ATTACHMENT A

Existing Traffic Conditions Memorandum

KITTELSON & ASSOCIATES, INC.
TRANSPORTATION ENGINEERING / PLANNING
1850 Centennial Park Drive, Suite 130, Reston, Virginia 20191 P 703-885-8970 F 703-885-8971

TECHNICAL MEMORANDUM

Date: May 7, 2014 Project #: 17289

To: Christina Fink, P.E. and Ken Ray
Toole Design Group

From: Caitlin Doolin and Zachary Horowitz, P.E.

Project: Lower King Street Multimodal Feasibility Study
Subject: Existing Traffic Conditions

INTRODUCTION

At the request of the City of Alexandria, Toole Design Group (TDG) and Kittelson & Associates, Inc. (KAI) is conducting a study of a potential pedestrian-only or shared street concept for the 100 block of King Street in the historic Old Town section of the City of Alexandria, Virginia. As part of the existing conditions analysis, KAI studied the current vehicle traffic operations along King Street and the surrounding intersections, and the effects of pedestrians and bicyclists on vehicle traffic operations.

This technical memorandum summarizes the existing traffic operational findings for the midday and p.m. peak hours for both weekday and weekend time periods. The analysis was completed in two parts: 1) An evaluation using Synchro and the Highway Capacity Manual (HCM) methodologies and 2) Microsimulation with the SimTraffic model that accounts for the interaction between pedestrians and bicyclists on vehicle operations.

The technical memorandum first provides the background on the study area followed by the analysis methodology. Next, the HCM results produced by Synchro and the results of the SimTraffic microsimulation modeling are presented. The memorandum closes by discussing the conclusions of the existing conditions traffic analysis.

BACKGROUND

Old Town is a historic neighborhood in the City of Alexandria. King Street is the main street in the neighborhood and forms the center east-west spine of the study area. The existing traffic operations incorporates traffic count data collected by the City on Fridays and Saturdays between March 8, 2013 and March 30, 2013 at the 15 intersections in the study area. All of the study intersections are all-way

stop-controlled with the exception of King Street/Fairfax Street, which is signalized and operates with a 65-second cycle length. The locations of the study intersections are shown in Figure 1.

Figure 1. Lower King Street Pedestrian Study intersections (Source: Google Earth)

METHODOLOGY

The system peak hour for each of the four time periods was calculated based on the sum of the total entering vehicle for all 15 study intersections. Table 1 summarizes the system peak hour for each of the time periods analyzed. Peak hour factors for each intersection approach were determined.

Table 1. Summary of the System Peak Hours

Study Period	Time Period	System Peak Hour
Weekday	Midday	12:00 p.m. -1:00 p.m.
	PM	5:00 p.m. – 6:00 p.m.
Weekend	Midday	12:30 p.m. – 1:30 p.m.
	PM	4:00 p.m. – 5:00 p.m.

Synchro models based on the existing street network, lane configurations, and intersection control were developed and error-checked against aerial photos and during a site visit. The lane configurations and traffic control for each of the study intersections are provided in Figure 2. For the system peak hours, traffic volumes for cars, heavy vehicles, bicycles, and pedestrians at each intersection were summarized by turning movement. The pedestrian and bicycle volumes for each intersection during each of the time periods are provided in Figures 3 through 6. Traffic volumes during each of the time periods can be found in Figures 7 through 10. Because the turning movement count data was collected on different dates, traffic volumes were balanced between intersections to account for and remove any inconsistencies. Once the turning movements were balanced, the vehicle, bicycle, and pedestrian volumes as well as the heavy vehicle percentages were added to the Synchro models.

HCM TRAFFIC OPERATIONS RESULTS

An HCM analysis evaluates traffic operations based on the geometric capacity of the intersection, type of traffic control, traffic volume for each of the turning movements at the intersections, percentage of heavy vehicles, number of hourly parking maneuvers, roadway grade, and several other factors. The results of the HCM traffic analysis are provided in Figures 7 through 10, and include the average per-vehicle delay, the level-of-service (LOS), the critical movement, the volume-to-capacity ratio, and the peak hour turning movement vehicle volumes. LOS is determined based on the average per-vehicle delay drivers experience when approaching the intersection. As indicated in the figures, all intersections currently operate at LOS “A” or LOS “B” based on the HCM methodology.

The results of the HCM analysis indicates that, based on the methodology, all 15 study intersections operate well and have adequate capacity for vehicles in each of the four peak hours studied. However, the HCM methodology does not account for the impact that pedestrians have on vehicle operations at the 14 intersections that have all-way stop-control. A microsimulation analysis with SimTraffic (discussed below) is needed to understand the effects of pedestrian traffic on vehicle operations.

SIMTRAFFIC TRAFFIC OPERATIONS RESULTS

SimTraffic models were developed from the Synchro models used to complete the HCM analysis. The models used the same input data (e.g. vehicle volumes, peak hour factors, heavy vehicle percentages)

as the Synchro models, with one exception: pedestrian volumes. The pedestrian volumes, particularly along King Street as shown in Figures 3 through 6, can exceed 1,000 pedestrians an hour. Using a methodology that was previously applied on the Union Street project for the City of Alexandria, pedestrian volumes greater than 400 pedestrians per hour were reduced by a factor of two. The reduction accounts for the fact that in a heavily traveled pedestrian zone, pedestrians are generally crossing the street in pairs or in groups of three or more. Reducing pedestrian volumes by two merely indicates that the average group of pedestrians crossing the street during the peak hour includes at least two individuals; this was observed to be the case during the site visit.

The SimTraffic microsimulation model was run following the procedures detailed in the VDOT Traffic Operations Analysis Tools Guidebook, Version 1.1. Model runs were based on the methodology available in SimTraffic, which included using a randomized initial traffic volume for each run in a 15-minute period prior to the peak hour simulation. Ten runs were conducted and reviewed for errors. The final output results of the SimTraffic analysis were based on averages across all applicable runs and are provided in Figures 11 through 14. Based on observations of actual conditions and engineering judgment, the SimTraffic models and results accurately depict vehicle delay and queing at the study intersections.

The traffic operations results for intersections along King Street are summarized in Table 2.

Table 2. Summary of SimTraffic King Street Operations Results

Intersection	LOS	Per-Vehicle Delay (Seconds)	Volume-to-Capacity (v/c) Ratio
Weekday Midday Peak Hour (Weekday PM Peak Hour)			
King Street/Fairfax Street	B (B)	12.0 (11.6)	0.43 (0.35)
King Street/Lee Street	B (B)	11.0 (10.4)	0.22 (0.26)
King Street/Union Street	D (E)	20.1 (37.6)	0.20 (0.30)
Weekend Midday Peak Hour (Weekend PM Peak Hour)			
King Street/Fairfax Street	C (E)	21.8 (76.4)	0.47 (0.47)
King Street/Lee Street	E (F)	46.4 (>50)	0.28 (0.35)
King Street/Union Street	E (F)	38.6 (>50)	0.24 (0.26)

The SimTraffic results for King Street clearly show a decrease in the vehicle level-of-service for all four time periods when pedestrians are accounted for. The weekday p.m. peak hour experiences LOS “E” operations at King Street/Union Street. The weekend midday peak hour experiences LOS “E” operations at King Street/Lee Street and King Street/Union Street. The p.m. peak hour experiences LOS “F” operations at King Street/Lee Street and King Street/Union Street and LOS “E” at King Street/Fairfax Street.

The SimTraffic results indicated that, similar to the results of the HCM analysis, all the intersections along Queen Street, Cameron Street, Prince Street, and Duke Street operate at LOS “A” during all four peak hours, with the exception of:

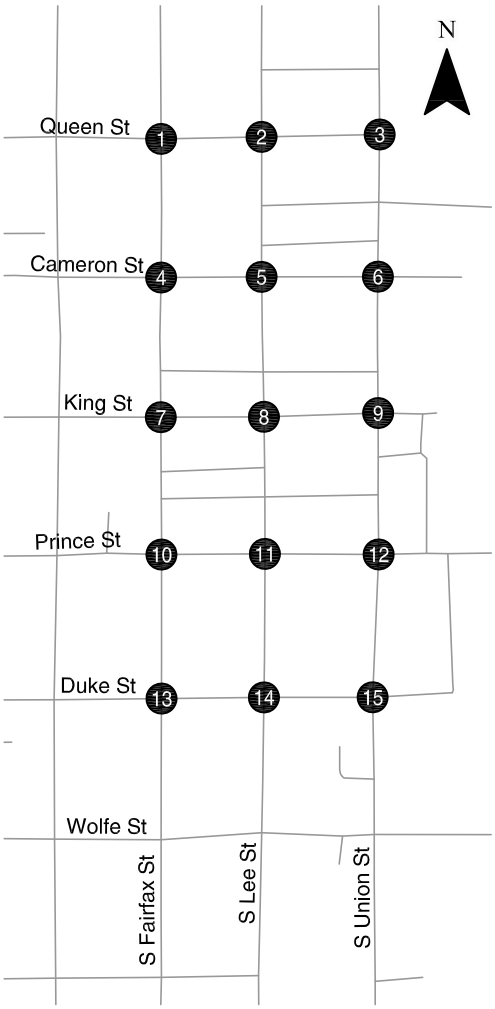
- Cameron Street/Union Street operates at LOS “D” during the weekend p.m. peak hour

