

**SOUTH GREENWOOD VILLAGE  
I-25 CORRIDOR  
TRAFFIC ANALYSIS**

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**TABLE OF CONTENTS**

	<u>Page</u>
<b>EXECUTIVE SUMMARY</b> .....	<b>i</b>
<b>I. INTRODUCTION</b> .....	<b>1</b>
<b>II. EXISTING CONDITIONS</b> .....	<b>3</b>
A. Land Use .....	3
B. Roadway Network and Traffic Control .....	3
C. Traffic Volumes .....	3
D. Traffic Operations .....	5
<b>III. TRAFFIC FORECASTING METHODOLOGY</b> .....	<b>9</b>
A. Model Refinements .....	9
B. Development Forecasts .....	9
C. Process to Develop Forecasts .....	12
D. Transit Mode Split .....	13
<b>IV. 2035 TRAFFIC CONDITIONS</b> .....	<b>15</b>
A. Traffic Volumes .....	15
B. Traffic Operations .....	17
C. Average Speed and Travel Time .....	19
D. Intersection Improvements .....	19
E. Traffic Operations and Improvement Recommendations for No Greenwood Village Growth Scenario .....	28
F. Cost and Right-of-Way Impacts .....	29
<b>V. SUMMARY AND CONCLUSIONS</b> .....	<b>32</b>

**APPENDIX A EXISTING AND 2035 PEAK HOUR TURNING MOVEMENT VOLUMES**

**APPENDIX B HOUSEHOLD AND EMPLOYMENT DEMOGRAPHICS**

**APPENDIX C LEVEL OF SERVICE WORKSHEETS (SEPARATELY BOUND APPENDIX)**

**LIST OF FIGURES**

	<u>Page</u>
Figure ES-1 Summary of Intersection Improvement Needs for Target Level of Service (LOS) -----	iv
Figure 1. Vicinity Map-----	2
Figure 2. Existing Roadway Network and Traffic Control-----	4
Figure 3. Hourly Volumes-----	6
Figure 4. Characteristics of Intersection Level of Service (LOS)-----	7
Figure 5. Existing Intersection Level of Service -----	8
Figure 6. Traffic Forecasting Process-----	10
Figure 7. Transportation Analysis Zones-----	11
Figure 8. Transit Service Area Shares-----	14
Figure 9. Daily Traffic Volume Comparison -----	16
Figure 10. 2035 Intersection Level of Service – With No Improvements and With Optimized Signal Timing-----	18
Figure 11. 2035 Intersection Level of Service - With Potential Improvements-----	20
Figure 12. Potential Roadway Widening-----	26
Figure 13. 2035 Intersection Level of Service – With no Greenwood Village Growth-----	27
Figure 14. Summary of Intersection Improvement Needs for Target LOS -----	33

**LIST OF TABLES**

Table ES-1 Existing and Future LOS and Average Delay With No Improvements-----	ii
Table 1. Anticipated New Development within the Study Area-----	12
Table 2. Household and Employment Forecasts for the Study Area -----	12
Table 3. Forecasted Daily Traffic Growth Ranges-----	17
Table 4. Average Speed and Travel Time for Study Area Roads -----	19
Table 5. Potential Physical Intersection Improvements with LOS and Average Delay -----	21
Table 6. Right-of-Way and Cost Impacts of Potential Improvements-----	30

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## EXECUTIVE SUMMARY

The City has engaged Felsburg Holt & Ullevig to prepare the South Greenwood Village I-25 Corridor Traffic Analysis for the planning area bounded by Orchard Road on the north, Yosemite Street on the east, Arapahoe Road on the south, and Quebec Street on the west. The regional transit accessibility provided by the Arapahoe at Village Center Transit Station, with a light rail stop on the west side of I-25 and a park-n-Ride lot on the east side of I-25, has provided an impetus for recent development activity in the study area.

The regional travel demand model was refined and used to develop two sets of traffic forecasts for evaluation in the study:

- 2035 - Greenwood Village No Growth Scenario: This set of 2035 projections assumes 2010 land use quantities for Greenwood Village and 2035 land use projections for the rest of the metropolitan area. The purpose in developing these projections with no growth in Greenwood Village is to assess the effects on study area streets of regional growth versus growth in Greenwood Village.
- 2035 - Greenwood Village Growth Scenario: This set of 2035 projections included 2035 growth projections for Greenwood Village per Denver Regional Council of Governments (DRCOG) for the region and 2035 growth projections for the study area and other parts of Greenwood Village based on DRCOG and Greenwood Village planners' forecasts.

Analysis of forecasts led to the following key observations:

- On the major roads on the periphery of the study area, including Quebec Street, Orchard Road, Yosemite Street and Arapahoe Road, daily volumes were projected to increase by 5% to 35% in the Greenwood Village No Growth scenario and 10% to 55% in the Greenwood Village Growth scenario.
- Interior study area streets generally show higher percentage increases. In the Greenwood Village No Growth scenario daily traffic volumes were forecasted to grow by 15% to 75%, while in the Growth scenario the projected increases were between 35% and 140%.
- These comparisons show that generally a majority of the projected traffic growth on the major perimeter roads is attributable to regional growth and development, while a majority of the projected traffic growth on the interior study area streets is attributable to development in the study area or other parts of Greenwood Village.

Forecasted year 2035 peak hour traffic operations were analyzed for 25 study area intersections, including three that are in Centennial. The level of congestion at an intersection is measured by level of service (LOS) on a scale from LOS A to LOS F, with LOS A representing minimal congestion or delay and LOS F representing very high levels of congestion and long delays. LOS D or better has been established as a target peak hour LOS for the study.

**Table ES-1** provides a comparison of the intersection peak hour LOS with existing traffic levels, 2035 forecasts with no Greenwood Village growth, and 2035 with Greenwood Village growth. The analyses assume existing signal timing and no physical improvements to existing intersections. The table shows that:

- Three intersections are currently operating below the LOS D target in one or both of the peak hours
- In 2035 with no growth in Greenwood Village, eight intersections would fall below the target LOS for one or both peak hours
- In 2035 with projected growth in Greenwood Village, 14 intersections would fall below the target LOS for one or both peak hours

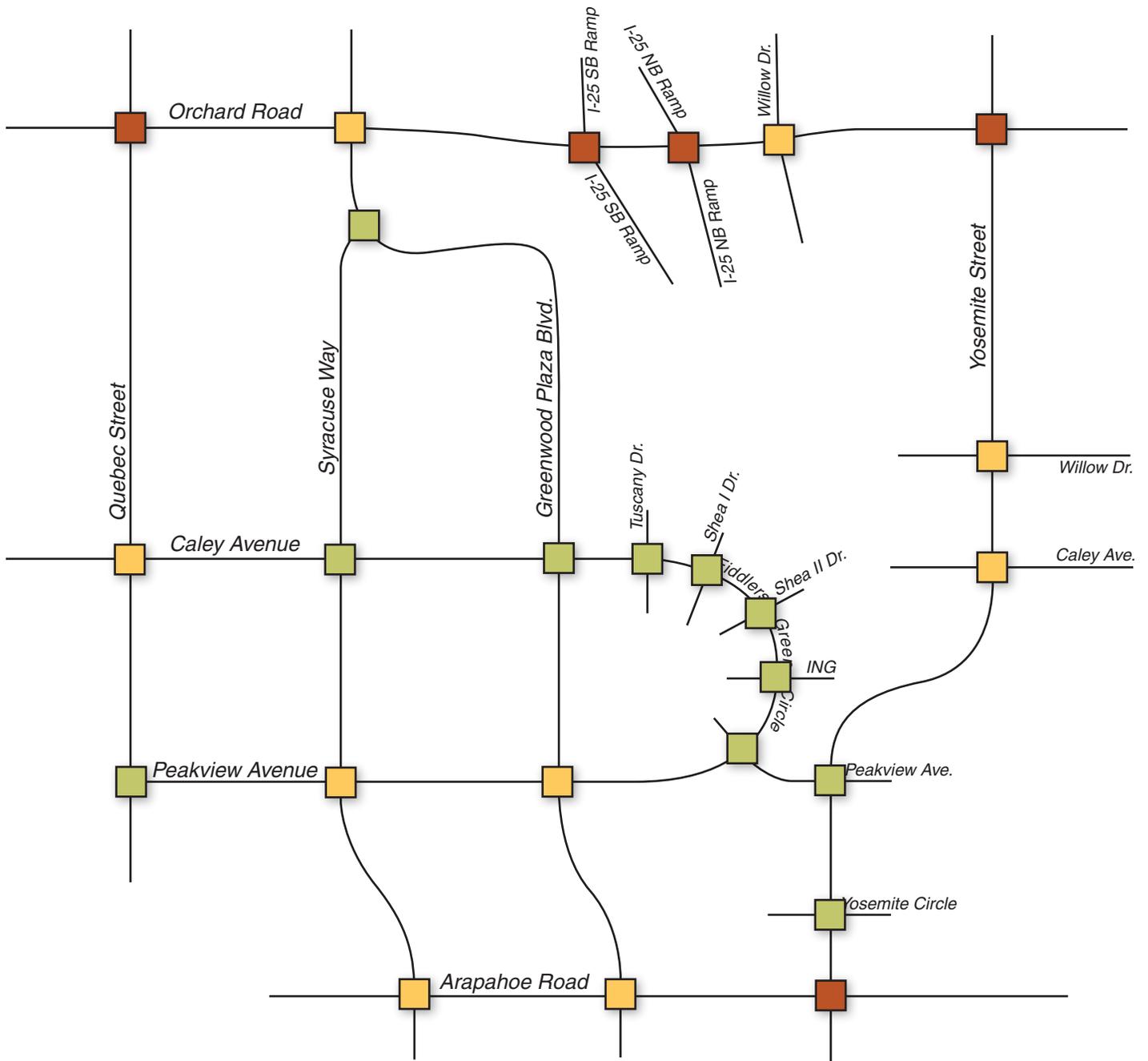
**Table ES-1 Existing and Future LOS and Average Delay With No Improvements**

Intersection	Level of Service (AM/PM) Delay in sec./veh. (AM/PM)		
	Existing 2010	2035 No Action No Village Growth	2035 No Action With Village Growth
Arapahoe & Greenwood Plaza	A/C 7/25	B/D 15/36	C/E 27/68
Arapahoe & Syracuse	A/B 11/15	B/C 17/21	C/C 25/27
Arapahoe & Yosemite	D/E 53/78	E/F 74/124	F/F 127/177
Quebec & Peakview (City of Centennial)	A/B 7/17	B/C 8/24	B/D 10/41
Quebec & Caley (City of Centennial)	E/C 56/34	E/C 60/35	E/D 60/44
Quebec & Orchard	C/C 33/33	D/F 50/90	E/F 57/93
Syracuse & Peakview (City of Centennial)	A/B (Stop Sign Control)	B/C (Stop Sign Control)	D/F (Stop Sign Control)
Greenwood Plaza & Peakview	B/B 18/18	C/C 24/30	D/F 40/98
Greenwood Plaza & Caley	B/B 15/13	B/B 15/14	B/B 18/17
Greenwood Plaza & Syracuse	A/A 6/9	A/A 7/9	A/B 10/11
Peakview & Fiddler's Green	A/B 8/15	A/B 9/17	B/C 20/25
Yosemite & Yosemite Circle	B/C 13/21	B/C 14/22	F/D 76/49
Orchard & Yosemite/DTC	C/C 32/32	E/E 60/62	E/E 70/74

Intersection	Level of Service (AM/PM) Delay in sec./veh. (AM/PM)		
	Existing 2010	2035 No Action No Village Growth	2035 No Action With Village Growth
Orchard & Greenwood Plaza	C/D 32/48	D/E 50/67	E/F 79/108
Orchard & I-25 NB Ramps	B/C 18/30	D/E 40/70	F/F 89/103
Orchard & I-25 SB Ramps	C/D 31/39	E/D 74/49	F/F 118/84
Orchard & Willow	B/D 10/42	B/D 17/48	B/E 19/63
Fiddler's Green & ING Drive	C/B 26/17	C/B 23/17	C/D 33/44
Fiddler's Green & Shea I Drive	A/A 0/0	A/A 0/0	A/B 6/11
Fiddler's Green & Shea II Drive	A/A 0/0	A/A 0/0	A/C 7/21
Fiddler's Green & Tuscany Drive	A/B 2/12	A/B 3/12	B/B 12/16
Syracuse & Caley	A/A 8/7	B/A 10/9	B/A 11/9
Yosemite & Caley	C/C 29/25	C/C 30/28	E/E 78/65
Yosemite & Peakview	B/C 11/29	B/C 19/30	C/D 22/45
Yosemite & Willow/Fair	<b>F/F (stop-sign control on Willow)</b>	<b>F/F (stop-sign control on Willow)</b>	<b>F/F (stop-sign control on Willow)</b>

Potential improvement needs were identified that could allow each intersection to accommodate projected 2035 traffic levels (with Greenwood Village growth) at the target LOS. The 25 intersections analyzed fall into three categories with respect to meeting the LOS D target with forecasted 2035 traffic volume, as described below and depicted on **Figure ES-1**:

- **No Improvements Needed** – 11 intersections would operate with LOS D or better without physical improvements. However, in some cases signal timing or turn lane modifications were identified that would enhance operations or safety.
- **Implementable Improvements Identified to Reach Target LOS** – At 9 intersections, physical improvements were identified that would improve operations to LOS D or better in 2035 or where projected volumes warrant an improvement such as additional left or right turn lanes. Improvements, including signal timing modifications, additional turn lanes, or minor intersection realignment, appear to be readily implementable at these locations.



**LEGEND**

- = No Improvements Needed
- = Implementable Improvements Identified
- = Challenging Intersection

**Figure ES-1**  
 Summary of Intersection Improvement Needs  
 for Target LOS

**NORTH**

- Challenging Intersections – At 5 intersections, potential improvements were identified but there are significant challenges associated with their implementation and additional study will be needed to determine the feasibility of these or other improvements. These challenging locations include:
  - Orchard Road/Quebec Street – Improvements needed for intersection capacity are inconsistent with previous Council policy with respect to Orchard Road west of Quebec Street. It is Council policy not to improve the LOS at this intersection.
  - Orchard Road/Yosemite Street – Improvements needed for intersection capacity are inconsistent with previous Council policy with respect to Yosemite Street south of Orchard Road and Orchard Road east of Yosemite Street. It is Council policy not to improve the LOS at this intersection.
  - Orchard Road/I-25 Ramp Terminal Intersections – Improvements needed for intersection capacity would require extensive bridge reconstruction and right-of-way acquisition. Improvements would need to be part of a coordinated interchange reconstruction with the Colorado Department of Transportation.
  - Arapahoe Road/Yosemite Street – Changes to achieve LOS D in 2035 were not identified in this study. Potential improvements are currently being explored through the I-25/Arapahoe Interchange Environmental Assessment.



