Low-Cost Improvements to Express-Highway Bottleneck Locations

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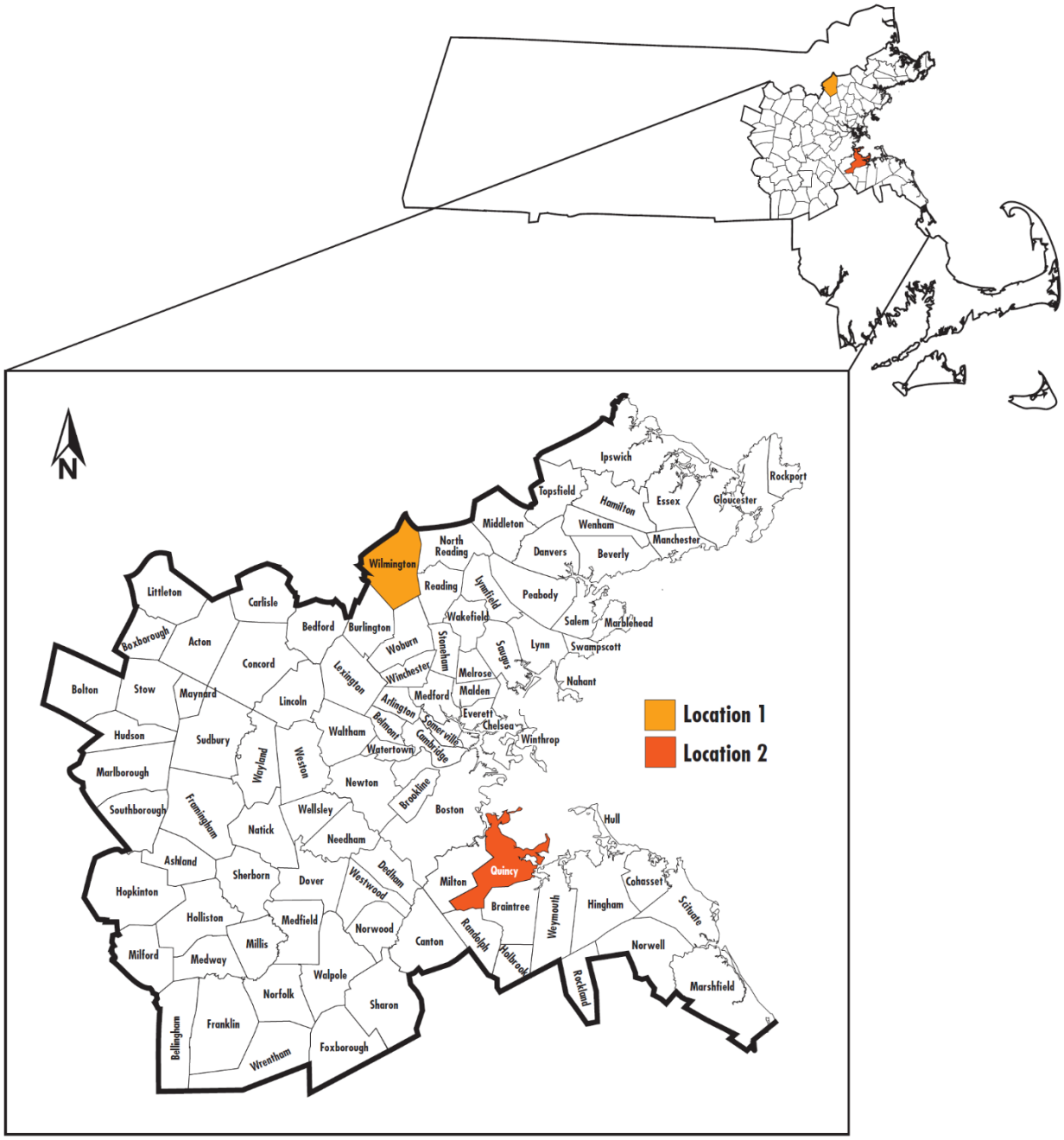

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Abstract

The purpose of the *Low-Cost Improvements to Express-Highway Bottleneck Locations* study is to identify low-cost improvements that will help reduce congestion at freeway bottleneck locations in the Boston Metropolitan Planning Organization (MPO) region. Bottlenecks in the freeway network can occur where geometric elements, such as ramps or lane drops, restrict traffic flow and are a major contributor to recurring congestion. This study was done in cooperation with the Massachusetts Department of Transportation (MassDOT) Highway Division and the Federal Highway Administration Massachusetts Division.

Candidate locations were selected based on input from the MassDOT Highway Division and Congestion Management Process data. The screening process yielded two locations that had the potential to respond to low-cost improvement measures. These locations included:

- Interstate 93 (I-93) northbound between Exit 40 (Route 62) and Exit 41 (Route 125) in Wilmington
- I-93 southbound at the end of the high occupancy zipper lane exit between Exit 7 (Route 3) and Exit 8 (Furnace Brook Parkway) in Braintree and Quincy

Both locations regularly experience poor level of service (LOS) because of one or more freeway bottlenecks during peak travel periods. MPO staff developed low-cost improvement proposals to address each bottleneck. If implemented, the modifications would result in capacity and safety improvements on these two high-volume facilities.

This report summarizes the analyses and recommendations from the study. The report is divided into multiple chapters, with two chapters covering each study location. Each location chapter summarizes existing conditions, proposes various low-cost measures to address the bottlenecks, and evaluates the efficacy of the proposed alternatives using methodology from the Highway Capacity Manual. The report concludes with a summary of the recommendations, followed by figures that illustrate features of the proposed improvements. As an addendum, the report includes technical appendices that cite the methods used and the data applied.

TABLE OF CONTENTS **PAGE**

TABLES

FIGURES

APPENDICES

Chapter 1—Introduction

1.1 INTRODUCTION

This report summarizes the results of the analyses and improvement alternatives considered in the federal fiscal year 2019 study, *Low-Cost Improvements to Express-Highway Bottleneck Locations*. The report begins with background information and describes the purpose of the study, followed by the selection of study locations, an assessment of the safety and operational problems, and a discussion of the potential improvement strategies. The final section presents the study recommendations. The report concludes with technical appendices, which cite the study methods, describe how the data and analyses were applied, including detailed reports from the freeway merge and diverge analyses. If implemented, the report's recommendations would not only result in improvements on the freeway facilities; they would improve traffic safety, make traffic operations more efficient, and reduce congestion at the bottlenecks.

1.2 BACKGROUND

According to the Federal Highway Administration (FHWA),

> Much of the recurring congestion is due to physical bottlenecks—potentially correctible points on the highway system where traffic flow is restricted. While many of the nation's bottlenecks can only be addressed through costly major construction projects, there is a significant opportunity for the application of operational and low-cost infrastructure solutions to bring about relief at these chokepoints.[1]

To be consistent with this guidance, the FHWA Massachusetts Division has recommended, as part of its comments on the Unified Planning Work Program process, that the Boston Region Metropolitan Planning Organization (MPO) identify the worst bottlenecks in the region that can be mitigated with low-cost countermeasures and develop recommendations for such countermeasures at these locations.

In general, recurring bottlenecks are influenced by the design or operation present at the point where the bottleneck begins; for example, at merge locations, diverges, lane drops, traffic weaving, and abrupt changes in highway alignment. In previous years, MPO staff analyzed several express-highway bottleneck locations in four consecutive studies, which were well received by the

[1] Federal Highway Administration, *Recurring Traffic Bottlenecks: A Primer: Focus on Low-Cost Operations Improvements,* US Department of Transportation, Federal Highway Administration, June 2009, p. 1.

Massachusetts Department of Transportation (MassDOT) and the FHWA.[2,3,4,5] Study locations included sections of Interstate 95 (I-95) in Burlington, Lexington, and Weston; sections of Interstate 93 (I-93) in Woburn; sections of Route 3 in Braintree; and sections of Route 24 in Canton and Randolph.

The MassDOT Highway Division has implemented many of the recommendations from those studies, and the FHWA has interviewed MPO staff about these successful implementations, including

- restriping lanes to serve traffic demand better on I-95 northbound at Interchange 24 in Weston;
- restriping lanes to serve traffic demand better on I-95 southbound at Interchange 24 in Weston;
- providing two-lane exits for traffic exiting I-95 northbound to Route 3 northbound and the Middlesex Turnpike at Interchange 32 in Lexington and Burlington; and
- providing two-lane exits for traffic exiting I-95 southbound to Route 3 northbound and the Middlesex Turnpike at Interchange 32 in Burlington.

1.3 PURPOSE OF STUDY

The purpose of this study is twofold. First, the study aims to identify two bottleneck segments or points where low-cost mitigation improvements seem applicable. Second, the study aims to recommend low-cost mitigation improvements based on analysis of geometric design, traffic volumes and other data, and projected service performance associated with the improvements at each location.

Since 2011, the MPO has conducted four bottleneck studies in the Boston region to identify low-cost methods to reduce congestion, increase safety, and improve traffic operations. In the current study, MPO staff will rely on technical expertise regarding the nature of bottlenecks and will seek input from the MassDOT Highway Division staff, who are familiar with the region's express-highway

[2] Seth Asante, MPO staff, memorandum to the Transportation Planning and Programming Committee of the Boston Region MPO, "Low-Cost Improvements to Bottleneck Locations, Phase I," June 2, 2011.

[3] Chen-Yuan Wang, MPO staff, memorandum to the Transportation Planning and Programming Committee of the Boston Region MPO, "Low-Cost Improvements to Bottleneck Locations, Phase II," March 12, 2012.

[4] Seth Asante, MPO staff, memorandum to the Boston Region MPO, "Low-Cost Improvements to Express-Highway Bottleneck Locations," December 3, 2015.

[5] Seth Asante and Ben Erban, "Low-Cost Improvements to Express-Highway Bottleneck Locations," January 18, 2018.

system operations, to develop and evaluate a comprehensive list of potential improvements at the bottleneck locations.

Chapter 2—Selection of Study Locations

To select the study locations, MPO staff had to first inventory and screen all candidate locations.[6] MPO staff developed an initial list of candidate locations in the MPO region based on the following parameters:

- Consultations with the MassDOT Highway Division
- Review of Congestion Management Process (CMP) monitoring data and recent MPO and other planning studies
- Staff knowledge of bottleneck locations in the Boston Region MPO area

Table 1 presents the inventory process, which yielded nine bottleneck locations in the Boston Region MPO area for screening.

Table 1
Inventory of Express-Highway Locations for Screening

Location Number	City/Town	MassDOT District	Express-Highway Section	Problem
1	Wilmington	4	I-93 northbound between Exit 40 (Route 62) and Exit 41 (Route 125)	Merge and diverge
2	Quincy and Braintree	6	I-93 southbound at the end of the HOV zipper lane	Merge and weave during the PM commute
3	Medford	4	I-93 southbound between Route 16 on-ramp and Exit 31 (Route 16 off-ramp)	Weave
4	Reading	4	I-95 northbound between Exit 37 (I-93) and Exit 38 (Route 28)	Weave
5	Boston	6	I-93 northbound at the end of the HOV zipper lane in Savin Hill	Merge during the AM commute
6	Boston	6	I-90 westbound and eastbound (just west of Ted Williams Tunnel Portal)	Westbound—diverge; Eastbound—merge
7	Canton and Randolph	6	I-93 northbound between Exit 1 (I-95) and Exit 4 (Route 24)	Merge, diverge, and weave
8	Canton and Randolph	6	I-93 southbound between Exit 1 (I-95) and Exit 4 (Route 24)	Merge, diverge, and weave
9	Newton	6	I-90 eastbound in Newton between Exit 16 and Exit 17	Merge, diverge, and weave

Note: Shading indicates locations selected for study
HOV = high occupancy vehicle. I-93 = Interstate 93. I-95 = Interstate 95. MassDOT = Massachusetts Department of Transportation.
Source: Central Transportation Planning Staff

[6] Seth Asante, MPO staff, memorandum to the Boston Region MPO, "Low-Cost Improvements to Express-Highway Bottleneck Locations: Selection of Study Locations," April 2, 2015.

2.1 SCREENING CRITERIA

MPO staff used the following three criteria to screen the bottleneck locations:

1. Does the location qualify as a bottleneck?
   A repetitive, long-traffic queue upstream trailing free-flowing traffic downstream usually characterizes the location as a bottleneck. In other words, the location experiences routine and predictable congestion because traffic volume exceeds the available capacity at that location.
2. Is a physical design constraint or operational conflict inherent in the location the cause of the bottleneck?
   Examples of these include the following constraints or conflicts:
   a. Lane drop: One or more travel lanes end, requiring traffic to merge
   b. Weaving area: Drivers must merge across one or more lanes to access an entry or exit ramp
   c. Merge area: On-ramp traffic merges with mainline traffic to enter the freeway
   d. Major interchanges: High-volume traffic is directed from one freeway to another
3. Can low-cost operational and geometric improvements fix the bottleneck?
   These exclude costly long-term solutions such as expansion or widening of the roadway. Examples of low-cost operational and geometric improvements include the following:
   a. Using a short section of shoulder as an additional travel lane or for lengthening an acceleration or deceleration lane
   b. Restriping merge and diverge areas to better serve traffic demand
   c. Providing all-purpose reversible lanes
   d. Changing or adding signs and striping

Locations selected for study must meet these criteria and the number of locations selected for the study is dependent on allocated funding.

2.2 STUDY LOCATIONS

Based on the screening criteria and consultations with the MassDOT Highway Division officials, MPO staff selected location numbers 1 and 2 for study. Figure 1 shows the study locations.[7] Although locations 3, 4, 5, 6, 7, and 8 met the screening criteria, MPO staff did not select them for this study due to funding

[7] All figures are included at the end of the report.

concerns. However, MPO staff would consider these locations in a future bottleneck study. In addition, MassDOT is currently developing a project to address the bottleneck at Location 9. Appendix A contains comments about the study from the MassDOT Highway Division and a memorandum to the MPO that describes the selection process in detail.

2.2.1 Location 1: I-93 Northbound between Exit 40 (Route 62) and Exit 41 (Route 125) in Wilmington

This mile-long segment of highway (with four travel lanes) is a bottleneck because of merging and diverging activities, which causes congestion, especially during the PM peak periods. In the segment, there are two exit ramps and three entry ramps connecting Routes 62 and 125 to I-93. The ramps also carry high volumes of traffic because of office and industrial parks located off Route 125.

At both exits, the northbound ramps have approximately 500 vehicles per hour (vph) and 700 vph exiting I-93 northbound to Route 62 and Route 125 during the AM peak period, respectively, and about 700 vph and 1,000 vph during the PM peak period. During the same periods, the on-ramps from Route 62 and Route 125 to I-93 northbound receive about 500 vph and 300 vph during the AM period, respectively, and about 400 vph and 600 vph during the PM peak period.

This entering and exiting of traffic interacts with approximately 4,000 to 5,500 vph on the mainline during the AM peak period and approximately 7,000 to 7,500 vph during the PM peak period. The merging and diverging maneuvers in the vicinity creates a bottleneck that backs up traffic on the mainline.

2.2.2 Location 2: I-93 Southbound at the End of the High Occupancy Vehicle (HOV) Zipper Lane in Quincy and Braintree

This bottleneck is located on I-93 southbound at the end of the HOV zipper lane, where traffic exits the southbound HOV lane and then merges with the traffic on the mainline. The bottleneck occurs only during PM peak periods when the southbound HOV lane is in operation. Traffic from six lanes is forced onto a four-lane freeway segment. The reduction in the number of lanes, merging, diverging, and weaving of traffic, and the high number of lane-changing maneuvers to disperse traffic to continue on I-93 southbound or head to Route 3 southbound, dramatically reduces capacity in the segment, creating a bottleneck. During PM peak periods, about 5,100 to 5,500 vph pass through the bottleneck—600 vph from the Furnace Brook Parkway on-ramp, 3,500 vph in the four general-purpose lanes, and 1,000 vph in the HOV lane. Given an upstream traffic demand of 8,000 vph, which is far greater than the capacity of the bottleneck, a long traffic queue forms on the mainline, which extends five miles to Columbia Road in Dorchester.

Chapter 3—Data Collection and Uses

3.1 TRAFFIC VOLUME DATA

The MassDOT Highway Division's Traffic Data Collection Program conducted automatic traffic recorder (ATR) counts for the ramps, freeways, and arterial roadways at the locations selected for study. The ATR counts traffic continuously for at least 48 hours. MPO staff used these counts to determine the average weekday traffic of a highway and operations performance. The traffic volume data are included in Appendix B. In addition, MassDOT collected turning movement counts (TMCs) for the signalized intersections at the ramp-arterial junction on Route 125. MassDOT performed TMCs during the weekday AM peak travel period (6:00 AM to 9:00 AM) and weekday PM peak travel period (3:00 PM to 6:00 PM).

3.2 CRASH DATA

MPO staff used crash data from January 2012 to December 2016 from the MassDOT's Registry of Motor Vehicles database to evaluate safety for motorists. Crash data are included in Appendix C.

3.3 SPEED DATA

The CMP maintains average speed data on express-highway systems in the MPO region with use of the INRIX historical traffic speed data.[8] MPO staff used the current speed data from the CMP (spring 2015 and fall 2015) to determine the average weekday travel speeds through the bottlenecks.

3.4 LEVEL OF SERVICE CRITERIA

Level of service (LOS) is a quality measure describing operational conditions within a traffic stream, generally in terms of such service measures as speed and travel time, freedom to maneuver, traffic interruptions, and comfort and convenience. Factors influencing LOS are volume, lane width, lateral obstructions, traffic composition, grade, and speed. The Highway Capacity Manual (HCM) methodology demonstrates driving conditions on freeways in terms of LOS ratings from A through F.[9] The LOS criteria characterize freeway performance measures in terms of density (passenger cars per lane mile, [pc/lane mile]). The LOS criteria has been developed for each freeway component—basic freeway, ramp merge/diverge, and weaving segments. The

[8] INRIX is a private company that collects roadway travel times and origin-destination data for most roadways that are collectors, arterials, limited-access roadways or freeways.

[9] Highway Capacity Manual 2010, Transportation Research Board of the National Academies, Washington, DC, December 2010.

locations and traffic flow characteristics at each of the components are described below.

- Basic freeway segments are outside of the influence area of ramps or weaving areas of the freeway. The flow in such segments occurs more smoothly than segments with merging, diverging, or weaving. The exact point at which basic freeway segments begin or end depends on local conditions, particularly the LOS operating at the time. If traffic flow is light, the influence may be negligible, whereas under congested conditions, queues may be extensive.
- Freeway merging segments are ramp junction areas where two separate traffic streams (mainline and on-ramp) join to form one stream on the mainline. The influence areas of merging segments depend on local traffic conditions.
- Freeway diverging segments are ramp junction areas where one traffic stream diverge to form two separate streams (mainline and off-ramp). The influence areas of merging segments depend on local traffic conditions.
- Weaving segments are areas of the freeway where two or more vehicle flows must cross paths along a length of the freeway in order to continue. They are usually formed when merge areas are closely followed by diverge areas.
- A major merge occurs when two multilane freeway segments combine to form a single freeway segment with three or more lanes. Likewise, a major diverge occurs when a freeway segment with three or more lanes splits into two multilane basic freeway segments. While these locations can create turbulence in the traffic flow, they are less restrictive than freeway ramps because speed differences are smaller and lane changes are often unnecessary.

Table 2 shows the LOS criteria for basic freeway, merge/diverge, and weaving segments.

Table 2
LOS Criteria for Basic Freeway, Merging/Diverging, and Weaving Segments

	Basic Freeway Segment	Ramp Merge/Diverge and Weaving Segments
LOS	Density (pc/lane mile)	Density (pc/lane mile)
A	0–11	0–10
B	11–18	10–20
C	18–26	20–28
D	26–35	28–35
E	35–45	>35
F	>45	Demand exceeds capacity (V/C>1)

LOS = level of service. pc/lane mile = passenger cars per lane mile. V/C = volume-to-capacity ratio.
Source: Highway Capacity Manual 2010.

LOS A represents the best operating conditions (unrestricted operations) while LOS F represents the worst operating conditions. LOS A through LOS D represent acceptable operating conditions. LOS E represents operating conditions at capacity. LOS F represents failing conditions (demand exceeds capacity).

The traffic operations analyses conducted by MPO staff were consistent with HCM methodologies. Using the data collected, MPO staff then built traffic analysis networks for the AM and PM peak hours using the 2010 Highway Capacity Software (HCS) to assess the capacity and quality of traffic flow at the two bottleneck areas.

Chapter 4—Location 1: I-93 Northbound between Exit 40 (Route 62) and Exit 41 (Route 125) in Wilmington

Study location 1 is a stretch of I-93 northbound in Wilmington. Figure 1 shows the location of the bottleneck within the MPO region. The northbound off- and on-ramps connect to and from Route 62 (Salem Street) and Route 125 (Ballardvale Street), and a service plaza. The bottleneck conditions form primarily during the PM peak period, when high volumes of rush hour traffic heads northbound on I-93. This interchange and the roadways are under the jurisdiction of the MassDOT Highway Division, located in District 4.

4.1 EXISTING FREEWAY CHARACTERISTICS

Operations at this bottleneck are associated with the following freeway components.

4.1.1 Basic Freeway Section

The basic freeway section of I-93 northbound has four 12-foot travel lanes, a 12-foot right shoulder, and a 6-foot left shoulder. This section carries approximately 4,000 to 5,500 vph during the AM peak period and 7,000 to 7,500 vph during the PM peak period.[10] The posted speed limit is 65 miles per hour (mph). Freeway exit signs are posted at one-mile and one-half-mile intervals to guide drivers to Routes 62 and 125.

4.1.2 Entrance Ramp

The entrance ramp from Route 62 to I-93 northbound is a one-lane, one-way roadway. It carries about 250 to 450 vph during the AM peak period and 250 to 400 vph during the PM peak period. The length of the acceleration lane for traffic entering the section from Route 62 westbound is approximately 300 feet long, and the design speed of the entrance ramp is presumed to be 25 mph (no posted speed limits observed).[11] Based on highway design and entrance ramp curve design speeds, the length of the acceleration lane does not meet MassDOT standards. The MassDOT Highway Division's current Project Development and Design Guide specifies a minimum acceleration lane of 1,220 feet for a freeway

[10] The AM peak period is 6:00 AM to 10:00 AM, and the PM peak period is 3:00 PM to 7:00 PM. Source: Central Transportation Planning Staff.

[11] Acceleration and deceleration lanes are measured from the point where the lane reaches 12 feet wide to the first controlling curve. Source: *A Policy on Geometric Design of Highways and Streets*, AASHTO, 2004. Chapter 10 Grade Separations and Interchanges.

facility with a design speed of 65 mph, an entrance ramp curve design speed of 25 mph, and a grade of two percent or less.[12]

4.1.3 Exit Ramp

The exit ramp from I-93 northbound to Route 125 is a one-way, one-lane roadway that gradually widens and splits into two approaches to connect Route 125 eastbound and westbound at the end of the ramp. The Route 125 eastbound (right-turn) approach has two lanes and the Route 125 westbound (left-turn) approach has only one lane, and the intersection is signalized. The ramp carries about 500 to 850 vph during the AM peak period and about 750 to 1,050 vph during the PM peak hour.

The length of the deceleration lane is approximately 400 feet long and the posted speed limit on the exit ramp is 30 mph. Based on highway design and exit ramp curve design speeds, the length of the deceleration lane is insufficient to meet the MassDOT design standards. The MassDOT Project Development and Design Guide specifies a minimum deceleration length of 440 feet for a freeway facility with a design speed of 65 mph, an exit ramp curve design speed of 35 mph, and a grade of two percent or less. The deceleration lane is the parallel type (at least half the length of the deceleration lane is parallel with the mainline) as recommended by the MassDOT design guide.

4.1.4 I-93/Route 125 Interchange

The exit ramp at Route 125 is signalized as part of a coordinated system that includes the traffic signals at I-93 southbound exit ramp and at Ballardvale Street. It is essential to ensure that traffic operations at the interchange would not cause traffic backup on the off-ramp into the I-93 northbound mainline, especially in the PM peak period when the ramp carries a high volume of traffic.

MPO staff conducted intersection capacity analyses and traffic simulations for the three intersections on Route 125 by using the Synchro traffic analysis and simulation program.[13] The PM peak hour analyses indicate that both intersections at the interchange operate at a desirable LOS A, and the

[12] Massachusetts Highway Department, *Project Development and Design Guide*, January 2006. The Guidebook describes the project development procedures and design guidelines applicable to projects with MassDOT Highway Division involvement. It provides guidance to municipalities, authorities, and other entities involved in the design and development of highways and streets, and other transportation facilities.

[13] Synchro Version 10.3 was used for the analyses. This software is developed and distributed by Trafficware Ltd. It can perform capacity analysis and traffic simulation (when combined with SimTraffic) for an individual intersection or a series of intersections in a roadway network.

intersection of Route 125 at Ballardvale Street operates at an acceptable LOS D. At the I-93 northbound off-ramp and Route 125 intersection, the off-ramp is evaluated to operate at LOS C, with an average queue length of about 100 feet and an estimated 95th percentile queue length of about 150 feet[14]. Traffic simulation runs showed no traffic queues from the ramp backing up into the I-93 northbound travel lanes.

4.2 PROBLEMS

The existing bottleneck creates an intense interruption of traffic flow primarily during PM peak travel periods, experienced by virtually all drivers in this section. Meanwhile, traffic on I-93 northbound is already congested during the same travel periods, due to a lane-drop bottleneck on the I-93 mainline about 1.2 miles downstream from this location.[15] Travel speeds on the freeway mainline in this section usually reduce to under 55 mph during the PM peak period. In addition, staff identified a number of crashes on I-93 northbound from Exit 40 to Exit 41, especially in the diverge area of the exit ramp to Route 125.

4.3 CAUSES

The following factors contribute to traffic congestion in this I-93 northbound section:

- A high volume of traffic during the PM peak hours
- A short acceleration lane at the ramp from Route 62
- A short deceleration lane at the ramp to Route 125
- Traffic congestion from I-93 northbound downstream bottleneck

4.3.1 High Traffic Volume

Figure 2 shows the traffic flows during the AM and PM peak periods. In the AM peak period (6:00–10:00), the I-93 mainline and the entrance and exit ramps generally carry moderate traffic volumes and do not cause serious traffic congestion. However, in the PM peak period (3:00–7:00), the I-93 mainline and the exit ramp carry high traffic volumes, causing traffic congestion at this bottleneck location.

4.3.2 Short Acceleration Lane

The short acceleration lane for the traffic entering I-93 northbound from Route 62 forces drivers to merge quickly and does not give them the distance needed to reach safe freeway speeds. Meanwhile, the merging maneuver is difficult during

[14] See Appendix D for detailed Synchro intersection-capacity analysis reports.

[15] I-93 northbound travel lanes reduce from four to three lanes about one mile north of the Route 125, near the Wilmington/Andover town line.

the PM peak period due to the congested conditions on the freeway mainline. The merging operation slows down I-93 mainline traffic, affecting traffic flow upstream from the merge location.

4.3.3 Short Deceleration Lane

Although the acceleration lane for the exit ramp to Route 125 is just short of MassDOT design standards, it carries a high volume of traffic during the PM peak hours. Under the congested conditions, drivers usually experience delays in reaching the exit ramp and occasionally some drivers would use the breakdown lane to access the ramp.

4.3.4 Traffic Congestion from I-93 Northbound Downstream Bottleneck

I-93 northbound reduces from four to three travel lanes about 1.2 miles downstream from this section. During the PM peak travel periods, traffic queues from the downstream bottleneck location frequently spill back into this section, increasing difficulties for the merging and diverging operations.

4.4 IMPACTS

4.4.1 Crashes

Table 3 presents a summary of the crashes in this segment. There were 102 crashes in this area based on MassDOT crash data from 2012–16. Figure 3 shows the location of these crashes. The majority of crashes (69 crashes to be exact) occurred near the off-ramp at Exit 41.

Table 3
Crash Summary (2012–16): Location 1—I-93 Northbound between Exit 40 (Route 62) and Exit 41 (Route 125)

Crash Variable	Number of Crashes
Crash severity	
Property damage only (none injured)	69
Non-fatal injury	31
Not reported	2
Fatal injury	0
Manner of collision	
Rear-end	57
Single vehicle crash	25
Angle	9
Sideswipe, same direction	11
Sideswipe, opposite direction	0
Head-on	0
Not reported	0
Road surface conditions	
Dry	89
Wet	9
Snow/Ice	4
Unknown	0
Ambient light conditions	
Daylight	79
Dark—roadway not lighted	17
Dark—lighted roadway	4
Dusk	2
Dawn	0
Not reported	0
Weather conditions	
Clear	66
Cloudy	17
Unknown	11
Rain	5
Snow	3
Travel period	
Weekday evening peak period	38
Other	64
Total crashes	102

Note: The weekday evening peak period is 3:00 PM to 7:00 PM from Monday through Friday.
Source: Central Transportation Planning Staff.

A summary of the crashes in this segment are as follows:

- 30 percent of the crashes resulted in injury
- 56 percent of the crashes were rear-end collisions
- 25 percent of the crashes were single vehicle collisions
- 37 percent of the crashes occurred during the PM peak travel periods
- 77 percent of the crashes occurred under daylight conditions
- 87 percent of the crashes occurred under dry roadway conditions

4.4.2 Travel Speed

Figure 4 is a congestion scan that covers the I-93 northbound stretch about three miles upstream and downstream of this study location. It shows the average travel speeds on I-93 northbound from the Concord Road interchange (Exit 39) to the Dascomb Road interchange (Exit 42). The 2015 spring and fall midweek Tuesday to Thursday travel time data (provided by INRIX) were used for this analysis.[16]

Travel speeds at the study location, in most cases, reduce to under 55 mph from 2:45 PM to 3:15 PM and from 4:30 PM to 6:00 PM. Travel speeds during the AM peak are less affected, and remain greater than 55 mph. The congestion scan shows that the downstream lane drop location (approximately at the 36.5-mile marker) is actually a more severe bottleneck than this study location. Travel speeds generally reduce to under 45 mph from 2:30 PM to 3:30 PM and from 4:30 PM to 6:00 PM. Field observations indicate that I-93 northbound traffic queues frequently extend from this location to the vicinity of the Route 62 interchange. The congestion scan also shows an interesting dual-peak phenomenon (2:30–3:30 PM and 4:30–6:00 PM) at the lane-drop bottleneck location. It is a combined effect of the lane drop bottleneck and the travel demand management strategy (use of the shoulder as a travel lane during the PM peak period), currently applied to the I-93 sections downstream use of the breakdown lane.

During the weekday PM period from 3:00 to 7:00, travel in the I-93 northbound breakdown lane is permitted beginning approximately a quarter mile north of the lane drop all the way to the north side of Merrimack River before Exit 46. The first wave of congestion begins around 2:30 PM when I-93 traffic gradually increases but travel in the breakdown lane is prohibited. After 3:00 PM, when travel in the breakdown lane is permitted, traffic congestion gradually dissipates. The severe congestion begins after 4:00 PM, and peaks around 5:30 PM. The congestion

[16] INRIX is a private company headquartered in Kirkland, Washington. It provides location-based data and analytics, such as traffic and parking, to automakers, cities and road authorities worldwide.

gradually dissipates after 6:00 PM, when the I-93 northbound sections carry most commuter traffic heading home in the north.

4.4.3 Level of Service

MPO staff conducted traffic operations analyses consistent with HCM methodologies. Using data from MassDOT, MPO staff built traffic analysis networks for the AM and PM peak hours with the HCS suite to assess the capacity and quality of traffic flow at the bottleneck area.[17] Full HCS reports are included in Appendix D.

Table 4 presents the results of the LOS analyses for existing conditions at Location 1. It contains the HCM merging and diverging analyses. The section between the merge area and diverge area was not analyzed as a basic freeway section because it is shorter than 1,000 feet and it is entirely within the merge and diverge influence areas.[18]

[17] Highway Capacity Software 7, Version 7.3, McTrans Center, PO Box 116585, Gainesville, Florida, 2017.

[18] For right-hand on-ramps, HCM defines the merge influence area to include the acceleration lane(s) and Lanes 1 and 2 of the freeway mainline (rightmost and second rightmost) for a distance of 1,500 feet downstream of the merge point. For right-hand off-ramps, the diverge influence area includes the deceleration lane(s) and Lanes 1 and 2 of the freeway mainline for a distance of 1,500 feet upstream of the diverge point. At this study location, the merge influence area overlaps with the diverge influence area for about 1,000 feet.

Table 4
LOS Analysis–Existing Conditions: Location 1—I-93 Northbound between Exit 40 (Route 62) and Exit 41 (Route 125)

Location	Peak Hour	Density (pc/lane mile)	Speed (mph)[a]	V/C Ratio[b]	LOS[c]
HCM Analysis Type: Merge Area[d]	--	--	--	--	--
Ramp from Route 62	AM	24.4	62.1	0.64	C
Ramp from Route 62	PM	30.8	59.9	0.88	D
HCM Analysis Type: Diverge Area	--	--	--	--	--
Exit 41 to Route 125	AM	27.1	55.3	0.64	C
Exit 41 to Route 125	PM	36.9	54.4	0.88	E

[a] Refers to ramp influence area speed for merge/diverge areas.
[b] Refers to the freeway section's volume-to-capacity ratio.
[c] LOS A through LOS D represent acceptable operating conditions; LOS E represents operating conditions at capacity; and LOS F represents failing conditions (demand exceeds capacity).
[d] In HCM merge and diverge analyses, acceleration and deceleration lanes are measured from the tip of the painted gore to the end of the taper. This may differ from the AASHTO length. AASHTO, or The American Association of State Highway Transportation Officials, is a nonprofit, nonpartisan association representing highway and transportation departments in the 50 states, the District of Columbia, and Puerto Rico. It represents all transportation modes, including air, highways, public transportation, active transportation, rail, and water. Its primary goal is to foster the development, operation, and maintenance of an integrated national transportation system.
HCM = Highway Capacity Manual. LOS = level of service. mph = miles per hour. pc/lane mile = passenger cars per lane mile. V/C = volume-to-capacity. vph = vehicles per hour.

Table 4 illustrates that both areas operate at LOS C during the AM peak hour, while the merge area operates at LOS D and the diverge area operates at LOS E during the PM peak hour. The PM peak-hour analysis shows that the diverge area has a high density of vehicles, causing delay for the traffic exiting to Route 125. Traffic congestion on I-93 northbound mainline frequently builds up from the downstream lane-drop location to the vicinity of this location, adding difficulties to the diverge operation. In addition, the estimated freeway speeds in the PM peak hour could be somewhat higher than the observed speeds (see Figure 4), as the downstream bottleneck congestion is not applicable to the HCM analyses.

