# MEMORANDUM

**TO:** **Transportation Planning and Programming Committee of the Boston Region Metropolitan Planning Organization and Newton Officials** **September 19, 2006**

**FROM:** **Alicia Wilson, Seth Asante, and Efi Pagitsas**

**RE:** **I-90 Interchange 17 (Newton Corner): Traffic Patterns and Operational and Safety Improvements**

## 1.0 INTRODUCTION

I-90 Interchange 17 in Newton Corner is a rotary-style interchange over the Massachusetts Turnpike's Boston Extension. As Figure 1 shows, 11 roadway elements (exclusive of various curb cuts) load or unload vehicles onto or away from the rotary, serving both local and regional traffic. Furthermore, the Newton Corner interchange is unusual in its ramp system's being fully and directly integrated into the local roadway system and the dense, urban, commercial, and residential environment. Regional and local traffic is fully mixed in a small amount of space; the interchange's roadways must accommodate maneuvers in and out of on-street parking spaces, side streets, and parking garages, bus operations, and pedestrian traffic. The entire north side of the interchange is over the right-of-way of a commuter rail line.

The regional nature of much of the traffic on the rotary interchange was documented by a random license plate survey conducted by the URS Corporation as part of its 2002 study,[1] which also included improvement recommendations for the interchange. The survey found that the vehicles on the eastbound exit ramp whose plates were matched were garaged in over 200 communities. The origins of the vehicles observed on the westbound exit ramp were just as diverse.

The objectives of the present study, which was funded by the Boston Region Metropolitan Planning Organization,[2] were:

1. To refine the URS recommendations (which are short-term) into specific actions and prioritize them.

2. To inform Newton's thinking about possible long-term actions.

[1] *The Effects of the July 1, 2002 Boston Extension (I-90) Toll Increase on Newton Neighborhoods*, URS Corporation in association with Howard/Stein Hudson Associates and Central Transportation Planning Staff, January 2003.
[2] "Work Program for: I-90 Interchange 17 (Newton Corner): Traffic Patterns and Operational Improvements," October 6, 2005.

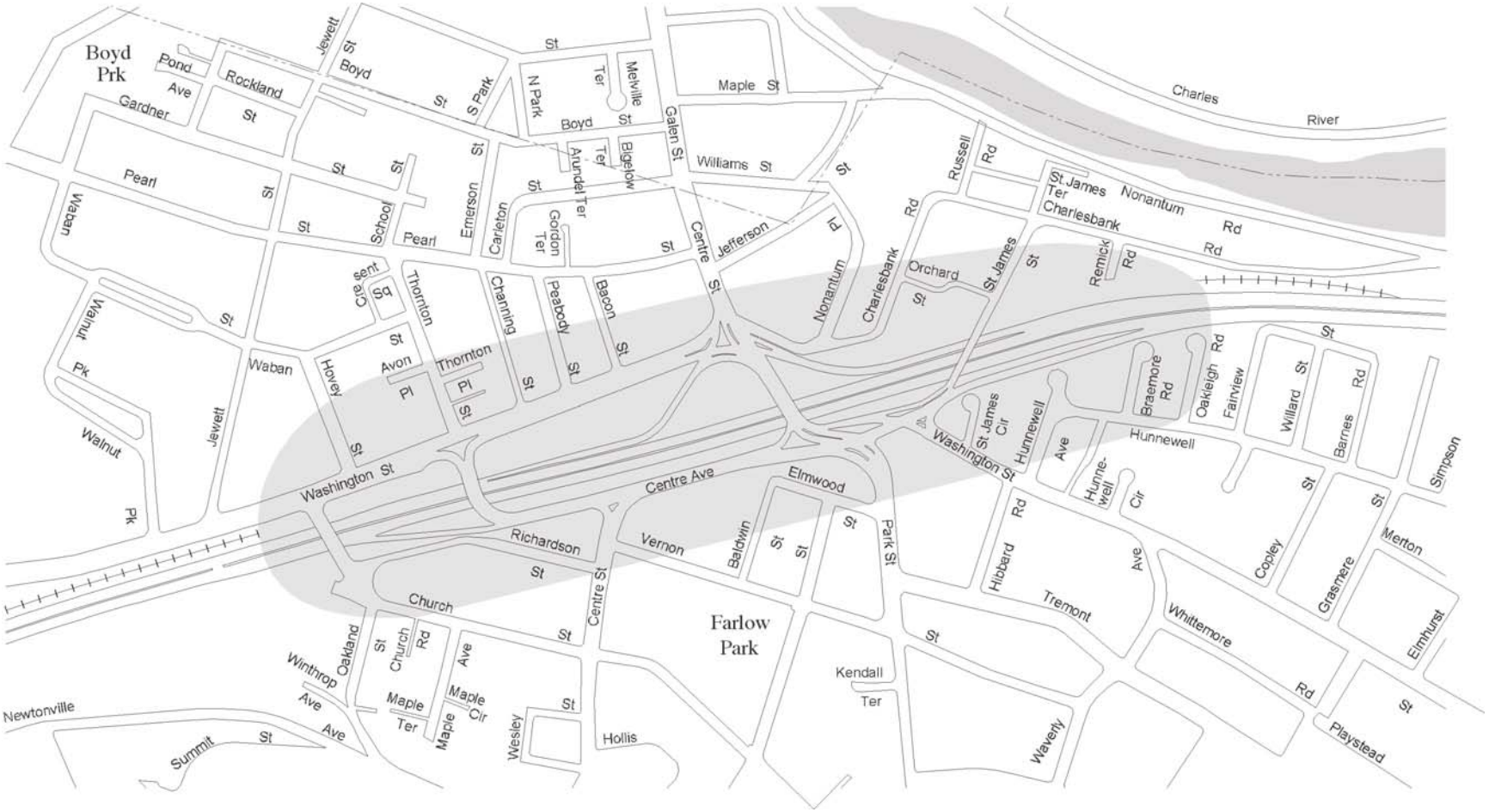


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**FIGURE 1**
**Study Area**

*I-90 Interchange 17:*
*Traffic Patterns and*
*Operational Improvements*

To those ends, CTPS staff conducted a license plate survey, simulated 2005 traffic operations in the study area, and then reran the simulation model with the URS and other traffic improvement assumptions. Based on the license plate survey findings and those from the traffic simulations, staff suggested and prioritized a set of short-term improvements and developed preliminary long-term improvement concepts to be considered in Phase II of this study.[3]

The remaining sections (and selected subsections) of this memo are:



## 2.0 EXISTING CONDITIONS

*(Note that in this memo, to avoid confusion, Centre Street north of the Turnpike is referred to as Galen Street.)*

Traffic circulation at the Newton Corner interchange is accommodated generally by a counterclockwise loop that connects the Massachusetts Turnpike's exit and entrance ramps, Galen Street, Centre Street, Park Street, Washington Street, and St. James Street. Two intersections are signalized: Park Street/Washington Street to the south and Galen Street/Washington Street/westbound off-ramp to the north. The remaining signals in the rotary are pedestrian signals that stop traffic only when pedestrians activate them.

Short weave distances, short storage lanes, and the considerable weaving and merging maneuvers that occur in the rotary contribute to motorists' confusion. More details on current operations and on concerns about operations and safety are provided in the following two subsections. Existing conditions related to MBTA bus operations and pedestrian circulation are discussed in section 3.0, which also suggests possible improvements in those areas.

[3] The fiscal year 2007 Unified Planning Work Program, endorsed on August 17, 2006, includes funding for Newton Corner Rotary, Phase II, a study to examine the impact of long-term improvements to this location.

## 2.1 Overview of Key Operational and Safety Characteristics and Concerns

Before data collection and in order to help guide the analysis and the development of suggested improvements, the staff for this study attempted to identify as many general traffic and safety concerns as possible about the interchange and its vicinity. This was done by discussing issues related to the interchange with professional staff and elected officials of Newton, reviewing previous studies and newspaper articles, and conducting field reconnaissance. The results are listed below; in addition to concerns, key characteristics pertinent to the concerns are listed.

- The rotary interchange has four connections to/from the Turnpike, and its circulating lanes have a series of closely spaced intersections with major and minor streets.
- The major streets and the ramps feed the rotary with heavy traffic that causes it to operate at capacity during the AM and PM peak periods.
- Except for traffic wishing to enter the westbound on-ramp, the hotel, and Gateway Center, the circular design of the interchange allows circulating traffic to make right turns only around the rotary until the desired exit point is reached. In doing so, traffic is continuously forced to merge, diverge, and change lanes (lane weaving), sometimes across two or three lanes.
- This activity, crossing paths, is performed by heavy peak-hour traffic, sometimes at signalized intersections, but mostly at non-controlled locations, for example the east-side and west-side bridges and the straight segments on the north and south sides.
- As this traffic-maneuvering takes place in a constrained right-of-way environment, it results in delays, queues, near-misses, perceived safety concerns, and a high incidence of documented traffic crashes.
- In addition, as soon as drivers complete the sorting-out maneuvers and find themselves in the right lane, they tend to speed away from the bottleneck. The straight southern segment of the rotary (Centre Avenue on either side of Centre Street south) is a frequent location for this.
- According to the Boston Region Metropolitan Planning Organization's Congestion Management System Report,[4] there were 252 crashes at Centre Street and Washington Street between 1997 and 1999, ranking it number 39 of the Top-1,000 High Crash Locations in the state. There were 302 crashes at this location between 1999 and 2001, ranking it number 32 of the Top-1,000 High Crash Locations in the state. Also, this location ranks third in terms of MassHighway's crash severity index[5] among the seven I-90 interchanges from I-95/Route 128 to I-93/Central Artery.

[4] *Mobility in the Boston Region: Existing Conditions and Next Steps*, December 2004.
[5] Severity index is based on MassHighway's Top-1,000 High Crash Locations. MassHighway uses a weighted scoring system, based on crash severity, to rank crash locations.

- A recent *Newton Tab* article stated that "The busy area in Newton Corner is the site of so many accidents that it appears three times on a list of the 10 most dangerous intersections provided … by police. Three Newton Corner intersections—at Centre Street and Washington Street; Centre Avenue; and Centre Street and 320 Washington Street—combined for 60 accidents in the past 12 months, each totaling more than $1,000 or resulting in personal injury."[6]

- In addition to the difficult maneuvers drivers must perform to navigate around the rotary, which cause delays, perceived and documented safety concerns, and a feeling of intimidation for drivers, the lack of logical signs and pavement markings (markings do not last long due to repeated lane crossing) adds to the problem. Often drivers find themselves in the wrong lane and are forced to take a turn that they did not intend to take or stop mid-stream until they can safely weave over to a lane that will take them to their final destination around the rotary.

- To address these operational concerns, which also lead to safety concerns, the URS report made numerous, and valid, traffic operational recommendations (URS did not test them; testing is one task of the present study) at strategic locations with deficient operations and potential safety concerns. The recommendations included overhead signs, traffic lane markings, and a new pedestrian traffic signal.

- A traffic signal recommended by the URS study has been installed at the intersection of Park Street and Tremont Street.

## 2.2 Major Intersections

The following are brief descriptions of current operations and of operational and safety concerns at the major intersections in the rotary, based on observations made during field reconnaissance and data collection (see Figure 2).

*Eastbound Exit Ramp at Centre Avenue (West-Side Bridge)*

The one-lane eastbound exit ramp is controlled by stop signs, and its traffic merges with traffic coming from the west-side bridge. It experiences congestion and traffic queues during the peak travel periods, and drivers usually form two lanes near the approach to enter the rotary even though it is not marked as two lanes. There is considerable merging and weaving in this vicinity between the eastbound exit ramp traffic and traffic already in the rotary, particularly traffic turning right onto Centre Street southbound.

*Centre Street at Centre Avenue*

The only traffic control at the Centre Street and Centre Avenue intersection is a pedestrian signal. At this intersection, Centre Avenue has four lanes—three through lanes

[6] "Newton's Worst Intersections," *Newton Tab*, p. 1, July 12, 2006.

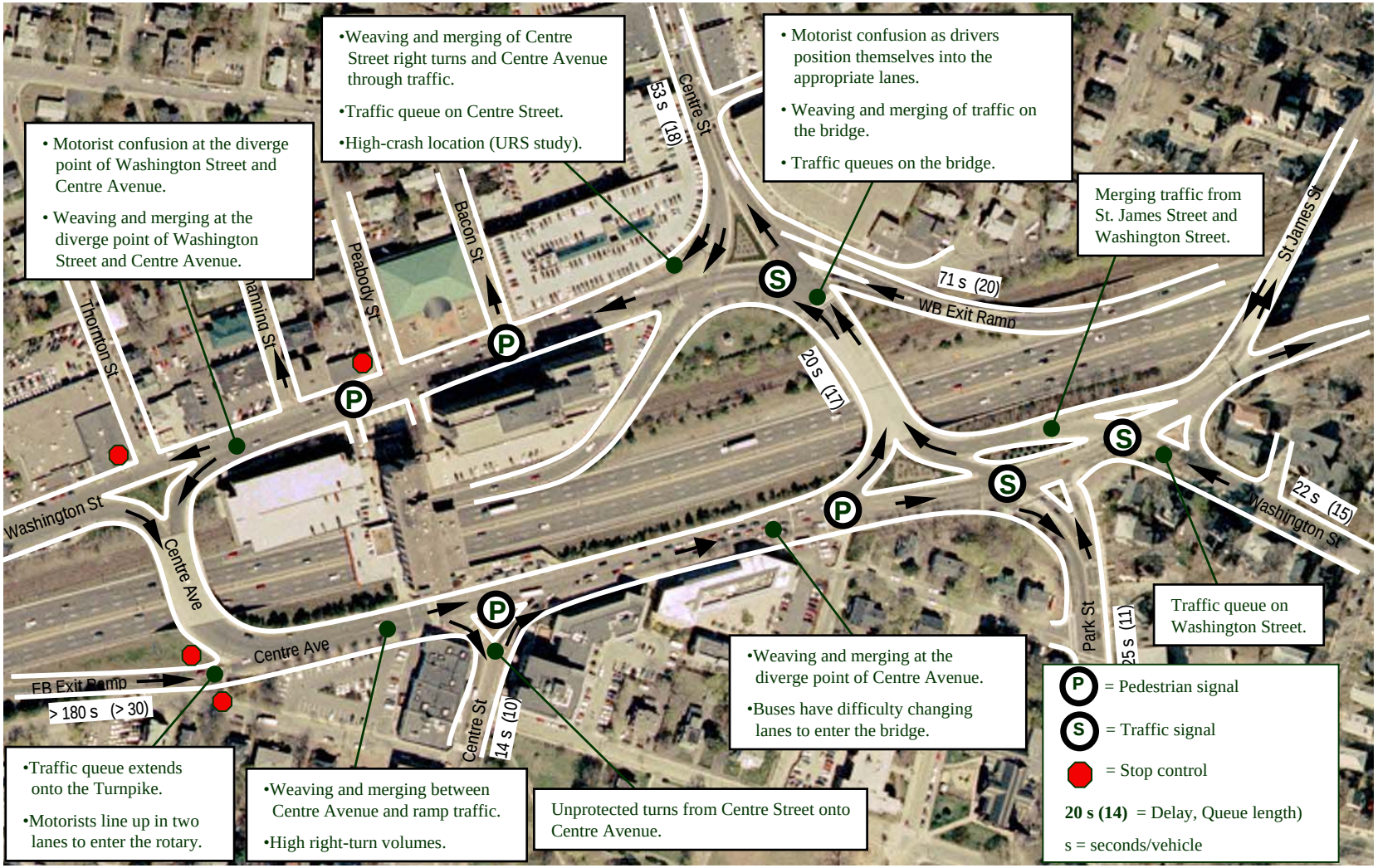


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**FIGURE 2**
**Existing Conditions**

*I-90 Interchange 17: Traffic Patterns and Operational Improvements*

and a right-turn lane—while Centre Street has two right-turn lanes. Both approaches have a green light, with neither having the clear right-of-way (a potential conflict and safety problem) except when a pedestrian activates the signal and both approaches have a red light. Another problem at this intersection is the difficult maneuver from Centre Street northbound onto the east-side bridge because of the high traffic volume on Centre Avenue. Also, because Centre Street intersects Centre Avenue at an angle, it creates a sight distance problem on Centre Street whenever two vehicles line up at the approach waiting for a gap to turn onto Centre Avenue. Another problem at the Centre Street and Centre Avenue intersection and on the south side of the rotary in general is that during off-peaks, drivers speed through the area. This creates a safety problem for traffic merging from Centre Street northbound.

*Park Street at Centre Avenue*

Park Street is a signalized T-intersection with a pedestrian push-button. It has two lanes at the approach, one for through traffic and the other an exclusive right-turn lane. The receiving lane at the Park Street approach is a free right turn from Centre Avenue. Occasionally, Park Street traffic experiences traffic queues when the traffic queue on the east-side bridge extends into it.

*Washington Street at Centre Avenue*

Washington Street is a signalized T-intersection with a pedestrian push-button. It is a one-way street with two lanes at the approach for through traffic and a channellized right-turn lane for traffic proceeding to the Turnpike or St. James Street. Right turns on red are prohibited on Washington Street. Washington Street westbound traffic merges with St. James Street traffic before proceeding to the east-side bridge. This intersection experiences congestion and traffic queues during the AM peak travel period.

*St. James Street at Washington Street*

St. James Street intersects Washington Street at an angle. Washington Street is uncontrolled, while St. James Street is controlled by a pedestrian signal. Therefore both streets have a free flow of traffic until a pedestrian actuation call is received on St. James Street, when its traffic is stopped. Westbound traffic from St. James Street merges with traffic from Washington Street before entering the east-side bridge. On some occasions, the traffic queue on the east-side bridge extends into the merge point of St. James Street and Washington Street, impacting their traffic flows.

*Westbound Exit Ramp at Galen Street and Washington Street (East-Side Bridge)*

The intersection of the westbound exit ramp, Galen Street, and Washington Street (east-side bridge) is a signalized intersection with pedestrian-activated push-buttons. There are five lanes on the bridge at the Washington Street approach: two for turning left onto the Turnpike, two for turning onto Washington Street, one of which is shared with Galen Street, and one for turning onto Galen Street. On the bridge there is significant

weaving and merging of traffic coming from Washington Street, Park Street, and Centre Avenue. This weaving and merging occurs as motorists change lanes in order to position themselves to enter the Turnpike, proceed to Washington Street, or continue onto Centre Street. Motorists' confusion is an issue at this intersection, particularly on the bridge.

The Galen Street southbound right turn is currently uncontrolled, and its traffic merges with traffic from the westbound off-ramp and from the east-side bridge on Washington Street. This merging is compounded by the bus activities associated with the bus stop at this location. The intersection experiences traffic congestion and queuing at all of the approaches during the AM peak travel period.

## 3.0 MBTA BUS AND PEDESTRIAN CIRCULATION

Ten MBTA bus routes traverse the Newton Corner interchange: two local buses, the 57 and the 52, and eight other buses passing through the Newton Corner area and continuing express on the Massachusetts Turnpike.

The 57 bus operates between Watertown Square and Kenmore Square with 7-minute headways during peak hours. The 52 bus operates between Dedham Mall and Watertown Square with 30-minute headways during peak hours.

Buses 553, 554, 556, and 558 operate between downtown Boston and, respectively, Brandeis-Roberts, Waverly, Waltham Center, and Auburndale. The 502 and 504 connect Watertown Square with Copley Square and downtown Boston, respectively. Finally, buses 501 and 503 originate at Brighton Center with downtown destinations. During rush hours, the 553, 554, 556, 558, and 503 buses operate every 60 minutes or less, and the 501, 502, and 504 operate every 10 minutes or less. All 500-series buses stop at Newton Corner both inbound and outbound and travel express on the Turnpike between there and downtown Boston.

Buses stop mainly at two locations on the Newton Corner rotary to pick up or drop off passengers: on the north side, the bus stop is on Washington Street between Galen Street and Bacon Street; on the south side, the bus stop is on Center Avenue, downstream from the Centre Street intersection.

From the MBTA bus schedule, it was estimated that over 60 buses traverse the Newton Corner rotary hourly. While bus transportation is critical for this part of the region, buses pulling in and out of traffic lanes to reach bus stops contribute to congestion, delays, and possibly safety issues.

In the case of the south-side bus stop, buses have to weave across three lanes of traffic to the east-side bridge to proceed to the bus stop at the other side of the rotary. For example, this is the case with the Waltham buses that travel around the rotary twice: first to pick up passengers from the south-side bus stop and then to pick up passengers from the north-side bus stop (in case the Watertown express bus did not pick up everyone) before proceeding to I-90 eastbound. Also, the Watertown Square express buses arriving from downtown first stop at the north-side bus stop and then proceed to the south-side bus stop

to discharge additional passengers before proceeding over the east-side bridge to reach the Watertown Square terminal. This latter routing was designed in this manner to serve passengers arriving from downtown and living on the southern side of the rotary who do not wish to cross the rotary (from north to south) at the designated crossing points because they consider it unsafe to do so. Otherwise, the bus could proceed to Watertown Square directly after arriving at the top of the westbound off-ramp and discharging passengers at the corner of Galen and Jefferson streets. This is just one example of patterns of bus circulation in this interchange that are the result of attempting to serve passengers in a tight right-of-way environment without jeopardizing pedestrian safety.

An additional point about buses and how they affect traffic operations has to do with the location and design of the bus stops. The northern bus stop almost obtrudes into the single right-turn lane from Galen Street. The stop includes a bay area, which was built by narrowing the sidewalk somewhat but is not wide enough for a bus to be entirely contained in it. As a result, traffic is often queued behind buses or forced to make awkward weaves into lanes to the left.