## I. INTRODUCTION

In 2008-2009, the City of Greenwood Village completed the *I-25 Corridor Transportation Improvement Study* that analyzed traffic conditions and improvement needs for the City's I-25 corridor using a 10-year planning horizon. The City has engaged Felsburg Holt & Ullevig to provide updated analysis for the south I-25 corridor planning area, incorporating recent development plans and providing a longer-range view of study area traffic conditions to the year 2035. This report documents the study methodology and key findings from this analysis.

The south I-25 corridor planning area is depicted on **Figure 1**. The area is at the center of Greenwood Village and includes areas both west and east of I-25. The study area is bounded by Orchard Road on the north, Yosemite Street on the east, Arapahoe Road on the south, and Quebec Street on the west. The regional transit accessibility provided by the Arapahoe at Village Center Transit Station, with a light rail stop on the west side of I-25 and a park-n-Ride facility on the east side of I-25, has provided an impetus for recent development activity in the study area.

A total of 25 intersections were analyzed for this study, including 23 intersections that are currently signalized and two unsignalized intersections. Three of the intersections are in Centennial and 22 are in Greenwood Village. The Denver Regional Council of Governments (DRCOG) regional travel demand forecasting model was used as the basis for forecasting year 2035 traffic volumes at these intersections. The DRCOG model was refined for the study to incorporate updated development expectations and additional transportation system focus in the south I-25 corridor planning area. This report documents the development of 2035 traffic forecasts with build-out of the study area, evaluation of future traffic operations with those forecasts, and identifies intersection improvements that would be needed to achieve acceptable traffic operations.



**LEGEND**

 = Study Area

**Figure 1**  
Vicinity Map

**NORTH** 

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## II. EXISTING CONDITIONS

Traffic volumes were compiled and traffic operational analyses were conducted at 25 intersections within the study area. **Figure 2** shows the 25 intersections evaluated for this study effort and the following sections describe existing roadway and traffic conditions within the study area.

### A. Land Use

The primary land use in the study area is office/commercial. Current data assembled by Greenwood Village staff and the Denver Council of Governments shows there are about 18,000 employees and 1,000 homes in the study area. This imbalance between employment and housing is typical of the overall Denver Tech Center area and it creates dramatic peaks in traffic volumes during the AM, midday and PM peak periods. These peaks in traffic volumes and their effects on intersection traffic operations will be discussed in more detail in the following sections.

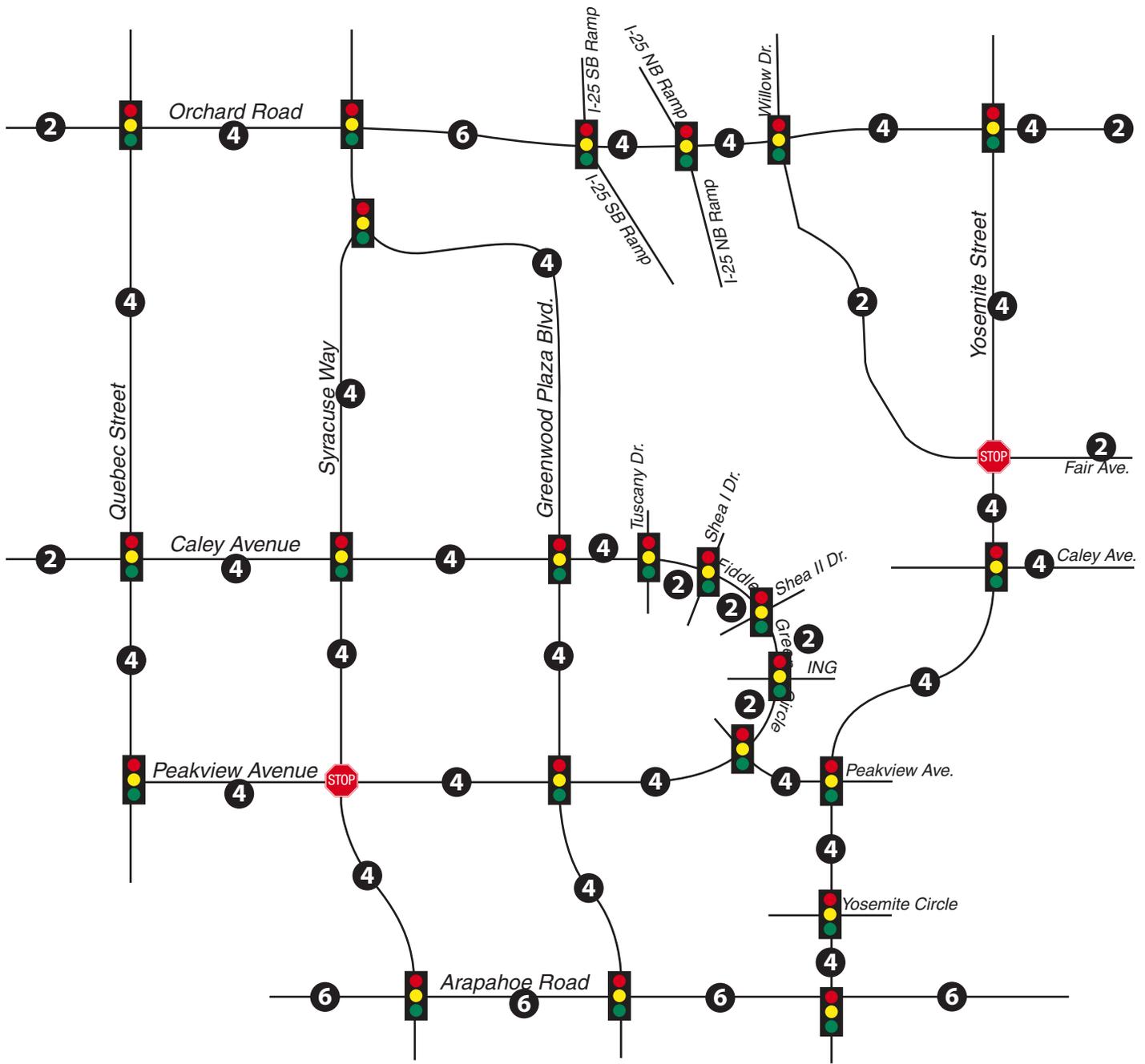
### B. Roadway Network and Traffic Control

**Figure 2** illustrates existing roadway lanes and traffic control within the study area. Most roadways in the study area have four through lanes. Arapahoe Road and a segment of Orchard Road west of I-25 have six lanes. Streets with two lanes include Orchard Road west of Quebec Street, just west of the study area and Fiddlers Green Circle, which was recently reduced from four to two through lanes. As shown in **Figure 2**, 23 of the 25 intersections within the study area are currently signalized. The only non-signalized intersections are the Peakview/Syracuse intersection which has all-way stop control and Yosemite/Willow intersection which has stop control on Willow Drive/Fair Avenue.

### C. Traffic Volumes

Traffic volume data within the study area was mostly collected from previous or on-going study efforts. Of the 25 study intersections traffic volume data was available at 23 intersections. This traffic volume data came from the following sources:

- Greenwood Village I-25 Corridor Study – This report included traffic volume data from June 2008 and covered many of the intersections in the study area.
- I-25/Arapahoe Road Environmental Assessment – This on-going effort included traffic volume data along Arapahoe Road that was collected the first week of December 2010.
- Fiddlers Green Circle Traffic Analysis – This analysis included data collected in 2007.
- Prime Tech MDP Traffic Study – This study was conducted for a proposed development at the Greenwood Plaza/Caley intersection. Existing data used in this study was collected in March 2010.
- New Traffic Counts – As part of this study effort it was necessary to collect new traffic volume counts at the Yosemite/Willow and the Quebec/Caley intersections.



**LEGEND**

-  = Unsignalized Intersection
-  = Signalized Intersection
-  = Number of Through Lanes

**Figure 2**  
Existing Roadway Network and Traffic Control

**NORTH**



Existing AM and PM peak hour turning movement counts for each study intersection are shown in **Figure A1** of **Appendix A**. **Figure 3** has three graphs that depict hourly traffic volumes in a weekday along roadways and at select intersections in the study area. These graphs show that the variations in traffic volume intensity are consistent throughout the study area, peaking during the morning commute, midday during the lunch hour and during the evening commute. Other observations regarding this data are as follows:

- For both intersections and roadways in most cases the PM peak has the highest volume.
- Roadways within the study area (bottom graph on **Figure 3**) have pronounced AM, midday and PM peaks.
- In general, volumes at intersections and on roadways bordering the study area gradually increase after the morning off-peak period, reaching their highest levels during the evening commute.

#### **D. Traffic Operations**

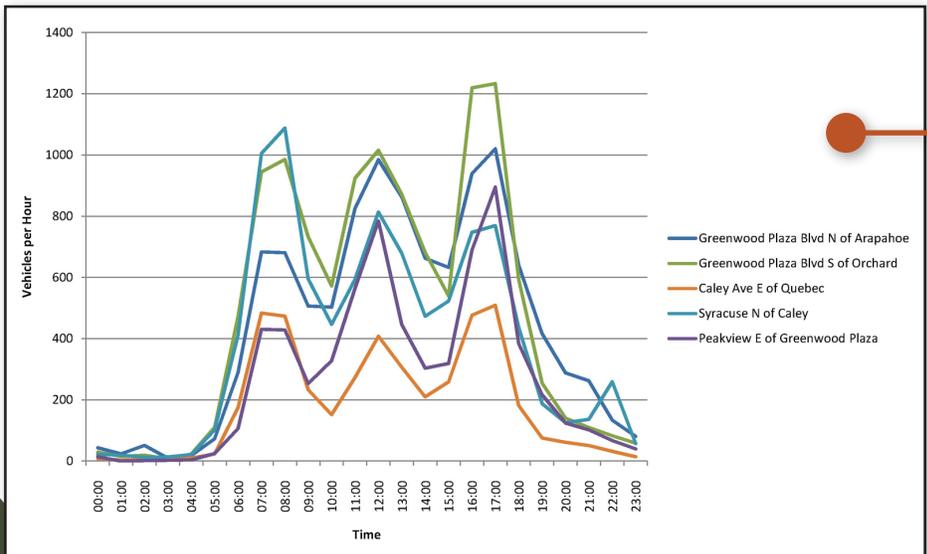
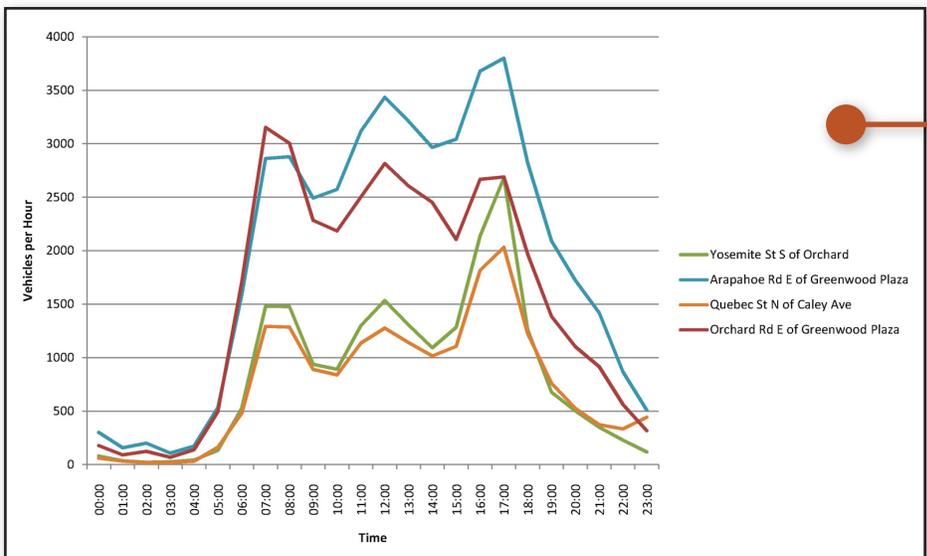
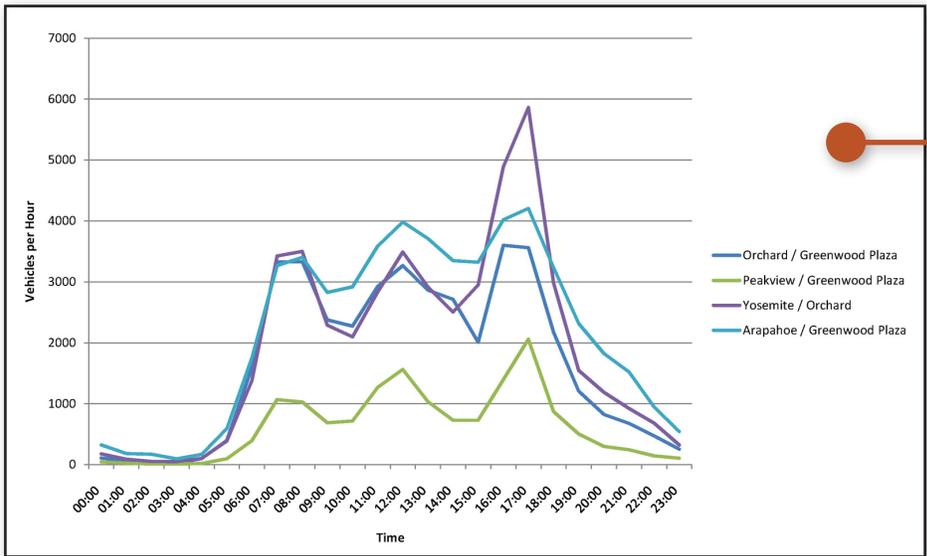
Traffic operations were evaluated at each of the study intersections by determining a level of service (LOS). Level of service is a measure of intersection operations ranging from LOS A to LOS F and is based on the average delay in seconds that a vehicle is anticipated to experience at an intersection. At signalized intersections, delay and resulting LOS represent averages for all vehicles traveling through the intersection. At unsignalized intersections, delay and LOS are measured for individual movements that are required to stop and wait for other traffic to clear before they can proceed through the intersection.