4.5 IMPROVEMENT ALTERNATIVES

The analyses identified that the on-ramp acceleration length and the off-ramp deceleration length do not meet MassDOT standards. A simple solution could be to extend their lengths; however, it would not be suitable at this location. As the two ramps are located in close proximity (about 1,600 feet), further extending the acceleration or deceleration length and reducing the space in between would

potentially increase crash risk.[19,20] The analyses also identified that one of the key problems at this location is the I-93 mainline congestion, causing difficulties for the merge and diverge maneuvers. However, this congestion is mainly due to the downstream lane drop bottleneck.

Under these conditions, there are not many applicable low-cost improvement alternatives. However, MPO staff developed two improvement alternatives to address safety and operational issues at this location. These improvements include:

- Alternative 1: Create an auxiliary lane for merging and diverging traffic
- Alternative 2: Examine potential improvements at the downstream lane drop location

4.5.1 Alternative 1: Create an Auxiliary Lane for Merging and Diverging Traffic

An auxiliary lane is defined as the portion of the roadway adjoining the traveled freeway for speed change, merging, diverging, weaving, and other purposes supplementary to through-traffic movement. Alternative 1 would create an auxiliary lane between the on-ramp at Exit 40 and the off-ramp at Exit 41. This lane would extend the distance available for merging or diverging traffic maneuvers and would provide sufficient distance to accommodate speed changes and vehicle weaving. The auxiliary lane would also upgrade the acceleration lane to meet MassDOT standards.

Figure 5 shows the improvements recommended in Alternative 1, including:

- Restriping I-93 northbound between Exit 40 and Exit 41 (about one-third of a mile) to accommodate a fifth 12-foot auxiliary lane on the right. This would bring the total lane width to 60 feet along this distance. Using the existing paved area on both the left and right shoulders would provide the required additional width. The highway alignment would also need to be shifted to the left by approximately two feet to accomplish this. It would reduce the left shoulder to approximately four feet and the right shoulder to a minimum of two feet.
- Relocating existing guide signs or installing new guide signs and pavement markings to direct drivers to merge onto the mainline or to use Exit 41.

[19] Ramp spacing is defined as the distance between the painted tips of successive ramps. As in this case, both the entrance and exit ramps are the parallel type; the spacing is estimated at the end of the solid white line extending from the painted tip of the two ramps.

[20] *Guidelines for Ramp and Interchange Spacing*, NCHRP (National Cooperative Highway Research Program) Report 687, Transportation Research Board, Washington D.C., 2011.

- Modifying pavement markings to delineate the auxiliary lane from the mainline travel lanes.

Although improvements could be made, Alternative 1 does present some design difficulties. First, the less-than-minimal right shoulder areas would require a design exception report. When conditions warrant, a design exception may be granted for a project design that proposes one or more controlling substandard design elements if it can be documented that a lesser design is the best practical alternative. Second, while the paved shoulder along this stretch of highway is wide enough to accommodate an extra travel lane, it is not wide enough to fit an additional emergency pullover or stopping area. Any such area would require additional paving and grading work due to a moderate slope to the right of the roadway.

4.5.2 Alternative 2: Examine Potential Improvements at the Downstream Lane Drop Location

This study identified that traffic congestion at this bottleneck location is mainly caused by a downstream bottleneck where the I-93 northbound mainline reduces from four to three lanes. Traffic operations at this location would be improved if the congested conditions from the downstream bottleneck can be substantially decreased. One possible solution is to open up the breakdown lane for travel earlier downstream of the bottleneck. Based on observations throughout the region, it is acknowledged that the peak congestion periods are expanding, so opening the breakdown lane may help to alleviate this bottleneck. However, this solution is beyond the scope of the current study.

4.6 EFFECTIVENESS AND COST OF THE IMPROVEMENTS

Table 5 presents the 2030 future LOS analyses compiled using HCS software, and compares the results from the no-build scenario and Alternative 1, where modifications would affect system operations. Full HCS reports are included in Appendix D. All scenarios use a uniform four percent growth for 2030 traffic volumes estimated based on the MPO regional travel demand model for this study area. Alternative 2 is a proposed future study and therefore, not included in Table 5. Approximations made as part of the HCM analysis are provided when applicable.

Table 5
2030 LOS Analysis–No-Build and Improvement Alternative 1 for Location 1—I-93 Northbound between Exit 40 (Route 62) and Exit 41 (Route 125)

Scenario and HCM Analysis Type	Peak Hour	Density (pc/lane mile)	Speed (mph)[a]	V/C Ratio[b]	LOS[c]
No-Build: Merge Area HCM Analysis	--	--	--	--	--
Ramp from Route 62	AM	25.3	61.9	0.67	C
Ramp from Route 62	PM	32.2	59.1	0.92	D
No-Build: Diverge Area HCM Analysis	--	--	--	--	--
Exit 41 to Route 125	AM	28.3	55.1	0.67	D
Exit 41 to Route 125	PM	38.5	54.3	0.92	E
Alternative 1: Weaving Segment HCM Analysis	--	--	--	--	--
I-93 northbound between Exit 40 and Exit 41	AM	21.9	57.2	0.61	C
I-93 northbound between Exit 40 and Exit 41	PM	32.3	53.6	0.83	D

[a] Refers to ramp influence area speed for merge/diverge areas and average of weaving and non-weaving speeds for the weaving segment.
[b] Refers to the freeway section's volume-to-capacity ratio.
[c] LOS A through LOS D represent acceptable operating conditions; LOS E represents operating conditions at capacity; and LOS F represents failing conditions (demand exceeds capacity).
HCM = Highway Capacity Manual. LOS = level of service. mph = miles per hour. pc/lane mile = passenger cars per lane mile. V/C = volume-to-capacity. vph = vehicles per hour.

A crash modification factor (CMF) is an estimate of the change in crashes expected after the implementation of a countermeasure. Using CMFs from the HSM and the CMF Clearinghouse show that adding continuous auxiliary lanes for weaving between the entrance ramp and the exit ramp would reduce crashes by 20 to 25 percent.[21,22] In addition, the LOS for Exit 41 would improve from D to C during the AM peak and from E to D during the PM peak by lengthening the acceleration lane. However, the merge from Route 62 would remain at LOS C in the AM peak and LOS D in the PM peak.

Implementing the changes in Alternative 1 would require pavement restriping to shift the northbound highway alignment to the left by approximately two feet, beginning at Exit 40 and extending to Exit 41. No right-of-way acquisition, pavement widening, or alignment changes should be required, other than providing an emergency pullover, if needed. Alternative 1 is estimated to cost

[21] American Association of State Highway and Transportation Officials. Highway Safety Manual. Washington, DC, 2010.
[22] Crash Modification Factors Clearinghouse. The Crash Modification Factors Clearinghouse provides a searchable online database of CMFs along with guidance and resources on using CMFs in road safety practice. www.cmfclearinghouse.org/index.cfm.

between $50,000 and $75,000 to construct and would require realignment of the lanes, pavement restriping, relocating existing guide signs or installing new guide signs, and adding pavement markings.

4.7 RECOMMENDATIONS

MPO staff recommends Alternative 1 because of the beneficial effects on safety and operational efficiency. Alternative 1 provides more space for entering and exiting traffic to move to and from the mainline travel lanes and would potentially reduce crashes in this I-93 northbound section. In addition, staff recommends studying possible alternatives, similar to those presented in Alternative 2, as a proposed future study for the I-93 northbound lane drop bottleneck about 1.2 miles downstream from this location. Traffic operations and crash risk at this location would be greatly improved if the congested conditions from the downstream bottleneck could be substantially decreased.

Chapter 5—Location 2: I-93 Southbound Segment at the End of the HOV Zipper Lane in Quincy and Braintree

The affected segment, approximately 0.8 miles long, extends from the beginning of Furnace Brook Parkway on-ramp at Exit 7 to the Route 3 diverge at Exit 8. The interchange and freeway, which are located in District 6, are under the jurisdiction of the MassDOT Highway Division. Figure 1 shows the location of the bottleneck within the MPO region. It is located on the I-93 southbound barrel at the end of the HOV zipper lane. The bottleneck occurs during PM peak southbound HOV lane operations, which begins at 3:00 PM and ends at 7:00 PM. This bottleneck is where traffic merges and weaves in order to continue onto I-93 southbound or Route 3 southbound. It is also where the on-ramp from Furnace Brook Parkway merges onto I-93 southbound. Just 0.4 miles north of the end of the HOV zipper lane exit, traffic heading to Route 3 southbound diverges off I-93.

5.1 EXISTING FREEWAY CHARACTERISTICS

5.1.1 Basic Freeway Section

The basic freeway section is about 1,000 feet long when the HOV lane is in operation. It has four 12-foot travel lanes, and an 11- to 12-foot right shoulder. There is no left shoulder at this section because of HOV lane operations during peak travel periods and storage of the zipper barriers during off-peak travel periods.

5.1.2 Entrance Ramps

There are two ramp merge areas relevant to this bottleneck location: the on-ramp from Furnace Brook Parkway and the HOV lane exit. Furnace Brook Parkway is a one-lane, on-ramp with an 800-foot acceleration lane.[23] Traffic in the HOV lane exits and merges with the mainline traffic about 200 feet north of Furnace Brook Parkway. The exit and merge area of the HOV is about 1,000 feet long.

5.1.3 Exit Connector

The Exit 7 connector to Route 3 southbound is a two-lane major diverge with design speed similar to that of the freeway. It is important to note that

[23] Acceleration and deceleration distances are measured from the point where the lane reaches 12 feet wide to the first controlling curve. Source: *A Policy on Geometric Design of Highways and Streets*, AASHTO, 2004. Chapter 10 Grade Separations and Interchanges.

downstream bottlenecks on Route 3 southbound during the PM peak travel period create a traffic queue that extends into the subject bottleneck and exacerbates traffic conditions.

5.2 PROBLEMS

The existing bottleneck creates a recurring long traffic queue on the mainline, which extends five miles northerly to Columbia Road in Dorchester. It reduces traffic flow to stop-and-go conditions with average travel speeds of less than 25 mph, even though the posted speed limit is 55 mph. In addition, the congested conditions lead to many crashes, pollution, and high person-hours of delay.

5.3 CAUSES

Physical design constraints and operational conflicts inherent in the location create the bottleneck, including the following:

- Lane drop: One or more travel lanes end, requiring traffic to merge onto the mainline.
- Weaving areas: Drivers must change lanes or cross each other's path along a length of the freeway in order to continue on I-93 southbound or Route 3 southbound.
- Merge areas: Furnace Brook Parkway on-ramp traffic merges with mainline traffic to enter the freeway and then, shortly ahead, traffic in the HOV lane exits and merges with the mainline traffic.
- Major diverge: High-volume traffic from the freeway diverges to Route 3 southbound at Exit 8.

At the bottleneck, traffic from six lanes (four on the mainline and one each on the HOV lane and the on-ramp from Furnace Brook Parkway) are forced onto four travel lanes in a short segment about 1,500–2,000 feet long. In addition, a high number of lane-changing maneuvers (merging, weaving, and diverging) take place within the segment to disperse traffic to continue on I-93 southbound or head to Route 3 southbound. These factors along with the close proximities of the merge and diverge areas dramatically reduce capacity in the segment.

Figure 6 shows the PM peak-period traffic volumes. During this period, when the HOV lane is in operation, the entry ramp from Furnace Brook Parkway serves about 600 vph while the HOV lane serves an average of 1,200 vph. The mainline serves about 3,500 vph. Traffic data are included in Appendix B.

In all, the bottleneck serves between 5,200 vph and 5,400 vph while the traffic demand is around 8,000 vph during PM peak periods. This suggests that traffic

demand at the bottleneck greatly exceeds the capacity and results in a long traffic queue trailing the bottleneck for over five miles to Columbia Road in Dorchester. Interestingly, between 2:00 PM and 3:00 PM when the HOV is not in operation, the four I-93 southbound lanes carry around 6,000 vph, which is even greater than the volume when the HOV lane is operation.[24]

5.4 PREVIOUS CONFIGURATION

Over the years, there have been several lane reconfigurations at the bottleneck to address safety operations and safety issues. The current configuration started in 2014. Before that, the mainline had the same four lanes; however, about 1,000 feet to the diverge to Route 3 southbound, the lane next to the rightmost lane widened to about 22 feet, which was used as a shared lane for traffic heading to either Route 3 southbound or continuing on I-93 southbound. In effect, three lanes headed to Route 3 southbound and two lanes went to I-93 southbound.

Assessment of the current configuration indicates that it reduces the lane changing maneuvers at the bottleneck and streamlines traffic heading to Route 3 southbound in anticipation of downstream bottlenecks. While the current configuration has safety benefits, a tradeoff to this may be reduced traffic flow.

5.5 IMPACTS

5.5.1 Crashes

Table 6 presents a summary of the crashes at the bottleneck. There were 132 crashes in this section between 2012 and 2016 (Appendix C). Figure 7 shows the location of these crashes. The majority, 108 of the crashes, occurred near the diverge area at Exit 7. Interestingly, the number of crashes between 2012 and 2016 (132 crashes) represent a 10 percent reduction to the five-year total between 2005 and 2009 (146 crashes). This suggests that the change in lane configuration around 2013 significantly influenced crash frequency. Figure 8 shows the location of the 31 crashes that occurred in the same period when the HOV lane is in operation, which represents 23 percent of the crashes.

[24] The AM peak period is 6:00 AM to 10:00 AM, and the PM peak period is 3:00 PM to 7:00 PM. Source: Central Transportation Planning Staff.

Table 6
Location 2—I-93 Southbound at the End of the HOV Zipper Lane: Five-Year Crash Summary (2012–16)

Crash Variable	All Crashes	Peak-Period Crashes
Crash severity	—	
Non-fatal injury	37	4
Property damage only (none injured)	90	26
Not reported	5	1
Manner of collision	—	
Rear-end	71	22
Single vehicle crash	24	2
Sideswipe, same direction	22	4
Angle	13	2
Not reported	2	1
Road surface conditions	—	
Dry	109	27
Wet	18	3
Snow/Ice	4	0
Unknown	1	1
Ambient light conditions	—	
Daylight	85	25
Dark—lighted roadway	45	5
Not reported	1	1
Dark–roadway not lighted	1	0
Weather conditions	—	
Clear	91	24
Cloudy	15	1
Unknown	11	4
Rain	11	2
Snow	4	0
Travel period	—	
Weekday evening peak period	31	31
Other	101	0
Total crashes	132	31

Note: Weekday evening peak period is 3:00 PM to 7:00 PM Monday through Friday.
Source: Central Transportation Planning Staff.

A summary of the crashes in this segment are as follows:

- Twenty-eight percent of the crashes resulted in injury
- The largest share of crashes (54 percent) were rear-end crashes

- Many of the rear-end and sideswipe crashes were caused by drivers changing lanes, merging or diverging
- Forty-seven crashes (36 percent) occurred outside of daylight conditions, including the one unreported crash
- Eighty-three percent of the crashes occurred on dry roadway conditions
- Sixty-four percent of the crashes occurred outside daylight conditions

5.5.2 Travel Speed

Figure 9 is a congestion scan that shows the average travel speeds on I-93 southbound at the bottleneck. Based on these data, the bottleneck reduces travel speeds to less than 25 mph between the hours of 3:00 PM and 7:00 PM. Vehicle speeds this far below free-flow speed correlate with LOS F conditions on the freeway. In addition, speeds at this bottleneck can fall to less than 25 mph and stay that low for two to three hours. The congestion scan also shows severe slowdowns (queue) trailing the bottleneck. The gradual relief after the bottleneck suggests that the HOV lane merge and Furnace Brook Parkway on-ramp merge are not the only causes of congestion, and that more issues are present further downstream on I-93 southbound and Route 3 southbound.

5.5.3 Level of Service

Traffic operations at the bottleneck are complex as merging, diverging, and weaving maneuvers all take place within the segment at the same time. MPO staff conducted traffic operations analyses consistent with HCM methodologies. Using the MassDOT data, MPO staff built traffic analysis networks for the PM peak hours with the HCS suite to assess the capacity and quality of traffic flow at the bottleneck area.[25] The analyses included

- merge analysis of the HOV lane;
- merge analyses of the on-ramp from Furnace Brook Parkway;
- weave analysis of the traffic from HOV lane to I-93 southbound; and
- weave analysis of the traffic from the Furnace Brook Parkway on-ramp to Route 3 southbound.

The HCM methodology has some limitations concerning weaving analysis, as it does not address the following conditions, which exist at the bottleneck, such as:

- Special lanes, for example, HOV lanes within weaving segments
- Specific operating conditions when oversaturated conditions exist
- Effects of downstream or upstream congestion
- Multiple weaving segments

[25] Highway Capacity Software 7, Version 7.3, McTrans Center, PO Box 116585, Gainesville, Florida, 2017.

Some simplifications were necessary to align the HCS model with observed conditions, such as the breaking up of multiple weave segments into merge and simple weave segments for analysis.

Table 7 presents the results of the LOS analyses for existing conditions. The results indicate that traffic in the HOV lane and Furnace Brook Parkway on-ramp operate at LOS D when they merge with the mainline traffic. In addition, the analyses indicate that traffic operating conditions at the weaving segment (where traffic weaves from the HOV lane, Furnace Brook Parkway on-ramp, and the freeway onto Route 3 southbound and I-93 southbound) is LOS F. Full HCS reports are included in Appendix D.

Based on these analyses, the primary cause of the bottleneck is intense weaving due to a lack of lane balance rather than merging or diverging conditions. The volume-to-capacity (v/c) ratios for the weaving segment was 1.4, meaning that the traffic demand is higher than maximum throughput of the weave segment with the given features. HCS suite does not provide density and speed data for scenarios that result in LOS F or have a v/c greater than 1.0.

Table 7
Location 2—I-93 Southbound at the End of the HOV Zipper Lane: Existing Conditions LOS Analysis

Scenario	Analysis Type	Density [a] (pc/lane mile)	Speed [a] (mph)f	V/C Ratio [b]	LOS [c]
HOV lane merge	Merge	38.4	48.7	0.84	D
Furnace Brook Parkway on-ramp merge	Merge	42.7	49	0.93	D
Weaving from HOV lane to Route 3 southbound (one-sided)	Weave	--	--	1.41	F
Weaving from Furnace Brook Parkway to I-93 southbound (one-sided)	Weave	--	--	1.21	F
Weaving from HOV lane to I-93 southbound (two-sided)	Weave	--	--	0.85	F
Weaving from Furnace Brook Parkway to Route southbound (two-sided)	Weave	36	47	0.78	E

[a] HCM does not provide density and speed data for scenarios that result in LOS F.
[b] Refers to the freeway section's v/c ratio.
[c] LOS A through LOS D represent acceptable operating conditions; LOS E represents operating conditions at capacity; and LOS F represents failing conditions (demand exceeds capacity).
HCM = Highway Capacity Manual. HOV = high-occupancy vehicles. LOS = level of service. mph = miles per hour. pc/lane mile = passenger cars per lane mile. v/c = volume-to-capacity. vph = vehicles per hour.
Source: Central Transportation Planning Staff.

5.6 IMPROVEMENT ALTERNATIVES

MPO staff developed the following improvements to address safety and operational issues at the bottleneck. These improvements include:

- Alternative 1: Lengthen the distance of the HOV lane merge
- Alternative 2: Lengthen the acceleration lane distance for Furnace Brook Parkway on-ramp
- Alternative 3: Alternatives 1 and 2 combined

All three alternatives have the objective of lengthening the merging and weaving segments to give drivers more space to carry out their intended maneuvers.

5.6.1 Alternative 1: Lengthen the Distance for the HOV Merge

Alternative 1 would move the HOV exit about 600 feet further north to lengthen the distance in which HOV traffic merges with the mainline traffic. The extension is expected to provide HOV lane drivers with ample distance for merging and weaving safely and comfortably to continue on I-93 southbound and Route 3 southbound. Figure 10 shows the improvements recommended in Alternative 1.

5.6.2 Alternative 2: Lengthen Acceleration Distance for Furnace Brook Parkway On-Ramp

Figure 11 shows the improvements recommended in Alternative 2. Alternative 2 would extend the acceleration lane distance for the Furnace Brook Parkway on-ramp about 600 feet using the existing right shoulder. An 11- to 12-foot right shoulder exists along the entire length of the bottleneck.

5.6.3 Alternative 3: Alternatives 1 and 2 Combined

Alternative 3 combines the improvement recommendations of both Alternatives 1 and 2 for added benefits.

5.7 EFFECTIVENESS AND COST OF THE IMPROVEMENTS

The improvement alternatives were analyzed using a total growth factor of five percent over the existing traffic demand to project short-term traffic volumes in 2030. Because the traffic operations at the bottleneck are at capacity for the entire four-hour PM peak period, it is likely that any growth in traffic demand would worsen the queue trailing the bottleneck.

5.7.1 HCS Analysis Results

Table 8 presents the results of the 2030 LOS analyses compiled using the HCS suite. The HCS analyses results show marginal benefits with the recommended

improvements but does not appear to reduce the impacts of intense weaving at the bottleneck, resulting in a LOS F for all weaving analyses.

Table 8
Location 2—I-93 Southbound at the End of the HOV Zipper Lane: 2030 Future LOS Analysis

Scenario	Analysis Type	Density [a] (pc/lane mile)	Speed [a] (mph)f	V/C Ratio [b]	LOS [c]
HOV lane merge	--	--	--	--	--
Existing	Merge	38.4	48.7	0.84	D
Alternative 1	Merge	38.6	49.7	0.86	D
Alternative 2	Merge	39.2	48.6	0.86	D
Alternative 3	Merge	38.6	49.7	0.86	D
Furnace Brook Parkway on-ramp merge					
Existing	Merge	42.7	49	0.93	D
Alternative 1	Merge	43.4	49	0.94	D
Alternative 2	Merge	43.2	50	0.94	C
Alternative 3	Merge	43.2	50	0.94	C
Weaving from HOV lane to Route 3 southbound (one-sided)					
Existing	Weave	--	--	1.41	F
Alternative 1	Weave	--	--	1.42	F
Alternative 2	Weave	--	--	1.42	F
Alternative 3	Weave	--	--	1.41	F
Weaving from Furnace Brook Parkway on-ramp to I-93 southbound (one-sided)					
Existing	Weave	--	--	1.21	F
Alternative 1	Weave	--	--	1.27	F
Alternative 2	Weave	--	--	1.27	F
Alternative 3	Weave	--	--	1.27	F
Weaving from HOV lane to I-93 southbound (two-sided)					
Existing	Weave	--	--	0.85	F
Alternative 1	Weave	--	--	0.83	F
Alternative 2	Weave	--	--	0.87	F
Alternative 3	Weave	--	--	0.83	F
Weaving from HOV lane to I-93 southbound (two-sided)					
Existing	Weave	36.0	47	0.78	E
Alternative 1	Weave	37.6	40	0.78	E
Alternative 2	Weave	37.6	40	0.78	E
Alternative 3	Weave	37.6	40	0.78	E

[a] HCM does not provide density and speed data for scenarios that result in LOS F.
[b] Refers to the freeway section's volume-to-capacity ratio.
[c] LOS A through LOS D represent acceptable operating conditions; LOS E represents operating conditions at capacity; and LOS F represents failing conditions (demand exceeds capacity).
HCM = Highway Capacity Manual. HOV = heavy-occupancy vehicle. LOS = level of service. mph = miles per hour. pc/lane mile = passenger cars per lane mile. v/c = volume-to-capacity. vph = vehicles per hour.
Source: Central Transportation Planning Staff.

5.7.2 VISSIM Simulation Results

In addition to the HCS suite, MPO staff used VISSIM traffic simulation software to analyze future traffic operations at the bottleneck.[26] Due to the complex nature of the bottleneck and limitations of the HCS analyses, VISSIM was used to account for all the maneuvers at the bottleneck simultaneously. Table 9 presents the results of the VISSIM analyses for the existing conditions and improvement alternatives. The primary performance measure in the simulation analysis was the total volume of traffic simulated through the bottleneck—the higher the total volume, the more effective the alternative. The results show that separately, Alternatives 1 and 2 would have minimal effect on the bottleneck and the trailing queue. VISSIM simulations show that while Alternative 3 may improve traffic operations at the bottleneck to some extent, it would not be able to reduce the trailing traffic queue significantly.

Table 9
Location 2—I-93 Southbound at the End of the HOV Zipper Lane: Traffic Simulation Analysis

Scenario	Total Volume Simulated (vph)	Average Speed (mph)
Existing	5,300	19
Alternative 1	5,500	22
Alternative 2	5,400	20
Alternative 3	5,900	23

HOV = high-occupancy vehicle. mph = miles per hour. vph = vehicles per hour.
Source: Central Transportation Planning Staff.

5.7.3 Costs

Alternative 1 is estimated to cost between $300,000 and $500,000 to construct. This estimate includes the relocation of existing median barriers, preparing the median area for staging HOV operations, restriping travel lanes, and the relocation and installation of signs and pavement markings.

Alternative 2 is estimated to cost between $100,000 and 300,000 to construct, and would require restriping travel lanes, possibly repaving, relocating rumble strips, creating an emergency pullover lane, and drainage systems.

Alternative 3 is estimated to cost about $1.0 million to construct, and includes all of the same items listed for Alternatives 1 and 2.

[26] VISSIM, PTV Group America, 1530 Wilson Blvd. Suite 510 Arlington VA 22209 United States.

5.8 RECOMMENDATIONS

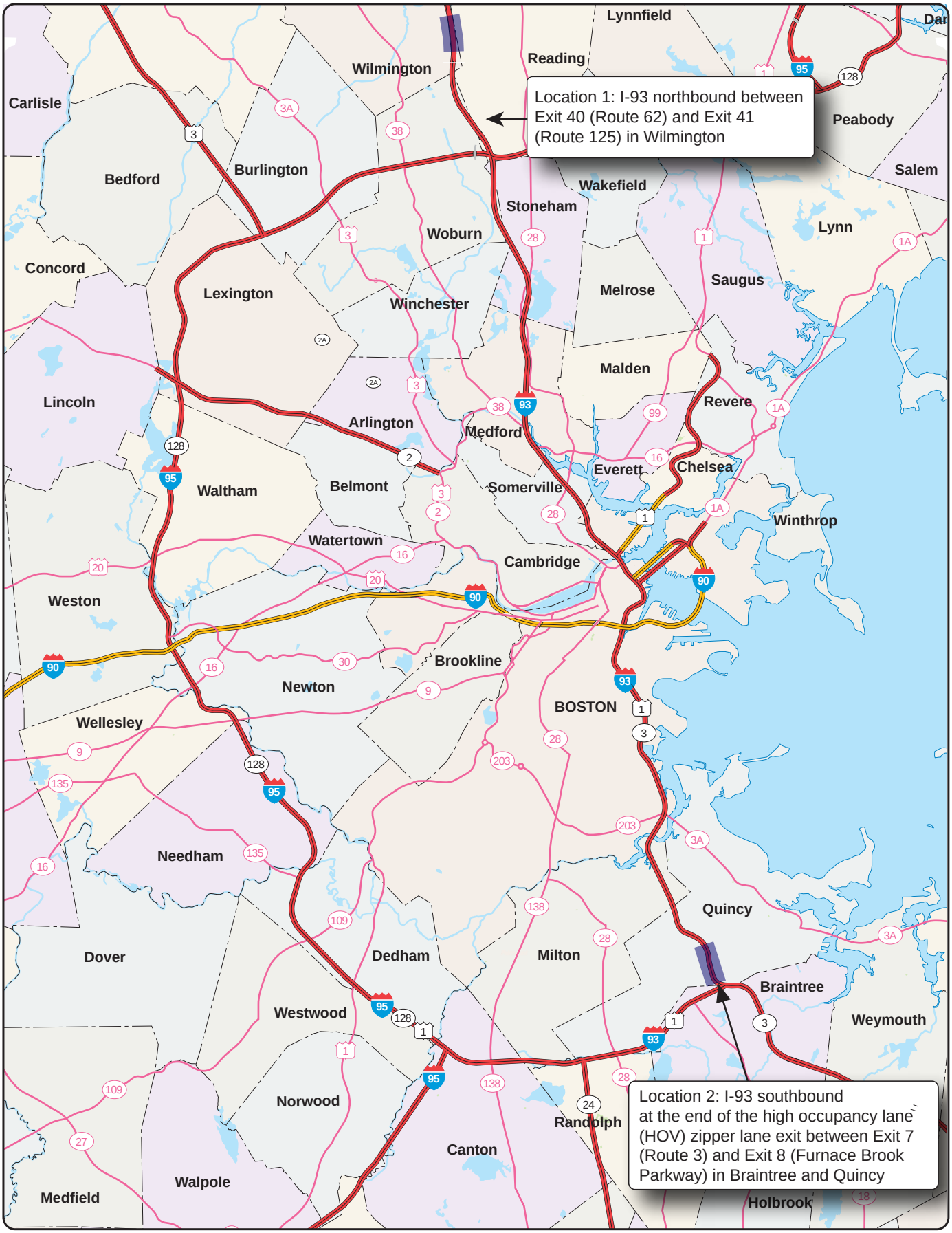
MPO staff recommends Alternative 1, as it produces safety and operational benefits.

The HOV lane is a contra-flow reversible lane meaning that a lane is borrowed from the off-peak direction to serve the peak direction. The HOV lane heads northbound in the morning peak period using a lane borrowed from the southbound direction, and in the afternoon peak period, that operation is reversed. Both the morning and afternoon HOV operations share a common space for staging and operations. Because of the shared space, the space requirements for the proposed improvements would need further evaluation regarding HOV staging and operations for the morning northbound HOV operations. MPO staff advises further consultation with personnel involved with HOV lane operations and maintenance.

Alternative 2 would have operational improvements during the PM peak period; however, it would also eliminate the existing shoulder for disabled vehicles. Another concern with Alternative 2 is that drivers would choose to enter the longer acceleration lane to "bypass" slow traffic in the general travel lanes. For these concerns, MPO staff cannot recommend Alternatives 2 and 3 without further assessment of safety and operational effects.

Chapter 6—Conclusion and Next Steps

MPO staff, working in conjunction with the MassDOT Highway staff, identified, developed, and evaluated improvements for two bottleneck locations in the MPO region. The study provides the MassDOT Highway Division with an opportunity to assess the most critical needs at the two bottleneck locations and to start planning design and engineering efforts. If implemented, these low-cost, short-term improvements would increase traffic safety, make traffic operations more efficient, and reduce congestion at the bottlenecks. The study aligns with the MPO's goals of managing capacity and improving mobility, and increasing safety on the region's highway system.



