Protected Phases	5	2	3	1	6		3	8		7	4	
Permitted Phases			2			6						4
Actuated Green, G (s)	8.6	69.5	81.2	9.0	69.9	69.9	11.7	11.6		8.9	8.8	8.8
Effective Green, g (s)	9.6	71.5	85.2	10.0	71.9	71.9	12.7	12.6		9.9	9.8	9.8
Actuated g/C Ratio	0.08	0.60	0.71	0.08	0.60	0.60	0.11	0.10		0.08	0.08	0.08
Clearance Time (s)	5.0	6.0	5.0	5.0	6.0	6.0	5.0	5.0		5.0	5.0	5.0
Vehicle Extension (s)	1.5	5.0	1.5	1.5	5.0	5.0	1.5	1.5		1.5	1.5	1.5
Lane Grp Cap (vph)	275	3030	1124	286	2232	948	363	336		283	289	129
v/s Ratio Prot	0.06	0.42	0.04	c0.08	c0.76		c0.07	c0.03		0.04	0.04	
v/s Ratio Perm			0.18			0.10						c0.05
v/c Ratio	0.69	0.71	0.31	0.93	1.27	0.16	0.64	0.28		0.49	0.46	0.59
Uniform Delay, d1	53.8	17.0	6.5	54.7	24.0	10.7	51.5	49.5		52.6	52.6	53.2
Progression Factor	1.23	0.47	0.31	1.00	1.00	1.00	1.00	1.00		1.00	1.00	1.00
Incremental Delay, d2	4.4	1.0	0.0	34.8	126.2	0.4	2.9	0.2		0.5	0.4	4.8
Delay (s)	70.7	9.0	2.1	89.4	150.3	11.0	54.4	49.7		53.1	53.0	57.9
Level of Service	E	A	A	F	F	B	D	D		D	D	E
Approach Delay (s)		12.4			137.3			52.1			55.1	
Approach LOS		B			F			D			E	

Intersection Summary			
HCM Average Control Delay	77.3	HCM Level of Service	E
HCM Volume to Capacity ratio	1.10		
Actuated Cycle Length (s)	120.0	Sum of lost time (s)	16.0
Intersection Capacity Utilization	71.6%	ICU Level of Service	C
Analysis Period (min)	15		
c Critical Lane Group			



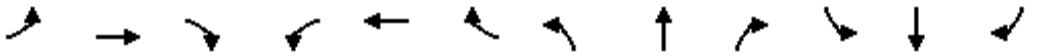
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	195	1330	140	350	1700	350	260	590	320	460	550	120
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0	4.0	4.0	4.0	6.0	4.0	4.0	5.0	4.0	4.0	
Lane Util. Factor	0.97	0.91	1.00	0.97	0.91	1.00	1.00	0.95	1.00	0.97	0.95	
Frpb, ped/bikes	1.00	1.00	0.99	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	
Flpb, ped/bikes	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	
Frt	1.00	1.00	0.85	1.00	1.00	0.85	1.00	1.00	0.85	1.00	0.97	
Flt Protected	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	
Satd. Flow (prot)	3433	5085	1562	3433	5085	1583	1770	3539	1583	3433	3444	
Flt Permitted	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	
Satd. Flow (perm)	3433	5085	1562	3433	5085	1583	1770	3539	1583	3433	3444	
Peak-hour factor, PHF	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97
Adj. Flow (vph)	201	1371	144	361	1753	361	268	608	330	474	567	124
RTOR Reduction (vph)	0	0	83	0	0	184	0	0	147	0	16	0
Lane Group Flow (vph)	201	1371	61	361	1753	177	268	608	183	474	675	0
Confl. Peds. (#/hr)	1		1									
Turn Type	Prot		Perm	Prot		Perm	Prot		Perm	Prot		
Protected Phases	5	2		1	6		3	8		7	4	
Permitted Phases			2			6			8			
Actuated Green, G (s)	8.8	42.2	42.2	15.1	48.5	48.5	17.0	22.7	22.7	18.0	23.7	
Effective Green, g (s)	9.8	44.2	44.2	16.1	50.5	48.5	18.0	24.7	23.7	19.0	25.7	
Actuated g/C Ratio	0.08	0.37	0.37	0.13	0.42	0.40	0.15	0.21	0.20	0.16	0.21	
Clearance Time (s)	5.0	6.0	6.0	5.0	6.0	6.0	5.0	6.0	6.0	5.0	6.0	
Vehicle Extension (s)	2.0	3.0	3.0	2.0	3.0	3.0	2.0	2.0	2.0	2.0	2.0	
Lane Grp Cap (vph)	280	1873	575	461	2140	640	266	728	313	544	738	
v/s Ratio Prot	0.06	0.27		c0.11	c0.34		c0.15	c0.17		0.14	c0.20	
v/s Ratio Perm			0.04			0.11			0.12			
v/c Ratio	0.72	0.73	0.11	0.78	0.82	0.28	1.01	0.84	0.59	0.87	0.92	
Uniform Delay, d1	53.8	32.8	24.9	50.3	30.7	24.0	51.0	45.7	43.7	49.3	46.1	
Progression Factor	1.00	1.00	1.00	1.22	0.90	0.65	1.00	1.00	1.00	1.00	1.00	
Incremental Delay, d2	7.1	2.6	0.4	6.1	2.8	0.8	57.1	7.9	1.8	13.8	15.6	
Delay (s)	60.9	35.3	25.3	67.5	30.4	16.5	108.1	53.6	45.5	63.2	61.7	
Level of Service	E	D	C	E	C	B	F	D	D	E	E	
Approach Delay (s)		37.5			33.8			63.5			62.3	
Approach LOS		D			C			E			E	

Intersection Summary			
HCM Average Control Delay	45.3	HCM Level of Service	D
HCM Volume to Capacity ratio	0.83		
Actuated Cycle Length (s)	120.0	Sum of lost time (s)	8.0
Intersection Capacity Utilization	85.4%	ICU Level of Service	E
Analysis Period (min)	15		

c Critical Lane Group

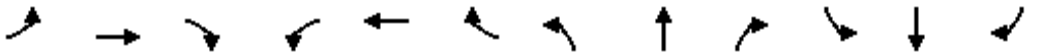
Movement	EBL	EBT	EBR	WBL	WBT	WBR	SBL2	SBL	SBR	NWL	NWR
Lane Configurations											
Volume (vph)	0	1010	1100	0	1780	740	950	0	620	0	0
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1700	1900	1900	1900	1900
Total Lost time (s)		4.0	6.0		4.0	6.0	4.0		4.0		
Lane Util. Factor		0.86	0.86		0.91	1.00	0.97		0.88		
Frt		0.95	0.85		1.00	0.85	1.00		0.85		
Flt Protected		1.00	1.00		1.00	1.00	0.95		1.00		
Satd. Flow (prot)		4548	1362		5085	1583	3072		2787		
Flt Permitted		1.00	1.00		1.00	1.00	0.95		1.00		
Satd. Flow (perm)		4548	1362		5085	1583	3072		2787		
Peak-hour factor, PHF	0.94	0.94	0.92	0.92	0.94	0.94	0.94	0.92	0.94	0.92	0.92
Adj. Flow (vph)	0	1074	1196	0	1894	787	1011	0	660	0	0
RTOR Reduction (vph)	0	0	0	0	0	342	0	0	14	0	0
Lane Group Flow (vph)	0	1672	598	0	1894	445	1011	0	646	0	0
Turn Type			Prot			Perm	Prot		custom		
Protected Phases		2	2		6		4				
Permitted Phases						6			4		
Actuated Green, G (s)		67.9	67.9		67.9	67.9	41.1		41.1		
Effective Green, g (s)		69.9	67.9		69.9	67.9	42.1		42.1		
Actuated g/C Ratio		0.58	0.57		0.58	0.57	0.35		0.35		
Clearance Time (s)		6.0	6.0		6.0	6.0	5.0		5.0		
Vehicle Extension (s)		5.0	5.0		5.0	5.0	1.5		1.5		
Lane Grp Cap (vph)		2649	771		2962	896	1078		978		
v/s Ratio Prot		0.37	c0.44		0.37		c0.33				
v/s Ratio Perm						0.28			0.23		
v/c Ratio		0.63	0.78		0.64	0.50	0.94		0.66		
Uniform Delay, d1		16.5	20.2		16.7	15.7	37.7		32.9		
Progression Factor		0.72	0.85		0.63	1.21	1.00		1.00		
Incremental Delay, d2		0.8	5.2		0.7	1.4	14.5		1.3		
Delay (s)		12.6	22.2		11.2	20.5	52.2		34.2		
Level of Service		B	C		B	C	D		C		
Approach Delay (s)		15.1			14.0			45.1		0.0	
Approach LOS		B			B			D		A	

Intersection Summary			
HCM Average Control Delay	22.2	HCM Level of Service	C
HCM Volume to Capacity ratio	0.84		
Actuated Cycle Length (s)	120.0	Sum of lost time (s)	10.0
Intersection Capacity Utilization	71.3%	ICU Level of Service	C
Analysis Period (min)	15		
c Critical Lane Group			



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	0	1960	0	0	2660	40	320	25	410	0	0	130
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)		4.0			4.0		4.0	4.0	5.0			4.0
Lane Util. Factor		0.91			*0.75		0.97	0.95	0.95			0.88
Frt		1.00			1.00		1.00	0.87	0.85			0.85
Flt Protected		1.00			1.00		0.95	1.00	1.00			1.00
Satd. Flow (prot)		5085			5576		3433	1534	1504			2787
Flt Permitted		1.00			1.00		0.95	1.00	1.00			1.00
Satd. Flow (perm)		5085			5576		3433	1534	1504			2787
Peak-hour factor, PHF	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
Adj. Flow (vph)	0	2063	0	0	2800	42	337	26	432	0	0	137
RTOR Reduction (vph)	0	0	0	0	1	0	0	90	90	0	0	28
Lane Group Flow (vph)	0	2063	0	0	2841	0	337	139	139	0	0	109
Turn Type							Perm		Perm			custom
Protected Phases		2			6			8				
Permitted Phases							8		8			4
Actuated Green, G (s)		81.4			81.4		15.6	15.6	15.6			7.0
Effective Green, g (s)		83.4			83.4		16.6	16.6	15.6			8.0
Actuated g/C Ratio		0.70			0.70		0.14	0.14	0.13			0.07
Clearance Time (s)		6.0			6.0		5.0	5.0	5.0			5.0
Vehicle Extension (s)		5.0			5.0		1.5	1.5	1.5			1.5
Lane Grp Cap (vph)		3534			3875		475	212	196			186
v/s Ratio Prot		0.41			c0.51			0.09				
v/s Ratio Perm							c0.10		0.09			c0.04
v/c Ratio		0.58			0.73		0.71	0.66	0.71			0.59
Uniform Delay, d1		9.4			11.4		49.4	49.0	50.0			54.4
Progression Factor		1.00			0.83		1.00	1.00	1.00			1.00
Incremental Delay, d2		0.4			0.1		4.0	5.5	9.1			3.0
Delay (s)		9.9			9.6		53.3	54.5	59.1			57.4
Level of Service		A			A		D	D	E			E
Approach Delay (s)		9.9			9.6			55.3			57.4	
Approach LOS		A			A			E			E	

Intersection Summary			
HCM Average Control Delay	17.0	HCM Level of Service	B
HCM Volume to Capacity ratio	0.72		
Actuated Cycle Length (s)	120.0	Sum of lost time (s)	12.0
Intersection Capacity Utilization	64.2%	ICU Level of Service	C
Analysis Period (min)	15		
c Critical Lane Group			

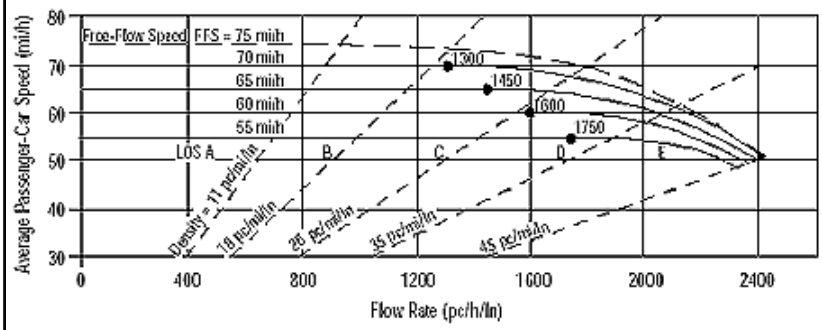


Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	200	1915	255	170	2000	180	430	200	140	120	160	270
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0	3.0	4.0	4.0	4.0	4.0	4.0		4.0	4.0	4.0
Lane Util. Factor	0.97	0.91	1.00	0.97	*0.50	1.00	0.97	0.95		0.97	0.95	1.00
Frpb, ped/bikes	1.00	1.00	0.99	1.00	1.00	1.00	1.00	1.00		1.00	1.00	1.00
Flpb, ped/bikes	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00		1.00	1.00	1.00
Frt	1.00	1.00	0.85	1.00	1.00	0.85	1.00	0.94		1.00	1.00	0.85
Flt Protected	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00		0.95	1.00	1.00
Satd. Flow (prot)	3433	5085	1565	3433	3725	1583	3433	3321		3433	3539	1583
Flt Permitted	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00		0.95	1.00	1.00
Satd. Flow (perm)	3433	5085	1565	3433	3725	1583	3433	3321		3433	3539	1583
Peak-hour factor, PHF	0.94	0.94	0.94	0.94	0.94	0.94	0.94	0.94	0.94	0.94	0.94	0.94
Adj. Flow (vph)	213	2037	271	181	2128	191	457	213	149	128	170	287
RTOR Reduction (vph)	0	0	51	0	0	53	0	109	0	0	0	131
Lane Group Flow (vph)	213	2037	220	181	2128	138	457	253	0	128	170	156
Confl. Peds. (#/hr)	3		3									
Turn Type	Prot		pm+ov	Prot		Perm	Prot			Prot		Perm
Protected Phases	5	2	3	1	6		3	8		7	4	
Permitted Phases			2			6						4
Actuated Green, G (s)	11.0	58.7	76.7	9.2	56.9	56.9	18.0	23.0		8.1	13.1	13.1
Effective Green, g (s)	12.0	60.7	80.7	10.2	58.9	58.9	19.0	24.0		9.1	14.1	14.1
Actuated g/C Ratio	0.10	0.51	0.67	0.08	0.49	0.49	0.16	0.20		0.08	0.12	0.12
Clearance Time (s)	5.0	6.0	5.0	5.0	6.0	6.0	5.0	5.0		5.0	5.0	5.0
Vehicle Extension (s)	1.5	5.0	1.5	1.5	5.0	5.0	1.5	1.5		1.5	1.5	1.5
Lane Grp Cap (vph)	343	2572	1052	292	1828	777	544	664		260	416	186
v/s Ratio Prot	c0.06	0.40	0.03	0.05	c0.57		c0.13	0.08		0.04	0.05	
v/s Ratio Perm			0.11			0.09						c0.10
v/c Ratio	0.62	0.79	0.21	0.62	1.16	0.18	0.84	0.38		0.49	0.41	0.84
Uniform Delay, d1	51.8	24.4	7.5	53.0	30.6	17.0	49.0	41.6		53.2	49.1	51.8
Progression Factor	1.23	0.57	0.80	1.00	1.00	1.00	1.00	1.00		1.00	1.00	1.00
Incremental Delay, d2	2.0	2.1	0.0	2.8	80.3	0.5	10.8	0.1		0.5	0.2	25.5
Delay (s)	65.8	16.1	6.0	55.8	110.8	17.5	59.8	41.7		53.8	49.3	77.3
Level of Service	E	B	A	E	F	B	E	D		D	D	E
Approach Delay (s)		19.2			99.7			51.8			64.0	
Approach LOS		B			F			D			E	

Intersection Summary			
HCM Average Control Delay	58.8	HCM Level of Service	E
HCM Volume to Capacity ratio	1.00		
Actuated Cycle Length (s)	120.0	Sum of lost time (s)	16.0
Intersection Capacity Utilization	74.3%	ICU Level of Service	D
Analysis Period (min)	15		

c Critical Lane Group

BASIC FREEWAY SEGMENTS WORKSHEET



Application	Input	Output
Operational (LOS)	FFS, N, v_p	LOS, S, D
Design (N)	FFS, LOS, v_p	N, S, D
Design (v_p)	FFS, LOS, N	v_p, S, D
Planning (LOS)	FFS, N, AADT	LOS, S, D
Planning (N)	FFS, LOS, AADT	N, S, D
Planning (v_p)	FFS, LOS, N	v_p, S, D

General Information

Analyst	*SST*
Agency or Company	*DEA*
Date Performed	*6/23/2007*
Analysis Time Period	*AM Peak*

Site Information

Highway/Direction of Travel	*Southbound I-25*
From/To	*Orchard to Arapahoe*
Jurisdiction	*Arapahoe County*
Analysis Year	*2006*

Project Description Existing Conditions

☑ Oper.(LOS) ☐ Des.(N) ☐ Planning Data

Flow Inputs

Volume, V	*5630*	veh/h	Peak-Hour Factor, PHF	*0.90*
AADT		veh/day	%Trucks and Buses, P_T	*7*
Peak-Hr Prop. of AADT, K			%RVs, P_R	*0*
Peak-Hr Direction Prop, D			General Terrain:	*Rolling*
DDHV = AADT x K x D		veh/h	Grade % Length	*mi*
Driver type adjustment	*1.00*		Up/Down %	

Calculate Flow Adjustments

f_p	*1.00*	E_R	*2.0*
E_T	*2.5*	$f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$	*0.905*

Speed Inputs

Lane Width	*12.0*	ft
Rt-Shoulder Lat. Clearance	*6.0*	ft
Interchange Density	*0.50*	I/mi
Number of Lanes, N	*5*	
FFS (measured)	*70.0*	mi/h
Base free-flow Speed, BFFS		mi/h

Calc Speed Adj and FFS

f_{LW}		mi/h
f_{LC}		mi/h
f_{ID}		mi/h
f_N		mi/h
FFS	*70.0*	mi/h

LOS and Performance Measures

Operational (LOS)

v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	*1382*	pc/h/ln
S	*70.0*	mi/h
D = v_p / S	*19.7*	pc/mi/ln
LOS	*C*	

Design (N)

Design (N)

Design LOS	
v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	pc/h
S	mi/h
D = v_p / S	pc/mi/ln
Required Number of Lanes, N	

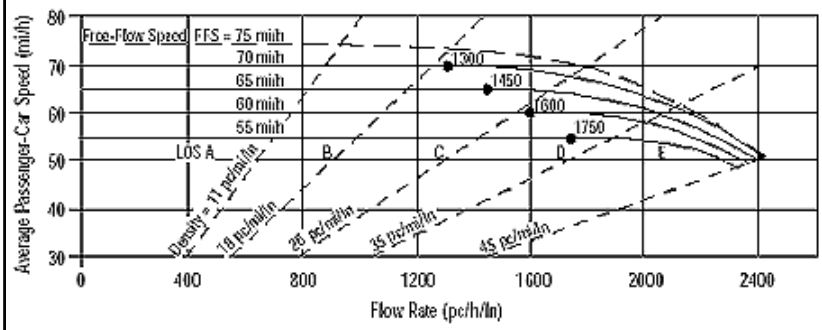
Glossary

N - Number of lanes	S - Speed
V - Hourly volume	D - Density
v_p - Flow rate	FFS - Free-flow speed
LOS - Level of service	BFFS - Base free-flow speed
DDHV - Directional design hour volume	

Factor Location

E_R - Exhibits23-8, 23-10	f_{LW} - Exhibit 23-4
E_T - Exhibits 23-8, 23-10, 23-11	f_{LC} - Exhibit 23-5
f_p - Page 23-12	f_N - Exhibit 23-6
LOS, S, FFS, v_p - Exhibits 23-2, 23-3	f_{ID} - Exhibit 23-7

BASIC FREEWAY SEGMENTS WORKSHEET



Application	Input	Output
Operational (LOS)	FFS, N, v_p	LOS, S, D
Design (N)	FFS, LOS, v_p	N, S, D
Design (v_p)	FFS, LOS, N	v_p, S, D
Planning (LOS)	FFS, N, AADT	LOS, S, D
Planning (N)	FFS, LOS, AADT	N, S, D
Planning (v_p)	FFS, LOS, N	v_p, S, D

General Information

Analyst	*SST*
Agency or Company	*DEA*
Date Performed	*6/23/2007*
Analysis Time Period	*PM Peak*

Site Information

Highway/Direction of Travel	*Southbound I-25*
From/To	*Orchard to Arapahoe*
Jurisdiction	*Arapahoe County*
Analysis Year	*2006*

Project Description Existing Conditions

☑ Oper.(LOS) ☐ Des.(N) ☐ Planning Data

Flow Inputs

Volume, V	*7860*	veh/h	Peak-Hour Factor, PHF	*0.90*
AADT		veh/day	%Trucks and Buses, P_T	*7*
Peak-Hr Prop. of AADT, K			%RVs, P_R	*0*
Peak-Hr Direction Prop, D			General Terrain:	*Rolling*
DDHV = AADT x K x D		veh/h	Grade % Length	*mi*
Driver type adjustment	*1.00*		Up/Down %	

Calculate Flow Adjustments

f_p	*1.00*	E_R	*2.0*
E_T	*2.5*	$f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$	*0.905*

Speed Inputs

Lane Width	*12.0*	ft
Rt-Shoulder Lat. Clearance	*6.0*	ft
Interchange Density	*0.50*	I/mi
Number of Lanes, N	*5*	
FFS (measured)	*70.0*	mi/h
Base free-flow Speed, BFFS		mi/h

Calc Speed Adj and FFS

f_{LW}		mi/h
f_{LC}		mi/h
f_{ID}		mi/h
f_N		mi/h
FFS	*70.0*	mi/h

LOS and Performance Measures

Operational (LOS)

v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	*1930*	pc/h/ln
S	*66.1*	mi/h
D = v_p / S	*29.2*	pc/mi/ln
LOS	*D*	

Design (N)

Design (N)

Design LOS	
v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	pc/h
S	mi/h
D = v_p / S	pc/mi/ln
Required Number of Lanes, N	

Glossary

N - Number of lanes	S - Speed
V - Hourly volume	D - Density
v_p - Flow rate	FFS - Free-flow speed
LOS - Level of service	BFFS - Base free-flow speed
DDHV - Directional design hour volume	

Factor Location

E_R - Exhibits23-8, 23-10	f_{LW} - Exhibit 23-4
E_T - Exhibits 23-8, 23-10, 23-11	f_{LC} - Exhibit 23-5
f_p - Page 23-12	f_N - Exhibit 23-6
LOS, S, FFS, v_p - Exhibits 23-2, 23-3	f_{ID} - Exhibit 23-7

RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information / Site Information

Analyst	SST	Freeway/Dir of Travel	Southbound I-25
Agency or Company	DEA	Junction	Arapahoe Exit Ramp
Date Performed	6/23/2007	Jurisdiction	Arapahoe County
Analysis Time Period	AM Peak	Analysis Year	2006

Project Description Existing Conditions

Inputs

Upstream Adj Ramp
☐ Yes ☐ On
☑ No ☐ Off
L_{up} = ft
V_u = veh/h

Terrain: Rolling

S_{FF} = 70.0 mph S_{FR} = 45.0 mph

Sketch (show lanes, L_A, L_D,V_R,V_f)

Downstream Adj Ramp
☑ Yes ☑ On
☐ No ☐ Off
L_{down} = 700 ft
V_D = 520 veh/h

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	%Truck	%Rv	f_{HV}	f_p	v = V/PHF x f_{HV} x f_p
Freeway	5630	0.90	Rolling	7	0	0.905	1.00	6912
Ramp	1840	0.90	Level	2	0	0.990	1.00	2065
UpStream								
DownStream	520	0.90	Level	2	0	0.990	1.00	584

Merge Areas

Estimation of v_{12}

$V_{12} = V_F (P_{FM})$

L_{EQ} = (Equation 25-2 or 25-3)

P_{FM} = using Equation (Exhibit 25-5)

V_{12} = pc/h

Capacity Checks

	Actual	Maximum	LOS F?
V_{FO}			
V_{R12}			

Level of Service Determination (if not F)

$D_R = 5.475 + 0.00734 v_R + 0.0078 V_{12} - 0.00627 L_A$

D_R = (pc/mi/ln)

LOS = (Exhibit 25-4)

Speed Estimation

M_S = (Exibit 25-19)

S_R= mph (Exhibit 25-19)

S_0= mph (Exhibit 25-19)

S = mph (Exhibit 25-14)

Diverge Areas

Estimation of v_{12}

$V_{12} = V_R + (V_F - V_R)P_{FD}$

L_{EQ} = (Equation 25-8 or 25-9)

P_{FD} = 0.260 using Equation (Exhibit 25-11)

V_{12} = 3056 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
$V_{FI} = V_F$	5876	9600	No
V_{12}	3056	4400:All	No
$V_{FO} = V_F - V_R$	3811	9600	No
V_R	2065	4100	No

Level of Service Determination (if not F)

$D_R = 4.252 + 0.0086 V_{12} - 0.0009 L_D$

D_R = 6.8 (pc/mi/ln)

LOS = A (Exhibit 25-4)

Speed Estimation

D_s = 0.484 (Exhibit 25-19)

S_R= 56.5 mph (Exhibit 25-19)

S_0= 75.2 mph (Exhibit 25-19)

S = 64.1 mph (Exhibit 25-15)

RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information / Site Information

Analyst	SST	Freeway/Dir of Travel	Southbound I-25
Agency or Company	DEA	Junction	Arapahoe Exit Ramp
Date Performed	6/23/2007	Jurisdiction	Arapahoe County
Analysis Time Period	PM Peak	Analysis Year	2006

Project Description Existing Conditions

Inputs

Upstream Adj Ramp
☐ Yes ☐ On
☑ No ☐ Off
L_{up} = ft
V_u = veh/h

Terrain: Rolling

S_{FF} = 70.0 mph S_{FR} = 45.0 mph

Sketch (show lanes, L_A, L_D,V_R,V_f)

Downstream Adj Ramp
☑ Yes ☑ On
☐ No ☐ Off
L_{down} = 700 ft
V_D = 520 veh/h

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	%Truck	%Rv	f_{HV}	f_p	v = V/PHF x f_{HV} x f_p
Freeway	7860	0.90	Rolling	7	0	0.905	1.00	9650
Ramp	1570	0.90	Level	2	0	0.990	1.00	1762
UpStream								
DownStream	520	0.90	Level	2	0	0.990	1.00	584

Merge Areas

Estimation of v_{12}

$V_{12} = V_F (P_{FM})$

L_{EQ} = (Equation 25-2 or 25-3)

P_{FM} = using Equation (Exhibit 25-5)

V_{12} = pc/h

Capacity Checks

	Actual	Maximum	LOS F?
V_{FO}			
V_{R12}			

Level of Service Determination (if not F)

$D_R = 5.475 + 0.00734\ v_R + 0.0078\ V_{12} - 0.00627\ L_A$

D_R = (pc/mi/ln)

LOS = (Exhibit 25-4)

Speed Estimation

M_S = (Exibit 25-19)

S_R= mph (Exhibit 25-19)

S_0= mph (Exhibit 25-19)

S = mph (Exhibit 25-14)

Diverge Areas

Estimation of v_{12}

$V_{12} = V_R + (V_F - V_R)P_{FD}$

L_{EQ} = (Equation 25-8 or 25-9)

P_{FD} = 0.260 using Equation (Exhibit 25-11)

V_{12} = 3311 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
$V_{FI} = V_F$	7720	9600	No
V_{12}	3311	4400:All	No
$V_{FO} = V_F - V_R$	5958	9600	No
V_R	1762	4100	No

Level of Service Determination (if not F)

$D_R = 4.252 + 0.0086\ V_{12} - 0.0009\ L_D$

D_R = 9.0 (pc/mi/ln)

LOS = A (Exhibit 25-4)

Speed Estimation

D_s = 0.457 (Exhibit 25-19)

S_R= 57.2 mph (Exhibit 25-19)

S_0= 72.1 mph (Exhibit 25-19)

S = 64.9 mph (Exhibit 25-15)

RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information / Site Information

Analyst	SST	Freeway/Dir of Travel	Southbound I-25
Agency or Company	DEA	Junction	Arapahoe Loop Ramp
Date Performed	6/23/2007	Jurisdiction	Arapahoe County
Analysis Time Period	AM Peak	Analysis Year	2006

Project Description Existing Conditions

Inputs

Upstream Adj Ramp

☐ Yes ☐ On

☑ No ☐ Off

L_{up} = ft

V_u = veh/h

Terrain: Rolling

S_{FF} = 70.0 mph S_{FR} = 25.0 mph

Sketch (show lanes, L_A, L_D,V_R,V_f)

Downstream Adj Ramp

☑ Yes ☑ On

☐ No ☐ Off

L_{down} = 800 ft

V_D = 610 veh/h

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	%Truck	%Rv	f_{HV}	f_p	v = V/PHF x f_{HV} x f_p
Freeway	3790	0.90	Rolling	6	0	0.917	1.00	4590
Ramp	520	0.90	Level	2	0	0.990	1.00	584
UpStream								
DownStream	610	0.90	Level	2	0	0.990	1.00	685

Merge Areas

Estimation of v_{12}

$$V_{12} = V_F (P_{FM})$$

L_{EQ} = (Equation 25-2 or 25-3)

P_{FM} = 0.502 using Equation (Exhibit 25-5)

V_{12} = 1796 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
V_{FO}	4165	See Exhibit 25-7	No
V_{R12}	2380	4600:All	No

Level of Service Determination (if not F)

$$D_R = 5.475 + 0.00734 v_R + 0.0078 V_{12} - 0.00627 L_A$$

D_R = 18.8 (pc/mi/ln)

LOS = B (Exhibit 25-4)

Speed Estimation

M_S = 0.323 (Exibit 25-19)

S_R= 61.0 mph (Exhibit 25-19)

S_0= 68.6 mph (Exhibit 25-19)

S = 64.0 mph (Exhibit 25-14)

Diverge Areas

Estimation of v_{12}

$$V_{12} = V_R + (V_F - V_R)P_{FD}$$

L_{EQ} = (Equation 25-8 or 25-9)

P_{FD} = using Equation (Exhibit 25-11)

V_{12} = pc/h

Capacity Checks

	Actual	Maximum	LOS F?
$V_{FI} = V_F$			
V_{12}			
$V_{FO} = V_F - V_R$			
V_R			

Level of Service Determination (if not F)

$$D_R = 4.252 + 0.0086 V_{12} - 0.0009 L_D$$

D_R = (pc/mi/ln)

LOS = (Exhibit 25-4)

Speed Estimation

D_s = (Exhibit 25-19)

S_R= mph (Exhibit 25-19)

S_0= mph (Exhibit 25-19)

S = mph (Exhibit 25-15)

RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information / Site Information

Analyst	SST	Freeway/Dir of Travel	Southbound I-25
Agency or Company	DEA	Junction	Arapahoe Loop Ramp
Date Performed	6/23/2007	Jurisdiction	Arapahoe County
Analysis Time Period	PM Peak	Analysis Year	2006

Project Description Existing Conditions

Inputs

Upstream Adj Ramp

☐ Yes ☐ On

☑ No ☐ Off

L_{up} = ft

V_u = veh/h

Terrain: Rolling

S_{FF} = 70.0 mph S_{FR} = 25.0 mph

Sketch (show lanes, L_A, L_D,V_R,V_f)

Downstream Adj Ramp

☑ Yes ☑ On

☐ No ☐ Off

L_{down} = 800 ft

V_D = 430 veh/h

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	%Truck	%Rv	f_{HV}	f_p	v = V/PHF x f_{HV} x f_p
Freeway	6290	0.90	Rolling	6	0	0.917	1.00	7618
Ramp	740	0.90	Level	2	0	0.990	1.00	830
UpStream								
DownStream	430	0.90	Level	2	0	0.990	1.00	483