**Figure 4** gives a description for each level of service category and the range in average delay that defines each level of service category. As shown, LOS A describes minimal vehicle delay while LOS F describes heavy congestion and gridlock.

In traffic operational analyses of intersections, the target peak hour level of service is LOS D, which is generally used as the standard target for Greenwood Village. At each study intersection, the AM and PM peak hour levels of service were calculated with existing traffic volumes. Existing LOS, shown on **Figure 5**, assumes existing intersection geometry and signal timing.

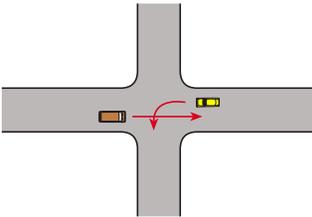
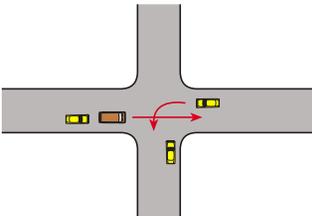
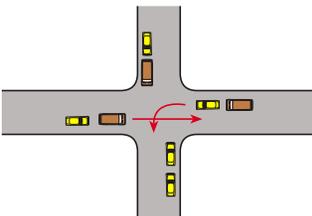
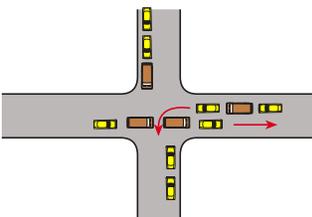
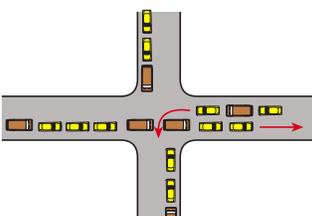
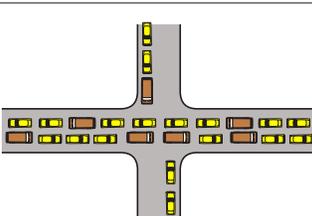
As shown, for 2010 conditions, three of the 25 intersections analyzed fall below the target LOS D for one or both peak hours. It should be noted that at a signalized intersection measured to operate at LOS D or better as a whole, there may be individual movements that experience greater delays and operate with poorer LOS. Intersections that currently have an overall peak hour LOS poorer than D include:

- Caley Avenue/Quebec Street (Centennial)
- Arapahoe Road/Yosemite Street
- Yosemite Street/Willow Drive (due to traffic movements from Willow Drive and Fair Avenue having stop-sign control)

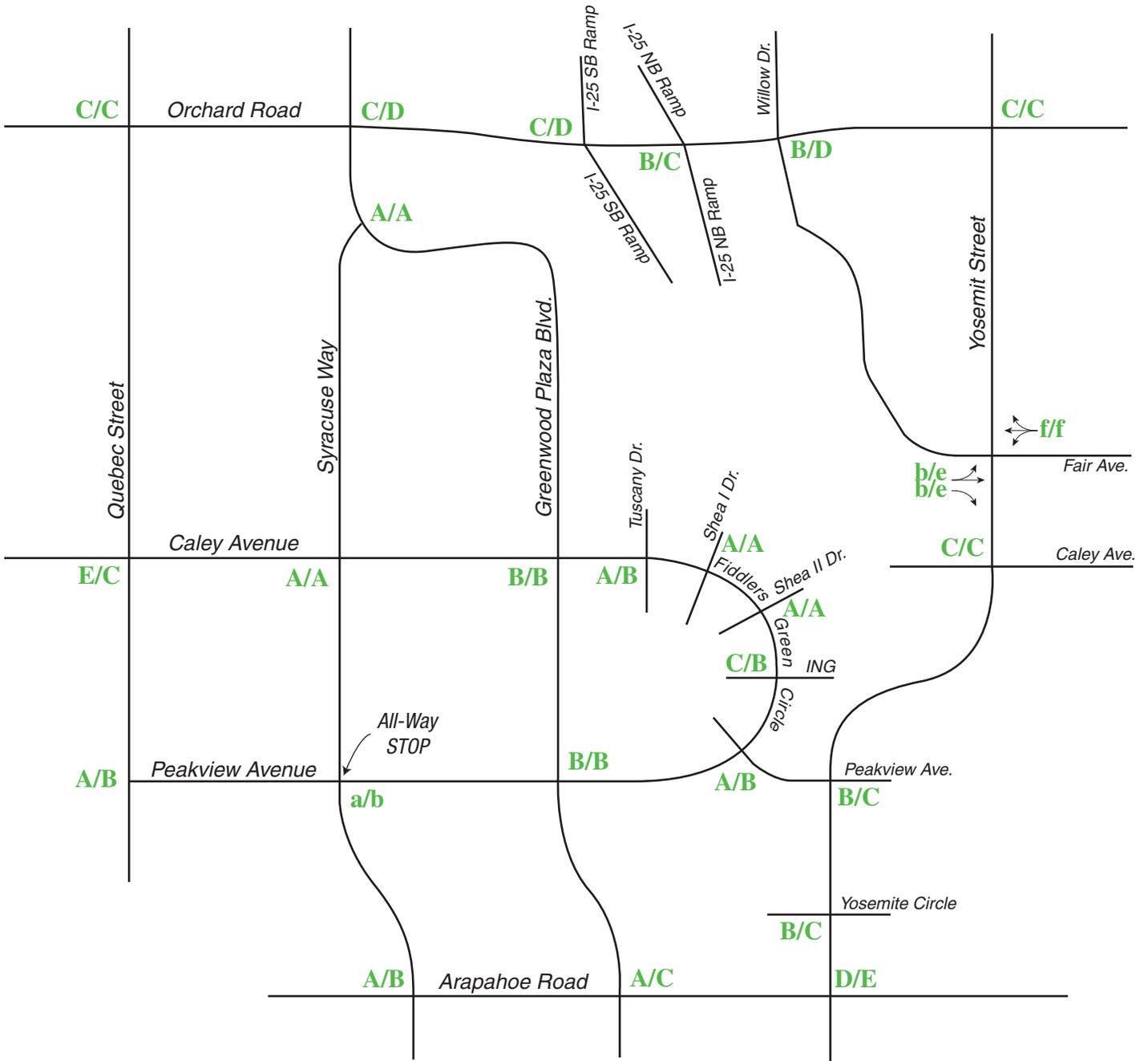


**Figure 3**  
Hourly Volumes

## Intersection Level of Service Based on Average Vehicle Seconds of Delay

DELAY DESCRIPTION	LEVEL of SERVICE	SECONDS of DELAY	
		Signalized	Unsignalized
Minimal or no vehicle delay.	 <b>A</b>	0-10	0-10
Slight delay to vehicles.	 <b>B</b>	>10-20	>10-15
Moderate vehicle delays, traffic flow remains stable.	 <b>C</b>	>20-35	>15-25
More extensive delays may occur at intersections.	 <b>D</b>	>35-55	>25-35
Long queues create lengthy delays.	 <b>E</b>	>55-80	>35-50
Severe delays and congestion "gridlock".	 <b>F</b>	>80	>50

**Figure 4**  
Characteristics of Intersection Level of Service (LOS)



**LEGEND**

- X/X** = AM/PM Peak Hour Signalized Intersection Level of Service
- x/x** = AM/PM Peak Hour Unsignalized Intersection Level of Service

**Figure 5**  
Existing Intersection Level of Service

**NORTH**



### III. TRAFFIC FORECASTING METHODOLOGY

The Denver Regional Council of Governments (DRCOG) regional travel forecasting model was used as the basis for development of year 2035 traffic forecasts for the study area. The regional model was refined to provide additional focus in the south I-25 corridor planning area and to reflect Greenwood Village's most current development expectations. **Figure 6** illustrates the principal steps in the traffic forecasting process for this analysis. Key model refinements and methods to use model output to develop forecasted peak hour intersection turning movements are described below.

#### A. Model Refinements

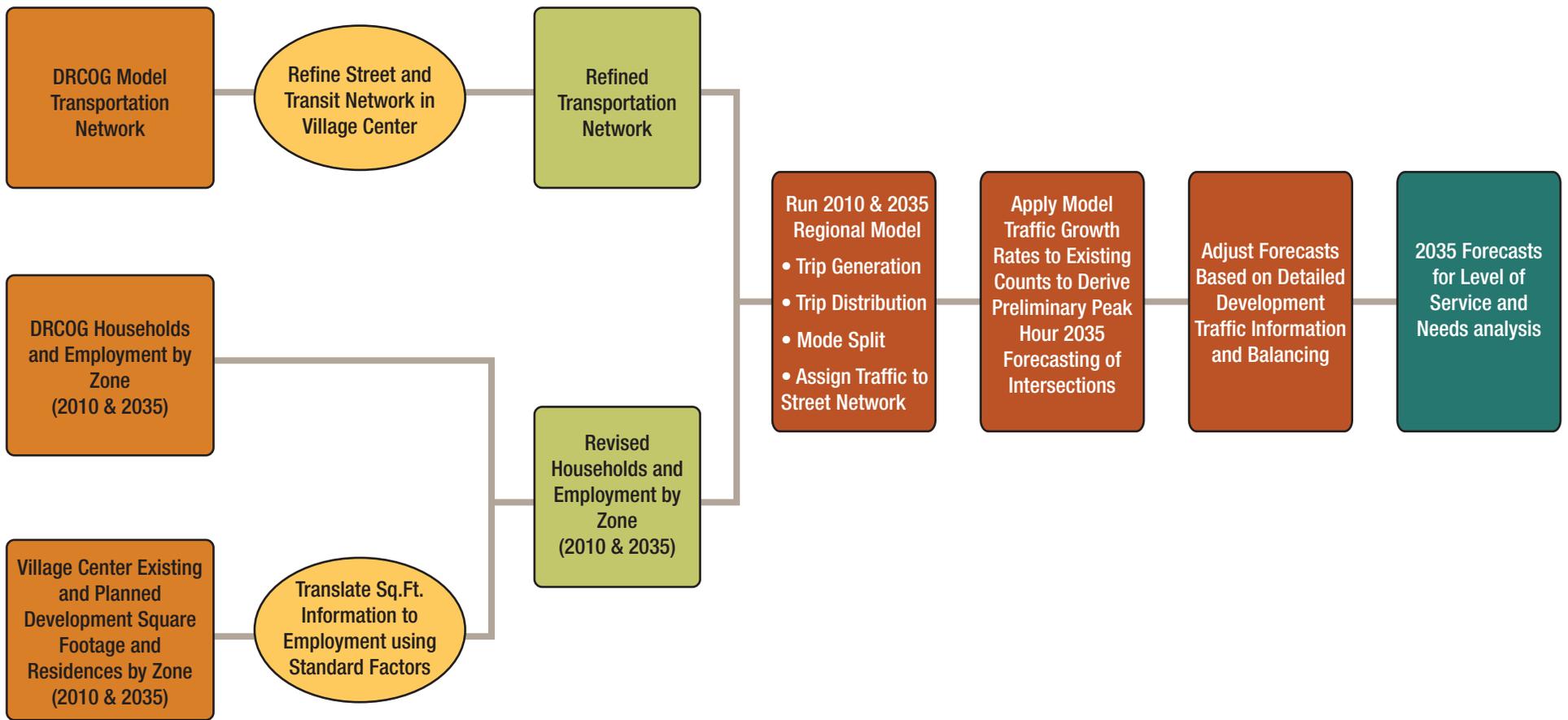
Refinements to the DRCOG regional model to improve the focus on the study area included:

- The transportation analysis zone (TAZ) system was refined by splitting two study area TAZs, as shown on **Figure 7**.
- Added several minor arterial and collector level street and street sections that are not in the regional model, including Greenwood Plaza Boulevard, Syracuse Way, Peakview Avenue, Caley Avenue, Fiddler's Green Circle and Willow Street.
- Refined the RTD bus system to better reflect actual routing to the Arapahoe Light Rail Station and to the Arapahoe park-n-Ride.

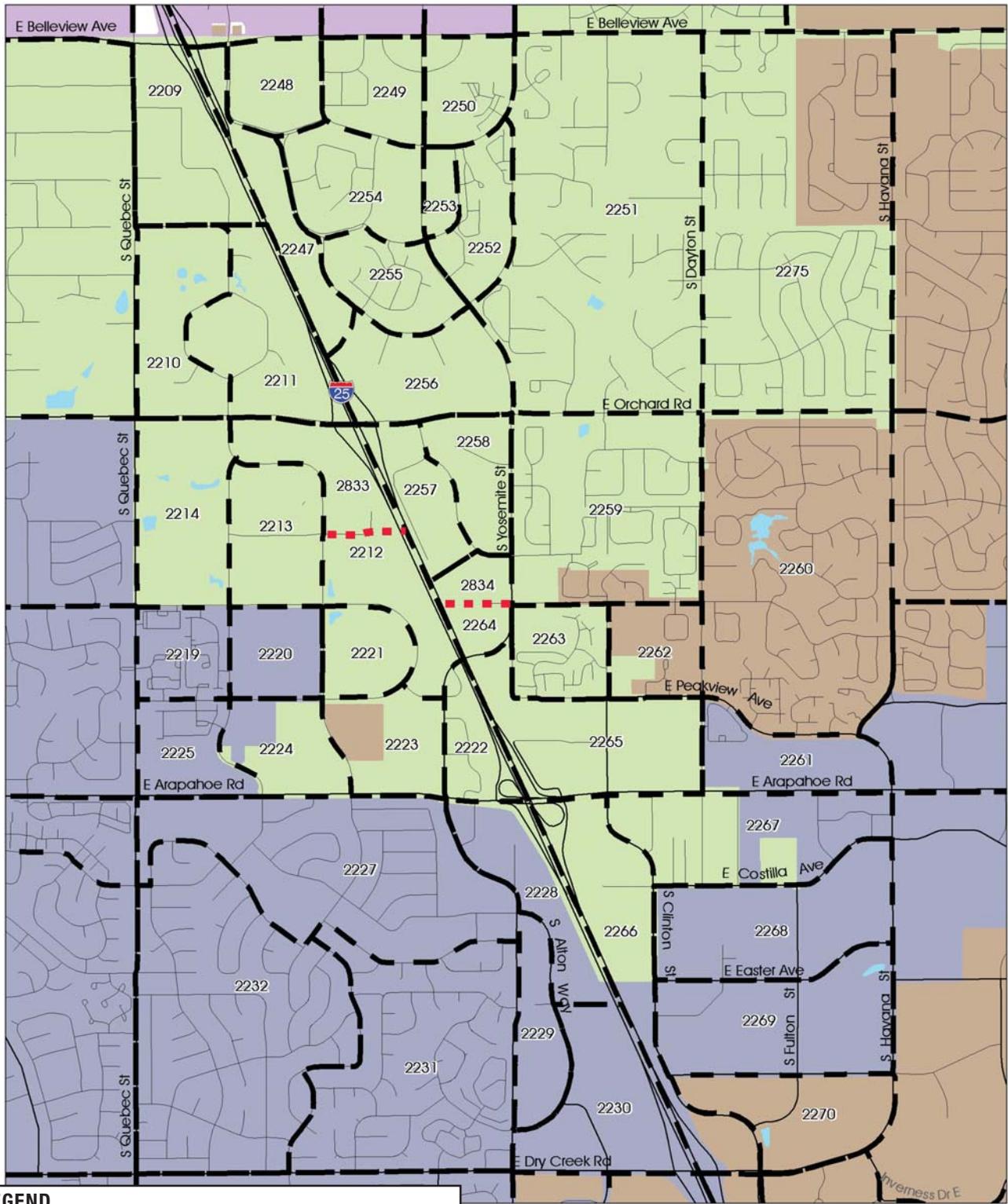
#### B. Development Forecasts

DRCOG household and employment data for study area TAZs were updated for the 2010 base year model and the 2035 forecast model. Existing (2010) land use and anticipated development information was assembled by Greenwood Village staff based on current development plans and assumed additional development based on build-out of the area according to existing zoning.