BOSTON REGION MPO

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Figure 1
Regional Map of Study Areas

Low-Cost Improvements to Express-Highway Bottleneck Locations

BOSTON REGION MPO

Figure 2
Location 1—I-93 Northbound between Exit 40 (Route 62) and Exit 41 (Route 125): Peak Period Traffic Volumes

Low-Cost Improvements to Express-Highway Bottleneck Locations

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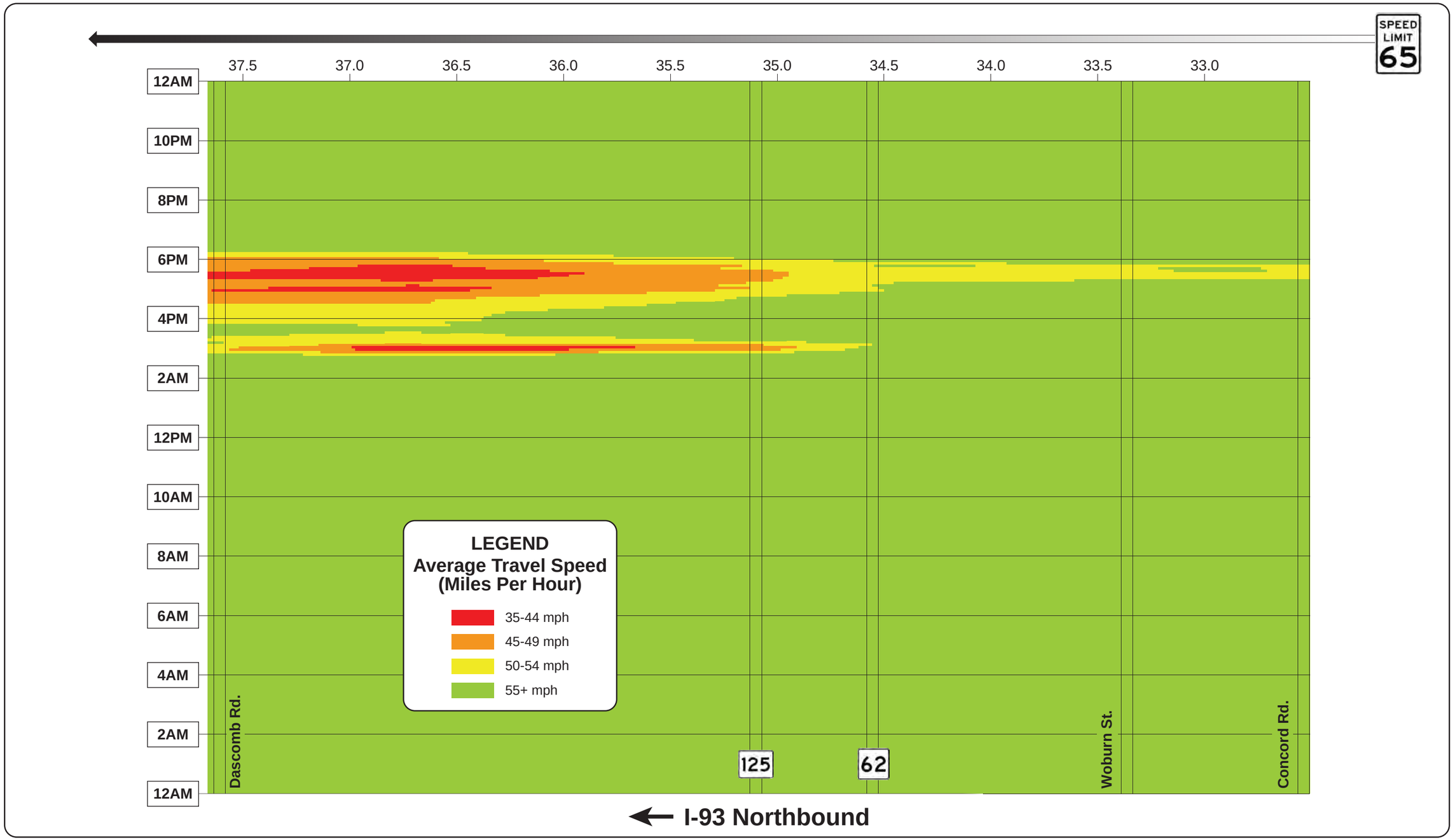
Figure 3
Location 1— I-93 Northbound between Exit 40 (Route 62) and Exit 41 (Route 125):
Location and Number of Crashes

Low-Cost Improvements
to Express-Highway
Bottleneck Locations



BOSTON REGION MPO

Figure 4
Location 1—I-93 Northbound between Exit 40 (Route 62) and Exit 41 (Route 125): Congestion Scan

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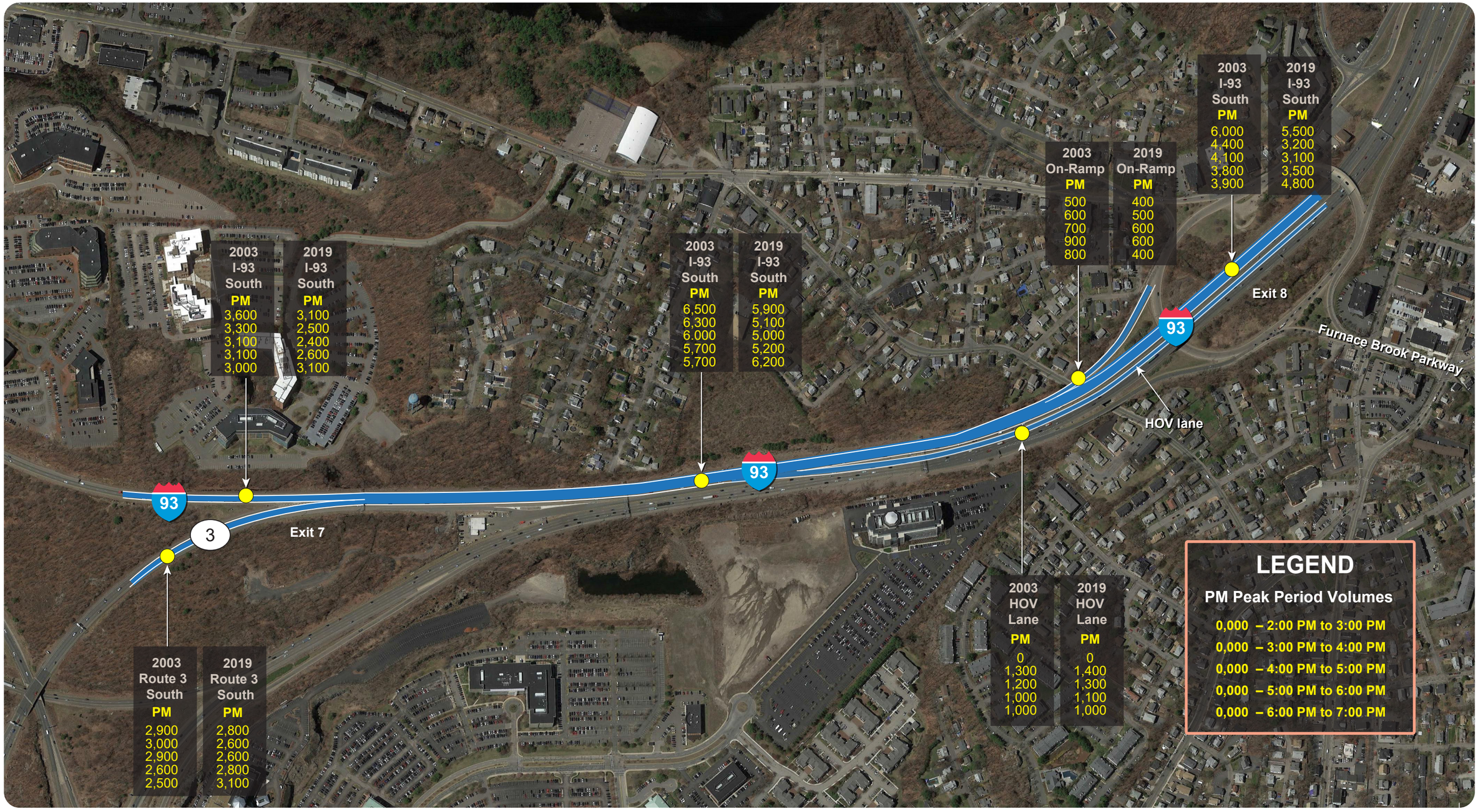
Figure 5
Location 1—I-93 Northbound between Exit 40 (Route 62) and Exit 41 (Route 125):
Alternative 1—Create Auxiliary Lane



BOSTON REGION MPO

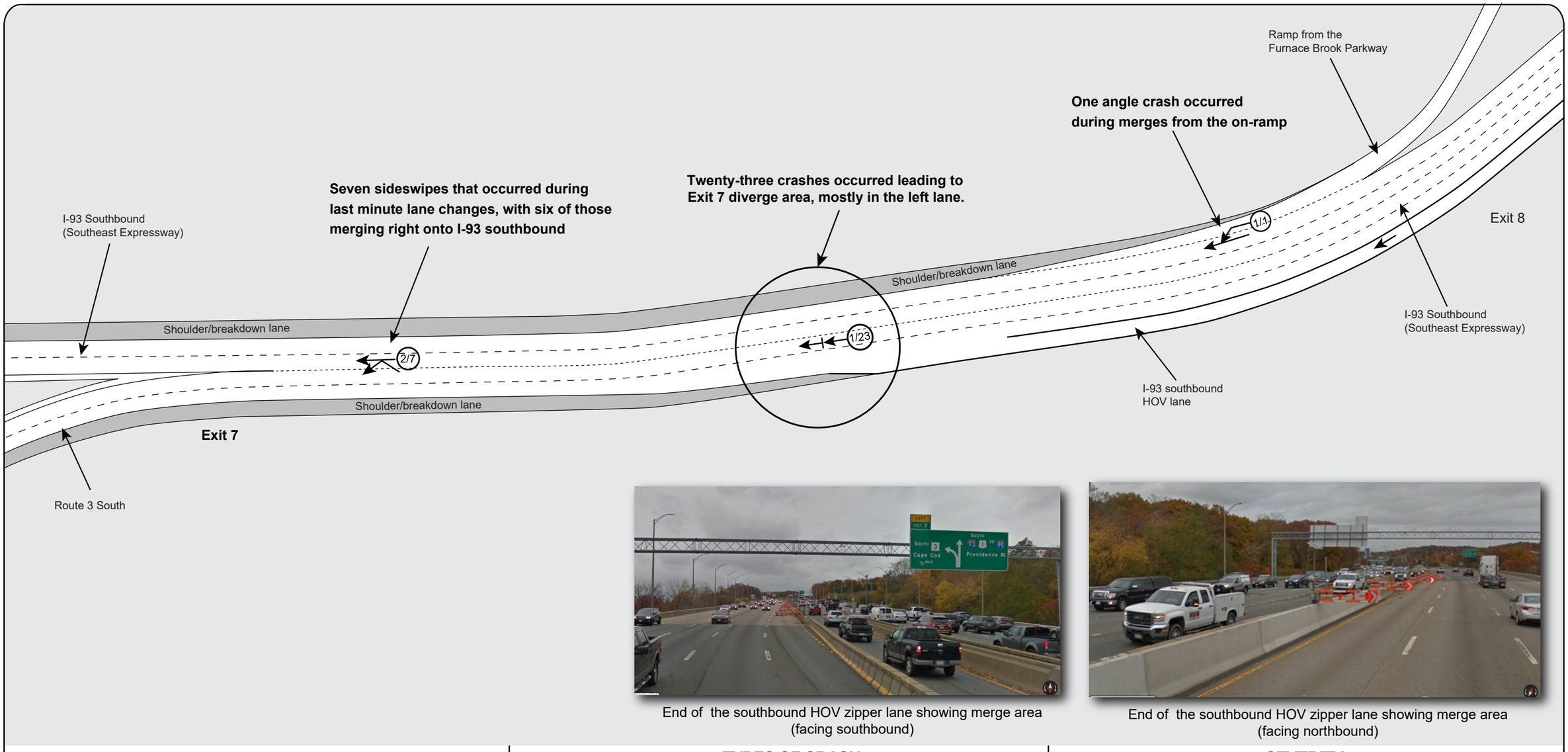
Figure 6
Location 2—I-93 Southbound at the End of the HOV Zipper Lane:
Peak Period Traffic Volumes

Low-Cost Improvements to Express-Highway Bottleneck Locations

BOSTON REGION MPO

Figure 7
Location 2—I-93 Southbound at the End of the HOV Zipper Lane: Location and Number of Crashes

Low-Cost Improvements to Express-Highway Bottleneck Locations



End of the southbound HOV zipper lane showing merge area
(facing southbound)

End of the southbound HOV zipper lane showing merge area
(facing northbound)

SYMBOLS	TYPES OF CRASH	SEVERITY
← Moving Vehicle	← Angle ←|← Rear End ↙↘ Sideswipe	0/0 Injury collisions/Total collisions

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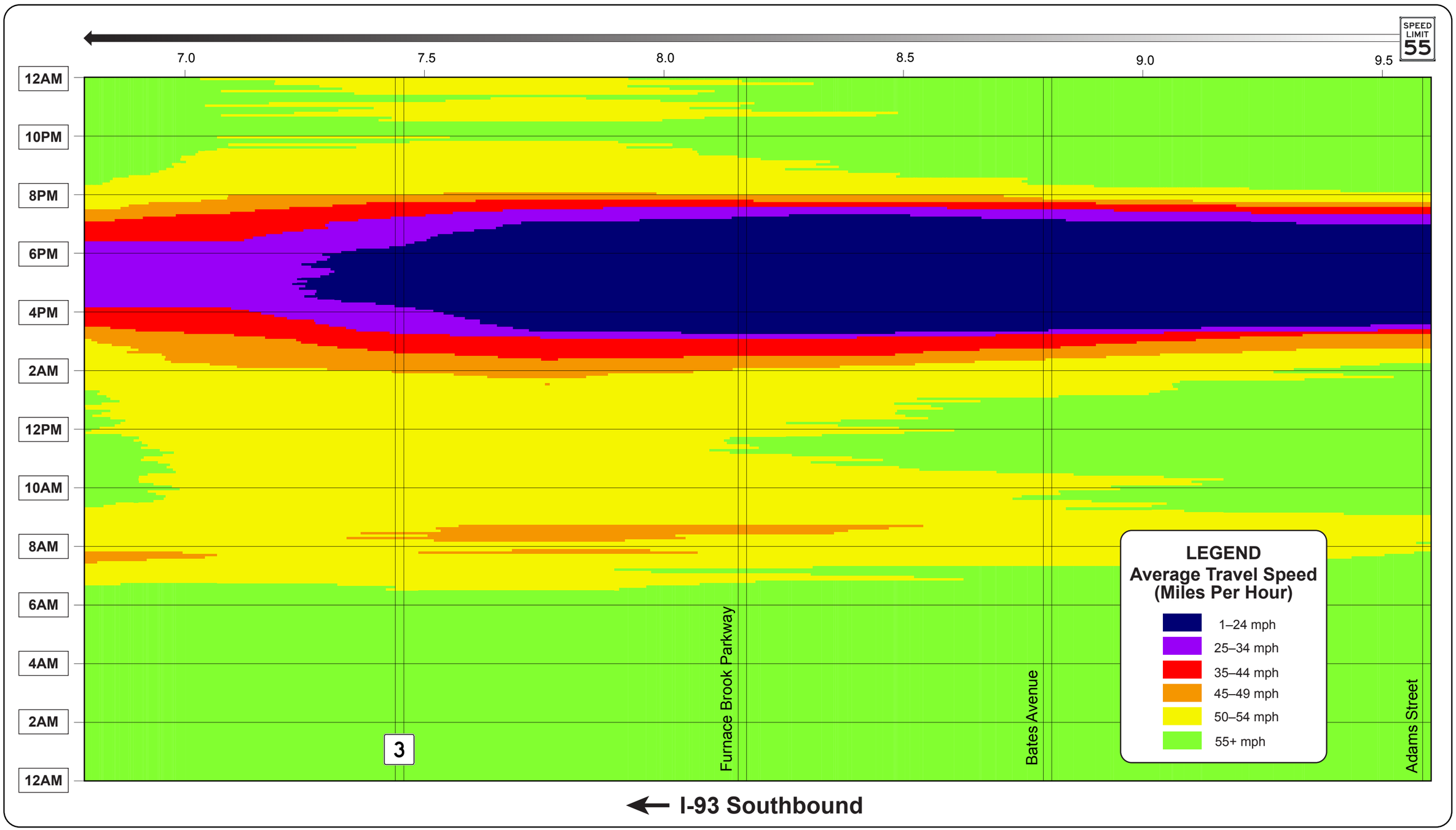
Figure 8
Location 2—I-93 Southbound at the End of the HOV Zipper Lane:
Five-Year (2012–16) Crashes when the HOV Lane is in Operation (3:00 PM to 7:00 PM)

Low-Cost Improvements
to Express-Highway
Bottleneck Locations



BOSTON REGION MPO

Figure 9
Location 2—I-93 Southbound at the End of the HOV Zipper Lane: Congestion Scan

Low-Cost Improvements to Express-Highway Bottleneck Locations

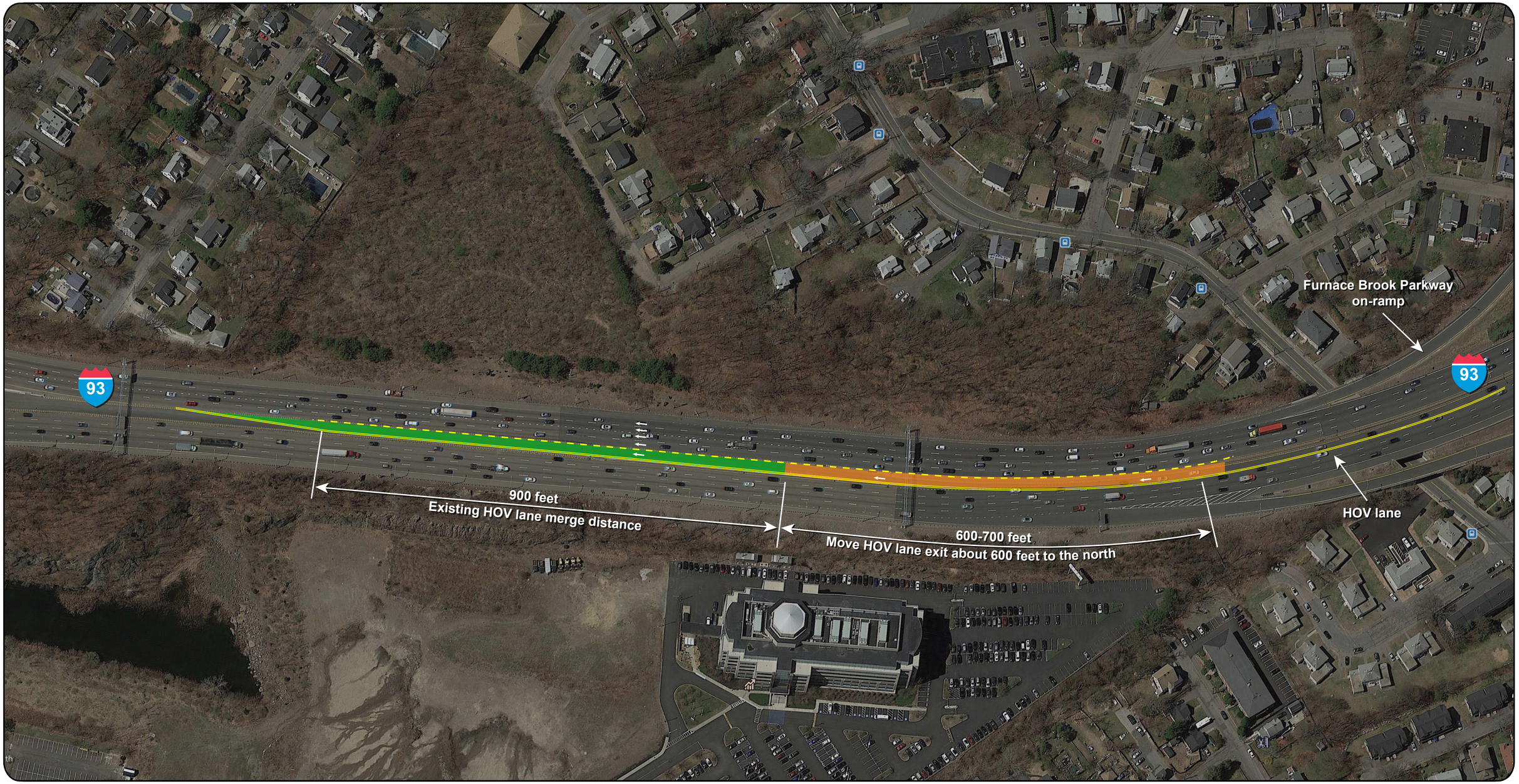


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Figure 10
Location 2—I-93 Southbound at the End of the HOV Zipper Lane:
Alternative 1—Lengthen the HOV Lane Merge Distance

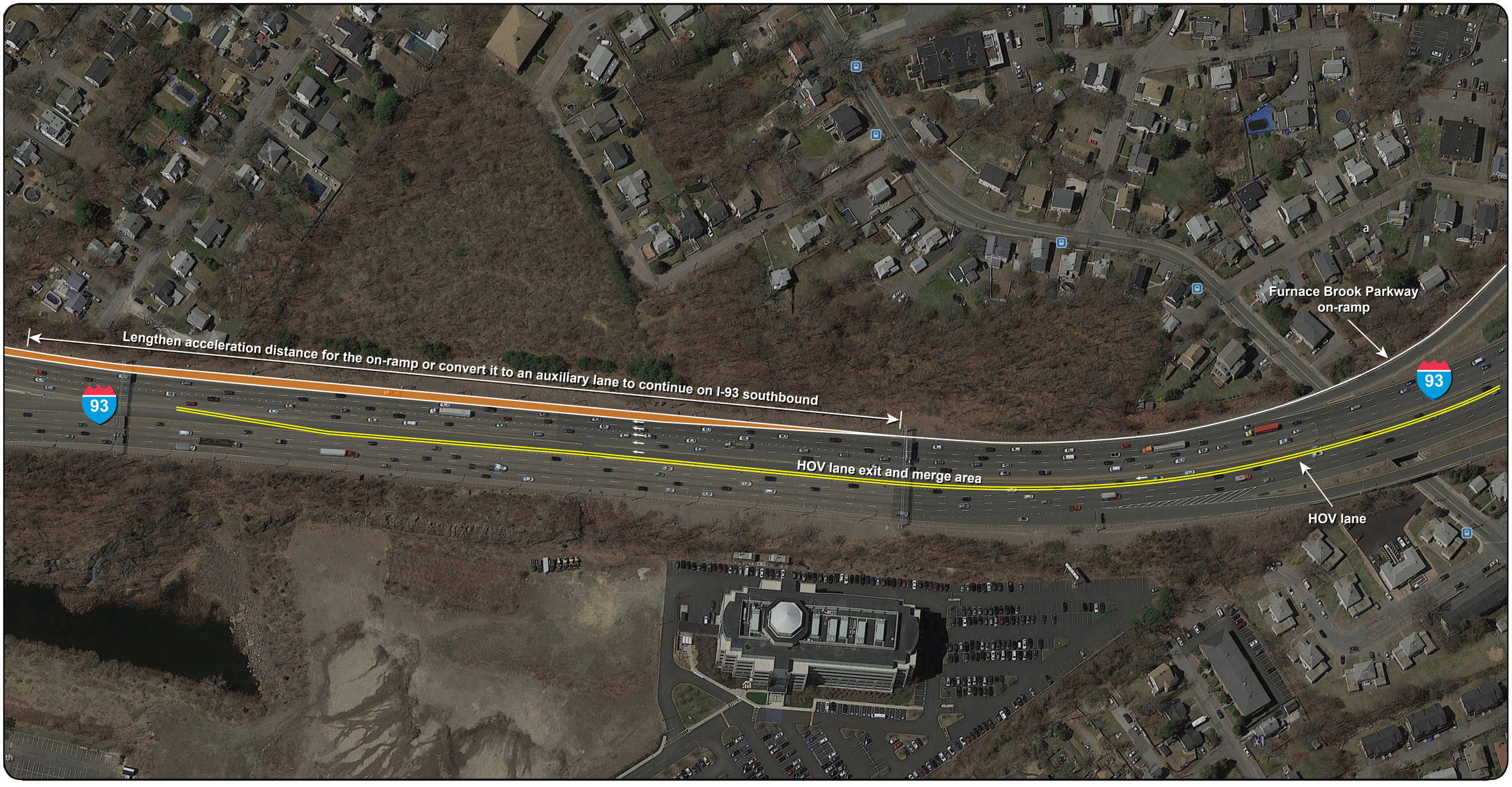

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Figure 11
Location 2—I-93 Southbound at the End of the HOV Zipper Lane:
Alternative 2—Lengthen the Acceleration Distance for Furnace Brook Parkway On-Ramp

Low-Cost Improvements
to Express-Highway
Bottleneck Locations

APPENDIX A

1. Review comments
2. Selection process

Seth Asante

From: Lipton, Amitai I. (DOT) <amitai.lipton@state.ma.us> on behalf of Lipton, Amitai I. (DOT)
Sent: Wednesday, November 13, 2019 1:03 PM
To: Seth Asante
Cc: Chen-Yuan Wang; Mark Abbott; Lavallee, Carrie E. (DOT); Worhunsky, Courtney (DOT); Kulen, Raj (DOT)
Subject: RE: FFY 2019 Low-Cost Improvements to Express-Highway Bottleneck Locations

Good afternoon Seth,

D6 Traffic section has reviewed the Draft report and submits the following comments for Chapter 5 (I-93 SB Braintree location):

- Alternative 1 (lengthen HOV/zipper lane merge): We note that a project has been initiated to replace the HOV/zipper systems; it may be possible to incorporate the proposed modifications into that project to avoid duplicated efforts/expenses.
- Alternative 2 (restripe shoulder to lengthen the acceleration lane): While lengthening the Furnace Brook Pkwy acceleration lane past Exit 7 (the split) might have some operational improvements during the PM peak period, we would want to evaluate any safety trade-offs involved with removing a shoulder, as there would not be any space left on the roadway for disabled vehicles. Some drivers might also choose to enter the long acceleration lane to "bypass" slow traffic in the general travel lanes. We would want to evaluate more thoroughly the safety and operational effects of having an unusually long acceleration lane that is less than 12 feet wide.
- Table 8 should include a baseline/no-build condition to compare with the 3 identified alternatives, similar to Table 9.
- Costs -- We feel Alternative 1 would be more expensive than estimated (to account for changes to the zipper barrier operations and any castings in the median area) while Alternative 2 would be less expensive than estimated (since extensive repaving should not be necessary).

Thank you,
Amitai

From: Seth Asante <sasante@ctps.org>
Sent: Wednesday, November 13, 2019 09:20
To: Lipton, Amitai I. (DOT) <Amitai.Lipton@dot.state.ma.us>; Vatan, Geraldine T. (DOT) <Geraldine.Vatan@dot.state.ma.us>; Raphael, Connie J. (DOT) <Connie.Raphael@dot.state.ma.us>; Timoner, Sara (DOT) <Sara.Timoner@dot.state.ma.us>
Cc: Chen-Yuan Wang <cwang@ctps.org>; Mark Abbott <mabbott@ctps.org>
Subject: FFY 2019 Low-Cost Improvements to Express-Highway Bottleneck Locations

Good morning,

This is a friendly reminder to send in your comments on the attached low-cost express-highway bottlenecks study. They were due on November 8.

MPO staff analyzed two bottleneck locations in the study:

- Location 1—I-93 Northbound between Exit 40 (Route 62) and Exit 41 (Route 125) in Wilmington
- Location 2—I-93 Southbound at the end of the HOV Zipper Lane in Quincy and Braintree

The study results for Locations 1, which is in MassDOT Highway District 4, is presented in Chapter 4 of the report. The study results for Locations 2, which is in MassDOT Highway District 6, is presented in Chapter 5.

Your comments are welcomed; please send them to me by November 20.

Thank you,
Seth

Seth A. Asante, P.E. | Chief Transportation Planner
CENTRAL TRANSPORTATION PLANNING STAFF
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Ten Park Plaza, Suite 2150 | Boston, MA 02116-3968
Main 857.702.3700 | Fax 617.570.9192 | TTY 617.570.9193

BOSTON REGION METROPOLITAN PLANNING ORGANIZATION

Stephanie Pollack, MassDOT Secretary and CEO and MPO Chair
Karl H. Quackenbush, Executive Director, MPO Staff

TECHNICAL MEMORANDUM

DATE: **December 20, 2018**
TO: **Boston Region Metropolitan Planning Organization (MPO)**
FROM: **Seth Asante, MPO Staff**
RE: **Federal Fiscal Year 2019 Express-Highway Bottleneck Study Locations**

This memorandum presents the process used to select the bottleneck study locations. MPO staff will submit this proposal to the MPO for discussion and approval

1 BACKGROUND

In Task 2 of the work program for the "Low-Cost Improvements to Express-Highway Bottleneck Locations: FFY 2019," MPO staff indicated in Task 2—screen bottleneck locations and select locations for analysis—that staff will present the results to the MPO for discussion.[1]

According to the Federal Highway Administration (FHWA), "Much of recurring congestion is due to physical bottlenecks—potentially correctible points on the highway system where traffic flow is restricted. While many of the nation's bottlenecks can only be addressed through costly major construction projects, there is a significant opportunity for the application of operational and low-cost infrastructure solutions to bring about relief at these chokepoints."[2]

The cause and duration of highway bottlenecks vary. In general, recurring bottlenecks, the subject of this study, are influenced by the design or operation present at the point where the bottleneck begins, for example, merges, diverges, lane drops, traffic weaving, abrupt changes in highway alignment, low-clearance structures, lane narrowing, intended disruption of traffic for management purposes, and less-than-optimal express-highway design.

[1] Work Program to the Boston Region Metropolitan Planning Organization, "Low-Cost Improvements to Express-Highway Bottleneck Locations: FFY 2019," September 20, 2018.
[2] Federal Highway Administration, *Recurring Traffic Bottlenecks: A Primer: Focus on Low-Cost Operations Improvements,* US Department of Transportation, Federal Highway Administration, June 2009, p. 1.

MPO staff analyzed several express-highway bottleneck locations in four previous studies; they were very well received by the Massachusetts Department of Transportation (MassDOT) and the FHWA.[3,4,5,6] Previous study locations included sections of Interstate 95 (I-95) in Burlington, Lexington, Waltham, and Weston; I-93 in Reading and Woburn; and sections of Route 24 in Randolph and Canton. Some of the recommendations from those studies have been implemented, and FHWA consultants have interviewed MPO staff about these successful implementations. Cost estimates for low-cost bottleneck improvements that have been implemented by the MassDOT Highway Division, or currently are in design status, range between $10,000 and $1 million.

2 SELECTION OF STUDY LOCATIONS

Selection of study locations was a two-stage process that comprised inventorying and screening candidate locations.

2.1 Inventorying Candidate Locations

MPO staff developed an initial list of candidate locations in the MPO region based on the following parameters:

- Consultations with MassDOT Highway Division
- Staff knowledge of bottleneck locations in the Boston MPO region
- Review of congestion management process (CMP) monitoring data, and recent MPO and other planning studies

The inventory process yielded nine bottleneck locations for screening, which are presented in the following table. All nine of the locations are in the Boston Region MPO area.

2.2 Screening Candidate Locations

MPO staff selected two bottleneck locations for analysis in federal fiscal year (FFY) 2019. After consulting with the MassDOT Highway Division, staff determined that these two locations likely could be corrected with low-cost mitigation strategies. The other bottlenecks in the Boston Region MPO area also

[3] Seth Asante, MPO staff, memorandum to the Transportation Planning and Programming Committee of the Boston Region Metropolitan Planning Organization, "Low-Cost Improvements to Bottleneck Locations," June 2, 2011.

[4] Chen-Yuan Wang, MPO staff, memorandum to the Transportation Planning and Programming Committee of the Boston Region Metropolitan Planning Organization, "Low-Cost Improvements to Bottleneck Locations, Phase II," March 12, 2012.

[5] Seth Asante, MPO staff, memorandum to the Boston Region Metropolitan Planning Organization, "Low-Cost Improvements to Bottleneck Locations," December 3, 2015.

[6] Seth Asante, MPO staff, "Low-Cost Improvements to Bottleneck Locations," Boston Region Metropolitan Planning Organization, January 2018.

could be corrected in a low-cost manner, but were not selected because of funding resources—these locations would be considered in future bottleneck studies.

Table 1
Inventory of Express-Highway Locations for Screening

Location Number	City/Town	MassDOT District	Express-Highway Section	Problem
1	Wilmington	4	I-93 northbound between Exit 40 (Route 62) and Exit 41 (Route 125)	Merge and diverge
2	Quincy and Braintree	6	I-93 southbound at the end of the HOV Zipper lane	Merge and weave during the PM commute
3	Medford	4	I-93 southbound between Route 16 on-ramp and Exit 31 (Route 16 off-ramp)	Weave
4	Reading	4	I-95 northbound between Exit 37 (I-93) and Exit 38 (Route 28)	Weave
5	Boston	6	I-93 northbound at the end of the HOV Zipper lane in Savin Hill	Merge during the AM commute
6	Boston	6	I-90 westbound and eastbound (just west of Ted Williams Tunnel Portal)	Westbound—diverge; Eastbound—merge
7	Canton and Randolph	6	I-93 northbound between Exit 1 (I-95) and Exit 4 (Route 24)	Merge, diverge, and weave
8	Canton and Randolph	6	I-93 southbound between Exit 1 (I-95) and Exit 4 (Route 24)	Merge, diverge, and weave
9	Newton	6	I-90 eastbound in Newton between Exit 16 and Exit 17	Merge, diverge, and weave

HOV = High occupancy vehicle. MassDOT = Massachusetts Department of Transportation.
Note: Shading indicates locations selected for study
Source: Central Transportation Planning Staff

MPO staff used the following criteria to screen the bottleneck locations:

- Does the location qualify as a bottleneck? A long traffic queue upstream trailing free-flowing traffic downstream usually characterizes the location as a bottleneck. In addition, the upstream congestion must be recurring—in other words, the location experiences routine and predictable congestion because traffic volume exceeds the available capacity at that location.
- Is a physical design constraint or operational conflict that is inherent in the location the cause of the bottleneck? Examples of these may include the following situations:
    - Lane drop—one or more travel lanes are lost, requiring traffic to merge

    - Weaving area—drivers must merge across one or more lanes in order to access an entry or exit ramp
    - Merge area—on-ramp traffic merges with mainline traffic in order to enter the freeway
    - Major interchanges—high-volume traffic is directed from one freeway to another
    - Horizontal curves—abrupt changes in highway alignment force drivers to slow down because of safety concerns
- Can the bottleneck be fixed with low-cost operational and geometric improvements? These would exclude costly long-term solutions such as expansion and major transit investments that alter drivers' mode choice. Examples of low-cost operational and geometric improvements may include the following:
    - Using a short section of shoulder as an additional travel lane, an auxiliary lane, or for lengthening an acceleration or deceleration lane
    - Restriping merge and diverge areas to better serve traffic demand
    - Providing better traveler information to allow drivers to respond to temporary changes in lane assignment, such as using a shoulder as an additional travel lane during peak periods
    - Providing all-purpose reversible lanes
    - Changing or adding signs and striping

Based on the screening criteria and consultations with MassDOT Highway Division officials, MPO staff selected locations one and two for study. Below is staff's rationale for not selecting locations three through nine.

Locations 3, 4, 5, 6, 7, and 8

These bottleneck locations may be correctible with low-cost improvements but were not selected because of funding. While the work program for this study assumed that "as many as three" locations would be selected, the MPO staff does not propose studying a third location because the two locations are complex and would require considerable resources for evaluating low-cost improvement plans. MPO staff may consider these locations in the next round of bottleneck studies.

Location 9

This bottleneck location was screened but was not considered in the selection process because a proposed project would address the bottleneck. MassDOT is

initiating a project to make improvements to traffic signals, signage, and pavement markings on the rotary around Newton Corner in order to improve traffic flow and safety, and to reduce the likelihood of the ramps backing up onto I-90. The project would also look at the feasibility of either restriping, or restriping with minor widening, the eastbound off-ramp in order to facilitate a second lane on the exit. These improvements would have positive impacts on the bottleneck.

3 SELECTED BOTTLENECK LOCATIONS FOR STUDY

3.1 Location 1: I-93 Northbound Between Exit 40 (Route 62) and Exit 41 (Route 125) in Wilmington

This segment of highway, about two miles long, with four travel lanes, frequently is congested because of merging and diverging activities, especially during the AM and PM peak periods. In the segment, there are two exit ramps and three entry ramps connecting Routes 62 and 125 to I-93. The ramps are heavily used because of office and industrial parks located off of Route 125. As a result, weekday rush hour congestion at the ramp-arterial junctions and queuing on the exit ramps are not uncommon.

At both exits, the northbound ramps have approximately 1,000 vehicles per hour (vph) exiting I-93 northbound to Routes 62 and 125 during the AM peak period and 1,500 vph during the PM peak period. During the same time periods, the entry ramps from Routes 62 and 125 to I-93 northbound receive about 700 vph during the AM period and 1,300 vph during the PM peak period.

This entering and exiting traffic interacts with about 5,700 vph on the mainline during the AM peak period and 7,600 vph during the PM peak period. The merging and diverging maneuvers in the vicinity creates a bottleneck that backs up traffic on the mainline.

3.2 Location 2: I-93 Southbound at the End of the High Occupancy Vehicle (HOV) Zipper Lane in Quincy and Braintree

This bottleneck is located on I-93 southbound at the end of the Zipper lane, where traffic diverges, merges, and weaves in order to continue onto I-93 southbound or Route 3 southbound. The bottleneck occurs only during PM peak periods when the southbound HOV lane is in operation.