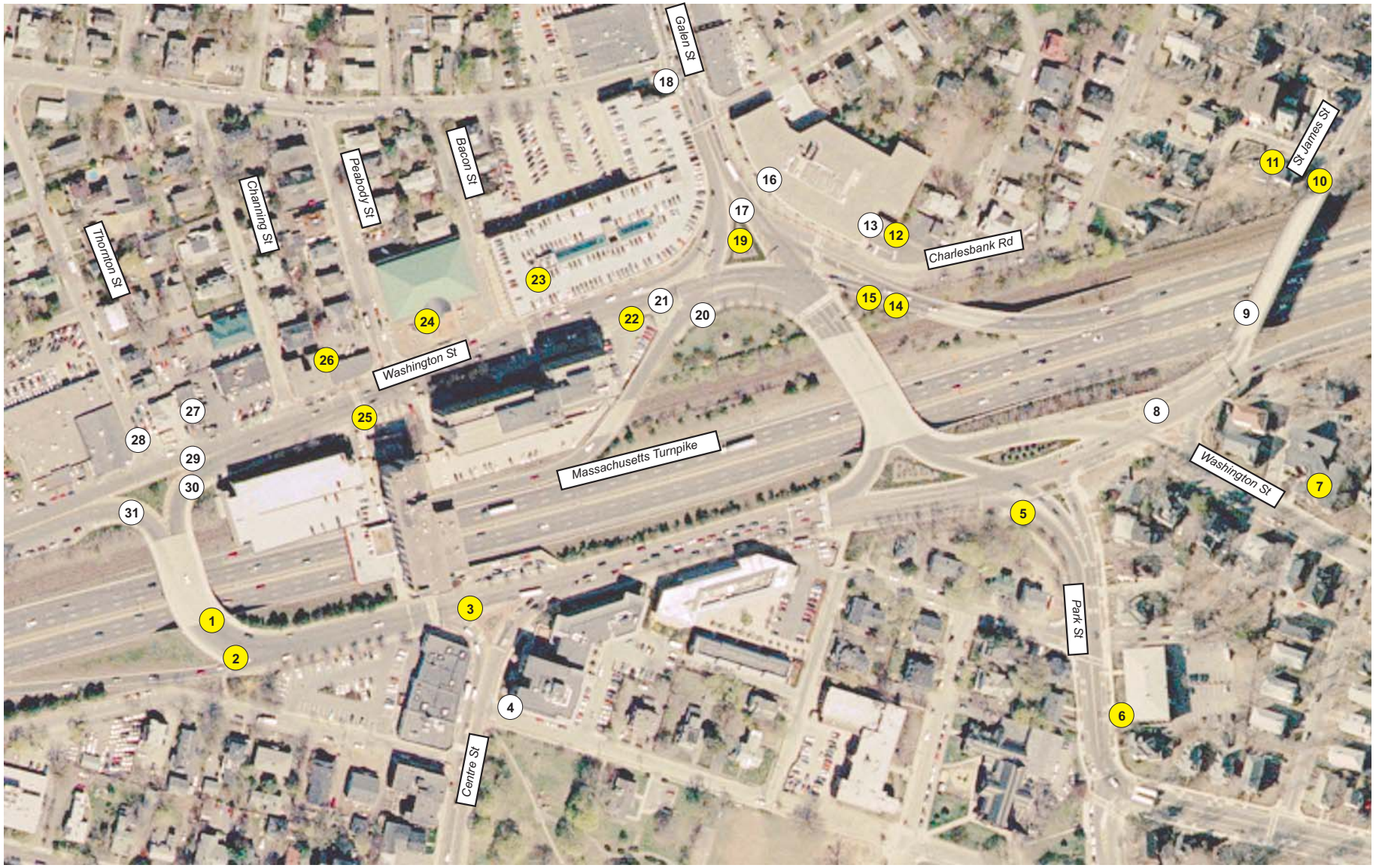
The south-side bus stop has no dedicated bay. Buses stop traffic in the rightmost lane when they pick up passengers. Unfortunately, the sidewalk at this location is narrow and the construction of a bus pullout infeasible.

It may be worthwhile to investigate, with input from abutters, whether the north-side bus stop can be moved westward from the present location, possibly between Bacon and Peabody streets, and whether it could also be split into two bus stops, the eastern for the Watertown Square buses and the western for the Waltham buses. The purpose of the redesign would be to move the bus stop away from the critical right turn from Galen Street onto Washington Street. Vehicles and buses would have a longer distance in which to merge/weave along that segment of Washington Street. In addition, the new location would be closer to the main crosswalk that allows pedestrians to cross to the southern side. If a sufficiently greater proportion of MBTA passengers decide to walk to the other side, buses may be able to reduce/stop their circulating around the rotary.

Finally, pedestrian crosswalk markings and signs must be kept in good condition at all times for improved visibility of pedestrian crossings by drivers. Police visibility to enforce safe pedestrian crossings is another measure for the City to consider.

## 4.0 LICENSE PLATE ORIGIN-DESTINATION SURVEY

A license plate origin-destination survey was conducted on November 1, 2005, between 7:00 AM and 9:00 AM at 31 locations (Figure 3) to determine the origins of vehicles and the paths they take when entering and exiting the study area. This task was specified in the work program. Identifying traffic patterns assisted in the development of suggested ways of enabling traffic to flow more efficiently and safely.

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= Camera location

= Voice recorder location

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*Aerial photo source: MrSID Geoviewer*

**FIGURE 3**
**License Plate Survey**
**Recording Locations**
**November 1, 2005**
**(7:00 to 9:00 AM)**

*I-90 Interchange 17:*
*Traffic Patterns and*
*Operational Improvements*

The steps used to collect and process the data are discussed below, followed by findings and data analysis.

### 4.1 Data Collection

CTPS personnel used special-purpose video camcorders to record images of the license plates of vehicles passing 13 of the survey locations. Tape recorders were used to record plate numbers at 18 locations. The survey was conducted on the same morning at all locations. The cameras were mounted on heavy-duty tripods located adjacent to the roadway lanes. Each camera was aimed and focused to record images of the rear license plates of vehicles. Each person recording data on a tape recorder was positioned to allow the best view of rear plates.

### 4.2 Image Transcription

CTPS personnel transcribed the videotaped and audiotaped plate numbers. The video recordings were played back using tape decks designed to produce sharp, steady images on a video monitor. An operator read each legible plate image and entered the alphanumeric characters into a computer file for each videotaped location. Personnel listened to the audiotapes and entered the alphanumeric characters into computer files. Even though not all license plates could be read, an accurate count of vehicles passing each survey location in each direction was obtained from the tapes. Overall, 83% of the plates were read. By location, the read rates ranged from 38% to 100%.

### 4.3 Data Analysis and Findings

Observed license plate data was matched with Registry of Motor Vehicles files to determine the community in which each vehicle is garaged. This data is used as a surrogate for trip origins. On average, the plates of 48% of the observed vehicles were matched. Plate match rates ranged from a low of 21% to a high of 72%.

Table 1 lists, for each survey location, total vehicles observed, number of plates read, number of plates matched, and the margin of error for the 95% confidence level for the origin data. The latter means that for any location, the estimate of the proportion of vehicles originating in any given community falls within the range of plus or minus the margin of error 95% of the time. For example, it is estimated that 12% of the vehicles observed at the MassPike eastbound off-ramp are garaged in Framingham, and the margin of error for this location is ± 1.4%. Then, 95% of the time, the proportion from Framingham would range between 10.6% and 13.4%. In other words, if this survey were conducted 100 times, 95 of those times the proportion of people from Framingham would be within 1.4 points of the percentage found in this survey. A conservative method was used to estimate the margins of error. Therefore, the actual margins of error are probably slightly smaller than those that appear in the table.

**TABLE 1**

**Traffic and License Plate Statistics**
**7:00-9:00 AM, November 1, 2005**

| Location Number | Survey Location | Observed Traffic | Plates Read | % Read | Plates Matched | Match Rate (%) | Margin of Error* |
|---|---|---|---|---|---|---|---|
| 1 and 2 | MassPike EB Off-Ramp | 1,839 | 1,816 | 99 | 1,316 | 72 | ±1.4% |
| 3 | Centre Street SB (at Centre Avenue) | 1,385 | 1,300 | 94 | 682 | 49 | ±2.7% |
| 4 | Centre Street NB (at Centre Avenue) | 1,594 | 604 | 38 | 335 | 21 | ±4.8% |
| 5 | Park Street SB | 918 | 874 | 95 | 466 | 51 | ±3.2% |
| 6 | Park Street NB | 1,328 | 952 | 72 | 409 | 31 | ±4.0% |
| 7 | Washington Street WB, east of St. James Circle | 1,872 | 1,674 | 89 | 901 | 48 | ±2.4% |
| 8 and 9 | MassPike EB On-Ramp | 3,332 | 3,040 | 91 | 1,655 | 50 | ±1.7% |
| 10 | St. James Street NB, South of Charlesbank Road | 1,598 | 1,526 | 96 | 978 | 61 | ±2.0% |
| 11 | St. James Street SB, South of Charlesbank Road | 931 | 917 | 98 | 475 | 51 | ±3.1% |
| 12 | Charlesbank Road WB | 42 | 42 | 100 | 15 | 36 | ±20.3% |
| 13-15 | MassPike WB Off-Ramps | 2,489 | 1,767 | 71 | 1,734 | 70 | ±1.3% |
| 16 and 17 | Centre Street (to Galen) NB | 1,817 | 1,689 | 93 | 931 | 51 | ±2.2% |
| 18 and 19 | Centre Street SB to Washington Street WB | 2,576 | 1,408 | 55 | 714 | 28 | ±3.1% |
| 20 and 21 | MassPike WB On-Ramp | 3,434 | 3,352 | 98 | 1,792 | 52 | ±1.6% |
| 22,24,25 | Office Building Parking Lot, Hotel Exit | 88 | 88 | 100 | 25 | 28 | ±16.6% |
| 22 and 25 | Hotel, Office Building Entrance | 259 | 257 | 99 | 148 | 57 | ±5.3% |
| 23 | Bacon Street NB | 158 | 144 | 91 | 78 | 49 | ±7.9% |
| 24 | Peabody Street SB | 291 | 288 | 99 | 162 | 56 | ±5.1% |
| 24 | Peabody Street NB | 28 | 26 | 93 | 14 | 50 | ±18.5% |
| 26 | Channing Street NB | 18 | 18 | 100 | 6 | 33 | ±32.7% |
| 27 | Thornton Street NB | 35 | 35 | 100 | 15 | 43 | ±19.1% |
| 27 | Thornton Street SB | 80 | 80 | 100 | 37 | 46 | ±11.8% |
| 28 and 29 | Washington Street WB | 1,366 | 1,127 | 83 | 573 | 42 | ±3.1% |
| 30 and 31 | Washington Street EB | 1,797 | 1,387 | 77 | 749 | 42 | ±2.7% |
| | TOTAL | 29,275 | 24,411 | 83 | 14,210 | 48 | |

*Margin of Error for 95% Confidence Level (for origin data)

### 4.4 Origin-Destination Matrix

The number of vehicles going from rotary entry points to rotary exit points was calculated by matching the license plate files of each entry point with the files of each exit point. This process created a 12-by-12 matrix of "from-to" movements (see Table 2). This matrix understated the true movement volumes because of the inability to read the plates of all vehicles observed at each location. If it is assumed that the failure to read a plate at any given location is random and that the failures are independent of each other, then the observed from-to values for a given pair can be adjusted in inverse proportion to the product of the read rates at a given station. For example, since 99% of the plates on the MassPike eastbound off-ramp were read and 94% of the plates on Centre Street southbound were read, the observed value of 100 vehicles moving from the MassPike eastbound off-ramp to Centre Street southbound was adjusted to 108 vehicles as follows:

$$100/(.99 \times .94) = 108$$

The from-to pairs in Table 2 were all adjusted in this way, with a final adjustment to allow for vehicles that entered/exited points in the rotary at the beginning and end of the survey period.

## 5.0 ANALYSIS OF SURVEY RESULTS

To extract the town-of-origin and circulation patterns at the Newton Corner interchange, staff examined two sources of data collected during the license plate survey: (1) the results of the license plate matching to the Registry of Motor Vehicles file containing town information on where the vehicle is garaged and (2) the origin-destination information contained in Table 2. Highlights of these results are presented below. All pertain to the morning two-hour survey period.

### 5.1 Town-of-Origin Results

Figures A-1 and A-2 in Appendix 1 show the top 10 towns of origin for, respectively, each of the entry points and each of the exit points around the rotary. Additional town-of-origin information for each entry and exit point can be found in tabular form in Appendix 1. The following major conclusions can be drawn from examining Figures A-1 and A-2:

- Traffic using the interchange is truly regional in nature. Vehicles from as far away as Amherst, Franklin, Winthrop, and Quincy were observed on the day of the survey.
- Approximately forty percent of traffic entering and exiting the rotary is from Newton (19%), Boston (15%), and Watertown (7%).
- When Figures A-1 and A-2 are viewed together, they reveal a pattern in which traffic from towns such as Quincy, Framingham, Needham, and Natick arrives at the rotary via the Turnpike eastbound off-ramp, Washington Street eastbound, or Centre Street northbound and proceeds to the Turnpike eastbound on-ramp, St. James Street northbound, or Galen Street northbound.

## 5.2 Traffic Circulation Patterns

Figures A-3 through A-10 in Appendix 1 show the rotary destinations for vehicles observed at each entry point. Figures A-11 through A-17 show the rotary origins of vehicles observed at each exit point. The following are some of the observed patterns:

- The Turnpike is the largest source of traffic to/from the rotary. Twenty-nine percent of morning peak period entering traffic comes from the Turnpike while almost half (46%) of the traffic leaving the rotary is going to the Turnpike.
- The exit points with the highest traffic volumes from the Turnpike are Galen Street, which receives 26% of the Turnpike traffic, and Washington Street westbound, St. James Street northbound, and Centre Street southbound, which receive about 17% of the Turnpike traffic each.
- The top two entry points contributing traffic to the Turnpike are Galen Street (24%) and Washington Street northbound (20%), followed by Washington Street eastbound, Centre Street northbound, and Park Street, which contribute roughly 14% each to the Turnpike traffic.
- Only 4% of the traffic was destined to the following exit points (combined): Bacon, Channing, Thornton, and Peabody streets and the hotel/office building over the Turnpike.
- Looking at the exit points of traffic coming from the major non-Turnpike entry points: for traffic entering from Washington Street northbound, the Turnpike/non-Turnpike split of exit points is 72%/28%; for traffic from Galen Street, that split is 63%/37%. For the rest of the major non-Turnpike entry points, the split is roughly 55%/45%.
- Looking at the entry points of traffic destined to the major non-Turnpike exit points: the Turnpike/non-Turnpike split of entry points is roughly 50%/50%.
- Of the non-Turnpike entry points, Galen Street, Washington Street eastbound, and Centre Street northbound contribute most heavily to the non-Turnpike exit points.
- Of the non-Turnpike exit points, St. James Street, Galen Street, and Washington Street westbound receive the highest traffic volumes from non-Turnpike entry points.
- Over 40% of the traffic entering the interchange cannot make a direct connection with its exit point around the rotary; instead, it must circulate a portion or the entirety of the rotary to reach the desired exit point. The entry points with the highest amounts of circulating traffic are Park Street and St. James Street.
- The east-side bridge and Centre Avenue are critical areas within the rotary because of the maneuvers required to navigate them. Over a quarter of all traffic entering the interchange crosses the east-side bridge at some point. Approximately 60% of the traffic entering the Turnpike westbound on-ramp has

**TABLE 2**
**License Plate Survey: Adjusted Origin-Destination Pairs**

| Location ► Number ▼ | Origins | Total Vehicles Observed | 20, 21 MassPike On-Ramp WB | 8, 9 MassPike On-Ramp EB | 16, 17 Galen Street NB | 10 St. James Street NB | 3 Centre Street SB | 28, 29 Washington Street WB | 5 Park Street SB | 23 Bacon Street NB | 24 Peabody Street NB | 26 Channing Street NB | 27 Thornton Street NB | 22, 25 Hotel, Office Building Entrance |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 13-15 | MassPike WB Off-Ramps | 2,489 | 47 | 209 | 581 | 15 | 564 | 733 | 170 | 44 | 12 | 5 | 15 | 43 |
| 1-2 | MassPike EB Off-Ramp | 1,839 | 0 | 23 | 556 | 670 | 141 | 38 | 337 | 23 | 0 | 4 | 4 | 40 |
| 18-19 | Galen Street SB to Washington Street WB | 2,576 | 1,093 | 535 | 199 | 26 | 341 | 122 | 146 | 60 | 9 | 2 | 2 | 26 |
| 30-31 | Washington Street EB | 1,797 | 176 | 787 | 82 | 337 | 23 | 171 | 185 | 7 | 0 | 0 | 3 | 13 |
| 7 | Washington Street NB, east of St. James Circle | 1,872 | 545 | 794 | 152 | 136 | 15 | 129 | 71 | 12 | 4 | 0 | 0 | 14 |
| 4 | Centre Street NB (at Centre Avenue) | 1,594 | 180 | 716 | 230 | 269 | 105 | 37 | 32 | 11 | 0 | 0 | 0 | 34 |
| 6 | Park Street NB | 1,328 | 585 | 202 | 189 | 75 | 20 | 104 | 105 | 14 | 0 | 0 | 0 | 10 |
| 11 | St. James Street SB | 931 | 509 | 14 | 5 | 70 | 138 | 158 | 19 | 4 | 1 | 1 | 2 | 8 |
| 12 | Charlesbank Road WB | 42 | 0 | 1 | 28 | 4 | 2 | 2 | 4 | 0 | 0 | 0 | 0 | 0 |
| 27 | Thornton Street NB | 80 | 5 | 2 | 4 | 2 | 0 | 60 | 0 | 0 | 0 | 2 | 5 | 0 |
| 24 | Peabody Street SB | 291 | 19 | 112 | 21 | 9 | 36 | 32 | 32 | 0 | 5 | 0 | 0 | 25 |
| 22, 24, 25 | Office Building Parking Lot, Hotel Exit | 88 | 0 | 24 | 5 | 4 | 6 | 0 | 2 | 1 | 4 | 1 | 6 | 34 |
| | Total Vehicles Observed* | 14,348 | 3,434 | 3,332 | 1,817 | 1,598 | 1,385 | 1,366 | 918 | 158 | 28 | 18 | 35 | 259 |

*Note that the movements to destinations do not always sum to the exact total observed because of rounding and other adjustment factors.

crossed the east-side bridge. Approximately 50% of all entering traffic travels on Centre Avenue.

- Critical weaving locations in the study area are:
  - Centre Street/Galen Street at Washington Street
  - Centre Avenue at the MassPike eastbound off-ramp
  - Centre Street at Centre Avenue
  - The south-side MBTA bus stop
  - The east-side bridge

The patterns discussed above result in a constant maneuvering of traffic around the rotary, depicted graphically in Figure A-18 in Appendix 1. For example, vehicles from the Turnpike eastbound off-ramp going to destinations other than Centre Street southbound have to weave across traffic from the west-side bridge that is going to Centre Street southbound. Centre Street northbound traffic heading to Galen Street, Washington Street, and the westbound Turnpike has to merge with and weave across Centre Avenue traffic (without the benefit of a traffic signal) to get to the east-side bridge. Then there are the multiple lane changes on the east-side bridge required to get to the Turnpike, Washington Street, and Galen Street. As mentioned in the introduction, this constant forced traffic maneuvering in a limited amount of space causes the delays and queues that staff, like many others, observed in the field and which will also be documented in the traffic simulation analysis in section 6.0. Also, driving under these conditions causes the real and perceived safety concerns that users of this interchange often describe.

Examination of Table 2 and Figures A-3 through A-18 in Appendix 1 can verify most of these observations.

## 6.0 ALTERNATIVE PACKAGES OF IMPROVEMENTS: TESTING AND RESULTS

This section reports on the results of using a microscopic traffic simulation model to examine the existing conditions and the potential impacts of the improvements suggested by URS and CTPS. Such models simulate the behavior of individual drivers as they respond to circumstances of weaving, merging, and diverging within the general traffic flow. An attractive aspect of simulation models is that they can estimate changes in queues and delays as related to operational changes such as those being considered for the Newton Corner rotary.

Testing the URS recommendations by examining how they work individually, as specified in the work program for the present study, was found to be inefficient, as it would require many traffic simulation runs and then additional simulation runs to determine how the recommendations work collectively, all of which would impact the study's
budget. Therefore, the URS recommendations and the CTPS modifications/refinements to them were packaged into a set of alternatives, described below in section 6.2, and were tested in that form.

## 6.1 CORSIM Traffic Simulation Model

The CORSIM traffic simulation model was used. This model, developed by the Federal Highway Administration, identifies each vehicle by fleet (auto, carpool, truck, or bus) and by type (based on nine different operating and performance characteristics). In addition, behavioral characteristics of drivers (passive or aggressive) are assigned to individual vehicles. In the simulation, the vehicles are moved according to a car-following logic in response to the circumstances within which the vehicles are traveling. Each time a vehicle is moved in the model, its position and relationship to other nearby vehicles are recalculated, as are its speed, acceleration, and other variables. The data are accumulated on a second-by-second basis for all of the vehicles in the highway network being simulated. At the end of the simulation, the accumulated data are used to estimate how the various system components are operating. The simulation network used here covers the entire Newton Corner rotary.

The traffic simulations were undertaken in a two-part process. In the first, the model was calibrated to 2005 AM peak hour conditions using 2005 traffic volume information obtained through the origin-destination survey and by adjusting CORSIM's calibration parameters to match existing conditions (volumes, observed delays and queues). In the second part of the process, the calibrated model was used to test the URS and CTPS traffic improvement assumptions. In the CORSIM calibration process, two types of variables needed to be considered: one was traffic queues observed at the major entry approaches to the rotary, and the other was traffic volumes observed at each entry point and their distribution to the various exit points. Calibration was conducted to duplicate as closely as possible the origin-destination pattern and the observed traffic volumes and queues. Calibration also involved manipulation of CORSIM's input parameters related to types of vehicles and operators.

## 6.2 Alternative Packages of Improvements: Defined and Tested

Testing of the improvements was carried out after calibrating the traffic simulation model for the existing conditions. In all, four different alternative packages were formulated and evaluated for traffic operations, in addition to the existing conditions scenario. The alternatives consist of various combinations of URS location-specific recommendations with some CTPS modifications. The URS recommendations are shown in Figure 4. Figures 5 through 8 show the alternatives; brief descriptions are given below. Alternative packages 2 and 3 build upon Alternative 1 by adding features progressively. Alternative 4 builds upon Alternative 1 by adding the connection of Centre Street and Galen Street via a new bridge over the Turnpike.

Note that URS's recommendation for positive separation that would prohibit right turns from Centre Avenue eastbound to Centre Street southbound, forcing these vehicles to make left turns at Church Street, was not pursued because it would send approximately 1,000 additional vehicles to a mostly residential street during the morning peak period.