Merge Areas

Estimation of v_{12}

$V_{12} = V_F (P_{FM})$

L_{EQ} = (Equation 25-2 or 25-3)

P_{FM} = 0.471 using Equation (Exhibit 25-5)

V_{12} = 2565 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
V_{FO}	6277	See Exhibit 25-7	No
V_{R12}	3395	4600:All	No

Level of Service Determination (if not F)

$D_R = 5.475 + 0.00734 v_R + 0.0078 V_{12} - 0.00627 L_A$

D_R = 26.6 (pc/mi/ln)

LOS = C (Exhibit 25-4)

Speed Estimation

M_S = 0.397 (Exibit 25-19)

S_R= 58.9 mph (Exhibit 25-19)

S_0= 66.6 mph (Exhibit 25-19)

S = 62.2 mph (Exhibit 25-14)

Diverge Areas

Estimation of v_{12}

$V_{12} = V_R + (V_F - V_R)P_{FD}$

L_{EQ} = (Equation 25-8 or 25-9)

P_{FD} = using Equation (Exhibit 25-11)

V_{12} = pc/h

Capacity Checks

	Actual	Maximum	LOS F?
$V_{FI} = V_F$			
V_{12}			
$V_{FO} = V_F - V_R$			
V_R			

Level of Service Determination (if not F)

$D_R = 4.252 + 0.0086 V_{12} - 0.0009 L_D$

D_R = (pc/mi/ln)

LOS = (Exhibit 25-4)

Speed Estimation

D_s = (Exhibit 25-19)

S_R= mph (Exhibit 25-19)

S_0= mph (Exhibit 25-19)

S = mph (Exhibit 25-15)

RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information / Site Information

Analyst	SST	Freeway/Dir of Travel	Southbound I-25
Agency or Company	DEA	Junction	Arapahoe On Ramp
Date Performed	6/23/2007	Jurisdiction	Arapahoe County
Analysis Time Period	AM Peak	Analysis Year	2006

Project Description Existing Conditions

Inputs

Upstream Adj Ramp

☑ Yes ☑ On

☐ No ☐ Off

L_{up} = 800 ft

V_u = 520 veh/h

Terrain: Rolling

S_{FF} = 70.0 mph S_{FR} = 45.0 mph

Sketch (show lanes, L_A, L_D,V_R,V_f)

Downstream Adj Ramp

☐ Yes ☐ On

☑ No ☐ Off

L_{down} = ft

V_D = veh/h

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	%Truck	%Rv	f_{HV}	f_p	v = V/PHF x f_{HV} x f_p
Freeway	4310	0.90	Rolling	6	0	0.917	1.00	5220
Ramp	610	0.90	Level	2	0	0.990	1.00	685
UpStream	520	0.90	Level	2	0	0.990	1.00	584
DownStream								

Merge Areas

Estimation of v_{12}

$V_{12} = V_F (P_{FM})$

L_{EQ} = (Equation 25-2 or 25-3)

P_{FM} = 0.786 using Equation (Exhibit 25-5)

V_{12} = 3202 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
V_{FO}	4757	See Exhibit 25-7	No
V_{R12}	3887	4600:All	No

Level of Service Determination (if not F)

$D_R = 5.475 + 0.00734 v_R + 0.0078 V_{12} - 0.00627 L_A$

D_R = 18.9 (pc/mi/ln)

LOS = B (Exhibit 25-4)

Speed Estimation

M_S = 0.274 (Exibit 25-19)

S_R= 62.3 mph (Exhibit 25-19)

S_0= 70.0 mph (Exhibit 25-19)

S = 63.6 mph (Exhibit 25-14)

Diverge Areas

Estimation of v_{12}

$V_{12} = V_R + (V_F - V_R)P_{FD}$

L_{EQ} = (Equation 25-8 or 25-9)

P_{FD} = using Equation (Exhibit 25-11)

V_{12} = pc/h

Capacity Checks

	Actual	Maximum	LOS F?
$V_{FI} = V_F$			
V_{12}			
$V_{FO} = V_F - V_R$			
V_R			

Level of Service Determination (if not F)

$D_R = 4.252 + 0.0086 V_{12} - 0.0009 L_D$

D_R = (pc/mi/ln)

LOS = (Exhibit 25-4)

Speed Estimation

D_s = (Exhibit 25-19)

S_R= mph (Exhibit 25-19)

S_0= mph (Exhibit 25-19)

S = mph (Exhibit 25-15)

RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information / Site Information

Analyst	SST	Freeway/Dir of Travel	Southbound I-25
Agency or Company	DEA	Junction	Arapahoe On Ramp
Date Performed	6/23/2007	Jurisdiction	Arapahoe County
Analysis Time Period	PM Peak	Analysis Year	2006

Project Description Existing Conditions

Inputs

Upstream Adj Ramp

☑ Yes ☑ On

☐ No ☐ Off

L_{up} = 800 ft

V_u = 740 veh/h

Terrain: Rolling

S_{FF} = 70.0 mph S_{FR} = 45.0 mph

Sketch (show lanes, L_A, L_D,V_R,V_f)

Downstream Adj Ramp

☐ Yes ☐ On

☑ No ☐ Off

L_{down} = ft

V_D = veh/h

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	%Truck	%Rv	f_{HV}	f_p	v = V/PHF x f_{HV} x f_p
Freeway	7030	0.90	Rolling	6	0	0.917	1.00	8514
Ramp	430	0.90	Level	2	0	0.990	1.00	483
UpStream	740	0.90	Level	2	0	0.990	1.00	830
DownStream								

Merge Areas

Estimation of v_{12}

$$V_{12} = V_F (P_{FM})$$

L_{EQ} = (Equation 25-2 or 25-3)

P_{FM} = 0.812 using Equation (Exhibit 25-5)

V_{12} = 4881 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
V_{FO}	6497	See Exhibit 25-7	No
V_{R12}	5364	4600:All	Yes

Level of Service Determination (if not F)

$$D_R = 5.475 + 0.00734 v_R + 0.0078 V_{12} - 0.00627 L_A$$

D_R = 30.5 (pc/mi/ln)

LOS = F (Exhibit 25-4)

Speed Estimation

M_S = 0.916 (Exibit 25-19)

S_R= 44.3 mph (Exhibit 25-19)

S_0= 69.8 mph (Exhibit 25-19)

S = 47.4 mph (Exhibit 25-14)

Diverge Areas

Estimation of v_{12}

$$V_{12} = V_R + (V_F - V_R)P_{FD}$$

L_{EQ} = (Equation 25-8 or 25-9)

P_{FD} = using Equation (Exhibit 25-11)

V_{12} = pc/h

Capacity Checks

	Actual	Maximum	LOS F?
$V_{FI} = V_F$			
V_{12}			
$V_{FO} = V_F - V_R$			
V_R			

Level of Service Determination (if not F)

$$D_R = 4.252 + 0.0086 V_{12} - 0.0009 L_D$$

D_R = (pc/mi/ln)

LOS = (Exhibit 25-4)

Speed Estimation

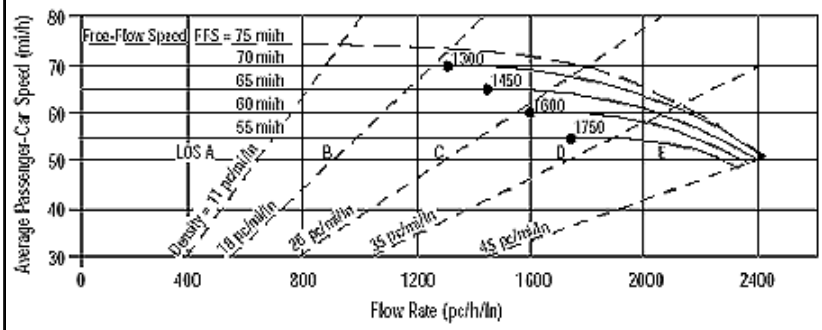
D_s = (Exhibit 25-19)

S_R= mph (Exhibit 25-19)

S_0= mph (Exhibit 25-19)

S = mph (Exhibit 25-15)

BASIC FREEWAY SEGMENTS WORKSHEET



Application	Input	Output
Operational (LOS)	FFS, N, v_p	LOS, S, D
Design (N)	FFS, LOS, v_p	N, S, D
Design (v_p)	FFS, LOS, N	v_p, S, D
Planning (LOS)	FFS, N, AADT	LOS, S, D
Planning (N)	FFS, LOS, AADT	N, S, D
Planning (v_p)	FFS, LOS, N	v_p, S, D

General Information

Analyst	*SST*
Agency or Company	*DEA*
Date Performed	*6/23/2007*
Analysis Time Period	*AM Peak*

Site Information

Highway/Direction of Travel	*Southbound I-25*
From/To	*Arapahoe to Dry Creek*
Jurisdiction	*Arapahoe County*
Analysis Year	*2006*

Project Description Existing Conditions

☑ Oper.(LOS) ☐ Des.(N) ☐ Planning Data

Flow Inputs

Volume, V	*4920*	veh/h	Peak-Hour Factor, PHF	*0.90*
AADT		veh/day	%Trucks and Buses, P_T	*6*
Peak-Hr Prop. of AADT, K			%RVs, P_R	*0*
Peak-Hr Direction Prop, D			General Terrain:	*Rolling*
DDHV = AADT x K x D		veh/h	Grade % Length	*mi*
Driver type adjustment	*1.00*		Up/Down %	

Calculate Flow Adjustments

f_p	*1.00*	E_R	*2.0*
E_T	*2.5*	$f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$	*0.917*

Speed Inputs

Lane Width	*12.0*	ft
Rt-Shoulder Lat. Clearance	*6.0*	ft
Interchange Density	*0.50*	I/mi
Number of Lanes, N	*5*	
FFS (measured)	*70.0*	mi/h
Base free-flow Speed, BFFS		mi/h

Calc Speed Adj and FFS

f_{LW}		mi/h
f_{LC}		mi/h
f_{ID}		mi/h
f_N		mi/h
FFS	*70.0*	mi/h

LOS and Performance Measures

Operational (LOS)

v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	*1192*	pc/h/ln
S	*70.0*	mi/h
D = v_p / S	*17.0*	pc/mi/ln
LOS	*B*	

Design (N)

Design (N)

Design LOS	
v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	pc/h
S	mi/h
D = v_p / S	pc/mi/ln
Required Number of Lanes, N	

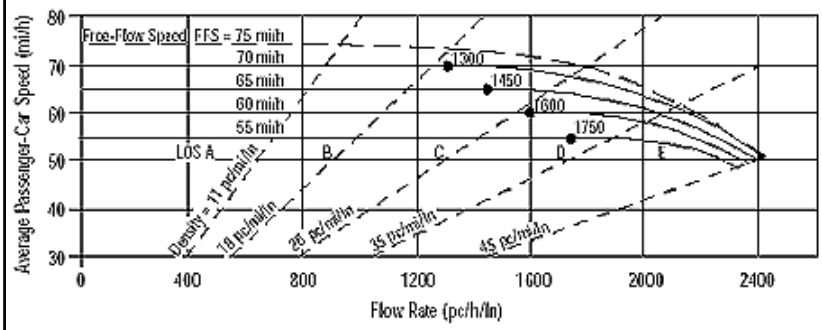
Glossary

N - Number of lanes	S - Speed
V - Hourly volume	D - Density
v_p - Flow rate	FFS - Free-flow speed
LOS - Level of service	BFFS - Base free-flow speed
DDHV - Directional design hour volume	

Factor Location

E_R - Exhibits23-8, 23-10	f_{LW} - Exhibit 23-4
E_T - Exhibits 23-8, 23-10, 23-11	f_{LC} - Exhibit 23-5
f_p - Page 23-12	f_N - Exhibit 23-6
LOS, S, FFS, v_p - Exhibits 23-2, 23-3	f_{ID} - Exhibit 23-7

BASIC FREEWAY SEGMENTS WORKSHEET



Application	Input	Output
Operational (LOS)	FFS, N, v_p	LOS, S, D
Design (N)	FFS, LOS, v_p	N, S, D
Design (v_p)	FFS, LOS, N	v_p, S, D
Planning (LOS)	FFS, N, AADT	LOS, S, D
Planning (N)	FFS, LOS, AADT	N, S, D
Planning (v_p)	FFS, LOS, N	v_p, S, D

General Information

Analyst	*SST*
Agency or Company	*DEA*
Date Performed	*6/23/2007*
Analysis Time Period	*PM Peak*

Site Information

Highway/Direction of Travel	*Southbound I-25*
From/To	*Arapahoe to Dry Creek*
Jurisdiction	*Arapahoe County*
Analysis Year	*2006*

Project Description Existing Conditions

☑ Oper.(LOS) ☐ Des.(N) ☐ Planning Data

Flow Inputs

Volume, V	*7460*	veh/h	Peak-Hour Factor, PHF	*0.90*
AADT		veh/day	%Trucks and Buses, P_T	*6*
Peak-Hr Prop. of AADT, K			%RVs, P_R	*0*
Peak-Hr Direction Prop, D			General Terrain:	*Rolling*
DDHV = AADT x K x D		veh/h	Grade % Length	*mi*
Driver type adjustment	*1.00*		Up/Down %	

Calculate Flow Adjustments

f_p	*1.00*	E_R	*2.0*
E_T	*2.5*	$f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$	*0.917*

Speed Inputs

Lane Width	*12.0*	ft
Rt-Shoulder Lat. Clearance	*6.0*	ft
Interchange Density	*0.50*	I/mi
Number of Lanes, N	*5*	
FFS (measured)	*70.0*	mi/h
Base free-flow Speed, BFFS		mi/h

Calc Speed Adj and FFS

f_{LW}		mi/h
f_{LC}		mi/h
f_{ID}		mi/h
f_N		mi/h
FFS	*70.0*	mi/h

LOS and Performance Measures

Operational (LOS)

v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	*1807*	pc/h/ln
S	*67.8*	mi/h
D = v_p / S	*26.7*	pc/mi/ln
LOS	*D*	

Design (N)

Design (N)

Design LOS	
v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	pc/h
S	mi/h
D = v_p / S	pc/mi/ln
Required Number of Lanes, N	

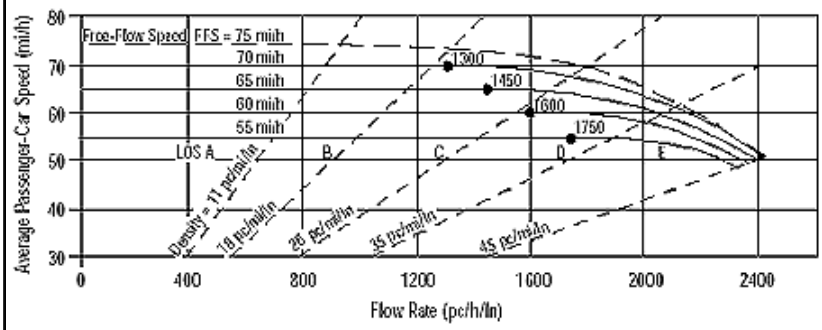
Glossary

N - Number of lanes	S - Speed
V - Hourly volume	D - Density
v_p - Flow rate	FFS - Free-flow speed
LOS - Level of service	BFFS - Base free-flow speed
DDHV - Directional design hour volume	

Factor Location

E_R - Exhibits23-8, 23-10	f_{LW} - Exhibit 23-4
E_T - Exhibits 23-8, 23-10, 23-11	f_{LC} - Exhibit 23-5
f_p - Page 23-12	f_N - Exhibit 23-6
LOS, S, FFS, v_p - Exhibits 23-2, 23-3	f_{ID} - Exhibit 23-7

BASIC FREEWAY SEGMENTS WORKSHEET



Application	Input	Output
Operational (LOS)	FFS, N, v_p	LOS, S, D
Design (N)	FFS, LOS, v_p	N, S, D
Design (v_p)	FFS, LOS, N	v_p, S, D
Planning (LOS)	FFS, N, AADT	LOS, S, D
Planning (N)	FFS, LOS, AADT	N, S, D
Planning (v_p)	FFS, LOS, N	v_p, S, D

General Information

Analyst	*SST*
Agency or Company	*DEA*
Date Performed	*6/23/2007*
Analysis Time Period	*AM Peak*

Site Information

Highway/Direction of Travel	*Northbound I-25*
From/To	
Jurisdiction	*Arapahoe County*
Analysis Year	*2006*

Project Description Existing Conditions

☑ Oper.(LOS) ☐ Des.(N) ☐ Planning Data

Flow Inputs

Volume, V	*6810*	veh/h	Peak-Hour Factor, PHF	*0.90*
AADT		veh/day	%Trucks and Buses, P_T	*6*
Peak-Hr Prop. of AADT, K			%RVs, P_R	*0*
Peak-Hr Direction Prop, D			General Terrain:	*Rolling*
DDHV = AADT x K x D		veh/h	Grade % Length	*mi*
Driver type adjustment	*1.00*		Up/Down %	

Calculate Flow Adjustments

f_p	*1.00*	E_R	*2.0*
E_T	*2.5*	$f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$	*0.917*

Speed Inputs

Lane Width	*12.0*	ft
Rt-Shoulder Lat. Clearance	*6.0*	ft
Interchange Density	*0.50*	I/mi
Number of Lanes, N	*5*	
FFS (measured)	*70.0*	mi/h
Base free-flow Speed, BFFS		mi/h

Calc Speed Adj and FFS

f_{LW}		mi/h
f_{LC}		mi/h
f_{ID}		mi/h
f_N		mi/h
FFS	*70.0*	mi/h

LOS and Performance Measures

Operational (LOS)

v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	*1650*	pc/h/ln
S	*69.2*	mi/h
D = v_p / S	*23.9*	pc/mi/ln
LOS	*C*	

Design (N)

Design (N)

Design LOS		
v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)		pc/h
S		mi/h
D = v_p / S		pc/mi/ln
Required Number of Lanes, N		

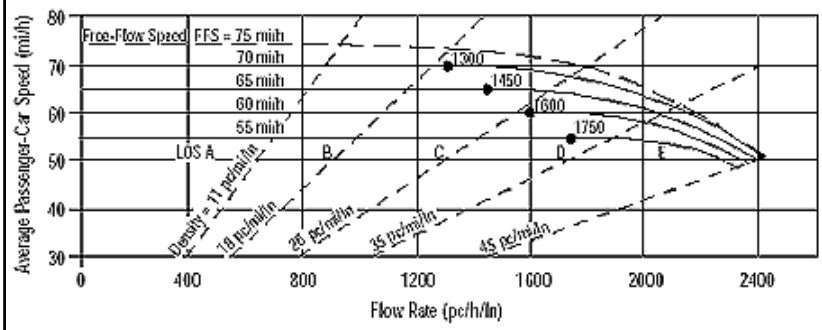
Glossary

N - Number of lanes	S - Speed
V - Hourly volume	D - Density
v_p - Flow rate	FFS - Free-flow speed
LOS - Level of service	BFFS - Base free-flow speed
DDHV - Directional design hour volume	

Factor Location

E_R - Exhibits23-8, 23-10	f_{LW} - Exhibit 23-4
E_T - Exhibits 23-8, 23-10, 23-11	f_{LC} - Exhibit 23-5
f_p - Page 23-12	f_N - Exhibit 23-6
LOS, S, FFS, v_p - Exhibits 23-2, 23-3	f_{ID} - Exhibit 23-7

BASIC FREEWAY SEGMENTS WORKSHEET



Application	Input	Output
Operational (LOS)	FFS, N, v_p	LOS, S, D
Design (N)	FFS, LOS, v_p	N, S, D
Design (v_p)	FFS, LOS, N	v_p, S, D
Planning (LOS)	FFS, N, AADT	LOS, S, D
Planning (N)	FFS, LOS, AADT	N, S, D
Planning (v_p)	FFS, LOS, N	v_p, S, D

General Information

Analyst	*SST*
Agency or Company	*DEA*
Date Performed	*6/23/2007*
Analysis Time Period	*PM Peak*

Site Information

Highway/Direction of Travel	*Northbound I-25*
From/To	*Dry Creek to Arapahoe*
Jurisdiction	*Arapahoe County*
Analysis Year	*2006*

Project Description Existing Conditions

☑ Oper.(LOS) ☐ Des.(N) ☐ Planning Data

Flow Inputs

Volume, V	*4820*	veh/h	Peak-Hour Factor, PHF	*0.90*
AADT		veh/day	%Trucks and Buses, P_T	*6*
Peak-Hr Prop. of AADT, K			%RVs, P_R	*0*
Peak-Hr Direction Prop, D			General Terrain:	*Rolling*
DDHV = AADT x K x D		veh/h	Grade % Length	*mi*
Driver type adjustment	*1.00*		Up/Down %	

Calculate Flow Adjustments

f_p	*1.00*	E_R	*2.0*
E_T	*2.5*	$f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$	*0.917*

Speed Inputs

Lane Width	*12.0*	ft
Rt-Shoulder Lat. Clearance	*6.0*	ft
Interchange Density	*0.50*	I/mi
Number of Lanes, N	*5*	
FFS (measured)	*70.0*	mi/h
Base free-flow Speed, BFFS		mi/h

Calc Speed Adj and FFS

f_{LW}		mi/h
f_{LC}		mi/h
f_{ID}		mi/h
f_N		mi/h
FFS	*70.0*	mi/h

LOS and Performance Measures

Operational (LOS)

v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	*1168*	pc/h/ln
S	*70.0*	mi/h
D = v_p / S	*16.7*	pc/mi/ln
LOS	*B*	

Design (N)

Design (N)

Design LOS	
v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	pc/h
S	mi/h
D = v_p / S	pc/mi/ln
Required Number of Lanes, N	

Glossary

N - Number of lanes	S - Speed
V - Hourly volume	D - Density
v_p - Flow rate	FFS - Free-flow speed
LOS - Level of service	BFFS - Base free-flow speed
DDHV - Directional design hour volume	

Factor Location

E_R - Exhibits23-8, 23-10	f_{LW} - Exhibit 23-4
E_T - Exhibits 23-8, 23-10, 23-11	f_{LC} - Exhibit 23-5
f_p - Page 23-12	f_N - Exhibit 23-6
LOS, S, FFS, v_p - Exhibits 23-2, 23-3	f_{ID} - Exhibit 23-7

RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information / Site Information

Analyst	SST	Freeway/Dir of Travel	Northbound I-25
Agency or Company	DEA	Junction	Arapahoe Exit Ramp
Date Performed	6/23/2007	Jurisdiction	Arapahoe County
Analysis Time Period	AM Peak	Analysis Year	2006

Project Description Existing Conditions

Inputs

Upstream Adj Ramp
☐ Yes ☐ On
☑ No ☐ Off
L_{up} = ft
V_u = veh/h

Terrain: Rolling

S_{FF} = 70.0 mph S_{FR} = 45.0 mph

Sketch (show lanes, L_A, L_D,V_R,V_f)

Downstream Adj Ramp
☑ Yes ☑ On
☐ No ☐ Off
L_{down} = 700 ft
V_D = 520 veh/h

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	%Truck	%Rv	f_{HV}	f_p	v = V/PHF x f_{HV} x f_p
Freeway	6810	0.90	Rolling	6	0	0.917	1.00	8248
Ramp	980	0.90	Level	2	0	0.990	1.00	1100
UpStream								
DownStream	520	0.90	Level	2	0	0.990	1.00	584

Merge Areas

Estimation of v_{12}

$V_{12} = V_F (P_{FM})$

L_{EQ} = (Equation 25-2 or 25-3)

P_{FM} = using Equation (Exhibit 25-5)

V_{12} = pc/h

Capacity Checks

	Actual	Maximum	LOS F?
V_{FO}			
V_{R12}			

Level of Service Determination (if not F)

$D_R = 5.475 + 0.00734 v_R + 0.0078 V_{12} - 0.00627 L_A$

D_R = (pc/mi/ln)

LOS = (Exhibit 25-4)

Speed Estimation

M_S = (Exibit 25-19)

S_R= mph (Exhibit 25-19)

S_0= mph (Exhibit 25-19)

S = mph (Exhibit 25-14)

Diverge Areas

Estimation of v_{12}

$V_{12} = V_R + (V_F - V_R)P_{FD}$

L_{EQ} = (Equation 25-8 or 25-9)

P_{FD} = 0.260 using Equation (Exhibit 25-11)

V_{12} = 2530 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
$V_{FI} = V_F$	6599	9600	No
V_{12}	2530	4400:All	No
$V_{FO} = V_F - V_R$	5499	9600	No
V_R	1100	4100	No

Level of Service Determination (if not F)

$D_R = 4.252 + 0.0086 V_{12} - 0.0009 L_D$

D_R = 2.3 (pc/mi/ln)

LOS = A (Exhibit 25-4)

Speed Estimation

D_s = 0.397 (Exhibit 25-19)

S_R= 58.9 mph (Exhibit 25-19)

S_0= 72.8 mph (Exhibit 25-19)

S = 66.7 mph (Exhibit 25-15)

RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information / Site Information

Analyst	SST	Freeway/Dir of Travel	Northbound I-25
Agency or Company	DEA	Junction	Arapahoe Exit Ramp
Date Performed	6/23/2007	Jurisdiction	Arapahoe County
Analysis Time Period	PM Peak	Analysis Year	2006

Project Description Existing Conditions

Inputs

Upstream Adj Ramp
☐ Yes ☐ On
☑ No ☐ Off
L_{up} = ft
V_u = veh/h

Terrain: Rolling

S_{FF} = 70.0 mph S_{FR} = 45.0 mph

Sketch (show lanes, L_A, L_D,V_R,V_f)

Downstream Adj Ramp
☑ Yes ☑ On
☐ No ☐ Off
L_{down} = 700 ft
V_D = 520 veh/h

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	%Truck	%Rv	f_{HV}	f_p	v = V/PHF x f_{HV} x f_p
Freeway	4820	0.90	Rolling	6	0	0.917	1.00	5838
Ramp	755	0.90	Level	2	0	0.990	1.00	847
UpStream								
DownStream	520	0.90	Level	2	0	0.990	1.00	584

Merge Areas

Estimation of v_{12}

$V_{12} = V_F (P_{FM})$

L_{EQ} = (Equation 25-2 or 25-3)

P_{FM} = using Equation (Exhibit 25-5)

V_{12} = pc/h

Capacity Checks

	Actual	Maximum	LOS F?
V_{FO}			
V_{R12}			

Level of Service Determination (if not F)

$D_R = 5.475 + 0.00734\ v_R + 0.0078\ V_{12} - 0.00627\ L_A$

D_R = (pc/mi/ln)

LOS = (Exhibit 25-4)

Speed Estimation

M_S = (Exibit 25-19)

S_R = mph (Exhibit 25-19)

S_0 = mph (Exhibit 25-19)

S = mph (Exhibit 25-14)

Diverge Areas

Estimation of v_{12}

$V_{12} = V_R + (V_F - V_R)P_{FD}$

L_{EQ} = (Equation 25-8 or 25-9)

P_{FD} = 0.260 using Equation (Exhibit 25-11)

V_{12} = 1917 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
$V_{FI} = V_F$	4963	9600	No
V_{12}	1917	4400:All	No
$V_{FO} = V_F - V_R$	4116	9600	No
V_R	847	4100	No

Level of Service Determination (if not F)

$D_R = 4.252 + 0.0086\ V_{12} - 0.0009\ L_D$

D_R = -3.0 (pc/mi/ln)

LOS = A (Exhibit 25-4)

Speed Estimation

D_s = 0.374 (Exhibit 25-19)

S_R = 59.5 mph (Exhibit 25-19)

S_0 = 74.8 mph (Exhibit 25-19)

S = 68.0 mph (Exhibit 25-15)

RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information / Site Information

Analyst	SST	Freeway/Dir of Travel	Northbound I-25
Agency or Company	DEA	Junction	Arapahoe Loop Ramp
Date Performed	6/23/2007	Jurisdiction	Arapahoe County
Analysis Time Period	AM Peak	Analysis Year	2006

Project Description Existing Conditions

Inputs

Upstream Adj Ramp

☐ Yes ☐ On

☑ No ☐ Off

L_{up} = ft

V_u = veh/h

Terrain: Rolling

S_{FF} = 70.0 mph S_{FR} = 25.0 mph

Sketch (show lanes, L_A, L_D,V_R,V_f)

Downstream Adj Ramp

☑ Yes ☑ On

☐ No ☐ Off

L_{down} = 800 ft

V_D = 710 veh/h

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	%Truck	%Rv	f_{HV}	f_p	v = V/PHF x f_{HV} x f_p
Freeway	5830	0.90	Rolling	6	0	0.917	1.00	7061
Ramp	470	0.90	Level	2	0	0.990	1.00	527
UpStream								
DownStream	710	0.90	Level	2	0	0.990	1.00	797

Merge Areas

Estimation of v_{12}

$V_{12} = V_F (P_{FM})$

L_{EQ} = (Equation 25-2 or 25-3)

P_{FM} = 0.209 using Equation (Exhibit 25-5)

V_{12} = 1077 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
V_{FO}	5682	See Exhibit 25-7	No
V_{R12}	1604	4600:All	No

Level of Service Determination (if not F)

$D_R = 5.475 + 0.00734 v_R + 0.0078 V_{12} - 0.00627 L_A$

D_R = -8.8 (pc/mi/ln)

LOS = A (Exhibit 25-4)

Speed Estimation

M_S = 0.128 (Exibit 25-19)

S_R= 66.4 mph (Exhibit 25-19)

S_0= 64.5 mph (Exhibit 25-19)

S = 65.0 mph (Exhibit 25-14)

Diverge Areas

Estimation of v_{12}

$V_{12} = V_R + (V_F - V_R)P_{FD}$

L_{EQ} = (Equation 25-8 or 25-9)

P_{FD} = using Equation (Exhibit 25-11)

V_{12} = pc/h

Capacity Checks

	Actual	Maximum	LOS F?
$V_{FI} = V_F$			
V_{12}			
$V_{FO} = V_F - V_R$			
V_R			

Level of Service Determination (if not F)

$D_R = 4.252 + 0.0086 V_{12} - 0.0009 L_D$

D_R = (pc/mi/ln)

LOS = (Exhibit 25-4)

Speed Estimation

D_s = (Exhibit 25-19)

S_R= mph (Exhibit 25-19)

S_0= mph (Exhibit 25-19)

S = mph (Exhibit 25-15)

RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information / Site Information

Analyst	SST	Freeway/Dir of Travel	Northbound I-25
Agency or Company	DEA	Junction	Arapahoe Loop Ramp
Date Performed	6/23/2007	Jurisdiction	Arapahoe County
Analysis Time Period	PM Peak	Analysis Year	2006

Project Description Existing Conditions

Inputs

Upstream Adj Ramp

☐ Yes ☐ On

☑ No ☐ Off

L_{up} = ft

V_u = veh/h

Terrain: Rolling

S_{FF} = 70.0 mph S_{FR} = 25.0 mph

Sketch (show lanes, L_A, L_D,V_R,V_f)

Downstream Adj Ramp

☑ Yes ☑ On

☐ No ☐ Off

L_{down} = 800 ft

V_D = 490 veh/h

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	%Truck	%Rv	f_{HV}	f_p	v = V/PHF x f_{HV} x f_p
Freeway	4065	0.90	Rolling	6	0	0.917	1.00	4923
Ramp	670	0.90	Level	2	0	0.990	1.00	752
UpStream								
DownStream	490	0.90	Level	2	0	0.990	1.00	550

Merge Areas

Estimation of v_{12}

$$V_{12} = V_F (P_{FM})$$

L_{EQ} = (Equation 25-2 or 25-3)

P_{FM} = 0.209 using Equation (Exhibit 25-5)

V_{12} = 803 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
V_{FO}	4592	See Exhibit 25-7	No
V_{R12}	1555	4600:All	No

Level of Service Determination (if not F)

$$D_R = 5.475 + 0.00734 v_R + 0.0078 V_{12} - 0.00627 L_A$$

D_R = -9.3 (pc/mi/ln)