At the bottleneck, traffic from six lanes (four on the mainline, one on the temporary HOV lane, and one from high-volume entry ramp from Furnace Brook Parkway) is forced onto four travel lanes in a short segment, about 0.5 miles long. The reduction in number of lanes dramatically reduces capacity in the segment creating a bottleneck. In addition, a significant amount of lane-changing maneuvers (weaving and diverging) and merging take place within the segment

to disperse traffic to continue on I-93 southbound or head to Route 3 southbound.

During the PM peak period, the entry ramp from Furnace Brook Parkway carries about 800 vph, and upstream of the bottleneck, the mainline and HOV lane carry 5,500 vph and 700 vph, respectively. Consequently, the traffic demand at the bottleneck greatly exceeds the capacity at the bottleneck. As a result, there are long traffic queues on the mainline and in the HOV lane, which extend five miles to Columbia Avenue in Dorchester.

4 SUMMARY

By identifying and evaluating a comprehensive list of potential improvements at the two locations, MPO staff will rely on their technical expertise and judgment regarding the nature of bottlenecks. In addition, MPO staff will seek input from MassDOT Highway Division staff that are familiar with the operations of the region's express-highway system.

This study addresses the MPO's goal of increasing safety on the region's highway system, capacity management and mobility, and system preservation. MPO staff will submit this proposal to the MPO for discussion. If the MPO approves this selection, staff will meet with officials from MassDOT and discuss the study specifics, conduct field visits, collect data, and perform various analyses.

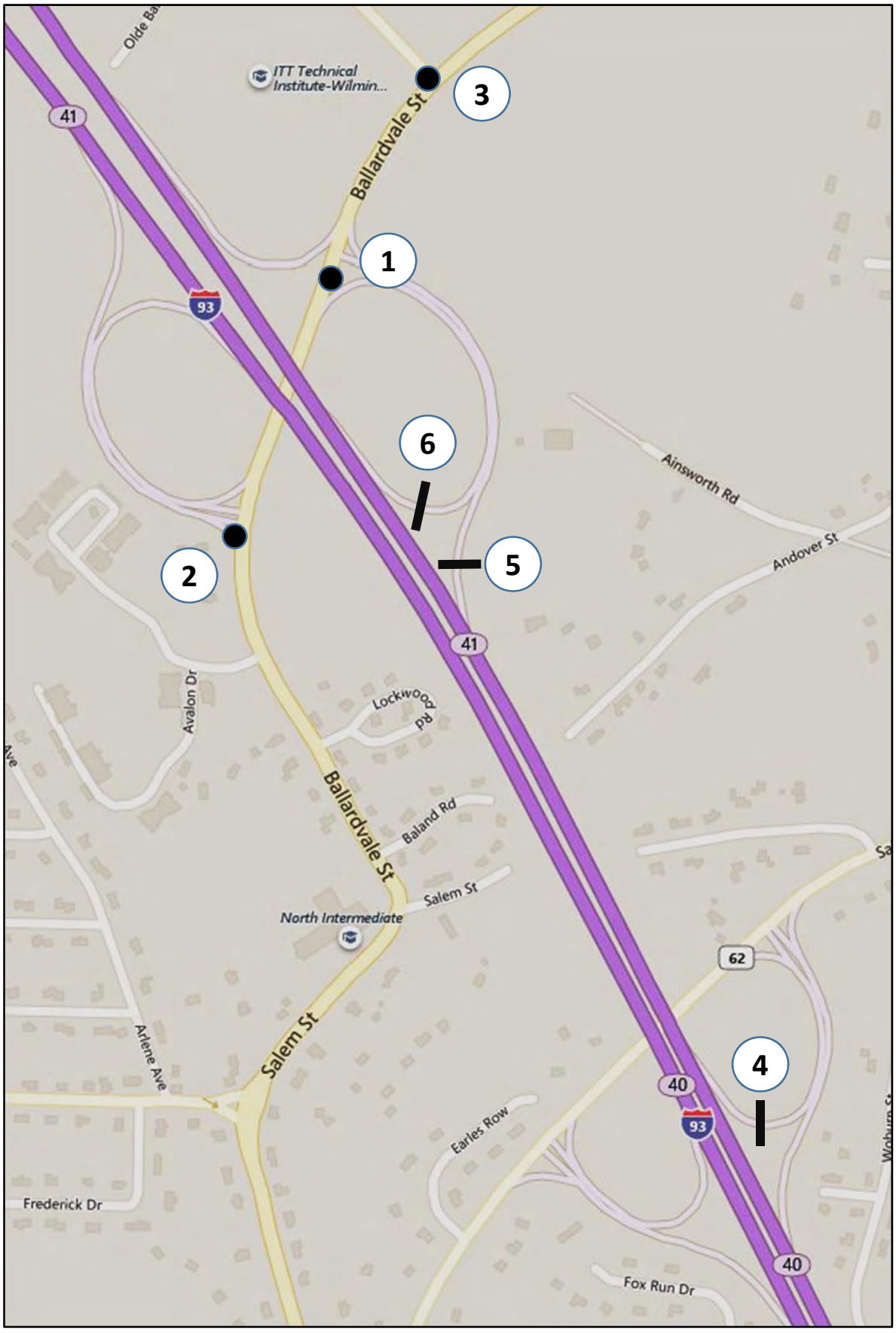
SA/sa

APPENDIX B

1. ATR data
2. Classification data

I-93 Northbound between
Exit 40 (Route 62) and Exit 41 (Route 125)

I-93 Northbound between
Exit 40 (Route 62) and Exit 41 (Route 125)



TM-1 Ballardvale Street (Route 125) @ I-93 N... - TMC
Wed Jan 16, 2019
Full Length (6 AM-9 AM, 3 PM-6 PM)
All Classes (Motorcycles, Lights, Single-Unit Trucks, Articulated Trucks, Buses, Pedestrians, Bicycles on Road, Bicycles on Crosswalk)
All Movements
ID: 609037, Location: 42.585518, -71.156976

Provided by: Precision Data Industries, LLC (PDI)
46 Morton Street,
Framingham, MA, MA, 01702, US

Leg	Ballardvale Street (Route 125)						I-93 NB Onramp/Offramp						Ballardvale Street (Route 125)						I-93 NB Onramp						
Direction	Southbound						Westbound						Northbound						Eastbound						
Time	R	T	L	U	App	Ped*	R	T	L	U	App	Ped*	R	T	L	U	App	Ped*	R	T	L	U	App	Ped*	Int
2019-01-16 6:00AM	19	150	0	0	**169**	0	63	1	2	0	**66**	0	5	101	0	0	**106**	0	0	0	0	0	**0**	0	**341**
6:15AM	30	170	0	0	**200**	0	87	0	2	0	**89**	0	12	136	0	0	**148**	0	0	0	0	0	**0**	0	**437**
6:30AM	29	165	0	0	**194**	0	132	0	1	0	**133**	0	9	144	0	0	**153**	0	0	0	0	0	**0**	0	**480**
6:45AM	29	204	0	0	**233**	0	152	0	3	0	**155**	0	11	162	0	0	**173**	0	0	0	0	0	**0**	0	**561**
Hourly Total	107	689	0	0	**796**	0	434	1	8	0	**443**	0	37	543	0	0	**580**	0	0	0	0	0	**0**	0	**1819**
7:00AM	39	208	0	0	**247**	0	170	0	0	0	**170**	0	11	177	0	0	**188**	0	0	0	0	0	**0**	0	**605**
7:15AM	41	246	0	0	**287**	0	167	0	1	0	**168**	0	14	196	0	0	**210**	0	0	0	0	0	**0**	0	**665**
7:30AM	60	245	0	0	**305**	0	203	0	7	0	**210**	0	17	220	0	0	**237**	0	0	0	0	0	**0**	0	**752**
7:45AM	42	246	0	0	**288**	0	242	0	3	0	**245**	0	15	195	0	0	**210**	0	0	0	0	0	**0**	0	**743**
Hourly Total	182	945	0	0	**1127**	0	782	0	11	0	**793**	0	57	788	0	0	**845**	0	0	0	0	0	**0**	0	**2765**
8:00AM	61	235	0	0	**296**	0	212	0	0	0	**212**	0	15	189	0	0	**204**	0	0	0	0	0	**0**	0	**712**
8:15AM	46	236	0	0	**282**	0	222	0	0	0	**222**	0	9	170	0	0	**179**	0	0	0	0	0	**0**	0	**683**
8:30AM	41	206	0	0	**247**	0	187	0	4	0	**191**	0	11	156	0	0	**167**	0	0	0	0	0	**0**	0	**605**
8:45AM	63	228	0	0	**291**	0	171	0	1	0	**172**	0	12	189	0	0	**201**	0	0	0	0	0	**0**	0	**664**
Hourly Total	211	905	0	0	**1116**	0	792	0	5	0	**797**	0	47	704	0	0	**751**	0	0	0	0	0	**0**	0	**2664**
3:00PM	112	209	0	0	**321**	0	148	0	28	0	**176**	0	11	78	0	0	**89**	0	0	0	0	0	**0**	0	**586**
3:15PM	106	186	0	0	**292**	0	159	0	43	0	**202**	0	6	76	0	0	**82**	0	0	0	0	0	**0**	0	**576**
3:30PM	150	258	0	0	**408**	0	186	0	27	0	**213**	0	2	57	0	0	**59**	0	0	0	0	0	**0**	0	**680**
3:45PM	102	208	0	0	**310**	0	199	0	37	0	**236**	0	5	73	0	0	**78**	0	0	0	0	0	**0**	0	**624**
Hourly Total	470	861	0	0	**1331**	0	692	0	135	0	**827**	0	24	284	0	0	**308**	0	0	0	0	0	**0**	0	**2466**
4:00PM	168	250	0	0	**418**	0	164	0	24	0	**188**	0	7	63	0	0	**70**	0	2	0	0	0	**2**	0	**678**
4:15PM	122	281	0	0	**403**	0	179	0	41	0	**220**	0	6	80	0	0	**86**	0	0	0	0	0	**0**	0	**709**
4:30PM	184	326	0	0	**510**	0	215	0	38	0	**253**	0	9	99	0	0	**108**	0	0	0	0	0	**0**	0	**871**
4:45PM	155	338	0	0	**493**	0	216	0	37	0	**253**	0	2	80	0	0	**82**	0	0	0	0	0	**0**	0	**828**
Hourly Total	629	1195	0	0	**1824**	0	774	0	140	0	**914**	0	24	322	0	0	**346**	0	2	0	0	0	**2**	0	**3086**
5:00PM	210	402	0	0	**612**	0	192	0	44	0	**236**	0	11	70	0	0	**81**	0	0	0	0	0	**0**	0	**929**
5:15PM	156	411	0	0	**567**	0	223	0	43	0	**266**	0	6	89	1	0	**96**	0	0	0	0	0	**0**	0	**929**
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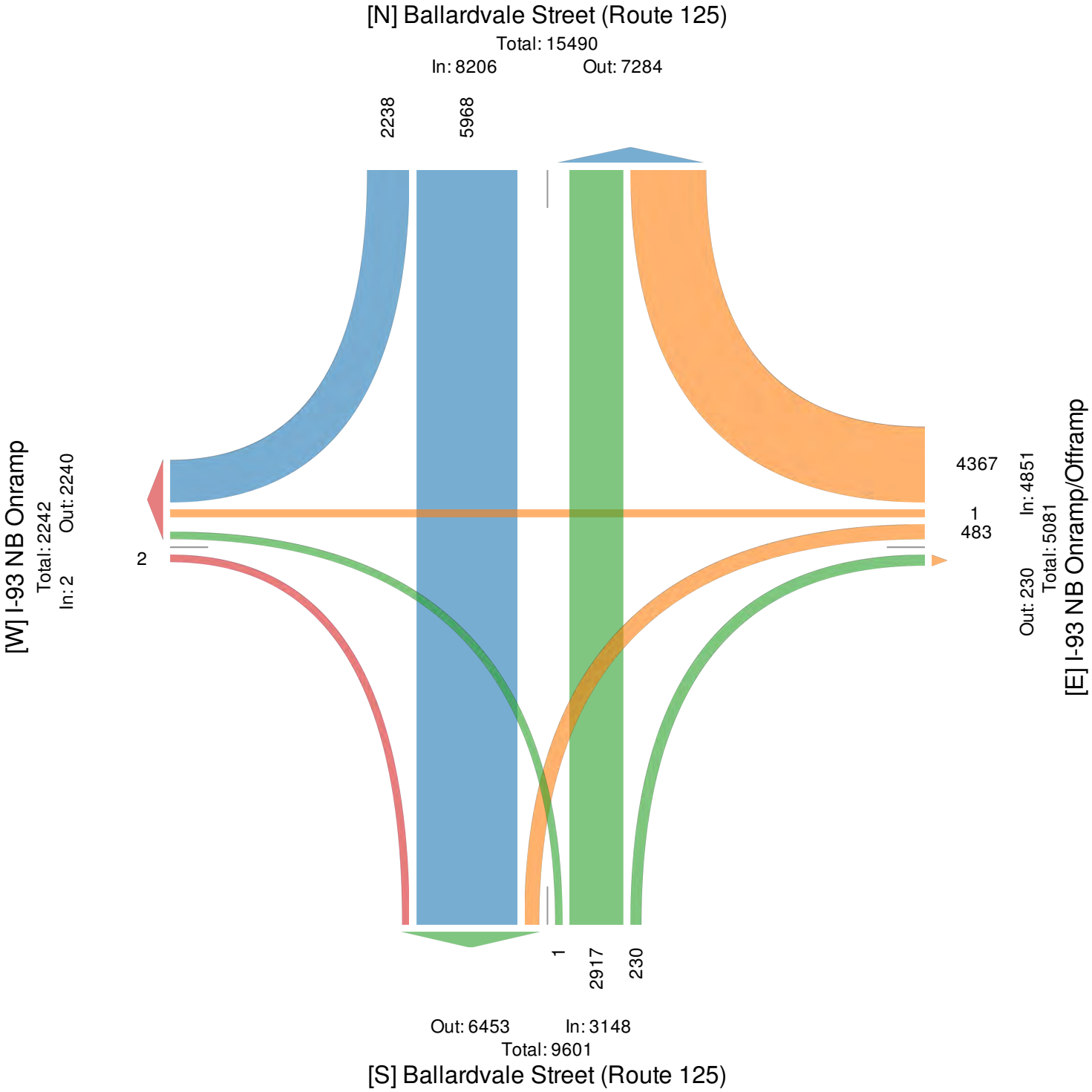
5:45PM	131	219	0	0	**350**	0	241	0	41	0	**282**	0	12	50	0	0	**62**	0	0	0	0	0	**0**	0	**694**
Hourly Total	639	1373	0	0	**2012**	0	893	0	184	0	**1077**	0	41	276	1	0	**318**	0	0	0	0	0	**0**	0	**3407**
Total	2238	5968	0	0	**8206**	0	4367	1	483	0	**4851**	0	230	2917	1	0	**3148**	0	2	0	0	0	**2**	0	**16207**
% Approach	27.3%	72.7%	0%	0%	**-**	-	90.0%	0%	10.0%	0%	**-**	-	7.3%	92.7%	0%	0%	**-**	-	100%	0%	0%	0%	**-**	-	-
% Total	13.8%	36.8%	0%	0%	**50.6%**	-	26.9%	0%	3.0%	0%	**29.9%**	-	1.4%	18.0%	0%	0%	**19.4%**	-	0%	0%	0%	0%	**0%**	-	-
Motorcycles	0	0	0	0	**0**	-	1	0	0	0	**1**	-	1	0	0	0	**1**	-	0	0	0	0	**0**	-	2
% Motorcycles	0%	0%	0%	0%	**0%**	-	0%	0%	0%	0%	**0%**	-	0.4%	0%	0%	0%	**0%**	-	0%	0%	0%	0%	**0%**	-	0%
Lights	2075	5671	0	0	**7746**	-	4095	0	476	0	**4571**	-	224	2734	1	0	**2959**	-	2	0	0	0	**2**	-	15278
% Lights	92.7%	95.0%	0%	0%	**94.4%**	-	93.8%	0%	98.6%	0%	**94.2%**	-	97.4%	93.7%	100%	0%	**94.0%**	-	100%	0%	0%	0%	**100%**	-	94.3%
Single-Unit Trucks	86	215	0	0	**301**	-	175	1	4	0	**180**	-	2	96	0	0	**98**	-	0	0	0	0	**0**	-	579
% Single-Unit Trucks	3.8%	3.6%	0%	0%	**3.7%**	-	4.0%	100%	0.8%	0%	**3.7%**	-	0.9%	3.3%	0%	0%	**3.1%**	-	0%	0%	0%	0%	**0%**	-	3.6%
Articulated Trucks	76	74	0	0	**150**	-	91	0	3	0	**94**	-	3	85	0	0	**88**	-	0	0	0	0	**0**	-	332
% Articulated Trucks	3.4%	1.2%	0%	0%	**1.8%**	-	2.1%	0%	0.6%	0%	**1.9%**	-	1.3%	2.9%	0%	0%	**2.8%**	-	0%	0%	0%	0%	**0%**	-	2.0%
Buses	1	8	0	0	**9**	-	5	0	0	0	**5**	-	0	2	0	0	**2**	-	0	0	0	0	**0**	-	16
% Buses	0%	0.1%	0%	0%	**0.1%**	-	0.1%	0%	0%	0%	**0.1%**	-	0%	0.1%	0%	0%	**0.1%**	-	0%	0%	0%	0%	**0%**	-	0.1%
Bicycles on Road	0	0	0	0	**0**	-	0	0	0	0	**0**	-	0	0	0	0	**0**	-	0	0	0	0	**0**	-	0
% Bicycles on Road	0%	0%	0%	0%	**0%**	-	0%	0%	0%	0%	**0%**	-	0%	0%	0%	0%	**0%**	-	0%	0%	0%	0%	**0%**	-	0%
Pedestrians	-	-	-	-	-	0	-	-	-	-	-	0	-	-	-	-	-	0	-	-	-	-	-	0	
% Pedestrians	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Bicycles on Crosswalk	-	-	-	-	-	0	-	-	-	-	-	0	-	-	-	-	-	0	-	-	-	-	-	0	
% Bicycles on Crosswalk	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

*Pedestrians and Bicycles on Crosswalk. L: Left, R: Right, T: Thru, U: U-Turn

TM-1 Ballardvale Street (Route 125) @ I-93 N... - TMC
Wed Jan 16, 2019
Full Length (6 AM-9 AM, 3 PM-6 PM)
All Classes (Motorcycles, Lights, Single-Unit Trucks, Articulated Trucks, Buses, Pedestrians, Bicycles on Road, Bicycles on Crosswalk)
All Movements
ID: 609037, Location: 42.585518, -71.156976

Provided by: Precision Data Industries, LLC (PDI)
46 Morton Street,
Framingham, MA, MA, 01702, US



TM-1 Ballardvale Street (Route 125) @ I-93 N... - TMC

Wed Jan 16, 2019
AM Peak (7:30 AM - 8:30 AM)
All Classes (Motorcycles, Lights, Single-Unit Trucks, Articulated Trucks, Buses, Pedestrians, Bicycles on Road, Bicycles on Crosswalk)
All Movements
ID: 609037, Location: 42.585518, -71.156976

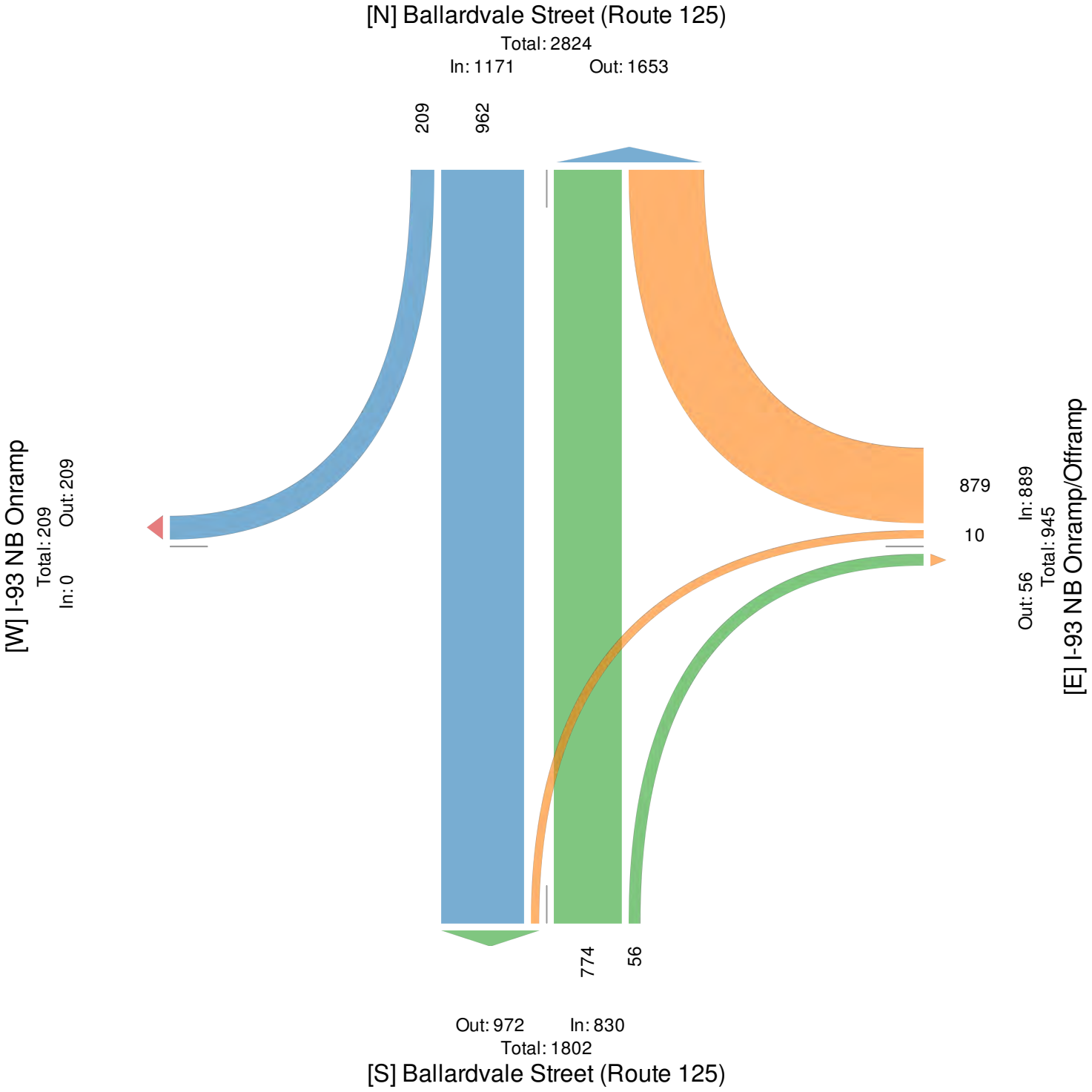
Provided by: Precision Data Industries, LLC (PDI)
46 Morton Street,
Framingham, MA, MA, 01702, US

Leg / Direction	Ballardvale Street (Route 125) Southbound						I-93 NB Onramp/Offramp Westbound						Ballardvale Street (Route 125) Northbound						I-93 NB Onramp Eastbound						
Time	R	T	L	U	App	Ped*	R	T	L	U	App	Ped*	R	T	L	U	App	Ped*	R	T	L	U	App	Ped*	Int
2019-01-16 7:30AM	60	245	0	0	**305**	0	203	0	7	0	**210**	0	17	220	0	0	**237**	0	0	0	0	0	**0**	0	**752**
7:45AM	42	246	0	0	**288**	0	242	0	3	0	**245**	0	15	195	0	0	**210**	0	0	0	0	0	**0**	0	**743**
8:00AM	61	235	0	0	**296**	0	212	0	0	0	**212**	0	15	189	0	0	**204**	0	0	0	0	0	**0**	0	**712**
8:15AM	46	236	0	0	**282**	0	222	0	0	0	**222**	0	9	170	0	0	**179**	0	0	0	0	0	**0**	0	**683**
Total	209	962	0	0	**1171**	0	879	0	10	0	**889**	0	56	774	0	0	**830**	0	0	0	0	0	**0**	0	**2890**
% Approach	17.8%	82.2%	0%	0%	**-**	-	98.9%	0%	1.1%	0%	**-**	-	6.7%	93.3%	0%	0%	**-**	-	0%	0%	0%	0%	**-**	-	-
% Total	7.2%	33.3%	0%	0%	**40.5%**	-	30.4%	0%	0.3%	0%	**30.8%**	-	1.9%	26.8%	0%	0%	**28.7%**	-	0%	0%	0%	0%	**0%**	-	-
PHF	0.857	0.978	-	-	**0.960**	-	0.908	-	0.357	-	**0.907**	-	0.824	0.880	-	-	**0.876**	-	-	-	-	-	**-**	-	0.961
Motorcycles	0	0	0	0	**0**	-	0	0	0	0	**0**	-	0	0	0	0	**0**	-	0	0	0	0	**0**	-	0
% Motorcycles	0%	0%	0%	0%	**0%**	-	0%	0%	0%	0%	**0%**	-	0%	0%	0%	0%	**0%**	-	0%	0%	0%	0%	**-**	-	0%
Lights	165	885	0	0	**1050**	-	828	0	9	0	**837**	-	55	735	0	0	**790**	-	0	0	0	0	**0**	-	2677
% Lights	78.9%	92.0%	0%	0%	**89.7%**	-	94.2%	0%	90.0%	0%	**94.2%**	-	98.2%	95.0%	0%	0%	**95.2%**	-	0%	0%	0%	0%	**-**	-	92.6%
Single-Unit Trucks	25	65	0	0	**90**	-	38	0	0	0	**38**	-	1	21	0	0	**22**	-	0	0	0	0	**0**	-	150
% Single-Unit Trucks	12.0%	6.8%	0%	0%	**7.7%**	-	4.3%	0%	0%	0%	**4.3%**	-	1.8%	2.7%	0%	0%	**2.7%**	-	0%	0%	0%	0%	**-**	-	5.2%
Articulated Trucks	19	11	0	0	**30**	-	13	0	1	0	**14**	-	0	18	0	0	**18**	-	0	0	0	0	**0**	-	62
% Articulated Trucks	9.1%	1.1%	0%	0%	**2.6%**	-	1.5%	0%	10.0%	0%	**1.6%**	-	0%	2.3%	0%	0%	**2.2%**	-	0%	0%	0%	0%	**-**	-	2.1%
Buses	0	1	0	0	**1**	-	0	0	0	0	**0**	-	0	0	0	0	**0**	-	0	0	0	0	**0**	-	1
% Buses	0%	0.1%	0%	0%	**0.1%**	-	0%	0%	0%	0%	**0%**	-	0%	0%	0%	0%	**0%**	-	0%	0%	0%	0%	**-**	-	0%
Bicycles on Road	0	0	0	0	**0**	-	0	0	0	0	**0**	-	0	0	0	0	**0**	-	0	0	0	0	**0**	-	0
% Bicycles on Road	0%	0%	0%	0%	**0%**	-	0%	0%	0%	0%	**0%**	-	0%	0%	0%	0%	**0%**	-	0%	0%	0%	0%	**-**	-	0%
Pedestrians	-	-	-	-	-	0	-	-	-	-	-	0	-	-	-	-	-	0	-	-	-	-	-	0	
% Pedestrians	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Bicycles on Crosswalk	-	-	-	-	-	0	-	-	-	-	-	0	-	-	-	-	-	0	-	-	-	-	-	0	
% Bicycles on Crosswalk	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

*Pedestrians and Bicycles on Crosswalk. L: Left, R: Right, T: Thru, U: U-Turn

TM-1 Ballardvale Street (Route 125) @ I-93 N... - TMC
Wed Jan 16, 2019
AM Peak (7:30 AM - 8:30 AM)
All Classes (Motorcycles, Lights, Single-Unit Trucks, Articulated Trucks, Buses, Pedestrians, Bicycles on Road, Bicycles on Crosswalk)
All Movements
ID: 609037, Location: 42.585518, -71.156976

Provided by: Precision Data Industries, LLC (PDI)
46 Morton Street,
Framingham, MA, MA, 01702, US



TM-1 Ballardvale Street (Route 125) @ I-93 N... - TMC
Wed Jan 16, 2019
PM Peak (4:30 PM - 5:30 PM) - Overall Peak Hour
All Classes (Motorcycles, Lights, Single-Unit Trucks, Articulated Trucks, Buses, Pedestrians, Bicycles on Road, Bicycles on Crosswalk)
All Movements
ID: 609037, Location: 42.585518, -71.156976

Provided by: Precision Data Industries, LLC (PDI)
46 Morton Street,
Framingham, MA, MA, 01702, US

Leg / Direction	Ballardvale Street (Route 125) Southbound						I-93 NB Onramp/Offramp Westbound						Ballardvale Street (Route 125) Northbound						I-93 NB Onramp Eastbound						
Time	R	T	L	U	App	Ped*	R	T	L	U	App	Ped*	R	T	L	U	App	Ped*	R	T	L	U	App	Ped*	Int
2019-01-16 4:30PM	184	326	0	0	**510**	0	215	0	38	0	**253**	0	9	99	0	0	**108**	0	0	0	0	0	**0**	0	**871**
4:45PM	155	338	0	0	**493**	0	216	0	37	0	**253**	0	2	80	0	0	**82**	0	0	0	0	0	**0**	0	**828**
5:00PM	210	402	0	0	**612**	0	192	0	44	0	**236**	0	11	70	0	0	**81**	0	0	0	0	0	**0**	0	**929**
5:15PM	156	411	0	0	**567**	0	223	0	43	0	**266**	0	6	89	1	0	**96**	0	0	0	0	0	**0**	0	**929**
Total	705	1477	0	0	**2182**	0	846	0	162	0	**1008**	0	28	338	1	0	**367**	0	0	0	0	0	**0**	0	**3557**
% Approach	32.3%	67.7%	0%	0%	-	-	83.9%	0%	16.1%	0%	-	-	7.6%	92.1%	0.3%	0%	-	-	0%	0%	0%	0%	-	-	-
% Total	19.8%	41.5%	0%	0%	**61.3%**	-	23.8%	0%	4.6%	0%	**28.3%**	-	0.8%	9.5%	0%	0%	**10.3%**	-	0%	0%	0%	0%	**0%**	-	-
PHF	0.839	0.898	-	-	**0.891**	-	0.948	-	0.920	-	**0.947**	-	0.636	0.854	0.250	-	**0.850**	-	-	-	-	-	-	-	0.957
Motorcycles	0	0	0	0	**0**	-	1	0	0	0	**1**	-	0	0	0	0	**0**	-	0	0	0	0	**0**	-	1
% Motorcycles	0%	0%	0%	0%	**0%**	-	0.1%	0%	0%	0%	**0.1%**	-	0%	0%	0%	0%	**0%**	-	0%	0%	0%	0%	-	-	0%
Lights	691	1461	0	0	**2152**	-	813	0	161	0	**974**	-	28	319	1	0	**348**	-	0	0	0	0	**0**	-	3474
% Lights	98.0%	98.9%	0%	0%	**98.6%**	-	96.1%	0%	99.4%	0%	**96.6%**	-	100%	94.4%	100%	0%	**94.8%**	-	0%	0%	0%	0%	-	-	97.7%
Single-Unit Trucks	7	8	0	0	**15**	-	27	0	1	0	**28**	-	0	13	0	0	**13**	-	0	0	0	0	**0**	-	56
% Single-Unit Trucks	1.0%	0.5%	0%	0%	**0.7%**	-	3.2%	0%	0.6%	0%	**2.8%**	-	0%	3.8%	0%	0%	**3.5%**	-	0%	0%	0%	0%	-	-	1.6%
Articulated Trucks	7	7	0	0	**14**	-	5	0	0	0	**5**	-	0	5	0	0	**5**	-	0	0	0	0	**0**	-	24
% Articulated Trucks	1.0%	0.5%	0%	0%	**0.6%**	-	0.6%	0%	0%	0%	**0.5%**	-	0%	1.5%	0%	0%	**1.4%**	-	0%	0%	0%	0%	-	-	0.7%
Buses	0	1	0	0	**1**	-	0	0	0	0	**0**	-	0	1	0	0	**1**	-	0	0	0	0	**0**	-	2
% Buses	0%	0.1%	0%	0%	**0%**	-	0%	0%	0%	0%	**0%**	-	0%	0.3%	0%	0%	**0.3%**	-	0%	0%	0%	0%	-	-	0.1%
Bicycles on Road	0	0	0	0	**0**	-	0	0	0	0	**0**	-	0	0	0	0	**0**	-	0	0	0	0	**0**	-	0
% Bicycles on Road	0%	0%	0%	0%	**0%**	-	0%	0%	0%	0%	**0%**	-	0%	0%	0%	0%	**0%**	-	0%	0%	0%	0%	-	-	0%
Pedestrians	-	-	-	-	-	0	-	-	-	-	-	0	-	-	-	-	-	0	-	-	-	-	-	0	
% Pedestrians	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Bicycles on Crosswalk	-	-	-	-	-	0	-	-	-	-	-	0	-	-	-	-	-	0	-	-	-	-	-	0	
% Bicycles on Crosswalk	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