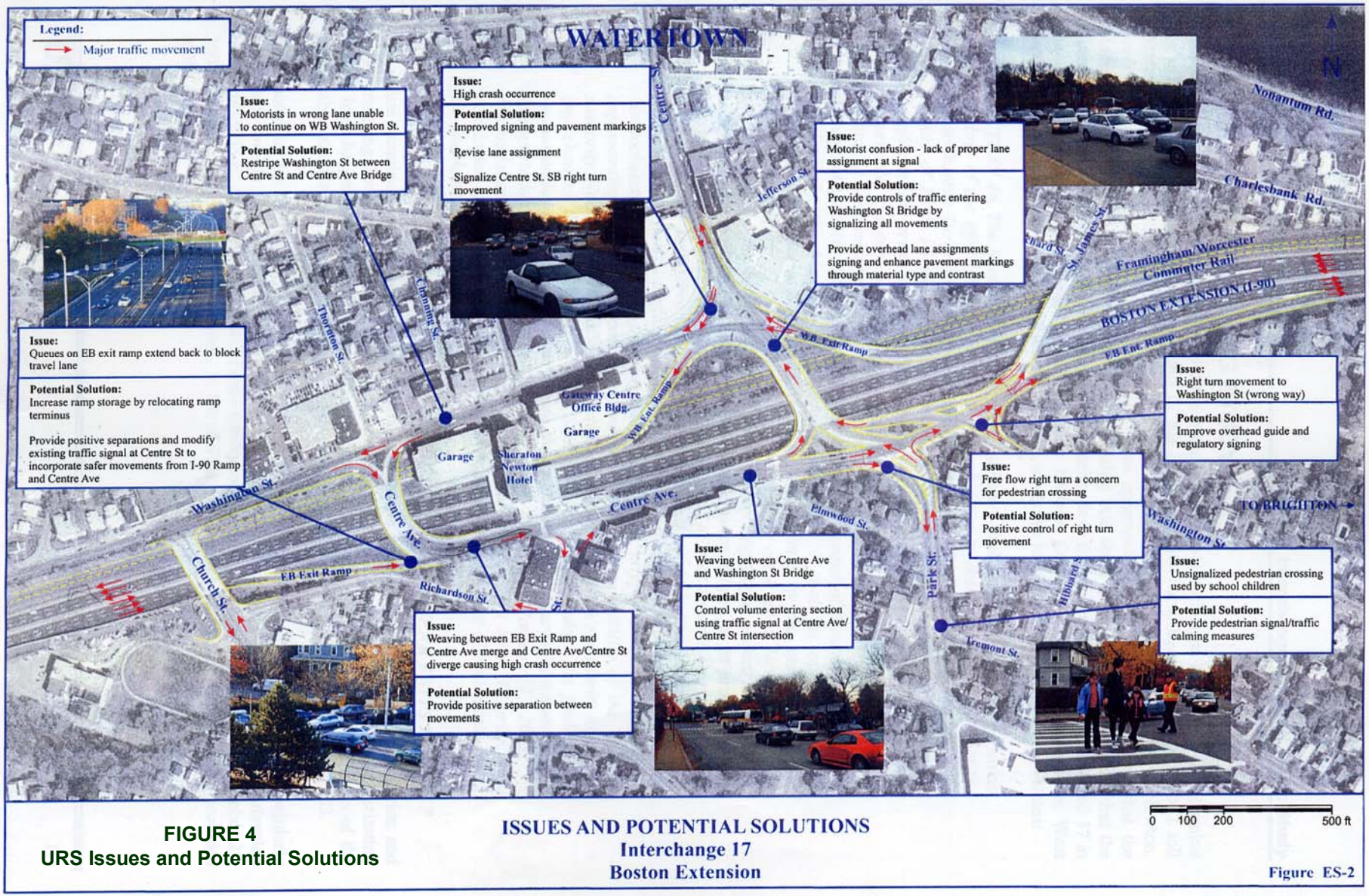



**FIGURE 4**
**URS Issues and Potential Solutions**

**ISSUES AND POTENTIAL SOLUTIONS**
**Interchange 17**
**Boston Extension**

Figure ES-2

*Source: URS Corp. The Effects of the July 1, 2002 Boston Extension (I-90) Toll Increase on Newton Neighborhoods*

For all four alternatives the results of the testing, expressed in terms of delay and queuing in the AM peak period (2005), are presented in Table 3, which also shows the simulation results for existing conditions. The results for the existing conditions serve as the basis for comparing the impacts of the alternatives. For evaluations of the individual improvements based on the results, see section 7.0

*Alternative 1*

Alternative 1 includes the following improvements (see Figure 5):

- Improve signing at the rotary; this should include providing overhead lane-assignment signs at the east-side bridge.
- Improve pavement markings at the rotary to reduce motorist confusion.
- Convert the existing pedestrian signal at Centre Street/Center Avenue to a full traffic signal in order to provide safer moves from Centre Street northbound onto Centre Avenue.
- Coordinate the traffic signals on Centre Avenue at Centre Street, Park Street, and Washington Street to control the volume of traffic entering the east-side bridge. (Both Park Street and Washington Street are controlled by one traffic signal.)

In the traffic simulation analysis for Alternative 1—and for the other alternatives also, in that they build on Alternative 1—the URS recommendations of improved signing and pavement markings were accounted for by raising, from 60 percent to 80 percent, the proportion of drivers who are familiar with the circulation of traffic at the Newton Corner rotary and thus know their next turning and can position themselves in advance.

*Alternative 2*

Alternative 2 (Figure 6) includes the following improvements:

- All of the improvements in Alternative 1.
- Signalize and revise lane assignments at Galen Street southbound right turns to reduce weaving and improve traffic safety. Note: The tested configuration provided a double right-turn lane.

*Alternative 3*

Alternative 3 (Figure 7) includes the following improvements:

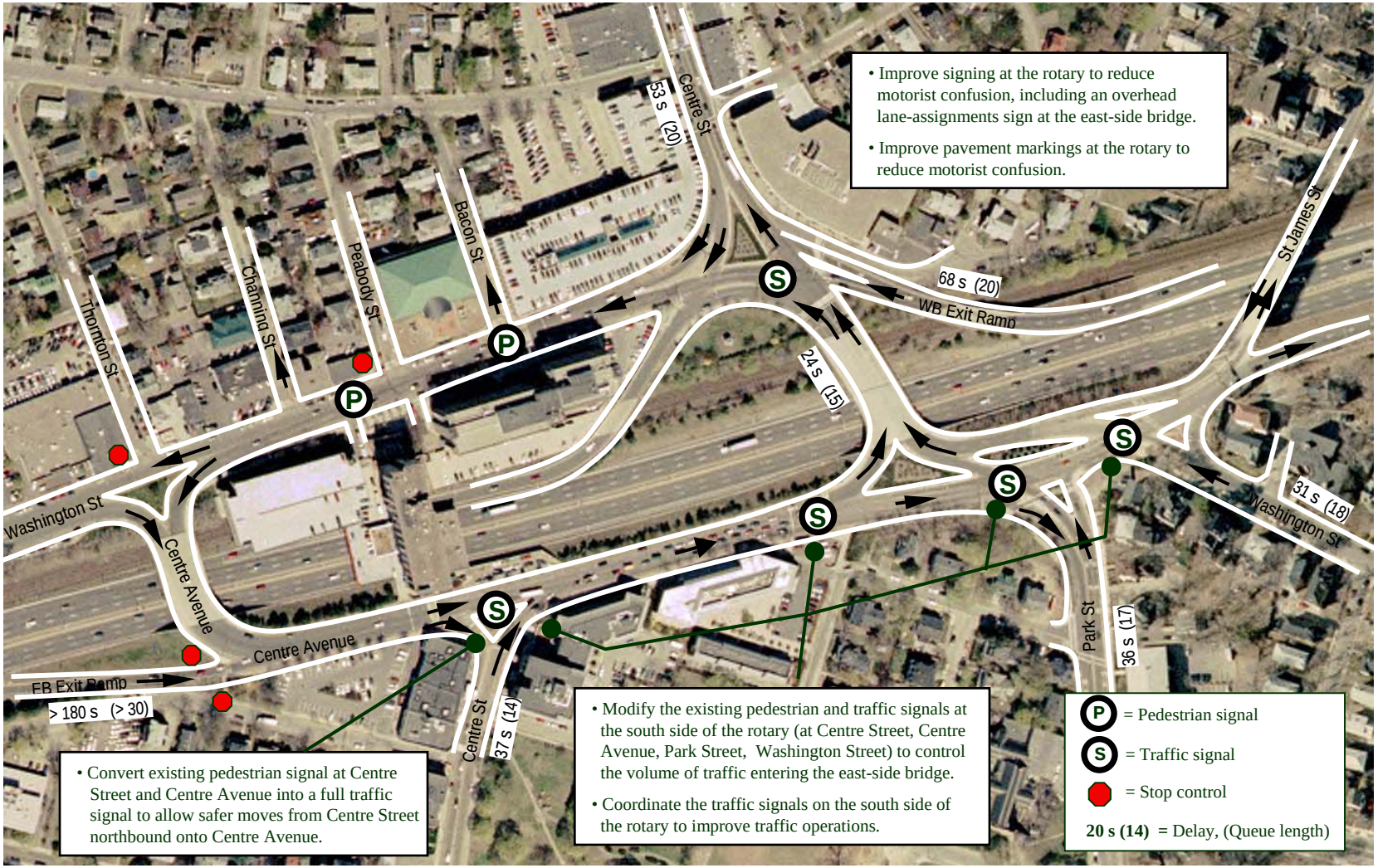
- All of the improvements in Alternatives 1 and 2.
- Signalize the eastbound exit ramp to reduce ramp traffic delay and allow safer moves from the ramp to Centre Avenue.

**TABLE 3**

**Analysis of Existing Conditions and Alternative Packages of Improvements**
**Traffic Delay and Queues at Major Intersection Approaches at the Newton Corner Rotary**
**(7:00-9:00 AM, 2005)**

| | Existing Conditions | | Alternative 1 | | Alternative 2 | | Alternative 3 | | Alternative 4 | |
|---|---|---|---|---|---|---|---|---|---|---|
| **Approach/Intersection** | **Control Delay[1]** | **Average Queue Length[2]** | **Control Delay** | **Average Queue Length** | **Control Delay** | **Average Queue Length** | **Control Delay** | **Average Queue Length** | **Control Delay** | **Average Queue Length** |
| EB Exit Ramp | > 180 | > 30 | > 180 | > 30 | > 180 | > 30 | > 180 | > 30 | > 180 | > 30 |
| Centre Street NB | 14 | 10 | 37 | 14 | 35 | 11 | 40 | 17 | 35 | 15 |
| Park Street | 25 | 11 | 36 | 17 | 33 | 17 | 65 | 21 | 146 | 29 |
| Washington Street NB | 22 | 15 | 31 | 18 | 30 | 18 | 56 | 21 | 70 | 28 |
| WB Exit Ramp | 71 | 20 | 68 | 20 | 119 | 23 | 146 | >30 | > 180 | > 30 |
| Galen Street SB | 53 | 18 | 53 | 20 | 53 | 20 | 54 | 20 | 103 | 29 |
| East-side Bridge | 20 | 17 | 24 | 15 | 19 | 14 | 32 | 17 | 59 | 21 |
| West-side Bridge | NA | NA | NA | NA | NA | NA | 23 | 12 | NA | NA |
| **Network Statistics** | | | | | | | | | | |
| Total Vehicles Discharged from All Origins[2] | 14,978 | | 14,945 | | 14,689 | | 14,294 | | 13,703 | |
| Total Vehicle Miles | 7,592 | | 7,622 | | 7,421 | | 7252 | | 6,512 | |
| Total Network Delay Time (veh-hrs) | 433 | | 474 | | 506 | | 684 | | 970 | |
| Average Network Speed (mph) | 11.07 | | 10.51 | | 9.87 | | 8.08 | | 5.62 | |

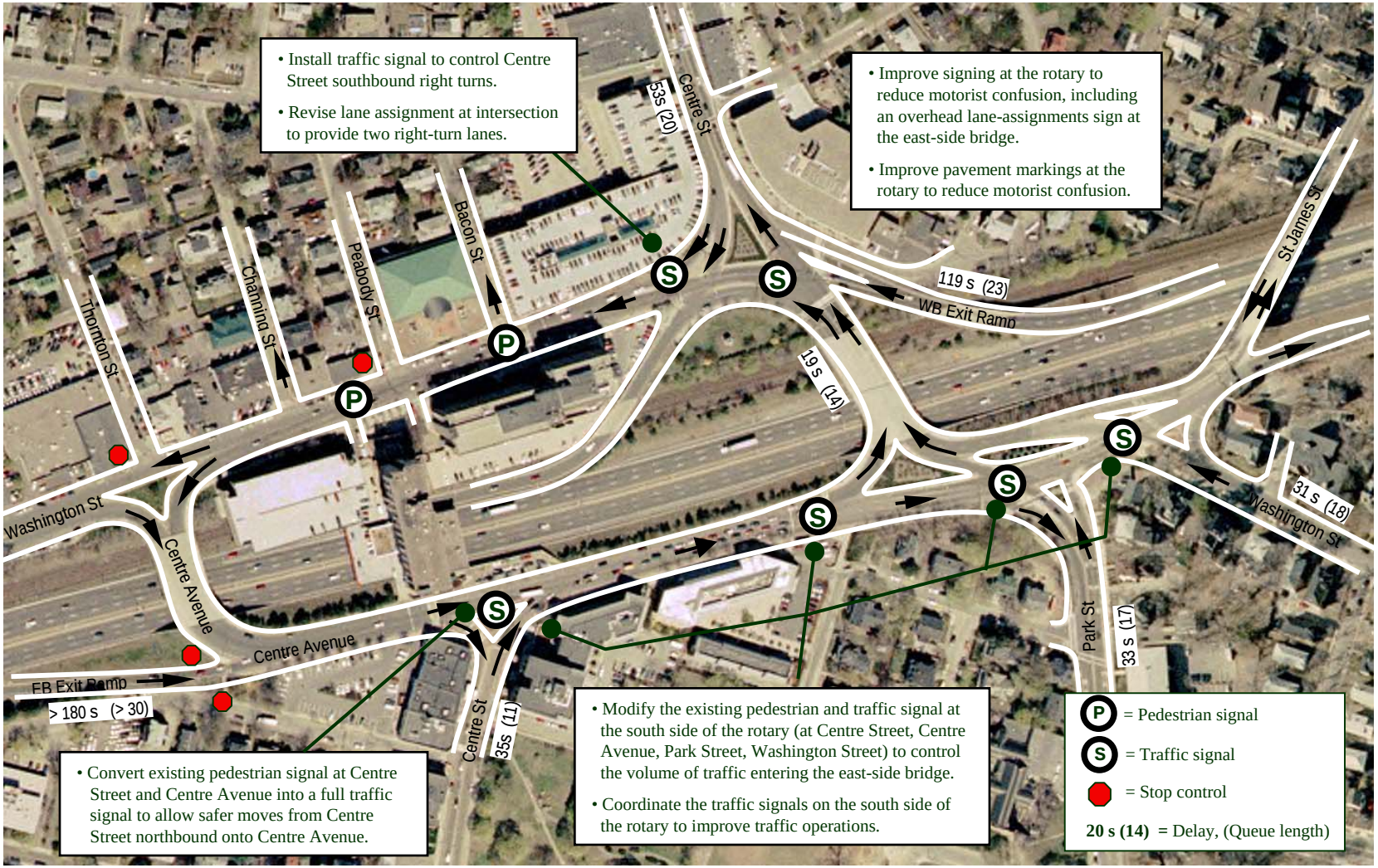
[1]Seconds per vehicle
[2]Vehicles




CTPS

**FIGURE 5**
**Improvements Tested in Alternative 1**

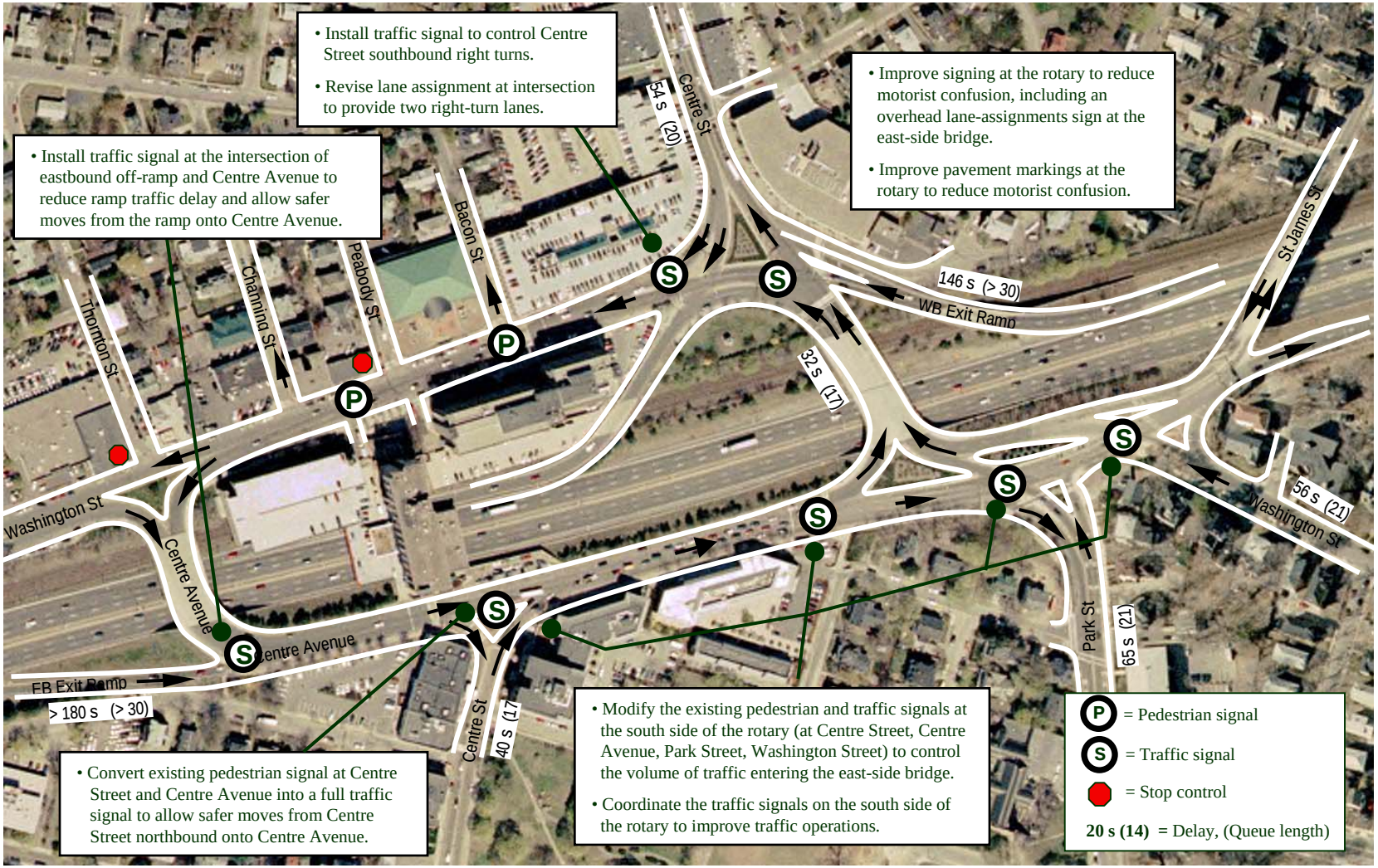
*I-90 Interchange 17: Traffic Patterns and Operational Improvements*




CTPS

**FIGURE 6**
**Improvements Tested in Alternative 2**

*I-90 Interchange 17: Traffic Patterns and Operational Improvements*




CTPS

**FIGURE 7**
**Improvements Tested in Alternative 3**

*I-90 Interchange 17: Traffic Patterns and Operational Improvements*

*Alternative 4*

Alternative 4 (Figure 8) includes the following improvements:

- All of the improvements in Alternative 1.
- Construct a new two-lane, two-way bridge over the Turnpike connecting Centre Street and Galen Street.

This is not a short-term solution: it requires capital funding and a very different planning, design, and public participation process from the rest of the alternatives considered in this study. Nevertheless, staff decided to include this long-term conceptual alternative in the mix of short-term improvements because a transportation planning model run is not required in order to make a preliminary assessment of its impacts.

Operationally, through traffic from Centre and Galen streets would use the bridge instead of going around the rotary along with traffic from St. James Street, the westbound exit ramp, Park Street, and Washington Street. On the south side, the bridge would meet Centre Avenue at a traffic signal, but left turns from Centre Avenue or to Centre Avenue would be prohibited. On the north side, the bridge would connect to the existing traffic signal at Washington and Galen streets. Again, to simplify traffic signal operations, left turns onto Washington Street would be prohibited. Under this assumption, the signal could operate under the existing three-phase design.

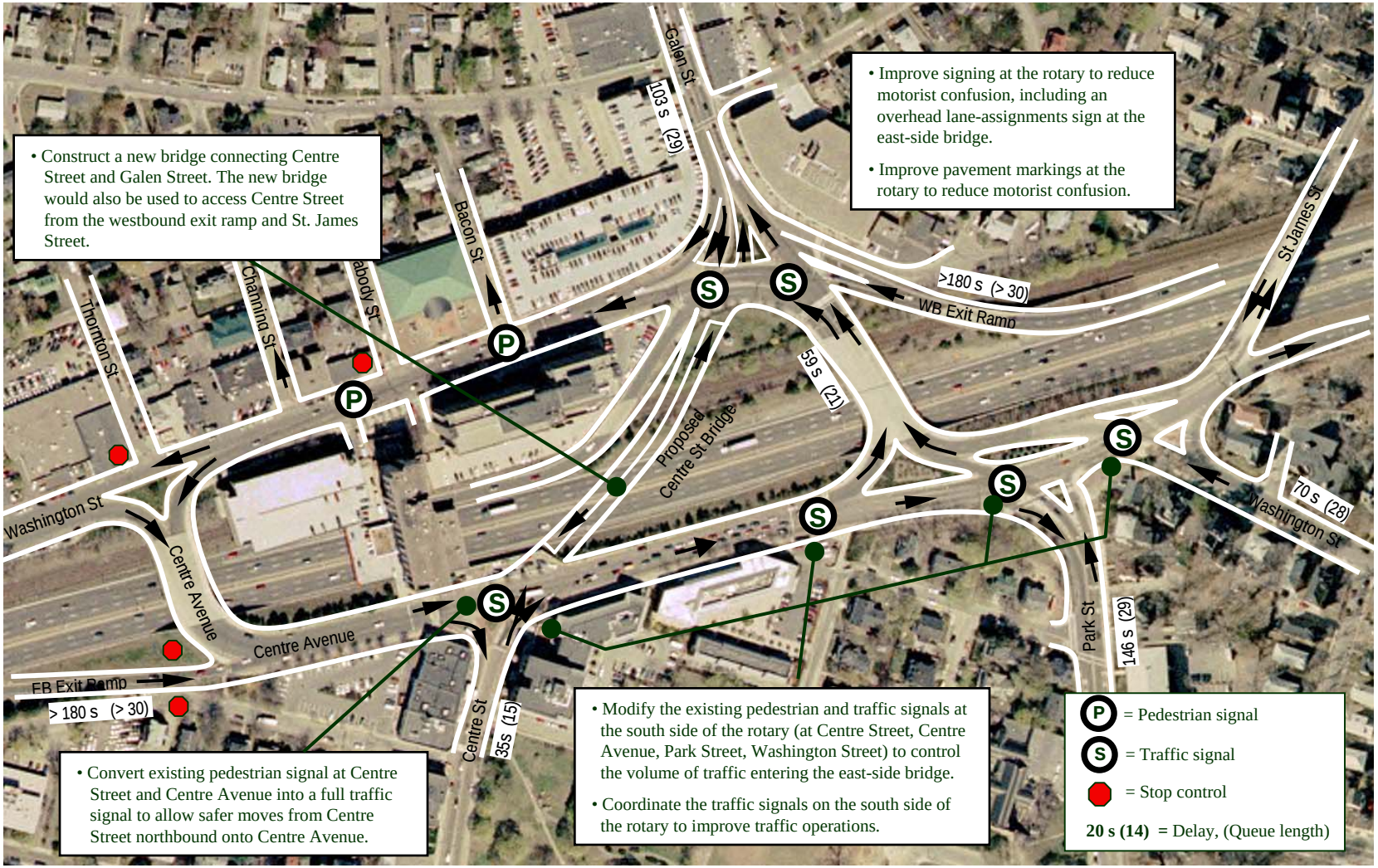
## 7.0 EVALUATION OF INDIVIDUAL IMPROVEMENTS

Whereas the impacts of the four alternative packages of improvements that were tested are presented in Table 3, this section discusses the impacts of the improvements individually. This study's suggestions regarding which improvements should be considered for implementation are presented in the following section.