**Table 1** shows the anticipated new development in study area TAZs. Employment data required as input to the model was developed from the building area projections based on typical employment density factors.



**Figure 6**  
Traffic Forecasting Process



**LEGEND**

TAZ Boundaries	Denver
TAZ Splits	Greenwood Village
Centennial	Arapahoe County

**Figure 7**  
Transportation Analysis Zones

**NORTH**



**Table 1. Anticipated New Development within the Study Area**

Transportation Analysis Zone (TAZ)	Anticipated New Development (2010 through 2035)
2212	Planning Area B Entitlements – 896,287 SF ING Plaza Tower Phase II – 350,509 SF Palomar Hotel – 169,491 SF
2213	Greenwood Corporate Plaza – 75,000 SF
2220 (Centennial)	Prime Tech I and II – 939,589 SF Prime Tech Retail – 14,600 SF
2221	Planning Area A Entitlements – 1,044,150 SF Plus Request for Additional – 200,000 SF
2223	Reduced Planning Area C – 100,000 SF High Pointe Phase II – 131,075 SF
2224 (partially in Centennial)	Peakview Heights – 458,056 SF Peakview Heights Homes – 400 dwelling units Greenwood Village Vacant Parcel – 6,000 SF retail
2264	Greenwood Village Vacant Parcel – 138,520 SF at 1.2 FAR
2834	Orchard Valley Entitlements – 721,600 SF

**Table 2** provides a summary of adjusted 2010 and 2035 household and employment data for the south I-25 corridor planning area. As shown, the number of households is forecast to grow by 61 percent between 2010 and 2035 in the study area. Employment is forecast to increase by 83 percent to nearly 34,000 in 2035. Detailed tables providing households by TAZ and employment by TAZ and by employment category are provided in **Appendix B**.

**Table 2. Household and Employment Forecasts for the Study Area**

	2010	2035	2010 – 2035 Growth Percent
Households	995	1,595	61%
Employment	18,499	33,773	83%

**C. Process to Develop Forecasts**

The refined model was run for the base year 2010 and for 2035. Several steps were needed to translate model-generated forecasts into 2035 peak hour intersection turning movement forecasts used as the basis for study area analysis:

- Collect existing peak hour traffic count data at all study area intersections
- Check historic traffic counts to incorporate pre-recession traffic levels as appropriate
- Compare 2010 and 2035 model results to develop traffic growth rates at each intersection

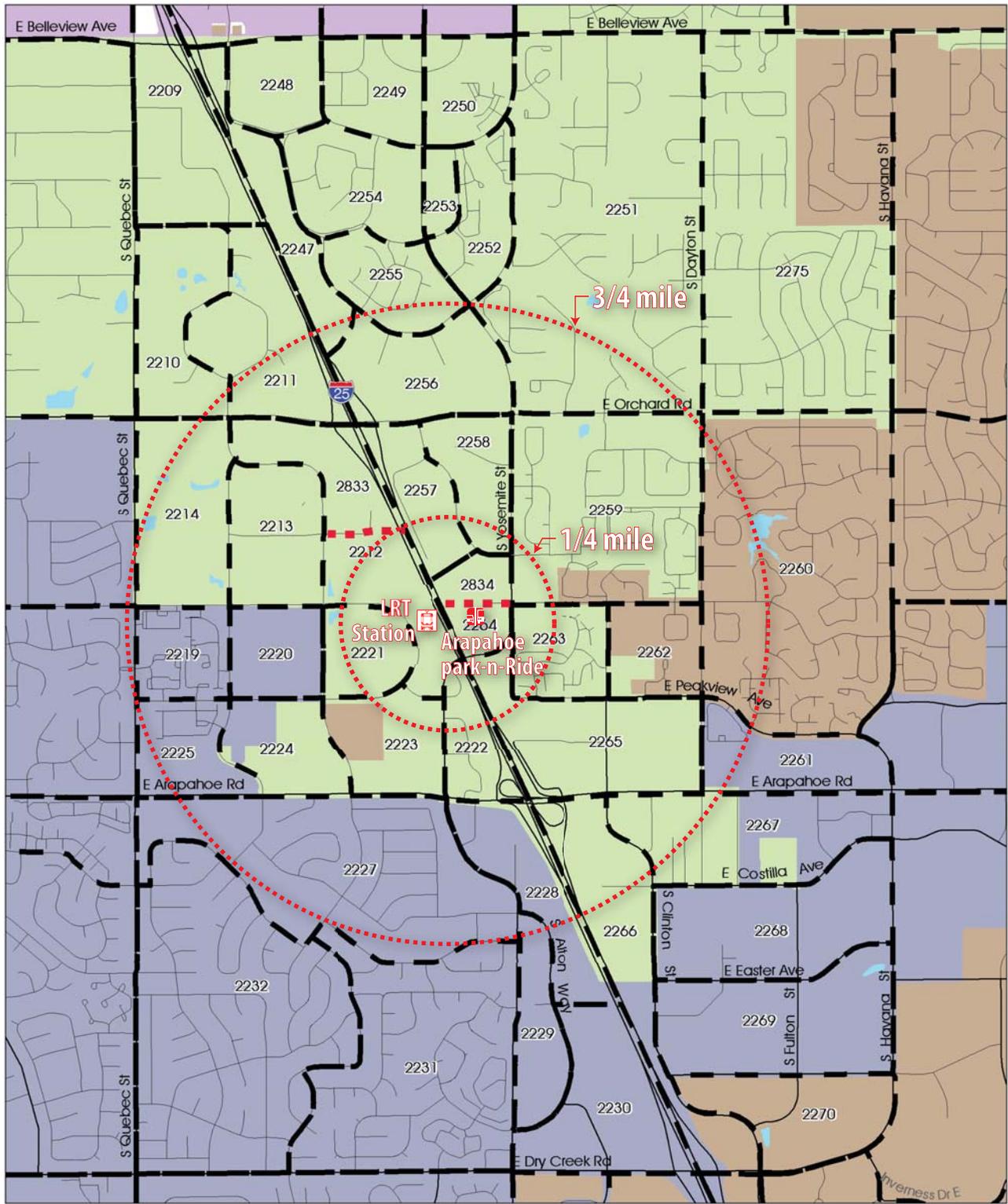
- Apply growth rates to existing peak hour traffic counts and used a balancing procedure to develop preliminary 2035 peak hour projections
- Adjust preliminary projections by:
  - Checking preliminary projections against existing counts
  - Reviewing individual area development traffic impact analyses (TIAs) and incorporating detailed driveway and local street intersection projections
  - Adjusting forecasts based on detailed development traffic information and balancing

#### **D. Transit Mode Split**

The traffic forecasting model's projections of proportions of travel to and from study area TAZs were reviewed to determine whether any adjustments were needed to ensure reasonableness of the mode split. As illustrated on **Figure 8**, the following proportions of trips were projected by the model to use transit:

- TAZs within approximately a quarter mile of station:
  - 6 to 8 percent transit for all trips
  - 10 to 12 percent transit for commuter trips
- TAZs approximately a quarter mile to three-quarters of a mile from the station:
  - 4 to 6 percent transit for all trips
  - 6 to 8 percent transit for commuter trips

Based on the reasonableness of these splits, adjustments were *not* made to the transit mode split from the model.



**Percent of trips by transit in 2035 per forecasting model -**

- within 1/4 mile: 6-8% of all trips  
10-12% of commuter trips
  
- 1/4 to 3/4 miles: 4-6% of all trips  
6-8% of commuter trips

**Figure 8**  
Transit Service Area Shares



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## IV. 2035 TRAFFIC CONDITIONS

### A. Traffic Volumes

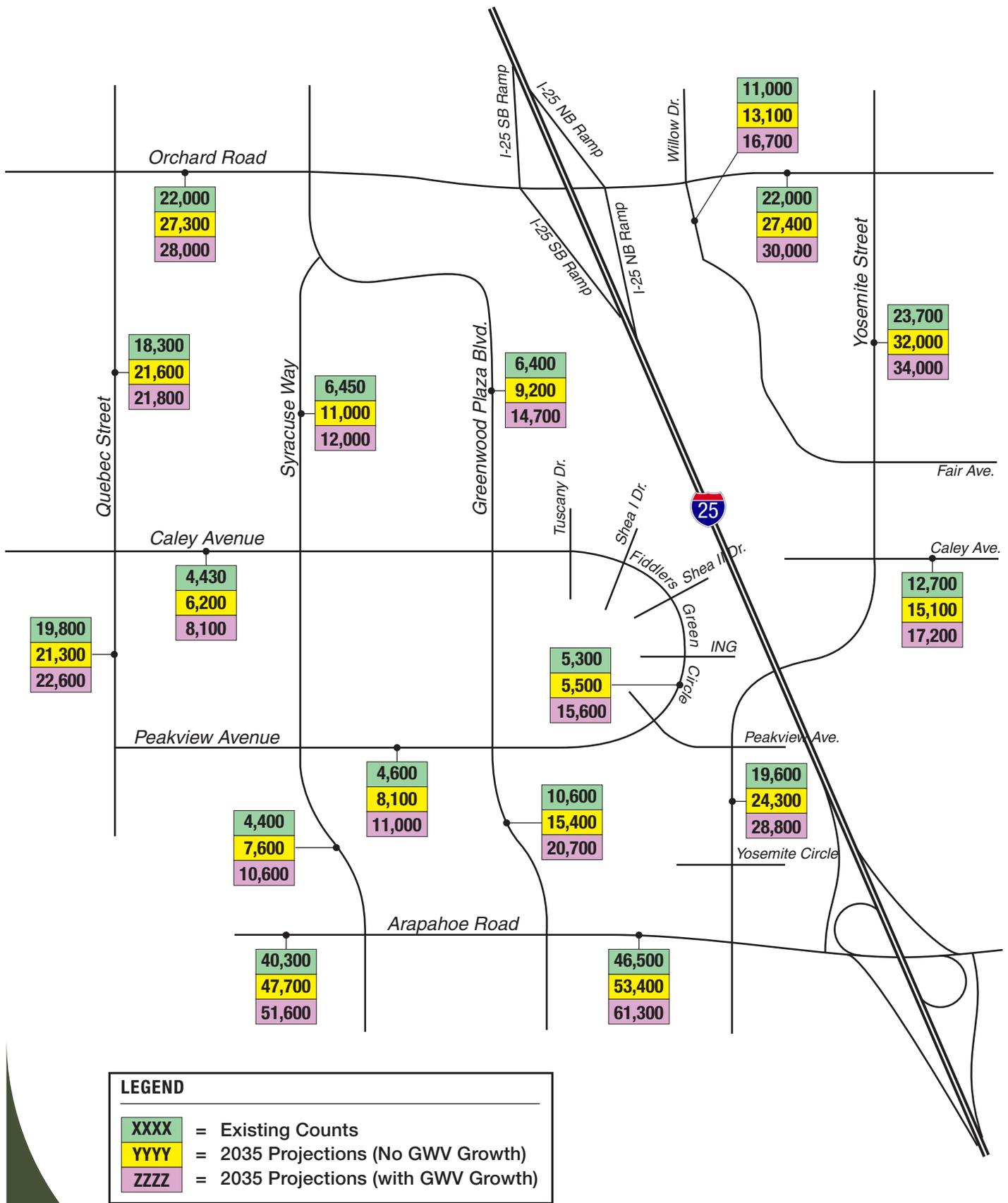
Using the forecasting process described in the previous section, two sets of 2035 daily and peak hour turning movement traffic volumes were projected along roadways and at each of the study intersections. These sets of 2035 projections represent the following future conditions:

- **Greenwood Village No Growth Scenario:** This set of 2035 projections assumes 2010 land use quantities for Greenwood Village and 2035 land use projections for the rest of the metropolitan area. The purpose in developing these projections with no growth in Greenwood Village is to assess the effects on study area streets of regional growth versus growth in Greenwood Village. The peak hour turning movement projections for this scenario are included in **Figure A2** of **Appendix A**.
- **Greenwood Village Growth Scenario:** This set of 2035 projections assumed 2035 Greenwood Village land use projections presented in the previous section and 2035 land use projections for the rest of the metropolitan area. The purpose of these projections was to identify potential roadway and intersection improvements needed to accommodate traffic associated with forecasted growth in Greenwood Village and the entire region. The peak hour turning movement projections for this scenario are included in **Figure A3** of **Appendix A**.

Existing daily traffic volumes and forecasts for the two scenarios described above are shown on **Figure 9. Table 3** provides a summary of daily traffic volume growth projections on study area roadways with these two scenarios. Analysis of forecasts led to the following key observations:

- On the major roads on the periphery of the study area, including Quebec Street, Orchard Road, Yosemite Street and Arapahoe Road, daily volumes were projected to increase by 5% to 35% in the Greenwood Village No Growth scenario and 10% to 55% in the Greenwood Village Growth scenario.
- Interior study area streets generally show higher percentage increases. In the Greenwood Village No Growth scenario daily traffic volumes were forecasted to grow by 15% to 75%, while in the Growth scenario the projected increases were between 35% and 140%.
- These comparisons show that generally a majority of the projected traffic growth on the major perimeter roads is attributable to regional growth and development, while a majority of the projected traffic growth on the interior study area streets is attributable to development in the study area or other parts of Greenwood Village.