*Pedestrians and Bicycles on Crosswalk. L: Left, R: Right, T: Thru, U: U-Turn

TM-1 Ballardvale Street (Route 125) @ I-93 N... - TMC

Wed Jan 16, 2019

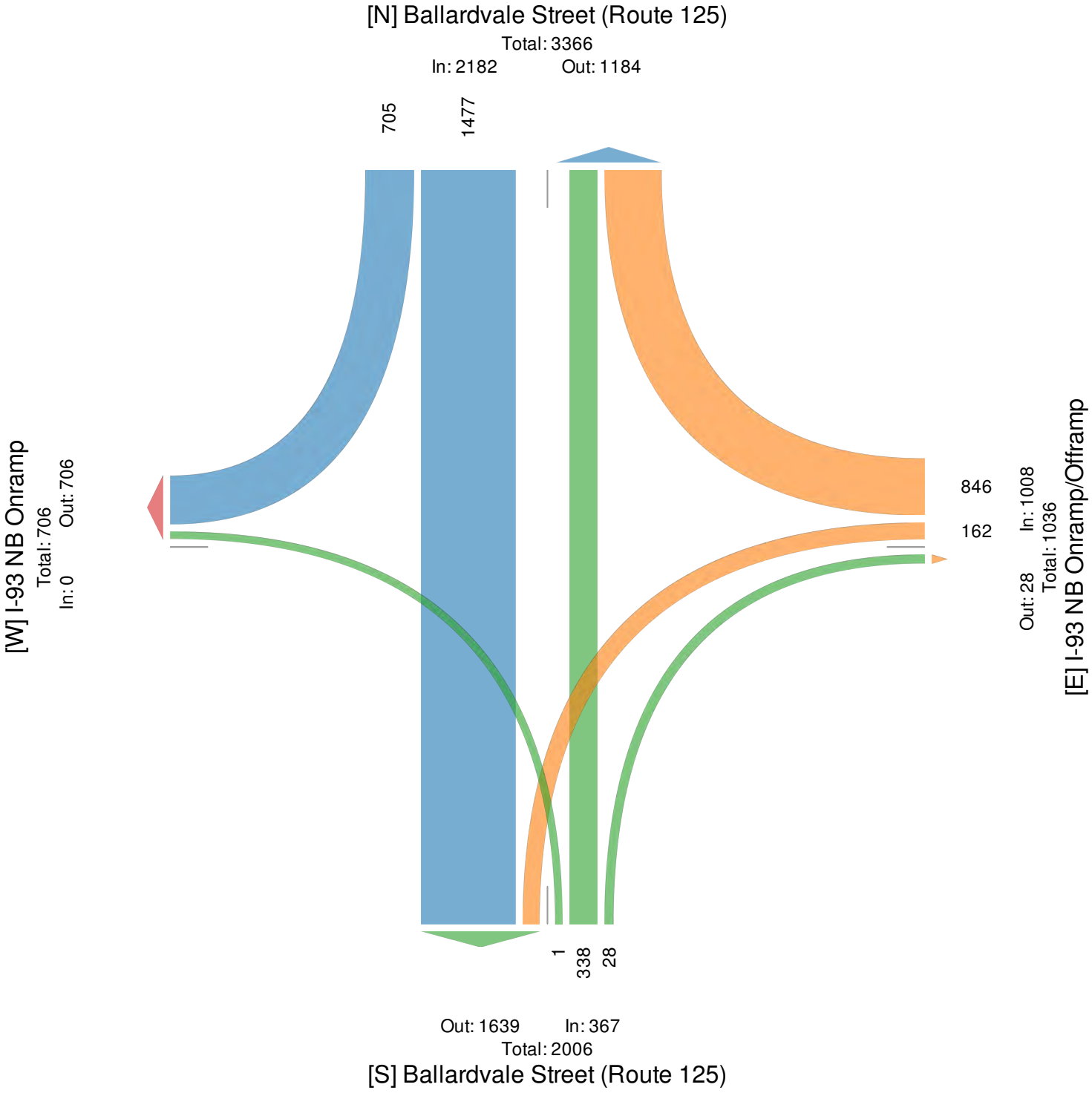
PM Peak (4:30 PM - 5:30 PM) - Overall Peak Hour

All Classes (Motorcycles, Lights, Single-Unit Trucks, Articulated Trucks, Buses, Pedestrians, Bicycles on Road, Bicycles on Crosswalk)

All Movements

ID: 609037, Location: 42.585518, -71.156976

Provided by: Precision Data Industries, LLC (PDI)
46 Morton Street,
Framingham, MA, MA, 01702, US



TM-2 Ballardville Street (Route 125) @ I-93 ... - TMC

Wed Jan 16, 2019
Full Length (6 AM-9 AM, 3 PM-6 PM)
All Classes (Motorcycles, Lights, Single-Unit Trucks, Articulated Trucks, Buses, Pedestrians, Bicycles on Road, Bicycles on Crosswalk)
All Movements
ID: 609038, Location: 42.582744, -71.158304

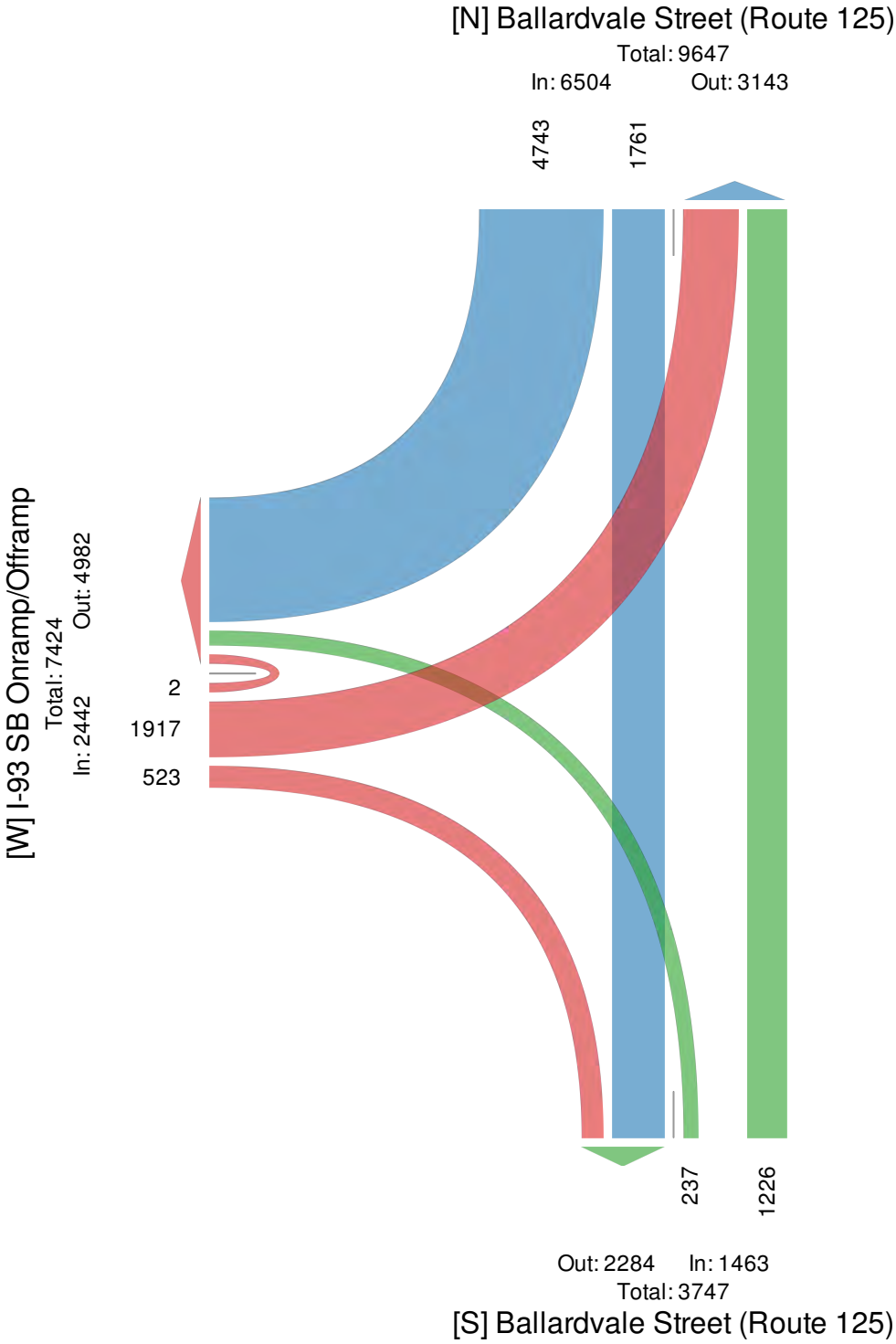
Provided by: Precision Data Industries, LLC (PDI)
46 Morton Street,
Framingham, MA, MA, 01702, US

Leg / Direction	Ballardvale Street (Route 125) Southbound					Ballardvale Street (Route 125) Northbound					I-93 SB Onramp/Offramp Eastbound					
Time	R	T	U	App	Ped*	T	L	U	App	Ped*	R	L	U	App	Ped*	Int
2019-01-16 6:00AM	137	12	0	**149**	0	23	9	0	**32**	0	17	88	0	**105**	0	**286**
6:15AM	150	17	0	**167**	0	45	7	0	**52**	0	21	95	0	**116**	0	**335**
6:30AM	158	18	0	**176**	0	45	10	0	**55**	0	16	113	0	**129**	0	**360**
6:45AM	152	27	0	**179**	0	51	19	0	**70**	0	19	130	0	**149**	0	**398**
Hourly Total	597	74	0	**671**	0	164	45	0	**209**	0	73	426	0	**499**	0	**1379**
7:00AM	201	19	0	**220**	0	58	13	0	**71**	0	14	142	0	**156**	0	**447**
7:15AM	218	31	0	**249**	0	85	12	0	**97**	0	18	123	0	**141**	0	**487**
7:30AM	207	33	0	**240**	0	101	24	0	**125**	0	16	139	0	**155**	0	**520**
7:45AM	217	44	0	**261**	0	81	27	0	**108**	0	15	128	0	**143**	0	**512**
Hourly Total	843	127	0	**970**	0	325	76	0	**401**	0	63	532	0	**595**	0	**1966**
8:00AM	204	40	0	**244**	0	65	22	0	**87**	0	6	123	0	**129**	0	**460**
8:15AM	191	44	0	**235**	0	59	16	0	**75**	0	13	131	0	**144**	0	**454**
8:30AM	183	50	0	**233**	0	48	11	0	**59**	0	24	117	0	**141**	0	**433**
8:45AM	198	43	0	**241**	0	55	5	0	**60**	0	21	125	0	**146**	0	**447**
Hourly Total	776	177	0	**953**	0	227	54	0	**281**	0	64	496	0	**560**	0	**1794**
3:00PM	153	86	0	**239**	0	47	1	0	**48**	0	14	41	0	**55**	0	**342**
3:15PM	149	86	0	**235**	0	38	4	0	**42**	0	22	44	0	**66**	0	**343**
3:30PM	174	95	0	**269**	0	29	8	0	**37**	0	37	30	0	**67**	0	**373**
3:45PM	157	90	0	**247**	0	38	4	0	**42**	0	23	40	0	**63**	0	**352**
Hourly Total	633	357	0	**990**	0	152	17	0	**169**	0	96	155	0	**251**	0	**1410**
4:00PM	198	86	0	**284**	0	30	2	0	**32**	0	32	41	0	**73**	0	**389**
4:15PM	207	124	0	**331**	0	48	7	0	**55**	0	26	44	0	**70**	0	**456**
4:30PM	220	147	0	**367**	0	51	7	0	**58**	0	36	57	1	**94**	0	**519**
4:45PM	268	128	0	**396**	0	41	7	0	**48**	0	29	45	0	**74**	0	**518**
Hourly Total	893	485	0	**1378**	0	170	23	0	**193**	0	123	187	1	**311**	0	**1882**
5:00PM	267	171	0	**438**	0	42	7	0	**49**	0	21	28	0	**49**	0	**536**
5:15PM	327	122	0	**449**	0	54	7	0	**61**	0	28	46	0	**74**	0	**584**
5:30PM	229	157	0	**386**	0	58	5	0	**63**	0	29	18	1	**48**	0	**497**
5:45PM	178	91	0	**269**	0	34	3	0	**37**	0	26	29	0	**55**	0	**361**
Hourly Total	1001	541	0	**1542**	0	188	22	0	**210**	0	104	121	1	**226**	0	**1978**
Total	4743	1761	0	**6504**	0	1226	237	0	**1463**	0	523	1917	2	**2442**	0	**10409**
% Approach	72.9%	27.1%	0%	-	-	83.8%	16.2%	0%	-	-	21.4%	78.5%	0.1%	-	-	-
% Total	45.6%	16.9%	0%	**62.5%**	-	11.8%	2.3%	0%	**14.1%**	-	5.0%	18.4%	0%	**23.5%**	-	-
Motorcycles	0	0	0	**0**	-	0	0	0	**0**	-	0	0	0	**0**	-	0
% Motorcycles	0%	0%	0%	**0%**	-	0%	0%	0%	**0%**	-	0%	0%	0%	**0%**	-	0%
Lights	4473	1726	0	**6199**	-	1207	234	0	**1441**	-	516	1744	2	**2262**	-	9902
% Lights	94.3%	98.0%	0%	**95.3%**	-	98.5%	98.7%	0%	**98.5%**	-	98.7%	91.0%	100%	**92.6%**	-	95.1%
Single-Unit Trucks	200	27	0	**227**	-	17	3	0	**20**	-	6	85	0	**91**	-	338
% Single-Unit Trucks	4.2%	1.5%	0%	**3.5%**	-	1.4%	1.3%	0%	**1.4%**	-	1.1%	4.4%	0%	**3.7%**	-	3.2%
Articulated Trucks	65	2	0	**67**	-	1	0	0	**1**	-	0	86	0	**86**	-	154
% Articulated Trucks	1.4%	0.1%	0%	**1.0%**	-	0.1%	0%	0%	**0.1%**	-	0%	4.5%	0%	**3.5%**	-	1.5%
Buses	5	6	0	**11**	-	1	0	0	**1**	-	1	2	0	**3**	-	15
% Buses	0.1%	0.3%	0%	**0.2%**	-	0.1%	0%	0%	**0.1%**	-	0.2%	0.1%	0%	**0.1%**	-	0.1%
Bicycles on Road	0	0	0	**0**	-	0	0	0	**0**	-	0	0	0	**0**	-	0
% Bicycles on Road	0%	0%	0%	**0%**	-	0%	0%	0%	**0%**	-	0%	0%	0%	**0%**	-	0%
Pedestrians	-	-	-	-	0	-	-	-	-	0	-	-	-	-	0	
% Pedestrians	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Bicycles on Crosswalk	-	-	-	-	0	-	-	-	-	0	-	-	-	-	0	
% Bicycles on Crosswalk	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

*Pedestrians and Bicycles on Crosswalk. L: Left, R: Right, T: Thru, U: U-Turn

TM-2 Ballardville Street (Route 125) @ I-93 ... - TMC
Wed Jan 16, 2019
Full Length (6 AM-9 AM, 3 PM-6 PM)
All Classes (Motorcycles, Lights, Single-Unit Trucks, Articulated Trucks, Buses, Pedestrians, Bicycles on Road, Bicycles on Crosswalk)
All Movements
ID: 609038, Location: 42.582744, -71.158304

Provided by: Precision Data Industries, LLC (PDI)
46 Morton Street,
Framingham, MA, MA, 01702, US



TM-2 Ballardville Street (Route 125) @ I-93 ... - TMC

Wed Jan 16, 2019
AM Peak (7:15 AM - 8:15 AM)
All Classes (Motorcycles, Lights, Single-Unit Trucks, Articulated Trucks, Buses, Pedestrians, Bicycles on Road, Bicycles on Crosswalk)
All Movements
ID: 609038, Location: 42.582744, -71.158304

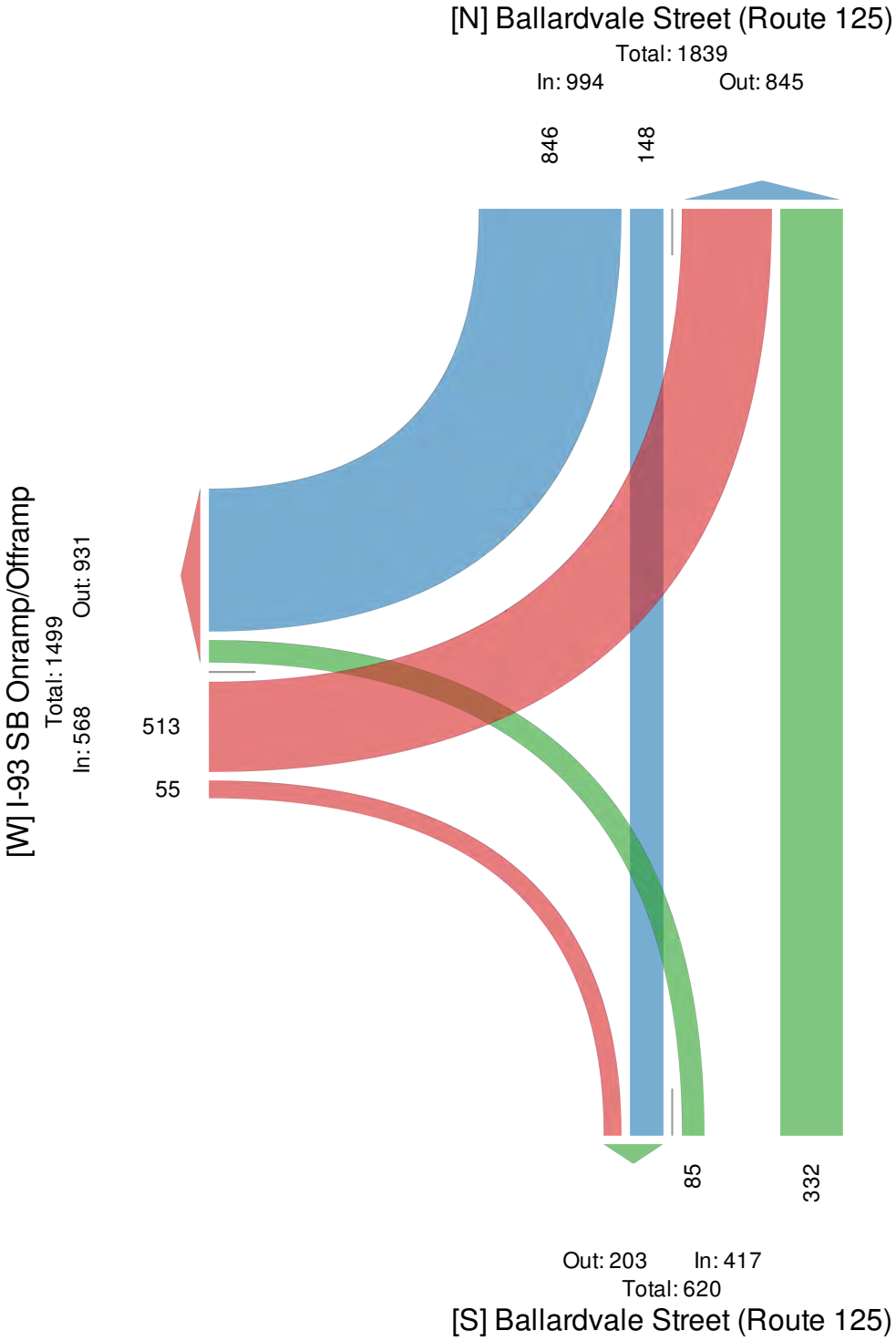
Provided by: Precision Data Industries, LLC (PDI)
46 Morton Street,
Framingham, MA, MA, 01702, US

Leg Direction	Ballardvale Street (Route 125) Southbound					Ballardvale Street (Route 125) Northbound					I-93 SB Onramp/Offramp Eastbound					
Time	R	T	U	**App**	Ped*	T	L	U	**App**	Ped*	R	L	U	**App**	Ped*	**Int**
2019-01-16 7:15AM	218	31	0	**249**	0	85	12	0	**97**	0	18	123	0	**141**	0	**487**
7:30AM	207	33	0	**240**	0	101	24	0	**125**	0	16	139	0	**155**	0	**520**
7:45AM	217	44	0	**261**	0	81	27	0	**108**	0	15	128	0	**143**	0	**512**
8:00AM	204	40	0	**244**	0	65	22	0	**87**	0	6	123	0	**129**	0	**460**
Total	846	148	0	**994**	0	332	85	0	**417**	0	55	513	0	**568**	0	**1979**
% Approach	85.1%	14.9%	0%	**-**	-	79.6%	20.4%	0%	**-**	-	9.7%	90.3%	0%	**-**	-	-
% Total	42.7%	7.5%	0%	**50.2%**	-	16.8%	4.3%	0%	**21.1%**	-	2.8%	25.9%	0%	**28.7%**	-	-
PHF	0.970	0.841	-	**0.952**	-	0.822	0.787	-	**0.834**	-	0.764	0.923	-	**0.916**	-	0.951
Motorcycles	0	0	0	**0**	-	0	0	0	**0**	-	0	0	0	**0**	-	0
% Motorcycles	0%	0%	0%	**0%**	-	0%	0%	0%	**0%**	-	0%	0%	0%	**0%**	-	0%
Lights	782	139	0	**921**	-	327	85	0	**412**	-	53	483	0	**536**	-	1869
% Lights	92.4%	93.9%	0%	**92.7%**	-	98.5%	100%	0%	**98.8%**	-	96.4%	94.2%	0%	**94.4%**	-	94.4%
Single-Unit Trucks	53	7	0	**60**	-	4	0	0	**4**	-	2	15	0	**17**	-	81
% Single-Unit Trucks	6.3%	4.7%	0%	**6.0%**	-	1.2%	0%	0%	**1.0%**	-	3.6%	2.9%	0%	**3.0%**	-	4.1%
Articulated Trucks	10	2	0	**12**	-	1	0	0	**1**	-	0	15	0	**15**	-	28
% Articulated Trucks	1.2%	1.4%	0%	**1.2%**	-	0.3%	0%	0%	**0.2%**	-	0%	2.9%	0%	**2.6%**	-	1.4%
Buses	1	0	0	**1**	-	0	0	0	**0**	-	0	0	0	**0**	-	1
% Buses	0.1%	0%	0%	**0.1%**	-	0%	0%	0%	**0%**	-	0%	0%	0%	**0%**	-	0.1%
Bicycles on Road	0	0	0	**0**	-	0	0	0	**0**	-	0	0	0	**0**	-	0
% Bicycles on Road	0%	0%	0%	**0%**	-	0%	0%	0%	**0%**	-	0%	0%	0%	**0%**	-	0%
Pedestrians	-	-	-	-	0	-	-	-	-	0	-	-	-	-	0	
% Pedestrians	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Bicycles on Crosswalk	-	-	-	-	0	-	-	-	-	0	-	-	-	-	0	
% Bicycles on Crosswalk	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

*Pedestrians and Bicycles on Crosswalk. L: Left, R: Right, T: Thru, U: U-Turn

TM-2 Ballardville Street (Route 125) @ I-93 ... - TMC
Wed Jan 16, 2019
AM Peak (7:15 AM - 8:15 AM)
All Classes (Motorcycles, Lights, Single-Unit Trucks, Articulated Trucks, Buses, Pedestrians, Bicycles on Road, Bicycles on Crosswalk)
All Movements
ID: 609038, Location: 42.582744, -71.158304

Provided by: Precision Data Industries, LLC (PDI)
46 Morton Street,
Framingham, MA, MA, 01702, US



TM-2 Ballardville Street (Route 125) @ I-93 ... - TMC

Wed Jan 16, 2019
PM Peak (4:30 PM - 5:30 PM) - Overall Peak Hour
All Classes (Motorcycles, Lights, Single-Unit Trucks, Articulated Trucks, Buses, Pedestrians, Bicycles on Road, Bicycles on Crosswalk)
All Movements
ID: 609038, Location: 42.582744, -71.158304

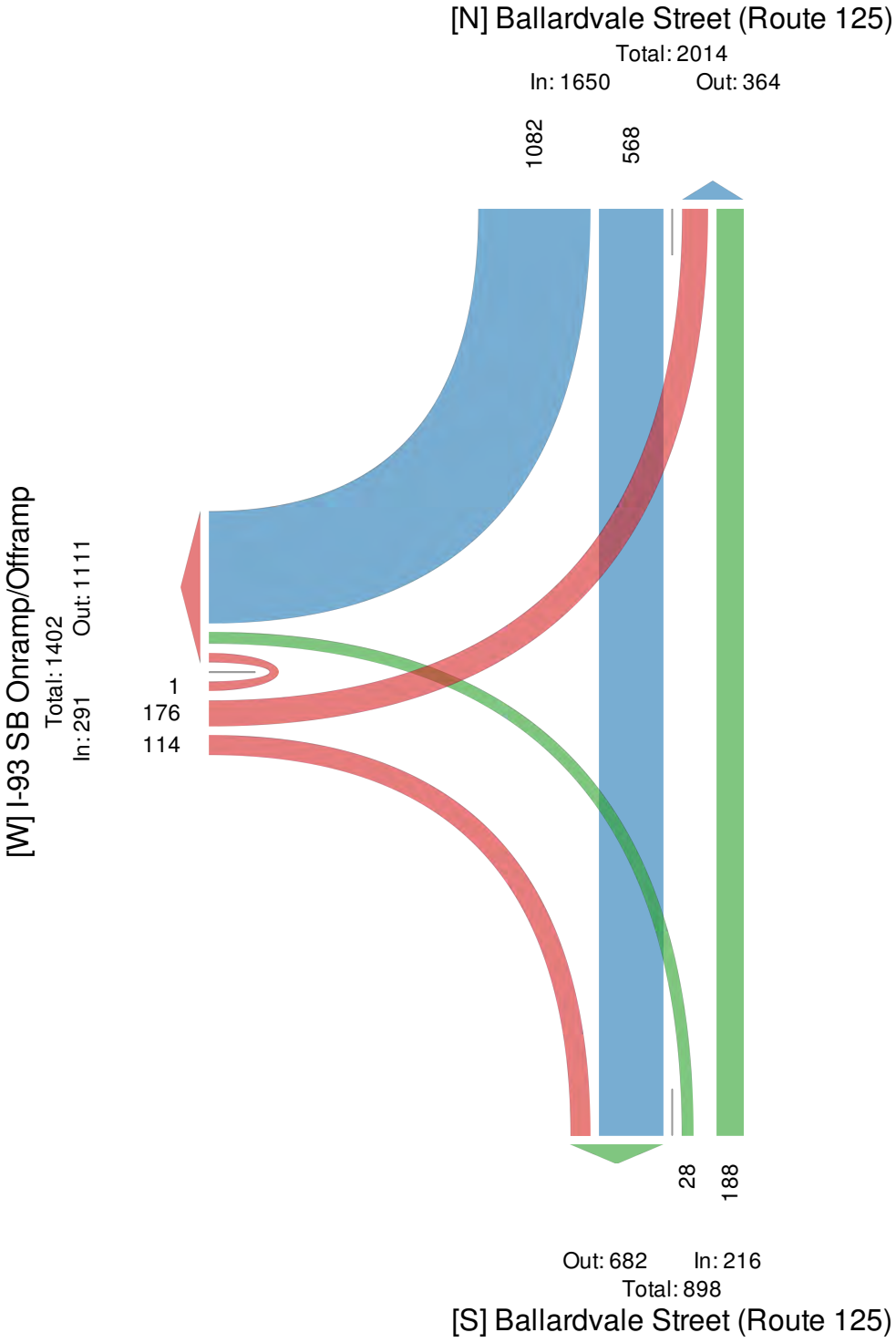
Provided by: Precision Data Industries, LLC (PDI)
46 Morton Street,
Framingham, MA, MA, 01702, US

Leg / Direction	Ballardvale Street (Route 125) Southbound					Ballardvale Street (Route 125) Northbound					I-93 SB Onramp/Offramp Eastbound					
Time	R	T	U	App	Ped*	T	L	U	App	Ped*	R	L	U	App	Ped*	Int
2019-01-16 4:30PM	220	147	0	**367**	0	51	7	0	**58**	0	36	57	1	**94**	0	**519**
4:45PM	268	128	0	**396**	0	41	7	0	**48**	0	29	45	0	**74**	0	**518**
5:00PM	267	171	0	**438**	0	42	7	0	**49**	0	21	28	0	**49**	0	**536**
5:15PM	327	122	0	**449**	0	54	7	0	**61**	0	28	46	0	**74**	0	**584**
Total	1082	568	0	**1650**	0	188	28	0	**216**	0	114	176	1	**291**	0	**2157**
% Approach	65.6%	34.4%	0%	-	-	87.0%	13.0%	0%	-	-	39.2%	60.5%	0.3%	-	-	-
% Total	50.2%	26.3%	0%	**76.5%**	-	8.7%	1.3%	0%	**10.0%**	-	5.3%	8.2%	0%	**13.5%**	-	-
PHF	0.827	0.830	-	**0.919**	-	0.870	1.000	-	**0.885**	-	0.792	0.772	0.250	**0.774**	-	0.923
Motorcycles	0	0	0	**0**	-	0	0	0	**0**	-	0	0	0	**0**	-	0
% Motorcycles	0%	0%	0%	**0%**	-	0%	0%	0%	**0%**	-	0%	0%	0%	**0%**	-	0%
Lights	1071	565	0	**1636**	-	186	28	0	**214**	-	114	159	1	**274**	-	2124
% Lights	99.0%	99.5%	0%	**99.2%**	-	98.9%	100%	0%	**99.1%**	-	100%	90.3%	100%	**94.2%**	-	98.5%
Single-Unit Trucks	3	2	0	**5**	-	2	0	0	**2**	-	0	13	0	**13**	-	20
% Single-Unit Trucks	0.3%	0.4%	0%	**0.3%**	-	1.1%	0%	0%	**0.9%**	-	0%	7.4%	0%	**4.5%**	-	0.9%
Articulated Trucks	7	0	0	**7**	-	0	0	0	**0**	-	0	3	0	**3**	-	10
% Articulated Trucks	0.6%	0%	0%	**0.4%**	-	0%	0%	0%	**0%**	-	0%	1.7%	0%	**1.0%**	-	0.5%
Buses	1	1	0	**2**	-	0	0	0	**0**	-	0	1	0	**1**	-	3
% Buses	0.1%	0.2%	0%	**0.1%**	-	0%	0%	0%	**0%**	-	0%	0.6%	0%	**0.3%**	-	0.1%
Bicycles on Road	0	0	0	**0**	-	0	0	0	**0**	-	0	0	0	**0**	-	0
% Bicycles on Road	0%	0%	0%	**0%**	-	0%	0%	0%	**0%**	-	0%	0%	0%	**0%**	-	0%
Pedestrians	-	-	-	-	0	-	-	-	-	0	-	-	-	-	0	
% Pedestrians	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Bicycles on Crosswalk	-	-	-	-	0	-	-	-	-	0	-	-	-	-	0	
% Bicycles on Crosswalk	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

*Pedestrians and Bicycles on Crosswalk. L: Left, R: Right, T: Thru, U: U-Turn

TM-2 Ballardville Street (Route 125) @ I-93 ... - TMC
Wed Jan 16, 2019
PM Peak (4:30 PM - 5:30 PM) - Overall Peak Hour
All Classes (Motorcycles, Lights, Single-Unit Trucks, Articulated Trucks, Buses, Pedestrians, Bicycles on Road, Bicycles on Crosswalk)
All Movements
ID: 609038, Location: 42.582744, -71.158304

Provided by: Precision Data Industries, LLC (PDI)
46 Morton Street,
Framingham, MA, MA, 01702, US



TM-3 Ballardvale Street (Route 125) @ Ballar... - TMC

Wed Jan 16, 2019
Full Length (6 AM-9 AM, 3 PM-6 PM)
All Classes (Motorcycles, Lights, Single-Unit Trucks, Articulated Trucks, Buses, Pedestrians, Bicycles on Road, Bicycles on Crosswalk)
All Movements
ID: 609040, Location: 42.587497, -71.155562

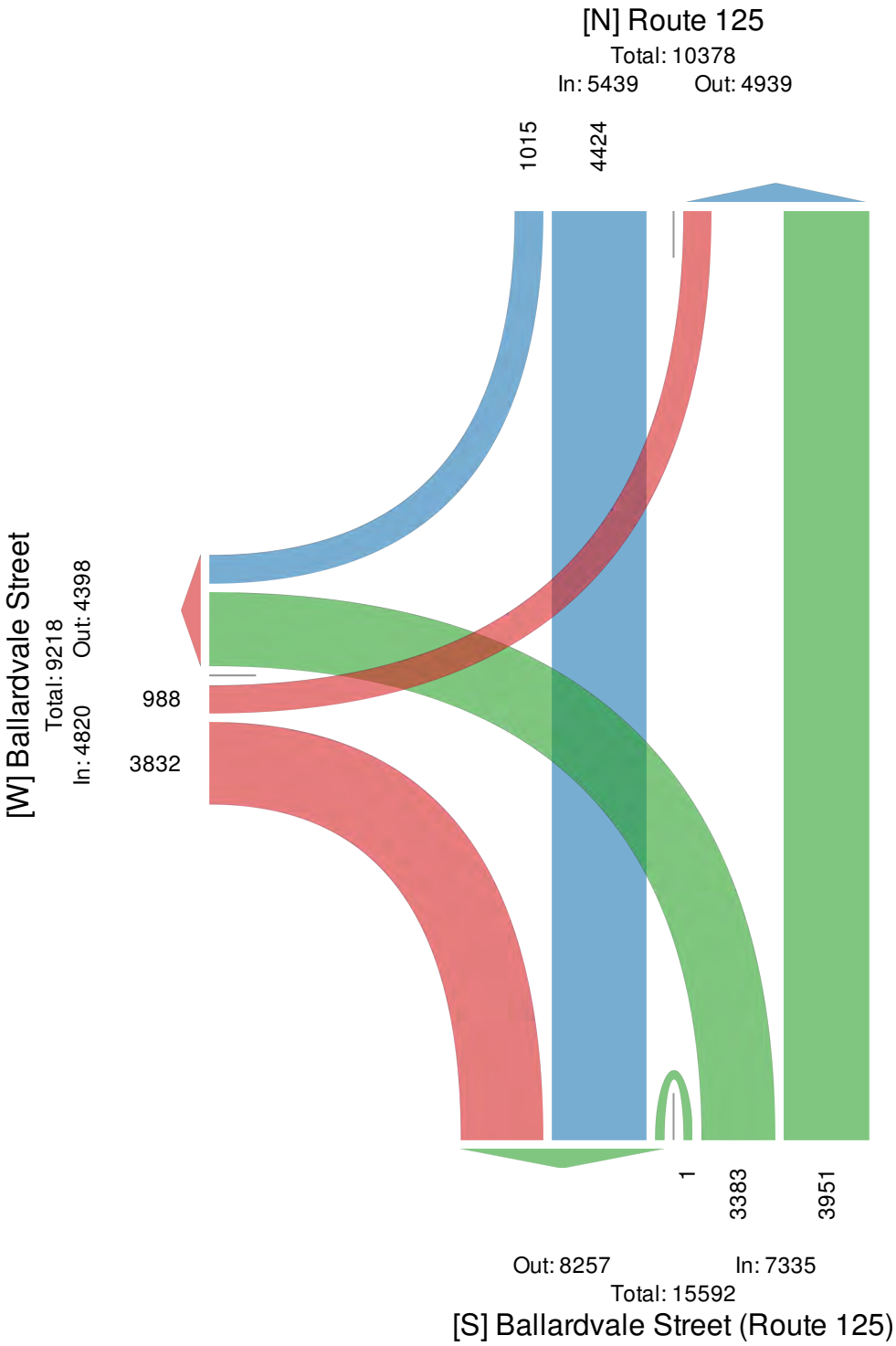
Provided by: Precision Data Industries, LLC (PDI)
46 Morton Street,
Framingham, MA, MA, 01702, US

