

# **APPENDIX A**

## **TRAFFIC STUDY**



## TECHNICAL MEMORANDUM

TO: Jay Eaton, PE, Public Works Director  
City of Tumwater

FROM: George Smith, Senior Transportation Planner  
SCJ Alliance

DATE: April 29, 2014

RE: Capitol Boulevard Corridor Phase 1 Design - Operational Analysis  
SCJ #0625.12

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### PURPOSE

The City of Tumwater recently completed the Capitol Boulevard Corridor Plan that identifies a preferred development strategy and roadway improvement plan for the South Capitol Boulevard area from Troser Road to Israel Road. The City is now embarking on the process of refining the transportation analysis to inform the design of the recommended roadway and intersection plan.

This memorandum describes the traffic count collection, traffic forecasting and operational analysis for the design study. The traffic volumes and analysis will be used to determine/confirm the intersection and roadway design. They also will be used to provide the “baseline” future conditions for a value engineering-style process of considering improvement alternatives for the Troser Road/Capitol Boulevard intersection and environs.

### EXISTING CONDITIONS

#### Traffic Volume Data

Traffic Count Consultants, Inc (TC2), a transportation data collection service, provided peak period turning movement counts for the study intersections. The counts were conducted between 7:00 am - 9:00 am and between 4:00 pm - 6:00 pm on Wednesday, March 25, 2014 at the following locations:

- Troser Road/Lake Park Drive
- Troser Road/2<sup>nd</sup> Avenue/Littlerock Road
- Troser Road/Tyee Drive/I-5 SB Ramps
- Troser Road/I-5 NB Ramps
- Troser Road/Capitol Boulevard
- Linda Street/Capitol Boulevard
- Ruby Street/Capitol Boulevard
- Lee Street/Capitol Boulevard
- T Street/Capitol Boulevard
- X Street/Capitol Boulevard
- Dennis Street/Capitol Boulevard

**Figure 1** shows the existing 2014 AM peak hour traffic volumes and **Figure 2** shows the existing 2014 PM peak hour traffic volumes for the study intersections. Based on the traffic count surveys the morning and evening peak hours were determined to be 7:15 - 8:15 AM and 4:30 - 5:30 PM. These periods represents the highest level of traffic in a single hour and will be used as the analysis period for this study. The turning movement count diagrams are provided in **Appendix A**.

## **TRAVEL DEMAND MODEL**

The traffic volume projections used in this analysis were prepared using the TRPC regional Emme/3 transportation demand model. The model, prepared by Thurston Regional Planning Council (TRPC), has been most recently updated to represent 2009 traffic conditions. The model provides AM and PM peak hour assignments.

TRPC has prepared a 2035 model scenario that includes the regionally adopted household and employment projections for the region. The 2035 scenario also includes all roadway improvements identified in the current Thurston County Regional Transportation Plan (RTP).

Specific enhancements were made to both the 2009 and 2035 regional models to provide more detailed distribution and assignment in the focus area. Additional enhancements were incorporated from the recent Brewery District planning effort. Below is a description of the model enhancements.

### **Brewery District Model Enhancements**

The recent Brewery District planning effort included several model enhancements to that area of the model. Multiple Traffic Analysis Zones (TAZ's) were added to improve local assignment. Additionally, several model links were refined to better reflect current conditions.

In addition to the zonal detail the following enhancements were added to the 2035 model scenarios:

- Interstate 5 was widened to 4 travel lanes in each direction from Exit 104 to Exit 99 to accommodate all of the regional growth predicted.
- The E Street extension, a 4/5 lane roadway connecting Capitol Boulevard and Cleveland Avenue across the valley, was added to the network.
- Household and employment projections were increased to represent redevelopment of the brewery property.

### **Capitol Boulevard Corridor Model Enhancements**

In addition to the brewery district model enhancements, several network enhancements were made to improve traffic assignment detail in the study area:

- An additional segment of Linderson Way was added to the model network from Israel Road to Lee Street.
- Zone centroid connectors along Capitol Boulevard were relocated to better reflect current conditions.
- T Street was added to the model network.

## **Future Land Use**

For the 2035 model scenario, the land use for the existing WSDOT site was customized to reflect the proposed 4 over 1 residential scenario (four stories of residential over ground floor retail/commercial) from the Capitol Boulevard Corridor Plan (January 2014).

## **FUTURE CONDITIONS**

### **Projected 2035 Traffic Volumes – Baseline**

While the model is calibrated to replicate existing travel patterns, traffic volumes on individual roadways vary somewhat from existing traffic counts. To account for this variation, model growth rates were calculated for the study area and applied to the existing 2014 count volumes. To develop the growth rate, the weighted average of growth at all of the major entry points to the study area was used. Separate calculations were done for the AM and PM peak hours. Both peak periods yielded growth rates of approximately 2.25%. This growth rate was then applied to the existing 2014 volumes as a straight line growth over 21 years to calculate the projected 2035 traffic volumes. **Figure 3** shows the projected 2035 AM peak hour traffic volumes and **Figure 4** shows the projected 2035 PM peak hour traffic volumes for the study intersections. The AM and PM peak hour model volume plots are provided in **Appendix B**.