LOS = A (Exhibit 25-4)

Speed Estimation

M_S = 0.127 (Exibit 25-19)

S_R= 66.4 mph (Exhibit 25-19)

S_0= 66.3 mph (Exhibit 25-19)

S = 66.4 mph (Exhibit 25-14)

Diverge Areas

Estimation of v_{12}

$$V_{12} = V_R + (V_F - V_R)P_{FD}$$

L_{EQ} = (Equation 25-8 or 25-9)

P_{FD} = using Equation (Exhibit 25-11)

V_{12} = pc/h

Capacity Checks

	Actual	Maximum	LOS F?
$V_{FI} = V_F$			
V_{12}			
$V_{FO} = V_F - V_R$			
V_R			

Level of Service Determination (if not F)

$$D_R = 4.252 + 0.0086 V_{12} - 0.0009 L_D$$

D_R = (pc/mi/ln)

LOS = (Exhibit 25-4)

Speed Estimation

D_s = (Exhibit 25-19)

S_R= mph (Exhibit 25-19)

S_0= mph (Exhibit 25-19)

S = mph (Exhibit 25-15)

RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information / Site Information

Analyst	SST	Freeway/Dir of Travel	Northbound I-25
Agency or Company	DEA	Junction	Arapahoe On Ramp
Date Performed	6/23/2007	Jurisdiction	Arapahoe County
Analysis Time Period	AM Peak	Analysis Year	2006

Project Description Existing Conditions

Inputs

Upstream Adj Ramp

☑ Yes ☑ On

☐ No ☐ Off

L_{up} = 800 ft

V_u = 470 veh/h

Terrain: Rolling

S_{FF} = 70.0 mph S_{FR} = 45.0 mph

Sketch (show lanes, L_A, L_D,V_R,V_f)

Downstream Adj Ramp

☐ Yes ☐ On

☑ No ☐ Off

L_{down} = ft

V_D = veh/h

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	%Truck	%Rv	f_{HV}	f_p	v = V/PHF x f_{HV} x f_p
Freeway	6300	0.90	Rolling	6	0	0.917	1.00	7630
Ramp	1000	0.90	Level	2	0	0.990	1.00	1122
UpStream	470	0.90	Level	2	0	0.990	1.00	527
DownStream								

Merge Areas

Estimation of v_{12}

$$V_{12} = V_F (P_{FM})$$

L_{EQ} = (Equation 25-2 or 25-3)

P_{FM} = 0.732 using Equation (Exhibit 25-5)

V_{12} = 3992 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
V_{FO}	6578	See Exhibit 25-7	No
V_{R12}	5114	4600:All	Yes

Level of Service Determination (if not F)

$$D_R = 5.475 + 0.00734 v_R + 0.0078 V_{12} - 0.00627 L_A$$

D_R = 28.3 (pc/mi/ln)

LOS = F (Exhibit 25-4)

Speed Estimation

M_S = 0.732 (Exibit 25-19)

S_R= 49.5 mph (Exhibit 25-19)

S_0= 69.2 mph (Exhibit 25-19)

S = 52.8 mph (Exhibit 25-14)

Diverge Areas

Estimation of v_{12}

$$V_{12} = V_R + (V_F - V_R)P_{FD}$$

L_{EQ} = (Equation 25-8 or 25-9)

P_{FD} = using Equation (Exhibit 25-11)

V_{12} = pc/h

Capacity Checks

	Actual	Maximum	LOS F?
$V_{FI} = V_F$			
V_{12}			
$V_{FO} = V_F - V_R$			
V_R			

Level of Service Determination (if not F)

$$D_R = 4.252 + 0.0086 V_{12} - 0.0009 L_D$$

D_R = (pc/mi/ln)

LOS = (Exhibit 25-4)

Speed Estimation

D_s = (Exhibit 25-19)

S_R= mph (Exhibit 25-19)

S_0= mph (Exhibit 25-19)

S = mph (Exhibit 25-15)

RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information / Site Information

Analyst	SST	Freeway/Dir of Travel	Northbound I-25
Agency or Company	DEA	Junction	Arapahoe On Ramp
Date Performed	6/23/2007	Jurisdiction	Arapahoe County
Analysis Time Period	PM Peak	Analysis Year	2006

Project Description Existing Conditions

Inputs

Upstream Adj Ramp

☑ Yes ☑ On

☐ No ☐ Off

L_{up} = 800 ft

V_u = 520 veh/h

Terrain: Rolling

S_{FF} = 70.0 mph S_{FR} = 45.0 mph

Sketch (show lanes, L_A, L_D,V_R,V_f)

Downstream Adj Ramp

☐ Yes ☐ On

☑ No ☐ Off

L_{down} = ft

V_D = veh/h

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	%Truck	%Rv	f_{HV}	f_p	v = V/PHF x f_{HV} x f_p
Freeway	4735	0.90	Rolling	6	0	0.917	1.00	5735
Ramp	590	0.90	Level	2	0	0.990	1.00	662
UpStream	520	0.90	Level	2	0	0.990	1.00	584
DownStream								

Merge Areas

Estimation of v_{12}

$$V_{12} = V_F (P_{FM})$$

L_{EQ} = (Equation 25-2 or 25-3)

P_{FM} = 0.789 using Equation (Exhibit 25-5)

V_{12} = 3440 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
V_{FO}	5021	See Exhibit 25-7	No
V_{R12}	4102	4600:All	No

Level of Service Determination (if not F)

$$D_R = 5.475 + 0.00734 v_R + 0.0078 V_{12} - 0.00627 L_A$$

D_R = 20.6 (pc/mi/ln)

LOS = C (Exhibit 25-4)

Speed Estimation

M_S = 0.319 (Exibit 25-19)

S_R= 61.1 mph (Exhibit 25-19)

S_0= 70.0 mph (Exhibit 25-19)

S = 62.5 mph (Exhibit 25-14)

Diverge Areas

Estimation of v_{12}

$$V_{12} = V_R + (V_F - V_R)P_{FD}$$

L_{EQ} = (Equation 25-8 or 25-9)

P_{FD} = using Equation (Exhibit 25-11)

V_{12} = pc/h

Capacity Checks

	Actual	Maximum	LOS F?
$V_{FI} = V_F$			
V_{12}			
$V_{FO} = V_F - V_R$			
V_R			

Level of Service Determination (if not F)

$$D_R = 4.252 + 0.0086 V_{12} - 0.0009 L_D$$

D_R = (pc/mi/ln)

LOS = (Exhibit 25-4)

Speed Estimation

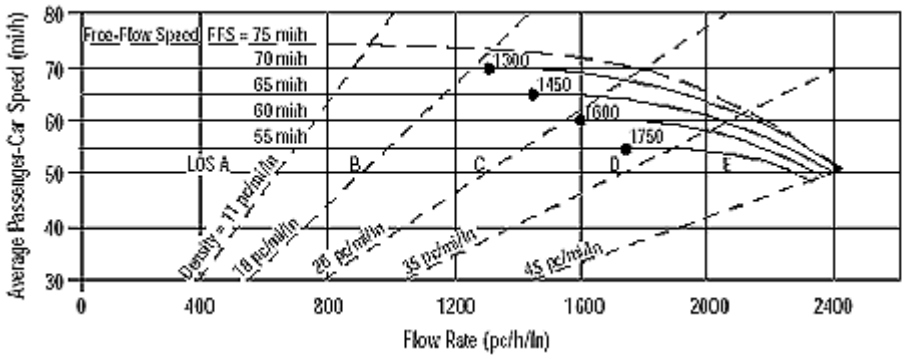
D_s = (Exhibit 25-19)

S_R= mph (Exhibit 25-19)

S_0= mph (Exhibit 25-19)

S = mph (Exhibit 25-15)

BASIC FREEWAY SEGMENTS WORKSHEET



Application	Input	Output
Operational (LOS)	FFS, N, v_p	LOS, S, D
Design (N)	FFS, LOS, v_p	N, S, D
Design (v_p)	FFS, LOS, N	v_p, S, D
Planning (LOS)	FFS, N, AADT	LOS, S, D
Planning (N)	FFS, LOS, AADT	N, S, D
Planning (v_p)	FFS, LOS, N	v_p, S, D

General Information

Analyst	*SST*
Agency or Company	*DEA*
Date Performed	*6/23/2007*
Analysis Time Period	*AM Peak*

Site Information

Highway/Direction of Travel	*Northbound I-25*
From/To	*Arapahoe to Orchard*
Jurisdiction	*Arapahoe County*
Analysis Year	*2006*

Project Description Existing Conditions

☑ Oper.(LOS) ☐ Des.(N) ☐ Planning Data

Flow Inputs

Volume, V	*7300*	veh/h	Peak-Hour Factor, PHF	*0.90*
AADT		veh/day	%Trucks and Buses, P_T	*7*
Peak-Hr Prop. of AADT, K			%RVs, P_R	*0*
Peak-Hr Direction Prop, D			General Terrain:	*Rolling*
DDHV = AADT x K x D		veh/h	Grade % Length	*mi*
Driver type adjustment	*1.00*		Up/Down %	

Calculate Flow Adjustments

f_p	*1.00*	E_R	*2.0*
E_T	*2.5*	$f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$	*0.905*

Speed Inputs

Lane Width	*12.0*	ft
Rt-Shoulder Lat. Clearance	*6.0*	ft
Interchange Density	*0.50*	I/mi
Number of Lanes, N	*5*	
FFS (measured)	*70.0*	mi/h
Base free-flow Speed, BFFS		mi/h

Calc Speed Adj and FFS

f_{LW}		mi/h
f_{LC}		mi/h
f_{ID}		mi/h
f_N		mi/h
FFS	*70.0*	mi/h

LOS and Performance Measures

Operational (LOS)

v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	*1793*	pc/h/ln
S	*67.9*	mi/h
D = v_p / S	*26.4*	pc/mi/ln
LOS	*D*	

Design (N)

Design (N)

Design LOS	
v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	pc/h
S	mi/h
D = v_p / S	pc/mi/ln
Required Number of Lanes, N	

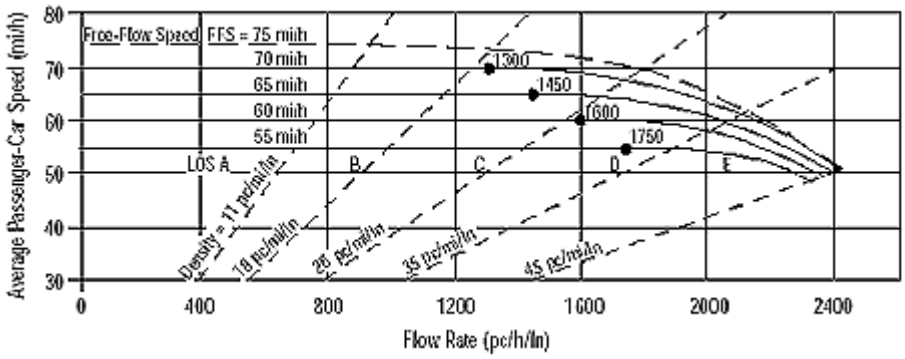
Glossary

N - Number of lanes	S - Speed
V - Hourly volume	D - Density
v_p - Flow rate	FFS - Free-flow speed
LOS - Level of service	BFFS - Base free-flow speed

Factor Location

E_R - Exhibits23-8, 23-10	f_{LW} - Exhibit 23-4
E_T - Exhibits 23-8, 23-10, 23-11	f_{LC} - Exhibit 23-5
f_p - Page 23-12	f_N - Exhibit 23-6

BASIC FREEWAY SEGMENTS WORKSHEET



Application	Input	Output
Operational (LOS)	FFS, N, v_p	LOS, S, D
Design (N)	FFS, LOS, v_p	N, S, D
Design (v_p)	FFS, LOS, N	v_p, S, D
Planning (LOS)	FFS, N, AADT	LOS, S, D
Planning (N)	FFS, LOS, AADT	N, S, D
Planning (v_p)	FFS, LOS, N	v_p, S, D

General Information

Analyst	*SST*
Agency or Company	*DEA*
Date Performed	*6/23/2007*
Analysis Time Period	*PM Peak*

Site Information

Highway/Direction of Travel	*Northbound I-25*
From/To	*Arapahoe to Orchard*
Jurisdiction	*Arapahoe County*
Analysis Year	*2006*

Project Description Existing Conditions

☑ Oper.(LOS) ☐ Des.(N) ☐ Planning Data

Flow Inputs

Volume, V	*5325*	veh/h	Peak-Hour Factor, PHF	*0.90*
AADT		veh/day	%Trucks and Buses, P_T	*7*
Peak-Hr Prop. of AADT, K			%RVs, P_R	*0*
Peak-Hr Direction Prop, D			General Terrain:	*Rolling*
DDHV = AADT x K x D		veh/h	Grade % Length	*mi*
Driver type adjustment	*1.00*		Up/Down %	

Calculate Flow Adjustments

f_p	*1.00*	E_R	*2.0*
E_T	*2.5*	$f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$	*0.905*

Speed Inputs

Lane Width	*12.0*	ft
Rt-Shoulder Lat. Clearance	*6.0*	ft
Interchange Density	*0.50*	I/mi
Number of Lanes, N	*5*	
FFS (measured)	*70.0*	mi/h
Base free-flow Speed, BFFS		mi/h

Calc Speed Adj and FFS

f_{LW}		mi/h
f_{LC}		mi/h
f_{ID}		mi/h
f_N		mi/h
FFS	*70.0*	mi/h

LOS and Performance Measures

Operational (LOS)

v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	*1308*	pc/h/ln
S	*70.0*	mi/h
D = v_p / S	*18.7*	pc/mi/ln
LOS	*C*	

Design (N)

Design (N)

Design LOS	
v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	pc/h
S	mi/h
D = v_p / S	pc/mi/ln
Required Number of Lanes, N	

Glossary

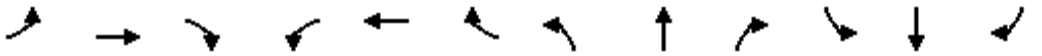
N - Number of lanes	S - Speed
V - Hourly volume	D - Density
v_p - Flow rate	FFS - Free-flow speed
LOS - Level of service	BFFS - Base free-flow speed

Factor Location

E_R - Exhibits23-8, 23-10	f_{LW} - Exhibit 23-4
E_T - Exhibits 23-8, 23-10, 23-11	f_{LC} - Exhibit 23-5
f_p - Page 23-12	f_N - Exhibit 23-6

Appendix C

No Build Operational Analysis



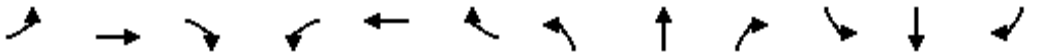
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	265	1720	130	550	2340	715	165	800	245	330	555	110
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0	4.0	4.0	4.0	6.0	4.0	4.0	4.0	4.0	4.0	
Lane Util. Factor	0.97	0.91	1.00	0.97	0.91	1.00	1.00	0.95	1.00	0.97	0.95	
Frt	1.00	1.00	0.85	1.00	1.00	0.85	1.00	1.00	0.85	1.00	0.98	
Flt Protected	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	
Satd. Flow (prot)	3433	5085	1583	3433	5085	1583	1770	3539	1583	3433	3451	
Flt Permitted	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	
Satd. Flow (perm)	3433	5085	1583	3433	5085	1583	1770	3539	1583	3433	3451	
Peak-hour factor, PHF	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
Adj. Flow (vph)	279	1811	137	579	2463	753	174	842	258	347	584	116
RTOR Reduction (vph)	0	0	61	0	0	148	0	0	5	0	14	0
Lane Group Flow (vph)	279	1811	76	579	2463	605	174	842	253	347	686	0
Turn Type	Prot		Perm	Prot		Perm	Prot		pm+ov	Prot		
Protected Phases	5	2		1	6		3	8	1	7	4	
Permitted Phases			2			6			8			
Actuated Green, G (s)	10.9	57.0	57.0	12.0	58.1	58.1	10.0	18.0	30.0	11.0	19.0	
Effective Green, g (s)	11.9	59.0	59.0	13.0	60.1	58.1	11.0	20.0	32.0	12.0	21.0	
Actuated g/C Ratio	0.10	0.49	0.49	0.11	0.50	0.48	0.09	0.17	0.27	0.10	0.18	
Clearance Time (s)	5.0	6.0	6.0	5.0	6.0	6.0	5.0	6.0	5.0	5.0	6.0	
Vehicle Extension (s)	2.0	3.0	3.0	2.0	3.0	3.0	2.0	2.0	2.0	2.0	2.0	
Lane Grp Cap (vph)	340	2500	778	372	2547	766	162	590	422	343	604	
v/s Ratio Prot	0.08	0.36		c0.17	c0.48		0.10	c0.24	0.06	c0.10	0.20	
v/s Ratio Perm			0.05			0.38			0.09			
v/c Ratio	0.82	0.72	0.10	1.56	0.97	0.79	1.07	1.43	0.60	1.01	1.14	
Uniform Delay, d1	53.0	24.1	16.3	53.5	29.0	25.8	54.5	50.0	38.4	54.0	49.5	
Progression Factor	1.00	1.00	1.00	1.36	0.68	0.60	1.00	1.00	1.00	1.00	1.00	
Incremental Delay, d2	14.0	1.9	0.3	251.6	1.7	0.8	91.8	201.9	1.5	51.6	80.1	
Delay (s)	67.0	25.9	16.5	324.2	21.5	16.4	146.3	251.9	39.9	105.6	129.6	
Level of Service	E	C	B	F	C	B	F	F	D	F	F	
Approach Delay (s)		30.5			66.6			194.6			121.6	
Approach LOS		C			E			F			F	

Intersection Summary			
HCM Average Control Delay	83.4	HCM Level of Service	F
HCM Volume to Capacity ratio	1.10		
Actuated Cycle Length (s)	120.0	Sum of lost time (s)	12.0
Intersection Capacity Utilization	97.6%	ICU Level of Service	F
Analysis Period (min)	15		
c Critical Lane Group			

Movement	EBL	EBT	EBR	WBL	WBT	WBR	SBL2	SBL	SBR	NWL	NWR
Lane Configurations											
Volume (vph)	0	765	1530	0	2870	755	1625	0	735	0	0
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1700	1900	1900	1900	1900
Total Lost time (s)		4.0	4.0		4.0	6.0	4.0		4.0		
Lane Util. Factor		0.86	0.86		0.91	1.00	0.97		0.88		
Frt		0.92	0.85		1.00	0.85	1.00		0.85		
Flt Protected		1.00	1.00		1.00	1.00	0.95		1.00		
Satd. Flow (prot)		4441	1362		5085	1583	3072		2842		
Flt Permitted		1.00	1.00		1.00	1.00	0.95		1.00		
Satd. Flow (perm)		4441	1362		5085	1583	3072		2842		
Peak-hour factor, PHF	0.94	0.94	0.92	0.92	0.94	0.94	0.94	0.92	0.94	0.92	0.92
Adj. Flow (vph)	0	814	1663	0	3053	803	1729	0	782	0	0
RTOR Reduction (vph)	0	154	0	0	0	408	0	0	0	0	0
Lane Group Flow (vph)	0	1492	831	0	3053	395	1729	0	782	0	0
Heavy Vehicles (%)	2%	2%	2%	2%	2%	2%	2%	2%	0%	2%	2%
Turn Type			Free			Perm	Prot		custom		
Protected Phases		2			6		4				
Permitted Phases			Free			6			4		
Actuated Green, G (s)		59.0	120.0		59.0	59.0	50.0		50.0		
Effective Green, g (s)		61.0	120.0		61.0	59.0	51.0		51.0		
Actuated g/C Ratio		0.51	1.00		0.51	0.49	0.42		0.42		
Clearance Time (s)		6.0			6.0	6.0	5.0		5.0		
Vehicle Extension (s)		5.0			5.0	5.0	1.5		1.5		
Lane Grp Cap (vph)		2258	1362		2585	778	1306		1208		
v/s Ratio Prot		0.34			c0.60		c0.56				
v/s Ratio Perm			0.61			0.25			0.28		
v/c Ratio		0.91dr	0.61		1.18	0.51	1.32		0.65		
Uniform Delay, d1		21.8	0.0		29.5	20.7	34.5		27.4		
Progression Factor		0.60	1.00		0.76	0.96	1.00		1.00		
Incremental Delay, d2		1.0	1.4		81.9	0.2	151.2		0.9		
Delay (s)		14.2	1.4		104.4	20.0	185.7		28.3		
Level of Service		B	A		F	B	F		C		
Approach Delay (s)		9.9			86.8			136.7		0.0	
Approach LOS		A			F			F		A	

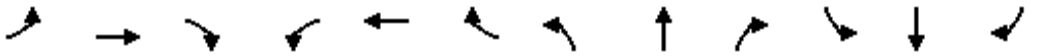
Intersection Summary			
HCM Average Control Delay	79.4	HCM Level of Service	E
HCM Volume to Capacity ratio	1.25		
Actuated Cycle Length (s)	120.0	Sum of lost time (s)	8.0
Intersection Capacity Utilization	113.9%	ICU Level of Service	H
Analysis Period (min)	15		

dr Defacto Right Lane. Recode with 1 though lane as a right lane.
c Critical Lane Group



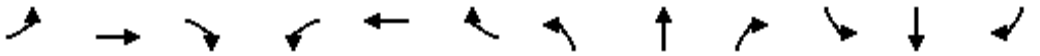
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	0	2390	0	0	4275	40	700	75	960	0	0	100
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)		4.0			4.0		4.0	4.0	5.0			4.0
Lane Util. Factor		0.91			*0.75		0.97	0.95	0.95			0.88
Frt		1.00			1.00		1.00	0.87	0.85			0.85
Flt Protected		1.00			1.00		0.95	1.00	1.00			1.00
Satd. Flow (prot)		5085			5580		3433	1542	1504			2787
Flt Permitted		1.00			1.00		0.95	1.00	1.00			1.00
Satd. Flow (perm)		5085			5580		3433	1542	1504			2787
Peak-hour factor, PHF	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96
Adj. Flow (vph)	0	2490	0	0	4453	42	729	78	1000	0	0	104
RTOR Reduction (vph)	0	0	0	0	1	0	0	80	81	0	0	0
Lane Group Flow (vph)	0	2490	0	0	4494	0	729	468	449	0	0	104
Turn Type							Split		Perm			custom
Protected Phases		2			6		8	8				
Permitted Phases									8			4
Actuated Green, G (s)		80.0			80.0		17.0	17.0	17.0			7.0
Effective Green, g (s)		82.0			82.0		18.0	18.0	17.0			8.0
Actuated g/C Ratio		0.68			0.68		0.15	0.15	0.14			0.07
Clearance Time (s)		6.0			6.0		5.0	5.0	5.0			5.0
Vehicle Extension (s)		5.0			5.0		1.5	1.5	1.5			1.5
Lane Grp Cap (vph)		3475			3813		515	231	213			186
v/s Ratio Prot		0.49			c0.81		0.21	c0.30				
v/s Ratio Perm									0.30			c0.04
v/c Ratio		0.72			1.18		1.42	2.03	2.11			0.56
Uniform Delay, d1		11.8			19.0		51.0	51.0	51.5			54.3
Progression Factor		0.81			0.44		1.00	1.00	1.00			1.00
Incremental Delay, d2		0.1			80.7		198.2	476.8	514.8			2.1
Delay (s)		9.7			89.1		249.2	527.8	566.3			56.4
Level of Service		A			F		F	F	F			E
Approach Delay (s)		9.7			89.1			426.7			56.4	
Approach LOS		A			F			F			E	

Intersection Summary			
HCM Average Control Delay	135.1	HCM Level of Service	F
HCM Volume to Capacity ratio	1.27		
Actuated Cycle Length (s)	120.0	Sum of lost time (s)	12.0
Intersection Capacity Utilization	98.4%	ICU Level of Service	F
Analysis Period (min)	15		
c Critical Lane Group			



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	320	2495	535	45	3700	90	360	95	45	80	125	255
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0	3.0	4.0	4.0	4.0	4.0	4.0		4.0	4.0	4.0
Lane Util. Factor	0.97	0.91	1.00	0.97	*0.50	1.00	0.97	0.95		0.97	0.95	1.00
Frt	1.00	1.00	0.85	1.00	1.00	0.85	1.00	0.95		1.00	1.00	0.85
Flt Protected	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00		0.95	1.00	1.00
Satd. Flow (prot)	3433	5085	1583	3433	3725	1583	3433	3368		3433	3539	1583
Flt Permitted	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00		0.95	1.00	1.00
Satd. Flow (perm)	3433	5085	1583	3433	3725	1583	3433	3368		3433	3539	1583
Peak-hour factor, PHF	0.94	0.94	0.94	0.94	0.94	0.94	0.94	0.94	0.94	0.94	0.94	0.94
Adj. Flow (vph)	340	2654	569	48	3936	96	383	101	48	85	133	271
RTOR Reduction (vph)	0	0	93	0	0	16	0	40	0	0	0	102
Lane Group Flow (vph)	340	2654	476	48	3936	80	383	109	0	85	133	169
Turn Type	Prot		pm+ov	Prot		Perm	Prot			Prot		Perm
Protected Phases	5	2	3	1	6		3	8		7	4	
Permitted Phases			2			6						4
Actuated Green, G (s)	9.0	68.4	82.3	5.7	65.1	65.1	13.9	18.7		6.2	11.0	11.0
Effective Green, g (s)	10.0	70.4	86.3	6.7	67.1	67.1	14.9	19.7		7.2	12.0	12.0
Actuated g/C Ratio	0.08	0.59	0.72	0.06	0.56	0.56	0.12	0.16		0.06	0.10	0.10
Clearance Time (s)	5.0	6.0	5.0	5.0	6.0	6.0	5.0	5.0		5.0	5.0	5.0
Vehicle Extension (s)	1.5	5.0	1.5	1.5	5.0	5.0	1.5	1.5		1.5	1.5	1.5
Lane Grp Cap (vph)	286	2983	1138	192	2083	885	426	553		206	354	158
v/s Ratio Prot	c0.10	c0.52	0.06	0.01	c1.06		c0.11	0.03		0.02	0.04	
v/s Ratio Perm			0.25			0.05						c0.11
v/c Ratio	1.19	0.89	0.42	0.25	1.89	0.09	0.90	0.20		0.41	0.38	1.07
Uniform Delay, d1	55.0	21.4	6.8	54.2	26.4	12.3	51.8	43.3		54.4	50.5	54.0
Progression Factor	1.16	0.47	0.57	1.00	1.00	1.00	1.00	1.00		1.00	1.00	1.00
Incremental Delay, d2	94.4	1.2	0.0	0.2	402.1	0.2	20.7	0.1		0.5	0.2	91.9
Delay (s)	158.2	11.3	3.9	54.5	428.6	12.5	72.5	43.4		54.9	50.7	145.9
Level of Service	F	B	A	D	F	B	E	D		D	D	F
Approach Delay (s)		24.1			414.4			64.4			104.2	
Approach LOS		C			F			E			F	

Intersection Summary			
HCM Average Control Delay	214.9	HCM Level of Service	F
HCM Volume to Capacity ratio	1.63		
Actuated Cycle Length (s)	120.0	Sum of lost time (s)	20.0
Intersection Capacity Utilization	92.2%	ICU Level of Service	F
Analysis Period (min)	15		
c Critical Lane Group			



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	200	1555	185	595	2155	310	345	970	495	665	865	125
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0	4.0	4.0	4.0	6.0	4.0	4.0	5.0	4.0	4.0	
Lane Util. Factor	0.97	0.91	1.00	0.97	0.91	1.00	1.00	0.95	1.00	0.97	0.95	
Frpb, ped/bikes	1.00	1.00	0.99	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	
Flpb, ped/bikes	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	
Frt	1.00	1.00	0.85	1.00	1.00	0.85	1.00	1.00	0.85	1.00	0.98	
Flt Protected	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	
Satd. Flow (prot)	3433	5085	1562	3433	5085	1583	1770	3539	1583	3433	3472	
Flt Permitted	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	
Satd. Flow (perm)	3433	5085	1562	3433	5085	1583	1770	3539	1583	3433	3472	
Peak-hour factor, PHF	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97
Adj. Flow (vph)	206	1603	191	613	2222	320	356	1000	510	686	892	129
RTOR Reduction (vph)	0	0	96	0	0	129	0	0	141	0	9	0
Lane Group Flow (vph)	206	1603	95	613	2222	191	356	1000	369	686	1012	0
Confl. Peds. (#/hr)	1		1									
Turn Type	Prot		Perm	Prot		Perm	Prot		Perm	Prot		
Protected Phases	5	2		1	6		3	8		7	4	
Permitted Phases			2			6			8			
Actuated Green, G (s)	8.8	41.0	41.0	16.0	48.2	48.2	17.0	24.0	24.0	17.0	24.0	
Effective Green, g (s)	9.8	43.0	43.0	17.0	50.2	48.2	18.0	26.0	25.0	18.0	26.0	
Actuated g/C Ratio	0.08	0.36	0.36	0.14	0.42	0.40	0.15	0.22	0.21	0.15	0.22	
Clearance Time (s)	5.0	6.0	6.0	5.0	6.0	6.0	5.0	6.0	6.0	5.0	6.0	
Vehicle Extension (s)	2.0	3.0	3.0	2.0	3.0	3.0	2.0	2.0	2.0	2.0	2.0	
Lane Grp Cap (vph)	280	1822	560	486	2127	636	266	767	330	515	752	
v/s Ratio Prot	0.06	0.32		c0.18	c0.44		0.20	c0.28		0.20	c0.29	
v/s Ratio Perm			0.06			0.12			0.23			
v/c Ratio	0.74	0.88	0.17	1.26	1.04	0.30	1.34	1.30	1.12	1.33	1.35	
Uniform Delay, d1	53.8	36.1	26.3	51.5	34.9	24.4	51.0	47.0	47.5	51.0	47.0	
Progression Factor	1.00	1.00	1.00	1.30	0.80	0.51	1.00	1.00	1.00	1.00	1.00	
Incremental Delay, d2	8.4	6.5	0.7	125.5	27.8	0.7	175.5	146.1	85.4	162.3	164.2	
Delay (s)	62.2	42.5	27.0	192.5	55.9	13.0	226.5	193.1	132.9	213.3	211.2	
Level of Service	E	D	C	F	E	B	F	F	F	F	F	
Approach Delay (s)		43.1			78.1			183.0			212.0	
Approach LOS		D			E			F			F	

Intersection Summary			
HCM Average Control Delay	118.7	HCM Level of Service	F
HCM Volume to Capacity ratio	1.16		
Actuated Cycle Length (s)	120.0	Sum of lost time (s)	8.0
Intersection Capacity Utilization	107.8%	ICU Level of Service	G
Analysis Period (min)	15		