Leg	Route 125					Ballardvale Street (Route 125)					Ballardvale Street					
Direction	Southbound					Northbound					Eastbound					
Time	R	T	U	App	Ped*	T	L	U	App	Ped*	R	L	U	App	Ped*	Int
2019-01-16 6:00AM	17	128	0	**145**	0	52	115	0	**167**	0	41	9	0	**50**	0	**362**
6:15AM	30	151	0	**181**	0	91	138	0	**229**	0	46	9	0	**55**	0	**465**
6:30AM	39	144	0	**183**	0	98	180	0	**278**	0	47	8	0	**55**	0	**516**
6:45AM	40	185	0	**225**	0	118	194	0	**312**	0	43	7	0	**50**	0	**587**
Hourly Total	126	608	0	**734**	0	359	627	0	**986**	0	177	33	0	**210**	0	**1930**
7:00AM	40	189	0	**229**	0	135	203	0	**338**	0	55	13	0	**68**	0	**635**
7:15AM	70	235	0	**305**	0	168	195	0	**363**	0	65	17	0	**82**	0	**750**
7:30AM	78	223	0	**301**	0	169	250	0	**419**	0	80	16	0	**96**	0	**816**
7:45AM	88	230	0	**318**	0	161	314	0	**475**	0	66	13	0	**79**	0	**872**
Hourly Total	276	877	0	**1153**	0	633	962	0	**1595**	0	266	59	0	**325**	0	**3073**
8:00AM	92	209	0	**301**	0	130	261	1	**392**	0	87	12	0	**99**	0	**792**
8:15AM	107	214	0	**321**	0	122	265	0	**387**	0	77	18	0	**95**	0	**803**
8:30AM	84	179	0	**263**	0	118	249	0	**367**	0	79	17	0	**96**	0	**726**
8:45AM	102	213	0	**315**	0	112	263	0	**375**	0	73	17	0	**90**	0	**780**
Hourly Total	385	815	0	**1200**	0	482	1038	1	**1521**	0	316	64	0	**380**	0	**3101**
3:00PM	24	151	0	**175**	0	160	75	0	**235**	0	177	42	0	**219**	0	**629**
3:15PM	21	138	0	**159**	0	152	77	0	**229**	0	170	47	0	**217**	0	**605**
3:30PM	25	181	0	**206**	0	169	69	0	**238**	0	220	53	0	**273**	0	**717**
3:45PM	20	131	0	**151**	0	200	58	0	**258**	0	187	45	0	**232**	0	**641**
Hourly Total	90	601	0	**691**	0	681	279	0	**960**	0	754	187	0	**941**	0	**2592**
4:00PM	14	169	0	**183**	0	184	58	0	**242**	0	267	86	0	**353**	0	**778**
4:15PM	22	164	0	**186**	0	205	63	0	**268**	0	224	62	0	**286**	0	**740**
4:30PM	19	198	0	**217**	0	226	74	0	**300**	0	292	84	0	**376**	0	**893**
4:45PM	22	213	0	**235**	0	243	68	0	**311**	0	281	75	0	**356**	0	**902**
Hourly Total	77	744	0	**821**	0	858	263	0	**1121**	0	1064	307	0	**1371**	0	**3313**
5:00PM	18	222	0	**240**	0	213	52	0	**265**	0	405	117	0	**522**	0	**1027**
5:15PM	11	205	0	**216**	0	254	54	0	**308**	0	365	98	0	**463**	0	**987**
5:30PM	21	205	0	**226**	0	242	49	0	**291**	0	284	75	0	**359**	0	**876**
5:45PM	11	147	0	**158**	0	229	59	0	**288**	0	201	48	0	**249**	0	**695**
Hourly Total	61	779	0	**840**	0	938	214	0	**1152**	0	1255	338	0	**1593**	0	**3585**
Total	1015	4424	0	**5439**	0	3951	3383	1	**7335**	0	3832	988	0	**4820**	0	**17594**
% Approach	18.7%	81.3%	0%	**-**	-	53.9%	46.1%	0%	**-**	-	79.5%	20.5%	0%	**-**	-	-
% Total	5.8%	25.1%	0%	**30.9%**	-	22.5%	19.2%	0%	**41.7%**	-	21.8%	5.6%	0%	**27.4%**	-	-
Motorcycles	0	0	0	**0**	-	0	0	0	**0**	-	0	0	0	**0**	-	0
% Motorcycles	0%	0%	0%	**0%**	-	0%	0%	0%	**0%**	-	0%	0%	0%	**0%**	-	0%
Lights	968	4262	0	**5230**	-	3798	3069	1	**6868**	-	3529	945	0	**4474**	-	16572
% Lights	95.4%	96.3%	0%	**96.2%**	-	96.1%	90.7%	100%	**93.6%**	-	92.1%	95.6%	0%	**92.8%**	-	94.2%
Single-Unit Trucks	34	108	0	**142**	-	114	185	0	**299**	-	200	31	0	**231**	-	672
% Single-Unit Trucks	3.3%	2.4%	0%	**2.6%**	-	2.9%	5.5%	0%	**4.1%**	-	5.2%	3.1%	0%	**4.8%**	-	3.8%
Articulated Trucks	12	43	0	**55**	-	33	129	0	**162**	-	103	11	0	**114**	-	331
% Articulated Trucks	1.2%	1.0%	0%	**1.0%**	-	0.8%	3.8%	0%	**2.2%**	-	2.7%	1.1%	0%	**2.4%**	-	1.9%
Buses	0	11	0	**11**	-	6	0	0	**6**	-	0	0	0	**0**	-	17
% Buses	0%	0.2%	0%	**0.2%**	-	0.2%	0%	0%	**0.1%**	-	0%	0%	0%	**0%**	-	0.1%
Bicycles on Road	1	0	0	**1**	-	0	0	0	**0**	-	0	1	0	**1**	-	2
% Bicycles on Road	0.1%	0%	0%	**0%**	-	0%	0%	0%	**0%**	-	0%	0.1%	0%	**0%**	-	0%
Pedestrians	-	-	-	-	0	-	-	-	-	0	-	-	-	-	0	
% Pedestrians	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Bicycles on Crosswalk	-	-	-	-	0	-	-	-	-	0	-	-	-	-	0	
% Bicycles on Crosswalk	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

*Pedestrians and Bicycles on Crosswalk. L: Left, R: Right, T: Thru, U: U-Turn

TM-3 Ballardvale Street (Route 125) @ Ballar... - TMC
Wed Jan 16, 2019
Full Length (6 AM-9 AM, 3 PM-6 PM)
All Classes (Motorcycles, Lights, Single-Unit Trucks, Articulated Trucks, Buses, Pedestrians, Bicycles on Road, Bicycles on Crosswalk)
All Movements
ID: 609040, Location: 42.587497, -71.155562

Provided by: Precision Data Industries, LLC (PDI)
46 Morton Street,
Framingham, MA, MA, 01702, US



TM-3 Ballardvale Street (Route 125) @ Ballar... - TMC

Wed Jan 16, 2019
AM Peak (7:30 AM - 8:30 AM)
All Classes (Motorcycles, Lights, Single-Unit Trucks, Articulated Trucks, Buses, Pedestrians, Bicycles on Road, Bicycles on Crosswalk)
All Movements
ID: 609040, Location: 42.587497, -71.155562

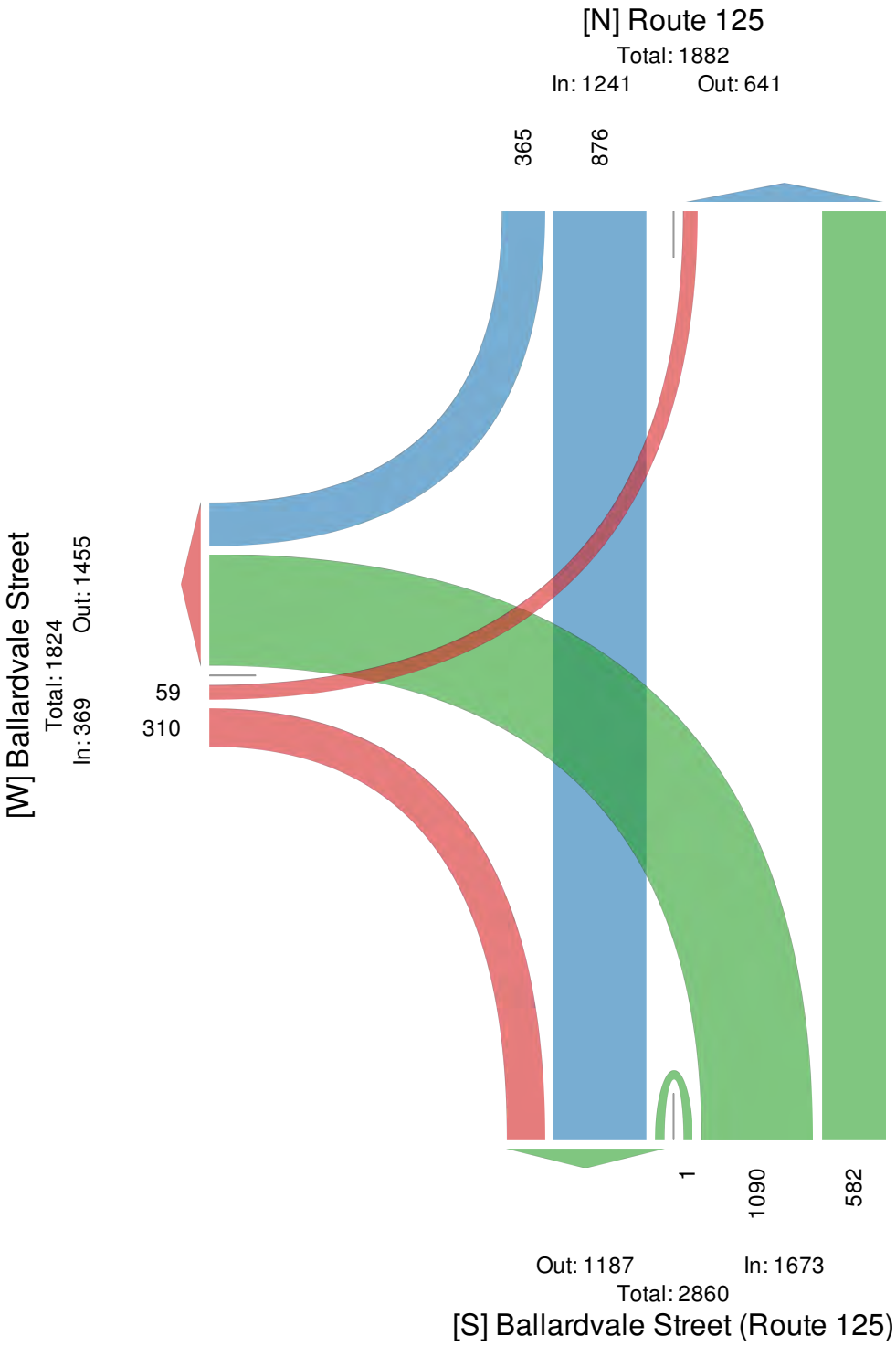
Provided by: Precision Data Industries, LLC (PDI)
46 Morton Street,
Framingham, MA, MA, 01702, US

Leg	Route 125					Ballardvale Street (Route 125)					Ballardvale Street					
Direction	Southbound					Northbound					Eastbound					
Time	R	T	U	App	Ped*	T	L	U	App	Ped*	R	L	U	App	Ped*	Int
2019-01-16 7:30AM	78	223	0	**301**	0	169	250	0	**419**	0	80	16	0	**96**	0	**816**
7:45AM	88	230	0	**318**	0	161	314	0	**475**	0	66	13	0	**79**	0	**872**
8:00AM	92	209	0	**301**	0	130	261	1	**392**	0	87	12	0	**99**	0	**792**
8:15AM	107	214	0	**321**	0	122	265	0	**387**	0	77	18	0	**95**	0	**803**
Total	365	876	0	**1241**	0	582	1090	1	**1673**	0	310	59	0	**369**	0	**3283**
% Approach	29.4%	70.6%	0%	-	-	34.8%	65.2%	0.1%	-	-	84.0%	16.0%	0%	-	-	-
% Total	11.1%	26.7%	0%	**37.8%**	-	17.7%	33.2%	0%	**51.0%**	-	9.4%	1.8%	0%	**11.2%**	-	-
PHF	0.850	0.952	-	**0.966**	-	0.861	0.868	0.250	**0.881**	-	0.891	0.819	-	**0.932**	-	0.941
Motorcycles	0	0	0	**0**	-	0	0	0	**0**	-	0	0	0	**0**	-	0
% Motorcycles	0%	0%	0%	**0%**	-	0%	0%	0%	**0%**	-	0%	0%	0%	**0%**	-	0%
Lights	349	833	0	**1182**	-	550	1029	1	**1580**	-	230	47	0	**277**	-	3039
% Lights	95.6%	95.1%	0%	**95.2%**	-	94.5%	94.4%	100%	**94.4%**	-	74.2%	79.7%	0%	**75.1%**	-	92.6%
Single-Unit Trucks	12	31	0	**43**	-	26	36	0	**62**	-	64	10	0	**74**	-	179
% Single-Unit Trucks	3.3%	3.5%	0%	**3.5%**	-	4.5%	3.3%	0%	**3.7%**	-	20.6%	16.9%	0%	**20.1%**	-	5.5%
Articulated Trucks	3	10	0	**13**	-	6	25	0	**31**	-	16	2	0	**18**	-	62
% Articulated Trucks	0.8%	1.1%	0%	**1.0%**	-	1.0%	2.3%	0%	**1.9%**	-	5.2%	3.4%	0%	**4.9%**	-	1.9%
Buses	0	2	0	**2**	-	0	0	0	**0**	-	0	0	0	**0**	-	2
% Buses	0%	0.2%	0%	**0.2%**	-	0%	0%	0%	**0%**	-	0%	0%	0%	**0%**	-	0.1%
Bicycles on Road	1	0	0	**1**	-	0	0	0	**0**	-	0	0	0	**0**	-	1
% Bicycles on Road	0.3%	0%	0%	**0.1%**	-	0%	0%	0%	**0%**	-	0%	0%	0%	**0%**	-	0%
Pedestrians	-	-	-	-	0	-	-	-	-	0	-	-	-	-	0	
% Pedestrians	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Bicycles on Crosswalk	-	-	-	-	0	-	-	-	-	0	-	-	-	-	0	
% Bicycles on Crosswalk	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

*Pedestrians and Bicycles on Crosswalk. L: Left, R: Right, T: Thru, U: U-Turn

TM-3 Ballardvale Street (Route 125) @ Ballar... - TMC
Wed Jan 16, 2019
AM Peak (7:30 AM - 8:30 AM)
All Classes (Motorcycles, Lights, Single-Unit Trucks, Articulated Trucks, Buses, Pedestrians, Bicycles on Road, Bicycles on Crosswalk)
All Movements
ID: 609040, Location: 42.587497, -71.155562

Provided by: Precision Data Industries, LLC (PDI)
46 Morton Street,
Framingham, MA, MA, 01702, US



TM-3 Ballardvale Street (Route 125) @ Ballar... - TMC

Wed Jan 16, 2019
PM Peak (4:30 PM - 5:30 PM) - Overall Peak Hour
All Classes (Motorcycles, Lights, Single-Unit Trucks, Articulated Trucks, Buses, Pedestrians, Bicycles on Road, Bicycles on Crosswalk)
All Movements
ID: 609040, Location: 42.587497, -71.155562

Provided by: Precision Data Industries, LLC (PDI)
46 Morton Street,
Framingham, MA, MA, 01702, US

Leg Direction	Route 125 Southbound					Ballardvale Street (Route 125) Northbound					Ballardvale Street Eastbound					
Time	R	T	U	**App**	Ped*	T	L	U	**App**	Ped*	R	L	U	**App**	Ped*	**Int**
2019-01-16 4:30PM	19	198	0	**217**	0	226	74	0	**300**	0	292	84	0	**376**	0	**893**
4:45PM	22	213	0	**235**	0	243	68	0	**311**	0	281	75	0	**356**	0	**902**
5:00PM	18	222	0	**240**	0	213	52	0	**265**	0	405	117	0	**522**	0	**1027**
5:15PM	11	205	0	**216**	0	254	54	0	**308**	0	365	98	0	**463**	0	**987**
Total	70	838	0	**908**	0	936	248	0	**1184**	0	1343	374	0	**1717**	0	**3809**
% Approach	7.7%	92.3%	0%	**-**	-	79.1%	20.9%	0%	**-**	-	78.2%	21.8%	0%	**-**	-	-
% Total	1.8%	22.0%	0%	**23.8%**	-	24.6%	6.5%	0%	**31.1%**	-	35.3%	9.8%	0%	**45.1%**	-	-
PHF	0.795	0.944	-	**0.946**	-	0.921	0.838	-	**0.952**	-	0.829	0.804	-	**0.823**	-	0.928
Motorcycles	0	0	0	**0**	-	0	0	0	**0**	-	0	0	0	**0**	-	0
% Motorcycles	0%	0%	0%	**0%**	-	0%	0%	0%	**0%**	-	0%	0%	0%	**0%**	-	0%
Lights	64	827	0	**891**	-	920	209	0	**1129**	-	1327	368	0	**1695**	-	3715
% Lights	91.4%	98.7%	0%	**98.1%**	-	98.3%	84.3%	0%	**95.4%**	-	98.8%	98.4%	0%	**98.7%**	-	97.5%
Single-Unit Trucks	4	4	0	**8**	-	9	34	0	**43**	-	8	4	0	**12**	-	63
% Single-Unit Trucks	5.7%	0.5%	0%	**0.9%**	-	1.0%	13.7%	0%	**3.6%**	-	0.6%	1.1%	0%	**0.7%**	-	1.7%
Articulated Trucks	2	6	0	**8**	-	5	5	0	**10**	-	8	1	0	**9**	-	27
% Articulated Trucks	2.9%	0.7%	0%	**0.9%**	-	0.5%	2.0%	0%	**0.8%**	-	0.6%	0.3%	0%	**0.5%**	-	0.7%
Buses	0	1	0	**1**	-	2	0	0	**2**	-	0	0	0	**0**	-	3
% Buses	0%	0.1%	0%	**0.1%**	-	0.2%	0%	0%	**0.2%**	-	0%	0%	0%	**0%**	-	0.1%
Bicycles on Road	0	0	0	**0**	-	0	0	0	**0**	-	0	1	0	**1**	-	1
% Bicycles on Road	0%	0%	0%	**0%**	-	0%	0%	0%	**0%**	-	0%	0.3%	0%	**0.1%**	-	0%
Pedestrians	-	-	-	-	0	-	-	-	-	0	-	-	-	-	0	
% Pedestrians	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Bicycles on Crosswalk	-	-	-	-	0	-	-	-	-	0	-	-	-	-	0	
% Bicycles on Crosswalk	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

*Pedestrians and Bicycles on Crosswalk. L: Left, R: Right, T: Thru, U: U-Turn

TM-3 Ballardvale Street (Route 125) @ Ballar... - TMC

Wed Jan 16, 2019

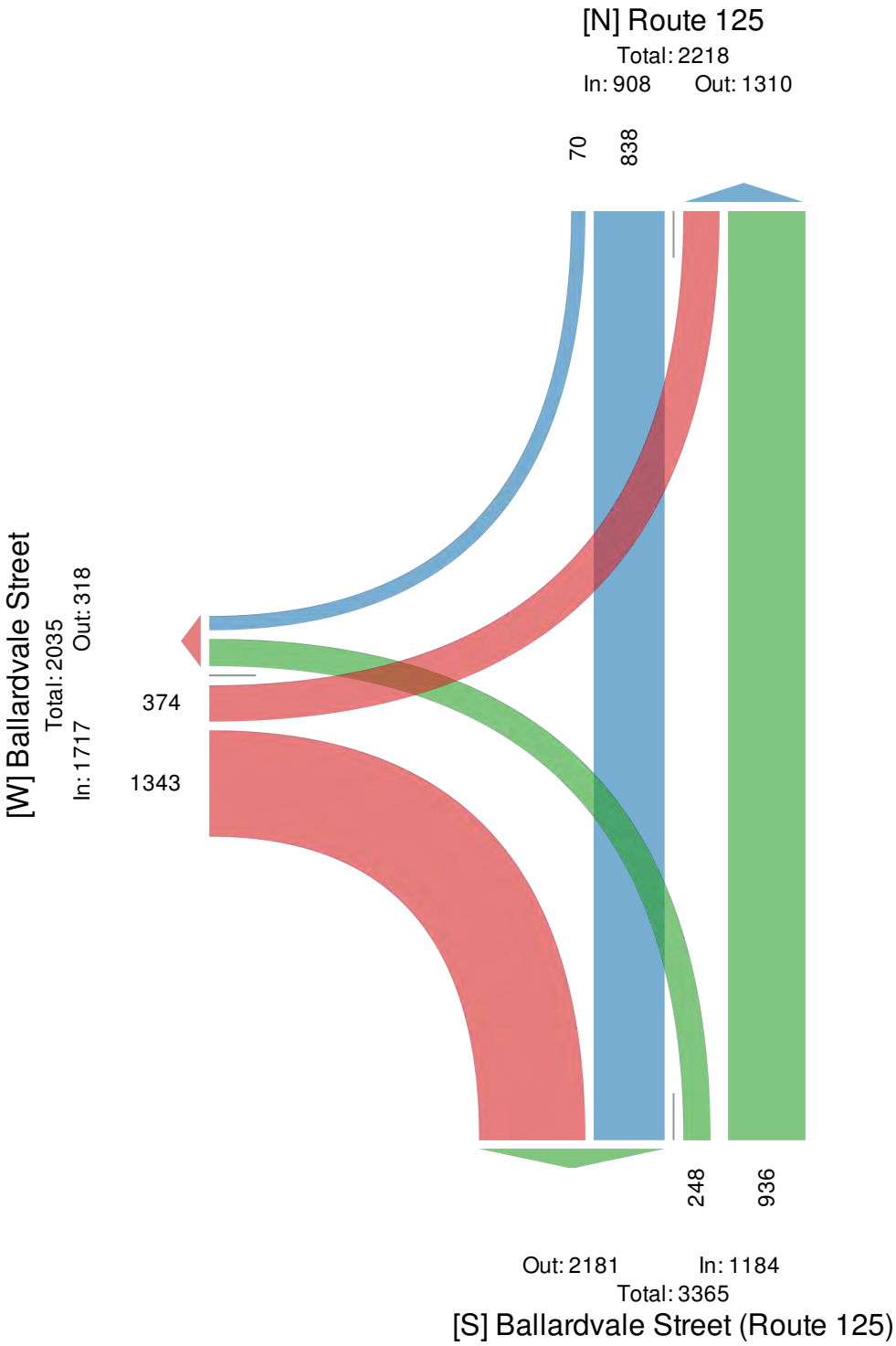
PM Peak (4:30 PM - 5:30 PM) - Overall Peak Hour

All Classes (Motorcycles, Lights, Single-Unit Trucks, Articulated Trucks, Buses, Pedestrians, Bicycles on Road, Bicycles on Crosswalk)

All Movements

ID: 609040, Location: 42.587497, -71.155562

Provided by: Precision Data Industries, LLC (PDI)
46 Morton Street,
Framingham, MA, MA, 01702, US



STA. 4

Massachusetts Highway Department

S18-055-342-01 Weekly Volume Report - Mon 01/14/2019 - Sun 01/20/2019

Location ID:	S18-055-342-01	**Type:**	SPOT
Located On:	ON-RAMP FROM RTE. 62 TO I-93NB	:	
Direction	RAMP		
Community:	WILMINGTON	**Period:**	Mon 01/14/2019 - Sun 01/20/2019
AADT:			

Start Time	Mon	Tue	Wed	Thu	Fri	Sat	Sun	Avg
12:00 AM			18	18	16			17
1:00 AM			14	11	11			12
2:00 AM			12	16	24			17
3:00 AM			14	18	14			15
4:00 AM			32	44	36			37
5:00 AM			103	105	106			105
6:00 AM			263	276	215			251
7:00 AM			470	408	360			413
8:00 AM			431	415	368			405
9:00 AM			328	334	291			318
10:00 AM		228	220	206				218
11:00 AM		216	234	239				230
12:00 PM		247	268	273				263
1:00 PM		290	303	283				292
2:00 PM		314	334	302				317
3:00 PM		378	331	337				349
4:00 PM		321	346	283				317
5:00 PM		300	320	258				293
6:00 PM		204	244	202				217
7:00 PM		120	139	168				142
8:00 PM		140	133	151				141
9:00 PM		80	76	97				84
10:00 PM		68	71	97				79
11:00 PM		39	40	41				40
Total	**0**	**2945**	**4744**	**4582**	**1441**	**0**	**0**	
24HrTotal			4630	4704	4378			4571
AM Pk Hr			7:00	8:00				
AM Peak			470	415				443
PM Pk Hr			4:00	3:00				
PM Peak			346	337				342
% Peak Hr			9.91%	9.06%				9.50%
% Peak Hr			8.16%	9.99%	9.48%			9.21%

STA. 5

Massachusetts Highway Department
R12208 Weekly Volume Report - Mon 01/28/2019 - Sun 02/03/2019

Location ID:	R12208
Located On:	RAMP-RT 93 NB TO RT 125
Direction	RAMP
Community:	Wilmington
AADT:	

Type:	SPOT
Period:	Mon 01/28/2019 - Sun 02/03/2019

Start Time	Mon	Tue	Wed	Thu	Fri	Sat	Sun	Avg
12:00 AM		46	56	62				55
1:00 AM		33	43	44				40
2:00 AM		48	41	62				50
3:00 AM		75	64	65				68
4:00 AM		107	114	111				111
5:00 AM		303	282	285				290
6:00 AM		471	400	431				434
7:00 AM		802	660	730				731
8:00 AM		909	762	831				834
9:00 AM		638	684	591				638
10:00 AM		428	449	426				434
11:00 AM		473	433	452				453
12:00 PM		538	487	515				513
1:00 PM	608	565	637					603
2:00 PM	713	709	702					708
3:00 PM	724	802	779					768
4:00 PM	945	771	917					878
5:00 PM	1037	1000	1015					1017
6:00 PM	724	866	665					752
7:00 PM	485	455	418					453
8:00 PM	342	317	408					356
9:00 PM	221	287	263					257
10:00 PM	184	221	226					210
11:00 PM	89	138	120					116
Total	**6072**	**11002**	**10625**	**4605**	**0**	**0**	**0**	
24HrTotal		10943	10606	10755				10768
AM Pk Hr		8:00	8:00					
AM Peak		909	762					836
PM Pk Hr		5:00	5:00					
PM Peak		1000	1015					1008
% Peak Hr		9.09%	9.55%					9.50%
% Peak Hr		9.48%	9.43%	9.44%				9.45%

STA. 6

Massachusetts Highway Department

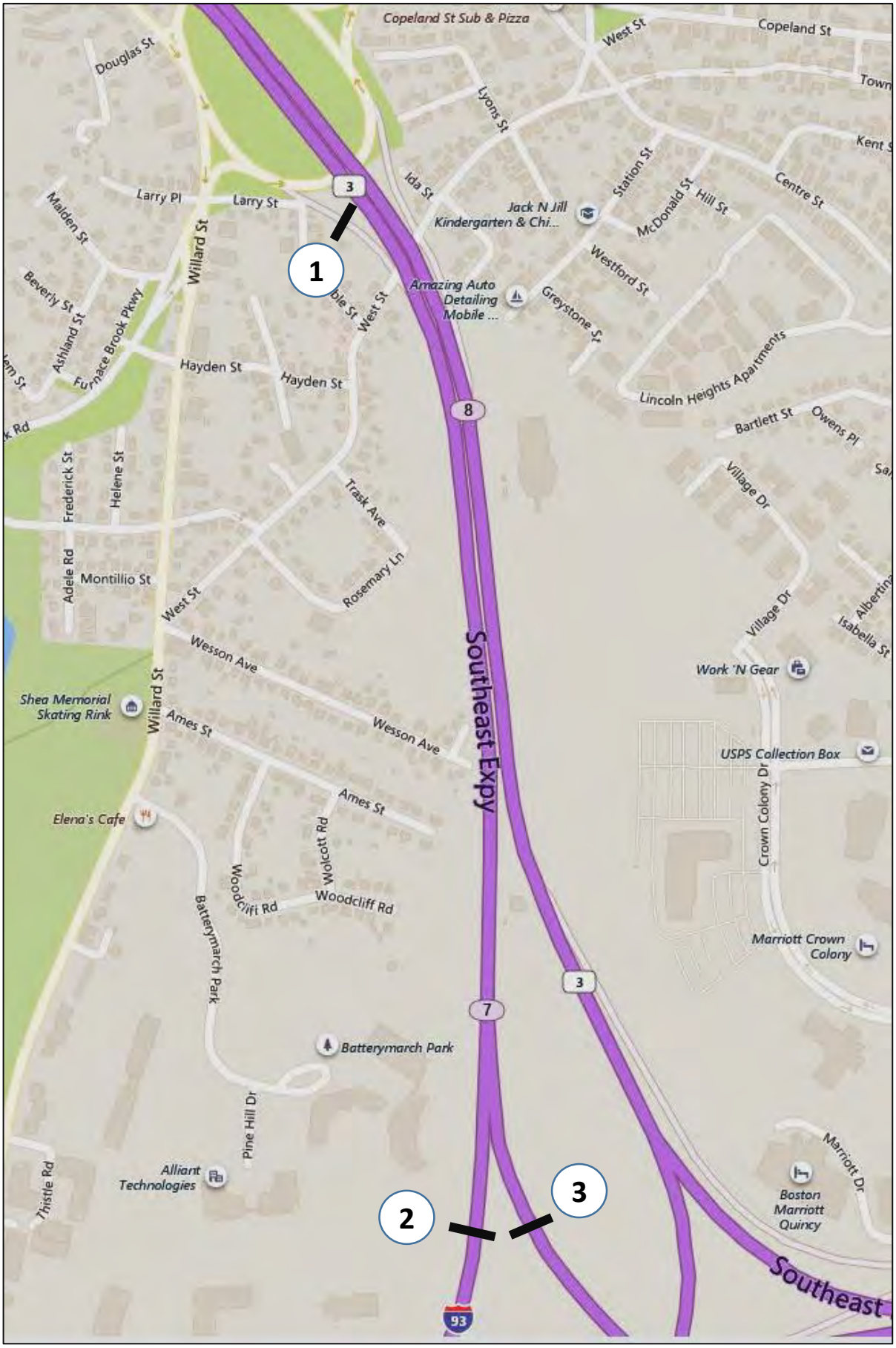
S18-055-342-03 Weekly Volume Report - Mon 01/14/2019 - Sun 01/20/2019

Location ID:	S18-055-342-03
Located On:	ON-RAMP FROM RTE.125 TO I-93NB
Direction	RAMP
Community:	WILMINGTON
AADT:	

Type:	SPOT
:	
Period:	Mon 01/14/2019 - Sun 01/20/2019

Start Time	Mon	Tue	Wed	Thu	Fri	Sat	Sun	Avg
12:00 AM			1	2				2
1:00 AM			5	0				3
2:00 AM			0	2				1
3:00 AM			2	0				1
4:00 AM			4	3				4
5:00 AM			11	11				11
6:00 AM			37	40				39
7:00 AM			57	57				57
8:00 AM			48	44				46
9:00 AM			37	51				44
10:00 AM			36	31				34
11:00 AM		29	36					33
12:00 PM		31	32					32
1:00 PM		30	25					28
2:00 PM		40	33					37
3:00 PM		36	25					31
4:00 PM		20	25					23
5:00 PM		43	42					43
6:00 PM		30	38					34
7:00 PM		27	39					33
8:00 PM		15	24					20
9:00 PM		17	15					16
10:00 PM		7	5					6
11:00 PM		1	3					2
Total	0	326	580	241	0	0	0	
24HrTotal			564	583				574
AM Pk Hr			7:00					
AM Peak			57					57
PM Pk Hr			5:00					
PM Peak			42					42
% Peak Hr			9.83%					10.00%
% Peak Hr			7.62%	9.78%				8.70%

I-93 Southbound between Exit 7 (Furnace Brook Parkway) and Exit 8 (Route 3 Southbound)



MassDOT Highway Division
WEEKLY SUMMARY FOR LANE 1
Starting: 6/16/2019

STA. 1

Site Reference: 190020000141
Site ID: Station 1
Location: Furnace Brook Pkwy. on-ramp to I-93 SB
Direction: SOUTH

File: 1.prn
City: Quincy
County: Ramp ID # 12076

TIME	MON 17	TUE 18	WED 19	THU 20	FRI 21	WKDAY AVG	SAT 22	SUN 16	WEEK AVG	TOTAL
01:00	26	48	41	39	45	39	86	127	58	412
02:00	14	18	12	24	28	19	51	70	31	217
03:00	14	16	17	16	26	17	34	36	22	159
04:00	16	15	23	25	16	19	30	23	21	148
05:00	39	58	56	54	43	50	33	15	42	298
06:00	171	166	170	159	133	159	65	35	128	899
07:00	427	320	315	308	291	332	171	91	274	1923
08:00	620	403	410	389	389	442	249	132	370	2592
09:00	641	430	422	447	416	471	319	225	414	2900
10:00	490	334	344	372	367	381	339	349	370	2595
11:00	483	365	359	367	408	396	423	451	408	2856
12:00	367	326	349	317	348	341	417	563	383	2687
13:00	360	352	333	361	419	365	372	484	383	2681
14:00	384	371	343	381	412	378	391	586	409	2868
15:00	438	444	418	427	469	439	444	515	450	3155
16:00	468	494	457	405	624	489	387	622	493	3457
17:00	483	635	649	548	559	574	350	450	524	3674
18:00	622	755	509	733	509	625	333	392	550	3853
19:00	415	528	447	425	389	440	307	296	401	2807
20:00	308	298	370	320	269	313	300	271	305	2136
21:00	260	218	283	217	225	240	278	230	244	1711
22:00	189	200	239	196	225	209	237	174	208	1460
23:00	131	161	163	136	179	154	222	97	155	1089
24:00	71	76	179	88	161	115	158	64	113	797
TOTALS	7437	7031	6908	6754	6950	7007	5996	6298	6756	47374
% AVG WKDY	106.1	100.3	98.5	96.3	99.1		85.5	89.8		
% AVG WEEK	110	104	102.2	99.9	102.8		88.7	93.2		
AM Times	09:00	09:00	09:00	09:00	09:00	09:00	11:00	12:00	09:00	
AM Peaks	641	430	422	447	416	471	423	563	414	
PM Times	18:00	18:00	17:00	18:00	16:00	18:00	15:00	16:00	18:00	
PM Peaks	622	755	649	733	624	625	444	622	550	

