



East High Streetscape Traffic Report

Existing and No-Build Conditions Draft – February 2018

PREPARED FOR



PREPARED BY

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Chapter 1 Introduction

1.1 Purpose

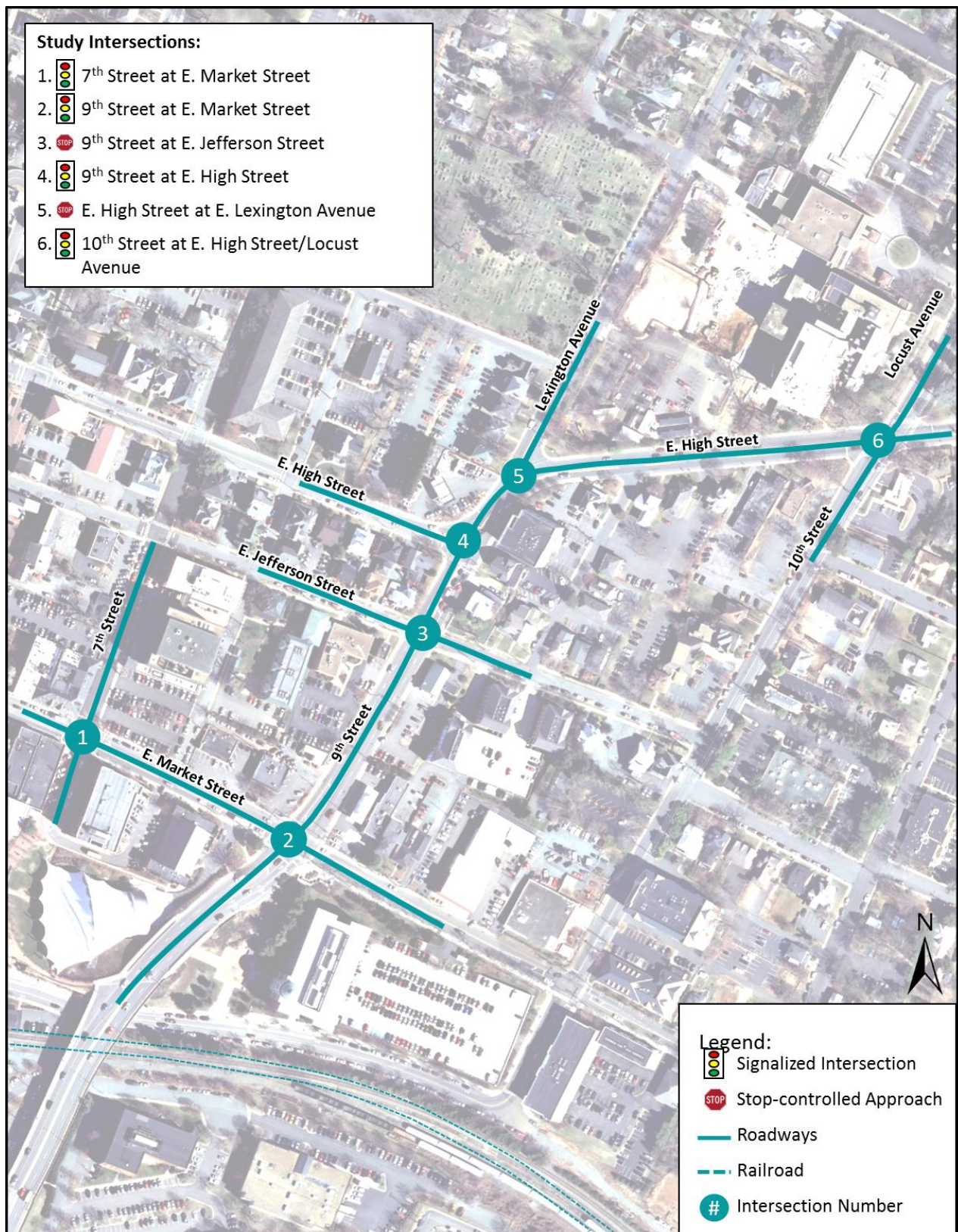
The City of Charlottesville successfully obtained funding for a streetscape project along East High Street through the SMART SCALE Prioritization Process in 2016. Virginia's SMART SCALE process grew out of General Assembly Bill 1887 and established a transparent statewide transportation prioritization process that allows stakeholders to be held accountable for public tax dollars invested into transportation improvements. The East High Streetscape project envisions multimodal improvements on E. Market Street between 7th Street and 9th Street and on 9th Street/E. High Street from E. Market Street to 10th Street/Locust Avenue. The streetscape improvements include: widening sidewalks, landscaping with street trees, intersection improvements for better ADA and pedestrian access, bike lanes, stormwater quality features, improved way-finding signage, traffic signal upgrades, enhanced access to existing transit facilities and energy efficient pedestrian lighting and relocation and/or undergrounding of overhead utilities. The purpose of the East High Streetscape Traffic Report is to support the preliminary and final design efforts for the streetscape improvements.

1.2 Study Area

The study area for the East High Streetscape Traffic Report extends along E. Market Street between 7th Street and 9th Street and 9th Street/E. High Street from E. Market Street to the 10th Street/Locust Avenue intersection. The length of the study area is approximately 0.35 miles. **Figure 1** shows the limits of the study. The study area included the following six at-grade intersections:

1. 7th Street at E. Market Street
2. 9th Street at E. Market Street
3. 9th Street at E. Jefferson Street
4. 9th Street at E. High Street
5. E. High Street at Lexington Avenue
6. 10th Street at E. High Street/Locust Avenue

Figure 1: Study Area Intersections



Chapter 2 Data Collection

A preliminary field review of the study area was conducted on November 14, 2017 to observe peak hour traffic conditions, driver behavior, and to verify existing data. In addition to the field review, existing traffic volume data was collected including turning movement counts, tube counts, historical AADTs, and signal timing plans. The following sections summarize the collected data and field review observations.

2.1 Corridor Characteristics

Field reconnaissance of existing (2017) conditions in the study area verified the posted speed limit on E. Market Street, 9th Street, and E. High Street throughout the study area was 25 MPH. According to VDOT's 2014 Functional Classification Map, E. Market Street, 9th Street, and E. High Street are classified as other principal arterials within the study area. Based on the latest (2016) published VDOT traffic data, the approximate annual average daily traffic (AADT) for the study area roadway segments are: 9,900 vehicles per day (vpd) on E. Market Street, 14,000 vpd on 9th Street, and 11,000 vpd on E. High Street.

2.2 Land Use

A review of existing zoning and future land use plans was conducted for the areas adjacent to E. High Street within the study area. Along the study corridor the primary zoning classifications is mixed use. Future zoning is expected to remain the same as existing.

2.3 Other Relevant Plans and Studies

The following plans and studies were identified as relevant to the East High Streetscape Traffic Report. These studies helped to inform future traffic projections.

Belmont Bridge Replacement Project Traffic Study (2011)

The *Belmont Bridge Replacement Project Traffic Study* was completed in May 2011. The study identified specific intersection improvements and bridge typical sections in support of the previous Belmont Bridge design efforts conducted by MMM Design Group. The study developed future traffic projections, developed potential maintenance of traffic options anticipated during construction, and summarized the traffic analysis findings of the intersection improvements.

City of Charlottesville Strategic Investment Area Plan (2013)

The *City of Charlottesville Strategic Investment Area (SIA) Plan* was completed in December 2013. The SIA is an approximately 330-acre area south and east of downtown Charlottesville, which includes the entire limits of this project's study area. The SIA was identified by the City as a potential growth area due to its low density and available land areas. In addition, the SIA serves as a gateway to Downtown Charlottesville, including pedestrian and bicycle connections to the Downtown Mall area. The purpose of the plan was to:

- Provide guidance for future redevelopment and investment in the area
- Provide guidance for improvements to affordable housing, including existing public and assisted housing
- Provide guidance for improved connections throughout the area
- Provide recommended strategies for expanding employment opportunities within the SIA

Belmont Bridge Traffic Report (2017)

The *Belmont Bridge Traffic Report* was completed in December 2017. The study identified specific intersection improvements and bridge typical sections in support of the ongoing Belmont Bridge design efforts conducted by Kimley-Horn. The study developed future traffic projections and summarized the traffic analysis findings of the intersection improvements.

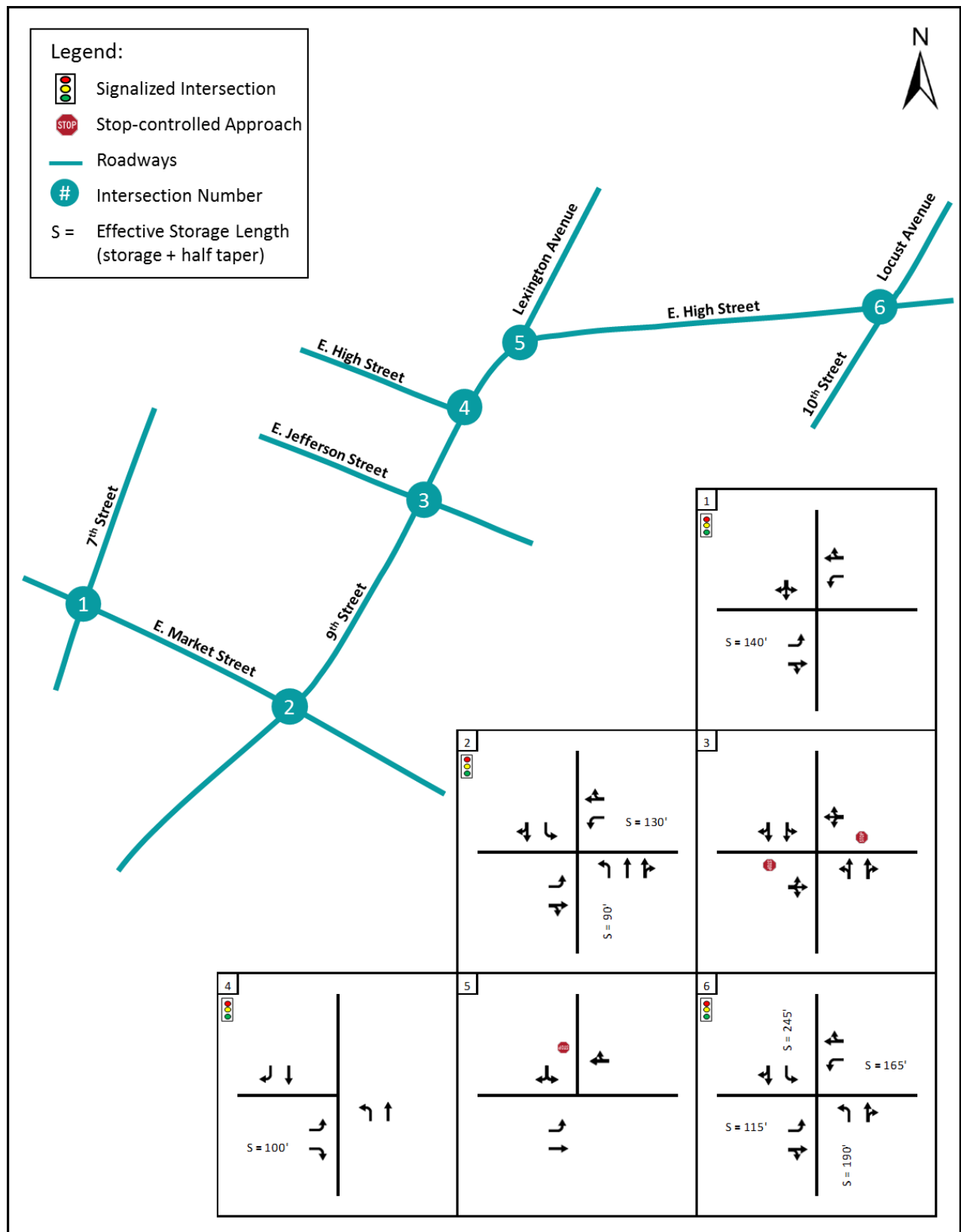
2.4 Existing Roadway Geometry

The existing (2017) roadway geometry in the East High Streetscape study area was observed and documented during the field review. **Figure 2** summarizes the existing lane geometry, including effective storage lengths for left- and right-turn storage bays, for the study area intersections.

The cross-section of Avon Street/9th Street/E. High Street varies throughout the study area. North of Levy Avenue, there are two travel lanes on northbound 9th Street until E. High Street, where the left travel lane drops as a northbound left-turn lane, and the right travel lane continues through to the northeast on E. High Street. 9th Street has two travel lanes in the southbound direction between E. High Street and E. Market Street, but the second travel lane drops as a southbound left-turn lane. Just south of E. Market Street, two 9th Street travel lanes merge to one lane near the Sprint Pavilion. The current design efforts for the Belmont Bridge intend to reconfigure the cross-section between Levy Avenue and E. Market Street to be one travel lane in both directions with turn lanes at intersection approaches.

Sidewalks exist on both sides of E. Market Street, 9th Street and E. High Street within the study area. There is a westbound dedicated shoulder bicycle lane on E. Market Street between 8th Street and 9th Street. The dedicated westbound bicycle lane becomes a shared lane west of 8th Street. Along eastbound E. Market Street, there is a shared bicycle lane between 2nd Street and 9th Street.