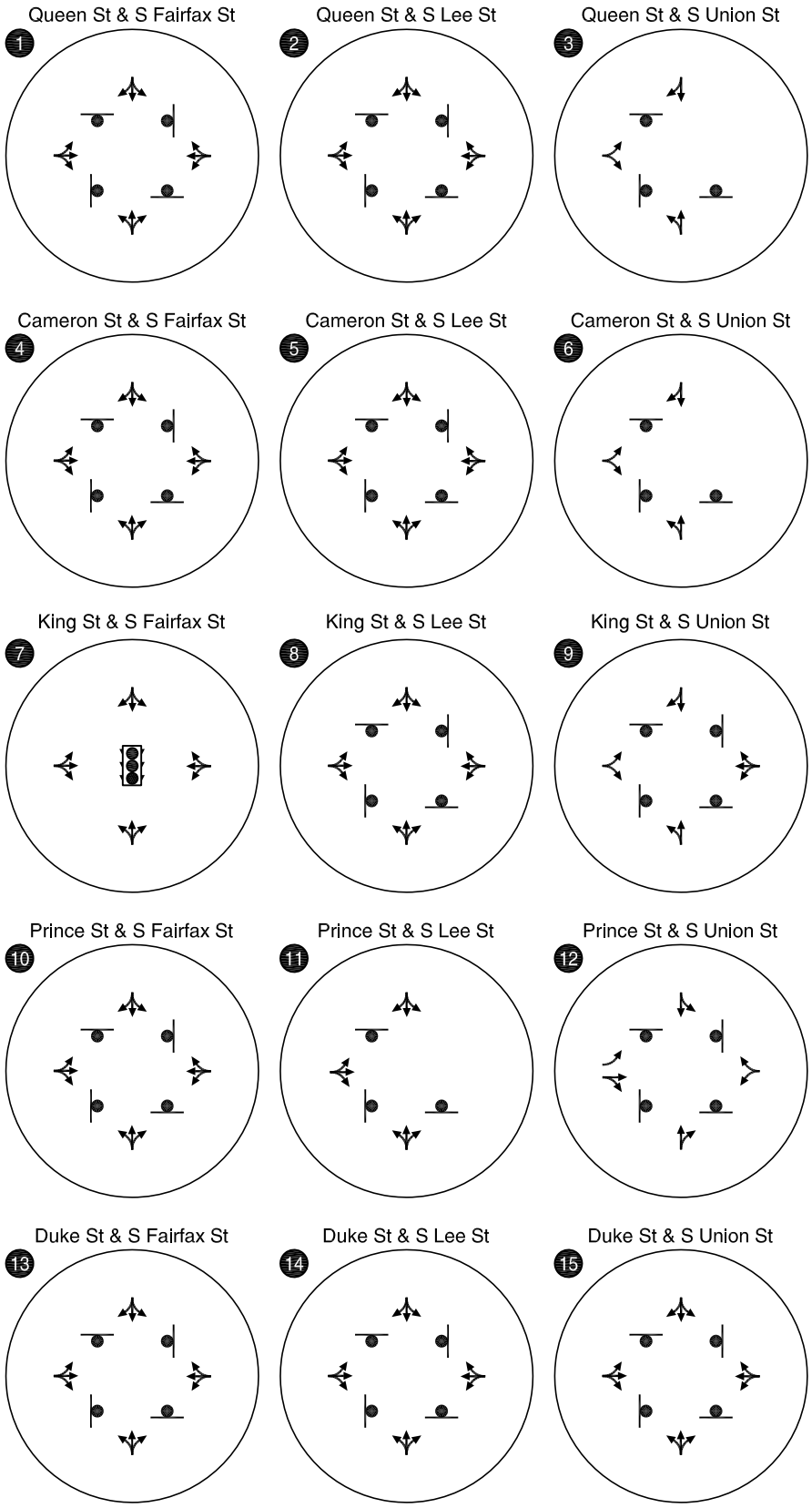
- Prince Street/Union Street operates at LOS 'F" during the weekend p.m. peak hour
- Duke Street/Union Street operates at LOS 'C" during the weekend p.m. peak hour

All three of the above intersections are affected by queue spillback from King Street/Union Street during the weekend p.m. peak hour; this accounts for their decrease in LOS for the SimTraffic results.

CONCLUSIONS

The analysis shows that while the King Street intersections operate at LOS "A" or LOS "B" with the HCM methodology, the SimTraffic results that incorporate pedestrian activity show that vehicles at those intersections experience much more delay. The difference in results between the two analysis methods is based on how each method accounts for the presence of conflicting pedestrians at the all-way stop controlled intersections. Because the HCM methodology is largely based on measuring the effects of geometric capacity on vehicle operations, the HCM results indicate that there is enough capacity on the roadway network to accommodate the existing traffic volumes (without accounting for interactions with pedestrians). The SimTraffic models better reflect the impacts of high pedestrian volumes on vehicle operations, and indicate that it is the pedestrian volumes that are constraining the vehicular operations.





- STOP SIGN
- TRAFFIC SIGNAL

Lane Configuration
Alexandria, VA

Figure
2

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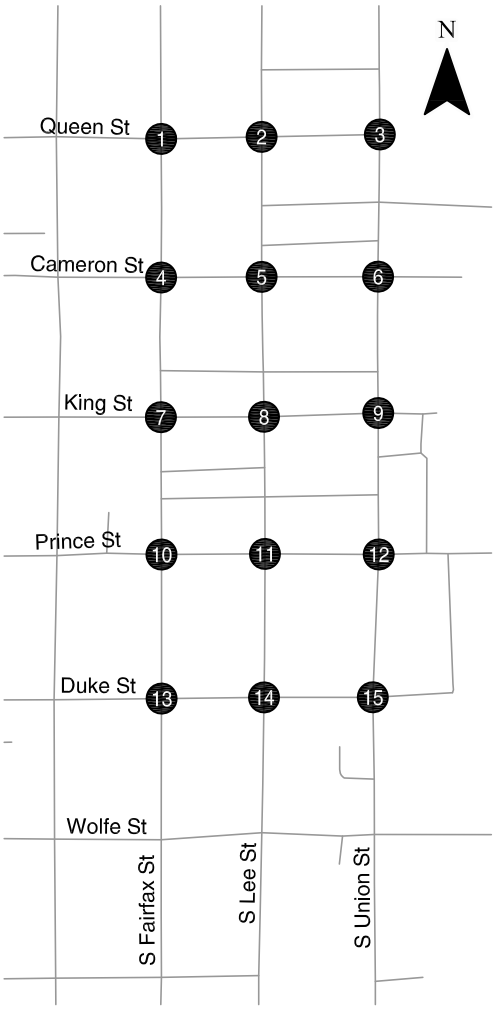