MassDOT Highway Division
WEEKLY SUMMARY FOR LANE
Starting: 6/16/2019

STA. 2
TOTAL

Site Reference: 190020000034
Site ID: Station 2
Location: I-93 SB ramp to I-95
Direction: ROAD TOTAL

File: comb..prn
City: Quincy
County: Ramp ID # 12077

TIME	MON 17	TUE 18	WED 19	THU 20	FRI 21	WKDAY AVG	SAT 22	SUN 16	WEEK AVG	TOTAL
01:00	811	915	933	1213	1203	1015	1674	1585	1190	8334
02:00	556	616	709	786	814	696	1172	1245	842	5898
03:00	368	443	434	534	724	500	943	980	632	4426
04:00	324	361	396	400	435	383	640	607	451	3163
05:00	623	728	677	744	593	673	582	445	627	4392
06:00	1521	1494	1500	1583	1340	1487	927	563	1275	8928
07:00	2580	2661	2581	2553	2338	2542	1680	943	2190	15336
08:00	2768	3003	2988	2790	2769	2863	2331	1494	2591	18143
09:00	2857	2938	2812	2703	2756	2813	2999	1877	2706	18942
10:00	2745	2887	2768	2641	2452	2698	3153	2641	2755	19287
11:00	2885	2855	2972	2840	2980	2906	3430	3370	3047	21332
12:00	3239	3313	3304	3033	3365	3250	3608	3618	3354	23480
13:00	3403	3004	3619	3238	3441	3341	3622	3619	3420	23946
14:00	3533	2702	3689	3092	2975	3198	3427	3522	3277	22940
15:00	3436	2631	3337	3189	2786	3075	3489	3106	3139	21974
16:00	2828	2291	2695	2165	2497	2495	3154	2815	2635	18445
17:00	2618	2409	2679	1765	2314	2357	3130	3477	2627	18392
18:00	2655	2625	2693	2932	2215	2624	2663	3113	2699	18896
19:00	2925	3112	3277	3074	2996	3076	3311	3023	3102	21718
20:00	3514	3600	3594	3174	3280	3432	3579	2891	3376	23632
21:00	2788	2984	3350	3125	2928	3035	3239	2600	3002	21014
22:00	2487	2492	2705	2502	2770	2591	3041	2343	2620	18340
23:00	2005	1871	1891	2327	2752	2169	2937	1659	2206	15442
24:00	1667	1700	1920	1971	2668	1985	2897	1376	2028	14199
TOTALS	55136	53635	57523	54374	55391	55204	61628	52912	55791	390599
% AVG WKDY	99.8	97.1	104.2	98.4	100.3		111.6	95.8		
% AVG WEEK	98.8	96.1	103.1	97.4	99.2		110.4	94.8		
AM Times	12:00	12:00	12:00	12:00	12:00	12:00	12:00	12:00	12:00	
AM Peaks	3239	3313	3304	3033	3365	3250	3608	3618	3354	
PM Times	14:00	20:00	14:00	13:00	13:00	20:00	13:00	13:00	13:00	
PM Peaks	3533	3600	3689	3238	3441	3432	3622	3619	3420	
D%	55	55	55	55	55		55	55		
K%	6	7	6	6	6		6	7		

MassDOT Highway Division
WEEKLY SUMMARY FOR LANE 1
Starting: 6/16/2019

STA. 2
LN. 1

Site Reference: 190020000034
Site ID: Station 2
Location: I-93 SB ramp to I-95
Direction: SOUTH

File: comb..prn
City: Quincy
County: Ramp ID # 12077

TIME	MON 17	TUE 18	WED 19	THU 20	FRI 21	WKDAY AVG	SAT 22	SUN 16	WEEK AVG	TOTAL
01:00	334	399	350	572	511	433	685	667	502	3518
02:00	226	242	262	355	348	286	475	505	344	2413
03:00	147	186	186	220	294	206	395	399	261	1827
04:00	125	145	153	164	177	152	265	245	182	1274
05:00	288	359	324	358	300	325	239	199	295	2067
06:00	696	695	677	724	647	687	354	218	573	4011
07:00	1233	1203	1204	1181	1109	1186	674	351	993	6955
08:00	1367	1431	1446	1365	1351	1392	982	616	1222	8558
09:00	1397	1404	1360	1321	1343	1365	1285	737	1263	8847
10:00	1376	1418	1388	1373	1215	1354	1355	1076	1314	9201
11:00	1334	1330	1353	1357	1362	1347	1596	1437	1395	9769
12:00	1495	1476	1487	1418	1567	1488	1701	1629	1539	10773
13:00	1509	1415	1618	1529	1582	1530	1710	1694	1579	11057
14:00	1581	1279	1685	1468	1465	1495	1568	1659	1529	10705
15:00	1616	1282	1589	1524	1349	1472	1638	1433	1490	10431
16:00	1385	1105	1327	1087	1218	1224	1500	1330	1278	8952
17:00	1359	1169	1423	875	1128	1190	1501	1591	1292	9046
18:00	1444	1371	1451	1488	1095	1369	1354	1394	1371	9597
19:00	1522	1531	1606	1520	1452	1526	1509	1344	1497	10484
20:00	1574	1635	1618	1496	1471	1558	1580	1275	1521	10649
21:00	1207	1270	1514	1390	1178	1311	1423	1139	1303	9121
22:00	1067	1079	1149	1032	1180	1101	1320	1006	1119	7833
23:00	865	738	864	897	1176	908	1241	727	929	6508
24:00	681	660	954	835	1098	845	1221	563	858	6012
TOTALS	25828	24822	26988	25549	25616	25750	27571	23234	25649	179608
% AVG WKDY	100.3	96.3	104.8	99.2	99.4		107	90.2		
% AVG WEEK	100.6	96.7	105.2	99.6	99.8		107.4	90.5		
AM Times	12:00	12:00	12:00	12:00	12:00	12:00	12:00	12:00	12:00	
AM Peaks	1495	1476	1487	1418	1567	1488	1701	1629	1539	
PM Times	15:00	20:00	14:00	13:00	13:00	20:00	13:00	13:00	13:00	
PM Peaks	1616	1635	1685	1529	1582	1558	1710	1694	1579	

STA. 2
LN. 2

Site Reference: 190020000034
Site ID: Station 2
Location: I-93 SB ramp to I-95
Direction: SOUTH

File: comb..prn
City: Quincy
County: Ramp ID # 12077

TIME	MON 17	TUE 18	WED 19	THU 20	FRI 21	WKDAY AVG	SAT 22	SUN 16	WEEK AVG	TOTAL
01:00	477	516	583	641	692	581	989	918	688	4816
02:00	330	374	447	431	466	409	697	740	497	3485
03:00	221	257	248	314	430	294	548	581	371	2599
04:00	199	216	243	236	258	230	375	362	269	1889
05:00	335	369	353	386	293	347	343	246	332	2325
06:00	825	799	823	859	693	799	573	345	702	4917
07:00	1347	1458	1377	1372	1229	1356	1006	592	1197	8381
08:00	1401	1572	1542	1425	1418	1471	1349	878	1369	9585
09:00	1460	1534	1452	1382	1413	1448	1714	1140	1442	10095
10:00	1369	1469	1380	1268	1237	1344	1798	1565	1440	10086
11:00	1551	1525	1619	1483	1618	1559	1834	1933	1651	11563
12:00	1744	1837	1817	1615	1798	1762	1907	1989	1815	12707
13:00	1894	1589	2001	1709	1859	1810	1912	1925	1841	12889
14:00	1952	1423	2004	1624	1510	1702	1859	1863	1747	12235
15:00	1820	1349	1748	1665	1437	1603	1851	1673	1649	11543
16:00	1443	1186	1368	1078	1279	1270	1654	1485	1356	9493
17:00	1259	1240	1256	890	1186	1166	1629	1886	1335	9346
18:00	1211	1254	1242	1444	1120	1254	1309	1719	1328	9299
19:00	1403	1581	1671	1554	1544	1550	1802	1679	1604	11234
20:00	1940	1965	1976	1678	1809	1873	1999	1616	1854	12983
21:00	1581	1714	1836	1735	1750	1723	1816	1461	1699	11893
22:00	1420	1413	1556	1470	1590	1489	1721	1337	1501	10507
23:00	1140	1133	1027	1430	1576	1261	1696	932	1276	8934
24:00	986	1040	966	1136	1570	1139	1676	813	1169	8187
TOTALS	29308	28813	30535	28825	29775	29440	34057	29678	30132	210991
% AVG WKDY	99.5	97.8	103.7	97.9	101.1		115.6	100.8		
% AVG WEEK	97.2	95.6	101.3	95.6	98.8		113	98.4		
AM Times	12:00	12:00	12:00	12:00	12:00	12:00	12:00	12:00	12:00	
AM Peaks	1744	1837	1817	1615	1798	1762	1907	1989	1815	
PM Times	14:00	20:00	14:00	21:00	13:00	20:00	20:00	13:00	20:00	
PM Peaks	1952	1965	2004	1735	1859	1873	1999	1925	1854	

MassDOT Highway Division
WEEKLY SUMMARY FOR LANE 1
Starting: 6/16/2019

STA. 3
LN. 1

Site Reference: 190020000042
Site ID: Station 3
Location: I-93 SB ramp to Route 3 SB
Direction: SOUTH

File: comb..prn
City: Quincy
County: Ramp ID # 12032

TIME	MON 17	TUE 18	WED 19	THU 20	FRI 21	WKDAY AVG	SAT 22	SUN 16	WEEK AVG	TOTAL
01:00	279	351	305	721	453	421	643	497	464	3249
02:00	187	198	225	277	281	233	421	463	293	2052
03:00	121	151	126	209	250	171	311	315	211	1483
04:00	124	134	143	170	194	153	243	219	175	1227
05:00	268	276	272	281	226	264	234	130	241	1687
06:00	621	616	631	628	587	616	378	213	524	3674
07:00	1054	1020	1047	981	966	1013	756	377	885	6201
08:00	1238	1281	1274	1197	1121	1222	1114	625	1121	7850
09:00	1201	1174	1188	1211	1039	1162	1340	776	1132	7929
10:00	1161	1180	1175	1213	1045	1154	1229	1091	1156	8094
11:00	1106	1129	1148	1079	1279	1148	1285	1220	1178	8246
12:00	1167	1248	1203	1146	1392	1231	1376	1245	1253	8777
13:00	1147	1043	1277	1164	1338	1193	1357	1384	1244	8710
14:00	1315	1068	1334	1270	1252	1247	1263	1166	1238	8668
15:00	1470	1248	1569	1353	1316	1391	1304	1122	1340	9382
16:00	1408	1207	1498	1166	1302	1316	1153	1026	1251	8760
17:00	1406	1176	1402	1052	1325	1272	1120	1215	1242	8696
18:00	1386	1398	1460	1499	1355	1419	983	1120	1314	9201
19:00	1531	1502	1579	1583	1543	1547	1149	1057	1420	9944
20:00	1313	1414	1414	1454	1262	1371	1120	1048	1289	9025
21:00	1064	1094	1218	1192	1211	1155	1037	904	1102	7720
22:00	901	843	987	1024	1029	956	1006	785	939	6575
23:00	685	646	1063	892	940	845	945	604	825	5775
24:00	553	513	1184	672	888	762	867	438	730	5115
TOTALS	22706	21910	24722	23434	23594	23262	22634	19040	22567	158040
% AVG WKDY	97.6	94.1	106.2	100.7	101.4		97.3	81.8		
% AVG WEEK	100.6	97	109.5	103.8	104.5		100.2	84.3		
AM Times	08:00	08:00	08:00	10:00	12:00	12:00	12:00	12:00	12:00	
AM Peaks	1238	1281	1274	1213	1392	1231	1376	1245	1253	
PM Times	19:00	19:00	19:00	19:00	19:00	19:00	13:00	13:00	19:00	
PM Peaks	1531	1502	1579	1583	1543	1547	1357	1384	1420	

STA. 3

LN. 2

NO DATA

STA. 2
TOTAL

Site Reference: 190020000034
Site ID: Station 2
Location: I-93 SB ramp to I-95
Direction: ROAD TOTAL

File: comb..prn
City: Quincy
County: Ramp ID # 12077

TIME	30	35	40	45	50	55	60	65	70	75	80	85	90	91+	Total
01:00	1	0	3	22	91	423	512	360	116	40	13	2	1	1	1585
02:00	1	1	5	7	72	261	390	285	140	65	15	3	0	0	1245
03:00	1	0	2	9	42	115	281	263	161	74	23	3	1	5	980
04:00	2	1	3	9	23	88	155	150	104	57	11	1	1	2	607
05:00	0	0	1	2	35	87	124	105	62	19	9	0	1	0	445
06:00	1	0	1	2	6	45	127	141	135	79	20	6	0	0	563
07:00	3	1	0	14	36	60	126	285	224	130	48	12	3	1	943
08:00	2	0	1	1	14	106	293	476	325	196	60	11	7	2	1494
09:00	0	4	3	2	30	223	528	582	331	143	29	2	0	0	1877
10:00	18	4	2	14	154	637	785	645	274	89	17	1	0	1	2641
11:00	7	32	80	248	601	1058	798	362	135	39	7	3	0	0	3370
12:00	199	228	488	894	842	656	243	54	13	0	1	0	0	0	3618
13:00	262	145	333	938	1159	668	104	4	2	3	0	0	0	1	3619
14:00	871	671	662	701	400	188	23	2	0	0	0	2	0	2	3522
15:00	421	361	299	514	582	590	272	56	6	4	0	1	0	0	3106
16:00	494	238	267	352	350	477	359	213	45	16	3	0	0	1	2815
17:00	102	183	409	899	991	651	182	46	8	4	1	1	0	0	3477
18:00	4	2	110	305	687	1118	653	185	34	8	5	0	0	2	3113
19:00	34	48	143	416	702	984	502	156	28	6	3	1	0	0	3023
20:00	10	33	92	246	587	1099	576	189	43	14	1	0	0	1	2891
21:00	5	9	41	222	534	947	570	210	43	12	6	1	0	0	2600
22:00	4	0	16	113	383	831	647	264	71	12	0	0	0	2	2343
23:00	2	1	5	20	142	401	542	369	125	37	13	1	0	1	1659
24:00	2	0	1	26	72	317	434	330	146	37	10	1	0	0	1376
DAY TOTAL	2446	1962	2967	5976	8535	12030	9226	5732	2571	1084	295	52	14	22	52912
PERCENTS	4.7%	3.8%	5.7%	11.3%	16.2%	22.8%	17.4%	10.8%	4.8%	2.0%	0.5%	0.0%	0.0%	0.0%	100%

Statistical Information...

15th Percentile Speed
40.5 mph

85th Percentile Speed
61.6 mph

Median Speed
51.9 mph

Average Speed
50.5 mph

10 MPH Pace Speed
50 mph to 60 mph
21256 vehicles in pace
Representing 40.1% of the total vehicles

Vehicles > 65 MPH
4038
7.6%

MassDOT Highway Division
SPEED SUMMARY
Sun 6/16/2019

STA. 3

LN. 1

Site Reference: 190020000042
Site ID: Station 3
Location: I-93 SB ramp to Route 3 SB
Direction: SOUTH
Lane: 1

File: comb..prn
City: Quincy
County: Ramp ID # 12032

TIME	40	45	50	55	60	65	70	75	80	85	86+	Total
01:00	0	6	50	149	167	85	30	8	1	1	0	497
02:00	1	16	44	139	145	88	14	14	2	0	0	463
03:00	0	7	23	75	99	75	27	8	1	0	0	315
04:00	1	7	21	46	67	50	19	8	0	0	0	219
05:00	1	0	12	43	34	30	7	3	0	0	0	130
06:00	0	4	9	43	55	68	27	7	0	0	0	213
07:00	1	7	16	49	106	112	68	16	2	0	0	377
08:00	0	2	5	80	193	200	103	34	5	2	1	625
09:00	0	0	14	164	263	255	63	14	3	0	0	776
10:00	1	18	43	283	443	223	61	16	3	0	0	1091
11:00	2	37	177	488	338	133	33	9	1	2	0	1220
12:00	6	108	383	526	180	33	9	0	0	0	0	1245
13:00	12	136	516	556	137	24	3	0	0	0	0	1384
14:00	37	218	400	394	92	18	6	1	0	0	0	1166
15:00	12	136	390	445	106	27	5	1	0	0	0	1122
16:00	15	147	306	311	164	71	11	1	0	0	0	1026
17:00	5	126	424	478	136	34	10	2	0	0	0	1215
18:00	0	33	178	530	299	63	13	3	1	0	0	1120
19:00	3	26	194	546	233	48	6	1	0	0	0	1057
20:00	18	34	212	505	226	40	11	2	0	0	0	1048
21:00	0	27	138	418	230	73	17	0	1	0	0	904
22:00	7	26	96	288	258	85	21	3	1	0	0	785
23:00	0	15	46	181	198	133	27	4	0	0	0	604
24:00	0	14	52	132	129	82	20	9	0	0	0	438
DAY TOTAL	122	1150	3749	6869	4298	2050	611	164	21	5	1	19040
PERCENTS	0.7%	6.1%	19.7%	36.1%	22.6%	10.7%	3.2%	0.8%	0.1%	0.0%	0.0%	100%

Statistical Information...

15th Percentile Speed
47.1 mph

85th Percentile Speed
60.0 mph

Median Speed
53.3 mph

Average Speed
53.6 mph

10 MPH Pace Speed
50 mph to 60 mph
11167 vehicles in pace
Representing 58.6% of the total vehicles

Vehicles > 65 MPH
802
4.2%

Site Reference: 190020000042
Site ID: Station 3
Location: I-93 SB ramp to Route 3 SB
Direction: SOUTH
Lane: 1

File: comb..prn
City: Quincy
County: Ramp ID # 12032

TIME	40	45	50	55	60	65	70	75	80	85	86+	Total
01:00	0	8	16	75	92	61	23	4	0	0	0	279
02:00	0	4	13	42	57	49	19	3	0	0	0	187
03:00	2	1	10	29	32	32	13	2	0	0	0	121
04:00	0	1	7	22	31	39	14	10	0	0	0	124
05:00	1	0	10	44	84	76	41	8	3	0	1	268
06:00	0	0	5	60	199	207	100	42	8	0	0	621
07:00	3	4	30	237	441	269	53	17	0	0	0	1054
08:00	1	7	73	336	500	255	60	6	0	0	0	1238
09:00	13	29	134	416	402	170	25	9	3	0	0	1201
10:00	3	13	93	375	442	183	38	10	3	0	1	1161
11:00	10	51	134	462	350	76	16	6	1	0	0	1106
12:00	7	83	242	453	278	82	18	1	3	0	0	1167
13:00	11	80	254	447	252	70	24	6	2	1	0	1147
14:00	4	39	247	644	296	67	13	5	0	0	0	1315
15:00	201	231	514	432	82	8	2	0	0	0	0	1470
16:00	289	589	396	108	18	5	1	1	1	0	0	1408
17:00	1361	28	12	3	2	0	0	0	0	0	0	1406
18:00	1378	4	3	0	0	1	0	0	0	0	0	1386
19:00	1359	104	53	13	2	0	0	0	0	0	0	1531
20:00	97	110	213	444	322	101	24	2	0	0	0	1313
21:00	0	5	94	418	375	138	23	10	0	0	1	1064
22:00	8	28	109	359	290	88	11	5	3	0	0	901
23:00	8	12	58	214	241	114	28	8	2	0	0	685
24:00	0	4	23	138	211	125	32	16	3	1	0	553
DAY TOTAL	4756	1435	2743	5771	4999	2216	578	171	32	2	3	22706
PERCENTS	21.0%	6.4%	12.1%	25.5%	22.0%	9.7%	2.5%	0.7%	0.1%	0.0%	0.0%	100%

Statistical Information...

15th Percentile Speed
28.7 mph

85th Percentile Speed
59.6 mph

Median Speed
52.1 mph

Average Speed
47.1 mph

10 MPH Pace Speed
50 mph to 60 mph
10770 vehicles in pace
Representing 47.4% of the total vehicles.

Vehicles > 65 MPH
786
3.5%

Site Reference: 190020000042
Site ID: Station 3
Location: I-93 SB ramp to Route 3 SB
Direction: SOUTH
Lane: 1

File: comb..prn
City: Quincy
County: Ramp ID # 12032

TIME	40	45	50	55	60	65	70	75	80	85	86+	Total
01:00	0	4	13	93	122	69	30	16	4	0	0	351
02:00	0	4	13	42	56	53	18	10	2	0	0	198
03:00	1	5	6	32	42	45	12	7	1	0	0	151
04:00	0	5	12	20	35	37	17	6	1	1	0	134
05:00	3	3	7	56	81	73	37	16	0	0	0	276
06:00	0	4	8	71	198	204	91	31	7	1	1	616
07:00	1	10	36	239	421	234	62	14	3	0	0	1020
08:00	1	10	56	362	556	234	50	9	3	0	0	1281
09:00	6	30	95	402	421	182	33	4	1	0	0	1174
10:00	0	39	148	447	412	113	19	1	1	0	0	1180
11:00	1	26	147	439	372	117	24	3	0	0	0	1129
12:00	4	28	263	557	297	74	20	5	0	0	0	1248
13:00	54	257	395	250	61	23	1	2	0	0	0	1043
14:00	317	462	217	57	9	4	1	0	1	0	0	1068
15:00	653	427	125	34	7	1	0	0	0	1	0	1248
16:00	816	255	91	31	10	3	1	0	0	0	0	1207
17:00	522	438	159	44	10	2	0	0	1	0	0	1176
18:00	1389	4	1	4	0	0	0	0	0	0	0	1398
19:00	1477	16	5	1	1	1	1	0	0	0	0	1502
20:00	185	343	491	329	53	10	0	0	0	1	2	1414
21:00	1	22	149	453	353	92	17	3	2	2	0	1094
22:00	14	63	138	304	228	74	16	5	1	0	0	843
23:00	1	11	38	253	231	81	25	5	0	0	1	646
24:00	1	4	17	113	184	145	31	15	3	0	0	513
DAY TOTAL	5447	2470	2630	4633	4160	1871	506	152	31	6	4	21910
PERCENTS	24.9%	11.3%	12.1%	21.2%	19.0%	8.5%	2.3%	0.6%	0.1%	0.0%	0.0%	100%

Statistical Information...

15th Percentile Speed
24.1 mph

85th Percentile Speed
59.1 mph

Median Speed
50.5 mph

Average Speed
45.0 mph

10 MPH Pace Speed
50 mph to 60 mph
8793 vehicles in pace
Representing 40.1% of the total vehicles

Vehicles > 65 MPH
699
3.2%

Site Reference: 190020000042
Site ID: Station 3
Location: I-93 SB ramp to Route 3 SB
Direction: SOUTH
Lane: 1

File: comb..prn
City: Quincy
County: Ramp ID # 12032

TIME	40	45	50	55	60	65	70	75	80	85	86+	Total
01:00	6	0	13	67	94	75	30	17	2	1	0	305
02:00	0	4	18	50	61	60	20	11	1	0	0	225
03:00	0	7	13	24	33	37	6	6	0	0	0	126
04:00	0	6	10	26	38	37	20	6	0	0	0	143
05:00	0	0	10	43	58	78	56	23	4	0	0	272
06:00	0	1	14	91	190	179	113	35	8	0	0	631
07:00	0	12	41	232	416	260	66	16	4	0	0	1047
08:00	2	42	155	383	447	192	42	10	0	1	0	1274
09:00	5	31	127	425	402	142	48	8	0	0	0	1188
10:00	0	7	105	462	381	197	21	1	1	0	0	1175
11:00	1	15	128	460	399	123	18	3	1	0	0	1148
12:00	9	134	263	501	231	53	8	3	0	0	1	1203
13:00	2	56	232	551	326	94	10	5	1	0	0	1277
14:00	10	79	291	611	276	52	10	5	0	0	0	1334
15:00	810	267	267	184	34	3	1	1	1	0	1	1569
16:00	1404	74	15	3	1	1	0	0	0	0	0	1498
17:00	1398	4	0	0	0	0	0	0	0	0	0	1402
18:00	1450	7	1	1	0	0	1	0	0	0	0	1460
19:00	1325	93	114	41	6	0	0	0	0	0	0	1579
20:00	34	324	578	368	82	23	1	2	0	0	2	1414
21:00	14	60	246	571	272	41	11	2	1	0	0	1218
22:00	6	25	144	431	268	90	16	6	1	0	0	987
23:00	22	131	228	399	203	61	15	3	1	0	0	1063
24:00	701	90	106	163	87	34	3	0	0	0	0	1184
DAY TOTAL	7199	1469	3119	6087	4305	1832	516	163	26	2	4	24722
PERCENTS	29.2%	6.0%	12.7%	24.6%	17.4%	7.4%	2.0%	0.6%	0.1%	0.0%	0.0%	100%

Statistical Information...

15th Percentile Speed
20.6 mph

85th Percentile Speed
58.7 mph

Median Speed
50.5 mph

Average Speed
43.9 mph

10 MPH Pace Speed
50 mph to 60 mph
10392 vehicles in pace
Representing 42.0% of the total vehicles

Vehicles > 65 MPH
711
2.9%

Site Reference: 190020000042
Site ID: Station 3
Location: I-93 SB ramp to Route 3 SB
Direction: SOUTH
Lane: 1

File: comb..prn
City: Quincy
County: Ramp ID # 12032

TIME	40	45	50	55	60	65	70	75	80	85	86+	Total
01:00	3	58	132	266	185	62	11	3	1	0	0	721
02:00	0	0	9	81	92	68	21	6	0	0	0	277
03:00	1	3	21	46	52	53	22	10	0	1	0	209
04:00	0	4	8	32	47	49	23	5	2	0	0	170
05:00	2	1	8	51	84	80	39	13	3	0	0	281
06:00	0	3	13	70	177	203	111	45	6	0	0	628
07:00	0	14	47	240	373	231	63	12	1	0	0	981
08:00	2	35	155	445	388	150	18	3	1	0	0	1197
09:00	5	56	234	480	324	92	17	2	0	0	1	1211
10:00	10	141	378	491	169	20	3	1	0	0	0	1213
11:00	10	87	263	496	174	41	7	0	1	0	0	1079
12:00	47	204	498	324	57	11	4	1	0	0	0	1146
13:00	45	308	478	275	41	12	3	1	1	0	0	1164
14:00	131	436	442	215	38	7	0	0	0	0	1	1270
15:00	250	360	469	215	44	12	3	0	0	0	0	1353
16:00	1074	68	15	8	1	0	0	0	0	0	0	1166
17:00	328	451	170	68	17	12	5	1	0	0	0	1052
18:00	1409	72	13	2	2	0	0	1	0	0	0	1499
19:00	1512	52	8	6	4	1	0	0	0	0	0	1583
20:00	386	557	411	87	9	3	1	0	0	0	0	1454
21:00	12	104	329	499	205	32	10	1	0	0	0	1192
22:00	13	80	185	398	248	75	19	6	0	0	0	1024
23:00	3	23	107	398	271	68	15	3	3	0	1	892
24:00	3	3	26	147	280	149	47	10	3	1	3	672
DAY TOTAL	5246	3120	4419	5340	3282	1431	442	124	22	2	6	23434
PERCENTS	22.4%	13.4%	18.9%	22.8%	14.1%	6.1%	1.8%	0.5%	0.0%	0.0%	0.0%	100%

Statistical Information...

15th Percentile Speed
26.8 mph

85th Percentile Speed
57.7 mph

Median Speed
48.8 mph

Average Speed
44.7 mph

10 MPH Pace Speed
45 mph to 55 mph
9759 vehicles in pace
Representing 41.6% of the total vehicles

Vehicles > 65 MPH
596
2.5%

Site Reference: 190020000042
Site ID: Station 3
Location: I-93 SB ramp to Route 3 SB
Direction: SOUTH
Lane: 1

File: comb..prn
City: Quincy
County: Ramp ID # 12032

TIME	40	45	50	55	60	65	70	75	80	85	86+	Total
01:00	5	4	21	109	153	108	34	13	0	0	6	453
02:00	1	5	20	50	81	72	26	21	3	1	1	281
03:00	2	4	14	66	75	55	23	8	0	2	1	250
04:00	3	6	17	38	69	43	14	2	1	0	1	194
05:00	3	10	40	74	51	34	12	1	0	0	1	226
06:00	3	34	136	255	115	36	6	1	0	0	1	587
07:00	2	35	172	436	251	61	5	1	0	1	2	966
08:00	1	53	217	449	314	69	13	2	0	1	2	1121
09:00	5	56	151	439	285	85	13	2	2	0	1	1039
10:00	10	56	180	444	279	61	8	3	0	0	4	1045
11:00	5	105	293	580	228	51	7	4	0	1	5	1279
12:00	19	167	495	598	96	9	3	0	0	0	5	1392
13:00	247	181	403	376	90	16	4	1	1	3	16	1338
14:00	432	318	341	113	16	9	2	0	4	5	12	1252
15:00	1009	217	64	13	3	4	0	1	0	2	3	1316
16:00	1166	109	23	2	1	1	0	0	0	0	0	1302
17:00	1294	26	4	1	0	0	0	0	0	0	0	1325
18:00	1320	33	1	1	0	0	0	0	0	0	0	1355
19:00	1196	198	105	38	4	1	0	0	0	0	1	1543
20:00	189	261	376	329	84	17	4	2	0	0	0	1262
21:00	1	57	202	544	318	70	11	5	2	0	1	1211
22:00	3	12	139	392	361	96	17	8	0	0	1	1029
23:00	4	21	104	328	320	128	29	4	0	1	1	940
24:00	1	13	51	274	337	163	33	14	2	0	0	888
DAY TOTAL	6921	1981	3569	5949	3531	1189	264	93	15	17	65	23594
PERCENTS	29.4%	8.4%	15.2%	25.3%	15.0%	5.1%	1.1%	0.3%	0.0%	0.0%	0.2%	100%

Statistical Information...

15th Percentile Speed
20.5 mph

85th Percentile Speed
57.3 mph

Median Speed
49.1 mph

Average Speed
42.9 mph

10 MPH Pace Speed
45 mph to 55 mph
9518 vehicles in pace
Representing 40.3% of the total vehicles

Vehicles > 65 MPH
454
1.9%

Site Reference: 190020000042
Site ID: Station 3
Location: I-93 SB ramp to Route 3 SB
Direction: SOUTH
Lane: 1

File: comb..prn
City: Quincy
County: Ramp ID # 12032

TIME	40	45	50	55	60	65	70	75	80	85	86+	Total
01:00	1	4	43	134	253	160	34	10	3	1	0	643
02:00	1	3	16	95	141	117	37	9	2	0	0	421
03:00	0	1	7	58	107	85	37	9	5	1	1	311
04:00	0	1	5	37	79	68	32	17	4	0	0	243
05:00	0	1	8	26	66	74	36	16	6	1	0	234
06:00	0	0	6	26	106	126	75	28	11	0	0	378
07:00	2	4	14	101	246	238	106	32	11	2	0	756
08:00	2	7	63	246	449	266	54	20	6	0	1	1114
09:00	3	27	98	399	547	212	44	9	1	0	0	1340
10:00	1	21	89	416	490	183	22	5	2	0	0	1229
11:00	6	132	367	532	190	45	12	0	1	0	0	1285
12:00	19	135	479	584	138	18	3	0	0	0	0	1376
13:00	15	141	413	625	139	16	4	4	0	0	0	1357
14:00	2	80	378	555	214	29	5	0	0	0	0	1263
15:00	5	111	372	557	210	36	10	3	0	0	0	1304
16:00	34	293	473	278	53	13	8	0	1	0	0	1153
17:00	38	220	398	357	86	14	5	2	0	0	0	1120
18:00	106	206	303	247	67	33	18	2	1	0	0	983
19:00	6	27	127	439	371	134	36	8	1	0	0	1149
20:00	4	20	119	417	384	138	25	10	2	1	0	1120
21:00	8	21	90	428	347	109	21	11	2	0	0	1037
22:00	1	30	124	433	316	75	21	3	3	0	0	1006
23:00	7	24	124	377	287	93	24	7	1	1	0	945
24:00	7	8	79	315	306	103	38	9	1	1	0	867
DAY TOTAL	268	1517	4195	7682	5592	2385	707	214	64	8	2	22634
PERCENTS	1.2%	6.8%	18.6%	34.0%	24.7%	10.5%	3.1%	0.9%	0.2%	0.0%	0.0%	100%

Statistical Information...

15th Percentile Speed
46.9 mph

85th Percentile Speed
60.0 mph

Median Speed
53.5 mph

Average Speed
53.6 mph

10 MPH Pace Speed
50 mph to 60 mph
13274 vehicles in pace
Representing 58.6% of the total vehicles

Vehicles > 65 MPH
995
4.4%

STA. 3

LN. 2

NO DATA

Site Reference: 190020000034
Site ID: Station 2
Location: I-93 SB ramp to I-95
Direction: ROAD TOTAL

File: comb..prn
City: Quincy
County: Ramp ID # 12077

TIME	30	35	40	45	50	55	60	65	70	75	80	85	90	91+	Total
01:00	2	1	0	4	20	101	241	241	138	51	10	2	0	0	811
02:00	0	0	2	2	6	73	167	151	100	43	7	3	1	1	556
03:00	3	0	0	6	19	56	93	102	51	25	7	5	1	0	368
04:00	0	0	1	2	16	45	54	90	76	28	8	3	0	1	324
05:00	0	0	0	1	18	39	96	171	165	86	36	9	0	2	623
06:00	2	0	4	2	21	97	298	513	353	170	46	11	2	2	1521
07:00	6	1	0	10	94	564	890	658	263	76	17	0	1	0	2580
08:00	17	17	35	71	189	757	898	519	184	62	19	0	0	0	2768
09:00	360	144	81	182	353	728	597	315	82	12	1	0	0	2	2857
10:00	4	2	8	150	424	852	754	395	124	23	7	1	0	1	2745
11:00	72	55	109	216	493	956	635	259	68	18	1	0	0	3	2885
12:00	137	141	224	563	570	796	493	236	59	17	3	0	0	0	3239
13:00	187	207	330	620	756	704	355	160	70	11	1	1	1	0	3403
14:00	160	180	416	694	727	839	383	91	26	11	2	2	0	2	3533
15:00	1031	587	551	643	397	181	30	7	3	0	3	0	1	2	3436
16:00	1960	446	235	131	37	8	0	3	1	2	3	0	0	2	2828
17:00	767	235	297	602	430	216	52	9	3	0	3	1	1	2	2618
18:00	21	58	274	1060	803	340	73	20	2	2	2	0	0	0	2655
19:00	5	37	364	1287	802	355	61	10	1	0	3	0	0	0	2925
20:00	3	2	81	441	768	1134	725	277	63	17	2	1	0	0	3514
21:00	2	2	9	89	325	953	887	392	102	21	3	2	0	1	2788
22:00	6	2	14	105	318	871	784	276	84	18	8	0	0	1	2487
23:00	5	2	14	42	206	691	576	332	96	35	5	0	1	0	2005
24:00	5	0	0	29	91	358	517	415	175	63	11	1	0	2	1667
DAY TOTAL	4755	2119	3049	6952	7883	11714	9659	5642	2289	791	208	42	9	24	55136
PERCENTS	8.7%	3.9%	5.6%	12.7%	14.3%	21.3%	17.5%	10.2%	4.1%	1.4%	0.3%	0.0%	0.0%	0.0%	100%

Statistical Information...