Figure 2: Existing (2017) Lane Geometry



2.5 Traffic Data

Study area traffic volumes were collected with tube counts and turning movement counts (TMCs). TMCs were collected on Tuesday, November 14, 2017 for the study area intersections. Pedestrians and bicyclist counts were collected along with the vehicle counts. TMCs were collected at the following intersections:

- 7th Street at E. Market Street
- 8th Street at E. Market Street
- 9th Street at E. Jefferson Street
- E. High Street at Lexington Street
- Lexington Avenue at Maple Street
- E. High Street at 9 ½ Street
- E. High Street at CFA Institute Entrance
- E. High Street at Locust Avenue/10th Street

TMCs collected in 2017 as part of the Belmont Bridge Replacement Project were utilized at the following intersections. These TMCs also included bike and pedestrian counts.

- Avon Street at Monticello Avenue
- Avon Street at Levy Avenue
- 9th Street at Graves Street
- 9th Street at E. Market Street
- 9th Street at E. High Street

72-hour bi-directional tube counts, taken in 15 minute increments, were conducted on E. High Street between Lexington Avenue and Locust Avenue/10th Street from Tuesday, November 14, 2017 to Thursday, November 16, 2017. The 72-hour tube count that was conducted on 9th Street between Graves Street and E. Market Street as a part of the Belmont Bridge Replacement Project was also utilized. The AM peak hour was determined to be between 8:00AM – 9:00AM, and the PM peak hour was determined to be 4:30PM – 5:30PM. Traffic count data is included in **Appendix A**.

2.5.1 Field Review Observations

During the field review on November 14, 2017, existing conditions and traffic operations were observed. The following observations were found:

- Pedestrian traffic traversing 9th Street at the unsignalized intersection crossing at E. Jefferson Street
- Bicyclists were observed traveling in mixed traffic along the 9th Street corridor
- Southbound vehicle queues at 9th Street and E. Market Street extended back to E. High Street during the AM peak hour
- Northbound vehicle queues at 9th Street and E. High Street extended beyond E. Jefferson Street during the AM peak hour
- Southbound vehicle queues at E. High Street and 10th Street/Locust Avenue extended toward Sycamore Street in the AM peak hour
- Southbound vehicle queues at Avon Street and Levy Avenue extended back to E. Market Street during the PM peak hour

- Eastbound vehicle queues at 9th Street and E. Market Street extended beyond 4th Street during the PM peak hour
- Minimal queuing on other side streets within the study area in both peak hours



PEDESTRIAN CROSSING 9TH STREET AT E. JEFFERSON STREET



BICYCLIST TRAVELING SOUTHBOUND ON 9TH STREET



SOUTHBOUND AM PEAK HOUR QUEUES AT 9TH STREET AND E. MARKET STREET



NORTHBOUND AM QUEUES AT 9TH STREET AND E. HIGH STREET



SOUTHBOUND PM PEAK HOUR QUEUES FROM AVON STREET AT LEVY AVENUE



EASTBOUND PM PEAK HOUR QUEUES AT 9TH STREET AND E. MARKET STREET

2.5.2 Traffic Volumes

Using the available TMC data, the traffic volumes were balanced through the network for the existing conditions operational analyses. Peak hour traffic volumes were balanced using an iterative process until the volumes were within a reasonable tolerance. The Existing 2017 balanced AM and PM peak hour volumes in the study area are summarized in **Figure 3**.

Pedestrian and bicycle traffic data was also collected in the TMCs within the study area. The AM and PM peak period pedestrian and bicycle volumes are summarized in **Figure 4** and **Figure 5**, respectively.

2.5.3 Heavy Vehicle Percentages

Heavy vehicle percentages were calculated for each movement at all study area intersections during the overall study area AM and PM peak hours. **Figure 6** contains a summary of the AM and PM peak hour heavy vehicle percentages for each intersection.



