Appendix B

Lakewood West Central Subarea Transportation Study

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Lakewood

West Central Subarea

Transportation Study

Final Report

Matrix Design Group Inc.
Integrated Design Solutions

LAKEWOOD WEST CENTRAL SUBAREA
TRANSPORTATION STUDY

Final Report

Prepared for:

City of Lakewood

Prepared by:

In Association with:

Felsburg Holt & Ullevig

June 2007

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EXECUTIVE SUMMARY

Study Purpose

The General Services Administration (GSA) is currently in the process of developing a Site Master Plan for the Denver Federal Center. This Site Master Plan will provide a new 20-year vision and development strategy for the 670-acre secured DFC site.

The ability of the perimeter street system to accommodate future travels demands at acceptable service levels will have an effect on the development potential of the DFC site. To ensure the street network does not unduly limit alternative site master plan/development scenarios, this subarea transportation study was initiated. The purpose of the study is to assess the cumulative effects of all proposed developments on the transportation system (including but not limited to the St. Anthony's Hospital relocation, the Federal Center LRT station, various in-fill proposals, and possible changes to the DFC site) and to identify improvements that will mitigate expected impacts.

DFC Development Alternatives

The following table provides a summary of the two DFC development alternatives. The defining characteristic of the Mall Alternative is the creation of a linear "Federal Mall" connecting Union Boulevard, the St. Anthony Central Hospital Campus, and the Federal Core. The defining characteristic of the Quad Alternative is the central "quad" located in the center of the DFC site.

Development Summary by Alternative

Land Use	Mall	Quad
Office (SF)	950,000	400,000
Research and Development (SF)	446,500	633,000
Retail (SF)	250,000	212,000
Residential (Units)	1,400	290
Lodging (Rooms)	200	200
Federal Center (SF)	4,700,776	4,636,927

As shown in the table, the Mall Alternative has significantly more office square footage and residential units but less research and development square footage. The size of the other land uses is either identical or comparable between the two alternatives.

Future Travel Demand

Future travel demands were forecast for both 2015 and 2030. In 2015, it was assumed there would be no change to the existing DFC uses and the St. Anthony Hospital Campus would include the hospital, physician offices, and a cancer care facility. The LRT station includes 1,000 parking spaces and 15 bus bays. In 2030, the St. Anthony Hospital Campus is built-out and includes both the hospital and related medical office buildings. The DFC site also is

built-out by alternative. Transit oriented development associated with the LRT station is included in the DFC alternatives.

The following table provides a summary of the trip generation. Today, the DFC site generates approximately 15,900 vehicle trips per day. By comparison, the 2030 trips will be between six and seven times greater, depending on the alternative.

Trip Generation

	Daily Trips
2015	
▪ **St. Anthony's**	19,320
▪ **LRT Station**	2,694
▪ **DFC**	15,369
▪ **Total**	**37,383**
2030	
▪ **St. Anthony's**	19,320
▪ **Medical Offices**	12,192
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▪ **LRT Station**	2,694
▪ **DFC - Quad**	61,319
▪ **Total**	**95,525**

Base Network Performance

The above trips were assigned to the base roadway network and 15 signalized intersections in the vicinity of the DFC were analyzed. In 2015, two out of the 15 intersections will be over capacity. In 2030, 10 out of the 15 intersections will be over capacity.

Required Improvements

The following improvements will be required to meet the forecasted 2030 travel for both build alternatives:

Roadway Improvements

- Widen Alameda to six lanes from west of Union to Allison
- Widen Kipling to six lanes from 6th Avenue to Mississippi
- Extend the proposed Routt Street to the north over 6th Avenue and connect to Quail Street. Routt Street should have four through lanes from Alameda Avenue to 8th Avenue. Separate left turn lanes should be provided at all signalized intersections.

Intersection Improvements

- Provide two westbound right turn lanes at the intersection of Union and 4th
- Provide two westbound right turn lanes, two southbound left turn lanes, and one southbound right turn lane at the intersection of Union and 2nd
- Provide two eastbound left turn lanes, one southbound exclusive left turn lane and one shared left and right turn lane, and one westbound right turn lane at the intersection of Alameda Avenue and Routt Street.
- Provide two eastbound left turn lanes, two southbound left turn lanes, two southbound right turn lanes, and one westbound right turn lane at the intersection of Alameda and Oak.
- Provide a northbound left turn at the intersection of Kipling Street and Gate One. This will require a realignment of the access to the JeffCo stadium on the east side of Kipling Street.

6th Avenue and Union Interchange Improvements

- Widen bridge by two lanes to accommodate double lefts from northbound to westbound and southbound to eastbound
- Signalize the double right turns from the westbound off ramp to northbound Simms
- Expand eastbound off ramp for double left turns and double right turns

With these roadway improvements, all but one of the signalized intersections either meets or exceeds the minimum acceptable service levels for signalized intersections. Numerous intersections, however, will still be operating at capacity (LOS E). With the system basically operating at capacity, the demand generated from the proposed development must be lower. This will be accomplished with a comprehensive Travel Demand Management Program. The success of this program is dependent on the ability to aggressively manage the parking supply and pricing site-wide. It also will require someone to act as a liaison between all major DFC employers and regional transportation agencies, including RTD, CDOT and DRCOG, and be a focal point for all TDM activities.

Only the Union Boulevard and Alameda Avenue intersection will be over capacity, even with an aggressive TDM program. Since widening Union Boulevard south of Alameda Avenue would be too disruptive to the residential neighborhood, a grade-separated facility at the intersection may be necessary to accommodate the 2030 traffic volumes.

Improvement Phasing

The improvements identified for the 6th and Union interchange will likely be needed within the next 10 years. All of the other improvements will be required when the DFC site builds out. The phasing of the remaining improvements will be subject to how fast and where development occurs.

INTRODUCTION

Background

In 2003, Representative Bob Beauprez, Republican-Arvada, and Senator Ben Nighthorse Campbell, Republican-Colorado, introduced legislation that would allow private development on the Denver Federal Center (DFC) site. Since then, planning and design has proceeded on the following major developments:

- St. Anthony Central Hospital expects to break ground on a new Central Hospital Campus on the DFC site in the near future and open the hospital's doors to patients in 2010.
- The Regional Transportation District's (RTD) West Corridor Light Rail Transit (LRT) line is scheduled to open in 2014. As part of this project, the existing Cold Springs park-n-Ride facility will be closed and replaced with a LRT station on the DFC site.

Rather than responding to these development changes on a piecemeal basis, the General Services Administration (GSA) began a comprehensive planning process to develop a Site Master Plan. This Site Master Plan will provide a new 20-year vision and development strategy for the 670-acre secured DFC site.

Study Purpose

The ability of the perimeter street system to accommodate future travels demands at acceptable service levels will have an effect on the development potential of the DFC site. To ensure the street network does not unduly limit alternative site master plan/development scenarios, this subarea transportation study was initiated. The purpose of the study is to assess the cumulative effects of all proposed developments on the transportation system (including but not limited to the St. Anthony's Hospital relocation, the Federal Center LRT station, various in-fill proposals, and possible changes to the DFC site) and to identify improvements that will mitigate expected impacts.

Study Area

Figure 1 illustrates the study area. As shown, the study area is bounded by Colfax Avenue on the north, Garrison Street on the east, Jewell Avenue/Alameda Parkway on the south, and C-470/I-70 on the west. This area includes all of the major transportation facilities and potential in-fill projects in the general vicinity of the DFC site and therefore forms the basis for the subarea travel demand model. The detailed operational analyses used to determine the street systems ability to accommodate the future traffic volumes are focused on the streets immediately adjacent to the DFC site, including Union Boulevard, Alameda Avenue, and Kipling Street.

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Study Area
Figure 1

Lakewood west central subarea transportation study

Report Organization

This report is organized into seven chapters, as described below:

1. **Introduction –** Describes the purpose and organization of the report.

2. **Existing Conditions –** Describes the existing land use, the roadway network, traffic volumes and intersection operations.

3. **Future Travel Demand** – Provides a detailed description of the travel demand model including all input parameters and 2030 traffic forecasts.

4. **Future Needs Assessment –** Shows how the existing roadway network performs with future traffic.

5. **Identification and Analysis of Alternatives –** Describes the level of improvements required to meet the forecasted travel demands.

6. **Improvement Phasing** – Identifies when the improvements will likely be required.

7. **Findings and Recommendations** – Describes what was learned from the detailed analysis.

EXISTING CONDITIONS

Land Use

The DFC site is located in a highly urbanized area of Lakewood. The surrounding land uses near the site are primarily single-family residential with a mix of commercial and light industrial uses. The following land uses are included within a one-mile radius of the DFC site:

The well-established neighborhoods of mostly single-family homes that surround the DFC site include Daniels Garden, Mountain View, Eiber, Green Mountain, Alameda, Glennon Heights, and Union Square. Most of the retail and office uses are found along the one-mile stretch of Union Boulevard that directly borders the western edge of the DFC site. The industrial uses are generally located north of 6th Avenue.

The DFC site currently has approximately 4,000,000 square feet of rental space in 90 buildings. There are 6,000 employees on-site.