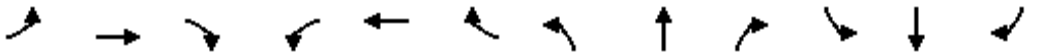
c Critical Lane Group

Movement	EBL	EBT	EBR	WBL	WBT	WBR	SBL2	SBL	SBR	NWL	NWR
Lane Configurations											
Volume (vph)	0	1270	1445	0	2410	1085	980	0	650	0	0
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1700	1900	1900	1900	1900
Total Lost time (s)		4.0	6.0		4.0	6.0	4.0		4.0		
Lane Util. Factor		0.86	0.86		0.91	1.00	0.97		0.88		
Frt		0.94	0.85		1.00	0.85	1.00		0.85		
Flt Protected		1.00	1.00		1.00	1.00	0.95		1.00		
Satd. Flow (prot)		4541	1362		5085	1583	3072		2787		
Flt Permitted		1.00	1.00		1.00	1.00	0.95		1.00		
Satd. Flow (perm)		4541	1362		5085	1583	3072		2787		
Peak-hour factor, PHF	0.94	0.94	0.92	0.92	0.94	0.94	0.94	0.92	0.94	0.92	0.92
Adj. Flow (vph)	0	1351	1571	0	2564	1154	1043	0	691	0	0
RTOR Reduction (vph)	0	0	0	0	0	477	0	0	3	0	0
Lane Group Flow (vph)	0	2137	785	0	2564	677	1043	0	688	0	0
Turn Type			Prot			Perm	Prot		custom		
Protected Phases		2	2		6		4				
Permitted Phases						6			4		
Actuated Green, G (s)		67.5	67.5		67.5	67.5	41.5		41.5		
Effective Green, g (s)		69.5	67.5		69.5	67.5	42.5		42.5		
Actuated g/C Ratio		0.58	0.56		0.58	0.56	0.35		0.35		
Clearance Time (s)		6.0	6.0		6.0	6.0	5.0		5.0		
Vehicle Extension (s)		5.0	5.0		5.0	5.0	1.5		1.5		
Lane Grp Cap (vph)		2630	766		2945	890	1088		987		
v/s Ratio Prot		0.47	c0.58		0.50		c0.34				
v/s Ratio Perm						0.43			0.25		
v/c Ratio		0.90dr	1.02		0.87	0.76	0.96		0.70		
Uniform Delay, d1		20.1	26.2		21.4	20.1	37.9		33.2		
Progression Factor		0.88	0.91		0.71	1.14	1.00		1.00		
Incremental Delay, d2		0.8	23.1		0.4	0.6	17.8		1.8		
Delay (s)		18.3	47.0		15.6	23.4	55.7		35.0		
Level of Service		B	D		B	C	E		C		
Approach Delay (s)		26.0			18.0			47.5		0.0	
Approach LOS		C			B			D		A	

Intersection Summary			
HCM Average Control Delay	26.9	HCM Level of Service	C
HCM Volume to Capacity ratio	1.00		
Actuated Cycle Length (s)	120.0	Sum of lost time (s)	10.0
Intersection Capacity Utilization	84.5%	ICU Level of Service	E
Analysis Period (min)	15		

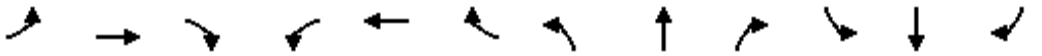
dr Defacto Right Lane. Recode with 1 though lane as a right lane.

c Critical Lane Group



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	0	2250	0	0	3430	40	655	35	645	0	0	150
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)		4.0			4.0		4.0	4.0	5.0			4.0
Lane Util. Factor		0.91			*0.75		0.97	0.95	0.95			0.88
Frt		1.00			1.00		1.00	0.87	0.85			0.85
Flt Protected		1.00			1.00		0.95	1.00	1.00			1.00
Satd. Flow (prot)		5085			5579		3433	1531	1504			2787
Flt Permitted		1.00			1.00		0.95	1.00	1.00			1.00
Satd. Flow (perm)		5085			5579		3433	1531	1504			2787
Peak-hour factor, PHF	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
Adj. Flow (vph)	0	2368	0	0	3611	42	689	37	679	0	0	158
RTOR Reduction (vph)	0	0	0	0	1	0	0	81	82	0	0	2
Lane Group Flow (vph)	0	2368	0	0	3652	0	689	282	271	0	0	156
Turn Type							Perm		Perm			custom
Protected Phases		2			6			8				
Permitted Phases							8		8			4
Actuated Green, G (s)		78.0			78.0		19.0	19.0	19.0			7.0
Effective Green, g (s)		80.0			80.0		20.0	20.0	19.0			8.0
Actuated g/C Ratio		0.67			0.67		0.17	0.17	0.16			0.07
Clearance Time (s)		6.0			6.0		5.0	5.0	5.0			5.0
Vehicle Extension (s)		5.0			5.0		1.5	1.5	1.5			1.5
Lane Grp Cap (vph)		3390			3719		572	255	238			186
v/s Ratio Prot		0.47			c0.65			0.18				
v/s Ratio Perm							c0.20		0.18			c0.06
v/c Ratio		0.70			0.98		1.20	1.11	1.14			0.84
Uniform Delay, d1		12.5			19.3		50.0	50.0	50.5			55.4
Progression Factor		0.90			0.88		1.00	1.00	1.00			1.00
Incremental Delay, d2		0.6			1.9		107.9	87.9	101.4			25.9
Delay (s)		11.7			18.8		157.9	137.9	151.9			81.2
Level of Service		B			B		F	F	F			F
Approach Delay (s)		11.7			18.8			151.2			81.2	
Approach LOS		B			B			F			F	

Intersection Summary			
HCM Average Control Delay	42.4	HCM Level of Service	D
HCM Volume to Capacity ratio	1.01		
Actuated Cycle Length (s)	120.0	Sum of lost time (s)	12.0
Intersection Capacity Utilization	84.9%	ICU Level of Service	E
Analysis Period (min)	15		
c Critical Lane Group			



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	330	2150	415	170	2510	180	695	200	145	120	165	265
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0	3.0	4.0	4.0	4.0	4.0	4.0		4.0	4.0	4.0
Lane Util. Factor	0.97	0.91	1.00	0.97	*0.50	1.00	0.97	0.95		0.97	0.95	1.00
Frpb, ped/bikes	1.00	1.00	0.99	1.00	1.00	1.00	1.00	1.00		1.00	1.00	1.00
Flpb, ped/bikes	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00		1.00	1.00	1.00
Frt	1.00	1.00	0.85	1.00	1.00	0.85	1.00	0.94		1.00	1.00	0.85
Flt Protected	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00		0.95	1.00	1.00
Satd. Flow (prot)	3433	5085	1565	3433	3725	1583	3433	3316		3433	3539	1583
Flt Permitted	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00		0.95	1.00	1.00
Satd. Flow (perm)	3433	5085	1565	3433	3725	1583	3433	3316		3433	3539	1583
Peak-hour factor, PHF	0.94	0.94	0.94	0.94	0.94	0.94	0.94	0.94	0.94	0.94	0.94	0.94
Adj. Flow (vph)	351	2287	441	181	2670	191	739	213	154	128	176	282
RTOR Reduction (vph)	0	0	48	0	0	44	0	111	0	0	0	127
Lane Group Flow (vph)	351	2287	393	181	2670	147	739	256	0	128	176	155
Confl. Peds. (#/hr)	3		3									
Turn Type	Prot		pm+ov	Prot		Perm	Prot			Prot		Perm
Protected Phases	5	2	3	1	6		3	8		7	4	
Permitted Phases			2			6						4
Actuated Green, G (s)	12.9	57.8	76.8	9.2	54.1	54.1	19.0	23.9		8.1	13.0	13.0
Effective Green, g (s)	13.9	59.8	80.8	10.2	56.1	56.1	20.0	24.9		9.1	14.0	14.0
Actuated g/C Ratio	0.12	0.50	0.67	0.08	0.47	0.47	0.17	0.21		0.08	0.12	0.12
Clearance Time (s)	5.0	6.0	5.0	5.0	6.0	6.0	5.0	5.0		5.0	5.0	5.0
Vehicle Extension (s)	1.5	5.0	1.5	1.5	5.0	5.0	1.5	1.5		1.5	1.5	1.5
Lane Grp Cap (vph)	398	2534	1054	292	1741	740	572	688		260	413	185
v/s Ratio Prot	c0.10	c0.45	0.07	0.05	c0.72		c0.22	0.08		0.04	0.05	
v/s Ratio Perm			0.19			0.09						c0.10
v/c Ratio	0.88	0.90	0.37	0.62	1.53	0.20	1.29	0.37		0.49	0.43	0.84
Uniform Delay, d1	52.2	27.4	8.5	53.0	32.0	18.8	50.0	40.8		53.2	49.3	51.9
Progression Factor	1.17	0.71	1.03	1.00	1.00	1.00	1.00	1.00		1.00	1.00	1.00
Incremental Delay, d2	12.9	3.7	0.0	2.8	243.1	0.6	144.1	0.1		0.5	0.3	25.7
Delay (s)	73.8	23.0	8.8	55.8	275.0	19.4	194.1	41.0		53.8	49.5	77.5
Level of Service	E	C	A	E	F	B	F	D		D	D	E
Approach Delay (s)		26.8			245.9			143.3			63.9	
Approach LOS		C			F			F			E	

Intersection Summary			
HCM Average Control Delay	131.4	HCM Level of Service	F
HCM Volume to Capacity ratio	1.35		
Actuated Cycle Length (s)	120.0	Sum of lost time (s)	20.0
Intersection Capacity Utilization	86.4%	ICU Level of Service	E
Analysis Period (min)	15		

c Critical Lane Group

RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information / Site Information

Analyst	SST	Freeway/Dir of Travel	Northbound I-25
Agency or Company	DEA	Junction	Arapahoe Loop Ramp
Date Performed	6/23/2007	Jurisdiction	Arapahoe County
Analysis Time Period	PM Peak	Analysis Year	2030

Project Description No Build Alternative

Inputs

Upstream Adj Ramp
☐ Yes ☐ On
☑ No ☐ Off
L_{up} = ft
V_u = veh/h

Terrain: Level

S_{FF} = 70.0 mph S_{FR} = 25.0 mph

Sketch (show lanes, L_A, L_D, V_R, V_f)

Downstream Adj Ramp
☑ Yes ☑ On
☐ No ☐ Off
L_{down} = 800 ft
V_D = 740 veh/h

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	%Truck	%Rv	f_{HV}	f_p	v = V/PHF x f_{HV} x f_p
Freeway	7105	0.90	Level	6	0	0.971	1.00	8131
Ramp	800	0.90	Level	2	0	0.990	1.00	898
UpStream								
DownStream	740	0.90	Level	2	0	0.990	1.00	830

Merge Areas

Estimation of v_{12}

$$V_{12} = V_F (P_{FM})$$

L_{EQ} = (Equation 25-2 or 25-3)
P_{FM} = 0.209 using Equation (Exhibit 25-5)
V_{12} = 1215 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
V_{FO}	6712	See Exhibit 25-7	No
V_{R12}	2113	4600:All	No

Level of Service Determination (if not F)

$$D_R = 5.475 + 0.00734\, v_R + 0.0078\, V_{12} - 0.00627\, L_A$$

D_R = -5.0 (pc/mi/ln)
LOS = A (Exhibit 25-4)

Speed Estimation

M_S = 0.141 (Exibit 25-19)
S_R = 66.0 mph (Exhibit 25-19)
S_0 = 63.5 mph (Exhibit 25-19)

Diverge Areas

Estimation of v_{12}

$$V_{12} = V_R + (V_F - V_R)P_{FD}$$

L_{EQ} = (Equation 25-8 or 25-9)
P_{FD} = using Equation (Exhibit 25-11)
V_{12} = pc/h

Capacity Checks

	Actual	Maximum	LOS F?
$V_{FI} = V_F$			
V_{12}			
$V_{FO} = V_F - V_R$			
V_R			

Level of Service Determination (if not F)

$$D_R = 4.252 + 0.0086\, V_{12} - 0.0009\, L_D$$

D_R = (pc/mi/ln)
LOS = (Exhibit 25-4)

Speed Estimation

D_s = (Exhibit 25-19)
S_R = mph (Exhibit 25-19)
S_0 = mph (Exhibit 25-19)

RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information / Site Information

Analyst	SST	Freeway/Dir of Travel	Northbound I-25
Agency or Company	DEA	Junction	Arapahoe Loop Ramp
Date Performed	6/23/2007	Jurisdiction	Arapahoe County
Analysis Time Period	AM Peak	Analysis Year	2030

Project Description No Build Alternative

Inputs

Upstream Adj Ramp

☐ Yes ☐ On

☑ No ☐ Off

L_{up} = ft

V_u = veh/h

Terrain: Level

S_{FF} = 70.0 mph S_{FR} = 25.0 mph

Sketch (show lanes, L_A, L_D,V_R,V_f)

Downstream Adj Ramp

☑ Yes ☑ On

☐ No ☐ Off

L_{down} = 800 ft

V_D = 1060 veh/h

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	%Truck	%Rv	f_{HV}	f_p	v = V/PHF x f_{HV} x f_p
Freeway	10165	0.90	Level	6	0	0.971	1.00	11633
Ramp	745	0.90	Level	2	0	0.990	1.00	836
UpStream								
DownStream	1060	0.90	Level	2	0	0.990	1.00	1190

Merge Areas

Estimation of v_{12}

$$V_{12} = V_F (P_{FM})$$

L_{EQ} = (Equation 25-2 or 25-3)

P_{FM} = 0.209 using Equation (Exhibit 25-5)

V_{12} = 1909 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
V_{FO}	9969	See Exhibit 25-7	Yes
V_{R12}	2745	4600:All	No

Level of Service Determination (if not F)

$$D_R = 5.475 + 0.00734 v_R + 0.0078 V_{12} - 0.00627 L_A$$

D_R = -0.1 (pc/mi/ln)

LOS = F (Exhibit 25-4)

Speed Estimation

M_S = 0.170 (Exibit 25-19)

S_R= 65.2 mph (Exhibit 25-19)

S_0= 55.6 mph (Exhibit 25-19)

S = 58.0 mph (Exhibit 25-14)

Diverge Areas

Estimation of v_{12}

$$V_{12} = V_R + (V_F - V_R)P_{FD}$$

L_{EQ} = (Equation 25-8 or 25-9)

P_{FD} = using Equation (Exhibit 25-11)

V_{12} = pc/h

Capacity Checks

	Actual	Maximum	LOS F?
$V_{FI} = V_F$			
V_{12}			
$V_{FO} = V_F - V_R$			
V_R			

Level of Service Determination (if not F)

$$D_R = 4.252 + 0.0086 V_{12} - 0.0009 L_D$$

D_R = (pc/mi/ln)

LOS = (Exhibit 25-4)

Speed Estimation

D_s = (Exhibit 25-19)

S_R= mph (Exhibit 25-19)

S_0= mph (Exhibit 25-19)

S = mph (Exhibit 25-15)

RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information / Site Information

Analyst	SST	Freeway/Dir of Travel	Northbound I-25
Agency or Company	DEA	Junction	Arapahoe Exit Ramp
Date Performed	6/23/2007	Jurisdiction	Arapahoe County
Analysis Time Period	AM Peak	Analysis Year	2030

Project Description No Build Alternative

Inputs

Upstream Adj Ramp

☐ Yes ☐ On

☑ No ☐ Off

L_{up} = ft

V_u = veh/h

Terrain: Level

S_{FF} = 70.0 mph S_{FR} = 45.0 mph

Sketch (show lanes, L_A, L_D,V_R,V_f)

Downstream Adj Ramp

☑ Yes ☑ On

☐ No ☐ Off

L_{down} = 700 ft

V_D = 745 veh/h

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	%Truck	%Rv	f_{HV}	f_p	v = V/PHF x f_{HV} x f_p
Freeway	11900	0.90	Level	6	0	0.971	1.00	13619
Ramp	1735	0.90	Level	2	0	0.990	1.00	1947
UpStream								
DownStream	745	0.90	Level	2	0	0.990	1.00	836

Merge Areas

Estimation of v_{12}

$V_{12} = V_F (P_{FM})$

L_{EQ} = (Equation 25-2 or 25-3)

P_{FM} = using Equation (Exhibit 25-5)

V_{12} = pc/h

Capacity Checks

	Actual	Maximum	LOS F?
V_{FO}			
V_{R12}			

Level of Service Determination (if not F)

$D_R = 5.475 + 0.00734\ v_R + 0.0078\ V_{12} - 0.00627\ L_A$

D_R = (pc/mi/ln)

LOS = (Exhibit 25-4)

Speed Estimation

M_S = (Exibit 25-19)

S_R= mph (Exhibit 25-19)

S_0= mph (Exhibit 25-19)

S = mph (Exhibit 25-14)

Diverge Areas

Estimation of v_{12}

$V_{12} = V_R + (V_F - V_R)P_{FD}$

L_{EQ} = (Equation 25-8 or 25-9)

P_{FD} = 0.260 using Equation (Exhibit 25-11)

V_{12} = 4274 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
$V_{FI} = V_F$	10896	9600	Yes
V_{12}	4274	4400:All	No
$V_{FO} = V_F - V_R$	8949	9600	No
V_R	1947	4100	No

Level of Service Determination (if not F)

$D_R = 4.252 + 0.0086\ V_{12} - 0.0009\ L_D$

D_R = 17.2 (pc/mi/ln)

LOS = F (Exhibit 25-4)

Speed Estimation

D_s = 0.473 (Exhibit 25-19)

S_R= 56.7 mph (Exhibit 25-19)

S_0= 67.8 mph (Exhibit 25-19)

S = 63.0 mph (Exhibit 25-15)

RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information / Site Information

Analyst	SST	Freeway/Dir of Travel	Northbound I-25
Agency or Company	DEA	Junction	Arapahoe Exit Ramp
Date Performed	6/23/2007	Jurisdiction	Arapahoe County
Analysis Time Period	PM Peak	Analysis Year	2030

Project Description No Build Alternative

Inputs

Upstream Adj Ramp
☐ Yes ☐ On
☑ No ☐ Off
L_{up} = ft
V_u = veh/h

Terrain: Level

S_{FF} = 70.0 mph S_{FR} = 45.0 mph

Sketch (show lanes, L_A, L_D, V_R, V_f)

Downstream Adj Ramp
☑ Yes ☑ On
☐ No ☐ Off
L_{down} = 700 ft
V_D = 800 veh/h

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	%Truck	%Rv	f_{HV}	f_p	v = V/PHF x f_{HV} x f_p
Freeway	8440	0.90	Level	6	0	0.971	1.00	9659
Ramp	1335	0.90	Level	2	0	0.990	1.00	1498
UpStream								
DownStream	800	0.90	Level	2	0	0.990	1.00	898

Merge Areas

Estimation of v_{12}

$$V_{12} = V_F (P_{FM})$$

L_{EQ} = (Equation 25-2 or 25-3)
P_{FM} = using Equation (Exhibit 25-5)
V_{12} = pc/h

Capacity Checks

	Actual	Maximum	LOS F?
V_{FO}			
V_{R12}			

Level of Service Determination (if not F)

$$D_R = 5.475 + 0.00734 v_R + 0.0078 V_{12} - 0.00627 L_A$$

D_R = (pc/mi/ln)
LOS = (Exhibit 25-4)

Speed Estimation

M_S = (Exibit 25-19)
S_R = mph (Exhibit 25-19)
S_0 = mph (Exhibit 25-19)

Diverge Areas

Estimation of v_{12}

$$V_{12} = V_R + (V_F - V_R)P_{FD}$$

L_{EQ} = (Equation 25-8 or 25-9)
P_{FD} = 0.260 using Equation (Exhibit 25-11)
V_{12} = 3118 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
$V_{FI} = V_F$	7728	9600	No
V_{12}	3118	4400:All	No
$V_{FO} = V_F - V_R$	6230	9600	No
V_R	1498	4100	No

Level of Service Determination (if not F)

$$D_R = 4.252 + 0.0086 V_{12} - 0.0009 L_D$$

D_R = 7.3 (pc/mi/ln)
LOS = A (Exhibit 25-4)

Speed Estimation

D_s = 0.433 (Exhibit 25-19)
S_R = 57.9 mph (Exhibit 25-19)
S_0 = 71.7 mph (Exhibit 25-19)

RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information / Site Information

Analyst	SST	Freeway/Dir of Travel	Northbound I-25
Agency or Company	DEA	Junction	Arapahoe On Ramp
Date Performed	6/23/2007	Jurisdiction	Arapahoe County
Analysis Time Period	AM Peak	Analysis Year	2030

Project Description No Build Alternative

Inputs

Upstream Adj Ramp

☑ Yes ☑ On

☐ No ☐ Off

L_{up} = 800 ft

V_u = 745 veh/h

Terrain: Level

S_{FF} = 70.0 mph S_{FR} = 45.0 mph

Sketch (show lanes, L_A, L_D,V_R,V_f)

Downstream Adj Ramp

☐ Yes ☐ On

☑ No ☐ Off

L_{down} = ft

V_D = veh/h

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	%Truck	%Rv	f_{HV}	f_p	v = V/PHF x f_{HV} x f_p
Freeway	10910	0.90	Level	6	0	0.971	1.00	12486
Ramp	1000	0.90	Level	2	0	0.990	1.00	1122
UpStream	745	0.90	Level	2	0	0.990	1.00	836
DownStream								

Merge Areas

Estimation of v_{12}

$V_{12} = V_F (P_{FM})$

L_{EQ} = (Equation 25-2 or 25-3)

P_{FM} = 0.732 using Equation (Exhibit 25-5)

V_{12} = 7307 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
V_{FO}	11108	See Exhibit 25-7	Yes
V_{R12}	8429	4600:All	Yes

Level of Service Determination (if not F)

$D_R = 5.475 + 0.00734 v_R + 0.0078 V_{12} - 0.00627 L_A$

D_R = 54.2 (pc/mi/ln)

LOS = F (Exhibit 25-4)

Speed Estimation

M_S = 17.937 (Exibit 25-19)

S_R= -432.2 mph (Exhibit 25-19)

S_0= 67.0 mph (Exhibit 25-19)

S = 541.9 mph (Exhibit 25-14)

Diverge Areas

Estimation of v_{12}

$V_{12} = V_R + (V_F - V_R)P_{FD}$

L_{EQ} = (Equation 25-8 or 25-9)

P_{FD} = using Equation (Exhibit 25-11)

V_{12} = pc/h

Capacity Checks

	Actual	Maximum	LOS F?
$V_{FI} = V_F$			
V_{12}			
$V_{FO} = V_F - V_R$			
V_R			

Level of Service Determination (if not F)

$D_R = 4.252 + 0.0086 V_{12} - 0.0009 L_D$

D_R = (pc/mi/ln)

LOS = (Exhibit 25-4)

Speed Estimation

D_s = (Exhibit 25-19)

S_R= mph (Exhibit 25-19)

S_0= mph (Exhibit 25-19)

S = mph (Exhibit 25-15)

RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information / Site Information

Analyst	SST	Freeway/Dir of Travel	Northbound I-25
Agency or Company	DEA	Junction	Arapahoe On Ramp
Date Performed	6/23/2007	Jurisdiction	Arapahoe County
Analysis Time Period	PM Peak	Analysis Year	2030

Project Description No Build Alternative

Inputs

Upstream Adj Ramp
☑ Yes ☑ On
☐ No ☐ Off
L_{up} = 800 ft
V_u = 800 veh/h

Terrain: Level

S_{FF} = 70.0 mph S_{FR} = 45.0 mph

Sketch (show lanes, L_A, L_D,V_R,V_f)

Downstream Adj Ramp
☐ Yes ☐ On
☑ No ☐ Off
L_{down} = ft
V_D = veh/h

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	%Truck	%Rv	f_{HV}	f_p	v = V/PHF x f_{HV} x f_p
Freeway	7905	0.90	Level	6	0	0.971	1.00	9047
Ramp	740	0.90	Level	2	0	0.990	1.00	830
UpStream	800	0.90	Level	2	0	0.990	1.00	898
DownStream								

Merge Areas

Estimation of v_{12}

$$V_{12} = V_F (P_{FM})$$

L_{EQ} = (Equation 25-2 or 25-3)

P_{FM} = 0.768 using Equation (Exhibit 25-5)

V_{12} = 5029 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
V_{FO}	7377	See Exhibit 25-7	No
V_{R12}	5859	4600:All	Yes

Level of Service Determination (if not F)

$$D_R = 5.475 + 0.00734\, v_R + 0.0078\, V_{12} - 0.00627\, L_A$$

D_R = 34.2 (pc/mi/ln)

LOS = F (Exhibit 25-4)

Speed Estimation

M_S = 1.450 (Exibit 25-19)

S_R= 29.4 mph (Exhibit 25-19)

S_0= 69.1 mph (Exhibit 25-19)

Diverge Areas

Estimation of v_{12}

$$V_{12} = V_R + (V_F - V_R)P_{FD}$$

L_{EQ} = (Equation 25-8 or 25-9)

P_{FD} = using Equation (Exhibit 25-11)

V_{12} = pc/h

Capacity Checks

	Actual	Maximum	LOS F?
$V_{FI} = V_F$			
V_{12}			
$V_{FO} = V_F - V_R$			
V_R			

Level of Service Determination (if not F)

$$D_R = 4.252 + 0.0086\, V_{12} - 0.0009\, L_D$$

D_R = (pc/mi/ln)

LOS = (Exhibit 25-4)

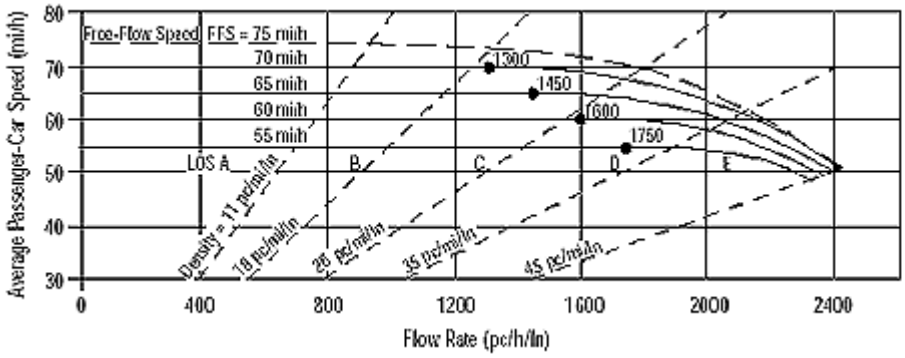
Speed Estimation

D_s = (Exhibit 25-19)

S_R= mph (Exhibit 25-19)

S_0= mph (Exhibit 25-19)

BASIC FREEWAY SEGMENTS WORKSHEET



Application	Input	Output
Operational (LOS)	FFS, N, v_p	LOS, S, D
Design (N)	FFS, LOS, v_p	N, S, D
Design (v_p)	FFS, LOS, N	v_p, S, D
Planning (LOS)	FFS, N, AADT	LOS, S, D
Planning (N)	FFS, LOS, AADT	N, S, D
Planning (v_p)	FFS, LOS, N	v_p, S, D

General Information

Analyst	*SST*
Agency or Company	*DEA*
Date Performed	*6/23/2007*
Analysis Time Period	*AM Peak*

Site Information

Highway/Direction of Travel	*Northbound I-25*
From/To	*Arapahoe to Orchard*
Jurisdiction	*Arapahoe County*
Analysis Year	*2030*

Project Description No Build Alternative

☑ Oper.(LOS) ☐ Des.(N) ☐ Planning Data

Flow Inputs

Volume, V	*12360*	veh/h	Peak-Hour Factor, PHF	*0.90*
AADT		veh/day	%Trucks and Buses, P_T	*7*
Peak-Hr Prop. of AADT, K			%RVs, P_R	*0*
Peak-Hr Direction Prop, D			General Terrain:	*Level*
DDHV = AADT x K x D		veh/h	Grade % Length	*mi*
Driver type adjustment	*1.00*		Up/Down %	

Calculate Flow Adjustments

f_p	*1.00*	E_R	*1.2*
E_T	*1.5*	$f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$	*0.966*

Speed Inputs

Lane Width	*12.0*	ft
Rt-Shoulder Lat. Clearance	*6.0*	ft
Interchange Density	*0.50*	I/mi
Number of Lanes, N	*5*	
FFS (measured)	*70.0*	mi/h
Base free-flow Speed, BFFS		mi/h

Calc Speed Adj and FFS

f_{LW}		mi/h
f_{LC}		mi/h
f_{ID}		mi/h
f_N		mi/h
FFS	*70.0*	mi/h

LOS and Performance Measures

Operational (LOS)

v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	*2843*	pc/h/ln
S		mi/h
D = v_p / S		pc/mi/ln
LOS	*F*	

Design (N)

Design (N)

Design LOS		
v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)		pc/h
S		mi/h
D = v_p / S		pc/mi/ln
Required Number of Lanes, N		

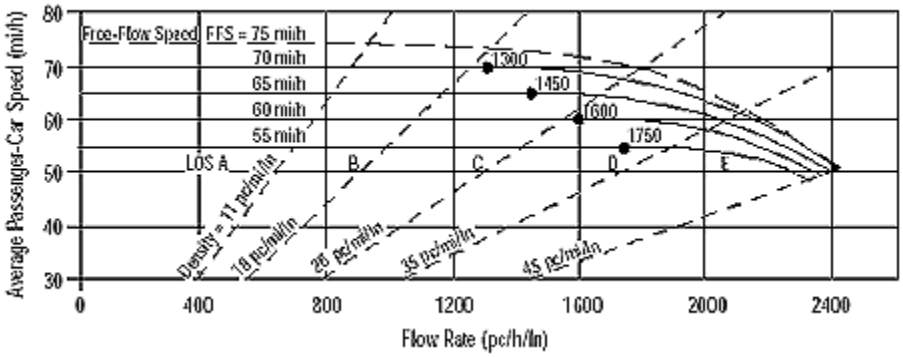
Glossary

N - Number of lanes	S - Speed
V - Hourly volume	D - Density
v_p - Flow rate	FFS - Free-flow speed
LOS - Level of service	BFFS - Base free-flow speed

Factor Location

E_R - Exhibits23-8, 23-10	f_{LW} - Exhibit 23-4
E_T - Exhibits 23-8, 23-10, 23-11	f_{LC} - Exhibit 23-5
f_p - Page 23-12	f_N - Exhibit 23-6

BASIC FREEWAY SEGMENTS WORKSHEET



Application	Input
Operational (LOS)	FFS, N, v_p
Design (N)	FFS, LOS, v_p
Design (v_p)	FFS, LOS, N
Planning (LOS)	FFS, N, AADT
Planning (N)	FFS, LOS, AADT
Planning (v_p)	FFS, LOS, N

General Information

Analyst	*SST*
Agency or Company	*DEA*
Date Performed	*6/23/2007*
Analysis Time Period	*PM Peak*

Site Information

Highway/Direction of Travel	*Northbound I-25*
From/To	*Arapahoe to Orch*
Jurisdiction	*Arapahoe County*
Analysis Year	*2030*

Project Description No Build Alternative

☑ Oper.(LOS) ☐ Des.(N) ☐ Planning Dat

Flow Inputs

Volume, V	*8645*	veh/h	Peak-Hour Factor, PHF	*0.90*
AADT		veh/day	%Trucks and Buses, P_T	*7*
Peak-Hr Prop. of AADT, K			%RVs, P_R	*0*
Peak-Hr Direction Prop, D			General Terrain:	*Level*
DDHV = AADT x K x D		veh/h	Grade % Length	*mi*
Driver type adjustment	*1.00*		Up/Down %	

Calculate Flow Adjustments

f_p	*1.00*	E_R	*1.2*
E_T	*1.5*	$f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$	*0.966*

Speed Inputs

Lane Width	*12.0*	ft
Rt-Shoulder Lat. Clearance	*6.0*	ft
Interchange Density	*0.50*	I/mi
Number of Lanes, N	*5*	
FFS (measured)	*70.0*	mi/h
Base free-flow Speed, BFFS		mi/h

Calc Speed Adj and FFS

f_{LW}	
f_{LC}	
f_{ID}	
f_N	
FFS	*70.0*

LOS and Performance Measures

Operational (LOS)

v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	*1988*	pc/h/ln
S	*65.1*	mi/h
D = v_p / S	*30.5*	pc/mi/ln
LOS	*D*	

Design (N)

Design (N)

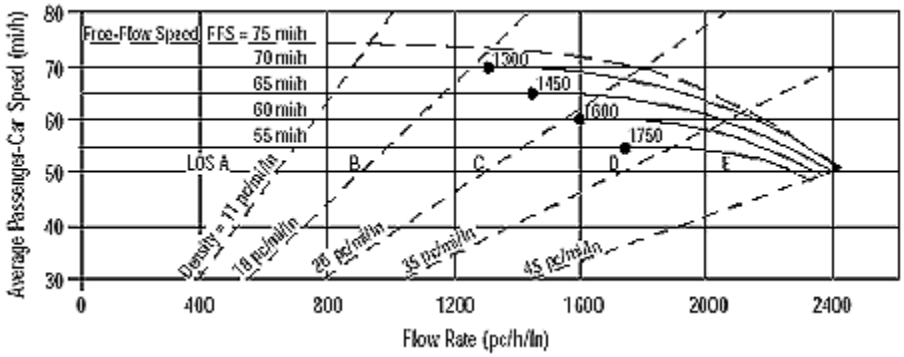
Design LOS	
v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	
S	
D = v_p / S	
Required Number of Lanes, N	