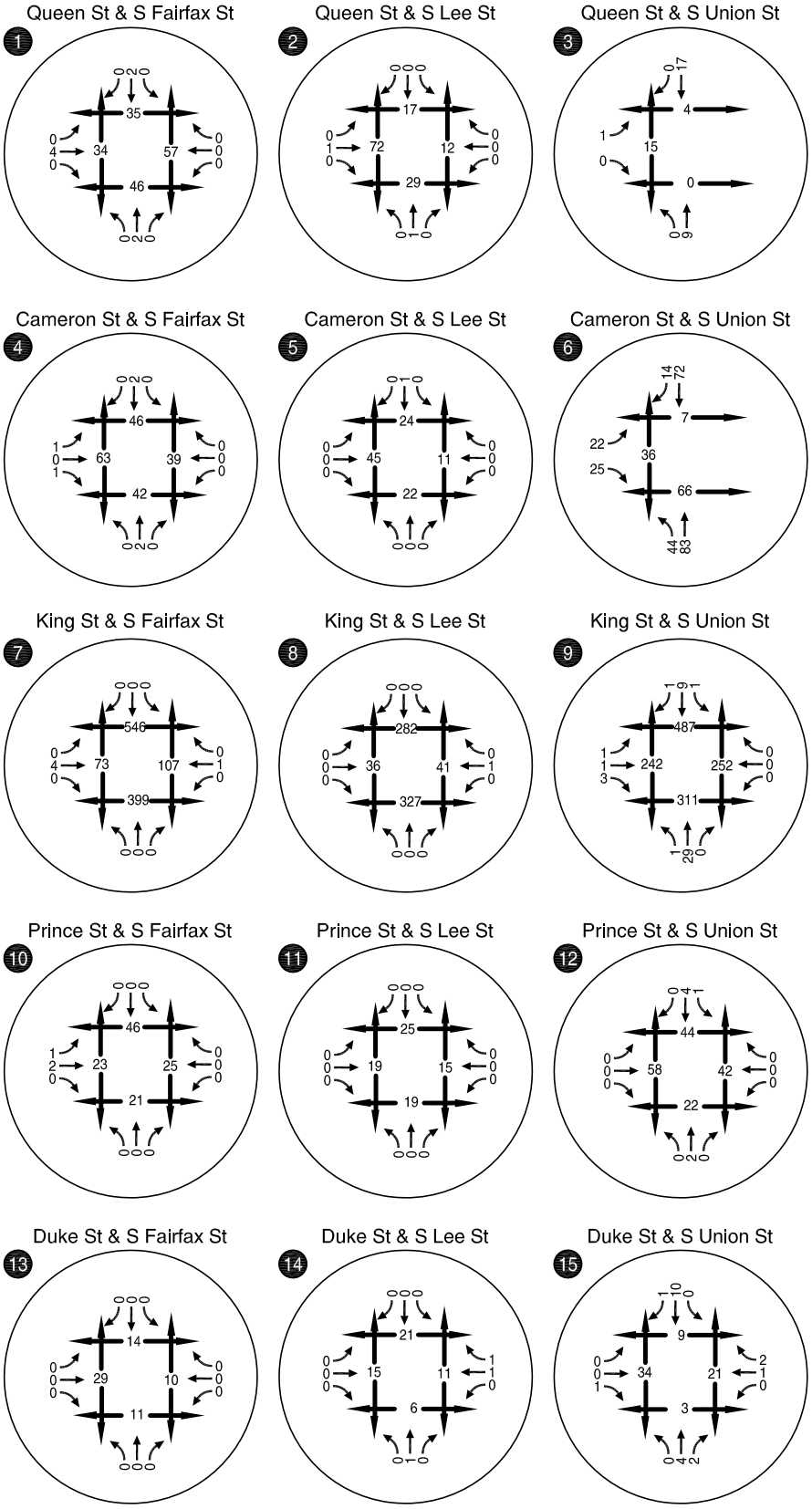

Weekday Midday Peak Hour Pedestrian and Bicycle Volumes
Alexandria, VA

Figure
3

= Pedestrian Crossing Volumes
= Bicycle Volumes

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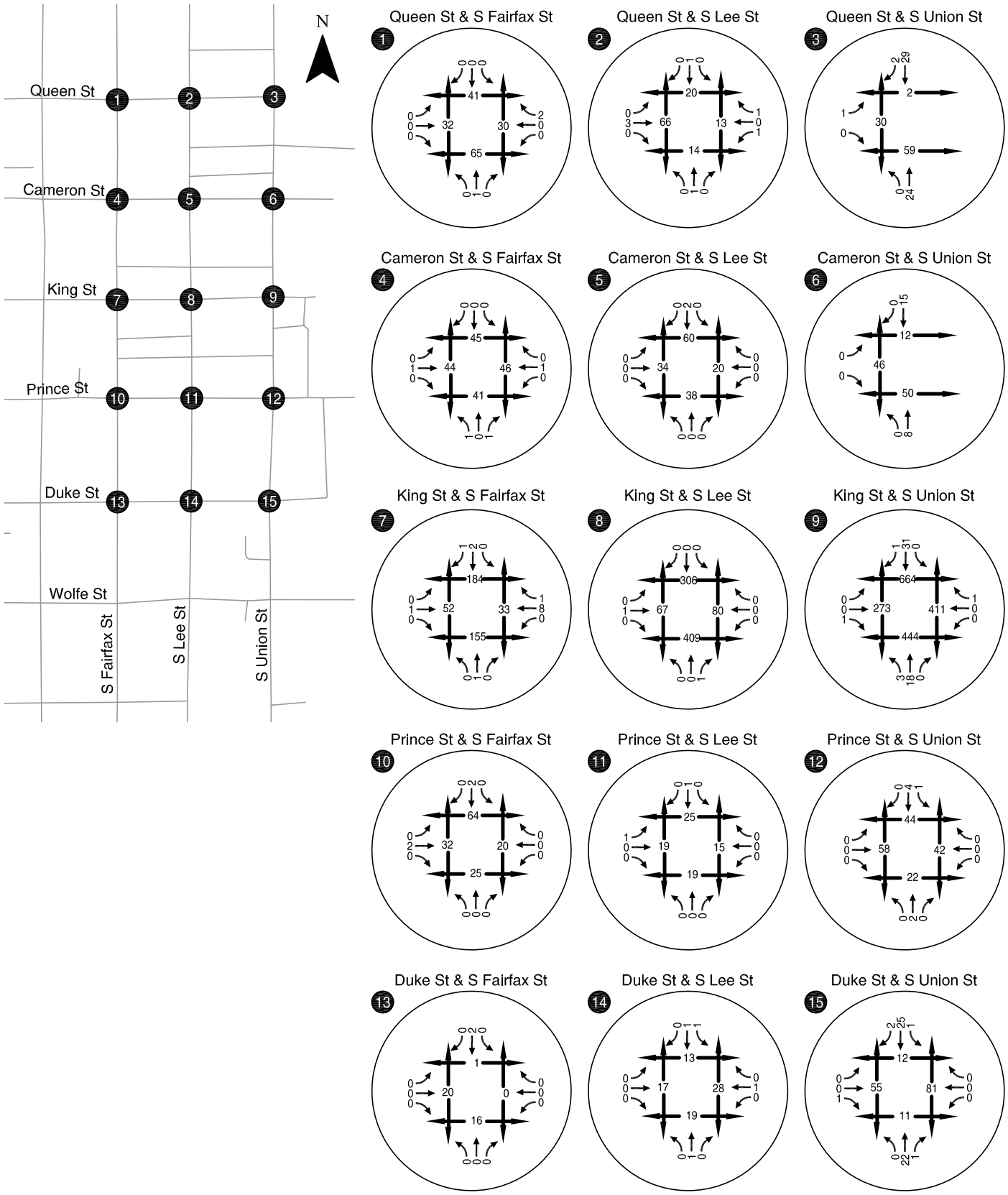

Weekday PM Peak Hour Pedestrian and Bicycle Volumes
Alexandria, VA

Figure
4

= Pedestrian Crossing Volumes
= Bicycle Volumes

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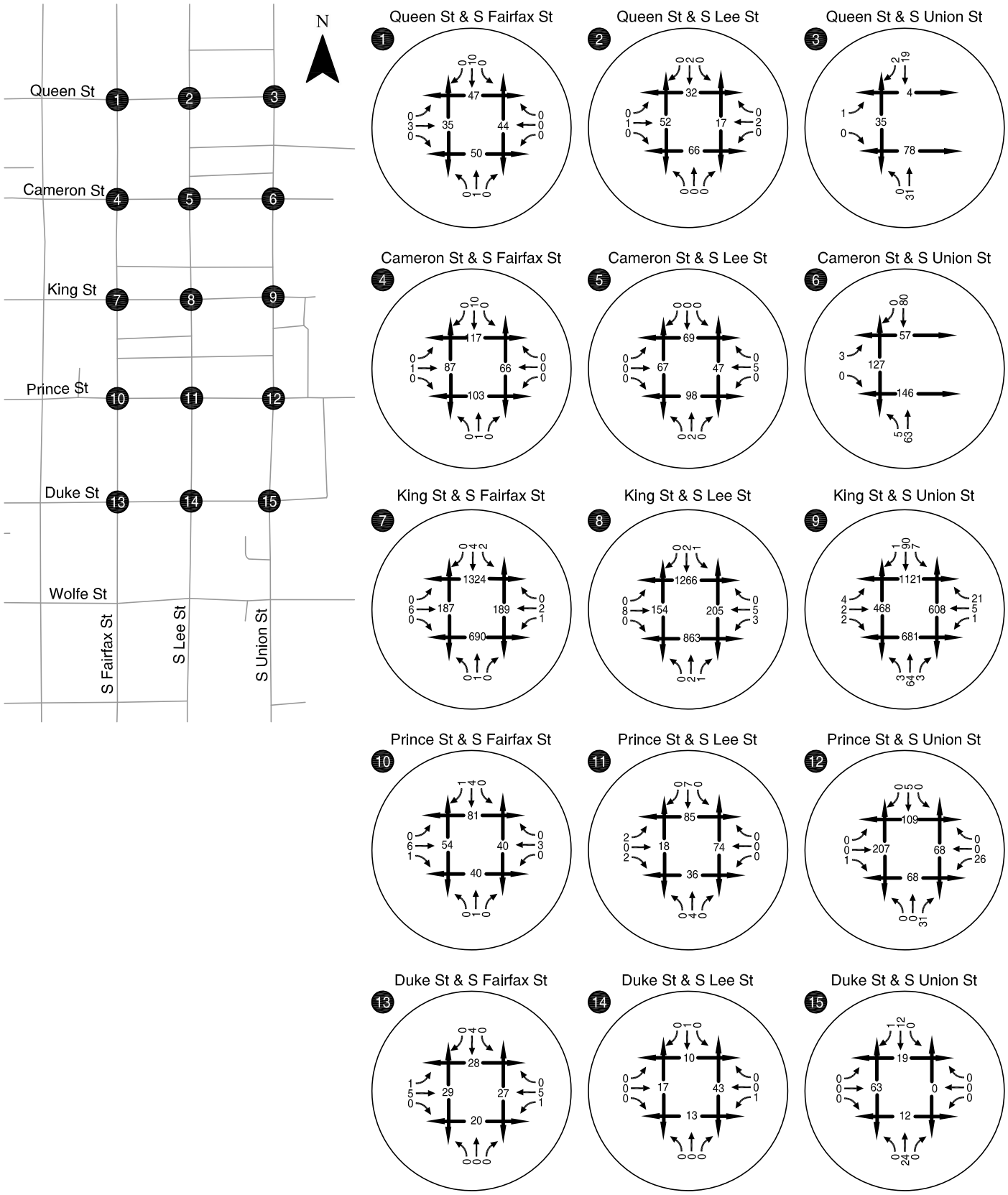

Weekend Midday Peak Hour Pedestrian and Bicycle Volumes
Alexandria, VA

Figure
5

= Pedestrian Crossing Volumes
= Bicycle Volumes

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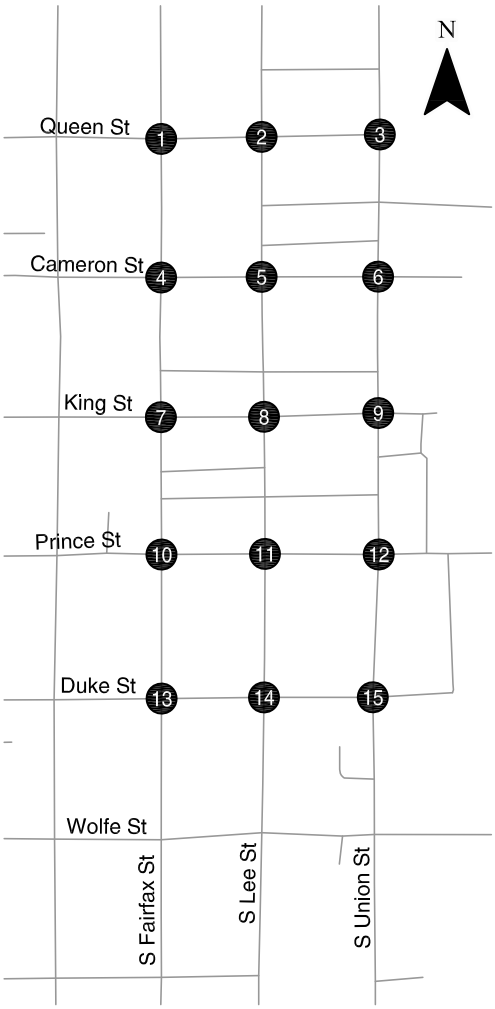