Existing and 2035 peak hour turning movement projections are included in **Appendix A**.



**Figure 9**  
Daily Traffic Volume Comparison

**NORTH**

**Table 3. Forecasted Daily Traffic Growth Ranges**

Study Area Roadway	Projected Daily Traffic Volume Increases	
	2035 – No Greenwood Village Growth	2035 – With Greenwood Village Growth
<i>Peripheral Study Area Streets</i>		
Orchard Road	15-25%	25-55%
Yosemite Street	20-35%	40-50%
Arapahoe Road	15-20%	25-35%
Quebec Street	5-20%	10-20%
<i>Interior Study Area Streets</i>		
Caley Avenue	15-40%	35-85%
Peakview Avenue	75%	140%
Syracuse Way	70-75%	85-140%
Greenwood Boulevard	40-45%	95-130%
Willow Drive	20%	50%

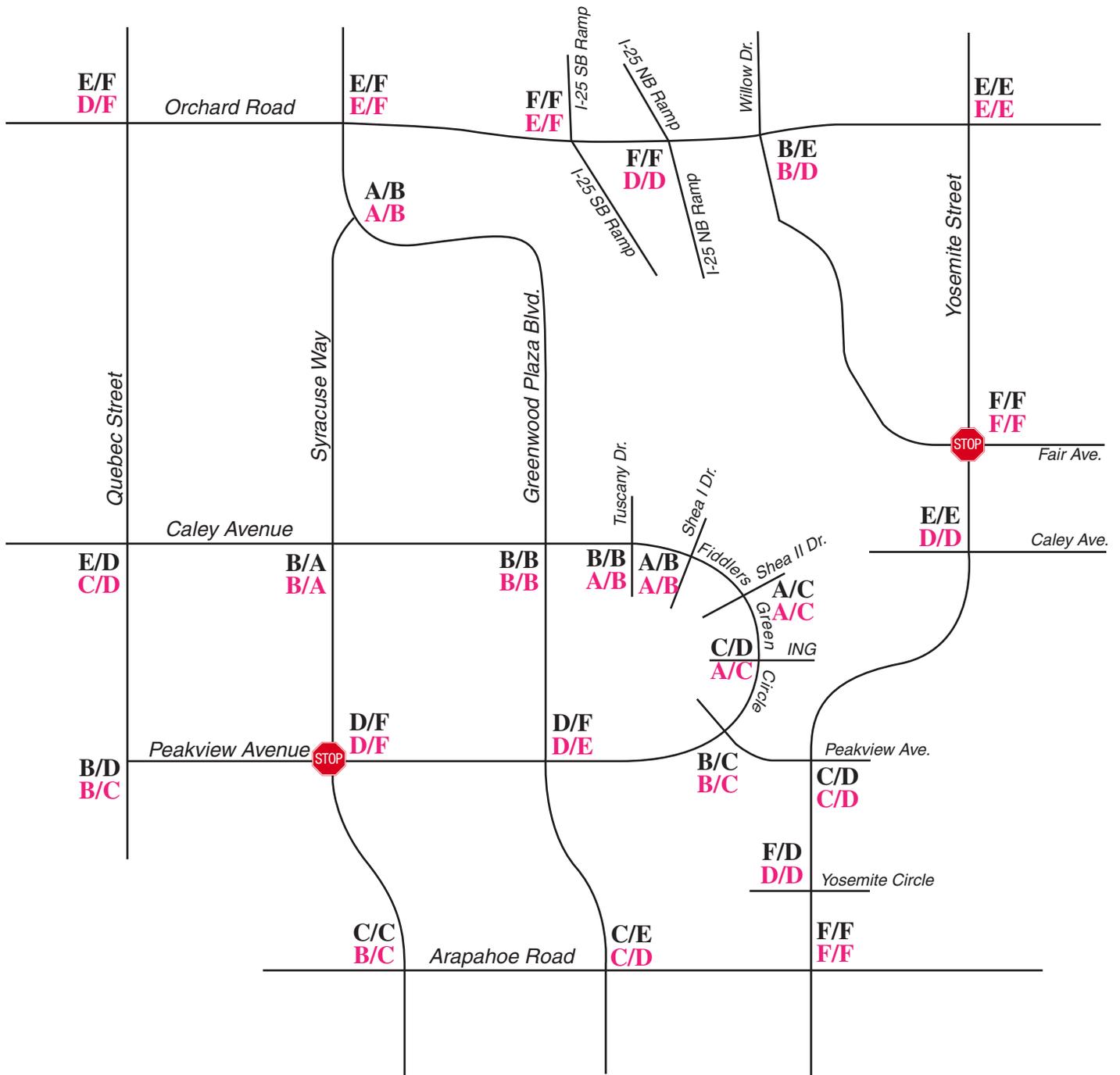
**B. Traffic Operations**

At each study intersection, the AM and PM peak hour levels of service were calculated with 2035 projected traffic volumes, including Greenwood Village growth. **Figure 10** shows the 2035 level of service for each study intersection for two scenarios. The no improvement scenario uses existing intersection geometry and signal timing. The signal timing only scenario uses existing intersection geometry with signal timing optimized for projected traffic conditions.

As shown in **Figure 10**, a total of 14 intersections are projected to fall below the target LOS D for one or both peak hours, including the three with current deficiencies plus the following:

- Orchard Road intersections with Quebec Street, Greenwood Village Boulevard, the southbound I-25 ramps, northbound I-25 ramps, Willow Drive and Yosemite Street. It is Council policy not to improve the LOS at the Orchard Road intersections with Quebec Street and with Yosemite Street.
- Arapahoe Road/Greenwood Plaza Boulevard
- Peakview Avenue/Greenwood Plaza Boulevard
- Caley Avenue/Yosemite Street
- Yosemite Street/Yosemite Circle
- The unsignalized Peakview Avenue/Syracuse Way intersection (Centennial)

Optimizing the signal timing improves the level of service at many intersections. Of the 14 intersections that were projected to fall below the target LOS D, six intersections would improve to LOS D or better with adjustments to the signal timing. The remaining eight intersections with LOS deficiencies are as follows:



LEGEND	
X/X	No Action Intersection Level of Service
X/X	Level of Service with Optimized Signal Timing
	Intersection with Stop Sign Control

**Figure 10**  
2035 Intersection Level of Service -  
with No Improvements and with Optimized Signal Timing

- Orchard Road intersections with Quebec Street, Greenwood Village Boulevard, the southbound I-25 ramps and Yosemite Street.
- Peakview Avenue/Greenwood Plaza Boulevard
- The unsignalized Peakview Avenue/Syracuse Way intersection (Centennial)
- Arapahoe Road/Yosemite Street
- Yosemite Street/Willow Drive (due to traffic movements from Willow Drive and Fair Avenue having stop-sign control)

**C. Average Speed and Travel Time**

For the study area roadways an analysis was conducted to determine the average speed and the anticipated travel time through the south I-25 corridor planning area. The average speed and travel time includes the delay experienced at signalized intersections. These estimates assume the improvements described later in this report as being implementable improvements (see **Figure 12**). As shown in **Table 4**, the average speed ranges between 15-20 mph. The travel time north-south from Arapahoe to Orchard was three to five minutes and east-west from Fiddlers Green Circle to Quebec was one to two minutes.

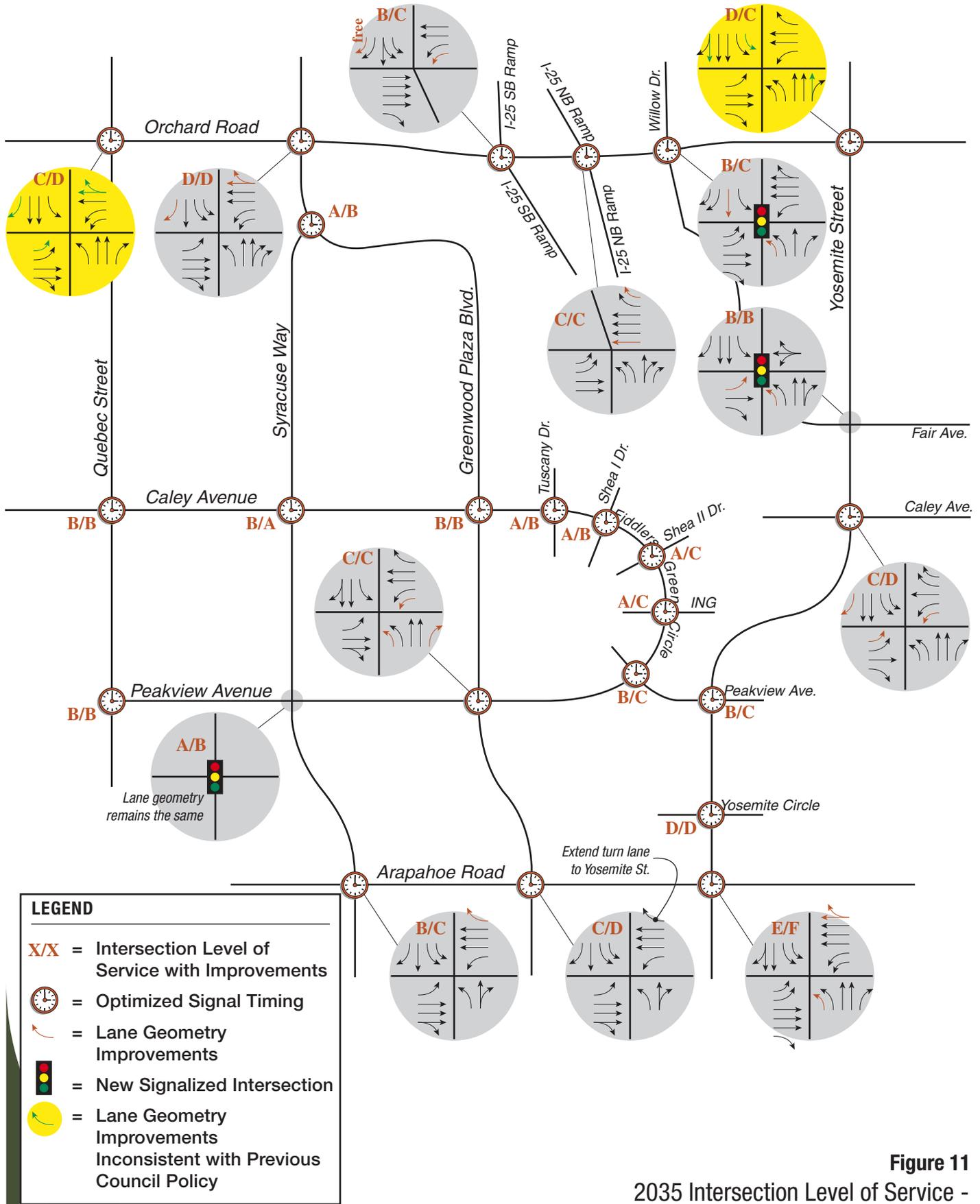
**Table 4. Average Speed and Travel Time for Study Area Roads**

Roadway	Average Speed	Travel Time
Peakview Ave (Fiddlers Green Cir. to Quebec St.)	15 mph	2 minutes
Caley Ave. (Fiddlers Green Cir. to Quebec St.)	20 mph	Less than 2 minutes
Syracuse Ave. (Arapahoe Rd to Orchard Rd.)	20 mph	3 minutes
Greenwood Plaza Blvd. (Arapahoe Rd. to Orchard Rd.)	17 mph	4-5 minutes

**D. Intersection Improvements**

For all of the intersections that would have projected LOS worse than LOS D, potential improvements were identified to reach projected LOS D or better. Additional improvements were identified to address future traffic flow and queuing issues that may or may not address a particular level of service issue. These potential improvements are described on **Table 5** and depicted on **Figure 11**. Both the table and the figure show how suggested improvements change the level of service while **Table 5** shows the change in average vehicle delay as a result of the improvement. In general, the potential improvements include:

- signalization of unsignalized intersections
- optimized signal timing if potential improvement changes intersection geometry
- additional turn or through lanes at intersections
- additional storage capacity for turn lanes



**Figure 11**  
2035 Intersection Level of Service -  
with Potential Improvements

**NORTH**

**Table 5. Potential Physical Intersection Improvements with LOS and Average Delay**

Intersection	Potential Improvements Based on Peak Hour Forecasts	Level of Service (AM/PM) Delay in sec./veh. (AM/PM)			
		Existing 2010	2035 No Improvements	2035 Signal Optimization	2035 With Improvements
Arapahoe & Greenwood Plaza	Extend westbound right turn lane to Yosemite Street	A/C	C/E	C/D	C/D
	Increase storage for southbound left turn lanes	7/25	27/68	24/51	24/51
Arapahoe & Syracuse	Provide westbound right-turn lane	A/B	C/C	B/C	B/C
	Increase southbound left-turn lane storage	11/15	25/27	17/25	15/25
Arapahoe & Yosemite	Provide northbound dual left turn lanes	D/E	F/F	F/F	E/F
	Convert westbound right-turn lane to a shared westbound thru/right lane and extend lane to Greenwood Plaza Blvd.	53/78	127/177	93/165	77/135
Quebec & Peakview <i>(City of Centennial)</i>	No physical intersection improvements necessary	A/B	B/D	B/C	B/B
		7/17	10/41	11/25	11/18
Quebec & Caley <i>(City of Centennial)</i>	Elimination of split phasing; may require lane realignment	E/C	E/D	C/D	B/C
		56/34	60/44	27/37	14/20
Quebec & Orchard	Provide westbound through lane.	C/C 33/33	E/F 57/93	D/F 37/80	C/D 25/43
	Provide eastbound dual left-turn lanes				
	Provide southbound right-turn lane.				
	Although these improvements are needed for intersection capacity, they are <i>inconsistent with previous Council policy with respect to Orchard Road west of Quebec Street</i>				
Syracuse & Peakview <i>(City of Centennial)</i>	Signalize the intersection	A/B (Stop Sign Control)	D/F (Stop Sign Control)	D/F (Stop Sign Control)	A/B 9/14
Greenwood Plaza & Peakview	Provide northbound dual left turn lanes and lengthen storage bay	B/B 18/18	D/F 40/98	D/E 38/61	C/C 28/33
	Provide northbound right-turn lane.				
	Provide westbound dual left turn lanes				