Figure 3: Existing (2017) Vehicle Volumes

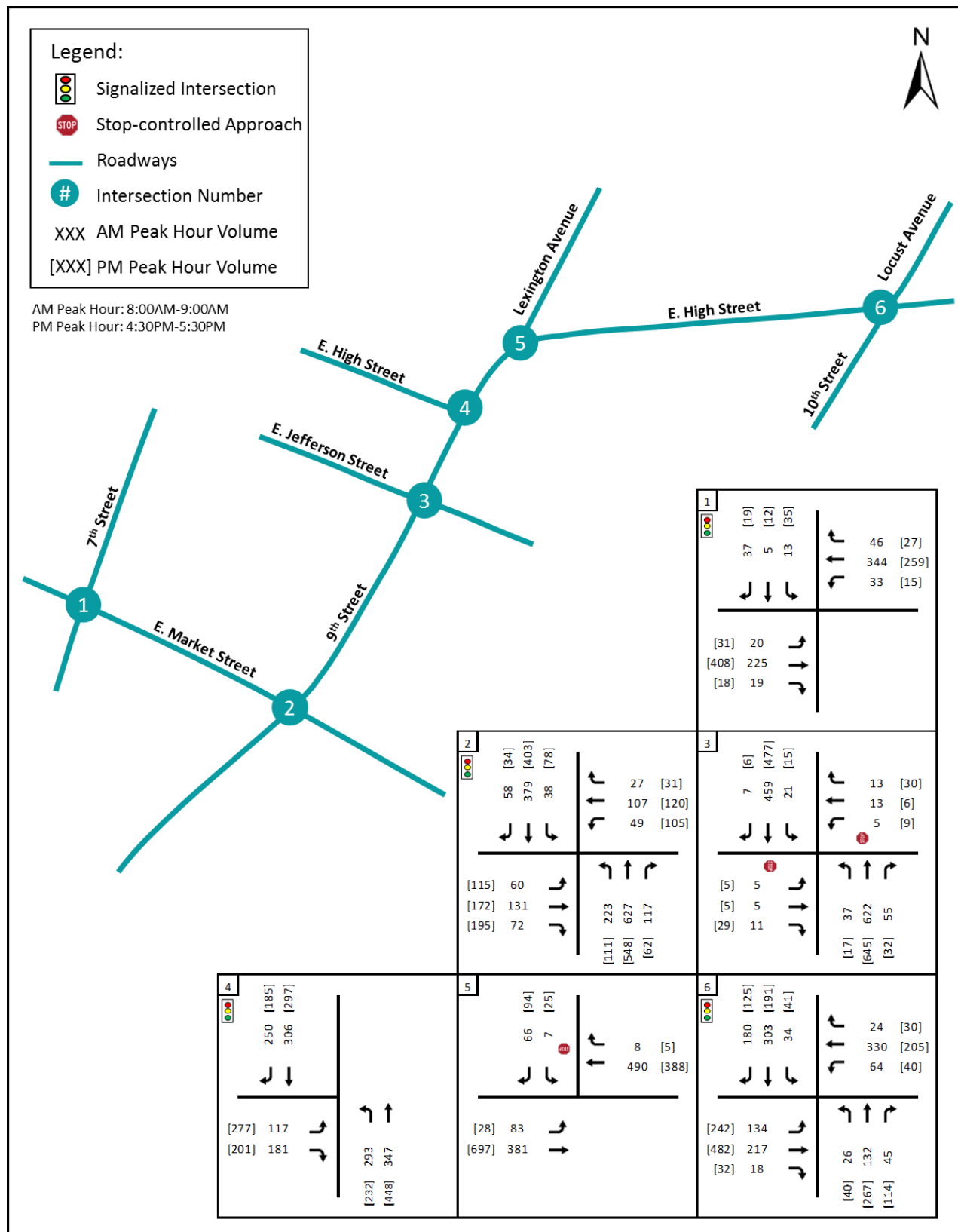


Figure 4: Existing (2017) Pedestrian Volumes

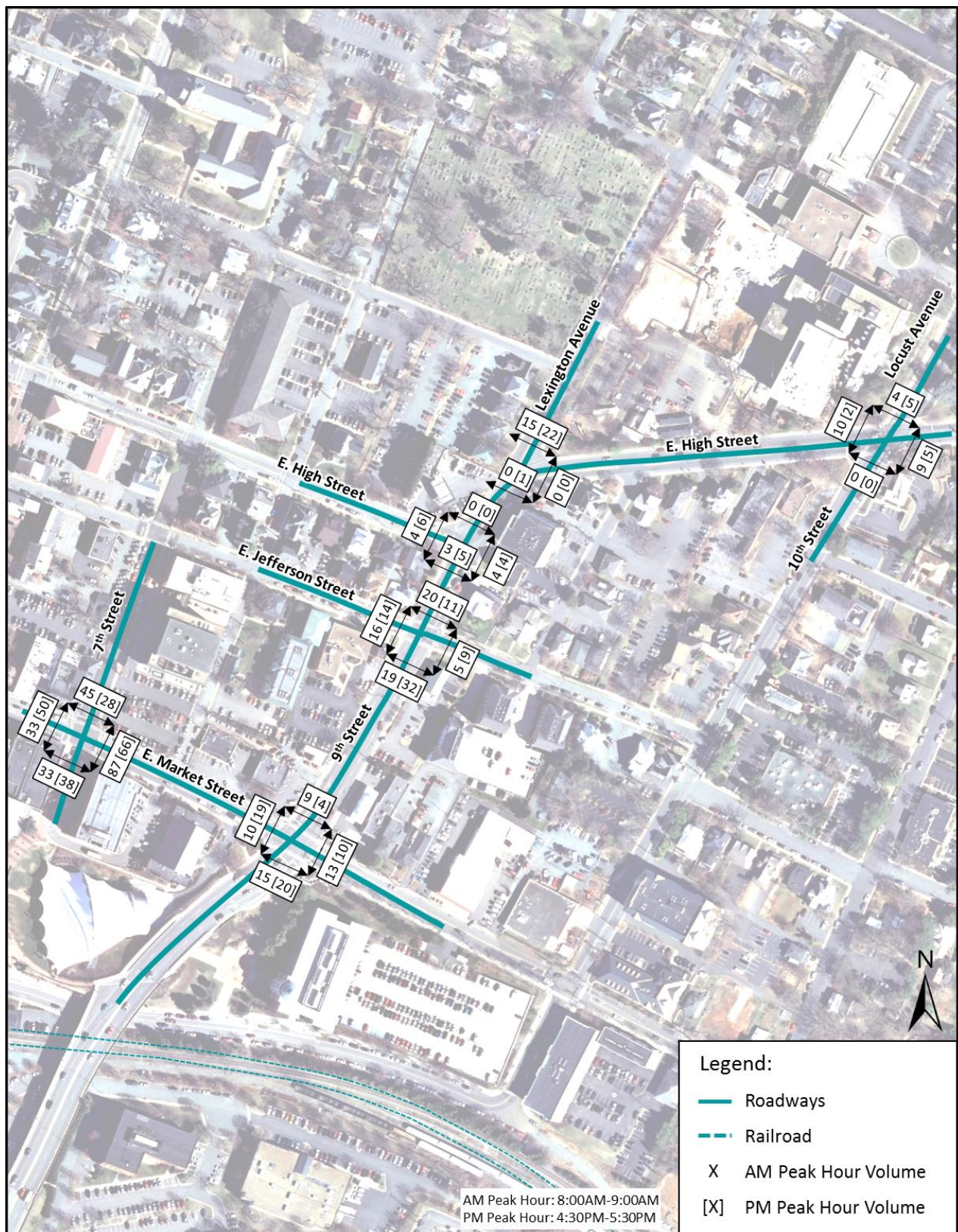


Figure 5: Existing (2017) Bicycle Volumes

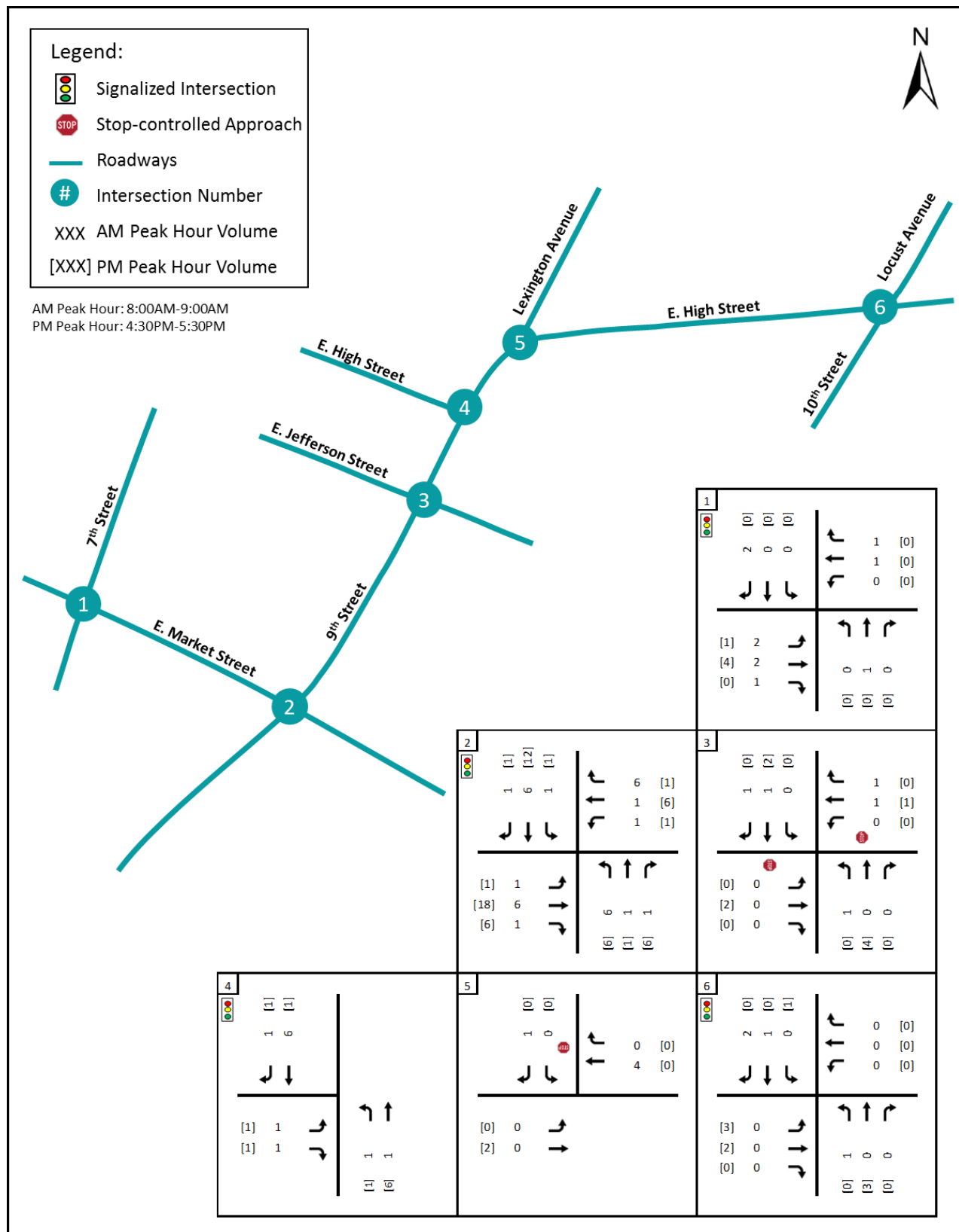
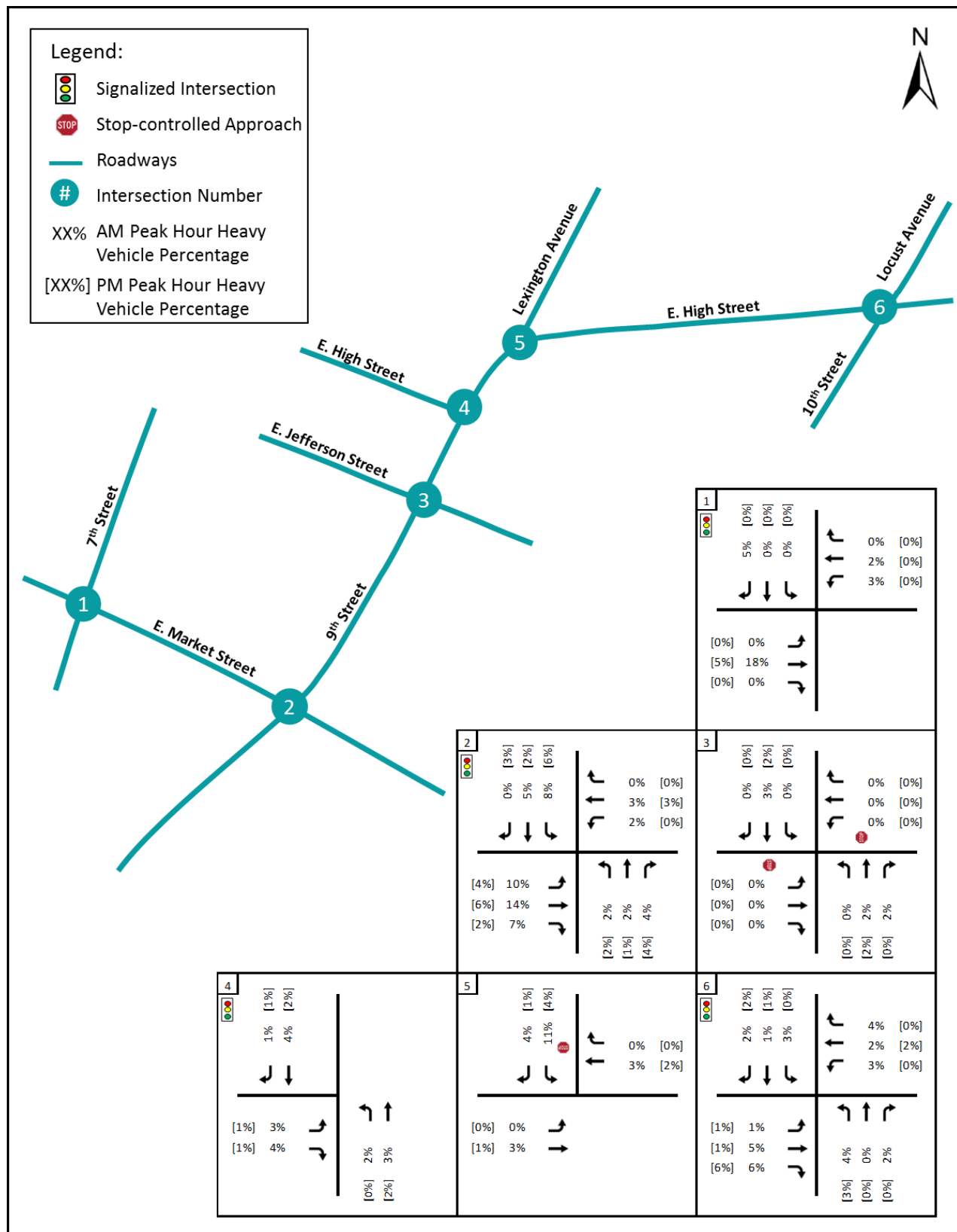


Figure 6: Heavy Vehicle Percentages



Chapter 3 Existing Conditions

Traffic operational analyses were conducted to evaluate the overall performance of the study area under existing (2017) AM and PM peak hour conditions. Existing (2017) roadway geometry, traffic control, balanced traffic volumes, peak hour factors, and heavy vehicle percentages were used in the analyses. The intent of the existing conditions analysis was to provide a general understanding of the baseline traffic conditions to serve as a starting point for developing future improvement strategies.

3.1 Traffic Analysis Assumptions

Existing signal timings and phasing were obtained from the City of Charlottesville. Capacity analyses were performed using *Synchro* (version 9.1) to determine existing intersection delay, measured in seconds per vehicle, and level of service (LOS). LOS illustrates the relative difference in delay and ranges from A to F. LOS A indicates a condition of little or no congestion and LOS F indicates a condition of severe congestion, unstable traffic flow, and stop-and-go conditions. **Table 1** summarizes the delay associated with each LOS for both signalized and unsignalized intersections.

Table 1: Intersection Level of Service (LOS) Analysis Criteria

LOS	Average Stopped Delay (seconds/vehicle)		Description of Traffic Conditions
	Signalized	Unsignalized	
A	≤ 10.0	≤ 10.0	Very low delay, progression is extremely favorable; most vehicles arrive during green phase.
B	> 10.0 to 20.0	> 10.0 to 15.0	Generally good progression, low delays, more vehicles must stop at intersection red phases.
C	> 20.0 to 35.0	> 15.0 to 25.0	Fair progression, increasing number of vehicles must stop; signal cycle fails to process all traffic.
D	> 35.0 to 55.0	> 25.0 to 35.0	Traffic congestion more noticeable, increasing cycle failures, unfavorable progression, and longer delays.
E	> 55.0 to 80.0	> 35.0 to 50.0	Poor progression, generally high v/c ratios, frequent cycle failures, intersection traffic approaching capacity.
F	≥ 80.0	≥ 50.0	Arrival flow exceeds intersection capacity, many cycle failures, poor progression, and high delays.

Source: 2000 Highway Capacity Manual (HCM)

Pedestrian and bicycle analyses was also conducted in the study area using *Synchro* (version 9.1). Existing pedestrian delay, measured in seconds per pedestrian, and LOS were reported at unsignalized intersections. Pedestrian LOS score and LOS was reported at signalized intersection. Existing bicycle operations was reported using bicycle LOS score and LOS. **Table 2** summarizes the pedestrian and bicycle LOS score associated with each LOS for signalized intersections. **Table 3** summarizes the pedestrian control delay associated with each LOS at unsignalized intersections.

Table 2: LOS Criteria: Pedestrian and Bicycle Modes (Signalized Intersections)

LOS	LOS Score
A	≤ 2.00
B	> 2.00-2.75
C	> 2.75-3.50
D	> 3.50-4.25
E	> 4.25-5.00
F	> 5.00

Table 3: LOS Criteria for Pedestrians at Unsignalized Intersections

LOS	Control Delay (seconds/pedestrian)	Comments
A	0-5	Usually no conflicting traffic
B	5-10	Occasionally some delay due to conflicting traffic
C	10-20	Delay noticeable to pedestrians, but not inconveniencing
D	20-30	Delay noticeable and irritating, increased likelihood of risk taking
E	30-45	Delay approaches tolerance level, risk-taking behavior likely
F	> 45	Delay exceeds tolerance level, high likelihood of pedestrian risk taking

Source: 2010 Highway Capacity Manual (HCM)

Queuing analyses were performed using *SimTraffic* (version 9.1) to determine maximum queue lengths. A maximum queuing analysis was completed for each of the study area intersections under existing (2017) AM and PM peak hour conditions using *SimTraffic* (version 9.1). Queue length is a performance indicator at both signalized and unsignalized intersections. Maximum queue lengths that exceed the length of turn lane storage bays may indicate capacity or operational issues.

The *VDOT Traffic Operations and Safety Analysis Manual (version 1.0)* guidance on determining the appropriate number of simulation runs needed to produce accurate microsimulation results was followed for all *SimTraffic* analyses. For each analysis scenario, ten *SimTraffic* simulation runs were conducted using different random number seeds and averaged together. The *VDOT Sample Size Determination Tool* was then used to confirm that the ten runs were performed at a 95th percentile confidence level with 10% tolerance. Average speed on northbound 9th Street between Graves Street and E. Market Street was the measure of effectiveness evaluated with the *VDOT Sample Size Determination Tool* for all analysis scenarios. The results of the *VDOT Sample Size Determination Tool* are provided in **Appendix B**.

The following measures of effectiveness (MOEs) were selected to measure the quantitative performance of the intersections within the network.

- Average vehicle delay and Highway Capacity Manual (HCM) LOS by movement, approach, and intersection – measured in seconds per vehicle
- Maximum queue length – measured in feet

Signalized intersections were analyzed using the methodologies contained in the **2000 Highway Capacity Manual (HCM 2000)**. HCM 2000 methodologies were used instead of the **2010 Highway Capacity Manual (HCM 2010)** methodologies to analyze intersections with non-standard traffic signal phasing. Unsignalized intersections were analyzed using the methodologies contained in the **2010 Highway Capacity Manual (HCM 2010)**.

Traffic analysis and modeling assumptions are included in **Appendix B**.

3.2 Existing (2017) Traffic Analysis Results

3.2.1 Delay and Level of Service

The results of the existing (2017) AM and PM peak hour capacity analyses are summarized in **Figure 7** and **Figure 8**. The corresponding *Synchro* output sheets are provided in **Appendix C** for reference. Existing (2017) pedestrian and bicycle LOS are also provided in **Appendix C**.

3.2.2 Queuing

The existing maximum queue lengths reported by *SimTraffic* were confirmed to accurately reflect the existing maximum queue lengths observed in the field. For movements without conflicting traffic volumes, no queue length was reported by *SimTraffic*. Movements and approaches with queuing that exceeds turn lane storage bay lengths, blocks access to turn lane storage bays, or spills to adjacent intersections were also identified.

The results of the existing (2017) AM and PM peak hour queuing analyses are summarized in **Figure 9**. The corresponding *SimTraffic* output sheets are provided in **Appendix C** for reference.