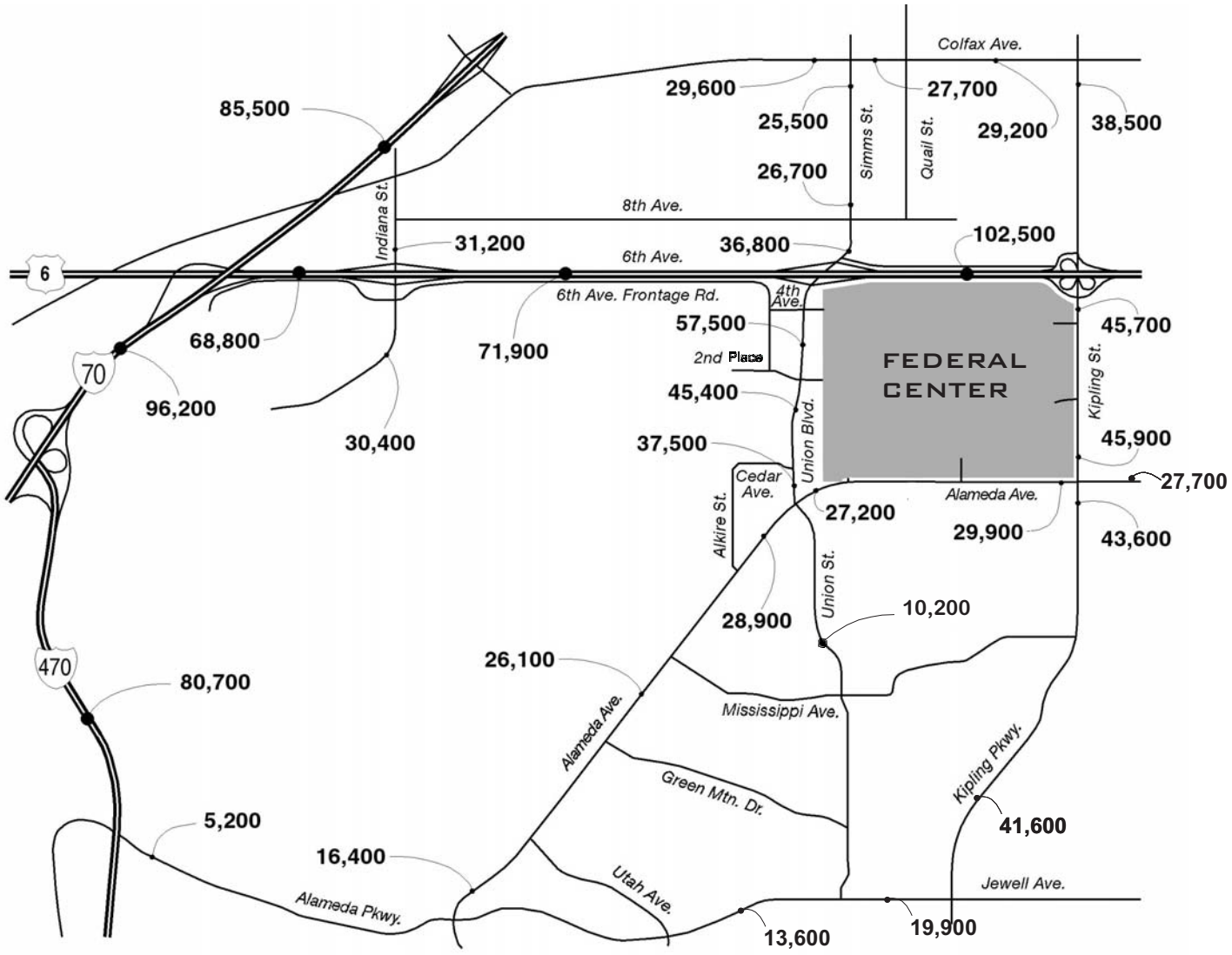
Roadway Network

Four major roadways bound the DFC site (6th Avenue on the north, Kipling Street on the east, Alameda Avenue on the south, and Union Boulevard on the west). Sixth Avenue (U.S. 6) is a six lane controlled access freeway. Kipling Street is a four lane arterial with a posted speed limit of 45 mph and has a partial cloverleaf interchange with 6th Avenue. It also is designated as State Highway 391 and is classified as a non-rural regional highway (NR-A). Alameda Avenue also is a four lane arterial with a posted speed limit of 45 mph. Union Boulevard is a six lane arterial with a posted speed limit of 40 mph and has a diamond interchange with 6th Avenue.

The Denver Federal Center has five functional access points. Two gates (1 and 2) are off of Kipling Street, one gate (7) is off of Alameda Avenue, and two gates (4 and 5) are off of Union Boulevard. All gates are secured entrances.

Traffic Operations

Figure 2 shows the average daily traffic volumes throughout the study area. These volumes were obtained from the City of Lakewood's 2004 Average Daily Traffic map. Figure 3 shows the AM and PM peak hour volumes at 14 signalized intersections in the immediate vicinity of the DFC site. These volumes represent counts conducted during the summer of 2006.



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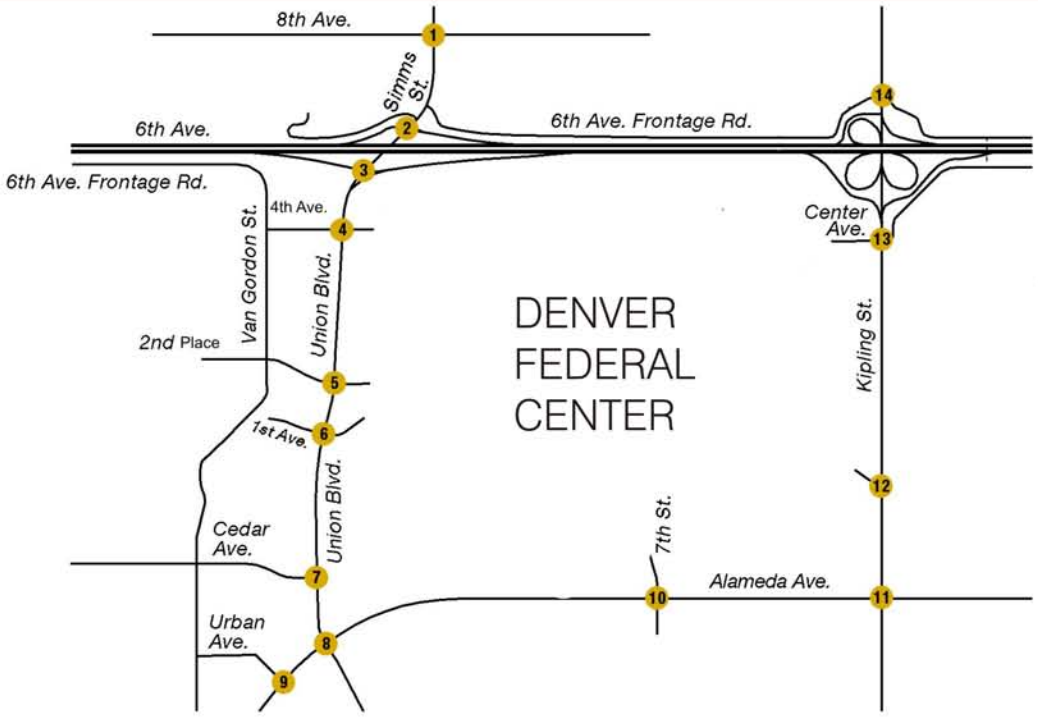
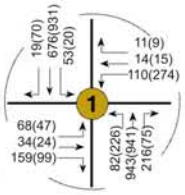
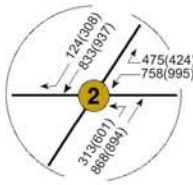
Existing Daily Traffic Volumes

Lakewood west central subarea transportation study Figure 2

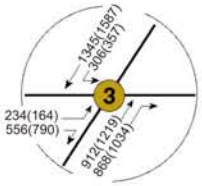




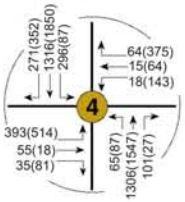
Simms St. / 8th Ave.



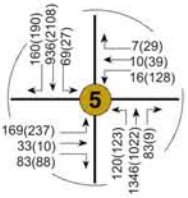
Union Blvd./ 6th Ave. WB Ramps



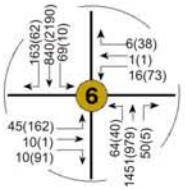
Union Blvd./ 6th Ave. EB Ramps



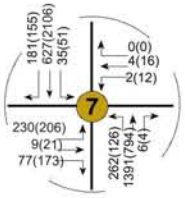
Union Blvd./ 4th Ave. (Gate 4)



Union Blvd./ 2nd Place (Gate 5)

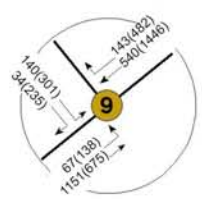


Union Blvd./ 1st. Ave.

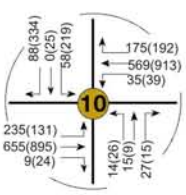


Union Blvd./ Cedar Ave.

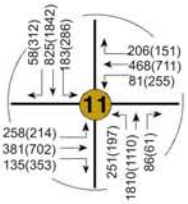
Union Blvd./ Alameda Ave.



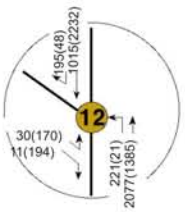
Alameda Ave./ Urban Ave.



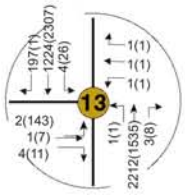
Alameda Ave./ 7th St. (Gate 7)



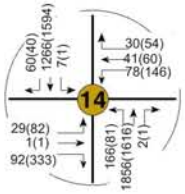
Alameda Ave./ Kipling St.



Kipling St./ Main Ave. (Gate 1)



Kipling St./ Center Ave. (Gate 2)



Kipling St./ 6th Ave. Frontage Rd.