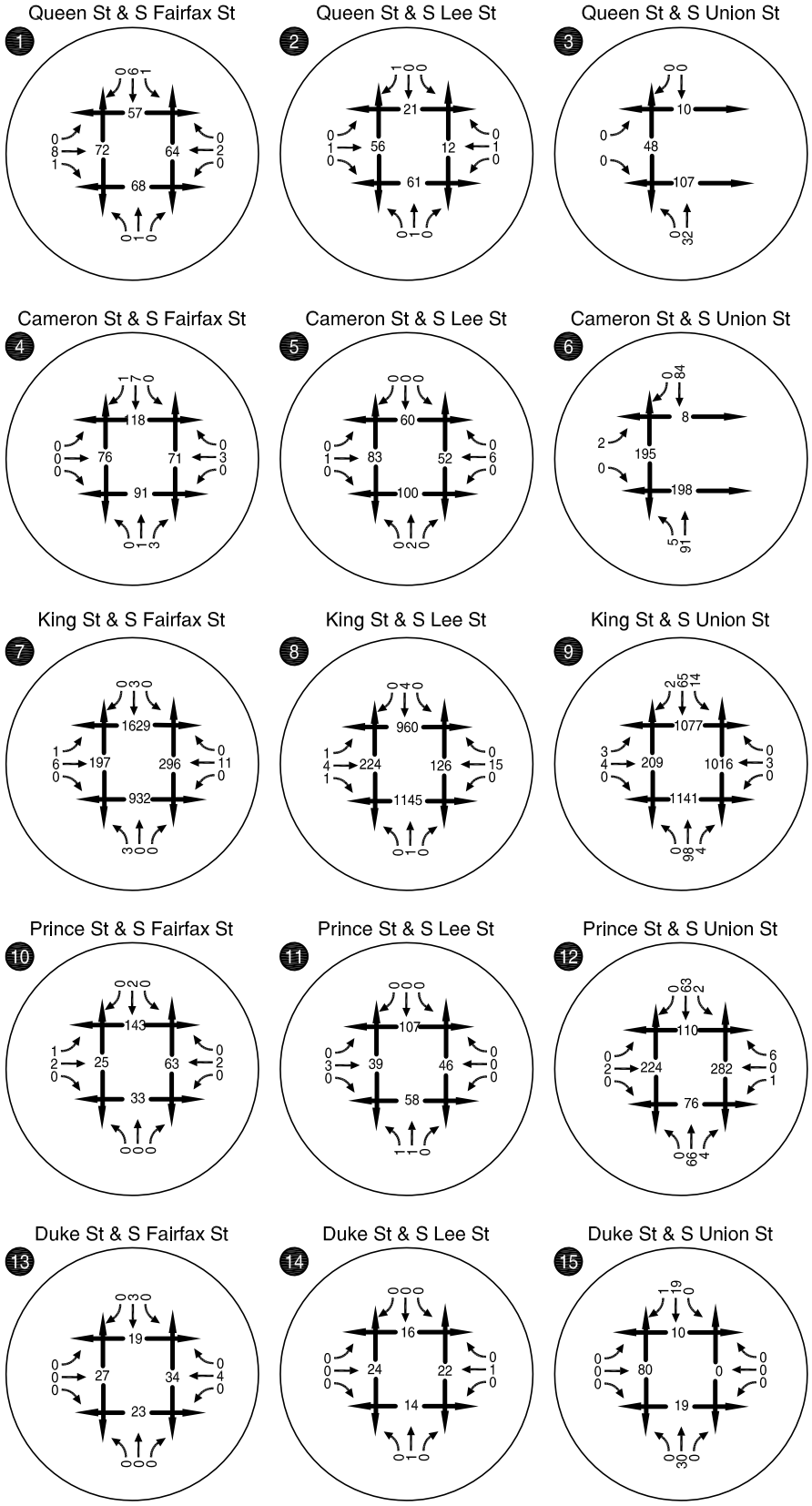

Weekend PM Peak Hour Pedestrian and Bicycle Volumes
Alexandria, VA

Figure
6

= Pedestrian Crossing Volumes
= Bicycle Volumes

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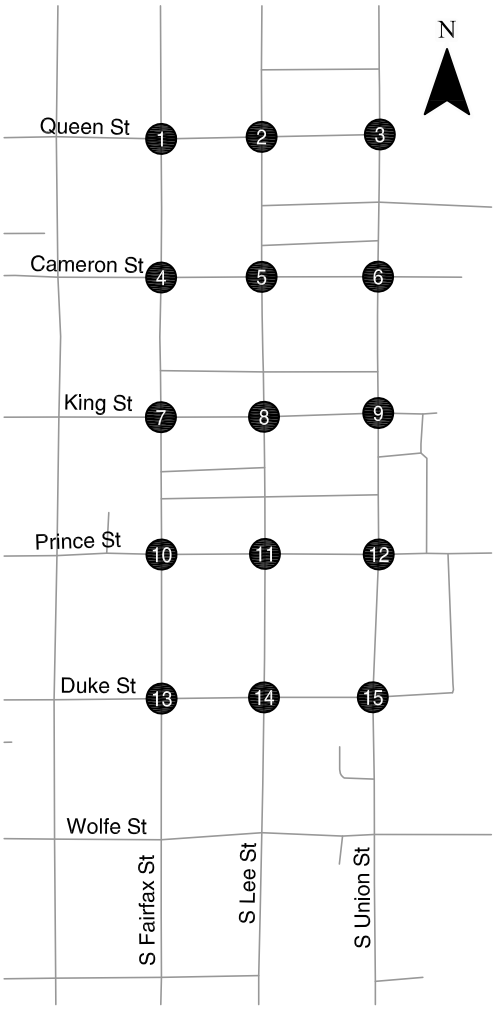

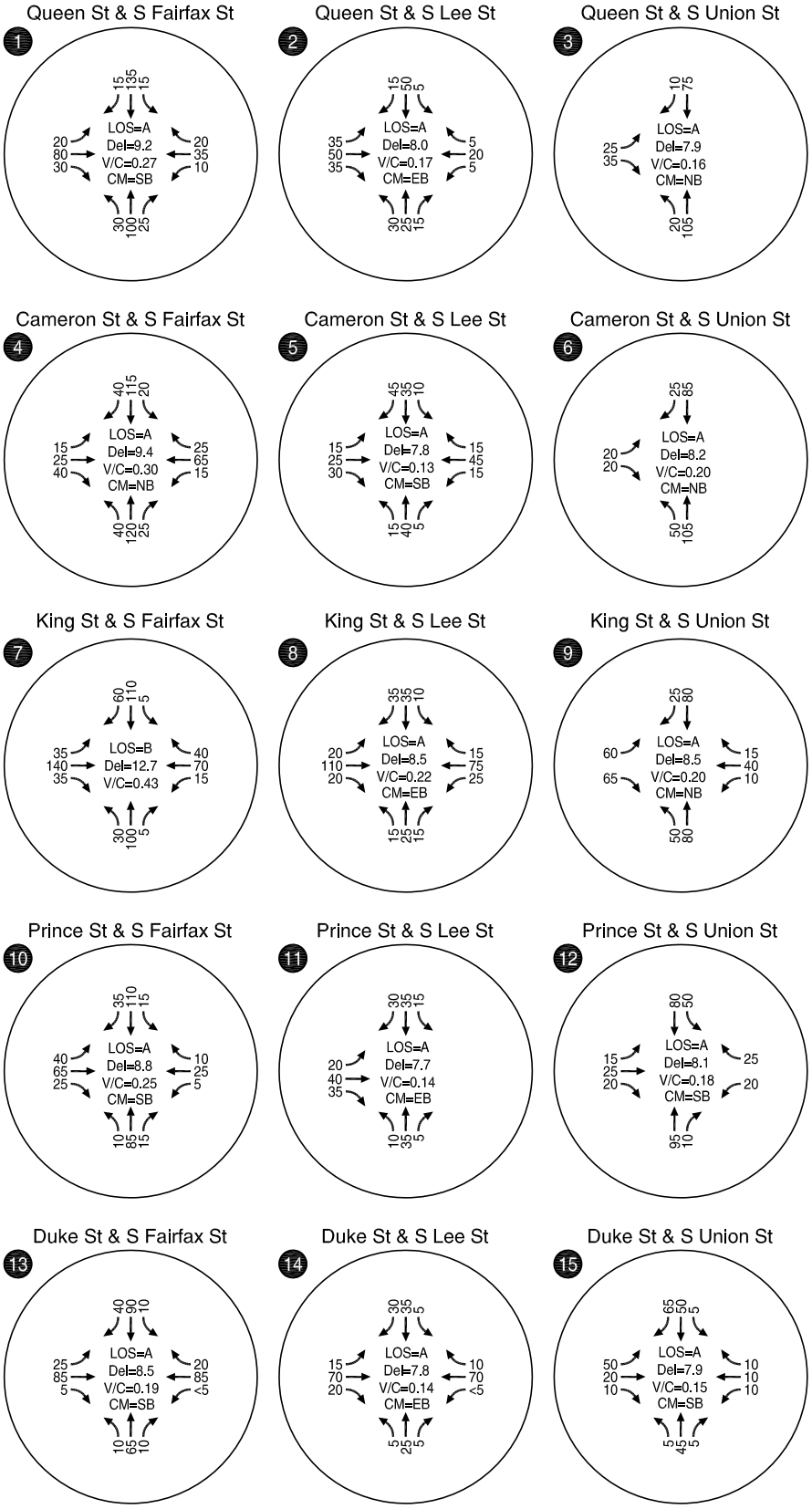

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Del = INTERSECTION AVERAGE CONTROL DELAY
V/C = INTERSECTION VOLUME-TO-CAPACITY RATIO (SIGNALS) CRITICAL VOLUME-TO-CAPACITY RATIO (AWSC)
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Weekday Midday Peak Hour Traffic Operations HCM Results Alexandria, VA