Intersection	Potential Improvements Based on Peak Hour Forecasts	Level of Service (AM/PM) Delay in sec./veh. (AM/PM)			
		Existing 2010	2035 No Improvements	2035 Signal Optimization	2035 With Improvements
Greenwood Plaza & Caley	No physical intersection improvements necessary	B/B 15/13	B/B 18/17	B/B 18/17	B/B 18/17
Greenwood Plaza & Syracuse	No physical intersection improvements necessary	A/A 6/9	A/B 10/11	A/B 9/11	A/B 9/11
Peakview & Fiddler's Green	No physical intersection improvements necessary	A/B 8/15	B/C 20/25	B/C 20/25	B/C 20/25
Yosemite & Yosemite Circle	No physical intersection improvements necessary	B/C 13/21	<b>F/D</b> <b>76/49</b>	D/D 53/50	D/D 41/52
Orchard & Yosemite/DTC	Provide additional northbound and southbound lanes on Yosemite. The northbound lane would begin south of Orchard and end at a logical point north of Orchard. The southbound lane would begin at a logical point north of Orchard and end as a right-turn lane at Caley.	C/C 32/32	<b>E/E</b> <b>70/74</b>	<b>E/E</b> <b>69/76</b>	D/C 39/34
	Provide southbound dual left turn lanes				
	Although these improvements are needed for intersection capacity, <i>they are inconsistent with previous Council policy with respect to Yosemite Street south of Orchard Road.</i>				
Orchard & Greenwood Plaza	Increase storage for westbound left turn lanes	C/D 32/48	<b>E/F</b> <b>79/108</b>	<b>E/F</b> <b>74/107</b>	D/D 42/54
	Add westbound through lane				
	Convert northbound right turn movement to a free right turn movement. This would require adding an eastbound lane on Orchard beginning at Greenwood Plaza Blvd. and ending at the southbound ramp intersection at the I-25 interchange. This would improve corridor operations but is not required to achieve LOS D.				
	Provide southbound right turn lane				

Intersection	Potential Improvements Based on Peak Hour Forecasts	Level of Service (AM/PM) Delay in sec./veh. (AM/PM)			
		Existing 2010	2035 No Improvements	2035 Signal Optimization	2035 With Improvements
Orchard & I-25 NB Ramps	Add a second westbound right turn lane	B/C 18/30	<b>F/F</b> <b>89/103</b>	D/D 42/54	C/C 23/34
	Extend the proposed additional left turn lane at the southbound ramp terminal through the intersection				
Orchard & I-25 SB Ramps	Provide westbound dual left turn lanes. This additional left turn lane would extend through the northbound ramp terminal.	C/D 31/39	<b>F/F</b> <b>118/84</b>	<b>E/F</b> <b>73/86</b>	B/C 15/28
	Provide a southbound free right turn lane with added westbound lane on Orchard				
	Lengthen eastbound left-turn storage bays				
Orchard & Willow	Eliminate split phasing	B/D 10/42	<b>B/E</b> <b>19/63</b>	<b>B/D</b> <b>19/52</b>	B/C 19/22
	Widen northbound approach to create exclusive dual left turn lanes				
	Restripe southbound approach to create a single left and a single thru lane				
Fiddler's Green & ING drive	No physical intersection improvements necessary	C/B 26/17	C/D 33/44	A/C 7/28	A/C 7/28
Fiddler's Green & Shea I drive	No physical intersection improvements necessary	A/A 0/0	A/B 6/11	A/B 6/11	A/B 6/11
Fiddler's Green & Shea II drive	No physical intersection improvements necessary	A/A 0/0	A/C 7/21	A/C 6/21	A/C 6/21
Fiddler's Green & Tuscany drive	No physical intersection improvements necessary	A/B 2/12	B/B 12/16	A/B 4/12	A/B 4/12
Syracuse & Caley	No physical intersection improvements necessary	A/A 8/7	B/A 11/9	B/A 11/9	B/A 11/9
Yosemite & Caley	Provide westbound and eastbound dual left turn lanes	C/C 29/25	<b>E/E</b> <b>78/65</b>	D/D 45/48	C/D 30/43
	Provide southbound right turn lane.				
Yosemite & Peakview	No physical intersection improvements necessary	B/C 11/29	C/D 22/45	C/D 22/38	B/C 15/33

Intersection	Potential Improvements Based on Peak Hour Forecasts	Level of Service (AM/PM) Delay in sec./veh. (AM/PM)			
		Existing 2010	2035 No Improvements	2035 Signal Optimization	2035 With Improvements
Yosemite & Willow/Fair	Signalize intersection	F/F (stop-sign control on Willow)	F/F (stop-sign control on Willow)	F/F (stop-sign control on Willow)	B/B 14/19
	Widen eastbound approach to provide separate left, through and right turn lanes				
	Provide northbound dual left turn lanes				

*Note: All improvements described in the table were necessary to improve operations at the study intersections to achieve target LOS and traffic operation or safety. Feasibility analysis has not been conducted to determine whether these improvements could be reasonably implemented.*

As mentioned, some geometry improvements are recommended even though an acceptable level of service is possible without an improvement or with just optimizing the signal timing. One example is at the Arapahoe Road/Syracuse Way intersection, where although acceptable overall LOS C was calculated without improvements, the forecasted westbound right-turning volume warrants construction of a separate turn lane to enhance safety and operations. Similarly at the Arapahoe Road/Greenwood Village Boulevard intersection, signal timing optimization would improve operations to an acceptable LOS D but extending the westbound right turn lane to Yosemite Street and increasing storage for the southbound left turns are recommended to improve operations and safety.

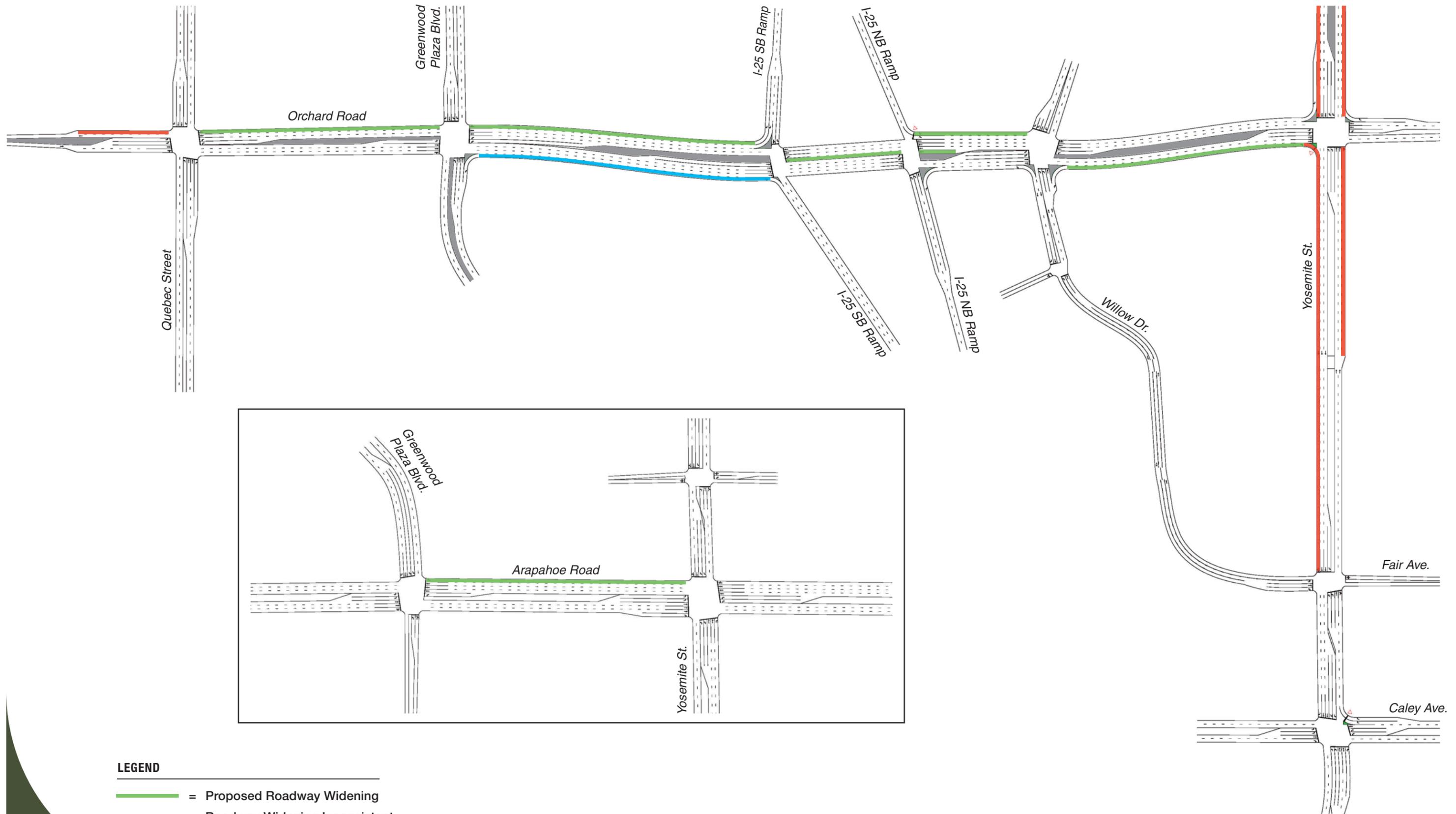
**Figure 11** shows potential improvements at intersections but does not show that in order to implement some of these improvements it would require widening adjacent roadways. For example, to implement a second southbound free right-turn lane on the southbound I-25 off-ramp Orchard Road needs an additional lane westbound from the off-ramp to the Greenwood Plaza Boulevard intersection. Therefore, **Figure 12** shows the locations where roadway widening is needed to implement the intersection improvements depicted in **Figure 11**.

**Figure 12** shows widening of eastbound Orchard Road from Greenwood Plaza Boulevard to I-25. This potential improvement although not required to achieve a LOS D at the Orchard Road / Greenwood Plaza Boulevard intersection but would reduce queuing on northbound Greenwood Plaza Boulevard and improve lane utilization along Orchard Road. The Arapahoe Road widening is an extension of the westbound right-turn lane at Greenwood Plaza. This improvement would allow for an additional westbound through lane on Arapahoe Road at Yosemite if the existing right-turn lane is converted to a shared through/right lane.

**Figure 12** also shows portions of Orchard Road and Yosemite Street would need widening in the study area to implement the needed intersection lane additions. In some cases these improvements have been identified as not compatible with prior City Council direction. Four specific intersections should be noted for the challenges associated with maintaining LOS D with forecasted volumes:

- Orchard Road/Quebec Street – Improvements needed for intersection capacity are inconsistent with previous Council policy with respect to Orchard Road west of Quebec Street.
- Orchard Road/Yosemite Street – Improvements needed for intersection capacity are inconsistent with previous Council policy with respect to Yosemite Street south of Orchard Road and Orchard Road east of Yosemite Street.
- Orchard Road/I-25 Ramp Intersections – Improvements needed for intersection capacity would require extensive bridge reconstruction and right-of-way acquisition. Improvements would need to be part of a coordinated interchange reconstruction with the Colorado Department of Transportation.
- Arapahoe Road/Yosemite Street – Changes to achieve LOS D in 2035 were not identified in this study. Potential improvements are currently being explored through the I-25/Arapahoe Interchange Environmental Assessment.





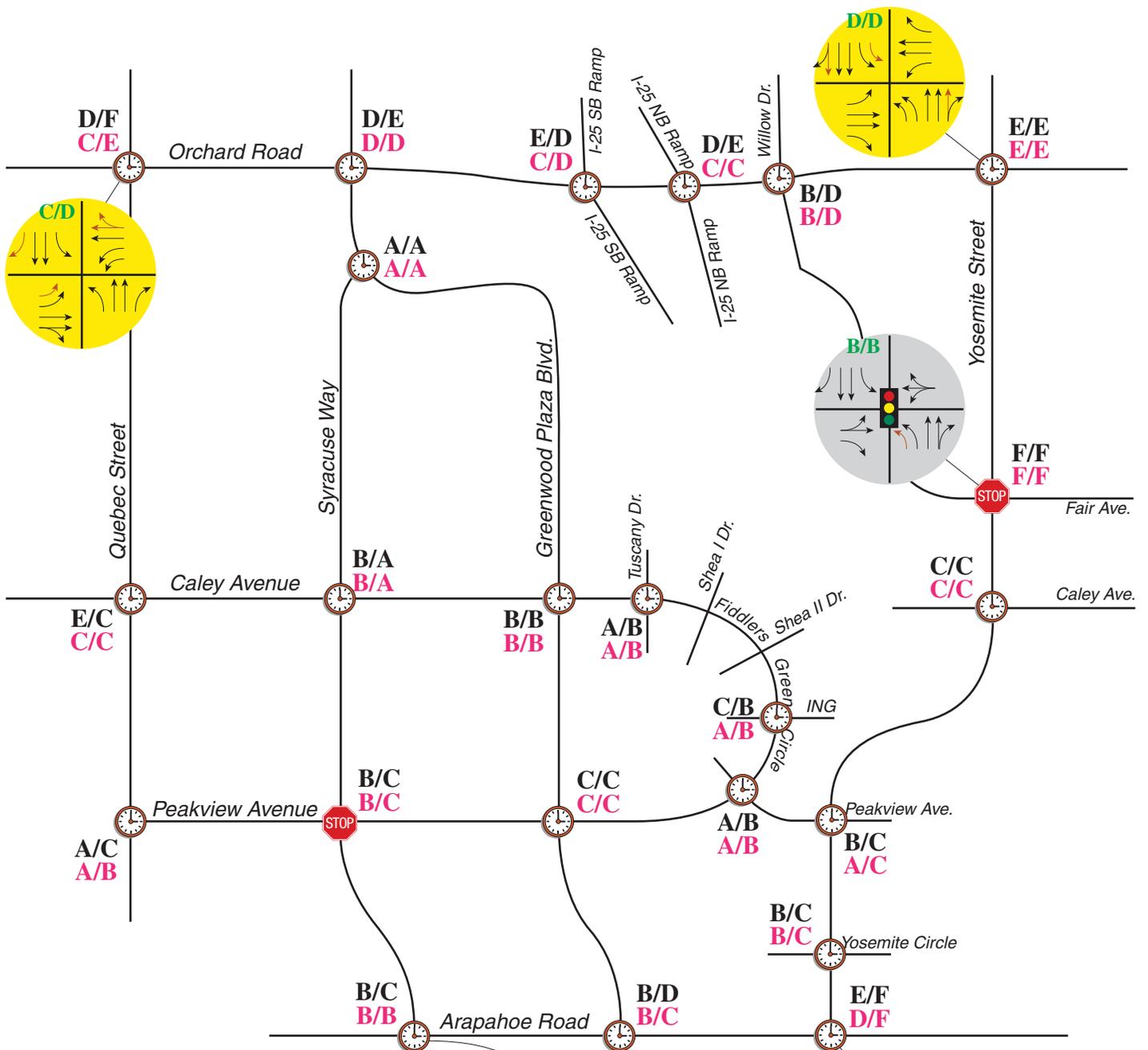
**LEGEND**

- = Proposed Roadway Widening
- = Roadway Widening Inconsistent with Previous Council Policy
- = Widening Beneficial but Not Required to Reach LOS D

**Figure 12**  
Potential Roadway Widening

**NORTH**





**LEGEND**

- X/X = No Action Intersection Level of Service
- X/X = Level of Service with Optimized Timing
- X/X = Intersection Level of Service with Improvements
- = Optimized Signal Timing
- = Lane Geometry Improvements
- = New Signalized Intersection
- = Intersection with Stop Sign Control
- = Lane Geometry Improvements Inconsistent with Previous Council Policy

**Figure 13**  
 2035 Intersection Level of Service -  
 with No Greenwood Village Growth

**E. Traffic Operations and Improvement Recommendations for No Greenwood Village Growth Scenario**

As mentioned the purpose of the No Greenwood Village Growth scenario is to assess the impact continuing growth in the metropolitan area has on Greenwood Village roadways. So, 2035 turning movement projections were developed and analyzed. **Figure 13** shows the operational analysis and the intersection improvement needs for the No Greenwood Village growth scenario.

