Town-Wide Traffic Study

Belmont, Massachusetts

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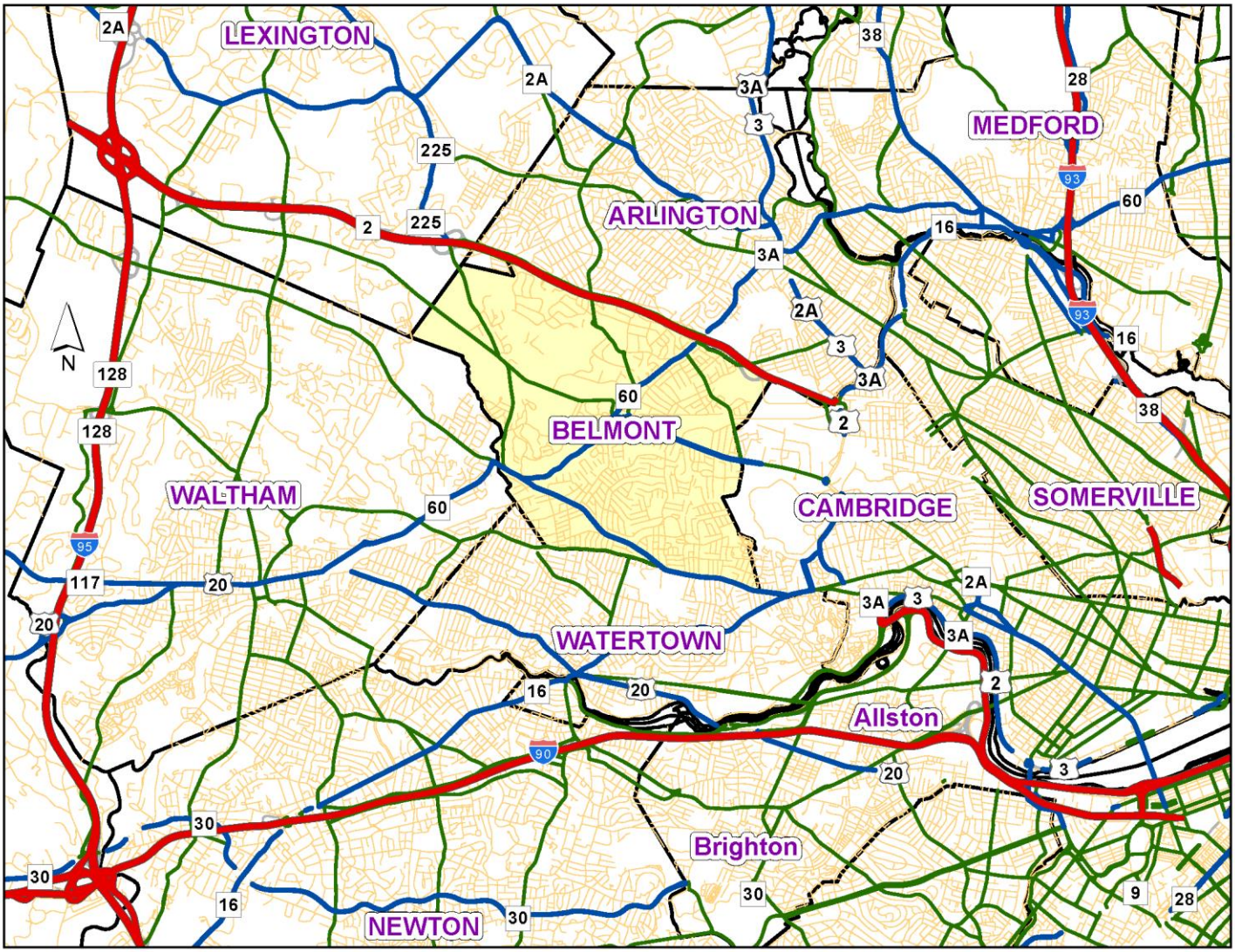
Study Overview

Belmont, Massachusetts is a town in Middlesex County and a western suburb of Boston, within the I-95/128 corridor, comprised primarily of residential development. The Town of Belmont is bordered by the Town of Watertown to the south, City of Waltham and Town of Lexington to the west, Town of Arlington to the north, and City of Cambridge to the east. Figure 1 shows the Town of Belmont and the surrounding municipalities in a regional context. The Concord Turnpike, designated as Massachusetts State Route 2, a primary route to Boston from the west, straddles Belmont's border with Arlington. Because of its geographic location and congestion on regional highways, Belmont is prone to "cut-through" traffic, as drivers seek alternate routes through town to their destinations (in other municipalities) without stopping within the area. The relatively recent development of real-time traffic data access to drivers, via Google Maps, Waze, and the like, appears to have had an influence on traffic diversion away from major arterials onto local roads. Additionally, residents complain about lack of pedestrian safety due to vehicular speeds and long delays stemming from increased traffic on their roadways.

Figure 1 Regional Context



1 Introduction

The Belmont Town-wide Study was undertaken to identify existing travel patterns, determine the extent of cut-through traffic, and to identify strategies to eliminate, reduce or mitigate such cut-through traffic. The goal of the study is improved safety of all users especially for pedestrians, bicyclists, and other non-vehicular modes of travel. This study was initiated in response to concerns raised by residents regarding increasing traffic congestion on town roads, and the proposed expansion and reconstruction of the Belmont High School to include 7th and 8th Grade students.

Travel patterns through Belmont are influenced by its central location in the Metro Boston region, the town's street layout, barriers to travel as a result of limited railroad crossings, and employment and other destinations in adjacent communities. Belmont is known as the "town of homes" and is surrounded by population and employment centers, such as the I-95/Route 128 corridor, Cambridge, Waltham, and Boston, with traffic headed for these destinations passing through town. The railroad bisects the town with only three points to cross, concentrating north-south flow to a few streets. Belmont's major streets also provide a direct connection between surrounding communities without much diversion or discontinuity, contributing to the street network's attraction as a cut-through route. The concentration of schools at certain areas of the Town also shape travel patterns, especially during the morning peak travel period.

2 Existing Conditions

2.1. Transportation Network

The location of the Town of Belmont, its proximity to Boston, Cambridge, and other employment centers, as well as the existing transportation network, makes its road network attractive to cut-through traffic. Congestion on regional highways, particularly, I-93, I-90, I-95/Route 128, and Route 2, results in diversions through residential neighborhoods on town roads that are less suitable to carry heavy commuter traffic. This diversion of traffic is further aided by route finding apps such as Google Maps and Waze.

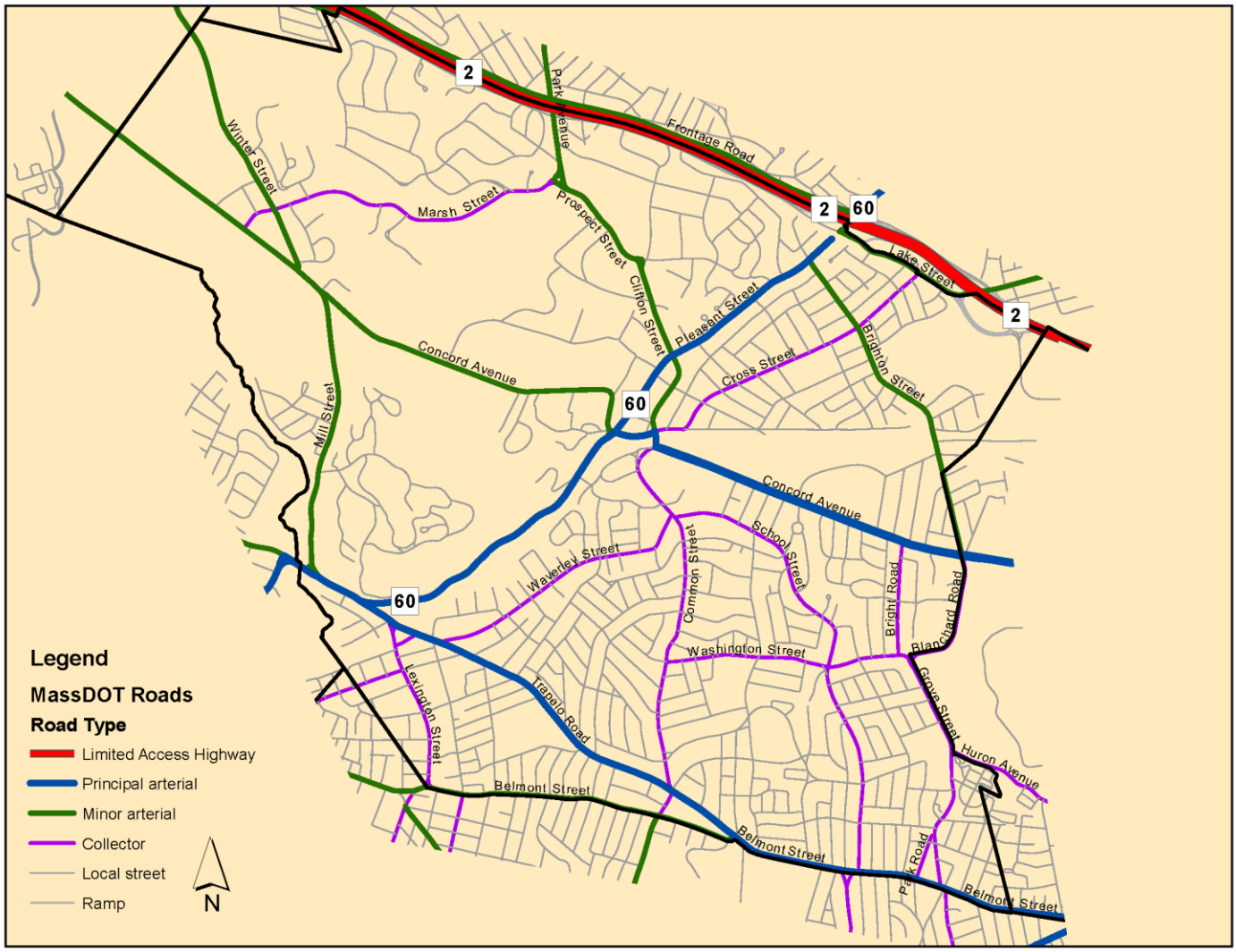
2.2. Roadway Functional Classification

Roadways are classified by their function and purpose. These kinds of classifications identify the hierarchy for effective collection and distribution of vehicles. Roadways may be classified as limited access highways, arterials, collectors, and local roadways. In the Town of Belmont, the roadway network has examples of all these roadway categories. Principal arterials support major shopping areas, high density residential development, or other regional scale developments serving high volumes of traffic. Minor arterials provide a link between principal arterials and collector streets. Collectors provide access to arterials from local streets and connect important small-scale land use serving the local community. Local streets form the most basic unit of roadway systems, and they are designed for lower traffic volumes and vehicle speeds. They provide access to residences, businesses, institutions, and access between adjacent properties. Most of the roadways in Belmont are local roads. Table 1 below shows the different roadway classification and examples in the Town of Belmont. The roadway classification is shown graphically in Figure 2.

Table 1 Roadway Classification

Roadway Classification	Examples
Limited Access Highway	• Concord Turnpike (Route 2)
Principal Arterial	• Concord Avenue • Pleasant Street (Route 60) • Trapelo Road/Belmont Street
Minor Arterial	• Brighton Street • Mill Street • Park Avenue • Clifton Street • Winter Street
Collector	• School Street • Cross Street • Marsh Street • Lexington Street • Common Street • Waverley Street • Grove Street
Local	• Goden Street • White Street • Beech Street • Baker Street • Waterhouse Road • Others

Figure 2 Roadway Functional Classification



Most streets in Belmont feature a sidewalk on at least one side of the street. The exception is within the Belmont Hill neighborhood, in the northwest corner of town, where most streets lack sidewalks. There are some streets, notably Bartlett Avenue in Belmont's southwest corner, where the grass strip separating the street and sidewalk has been paved over, eliminating a physical barrier between vehicles and pedestrians. Some residents have expressed concern about the proximity of vehicles to pedestrians in areas where the grass strip was eliminated.

Bicycle lanes are present along Trapelo Road, Belmont Street east of Trapelo Road, Concord Avenue east of Belmont Center, Grove Street, and Leonard Street. The Town is currently pursuing the design and construction of multi-use "Community Path" that will connect the Fitchburg Cut-off Path near Brighton Street to the Clark Street bridge.

2.3. Public Transportation

The Fitchburg Line of the Massachusetts Bay Transportation Authority (MBTA) Commuter Rail system effectively splits the town into two sections, having vehicular crossover points at Brighton Street,

Concord Avenue, and Waverley Square. Stations are located in the Town Centre, at Concord Avenue and Waverley Square with crossings being grade separated. The crossing at Brighton Street is at-grade.

Belmont is served by nine MBTA bus routes that provide connections to the MBTA Red Line via Alewife or Harvard Square stations. The buses originate mostly from Waverley Square and the town center. Recent creation of a bus only lane on Mount Auburn Street in Cambridge was meant to improve bus operations including those originating from Waverley Square and traveling along Trapelo Road/Belmont Street.

3 Community Input

The Town of Belmont Traffic Advisory Committee (TAC) organized several meetings to solicit input from residents regarding traffic concerns in town. Some of the concerns were also discussed during meetings for the proposed redevelopment of the Belmont High School. Figure 3 shows a road map with associated comments by residents. The comments can be summarized under the following headings:

3.1. Cut Through Traffic

- Heavy congestion on town's roadway network is getting worse. Congestion on regional highways such as Route 2 at Alewife and I-95 cause drivers to seek alternate routes, including routes through Belmont.
- With the use of navigational apps, local roads in town are increasingly being used as cut-through.
- Speeding is a major concern on local streets, even with the introduction of the town-wide speed limit of 25 miles per hour.
- There is a lack of enforcement on existing traffic regulations regarding turn restrictions.

3.2. Intersections

- Traffic operations at the offset intersection of School Street at Goden Street is a safety issue for both pedestrians and drivers. Conflicts between students crossing the intersection on foot and vehicles were noted.
- Some intersections act as a bottleneck due to outdated and non-responsive traffic signal timing. Concord Avenue at Blanchard Road, which is under the control of the City of Cambridge is one such example. The intersection of Lake Street at Brooks Avenue in the Town of Arlington also creates a bottleneck that results in vehicle queues extending far back into Belmont in the evening commuter period.
- The Route 2/Alewife Parkway intersection is seen as the biggest contributor of traffic diversion through Belmont.
- Traffic operations at Concord Avenue and Common Street is a source of significant delay in Belmont center.
- The intersection of Concord Avenue at Baker Street is wide open and difficult to traverse.

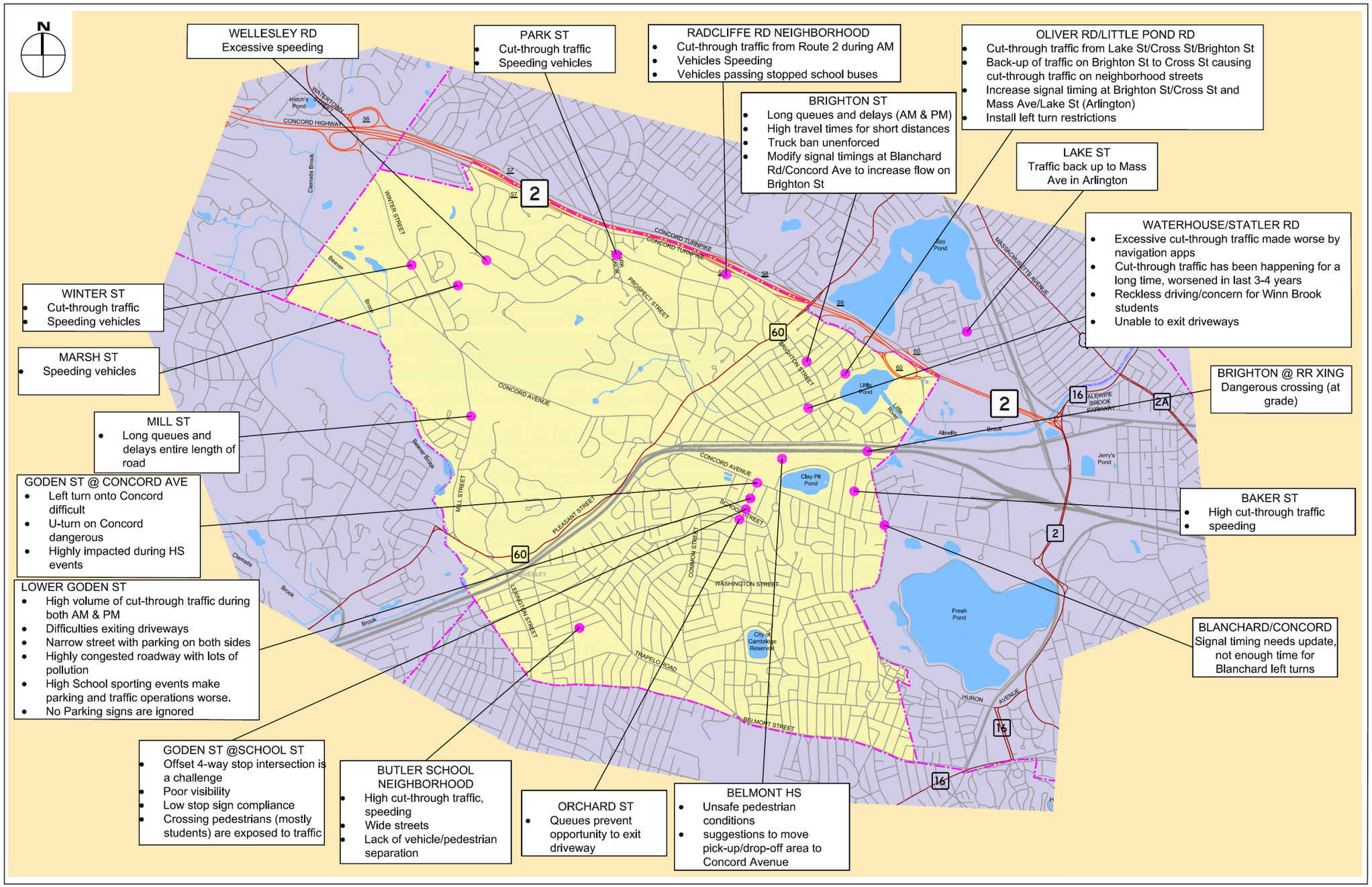
3.3. Bicyclists and Pedestrian Safety

- Residents would like to see more separation between pedestrians and vehicular traffic on certain streets, including Bartlett Avenue and the Butler School neighborhood.
- High speeds on local roads are a source of concern for non-motorized traffic.
- Crosswalk visibility

3.4. School Traffic

- School traffic has a pronounced effect on morning traffic congestion, especially in areas with a concentration of several schools.
- Potential traffic impacts from the proposed redevelopment and expansion of the High School is a concern
- On-Street parking during High School sporting activities spills over into surrounding neighborhoods.

Figure 3 **Resident Concerns**



4 Data Collection

Traffic data was collected at several locations in town to develop an understanding of existing traffic conditions and travel patterns. This section summarizes the data collection methods and analysis of existing traffic conditions in Belmont. The data collection involved Turning Movement Counts (TMC), Automatic Traffic Recorder counts (ATR), license plate survey, and Media Access Control (MAC). Figure 4 illustrates the count locations and types of data collected.

4.1. Turning Movement Counts/Automatic Traffic Recorder Counts

Intersection turning movement counts, vehicle classification, pedestrian and bicycle volumes were obtained at 21 locations throughout Belmont for 12 hours (6AM to 6PM). The TMCs were completed using video recorders on Wednesday April 10, 2018, except as noted, at the following locations:

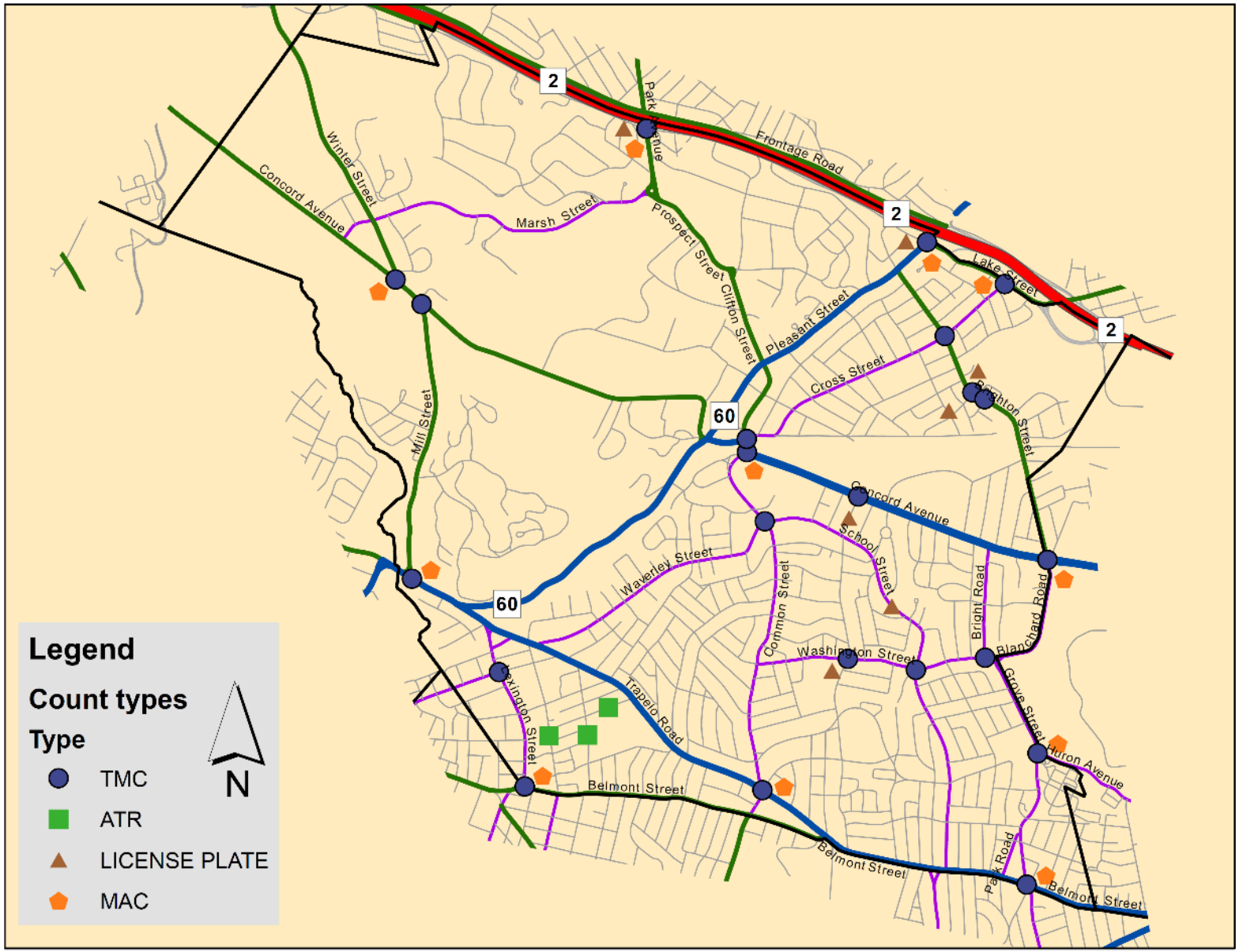
- Winter Street at Concord Avenue
- Concord Avenue at Mill Street
- Trapelo Road at Mill Street
- Park Avenue at Route 2 EB Off Ramp/Frontage Rd
- Pleasant Street at Route 2 EB Off Ramp/Lake St
- Lake Street at Cross Street
- Cross Street at Brighton Street
- Lexington Street at Sycamore Street (10/02/2018)
- Lexington Street at Belmont Street
- Trapelo Road at Common Street
- Common Street at Waverley St/School Street
- School Street at Washington Street
- Concord Avenue at Common Street
- Concord Avenue at Leonard Street/Channing Road
- Concord Avenue at Goden Street
- Washington Street at Goden Street
- Belmont Street at Grove Street/Arlington Street
- Brighton Street at Eliot Street
- Brighton Street at Statler Street
- Concord Avenue at Blanchard Road
- Bright Road at Washington Street
- Grove Street at Huron Avenue

Additionally, 24-hour automatic traffic recorder (ATR) data was collected on Wednesday October 2, 2018 at the following three locations:

- White Street south of Walnut Street
- Walnut Street south of Trapelo Road
- Maple Street south of Loring Street

The ATR data included traffic volumes, vehicle classification and speed.