### **Projected 2035 Traffic Volumes – Corridor Plan Adjustment**

In addition to calculating and analyzing projected 2035 baseline volumes, a volume scenario reflecting the proposed improvements from the Capitol Boulevard Corridor Plan was also developed. For the purpose of reassigning traffic, there were two improvement strategies that were included.

#### **Enhanced Connectivity east of Capitol Boulevard (Lee St to Trosper Rd)**

The Corridor Plan calls for improvements east of Capitol Boulevard from Lee Street up to Trosper Road to allow for the properties in that area to access Capitol Boulevard at Trosper Road. This is expected to reduce the number of vehicles making right turns onto northbound Capitol Boulevard at Lee Street, Ruby Street and Linda Street. All of these movements were reduced significantly in the AM and PM peak hours and assigned as westbound through trips at the Trosper Road/Capitol Boulevard intersection.

As part of this improvement, the primary access for the WSDOT property redevelopment will be located on Capitol Boulevard at T Street. The traffic volumes were adjusted accordingly.

#### **Installation of median on Capitol Boulevard**

The Corridor Plan proposes to install a median along Capitol Boulevard through the study area from Trosper Road to Dennis Street with median breaks at major intersections. At the Linda Street and Ruby Street intersections, left-turning and through traffic was relocated south to Lee Street and north to Trosper Road as appropriate. Additionally, as part of this improvement, the intersections at T Street, X Street and Dennis Street are all proposed to be converted to roundabouts. For the analysis of each of these roundabouts, a default U-turn volume of 25 vehicles was assumed for both directions along Capitol Boulevard to account for the median installation.

**Figure 5** shows the projected 2035 AM peak hour traffic volumes and **Figure 6** shows the projected 2035 PM peak hour traffic volumes for the study intersections reflecting the corridor plan adjustments.

## OPERATIONS

### Level of Service

The acknowledged source for determining overall capacity for arterial segments and independent intersections is the current edition of the Highway Capacity Manual (HCM). Capacity analyses were completed for existing conditions under AM and PM peak hour traffic volume scenarios for all study intersections.

Intersection analysis was performed using the Synchro/Trafficware software program (Version 8). This software implements the methods of the 2010 HCM. Capacity analysis results are described in terms of Level of Service (LOS). LOS is a qualitative term describing the operating conditions a driver will experience while traveling on a particular street or highway during a specific time interval. It ranges from A (very little delay) to F (long delays and congestion).

Level of Service calculations for intersections determine the amount of “control delay” (in seconds) that drivers will experience while proceeding through an intersection. Control delay includes all deceleration delay, stopped delay and acceleration delay caused by the traffic control device. The Level of Service is directly related to the amount of delay experienced.

For intersections under traffic signal control, the weighted average delay of all vehicles is used to determine the intersection LOS. For intersections under stop-sign control, the LOS of the most difficult movement (typically the minor street left-turn) represents the intersection Level of Service. The intersection average LOS is also commonly considered in assessing the overall function of stop sign-controlled intersections. The following tables show the Level of Service criteria for signalized and stop sign-controlled intersections.

**Table 1. Level of Service Criteria for Signalized and Roundabout Intersections**

Level of Service	Average Control Delay (seconds/vehicle)
A	≤ 10
B	> 10 – 20
C	>20 – 35
D	>35 – 55
E	> 55 - 80
F	> 80

**Table 2. Level of Service Criteria for Stop Sign-Controlled Intersections**

Level of Service	Average Control Delay (seconds/vehicle)
A	≤ 10
B	> 10 – 15
C	> 15 – 25
D	> 25 – 35
E	> 35 – 50
F	> 50

The City of Tumwater has adopted a standard of LOS D for transportation facilities within the City and its Urban Growth Area. The only exception to this is the intersection of Capitol Boulevard/Trosper Road where LOS E is the standard. Transportation facilities that function below the adopted standards are determined to be failing. In addition to LOS, queuing was considered between the closely spaced intersections on Capitol Boulevard and Trosper Road.

### **Existing Operations**

Traffic analyses were conducted for the existing 2014 AM and PM peak hours. The current cycle lengths and phasings were used. The Trosper Road signals and the Lee Street/Capitol Boulevard signal were analyzed as a coordinated system and the offsets were optimized in Synchro.

### **2035 Baseline Operations**

Traffic analyses were conducted for the 2035 baseline using the projected 2035 AM and PM peak hour volumes. For this analysis scenario, the cycle lengths and phase lengths were all optimized. The coordination offsets were also re-optimized for this volume scenario. In addition, the following improvement was integrated into the analysis:

- Addition of an eastbound right-turn pocket at the Trosper Road/Capitol Boulevard intersection to provide two EB to SB right-turn lanes

### **2035 Corridor Plan Improvement Operations**

Traffic analyses were conducted for the 2035 Corridor Plan Improvements using the projected 2035 AM and PM peak hour volumes. For this analysis scenario, the cycle lengths and phase lengths were all optimized. The coordination offsets were also re-optimized for this volume scenario. In addition to the improvements used in the 2035 baseline scenario, the following improvements were integrated into the analysis:

- T Street/Capitol Boulevard intersection conversion to 2-lane roundabout
- X Street/Capitol Boulevard intersection conversion to 2-lane roundabout
- Dennis Street/Capitol Boulevard intersection conversion to 2-lane roundabout
- Volume adjustment to account for the improved access and circulation to the properties east of Capitol Boulevard between Lee Street and Trosper Road
- Volume adjustment to account for the proposed median on Capitol Boulevard

The AM peak hour and PM peak hour operational results for the existing 2014, 2035 Baseline and 2035 Corridor Plan Improvement analysis scenarios are summarized below in **Table 3** and **Table 4**.