The operational analysis of this no growth scenario included an analysis of traffic operations with existing geometry and signal timing. This analysis showed eight intersections operating with less than acceptable conditions. Optimizing the signal timing improved overall intersection operations to LOS D or better at four of these eight intersections leaving four intersections at deficient levels of service.

Compared to the Greenwood Village Growth Scenario, which had eight intersections with deficient levels of service, the “No Greenwood Village Growth Scenario” has only four intersections with deficient levels of service. These deficient intersections are along the periphery of the study area on roadways such as Orchard Road, Yosemite Street and Arapahoe Road. Unlike the growth scenario, there are no intersections on interior streets within the south I-25 corridor planning area that have deficient levels of service. As previously mentioned some intersection improvements are recommended even though the target LOS could be achieved without physical improvements. However, because of turning vehicle volumes intersection improvements may be recommended to improve operations or safety.

**Figure 13** shows improvements needed under the no growth scenario to achieve at least a LOS D at the deficient intersections. The identified improvements at these intersections are nearly identical to those identified in the Greenwood Village growth scenario. This suggests that needed improvements along Arapahoe Road, Orchard Road and Yosemite Street are more driven by regional traffic growth than new development within the south I-25 corridor planning area.

**F. Cost and Right-of-Way Impacts**

**Table 6** provides an assessment of the right-of-way and cost impacts of the recommended improvements identified by this study. Impacts were not specifically quantified but were categorized by the anticipated impact of an improvement. Right-of-way impacts were evaluated using right-of-way lines overlaid on an aerial photograph and were defined as follows:

- Low: no new right-of-way needed
- Medium: right-of-way needs would impact landscape areas only
- High: right-of-way needs would impact parking areas, buildings or major drainage facilities

Cost impacts were evaluated by a range of cost. These ranges were defined as follows:

- Low: Less than \$100,000. Typically this would include signing, striping and some minor widening.
- Medium: Between \$100,000 and \$500,000. Typically this would include new traffic signals and turn lanes.
- High: Over \$500,000. Typically this would include items such as new travel lanes between intersections and new bridges.

**Table 6. Right-of-Way and Cost Impacts of Potential Improvements**

Intersection	Recommended Potential Improvements	Right-of-Way	Cost	Notes
Arapahoe & Greenwood Plaza	Extend westbound right-turn lane to Yosemite Street	Medium	Medium	
	Increase storage for southbound left-turn lanes	Medium	Low	Widen into median; could impact access
Arapahoe & Syracuse	Provide westbound right-turn lane	Low	Low	
	Increase southbound left-turn lane storage	Low	Low	Restriping. Could impact access
Arapahoe & Yosemite	Provide northbound dual left turn lanes	Medium	Medium	Likely impact both sides of Yosemite
	Convert westbound right-turn lane to a shared westbound thru/right lane	Low	Medium	Extend to Greenwood Plaza Blvd.
Quebec & Caley ( <i>City of Centennial</i> )	Explore the elimination of split phasing.	Low	Low	
Quebec & Orchard	Provide westbound through lane.	Medium	High	Project inconsistent with previous Council policy
	Provide eastbound dual left-turn lanes	Low	Medium	
	Provide southbound right-turn lane.	Low	Medium	
Syracuse & Peakview ( <i>City of Centennial</i> )	Signalize the intersection	Low	Medium	
Greenwood Plaza & Peakview	Provide northbound dual left turn lanes and lengthen storage bay	Low	Medium	Widen into median
	Provide northbound right-turn lane.	Low	Medium	Land already dedicated
	Provide westbound dual left turn lanes	Low	Medium	Widen into median
Orchard & Yosemite/DTC	Provide additional northbound and southbound lanes on Yosemite. The northbound lane would begin south of Orchard and end at a logical point north of Orchard. The southbound lane would begin at a logical point north of Orchard and end as a right-turn lane at Caley.	Medium	High	100' feet of ROW on Yosemite. Could accommodate additional lane
	Provide southbound dual left turn lanes	Low	Medium	Widen into median

Intersection	Recommended Potential Improvements	Right-of-Way	Cost	Notes
Orchard & Greenwood Plaza	Increase storage for westbound left turn lanes	Low	Low	Widen into Median
	Add westbound through lane	Medium	High	Impacts driveway throat lengths. Could impact parking
	Convert northbound right turn movement to a free right turn movement. This would require adding an eastbound lane on Orchard beginning at Greenwood Plaza Blvd. and ending at the southbound ramp intersection at the I-25 interchange	Medium	High	Likely not impact parking but would impact median
	Provide southbound right turn lane	Medium	Medium	Currently in Greenwood Village CIP
Orchard & I-25 NB Ramps	Add a second westbound right turn lane	Medium	Medium	Needs to be evaluated for effect on I-25 ramp meter
	Extend the proposed additional left turn lane at the southbound ramp terminal through the intersection	Low	Low	Widen into median
Orchard & I-25 SB Ramps	Provide westbound dual left turn lanes. This additional left turn lane would extend through the northbound ramp terminal.	Low	High	Need new I-25 bridge
	Provide a southbound free right turn lane with added westbound lane on Orchard	Low	Medium	
	Lengthen eastbound left-turn storage bays	Low	Medium	Widen into median
Orchard & Willow	Widen northbound approach to create exclusive dual left turn lanes	Low	Low	Widen into median
	Restripe southbound approach to a single left and a single through lane	Low	Low	
Yosemite & Caley	Provide westbound dual left turn lanes	Low	Low	Restripe approach
	Provide eastbound dual left turn lanes	Low	Low	Restripe approach
	Provide southbound right turn lane.	Medium	Medium	Consistent with preliminary study area development plans
Yosemite & Willow/Fair	Signalize intersection	Low	Medium	
	Widen eastbound approach to provide separate left, through and right turn lanes	Low	Low	Widen into Median
	Provide northbound dual left turn lanes	Low	Medium	Would need to widen to the north for redirects

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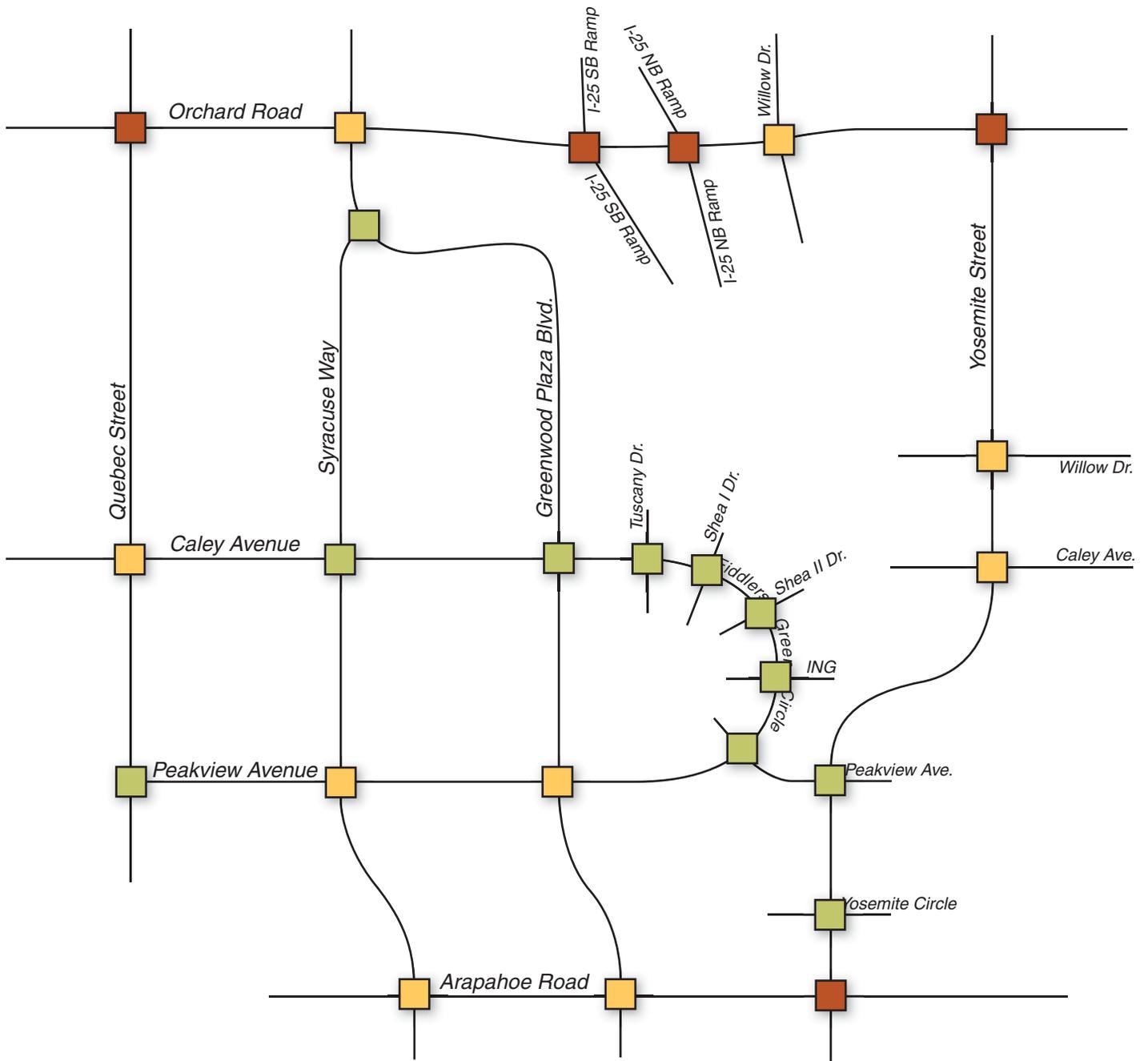
## V. SUMMARY AND CONCLUSIONS

Long-range (2035) traffic forecasts were prepared for the south I-25 corridor planning area of Greenwood Village using the Denver Regional Council of Governments regional travel model as a basis. The model was refined to add more focus to the south I-25 corridor planning area and the most current development expectations were incorporated to represent anticipated build-out of the study area.

Forecasted year 2035 peak hour traffic operations were analyzed for 25 study area intersections. The level of congestion at an intersection is measured by level of service (LOS) on a scale from LOS A to LOS F, with LOS A representing minimal congestion or delay and LOS F representing very high levels of congestion and long delays. LOS D or better has been established as a target peak hour LOS for the study.

The 25 intersections analyzed fall into three categories with respect to meeting the LOS D target with forecasted 2035 traffic volume, as described below and depicted on **Figure 14**:

- No Improvements Needed – 11 intersections would operate with LOS D or better without physical improvements. However, in some cases signal timing or turn lane modifications were identified that would enhance operations.
- Implementable Improvements Identified to Reach Target LOS – At 9 intersections, physical improvements were identified that would improve operations to LOS D or better in 2035 or where projected volumes warrant an improvement such as additional left or right turn lanes. Improvements, including signal timing modifications, additional turn lanes, or minor intersection realignment, appear to be readily implementable at these locations.
- Challenging Intersections – At 5 intersections, potential improvements were identified but there are significant challenges associated with their implementation and additional study will be needed to determine the feasibility of these or other improvements. These challenging locations include:
  - Orchard Road/Quebec Street – Improvements needed for intersection capacity are inconsistent with previous Council policy with respect to Orchard Road west of Quebec Street.
  - Orchard Road/Yosemite Street – Improvements needed for intersection capacity are inconsistent with previous Council policy with respect to Yosemite Street south of Orchard Road and Orchard Road east of Yosemite Street.
  - Orchard Road/I-25 Ramp Terminal Intersections – Improvements needed for intersection capacity would require extensive bridge reconstruction and right-of-way acquisition. Improvements would need to be part of a coordinated interchange reconstruction with the Colorado Department of Transportation.
  - Arapahoe Road/Yosemite Street – Changes to achieve LOS D in 2035 were not identified in this study. Potential improvements are currently being explored through the I-25/Arapahoe Interchange Environmental Assessment.