Figure 7

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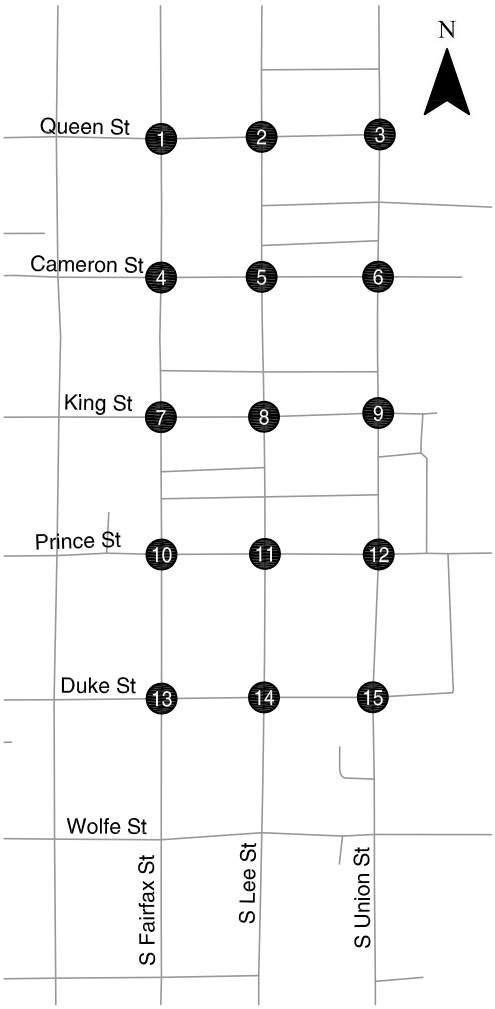

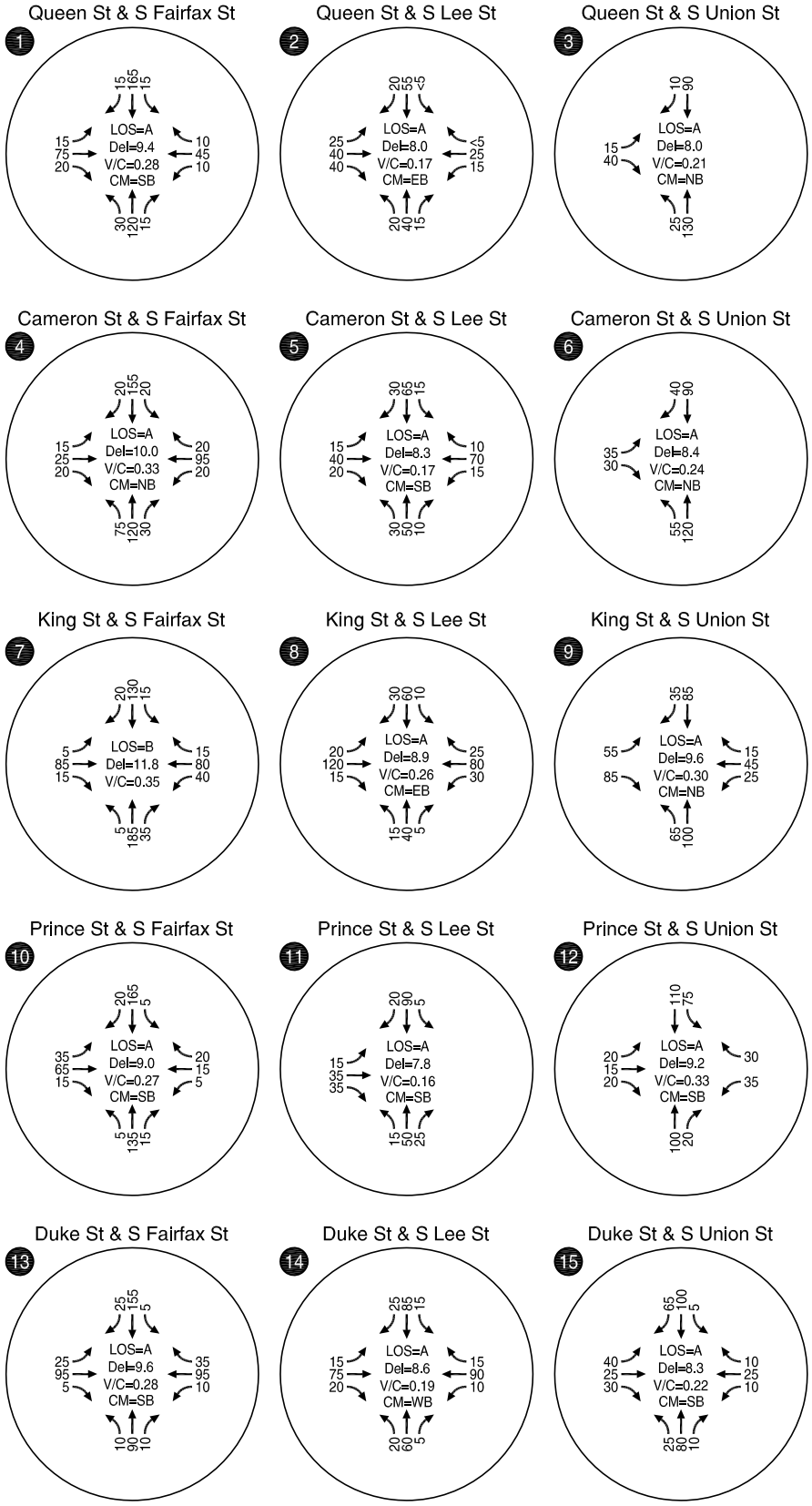

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Weekday PM Peak Hour Traffic Operations HCM Results Alexandria, VA

Figure 8

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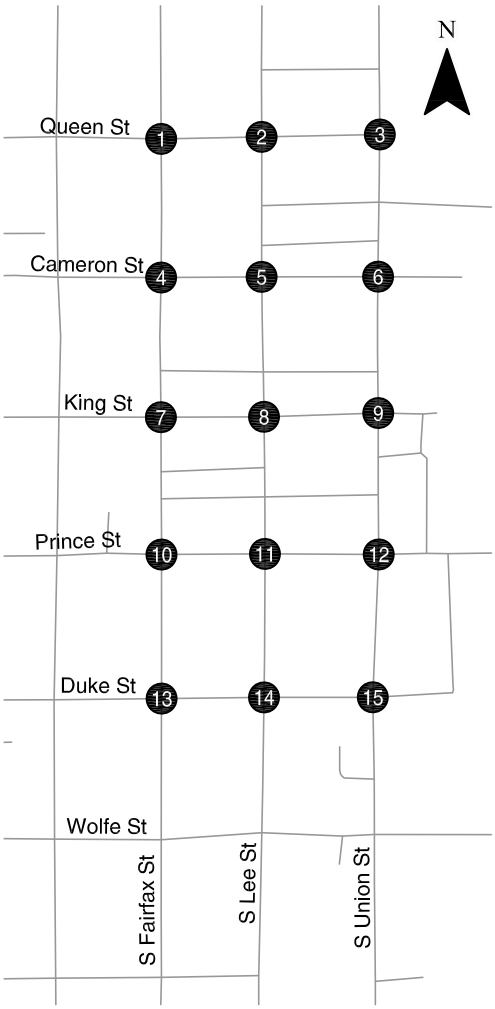

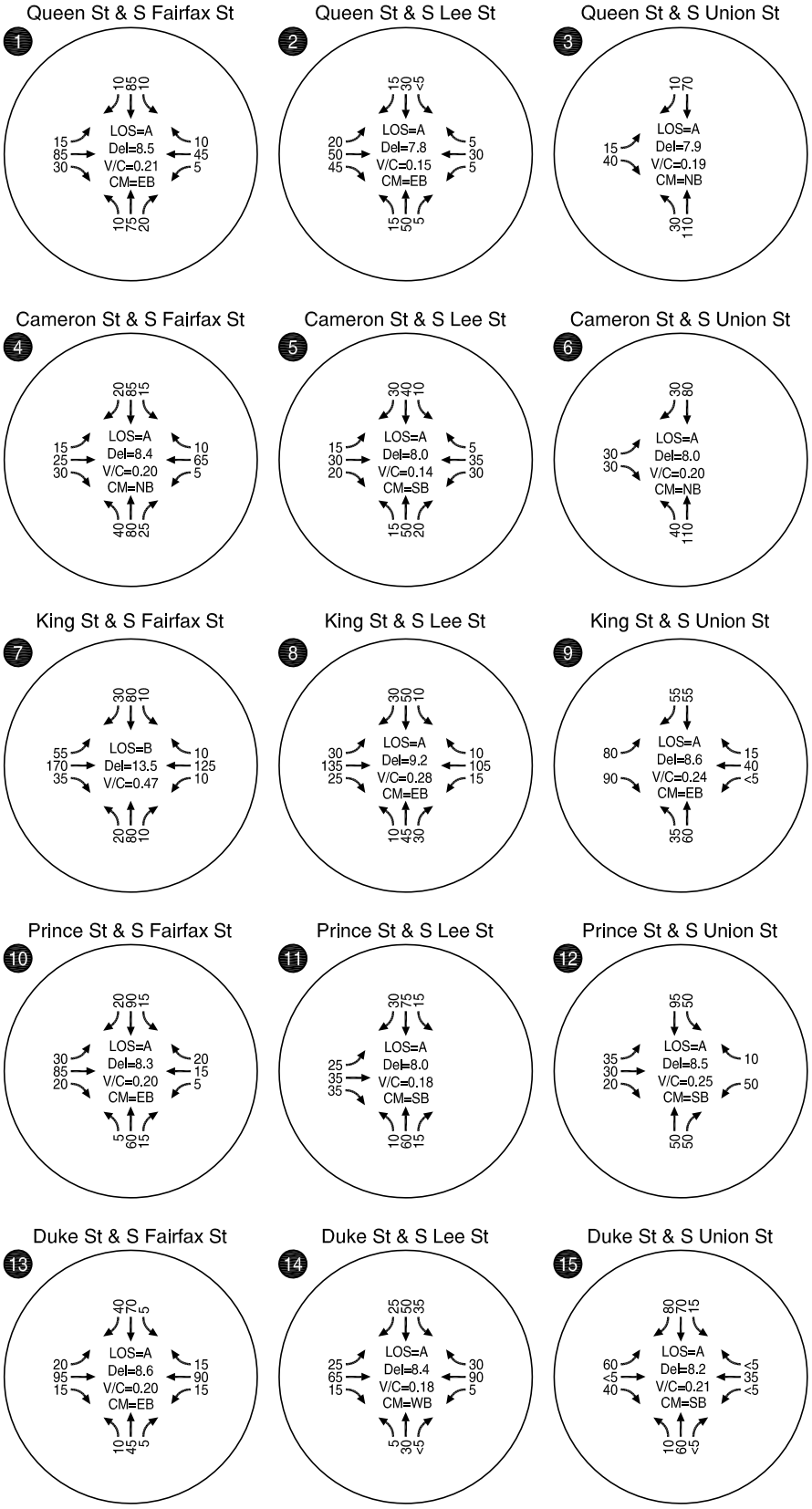

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Weekend Midday Peak Hour Traffic Operations HCM Results Alexandria, VA