**Table 3. AM Peak Hour Intersection LOS Summary**

Intersection	Control Type	Existing 2014	2035 Baseline	2035 - Corridor Plan Improvements
		Intersection LOS and Delay	Intersection LOS and Delay	Intersection LOS and Delay
Trosper Road at Tye Drive/I-5 SB Ramps	Signal	D (42.1)	E (72.5)	E (72.4)
Trosper Road at I-5 NB Ramps	Signal	A (4.8)	A (8.7)	A (8.8)
Trosper Road at Capitol Boulevard	Signal	C (34.3)	C (33.5)	D (37.6)
Linda Street at Capitol Boulevard	Stop	B (13.5)	B (14.7)	B (14.5)
Ruby Street at Capitol Boulevard	Stop	B (12.7)	C (17.8)	B (10.7)
Lee Street at Capitol Boulevard	Signal	B (12.6)	B (18.5)	B (18.2)
T Street at Capitol Boulevard	Stop	C (16.4)	C (23.7)	A (9.3) <sup>1</sup>
X Street at Capitol Boulevard	Signal	A (4.5)	A (8.4)	A (7.4) <sup>1</sup>
Dennis Street at Capitol Boulevard	Signal	A (8.2)	B (10.5)	B (11.3) <sup>1</sup>

<sup>1</sup> Reflects conversion to RAB

**Table 4. PM Peak Hour Intersection LOS Summary**

Intersection	Control Type	Existing 2014	2035 Baseline	2035 - Corridor Plan Improvements
		Intersection LOS and Delay	Intersection LOS and Delay	Intersection LOS and Delay
Trosper Road at Tye Drive/I-5 SB Ramps	Signal	C (32.2)	E (67.4)	E (67.4)
Trosper Road at I-5 NB Ramps	Signal	A (6.4)	B (10.9)	B (10.9)
Trosper Road at Capitol Boulevard	Signal	D (54.5)	F (124.1)	F (132.8)
Linda Street at Capitol Boulevard	Stop	B (10.0)	B (11.9)	B (11.7)
Ruby Street at Capitol Boulevard	Stop	B (11.1)	C (19.0)	B (11.0)
Lee Street at Capitol Boulevard	Signal	B (19.7)	D (47.8)	D (35.1)
T Street at Capitol Boulevard	Stop	C (20.7)	D (31.2)	B (14.2) <sup>1</sup>
X Street at Capitol Boulevard	Signal	A (5.8)	A (3.3)	A (8.3) <sup>1</sup>
Dennis Street at Capitol Boulevard	Signal	B (11.1)	B (13.2)	B (12.5) <sup>1</sup>

<sup>1</sup> Reflects conversion to RAB

## Vehicle Queuing

Vehicle queuing was estimated for the existing and future scenarios using Simtraffic software. The average of five simulations was calculated to identify the 95<sup>th</sup> percentile queue at key locations along Capitol Boulevard and Trosper Road. **Figures 7 and 8** show the 95<sup>th</sup> percentile queues on Capitol Boulevard and Trosper Road from the freeway ramps through Lee Street. The queues at the other study intersections are provided with the Simtraffic analysis worksheets, attached.

## Operations Summary

### *Existing Conditions*

In the morning and evening peak hours, the intersections in the study area generally function well. The primary capacity issues are associated with commute traffic going between Interstate 5 and Capitol Boulevard. Although the intersection LOS is acceptable at each of the study intersections, individual movements experience capacity constraint that can lead to excessive queuing between intersections. The following periodic deficiencies are noted:

- Traffic occasionally backs up on eastbound Trosper Road from Capitol Boulevard through 2<sup>nd</sup> Avenue. This primarily occurs in the morning commute.
- During the evening commute the queue on northbound Capitol Boulevard at Trosper Road frequently extends through the Lee Street intersection.
- Short merge/weave areas on Trosper Road result in unequal usage of dual turn lanes. The southbound left-turn lanes on the SB I-5 off-ramp and the NB left-turn lanes on Capitol Boulevard at Trosper Road experience lane imbalance of up to 70/30 which results in less efficient intersection operation.

### *Projected 2035 Baseline Conditions*

By the 2035 horizon traffic volume increase will result in failing conditions at the Capitol Boulevard/Trosper Road intersection causing excessive queuing and delay on Capitol Boulevard and Trosper Road. The double eastbound to southbound right-turn lane effectively corrects the queuing on eastbound Trosper Road at Capitol Boulevard, however, the volume of traffic on Trosper Road creates queues across the freeway ramp terminal intersections through Lake Park Drive.