Figure 7: Existing (2017) AM Delay and Level of Service

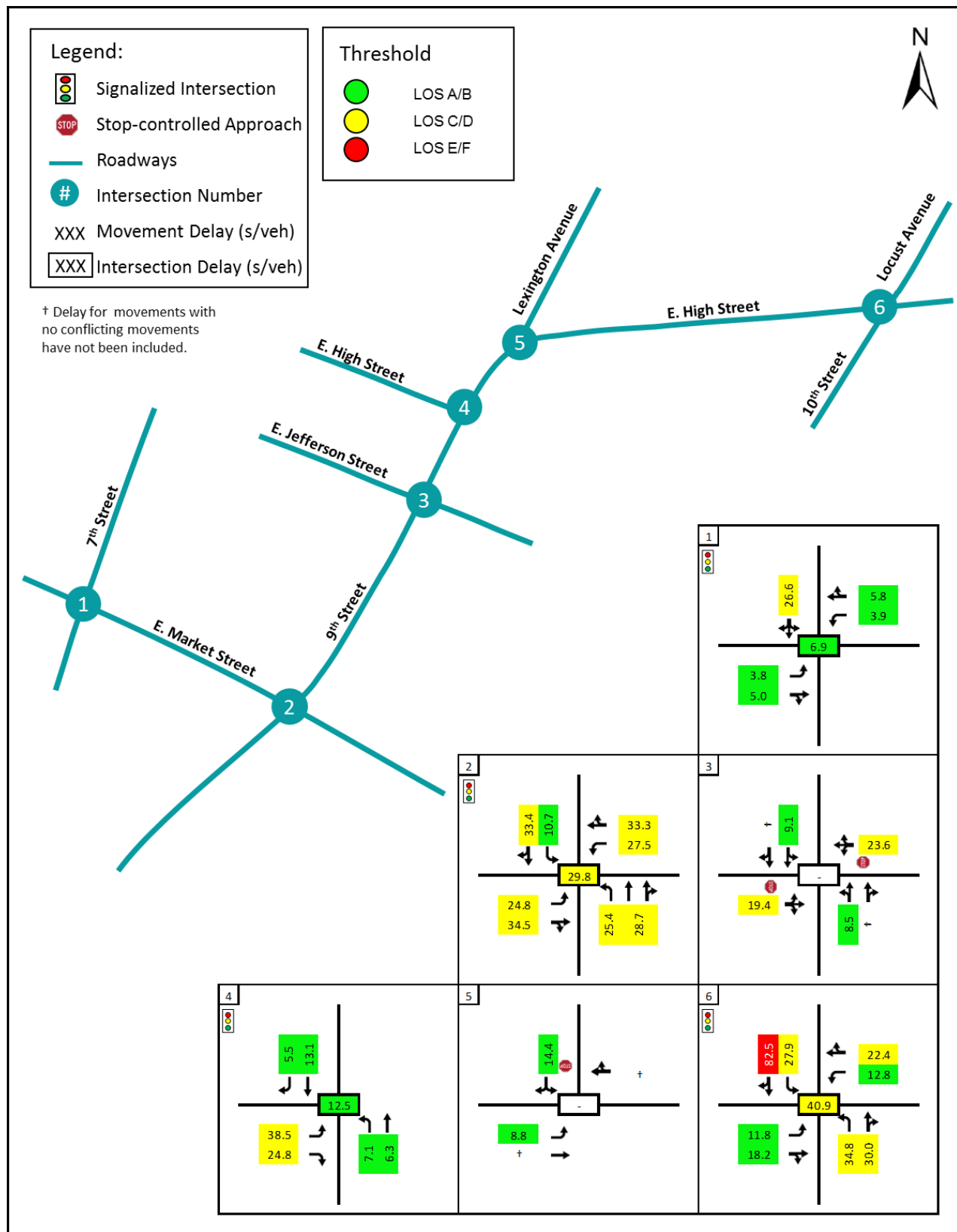


Figure 8: Existing (2017) PM Delay and Level of Service

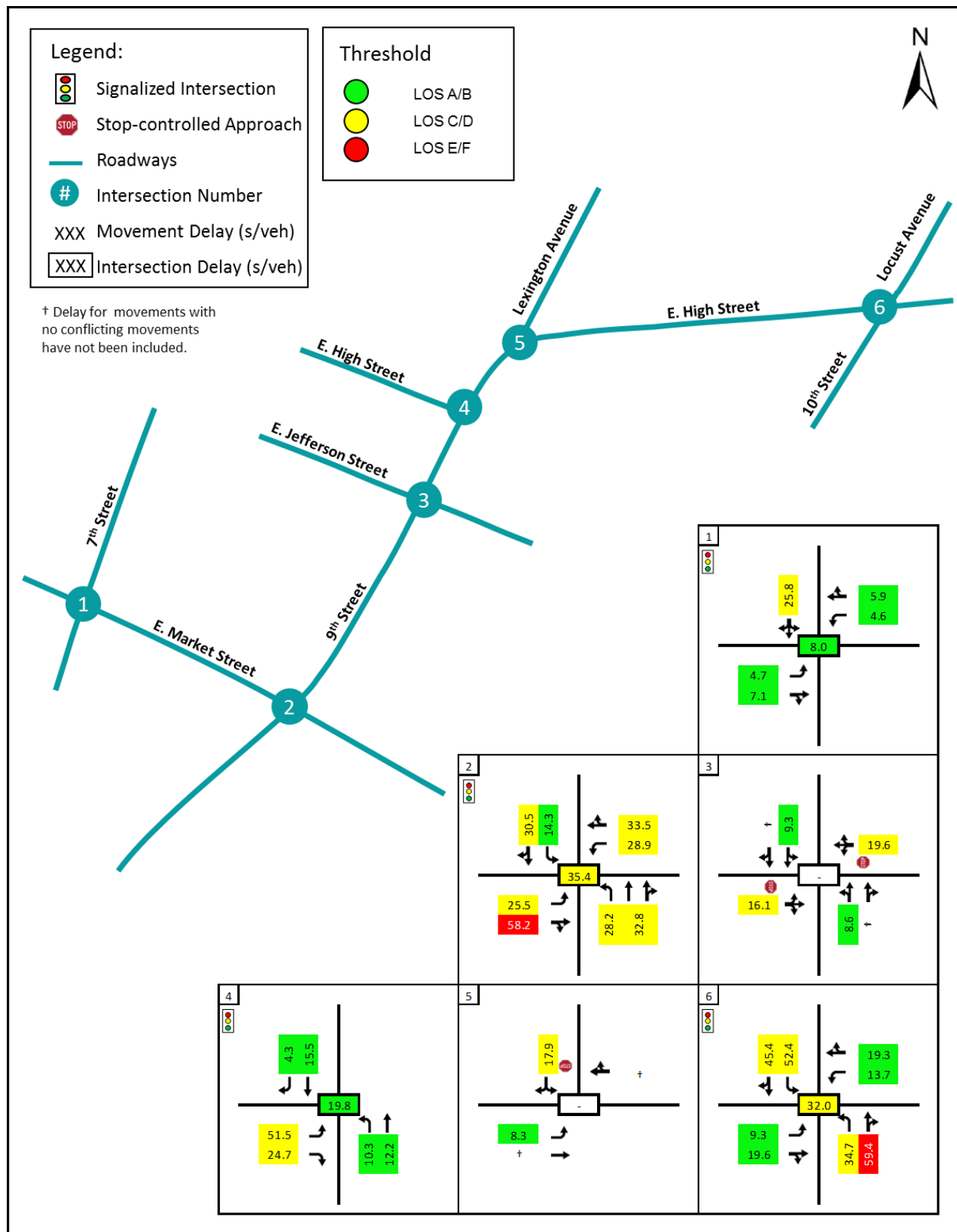
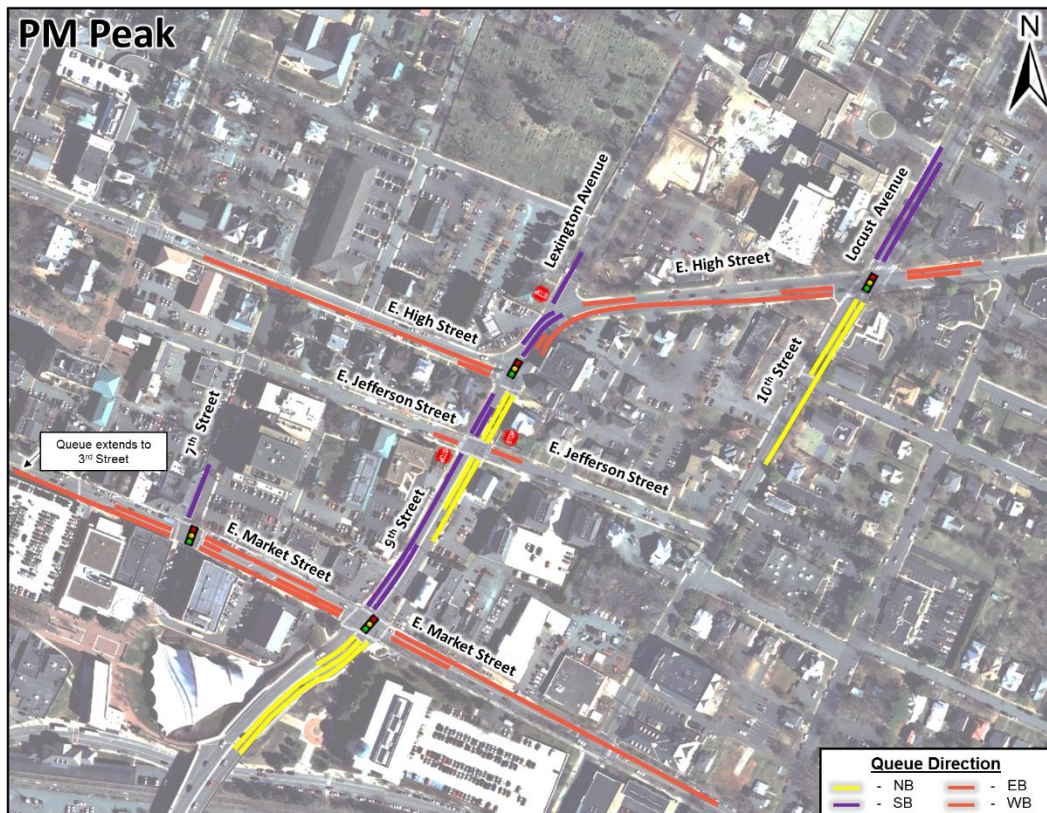
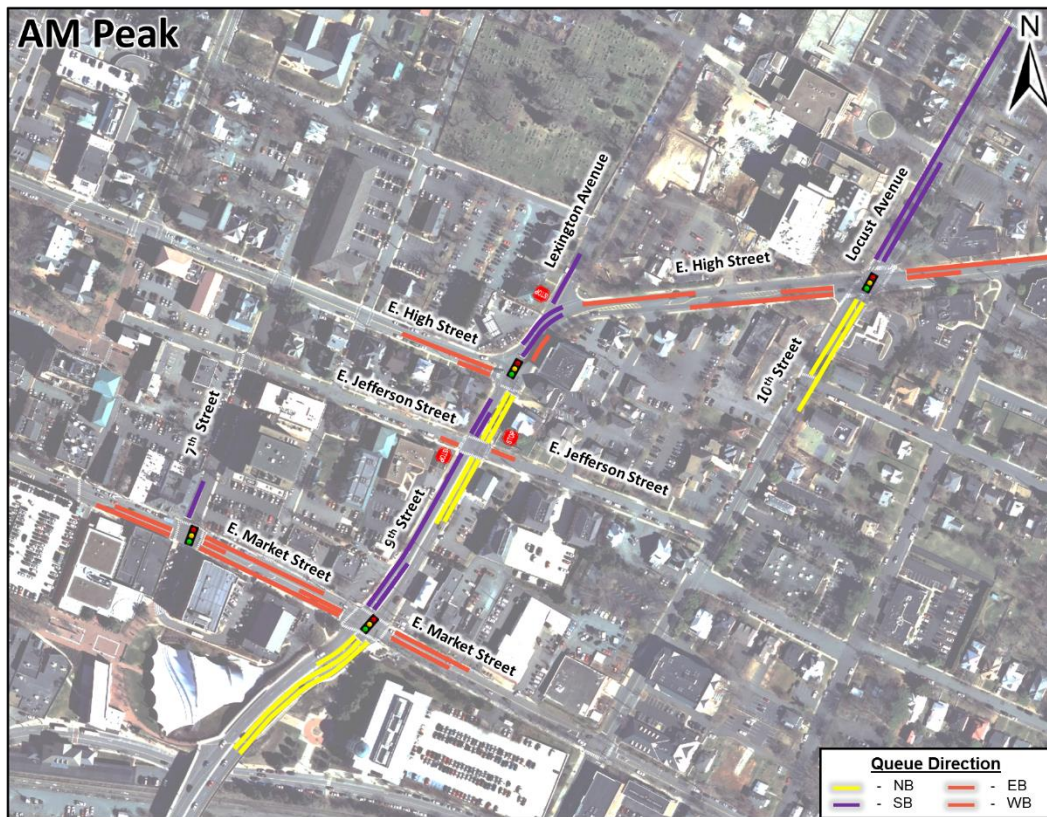


Figure 9: Existing (2017) Queues



3.3 Traffic Signal Warrant Analysis - 7th Street at E. Market Street

A traffic signal warrant analysis was performed for the intersection of 7th Street and E. Market Street to determine if a signal is still warranted at the intersection. Using the methodologies presented in the *2009 Edition of the Manual of Uniform Traffic Control Devices (MUTCD)*, zero of the nine traffic signal warrants were met at 7th Street and E. Market Street. The results of the signal warrant analysis are presented in **Table 4**. The detailed traffic signal warrant analysis is provided in **Appendix C**.

Table 4: Traffic Signal Warrant Analysis Results

Warrant	Result	Note
Warrant 1 – Eight-Hour Vehicular Volume (Condition A)	Not Met	Insufficient vehicular volume
Warrant 1 – Eight-Hour Vehicular Volume (Condition A)	Not Met	Insufficient vehicular volume
Warrant 1 – Eight-Hour Vehicular Volume (Combination of Conditions A and B)	Not Met	Insufficient vehicular volume
Warrant 2 – Four-Hour Vehicular Volume	Not Met	Insufficient vehicular volume
Warrant 3 – Peak Hour	Not Met	Insufficient vehicular volume
Warrant 4 – Pedestrian Volume	Not Met	Insufficient pedestrian volume
Warrant 5 – School Crossing	Not Examined	--
Warrant 6 – Coordinated Signal System	Not Met	Existing traffic signal is within 1,000 feet of the 9 th Street at E. Market Street traffic signal
Warrant 7 – Crash Experience	Not Applicable	Traffic signal is already installed
Warrant 8 – Roadway Network	Not Met	Entering traffic volume on both intersecting roadways is less than 1,000 vehicles in the peak hour
Warrant 9 – Intersection Near a Grade Crossing	Not Applicable	No nearby at-grade railroad crossing

Chapter 4 Traffic Forecasting

An opening year of 2021 and a design year of 2041 were identified for future conditions analysis. The following sections describe the methodology for developing growth rates and projecting traffic volumes within the study area.