Legend

xxx(xxx) am peak/pm peak Peak Hour Volumes

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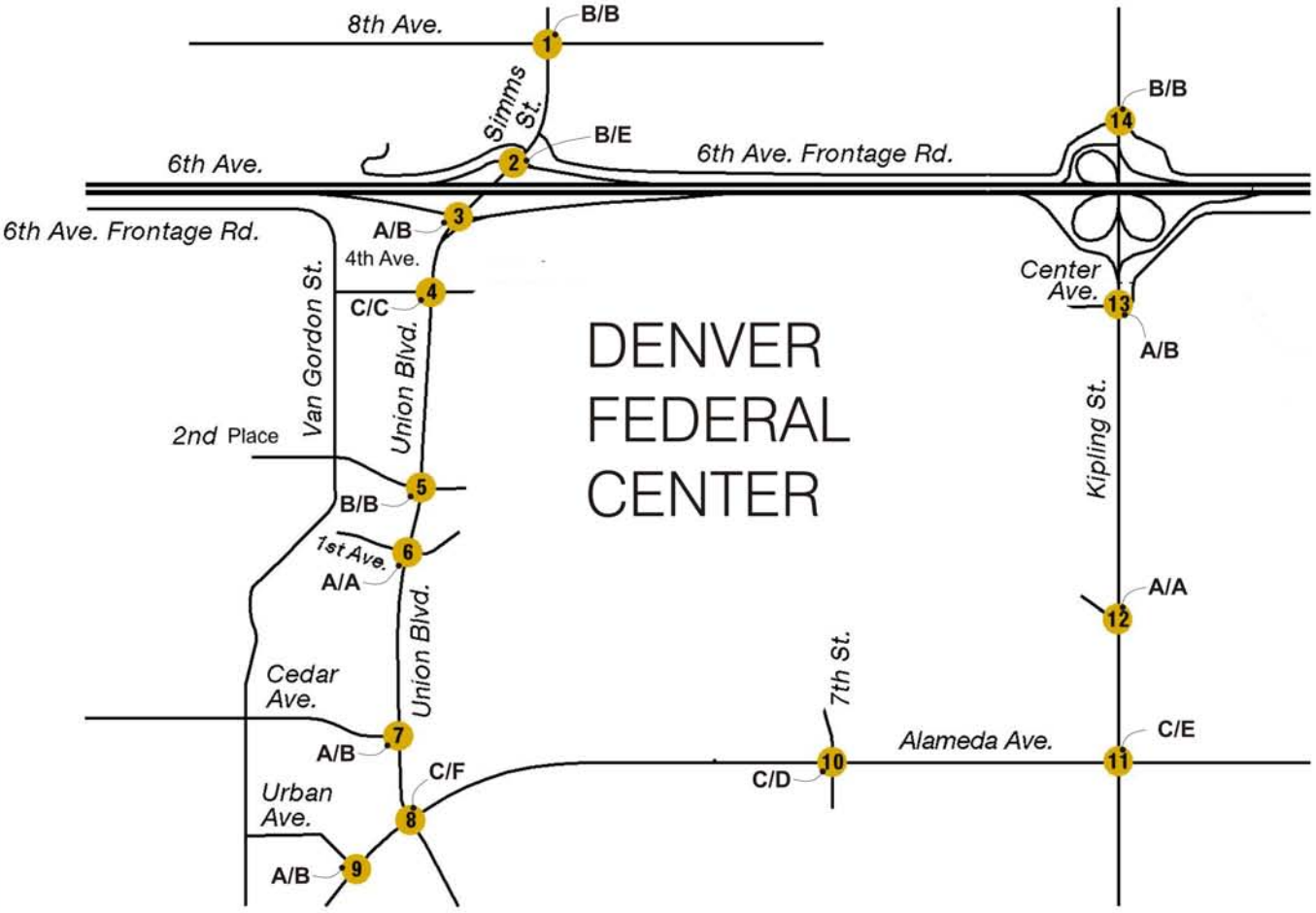
Existing Peak Hour Volumes

Lakewood west central subarea transportation study

Figure 3

To determine how efficiently and effectively the existing roadway network accommodates the existing traffic volumes, all of the signalized intersections were analyzed using Synchro software. The results are shown as Levels of Service (LOS). Letters designate each level, from A to F, with LOS A representing the best operating conditions and LOS F the worst. LOS A, B and C represent the intersection status as under capacity. LOS D is near capacity, LOS E is at capacity, and LOS F is over capacity. LOS D is the desired performance and LOS E is the minimum acceptable level of service at signalized intersections.

Figure 4 shows the results of the intersection operations analysis. Appendix A contains all of the analysis output, including the lane configurations, the volumes by movement, and the traffic signal timings. As shown, all of the intersections operate at acceptable service levels in both peak periods, with one notable exception. The intersection of Union Boulevard and Alameda Avenue is over capacity in the PM peak hour. The primary problem is that Union Boulevard goes from three lanes north of Alameda Avenue to one lane south of Alameda Avenue. South of Alameda Avenue is an established residential neighborhood so it is highly unlikely this segment of Union will ever be widened.



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Legend

A/B am peak/pm peak levels of service

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Existing Levels of Service

Lakewood west central subarea transportation study

Figure 4

FUTURE TRAVEL DEMAND

Model Development

The platforms for the subarea travel demand model were the Denver Regional Council of Government's (DRCOG) 2005, 2015 and 2030 regional transportation models. The first step in creating the subarea travel model involved splitting select traffic analysis zones (TAZ) and relocating some of the centriod connectors to reflect the actual access locations. Figure 5 and Table 1 show the zones that were split and the corresponding new TAZ ID.

Table 1 - Zone Splits

Original Zone ID	New Zone ID
615	615
	2675
616	616
	2678
628	628
	2676
	2677
632	632
	2672
	2673
677	677
	2674

The increase in the number of TAZ's in the model required the modification of a number of input files so that the calculations and results properly reflect the zone changes. The TAZ's that were added to the model required the modification of the land use, highway, transit base, and TAZ geographic files. Moreover, transit routes were updated to run on new roadway links where appropriate in order to provide better connectivity to the additional zones. The intrazonal travel timetable and the k-factor matrices were expanded to include the additional zones. For the trip distribution model step, final speeds from DRCOG's speed balanced runs were used as input speeds in the subarea model runs. The speed balancing procedure was used on the initial model runs for each of the model years; subsequent model runs did not include speed balancing to provide a direct comparison between the model runs.

Figure 6 shows the base roadway network used in the subarea model. The base network is identical to the existing system, with one major difference. The base network includes a new interchange at Alameda and C-470.

DRCOG's land use files were modified to include the St. Anthony's Hospital development and the two DFC development alternatives. No changes were made to the Union Boulevard zones because the Union Boulevard corridor plans were comparable to the DRCOG land use assumptions. Appendix B contains all of the land use tables used in the subarea model.

Table 2 provides a summary of the two DFC development alternatives. The defining characteristic of the Mall Alternative is the creation of a linear "Federal Mall" connecting Union Boulevard, the St. Anthony Central Hospital Campus, and the Federal Core. The defining characteristic of the Quad Alternative is the central "quad" located in the center of the DFC site.

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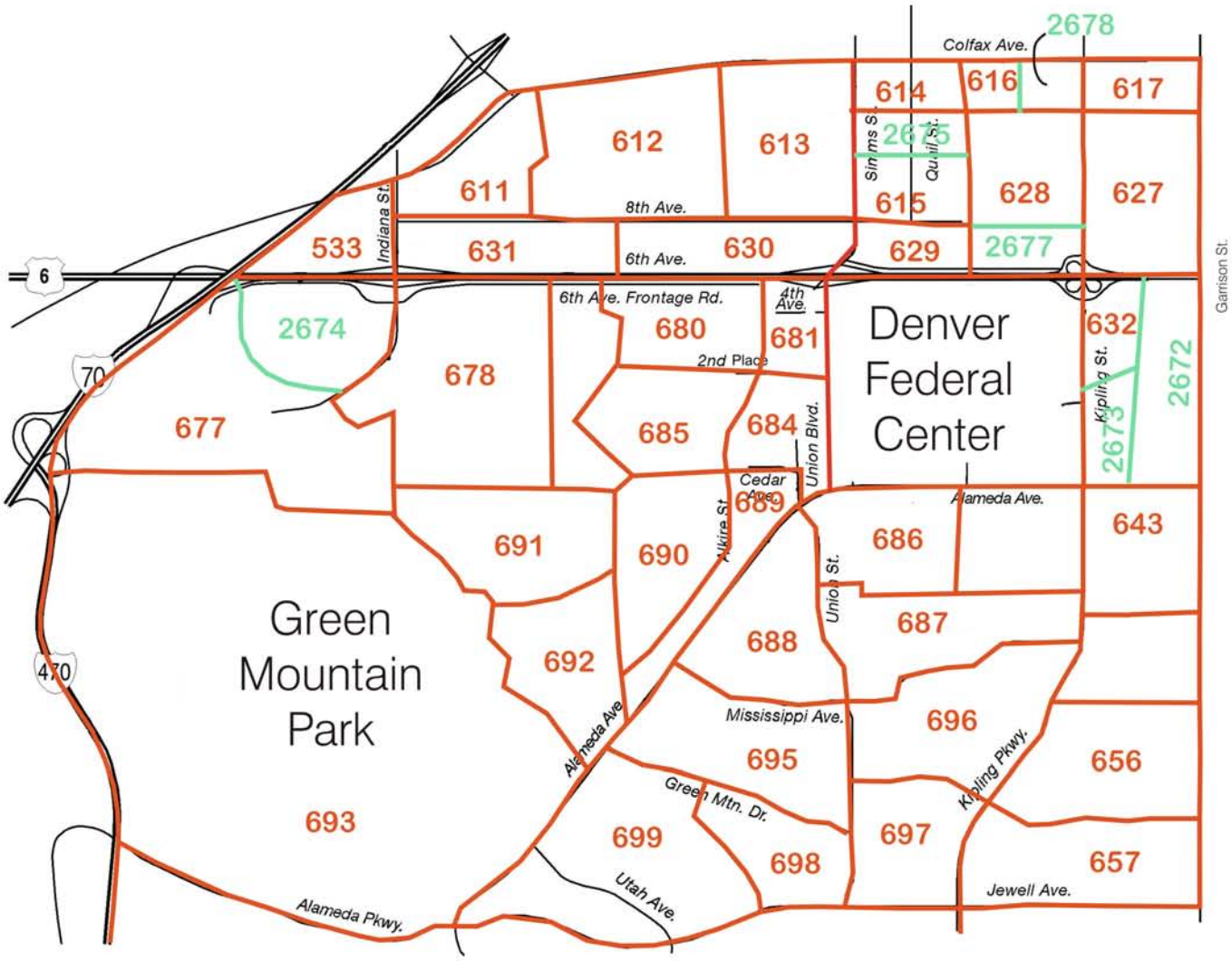