The Capitol Boulevard Trosper Road intersection will operate at a LOS F with multiple failing movements. This will result in frequent signal cycle failures with queues building throughout the peak period. In the evening peak period the queues will extend over 3,000 feet to the north and south.

### *Projected 2035 Corridor Plan Conditions*

This scenario routes more of the traffic on the east side of Capitol Boulevard to the westbound approach at the Trosper Road/Capitol Boulevard intersection. This removes conflicts on Capitol Boulevard at Ruby, Linda and Lee Street but increases delay and congestion on the WB approach of Trosper Road resulting in an 800 foot queue on the eastbound approach. Under this scenario the queues on Capitol Boulevard at Trosper Road are comparable to the baseline scenario.







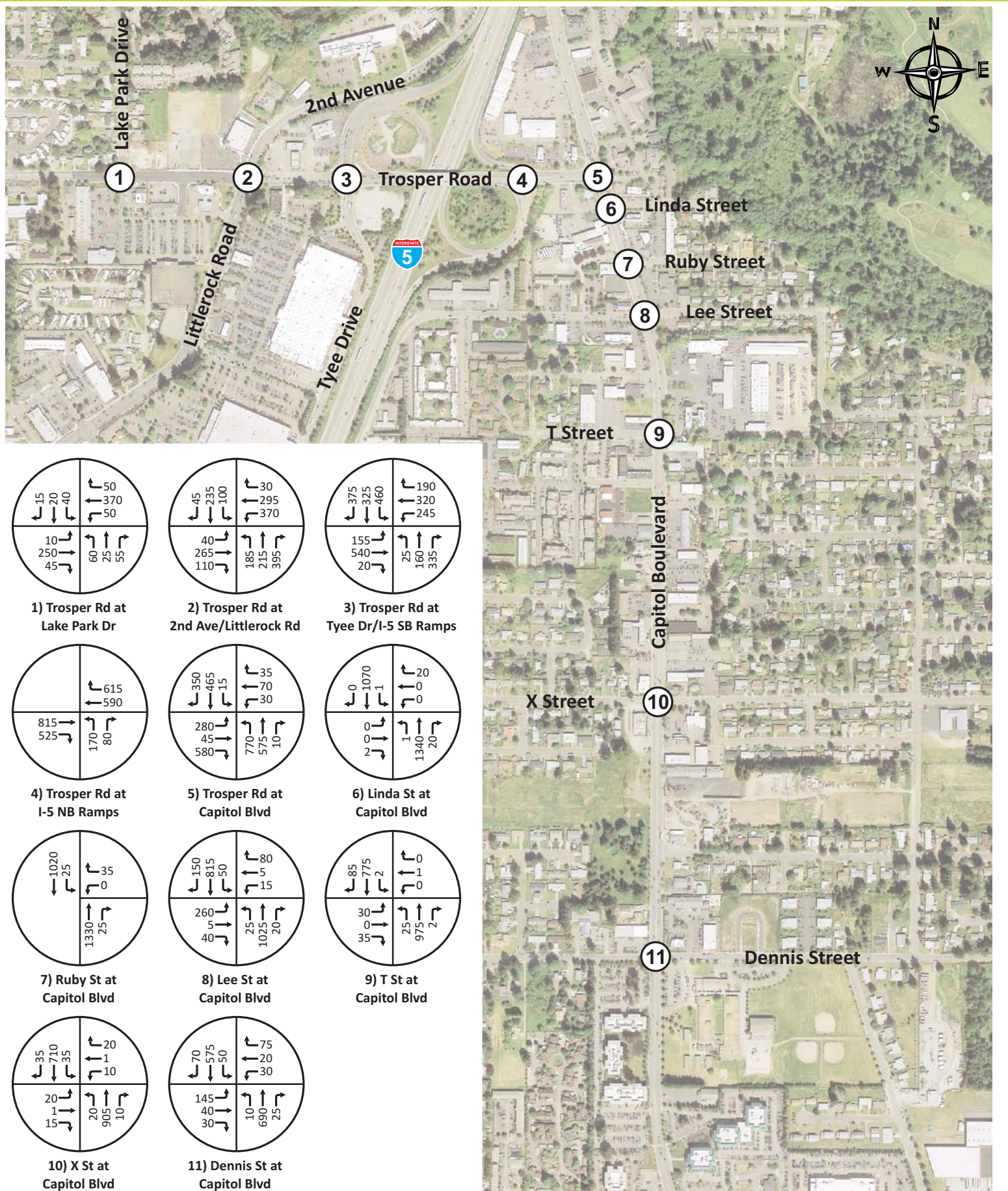