Figure 9

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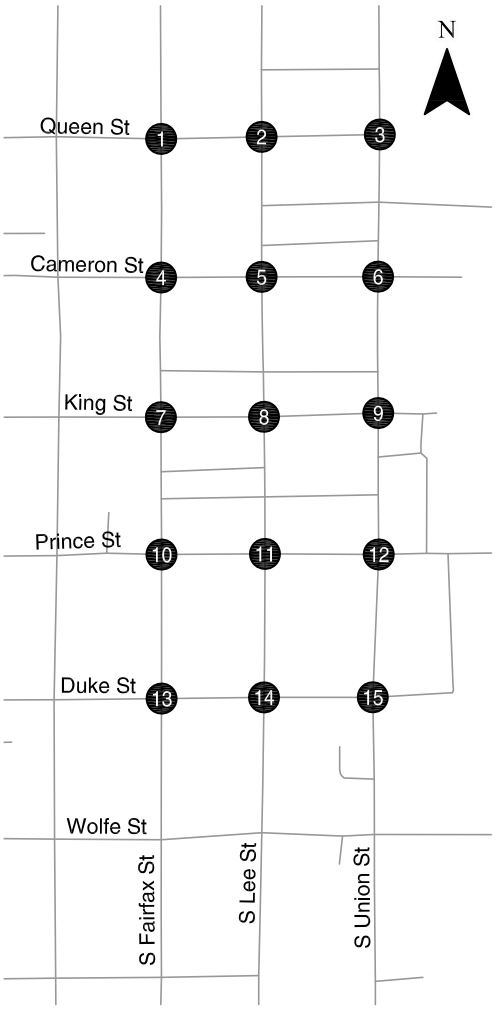

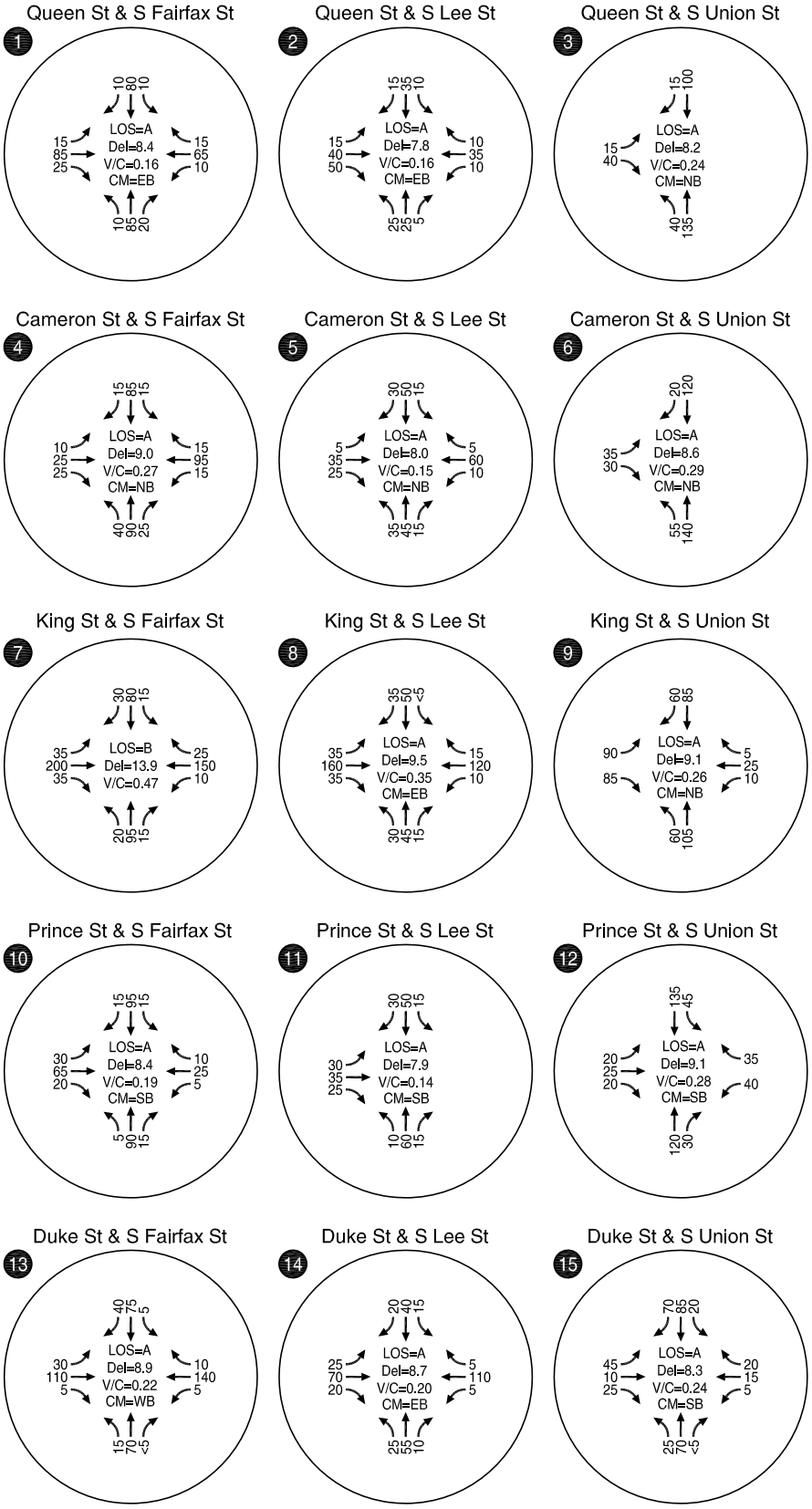

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Weekend PM Peak Hour Traffic Operations HCM Results Alexandria, VA

Figure 10

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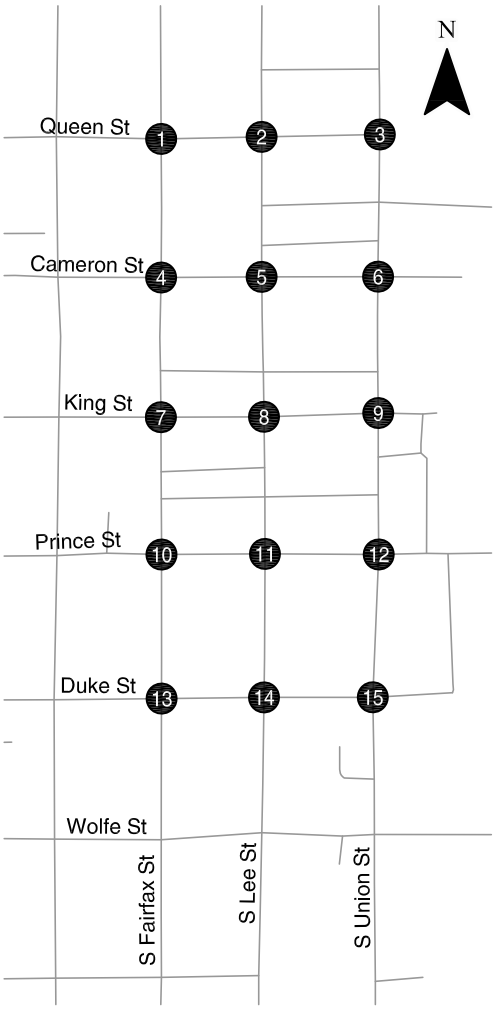