*Signing and Pavement Markings (included in all four alternatives)*

Signing and pavement markings reduce motorist confusion and tend to improve the overall safety and traffic operations of a rotary. Improving signing and pavement markings at the Newton Corner rotary would benefit traffic operations, particularly at the following locations where weaving and merging maneuvers occur:

- The area on Centre Avenue between the eastbound exit ramp and the Centre Avenue/Centre Street intersection.
- The area on Centre Avenue where traffic diverges onto the east-side bridge or continues onto Park and St. James streets or onto the Turnpike eastbound.
- The area on Washington Street where traffic continues on westbound Washington Street or onto the west-side bridge. At this location motorists in the wrong lane are unable to continue either onto Washington Street or into the rotary.




CTPS

**FIGURE 8**
**Improvements Tested in Alternative 4**

*I-90 Interchange 17: Traffic Patterns and Operational Improvements*

- On the east-side bridge where traffic continues onto the Turnpike, Washington Street, or Galen Street.

*Converting the Existing Centre Street/Centre Avenue Pedestrian Signal into a Full Traffic Signal (included in all four alternatives)*

The existing pedestrian signal on the south side at the intersection of Centre Street and Centre Avenue presently does not give a clear right-of-way indication to drivers on either of the two approaches: both intersecting streets have the green ball, unless a pedestrian activates the pedestrian phase, in which both approaches have the red ball. Converting this light into a full traffic signal has several benefits. First, it provides protection for Centre Street northbound traffic to enter the rotary safely. Secondly, it allows the signal to be coordinated with other signals on the south side of the rotary to control the volume of traffic entering the east-side bridge. The drawback of this improvement is the likelihood of traffic queues extending onto the eastbound off-ramp and the west-side bridge.

*Signal Coordination on the South Side of the Rotary (included in all four alternatives)*

Coordinating the signals on the south side of the rotary to control the volume of traffic entering the east-side bridge involves the following four signals (the two pedestrian signals would be converted to full traffic signals):

1. The pedestrian signal at Centre Street at Centre Avenue.
2. The pedestrian signal on Center Avenue at the diverge point onto the east-side bridge.
3. The traffic signal at Park Street.
4. The traffic signal at Washington Street.

With signal coordination, when traffic on Center Avenue is moving, the side-street traffic from Park Street and Washington Street would be stopped. Likewise, when the traffic from the side street is moving, the traffic on Centre Avenue would be stopped. This controls the volume of traffic entering the east-side bridge, reducing weaving and motorists' confusion on the bridge. Since the coordination involves converting the pedestrian signals at Centre Street/Centre Avenue and at the diverge point to the east-side bridge into full traffic signals, this improvement would also serve as a traffic-calming measure, reducing speeding on the south side of the rotary. Delay would increase slightly.

*Traffic Signal to Control Galen Street Southbound Right Turns (included in Alternatives 2 and 3)*

Installing a traffic signal to control Galen Street southbound right turns into the rotary would be expected to improve safety at the location where its traffic merges with the traffic from the east-side bridge and from the westbound exit ramp. However, the signal creates a longer traffic queue on Galen Street southbound. Also, because this new signal

is closer to the bus stop, there are occasions when the right turns get a green light only to be blocked by buses as passengers alight and board.

Both problems, traffic queues on Galen Street and buses blocking the right turns, could be addressed by reconfiguring the intersection to provide two right-turn lanes to enter the rotary. The additional lane would allow traffic to pass by buses stopping for passengers to alight and board, as well as provide needed capacity to minimize traffic queues on Galen Street. This improvement is reflected in the results of testing Alternatives 2 and 3 via traffic simulations.

*Signalization of the Eastbound Off-Ramp from the Turnpike (included in Alternative 3)*

Signalizing the eastbound off-ramp from the Turnpike benefits safety, as it protects traffic entering the rotary at this location and reduces weaving and merging between the ramp traffic and traffic on Centre Avenue. On the other hand, it not only creates traffic queues on the west-side bridge but also sends more traffic into the rotary, making lane changes difficult. Signalizing the exit ramp also impacts signal timings on the east-side bridge, as more green time would be needed for the additional traffic on the bridge, increasing the traffic delay at the other approaches. Overall, delay increases compared to existing conditions.

*Centre Street Bridge over the Turnpike (included in Alternative 4)*

Building a bridge to provide a direct connection between Centre Street and Galen Street as well as from St. James Street and the westbound exit ramp to Centre Street reduces traffic circulating around the rotary. It also reduces the high volume of right turns from Centre Avenue onto Centre Street and, therefore, some of the weaving maneuvers that take place on Centre Avenue between the eastbound exit ramp and Centre Street.

On the other hand, traffic simulation analysis shows that the new bridge would create weaving problems at its intersection with Galen Street, especially for traffic coming from the westbound exit ramp and the east-side bridge that is headed to Centre Street, the Turnpike, and Centre Avenue. This would require complex signing and pavement markings and would add to motorists' confusion. The simulation analysis shows that weaving maneuvers appear to interrupt traffic flow from the east-side bridge and the westbound exit ramp, causing long queues. In short, the existing, difficult intersection at Washington and Galen streets would become even more confusing and difficult to navigate.

## 8.0 CONCLUSIONS AND SUGGESTED IMPROVEMENTS

### 8.1 Conclusions

Key conclusions arrived at in this study, both general conclusions and those pertaining to specific locations, are the following:

1. Observation and traffic simulation analysis confirmed the operational and safety concerns expressed by City of Newton officials and those documented in the URS and other previous studies/articles. Two key concerns follow.
2. The most congested location around the rotary interchange is the east-side bridge/Galen Street/Washington Street/westbound off-ramp/westbound on-ramp signalized intersection. The right-of-way is very tight, and the volumes demanding to be processed are extremely high during the morning and evening peak hours.
3. At the intersection of Centre Street and Centre Avenue, Centre Street northbound movements are currently unprotected and operate in an unsafe environment because there is no clear right-of-way indication.
4. The right-of-way is tight and the traffic demand volumes are high; the result is saturated flow conditions: simply, traffic demand is too high for the available capacity. To improve operations under such circumstances, one of the following must happen: a decrease in demand or an increase in capacity. In the case of Interchange 17, there are limited opportunities to bring about either of these in the short term, even through creative solutions. Staff were unable to identify any short-term improvements that would bring the operation of the rotary to an acceptable level of service.
5. Though some of the safety issues at the interchange result from operational issues that cannot be solved in the short term, there are some short-term safety improvements that can be effective.
6. The URS recommendations made previously are generally sound; only minor modifications, which have been described, are called for.
7. The improvements that were tested for the short term (including long-term Alternative 4) do not improve traffic operations significantly over existing conditions. In fact, Alternatives 3 and 4, if implemented, would worsen the overall level of service.
8. The improvements tested in Alternatives 1 and 2 would be expected to have a beneficial effect on safety by reducing the number of conflicts and, in some instances, through providing a clear indication of which approach has the right-of-way.
9. Converting the pedestrian signal at the intersection of Centre Street and Centre Avenue into a full traffic signal provides protection for Centre Street northbound traffic to enter the rotary. The new signal could also be coordinated with the other signals on the south side of the rotary (see next item). However, there is the likelihood of traffic queues extending onto the eastbound off-ramp and the west-side bridge.
10. Coordinating the signals on the south side of the rotary to control the volume of traffic entering the east-side bridge reduces weaving and motorist confusion.
11. The number of buses and the number/location of bus stops influence circulation around the rotary. Through discussions with the MBTA and citizens groups, some

of these influencing factors and possible bus stop relocation away from the Galen Street right turns into Washington Street should be investigated. Any plan to relocate bus stops should be contingent upon receiving the consent of abutters to the new stops.

## 8.2 Suggested Improvements

The following are improvements that the City of Newton and the Massachusetts Turnpike Authority may wish to consider. Based on the performance measures in Table 3, we suggest implementing the improvements in Alternative 1 or Alternative 2: though they do not have a significant effect on operations, they address safety issues. In addition, the possibility of relocating the north-side bus stop should be examined. Consideration of the improvements that are particular to Alternatives 3 and 4 is not suggested because they adversely affect traffic operations in the rotary.

Both Alternatives 1 and 2 include improving pavement markings and signing at the rotary, installing a full traffic signal at Centre Avenue and Centre Street, and coordinating the signals on the south side of the rotary (see detailed list below). The only difference between the two alternatives is that Alternative 2 includes, for the right turn from Galen Street into the rotary, signalization and construction of two right-turn lanes. The purpose of those additional improvements is to address the high incidence of crashes at that location.

To summarize, it is suggested that the following improvements be considered:

1. Improve signing at the rotary to reduce motorist confusion and increase safety through increased awareness; this should include an overhead lane-assignment sign at the east-side bridge.
2. Improve pavement markings at the rotary to reduce motorist confusion and increase motorist awareness of pedestrian crosswalks.
3. Convert the existing pedestrian signal at Centre Street/Center Avenue to a full traffic signal, to provide safer moves from Centre Street northbound onto Centre Avenue by providing a clear indication of which approach has the right-of-way, thus reducing the number of conflicts, particularly damaging sideswipe collisions.
4. Coordinate the traffic signals on Centre Avenue at Centre Street, Park Street, and Washington Street to control the volume of traffic entering the east-side bridge, reducing weaving and motorist confusion. (Park Street and Washington Street are controlled by one traffic signal.)
5. Signalizing the Galen Street southbound right turn would improve safety by eliminating the free right turn, which would reduce conflicts; if the City chooses to implement this improvement, the intersection would need to be reconfigured to provide two southbound right-turn lanes to prevent traffic queues on Galen Street and buses from blocking the right turns.

6. The City of Newton and the MBTA, with input from abutters, should investigate the possibility of relocating the north-side bus stop from a congested, high-crash area to a location just west of the present one.

## 9.0 COST ESTIMATES FOR IMPROVEMENTS

The cost estimates for the suggested improvements are shown in Table 4 and described below. The table also prioritizes the improvements.

**TABLE 4**
**Cost Estimates for Suggested Improvements**

| Priority | Improvement | Estimated Cost |
|---|---|---|
| 1 | Improve signing at the rotary to reduce motorist confusion; this should include providing an overhead-lane assignments sign at the east-side bridge. | $50,000 |
| 2 | Improve pavement markings at the rotary to reduce motorist confusion. | *$25,000 |
| 3 | Convert the existing pedestrian signal at Centre Street/Center Avenue into a full traffic signal to allow safer moves from Centre Street northbound onto Centre Avenue. | $50,000 |
| 4 | Coordinate the traffic signals on Centre Avenue at Centre Street, Park Street, and Washington Street to control the volume of traffic entering the east-side bridge. | **$150,000 |
| 5 | Signalize Galen Street southbound right turns to improve safety and reconfigure the intersection to provide two southbound right-turn lanes in order to prevent excessive queuing on Galen Street and prevent buses from blocking the right turns. | $75,000 |

*New pavement markings only
**Including item 3

*Improving Signing*

The cost of an overhead sign has two components: the sign panel and the support (overhead truss) to which the sign panel is attached. The cost estimate for the sign panel is about $20 per square foot, while the support is about $600 per linear foot; these figures include labor and installation. Based on these estimates the installation of an overhead sign with two 10-foot-by-6-foot panels spanning 60 feet across Centre Avenue would cost about $40,000. Post-mounted signs installed at the side of the rotary typically cost between $200 and $300. Overall, improving signing would be expected to cost about $50,000.

*Improving Pavement Markings*

Applying pavement markings costs about $1 per linear foot. Based on that unit cost, it is

estimated that applying new markings at the rotary (both where none currently exist and where the existing markings need renewal) would cost approximately $25,000. It should be noted, however, that a preliminary step of removing the old paint is sometimes required and that this step typically costs more than applying the new markings. Another preliminary step that is sometimes necessary if the pavement has cracks is the resurfacing of the pavement. If either of these preliminary steps were required, the cost would be substantially higher than the estimate given above.

*Modifying and Coordinating Traffic Signals*

Although the existing signals in the rotary already have hardware that is capable of being interconnected and coordinated, it may need to be replaced with more up-to-date equipment. Conduits between the signals have been installed, but the interconnection wiring has not. New traffic signal controllers would cost about $10,000 each, and interconnection wiring and remote access would cost about $15,000. All of the signals currently operate on time-of-day plans; making them fully actuated (traffic responsive) would require new signal timing plans for the coordinated signal system, which would probably cost around $50,000. Converting the pedestrian signal at Centre Street/Centre Avenue to a full traffic signal is estimated to cost approximately $50,000 (this is necessary to coordination; as discussed, it may also be implemented as an independent improvement). Signal coordination, overall, including conversion of the pedestrian signal on Center Avenue at the diverge point onto the east-side bridge into a full signal, would be expected to cost around $150,000.

*Signalizing Galen Street Southbound Right Turns*

This improvement requires installation of a new signal and reconfiguration of the intersection to provide two right-turn lanes. The cost of this improvement, including installation of a new signal post and signal head and intersection geometric improvements, would be expected to be in the vicinity of $75,000.

## 10.0 LONG-TERM DESIGN CONCEPTS

The summary of simulation results in Table 3 and the discussion that followed point to two major conclusions regarding operational improvements for Newton Corner:

- Certain operational and signing improvements would promote safer maneuvers around the rotary interchange.
- However, these improvements would not be expected to improve traffic operations significantly beyond existing conditions, and long-term solutions may need to be sought.

In search of long-term capital improvements, one could study the pattern and level of traffic demand that was identified by the license plate survey and explore concepts that would reduce traffic demand to, from, or through Interchange 17. For example, in order to disaggregate traffic demand at the critical Washington Street/Galen Street/east-side

bridge/westbound off-ramp/westbound on-ramp intersection, one thought would be to remove from this location the westbound on-ramp to the Turnpike. Then the existing demand for this ramp would be served on other existing or new facilities, away from this location.

In the following discussions, most of the attention will be paid to ways to free-up capacity for the intersection just referred to, the most congested of all locations around the interchange. The discussions are qualitative and based on professional experience and knowledge of the traffic patterns and processing capacities of the roadway network in the vicinity of the rotary. Applying the regional transportation planning model for more complete traffic distribution and assignment would be a more sure-footed way to analyze the impacts from roadway element closures and the construction of new roadway elements. Finally, none of these discussions is in any way conclusive: instead, they are meant to begin the thought process around the feasibility of the concepts, so that some of them can be evaluated eventually.

**Build an Underpass for the Centre Street/Galen Street Traffic to the Westbound On-Ramp**

While an underpass would eliminate the existing traffic signal phase controlling this southbound movement, there are a number of problems associated with this improvement, making it infeasible. First, Galen Street southbound traffic would have to merge with traffic from the east-side bridge heading to the Turnpike, which would create merging problems on the ramp itself. Secondly, because the Turnpike is on lower ground and has the railway line beside it, it would be difficult to achieve the required vertical clearance over the railway line and slope to merge with the Turnpike with an underpass, given the limited distance and site constraints. On Galen Street itself, site constraints pose a major challenge for the construction of an underpass. For these reasons, the idea of constructing an underpass for Galen Street traffic heading to the Turnpike westbound may be difficult to retain for further consideration.

**Close or Modify Operations of the St. James Street Bridge to Nonantum Road**

This bridge carries over 1,100 vehicles an hour in the morning and serves to connect the Newton Corner rotary with Nonantum Road, which is part of the Department of Conservation Resources parkway system. Nonantum Road serves recreational sites along the Charles River and connects Cambridge, Newton, Watertown, downtown Boston (via Soldiers Field Road and Storrow Drive) and other locations. One quarter of the traffic on this road is City of Newton residents, and 10% is Boston/Brighton residents. The rest of it is from all over the region.

If the St. James Street bridge connection to Nonantum Road were to be closed, traffic operations on the east-side bridge and the downstream intersection would likely improve. This is because traffic served by St. James Street would be distributed to other roads, although some of it may still pass through or enter the rotary from other entry points. For example, looking at the top 10 residential origin communities served by the St. James

Street bridge, Natick, Framingham, and Wellesley residents may choose to take the Turnpike to points east of Newton Corner. However, depending on their destination, they may choose to continue to pass through Newton Corner and reach Nonantum Road through Watertown Square. Newton residents will likely follow similar paths: proceed to the eastbound on-ramp to I-90 or proceed to Nonantum Road through Watertown Square.

**Move the Westbound On-Ramp to a New Location West of the West-Side Bridge**

This ramp is heavily used: it serves over 1,700 vehicles in the morning peak hour. About 50% of the traffic is composed roughly equally of Boston, Watertown, and Newton residents. One way to lower the demand on the east-side bridge/Washington Street/westbound off-ramp/westbound on-ramp traffic signal would be to move the westbound on-ramp downstream from this location to another location just west of the west-side bridge. This strategy actually removes the need for a third phase for this traffic signal, as the Galen/Center streets southbound and east-side bridge northbound traffic wishing to reach the westbound on-ramp would now continue onto Washington Street westbound past the west-side bridge to reach the new on-ramp. A likely new location for entry to the westbound Turnpike would be at the Washington Street/Church Street intersection traffic signal.

**Close the Westbound On-Ramp and Construct a New Westbound On-Ramp at Interchange 16**

Another strategy would involve reconfiguring the I-90/Route 16 interchange to accommodate westbound traffic from Route 16 (Washington Street). Assuming that this option is physically and operationally feasible, traffic wishing to enter I-90 westbound would travel along Washington Street and Watertown Street (Route 16) through Newton Corner or Watertown Square and West Newton to reach a new westbound on-ramp at the I-90/Route 16 interchange, which currently does not allow westbound traffic to enter I-90. The feasibility of this potential conceptual option must be examined in terms of right-of-way, traffic diversion, environmental, fiscal, and structural impacts.

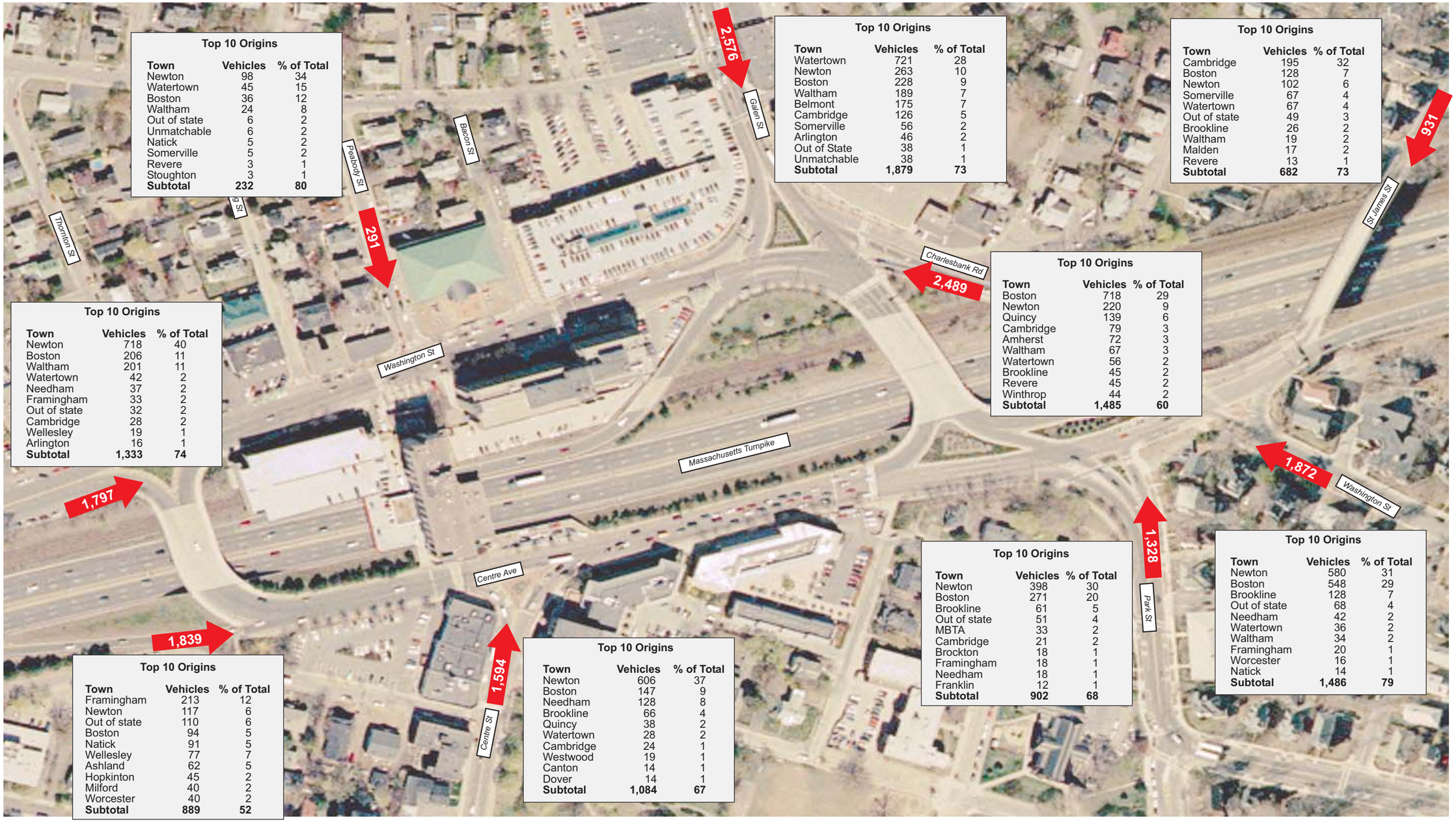
## 11.0 NEXT STEPS

In closing, there are some long-term concepts that could be worthwhile to consider further. Their goal would be to reduce the traffic demand and concentration presently imposed on the Newton Corner rotary's roadway system in order to reduce delay and increase operational efficiency and safety. So far, after only qualitative analysis, no single option appears to stand out as easy, an obvious cure-all, or inexpensive to implement, and all could have some adverse traffic and other impacts somewhere else in the network of Newton or Watertown. However, some of the most promising concepts will be tested as part of the forthcoming Newton Corner Rotary, Phase II, study, which was recently funded by the Boston Region MPO for the 2007 fiscal year. In that study, the feasibility of some long-term concepts will be explored for traffic impacts, including traffic diversions. Applying the Boston Region transportation-planning model under existing

conditions and under a few alternative designs at Interchange 17 and the adjacent interchanges should fulfill that study's purpose.