Traffic Analysis Zones

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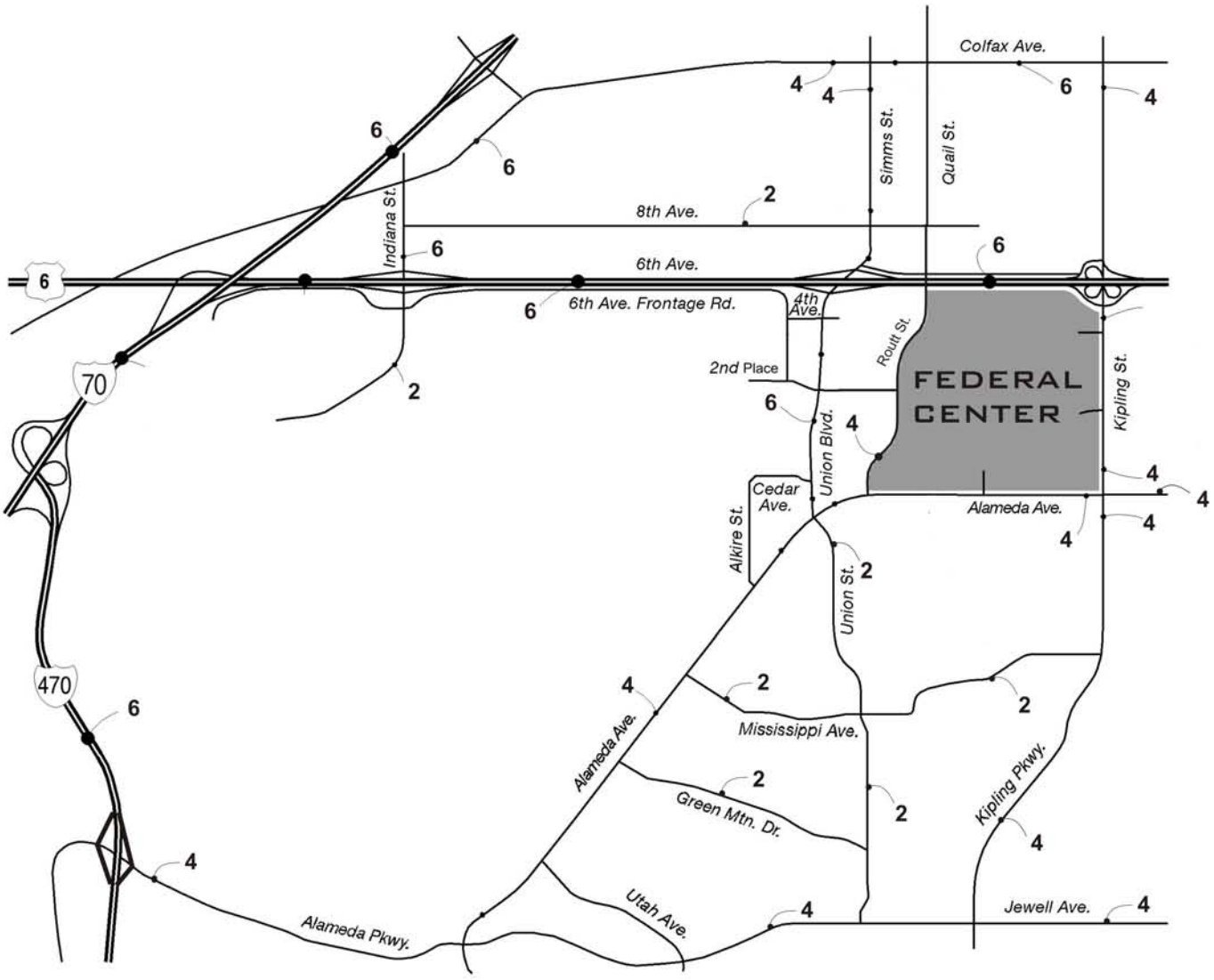
Figure 5



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Legend

4 Total number of through lanes

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Base Roadway Network

Lakewood west central subarea transportation study Figure 6

Model Output

Table 3 presents the trip generation from the subarea travel model. In 2015, it was assumed there would be no change to the existing DFC uses and the St. Anthony Hospital Campus would include the hospital, physician offices, and a cancer care facility. The LRT station includes 1,000 parking spaces and 15 bus bays. In 2030, the St. Anthony Hospital Campus is built-out and includes both the hospital and related medical office buildings. The DFC site also is built-out by alternative. Transit oriented development associated with the LRT station is included in the DFC alternatives.

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Table 3 – Trip Generation

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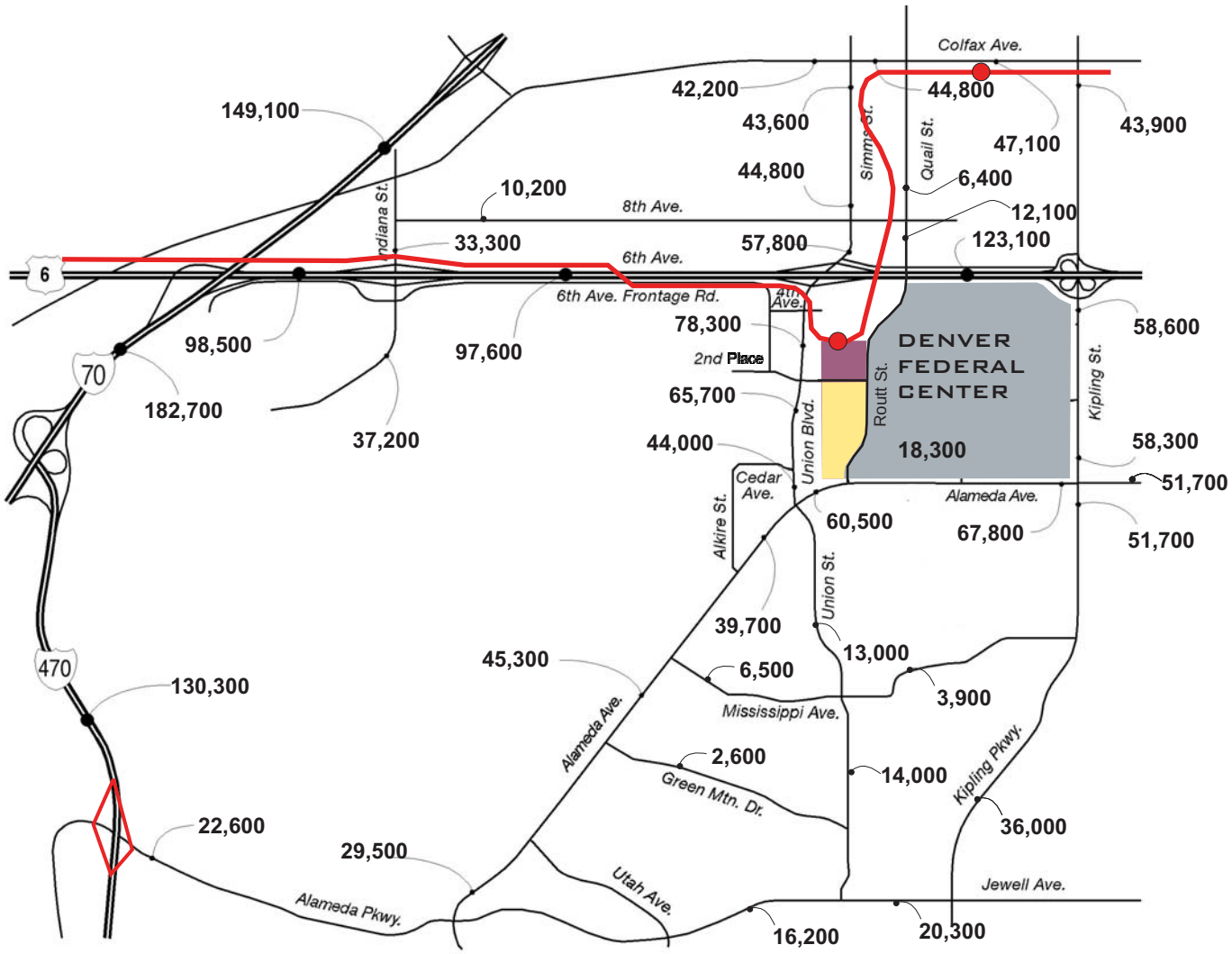
▪ **DFC - Quad**	61,319
▪ **Total**	**95,525**

The next step in the process involved running the subarea travel model. Model outputs were adjusted based on the procedure provided in *National Cooperative Highway Research Program Report (NCHRP) 255*, Transportation Research Board, 1982. This refinement procedure involves comparing model output to existing daily traffic counts to calibrate the model results for future year traffic forecasts. In this case, the 2005 model run output was compared to actual 2005 daily traffic volumes. The NCHRP process involves two adjustment methods: percentage adjustments and difference adjustments. The percentage method adjusts the future year output (2015 or 2030) by a ratio of the existing count to the base year model output. The difference method adjusts the future year output by the difference between the existing count and the base year model output. The reported daily traffic volume is typically

the average of the two adjusted numbers. However, in cases where the ratio method yields unreasonable results, engineering judgment is applied to determine a reasonable forecast.

Figure 7 shows the 2030 daily traffic forecasts for the Mall Alternative. These daily link volumes were then used to determine a growth rate for each intersection in the study area. This growth rate was then applied to the existing peak hour volumes entering and exiting each intersection. The entering and exiting volumes were converted to turning movements utilizing guidance contained in NCHRP 255 Highway Traffic Data for Urbanized Area Project Planning and Design, 1982. This report provides an iterative process for determining peak hour volume projections by balancing the entering and exiting traffic at an intersection until an acceptable level of closure is reached. The study area intersections were "seeded" with existing peak hour turning movement volumes to serve as a baseline condition, and then manual adjustments were made where appropriate, based on engineering judgment. Figure 8 shows the 2030 peak hour intersection volumes for the Mall Alternative.

Figures 9 and 10 show the 2030 daily and peak hour intersection traffic volumes for the Quad Alternative, respectively. The process described above was repeated to convert the daily link volumes to peak hour intersection volumes.