Figure 4 Study Area



4.2. Data Summary

Pedestrian crossing counts over a 12-hour period (6 AM to 6 PM) at the study area intersections are presented in Figure 5. Cushing Square recorded the highest number of pedestrian crossings, over 1,100, followed by Washington Street at School Street (719), Concord Avenue/Blanchard Road (501) Belmont Street/Grove Street (491), and Lexington Street/Sycamore Street (468). Other locations with high pedestrian crossing volumes were at intersections near the schools. It is worth noting that minimal pedestrian activities were observed at the Concord Avenue/Common Street intersection.

Figure 6 shows 12-hour traffic volumes (6 AM to 6 PM) on the study area roadway segments in Belmont. Data for White Street, Walnut Street, and Maple Street were obtained over a 24-hour period. Morning and afternoon peak hour turning movement counts are presented in Figures 7 and 8, respectively. Figures 9 and 10 present peak hour Pedestrian and Bicycle volumes at the study intersections. Detailed traffic count data is included in the Appendix of this report.

Vehicle speeds (average and 85 percentile) were recorded on White Street, Maple Street, and Walnut Street. The speeds on White Street were 27 mph and 31 mph respectively; on Maple Street, the speeds were 26 mph and 33 mph, respectively; and on Walnut Street, the speeds were 21 mph and 25 mph, respectively.

Figure 5 Existing 12-Hour Pedestrian Crossing Volumes

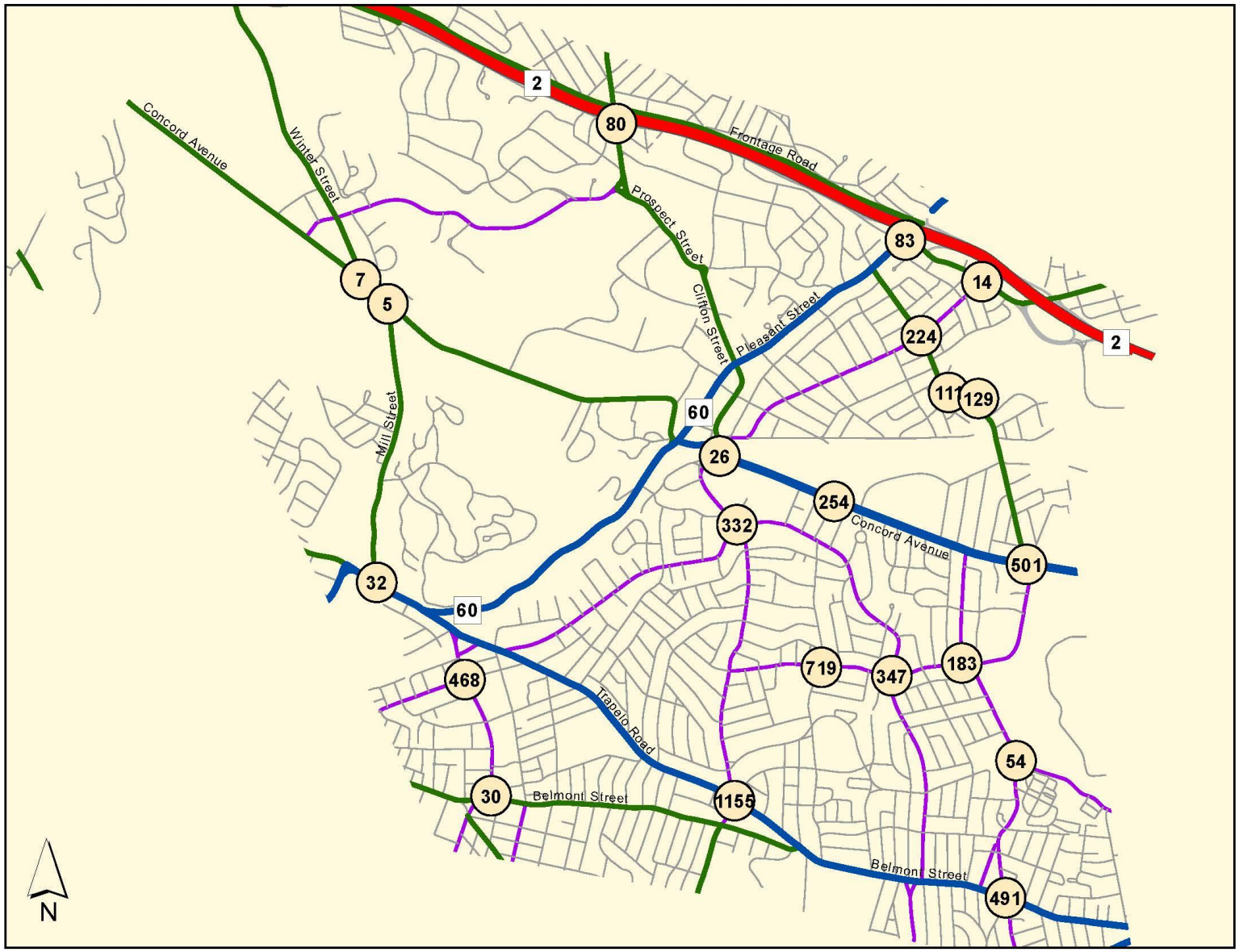


Figure 6 12-Hour Traffic Volumes

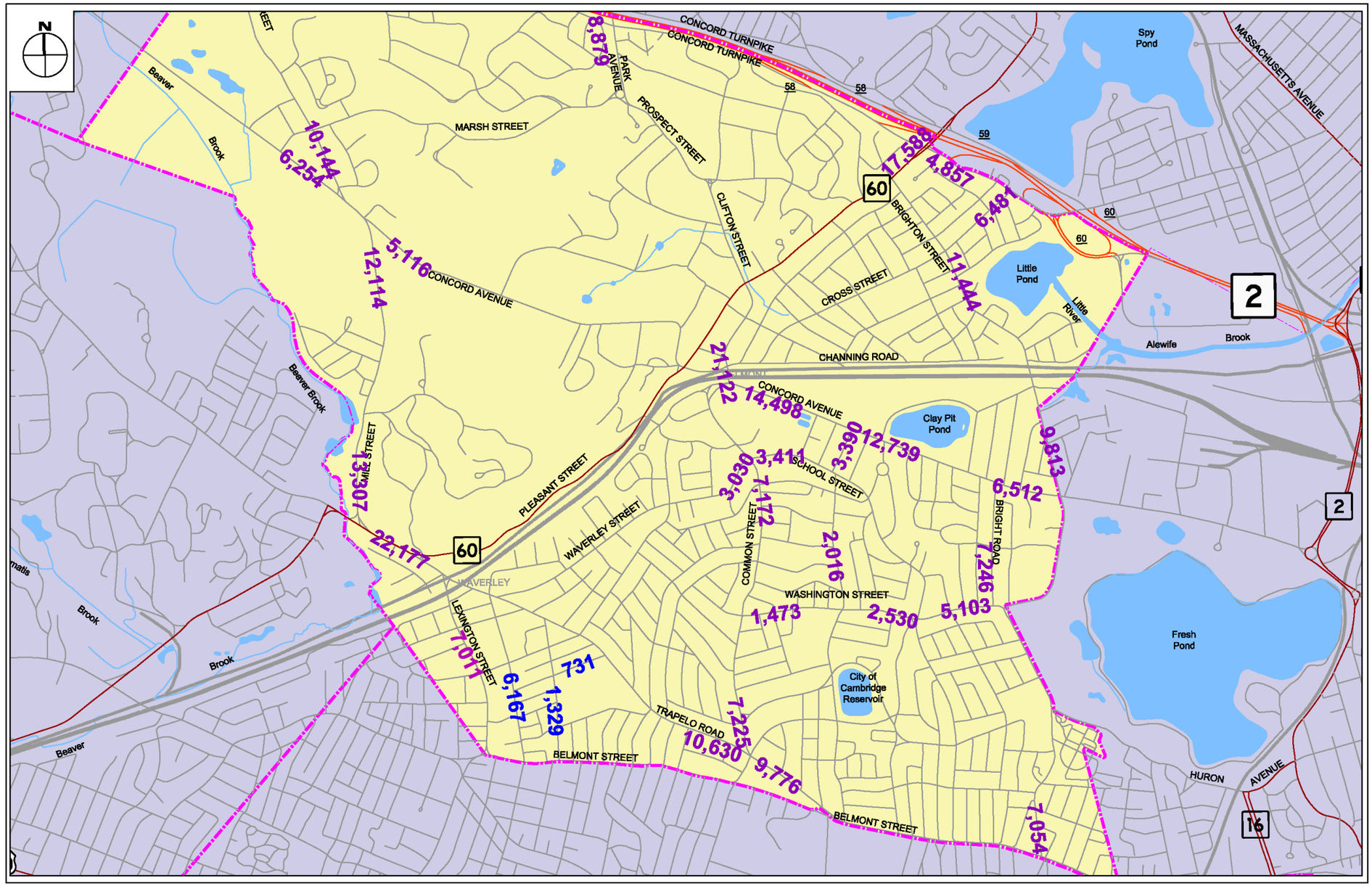
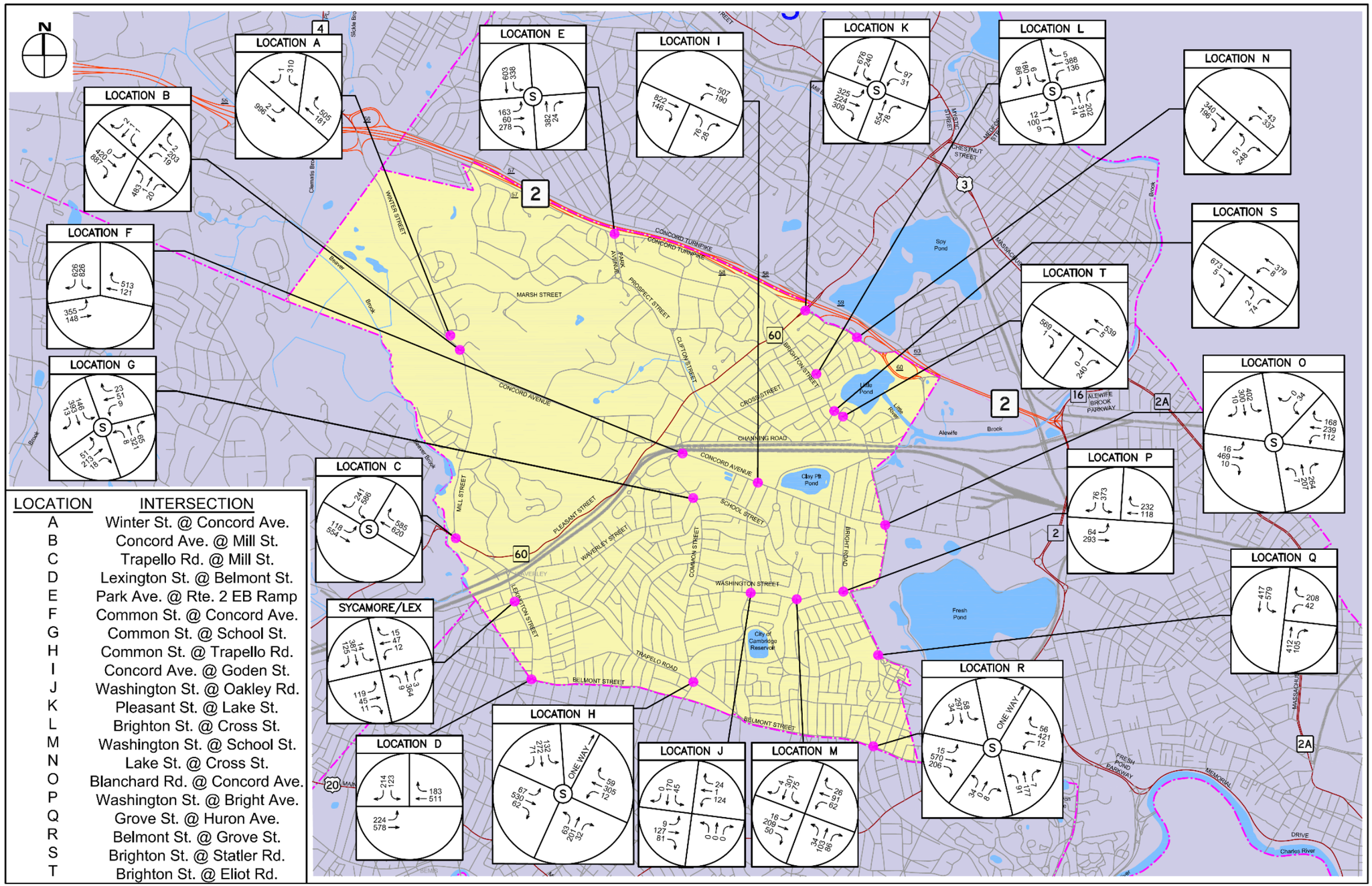
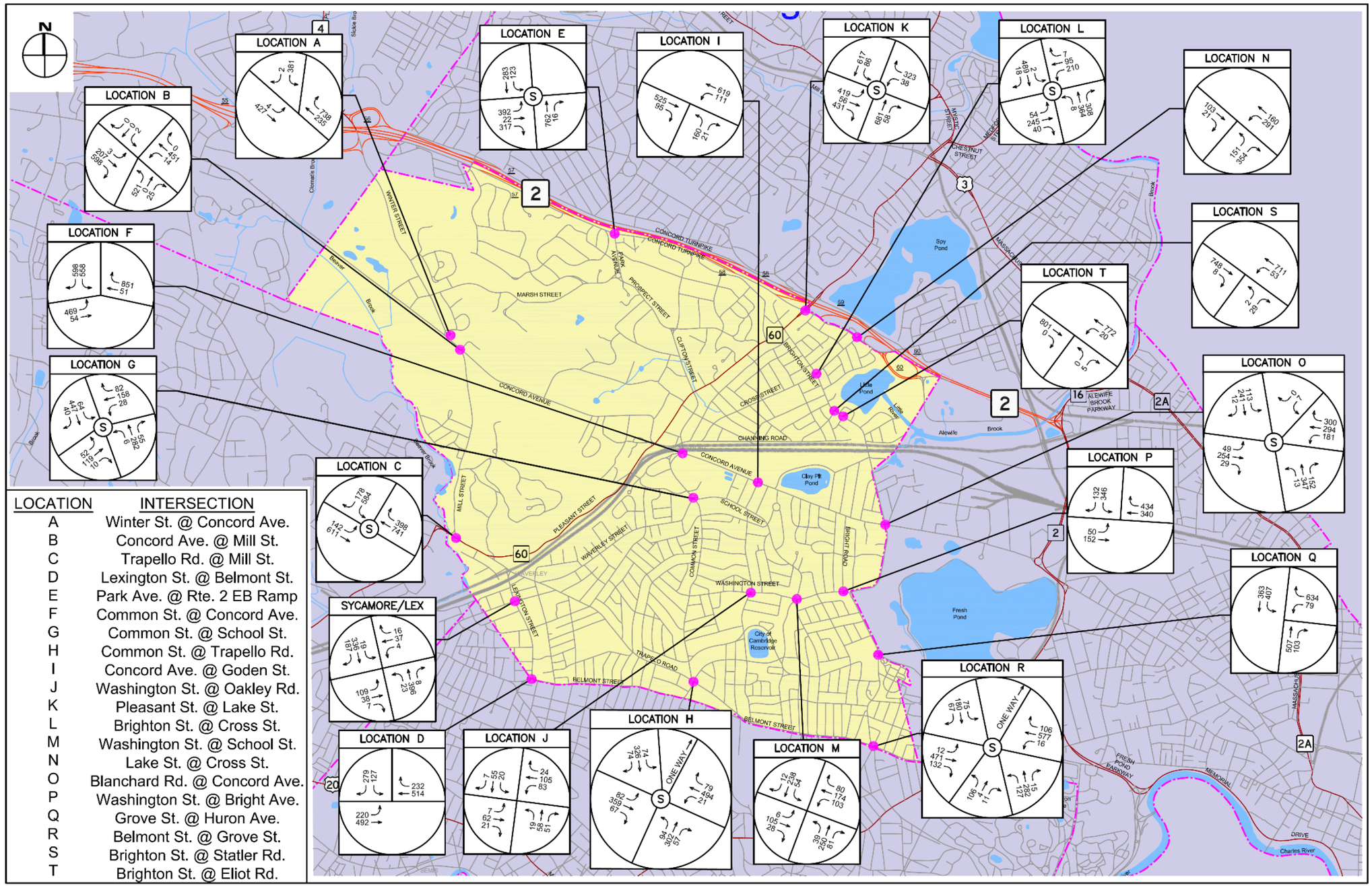


Figure 7 Existing 2018 Weekday Morning Peak Hour Traffic Volumes



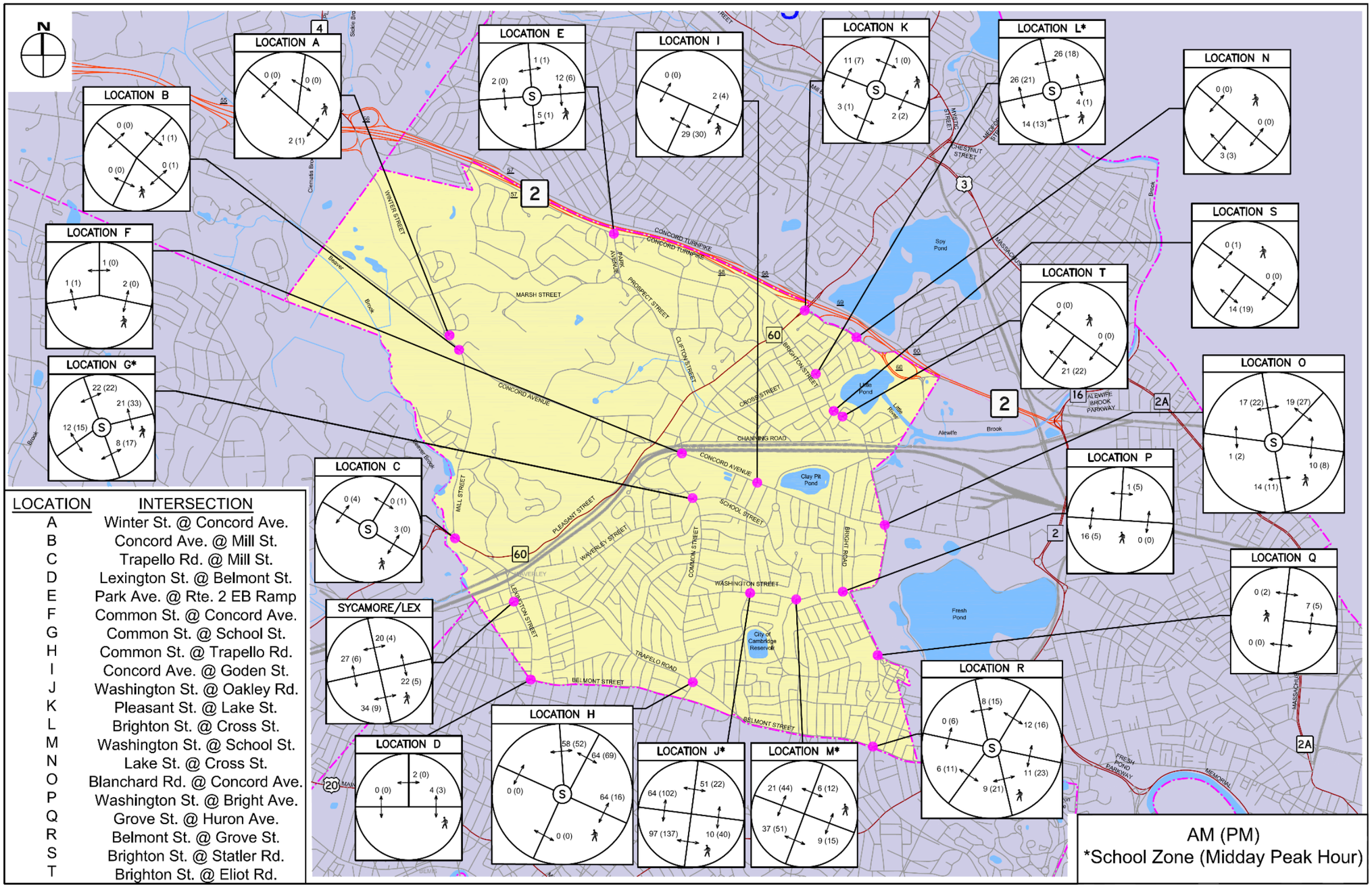
LOCATION	INTERSECTION
A	Winter St. @ Concord Ave.
B	Concord Ave. @ Mill St.
C	Trapello Rd. @ Mill St.
D	Lexington St. @ Belmont St.
E	Park Ave. @ Rte. 2 EB Ramp
F	Common St. @ Concord Ave.
G	Common St. @ School St.
H	Common St. @ Trapello Rd.
I	Concord Ave. @ Goden St.
J	Washington St. @ Oakley Rd.
K	Pleasant St. @ Lake St.
L	Brighton St. @ Cross St.
M	Washington St. @ School St.
N	Lake St. @ Cross St.
O	Blanchard Rd. @ Concord Ave.
P	Washington St. @ Bright Ave.
Q	Grove St. @ Huron Ave.
R	Belmont St. @ Grove St.
S	Brighton St. @ Statler Rd.
T	Brighton St. @ Eliot Rd.