Glossary

N - Number of lanes S - Speed

Factor Location

BASIC FREEWAY SEGMENTS WORKSHEET



Application	Input
Operational (LOS)	FFS, N, v_p
Design (N)	FFS, LOS, v_p
Design (v_p)	FFS, LOS, N
Planning (LOS)	FFS, N, AADT
Planning (N)	FFS, LOS, AADT
Planning (v_p)	FFS, LOS, N

General Information

Analyst	*SST*
Agency or Company	*DEA*
Date Performed	*6/23/2007*
Analysis Time Period	*AM Peak*

Site Information

Highway/Direction of Travel	*Southbound I-25*
From/To	*Orchard to Arapah*
Jurisdiction	*Arapahoe County*
Analysis Year	*2030*

Project Description No Build Alternative

☑ Oper.(LOS) ☐ Des.(N) ☐ Planning Dat

Flow Inputs

Volume, V	*8970*	veh/h	Peak-Hour Factor, PHF	*0.90*
AADT		veh/day	%Trucks and Buses, P_T	*7*
Peak-Hr Prop. of AADT, K			%RVs, P_R	*0*
Peak-Hr Direction Prop, D			General Terrain:	*Level*
DDHV = AADT x K x D		veh/h	Grade % Length	*mi*
Driver type adjustment	*1.00*		Up/Down %	

Calculate Flow Adjustments

f_p	*1.00*	E_R	*1.2*
E_T	*1.5*	$f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$	*0.966*

Speed Inputs

Lane Width	*12.0*	ft
Rt-Shoulder Lat. Clearance	*6.0*	ft
Interchange Density	*0.50*	I/mi
Number of Lanes, N	*5*	
FFS (measured)	*70.0*	mi/h
Base free-flow Speed, BFFS		mi/h

Calc Speed Adj and FFS

f_{LW}	
f_{LC}	
f_{ID}	
f_N	
FFS	*70.0*

LOS and Performance Measures

Operational (LOS)

v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	*2063*	pc/h/ln
S	*63.6*	mi/h
D = v_p / S	*32.5*	pc/mi/ln
LOS	*D*	

Design (N)

Design (N)

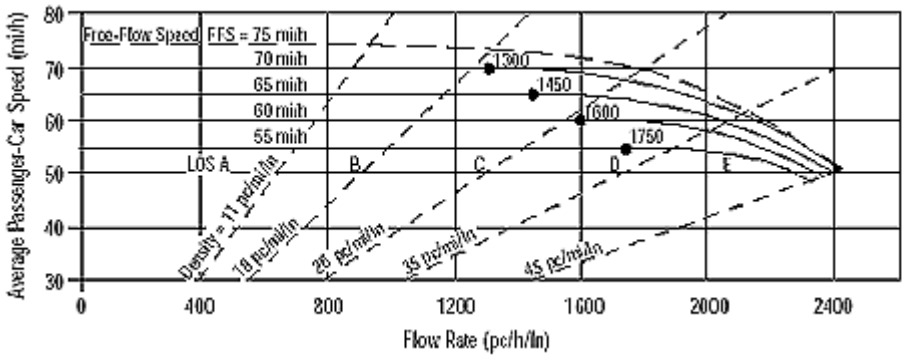
Design LOS	
v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	
S	
D = v_p / S	
Required Number of Lanes, N	

Glossary

N - Number of lanes S - Speed

Factor Location

BASIC FREEWAY SEGMENTS WORKSHEET



Application	Input	Output
Operational (LOS)	FFS, N, v_p	LOS, S, D
Design (N)	FFS, LOS, v_p	N, S, D
Design (v_p)	FFS, LOS, N	v_p, S, D
Planning (LOS)	FFS, N, AADT	LOS, S, D
Planning (N)	FFS, LOS, AADT	N, S, D
Planning (v_p)	FFS, LOS, N	v_p, S, D

General Information

Analyst	*SST*
Agency or Company	*DEA*
Date Performed	*6/23/2007*
Analysis Time Period	*PM Peak*

Site Information

Highway/Direction of Travel	*Southbound I-25*
From/To	*Orchard to Arapahoe*
Jurisdiction	*Arapahoe County*
Analysis Year	*2030*

Project Description No Build Alternative

☑ Oper.(LOS) ☐ Des.(N) ☐ Planning Data

Flow Inputs

Volume, V	*11905*	veh/h	Peak-Hour Factor, PHF	*0.90*
AADT		veh/day	%Trucks and Buses, P_T	*7*
Peak-Hr Prop. of AADT, K			%RVs, P_R	*0*
Peak-Hr Direction Prop, D			General Terrain:	*Level*
DDHV = AADT x K x D		veh/h	Grade % Length	*mi*
Driver type adjustment	*1.00*		Up/Down %	

Calculate Flow Adjustments

f_p	*1.00*	E_R	*1.2*
E_T	*1.5*	$f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$	*0.966*

Speed Inputs

Lane Width	*12.0*	ft
Rt-Shoulder Lat. Clearance	*6.0*	ft
Interchange Density	*0.50*	I/mi
Number of Lanes, N	*5*	
FFS (measured)	*70.0*	mi/h
Base free-flow Speed, BFFS		mi/h

Calc Speed Adj and FFS

f_{LW}		mi/h
f_{LC}		mi/h
f_{ID}		mi/h
f_N		mi/h
FFS	*70.0*	mi/h

LOS and Performance Measures

Operational (LOS)

v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	*2738*	pc/h/ln
S		mi/h
D = v_p / S		pc/mi/ln
LOS	*F*	

Design (N)

Design (N)

Design LOS		
v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)		pc/h
S		mi/h
D = v_p / S		pc/mi/ln
Required Number of Lanes, N		

Glossary

N - Number of lanes	S - Speed
V - Hourly volume	D - Density
v_p - Flow rate	FFS - Free-flow speed
LOS - Level of service	BFFS - Base free-flow speed

Factor Location

E_R - Exhibits23-8, 23-10	f_{LW} - Exhibit 23-4
E_T - Exhibits 23-8, 23-10, 23-11	f_{LC} - Exhibit 23-5
f_p - Page 23-12	f_N - Exhibit 23-6

RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information / Site Information

Analyst	SST	Freeway/Dir of Travel	Southbound I-25
Agency or Company	DEA	Junction	Arapahoe Loop Ramp
Date Performed	6/23/2007	Jurisdiction	Arapahoe County
Analysis Time Period	AM Peak	Analysis Year	2030

Project Description No Build Alternative

Inputs

Upstream Adj Ramp

☐ Yes ☐ On

☑ No ☐ Off

L_{up} = ft

V_u = veh/h

Terrain: Level

S_{FF} = 70.0 mph S_{FR} = 25.0 mph

Sketch (show lanes, L_A, L_D,V_R,V_f)

Downstream Adj Ramp

☑ Yes ☑ On

☐ No ☐ Off

L_{down} = 800 ft

V_D = 785 veh/h

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	%Truck	%Rv	f_{HV}	f_p	v = V/PHF x f_{HV} x f_p
Freeway	6610	0.90	Level	6	0	0.971	1.00	7565
Ramp	755	0.90	Level	2	0	0.990	1.00	847
UpStream								
DownStream	785	0.90	Level	2	0	0.990	1.00	881

Merge Areas

Estimation of v_{12}

$$V_{12} = V_F (P_{FM})$$

L_{EQ} = (Equation 25-2 or 25-3)

P_{FM} = 0.469 using Equation (Exhibit 25-5)

V_{12} = 2535 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
V_{FO}	6256	See Exhibit 25-7	No
V_{R12}	3382	4600:All	No

Level of Service Determination (if not F)

$$D_R = 5.475 + 0.00734\, v_R + 0.0078\, V_{12} - 0.00627\, L_A$$

D_R = 26.4 (pc/mi/ln)

LOS = C (Exhibit 25-4)

Speed Estimation

M_S = 0.396 (Exibit 25-19)

S_R= 58.9 mph (Exhibit 25-19)

S_0= 66.6 mph (Exhibit 25-19)

Diverge Areas

Estimation of v_{12}

$$V_{12} = V_R + (V_F - V_R)P_{FD}$$

L_{EQ} = (Equation 25-8 or 25-9)

P_{FD} = using Equation (Exhibit 25-11)

V_{12} = pc/h

Capacity Checks

	Actual	Maximum	LOS F?
$V_{FI} = V_F$			
V_{12}			
$V_{FO} = V_F - V_R$			
V_R			

Level of Service Determination (if not F)

$$D_R = 4.252 + 0.0086\, V_{12} - 0.0009\, L_D$$

D_R = (pc/mi/ln)

LOS = (Exhibit 25-4)

Speed Estimation

D_s = (Exhibit 25-19)

S_R= mph (Exhibit 25-19)

S_0= mph (Exhibit 25-19)

RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information / Site Information

Analyst	SST	Freeway/Dir of Travel	Southbound I-25
Agency or Company	DEA	Junction	Arapahoe Loop Ramp
Date Performed	6/23/2007	Jurisdiction	Arapahoe County
Analysis Time Period	PM Peak	Analysis Year	2030

Project Description No Build Alternative

Inputs

Upstream Adj Ramp

☐ Yes ☐ On

☑ No ☐ Off

L_{up} = ft

V_u = veh/h

Terrain: Level

S_{FF} = 70.0 mph S_{FR} = 25.0 mph

Sketch (show lanes, L_A, L_D,V_R,V_f)

Downstream Adj Ramp

☑ Yes ☑ On

☐ No ☐ Off

L_{down} = 800 ft

V_D = 645 veh/h

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	%Truck	%Rv	f_{HV}	f_p	v = V/PHF x f_{HV} x f_p
Freeway	10440	0.90	Level	6	0	0.971	1.00	11948
Ramp	1085	0.90	Level	2	0	0.990	1.00	1218
UpStream								
DownStream	645	0.90	Level	2	0	0.990	1.00	724

Merge Areas

Estimation of v_{12}

$$V_{12} = V_F (P_{FM})$$

L_{EQ} = (Equation 25-2 or 25-3)

P_{FM} = 0.422 using Equation (Exhibit 25-5)

V_{12} = 3990 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
V_{FO}	10666	See Exhibit 25-7	Yes
V_{R12}	5208	4600:All	Yes

Level of Service Determination (if not F)

$$D_R = 5.475 + 0.00734 v_R + 0.0078 V_{12} - 0.00627 L_A$$

D_R = 40.5 (pc/mi/ln)

LOS = F (Exhibit 25-4)

Speed Estimation

M_S = 0.994 (Exibit 25-19)

S_R = 42.2 mph (Exhibit 25-19)

S_0 = 60.9 mph (Exhibit 25-19)

S = 50.1 mph (Exhibit 25-14)

Diverge Areas

Estimation of v_{12}

$$V_{12} = V_R + (V_F - V_R)P_{FD}$$

L_{EQ} = (Equation 25-8 or 25-9)

P_{FD} = using Equation (Exhibit 25-11)

V_{12} = pc/h

Capacity Checks

	Actual	Maximum	LOS F?
$V_{FI} = V_F$			
V_{12}			
$V_{FO} = V_F - V_R$			
V_R			

Level of Service Determination (if not F)

$$D_R = 4.252 + 0.0086 V_{12} - 0.0009 L_D$$

D_R = (pc/mi/ln)

LOS = (Exhibit 25-4)

Speed Estimation

D_s = (Exhibit 25-19)

S_R = mph (Exhibit 25-19)

S_0 = mph (Exhibit 25-19)

S = mph (Exhibit 25-15)

RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information / Site Information

Analyst	SST	Freeway/Dir of Travel	Southbound I-25
Agency or Company	DEA	Junction	Arapahoe Exit Ramp
Date Performed	6/23/2007	Jurisdiction	Arapahoe County
Analysis Time Period	AM Peak	Analysis Year	2030

Project Description: No Build Alternative

Inputs

Upstream Adj Ramp
☐ Yes ☐ On
☑ No ☐ Off
L_{up} = ft
V_u = veh/h

Terrain: Level

S_{FF} = 70.0 mph S_{FR} = 45.0 mph

Sketch (show lanes, L_A, L_D, V_R, V_f)

Downstream Adj Ramp
☑ Yes ☑ On
☐ No ☐ Off
L_{down} = 700 ft
V_D = 755 veh/h

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	%Truck	%Rv	f_{HV}	f_p	v = V/PHF x f_{HV} x f_p
Freeway	8970	0.90	Level	7	0	0.966	1.00	10315
Ramp	2360	0.90	Level	2	0	0.990	1.00	2648
UpStream								
DownStream	755	0.90	Level	2	0	0.990	1.00	847

Merge Areas

Estimation of v_{12}

$$V_{12} = V_F (P_{FM})$$

L_{EQ} = (Equation 25-2 or 25-3)
P_{FM} = using Equation (Exhibit 25-5)
V_{12} = pc/h

Capacity Checks

	Actual	Maximum	LOS F?
V_{FO}			
V_{R12}			

Level of Service Determination (if not F)

$$D_R = 5.475 + 0.00734\, v_R + 0.0078\, V_{12} - 0.00627\, L_A$$

D_R = (pc/mi/ln)
LOS = (Exhibit 25-4)

Speed Estimation

M_S = (Exibit 25-19)
S_R = mph (Exhibit 25-19)
S_0 = mph (Exhibit 25-19)

Diverge Areas

Estimation of v_{12}

$$V_{12} = V_R + (V_F - V_R)P_{FD}$$

L_{EQ} = (Equation 25-8 or 25-9)
P_{FD} = 0.260 using Equation (Exhibit 25-11)
V_{12} = 4105 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
$V_{FI} = V_F$	8252	9600	No
V_{12}	4105	4400:All	No
$V_{FO} = V_F - V_R$	5604	9600	No
V_R	2648	4100	No

Level of Service Determination (if not F)

$$D_R = 4.252 + 0.0086\, V_{12} - 0.0009\, L_D$$

D_R = 15.8 (pc/mi/ln)
LOS = B (Exhibit 25-4)

Speed Estimation

D_s = 0.536 (Exhibit 25-19)
S_R = 55.0 mph (Exhibit 25-19)
S_0 = 72.6 mph (Exhibit 25-19)

RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information / Site Information

Analyst	SST	Freeway/Dir of Travel	Southbound I-25
Agency or Company	DEA	Junction	Arapahoe Exit Ramp
Date Performed	6/23/2007	Jurisdiction	Arapahoe County
Analysis Time Period	PM Peak	Analysis Year	2030

Project Description No Build Alternative

Inputs

Upstream Adj Ramp

☐ Yes ☐ On

☑ No ☐ Off

L_{up} = ft

V_u = veh/h

Terrain: Level

S_{FF} = 70.0 mph S_{FR} = 45.0 mph

Sketch (show lanes, L_A, L_D,V_R,V_f)

Downstream Adj Ramp

☑ Yes ☑ On

☐ No ☐ Off

L_{down} = 700 ft

V_D = 1085 veh/h

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	%Truck	%Rv	f_{HV}	f_p	v = V/PHF x f_{HV} x f_p
Freeway	11905	0.90	Level	7	0	0.966	1.00	13691
Ramp	1465	0.90	Level	2	0	0.990	1.00	1644
UpStream								
DownStream	1085	0.90	Level	2	0	0.990	1.00	1218

Merge Areas

Estimation of v_{12}

$V_{12} = V_F (P_{FM})$

L_{EQ} = (Equation 25-2 or 25-3)

P_{FM} = using Equation (Exhibit 25-5)

V_{12} = pc/h

Capacity Checks

	Actual	Maximum	LOS F?
V_{FO}			
V_{R12}			

Level of Service Determination (if not F)

$D_R = 5.475 + 0.00734\ v_R + 0.0078\ V_{12} - 0.00627\ L_A$

D_R = (pc/mi/ln)

LOS = (Exhibit 25-4)

Speed Estimation

M_S = (Exibit 25-19)

S_R= mph (Exhibit 25-19)

S_0= mph (Exhibit 25-19)

S = mph (Exhibit 25-14)

Diverge Areas

Estimation of v_{12}

$V_{12} = V_R + (V_F - V_R)P_{FD}$

L_{EQ} = (Equation 25-8 or 25-9)

P_{FD} = 0.260 using Equation (Exhibit 25-11)

V_{12} = 4064 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
$V_{FI} = V_F$	10953	9600	Yes
V_{12}	4064	4400:All	No
$V_{FO} = V_F - V_R$	9309	9600	No
V_R	1644	4100	No

Level of Service Determination (if not F)

$D_R = 4.252 + 0.0086\ V_{12} - 0.0009\ L_D$

D_R = 15.4 (pc/mi/ln)

LOS = F (Exhibit 25-4)

Speed Estimation

D_s = 0.446 (Exhibit 25-19)

S_R= 57.5 mph (Exhibit 25-19)

S_0= 67.3 mph (Exhibit 25-19)

S = 63.3 mph (Exhibit 25-15)

RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information / Site Information

Analyst	SST	Freeway/Dir of Travel	Southbound I-25
Agency or Company	DEA	Junction	Arapahoe On Ramp
Date Performed	6/23/2007	Jurisdiction	Arapahoe County
Analysis Time Period	AM Peak	Analysis Year	2030

Project Description No Build Alternative

Inputs

Upstream Adj Ramp
☑ Yes ☑ On
☐ No ☐ Off
L_{up} = 800 ft
V_u = 755 veh/h

Terrain: Level

S_{FF} = 70.0 mph S_{FR} = 45.0 mph

Sketch (show lanes, L_A, L_D,V_R,V_f)

Downstream Adj Ramp
☐ Yes ☐ On
☑ No ☐ Off
L_{down} = ft
V_D = veh/h

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	%Truck	%Rv	f_{HV}	f_p	v = V/PHF x f_{HV} x f_p
Freeway	7365	0.90	Level	6	0	0.971	1.00	8429
Ramp	785	0.90	Level	2	0	0.990	1.00	881
UpStream	755	0.90	Level	2	0	0.990	1.00	847
DownStream								

Merge Areas

Estimation of v_{12}

$V_{12} = V_F (P_{FM})$

L_{EQ} = (Equation 25-2 or 25-3)

P_{FM} = 0.762 using Equation (Exhibit 25-5)

V_{12} = 4591 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
V_{FO}	6908	See Exhibit 25-7	No
V_{R12}	5472	4600:All	Yes

Level of Service Determination (if not F)

$D_R = 5.475 + 0.00734\ v_R + 0.0078\ V_{12} - 0.00627\ L_A$

D_R = 31.2 (pc/mi/ln)

LOS = F (Exhibit 25-4)

Speed Estimation

M_S = 1.011 (Exibit 25-19)

S_R= 41.7 mph (Exhibit 25-19)

S_0= 69.2 mph (Exhibit 25-19)

Diverge Areas

Estimation of v_{12}

$V_{12} = V_R + (V_F - V_R)P_{FD}$

L_{EQ} = (Equation 25-8 or 25-9)

P_{FD} = using Equation (Exhibit 25-11)

V_{12} = pc/h

Capacity Checks

	Actual	Maximum	LOS F?
$V_{FI} = V_F$			
V_{12}			
$V_{FO} = V_F - V_R$			
V_R			

Level of Service Determination (if not F)

$D_R = 4.252 + 0.0086\ V_{12} - 0.0009\ L_D$

D_R = (pc/mi/ln)

LOS = (Exhibit 25-4)

Speed Estimation

D_s = (Exhibit 25-19)

S_R= mph (Exhibit 25-19)

S_0= mph (Exhibit 25-19)

RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information / Site Information

Analyst	SST	Freeway/Dir of Travel	Southbound I-25
Agency or Company	DEA	Junction	Arapahoe On Ramp
Date Performed	6/23/2007	Jurisdiction	Arapahoe County
Analysis Time Period	PM Peak	Analysis Year	2030

Project Description No Build Alternative

Inputs

Upstream Adj Ramp

☑ Yes ☑ On

☐ No ☐ Off

L_{up} = 800 ft

V_u = 1085 veh/h

Terrain: Level

S_{FF} = 70.0 mph S_{FR} = 45.0 mph

Sketch (show lanes, L_A, L_D,V_R,V_f)

Downstream Adj Ramp

☐ Yes ☐ On

☑ No ☐ Off

L_{down} = ft

V_D = veh/h

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	%Truck	%Rv	f_{HV}	f_p	v = V/PHF x f_{HV} x f_p
Freeway	11525	0.90	Level	6	0	0.971	1.00	13190
Ramp	645	0.90	Level	2	0	0.990	1.00	724
UpStream	1085	0.90	Level	2	0	0.990	1.00	1218
DownStream								

Merge Areas

Estimation of v_{12}

$$V_{12} = V_F (P_{FM})$$

L_{EQ} = (Equation 25-2 or 25-3)

P_{FM} = 0.781 using Equation (Exhibit 25-5)

V_{12} = 8354 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
V_{FO}	11414	See Exhibit 25-7	Yes
V_{R12}	9078	4600:All	Yes

Level of Service Determination (if not F)

$$D_R = 5.475 + 0.00734 v_R + 0.0078 V_{12} - 0.00627 L_A$$

D_R = 59.4 (pc/mi/ln)

LOS = F (Exhibit 25-4)

Speed Estimation

M_S = 34.249 (Exibit 25-19)

S_R = -889.0 mph (Exhibit 25-19)

S_0 = 67.6 mph (Exhibit 25-19)

S = 468.8 mph (Exhibit 25-14)

Diverge Areas

Estimation of v_{12}

$$V_{12} = V_R + (V_F - V_R)P_{FD}$$

L_{EQ} = (Equation 25-8 or 25-9)

P_{FD} = using Equation (Exhibit 25-11)

V_{12} = pc/h

Capacity Checks

	Actual	Maximum	LOS F?
$V_{FI} = V_F$			
V_{12}			
$V_{FO} = V_F - V_R$			
V_R			

Level of Service Determination (if not F)

$$D_R = 4.252 + 0.0086 V_{12} - 0.0009 L_D$$

D_R = (pc/mi/ln)

LOS = (Exhibit 25-4)

Speed Estimation

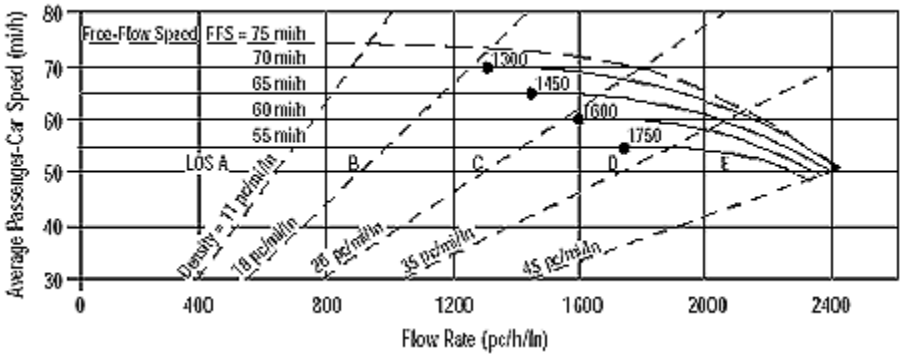
D_s = (Exhibit 25-19)

S_R = mph (Exhibit 25-19)

S_0 = mph (Exhibit 25-19)

S = mph (Exhibit 25-15)

BASIC FREEWAY SEGMENTS WORKSHEET



Application	Input
Operational (LOS)	FFS, N, v_p
Design (N)	FFS, LOS, v_p
Design (v_p)	FFS, LOS, N
Planning (LOS)	FFS, N, AADT
Planning (N)	FFS, LOS, AADT
Planning (v_p)	FFS, LOS, N

General Information

Analyst	*SST*
Agency or Company	*DEA*
Date Performed	*6/23/2007*
Analysis Time Period	*AM Peak*

Site Information

Highway/Direction of Travel	*Northbound I-25*
From/To	
Jurisdiction	*Arapahoe County*
Analysis Year	*2030*

Project Description

☑ Oper.(LOS) ☐ Des.(N) ☐ Planning Dat

Flow Inputs

Volume, V	*11900*	veh/h	Peak-Hour Factor, PHF	*0.90*
AADT		veh/day	%Trucks and Buses, P_T	*6*
Peak-Hr Prop. of AADT, K			%RVs, P_R	*0*
Peak-Hr Direction Prop, D			General Terrain:	*Level*
DDHV = AADT x K x D		veh/h	Grade % Length	*mi*
Driver type adjustment	*1.00*		Up/Down %	

Calculate Flow Adjustments

f_p	*1.00*	E_R	*1.2*
E_T	*1.5*	$f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$	*0.971*

Speed Inputs

Lane Width	*12.0*	ft
Rt-Shoulder Lat. Clearance	*6.0*	ft
Interchange Density	*0.50*	I/mi
Number of Lanes, N	*5*	
FFS (measured)	*70.0*	mi/h
Base free-flow Speed, BFFS		mi/h

Calc Speed Adj and FFS

f_{LW}	
f_{LC}	
f_{ID}	
f_N	
FFS	*70.0*

LOS and Performance Measures

Operational (LOS)

v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	*2724*	pc/h/ln
S		mi/h
D = v_p / S		pc/mi/ln
LOS	*F*	

Design (N)

Design (N)

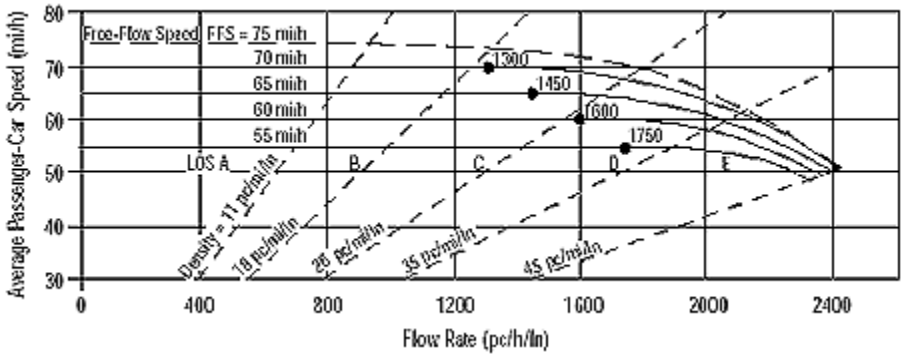
Design LOS	
v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	
S	
D = v_p / S	
Required Number of Lanes, N	

Glossary

N - Number of lanes S - Speed

Factor Location

BASIC FREEWAY SEGMENTS WORKSHEET



Application	Input
Operational (LOS)	FFS, N, v_p
Design (N)	FFS, LOS, v_p
Design (v_p)	FFS, LOS, N
Planning (LOS)	FFS, N, AADT
Planning (N)	FFS, LOS, AADT
Planning (v_p)	FFS, LOS, N

General Information

Analyst	*SST*
Agency or Company	*DEA*
Date Performed	*6/23/2007*
Analysis Time Period	*PM Peak*

Site Information

Highway/Direction of Travel	*Northbound I-25*
From/To	
Jurisdiction	*Arapahoe County*
Analysis Year	*2030*

Project Description Mp Build Alternative

☑ Oper.(LOS) ☐ Des.(N) ☐ Planning Dat

Flow Inputs

Volume, V	*8440*	veh/h	Peak-Hour Factor, PHF	*0.90*
AADT		veh/day	%Trucks and Buses, P_T	*6*
Peak-Hr Prop. of AADT, K			%RVs, P_R	*0*
Peak-Hr Direction Prop, D			General Terrain:	*Level*
DDHV = AADT x K x D		veh/h	Grade % Length	*mi*
Driver type adjustment	*1.00*		Up/Down %	

Calculate Flow Adjustments

f_p	*1.00*	E_R	*1.2*
E_T	*1.5*	$f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$	*0.971*

Speed Inputs

Lane Width	*12.0*	ft
Rt-Shoulder Lat. Clearance	*6.0*	ft
Interchange Density	*0.50*	I/mi
Number of Lanes, N	*5*	
FFS (measured)	*70.0*	mi/h
Base free-flow Speed, BFFS		mi/h

Calc Speed Adj and FFS

f_{LW}	
f_{LC}	
f_{ID}	
f_N	
FFS	*70.0*

LOS and Performance Measures

Operational (LOS)

v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	*1932*	pc/h/ln
S	*66.1*	mi/h
D = v_p / S	*29.2*	pc/mi/ln
LOS	*D*	

Design (N)

Design (N)

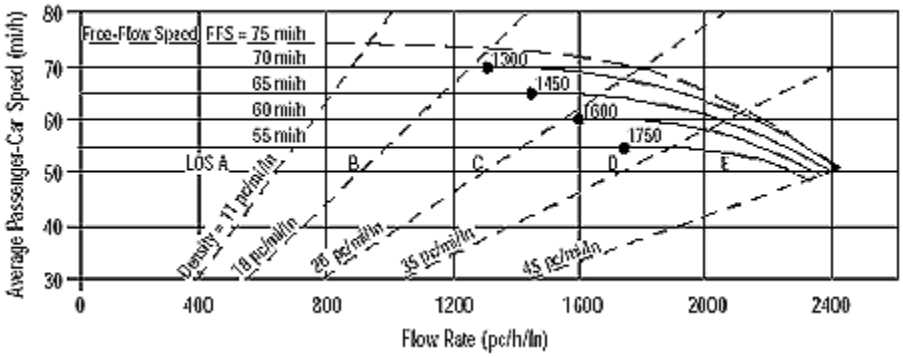
Design LOS	
v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	
S	
D = v_p / S	
Required Number of Lanes, N	

Glossary

N - Number of lanes S - Speed

Factor Location

BASIC FREEWAY SEGMENTS WORKSHEET



Application	Input
Operational (LOS)	FFS, N, v_p
Design (N)	FFS, LOS, v_p
Design (v_p)	FFS, LOS, N
Planning (LOS)	FFS, N, AADT
Planning (N)	FFS, LOS, AADT
Planning (v_p)	FFS, LOS, N

General Information

Analyst	*SST*
Agency or Company	*DEA*
Date Performed	*6/23/2007*
Analysis Time Period	*AM Peak*

Site Information

Highway/Direction of Travel	*Southbound I-25*
From/To	*Arapahoe to Dry C*
Jurisdiction	*Arapahoe County*
Analysis Year	*2030*

Project Description No Build Alternative

☑ Oper.(LOS) ☐ Des.(N) ☐ Planning Dat

Flow Inputs

Volume, V	*8150*	veh/h	Peak-Hour Factor, PHF	*0.90*
AADT		veh/day	%Trucks and Buses, P_T	*6*
Peak-Hr Prop. of AADT, K			%RVs, P_R	*0*
Peak-Hr Direction Prop, D			General Terrain:	*Level*
DDHV = AADT x K x D		veh/h	Grade % Length	*mi*
Driver type adjustment	*1.00*		Up/Down %	

Calculate Flow Adjustments

f_p	*1.00*	E_R	*1.2*
E_T	*1.5*	$f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$	*0.971*

Speed Inputs

Lane Width	*12.0*	ft
Rt-Shoulder Lat. Clearance	*6.0*	ft
Interchange Density	*0.50*	I/mi
Number of Lanes, N	*5*	
FFS (measured)	*70.0*	mi/h
Base free-flow Speed, BFFS		mi/h

Calc Speed Adj and FFS

f_{LW}	
f_{LC}	
f_{ID}	
f_N	
FFS	*70.0*

LOS and Performance Measures

Operational (LOS)

v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	*1865*	pc/h/ln
S	*67.1*	mi/h
D = v_p / S	*27.8*	pc/mi/ln
LOS	*D*	

Design (N)

Design (N)