4.1 Traffic Growth Rate Development

The downtown Charlottesville area is near to fully developed, and although there is some redevelopment occurring in pockets. Vehicle volume is projected to remain relatively constant. It is anticipated, however, that mode choices will shift to increase the volume of bicycles and pedestrians within the already vibrant area. To account for these assumptions, linear growth rates consistent with the *Belmont Bridge Traffic Report*, as shown in **Table 5**, were used to develop the projected opening year (2021) and design year (2041) peak hour traffic volumes.

Table 5: Growth Rates

Mode Type	Growth Rate
Vehicles	0.20%
Pedestrians	3.00%
Bicycles	3.00%

4.2 Projected Traffic Volumes

Standard linear growth rate calculations were applied to the existing (2017) peak hour traffic volumes to generate opening year (2021) and design year (2041) no-build peak hour projected traffic volumes. The projected traffic volumes were then re-balanced throughout the study area. The balanced projected 2021 and 2041 no-build AM and PM peak hour volumes for vehicles, pedestrians, and bicycles are summarized in **Figure 10** through **Figure 15**

Figure 10: Opening Year (2021) Vehicle Volumes

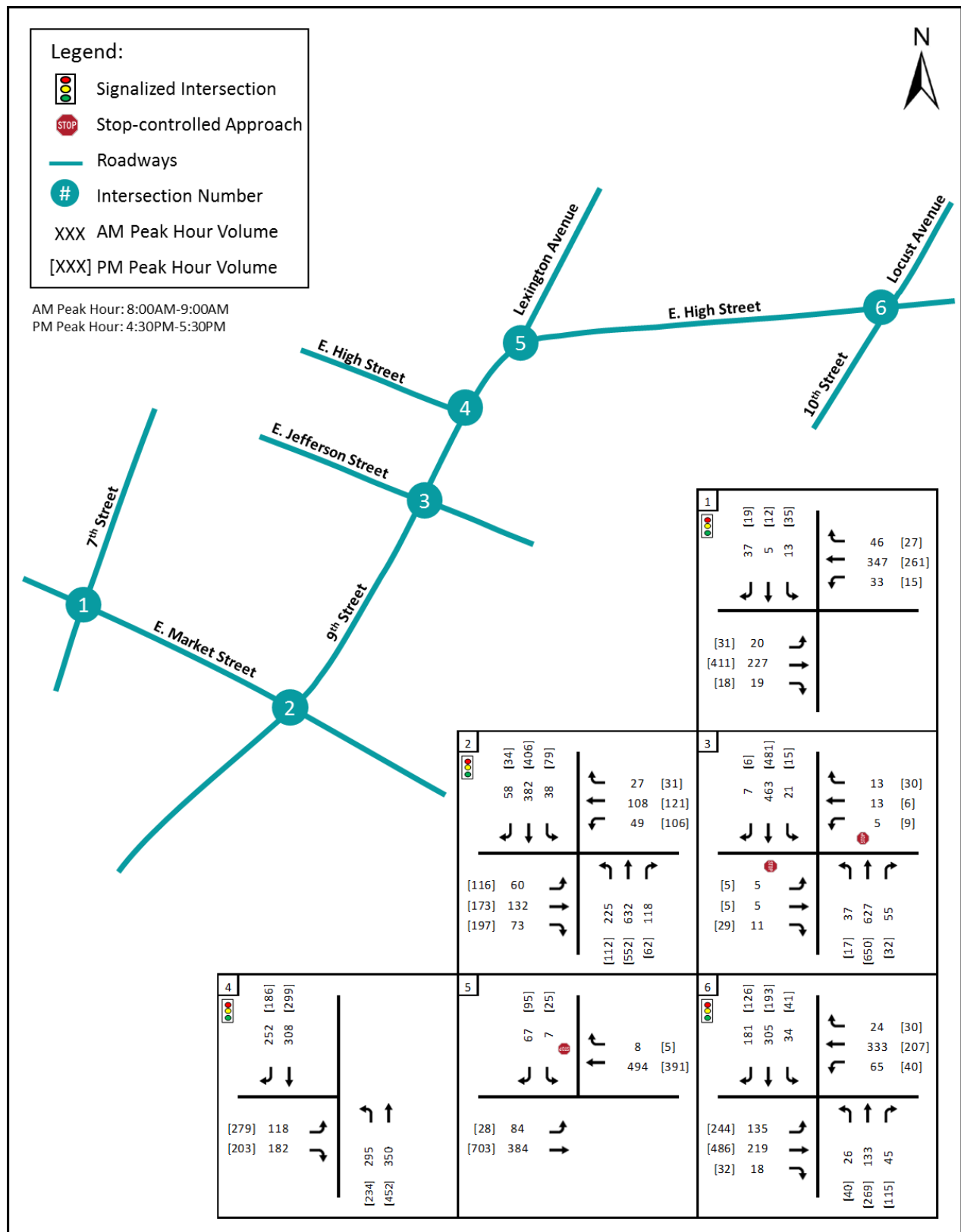


Figure 11: Opening Year (2021) Pedestrian Volumes

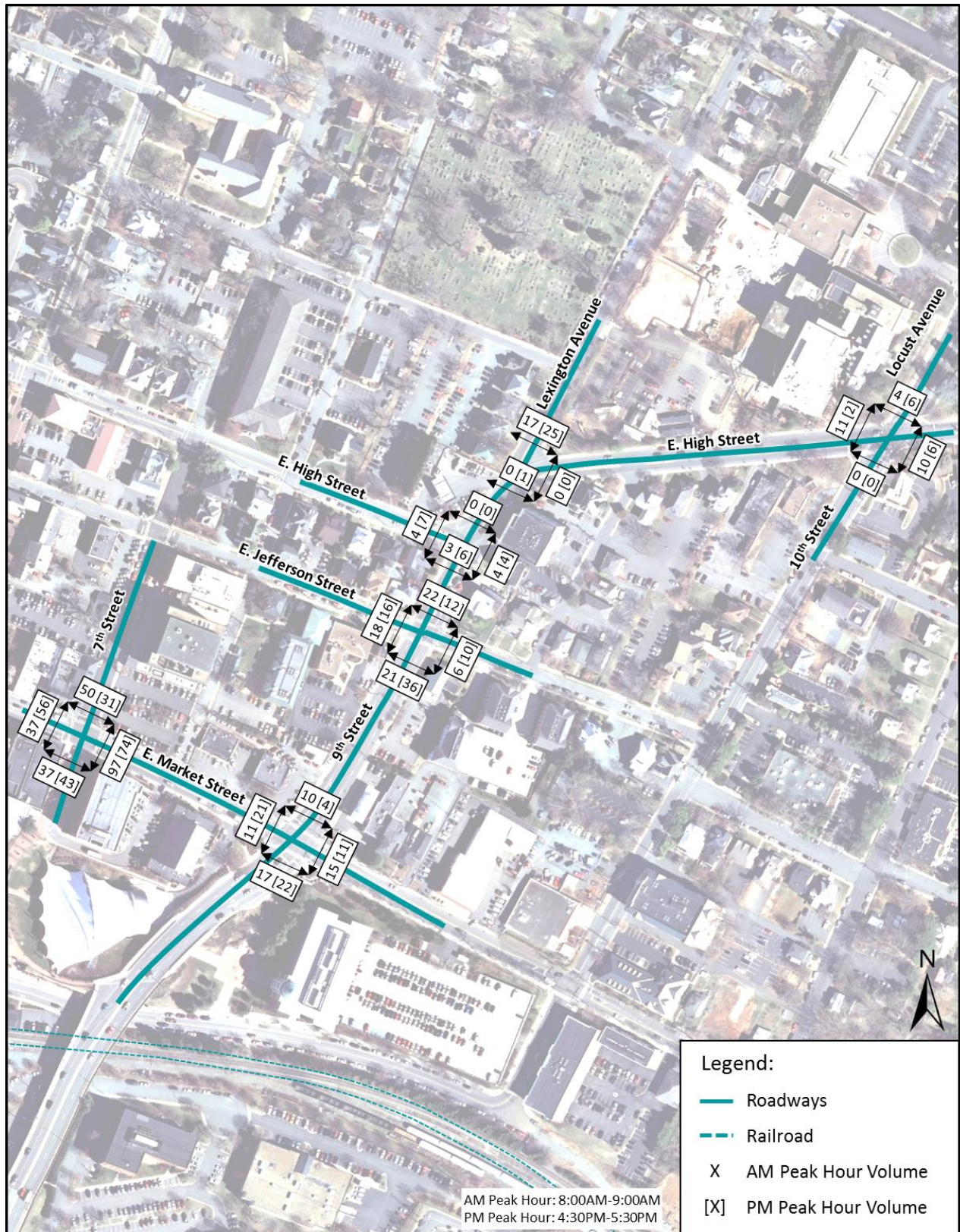


Figure 12: Opening Year (2021) Bicycle Volumes

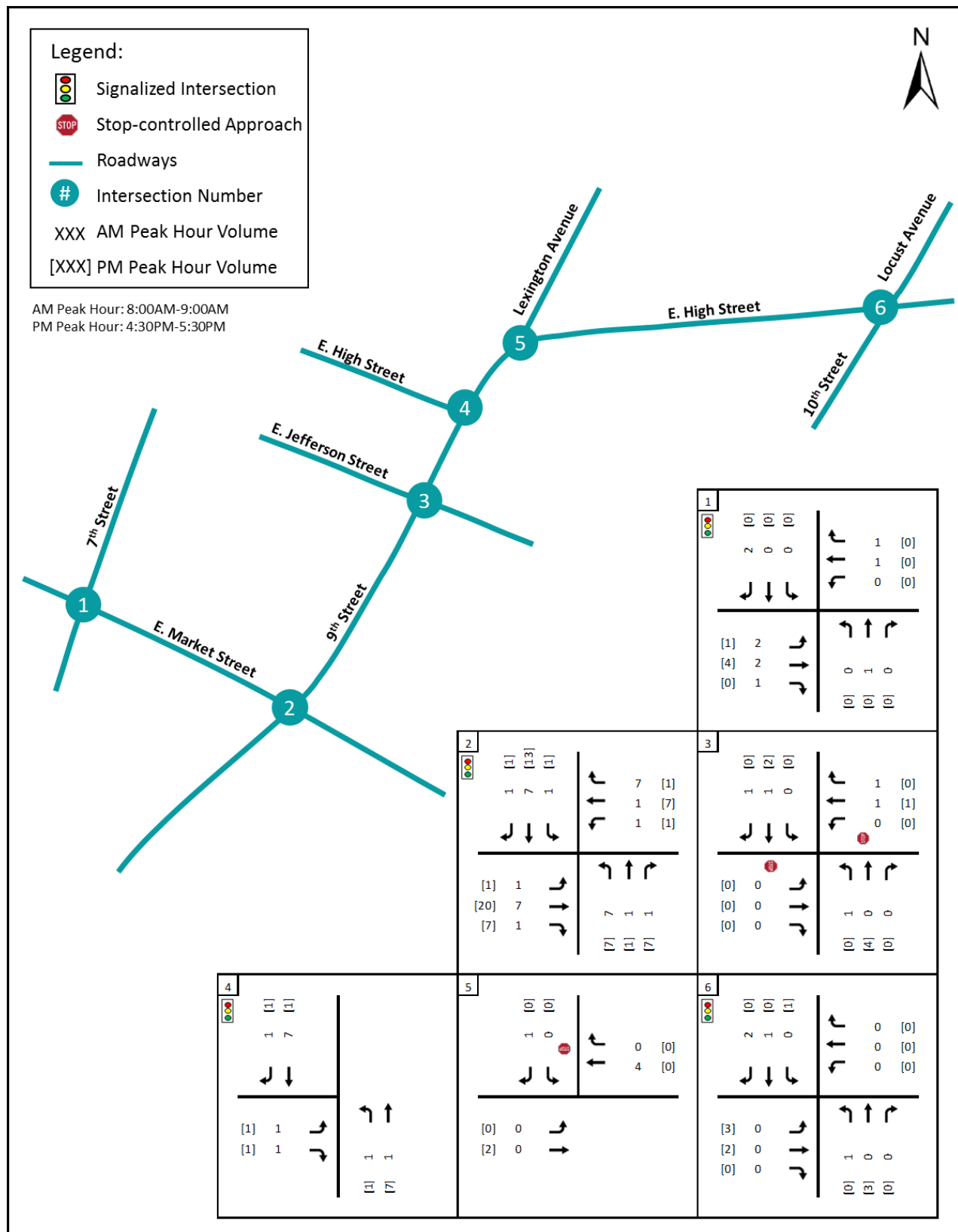


Figure 13: Design Year (2041) Vehicle Volumes

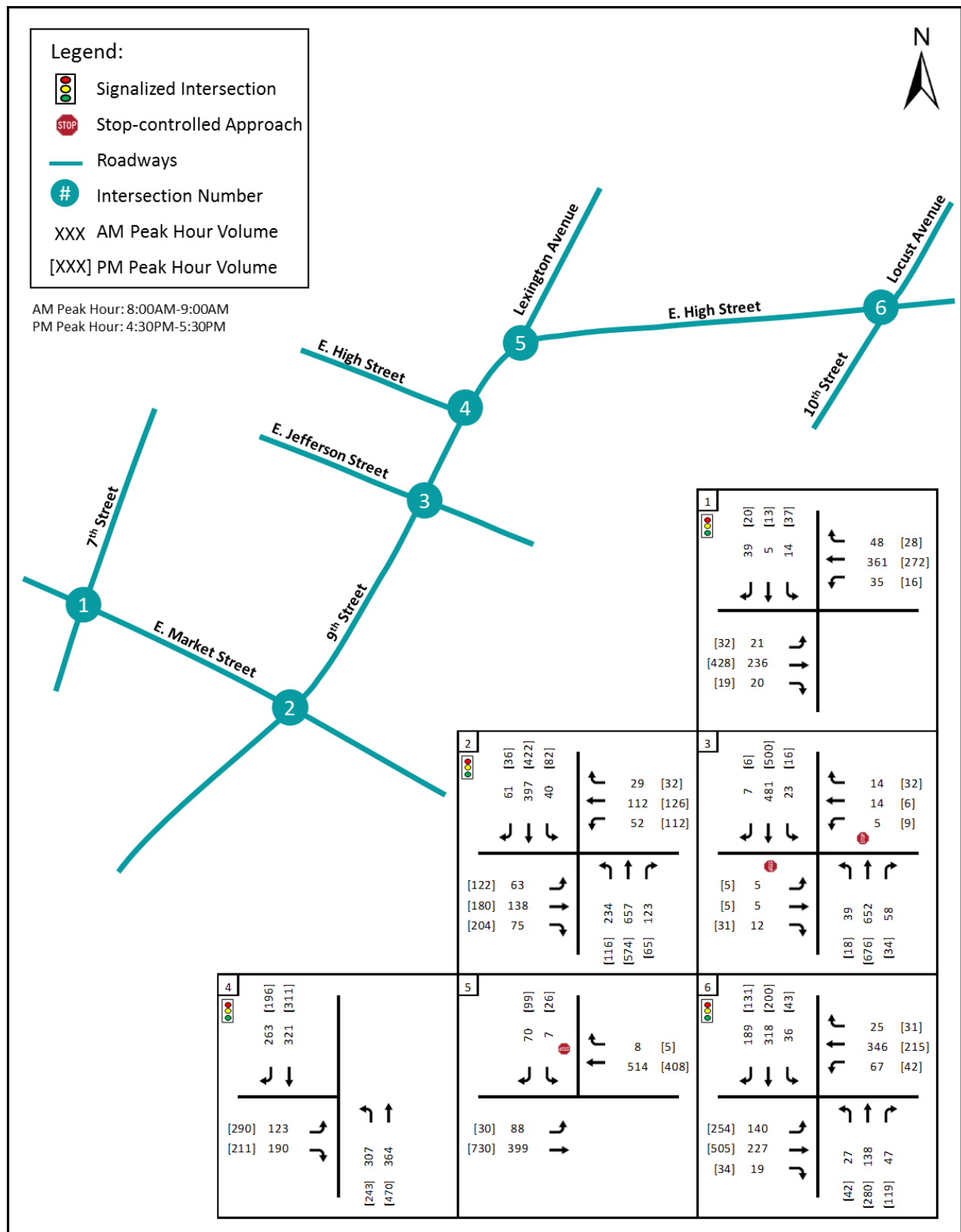


Figure 14: Design Year (2041) Pedestrian Volumes

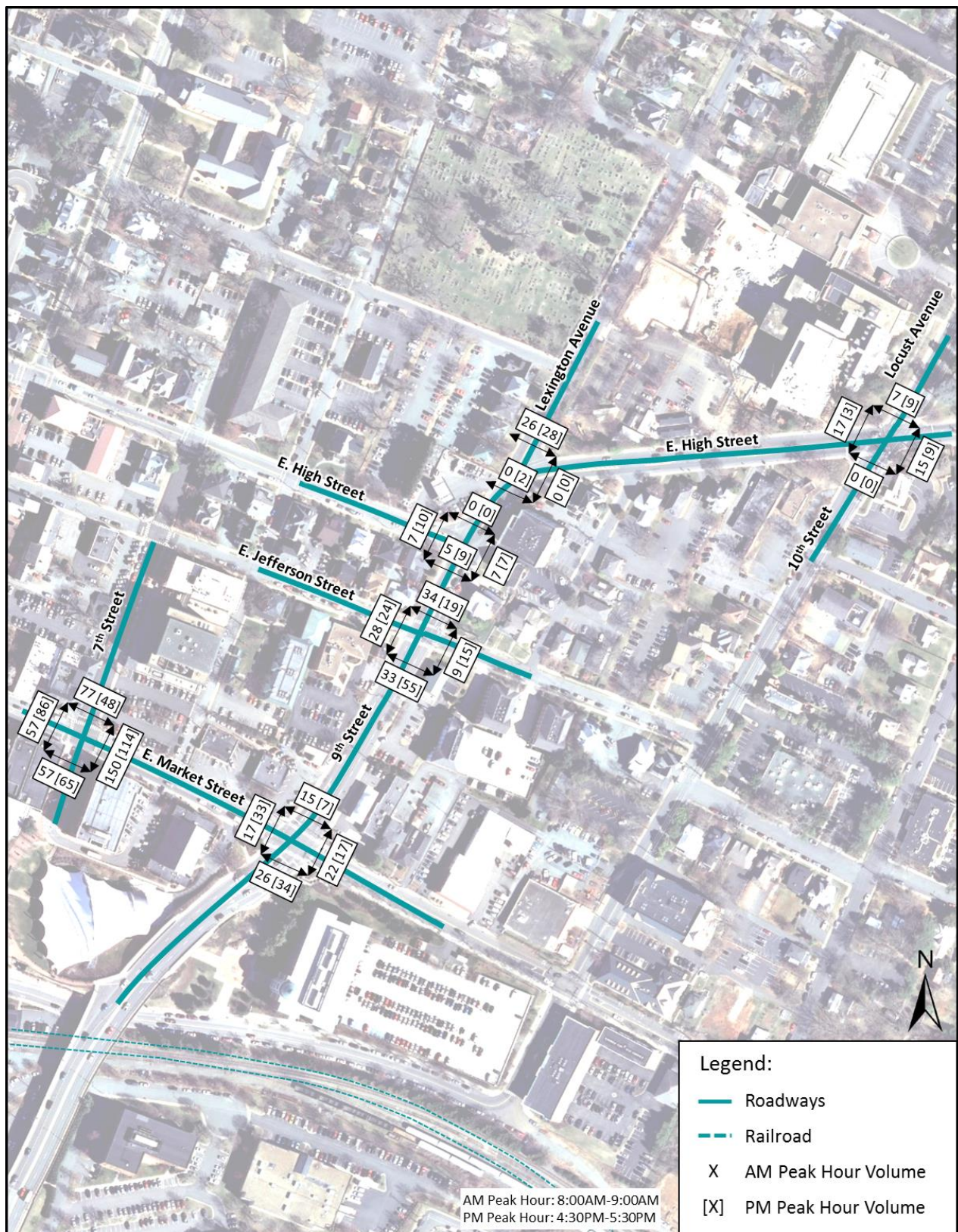
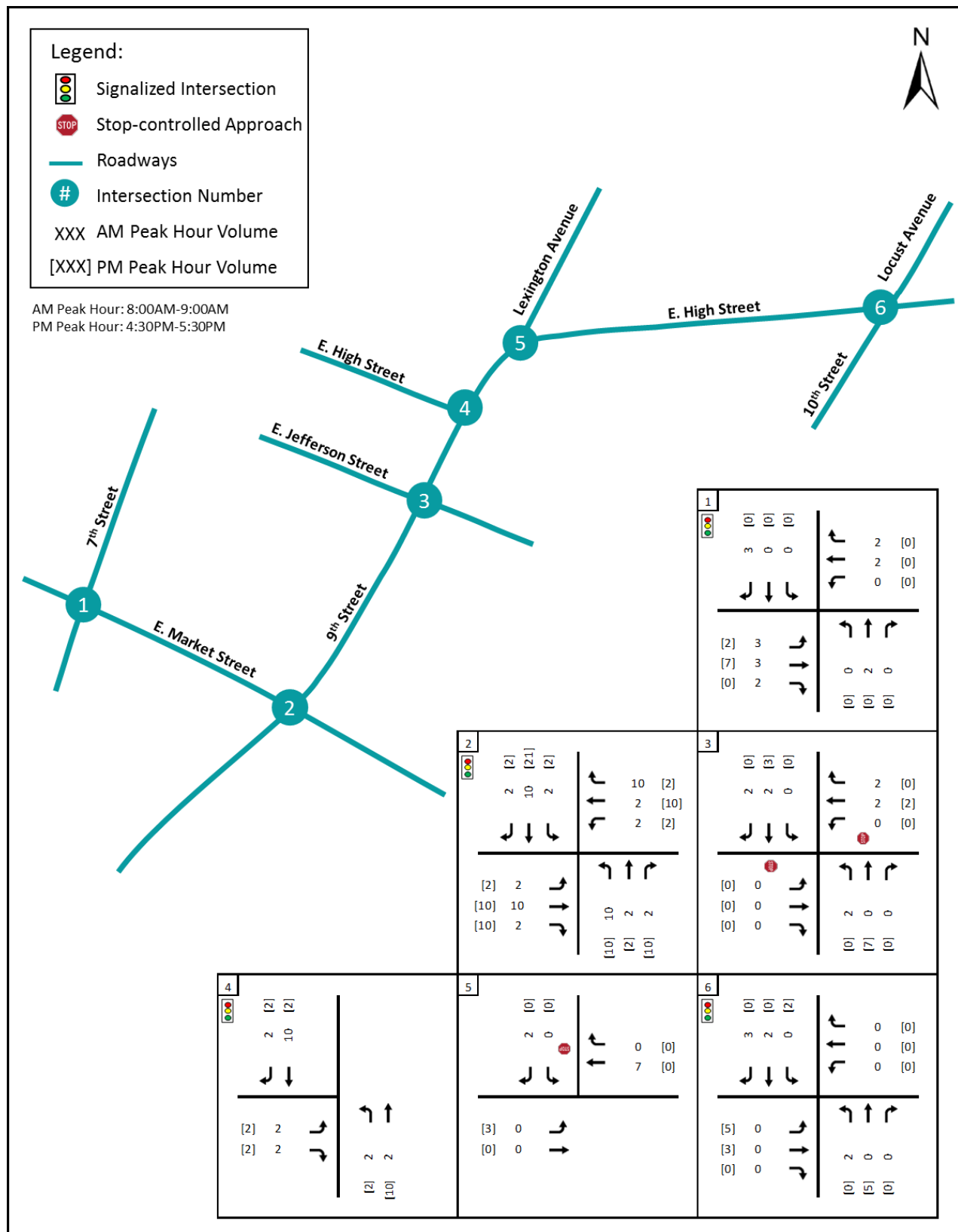


Figure 15: Design Year (2041) Bicycle Volumes



Chapter 5 No-Build Conditions