Figure 8 Existing 2018 Weekday Evening Peak Hour Traffic Volumes



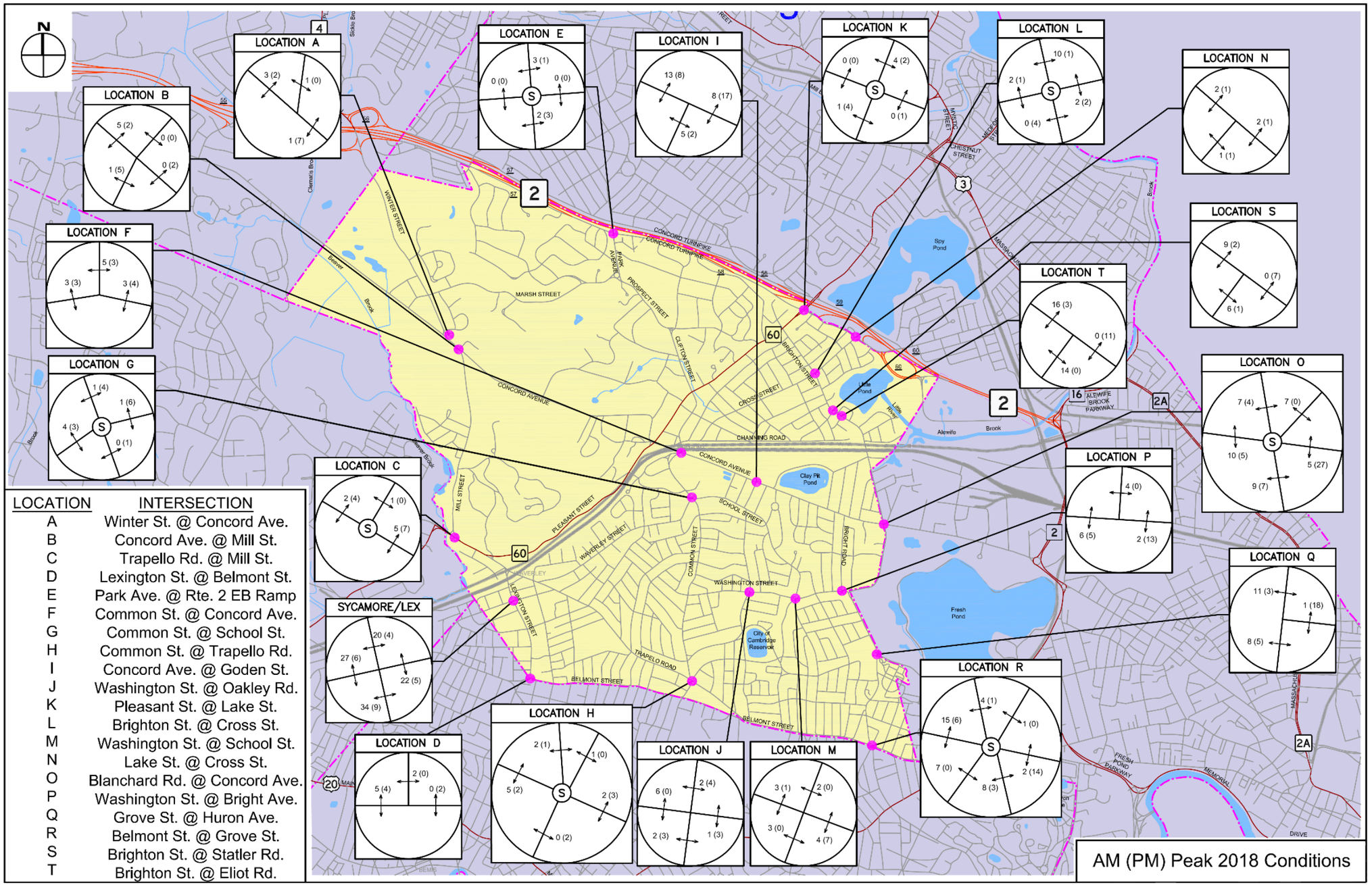
LOCATION	INTERSECTION
A	Winter St. @ Concord Ave.
B	Concord Ave. @ Mill St.
C	Trapello Rd. @ Mill St.
D	Lexington St. @ Belmont St.
E	Park Ave. @ Rte. 2 EB Ramp
F	Common St. @ Concord Ave.
G	Common St. @ School St.
H	Common St. @ Trapello Rd.
I	Concord Ave. @ Goden St.
J	Washington St. @ Oakley Rd.
K	Pleasant St. @ Lake St.
L	Brighton St. @ Cross St.
M	Washington St. @ School St.
N	Lake St. @ Cross St.
O	Blanchard Rd. @ Concord Ave.
P	Washington St. @ Bright Ave.
Q	Grove St. @ Huron Ave.
R	Belmont St. @ Grove St.
S	Brighton St. @ Statler Rd.
T	Brighton St. @ Eliot Rd.

Figure 9 **Existing 2018 Peak Hour Pedestrian Volumes**



LOCATION	INTERSECTION
A	Winter St. @ Concord Ave.
B	Concord Ave. @ Mill St.
C	Trapello Rd. @ Mill St.
D	Lexington St. @ Belmont St.
E	Park Ave. @ Rte. 2 EB Ramp
F	Common St. @ Concord Ave.
G	Common St. @ School St.
H	Common St. @ Trapello Rd.
I	Concord Ave. @ Goden St.
J	Washington St. @ Oakley Rd.
K	Pleasant St. @ Lake St.
L	Brighton St. @ Cross St.
M	Washington St. @ School St.
N	Lake St. @ Cross St.
O	Blanchard Rd. @ Concord Ave.
P	Washington St. @ Bright Ave.
Q	Grove St. @ Huron Ave.
R	Belmont St. @ Grove St.
S	Brighton St. @ Statler Rd.
T	Brighton St. @ Eliot Rd.

Figure 10 **Existing 2018 Peak Hour Bicycle Volumes**



5 Existing Traffic Trends

Traffic flow in Belmont, in general, is directional based on the time of day. During the morning peak period, traffic movements are predominantly from the north and west towards Boston and Cambridge. This trend is reversed in the evening. Figures 11 and 12 show the volume and direction of travel on heavily travelled roadways in Belmont, during two hours in the morning (7-9 AM) and evening (4-6 PM) peak periods. Heavily travelled roads include Concord Avenue, Pleasant Street, and Trapelo Road, which are all classified as principal arterials for either part or the whole of their length in Belmont. Other highlighted roadways include Brighton Street, Cross Street, Common Street, Mill Street, and Park Avenue.

Figure 11 Weekday Morning Peak Hour Travel Patterns

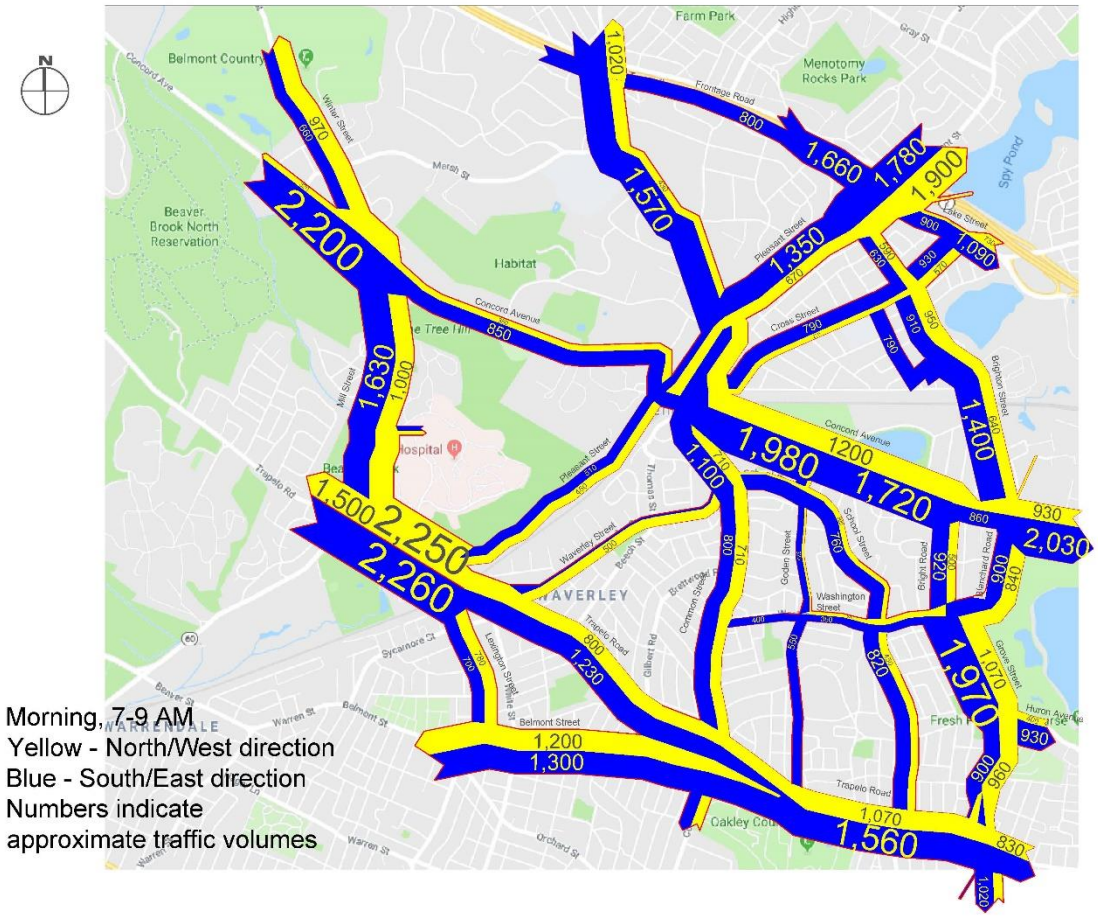


Figure 12 Weekday Evening Peak Hour Travel Patterns

5.1. Hourly Traffic Volume Variations

As noted earlier, traffic volumes were recorded over a 12-hour period at each of the study intersections. Hourly volumes were graphed to provide a picture of traffic variation throughout the day. Distinct spikes or peaks were observed during the morning and evening hours, along with a general decrease in volume during the other times of the day. At the intersection of Trapelo Road and Mill Street, the southbound traffic on Mill Street peaked between 8 and 9 AM and again between 4 and 5 PM. Trapelo Road eastbound exhibited similar characteristics, though Trapelo Road westbound appeared to have significantly high volumes all day long (Figure 13).

On Eliot Street near Brighton Street, there is a significant spike in traffic between 7 and 9 AM and very low volumes other times of the day. Traffic on Eliot Street peaks at 240 vehicles per hour between 8 and 9 AM while it averages less than 10 vehicles per hour the rest of the day. This is a clear indication of traffic diverting onto Eliot Street to avoid congestion on Brighton Street during the morning commuter period (Figure 14).

For intersections near schools, such as Concord Avenue and Goden Street near Belmont High School (Figure 15), a second peak can be seen in the early to mid-afternoon coinciding with school dismissal

times. The use of Goden Street as a cut-through traffic route, especially during the weekday evening is evident in the high northbound traffic volumes, between 3 and 6 PM.

At Concord Avenue and Common Street (Figure 16), traffic volumes during the morning peak period appear to be significantly higher than those during the afternoon.

Other hourly variation charts are contained in the Appendix.