Figure 2  
Existing 2014 PM Peak Hour  
Traffic Volumes



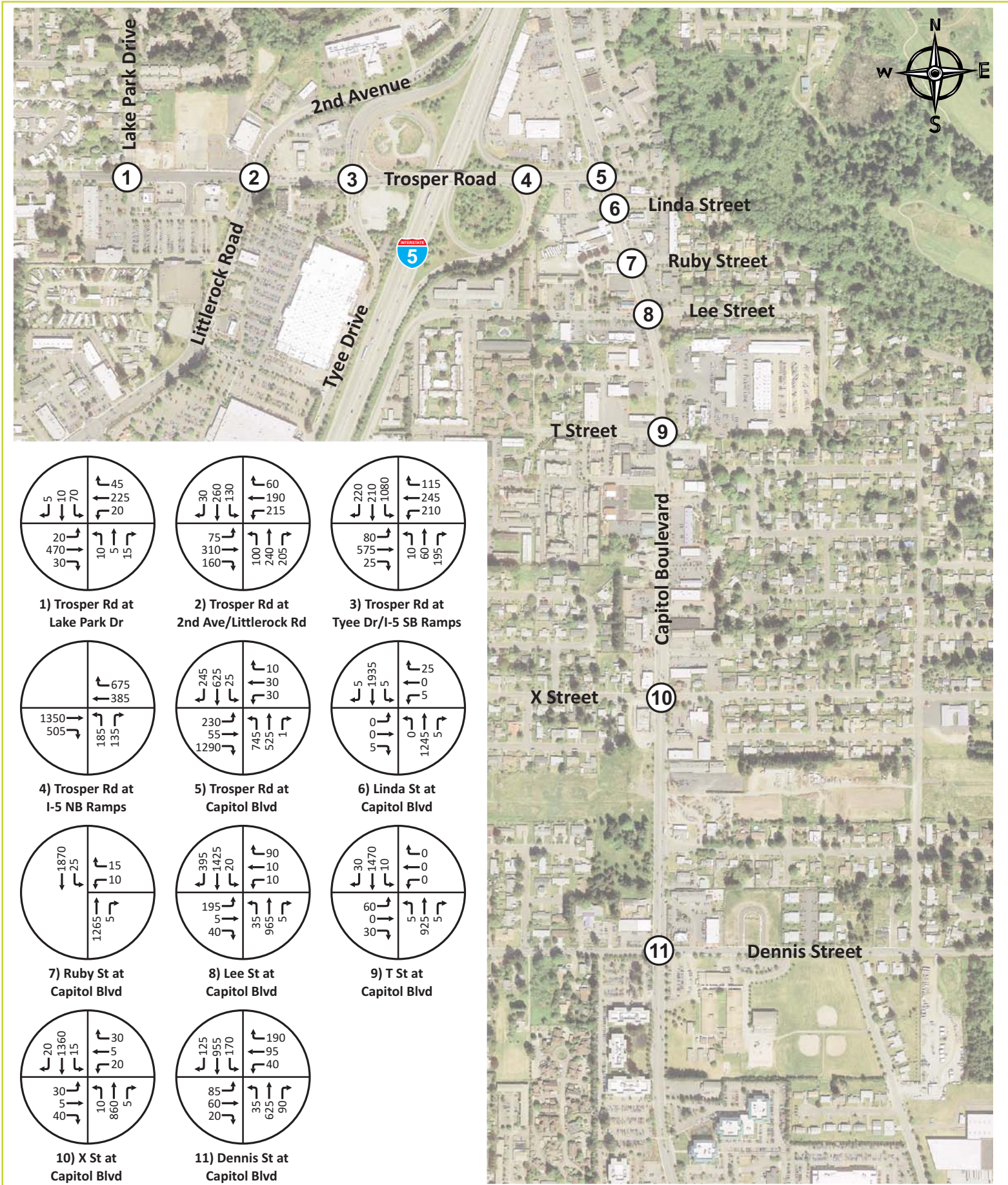


Figure 3  
 Projected 2035 AM Peak Hour  
 Traffic Volumes - Baseline



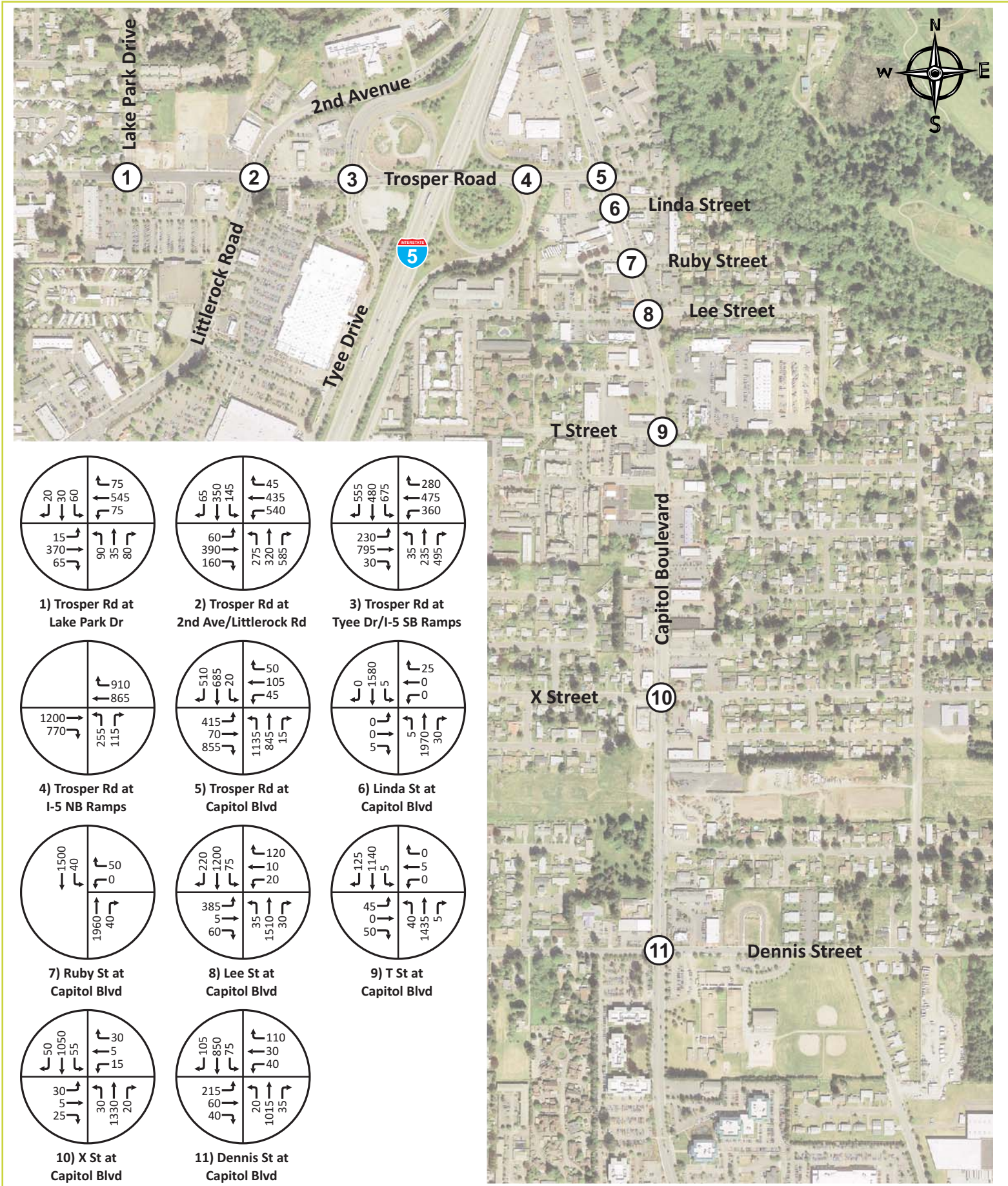


Figure 4  
 Projected 2035 PM Peak Hour  
 Traffic Volumes - Baseline



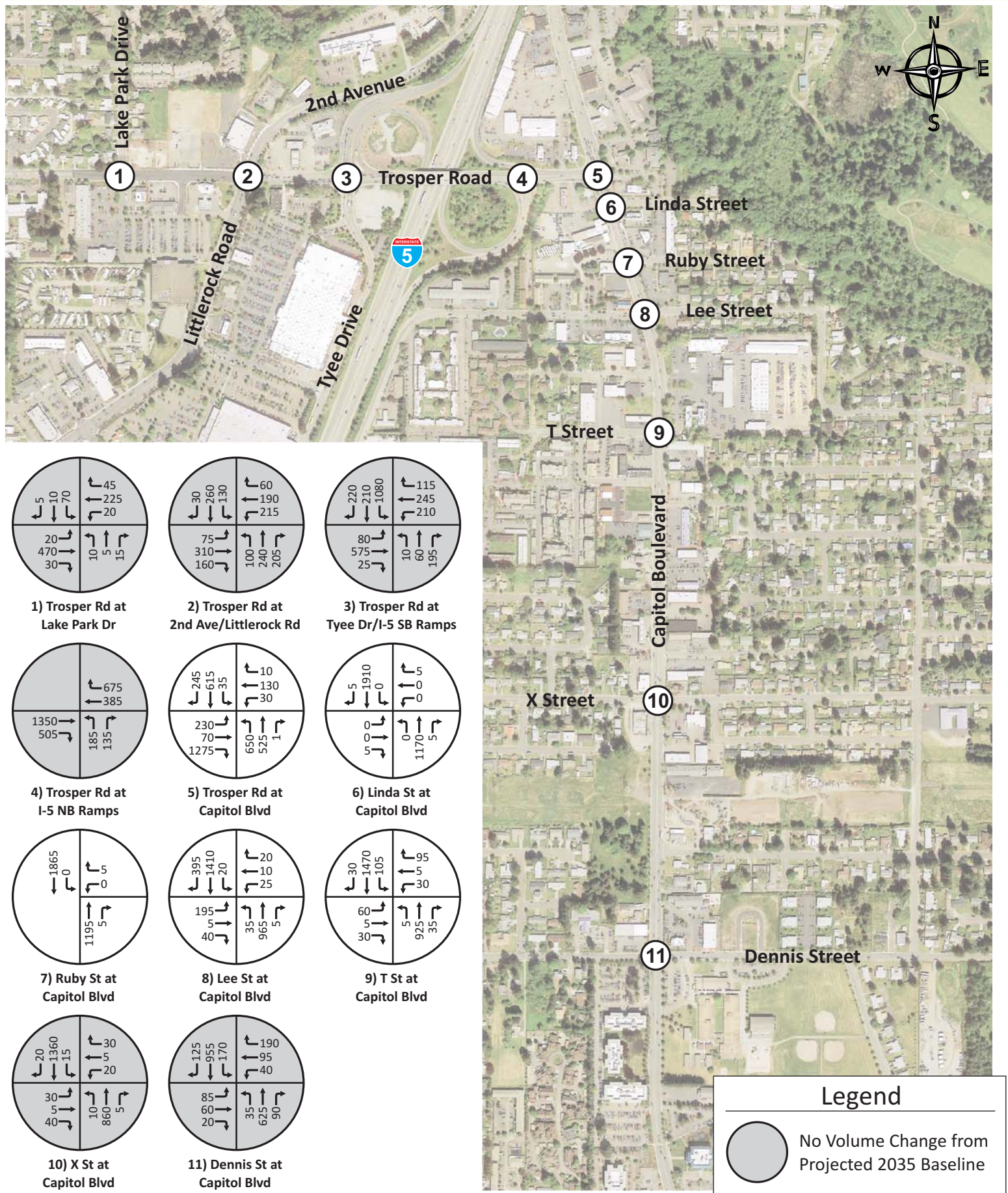


Figure 5  
 Projected 2035 AM Peak Hour  
 Traffic Volumes - Corridor Plan Adjustments