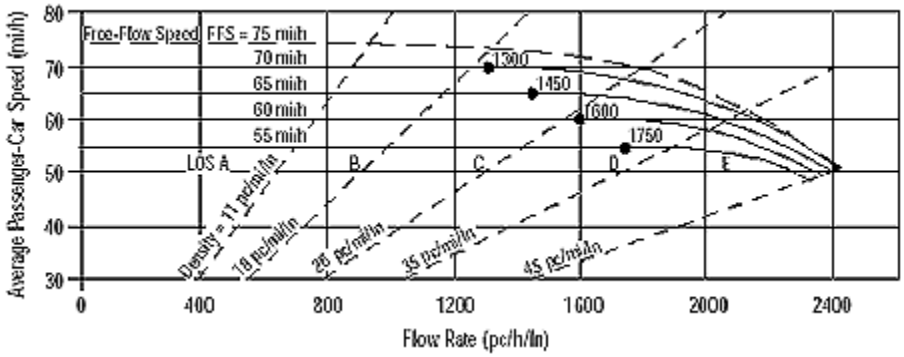
Design LOS	
v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	
S	
D = v_p / S	
Required Number of Lanes, N	

Glossary

N - Number of lanes S - Speed

Factor Location

BASIC FREEWAY SEGMENTS WORKSHEET



Application	Input
Operational (LOS)	FFS, N, v_p
Design (N)	FFS, LOS, v_p
Design (v_p)	FFS, LOS, N
Planning (LOS)	FFS, N, AADT
Planning (N)	FFS, LOS, AADT
Planning (v_p)	FFS, LOS, N

General Information

Analyst	*SST*
Agency or Company	*DEA*
Date Performed	*6/23/2007*
Analysis Time Period	*PM Peak*

Site Information

Highway/Direction of Travel	*Southbound I-25*
From/To	*Arapahoe to Dry C*
Jurisdiction	*Arapahoe County*
Analysis Year	*2030*

Project Description No Build Alternative

☑ Oper.(LOS) ☐ Des.(N) ☐ Planning Dat

Flow Inputs

Volume, V	*12170*	veh/h	Peak-Hour Factor, PHF	*0.90*
AADT		veh/day	%Trucks and Buses, P_T	*6*
Peak-Hr Prop. of AADT, K			%RVs, P_R	*0*
Peak-Hr Direction Prop, D			General Terrain:	*Level*
DDHV = AADT x K x D		veh/h	Grade % Length	*mi*
Driver type adjustment	*1.00*		Up/Down %	

Calculate Flow Adjustments

f_p	*1.00*	E_R	*1.2*
E_T	*1.5*	$f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$	*0.971*

Speed Inputs

Lane Width	*12.0*	ft
Rt-Shoulder Lat. Clearance	*6.0*	ft
Interchange Density	*0.50*	I/mi
Number of Lanes, N	*5*	
FFS (measured)	*70.0*	mi/h
Base free-flow Speed, BFFS		mi/h

Calc Speed Adj and FFS

f_{LW}	
f_{LC}	
f_{ID}	
f_N	
FFS	*70.0*

LOS and Performance Measures

Operational (LOS)

v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	*2786*	pc/h/ln
S		mi/h
D = v_p / S		pc/mi/ln
LOS	*F*	

Design (N)

Design (N)

Design LOS	
v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	
S	
D = v_p / S	
Required Number of Lanes, N	

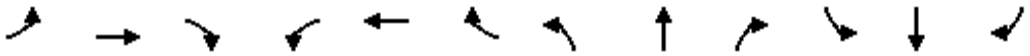
Glossary

N - Number of lanes S - Speed

Factor Location

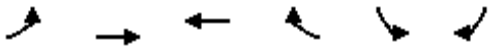
Appendix D

Alternatives Operational Analysis



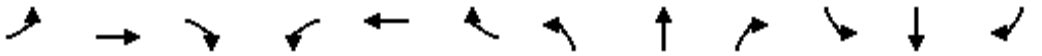
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	265	1605	165	535	2105	700	260	810	190	255	555	110
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	
Lane Util. Factor	0.97	0.91	1.00	0.97	0.91	1.00	0.97	0.95	1.00	0.97	0.95	
Frt	1.00	1.00	0.85	1.00	1.00	0.85	1.00	1.00	0.85	1.00	0.98	
Flt Protected	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	
Satd. Flow (prot)	3433	5085	1583	3433	5085	1583	3433	3539	1583	3433	3451	
Flt Permitted	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	
Satd. Flow (perm)	3433	5085	1583	3433	5085	1583	3433	3539	1583	3433	3451	
Peak-hour factor, PHF	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
Adj. Flow (vph)	279	1689	174	563	2216	737	274	853	200	268	584	116
RTOR Reduction (vph)	0	0	42	0	0	133	0	0	150	0	13	0
Lane Group Flow (vph)	279	1689	132	563	2216	604	274	853	50	268	687	0
Turn Type	Prot		Perm	Prot		Perm	Prot		Perm	Prot		
Protected Phases	5	2		1	6		3	8		7	4	
Permitted Phases			2			6			8			
Actuated Green, G (s)	9.0	41.0	41.0	20.0	52.0	52.0	13.5	29.0	29.0	9.0	24.5	
Effective Green, g (s)	10.0	43.0	43.0	21.0	54.0	54.0	14.5	30.0	30.0	10.0	25.5	
Actuated g/C Ratio	0.08	0.36	0.36	0.18	0.45	0.45	0.12	0.25	0.25	0.08	0.21	
Clearance Time (s)	5.0	6.0	6.0	5.0	6.0	6.0	5.0	5.0	5.0	5.0	5.0	
Vehicle Extension (s)	2.0	3.0	3.0	2.0	3.0	3.0	2.0	2.0	2.0	2.0	2.0	
Lane Grp Cap (vph)	286	1822	567	601	2288	712	415	885	396	286	733	
v/s Ratio Prot	0.08	c0.33		0.16	c0.44		0.08	c0.24		0.08	c0.20	
v/s Ratio Perm			0.08			0.38			0.03			
v/c Ratio	0.98	0.93	0.23	0.94	0.97	0.85	0.66	0.96	0.13	0.94	0.94	
Uniform Delay, d1	54.9	37.0	26.9	48.8	32.2	29.4	50.4	44.5	34.9	54.7	46.5	
Progression Factor	1.00	1.00	1.00	0.78	0.66	0.45	0.52	0.62	1.30	1.00	1.00	
Incremental Delay, d2	45.9	9.7	1.0	3.1	1.9	1.2	1.2	11.3	0.0	36.0	19.0	
Delay (s)	100.8	46.7	27.9	41.1	23.2	14.3	27.4	39.1	45.2	90.7	65.5	
Level of Service	F	D	C	D	C	B	C	D	D	F	E	
Approach Delay (s)		52.2			24.2			37.6			72.5	
Approach LOS		D			C			D			E	

Intersection Summary			
HCM Average Control Delay	39.9	HCM Level of Service	D
HCM Volume to Capacity ratio	0.96		
Actuated Cycle Length (s)	120.0	Sum of lost time (s)	12.0
Intersection Capacity Utilization	91.2%	ICU Level of Service	F
Analysis Period (min)	15		
c Critical Lane Group			



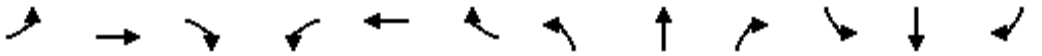
Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Volume (vph)	0	2050	2465	0	1485	875
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)		4.0	4.0		4.0	3.0
Lane Util. Factor		0.81	0.91		0.94	0.86
Frt		1.00	1.00		0.97	0.85
Flt Protected		1.00	1.00		0.96	1.00
Satd. Flow (prot)		7544	5085		4910	1362
Flt Permitted		1.00	1.00		0.96	1.00
Satd. Flow (perm)		7544	5085		4910	1362
Peak-hour factor, PHF	0.94	0.94	0.94	0.94	0.94	0.94
Adj. Flow (vph)	0	2181	2622	0	1580	931
RTOR Reduction (vph)	0	0	0	0	0	0
Lane Group Flow (vph)	0	2181	2622	0	1924	587
Turn Type						Free
Protected Phases		2	6		4	
Permitted Phases						Free
Actuated Green, G (s)		51.1	51.1		58.9	120.0
Effective Green, g (s)		52.1	52.1		59.9	120.0
Actuated g/C Ratio		0.43	0.43		0.50	1.00
Clearance Time (s)		5.0	5.0		5.0	
Vehicle Extension (s)		3.0	3.0		3.0	
Lane Grp Cap (vph)		3275	2208		2451	1362
v/s Ratio Prot		0.29	c0.52		c0.39	
v/s Ratio Perm						0.43
v/c Ratio		0.67	1.19		0.78	0.43
Uniform Delay, d1		27.0	33.9		24.7	0.0
Progression Factor		0.77	0.74		1.00	1.00
Incremental Delay, d2		0.5	86.7		1.7	1.0
Delay (s)		21.4	111.9		26.5	1.0
Level of Service		C	F		C	A
Approach Delay (s)		21.4	111.9		20.5	
Approach LOS		C	F		C	

Intersection Summary			
HCM Average Control Delay	53.5	HCM Level of Service	D
HCM Volume to Capacity ratio	0.97		
Actuated Cycle Length (s)	120.0	Sum of lost time (s)	8.0
Intersection Capacity Utilization	88.6%	ICU Level of Service	E
Analysis Period (min)	15		
c Critical Lane Group			



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	0	1970	0	0	3790	40	680	125	910	0	0	100
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)		4.0			4.0		4.0	4.0	4.0			4.0
Lane Util. Factor		0.91			0.81		0.91	0.86	0.95			1.00
Frt		1.00			1.00		1.00	0.90	0.85			0.86
Flt Protected		1.00			1.00		0.95	0.99	1.00			1.00
Satd. Flow (prot)		5085			7532		3221	1435	1504			1611
Flt Permitted		1.00			1.00		0.95	0.99	1.00			1.00
Satd. Flow (perm)		5085			7532		3221	1435	1504			1611
Peak-hour factor, PHF	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96
Adj. Flow (vph)	0	2052	0	0	3948	42	708	130	948	0	0	104
RTOR Reduction (vph)	0	0	0	0	1	0	0	0	0	0	0	0
Lane Group Flow (vph)	0	2052	0	0	3989	0	637	590	559	0	0	104
Turn Type							Perm		Perm			custom
Protected Phases		2			6			8				
Permitted Phases							8		8			4
Actuated Green, G (s)		63.0			63.0		47.0	47.0	47.0			47.0
Effective Green, g (s)		64.0			64.0		48.0	48.0	48.0			48.0
Actuated g/C Ratio		0.53			0.53		0.40	0.40	0.40			0.40
Clearance Time (s)		5.0			5.0		5.0	5.0	5.0			5.0
Vehicle Extension (s)		3.0			3.0		1.5	1.5	1.5			3.0
Lane Grp Cap (vph)		2712			4017		1288	574	602			644
v/s Ratio Prot		0.40			c0.53							
v/s Ratio Perm							0.20	0.41	0.37			0.06
v/c Ratio		0.76			0.99		0.49	1.03	0.93			0.16
Uniform Delay, d1		21.9			27.8		26.9	36.0	34.4			23.1
Progression Factor		1.09			0.42		1.00	1.00	1.00			1.00
Incremental Delay, d2		1.5			2.9		0.1	44.9	20.4			0.1
Delay (s)		25.3			14.6		27.0	80.9	54.7			23.2
Level of Service		C			B		C	F	D			C
Approach Delay (s)		25.3			14.6			53.5			23.2	
Approach LOS		C			B			D			C	

Intersection Summary			
HCM Average Control Delay	26.2	HCM Level of Service	C
HCM Volume to Capacity ratio	1.01		
Actuated Cycle Length (s)	120.0	Sum of lost time (s)	8.0
Intersection Capacity Utilization	82.3%	ICU Level of Service	E
Analysis Period (min)	15		
c Critical Lane Group			

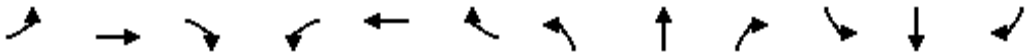


Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	350	2110	420	60	3350	90	250	125	60	70	150	230
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0		4.0	4.0	4.0
Lane Util. Factor	0.97	0.91	1.00	0.97	*0.80	1.00	0.97	0.95		0.97	0.95	1.00
Frt	1.00	1.00	0.85	1.00	1.00	0.85	1.00	0.95		1.00	1.00	0.85
Flt Protected	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00		0.95	1.00	1.00
Satd. Flow (prot)	3433	5085	1583	3433	5961	1583	3433	3367		3433	3539	1583
Flt Permitted	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00		1.00	1.00	1.00
Satd. Flow (perm)	3433	5085	1583	3433	5961	1583	3433	3367		3614	3539	1583
Peak-hour factor, PHF	0.94	0.94	0.94	0.94	0.94	0.94	0.94	0.94	0.94	0.94	0.94	0.94
Adj. Flow (vph)	372	2245	447	64	3564	96	266	133	64	74	160	245
RTOR Reduction (vph)	0	0	153	0	0	49	0	56	0	0	0	77
Lane Group Flow (vph)	372	2245	294	64	3564	47	266	141	0	74	160	168
Turn Type	Prot		Perm	Prot		Perm	Prot			pm+pt		Perm
Protected Phases	5	2		1	6		3	8		7	4	
Permitted Phases			2			6				4		4
Actuated Green, G (s)	14.8	66.9	66.9	4.9	57.0	57.0	10.0	12.2		17.2	17.2	17.2
Effective Green, g (s)	15.8	68.9	68.9	5.9	59.0	59.0	11.0	13.2		18.2	18.2	18.2
Actuated g/C Ratio	0.13	0.57	0.57	0.05	0.49	0.49	0.09	0.11		0.15	0.15	0.15
Clearance Time (s)	5.0	6.0	6.0	5.0	6.0	6.0	5.0	5.0		5.0	5.0	5.0
Vehicle Extension (s)	1.5	5.0	5.0	1.5	5.0	5.0	1.5	1.5		1.5	1.5	1.5
Lane Grp Cap (vph)	452	2920	909	169	2931	778	315	370		548	537	240
v/s Ratio Prot	c0.11	0.44		0.02	c0.60		c0.08	0.04		0.02	0.05	
v/s Ratio Perm			0.19			0.03				0.00		c0.11
v/c Ratio	0.82	0.77	0.32	0.38	1.22	0.06	0.84	0.38		0.14	0.30	0.70
Uniform Delay, d1	50.7	19.5	13.4	55.3	30.5	16.0	53.7	49.6		44.1	45.2	48.3
Progression Factor	1.09	0.76	0.59	1.00	1.00	1.00	1.00	1.00		1.00	1.00	1.00
Incremental Delay, d2	6.5	1.1	0.5	0.5	100.5	0.1	17.6	0.2		0.0	0.1	7.0
Delay (s)	62.0	16.0	8.4	55.8	131.0	16.1	71.3	49.8		44.1	45.3	55.3
Level of Service	E	B	A	E	F	B	E	D		D	D	E
Approach Delay (s)		20.5			126.8			62.2			50.2	
Approach LOS		C			F			E			D	

Intersection Summary			
HCM Average Control Delay	76.0	HCM Level of Service	E
HCM Volume to Capacity ratio	0.99		
Actuated Cycle Length (s)	120.0	Sum of lost time (s)	12.0
Intersection Capacity Utilization	83.1%	ICU Level of Service	E
Analysis Period (min)	15		
c Critical Lane Group			

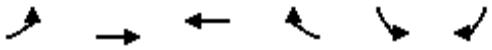
Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Volume (vph)	420	405	1360	725	475	975
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0	4.0	4.0	4.0	4.0
Lane Util. Factor	1.00	1.00	0.95	1.00	1.00	0.95
Frt	1.00	0.85	1.00	0.85	1.00	1.00
Flt Protected	0.95	1.00	1.00	1.00	0.95	1.00
Satd. Flow (prot)	1770	1583	3539	1583	1770	3539
Flt Permitted	0.95	1.00	1.00	1.00	0.07	1.00
Satd. Flow (perm)	1770	1583	3539	1583	138	3539
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	457	440	1478	788	516	1060
RTOR Reduction (vph)	0	295	0	354	0	0
Lane Group Flow (vph)	457	145	1478	435	516	1060
Turn Type		Perm		Perm	pm+pt	
Protected Phases	8		2		1	6
Permitted Phases		8		2	6	
Actuated Green, G (s)	29.0	29.0	49.0	49.0	81.0	81.0
Effective Green, g (s)	30.0	30.0	50.0	50.0	82.0	82.0
Actuated g/C Ratio	0.25	0.25	0.42	0.42	0.68	0.68
Clearance Time (s)	5.0	5.0	5.0	5.0	5.0	5.0
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0	3.0
Lane Grp Cap (vph)	443	396	1475	660	475	2418
v/s Ratio Prot	c0.26		0.42		c0.25	0.30
v/s Ratio Perm		0.09		0.27	c0.49	
v/c Ratio	1.03	0.37	1.00	0.66	1.09	0.44
Uniform Delay, d1	45.0	37.2	35.0	28.1	39.2	8.6
Progression Factor	1.00	1.00	1.00	1.00	1.01	0.35
Incremental Delay, d2	51.1	0.6	23.9	5.1	60.0	0.4
Delay (s)	96.1	37.7	58.9	33.2	99.7	3.4
Level of Service	F	D	E	C	F	A
Approach Delay (s)	67.5		50.0			34.9
Approach LOS	E		D			C

Intersection Summary			
HCM Average Control Delay	48.3	HCM Level of Service	D
HCM Volume to Capacity ratio	1.06		
Actuated Cycle Length (s)	120.0	Sum of lost time (s)	8.0
Intersection Capacity Utilization	97.2%	ICU Level of Service	F
Analysis Period (min)	15		
c Critical Lane Group			



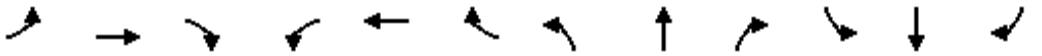
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	200	1445	210	555	2005	280	460	980	420	570	865	125
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	
Lane Util. Factor	0.97	0.91	1.00	0.97	0.91	1.00	0.97	0.95	1.00	0.97	0.95	
Frt	1.00	1.00	0.85	1.00	1.00	0.85	1.00	1.00	0.85	1.00	0.98	
Flt Protected	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	
Satd. Flow (prot)	3433	5085	1583	3433	5085	1583	3433	3539	1583	3433	3472	
Flt Permitted	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	
Satd. Flow (perm)	3433	5085	1583	3433	5085	1583	3433	3539	1583	3433	3472	
Peak-hour factor, PHF	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
Adj. Flow (vph)	211	1521	221	584	2111	295	484	1032	442	600	911	132
RTOR Reduction (vph)	0	0	59	0	0	126	0	0	221	0	9	0
Lane Group Flow (vph)	211	1521	162	584	2111	169	484	1032	221	600	1034	0
Turn Type	Prot		Perm	Prot		Perm	Prot		Perm	Prot		
Protected Phases	5	2		1	6		3	8		7	4	
Permitted Phases			2			6			8			
Actuated Green, G (s)	6.0	32.0	32.0	18.0	44.0	44.0	16.0	31.0	31.0	18.0	33.0	
Effective Green, g (s)	7.0	34.0	34.0	19.0	46.0	46.0	17.0	32.0	32.0	19.0	34.0	
Actuated g/C Ratio	0.06	0.28	0.28	0.16	0.38	0.38	0.14	0.27	0.27	0.16	0.28	
Clearance Time (s)	5.0	6.0	6.0	5.0	6.0	6.0	5.0	5.0	5.0	5.0	5.0	
Vehicle Extension (s)	2.0	3.0	3.0	2.0	3.0	3.0	2.0	2.0	2.0	2.0	2.0	
Lane Grp Cap (vph)	200	1441	449	544	1949	607	486	944	422	544	984	
v/s Ratio Prot	0.06	c0.30		0.17	c0.42		0.14	c0.29		0.17	c0.30	
v/s Ratio Perm			0.10			0.11			0.14			
v/c Ratio	1.06	1.06	0.36	1.07	1.08	0.28	1.00	1.09	0.52	1.10	1.05	
Uniform Delay, d1	56.5	43.0	34.3	50.5	37.0	25.5	51.5	44.0	37.5	50.5	43.0	
Progression Factor	1.00	1.00	1.00	0.86	0.82	0.43	0.71	0.74	0.58	1.00	1.00	
Incremental Delay, d2	78.9	39.9	2.2	52.6	44.0	0.7	35.2	55.5	0.4	69.8	42.9	
Delay (s)	135.4	82.9	36.5	96.1	74.3	11.8	71.9	88.0	22.0	120.3	85.9	
Level of Service	F	F	D	F	E	B	E	F	C	F	F	
Approach Delay (s)		83.3			72.4			69.1			98.5	
Approach LOS		F			E			E			F	

Intersection Summary			
HCM Average Control Delay	79.2	HCM Level of Service	E
HCM Volume to Capacity ratio	1.04		
Actuated Cycle Length (s)	120.0	Sum of lost time (s)	8.0
Intersection Capacity Utilization	101.1%	ICU Level of Service	G
Analysis Period (min)	15		
c Critical Lane Group			



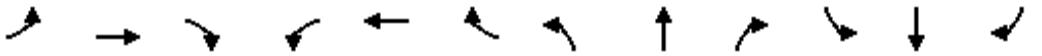
Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Volume (vph)	0	2435	2085	0	820	755
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)		4.0	4.0		4.0	4.0
Lane Util. Factor		0.81	0.91		0.94	0.86
Frt		1.00	1.00		0.95	0.85
Flt Protected		1.00	1.00		0.97	1.00
Satd. Flow (prot)		7544	5085		4839	1362
Flt Permitted		1.00	1.00		0.97	1.00
Satd. Flow (perm)		7544	5085		4839	1362
Peak-hour factor, PHF	0.94	0.94	0.94	0.94	0.94	0.94
Adj. Flow (vph)	0	2590	2218	0	872	803
RTOR Reduction (vph)	0	0	0	0	2	2
Lane Group Flow (vph)	0	2590	2218	0	1272	399
Turn Type						Perm
Protected Phases		2	6		4	
Permitted Phases						4
Actuated Green, G (s)		66.7	66.7		43.3	43.3
Effective Green, g (s)		67.7	67.7		44.3	44.3
Actuated g/C Ratio		0.56	0.56		0.37	0.37
Clearance Time (s)		5.0	5.0		5.0	5.0
Vehicle Extension (s)		3.0	3.0		3.0	3.0
Lane Grp Cap (vph)		4256	2869		1786	503
v/s Ratio Prot		0.34	c0.44		0.26	
v/s Ratio Perm						c0.29
v/c Ratio		0.61	0.77		0.71	0.79
Uniform Delay, d1		17.4	20.2		32.4	33.8
Progression Factor		0.28	0.62		1.00	1.00
Incremental Delay, d2		0.2	1.7		1.4	8.4
Delay (s)		5.0	14.2		33.8	42.2
Level of Service		A	B		C	D
Approach Delay (s)		5.0	14.2		35.8	
Approach LOS		A	B		D	

Intersection Summary			
HCM Average Control Delay	16.1	HCM Level of Service	B
HCM Volume to Capacity ratio	0.78		
Actuated Cycle Length (s)	120.0	Sum of lost time (s)	8.0
Intersection Capacity Utilization	78.1%	ICU Level of Service	D
Analysis Period (min)	15		
c Critical Lane Group			



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	0	1640	0	0	3010	40	660	85	590	0	0	150
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)		4.0			4.0		4.0	4.0	4.0			4.0
Lane Util. Factor		0.91			0.81		0.91	0.86	0.95			1.00
Frt		1.00			1.00		1.00	0.91	0.85			0.86
Flt Protected		1.00			1.00		0.95	0.99	1.00			1.00
Satd. Flow (prot)		5085			7529		3221	1445	1504			1611
Flt Permitted		1.00			1.00		0.95	0.99	1.00			1.00
Satd. Flow (perm)		5085			7529		3221	1445	1504			1611
Peak-hour factor, PHF	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96
Adj. Flow (vph)	0	1708	0	0	3135	42	688	89	615	0	0	156
RTOR Reduction (vph)	0	0	0	0	2	0	0	0	0	0	0	0
Lane Group Flow (vph)	0	1708	0	0	3175	0	619	398	375	0	0	156
Turn Type							Perm		Perm			custom
Protected Phases		2			6			8				
Permitted Phases							8		8			4
Actuated Green, G (s)		71.4			71.4		38.6	38.6	38.6			38.6
Effective Green, g (s)		72.4			72.4		39.6	39.6	39.6			39.6
Actuated g/C Ratio		0.60			0.60		0.33	0.33	0.33			0.33
Clearance Time (s)		5.0			5.0		5.0	5.0	5.0			5.0
Vehicle Extension (s)		3.0			3.0		1.5	1.5	1.5			3.0
Lane Grp Cap (vph)		3068			4542		1063	477	496			532
v/s Ratio Prot		0.34			c0.42							
v/s Ratio Perm							0.19	0.28	0.25			0.10
v/c Ratio		0.56			0.70		0.58	0.83	0.76			0.29
Uniform Delay, d1		14.2			16.3		33.3	37.2	35.9			29.8
Progression Factor		0.99			0.40		1.00	1.00	1.00			1.00
Incremental Delay, d2		0.6			0.5		0.5	11.4	5.8			0.3
Delay (s)		14.6			7.0		33.9	48.6	41.7			30.1
Level of Service		B			A		C	D	D			C
Approach Delay (s)		14.6			7.0			40.2			30.1	
Approach LOS		B			A			D			C	

Intersection Summary			
HCM Average Control Delay	16.7	HCM Level of Service	B
HCM Volume to Capacity ratio	0.75		
Actuated Cycle Length (s)	120.0	Sum of lost time (s)	8.0
Intersection Capacity Utilization	72.4%	ICU Level of Service	C
Analysis Period (min)	15		
c Critical Lane Group			

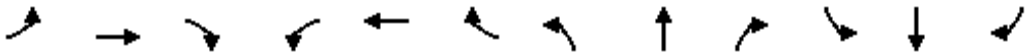


Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	280	1585	365	200	2270	180	540	235	175	105	190	240
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0		4.0	4.0	4.0
Lane Util. Factor	0.97	0.91	1.00	0.97	*0.80	1.00	0.97	0.95		0.97	0.95	1.00
Frt	1.00	1.00	0.85	1.00	1.00	0.85	1.00	0.94		1.00	1.00	0.85
Flt Protected	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00		0.95	1.00	1.00
Satd. Flow (prot)	3433	5085	1583	3433	5961	1583	3433	3313		3433	3539	1583
Flt Permitted	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00		0.50	1.00	1.00
Satd. Flow (perm)	3433	5085	1583	3433	5961	1583	3433	3313		1802	3539	1583
Peak-hour factor, PHF	0.94	0.94	0.94	0.94	0.94	0.94	0.94	0.94	0.94	0.94	0.94	0.94
Adj. Flow (vph)	298	1686	388	213	2415	191	574	250	186	112	202	255
RTOR Reduction (vph)	0	0	155	0	0	91	0	140	0	0	0	111
Lane Group Flow (vph)	298	1686	233	213	2415	100	574	296	0	112	202	144
Turn Type	Prot		Perm	Prot		Perm	Prot			pm+pt		Perm
Protected Phases	5	2		1	6		3	8		7	4	
Permitted Phases			2			6				4		4
Actuated Green, G (s)	7.0	61.1	61.1	7.0	61.1	61.1	16.0	26.9		18.9	14.9	14.9
Effective Green, g (s)	8.0	63.1	63.1	8.0	63.1	63.1	17.0	27.9		20.9	15.9	15.9
Actuated g/C Ratio	0.07	0.53	0.53	0.07	0.53	0.53	0.14	0.23		0.17	0.13	0.13
Clearance Time (s)	5.0	6.0	6.0	5.0	6.0	6.0	5.0	5.0		5.0	5.0	5.0
Vehicle Extension (s)	1.5	5.0	5.0	1.5	5.0	5.0	1.5	1.5		1.5	1.5	1.5
Lane Grp Cap (vph)	229	2674	832	229	3134	832	486	770		382	469	210
v/s Ratio Prot	c0.09	0.33		0.06	c0.41		c0.17	0.09		0.01	0.06	
v/s Ratio Perm			0.15			0.06				0.04		c0.09
v/c Ratio	1.30	0.63	0.28	0.93	0.77	0.12	1.18	0.38		0.29	0.43	0.69
Uniform Delay, d1	56.0	20.2	15.8	55.7	22.7	14.4	51.5	38.8		42.3	47.9	49.7
Progression Factor	0.98	0.80	0.68	1.00	1.00	1.00	1.00	1.00		1.00	1.00	1.00
Incremental Delay, d2	159.6	1.0	0.7	40.2	1.9	0.3	101.0	0.1		0.2	0.2	7.2
Delay (s)	214.6	17.1	11.5	95.9	24.6	14.7	152.5	38.9		42.5	48.1	56.8
Level of Service	F	B	B	F	C	B	F	D		D	D	E
Approach Delay (s)		41.0			29.3			103.5			50.9	
Approach LOS		D			C			F			D	

Intersection Summary			
HCM Average Control Delay	46.3	HCM Level of Service	D
HCM Volume to Capacity ratio	0.87		
Actuated Cycle Length (s)	120.0	Sum of lost time (s)	16.0
Intersection Capacity Utilization	74.9%	ICU Level of Service	D
Analysis Period (min)	15		
c Critical Lane Group			

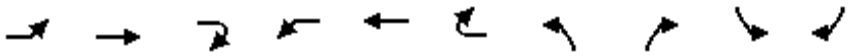
Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Volume (vph)	710	480	890	690	305	1415
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0	4.0	4.0	4.0	4.0
Lane Util. Factor	1.00	1.00	0.95	1.00	1.00	0.95
Frt	1.00	0.85	1.00	0.85	1.00	1.00
Flt Protected	0.95	1.00	1.00	1.00	0.95	1.00
Satd. Flow (prot)	1770	1583	3539	1583	1770	3539
Flt Permitted	0.95	1.00	1.00	1.00	0.10	1.00
Satd. Flow (perm)	1770	1583	3539	1583	187	3539
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	772	522	967	750	332	1538
RTOR Reduction (vph)	0	202	0	526	0	0
Lane Group Flow (vph)	772	320	967	224	332	1538
Turn Type		Perm		Perm	pm+pt	
Protected Phases	8		2		1	6
Permitted Phases		8		2	6	
Actuated Green, G (s)	52.8	52.8	34.9	34.9	57.2	57.2
Effective Green, g (s)	53.8	53.8	35.9	35.9	58.2	58.2
Actuated g/C Ratio	0.45	0.45	0.30	0.30	0.49	0.49
Clearance Time (s)	5.0	5.0	5.0	5.0	5.0	5.0
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0	3.0
Lane Grp Cap (vph)	794	710	1059	474	332	1716
v/s Ratio Prot	c0.44		0.27		c0.15	0.43
v/s Ratio Perm		0.20		0.14	c0.33	
v/c Ratio	0.97	0.45	0.91	0.47	1.00	0.90
Uniform Delay, d1	32.4	22.9	40.5	34.3	37.0	28.2
Progression Factor	1.00	1.00	1.00	1.00	1.38	0.54
Incremental Delay, d2	25.1	0.5	13.3	3.4	31.9	3.5
Delay (s)	57.5	23.3	53.9	37.7	82.9	18.7
Level of Service	E	C	D	D	F	B
Approach Delay (s)	43.7		46.8			30.1
Approach LOS	D		D			C

Intersection Summary			
HCM Average Control Delay	39.6	HCM Level of Service	D
HCM Volume to Capacity ratio	0.97		
Actuated Cycle Length (s)	120.0	Sum of lost time (s)	8.0
Intersection Capacity Utilization	90.8%	ICU Level of Service	E
Analysis Period (min)	15		
c Critical Lane Group			