St. Anthony's Hospital

LRT Station

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41,500 Daily Traffic Volumes

LRT Line

LRT Station

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2030 Traffic Forecasts Mall

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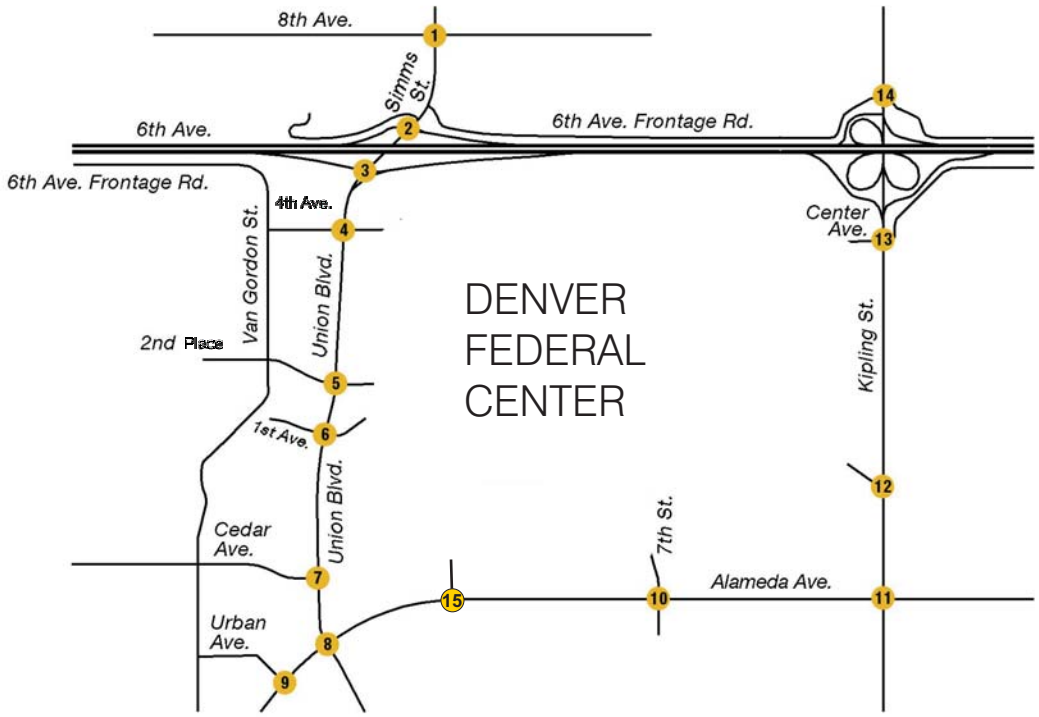
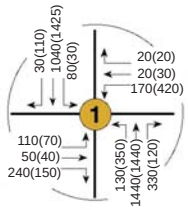
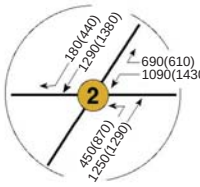
Figure 7

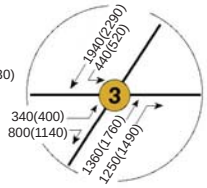




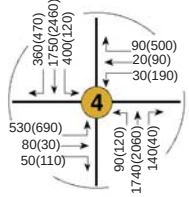
Simms St. / 8th Ave.



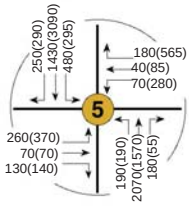
Union Blvd./ 6th Ave. WB Ramps



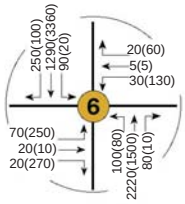
Union Blvd./ 6th Ave. EB Ramps



Union Blvd./ 4th Ave. (Gate 4)



Union Blvd./ 2nd Place (Gate 5)



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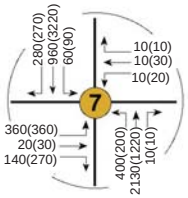
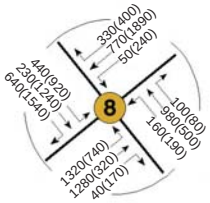
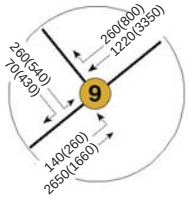


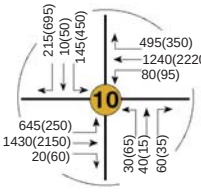
Union Blvd./ Cedar Ave.



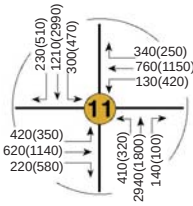
Union Blvd./ Alameda Ave.



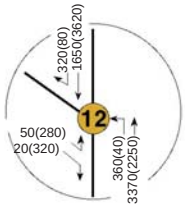
Alameda Ave./ Urban Ave.



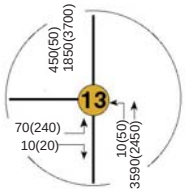
Alameda Ave./ 7th St. (Gate 7)



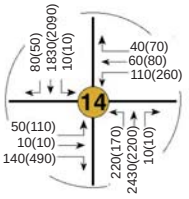
Alameda Ave./ Kipling St.



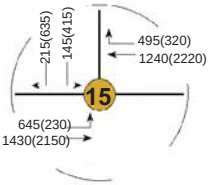
Kipling St./ Main Ave. (Gate 1)



Kipling St./ Center Ave. (Gate 2)



Kipling St./ 6th Ave. Frontage Rd.



Alameda Ave./ Routt St.