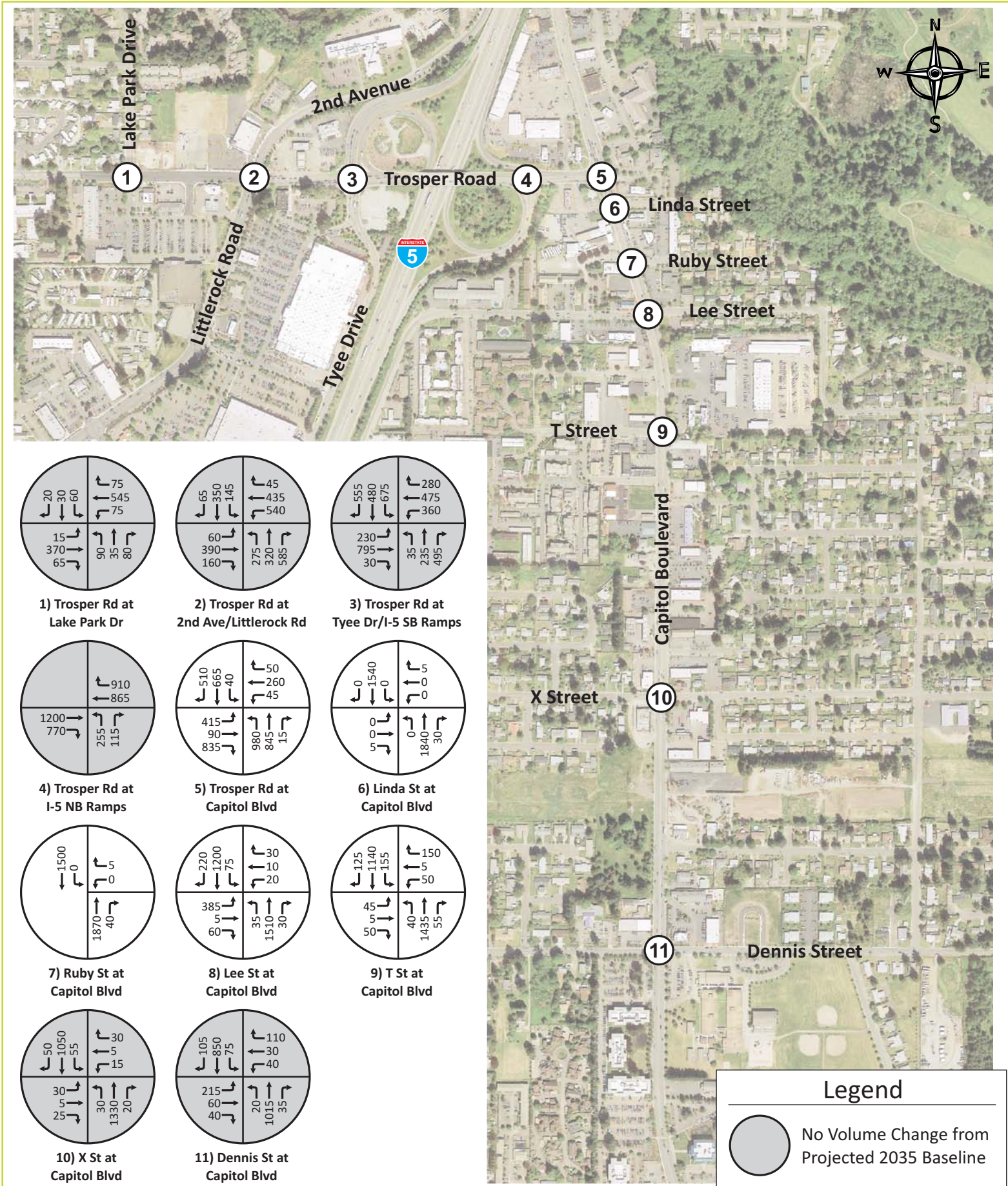


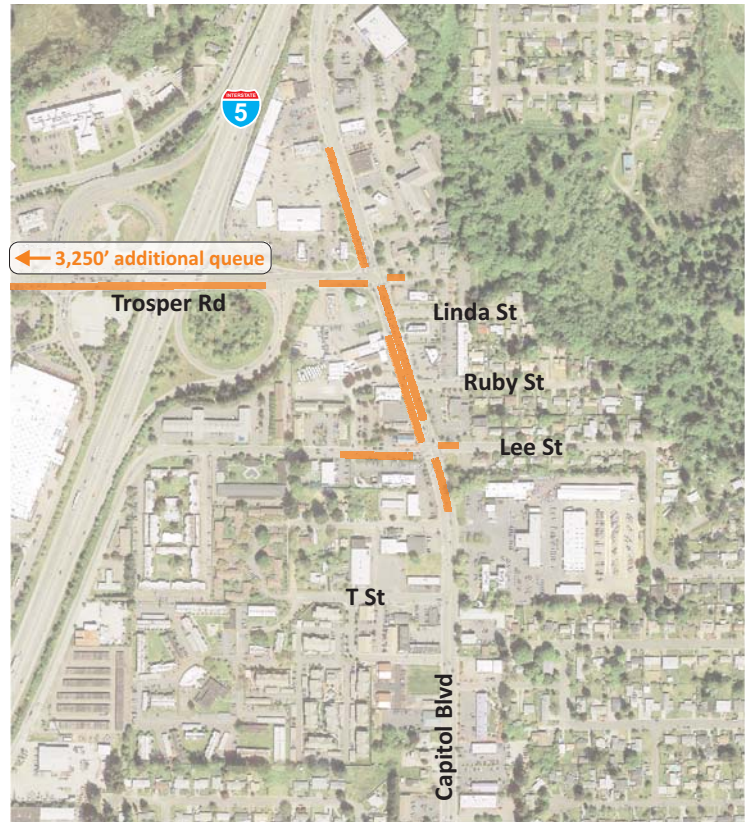
Figure 6  
 Projected 2035 PM Peak Hour  
 Traffic Volumes - Corridor Plan Adjustments



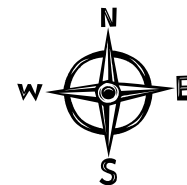
### Existing 2014 Queues



### Projected 2035 Queues



### Projected 2035 with Corridor Plan Queues



**Legend**

— 95th Percentile Queue Length