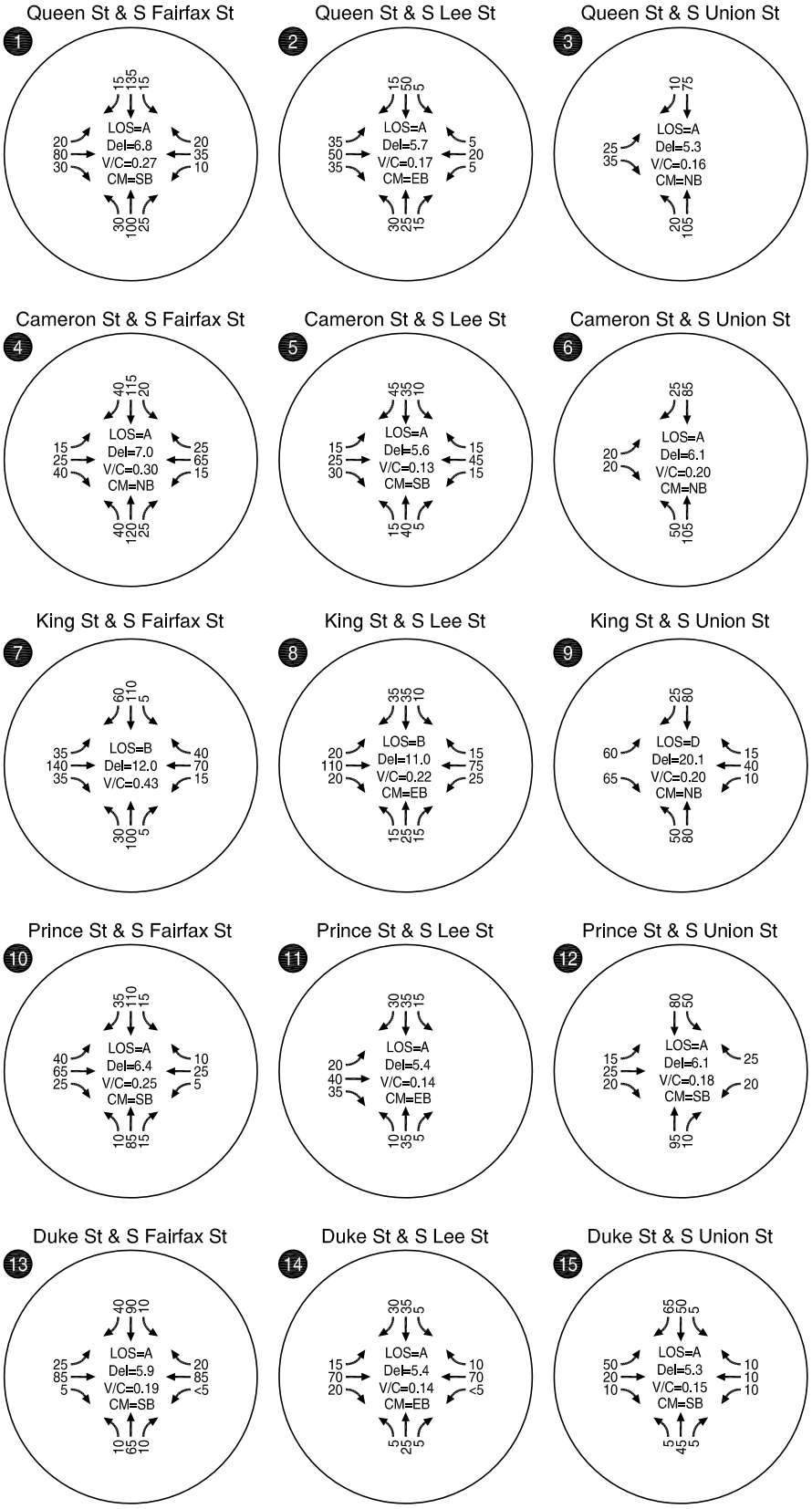

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Weekday Midday Peak Hour Traffic Operations SimTraffic Results Alexandria, VA

Figure 11

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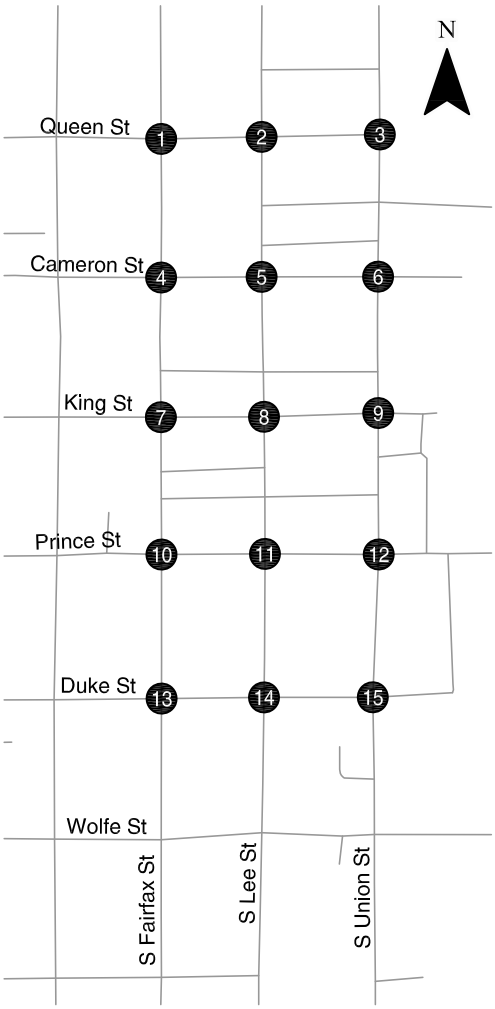

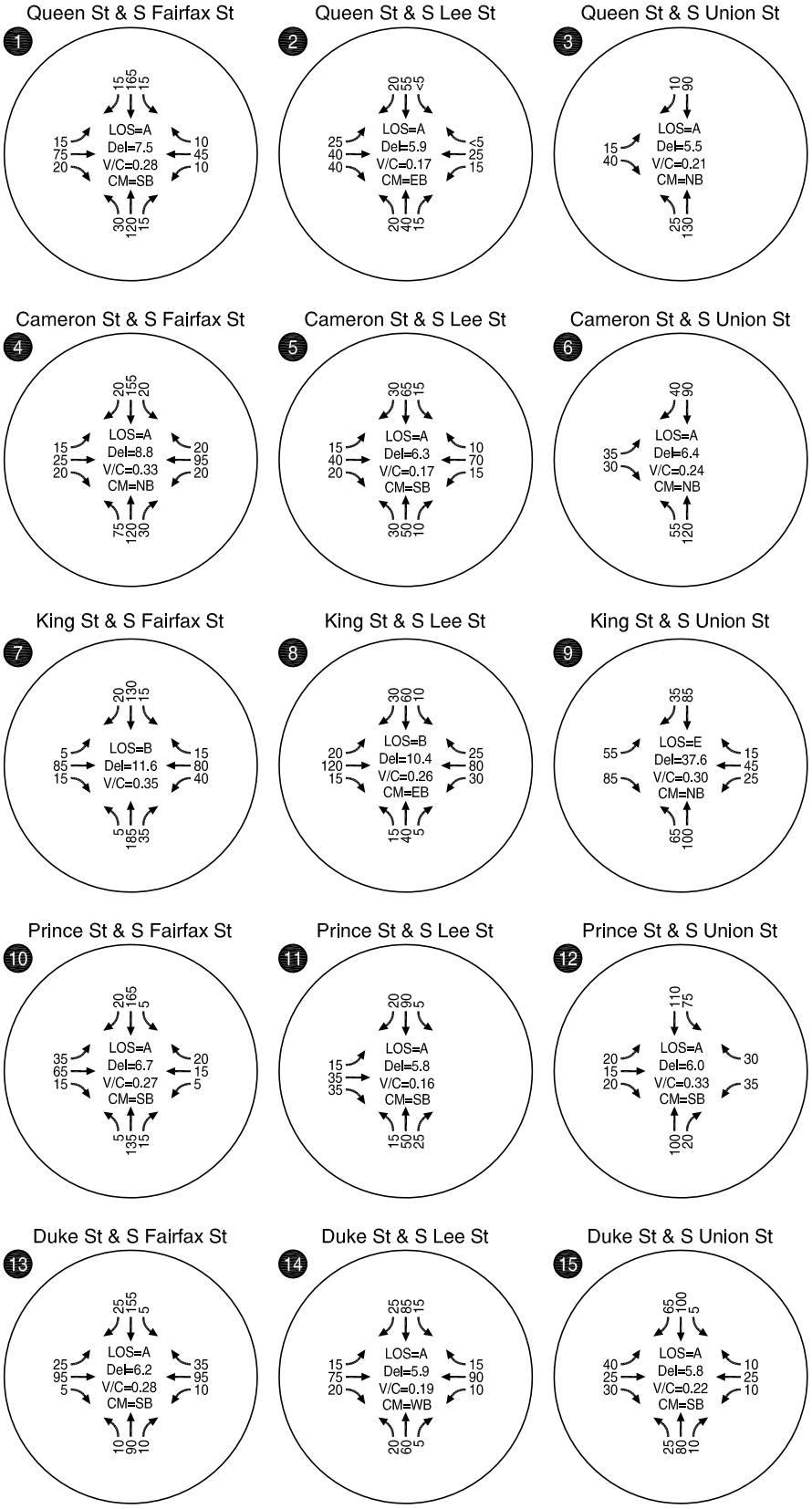

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Weekday PM Peak Hour Traffic Operations SimTraffic Results Alexandria, VA

Figure 12

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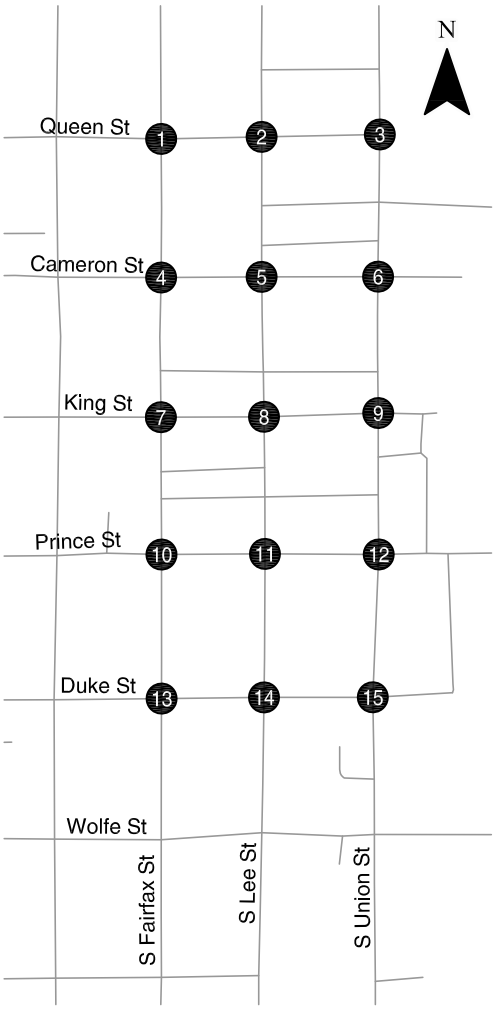