Legend

xxx(xxx) am peak/pm peak Peak Hour Volumes

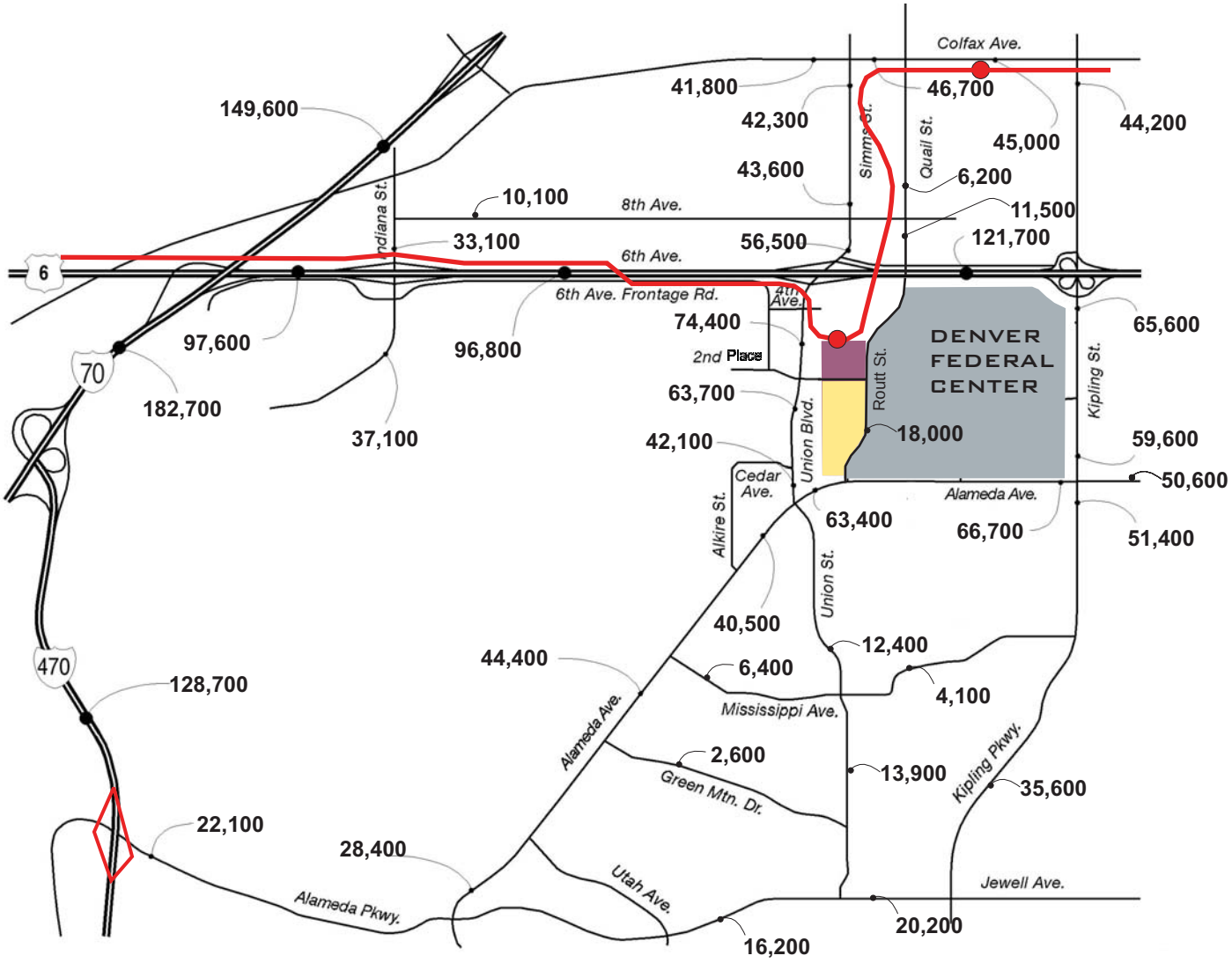
N

Matrix Design Group Inc.
Integrated Design Solutions

2030 Peak Hour Volumes - Mall

Lakewood west central subarea transportation study

Figure 8



St. Anthony's Hospital

LRT Station

N

Legend

41,500 Daily Traffic Volumes

LRT Line

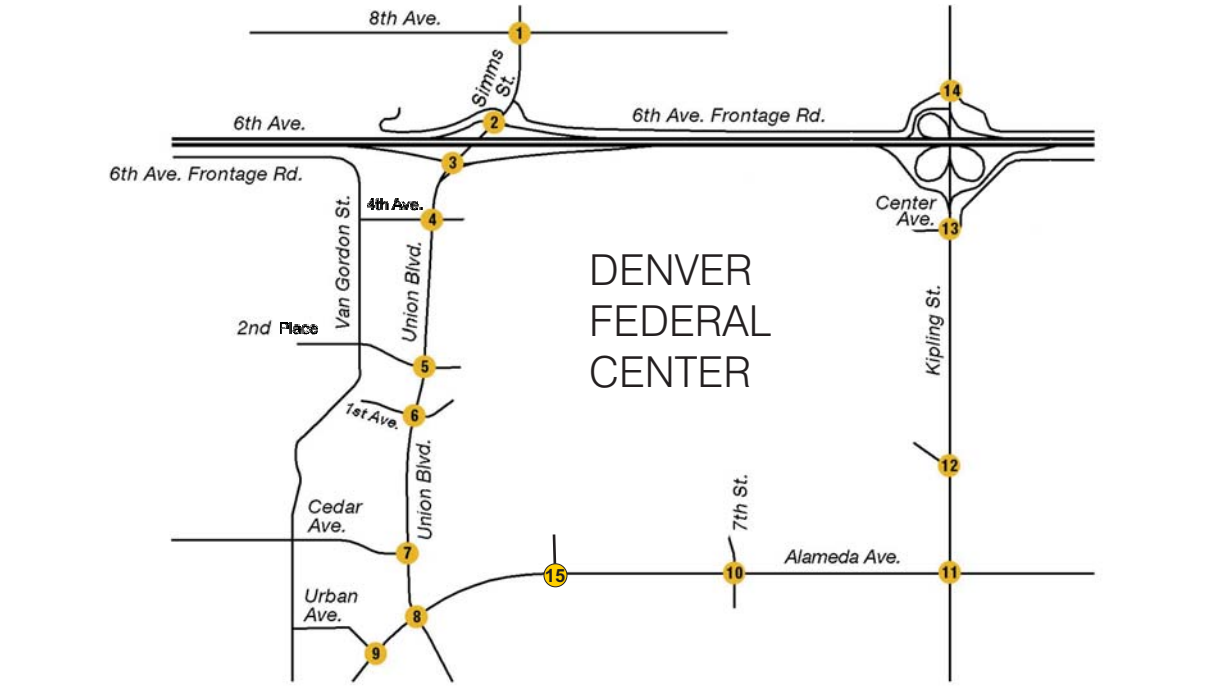
LRT Station

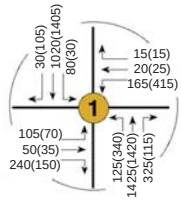
Matrix Design Group Inc.
Integrated Design Solutions

2030 Traffic Forecasts Quad

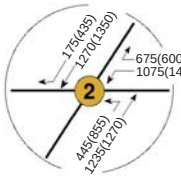
Lakewood west central subarea transportation study

Figure 9

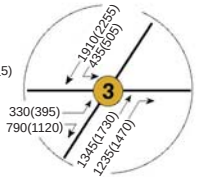




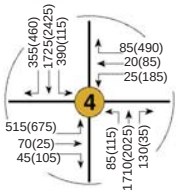
Simms St. / 8th Ave.



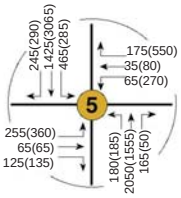
Union Blvd./ 6th Ave. WB Ramps



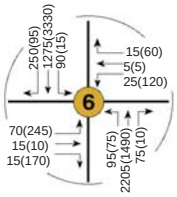
Union Blvd./ 6th Ave. EB Ramps



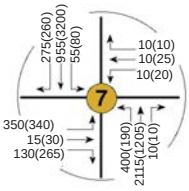
Union Blvd./ 4th Ave. (Gate 4)



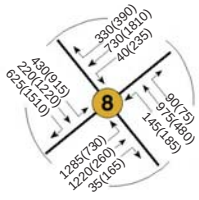
Union Blvd./ 2nd Place (Gate 5)



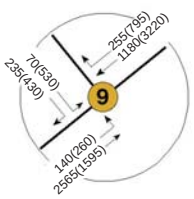
Union Blvd./ 1st. Ave.



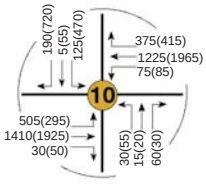
Union Blvd./ Cedar Ave.



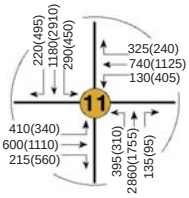
Union Blvd./ Alameda Ave.



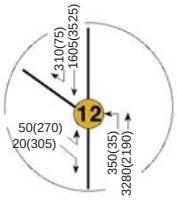
Alameda Ave./ Urban Ave.



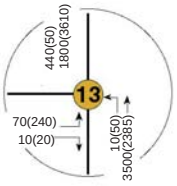
Alameda Ave./ 7th St. (Gate 7)



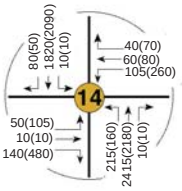
Alameda Ave./ Kipling St.



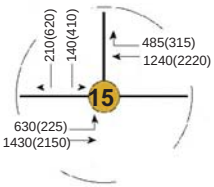
Kipling St./ Main Ave. (Gate 1)



Kipling St./ Center Ave. (Gate 2)



Kipling St./ 6th Ave. Frontage Rd.



Alameda Ave./ Routt St.

Legend

xxx(xxx) am peak/pm peak Peak Hour Volumes

N

Matrix Design Group Inc.
Integrated Design Solutions

2030 Peak Hour Volumes - Quad

Lakewood west central subarea transportation study

Figure 10

FUTURE NEEDS ASSESSMENT

Mall Alternative

To determine how efficiently and effectively the base roadway network accommodates the 2030 peak hour volumes shown in Figure 8, all of the signalized intersections in the vicinity of the DFC were analyzed. Table 4 presents the results of this analysis. Appendix C contains all of the analysis output, including the lane configurations, the volumes by movement, and the traffic signal timings.

As shown, six of the intersections in the AM peak hour and ten of the intersections in the PM peak hour are expected to be over capacity and fail to meet the minimum acceptable service levels established by the City of Lakewood.

Table 4 - 2030 Levels of Service for Mall Alternative – Base Network

Intersection	AM	PM
Simms Rd & 8th Ave.	B	C
Union Blvd. & 6th Ave. WB Ramps	C	F
Union Blvd. & 6th Ave. EB Ramps	B	E
Union Blvd & 4th Ave (Gate 4)	C	F
Union Blvd & 2nd Ave (Gate 5)	F	F
Union Blvd & 1st Ave	A	C
Union Blvd & Cedar Dr	B	E
Union Blvd & Alameda Ave	F	F
Alameda Ave & Urban Ave	B	F
Alameda Ave & Routt Street	F	F
Alameda Ave & Oak St (Gate 7)	F	F
Alameda Ave & Kipling St	F	F
Kipling St & Gate 1	D	F
Kipling St & Gate 2	F	F
Kipling St & 6th Ave Frontage Rd	B	D

Quad Alternative

To determine how efficiently and effectively the base roadway network accommodates the 2030 peak hour volumes shown in Figure 10, all of the signalized intersections in the vicinity of the DFC were analyzed. Table 5 presents the results of this analysis. Appendix D contains all of the analysis output, including the lane configurations, the volumes by movement, and the traffic signal timings.

As shown, five of the intersections in the AM peak hour and ten of the intersections in the PM peak hour are expected to be over capacity and fail to meet the minimum acceptable service levels established by the City of Lakewood.

Table 5 - 2030 Levels of Service for Quad Alternative – Base Network

Intersection	AM	PM
Simms Rd & 8th Ave.	B	C
Union Blvd. & 6th Ave. WB Ramps	C	F
Union Blvd. & 6th Ave. EB Ramps	B	E
Union Blvd & 4th Ave (Gate 4)	C	F
Union Blvd & 2nd Ave (Gate 5)	D	F
Union Blvd & 1st Ave	A	C
Union Blvd & Cedar Dr	B	D
Union Blvd & Alameda Ave	F	F
Alameda Ave & Urban Ave	B	F
Alameda Ave & Routt St	F	F
Alameda Ave & Oak St (Gate 7)	F	F
Alameda Ave & Kipling St	F	F
Kipling St & Gate 1	D	F
Kipling St & Gate 2	F	F
Kipling St & 6th Ave Frontage Rd	B	D

Comparative Analysis

As shown above, the travel demands from the proposed alternatives exceed the capacity of most of the signalized intersections in the vicinity of the DFC site. In order to provide a baseline for comparison, the base roadway network was analyzed using 2030 traffic forecasts but assumed no change to the existing DFC land use density and mix. In other words, it assumed build-out of the St. Anthony Hospital Complex, the LRT station, continued growth in the Union Boulevard corridor, and continued residential growth in the western portions of the City of Lakewood but no change to the existing 4,000,000 square feet of buildings on the DFC site. Table 6 provides the results. Appendix E contains all of the analysis output, including the lane configurations, the volumes by movement, and the traffic signal timings.

Table 6 - 2030 Levels of Service for No-Action Alternative

Intersection	AM	PM
Simms Rd & 8th Ave.	C	C
Union Blvd. & 6th Ave. WB Ramps	C	F
Union Blvd. & 6th Ave. EB Ramps	B	D
Union Blvd & 4th Ave (Gate 4)	C	F
Union Blvd & 2nd Ave (Gate 5)	D	E
Union Blvd & 1st Ave	A	C
Union Blvd & Cedar Dr	B	E
Union Blvd & Alameda Ave	F	F
Alameda Ave & Urban Ave	A	F
Alameda Ave & Routt St.	C	D
Alameda Ave & Oak St (Gate 7)	C	D
Alameda Ave & Kipling St	E	F
Kipling St & Gate 1	A	B
Kipling St & Gate 2	A	B
Kipling St & 6th Ave Frontage Rd	B	C

As shown, one intersection in the AM peak hour and five intersections in the PM peak hour are over capacity and fail to meet the minimum acceptable service levels established by the City of Lakewood.

IDENTIFICATION AND ANALYSIS OF ALTERNATIVES

Roadway Improvements

Based on the magnitude of the problems identified in the previous section, a wide range of roadway capacity improvements were identified. These improvements included upgrading interchanges, widening streets, and adding turn lanes to intersections.

For the interchange upgrades, two concepts were identified and tested. The first concept involved replacing both the Kipling and Union interchanges with one split diamond interchange. This concept would allow traffic going to and from the DFC site via 6th Avenue to access the site directly without having to use either Union Boulevard or Kipling Street. The second concept involved no change to the Kipling interchange but improving the Union Boulevard interchange. The improvements consist of: widen the bridge over 6th Avenue by two lanes to accommodate double lefts from northbound to southbound and southbound to eastbound; signalize the double right turns from the westbound off ramp to northbound Simms; and expand the eastbound off ramp to provide for double left turns and double right turns. The concept that improves just the Union interchange is preferred over the Split Diamond concept for the following reasons:

- Based on the travel demand model, the split diamond concept would reduce travel on Union Boulevard by eight percent over the course of a day. This reduction does not eliminate the need for other major roadway improvements.
- The split diamond concept would cost three to four times more than the Union concept.
- The Union concept is consistent with ongoing planning efforts by both RTD and the Colorado Department of Transportation (CDOT).
- The potential impacts associated with the Union concept are localized. The Split diamond concept would impact residential properties and existing travel patterns over a mile to the east of Kipling Boulevard.