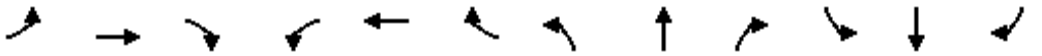
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	265	1605	165	535	2105	700	260	810	190	255	555	110
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	
Lane Util. Factor	0.97	0.91	1.00	0.97	0.91	1.00	0.97	0.95	1.00	0.97	0.95	
Frt	1.00	1.00	0.85	1.00	1.00	0.85	1.00	1.00	0.85	1.00	0.98	
Flt Protected	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	
Satd. Flow (prot)	3433	5085	1583	3433	5085	1583	3433	3539	1583	3433	3451	
Flt Permitted	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	
Satd. Flow (perm)	3433	5085	1583	3433	5085	1583	3433	3539	1583	3433	3451	
Peak-hour factor, PHF	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
Adj. Flow (vph)	279	1689	174	563	2216	737	274	853	200	268	584	116
RTOR Reduction (vph)	0	0	42	0	0	136	0	0	150	0	14	0
Lane Group Flow (vph)	279	1689	132	563	2216	601	274	853	50	268	686	0
Turn Type	Prot		Perm	Prot		Perm	Prot		Perm	Prot		
Protected Phases	5	2		1	6		3	8		7	4	
Permitted Phases			2			6			8			
Actuated Green, G (s)	9.0	42.0	42.0	19.0	52.0	52.0	16.0	29.0	29.0	9.0	22.0	
Effective Green, g (s)	10.0	44.0	44.0	20.0	54.0	54.0	17.0	30.0	30.0	10.0	23.0	
Actuated g/C Ratio	0.08	0.37	0.37	0.17	0.45	0.45	0.14	0.25	0.25	0.08	0.19	
Clearance Time (s)	5.0	6.0	6.0	5.0	6.0	6.0	5.0	5.0	5.0	5.0	5.0	
Vehicle Extension (s)	2.0	3.0	3.0	2.0	3.0	3.0	2.0	2.0	2.0	2.0	2.0	
Lane Grp Cap (vph)	286	1865	580	572	2288	712	486	885	396	286	661	
v/s Ratio Prot	0.08	c0.33		0.16	c0.44		0.08	c0.24		c0.08	c0.20	
v/s Ratio Perm			0.08			0.38			0.03			
v/c Ratio	0.98	0.91	0.23	0.98	0.97	0.84	0.56	0.96	0.13	0.94	1.04	
Uniform Delay, d1	54.9	36.0	26.2	49.8	32.2	29.3	48.0	44.5	34.9	54.7	48.5	
Progression Factor	1.00	1.00	1.00	0.77	0.66	0.46	0.63	0.48	0.38	1.00	1.00	
Incremental Delay, d2	45.9	7.8	0.9	21.7	7.4	5.9	0.3	11.3	0.0	36.0	45.3	
Delay (s)	100.8	43.9	27.2	60.0	28.7	19.3	30.6	32.6	13.1	90.7	93.8	
Level of Service	F	D	C	E	C	B	C	C	B	F	F	
Approach Delay (s)		49.9			31.7			29.2			92.9	
Approach LOS		D			C			C			F	

Intersection Summary			
HCM Average Control Delay	43.7	HCM Level of Service	D
HCM Volume to Capacity ratio	0.95		
Actuated Cycle Length (s)	120.0	Sum of lost time (s)	12.0
Intersection Capacity Utilization	91.2%	ICU Level of Service	F
Analysis Period (min)	15		
c Critical Lane Group			



Movement	EBL	EBT	EBR2	WBL	WBT	WBR2	NBL	NBR2	SBL	SBR2
Lane Configurations										
Volume (vph)	760	485	805	755	1785	1350	680	910	1485	875
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
Lane Util. Factor	0.97	0.91	1.00	0.97	0.91	1.00	0.97	0.88	0.97	1.00
Frt	1.00	1.00	0.85	1.00	1.00	0.85	1.00	0.85	1.00	0.85
Flt Protected	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	0.95	1.00
Satd. Flow (prot)	3433	5085	1583	3433	5085	1583	3433	2787	3433	1583
Flt Permitted	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	0.95	1.00
Satd. Flow (perm)	3433	5085	1583	3433	5085	1583	3433	2787	3433	1583
Peak-hour factor, PHF	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
Adj. Flow (vph)	800	511	847	795	1879	1421	716	958	1563	921
RTOR Reduction (vph)	0	0	0	0	0	0	0	0	0	0
Lane Group Flow (vph)	800	511	847	795	1879	1421	716	958	1563	921
Turn Type	Prot		Free	Prot		Free	Prot	Free	Prot	Free
Protected Phases	5	2		1	6		3		7	
Permitted Phases			Free			Free		Free		Free
Actuated Green, G (s)	19.0	21.0	120.0	33.0	35.0	120.0	42.0	120.0	42.0	120.0
Effective Green, g (s)	23.0	25.0	120.0	37.0	39.0	120.0	46.0	120.0	46.0	120.0
Actuated g/C Ratio	0.19	0.21	1.00	0.31	0.32	1.00	0.38	1.00	0.38	1.00
Clearance Time (s)	8.0	8.0		8.0	8.0		8.0		8.0	
Vehicle Extension (s)	3.0	3.0		3.0	3.0		3.0		3.0	
Lane Grp Cap (vph)	658	1059	1583	1059	1653	1583	1316	2787	1316	1583
v/s Ratio Prot	c0.23	0.10		0.23	c0.37		0.21		c0.46	
v/s Ratio Perm			0.53			c0.90		0.34		0.58
v/c Ratio	1.22	0.48	0.54	0.75	1.14	0.90	0.54	0.34	1.19	0.58
Uniform Delay, d1	48.5	41.8	0.0	37.3	40.5	0.0	28.8	0.0	37.0	0.0
Progression Factor	0.52	0.45	1.00	0.49	0.53	1.00	1.00	1.00	1.00	1.00
Incremental Delay, d2	104.1	0.8	0.6	0.3	62.3	0.9	0.5	0.3	92.4	1.6
Delay (s)	129.1	19.6	0.6	18.5	83.8	0.9	29.3	0.3	129.4	1.6
Level of Service	F	B	A	B	F	A	C	A	F	A
Approach Delay (s)		52.7			42.4					
Approach LOS		D			D					

Intersection Summary			
HCM Average Control Delay	49.2	HCM Level of Service	D
HCM Volume to Capacity ratio	1.15		
Actuated Cycle Length (s)	120.0	Sum of lost time (s)	8.0
Intersection Capacity Utilization	108.5%	ICU Level of Service	G
Analysis Period (min)	15		
c Critical Lane Group			

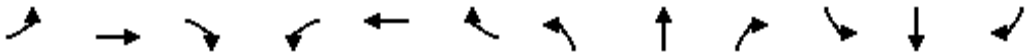


Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	350	2110	420	60	3350	90	250	125	60	70	150	290
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0		4.0	4.0	4.0
Lane Util. Factor	0.97	0.91	1.00	0.97	*0.80	1.00	0.97	0.95		0.97	0.95	1.00
Frt	1.00	1.00	0.85	1.00	1.00	0.85	1.00	0.95		1.00	1.00	0.85
Flt Protected	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00		0.95	1.00	1.00
Satd. Flow (prot)	3433	5085	1583	3433	5961	1583	3433	3367		3433	3539	1583
Flt Permitted	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00		0.63	1.00	1.00
Satd. Flow (perm)	3433	5085	1583	3433	5961	1583	3433	3367		2269	3539	1583
Peak-hour factor, PHF	0.94	0.94	0.94	0.94	0.94	0.94	0.94	0.94	0.94	0.94	0.94	0.94
Adj. Flow (vph)	372	2245	447	64	3564	96	266	133	64	74	160	309
RTOR Reduction (vph)	0	0	144	0	0	45	0	50	0	0	0	73
Lane Group Flow (vph)	372	2245	303	64	3564	51	266	147	0	74	160	236
Turn Type	Prot		Perm	Prot		Perm	Prot			pm+pt		Perm
Protected Phases	5	2		1	6		3	8		7	4	
Permitted Phases			2			6				4		4
Actuated Green, G (s)	9.0	66.5	66.5	4.0	61.5	61.5	6.0	25.3		25.7	22.5	22.5
Effective Green, g (s)	10.0	68.5	68.5	5.0	63.5	63.5	7.0	26.3		27.7	23.5	23.5
Actuated g/C Ratio	0.08	0.57	0.57	0.04	0.53	0.53	0.06	0.22		0.23	0.20	0.20
Clearance Time (s)	5.0	6.0	6.0	5.0	6.0	6.0	5.0	5.0		5.0	5.0	5.0
Vehicle Extension (s)	1.5	5.0	5.0	1.5	5.0	5.0	1.5	1.5		1.5	1.5	1.5
Lane Grp Cap (vph)	286	2903	904	143	3154	838	200	738		565	693	310
v/s Ratio Prot	c0.11	0.44		0.02	c0.60		c0.08	c0.04		0.00	0.05	
v/s Ratio Perm			0.19			0.03				0.03		c0.15
v/c Ratio	1.30	0.77	0.33	0.45	1.13	0.06	1.33	0.20		0.13	0.23	0.76
Uniform Delay, d1	55.0	19.8	13.7	56.2	28.2	13.7	56.5	38.3		36.3	40.6	45.6
Progression Factor	0.90	0.46	0.15	1.00	1.00	1.00	1.00	1.00		1.00	1.00	1.00
Incremental Delay, d2	149.6	1.2	0.6	0.8	63.1	0.1	178.7	0.0		0.0	0.1	9.5
Delay (s)	199.0	10.3	2.7	57.0	91.3	13.9	235.2	38.3		36.3	40.7	55.1
Level of Service	F	B	A	E	F	B	F	D		D	D	E
Approach Delay (s)		32.1			88.8			151.4			48.3	
Approach LOS		C			F			F			D	

Intersection Summary			
HCM Average Control Delay	67.4	HCM Level of Service	E
HCM Volume to Capacity ratio	1.10		
Actuated Cycle Length (s)	120.0	Sum of lost time (s)	20.0
Intersection Capacity Utilization	83.6%	ICU Level of Service	E
Analysis Period (min)	15		
c Critical Lane Group			

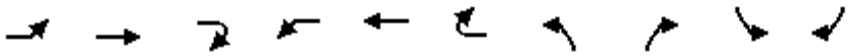
Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Volume (vph)	420	405	1360	725	475	975
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0	4.0	4.0	4.0	4.0
Lane Util. Factor	1.00	1.00	0.95	1.00	1.00	0.95
Frt	1.00	0.85	1.00	0.85	1.00	1.00
Flt Protected	0.95	1.00	1.00	1.00	0.95	1.00
Satd. Flow (prot)	1770	1583	3539	1583	1770	3539
Flt Permitted	0.95	1.00	1.00	1.00	0.07	1.00
Satd. Flow (perm)	1770	1583	3539	1583	138	3539
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	457	440	1478	788	516	1060
RTOR Reduction (vph)	0	295	0	354	0	0
Lane Group Flow (vph)	457	145	1478	435	516	1060
Turn Type		Perm		Perm	pm+pt	
Protected Phases	8		2		1	6
Permitted Phases		8		2	6	
Actuated Green, G (s)	29.0	29.0	49.0	49.0	81.0	81.0
Effective Green, g (s)	30.0	30.0	50.0	50.0	82.0	82.0
Actuated g/C Ratio	0.25	0.25	0.42	0.42	0.68	0.68
Clearance Time (s)	5.0	5.0	5.0	5.0	5.0	5.0
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0	3.0
Lane Grp Cap (vph)	443	396	1475	660	475	2418
v/s Ratio Prot	c0.26		0.42		c0.25	0.30
v/s Ratio Perm		0.09		0.27	c0.49	
v/c Ratio	1.03	0.37	1.00	0.66	1.09	0.44
Uniform Delay, d1	45.0	37.2	35.0	28.1	39.2	8.6
Progression Factor	1.00	1.00	1.00	1.00	0.81	0.30
Incremental Delay, d2	51.1	0.6	23.9	5.1	58.5	0.4
Delay (s)	96.1	37.7	58.9	33.2	90.1	2.9
Level of Service	F	D	E	C	F	A
Approach Delay (s)	67.5		50.0			31.5
Approach LOS	E		D			C

Intersection Summary			
HCM Average Control Delay	47.1	HCM Level of Service	D
HCM Volume to Capacity ratio	1.06		
Actuated Cycle Length (s)	120.0	Sum of lost time (s)	8.0
Intersection Capacity Utilization	97.2%	ICU Level of Service	F
Analysis Period (min)	15		
c Critical Lane Group			



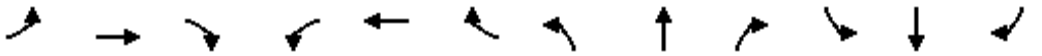
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	200	1475	210	555	1975	200	460	980	420	570	865	125
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	
Lane Util. Factor	0.97	0.91	1.00	0.97	0.91	1.00	0.97	0.95	1.00	0.97	0.95	
Frt	1.00	1.00	0.85	1.00	1.00	0.85	1.00	1.00	0.85	1.00	0.98	
Flt Protected	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	
Satd. Flow (prot)	3433	5085	1583	3433	5085	1583	3433	3539	1583	3433	3472	
Flt Permitted	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	
Satd. Flow (perm)	3433	5085	1583	3433	5085	1583	3433	3539	1583	3433	3472	
Peak-hour factor, PHF	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
Adj. Flow (vph)	211	1553	221	584	2079	211	484	1032	442	600	911	132
RTOR Reduction (vph)	0	0	58	0	0	91	0	0	234	0	9	0
Lane Group Flow (vph)	211	1553	163	584	2079	120	484	1032	208	600	1034	0
Turn Type	Prot		Perm	Prot		Perm	Prot		Perm	Prot		
Protected Phases	5	2		1	6		3	8		7	4	
Permitted Phases			2			6			8			
Actuated Green, G (s)	6.0	32.0	32.0	18.0	44.0	44.0	16.0	31.0	31.0	18.0	33.0	
Effective Green, g (s)	7.0	34.0	34.0	19.0	46.0	46.0	17.0	32.0	32.0	19.0	34.0	
Actuated g/C Ratio	0.06	0.28	0.28	0.16	0.38	0.38	0.14	0.27	0.27	0.16	0.28	
Clearance Time (s)	5.0	6.0	6.0	5.0	6.0	6.0	5.0	5.0	5.0	5.0	5.0	
Vehicle Extension (s)	2.0	3.0	3.0	2.0	3.0	3.0	2.0	2.0	2.0	2.0	2.0	
Lane Grp Cap (vph)	200	1441	449	544	1949	607	486	944	422	544	984	
v/s Ratio Prot	0.06	c0.31		0.17	c0.41		0.14	c0.29		0.17	c0.30	
v/s Ratio Perm			0.10			0.08			0.13			
v/c Ratio	1.06	1.08	0.36	1.07	1.07	0.20	1.00	1.09	0.49	1.10	1.05	
Uniform Delay, d1	56.5	43.0	34.3	50.5	37.0	24.7	51.5	44.0	37.2	50.5	43.0	
Progression Factor	1.00	1.00	1.00	0.84	0.65	0.37	0.67	0.71	0.42	1.00	1.00	
Incremental Delay, d2	78.9	47.7	2.3	53.8	38.1	0.5	35.2	55.5	0.3	69.8	42.9	
Delay (s)	135.4	90.7	36.6	96.2	62.2	9.7	69.9	86.8	15.7	120.3	85.9	
Level of Service	F	F	D	F	E	A	E	F	B	F	F	
Approach Delay (s)		89.4			65.2			66.6			98.5	
Approach LOS		F			E			E			F	

Intersection Summary			
HCM Average Control Delay	77.7	HCM Level of Service	E
HCM Volume to Capacity ratio	1.04		
Actuated Cycle Length (s)	120.0	Sum of lost time (s)	8.0
Intersection Capacity Utilization	101.0%	ICU Level of Service	G
Analysis Period (min)	15		
c Critical Lane Group			



Movement	EBL	EBT	EBR2	WBL	WBT	WBR2	NBL	NBR2	SBL	SBR2
Lane Configurations										
Volume (vph)	810	995	660	1085	1315	650	660	590	820	755
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
Lane Util. Factor	0.97	0.91	1.00	0.97	0.91	1.00	0.97	0.88	0.97	1.00
Frt	1.00	1.00	0.85	1.00	1.00	0.85	1.00	0.85	1.00	0.85
Flt Protected	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	0.95	1.00
Satd. Flow (prot)	3433	5085	1583	3433	5085	1583	3433	2787	3433	1583
Flt Permitted	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	0.95	1.00
Satd. Flow (perm)	3433	5085	1583	3433	5085	1583	3433	2787	3433	1583
Peak-hour factor, PHF	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
Adj. Flow (vph)	853	1047	695	1142	1384	684	695	621	863	795
RTOR Reduction (vph)	0	0	0	0	0	0	0	0	0	0
Lane Group Flow (vph)	853	1047	695	1142	1384	684	695	621	863	795
Turn Type	Prot		Free	Prot		Free	Prot	Free	Prot	Free
Protected Phases	5	2		1	6		3		7	
Permitted Phases			Free			Free		Free		Free
Actuated Green, G (s)	29.8	26.3	120.0	39.8	36.3	120.0	29.9	120.0	29.9	120.0
Effective Green, g (s)	33.8	30.3	120.0	43.8	40.3	120.0	33.9	120.0	33.9	120.0
Actuated g/C Ratio	0.28	0.25	1.00	0.36	0.34	1.00	0.28	1.00	0.28	1.00
Clearance Time (s)	8.0	8.0		8.0	8.0		8.0		8.0	
Vehicle Extension (s)	3.0	3.0		3.0	3.0		3.0		3.0	
Lane Grp Cap (vph)	967	1284	1583	1253	1708	1583	970	2787	970	1583
v/s Ratio Prot	0.25	0.21		c0.33	c0.27		0.20		c0.25	
v/s Ratio Perm			0.44			0.43		0.22		0.50
v/c Ratio	0.88	0.82	0.44	0.91	0.81	0.43	0.72	0.22	0.89	0.50
Uniform Delay, d1	41.2	42.2	0.0	36.3	36.4	0.0	38.7	0.0	41.3	0.0
Progression Factor	0.63	1.03	1.00	0.68	0.67	1.00	1.00	1.00	1.00	1.00
Incremental Delay, d2	1.0	0.6	0.1	3.8	1.5	0.3	2.5	0.2	10.1	1.1
Delay (s)	26.8	44.2	0.1	28.3	25.7	0.3	41.3	0.2	51.3	1.1
Level of Service	C	D	A	C	C	A	D	A	D	A
Approach Delay (s)		26.7			21.2					
Approach LOS		C			C					

Intersection Summary			
HCM Average Control Delay	24.1	HCM Level of Service	C
HCM Volume to Capacity ratio	0.86		
Actuated Cycle Length (s)	120.0	Sum of lost time (s)	8.0
Intersection Capacity Utilization	83.6%	ICU Level of Service	E
Analysis Period (min)	15		
c Critical Lane Group			



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	280	1760	365	200	2270	180	540	235	175	105	190	240
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0		4.0	4.0	4.0
Lane Util. Factor	0.97	0.91	1.00	0.97	*0.80	1.00	0.97	0.95		0.97	0.95	1.00
Frt	1.00	1.00	0.85	1.00	1.00	0.85	1.00	0.94		1.00	1.00	0.85
Flt Protected	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00		0.95	1.00	1.00
Satd. Flow (prot)	3433	5085	1583	3433	5961	1583	3433	3313		3433	3539	1583
Flt Permitted	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00		0.50	1.00	1.00
Satd. Flow (perm)	3433	5085	1583	3433	5961	1583	3433	3313		1802	3539	1583
Peak-hour factor, PHF	0.94	0.94	0.94	0.94	0.94	0.94	0.94	0.94	0.94	0.94	0.94	0.94
Adj. Flow (vph)	298	1872	388	213	2415	191	574	250	186	112	202	255
RTOR Reduction (vph)	0	0	137	0	0	109	0	125	0	0	0	124
Lane Group Flow (vph)	298	1872	251	213	2415	82	574	311	0	112	202	131
Turn Type	Prot		Perm	Prot		Perm	Prot			pm+pt		Perm
Protected Phases	5	2		1	6		3	8		7	4	
Permitted Phases			2			6				4		4
Actuated Green, G (s)	19.2	62.9	62.9	6.0	49.7	49.7	16.0	26.1		18.1	14.1	14.1
Effective Green, g (s)	20.2	64.9	64.9	7.0	51.7	51.7	17.0	27.1		20.1	15.1	15.1
Actuated g/C Ratio	0.17	0.54	0.54	0.06	0.43	0.43	0.14	0.23		0.17	0.13	0.13
Clearance Time (s)	5.0	6.0	6.0	5.0	6.0	6.0	5.0	5.0		5.0	5.0	5.0
Vehicle Extension (s)	1.5	5.0	5.0	1.5	5.0	5.0	1.5	1.5		1.5	1.5	1.5
Lane Grp Cap (vph)	578	2750	856	200	2568	682	486	748		370	445	199
v/s Ratio Prot	0.09	c0.37		0.06	c0.41		c0.17	0.09		0.01	0.06	
v/s Ratio Perm			0.16			0.05				0.04		c0.08
v/c Ratio	0.52	0.68	0.29	1.06	0.94	0.12	1.18	0.42		0.30	0.45	0.66
Uniform Delay, d1	45.4	20.0	15.0	56.5	32.7	20.5	51.5	39.7		43.0	48.6	50.0
Progression Factor	0.93	0.33	0.13	1.00	1.00	1.00	1.00	1.00		1.00	1.00	1.00
Incremental Delay, d2	0.2	1.0	0.6	81.9	8.4	0.4	101.0	0.1		0.2	0.3	5.9
Delay (s)	42.6	7.5	2.6	138.4	41.1	20.9	152.5	39.8		43.2	48.9	55.8
Level of Service	D	A	A	F	D	C	F	D		D	D	E
Approach Delay (s)		10.9			47.1			103.8			50.9	
Approach LOS		B			D			F			D	

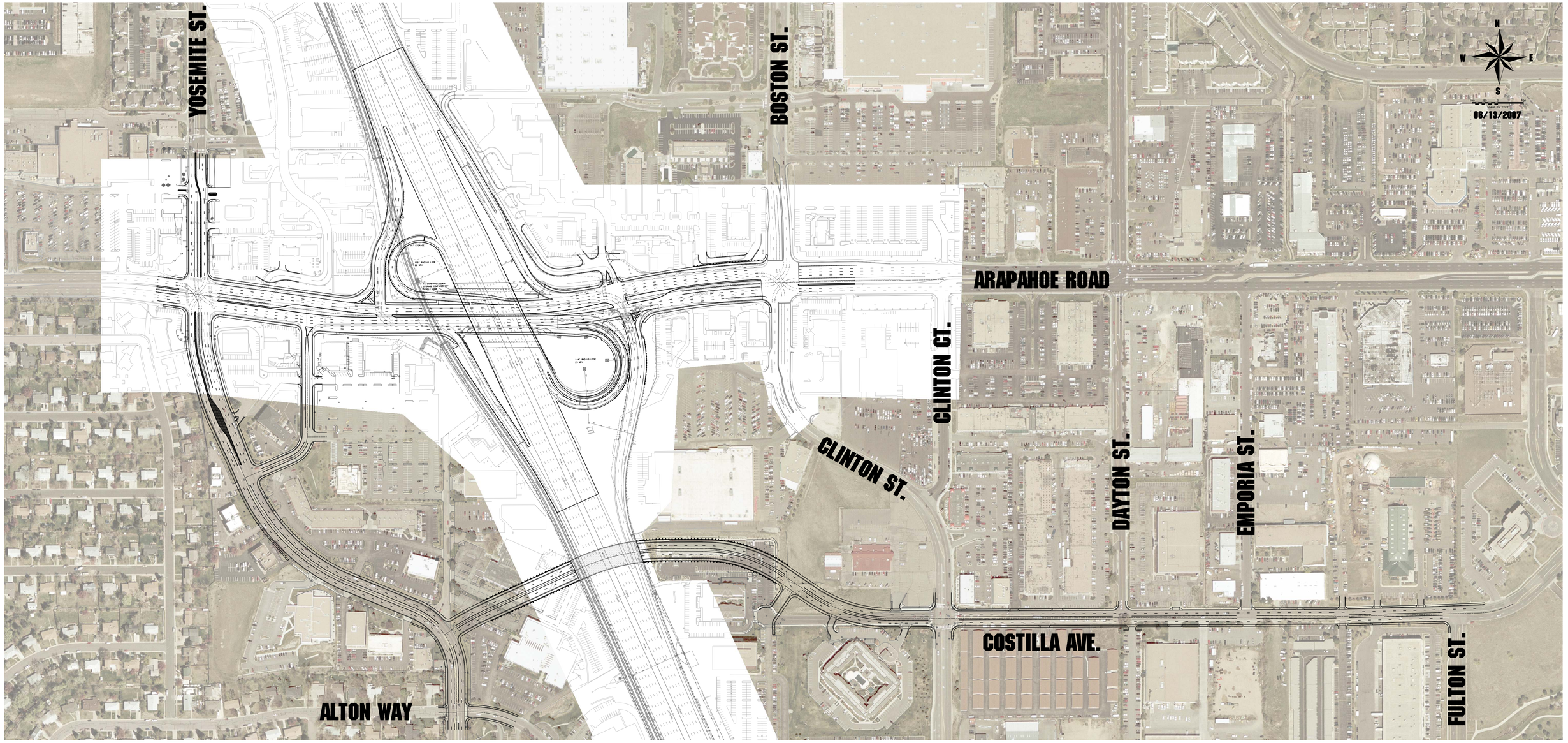
Intersection Summary			
HCM Average Control Delay	42.3	HCM Level of Service	D
HCM Volume to Capacity ratio	0.90		
Actuated Cycle Length (s)	120.0	Sum of lost time (s)	16.0
Intersection Capacity Utilization	74.9%	ICU Level of Service	D
Analysis Period (min)	15		
c Critical Lane Group			

Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Volume (vph)	710	480	890	690	305	1415
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0	4.0	4.0	4.0	4.0
Lane Util. Factor	1.00	1.00	0.95	1.00	1.00	0.95
Frt	1.00	0.85	1.00	0.85	1.00	1.00
Flt Protected	0.95	1.00	1.00	1.00	0.95	1.00
Satd. Flow (prot)	1770	1583	3539	1583	1770	3539
Flt Permitted	0.95	1.00	1.00	1.00	0.10	1.00
Satd. Flow (perm)	1770	1583	3539	1583	186	3539
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	772	522	967	750	332	1538
RTOR Reduction (vph)	0	202	0	525	0	0
Lane Group Flow (vph)	772	320	967	225	332	1538
Turn Type		Perm		Perm	pm+pt	
Protected Phases	8		2		1	6
Permitted Phases		8		2	6	
Actuated Green, G (s)	52.8	52.8	35.0	35.0	57.2	57.2
Effective Green, g (s)	53.8	53.8	36.0	36.0	58.2	58.2
Actuated g/C Ratio	0.45	0.45	0.30	0.30	0.49	0.49
Clearance Time (s)	5.0	5.0	5.0	5.0	5.0	5.0
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0	3.0
Lane Grp Cap (vph)	794	710	1062	475	330	1716
v/s Ratio Prot	c0.44		0.27		c0.15	0.43
v/s Ratio Perm		0.20		0.14	c0.33	
v/c Ratio	0.97	0.45	0.91	0.47	1.01	0.90
Uniform Delay, d1	32.4	22.9	40.4	34.3	44.6	28.2
Progression Factor	1.00	1.00	1.00	1.00	0.60	0.38
Incremental Delay, d2	25.1	0.5	13.0	3.4	33.5	3.5
Delay (s)	57.5	23.3	53.5	37.6	60.3	14.3
Level of Service	E	C	D	D	E	B
Approach Delay (s)	43.7		46.6			22.5
Approach LOS	D		D			C

Intersection Summary			
HCM Average Control Delay	36.6	HCM Level of Service	D
HCM Volume to Capacity ratio	0.97		
Actuated Cycle Length (s)	120.0	Sum of lost time (s)	8.0
Intersection Capacity Utilization	90.8%	ICU Level of Service	E
Analysis Period (min)	15		
c Critical Lane Group			

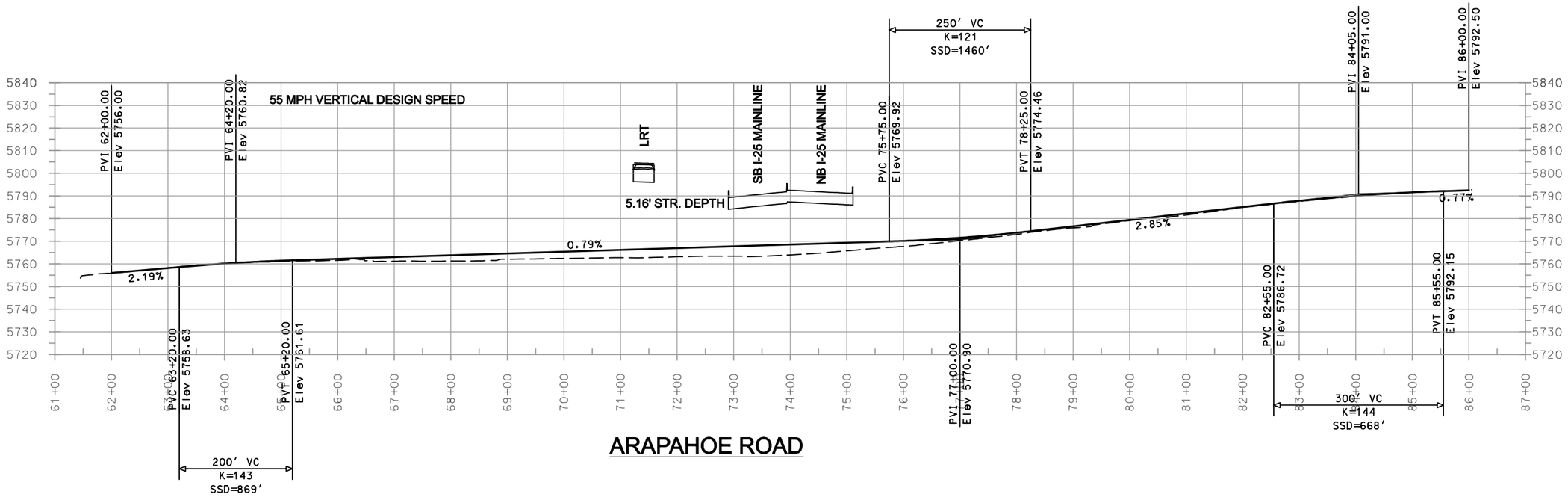
Appendix E

Recommended Alternative Profiles


YOSEMITE ST.
BOSTON ST.
ARAPAHOE ROAD
CLINTON CT.
CLINTON ST.
DAYTON ST.
EMPORIA ST.
COSTILLA AVE.
FULTON ST.
ALTON WAY
N
W
E
S
06/13/2007