Figure 7  
AM Peak Hour SimTraffic  
Queue Results



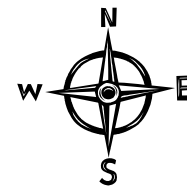
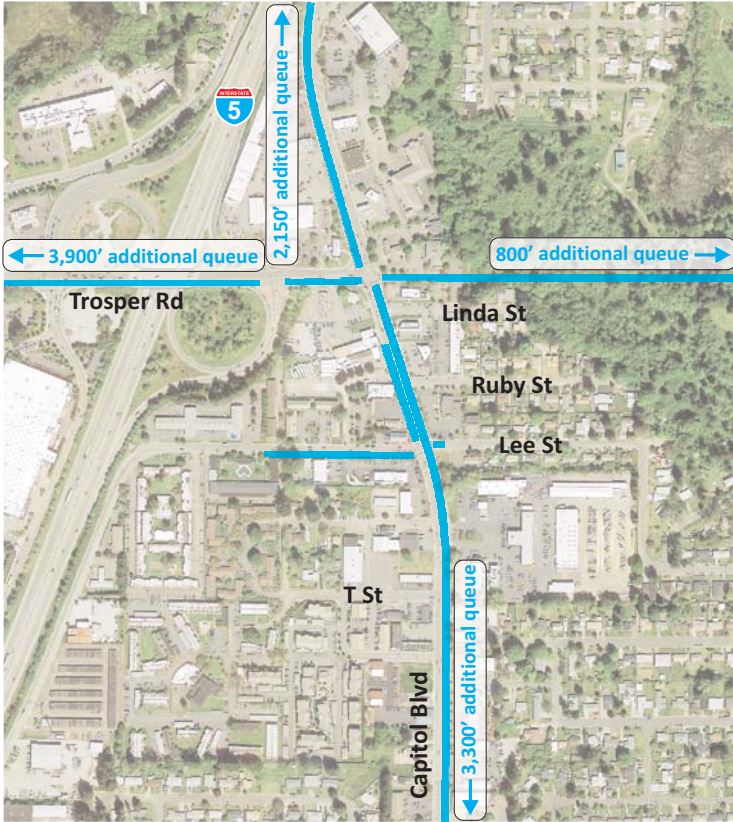
### Existing 2014 Queues



### Projected 2035 Queues



### Projected 2035 with Corridor Plan Queues



**Legend**

█ 95th Percentile Queue Length

Figure 8  
PM Peak Hour SimTraffic  
Queue Results