Traffic operational analyses were conducted to evaluate the overall performance of the study area under the no-build opening year (2021) and design year (2041) AM and PM peak hour conditions. The intent of the no-build conditions analysis was to provide a baseline traffic conditions for comparing improvement alternatives.

5.1 Traffic Analysis Assumptions

The calibrated existing conditions Synchro/SimTraffic models were used as a basis to develop the no-build models. The preferred concept from the *Belmont Bridge Traffic Report* were coded as background improvements into the 2021 and 2041 no-build models. The no-build lane configurations are shown in **Figure 16**. The preferred build concept consists of:

- Constructing a 2-lane bridge cross-section (one travel lane in both directions) between Graves Street and E. Market Street
- Constructing a dedicated left turn lane, through, and right turn lane on the northbound 9th Street approach at E. Market Street
- Maintaining the existing lane configurations on the southbound 9th Street approach at Levy Avenue
- Closing Old Avon Street at the 9th Street and Levy Avenue intersection
- Converting Graves Street to left-in/right-in/right-out
- Removing the existing at-grade pedestrian crossing at Graves Street and constructing a pedestrian underpass beneath 9th Street just north of Graves Street

The models were updated with projected 2021 and 2041 traffic volumes. Traffic signal timings impacted by the Belmont Bridge project were taken from the Belmont Bridge Synchro models for 2021 and 2041. Traffic signal timing splits and offsets were optimized for 2041 conditions only for intersections outside of the Belmont Bridge study area. A summary of Synchro/SimTraffic modeling inputs and assumptions for the no-build traffic models is provided in **Appendix B**.