ALTERNATIVE 1 – IMPROVED PARTIAL CLOVERLEAF INTERCHANGE

07/16/2007

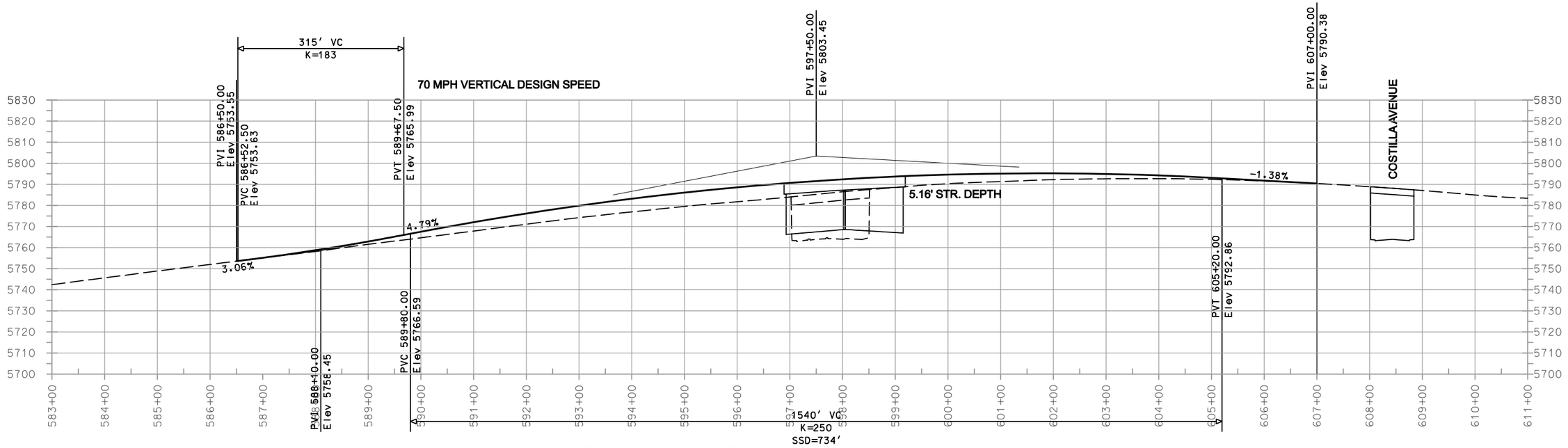


ARAPAHOE ROAD

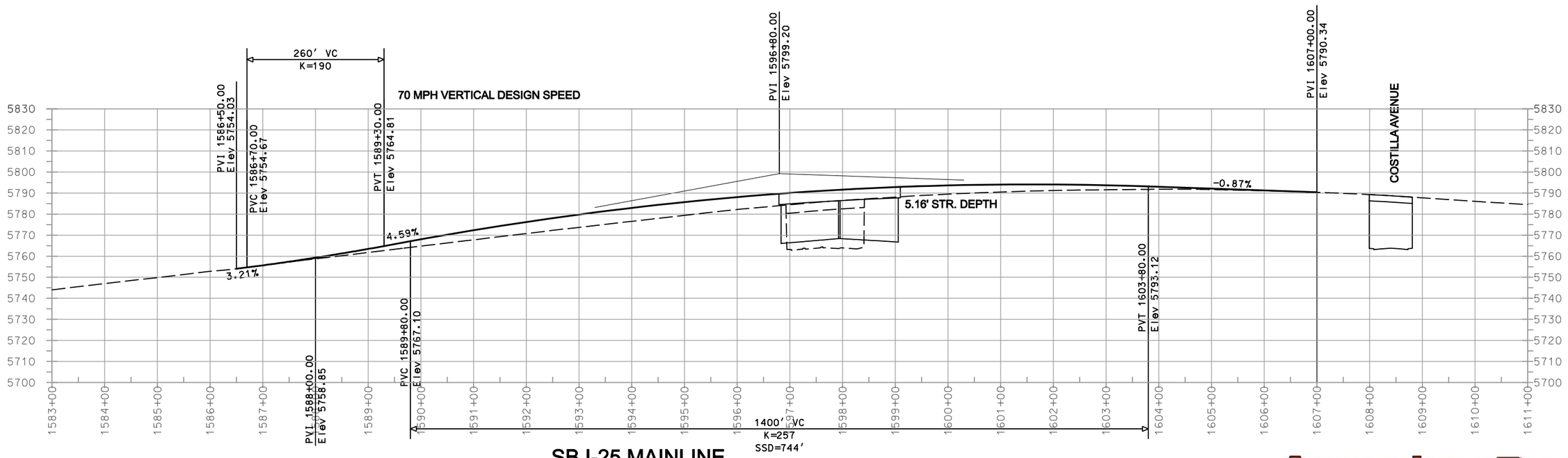
ArapahoeRoad corridor study

ALTERNATIVE 1 – IMPROVED PARTIAL CLOVERLEAF INTERCHANGE

07/16/2007



NB I-25 MAINLINE



SB I-25 MAINLINE

ArapahoeRoad corridor study

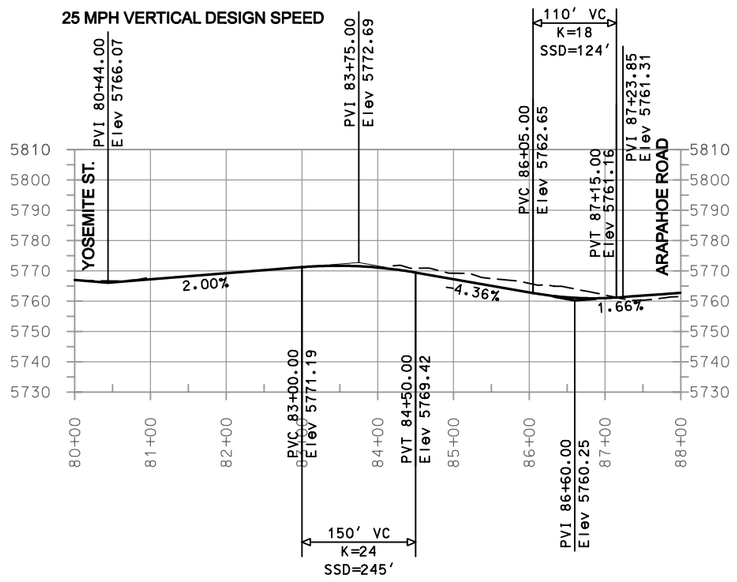
ALTERNATIVE 1 – IMPROVED PARTIAL CLOVERLEAF INTERCHANGE

07/16/2007

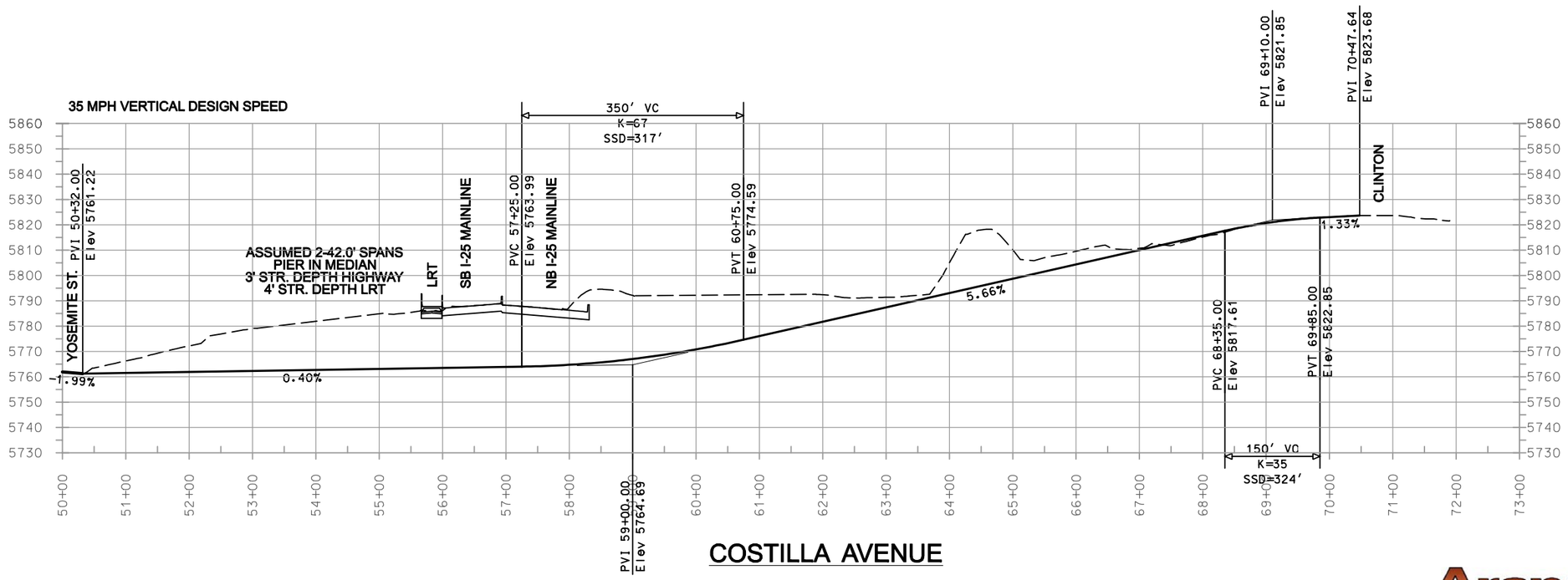
ArapahoeRoad corridor study

ALTERNATIVE 1 – IMPROVED PARTIAL CLOVERLEAF INTERCHANGE

07/16/2007



SOUTH XANTHIA STREET

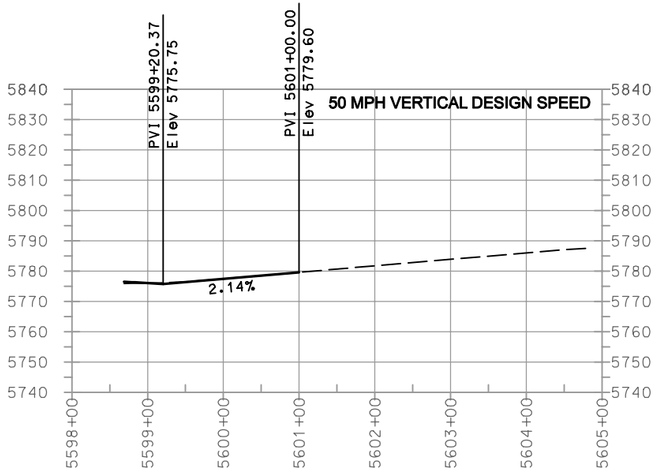


COSTILLA AVENUE

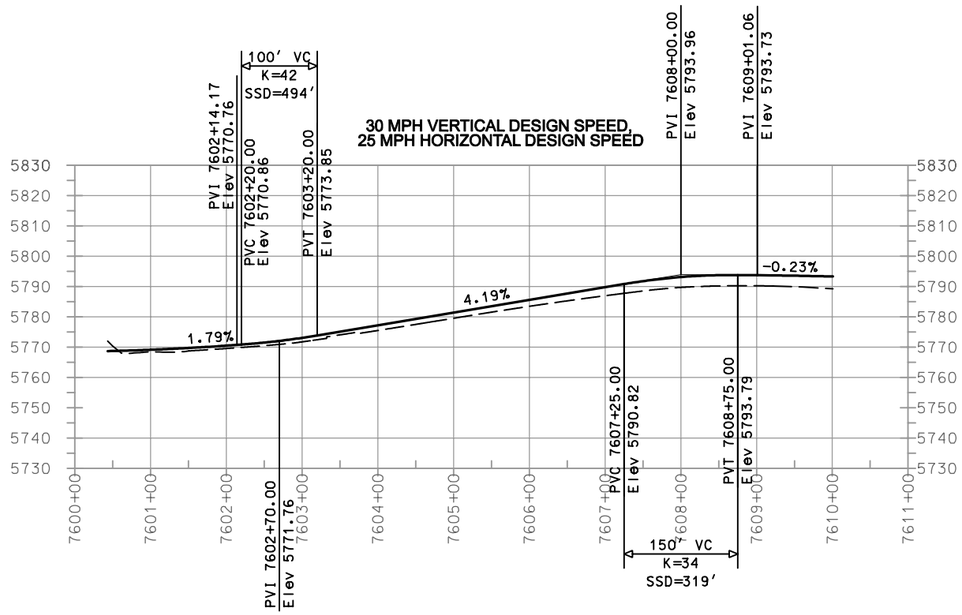
ArapahoeRoad corridor study

ALTERNATIVE 1 – IMPROVED PARTIAL CLOVERLEAF INTERCHANGE

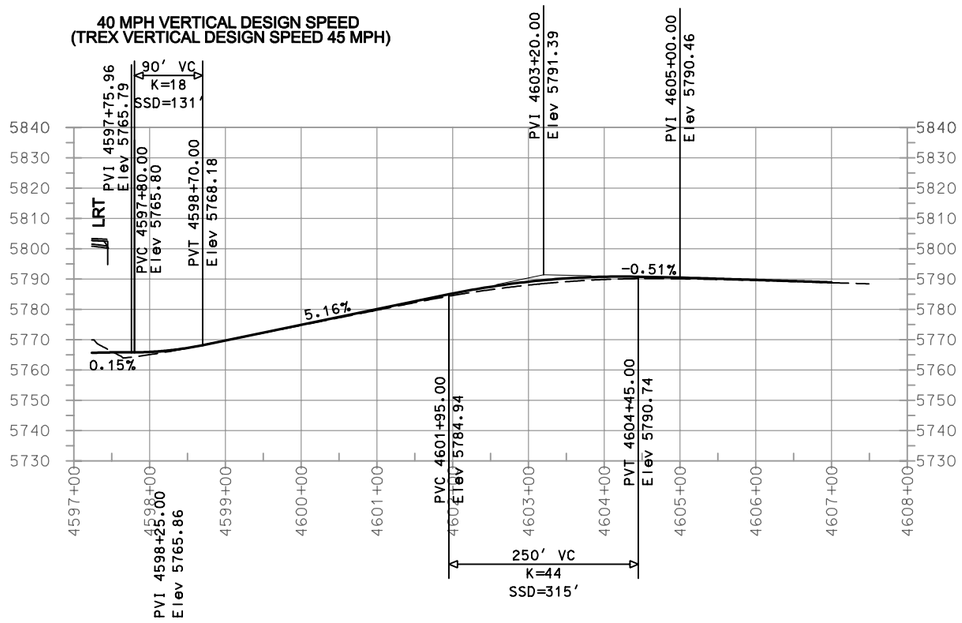
07/16/2007



NB I-25 TO ARAPAHOE OFF-RAMP



EB ARAPAHOE TO NB I-25 LOOP RAMP

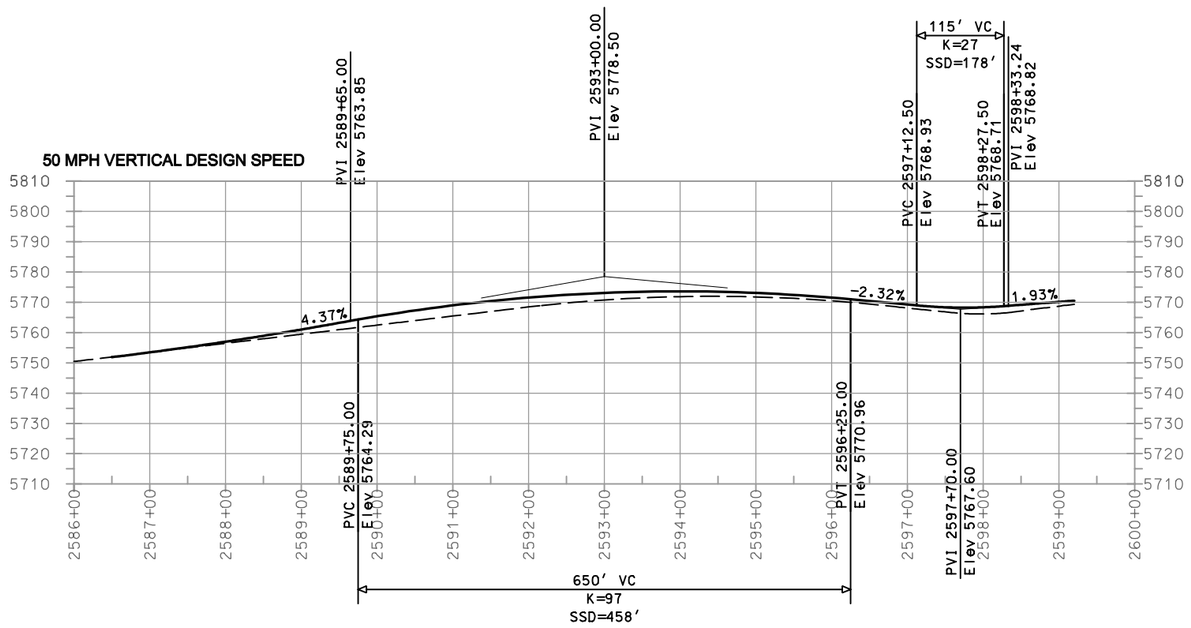


EB ARAPAHOE TO SB I-25 ON-RAMP

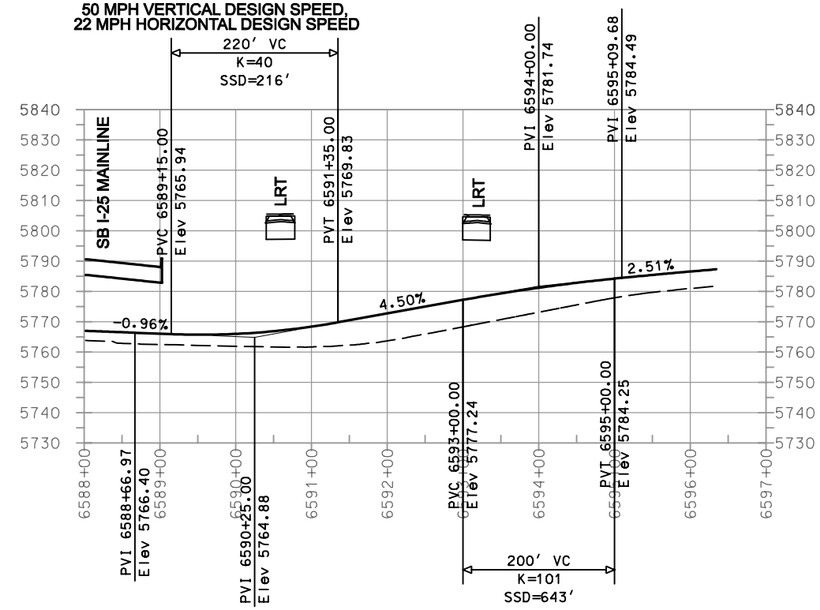
ArapahoeRoad corridor study

ALTERNATIVE 1 – IMPROVED PARTIAL CLOVERLEAF INTERCHANGE

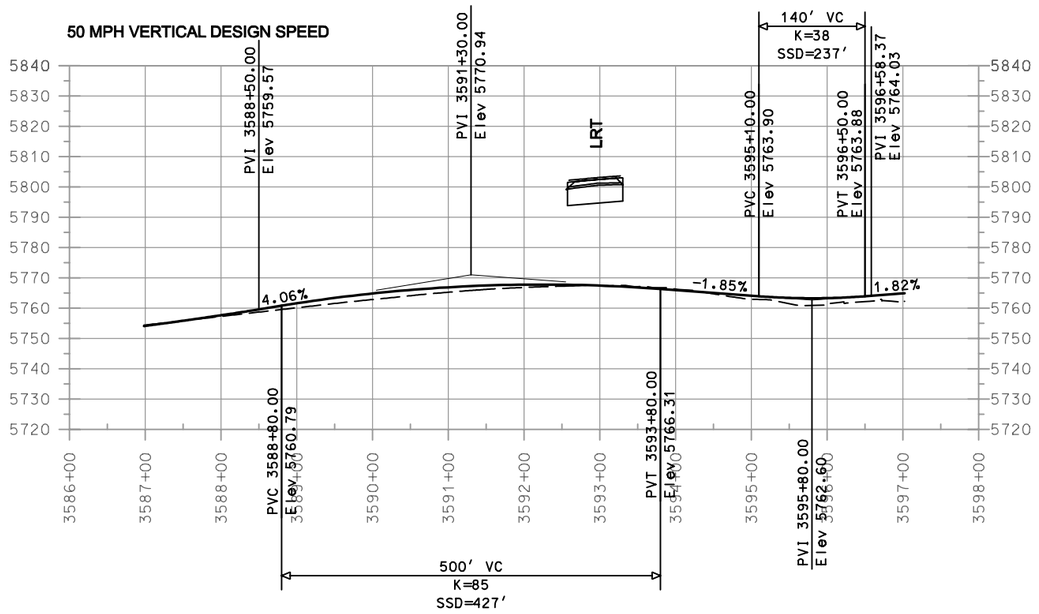
07/16/2007



WB ARAPAHOE TO NB I-25 ON-RAMP



WB ARAPAHOE TO SB I-25 LOOP RAMP



SB I-25 TO ARAPAHOE OFF-RAMP

ArapahoeRoad corridor study

Appendix F

Estimate of Probable Construction Cost

	System Level Feasibility Study Cost Estimate					
		in 2006 year $$				
Project No:	**I-25 / Arapahoe Road Interchange**					
Target Construction Begin Yr: All Costs Assume 2006 Prices						
Description: (Arapahoe Road / I-25 Interchange) Partial Cloverleaf Interchange						
	% Range		**% Used**		**Cost**	
Project Construction Bid Items	Project Dependent		N/A		$14,556,719.07	(A)
Contingencies	(15% - 30%) of (A)		30.00%		$4,367,015.72	(B)
ITS	(6-10%) of (A+B)		10.00%		$1,892,373.48	(C)
	Default = 6%					
Drainage/Utilities	(3-10%)of (A+B)		10.00%		$1,892,373.48	(D)
	Default = 6%					
Signing and Striping	(1-5%) of (A+B+C+D)		5.00%		$1,135,424.09	(E)
	Default = 5%					
Construction Signing & Traffic Control	5 to 25% of (A+B+C+D+E)		25.00%		$5,960,976.46	(F)
	Default = 20%					
Mobilization	(4 to 10%) of (A+B+C+D+E+F)		10.00%		$2,980,488.23	(G)
	Default = 7%					
Total of Construction Bid Items	(A+B+C+D+E+F+G)				$32,785,370.52	(H)
Force Account - Utilities	(1 to 2%) of (H)		2.00%		$655,707.41	(I)
	Default = 2%					
Force Account - Misc.	(10 to 15%) of (H)		15.00%		$4,917,805.58	(J)
	Default = 12%					
Subtotal of Construction Cost	(H+I+J)				$38,358,883.51	(K)
Total Construction Engineering	21% of (K)		21.00%		$8,055,365.54	(L)
Total Preliminary Engineering	15% of (K)		15.00%		$5,753,832.53	(M)
Right of Way	Project Dependent		N/A		Not Included	
Utilities	Project Dependent		N/A		$1,000,000.00	(N)
Total Project Cost					$53,168,081.57	(P)
Date Prepared:	September 21, 2006 (QUANTITIES REVISED JUNE 20, 2007 HARTWIG & ASSOCIATES)					
Prepared By:	Steve Long (DEA) / JK Allen					

System Level Feasibility Study Cost Estimate						
	in 2006 year $$					
Project No:	**I-25 / Arapahoe Road Interchange**					
Target Construction Begin Yr: All Costs Assume 2006 Prices						
Description: (Arapahoe Road / I-25 Interchange) Partial Cloverleaf Interchange						
Estimate Worksheet						
	% Range			**% Used**		
Project Construction Items						
Item Description						
	Quantity	Item Unit	Per Unit Cost			Cost
Removals / Demolition of Existing Structures	1	Lump Sum	$1,000,000.00			$1,000,000.00
Pavement -HMA	59,918	Tons	$80.00			$4,793,476.84
Unclassified Excavation (CIP)	190,553	Cubic Yard	$20.00			$3,811,053.33
Curb and Gutter Type 2 (Section I-B)	4,917	Linear Feet	$15.00			$73,755.00
Curb and Gutter Type 2 (Section II-B)	8,359	Linear Feet	$20.00			$167,180.00
Median Cover Material	32,538	Square Feet	$10.00			$325,380.00
Concrete Sidewalk	4,422	Square Yard	$40.00			$176,888.89
Structures	46,375	Square Feet	$90.00			$4,173,750.00
Retaining Walls	783	Square Feet	$45.00			$35,235.00
Total accounted construciton items						$14,556,719.07
Contingencies	(15% - 30%) of (A)			30.00%	Carried to Sheet One	
Established as a percentage						
ITS	(6-10%) of (a+b)			10.00%	Carried to Sheet One	
	Default = 6%					
Drainage/Water/Sewer	(3-10%)of (a+b)			10.00%	Carried to Sheet One	
	Default = 6%					
Signing and Striping	(1-5%) of (a+b+c+d)			5.00%	Carried to Sheet One	
	Default = 5%					
Construction Signing & Traffic Control	5 to 25% of (a+b+c+d+e)			25.00%	Carried to Sheet One	
	Default = 20%					
Mobilization	(4 to 10%) of (a+b+c+d+e+f)			10.00%	Carried to Sheet One	
	Default = 7%					
Total of Construction Items	(a+b+c+d+e+f+g)					
Force Account - Utilities	(1 to 2%) of (h)			2.00%	Carried to Sheet One	
	Default = 2%					
Force Account - Misc.	(10 to 15%) of (h)			15.00%	Carried to Sheet One	
	Default = 12%					
Subtotal of Construction Cost	(h+i+j)					
Total Construction Engineering	21% of (k)			21.00%	Carried to Sheet One	
Total Preliminary Engineering	15% of (k)			15.00%	Carried to Sheet One	
Right of Way	Not Included	Square Feet	$25.00			Not Included

System Level Feasibility Study Cost Estimate

	in 2006 year $$			
Project No:	**I-25 / Arapahoe Road Interchange**			
Target Construction Begin Yr: All Costs Assume 2006 Prices				
Description: (Arapahoe Road / I-25 Interchange) Partial Cloverleaf Interchange				

Quantity Worksheet

Project Construction Items

Item Description

Pavement - HMA	SF	SY	Thickness (inch)	Tons
I-25	349030	38781	13	27728
Ramps	139578	15509	11	9383
Arapahoe	339281	37698	11	22807
Total	827889	91988		**59918**

	SF
Median Cover Material	**32538**

	SF	SY
Concrete Sidewalk	39800	**4422**

	LF
Curb and Gutter Type 2 (Section II-B)	**8359**
Curb and Gutter Type 2 (Section I-B)	**4917**

	SF
Structures	**46375**

	LF	SF
Retaining Wall	261	**783**

	LS
Removal of Existing Structures	1

Unclassified Excavation (CIP)	CF	CY
I-25 and Ramps	4466360	165421
Arapahoe	678562	25132
Total		**190553**

*Assumes 3 to 4 ft of earthwork on I-25, and 2 ft of earthwork on Arapahoe

System Level Feasibility Study Cost Estimate

		in 2006 year $$				
Project No:	**I-25 / Arapahoe Road Interchange**					
Target Construction Begin Yr: All Costs Assume 2006 Prices						
Description: (Arapahoe Road / I-25 Interchange) Costilla / Yosemite Connection						
	% Range		**% Used**		**Cost**	
Project Construction Bid Items	Project Dependent		N/A		$5,831,607.14	(A)
Contingencies	(15% - 30%) of (A)		30.00%		$1,749,482.14	(B)
ITS	(6-10%) of (A+B)		10.00%		$758,108.93	(C)
	Default = 6%					
Drainage/Utilities	(3-10%)of (A+B)		10.00%		$758,108.93	(D)
	Default = 6%					
Signing and Striping	(1-5%) of (A+B+C+D)		5.00%		$454,865.36	(E)
	Default = 5%					
Construction Signing & Traffic Control	5 to 25% of (A+B+C+D+E)		25.00%		$2,388,043.12	(F)
	Default = 20%					
Mobilization	(4 to 10%) of (A+B+C+D+E+F)		10.00%		$1,194,021.56	(G)
	Default = 7%					
Total of Construction Bid Items	(A+B+C+D+E+F+G)				$13,134,237.18	(H)
Force Account - Utilities	(1 to 2%) of (H)		2.00%		$262,684.74	(I)
	Default = 2%					
Force Account - Misc.	(10 to 15%) of (H)		15.00%		$1,970,135.58	(J)
	Default = 12%					
Subtotal of Construction Cost	(H+I+J)				$15,367,057.50	(K)
Total Construction Engineering	21% of (K)		21.00%		$3,227,082.08	(L)
Total Preliminary Engineering	15% of (K)		15.00%		$2,305,058.63	(M)
Right of Way	Project Dependent		N/A		Not Included	
Utilities	Project Dependent		N/A		$500,000.00	(N)
Total Project Cost					$21,399,198.21	(P)
Date Prepared:	September 21, 2006 (QUANTITIES REVISED JUNE 20, 2007 HARTWIG & ASSOCIATES)					
Prepared By:	Steve Long (DEA) / JK Allen					

System Level Feasibility Study Cost Estimate						
	in 2006 year $$					
Project No:	**I-25 / Arapahoe Road Interchange**					
Target Construction Begin Yr: All Costs Assume 2006 Prices						
Description: (Arapahoe Road / I-25 Interchange) Costilla / Yosemite Connection						
Estimate Worksheet						
	% Range			**% Used**		
Project Construction Items						
Item Description						
	Quantity	Item Unit	Per Unit Cost			Cost
Removals / Demolition of Existing Structures	1	Lump Sum	$500,000.00			$500,000.00
Pavement - HMA	18,024	Tons	$80.00			$1,441,911.29
Unclassified Excavation (CIP)	19,861	Cubic Yard	$20.00			$397,220.74
Curb and Gutter Type 2 (Section I-B)	0	Linear Feet	$15.00			$0.00
Curb and Gutter Type 2 (Section II-B)	8,687	Linear Feet	$20.00			$173,744.00
Median Cover Material	0	Square Feet	$10.00			$0.00
Concrete Sidewalk	7,930	Square Yard	$40.00			$317,208.89
Concrete Driveway	1,486	Square Yard	$40.00			$59,422.22
Structures	21,350	Square Feet	$90.00			$1,921,500.00
Retaining Walls	22,680	Square Feet	$45.00			$1,020,600.00
Total accounted construciton items						$5,831,607.14
Contingencies	(15% - 30%) of (A)			30.00%	Carried to Sheet One	
Established as a percentage						
ITS	(6-10%) of (a+b)			10.00%	Carried to Sheet One	
	Default = 6%					
Drainage/Water/Sewer	(3-10%)of (a+b)			10.00%	Carried to Sheet One	
	Default = 6%					
Signing and Striping	(1-5%) of (a+b+c+d)			5.00%	Carried to Sheet One	
	Default = 5%					
Construction Signing & Traffic Control	5 to 25% of (a+b+c+d+e)			25.00%	Carried to Sheet One	
	Default = 20%					
Mobilization	(4 to 10%) of (a+b+c+d+e+f)			10.00%	Carried to Sheet One	
	Default = 7%					
Total of Construction Items	(a+b+c+d+e+f+g)					
Force Account - Utilities	(1 to 2%) of (h)			2.00%	Carried to Sheet One	
	Default = 2%					
Force Account - Misc.	(10 to 15%) of (h)			15.00%	Carried to Sheet One	
	Default = 12%					
Subtotal of Construction Cost	(h+i+j)					
Total Construction Engineering	21% of (k)			21.00%	Carried to Sheet One	
Total Preliminary Engineering	15% of (k)			15.00%	Carried to Sheet One	
Right of Way	Not Included	Square Feet	$25.00	N/A		Not Included

System Level Feasibility Study Cost Estimate

in 2006 year $$

Project No: **I-25 / Arapahoe Road Interchange**

Description: (Arapahoe Road / I-25 Interchange) Costilla / Yosemite Connection

Quantity Worksheet

Project Construction Items

Item Description				
	SF	SY	Thickness (inch)	Tons
Pavement - HMA	268124	29792	11	**18024**
	SF			
Median Cover Material	**0**			
	SF	SY		
Concrete Sidewalk	71372	**7930**		
	LF			
Curb and Gutter Type 2 (Section II-B)	**8687**			
Curb and Gutter Type 2 (Section I-B)	**0**			
	SF			
Structures	21350			
	LF	SF		
Retaining Wall	1890	**22680**		
	LS			
Removal of Existing Structures	1			
	CF	CY		
Unclassified Excavation (CIP)	536248	**19861**		
* Assumes 2 ft of earthwork for the surface area of roadway				
	SF	SY		
Concrete Driveways	13370	**1486**		