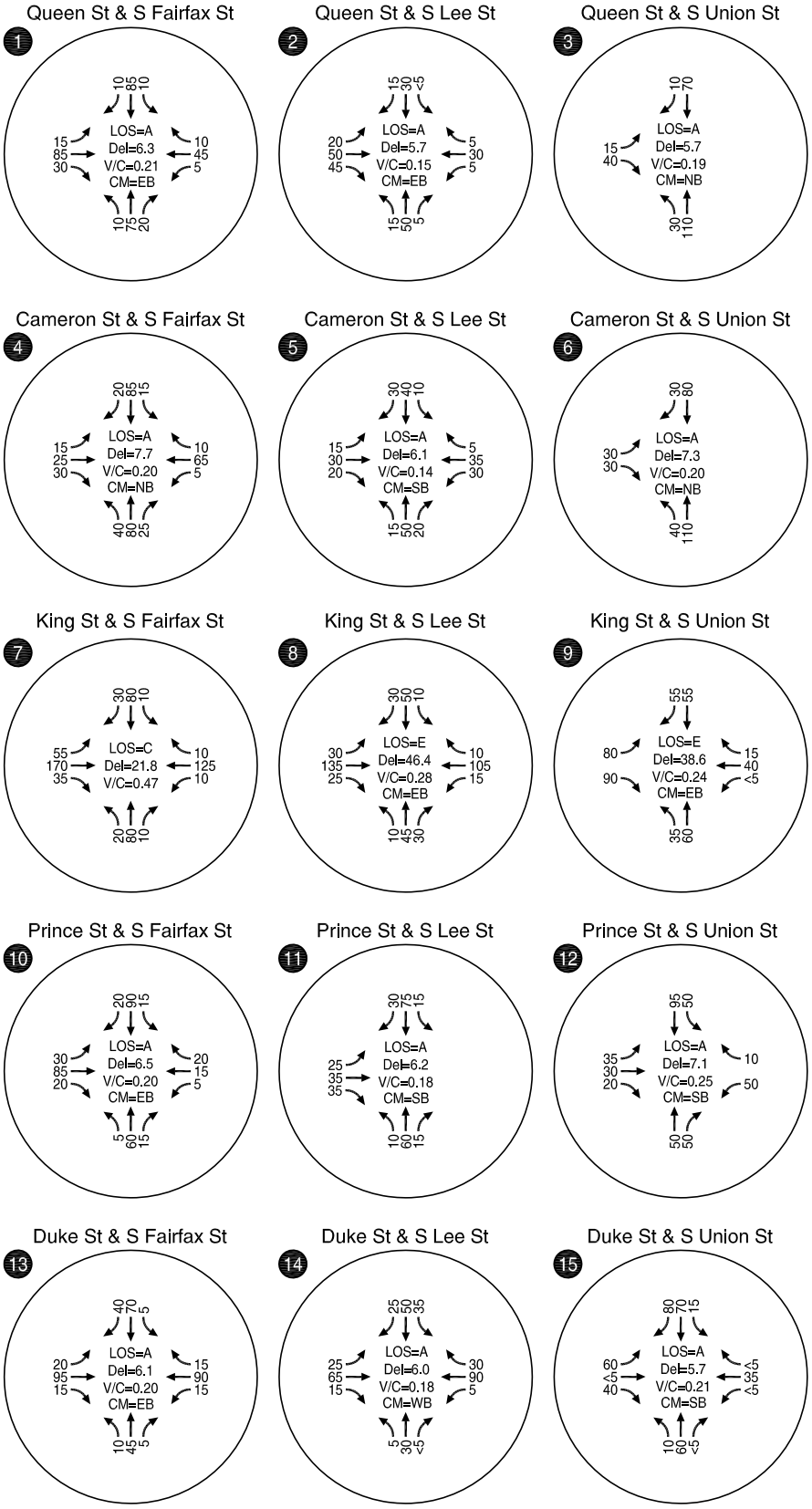

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Weekend Midday Peak Hour Traffic Operations SimTraffic Results Alexandria, VA

Figure 13

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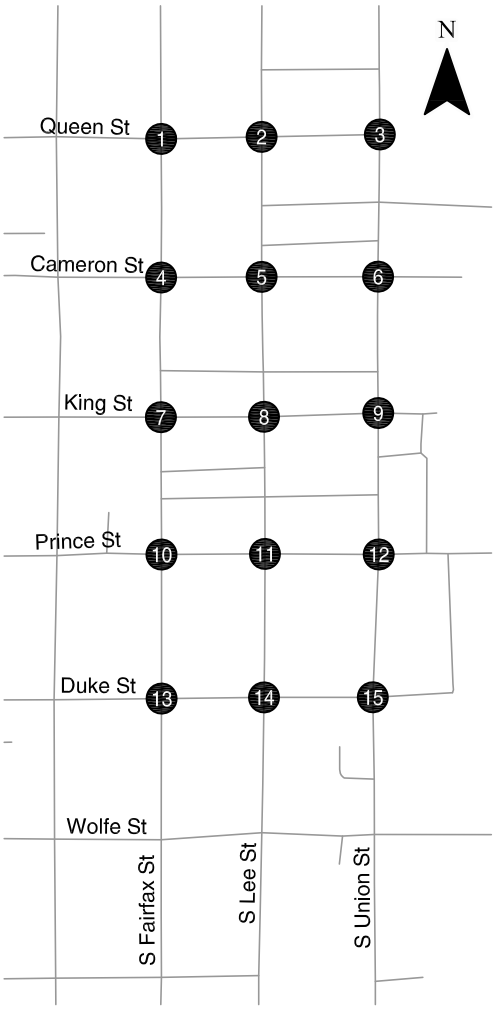

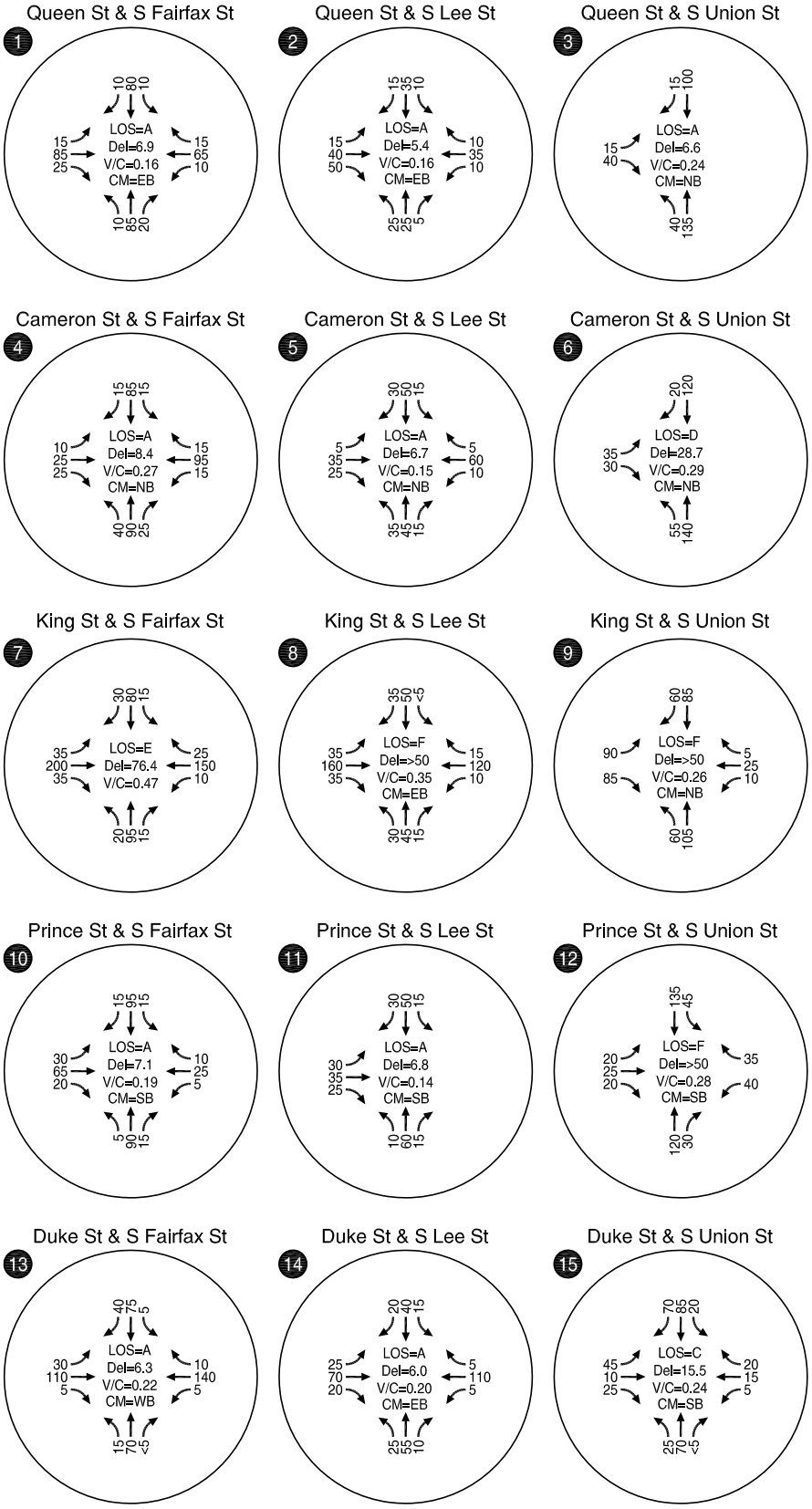

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Weekend PM Peak Hour Traffic Operations SimTraffic Results Alexandria, VA

Figure 14

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