Figure 13 Hourly Traffic Volume Variation – Trapelo Road at Mill Street

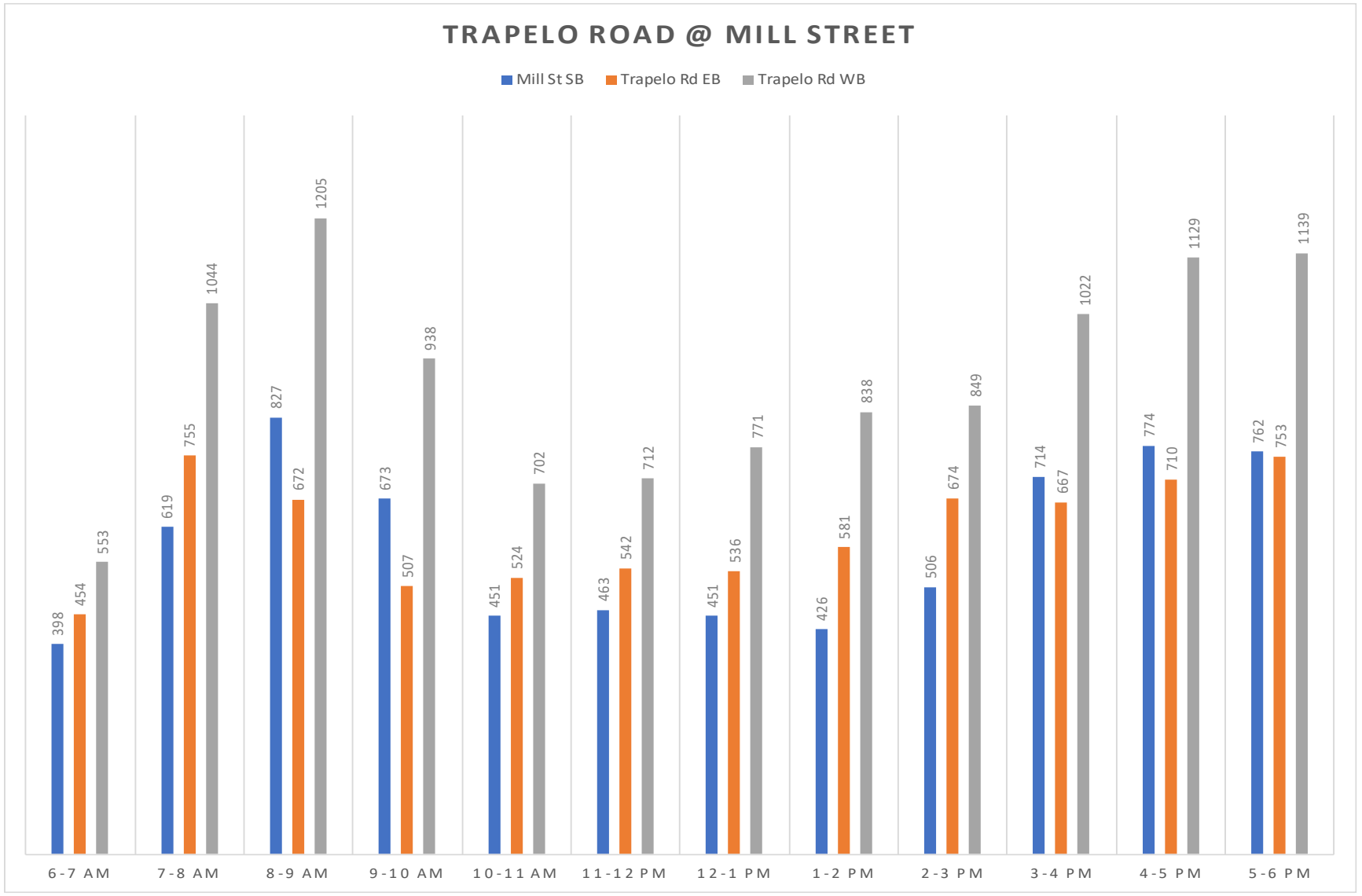


Figure 14 Hourly Traffic Volume Variation – Concord Avenue at Goden Street

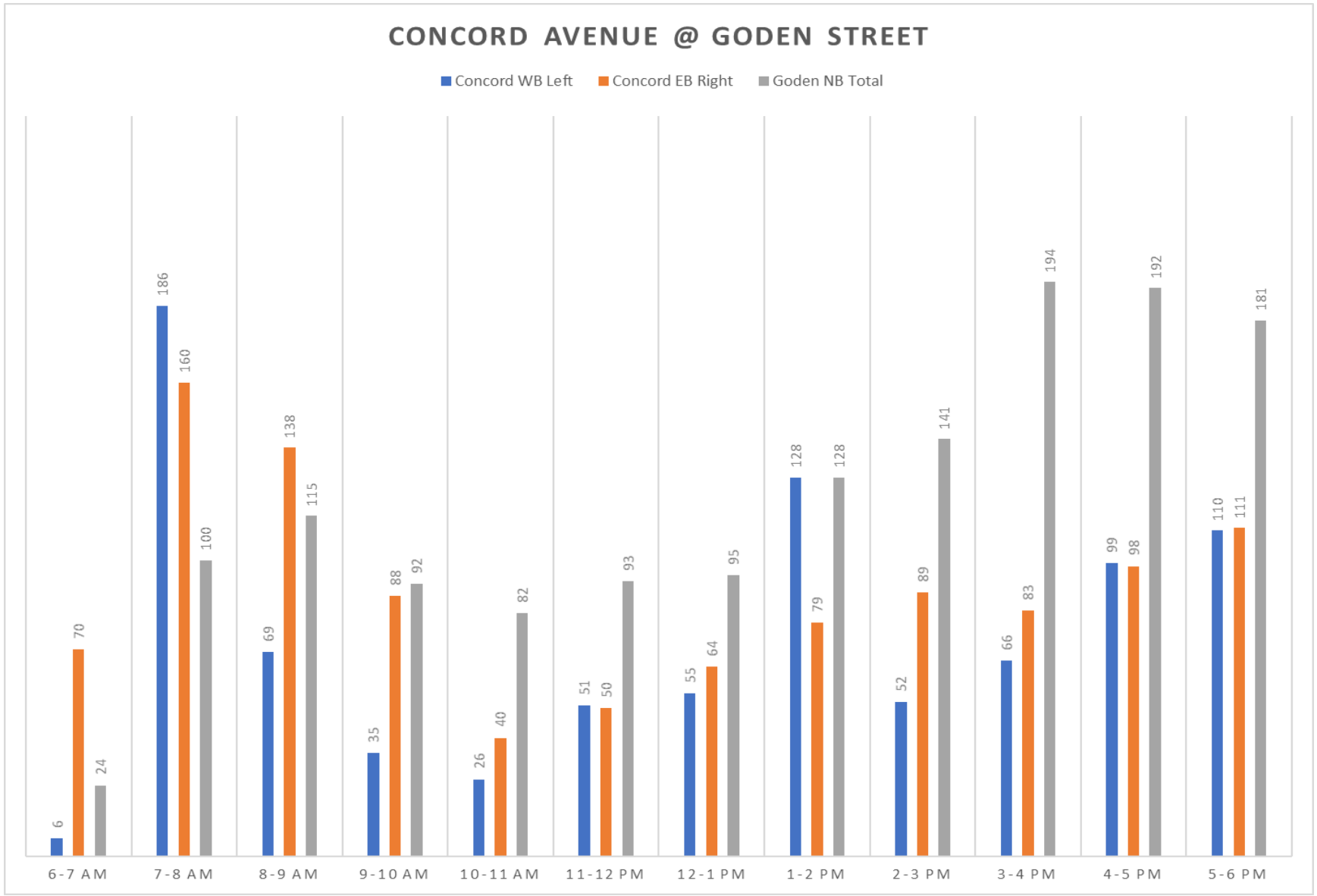


Figure 15 Hourly Traffic Volume Variation – Brighton Street at Eliot Road

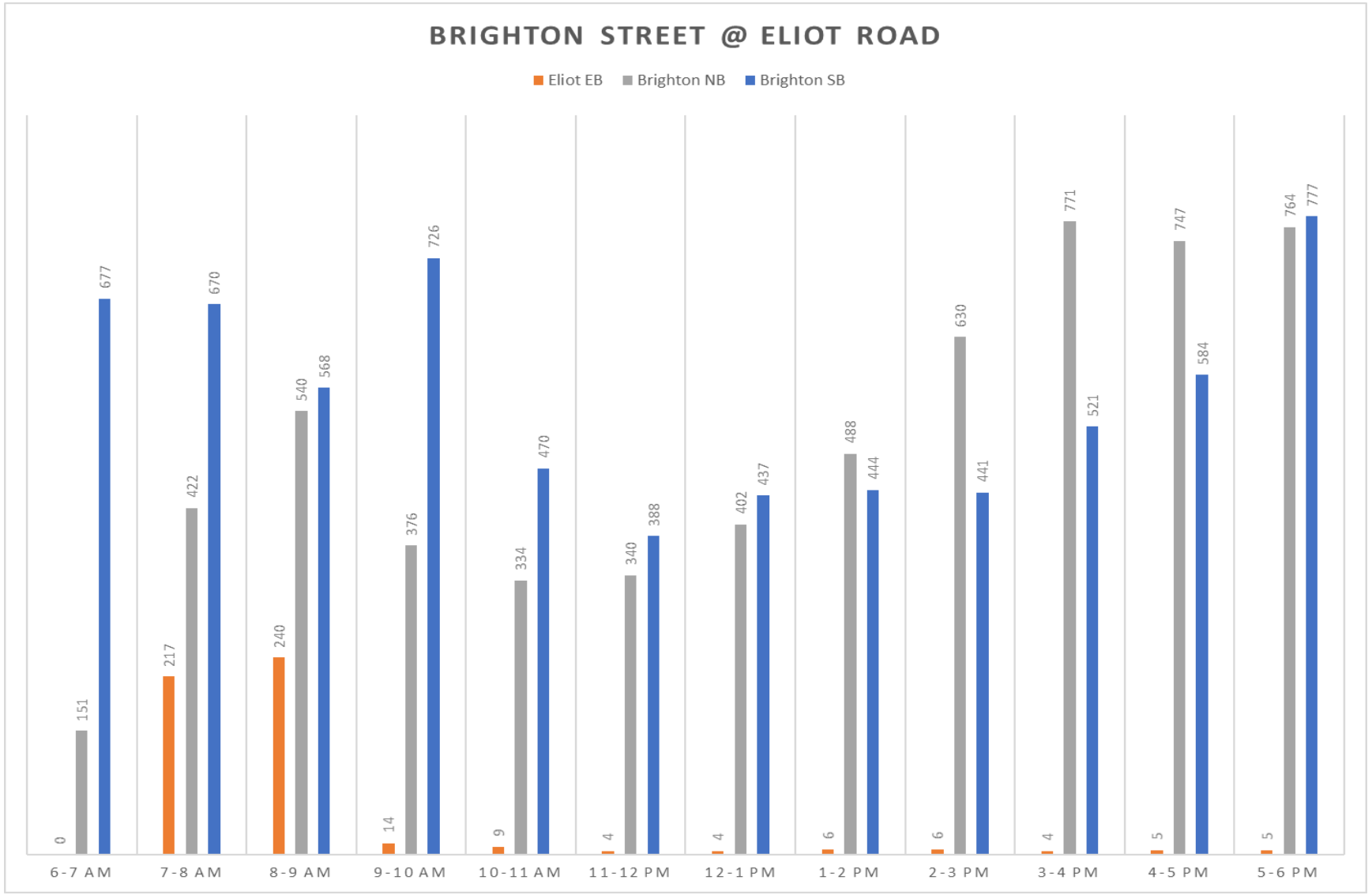


Figure 16 Hourly Traffic Volume Variation – Concord Avenue at Common Street

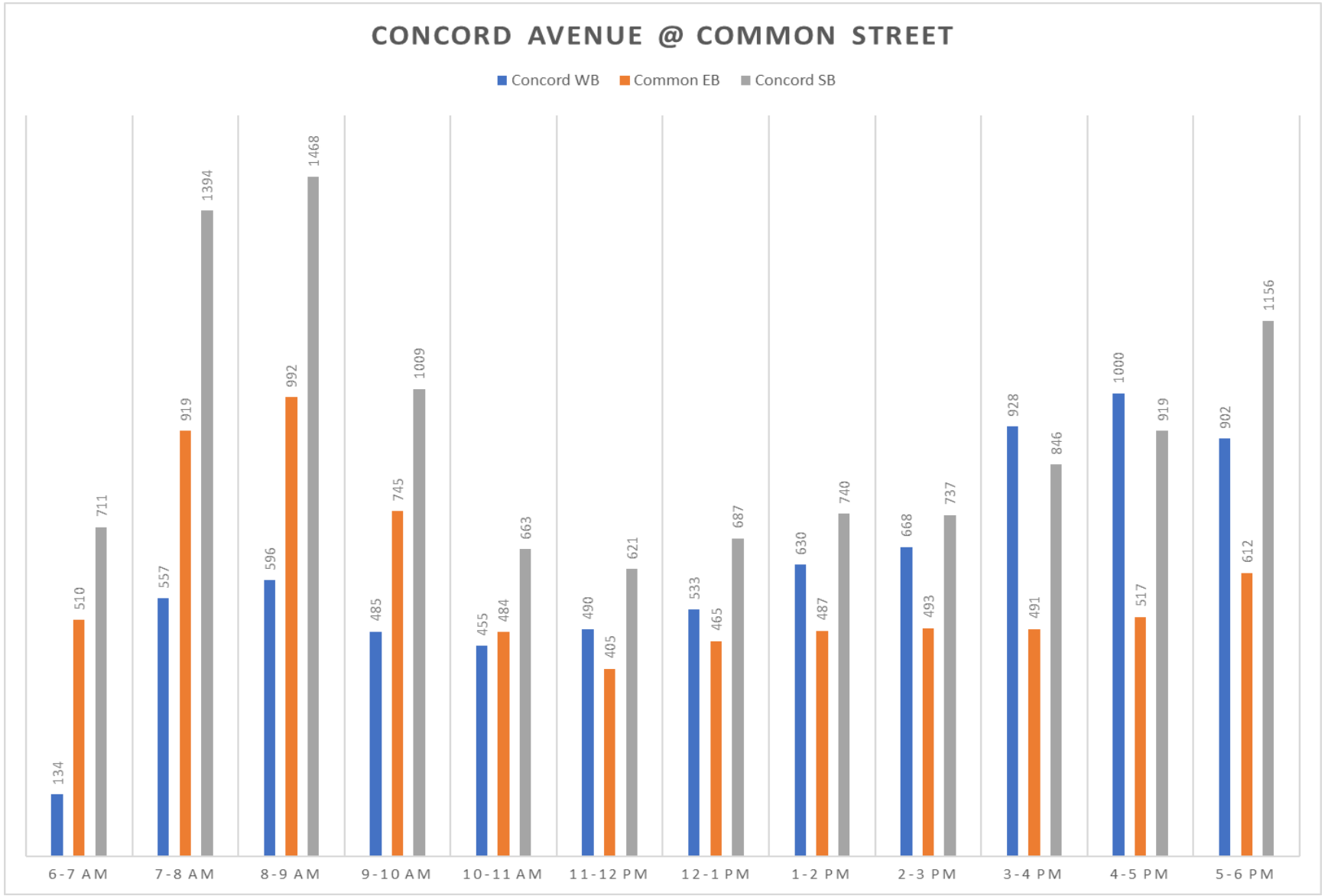


Figure 17 Hourly Traffic Volume Variation – Park Avenue at Frontage Road

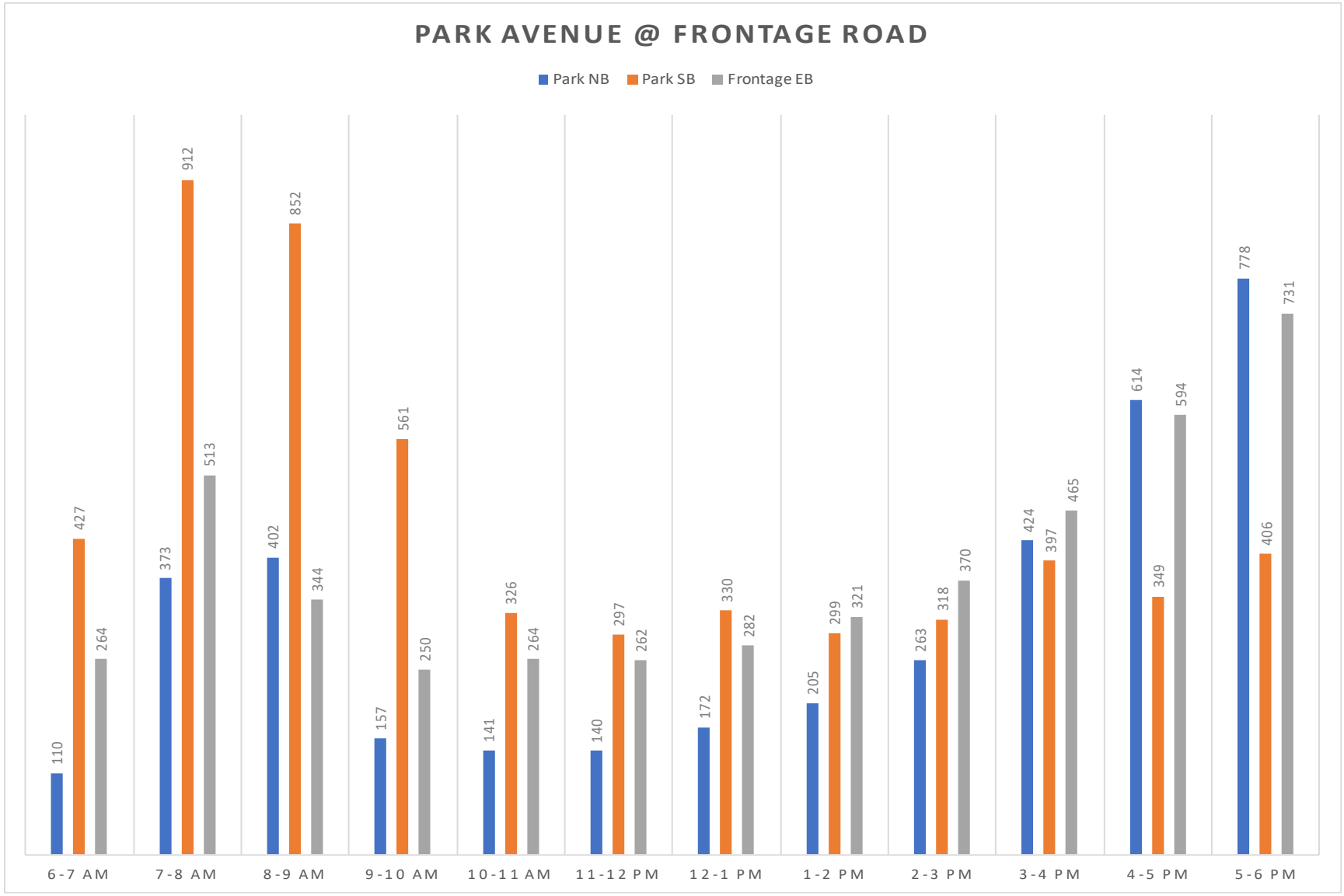
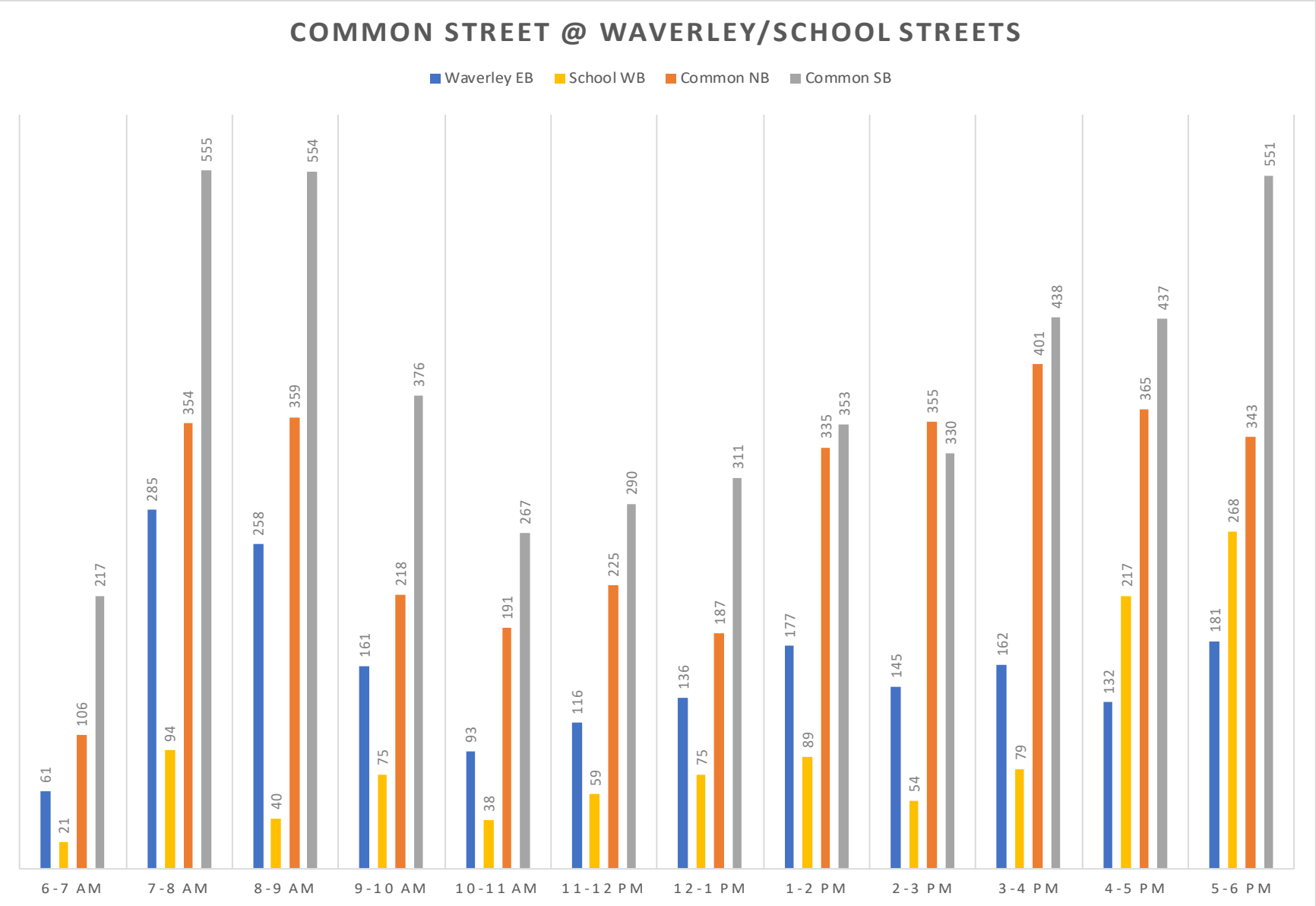


Figure 18 Hourly Traffic Volume Variation – Common Street at Waverly Street/School Street



5.2. Travel Time Data Collection

At 11 of the count locations, in addition to the TMC data collection, equipment was deployed to record media access control (MAC) addresses of Wi-Fi enabled devices going past the counting station. Ten of the eleven locations were gateway or entry points to the town of Belmont where MAC addresses of vehicles entering or exiting Belmont were recorded to identify travel patterns and the number (extent or magnitude) of trips using Belmont roads as cut-through routes. MAC addresses were also recorded at Concord Avenue and Common Street in the town center. These locations are listed in Table 2 and displayed in Figure 19.

Table 2 Intersection Numbering for MAC Address Collection

ID	Intersection
1	Concord Avenue and Winter Street
2	Park Avenue and Concord Turnpike
3	Trapelo Road and Mill Street
4	Concord Avenue and Common Street
5	Belmont Street and Lexington Street
6	Pleasant Street and Lake Street
7	Lake Street and Cross Street
8	Trapelo Road and Common Street
9	Concord Avenue and Blanchard Road
10	Grove Street and Huron Avenue
11	Belmont Street and Grove Street

5.3. Travel and Trip Patterns

Origin and destinations of trips entering and exiting Belmont were determined by MAC address collections at various points near the town's borders (Table 2). The number of trips and travel time between origin and destination pairs were tabulated. Vehicle travel and trip patterns were tracked via MAC address collection and the license plate survey. Figures 20 -24 below illustrate percentage of vehicles mapped between entries and exits out of Belmont.

Figure 20 shows the percent share of vehicles passing through the intersection of Pleasant Street at Lake Street in the AM peak that were detected at other data collection points that they pass through. The map illustrates that most of these vehicles are proceeding down Lake Street into Arlington and Cambridge, the next largest share center being Cambridge by way of Brighton Street. Locations with less than 5% share are not shown graphically. Figures 21 through 24 show origin and destination percentages for Park Avenue, Concord Avenue, Cushing Square, and Trapelo Road at Mill Street, during either the AM or the PM peak periods.

Figure 19 Daily Trip Patterns

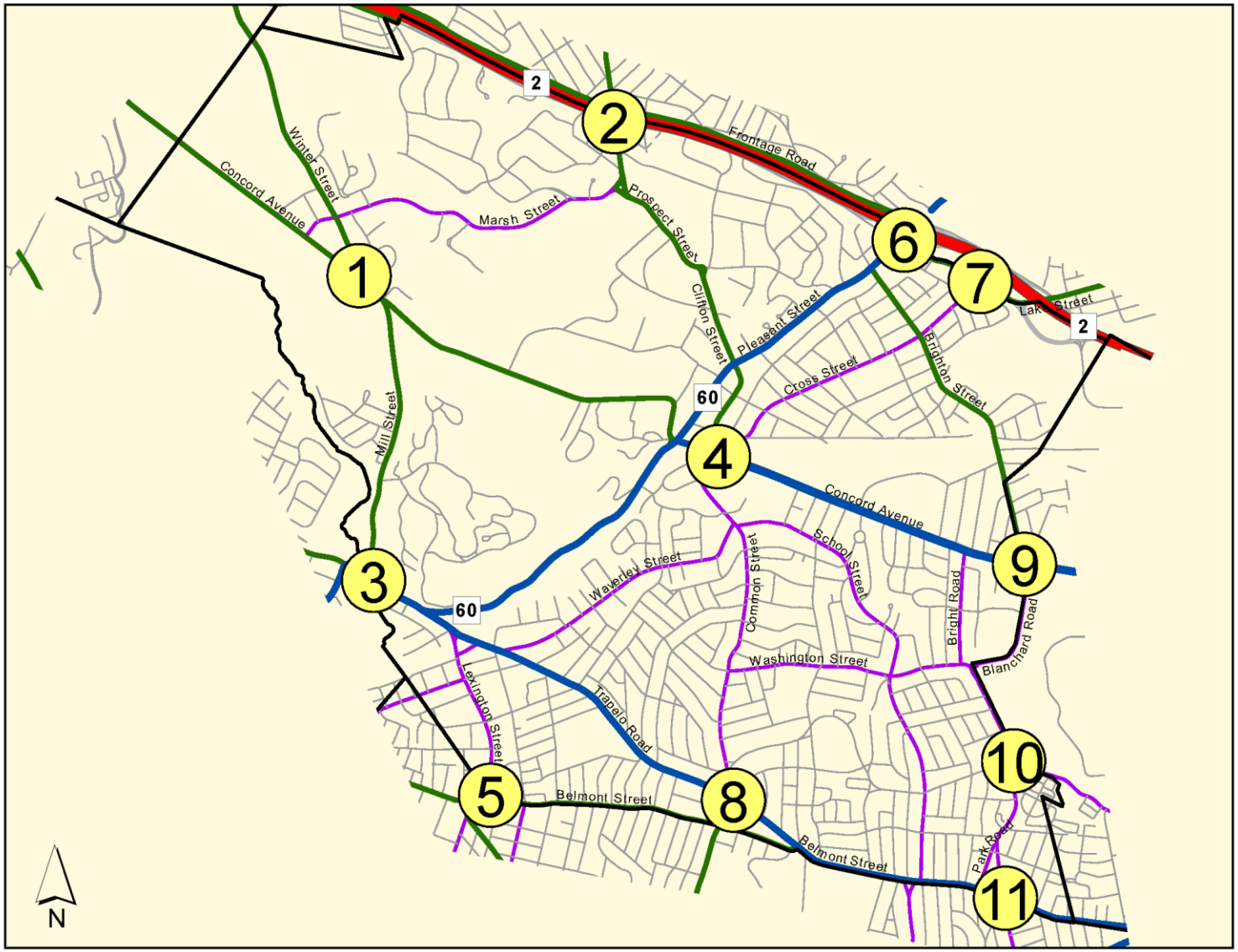
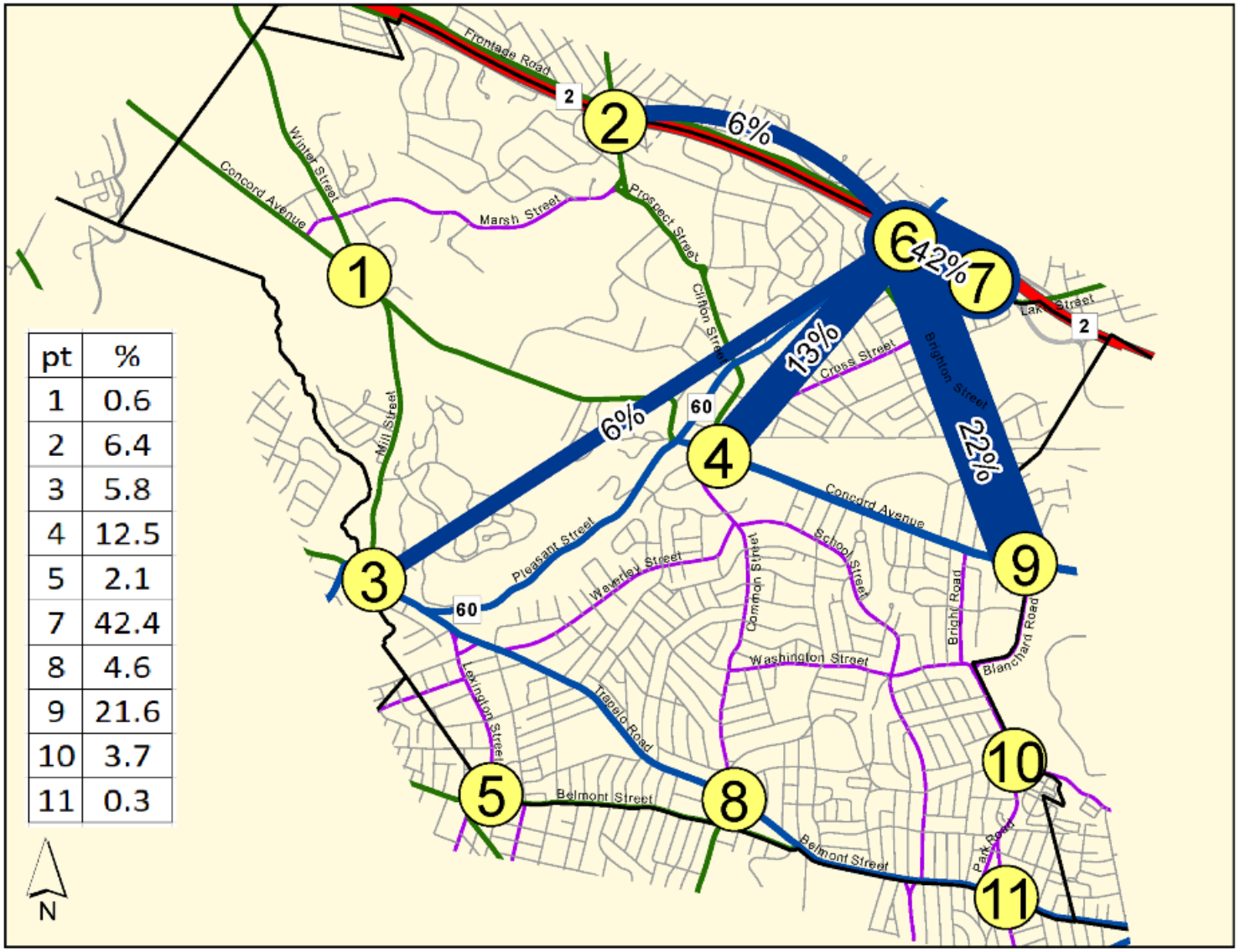


Figure 20 Weekday Morning Peak Hour Trip Pattern: From Pleasant Street/Lake Street