sa/ep/aw

# APPENDIX 1
# MAPS



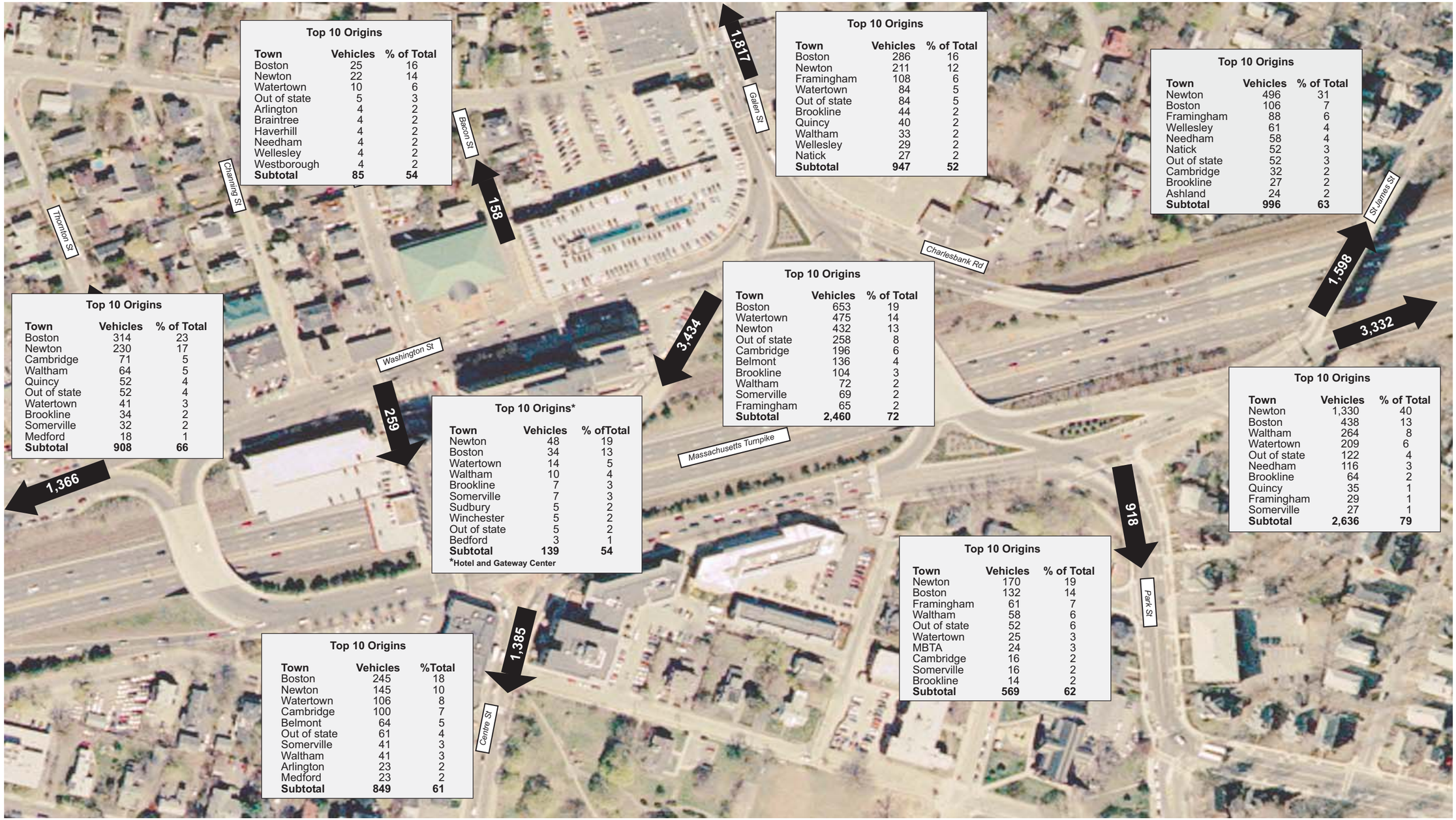

CTPS

Entrance

**FIGURE A-1**
**Vehicle Origins at Entrance Points**
**(7:00 to 9:00 AM)**

N

*I-90 Interchange 17: Traffic Patterns and Operational Improvements*




CTPS

Exit

**FIGURE A-2**
**Vehicle Origins at Exit Points**
**(7:00 to 9:00 AM)**

N

*I-90 Interchange 17: Traffic Patterns and Operational Improvements*


CTPS

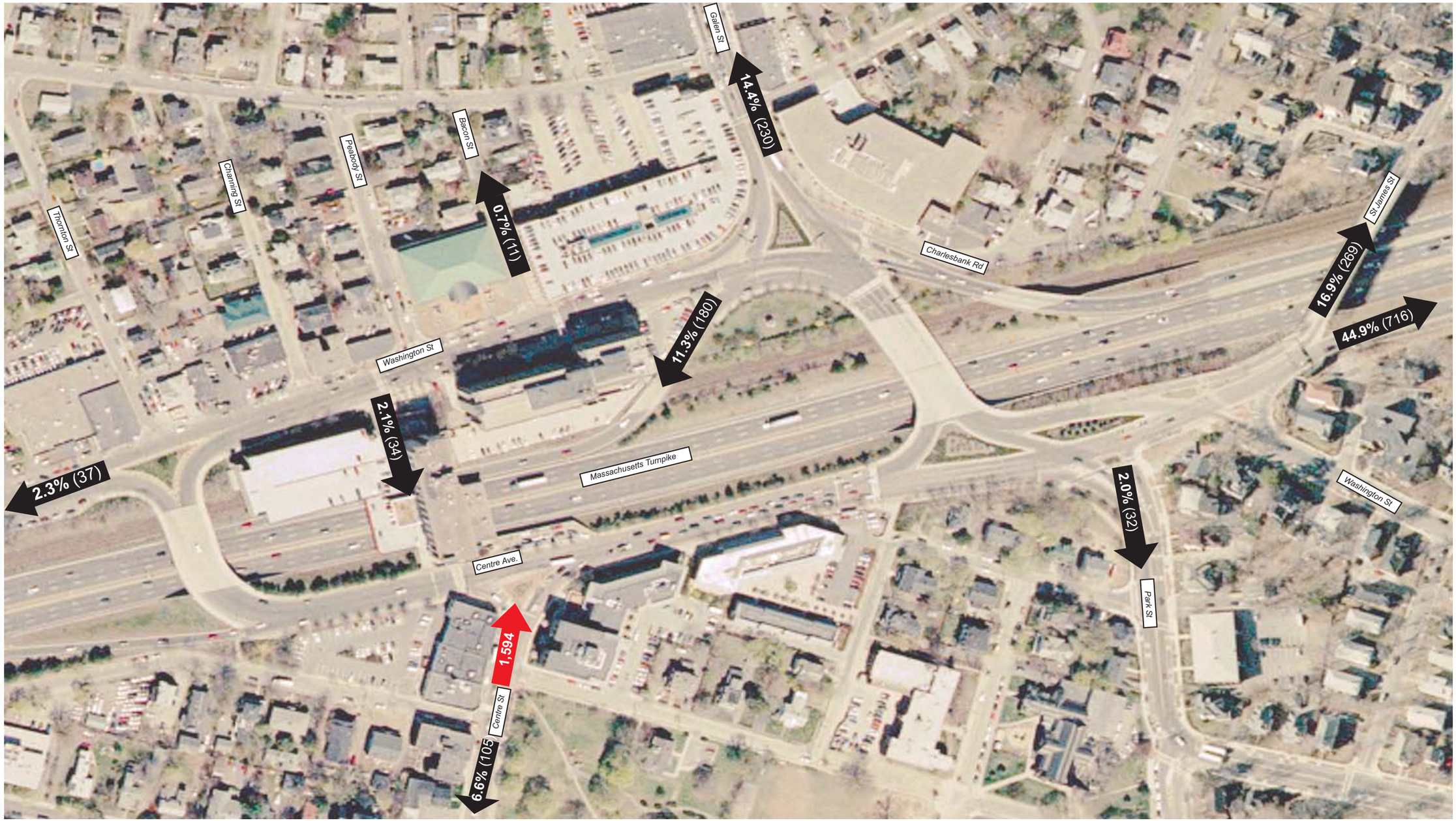
Entrance

Exit

**FIGURE A-3**
**Vehicle Destinations from MassPike Eastbound Off-Ramp (7:00 to 9:00 AM)**

N

*I-90 Interchange 17: Traffic Patterns and Operational Improvements*




CTPS

Entrance

Exit

**FIGURE A-4**
**Vehicle Destinations from Centre Street Northbound (7:00 to 9:00 AM)**

N

*I-90 Interchange 17: Traffic Patterns and Operational Improvements*

Entrance


CTPS

Entrance

Exit

**FIGURE A-5**
**Vehicle Destinations from Park Street Northbound (7:00 to 9:00 AM)**

N

*I-90 Interchange 17: Traffic Patterns and Operational Improvements*


CTPS

Entrance

Exit

**FIGURE A-6**
**Vehicle Destinations from Washington Street Northbound (7:00 to 9:00 AM)**

N

*I-90 Interchange 17: Traffic Patterns and Operational Improvements*


CTPS

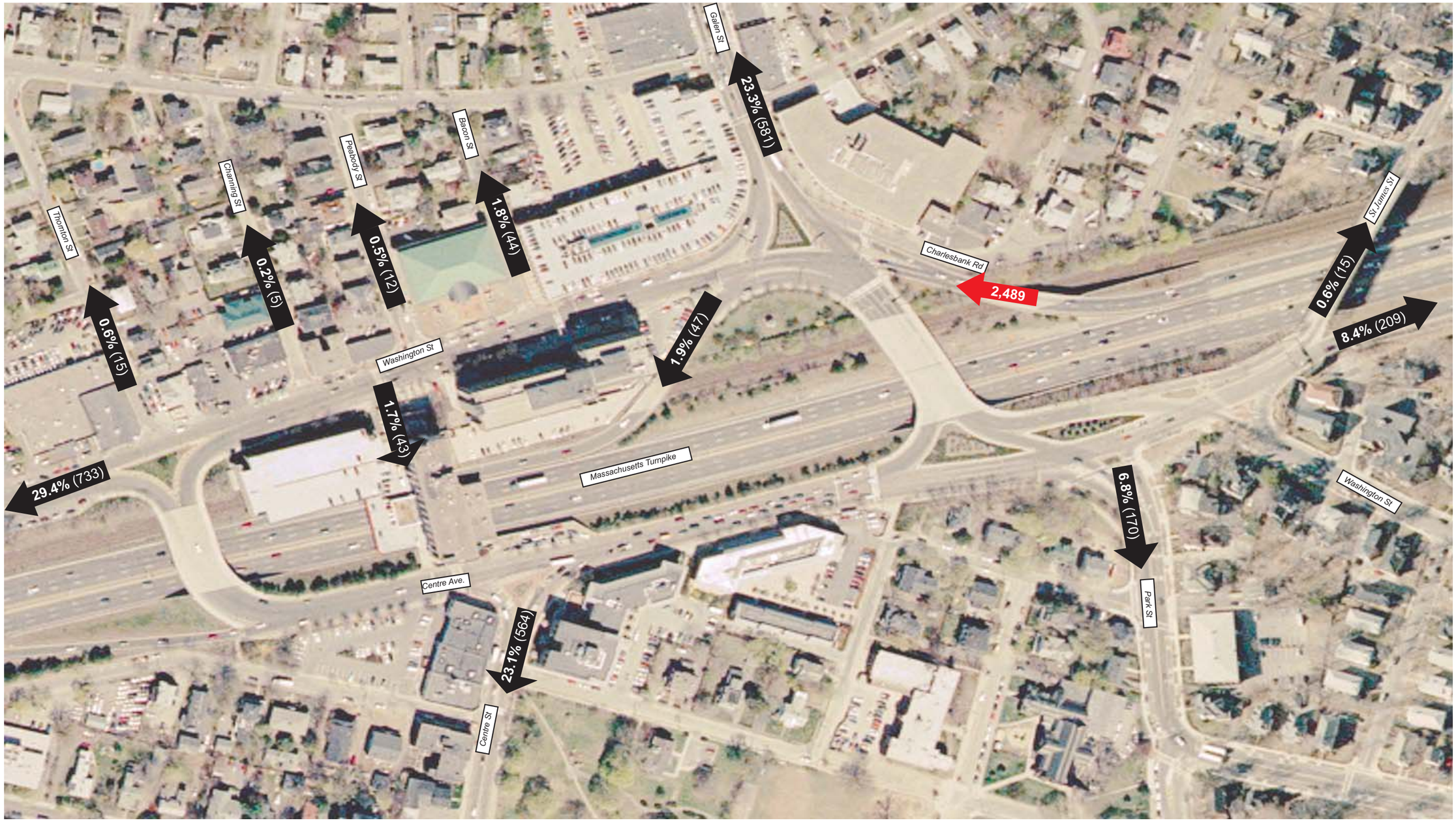
Entrance

Exit

**FIGURE A-7**
**Vehicle Destinations from**
**St. James Street Southbound**
**(7:00 to 9:00 AM)**

N

*I-90 Interchange 17:*
*Traffic Patterns and*
*Operational Improvements*




CTPS

Entrance

Exit

**FIGURE A-8**
**Vehicle Destinations from**
**MassPike Westbound Off-Ramp**
**(7:00 to 9:00 AM)**

N

*I-90 Interchange 17:*
*Traffic Patterns and*
*Operational Improvements*


CTPS

Entrance

Exit

**FIGURE A-9**
**Vehicle Destinations from**
**Centre Street (Galen) Southbound**
**(7:00 to 9:00 AM)**

N

*I-90 Interchange 17:*
*Traffic Patterns and*
*Operational Improvements*


CTPS

Entrance

Exit

**FIGURE A-10**
**Vehicle Destinations from Washington Street Eastbound (7:00 to 9:00 AM)**

N

*I-90 Interchange 17: Traffic Patterns and Operational Improvements*


CTPS

*Does not include vehicles
also seen northbound on Centre Street

**FIGURE A-11**
**Vehicle Origins to**
**Centre Street Southbound**
**(7:00 to 9:00 AM)**

N

*I-90 Interchange 17:*
*Traffic Patterns and*
*Operational Improvements*


CTPS

*Does not include vehicles also seen northbound on Park Street

**FIGURE A-12**
**Vehicle Origins to Park Street Southbound**

N

*I-90 Interchange 17: Traffic Patterns and Operational Improvements*


CTPS

*Does not include vehicles also seen on westbound off ramp

**FIGURE A-13**
**Vehicle Origins to MassPike EB**
**(7:00 to 9:00 AM)**

N

*I-90 Interchange 17: Traffic Patterns and Operational Improvements*


CTPS

*Does not include vehicles also seen southbound on St. James

**FIGURE A-14**
**Vehicle Origins to**
**St. James Street Northbound**
**(7:00 to 9:00 AM)**

N

*I-90 Interchange 17: Traffic Patterns and Operational Improvements*


CTPS

*Does not include vehicles also seen on westbound off-ramp

**FIGURE A-15**
**Vehicle Origins to MassPike Westbound (7:00 to 9:00 AM)**

N

*I-90 Interchange 17: Traffic Patterns and Operational Improvements*


CTPS

*Does not include vehicles also seen southbound on Centre Street

**FIGURE A-16**
**Vehicle Origins to Centre/Galen Street Northbound (7:00 to 9:00 AM)**

N

*I-90 Interchange 17: Traffic Patterns and Operational Improvements*


CTPS

*Does not include vehicles also seen eastbound on Washington Street

**FIGURE A-17**
**Vehicle Origins to**
**Washington Street Westbound**
**(7:00 to 9:00 AM)**

N

*I-90 Interchange 17:*
*Traffic Patterns and*
*Operational Improvements*

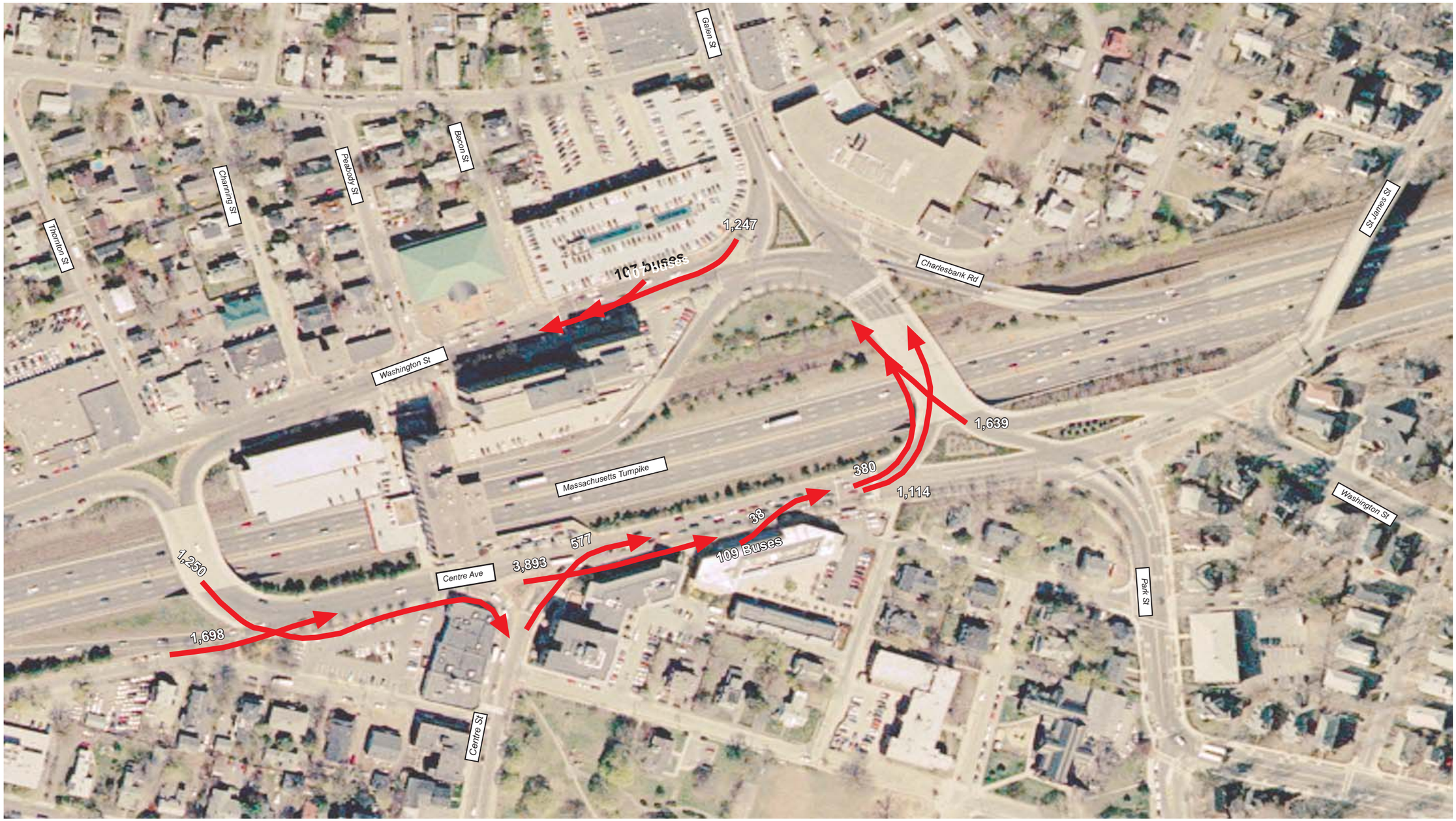



**FIGURE A-18**
**Weaving Areas**
**(7:00 to 9:00 AM)**

CTPS

N

*I-90 Interchange 17:*
*Traffic Patterns and*
*Operational Improvements*

# APPENDIX 2
# COMMUNITIES IN WHICH VEHICLES ARE GARAGED

**Origins of Vehicles Observed at the MassPike Eastbound Off-Ramp**

| Community | Vehicles | % Total | Community | Vehicles | % Total | Community | Vehicles | % Total |
|---|---|---|---|---|---|---|---|---|
| Framingham | 213 | 12% | Woburn | 8 | 0% | Acushnet | 2 | 0% |
| Newton | 117 | 6% | Wrentham | 8 | 0% | Adams | 2 | 0% |
| Out of State | 110 | 6% | Arlington | 6 | 0% | Amherst | 2 | 0% |
| Boston | 94 | 5% | Attleboro | 6 | 0% | Athol | 2 | 0% |
| Natick | 91 | 5% | Auburn | 6 | 0% | Berlin | 2 | 0% |
| Wellesley | 77 | 4% | Bellingham | 6 | 0% | Braintree | 2 | 0% |
| Ashland | 62 | 3% | Belmont | 6 | 0% | Brookfield | 2 | 0% |
| Hopkinton | 45 | 2% | Blackstone | 6 | 0% | Carver | 2 | 0% |
| Milford | 40 | 2% | Lowell | 6 | 0% | E.Bridgewater | 2 | 0% |
| Worcester | 40 | 2% | Maynard | 6 | 0% | E.Brookfield | 2 | 0% |
| Marlborough | 35 | 2% | Medford | 6 | 0% | Everett | 2 | 0% |
| Shrewsbury | 34 | 2% | Norfolk | 6 | 0% | Granville | 2 | 0% |
| Wayland | 34 | 2% | Peabody | 6 | 0% | Halifax | 2 | 0% |
| Needham | 29 | 2% | Sharon | 6 | 0% | Haverhill | 2 | 0% |
| Westborough | 29 | 2% | Webster | 6 | 0% | Hingham | 2 | 0% |
| Upton | 27 | 1% | Billerica | 5 | 0% | Holbrook | 2 | 0% |
| Watertown | 27 | 1% | Burlington | 5 | 0% | Hull | 2 | 0% |
| Weston | 24 | 1% | Charlton | 5 | 0% | Lakeville | 2 | 0% |
| Southborough | 22 | 1% | Douglas | 5 | 0% | Lenox | 2 | 0% |
| Mansfield | 21 | 1% | Dover | 5 | 0% | Littleton | 2 | 0% |
| Sudbury | 21 | 1% | Leominster | 5 | 0% | Ludlow | 2 | 0% |
| Waltham | 21 | 1% | Milton | 5 | 0% | Malden | 2 | 0% |
| Franklin | 18 | 1% | Quincy | 5 | 0% | Marshfield | 2 | 0% |
| Holliston | 18 | 1% | Randolph | 5 | 0% | Mashpee | 2 | 0% |
| Medfield | 18 | 1% | Weymouth | 5 | 0% | New Bedford | 2 | 0% |
| Northborough | 18 | 1% | Agawam | 3 | 0% | Newburyport | 2 | 0% |
| Grafton | 16 | 1% | Bedford | 3 | 0% | Northampton | 2 | 0% |
| Millbury | 16 | 1% | Boylston | 3 | 0% | Paxton | 2 | 0% |
| Norwood | 16 | 1% | Carlisle | 3 | 0% | Pembroke | 2 | 0% |
| Canton | 14 | 1% | Chelmsford | 3 | 0% | Pepperell | 2 | 0% |
| Easton | 13 | 1% | Clinton | 3 | 0% | Plainville | 2 | 0% |
| Hudson | 13 | 1% | Concord | 3 | 0% | Plymouth | 2 | 0% |
| Northbridge | 13 | 1% | Fitchburg | 3 | 0% | Reading | 2 | 0% |
| Somerville | 13 | 1% | Foxborough | 3 | 0% | Rehoboth | 2 | 0% |
| Stoughton | 13 | 1% | Harvard | 3 | 0% | Salisbury | 2 | 0% |
| Sutton | 13 | 1% | Holden | 3 | 0% | Seekonk | 2 | 0% |
| Walpole | 13 | 1% | Leicester | 3 | 0% | Southbridge | 2 | 0% |
| Brookline | 11 | 1% | Lexington | 3 | 0% | Spencer | 2 | 0% |
| Westwood | 11 | 1% | Lincoln | 3 | 0% | Stow | 2 | 0% |
| Unmatchable | 11 | 1% | Melrose | 3 | 0% | Tyngsborough | 2 | 0% |
| Norton | 10 | 1% | North Attleboro | 3 | 0% | Uxbridge | 2 | 0% |
| Oxford | 10 | 1% | Princeton | 3 | 0% | Wakefield | 2 | 0% |
| Brockton | 8 | 0% | Sherborn | 3 | 0% | West Brookfield | 2 | 0% |
| Cambridge | 8 | 0% | Stoneham | 3 | 0% | Westport | 2 | 0% |
| Dedham | 8 | 0% | Taunton | 3 | 0% | Whately | 2 | 0% |
| Hopedale | 8 | 0% | Tewksbury | 3 | 0% | Winchendon | 2 | 0% |
| Medway | 8 | 0% | Westford | 3 | 0% | Winchester | 2 | 0% |
| Mendon | 8 | 0% | Abington | 2 | 0% | Winthrop | 2 | 0% |
| Millis | 8 | 0% | Acton | 2 | 0% | **Total** | **1,839** | **100%** |