5.2 No-Build Opening Year (2021) Traffic Analysis Results

5.2.1 Delay and Level of Service

The results of the no-build opening year (2021) AM and PM peak hour capacity analyses are summarized in **Figure 17** and **Figure 18**. The corresponding *Synchro* output sheets are provided in **Appendix D** for reference. No-build opening year (2021) pedestrian and bicycle scores and LOS are also provided in **Appendix D**.

5.2.2 Queuing

The results of the no-build opening year (2021) AM and PM peak hour queuing analyses are summarized in **Figure 19**. The corresponding *SimTraffic* output sheets are provided in **Appendix D** for reference.

Figure 16: No-Build Opening Year (2021) and Design Year (2041) Lane Configuration

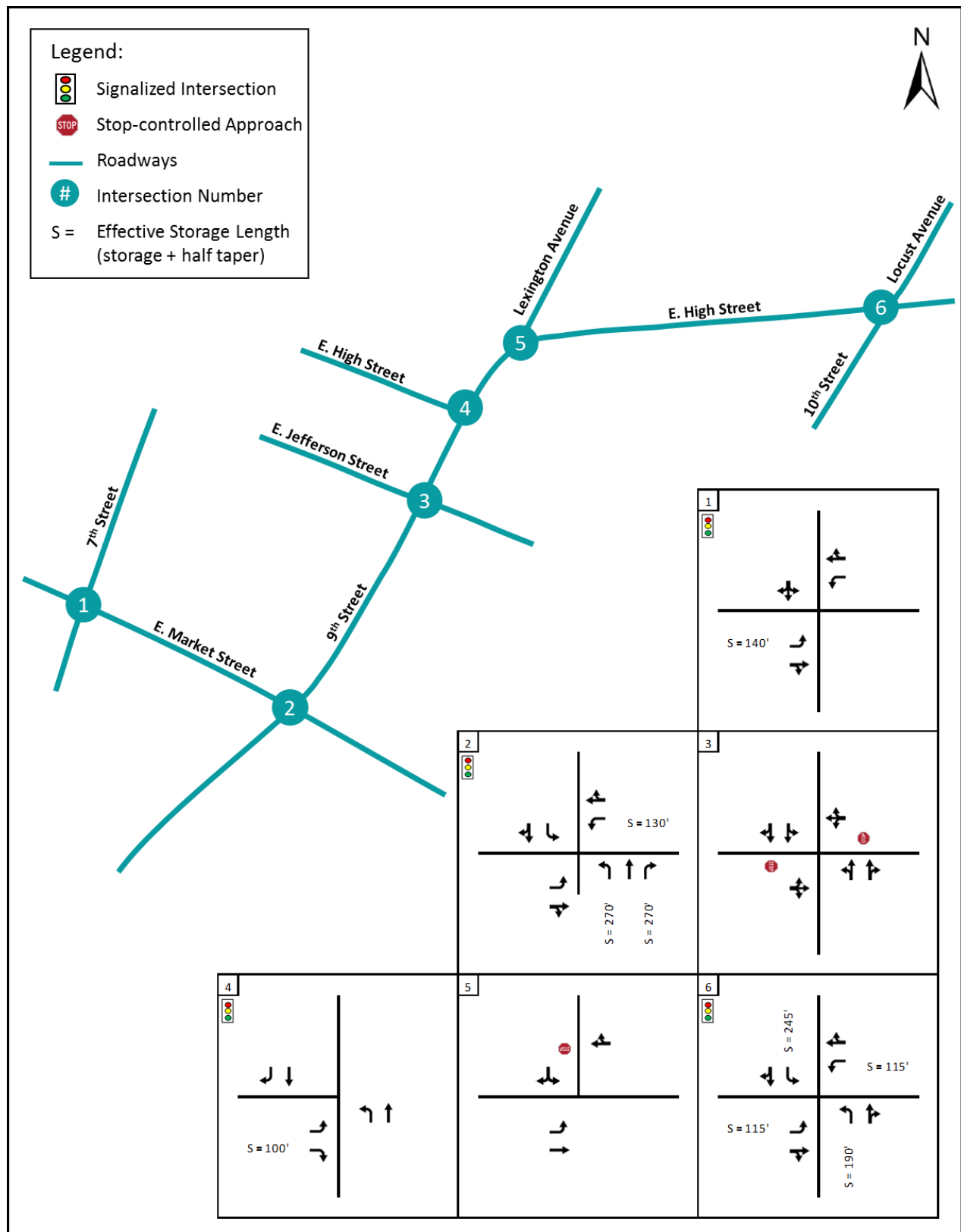


Figure 17: No-Build Opening Year (2021) AM Delay and Level of Service

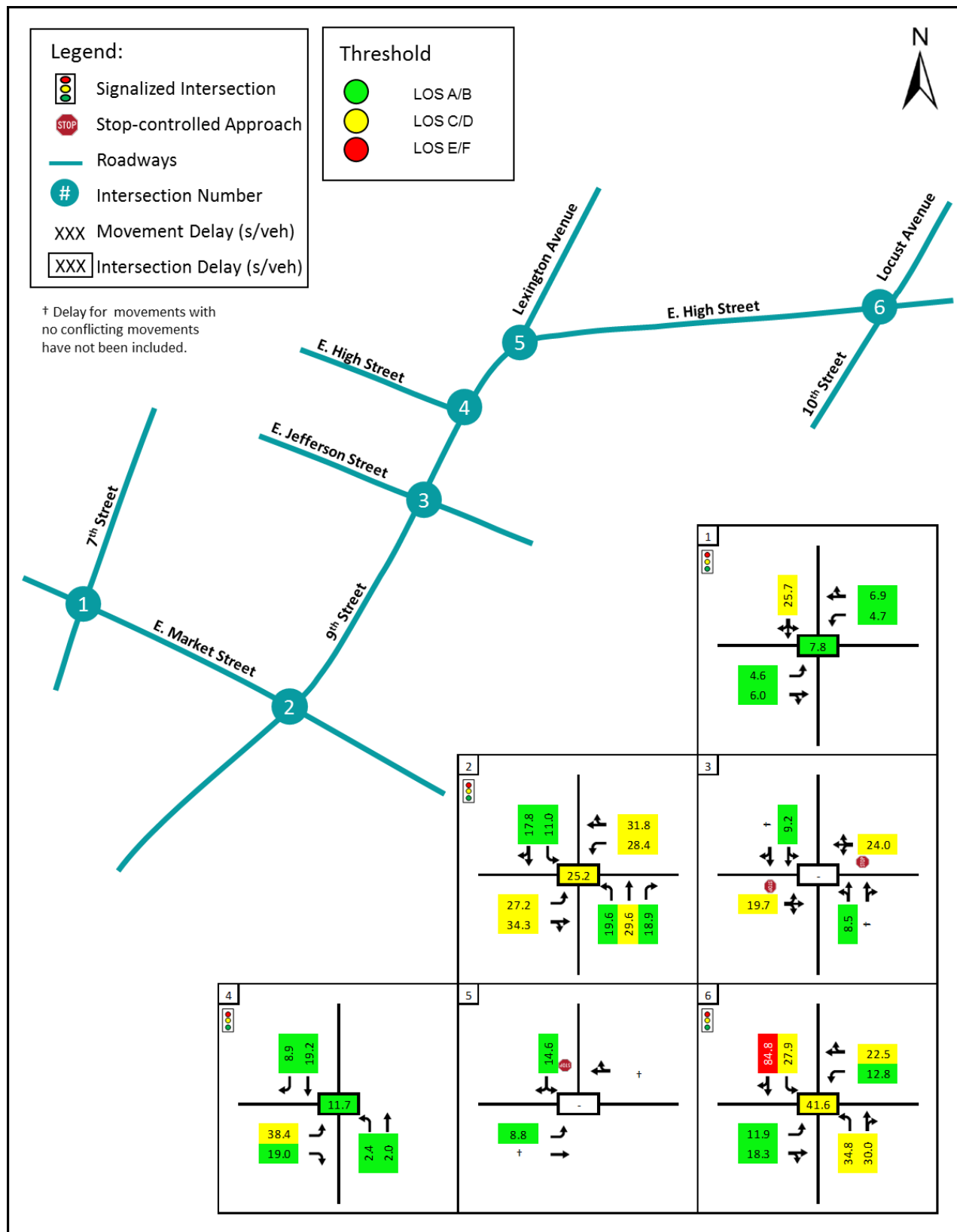


Figure 18: No-Build Opening Year (2021) PM Delay and Level of Service

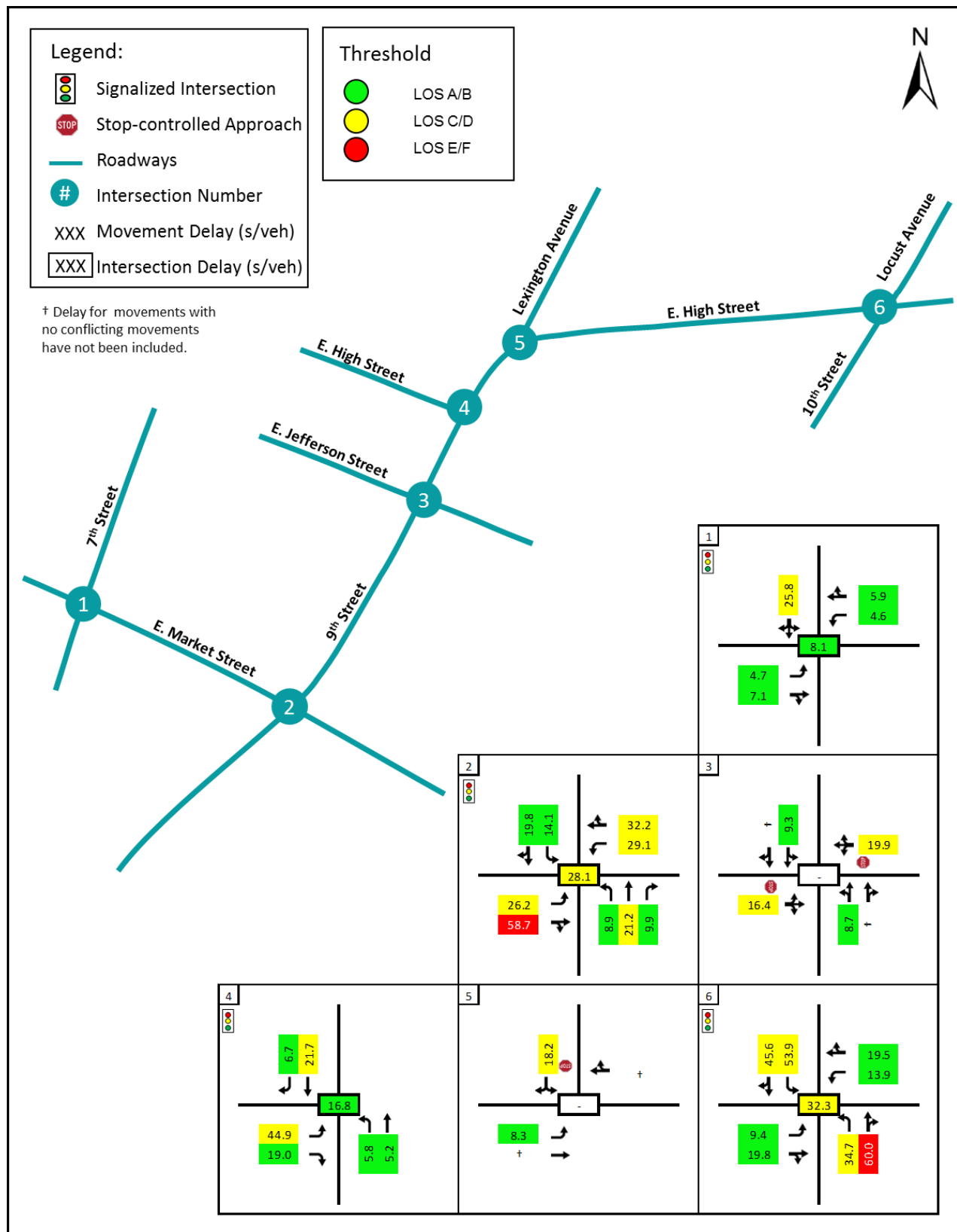
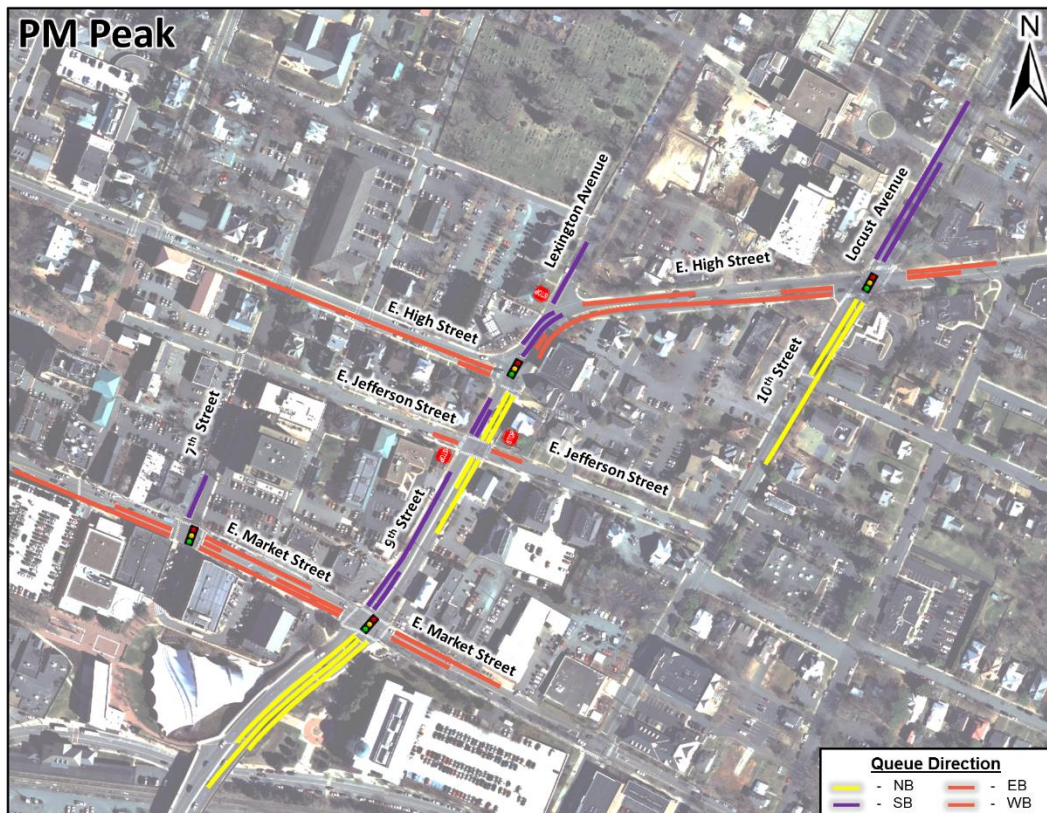
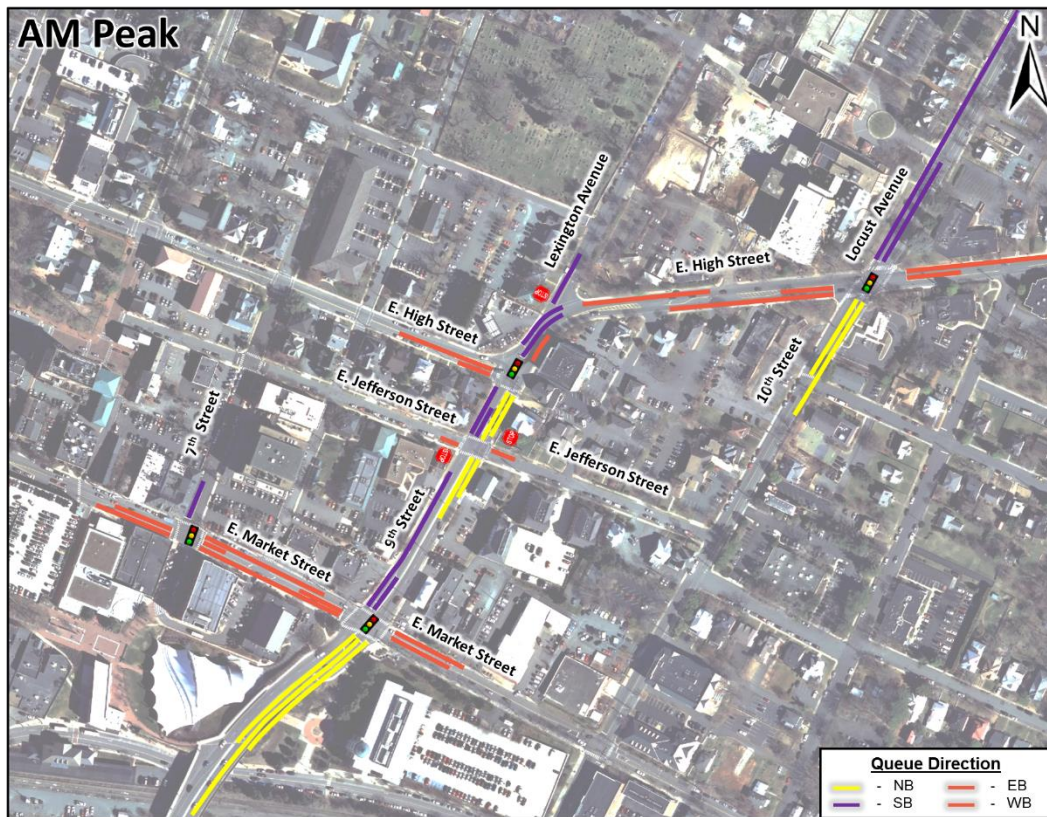