pt	%
1	0.6
2	6.4
3	5.8
4	12.5
5	2.1
7	42.4
8	4.6
9	21.6
10	3.7
11	0.3

Figure 21 Weekday Morning Peak Hour Trip Pattern: From Park Avenue/Frontage Road

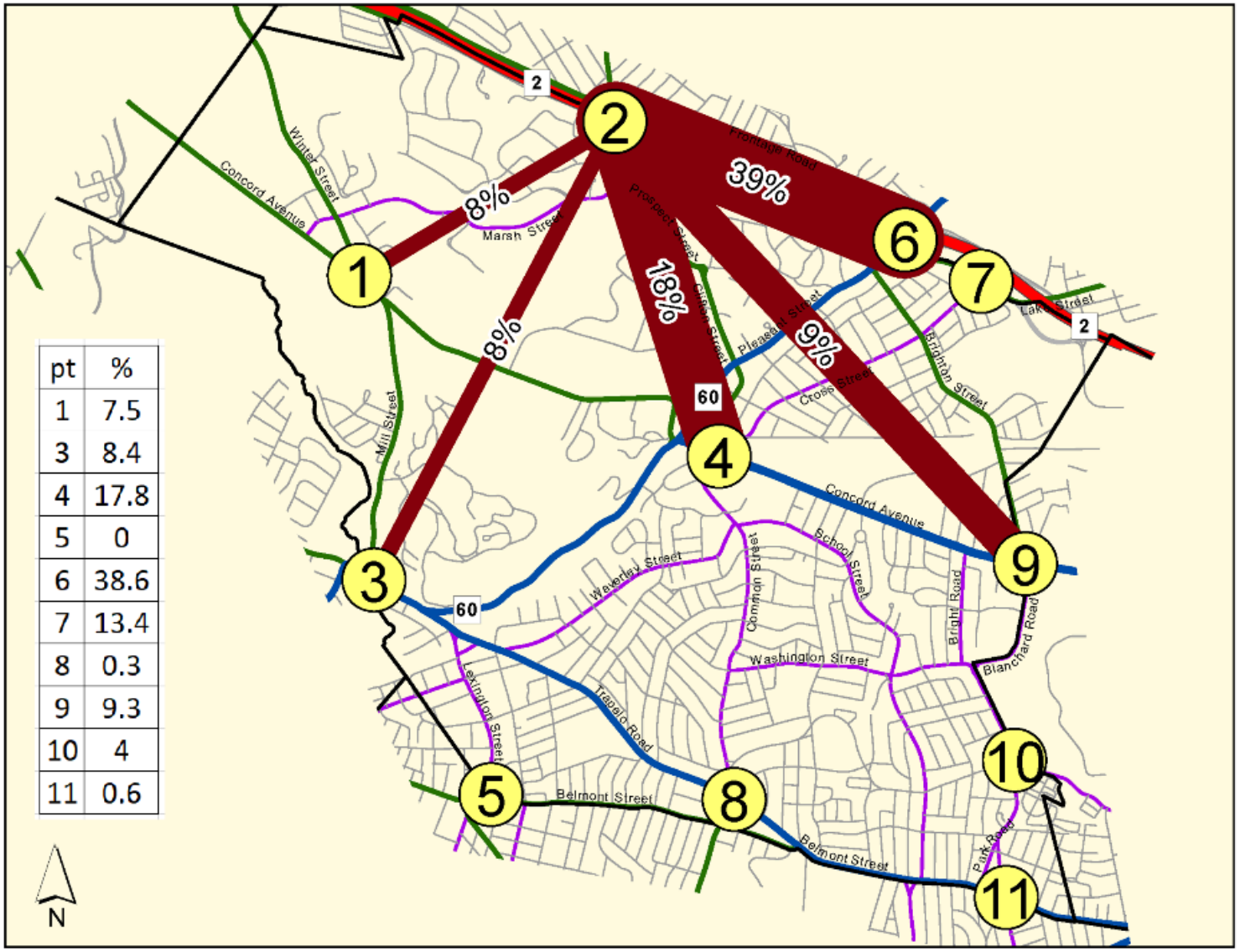


Figure 22 Weekday Morning Peak Hour Trip Pattern: From Trapelo Road/Mill Street

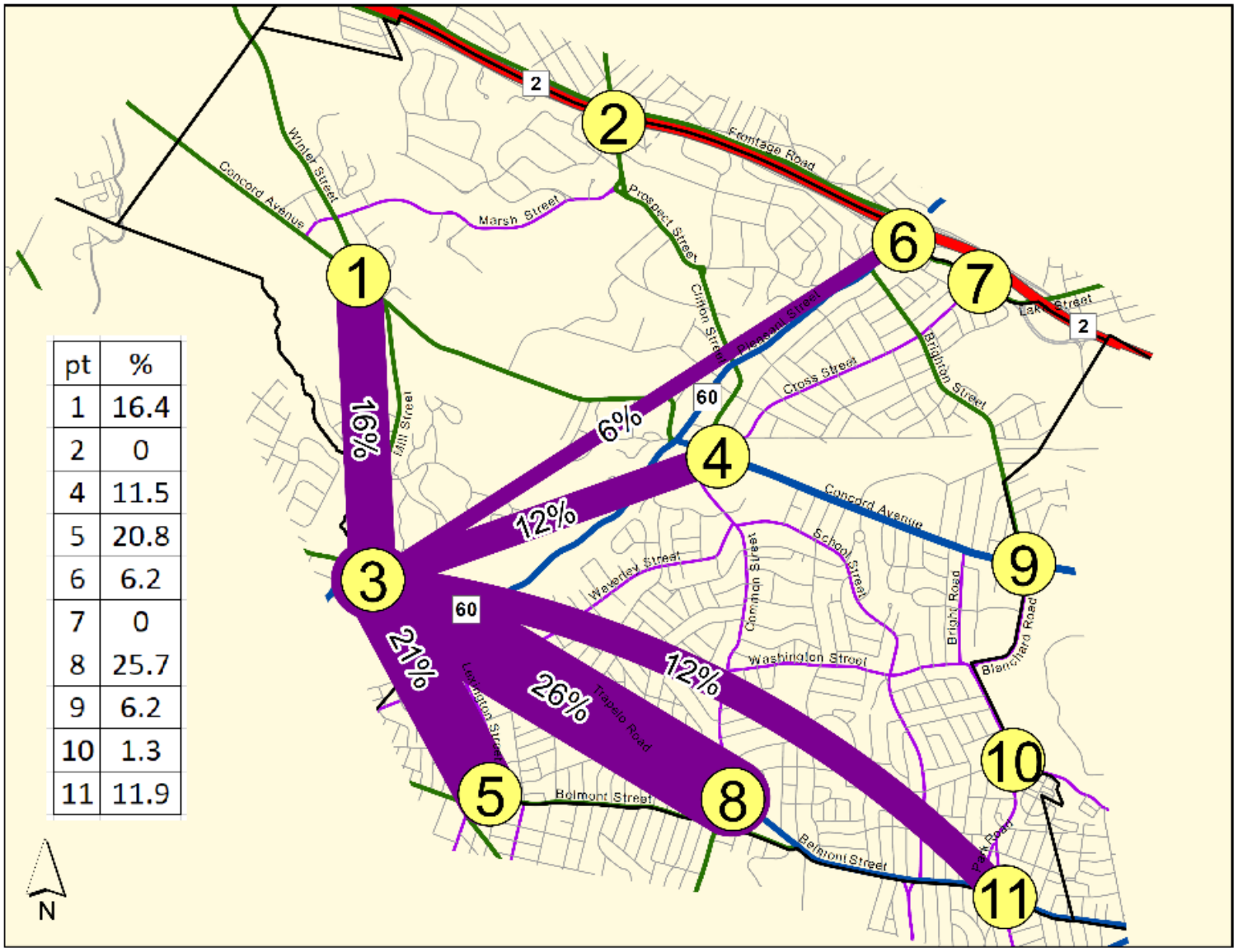


Figure 23 Weekday Evening Peak Hour Trip Pattern: From Cushing Square

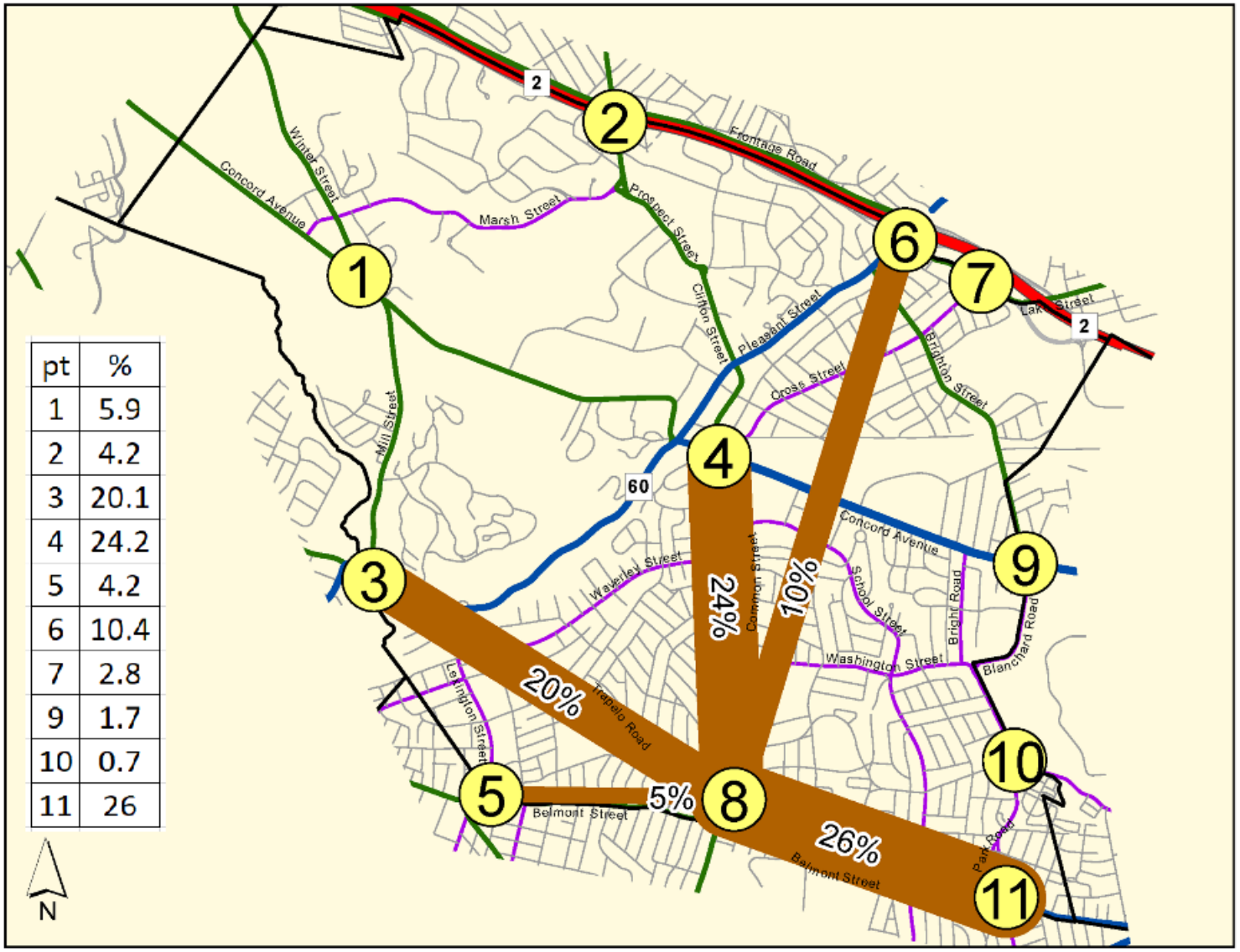
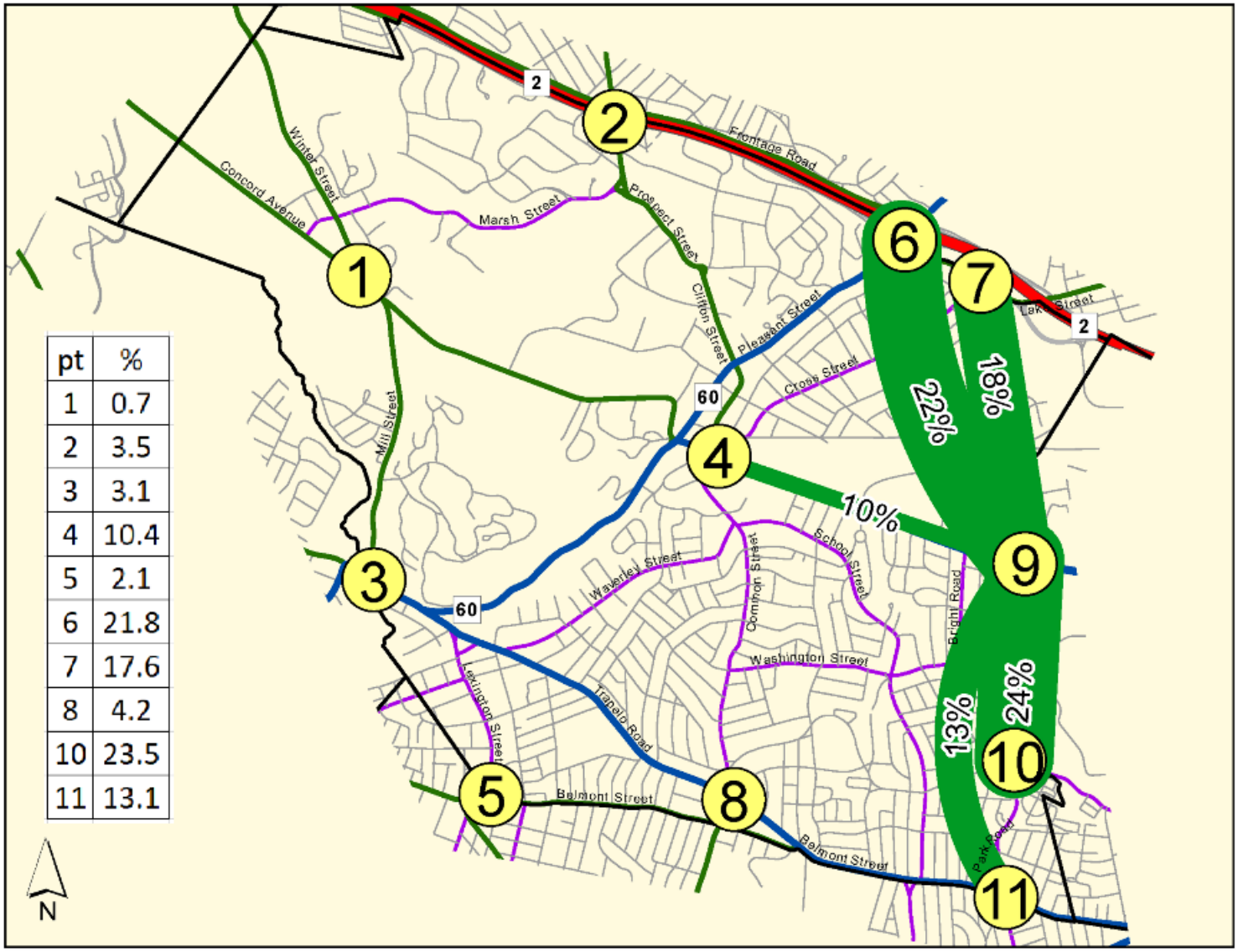


Figure 24 Weekday Evening Peak Hour Trip Pattern: From Concord Avenue/Blanchard Road



5.4. Travel Times

In addition to estimating routes travelled throughout town, comparing MAC addresses also provided travel times between the count locations. Travel times were generally longer during the morning and afternoon peak periods. Figures 26 and 27 represent travel time variations between Concord Avenue/Mill Street (node 1) and Trapelo Road/Mill Street (node 3) (Figure 25-27). It can be seen that during the morning peak, the travel time between these two points ranged between 6 and 7 minutes and much less during the rest of the day. The reverse direction, from 3 to 1 shows longer travel times, over 12 minutes in the evening, due to delays at the Concord Avenue and Mill Street intersection.

Figure 29 depicts travel times recorded between Pleasant Street at Lake Street (node 6) to Concord Avenue at Blanchard Road (node 9) In the morning, it took nearly 22 minutes to cover a distance of one mile on Brighton Street. In the evening a high of approximately 11 minutes was recorded between the two nodes (Figure 30). Travel times along Concord Avenue between Common Street and Blanchard Road are presented in Figures 31 and 32. The figures show long delays in the evening with travel times more than 16 minutes from Blanchard Road to Common Street.