Based on the traffic forecasts, both Kipling Street and Alameda Avenue will need to be widened from four through lanes to six through lanes. By providing additional capacity in these two corridors, the reliance on Union Boulevard is reduced. The travel demand model shows a seven percent reduction in daily traffic on Union when both Kipling and Alameda are widened. Union Boulevard currently has six through lanes between 6th Avenue and Alameda Avenue. Widening Union was not considered because of probable land use impacts and the desire to not create a barrier between the land uses on either side of the street.

The roadway improvements that will be needed to accommodate the 2030 travel demands are listed below. It should be noted these improvements apply to both the Quad and Mall alternatives.

- Roadway Improvements
  - Widen Alameda to six lanes from west of Union to Allison
  - Widen Kipling to six lanes from 6th Avenue to Mississippi
  - Extend the proposed Routt Street to the north over 6th Avenue and connect to Quail Street. Routt Street should have four through lanes from Alameda Avenue to 8th Avenue. Separate left turn lanes should be provided at all signalized intersections.
- Intersection Improvements
  - Provide two westbound right turn lanes at the intersection of Union and 4th
  - Provide two westbound right turn lanes, two southbound left turn lanes, and one southbound right turn lane at the intersection of Union and 2nd
  - Provide two eastbound left turn lanes, one southbound exclusive left turn lane and one shared left and right turn lane, and one westbound right turn lane at the intersection of Alameda Avenue and Routt Street.
  - Provide two eastbound left turn lanes, two southbound left turn lanes, two southbound right turn lanes, and one westbound right turn lane at the intersection of Alameda and Oak.
  - Provide a northbound left turn at the intersection of Kipling Street and Gate One. This will require a realignment of the access to the JeffCo stadium on the east side of Kipling Street.
- 6th Avenue and Union Interchange Improvements
  - Widen bridge by two lanes to accommodate double lefts from northbound to westbound and southbound to eastbound
  - Signalize the double right turns from the westbound off ramp to northbound Simms
  - Expand eastbound off ramp for double left turns and double right turns

The base roadway network with the above improvements was then analyzed. Table 7 provides the results. Appendices F and G contain all of the analysis output, including the lane configurations, the volumes by movement, and the traffic signal timings. As shown, all of the intersections in the AM peak hour and all but one intersection in the PM peak hour either meets or exceeds the minimum acceptable service levels for signalized intersections. The lone exception is the intersection of Union and Alameda, which continues to be over capacity. Since widening Union Boulevard south of Alameda Avenue would be too disruptive to the residential neighborhood, a grade-separated facility at the intersection may be necessary to accommodate the 2030 traffic volumes. This is comparable to the results of the existing conditions analysis shown in Figure 4.

Table 7 - 2030 Levels of Service with Improvements

	Mall		Quad	
Intersection	**AM**	**PM**	**AM**	**PM**
Simms Rd & 8th Ave.	B	C	B	C
Union Blvd. & 6th Ave. WB Ramps	C	D	C	D
Union Blvd. & 6th Ave. EB Ramps	B	B	B	B
Union Blvd & 4th Ave (Gate 4)	C	E	C	D
Union Blvd & 2nd Ave (Gate 5)	C	E	C	E
Union Blvd & 1st Ave	A	C	A	C
Union Blvd & Cedar Dr	B	E	B	D
Union Blvd & Alameda Ave	E	F	E	F
Alameda Ave & Urban Ave	B	E	A	C
Alameda Ave & Routt St	B	D	B	D
Alameda Ave & Oak St (Gate 7)	D	D	C	D
Alameda Ave & Kipling St	E	E	E	E
Kipling St & Gate 1	A	D	A	B
Kipling St & Gate 2	A	B	A	B
Kipling St & 6th Ave Frontage Rd	B	D	B	D

Travel Demand Management

As shown in Table 7, all but one of the signalized intersections either meets or exceeds the minimum acceptable service levels for signalized intersections. Numerous intersections, however, are shown as operating at capacity (LOS E). Consequently, there is no margin for error and any small problem such as an accident or weather (rain/snow) will cause forced flow conditions. Since the capacity has essentially been "maxed out", the next option is to reduce the demand. This is typically accomplished through travel demand management (TDM).

The primary purpose of TDM is to reduce the number of vehicles using the roadway system, especially during peak-use hours. The term TDM encompasses both alternatives to driving alone and the techniques/supporting strategies that encourage either the use of other modes or influences the time of, or need to travel.

Typical TDM alternatives include:

- Carpools and vanpools
- Public and private transit, including shuttles and a site-wide bus circulator system
- Non-motorized travel, including bicycling and walking

TDM strategies include:

- Financial and time incentives for the use of alternative modes
- Flextime, staggered work hours and compressed work weeks
- Working from home
- Information dissemination and marketing activities to promote TDM options
- Supporting services that make the use of TDM options more convenient or that remove psychological impediments to their use

Table 8 summarizes the characteristics of successful TDM efforts from around the country. As shown, the plans for the DFC site will meet all of the required characteristics.

Table 8 – Characteristics of Successful TDM Programs

TDM Alternative	Required Characteristics
Carpooling/Vanpooling	Large concentration of employees
	Large single employers
	Employees with similar work hours
	On-site employee oriented services
Transit	Available fixed route bus service
	Available light rail service
	Convenient pedestrian access
	Land use Density
	Land use diversity
Bicycling and Walking	Convenient and safe bicycle access/linkages
	Secure bicycle parking areas
	Convenient and safe pedestrian access/linkages

Source: *Commute Alternative Systems Handbook,* Center for Urban Transportation Research, University of South Florida, 1996.

With the unique opportunities for implementation of TDM measures at the DFC site, the peak hour vehicle trips could be reduced from 15 to 25 percent. These percentages are high but well within the range of what are considered both reasonable and practical. For comparative purposes, the travel demand model showed approximately 95 percent of the trips would be made via automobile.

To achieve the 15 to 25 percent reduction levels, several TDM strategies will be required to complement the future transit system and land use plans. Each one is described below.

Parking Management – Based on a review of established TDM programs, parking supply and pricing are the most potent strategies available to meet aggressive TDM goals. The supply of parking is an important determinant underlying choice of travel mode. Generally, with greater parking supply, fewer drivers will consider using alternate modes. The effectiveness of parking pricing depends on the level of the price and the share of cost actually borne by the driver.

TDM Program Manager – Given the size and scope of the entire DFC redevelopment, as well as the need to reduce vehicle trips, a TDM Program Manager will be required to support site-wide TDM efforts. This individual will act as a liaison between all major DFC employers and regional transportation agencies, including RTD, CDOT and DRCOG. The TDM Program Manager, working with DRCOG, will be able to assist in establishing a ride matching service for carpooling and vanpooling. The Program Manager will also act as a focal point for ongoing promotions, special events, monitoring special programs such as flexible work hours, preparation of materials, and other related duties.

IMPROVEMENT PHASING

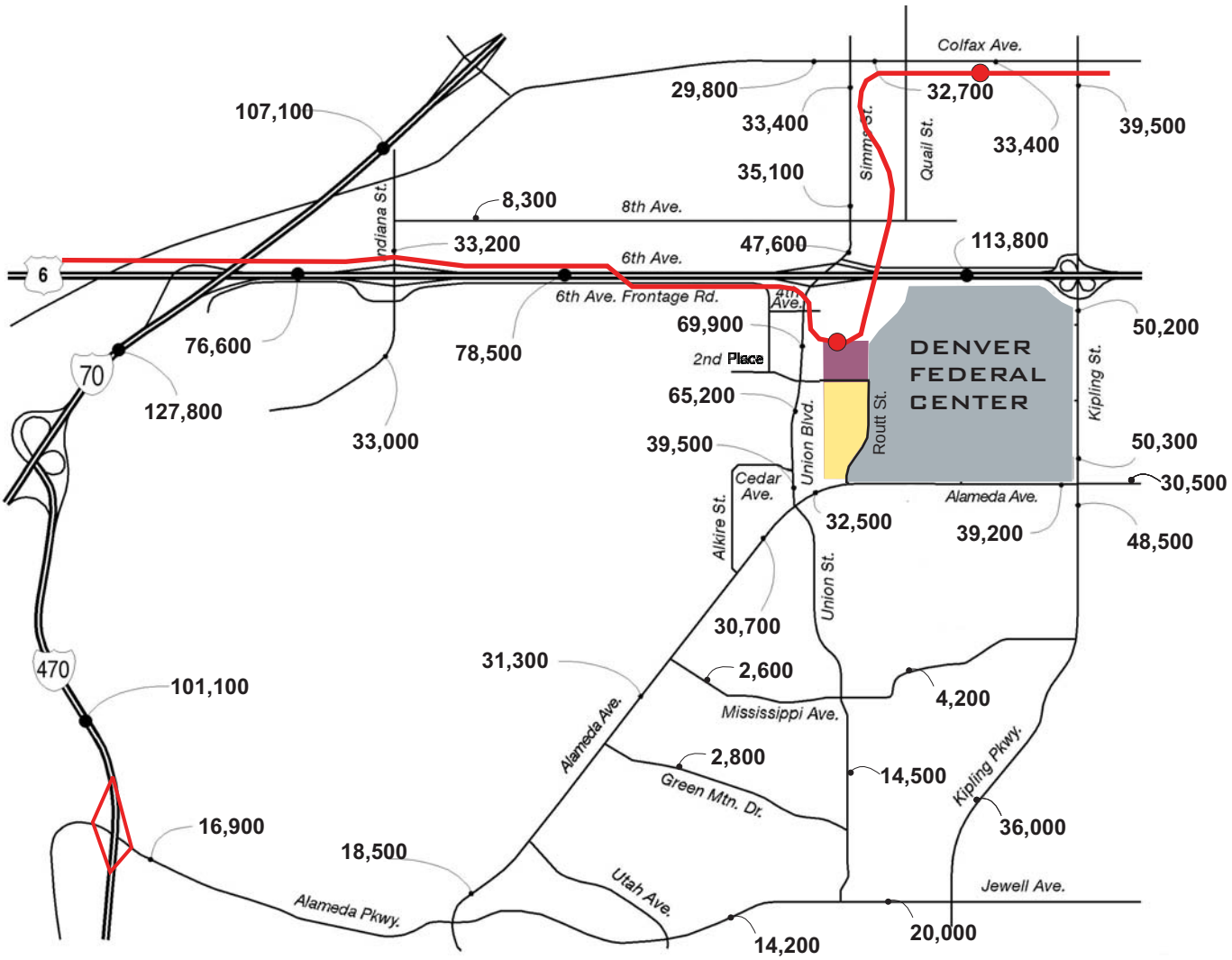
The purpose of this section is to identify when the proposed roadway improvements will generally be needed. To make this determination, 2015 was chosen as the interim timeframe. In 2015, both the first phase of the St. Anthony Hospital Campus and the LRT West Corridor line will be complete. Figures 11 and 12 show the 2015 daily and peak hour intersection traffic volumes, respectively. The process described previously was used to convert the daily link volumes to peak hour intersection volumes.