**Origins of Vehicles Observed Southbound on Centre Street (at Centre Avenue)**

| Community | Vehicles | % Total | Community | Vehicles | % Total | Community | Vehicles | % Total |
|---|---|---|---|---|---|---|---|---|
| Boston | 245 | 18% | Auburn | 4 | 0% | Hudson | 2 | 0% |
| Newton | 145 | 10% | Canton | 4 | 0% | Leominster | 2 | 0% |
| Watertown | 106 | 8% | Carlisle | 4 | 0% | Lowell | 2 | 0% |
| Cambridge | 100 | 7% | Concord | 4 | 0% | Mansfield | 2 | 0% |
| Belmont | 64 | 5% | Dedham | 4 | 0% | Medway | 2 | 0% |
| Out of State | 61 | 4% | Hull | 4 | 0% | Methuen | 2 | 0% |
| Somerville | 41 | 3% | Medfield | 4 | 0% | New Bedford | 2 | 0% |
| Waltham | 41 | 3% | Melrose | 4 | 0% | Northbridge | 2 | 0% |
| Arlington | 23 | 2% | Millis | 4 | 0% | Oxford | 2 | 0% |
| Medford | 23 | 2% | Milton | 4 | 0% | Plainville | 2 | 0% |
| Malden | 21 | 2% | Newbury | 4 | 0% | Princeton | 2 | 0% |
| Brookline | 19 | 1% | Northborough | 4 | 0% | Raynham | 2 | 0% |
| Framingham | 15 | 1% | Randolph | 4 | 0% | Rockland | 2 | 0% |
| Worcester | 15 | 1% | Salem | 4 | 0% | Sharon | 2 | 0% |
| Quincy | 14 | 1% | Saugus | 4 | 0% | Southwick | 2 | 0% |
| Winthrop | 14 | 1% | Scituate | 4 | 0% | Stoneham | 2 | 0% |
| Everett | 12 | 1% | Southborough | 4 | 0% | Truro | 2 | 0% |
| Lynn | 12 | 1% | Tewksbury | 4 | 0% | Tyngsborough | 2 | 0% |
| Needham | 12 | 1% | Wellesley | 4 | 0% | Uxbridge | 2 | 0% |
| Shrewsbury | 12 | 1% | Woburn | 4 | 0% | Ware | 2 | 0% |
| Plymouth | 10 | 1% | Amherst | 2 | 0% | Wareham | 2 | 0% |
| Westborough | 10 | 1% | Ashby | 2 | 0% | Wellfleet | 2 | 0% |
| Weymouth | 10 | 1% | Bedford | 2 | 0% | Wenham | 2 | 0% |
| Winchester | 10 | 1% | Bellingham | 2 | 0% | West Boylston | 2 | 0% |
| Barnstable | 8 | 1% | Beverly | 2 | 0% | West Springfield | 2 | 0% |
| Brockton | 8 | 1% | Billerica | 2 | 0% | Westfield | 2 | 0% |
| Chelsea | 8 | 1% | Braintree | 2 | 0% | Westport | 2 | 0% |
| Lexington | 8 | 1% | Brewster | 2 | 0% | Williamsburg | 2 | 0% |
| Marlborough | 8 | 1% | Chelmsford | 2 | 0% | Winchendon | 2 | 0% |
| Natick | 8 | 1% | Cohasset | 2 | 0% | Wrentham | 2 | 0% |
| Peabody | 8 | 1% | Dennis | 2 | 0% | Yarmouth | 2 | 0% |
| Sudbury | 8 | 1% | Dover | 2 | 0% | **Total** | **1385** | **100%** |
| MBTA | 6 | 0% | Duxbury | 2 | 0% | | | |
| Ashland | 6 | 0% | East Bridgewater | 2 | 0% | | | |
| Clinton | 6 | 0% | East Brookfield | 2 | 0% | | | |
| Marblehead | 6 | 0% | Fall River | 2 | 0% | | | |
| Mattapoisett | 6 | 0% | Falmouth | 2 | 0% | | | |
| Milford | 6 | 0% | Fitchburg | 2 | 0% | | | |
| Norwood | 6 | 0% | Foxborough | 2 | 0% | | | |
| Reading | 6 | 0% | Franklin | 2 | 0% | | | |
| Revere | 6 | 0% | Freetown | 2 | 0% | | | |
| Springfield | 6 | 0% | Grafton | 2 | 0% | | | |
| Swampscott | 6 | 0% | Halifax | 2 | 0% | | | |
| Upton | 6 | 0% | Hanover | 2 | 0% | | | |
| Wayland | 6 | 0% | Harwich | 2 | 0% | | | |
| Weston | 6 | 0% | Haverhill | 2 | 0% | | | |
| Westwood | 6 | 0% | Holden | 2 | 0% | | | |
| Wilmington | 6 | 0% | Holliston | 2 | 0% | | | |
| Attleboro | 4 | 0% | Hopkinton | 2 | 0% | | | |

**Origins of Vehicles Observed Northbound on Centre Street (at Centre Avenue)**

| Community | Vehicles | % Total | Community | Vehicles | % Total | Community | Vehicles | % Total |
|---|---|---|---|---|---|---|---|---|
| Newton | 606 | 38% | Norfolk | 9 | 1% | Haverhill | 5 | 0% |
| Boston | 147 | 9% | Randolph | 9 | 1% | Holliston | 5 | 0% |
| Needham | 128 | 8% | Somerville | 9 | 1% | Kingston | 5 | 0% |
| Brookline | 66 | 4% | South Hadley | 9 | 1% | Lynnfield | 5 | 0% |
| Quincy | 38 | 2% | Waltham | 9 | 1% | Mansfield | 5 | 0% |
| Watertown | 28 | 2% | Weston | 9 | 1% | Marlborough | 5 | 0% |
| Cambridge | 24 | 1% | Weymouth | 9 | 1% | Mattapoisett | 5 | 0% |
| Westwood | 19 | 1% | Winchester | 9 | 1% | Melrose | 5 | 0% |
| Canton | 14 | 1% | Wrentham | 9 | 1% | Methuen | 5 | 0% |
| Dover | 14 | 1% | MBTA | 5 | 0% | Milford | 5 | 0% |
| Lynn | 14 | 1% | Acushnet | 5 | 0% | North Andover | 5 | 0% |
| Medford | 14 | 1% | Athol | 5 | 0% | North Attleboro | 5 | 0% |
| Milton | 14 | 1% | Attleboro | 5 | 0% | Revere | 5 | 0% |
| Norwood | 14 | 1% | Braintree | 5 | 0% | Scituate | 5 | 0% |
| Worcester | 14 | 1% | Burlington | 5 | 0% | Seekonk | 5 | 0% |
| Arlington | 9 | 1% | Carlisle | 5 | 0% | Southbridge | 5 | 0% |
| Belmont | 9 | 1% | Chatham | 5 | 0% | Sudbury | 5 | 0% |
| Brockton | 9 | 1% | Clarksburg | 5 | 0% | Tewksbury | 5 | 0% |
| Danvers | 9 | 1% | Dedham | 5 | 0% | Topsfield | 5 | 0% |
| Foxborough | 9 | 1% | Dennis | 5 | 0% | Truro | 5 | 0% |
| Framingham | 9 | 1% | E. Longmeadow | 5 | 0% | Wakefield | 5 | 0% |
| Harwich | 9 | 1% | Everett | 5 | 0% | Walpole | 5 | 0% |
| Holyoke | 9 | 1% | Fairhaven | 5 | 0% | Wayland | 5 | 0% |
| Lexington | 9 | 1% | Fall River | 5 | 0% | Wellesley | 5 | 0% |
| Malden | 9 | 1% | Falmouth | 5 | 0% | W. Bridgewater | 5 | 0% |
| Manchester | 9 | 1% | Fitchburg | 5 | 0% | Winthrop | 5 | 0% |
| Marshfield | 9 | 1% | Franklin | 5 | 0% | Out of State | 3 | 0% |
| Medfield | 9 | 1% | Gardner | 5 | 0% | Unmatchable | 1 | 0% |
| Medway | 9 | 1% | Harvard | 5 | 0% | **Total** | **1595** | **100%** |

**Origins of Vehicles Observed Southbound on Park Centre Street (at Centre Avenue)**

| Community | Vehicles | % Total | Community | Vehicles | % Total | Community | Vehicles | % Total |
|---|---|---|---|---|---|---|---|---|
| Newton | 170 | 19% | Westwood | 4 | 0% | Weymouth | 2 | 0% |
| Boston | 132 | 14% | Winthrop | 4 | 0% | Wilmington | 2 | 0% |
| Framingham | 61 | 7% | Acushnet | 2 | 0% | Winchester | 2 | 0% |
| Waltham | 58 | 6% | Adams | 2 | 0% | Yarmouth | 2 | 0% |
| Out of State | 52 | 6% | Agawam | 2 | 0% | **Total** | **918** | **100%** |
| Watertown | 25 | 3% | Auburn | 2 | 0% | | | |
| MBTA | 24 | 3% | Bellingham | 2 | 0% | | | |
| Cambridge | 16 | 2% | Berlin | 2 | 0% | | | |
| Somerville | 16 | 2% | Billerica | 2 | 0% | | | |
| Brookline | 14 | 2% | Braintree | 2 | 0% | | | |
| Natick | 14 | 2% | Brookfield | 2 | 0% | | | |
| Wayland | 13 | 1% | Burlington | 2 | 0% | | | |
| Worcester | 13 | 1% | Canton | 2 | 0% | | | |
| Quincy | 11 | 1% | Chelmsford | 2 | 0% | | | |
| Westborough | 11 | 1% | Dedham | 2 | 0% | | | |
| Weston | 11 | 1% | Duxbury | 2 | 0% | | | |
| Ashland | 9 | 1% | East Brookfield | 2 | 0% | | | |
| Belmont | 9 | 1% | Fitchburg | 2 | 0% | | | |
| Lexington | 9 | 1% | Foxborough | 2 | 0% | | | |
| Norwood | 9 | 1% | Franklin | 2 | 0% | | | |
| Arlington | 7 | 1% | Grafton | 2 | 0% | | | |
| Milford | 7 | 1% | Groton | 2 | 0% | | | |
| Needham | 7 | 1% | Hamilton | 2 | 0% | | | |
| Wellesley | 7 | 1% | Haverhill | 2 | 0% | | | |
| Chelsea | 5 | 1% | Longmeadow | 2 | 0% | | | |
| Everett | 5 | 1% | Malden | 2 | 0% | | | |
| Holliston | 5 | 1% | Manchester | 2 | 0% | | | |
| Hudson | 5 | 1% | Maynard | 2 | 0% | | | |
| Lowell | 5 | 1% | Medway | 2 | 0% | | | |
| Lynn | 5 | 1% | Melrose | 2 | 0% | | | |
| Millis | 5 | 1% | Millbury | 2 | 0% | | | |
| Northbridge | 5 | 1% | Milton | 2 | 0% | | | |
| Peabody | 5 | 1% | Nantucket | 2 | 0% | | | |
| Sharon | 5 | 1% | Northborough | 2 | 0% | | | |
| Shrewsbury | 5 | 1% | Norton | 2 | 0% | | | |
| Southborough | 5 | 1% | Pepperell | 2 | 0% | | | |
| Beverly | 4 | 0% | Plymouth | 2 | 0% | | | |
| Boylston | 4 | 0% | Princeton | 2 | 0% | | | |
| Clinton | 4 | 0% | Reading | 2 | 0% | | | |
| Hopedale | 4 | 0% | Rehoboth | 2 | 0% | | | |
| Hopkinton | 4 | 0% | Saugus | 2 | 0% | | | |
| Marlborough | 4 | 0% | Stoughton | 2 | 0% | | | |
| Medford | 4 | 0% | Swampscott | 2 | 0% | | | |
| North Attleboro | 4 | 0% | Tewksbury | 2 | 0% | | | |
| Paxton | 4 | 0% | unknown | 2 | 0% | | | |
| Revere | 4 | 0% | Upton | 2 | 0% | | | |
| Sudbury | 4 | 0% | Wareham | 2 | 0% | | | |
| Webster | 4 | 0% | West Springfield | 2 | 0% | | | |
| Westford | 4 | 0% | Westminster | 2 | 0% | | | |

**Origins of Vehicles Observed Northbound on Park Centre Street (at Centre Avenue)**

| Community | Vehicles | % Total | Community | Vehicles | % Total | Community | Vehicles | % Total |
|---|---|---|---|---|---|---|---|---|
| Newton | 398 | 30% | Burlington | 3 | 0% | Wrentham | 3 | 0% |
| Boston | 271 | 20% | Carlisle | 3 | 0% | Yarmouth | 3 | 0% |
| Brookline | 61 | 5% | Carver | 3 | 0% | **Total** | **1,328** | **100%** |
| Out of State | 51 | 4% | Charlton | 3 | 0% | | | |
| MBTA | 33 | 2% | Chelmsford | 3 | 0% | | | |
| Cambridge | 21 | 2% | Chelsea | 3 | 0% | | | |
| Brockton | 18 | 1% | Dover | 3 | 0% | | | |
| Framingham | 18 | 1% | Foxborough | 3 | 0% | | | |
| Needham | 18 | 1% | Greenfield | 3 | 0% | | | |
| Franklin | 12 | 1% | Hamilton | 3 | 0% | | | |
| Quincy | 12 | 1% | Holliston | 3 | 0% | | | |
| Winchester | 12 | 1% | Holyoke | 3 | 0% | | | |
| Worcester | 12 | 1% | Hopkinton | 3 | 0% | | | |
| Arlington | 9 | 1% | Leominster | 3 | 0% | | | |
| Belmont | 9 | 1% | Longmeadow | 3 | 0% | | | |
| Billerica | 9 | 1% | Lynn | 3 | 0% | | | |
| Braintree | 9 | 1% | Marlborough | 3 | 0% | | | |
| Easton | 9 | 1% | Mattapoisett | 3 | 0% | | | |
| Lowell | 9 | 1% | Medfield | 3 | 0% | | | |
| Milton | 9 | 1% | Melrose | 3 | 0% | | | |
| Natick | 9 | 1% | Merrimac | 3 | 0% | | | |
| Plymouth | 9 | 1% | Milford | 3 | 0% | | | |
| Saugus | 9 | 1% | Nantucket | 3 | 0% | | | |
| Sharon | 9 | 1% | New Bedford | 3 | 0% | | | |
| Somerville | 9 | 1% | North Adams | 3 | 0% | | | |
| Tyngsborough | 9 | 1% | Northbridge | 3 | 0% | | | |
| Wayland | 9 | 1% | Norwell | 3 | 0% | | | |
| Beverly | 6 | 0% | Norwood | 3 | 0% | | | |
| Fairhaven | 6 | 0% | Oxford | 3 | 0% | | | |
| Falmouth | 6 | 0% | Peabody | 3 | 0% | | | |
| Granby | 6 | 0% | Randolph | 3 | 0% | | | |
| Hudson | 6 | 0% | Reading | 3 | 0% | | | |
| Malden | 6 | 0% | Rochester | 3 | 0% | | | |
| Marshfield | 6 | 0% | Rockland | 3 | 0% | | | |
| Methuen | 6 | 0% | Sherborn | 3 | 0% | | | |
| North Attleboro | 6 | 0% | Southampton | 3 | 0% | | | |
| Plainville | 6 | 0% | Southborough | 3 | 0% | | | |
| Stoughton | 6 | 0% | Southbridge | 3 | 0% | | | |
| Wakefield | 6 | 0% | Taunton | 3 | 0% | | | |
| Waltham | 6 | 0% | Truro | 3 | 0% | | | |
| Acton | 3 | 0% | Wellesley | 3 | 0% | | | |
| Amherst | 3 | 0% | Westfield | 3 | 0% | | | |
| Ashland | 3 | 0% | Westford | 3 | 0% | | | |
| Attleboro | 3 | 0% | Weston | 3 | 0% | | | |
| Avon | 3 | 0% | Westwood | 3 | 0% | | | |
| Ayer | 3 | 0% | Weymouth | 3 | 0% | | | |
| Barnstable | 3 | 0% | Wilbraham | 3 | 0% | | | |
| Blackstone | 3 | 0% | Wilmington | 3 | 0% | | | |
| Brewster | 3 | 0% | Woburn | 3 | 0% | | | |

**Origins of Vehicles Observed Southbound on Washington Street**

| Community | Vehicles | % Total |
|---|---|---|
| Newton | 580 | 31% |
| Boston | 548 | 29% |
| Brookline | 128 | 7% |
| Out of State | 68 | 4% |
| Needham | 42 | 2% |
| Watertown | 36 | 2% |
| Waltham | 34 | 2% |
| Framingham | 20 | 1% |
| Worcester | 16 | 1% |
| Natick | 14 | 1% |
| Somerville | 14 | 1% |
| Ashland | 12 | 1% |
| Belmont | 12 | 1% |
| Cambridge | 12 | 1% |
| Dedham | 12 | 1% |
| Medford | 10 | 1% |
| Brockton | 8 | 0% |
| Quincy | 8 | 0% |
| Other Unmatcha | 7 | 0% |
| Arlington | 6 | 0% |
| Braintree | 6 | 0% |
| Canton | 6 | 0% |
| Chelsea | 6 | 0% |
| Fall River | 6 | 0% |
| Mansfield | 6 | 0% |
| Milford | 6 | 0% |
| Milton | 6 | 0% |
| Norwood | 6 | 0% |
| Randolph | 6 | 0% |
| Scituate | 6 | 0% |
| Taunton | 6 | 0% |
| Walpole | 6 | 0% |
| Wayland | 6 | 0% |
| Wellesley | 6 | 0% |
| Weston | 6 | 0% |
| Westwood | 6 | 0% |
| Weymouth | 6 | 0% |
| Woburn | 6 | 0% |
| Amherst | 4 | 0% |
| Bridgewater | 4 | 0% |
| Cohasset | 4 | 0% |
| Dover | 4 | 0% |
| Easton | 4 | 0% |
| Holliston | 4 | 0% |
| Lexington | 4 | 0% |
| Medfield | 4 | 0% |
| Medway | 4 | 0% |
| North Attleboro | 4 | 0% |
| Northborough | 4 | 0% |
| Plymouth | 4 | 0% |
| Southborough | 4 | 0% |
| Stow | 4 | 0% |
| West Boylston | 4 | 0% |
| Acton | 2 | 0% |
| Acushnet | 2 | 0% |
| Agawam | 2 | 0% |
| Attleboro | 2 | 0% |
| Auburn | 2 | 0% |
| Bedford | 2 | 0% |
| Belchertown | 2 | 0% |
| Blackstone | 2 | 0% |
| Burlington | 2 | 0% |
| Chicopee | 2 | 0% |
| Clinton | 2 | 0% |
| Danvers | 2 | 0% |
| Egremont | 2 | 0% |
| Everett | 2 | 0% |
| Falmouth | 2 | 0% |
| Gloucester | 2 | 0% |
| Grafton | 2 | 0% |
| Hanover | 2 | 0% |
| Hingham | 2 | 0% |
| Holbrook | 2 | 0% |
| Hudson | 2 | 0% |
| Huntington | 2 | 0% |
| Kingston | 2 | 0% |
| Lawrence | 2 | 0% |
| Leominster | 2 | 0% |
| Lowell | 2 | 0% |
| Lynn | 2 | 0% |
| Malden | 2 | 0% |
| Mashpee | 2 | 0% |
| Melrose | 2 | 0% |
| Millis | 2 | 0% |
| Nantucket | 2 | 0% |
| Norfolk | 2 | 0% |
| North Andover | 2 | 0% |
| Orange | 2 | 0% |
| Paxton | 2 | 0% |
| Peabody | 2 | 0% |
| Pembroke | 2 | 0% |
| Rehoboth | 2 | 0% |
| Revere | 2 | 0% |
| Rockland | 2 | 0% |
| Sandwich | 2 | 0% |
| Seekonk | 2 | 0% |
| Southwick | 2 | 0% |
| Springfield | 2 | 0% |
| Stoughton | 2 | 0% |
| Sturbridge | 2 | 0% |
| Sudbury | 2 | 0% |
| Sunderland | 2 | 0% |
| Swampscott | 2 | 0% |
| Tyngsborough | 2 | 0% |
| Upton | 2 | 0% |
| Wakefield | 2 | 0% |
| West Springfield | 2 | 0% |
| Westborough | 2 | 0% |
| Westfield | 2 | 0% |
| Westford | 2 | 0% |
| Wilmington | 2 | 0% |
| Winchendon | 2 | 0% |
| **Total** | **1872** | **100%** |