Figure 25 Travel Time Patterns: Between Node 1 and Node 3

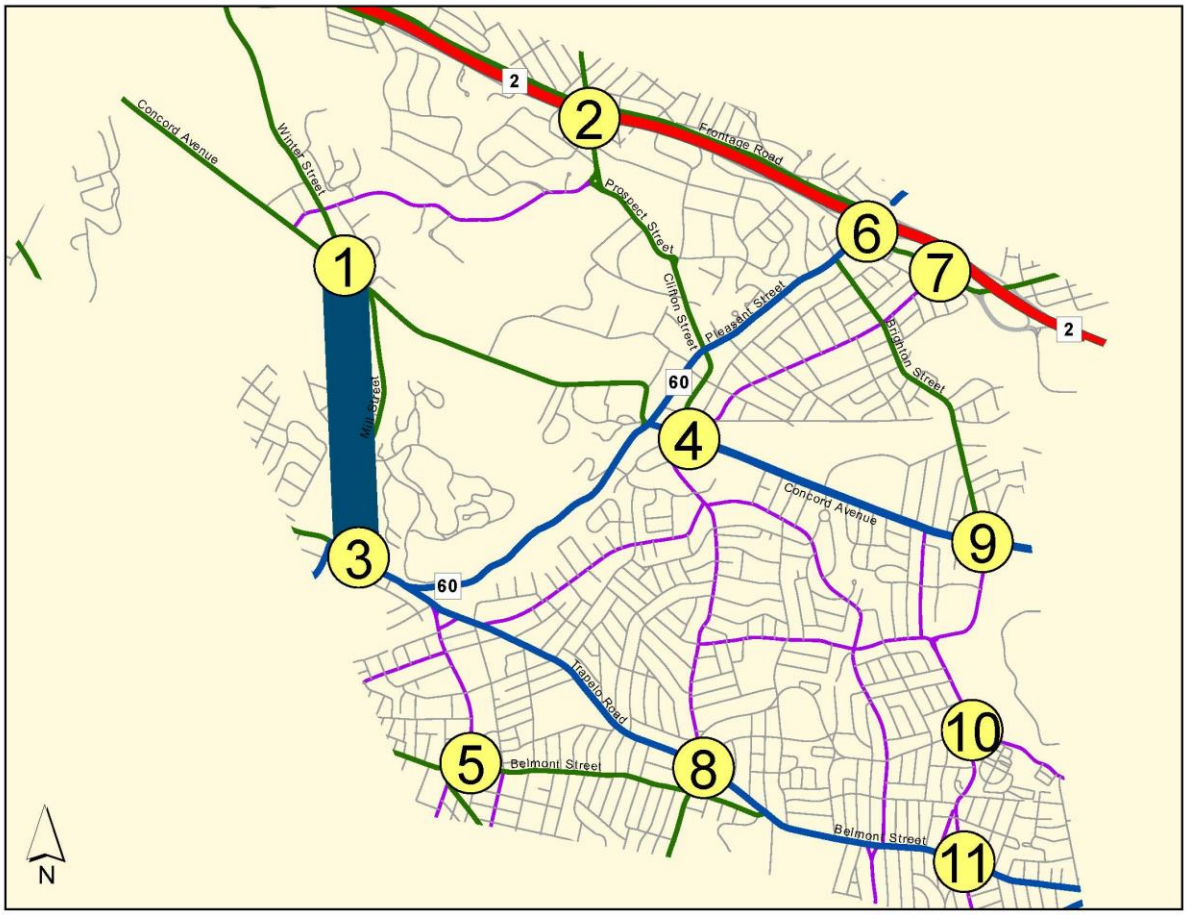


Figure 26 Travel Times: Node 1 to Node 3

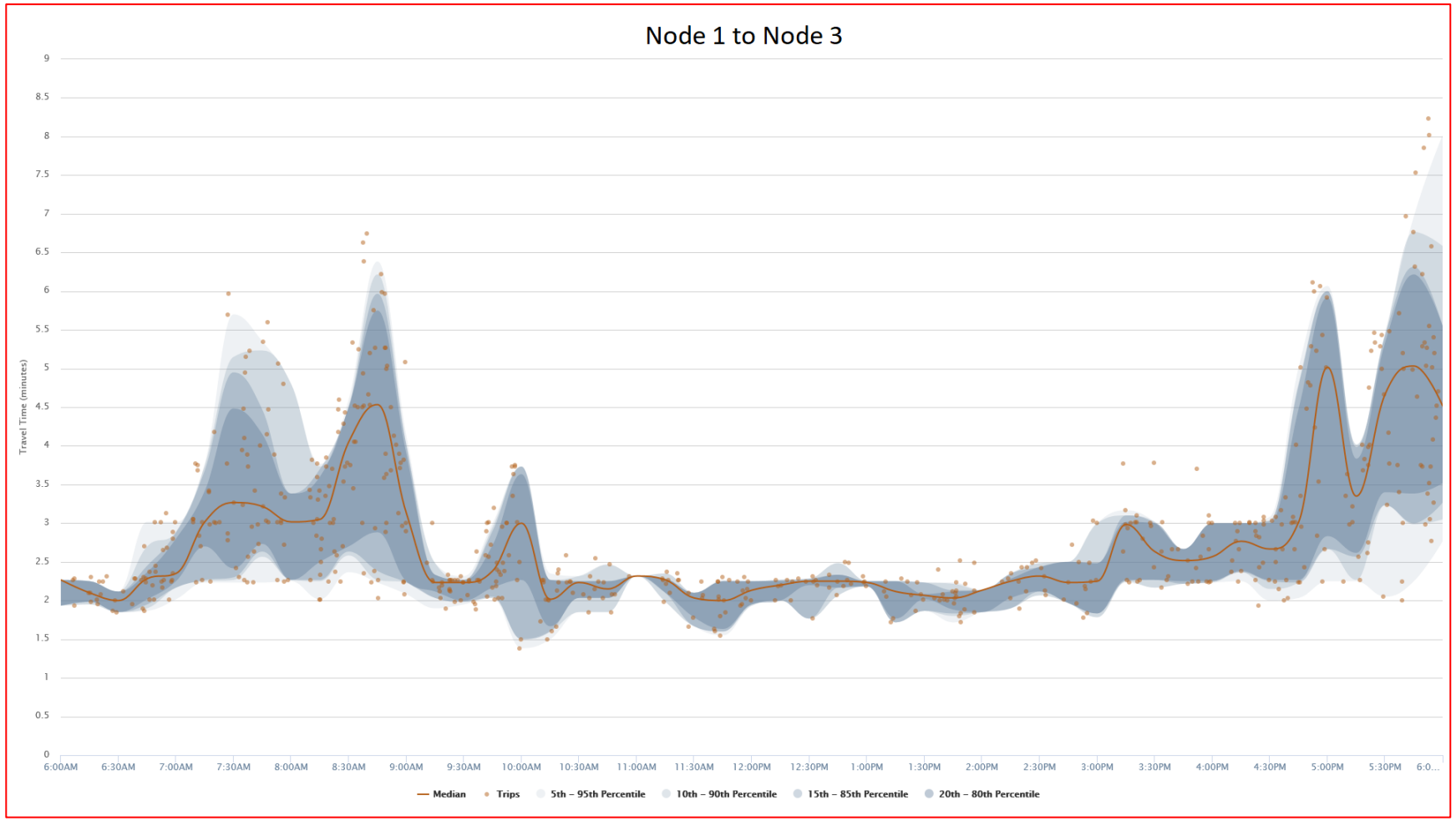


Figure 27 Travel Times: Node 3 to Node 1

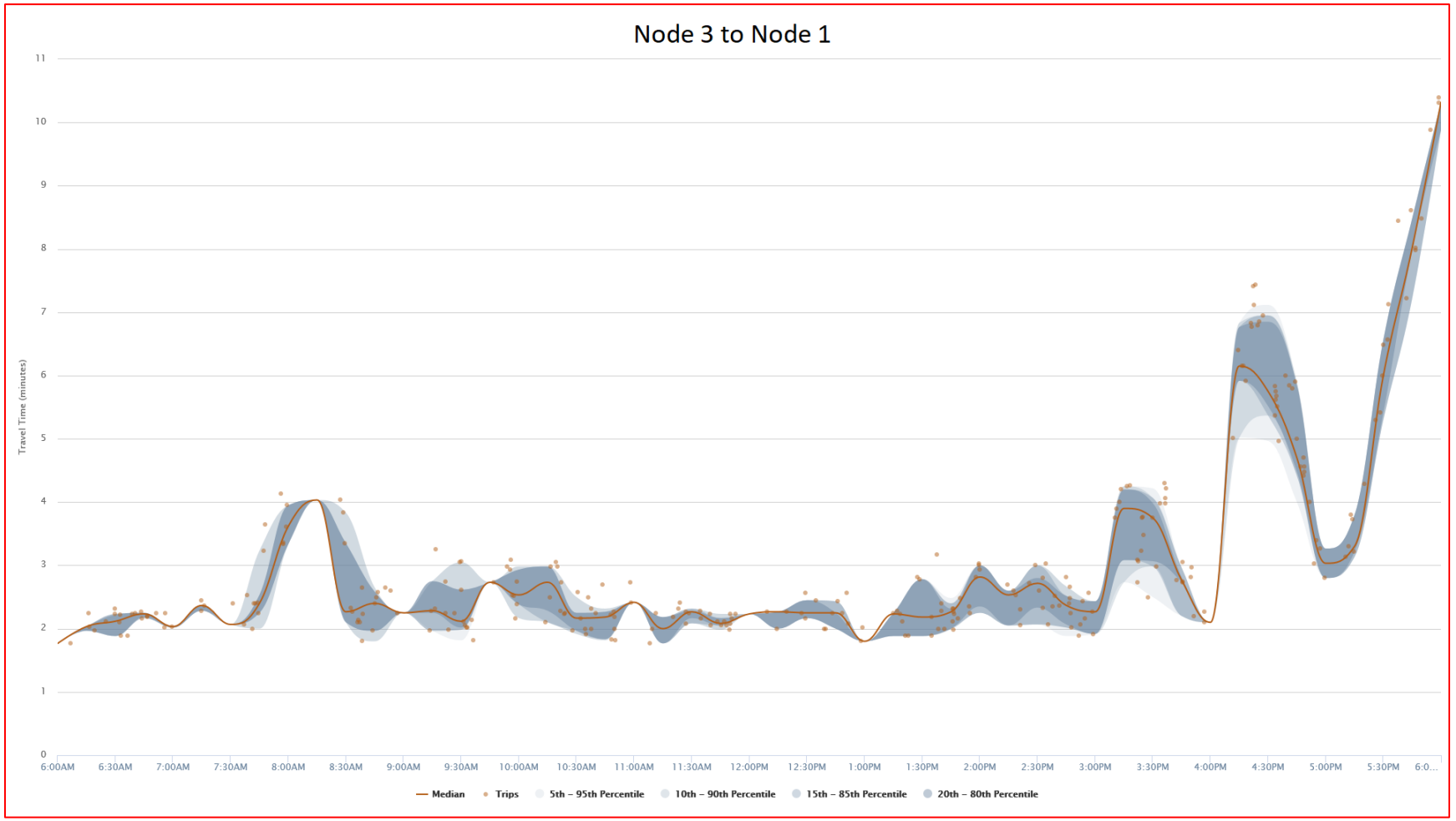


Figure 28 Travel Time Patterns: Between Node 6 and Node 9

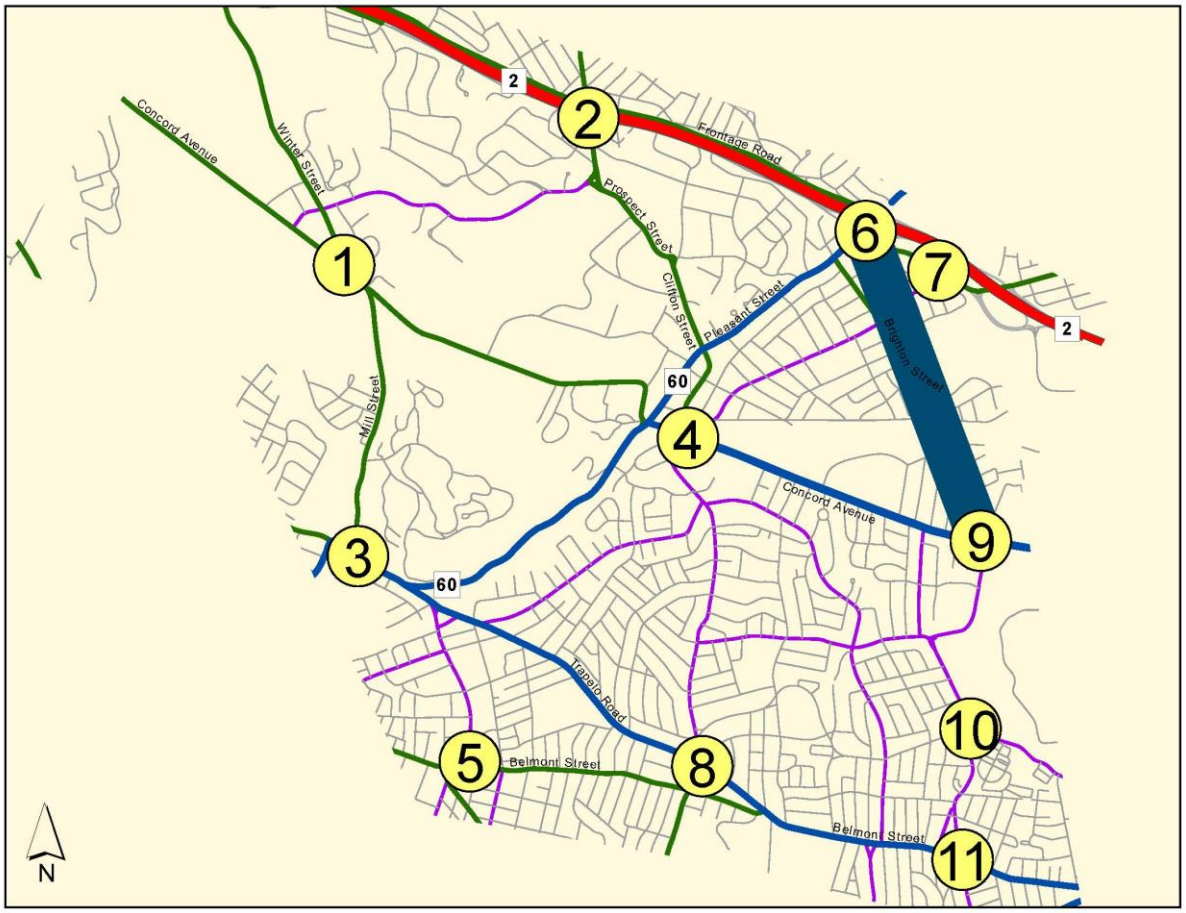


Figure 29 Travel Times: Node 6 to Node 9

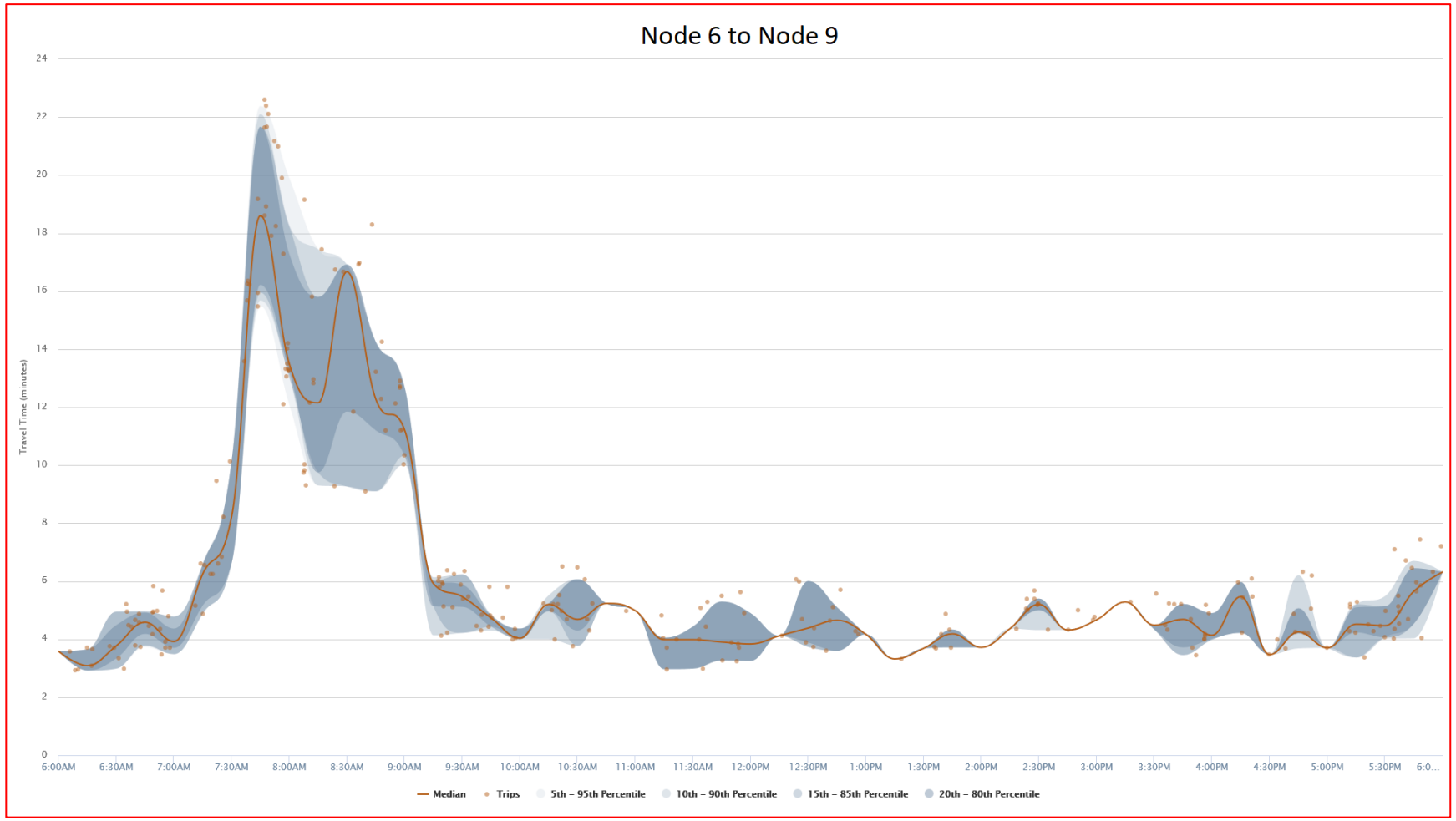


Figure 30 Travel Times: Node 9 to Node 6

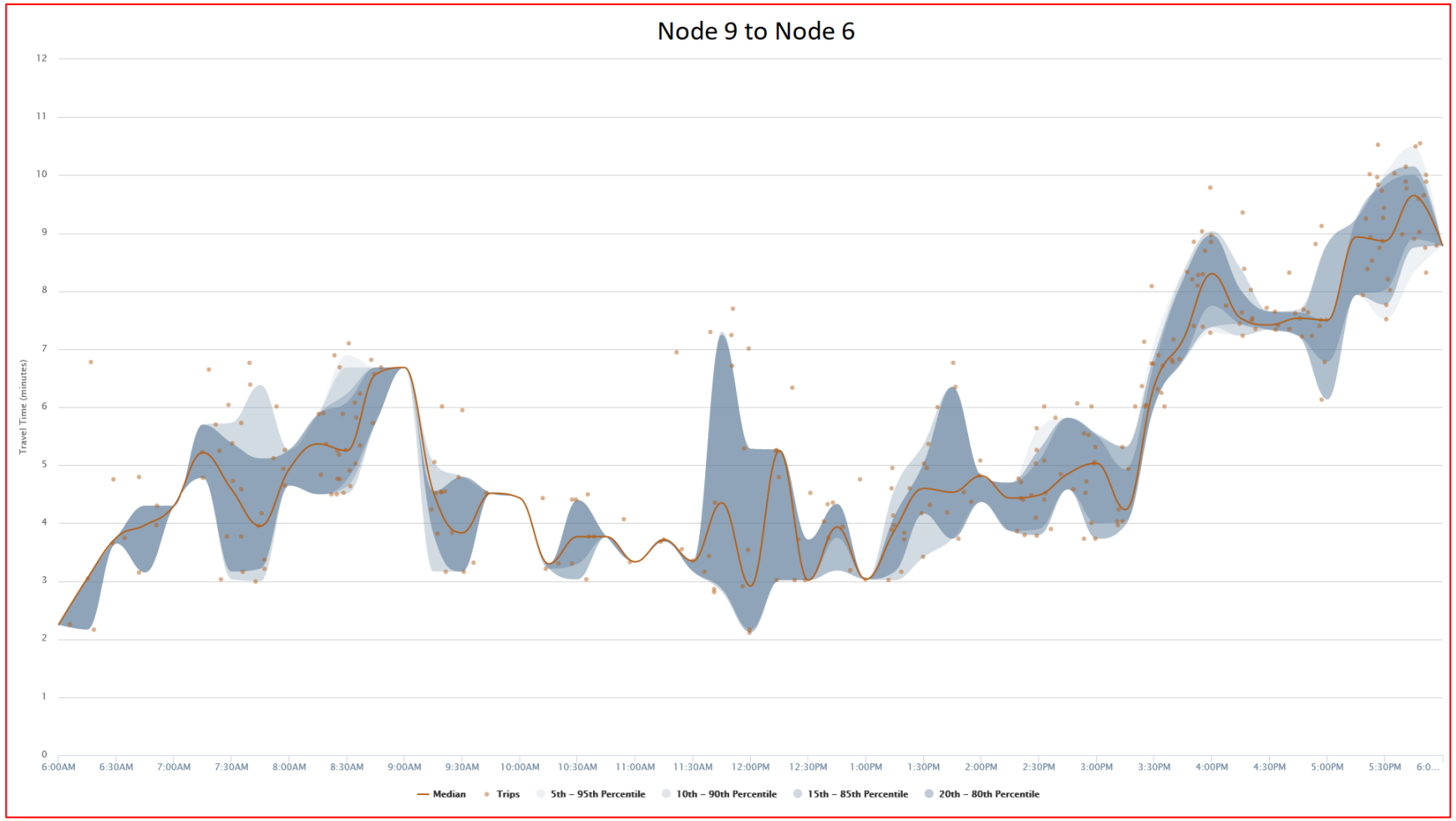


Figure 31 Travel Time Patterns: Between Node 4 and Node 9

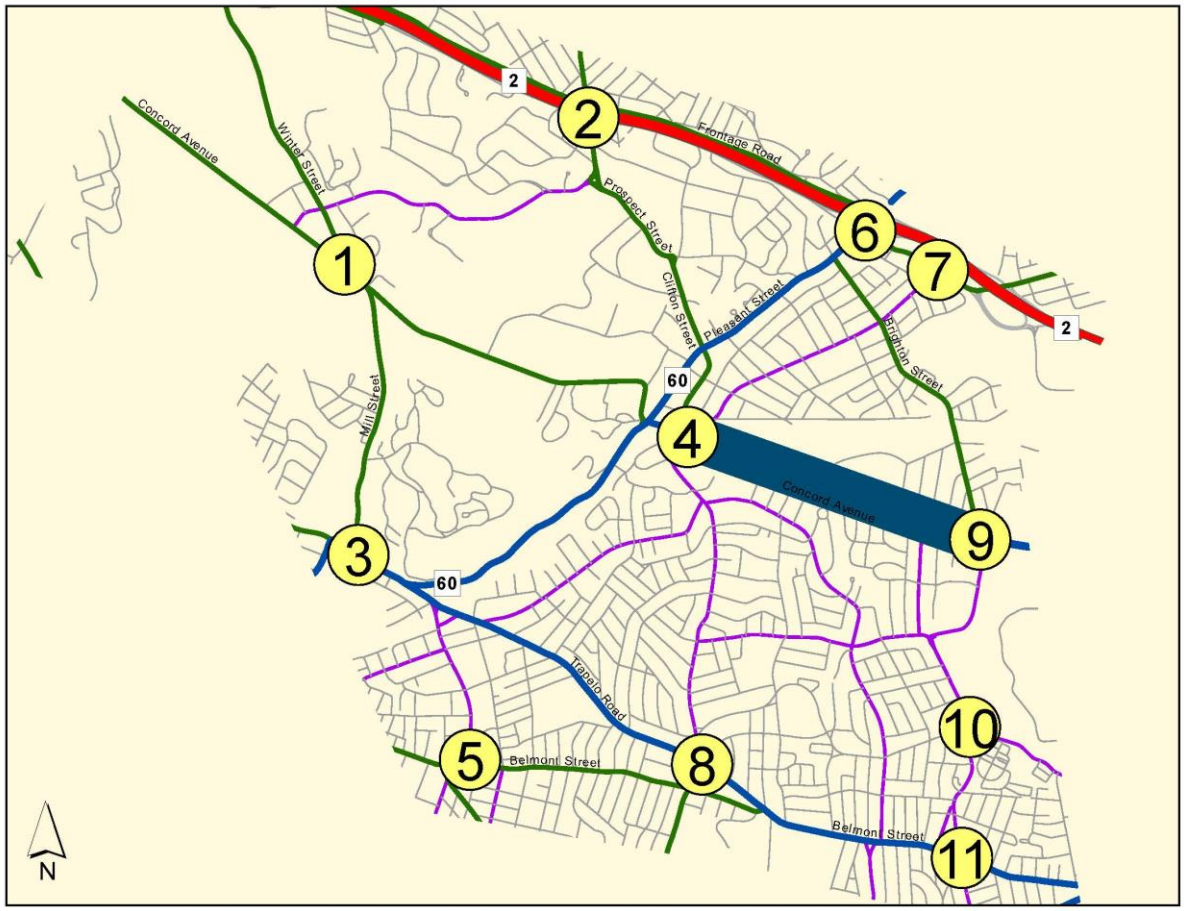


Figure 32 Travel Times: Node 4 to Node 9

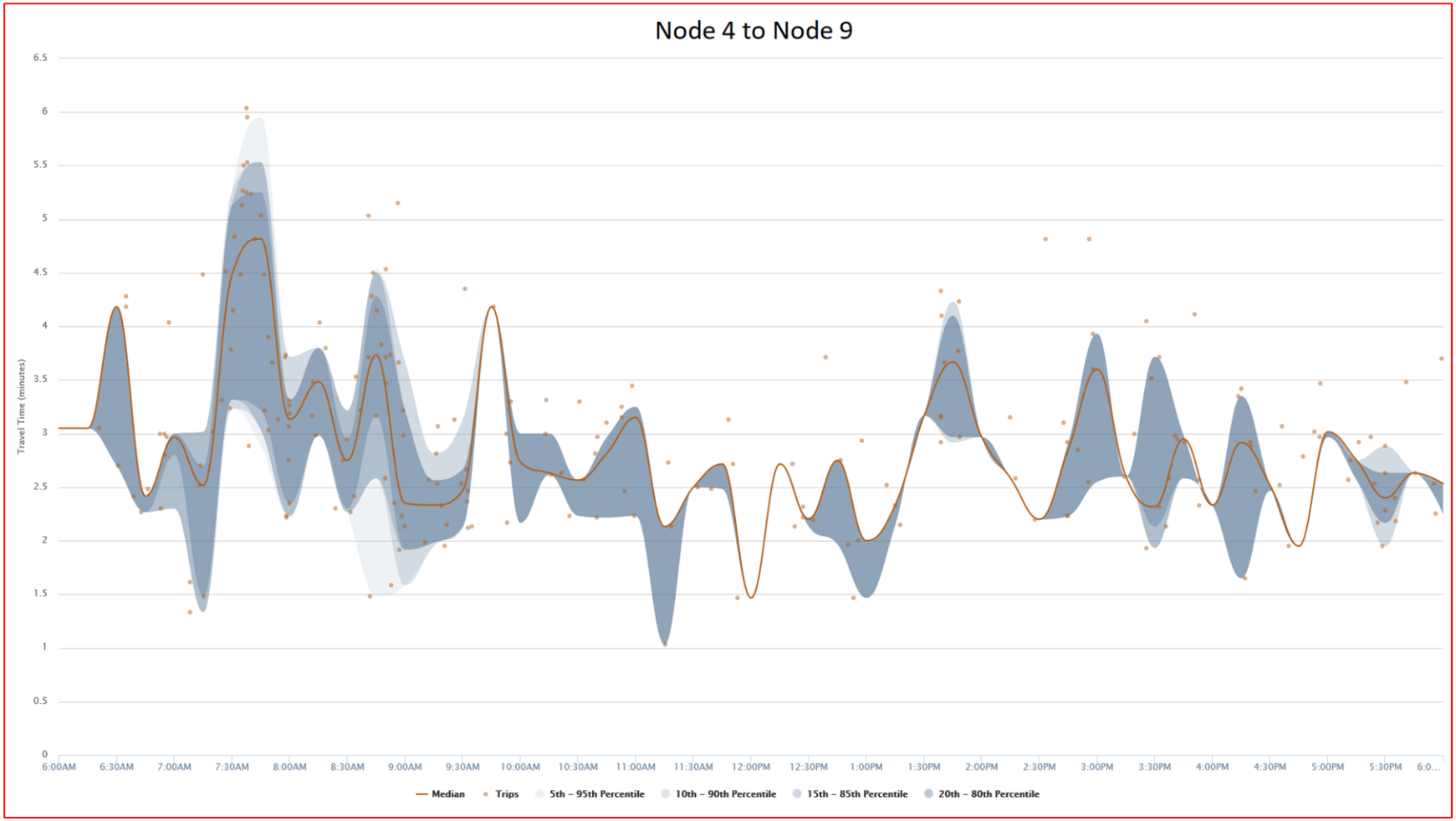
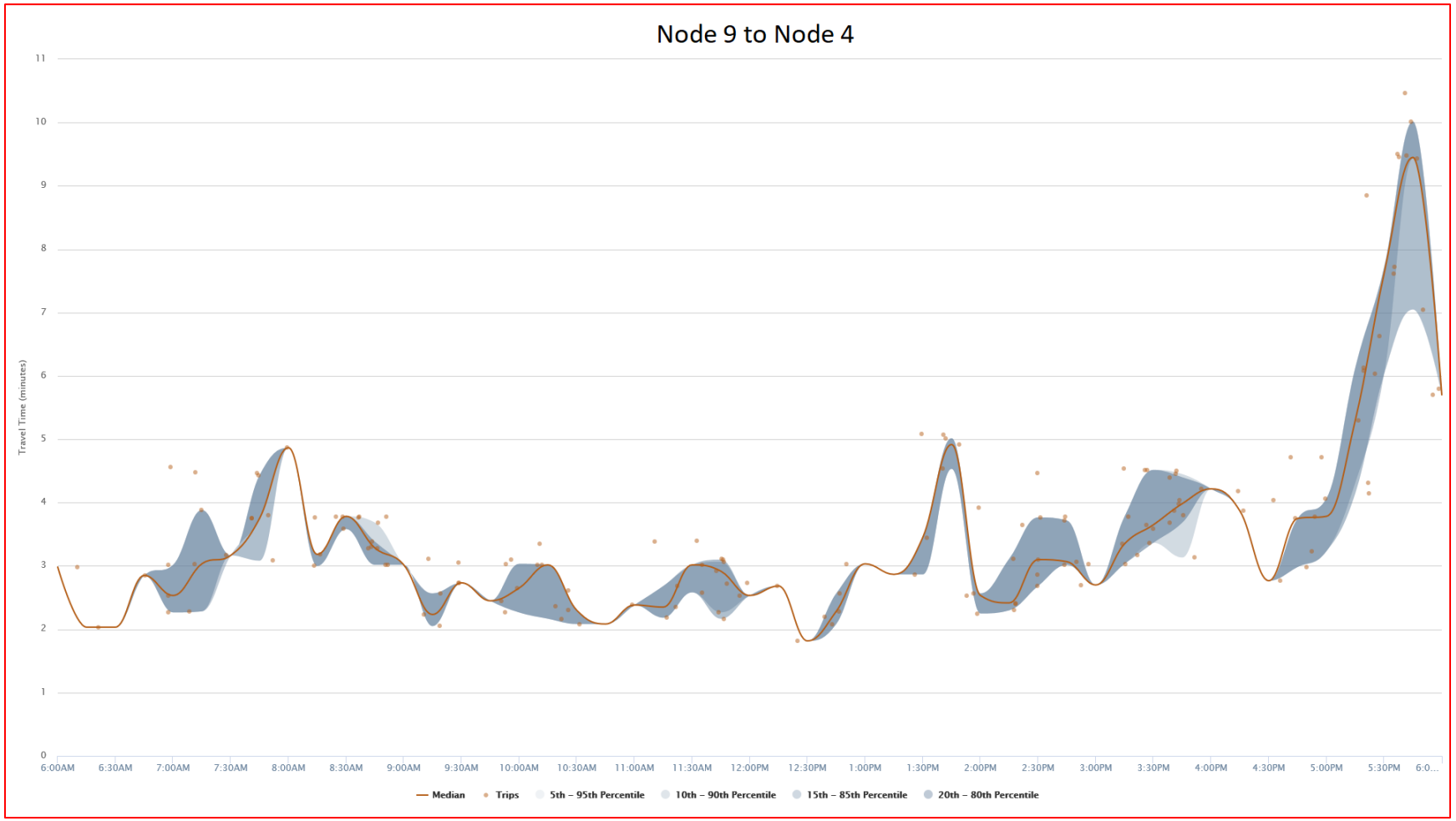


Figure 33 Travel Times: Node 9 to Node 4



5.5. License Plate Survey

License plate surveys were completed by the Belmont Police Department (BPD) at seven locations throughout town: Park Avenue at Route 2, Pleasant Street at Route 2, Goden Street between Concord Avenue and School Street, Goden Street at Washington Street, School Street between Stone and Bow Streets, Brighton Street at Statler Road, and Waterhouse Road at Statler Road. These counts were completed in the morning and afternoon peak periods for 30 minutes each. For the morning session license plates of vehicles travelling south were recorded, and in the afternoon, vehicles heading north. BPD used these license plate surveys to identify in which municipality the vehicle was garaged, and as a substitute for origins of traffic on Belmont town roads during peak periods. Figures 34 and 35 summarizes the results of the license plate survey. In general, most of the license plates recorded were from adjacent towns.