To determine how efficiently and effectively the base roadway network accommodates the 2015 peak hour volumes shown in Figure 12, all of the signalized intersections in the vicinity of the DFC were analyzed. Table 9 presents the results of this analysis. Appendix H contains all of the analysis output, including the lane configurations, the volumes by movement, and the traffic signal timings. As shown, all of the intersections in the AM peak hour operate at acceptable service levels. In the PM peak hour, all but two of the intersections operate at acceptable service levels. The Union Boulevard and 6th Avenue westbound off-ramp intersection and the Union Boulevard and Alameda Avenue intersection are both expected to experience LOS F conditions.

Table 9 - 2015 Levels of Service

Intersection	AM	PM
Simms Rd & 8th Ave.	B	C
Union Blvd. & 6th Ave. WB Ramps	C	F
Union Blvd. & 6th Ave. EB Ramps	B	D
Union Blvd & 4th Ave (Gate 4)	C	D
Union Blvd & 2nd Ave (Gate 5)	C	D
Union Blvd & 1st Ave	A	C
Union Blvd & Cedar Dr	B	D
Union Blvd & Alameda Ave	D	F
Alameda Ave & Urban Ave	A	B
Alameda Ave & Routt St	A	B
Alameda Ave & Oak St (Gate 7)	C	D
Alameda Ave & Kipling St	D	E
Kipling St & Gate 1	A	B
Kipling St & Gate 2	A	B
Kipling St & 6th Ave Frontage Rd	B	C

Based on this analysis, the 6th Avenue and Union Interchange Improvements will likely be needed within the next ten years. All of the other roadway improvements will be required when the DFC site builds out. The phasing of the remaining improvements will be subject to how fast and where development occurs.



St. Anthony's Hospital

LRT Station

N

Legend

41,500 Daily Traffic Volumes

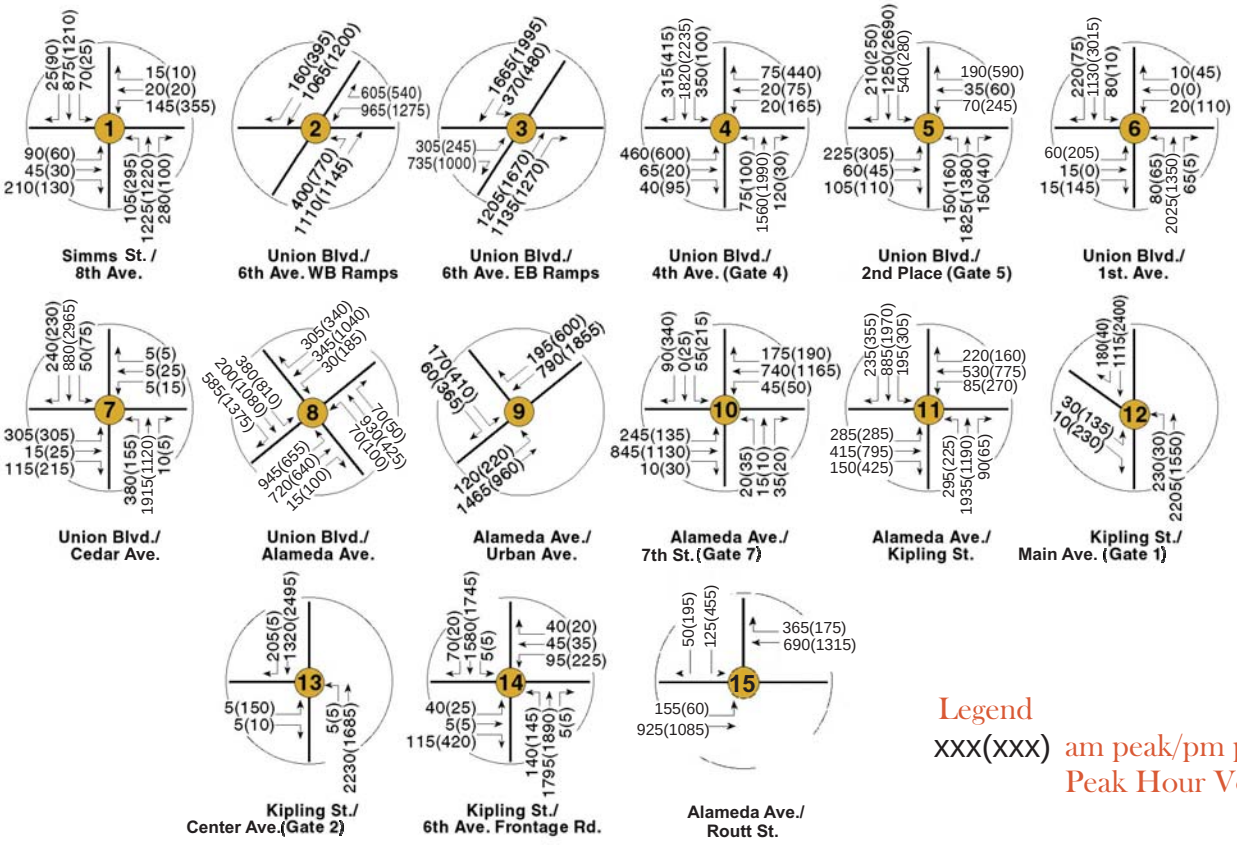
LRT Line

LRT Station

Matrix Design Group Inc.
Integrated Design Solutions

2015 Traffic Forecasts

Lakewood west central subarea transportation study Figure 11



Legend

xxx(xxx) am peak/pm peak Peak Hour Volumes

Matrix Design Group Inc.
Integrated Design Solutions

2015 Peak Hour Volumes

Lakewood west central subarea transportation study Figure 12

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FINDINGS AND RECOMMENDATIONS

Based on the foregoing analyses, the following was concluded:

- Today, the DFC site generates approximately 15,900 vehicle trips per day. By comparison, the 2030 trips will be between six and seven times greater, depending on the alternative.
- The Base Roadway Network is not capable of accommodating the future travel demand at the minimum acceptable service levels established by the City of Lakewood.
- While the travel demand for the Mall Alternative is 15 percent higher than the Quad Alternative, the system performance of each is basically the same.
- Even with no changes to the existing 4,000,000 square feet of DFC buildings, one intersection in the AM peak hour and five intersections in the PM peak hour will be over capacity in 2030.
- The following roadway improvements will be required to meet the forecasted 2030 travel for both build alternatives:

  Roadway Improvements
  - Widen Alameda to six lanes from west of Union to Allison
  - Widen Kipling to six lanes from 6th Avenue to Mississippi
  - Extend the proposed Routt Street to the north over 6th Avenue and connect to Quail Street. Routt Street should have four through lanes from Alameda Avenue to 8th Avenue. Separate left turn lanes should be provided at all signalized intersections.

  Intersection Improvements
  - Provide two westbound right turn lanes at the intersection of Union and 4th
  - Provide two westbound right turn lanes, two southbound left turn lanes, and one southbound right turn lane at the intersection of Union and 2nd
  - Provide two eastbound left turn lanes, one southbound exclusive left turn lane and one shared left and right turn lane, and one westbound right turn lane at the intersection of Alameda Avenue and Routt Street.
  - Provide two eastbound left turn lanes, two southbound left turn lanes, two southbound right turn lanes, and one westbound right turn lane at the intersection of Alameda and Oak.
  - Provide a northbound left turn at the intersection of Kipling Street and Gate One. This will require a realignment of the access to the JeffCo stadium on the east side of Kipling Street.

  6th Avenue and Union Interchange Improvements
  - Widen bridge by two lanes to accommodate double lefts from northbound to westbound and southbound to eastbound
  - Signalize the double right turns from the westbound off ramp to northbound Simms
  - Expand eastbound off ramp for double left turns and double right turns

- The improved 6th and Union interchange will likely be needed within the next 10 years. All of the other improvements will be required when the DFC site builds out. The phasing of the remaining improvements will be subject to how fast and where development occurs.
- With these roadway improvements, all but one of the signalized intersections either meets or exceeds the minimum acceptable service levels for signalized intersections. Numerous intersections, however, will still be operating at capacity (LOS E).
- With the system basically operating at capacity, the demand generated from the proposed development must be lower. This will be accomplished with a comprehensive Travel Demand Management Program. The success of this program is dependent on the ability to aggressively manage the parking supply and pricing site-wide. It also will require someone to act as a liaison between all major DFC employers and regional transportation agencies, including RTD, CDOT and DRCOG, and be a focal point for all TDM activities.
- Only the Union Boulevard and Alameda Avenue intersection will be over capacity, even with an aggressive TDM program. Since widening Union Boulevard south of Alameda Avenue would be too disruptive to the residential neighborhood, a grade-separated facility at the intersection may be necessary to accommodate the 2030 traffic volumes.