**Origins of Vehicles Observed on the MassPike Eastbound On-Ramp**

| Community | Vehicles | % Total | Community | Vehicles | % Total | Community | Vehicles | % Total |
|---|---|---|---|---|---|---|---|---|
| Newton | 1,330 | 40% | Upton | 6 | 0% | Hanover | 2 | 0% |
| Boston | 438 | 13% | Westford | 6 | 0% | Hanson | 2 | 0% |
| Waltham | 264 | 8% | Winchester | 6 | 0% | Harvard | 2 | 0% |
| Watertown | 209 | 6% | Woburn | 6 | 0% | Holyoke | 2 | 0% |
| Out of State | 122 | 4% | Worcester | 6 | 0% | Hopedale | 2 | 0% |
| Needham | 116 | 3% | Abington | 4 | 0% | Hopkinton | 2 | 0% |
| Brookline | 64 | 2% | Agawam | 4 | 0% | Hudson | 2 | 0% |
| Quincy | 35 | 1% | Beverly | 4 | 0% | Ipswich | 2 | 0% |
| Framingham | 29 | 1% | Billerica | 4 | 0% | Lawrence | 2 | 0% |
| Somerville | 27 | 1% | Boxborough | 4 | 0% | Lee | 2 | 0% |
| Belmont | 23 | 1% | Bridgewater | 4 | 0% | Leominster | 2 | 0% |
| Dedham | 23 | 1% | Dighton | 4 | 0% | Longmeadow | 2 | 0% |
| Cambridge | 21 | 1% | Holbrook | 4 | 0% | Lynnfield | 2 | 0% |
| Natick | 19 | 1% | Holliston | 4 | 0% | Marshfield | 2 | 0% |
| Canton | 17 | 1% | Lynn | 4 | 0% | Mattapoisett | 2 | 0% |
| Milton | 17 | 1% | Malden | 4 | 0% | Maynard | 2 | 0% |
| Wellesley | 17 | 1% | Mansfield | 4 | 0% | Middleborough | 2 | 0% |
| Arlington | 16 | 0% | Melrose | 4 | 0% | Millis | 2 | 0% |
| Weymouth | 16 | 0% | New Bedford | 4 | 0% | Nantucket | 2 | 0% |
| Lexington | 14 | 0% | Norfolk | 4 | 0% | Newburyport | 2 | 0% |
| Wayland | 14 | 0% | Pembroke | 4 | 0% | North Andover | 2 | 0% |
| Weston | 14 | 0% | Richmond | 4 | 0% | North Attleboro | 2 | 0% |
| Franklin | 12 | 0% | Saugus | 4 | 0% | North Reading | 2 | 0% |
| Marlborough | 12 | 0% | Sherborn | 4 | 0% | Northampton | 2 | 0% |
| Randolph | 12 | 0% | Shrewsbury | 4 | 0% | Northborough | 2 | 0% |
| Sudbury | 12 | 0% | Stoneham | 4 | 0% | Northbridge | 2 | 0% |
| Walpole | 12 | 0% | Wakefield | 4 | 0% | Norwell | 2 | 0% |
| Acton | 10 | 0% | Westborough | 4 | 0% | Pittsfield | 2 | 0% |
| Hingham | 10 | 0% | Winthrop | 4 | 0% | Princeton | 2 | 0% |
| Medfield | 10 | 0% | Attleboro | 2 | 0% | Provincetown | 2 | 0% |
| Medford | 10 | 0% | Ayer | 2 | 0% | Reading | 2 | 0% |
| Westwood | 10 | 0% | Bellingham | 2 | 0% | Rockland | 2 | 0% |
| Amherst | 8 | 0% | Bernardston | 2 | 0% | Rowley | 2 | 0% |
| Barnstable | 8 | 0% | Blackstone | 2 | 0% | Salem | 2 | 0% |
| Braintree | 8 | 0% | Bourne | 2 | 0% | Salisbury | 2 | 0% |
| Dover | 8 | 0% | Burlington | 2 | 0% | Sandwich | 2 | 0% |
| Norwood | 8 | 0% | Carlisle | 2 | 0% | Somerset | 2 | 0% |
| Plymouth | 8 | 0% | Cohasset | 2 | 0% | Southborough | 2 | 0% |
| Revere | 8 | 0% | Concord | 2 | 0% | Southbridge | 2 | 0% |
| Ashland | 6 | 0% | Dracut | 2 | 0% | Spencer | 2 | 0% |
| Chatham | 6 | 0% | East Bridgewater | 2 | 0% | Springfield | 2 | 0% |
| Chelsea | 6 | 0% | East Longmeadow | 2 | 0% | Stow | 2 | 0% |
| Everett | 6 | 0% | Fairhaven | 2 | 0% | Swampscott | 2 | 0% |
| Haverhill | 6 | 0% | Fall River | 2 | 0% | Taunton | 2 | 0% |
| Lincoln | 6 | 0% | Falmouth | 2 | 0% | Truro | 2 | 0% |
| Medway | 6 | 0% | Fitchburg | 2 | 0% | Tyngsborough | 2 | 0% |
| Milford | 6 | 0% | Foxborough | 2 | 0% | Webster | 2 | 0% |
| Scituate | 6 | 0% | Gloucester | 2 | 0% | Wenham | 2 | 0% |
| Stoughton | 6 | 0% | Groton | 2 | 0% | West Boylston | 2 | 0% |

**Origins of Vehicles Observed on the MassPike Eastbound On-Ramp (continued)**

| Community | Vehicles | % Total |
|---|---|---|
| Westminster | 2 | 0% |
| Wilbraham | 2 | 0% |
| Winchendon | 2 | 0% |
| Wrentham | 2 | 0% |
| Yarmouth | 2 | 0% |
| Total | 3,332 | 100% |

## Origins of Vehicles Observed on the MassPike Westbound Off-Ramp

| Community | Vehicles | % Total | Community | Vehicles | % Total | Community | Vehicles | % Total |
|---|---|---|---|---|---|---|---|---|
| Boston | 718 | 29% | Needham | 7 | 0% | Fairhaven | 2 | 0% |
| Newton | 220 | 9% | Northampton | 7 | 0% | Gloucester | 2 | 0% |
| Quincy | 139 | 6% | Reading | 7 | 0% | Hanson | 2 | 0% |
| Cambridge | 79 | 3% | Sudbury | 7 | 0% | Harwich | 2 | 0% |
| Amherst | 72 | 3% | Wellesley | 7 | 0% | Hinsdale | 2 | 0% |
| Waltham | 67 | 3% | Acton | 5 | 0% | Holbrook | 2 | 0% |
| Watertown | 56 | 2% | Ashland | 5 | 0% | Holliston | 2 | 0% |
| Brookline | 45 | 2% | Auburn | 5 | 0% | Hull | 2 | 0% |
| Revere | 45 | 2% | Barnstable | 5 | 0% | Ipswich | 2 | 0% |
| Winthrop | 44 | 2% | Chatham | 5 | 0% | Lawrence | 2 | 0% |
| Out of State | 43 | 2% | Clinton | 5 | 0% | Lee | 2 | 0% |
| MBTA | 43 | 2% | Danvers | 5 | 0% | Leicester | 2 | 0% |
| Medford | 34 | 1% | Fall River | 5 | 0% | Leominster | 2 | 0% |
| Everett | 31 | 1% | Franklin | 5 | 0% | Lincoln | 2 | 0% |
| Malden | 31 | 1% | Hanover | 5 | 0% | Lowell | 2 | 0% |
| Chelsea | 29 | 1% | Haverhill | 5 | 0% | Mansfield | 2 | 0% |
| Braintree | 26 | 1% | Lynnfield | 5 | 0% | Marlborough | 2 | 0% |
| Lynn | 26 | 1% | Middleborough | 5 | 0% | Marshfield | 2 | 0% |
| Milton | 26 | 1% | Milford | 5 | 0% | Medfield | 2 | 0% |
| Somerville | 26 | 1% | New Bedford | 5 | 0% | Medway | 2 | 0% |
| Weymouth | 24 | 1% | North Reading | 5 | 0% | Millbury | 2 | 0% |
| Brockton | 22 | 1% | Northborough | 5 | 0% | Montague | 2 | 0% |
| Marblehead | 22 | 1% | Norwood | 5 | 0% | Nantucket | 2 | 0% |
| Randolph | 22 | 1% | Pembroke | 5 | 0% | Newburyport | 2 | 0% |
| Saugus | 22 | 1% | Rockport | 5 | 0% | North Andover | 2 | 0% |
| Swampscott | 22 | 1% | Sandwich | 5 | 0% | Norton | 2 | 0% |
| Arlington | 19 | 1% | Sharon | 5 | 0% | Princeton | 2 | 0% |
| Belmont | 15 | 1% | Sterling | 5 | 0% | Raynham | 2 | 0% |
| Framingham | 14 | 1% | Tewksbury | 5 | 0% | Rockland | 2 | 0% |
| Plymouth | 14 | 1% | Walpole | 5 | 0% | Seekonk | 2 | 0% |
| Salem | 14 | 1% | Wayland | 5 | 0% | Shrewsbury | 2 | 0% |
| Worcester | 14 | 1% | West Springfield | 5 | 0% | Southborough | 2 | 0% |
| Beverly | 13 | 1% | Westborough | 5 | 0% | Southwick | 2 | 0% |
| Peabody | 12 | 0% | Weston | 5 | 0% | Springfield | 2 | 0% |
| Winchester | 12 | 0% | Westwood | 5 | 0% | Stoughton | 2 | 0% |
| Woburn | 12 | 0% | Wilmington | 5 | 0% | Swansea | 2 | 0% |
| Easton | 10 | 0% | Attleboro | 3 | 0% | Taunton | 2 | 0% |
| Melrose | 10 | 0% | Bellingham | 3 | 0% | Templeton | 2 | 0% |
| Natick | 10 | 0% | Billerica | 3 | 0% | unknown | 2 | 0% |
| Norwell | 10 | 0% | Boxborough | 3 | 0% | Wakefield | 2 | 0% |
| Scituate | 10 | 0% | Abington | 2 | 0% | Wareham | 2 | 0% |
| Stoneham | 10 | 0% | Boxford | 2 | 0% | West Boylston | 2 | 0% |
| Othr Unmatchab | 10 | 0% | Boylston | 2 | 0% | Westfield | 2 | 0% |
| Chelmsford | 7 | 0% | Brewster | 2 | 0% | Yarmouth | 2 | 0% |
| Concord | 7 | 0% | Cohasset | 2 | 0% | **Total** | **2,489** | **100%** |
| Dedham | 7 | 0% | Dover | 2 | 0% | | | |
| Duxbury | 7 | 0% | Dudley | 2 | 0% | | | |
| Hingham | 7 | 0% | Easthampton | 2 | 0% | | | |
| Lexington | 7 | 0% | Egremont | 2 | 0% | | | |

**Origins of Vehicles Observed on St James Street North of the MassPike**

| Community | Vehicles | % Total | Community | Vehicles | % Total | Community | Vehicles | % Total |
|---|---|---|---|---|---|---|---|---|
| Cambridge | 195 | 21% | Braintree | 2 | 0% | | | |
| Boston | 128 | 14% | Burlington | 2 | 0% | | | |
| Newton | 102 | 11% | Dennis | 2 | 0% | | | |
| Somerville | 67 | 7% | Dracut | 2 | 0% | | | |
| Watertown | 67 | 7% | East Bridgewater | 2 | 0% | | | |
| Out of State | 49 | 5% | Falmouth | 2 | 0% | | | |
| Brookline | 26 | 3% | Gardner | 2 | 0% | | | |
| Waltham | 19 | 2% | Gloucester | 2 | 0% | | | |
| Malden | 17 | 2% | Groton | 2 | 0% | | | |
| Revere | 13 | 1% | Halifax | 2 | 0% | | | |
| Belmont | 11 | 1% | Holliston | 2 | 0% | | | |
| Medford | 11 | 1% | Lawrence | 2 | 0% | | | |
| Arlington | 7 | 1% | Lynnfield | 2 | 0% | | | |
| Everett | 7 | 1% | Medfield | 2 | 0% | | | |
| Framingham | 7 | 1% | Mendon | 2 | 0% | | | |
| Sudbury | 7 | 1% | Norfolk | 2 | 0% | | | |
| Worcester | 7 | 1% | Norwell | 2 | 0% | | | |
| Chelsea | 6 | 1% | Pepperell | 2 | 0% | | | |
| Needham | 6 | 1% | Plymouth | 2 | 0% | | | |
| Norwood | 6 | 1% | Rehoboth | 2 | 0% | | | |
| Quincy | 6 | 1% | Rockport | 2 | 0% | | | |
| Saugus | 6 | 1% | Rutland | 2 | 0% | | | |
| Wayland | 6 | 1% | Scituate | 2 | 0% | | | |
| Wellesley | 6 | 1% | Sherborn | 2 | 0% | | | |
| Dedham | 4 | 0% | Southbridge | 2 | 0% | | | |
| Dover | 4 | 0% | Springfield | 2 | 0% | | | |
| Franklin | 4 | 0% | Stoneham | 2 | 0% | | | |
| Holbrook | 4 | 0% | Swansea | 2 | 0% | | | |
| Lexington | 4 | 0% | Taunton | 2 | 0% | | | |
| Lynn | 4 | 0% | Tewksbury | 2 | 0% | | | |
| Marion | 4 | 0% | Tyngsborough | 2 | 0% | | | |
| Marlborough | 4 | 0% | Wakefield | 2 | 0% | | | |
| Melrose | 4 | 0% | Walpole | 2 | 0% | | | |
| Natick | 4 | 0% | West Boylston | 2 | 0% | | | |
| North Attleboro | 4 | 0% | Westborough | 2 | 0% | | | |
| North Reading | 4 | 0% | Westfield | 2 | 0% | | | |
| Peabody | 4 | 0% | Wilbraham | 2 | 0% | | | |
| Randolph | 4 | 0% | Winchester | 2 | 0% | | | |
| Stow | 4 | 0% | Woburn | 2 | 0% | | | |
| Weston | 4 | 0% | **Total** | **931** | **100%** | | | |
| Wilmington | 4 | 0% | | | | | | |
| Acton | 2 | 0% | | | | | | |
| Ashby | 2 | 0% | | | | | | |
| Ashland | 2 | 0% | | | | | | |
| Attleboro | 2 | 0% | | | | | | |
| Barnstable | 2 | 0% | | | | | | |
| Bedford | 2 | 0% | | | | | | |
| Berkley | 2 | 0% | | | | | | |
| Beverly | 2 | 0% | | | | | | |

**Origins of Vehicles Observed on Charlesbank Road at Centre Street**

| Community | Vehicles | % Total |
|---|---|---|
| Boston | 6 | 13% |
| Needham | 6 | 13% |
| Newton | 22 | 53% |
| North Attleboro | 3 | 7% |
| Spencer | 3 | 7% |
| Walpole | 3 | 7% |
| **Total** | **42** | **100%** |

**Origins of Vehicles Observed Northbound Centre Street (Galen Street north of Charlesbank Road)**

| Community | Vehicles | % Total | Community | Vehicles | % Total | Community | Vehicles | % Total |
|---|---|---|---|---|---|---|---|---|
| Boston | 286 | 16% | Malden | 7 | 0% | Bridgewater | 2 | 0% |
| Newton | 211 | 12% | Medway | 7 | 0% | Burlington | 2 | 0% |
| Framingham | 108 | 6% | Norton | 7 | 0% | Carlisle | 2 | 0% |
| Watertown | 84 | 5% | Stoughton | 7 | 0% | Clinton | 2 | 0% |
| Out of State | 84 | 5% | Sudbury | 7 | 0% | Cohasset | 2 | 0% |
| Brookline | 44 | 2% | Taunton | 7 | 0% | Douglas | 2 | 0% |
| Quincy | 40 | 2% | Upton | 7 | 0% | Dover | 2 | 0% |
| Waltham | 33 | 2% | Woburn | 7 | 0% | Duxbury | 2 | 0% |
| Wellesley | 29 | 2% | Other Unmatchat | 6 | 0% | Fairhaven | 2 | 0% |
| Natick | 27 | 2% | Blackstone | 5 | 0% | Falmouth | 2 | 0% |
| Needham | 27 | 2% | Marshfield | 5 | 0% | Hanson | 2 | 0% |
| Belmont | 26 | 1% | Millbury | 5 | 0% | Harwich | 2 | 0% |
| Milton | 24 | 1% | New Bedford | 5 | 0% | Holbrook | 2 | 0% |
| Worcester | 22 | 1% | Norfolk | 5 | 0% | Holden | 2 | 0% |
| MBTA | 21 | 1% | Sutton | 5 | 0% | Holland | 2 | 0% |
| Marlborough | 20 | 1% | Westwood | 5 | 0% | Hopedale | 2 | 0% |
| Randolph | 20 | 1% | Acton | 4 | 0% | Hull | 2 | 0% |
| Revere | 20 | 1% | Attleboro | 4 | 0% | Leicester | 2 | 0% |
| Cambridge | 18 | 1% | Boxford | 4 | 0% | Lexington | 2 | 0% |
| Canton | 18 | 1% | Chelmsford | 4 | 0% | Lincoln | 2 | 0% |
| Norwood | 18 | 1% | Concord | 4 | 0% | Littleton | 2 | 0% |
| Shrewsbury | 18 | 1% | Danvers | 4 | 0% | Lynnfield | 2 | 0% |
| Arlington | 16 | 1% | Franklin | 4 | 0% | Mashpee | 2 | 0% |
| Braintree | 16 | 1% | Hanover | 4 | 0% | Maynard | 2 | 0% |
| Dedham | 16 | 1% | Hingham | 4 | 0% | Mendon | 2 | 0% |
| Hopkinton | 16 | 1% | Holyoke | 4 | 0% | Millis | 2 | 0% |
| Somerville | 16 | 1% | Hudson | 4 | 0% | North Reading | 2 | 0% |
| Ashland | 15 | 1% | Leominster | 4 | 0% | Paxton | 2 | 0% |
| Milford | 15 | 1% | Marblehead | 4 | 0% | Plainville | 2 | 0% |
| Brockton | 13 | 1% | Medford | 4 | 0% | Princeton | 2 | 0% |
| Easton | 13 | 1% | Melrose | 4 | 0% | Reading | 2 | 0% |
| Walpole | 13 | 1% | Middleborough | 4 | 0% | Rehoboth | 2 | 0% |
| Westborough | 13 | 1% | North Attleboro | 4 | 0% | Rockland | 2 | 0% |
| Weymouth | 13 | 1% | Northbridge | 4 | 0% | Rockport | 2 | 0% |
| Everett | 11 | 1% | Norwell | 4 | 0% | Salisbury | 2 | 0% |
| Holliston | 11 | 1% | Oxford | 4 | 0% | Scituate | 2 | 0% |
| Mansfield | 11 | 1% | Peabody | 4 | 0% | Sherborn | 2 | 0% |
| Winchester | 11 | 1% | Pembroke | 4 | 0% | Springfield | 2 | 0% |
| Winthrop | 11 | 1% | Plymouth | 4 | 0% | Stoneham | 2 | 0% |
| Grafton | 9 | 1% | Salem | 4 | 0% | Templeton | 2 | 0% |
| Lynn | 9 | 1% | Saugus | 4 | 0% | Tewksbury | 2 | 0% |
| Medfield | 9 | 1% | Topsfield | 4 | 0% | Tyngsborough | 2 | 0% |
| Northborough | 9 | 1% | Wakefield | 4 | 0% | Webster | 2 | 0% |
| Sharon | 9 | 1% | Wayland | 4 | 0% | Whately | 2 | 0% |
| Southborough | 9 | 1% | Wilmington | 4 | 0% | Williamsburg | 2 | 0% |
| Auburn | 7 | 0% | Wrentham | 4 | 0% | **Total** | **1817** | **100%** |
| Bellingham | 7 | 0% | Abington | 2 | 0% | | | |
| Chelsea | 7 | 0% | Acushnet | 2 | 0% | | | |
| Lowell | 7 | 0% | Beverly | 2 | 0% | | | |

**Origins of Vehicles Observed Northbound Centre Street (Galen Street north of Charlesbank Road)**

| Community | Vehicles | % Total |
|---|---|---|
| Watertown | 721 | 28% |
| Newton | 263 | 10% |
| Boston | 228 | 9% |
| Waltham | 189 | 7% |
| Belmont | 175 | 7% |
| Cambridge | 126 | 5% |
| Somerville | 56 | 2% |
| Arlington | 46 | 2% |
| Out of State | 38 | 1% |
| MBTA | 37 | 1% |
| Framingham | 35 | 1% |
| Lexington | 32 | 1% |
| Needham | 28 | 1% |
| Medford | 25 | 1% |
| Winchester | 25 | 1% |
| Brookline | 21 | 1% |
| Worcester | 21 | 1% |
| Natick | 18 | 1% |
| Randolph | 18 | 1% |
| Everett | 14 | 1% |
| Malden | 14 | 1% |
| Weston | 14 | 1% |
| Chelsea | 11 | 0% |
| Marlborough | 11 | 0% |
| Medway | 11 | 0% |
| Norwood | 11 | 0% |
| Quincy | 11 | 0% |
| Saugus | 11 | 0% |
| Weymouth | 11 | 0% |
| Ashland | 7 | 0% |
| Bedford | 7 | 0% |
| Beverly | 7 | 0% |
| Billerica | 7 | 0% |
| Braintree | 7 | 0% |
| Franklin | 7 | 0% |
| Lincoln | 7 | 0% |
| Methuen | 7 | 0% |
| Northampton | 7 | 0% |
| Revere | 7 | 0% |
| Sandwich | 7 | 0% |
| Shrewsbury | 7 | 0% |
| Stoughton | 7 | 0% |
| Swampscott | 7 | 0% |
| Upton | 7 | 0% |
| Wellesley | 7 | 0% |
| Westborough | 7 | 0% |
| Whitman | 7 | 0% |
| Winchendon | 7 | 0% |
| Woburn | 7 | 0% |
| Agawam | 4 | 0% |
| Amherst | 4 | 0% |
| Andover | 4 | 0% |
| Auburn | 4 | 0% |
| Barnstable | 4 | 0% |
| Bridgewater | 4 | 0% |
| Brockton | 4 | 0% |
| Canton | 4 | 0% |
| Carlisle | 4 | 0% |
| Chelmsford | 4 | 0% |
| Concord | 4 | 0% |
| Dedham | 4 | 0% |
| Dennis | 4 | 0% |
| Douglas | 4 | 0% |
| East Longmeado | 4 | 0% |
| Eastham | 4 | 0% |
| Easthampton | 4 | 0% |
| Easton | 4 | 0% |
| Fall River | 4 | 0% |
| Falmouth | 4 | 0% |
| Gardner | 4 | 0% |
| Georgetown | 4 | 0% |
| Grafton | 4 | 0% |
| Greenfield | 4 | 0% |
| Groton | 4 | 0% |
| Hanover | 4 | 0% |
| Holyoke | 4 | 0% |
| Hopedale | 4 | 0% |
| Hopkinton | 4 | 0% |
| Hudson | 4 | 0% |
| Kingston | 4 | 0% |
| Lakeville | 4 | 0% |
| Lawrence | 4 | 0% |
| Leicester | 4 | 0% |
| Lowell | 4 | 0% |
| Lunenburg | 4 | 0% |
| Lynn | 4 | 0% |
| Mansfield | 4 | 0% |
| Mattapoisett | 4 | 0% |
| Melrose | 4 | 0% |
| Middleton | 4 | 0% |
| Milford | 4 | 0% |
| Milton | 4 | 0% |
| North Andover | 4 | 0% |
| North Reading | 4 | 0% |
| Northborough | 4 | 0% |
| Norwell | 4 | 0% |
| Plymouth | 4 | 0% |
| Raynham | 4 | 0% |
| Reading | 4 | 0% |
| Rowley | 4 | 0% |
| Rutland | 4 | 0% |
| Salisbury | 4 | 0% |
| Southbridge | 4 | 0% |
| Southwick | 4 | 0% |
| Taunton | 4 | 0% |
| Tewksbury | 4 | 0% |
| Wakefield | 4 | 0% |
| Walpole | 4 | 0% |
| Wayland | 4 | 0% |
| Westwood | 4 | 0% |
| Windsor | 4 | 0% |
| Wrentham | 4 | 0% |
| Unmatchable | 1 | 0% |
| | 2,576 | 100% |