During the morning peak period, Arlington accounted for 36 percent of vehicles traveling southbound on Park Avenue, 22 percent on Pleasant Street and 26 percent on Brighton Street. Vehicles from more than twenty other municipalities, including out of state vehicles, were documented in the survey including Lexington, Winchester, Medford, Waltham, Woburn, Cambridge, and Watertown.

The license plate survey in the evening shows a similar mix of vehicles headed in the northbound direction. As expected, most of the vehicles surveyed on roadways near schools, generally, originated from Belmont. Surveys on School Street between Stone Road and Bow Road, for both morning and afternoon peak hours, revealed that about one quarter of vehicles are registered in Belmont (Figures 34, 35). Most of the remaining vehicles came from towns to the north of Belmont.

On Goden Street (Upper Goden) between Long Avenue and Washington Street the license plate survey showed that approximately 70% of traffic during the morning are vehicles registered in Belmont; about 50% in the afternoon are from Belmont. There are two public schools along this corridor, which contribute to the high number of Belmont origins. This section has the highest percentage of Belmont registered vehicles out of all points counted.

Overall, the license plate survey supports the concern over cut-through traffic as vehicles from several municipalities were recorded on some local roads such as Waterhouse Road and Goden Street.

Figure 34 License Plate Survey – Weekday Morning Peak Hour

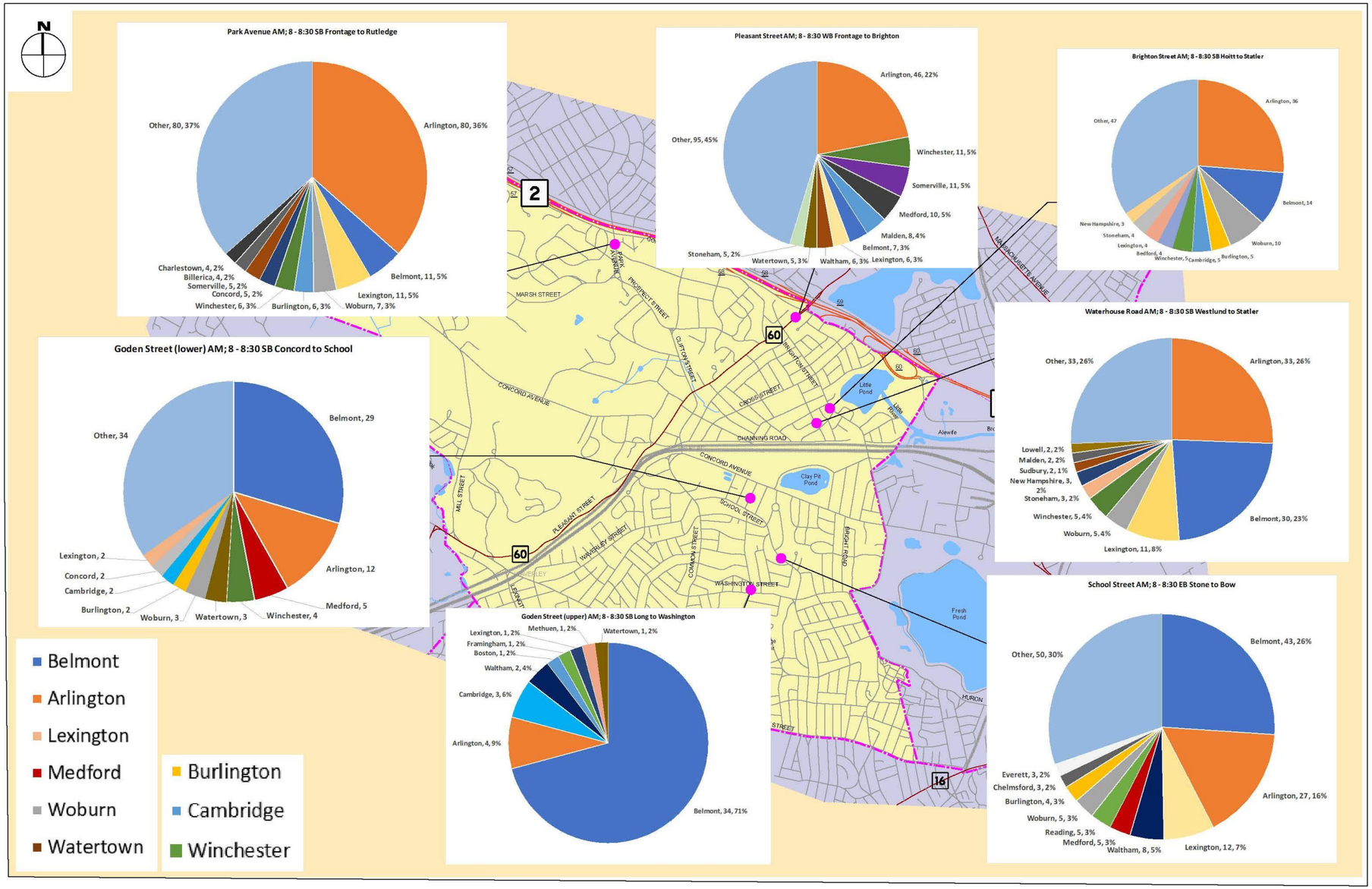
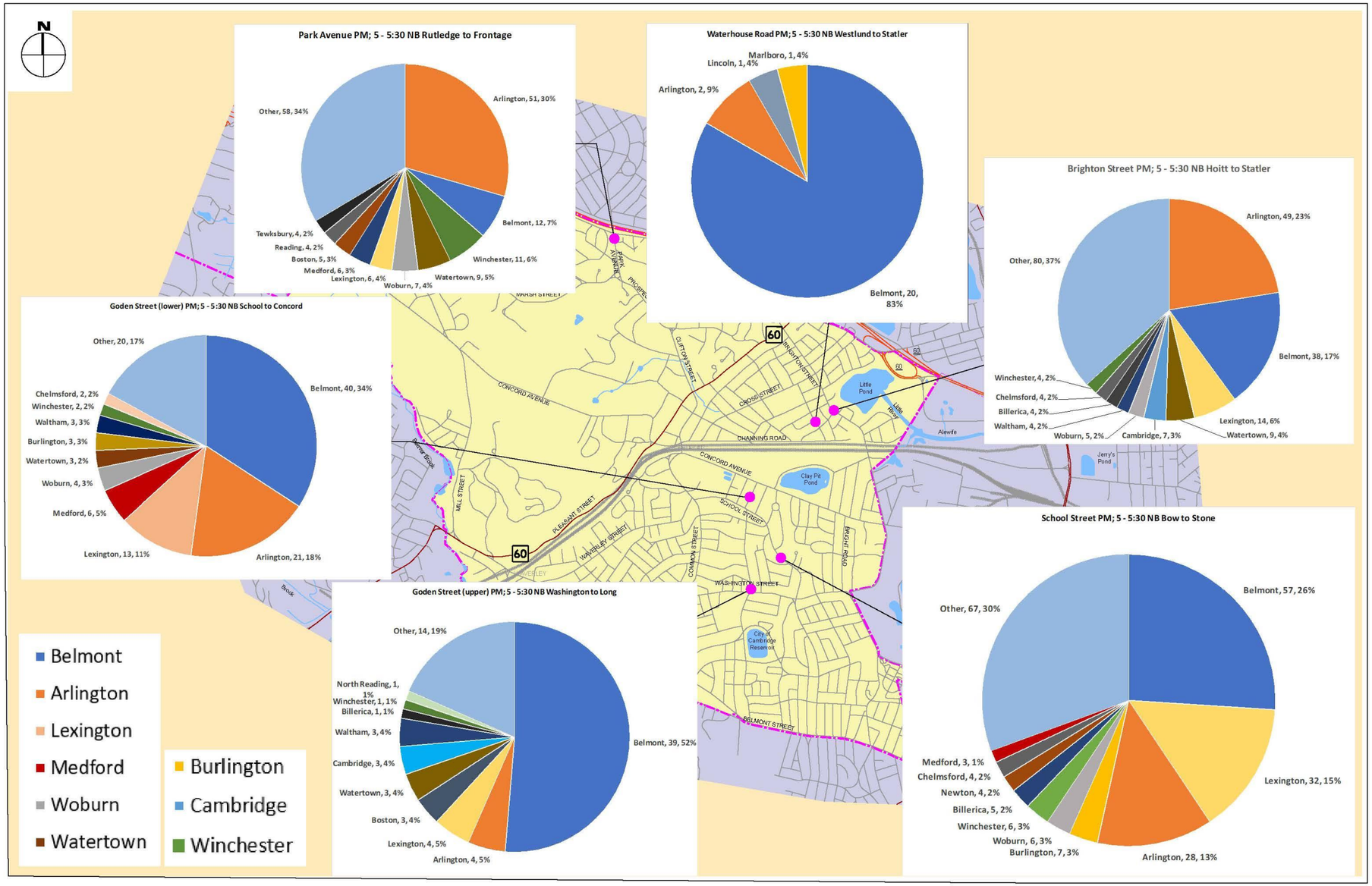


Figure 35 License Plate Survey - Weekday Evening Peak Hour



5.6. Cut-Through Percentages

As noted earlier, MAC addresses of devices equipped with WI-FI were recorded as they passed the data collection points. Cut-through traffic percentages were estimating by matching data obtained at each of the entry points to an exit node. The results are summarized in Table 3 below. Trapelo Road at Mill Street has the highest cut-through percentage, approximately 90% followed by Pleasant Street at Lake Street, 82% on a daily basis. The morning and afternoon patterns are similar. Other high cut-through entry points into Belmont are Concord Avenue at Blanchard Road, Park Avenue at Route 2 in the AM, and Belmont Street at Grove Street.

Table 3 Approximate Cut-Through Traffic Percentages

	Trips Ending Outside Belmont		
ENTRY POINT	**12 hr (6-6)**	**AM (7-9)**	**PM (4-6)**
Concord @ Winter	25%-41%	29%-41%	19%-37%
Park @ Rt 2	38%-58%	54%-80%	20%-26%
Trapelo @ Mill	79%-89%	85%-94%	83%-93%
Belmont @ Lexington	37%-46%	25%-29%	42%-56%
Pleasant @ Rt 2	66%-82%	57%-83%	71%-81%
Lake @ Cross	44%-52%	35%-39%	51%-74%
Trapelo @ Common	48%-53%	42%-48%	64%-70%
Concord @ Blanchard	64%-71%	66%-72%	74%-83%
Grove @ Huron	30%-50%	25%-46%	35%-50%
Belmont @ Grove	64%-71%	67%-72%	69%-79%

6 Existing Traffic Restrictions

In an effort to counter the high incidence of cut-through traffic on local streets, the Town of Belmont has in the past instituted several restrictions at affected intersections. Figure 36 shows the overall map of Belmont with the existing restrictions. There are numerous turning and do not enter restrictions around Belmont, many having effective times and being concentrated around the town's schools often to prevent student pick-up/drop-off on other local streets in the area. For clarity, maps of different areas of the town are enlarged to show the current restrictions. Figure 37 shows that most of the restrictions on Brighton Street are relative to the morning commuter period, where drivers are prohibited from turning onto the side streets to avoid congestion on Brighton Street. Figure 39 shows the southeastern corner of Belmont, where several of the town's public schools are located, and a high concentration of regulatory signage, most having effective periods that coincide with the start of school and dismissal times.