Figure 19: No-Build Opening Year (2021) Queues



5.3 No-Build Design Year (2041) Traffic Analysis Results

5.3.1 Delay and Level of Service

The results of the no-build design year (2041) AM and PM peak hour capacity analyses are summarized in **Figure 20** and **Figure 21**. The corresponding *Synchro* output sheets are provided in **Appendix D** for reference. No-build opening year (2041) pedestrian and bicycle scores and LOS are also provided in **Appendix D**.

5.3.2 Queuing

The results of the no-build design year (2041) AM and PM peak hour queuing analyses are summarized in **Figure 22**. The corresponding *SimTraffic* output sheets are provided in **Appendix D** for reference.

5.4 Summary

The no-build traffic analysis results showed that vehicular, pedestrian, and bicycle operations remain similar to existing conditions. Minor degradations in delays or queues were experienced between existing and 2021 no-build conditions resulting from an increase in traffic volumes. Slight improvements in delay, LOS, and maximum queues were a result of optimized signal timings associated with the preferred concept from the Belmont Bridge replacement and the optimized signal timings applied for analysis of the 2041 no-build conditions.



Figure 20: No-Build Design Year (2041) AM Delay and Level of Service

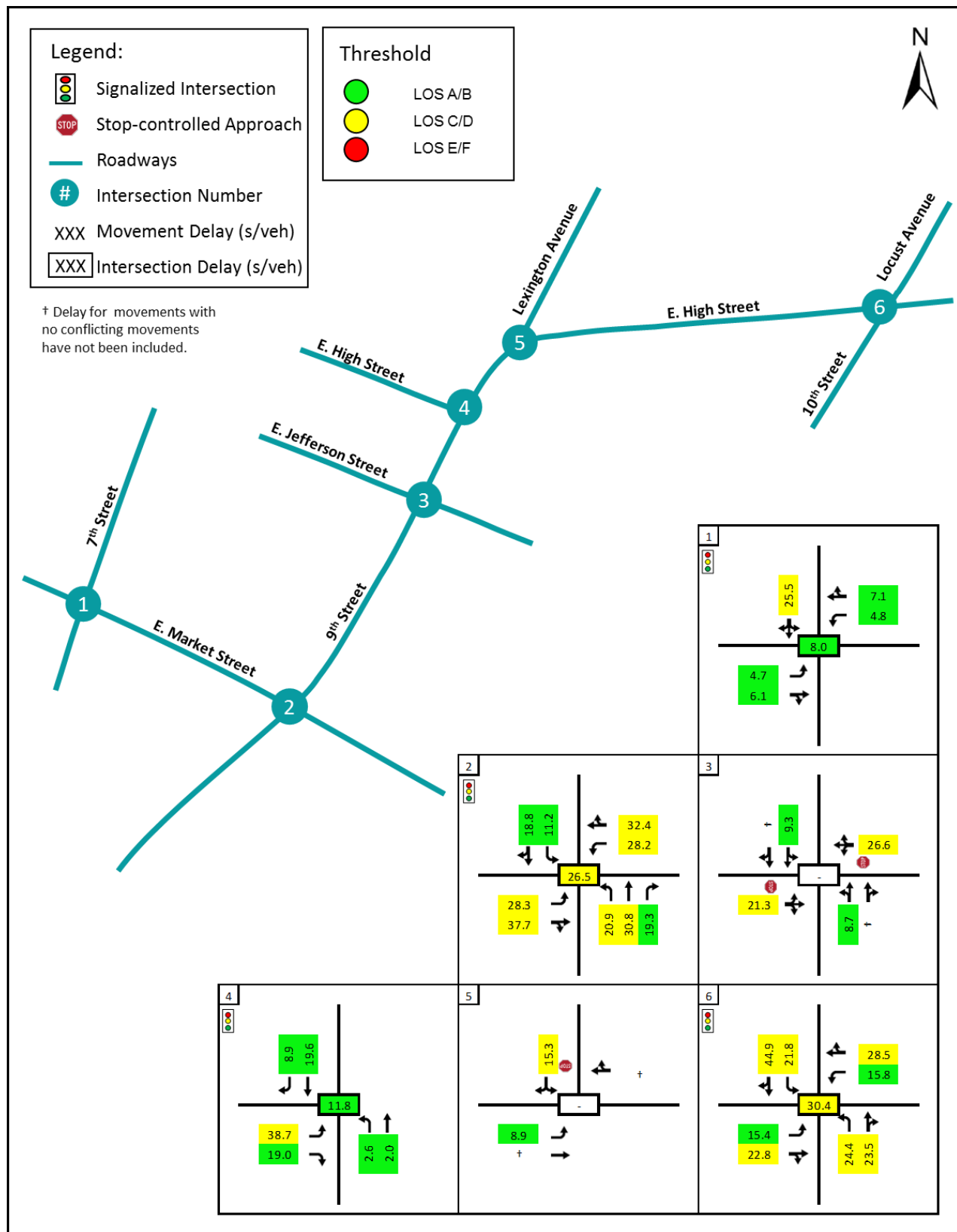


Figure 21: No-Build Design Year (2041) PM Delay and Level of Service

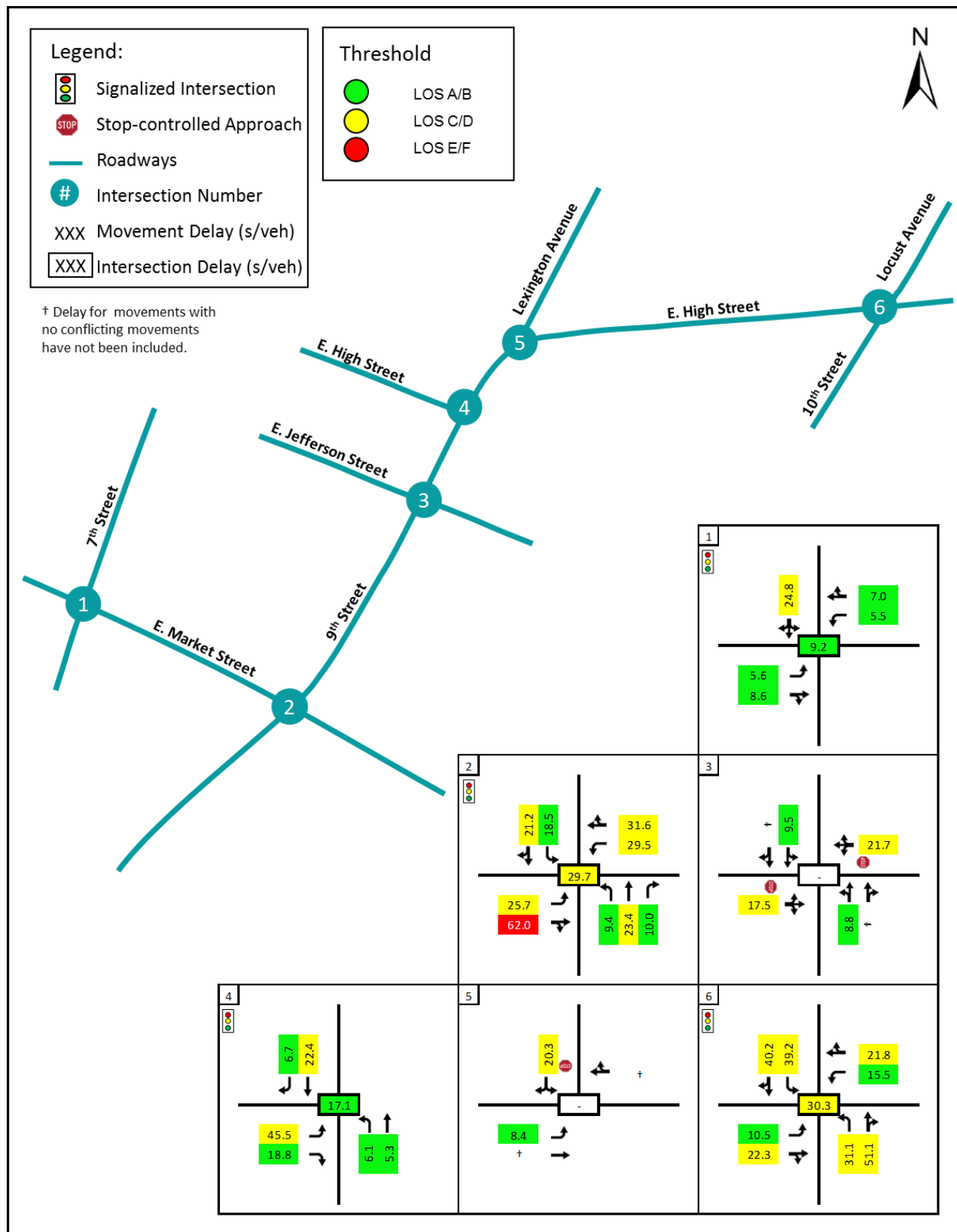


Figure 22: No-Build Design Year (2041) Queues