**Origins of Vehicles Observed at the Westbound MassPike On-Ramp**

| Community | Vehicles | % Total | Community | Vehicles | % Total | Community | Vehicles | % Total |
|---|---|---|---|---|---|---|---|---|
| Boston | 653 | 19% | Easton | 7 | 0% | Lowell | 4 | 0% |
| Watertown | 475 | 14% | Leominster | 7 | 0% | Marshfield | 4 | 0% |
| Newton | 432 | 13% | Melrose | 7 | 0% | Mattapoisett | 4 | 0% |
| out of state | 258 | 8% | Mendon | 7 | 0% | Maynard | 4 | 0% |
| Cambridge | 196 | 6% | North Attleboro | 7 | 0% | Medfield | 4 | 0% |
| Belmont | 136 | 4% | Northborough | 7 | 0% | Millbury | 4 | 0% |
| Brookline | 104 | 3% | Peabody | 7 | 0% | North Brookfield | 4 | 0% |
| Waltham | 72 | 2% | Revere | 7 | 0% | Northbridge | 4 | 0% |
| Somerville | 69 | 2% | Southbridge | 7 | 0% | Pembroke | 4 | 0% |
| Framingham | 65 | 2% | Upton | 7 | 0% | Pittsfield | 4 | 0% |
| Natick | 34 | 1% | Weymouth | 7 | 0% | Randolph | 4 | 0% |
| Needham | 30 | 1% | Winchester | 7 | 0% | Reading | 4 | 0% |
| Worcester | 28 | 1% | Attleboro | 5 | 0% | Rutland | 4 | 0% |
| Arlington | 23 | 1% | Beverly | 5 | 0% | Sandwich | 4 | 0% |
| Medford | 19 | 1% | Billerica | 5 | 0% | Scituate | 4 | 0% |
| Norwood | 19 | 1% | Chelsea | 5 | 0% | Stoughton | 4 | 0% |
| Wellesley | 18 | 1% | Chicopee | 5 | 0% | Stow | 4 | 0% |
| Westborough | 16 | 0% | Falmouth | 5 | 0% | Swansea | 4 | 0% |
| Malden | 14 | 0% | Grafton | 5 | 0% | Wakefield | 4 | 0% |
| Milford | 14 | 0% | Greenfield | 5 | 0% | Webster | 4 | 0% |
| Other Unmatcha | 14 | 0% | Hopkinton | 5 | 0% | Westfield | 4 | 0% |
| Ashland | 12 | 0% | Lakeville | 5 | 0% | Westwood | 4 | 0% |
| Braintree | 12 | 0% | Mansfield | 5 | 0% | Wilbraham | 4 | 0% |
| Brockton | 12 | 0% | Medway | 5 | 0% | Wilmington | 4 | 0% |
| Dedham | 12 | 0% | Methuen | 5 | 0% | Wrentham | 4 | 0% |
| Holliston | 12 | 0% | Milton | 5 | 0% | Abington | 2 | 0% |
| Shrewsbury | 12 | 0% | Plymouth | 5 | 0% | Agawam | 2 | 0% |
| Sudbury | 12 | 0% | Seekonk | 5 | 0% | Ashburnham | 2 | 0% |
| Taunton | 12 | 0% | Tewksbury | 5 | 0% | Ashby | 2 | 0% |
| Wayland | 12 | 0% | Tyngsborough | 5 | 0% | Athol | 2 | 0% |
| Burlington | 11 | 0% | West Boylston | 5 | 0% | Avon | 2 | 0% |
| Dover | 11 | 0% | Westford | 5 | 0% | Ayer | 2 | 0% |
| Everett | 11 | 0% | Whitman | 5 | 0% | Belchertown | 2 | 0% |
| Foxborough | 11 | 0% | Acton | 4 | 0% | Berkley | 2 | 0% |
| Hudson | 11 | 0% | Andover | 4 | 0% | Blackstone | 2 | 0% |
| Lexington | 11 | 0% | Auburn | 4 | 0% | Boxborough | 2 | 0% |
| Quincy | 11 | 0% | Bellingham | 4 | 0% | Brewster | 2 | 0% |
| Walpole | 11 | 0% | Bolton | 4 | 0% | Carlisle | 2 | 0% |
| Weston | 11 | 0% | Bridgewater | 4 | 0% | Carver | 2 | 0% |
| Woburn | 11 | 0% | Canton | 4 | 0% | Chilmark | 2 | 0% |
| Franklin | 9 | 0% | Clinton | 4 | 0% | Cohasset | 2 | 0% |
| Marlborough | 9 | 0% | Duxbury | 4 | 0% | Danvers | 2 | 0% |
| North Andover | 9 | 0% | Gloucester | 4 | 0% | Dartmouth | 2 | 0% |
| Sharon | 9 | 0% | Groton | 4 | 0% | Dennis | 2 | 0% |
| Southborough | 9 | 0% | Hamilton | 4 | 0% | Dracut | 2 | 0% |
| Barnstable | 7 | 0% | Hampden | 4 | 0% | East Longmeado | 2 | 0% |
| Bedford | 7 | 0% | Hingham | 4 | 0% | Eastham | 2 | 0% |
| Chelmsford | 7 | 0% | Hopedale | 4 | 0% | Easthampton | 2 | 0% |
| Concord | 7 | 0% | Longmeadow | 4 | 0% | Fall River | 2 | 0% |

**Origins of Vehicles Observed at the Westbound MassPike On-Ramp (continued)**

| Community | Vehicles | % Total |
|---|---|---|
| Fitchburg | 2 | 0% |
| Gardner | 2 | 0% |
| Groveland | 2 | 0% |
| Halifax | 2 | 0% |
| Harwich | 2 | 0% |
| Holden | 2 | 0% |
| Holland | 2 | 0% |
| Holyoke | 2 | 0% |
| Huntington | 2 | 0% |
| Lawrence | 2 | 0% |
| Leicester | 2 | 0% |
| Lunenburg | 2 | 0% |
| Lynnfield | 2 | 0% |
| Marblehead | 2 | 0% |
| Marion | 2 | 0% |
| Merrimac | 2 | 0% |
| Middleborough | 2 | 0% |
| Middleton | 2 | 0% |
| Nantucket | 2 | 0% |
| New Marlborough | 2 | 0% |
| Norfolk | 2 | 0% |
| North Adams | 2 | 0% |
| Northampton | 2 | 0% |
| Norton | 2 | 0% |
| Norwell | 2 | 0% |
| Otis | 2 | 0% |
| Pepperell | 2 | 0% |
| Princeton | 2 | 0% |
| Rehoboth | 2 | 0% |
| Richmond | 2 | 0% |
| Rockland | 2 | 0% |
| Rockport | 2 | 0% |
| Salem | 2 | 0% |
| Saugus | 2 | 0% |
| Southampton | 2 | 0% |
| Sterling | 2 | 0% |
| Stoneham | 2 | 0% |
| Swampscott | 2 | 0% |
| Ware | 2 | 0% |
| Westport | 2 | 0% |
| Winthrop | 2 | 0% |
| Total | 3434 | 100% |

**Origins of Vehicles Observed at the Sheraton Hotel and Gateway Center Entrance**

| Community | Vehicles | % Total | Community | Vehicles | % Total | Community | Vehicles | % Total |
|---|---|---|---|---|---|---|---|---|
| Newton | 48 | 19% | Milford | 2 | 1% | | | |
| Boston | 34 | 13% | Millis | 2 | 1% | | | |
| Watertown | 14 | 5% | Needham | 2 | 1% | | | |
| Waltham | 10 | 4% | North Andover | 2 | 1% | | | |
| Brookline | 7 | 3% | North Attleboro | 2 | 1% | | | |
| Somerville | 7 | 3% | Northborough | 2 | 1% | | | |
| Sudbury | 5 | 2% | Norwell | 2 | 1% | | | |
| Winchester | 5 | 2% | Peabody | 2 | 1% | | | |
| Out of State | 5 | 2% | Plymouth | 2 | 1% | | | |
| Bedford | 3 | 1% | Quincy | 2 | 1% | | | |
| Braintree | 3 | 1% | Sharon | 2 | 1% | | | |
| Brockton | 3 | 1% | Southborough | 2 | 1% | | | |
| Easton | 3 | 1% | Stoneham | 2 | 1% | | | |
| Framingham | 3 | 1% | Stoughton | 2 | 1% | | | |
| Hanover | 3 | 1% | Tewksbury | 2 | 1% | | | |
| Marblehead | 3 | 1% | Tyngsborough | 2 | 1% | | | |
| Medford | 3 | 1% | Webster | 2 | 1% | | | |
| Natick | 3 | 1% | Westwood | 2 | 1% | | | |
| Revere | 3 | 1% | Weymouth | 2 | 1% | | | |
| Scituate | 3 | 1% | **Total** | **259** | **100%** | | | |
| Wilmington | 3 | 1% | | | | | | |
| Winthrop | 3 | 1% | | | | | | |
| Arlington | 2 | 1% | | | | | | |
| Ashland | 2 | 1% | | | | | | |
| Belmont | 2 | 1% | | | | | | |
| Billerica | 2 | 1% | | | | | | |
| Blackstone | 2 | 1% | | | | | | |
| Cambridge | 2 | 1% | | | | | | |
| Canton | 2 | 1% | | | | | | |
| Chelmsford | 2 | 1% | | | | | | |
| Dalton | 2 | 1% | | | | | | |
| Danvers | 2 | 1% | | | | | | |
| Dedham | 2 | 1% | | | | | | |
| Dover | 2 | 1% | | | | | | |
| Fall River | 2 | 1% | | | | | | |
| Franklin | 2 | 1% | | | | | | |
| Gloucester | 2 | 1% | | | | | | |
| Ipswich | 2 | 1% | | | | | | |
| Lawrence | 2 | 1% | | | | | | |
| Leominster | 2 | 1% | | | | | | |
| Lexington | 2 | 1% | | | | | | |
| Lincoln | 2 | 1% | | | | | | |
| Lowell | 2 | 1% | | | | | | |
| Malden | 2 | 1% | | | | | | |
| Mansfield | 2 | 1% | | | | | | |
| Marshfield | 2 | 1% | | | | | | |
| Maynard | 2 | 1% | | | | | | |
| Melrose | 2 | 1% | | | | | | |
| Mendon | 2 | 1% | | | | | | |

**Origins of Vehicles Observed at the Sheraton Hotel and Gateway Center Exits**

| Community | Vehicles | % Total |
|---|---|---|
| Newton | 23 | 26.1% |
| Boston | 7 | 7.5% |
| Revere | 7 | 7.5% |
| Watertown | 7 | 7.5% |
| Agawam | 3 | 3.7% |
| Brookline | 3 | 3.7% |
| Fall River | 3 | 3.7% |
| Maynard | 3 | 3.7% |
| Medford | 3 | 3.7% |
| Mendon | 3 | 3.7% |
| Milford | 3 | 3.7% |
| Natick | 3 | 3.7% |
| Needham | 3 | 3.7% |
| Quincy | 3 | 3.7% |
| Tewksbury | 3 | 3.7% |
| Waltham | 3 | 3.7% |
| Out of State | 6 | 6.8% |
| | 88 | 100.0% |

**Origins of Vehicles Observed on Bacon Street Northbound**

| Community | Vehicles | % Total |
|---|---|---|
| Boston | 26 | 16% |
| Newton | 22 | 14% |
| Watertown | 10 | 6% |
| Out of State | 5 | 3% |
| Arlington | 4 | 2% |
| Braintree | 4 | 2% |
| Haverhill | 4 | 2% |
| Needham | 4 | 2% |
| Wellesley | 4 | 2% |
| Westborough | 4 | 2% |
| Winchester | 4 | 2% |
| Acton | 2 | 1% |
| Athol | 2 | 1% |
| Auburn | 2 | 1% |
| Barnstable | 2 | 1% |
| Bellingham | 2 | 1% |
| Brookline | 2 | 1% |
| Cambridge | 2 | 1% |
| Canton | 2 | 1% |
| Chelmsford | 2 | 1% |
| Easthampton | 2 | 1% |
| Everett | 2 | 1% |
| Foxborough | 2 | 1% |
| Gloucester | 2 | 1% |
| Holbrook | 2 | 1% |
| Holliston | 2 | 1% |
| Hudson | 2 | 1% |
| Kingston | 2 | 1% |
| Leicester | 2 | 1% |
| Ludlow | 2 | 1% |
| Malden | 2 | 1% |
| Mansfield | 2 | 1% |
| Marlborough | 2 | 1% |
| Natick | 2 | 1% |
| Quincy | 2 | 1% |
| Reading | 2 | 1% |
| Shrewsbury | 2 | 1% |
| Somerville | 2 | 1% |
| Southborough | 2 | 1% |
| Walpole | 2 | 1% |
| Waltham | 2 | 1% |
| Weymouth | 2 | 1% |
| Wilmington | 2 | 1% |
| Woburn | 2 | 1% |
| Wrentham | 2 | 1% |
| Yarmouth | 2 | 1% |
| **Total** | **158** | **100%** |

## Origins of Vehicles Observed on Peabody Street

| Community | Vehicles | % Total | Community | Vehicles | % Total | Community | Vehicles | % Total |
|---|---|---|---|---|---|---|---|---|
| Northbound | | | Southbound | | | | | |
| Newton | 6 | 20% | Newton | 98 | 34% | | | |
| Watertown | 4 | 13% | Watertown | 45 | 15% | | | |
| Boston | 2 | 7% | Boston | 36 | 12% | | | |
| Brookline | 2 | 7% | Waltham | 24 | 8% | | | |
| Cambridge | 2 | 7% | Out of State | 6 | 2% | | | |
| Chatham | 2 | 7% | Other Umat | 6 | 2% | | | |
| Marblehead | 2 | 7% | Natick | 5 | 2% | | | |
| Medway | 2 | 7% | Somerville | 5 | 2% | | | |
| Weymouth | 2 | 7% | Revere | 3 | 1% | | | |
| Winthrop | 2 | 7% | Stoughton | 3 | 1% | | | |
| Worcester | 2 | 7% | Acton | 2 | 1% | | | |
| Out of State | 2 | 7% | Arlington | 2 | 1% | | | |
| | 28 | 100% | Belmont | 2 | 1% | | | |
| | | | Beverly | 2 | 1% | | | |
| | | | Bourne | 2 | 1% | | | |
| | | | Burlington | 2 | 1% | | | |
| | | | Cambridge | 2 | 1% | | | |
| | | | Canton | 2 | 1% | | | |
| | | | Carver | 2 | 1% | | | |
| | | | Dedham | 2 | 1% | | | |
| | | | Dunstable | 2 | 1% | | | |
| | | | Everett | 2 | 1% | | | |
| | | | Fairhaven | 2 | 1% | | | |
| | | | Framingham | 2 | 1% | | | |
| | | | Hampden | 2 | 1% | | | |
| | | | Hingham | 2 | 1% | | | |
| | | | Hudson | 2 | 1% | | | |
| | | | Mansfield | 2 | 1% | | | |
| | | | Medfield | 2 | 1% | | | |
| | | | Melrose | 2 | 1% | | | |
| | | | Millis | 2 | 1% | | | |
| | | | Needham | 2 | 1% | | | |
| | | | Norwood | 2 | 1% | | | |
| | | | Pembroke | 2 | 1% | | | |
| | | | Quincy | 2 | 1% | | | |
| | | | Rockland | 2 | 1% | | | |
| | | | Salisbury | 2 | 1% | | | |
| | | | Sudbury | 2 | 1% | | | |
| | | | Walpole | 2 | 1% | | | |
| | | | Wayland | 2 | 1% | | | |
| | | | Wellfleet | 2 | 1% | | | |
| | | | Westborough | 2 | 1% | | | |
| | | | Westfield | 2 | 1% | | | |
| | | | Worcester | 2 | 1% | | | |
| | | | | 291 | 100% | | | |

## Origins of Vehicles Observed on Washington Street Westbound

| Community | Vehicles | % Total | Community | Vehicles | % Total | Community | Vehicles | % Total |
|---|---|---|---|---|---|---|---|---|
| Boston | 314 | 23% | Rockport | 5 | 0% | Norfolk | 2 | 0% |
| Newton | 230 | 17% | Salem | 5 | 0% | North Attleboro | 2 | 0% |
| Cambridge | 71 | 5% | Saugus | 5 | 0% | Northampton | 2 | 0% |
| Waltham | 64 | 5% | Southborough | 5 | 0% | Peabody | 2 | 0% |
| Quincy | 52 | 4% | Stoughton | 5 | 0% | Pembroke | 2 | 0% |
| Out of State | 52 | 4% | Swampscott | 5 | 0% | Rockland | 2 | 0% |
| Watertown | 41 | 3% | Westwood | 5 | 0% | Sandwich | 2 | 0% |
| Brookline | 34 | 2% | Weymouth | 5 | 0% | Sherborn | 2 | 0% |
| Somerville | 32 | 2% | Wilmington | 5 | 0% | Shrewsbury | 2 | 0% |
| Medford | 18 | 1% | Winchester | 5 | 0% | Springfield | 2 | 0% |
| Belmont | 14 | 1% | Woburn | 5 | 0% | Sudbury | 2 | 0% |
| Stoneham | 14 | 1% | Acushnet | 2 | 0% | Templeton | 2 | 0% |
| Framingham | 11 | 1% | Andover | 2 | 0% | Townsend | 2 | 0% |
| Malden | 11 | 1% | Ayer | 2 | 0% | Walpole | 2 | 0% |
| Milton | 11 | 1% | Bedford | 2 | 0% | Wareham | 2 | 0% |
| Randolph | 11 | 1% | Boylston | 2 | 0% | Wayland | 2 | 0% |
| Revere | 11 | 1% | Bridgewater | 2 | 0% | Wenham | 2 | 0% |
| MBTA | 10 | 1% | Carver | 2 | 0% | West Brookfield | 2 | 0% |
| Arlington | 9 | 1% | Chatham | 2 | 0% | Williamsburg | 2 | 0% |
| Chelsea | 9 | 1% | Chelmsford | 2 | 0% | **Total** | **1366** | **100%** |
| Easton | 9 | 1% | Douglas | 2 | 0% | | | |
| Reading | 9 | 1% | Dover | 2 | 0% | | | |
| Weston | 9 | 1% | Dracut | 2 | 0% | | | |
| Worcester | 9 | 1% | Dudley | 2 | 0% | | | |
| Ashland | 7 | 0% | Dunstable | 2 | 0% | | | |
| Barnstable | 7 | 0% | Duxbury | 2 | 0% | | | |
| Braintree | 7 | 0% | E. Bridgewater | 2 | 0% | | | |
| Lowell | 7 | 0% | Everett | 2 | 0% | | | |
| Lynn | 7 | 0% | Gloucester | 2 | 0% | | | |
| Melrose | 7 | 0% | Great Barrington | 2 | 0% | | | |
| Natick | 7 | 0% | Halifax | 2 | 0% | | | |
| Plymouth | 7 | 0% | Hanover | 2 | 0% | | | |
| Wellesley | 7 | 0% | Holbrook | 2 | 0% | | | |
| Winthrop | 7 | 0% | Holden | 2 | 0% | | | |
| Beverly | 5 | 0% | Holyoke | 2 | 0% | | | |
| Billerica | 5 | 0% | Hopedale | 2 | 0% | | | |
| Brewster | 5 | 0% | Hopkinton | 2 | 0% | | | |
| Brockton | 5 | 0% | Hubbardston | 2 | 0% | | | |
| Canton | 5 | 0% | Hudson | 2 | 0% | | | |
| Fall River | 5 | 0% | Leicester | 2 | 0% | | | |
| Franklin | 5 | 0% | Lincoln | 2 | 0% | | | |
| Hull | 5 | 0% | Lynnfield | 2 | 0% | | | |
| Lawrence | 5 | 0% | Mansfield | 2 | 0% | | | |
| Leominster | 5 | 0% | Marblehead | 2 | 0% | | | |
| Lexington | 5 | 0% | Marlborough | 2 | 0% | | | |
| Needham | 5 | 0% | Maynard | 2 | 0% | | | |
| Northborough | 5 | 0% | Milford | 2 | 0% | | | |
| Norwood | 5 | 0% | Millbury | 2 | 0% | | | |

## Origins of Vehicles Observed on Washington Street Eastbound

| Community | Vehicles | % Total | Community | Vehicles | % Total | Community | Vehicles | % Total |
|---|---|---|---|---|---|---|---|---|
| Newton | 718 | 40% | Ashburnham | 2 | 0% | Plymouth | 2 | 0% |
| Boston | 206 | 11% | Ashland | 2 | 0% | Revere | 2 | 0% |
| Waltham | 201 | 11% | Attleboro | 2 | 0% | Rockland | 2 | 0% |
| Watertown | 42 | 2% | Auburn | 2 | 0% | Sandwich | 2 | 0% |
| Needham | 37 | 2% | Bellingham | 2 | 0% | Scituate | 2 | 0% |
| Framingham | 33 | 2% | Berlin | 2 | 0% | Somerset | 2 | 0% |
| Out of State | 32 | 2% | Bernardston | 2 | 0% | Southborough | 2 | 0% |
| Cambridge | 28 | 2% | Beverly | 2 | 0% | Swampscott | 2 | 0% |
| Wellesley | 19 | 1% | Billerica | 2 | 0% | Taunton | 2 | 0% |
| Arlington | 16 | 1% | Brockton | 2 | 0% | Wakefield | 2 | 0% |
| Canton | 16 | 1% | Burlington | 2 | 0% | Webster | 2 | 0% |
| Brookline | 14 | 1% | Carlisle | 2 | 0% | Westport | 2 | 0% |
| Weston | 14 | 1% | Chatham | 2 | 0% | Westwood | 2 | 0% |
| Weymouth | 14 | 1% | Chelmsford | 2 | 0% | Wilbraham | 2 | 0% |
| Other Unmatcha | 13 | 1% | Dighton | 2 | 0% | Winthrop | 2 | 0% |
| Natick | 12 | 1% | Dracut | 2 | 0% | Worcester | 2 | 0% |
| Quincy | 12 | 1% | Dudley | 2 | 0% | Wrentham | 2 | 0% |
| Shrewsbury | 12 | 1% | Dunstable | 2 | 0% | **Total** | **1797** | **100%** |
| Somerville | 12 | 1% | Duxbury | 2 | 0% | | | |
| Walpole | 12 | 1% | Everett | 2 | 0% | | | |
| Belmont | 9 | 1% | Fairhaven | 2 | 0% | | | |
| Chelsea | 9 | 1% | Fall River | 2 | 0% | | | |
| Dedham | 9 | 1% | Falmouth | 2 | 0% | | | |
| Lexington | 9 | 1% | Fitchburg | 2 | 0% | | | |
| Sudbury | 9 | 1% | Goshen | 2 | 0% | | | |
| Wayland | 9 | 1% | Granby | 2 | 0% | | | |
| Barnstable | 7 | 0% | Groton | 2 | 0% | | | |
| Dover | 7 | 0% | Harwich | 2 | 0% | | | |
| Hingham | 7 | 0% | Holden | 2 | 0% | | | |
| Marlborough | 7 | 0% | Hopedale | 2 | 0% | | | |
| Sharon | 7 | 0% | Hudson | 2 | 0% | | | |
| Stoneham | 7 | 0% | Huntington | 2 | 0% | | | |
| Westborough | 7 | 0% | Ipswich | 2 | 0% | | | |
| Acton | 5 | 0% | Leominster | 2 | 0% | | | |
| Amherst | 5 | 0% | Lowell | 2 | 0% | | | |
| Bedford | 5 | 0% | Malden | 2 | 0% | | | |
| Bridgewater | 5 | 0% | Mansfield | 2 | 0% | | | |
| Foxborough | 5 | 0% | Maynard | 2 | 0% | | | |
| Franklin | 5 | 0% | Medfield | 2 | 0% | | | |
| Hanover | 5 | 0% | Medway | 2 | 0% | | | |
| Holliston | 5 | 0% | Methuen | 2 | 0% | | | |
| Medford | 5 | 0% | Middleborough | 2 | 0% | | | |
| North Reading | 5 | 0% | Milford | 2 | 0% | | | |
| Norton | 5 | 0% | Milton | 2 | 0% | | | |
| Salem | 5 | 0% | Northborough | 2 | 0% | | | |
| Sherborn | 5 | 0% | Northbridge | 2 | 0% | | | |
| Stoughton | 5 | 0% | Norwood | 2 | 0% | | | |
| Woburn | 5 | 0% | Peabody | 2 | 0% | | | |
| Yarmouth | 5 | 0% | Pittsfield | 2 | 0% | | | |