Figure 36 Existing Traffic Restrictions

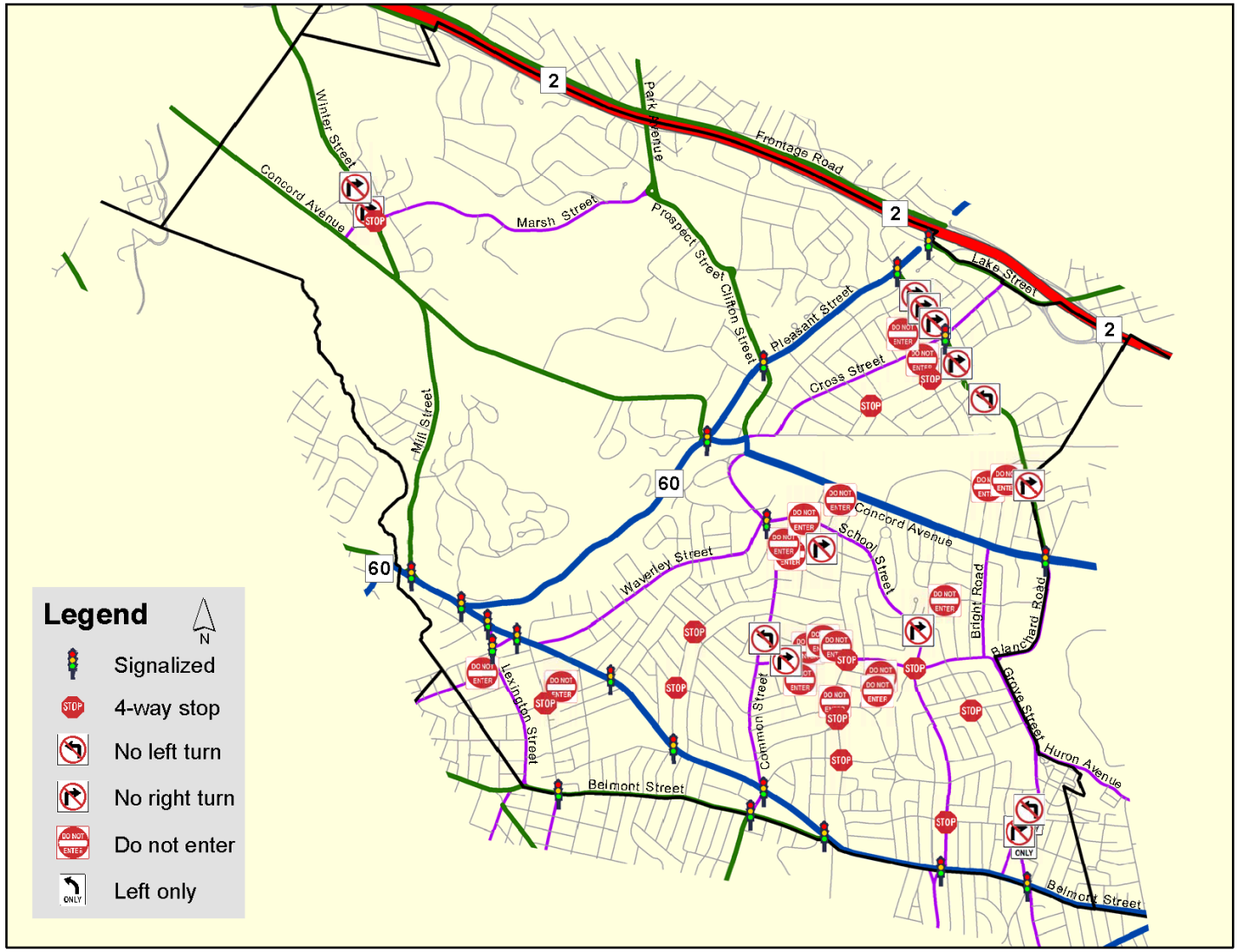


Figure 37 Existing Traffic Restrictions – Northeast Detail

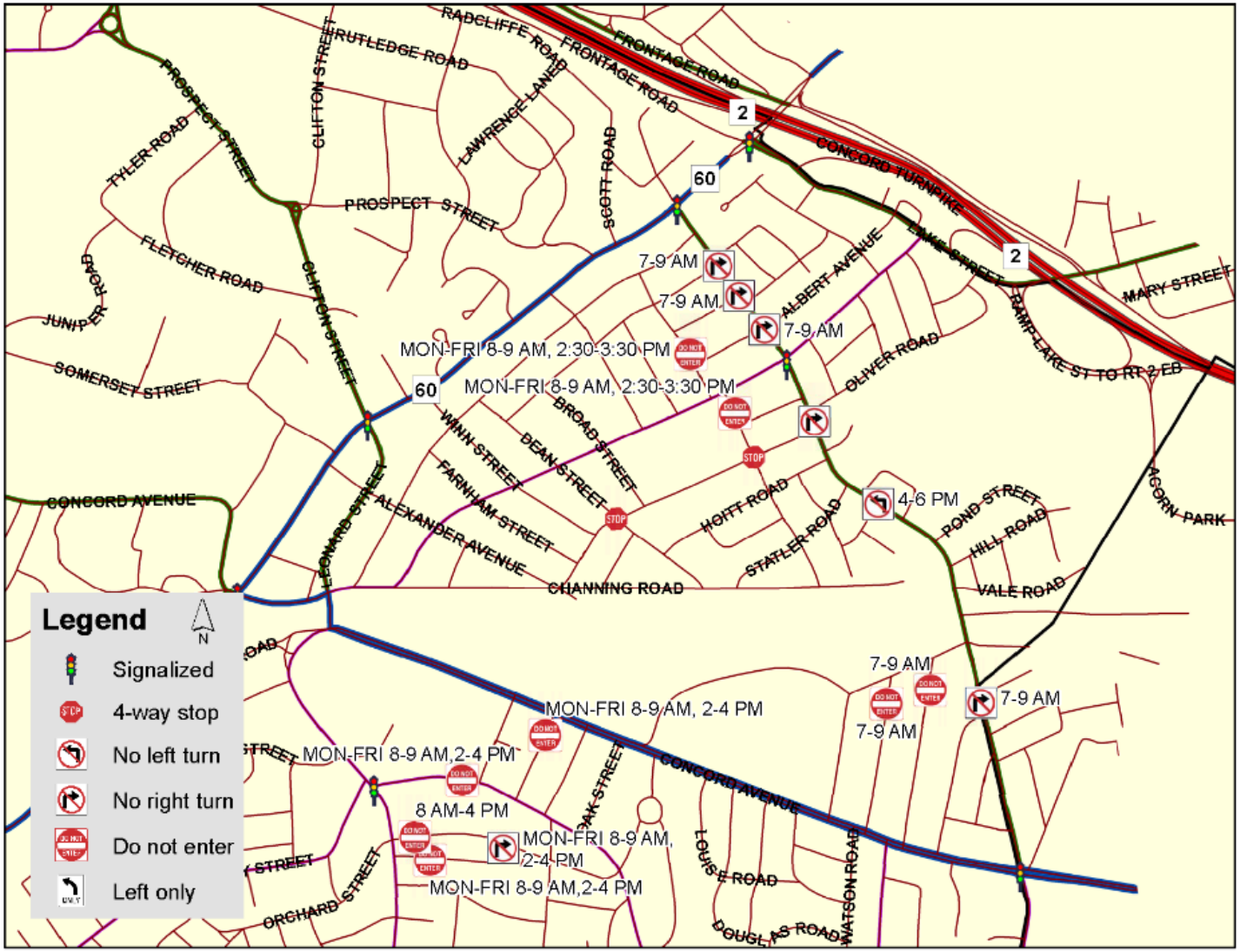


Figure 38 Existing Traffic Restrictions - Northwest Detail

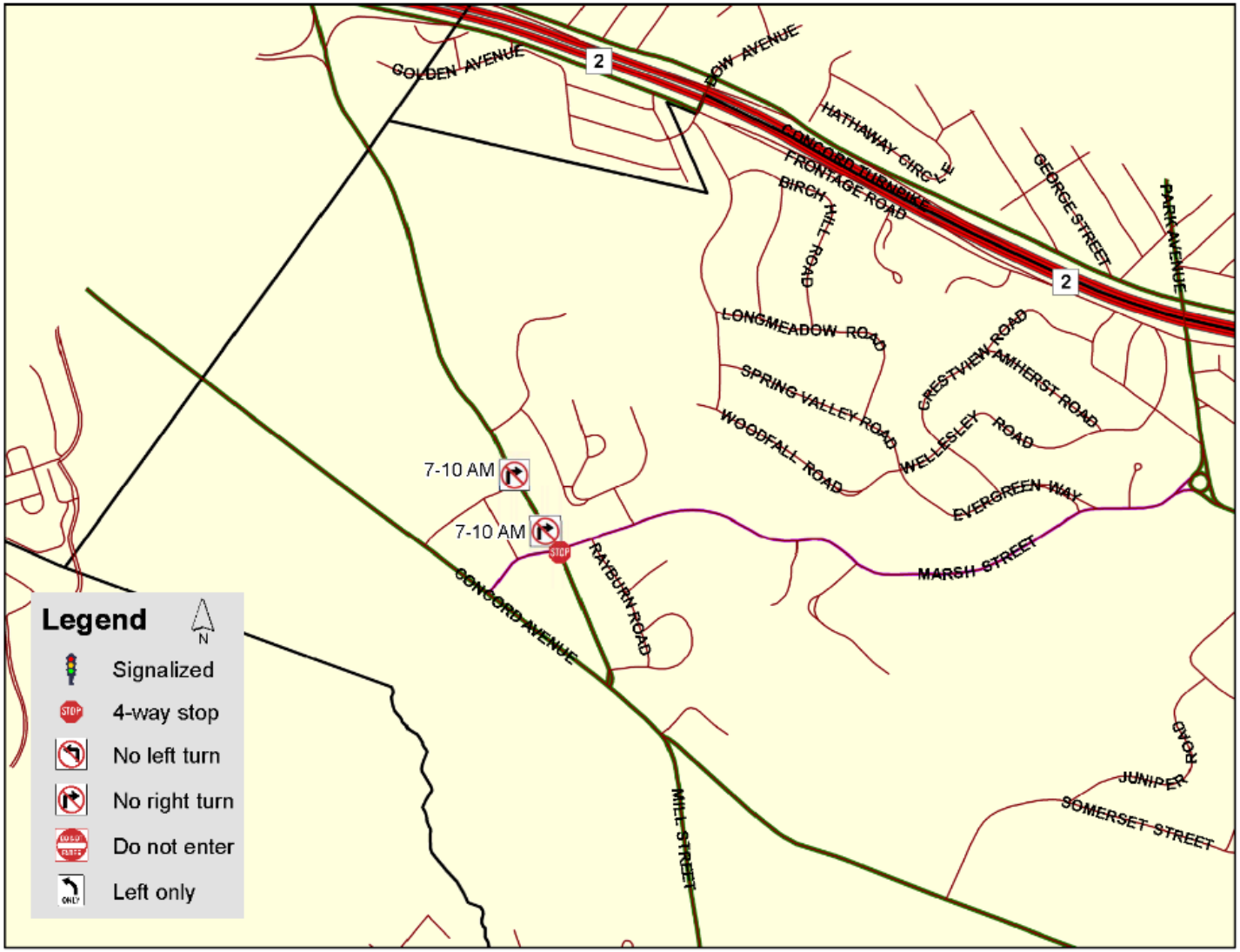


Figure 39 Existing Traffic Restrictions - Southeast Detail

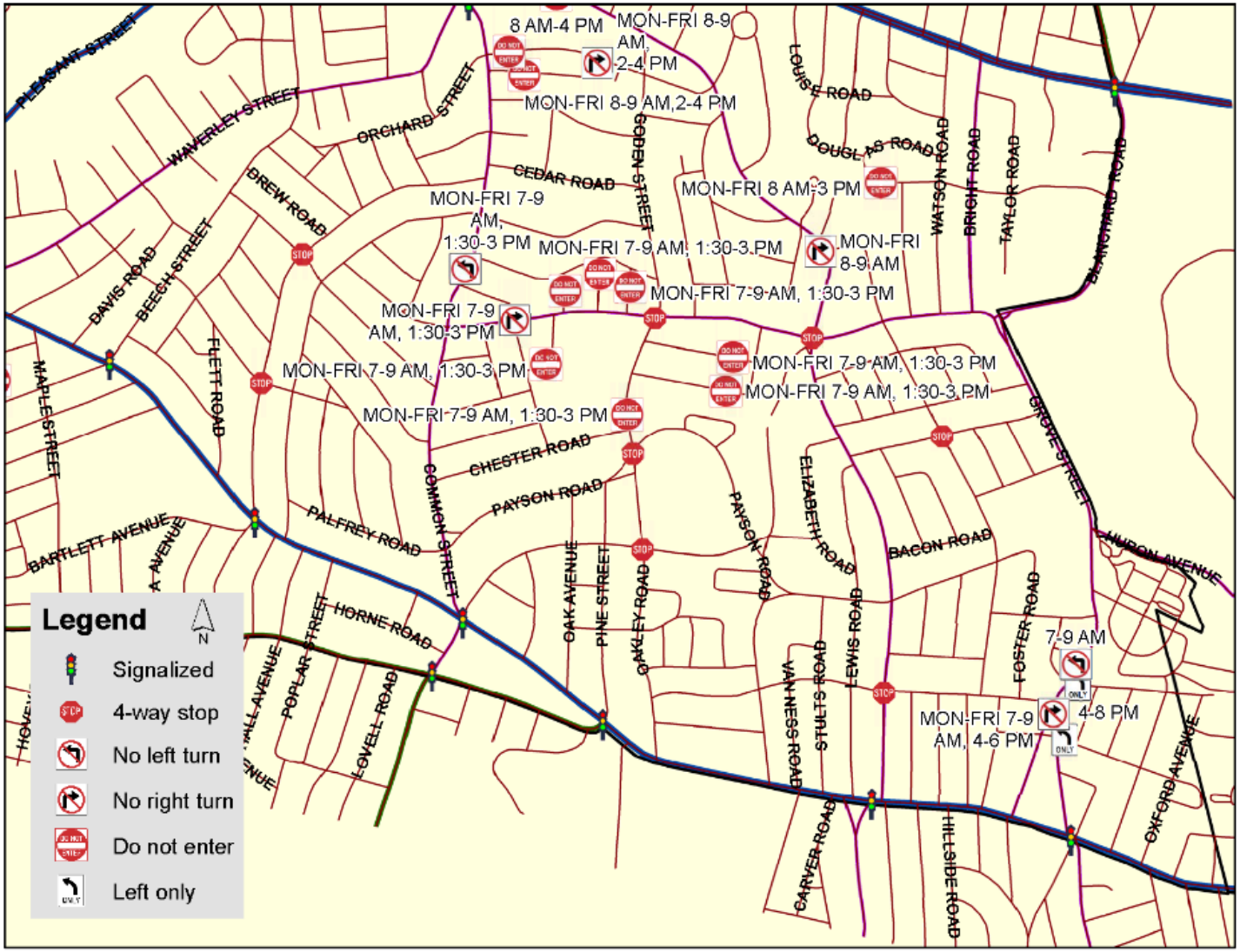
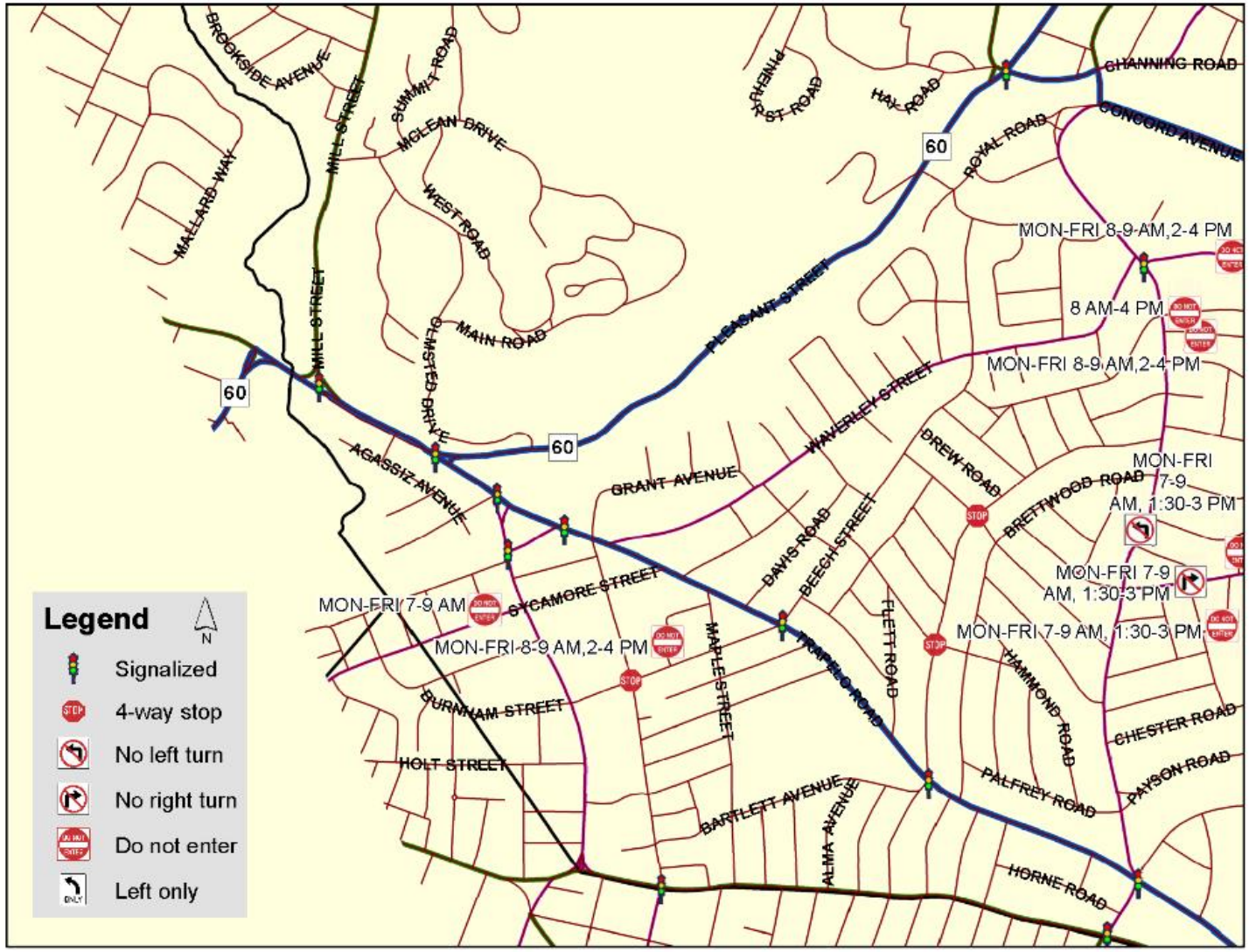


Figure 40 Existing Traffic Restrictions – Southwest Detail



7 Crash Data Summary

Vehicle collision data for 10 years starting in 2008 is presented in Figure 41. The most recent 5 years of data are summarized in Table 4. It should be noted that both intersections shown as having above 60 collisions, Trapelo Road at Pleasant Street and Lexington Street at Sycamore Street, have been redesigned after 2008 in response to high collision rates. Additional improvements are being contemplated at Lexington Street/Sycamore Street.

Figure 41 Motor Vehicle Crash Data

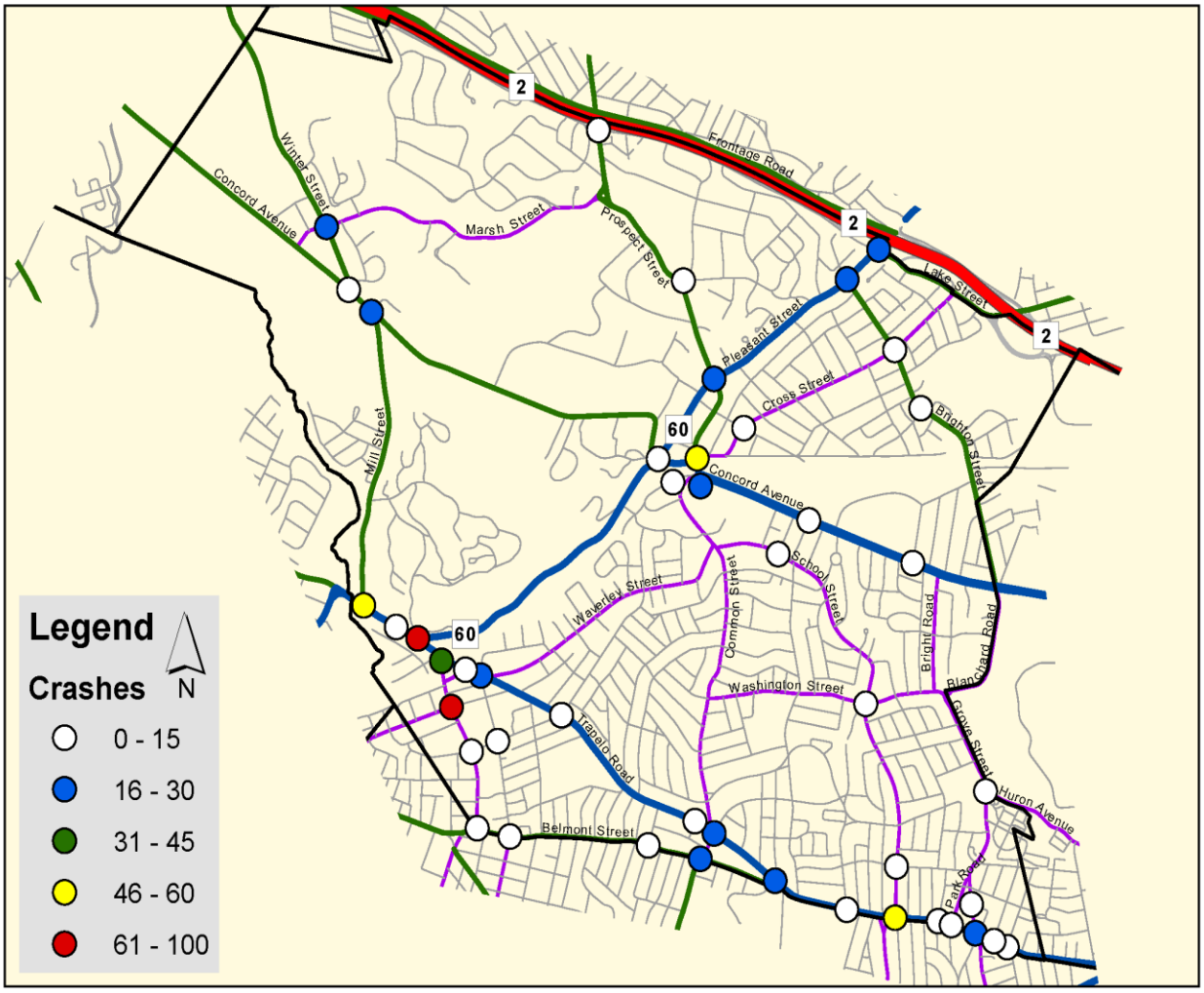


Table 4 **Motor Vehicle Crash Data Summary**

Intersection	2013	2014	2015	2016	2017
Pleasant St & Trapelo Rd.	6	12	13	9	6
Lexington St. & Sycamore St.	9	9	6	7	2
Belmont St. & School St.	4	6	4	11	4
Concord Ave. & Leonard St.	7		3	8	6
Mill St. & Trapelo Rd.	6	9	5	9	3
Lake St. & Pleasant St.	4		3		4
Lexington St. & Trapelo Rd.		6	5	5	6
Trapelo Rd. & White St.	3		4		3
Marsh St. & Winter St.				6	8
Brighton St. & Pleasant St.	4	5	3	3	1
Concord Ave. & Mill St.	5	5		3	2
Concord Ave. & Pleasant St.		4			1
Belmont St. & Trapelo Rd.		5	4		2
Common St. & Trapelo Rd.		3	4	8	6
Belmont St. & Common St.	5				3
Beech St. & Trapelo Rd.					3
Concord Ave. & Winter St.			4	3	1
Grove St. & Huron Ave.			3		1
Fairview Ave. & School St.	3				3
Belmont St. & Grove St.	4	4	4		2
Clifton St. & Pleasant St.	4		4	3	2
Alexander Ave. & Cross St.			4		
Common St. & Concord Ave.		6	5		4
Belmont St. & Lexington St.			3		4
Concord Ave. & Goden St.	3				1
Brighton St. & Cross St.	4		3		2
Beech St. & White St.	3	6			
Belmont St. & White St.			3	3	3

8 Mitigation Strategies

8.1. Traffic Calming Elements

Belmont's central location in the Boston Metropolitan area, employment centers in adjacent municipalities, and congestion on regional roadway network, put pressure on its roadway network. The resulting cut-through traffic is most evident during the morning and evening peak commuting hours. Some roadways register as high as 90% cut-through during those periods. Objectives of this study included identification of measures to eliminate, reduce, or minimize the incidence of cut-through. During meetings with residents, there were suggestions to prevent complete entry into Belmont on certain streets in the morning and evening peaks. To achieve this, it was suggested that residents be issued stickers, and tolls be imposed on non-residents.

Per Massachusetts General Laws, Chapter 85, Section 2, the Massachusetts Department of Transportation's written approval is required for any rule or regulation changes in connection with the following:

- any way at its intersection or junction with a state highway;
- any project which is or was federally aided, in whole or in part;
- any sign excluding heavy commercial vehicles
- any rule, regulation, order, ordinance or by-law of a city or a town which when made or promulgated would exclude motor vehicle travel on any existing way which connects one city of town with another

Restricting turns from Route 2 onto Pleasant Street or Park Avenue, or prohibiting vehicles entering federal aided roadways such as Pleasant Street or Trapelo Road/Belmont Street would require MassDOT's approval.

While it may not be practical to eliminate all cut-through traffic on the Town roads, strategies could be implemented to reduce the effects of their impacts. Traffic calming measures may be employed to protect local/neighborhood streets by controlling vehicle speeds and reducing capacity, thereby volumes. The goal is to keep arterial traffic on arterial roadways, and away from local streets. This would improve the pedestrian and bicyclist travel environment.

Traffic calming includes physical geometric road design and other measures to improve safety for all users of the roadway. These measures are frequently used to restrict the speed of motorists and to prevent vehicles from using some portions of the network. Common traffic calming elements are speed humps, curb extensions, raised pedestrian crossings, and median diverters preventing left turn movements at an intersection.

8.2. Speed Measures

Traffic speed can be regulated by geometric design of the roadway in addition to legal measures (posted speed limit, etc.). Effective geometric features when attempting to slow vehicles include placing obstacles in the roadway that require a vehicle to slow down, narrow the roadway giving the driver the illusion that the vehicle is travelling faster than it really is, placing diversions in the travel lanes, or a combination of several.

Figure 42 Examples of Speed Related Traffic Calming Measures

Lateral Shift

Chicane

On-Street Parking

Choker

Speed Feedback Sign

8.3. Volume Measures

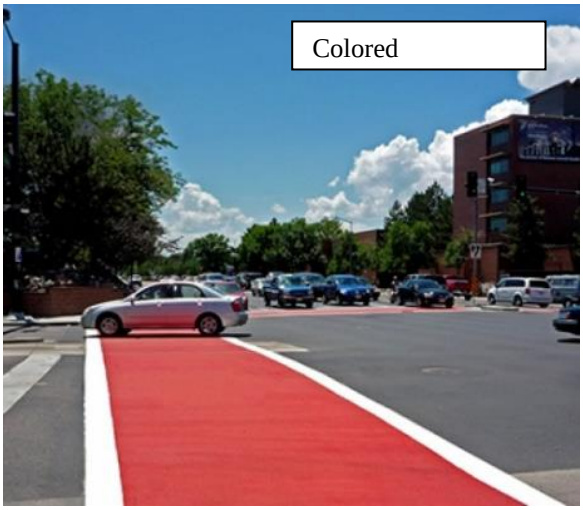
Common volume mitigation measures are turn restrictions, either by posting signage or more aggressive physical barriers, such as closing a street midblock or median barrier preventing left turns, to keep through traffic on certain corridors and arterials. As a note of caution, volume measures should be considered on an areawide basis to ensure that traffic is not diverted from one local street to another. Example of volume control measures include diverters, one-way operation, road closures and median barriers.

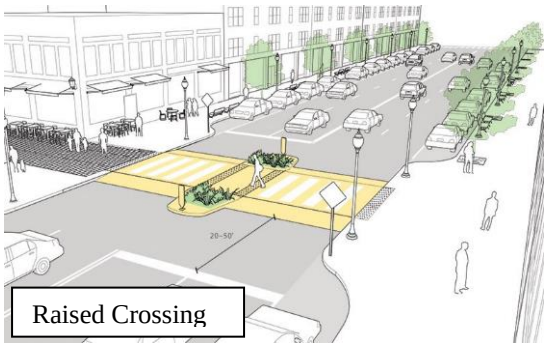
Figure 43 Examples of Volume Related Traffic Calming Measures

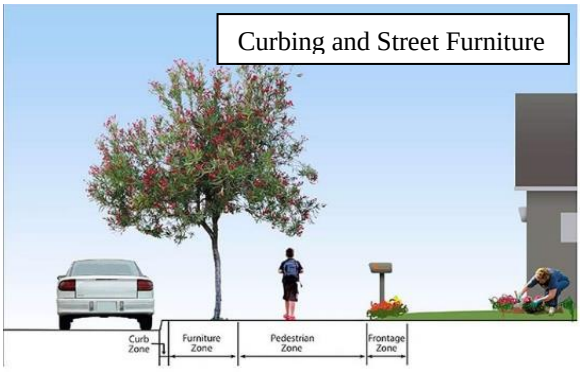
8.4. Pedestrian Safety Measures

Pedestrian safety measures are intended to slow vehicles down, make crosswalks highly visible, and separate non-motorized from motorized vehicles. Examples include raised crosswalks, raised intersections, use of curbing and street furniture to separate pedestrians from vehicular traffic, and installation of Rectangular Rapid Flash Beacons at mid-block locations where full traffic signal operations are not warranted.

Figure 44 Examples of Pedestrian Related Safety Measures







9 Specific Traffic Control Proposals

9.1. Roadway Design Improvements

There are several streets in Belmont that encourage speeding and additional traffic volume by way of their design. These streets are mostly unmarked and lack on-street parking, giving vehicles more than enough space for higher speeds. Notable unmarked streets prone to excessive speeding include: Marsh Street, Baker Street, Washington Street, Maple Street, Bartlett Avenue, and White Street.

At a minimum, it is recommended that a double-yellow center line be painted on these streets to prevent the street appearing as one large travel lane. A chicane treatment by alternating street parking sides should also be considered to further reduce speeding. Speed humps may be considered where the previous measures are deemed ineffective.

Figure 45 Examples of Unmarked Streets

9.2. Additional Turning Restrictions

There already exists a significant amount of turning restrictions in Belmont, prohibiting through traffic from using side streets to bypass major roads. Additional restrictions on certain streets with high cut-through traffic should be considered. These locations include:

- Radcliffe Road,
- Oliver Road/Little Pond Road/Cross Street neighborhood
- Waterhouse Road/Statler Road/Eliot Road corridor.

Additional restrictions by signage will further help reduce cut-through traffic on local streets and keep traffic on the town's major arterials. However, noncompliance is likely with signage alone and physical diversions and barriers can be considered on particularly critical intersection approaches.

9.3. Traffic Signal Improvements

Some traffic signals at critical intersections, both within and outside of the control of Belmont, should be considered for timing and equipment updates.

Blanchard Road at Concord Avenue: this intersection is on the border between Belmont and Cambridge with a signal under the control of the City of Cambridge. Concord Avenue is a major thoroughfare into and out of Belmont and this intersection is critical to controlling traffic flow. The signal's phase timing is out of date and in need of update to accommodate current traffic volumes. Specifically, more time should be assigned to Blanchard Road southbound in the morning to alleviate congestion on Brighton Street.

Lake Street at Brooks Avenue: this intersection is within the Town of Arlington along another popular route into and out of Belmont. The signal here is also out of date and causes excessive spillback into Belmont along Lake Street, hindering traffic flow from Route 2 and other connecting streets.

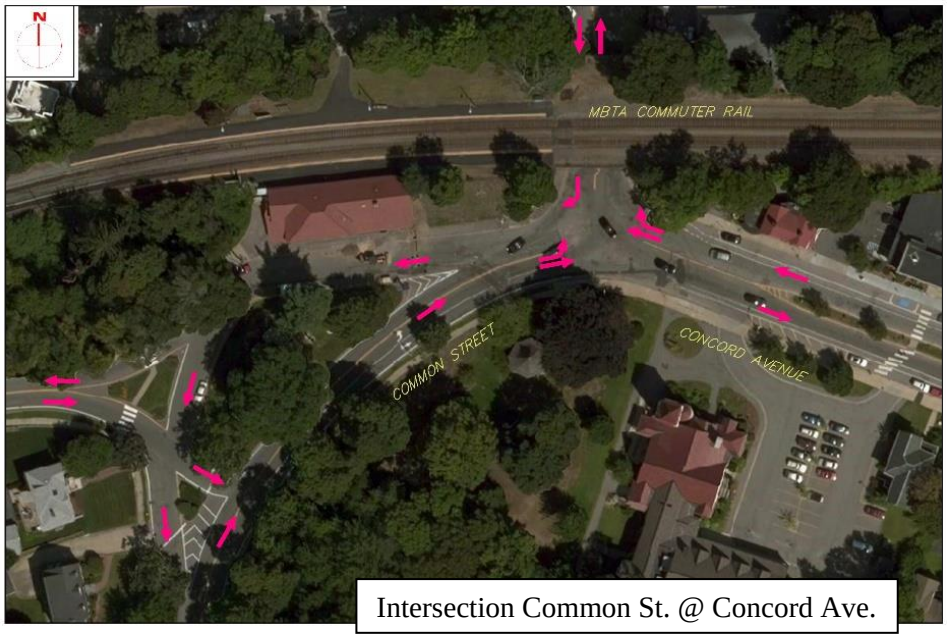
In addition to existing signal updates, new signals should be considered at Lexington Street at Sycamore Street. This unsignalized location has recently been rebuilt as a raised intersection to increase pedestrian safety. There is stop control on Sycamore Street only. Certain geometric and topographic features of the intersection and its surroundings, such as the retaining wall on the northeastern corner, reduce sight lines from Sycamore Street and cause difficulty for traffic to enter Lexington Street. There has also been a pedestrian fatality within the last year, showing the need for increased pedestrian safety at this location. A new traffic signal may be required with the proposed High School drive alignment with Goden Street.

9.4. Concord Avenue/Common Street Realignment

Heavy traffic volumes, conflicting movements, and confusion regarding who has the right of way at the Concord Avenue and Common Street intersection, result in long delays and contributes to significant congestion in the town center. Previous evaluation of this intersection did not recommend traffic signals due to constraints imposed by the to the railroad overpass. Improving traffic operations at this location would require the elimination of one or more conflicting movements. Directional arrows on the above aerial map depict proposed circulation that will create a partial roundabout by using the portion of Royal Road in front of the Belmont commuter rail station building and converting a portion of Common Street to one-way, keeping traffic movement in a counterclockwise direction around the existing park. Concord Avenue southbound traffic approaching from underneath the railroad overpass would be restricted to right turns only, eliminating a heavy conflicting left turn movement that causes much of the delay at the intersection.

This improvement may require a signal to be installed on the opposite side of the railroad at Concord Avenue, Leonard Street, and Channing Road intersection to regulate traffic operations.

Figure 46 Concord Avenue at Common Street Movements



Intersection Common St. @ Concord Ave.