**LEGEND**

- = No Improvements Needed
- = Implementable Improvements Identified
- = Challenging Intersection

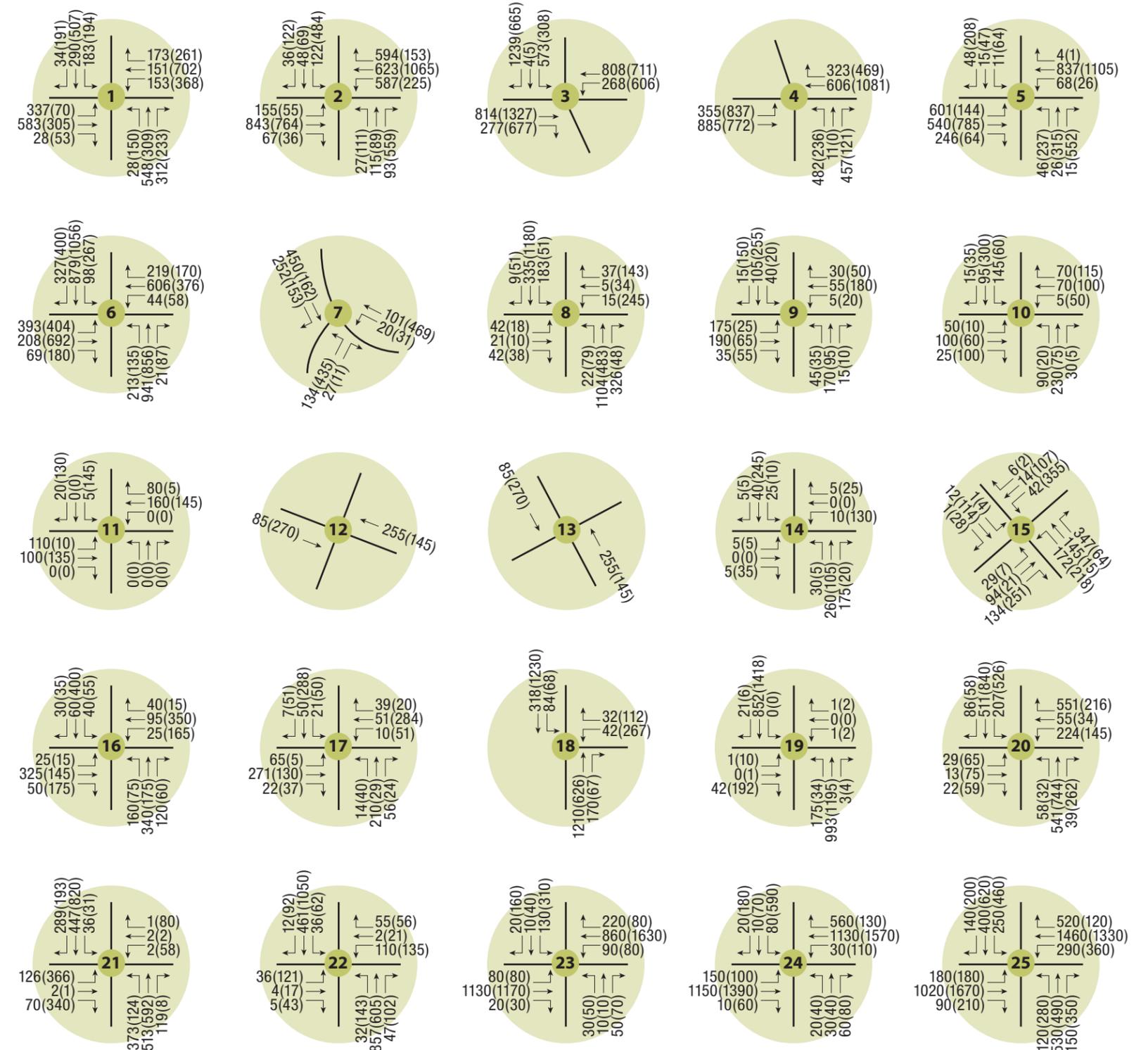
**Figure 14**  
 Summary of Intersection Improvement Needs  
 for Target LOS

**NORTH**



**APPENDIX A      EXISTING AND 2035 PEAK HOUR TURNING MOVEMENT  
VOLUMES**

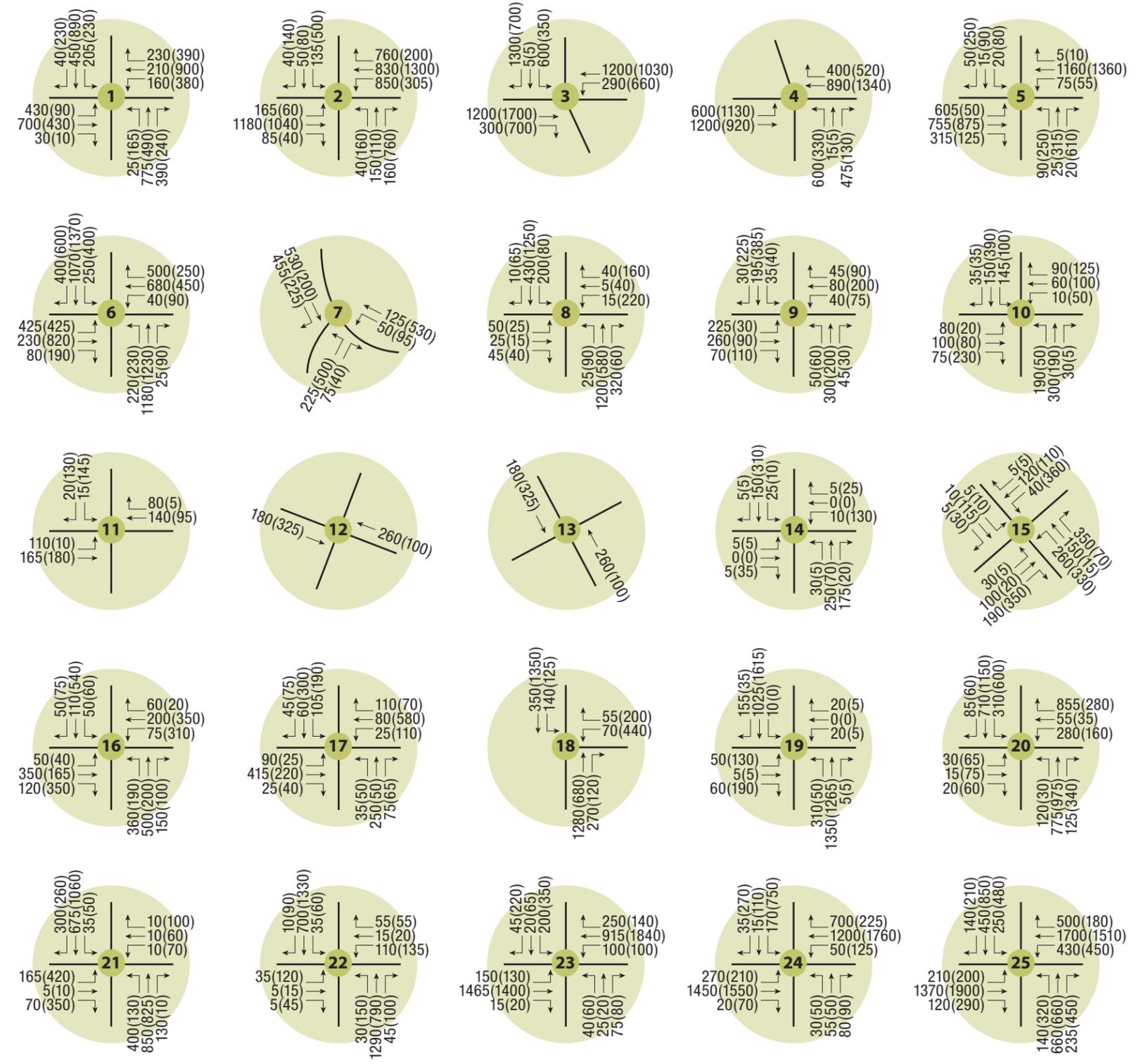




**LEGEND**  
 XXX(XXX) = AM(PM) Peak Hour Traffic Volumes

**Figure A1**  
 Existing Traffic Volumes



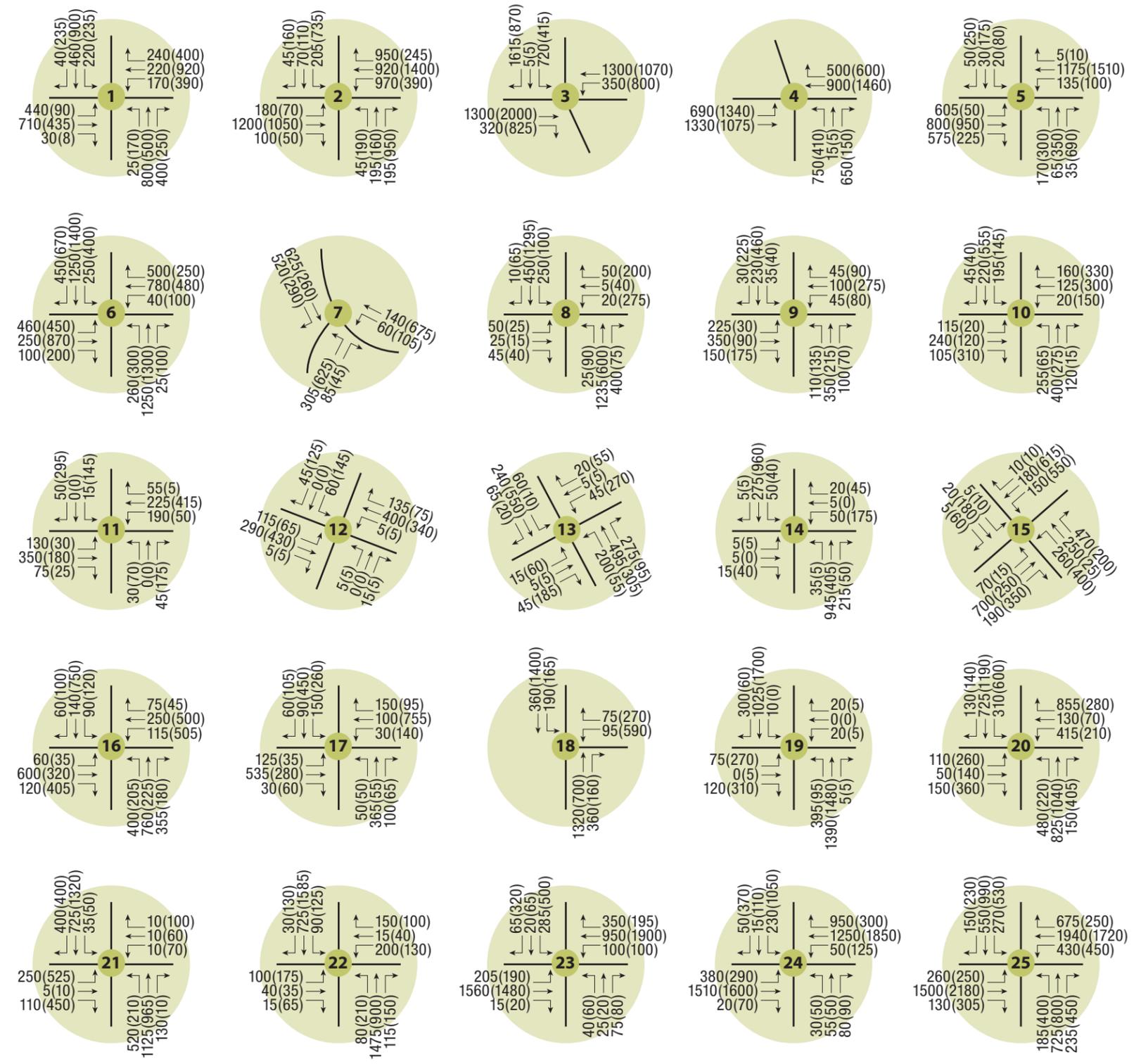


**LEGEND**  
 XXX(XXX) = AM(PM) Peak Hour Traffic Volumes

**Figure A2**  
 2035 Traffic Volumes  
 (with No Greenwood Village Growth)







**LEGEND**  
 XXX(XXX) = AM(PM) Peak Hour Traffic Volumes

**Figure A3**  
 2035 Traffic Volumes  
 (with Greenwood Village Growth)





**APPENDIX B      HOUSEHOLD AND EMPLOYMENT DEMOGRAPHICS**



**Table B1. 2010 Study Area Household and Employment by Transportation Analysis Zone**

TAZ	Original 2010 DRCOG Land Use					2010 Study Area Land Use				
	Total HH	Prod/Dist Emp	Retail Emp	Service Emp	Total Emp	Total HH	Prod/Dist Emp	Retail Emp	Service Emp	Total Emp
2214	0	183	221	2,404	2,808	0	183	221	2,404	2,808
2219	436	149	65	586	800	436	149	65	586	800
2225	292	7	186	202	395	292	7	186	202	395
2212	8	820	286	1,399	2,505	0	0	50	2,835	2,885
2213	0	289	187	1,613	2,089	0	0	0	2,750	2,750
2220	5	96	18	1,044	1,158	0	0	0	1,999	1,999
2221	0	43	64	811	918	0	0	0	2,057	2,057
2223	0	124	218	679	1,021	0	0	387	1,486	1,873
2224	0	2	177	329	508	0	0	409	48	457
2258	242	32	92	1,830	1,954	267	0	0	1,036	1,036
2264	57	0	0	0	0	0	0	0	0	0
2833	0	0	0	0	0	0	0	0	1,439	1,439
2834	0	0	0	0	0	0	0	0	0	0
<b>Total</b>	<b>1,040</b>				<b>14,156</b>	<b>995</b>				<b>18,499</b>

Source: Greenwood Village staff and DRCOG

**Table B2. 2035 Household and Employment Forecasts by Transportation Analysis Zone**

TAZ	Original 2035 DRCOG Land Use					2035 Study Area Land Use				
	Total HH	Prod/Dist Emp	Retail Emp	Service Emp	Total Emp	Total HH	Prod/Dist Emp	Retail Emp	Service Emp	Total Emp
2214	0	307	371	4,036	4,714	0	307	371	4,036	4,714
2219	536	206	90	809	1,105	536	206	90	809	1,105
2225	392	10	257	280	547	392	10	257	280	547
2212	24	1,046	365	1,748	3,159	0	0	160	6,799	6,959
2213	0	702	454	3,916	5,072	0	0	0	2,964	2,964
2220	44	99	19	1,081	1,199	0	0	29	4,656	4,685
2221	0	99	148	1,866	2,113	0	0	0	3,555	3,555
2223	0	389	681	2,123	3,193	0	0	387	2,146	2,533
2224	0	4	459	854	1,317	400	0	421	1,357	1,778
2258	344	36	104	2,079	2,219	267	0	0	1,036	1,036
2264	0	0	0	0	0	0	0	0	396	396
2833	42	1,706	595	2,911	5,212	0	0	0	1,439	1,439
2834	497	43	260	1,843	2,146	0	0	0	2,062	2,062
<b>Total</b>	<b>1,879</b>				<b>31,996</b>	<b>1,595</b>				<b>33,773</b>

Source: Greenwood Village staff and DRCOG