15th Percentile Speed
37.3 mph

85th Percentile Speed
60.7 mph

Median Speed
51.2 mph

Average Speed
48.6 mph

10 MPH Pace Speed
50 mph to 60 mph
21373 vehicles in pace
Representing 38.7% of the total vehicles

Vehicles > 65 MPH
3363
6.1%

Site Reference: 190020000034
Site ID: Station 2
Location: I-93 SB ramp to I-95
Direction: ROAD TOTAL

File: comb..prn
City: Quincy
County: Ramp ID # 12077

TIME	30	35	40	45	50	55	60	65	70	75	80	85	90	91+	Total
01:00	1	0	1	6	29	169	265	271	109	52	11	0	0	1	915
02:00	2	0	1	4	22	78	163	183	104	37	20	1	0	1	616
03:00	0	0	1	0	19	61	110	129	78	32	10	2	0	1	443
04:00	2	0	1	0	12	35	90	104	59	38	17	2	0	1	361
05:00	0	0	5	8	22	73	162	206	141	73	28	7	3	0	728
06:00	0	0	0	14	12	128	360	450	327	152	42	6	1	2	1494
07:00	8	0	6	59	211	631	820	586	242	73	21	3	0	1	2661
08:00	11	0	1	38	252	1003	987	521	146	36	7	1	0	0	3003
09:00	12	3	21	128	457	990	854	353	98	20	2	0	0	0	2938
10:00	9	12	34	190	458	1025	714	333	88	21	1	1	0	1	2887
11:00	10	0	8	148	542	1041	739	276	79	9	2	0	0	1	2855
12:00	11	18	130	468	881	983	549	229	31	12	1	0	0	0	3313
13:00	1441	710	386	244	89	58	42	22	5	2	0	0	0	5	3004
14:00	1956	278	259	152	44	7	0	1	3	0	0	0	0	2	2702
15:00	2347	189	69	16	2	3	1	2	0	0	1	1	0	0	2631
16:00	2174	76	25	4	2	1	3	1	0	0	1	3	1	0	2291
17:00	2234	93	29	27	9	8	4	0	0	2	0	1	1	1	2409
18:00	668	187	562	809	306	83	8	1	0	0	0	0	1	0	2625
19:00	24	190	896	1417	446	118	15	1	2	0	1	1	1	0	3112
20:00	8	64	587	1460	824	503	119	18	9	4	1	2	0	1	3600
21:00	7	7	34	197	583	1142	676	254	74	8	2	0	0	0	2984
22:00	8	5	162	454	386	674	511	227	46	16	1	0	0	2	2492
23:00	4	2	8	47	209	614	587	295	77	20	8	0	0	0	1871
24:00	3	1	10	17	75	347	538	454	167	71	13	4	0	0	1700
DAY TOTAL	10940	1835	3236	5907	5892	9775	8317	4917	1885	678	190	35	8	20	53635
PERCENTS	20.4%	3.5%	6.1%	11.1%	11.0%	18.3%	15.5%	9.1%	3.5%	1.2%	0.3%	0.0%	0.0%	0.0%	100%

Statistical Information...

15th Percentile Speed
22.1 mph

85th Percentile Speed
59.8 mph

Median Speed
49.2 mph

Average Speed
44.2 mph

10 MPH Pace Speed
50 mph to 60 mph
18092 vehicles in pace
Representing 33.7% of the total vehicles

Vehicles > 65 MPH
2816
5.3%

Site Reference: 190020000034
Site ID: Station 2
Location: I-93 SB ramp to I-95
Direction: ROAD TOTAL

File: comb..prn
City: Quincy
County: Ramp ID # 12077

TIME	30	35	40	45	50	55	60	65	70	75	80	85	90	91+	Total
01:00	1	0	0	0	36	137	274	258	139	68	17	2	1	0	933
02:00	0	1	2	2	19	122	191	201	106	45	14	5	1	0	709
03:00	0	0	0	4	20	57	112	124	69	31	14	1	0	2	434
04:00	0	0	2	5	13	51	88	122	58	43	11	2	1	0	396
05:00	1	0	0	9	14	63	127	206	132	79	38	6	2	0	677
06:00	4	0	1	6	21	102	348	478	346	156	29	9	0	0	1500
07:00	0	0	0	16	107	614	944	617	209	57	15	2	0	0	2581
08:00	240	47	94	139	325	849	809	351	102	27	4	0	0	1	2988
09:00	449	105	117	197	329	747	591	203	53	10	4	2	1	4	2812
10:00	31	15	12	126	437	960	779	306	79	20	2	0	0	1	2768
11:00	54	46	54	233	474	1045	711	262	73	15	3	1	0	1	2972
12:00	450	385	388	528	554	644	242	86	16	7	3	0	0	1	3304
13:00	163	166	233	633	825	983	452	121	33	3	2	1	0	4	3619
14:00	27	57	300	951	1020	989	260	65	14	2	1	2	1	0	3689
15:00	13	35	348	1102	1161	576	77	20	2	0	0	0	1	2	3337
16:00	932	97	345	729	381	169	26	10	2	2	0	0	2	0	2695
17:00	215	119	363	906	654	319	70	26	6	0	1	0	0	0	2679
18:00	13	20	205	895	910	484	126	30	7	3	0	0	0	0	2693
19:00	35	134	559	1380	844	259	49	10	2	0	3	0	1	1	3277
20:00	16	70	426	1332	1038	543	119	34	12	1	2	0	0	1	3594
21:00	38	91	143	513	990	1033	372	141	20	6	1	1	0	1	3350
22:00	2	6	34	221	511	979	592	266	68	20	3	1	0	2	2705
23:00	2	1	19	64	234	597	575	303	79	13	3	0	1	0	1891
24:00	6	4	34	153	356	654	438	211	47	14	1	0	1	1	1920
DAY TOTAL	2692	1399	3679	10144	11273	12976	8372	4451	1674	622	171	35	13	22	57523
PERCENTS	4.7%	2.5%	6.4%	17.7%	19.6%	22.6%	14.6%	7.8%	2.9%	1.0%	0.2%	0.0%	0.0%	0.0%	100%

Statistical Information...

15th Percentile Speed
40.4 mph

85th Percentile Speed
59.0 mph

Median Speed
49.8 mph

Average Speed
48.8 mph

10 MPH Pace Speed
45 mph to 55 mph
24249 vehicles in pace
Representing 42.1% of the total vehicles

Vehicles > 65 MPH
2537
4.4%

Site Reference: 190020000034
Site ID: Station 2
Location: I-93 SB ramp to I-95
Direction: ROAD TOTAL

File: comb..prn
City: Quincy
County: Ramp ID # 12077

TIME	30	35	40	45	50	55	60	65	70	75	80	85	90	91+	Total
01:00	1	0	0	4	45	300	400	310	112	34	6	1	0	0	1213
02:00	1	0	0	3	32	130	224	225	87	63	17	1	0	3	786
03:00	4	2	0	7	19	66	155	150	79	36	13	2	0	1	534
04:00	0	0	0	5	9	74	102	98	60	42	8	2	0	0	400
05:00	1	0	3	6	20	85	155	200	147	86	35	5	1	0	744
06:00	1	1	4	13	31	183	372	418	337	156	56	9	1	1	1583
07:00	8	1	19	56	178	680	853	492	182	71	11	2	0	0	2553
08:00	2	0	7	88	396	1107	804	286	80	18	2	0	0	0	2790
09:00	147	29	122	334	545	833	482	172	33	5	0	0	0	1	2703
10:00	4	8	51	340	823	920	372	92	22	5	0	4	0	0	2641
11:00	10	11	78	433	829	989	362	100	23	4	0	0	0	1	2840
12:00	242	203	499	962	686	331	79	26	3	0	0	0	0	2	3033
13:00	801	696	638	679	307	99	13	2	0	1	1	0	0	1	3238
14:00	1470	638	407	335	153	69	12	2	0	2	0	1	0	3	3092
15:00	1427	583	417	408	236	93	20	4	0	0	0	1	0	0	3189
16:00	1562	178	213	152	40	13	1	1	0	1	2	0	1	1	2165
17:00	1603	92	34	31	2	1	1	0	1	0	0	0	0	0	1765
18:00	227	241	610	1153	513	159	21	4	1	0	0	1	0	2	2932
19:00	70	173	735	1337	564	165	23	3	1	0	0	1	0	2	3074
20:00	14	82	603	1331	840	263	27	12	0	1	0	1	0	0	3174
21:00	3	15	126	562	833	979	452	120	28	4	2	1	0	0	3125
22:00	165	34	94	360	488	674	419	192	64	9	2	0	0	1	2502
23:00	212	7	35	137	382	745	520	195	81	12	1	0	0	0	2327
24:00	82	2	9	23	135	454	628	449	132	45	10	1	0	1	1971
DAY TOTAL	8057	2996	4704	8759	8106	9412	6497	3553	1473	595	166	33	3	20	54374
PERCENTS	14.9%	5.6%	8.7%	16.2%	14.9%	17.3%	11.9%	6.5%	2.7%	1.0%	0.3%	0.0%	0.0%	0.0%	100%

Statistical Information...

15th Percentile Speed
30.2 mph

85th Percentile Speed
58.2 mph

Median Speed
46.7 mph

Average Speed
44.2 mph

10 MPH Pace Speed
45 mph to 55 mph
17518 vehicles in pace
Representing 32.2% of the total vehicles

Vehicles > 65 MPH
2290
4.2%

Site Reference: 190020000034
Site ID: Station 2
Location: I-93 SB ramp to I-95
Direction: ROAD TOTAL

File: comb..prn
City: Quincy
County: Ramp ID # 12077

TIME	30	35	40	45	50	55	60	65	70	75	80	85	90	91+	Total
01:00	15	0	3	9	54	225	406	276	147	51	13	2	0	2	1203
02:00	0	0	0	6	34	119	245	198	126	66	13	6	0	1	814
03:00	1	1	4	13	38	136	223	176	82	39	9	1	0	1	724
04:00	2	0	0	2	28	96	122	106	57	19	2	0	0	1	435
05:00	3	0	4	31	54	160	140	118	47	31	5	0	0	0	593
06:00	1	4	2	65	203	485	377	144	50	9	0	0	0	0	1340
07:00	15	18	51	115	489	891	532	166	47	11	1	2	0	0	2338
08:00	13	11	52	230	615	1091	543	183	26	4	0	0	0	1	2769
09:00	19	5	50	222	599	1095	572	148	26	15	3	0	0	2	2756
10:00	13	7	44	226	598	901	443	162	45	8	1	0	0	4	2452
11:00	15	10	91	576	930	870	379	87	20	1	1	0	0	0	2980
12:00	25	62	214	904	1160	772	200	22	4	1	1	0	0	0	3365
13:00	231	126	498	1067	845	520	132	17	3	0	1	1	0	0	3441
14:00	1760	562	396	169	49	26	6	1	2	1	2	0	0	1	2975
15:00	1782	338	329	231	80	16	6	1	0	0	0	1	0	2	2786
16:00	2296	165	21	7	1	1	1	0	1	0	0	2	1	1	2497
17:00	2233	51	12	6	2	4	2	0	1	1	1	1	0	0	2314
18:00	2041	104	42	17	4	3	2	0	1	0	1	0	0	0	2215
19:00	466	129	439	1091	642	189	30	6	0	0	2	2	0	0	2996
20:00	33	37	313	1000	962	732	164	32	3	1	1	1	0	1	3280
21:00	156	4	92	231	596	1033	551	197	48	17	0	0	0	3	2928
22:00	39	7	16	108	483	1127	639	269	69	12	0	0	0	1	2770
23:00	19	23	58	190	462	938	707	263	70	20	2	0	0	0	2752
24:00	5	0	7	76	272	887	880	367	139	31	3	1	0	0	2668
DAY TOTAL	11183	1664	2738	6592	9200	12317	7302	2939	1014	338	62	20	1	21	55391
PERCENTS	20.2%	3.1%	5.0%	12.0%	16.6%	22.2%	13.1%	5.3%	1.8%	0.6%	0.1%	0.0%	0.0%	0.0%	100%

Statistical Information...

15th Percentile Speed
22.3 mph

85th Percentile Speed
57.3 mph

Median Speed
48.0 mph

Average Speed
43.2 mph

10 MPH Pace Speed
45 mph to 55 mph
21517 vehicles in pace
Representing 38.8% of the total vehicles

Vehicles > 65 MPH
1456
2.6%

Site Reference: 190020000034
Site ID: Station 2
Location: I-93 SB ramp to I-95
Direction: ROAD TOTAL

File: comb..prn
City: Quincy
County: Ramp ID # 12077

TIME	30	35	40	45	50	55	60	65	70	75	80	85	90	91+	Total
01:00	5	0	7	27	78	400	519	388	175	57	16	0	0	2	1674
02:00	3	0	1	16	65	186	316	308	180	85	8	2	1	1	1172
03:00	1	0	1	4	17	97	249	285	164	73	40	8	2	2	943
04:00	0	0	0	4	13	81	137	180	122	64	24	10	2	3	640
05:00	0	0	0	4	13	52	104	185	115	75	30	4	0	0	582
06:00	1	0	1	1	7	51	118	227	250	191	62	15	2	1	927
07:00	5	0	1	7	25	126	355	526	345	201	69	16	2	2	1680
08:00	6	0	0	17	67	337	660	668	359	170	40	4	1	2	2331
09:00	6	1	8	60	211	786	941	667	247	58	13	1	0	0	2999
10:00	6	2	4	62	272	1003	1107	508	157	25	5	1	0	1	3153
11:00	14	71	222	697	1109	898	289	95	25	7	0	0	0	3	3430
12:00	16	47	311	1020	1327	757	99	25	2	2	0	1	0	1	3608
13:00	104	109	252	848	1208	908	163	22	3	0	0	2	1	2	3622
14:00	62	94	222	736	1015	994	245	48	5	3	0	0	1	2	3427
15:00	61	128	241	779	1037	911	249	56	16	6	0	2	0	3	3489
16:00	1541	813	492	218	66	14	3	2	2	0	1	0	0	2	3154
17:00	1188	440	684	593	161	48	6	5	1	1	1	1	0	1	3130
18:00	234	299	486	734	436	256	135	61	14	8	0	0	0	0	2663
19:00	22	34	71	334	663	1185	691	242	56	7	2	2	0	2	3311
20:00	85	126	173	424	747	1170	601	195	47	8	0	2	1	0	3579
21:00	7	10	46	274	647	1199	717	243	65	27	2	0	0	2	3239
22:00	201	67	153	351	619	956	477	165	37	10	4	0	0	1	3041
23:00	8	24	35	220	597	1072	670	247	52	6	3	1	1	1	2937
24:00	4	9	34	183	487	1018	771	291	76	16	6	1	0	1	2897
DAY TOTAL	3580	2274	3445	7613	10887	14505	9622	5639	2515	1100	326	73	14	35	61628
PERCENTS	5.9%	3.7%	5.6%	12.4%	17.7%	23.6%	15.7%	9.1%	4.0%	1.7%	0.5%	0.1%	0.0%	0.0%	100%

Statistical Information...

15th Percentile Speed
39.9 mph

85th Percentile Speed
60.4 mph

Median Speed
51.0 mph

Average Speed
49.5 mph

10 MPH Pace Speed
45 mph to 55 mph
25392 vehicles in pace
Representing 41.2% of the total vehicles

Vehicles > 65 MPH
4063
6.6%

MassDOT Highway Division
SPEED SUMMARY
Sun 6/16/2019

STA. 2
LN. 1

Site Reference: 190020000034
Site ID: Station 2
Location: I-93 SB ramp to I-95
Direction: SOUTH
Lane: 1

File: comb..prn
City: Quincy
County: Ramp ID # 12077

TIME	30	35	40	45	50	55	60	65	70	75	80	85	90	91+	Total
01:00	1	0	0	7	41	224	202	141	34	11	2	2	1	1	667
02:00	1	0	0	3	35	116	163	105	56	23	3	0	0	0	505
03:00	1	0	2	8	17	64	130	85	59	27	3	1	1	1	399
04:00	1	1	3	5	14	46	72	49	36	12	5	0	0	1	245
05:00	0	0	0	2	20	44	59	44	22	7	0	0	1	0	199
06:00	1	0	1	2	5	28	67	49	43	17	4	1	0	0	218
07:00	0	1	0	5	23	30	78	102	65	36	7	3	1	0	351
08:00	0	0	1	1	13	67	154	197	115	56	11	1	0	0	616
09:00	0	4	3	2	21	159	234	201	81	29	3	0	0	0	737
10:00	6	2	2	11	71	356	336	206	60	21	3	1	0	1	1076
11:00	2	5	37	133	325	481	290	118	32	11	3	0	0	0	1437
12:00	84	98	275	506	368	217	59	15	6	0	1	0	0	0	1629
13:00	132	68	186	594	524	182	5	1	0	1	0	0	0	1	1694
14:00	417	359	350	329	145	52	5	0	0	0	0	1	0	1	1659
15:00	199	193	153	311	278	224	61	9	4	0	0	1	0	0	1433
16:00	243	113	154	204	165	226	141	74	6	3	0	0	0	1	1330
17:00	42	100	272	501	434	177	42	14	5	3	0	1	0	0	1591
18:00	0	0	53	175	400	514	179	59	9	1	2	0	0	2	1394
19:00	2	26	64	228	334	457	171	47	13	1	0	1	0	0	1344
20:00	4	9	49	110	280	496	239	71	11	6	0	0	0	0	1275
21:00	5	0	14	117	256	442	218	66	14	4	3	0	0	0	1139
22:00	2	0	5	44	182	385	247	108	29	4	0	0	0	0	1006
23:00	2	0	3	8	80	195	217	155	44	19	4	0	0	0	727
24:00	2	0	0	4	33	141	183	130	51	14	5	0	0	0	563
DAY TOTAL	1147	979	1627	3310	4064	5323	3552	2046	795	306	59	13	4	9	23234
PERCENTS	5.0%	4.3%	7.1%	14.3%	17.5%	22.9%	15.2%	8.8%	3.4%	1.3%	0.2%	0.0%	0.0%	0.0%	100%

Statistical Information...

15th Percentile Speed
39.2 mph

85th Percentile Speed
59.7 mph

Median Speed
50.5 mph

Average Speed
49.0 mph

10 MPH Pace Speed
45 mph to 55 mph
9387 vehicles in pace
Representing 40.4% of the total vehicles

Vehicles > 65 MPH
1186
5.1%

Site Reference: 190020000034
Site ID: Station 2
Location: I-93 SB ramp to I-95
Direction: SOUTH
Lane: 1

File: comb..prn
City: Quincy
County: Ramp ID # 12077

TIME	30	35	40	45	50	55	60	65	70	75	80	85	90	91+	Total
01:00	1	0	0	3	10	58	108	86	45	18	3	2	0	0	334
02:00	0	0	2	2	5	39	73	56	38	10	0	0	1	0	226
03:00	3	0	0	1	12	31	41	34	12	9	2	2	0	0	147
04:00	0	0	1	1	12	26	25	24	23	10	2	1	0	0	125
05:00	0	0	0	1	14	23	54	83	67	37	8	1	0	0	288
06:00	2	0	4	2	16	75	183	239	123	45	4	2	0	1	696
07:00	6	1	0	9	71	362	463	225	79	14	2	0	1	0	1233
08:00	15	12	23	43	145	527	419	126	43	11	3	0	0	0	1367
09:00	184	78	37	122	251	416	234	59	11	3	1	0	0	1	1397
10:00	4	2	6	103	289	522	330	92	23	3	2	0	0	0	1376
11:00	36	30	75	153	298	475	192	65	9	0	0	0	0	1	1334
12:00	67	72	117	310	273	370	209	64	8	3	2	0	0	0	1495
13:00	91	78	182	378	384	230	109	36	18	3	0	0	0	0	1509
14:00	63	80	207	373	353	368	116	17	0	2	0	1	0	1	1581
15:00	494	299	308	296	161	48	3	3	0	0	1	0	1	2	1616
16:00	977	229	88	68	13	1	0	2	1	2	3	0	0	1	1385
17:00	411	97	167	379	218	71	9	1	1	0	3	0	1	1	1359
18:00	15	34	186	663	419	104	20	3	0	0	0	0	0	0	1444
19:00	5	15	210	800	377	99	12	2	1	0	1	0	0	0	1522
20:00	2	1	42	256	440	467	264	74	22	5	0	1	0	0	1574
21:00	1	0	2	41	175	472	328	138	46	4	0	0	0	0	1207
22:00	3	0	4	37	167	404	325	89	31	4	2	0	0	1	1067
23:00	2	0	6	20	111	306	257	115	31	14	3	0	0	0	865
24:00	4	0	0	15	52	165	209	157	58	15	4	1	0	1	681
DAY TOTAL	2386	1028	1667	4076	4266	5659	3983	1790	690	212	46	11	4	10	25828
PERCENTS	9.3%	4.0%	6.5%	15.8%	16.6%	22.0%	15.4%	6.9%	2.6%	0.8%	0.1%	0.0%	0.0%	0.0%	100%

Statistical Information...

15th Percentile Speed
36.4 mph

85th Percentile Speed
58.6 mph

Median Speed
49.4 mph

Average Speed
47.0 mph

10 MPH Pace Speed
45 mph to 55 mph
9925 vehicles in pace
Representing 38.4% of the total vehicles

Vehicles > 65 MPH
973
3.8%

Site Reference: 190020000034
Site ID: Station 2
Location: I-93 SB ramp to I-95
Direction: SOUTH
Lane: 1

File: comb..prn
City: Quincy
County: Ramp ID # 12077

TIME	30	35	40	45	50	55	60	65	70	75	80	85	90	91+	Total
01:00	1	0	0	2	17	90	111	120	36	20	2	0	0	0	399
02:00	2	0	0	3	12	38	66	66	33	17	5	0	0	0	242
03:00	0	0	1	0	13	33	44	57	27	7	2	1	0	1	186
04:00	1	0	0	0	10	21	39	37	22	11	4	0	0	0	145
05:00	0	0	5	7	16	55	81	95	68	22	8	2	0	0	359
06:00	0	0	0	13	12	91	234	198	103	34	10	0	0	0	695
07:00	8	0	6	49	149	374	360	196	50	7	4	0	0	0	1203
08:00	8	0	1	25	205	637	412	123	16	4	0	0	0	0	1431
09:00	12	1	13	97	366	535	284	82	13	1	0	0	0	0	1404
10:00	6	10	24	142	301	606	247	66	12	2	1	0	0	1	1418
11:00	10	0	5	96	362	537	252	54	11	2	0	0	0	1	1330
12:00	8	8	75	262	431	420	195	62	12	3	0	0	0	0	1476
13:00	696	332	209	98	33	16	14	10	1	1	0	0	0	5	1415
14:00	941	143	114	56	17	3	0	1	2	0	0	0	0	2	1279
15:00	1159	89	24	3	1	2	0	2	0	0	1	1	0	0	1282
16:00	1054	35	5	1	1	1	2	1	0	0	1	3	1	0	1105
17:00	1065	56	20	12	3	5	3	0	0	2	0	1	1	1	1169
18:00	343	90	327	440	145	24	1	0	0	0	0	0	1	0	1371
19:00	7	121	538	688	141	30	3	1	1	0	1	0	0	0	1531
20:00	3	36	271	750	343	179	41	6	2	1	1	1	0	1	1635
21:00	4	0	17	108	300	502	237	86	15	1	0	0	0	0	1270
22:00	1	4	72	214	186	286	208	88	13	5	0	0	0	2	1079
23:00	2	0	3	29	97	235	221	121	23	5	2	0	0	0	738
24:00	3	0	4	10	29	129	201	182	72	24	3	3	0	0	660
DAY TOTAL	5334	925	1734	3105	3190	4849	3256	1654	532	169	45	12	3	14	24822
PERCENTS	21.5%	3.8%	7.0%	12.6%	12.9%	19.6%	13.2%	6.6%	2.1%	0.6%	0.1%	0.0%	0.0%	0.0%	100%

Statistical Information...

15th Percentile Speed
21.0 mph

85th Percentile Speed
58.0 mph

Median Speed
47.1 mph

Average Speed
42.6 mph

10 MPH Pace Speed
50 mph to 60 mph
8105 vehicles in pace
Representing 32.6% of the total vehicles

Vehicles > 65 MPH
775
3.1%

Site Reference: 190020000034
Site ID: Station 2
Location: I-93 SB ramp to I-95
Direction: SOUTH
Lane: 1

File: comb..prn
City: Quincy
County: Ramp ID # 12077

TIME	30	35	40	45	50	55	60	65	70	75	80	85	90	91+	Total
01:00	0	0	0	0	11	66	107	95	47	19	5	0	0	0	350
02:00	0	1	2	0	16	56	60	70	37	15	4	1	0	0	262
03:00	0	0	0	2	16	33	47	50	23	12	3	0	0	0	186
04:00	0	0	2	3	3	24	45	45	14	13	4	0	0	0	153
05:00	1	0	0	9	10	45	65	100	58	29	7	0	0	0	324
06:00	3	0	1	4	18	78	208	212	107	38	6	2	0	0	677
07:00	0	0	0	7	75	370	481	211	50	7	3	0	0	0	1204
08:00	124	21	69	80	201	502	332	91	20	4	1	0	0	1	1446
09:00	224	46	70	118	230	448	180	32	9	1	1	0	0	1	1360
10:00	7	2	7	96	309	584	278	85	19	1	0	0	0	0	1388
11:00	30	19	23	158	292	509	239	63	15	4	0	0	0	1	1353
12:00	235	173	173	280	257	264	67	30	5	2	0	0	0	1	1487
13:00	76	32	115	337	446	430	140	30	8	0	0	0	0	4	1618
14:00	13	29	167	521	498	385	57	13	2	0	0	0	0	0	1685
15:00	13	22	214	656	505	161	11	4	1	0	0	0	0	2	1589
16:00	461	65	200	363	175	54	5	3	1	0	0	0	0	0	1327
17:00	130	55	226	533	333	122	19	2	2	0	1	0	0	0	1423
18:00	4	9	146	601	505	166	15	5	0	0	0	0	0	0	1451
19:00	6	57	315	775	366	77	6	2	0	0	1	0	1	0	1606
20:00	6	27	223	726	412	185	26	8	2	0	2	0	0	1	1618
21:00	13	46	60	235	537	447	133	34	4	3	1	0	0	1	1514
22:00	2	5	18	95	237	421	247	101	19	3	0	0	0	1	1149
23:00	1	0	11	39	144	324	226	96	18	3	1	0	1	0	864
24:00	4	0	19	94	202	347	196	68	18	6	0	0	0	0	954
DAY TOTAL	1353	609	2061	5732	5798	6098	3190	1450	479	160	40	3	2	13	26988
PERCENTS	5.1%	2.3%	7.7%	21.3%	21.5%	22.6%	11.9%	5.3%	1.7%	0.5%	0.1%	0.0%	0.0%	0.0%	100%

Statistical Information...

15th Percentile Speed
40.0 mph

85th Percentile Speed
57.0 mph

Median Speed
48.2 mph

Average Speed
47.4 mph

10 MPH Pace Speed
45 mph to 55 mph
11896 vehicles in pace
Representing 44.0% of the total vehicles

Vehicles > 65 MPH
697
2.6%

Site Reference: 190020000034
Site ID: Station 2
Location: I-93 SB ramp to I-95
Direction: SOUTH
Lane: 1

File: comb..prn
City: Quincy
County: Ramp ID # 12077

TIME	30	35	40	45	50	55	60	65	70	75	80	85	90	91+	Total
01:00	0	0	0	4	35	173	181	132	39	7	1	0	0	0	572
02:00	1	0	0	2	21	79	100	103	24	17	6	0	0	2	355
03:00	1	0	0	6	10	42	75	54	18	9	5	0	0	0	220
04:00	0	0	0	3	6	44	43	32	19	13	3	1	0	0	164
05:00	1	0	3	6	14	63	95	87	51	28	9	1	0	0	358
06:00	0	1	3	11	18	128	235	194	95	32	5	2	0	0	724
07:00	8	1	19	53	126	397	361	169	32	14	1	0	0	0	1181
08:00	1	0	7	76	294	628	289	59	9	1	1	0	0	0	1365
09:00	79	16	81	216	345	418	136	26	2	1	0	0	0	1	1321
10:00	4	7	32	261	562	401	84	14	4	0	0	4	0	0	1373
11:00	8	1	47	285	453	418	113	25	7	0	0	0	0	0	1357
12:00	133	105	265	524	260	102	20	5	2	0	0	0	0	2	1418
13:00	403	361	320	325	99	12	4	2	0	1	1	0	0	1	1529
14:00	703	326	186	153	70	17	7	0	0	2	0	1	0	3	1468
15:00	699	298	221	189	92	18	4	2	0	0	0	1	0	0	1524
16:00	790	83	121	68	16	3	0	1	0	1	2	0	1	1	1087
17:00	807	47	13	5	0	1	1	0	1	0	0	0	0	0	875
18:00	132	123	385	608	192	41	3	0	1	0	0	1	0	2	1488
19:00	38	100	457	676	201	41	4	0	0	0	0	1	0	2	1520
20:00	9	35	366	731	288	58	7	2	0	0	0	0	0	0	1496
21:00	1	6	60	292	400	422	152	42	11	2	2	0	0	0	1390
22:00	159	6	52	154	189	257	134	57	21	2	0	0	0	1	1032
23:00	209	4	7	36	142	239	163	59	34	4	0	0	0	0	897
24:00	81	1	1	4	61	183	275	171	42	14	2	0	0	0	835
DAY TOTAL	4267	1521	2646	4688	3894	4185	2486	1236	412	148	38	12	1	15	25549
PERCENTS	16.8%	6.0%	10.4%	18.4%	15.3%	16.4%	9.7%	4.8%	1.6%	0.5%	0.1%	0.0%	0.0%	0.0%	100%

Statistical Information...

15th Percentile Speed
27.0 mph

85th Percentile Speed
56.0 mph

Median Speed
44.6 mph

Average Speed
42.3 mph

10 MPH Pace Speed
40 mph to 50 mph
8582 vehicles in pace
Representing 33.5% of the total vehicles

Vehicles > 65 MPH
626
2.5%

Site Reference: 190020000034
Site ID: Station 2
Location: I-93 SB ramp to I-95
Direction: SOUTH
Lane: 1

File: comb..prn
City: Quincy
County: Ramp ID # 12077

TIME	30	35	40	45	50	55	60	65	70	75	80	85	90	91+	Total
01:00	13	0	0	7	33	112	178	110	42	14	1	0	0	1	511
02:00	0	0	0	5	15	66	117	69	51	19	2	4	0	0	348
03:00	1	0	2	6	19	58	103	54	36	14	0	1	0	0	294
04:00	2	0	0	2	17	47	48	40	17	3	1	0	0	0	177
05:00	3	0	3	17	35	97	68	52	15	10	0	0	0	0	300
06:00	1	4	2	40	134	255	159	40	11	1	0	0	0	0	647
07:00	13	12	30	74	317	426	175	43	16	2	0	1	0	0	1109
08:00	12	11	40	153	409	523	157	37	7	1	0	0	0	1	1351
09:00	18	5	45	179	411	511	140	24	5	2	3	0	0	0	1343
10:00	10	2	32	172	418	460	94	19	7	0	0	0	0	1	1215
11:00	12	2	40	357	503	354	76	15	2	0	1	0	0	0	1362
12:00	12	31	133	556	565	229	35	4	2	0	0	0	0	0	1567
13:00	133	75	261	554	381	151	22	2	1	0	1	1	0	0	1582
14:00	865	300	183	79	16	10	5	1	2	1	2	0	0	1	1465
15:00	881	170	153	107	27	4	4	0	0	0	0	1	0	2	1349
16:00	1141	59	6	5	1	0	1	0	1	0	0	2	1	1	1218
17:00	1095	17	5	2	2	2	1	0	1	1	1	1	0	0	1128
18:00	1021	46	12	6	3	3	2	0	1	0	1	0	0	0	1095
19:00	267	49	242	560	267	61	3	1	0	0	0	2	0	0	1452
20:00	31	22	173	525	439	231	41	6	1	0	0	1	0	1	1471
21:00	154	1	20	95	239	406	179	66	13	2	0	0	0	3	1178
22:00	29	2	5	60	239	488	235	101	19	2	0	0	0	0	1180
23:00	9	4	17	62	214	447	306	90	22	5	0	0	0	0	1176
24:00	3	0	4	25	119	380	344	164	53	6	0	0	0	0	1098
DAY TOTAL	5726	812	1408	3648	4823	5321	2493	938	325	83	13	14	1	11	25616
PERCENTS	22.4%	3.2%	5.5%	14.3%	18.9%	20.8%	9.8%	3.6%	1.2%	0.3%	0.0%	0.0%	0.0%	0.0%	100%

Statistical Information...

15th Percentile Speed
20.1 mph

85th Percentile Speed
55.1 mph

Median Speed
46.3 mph

Average Speed
41.4 mph

10 MPH Pace Speed
45 mph to 55 mph
10144 vehicles in pace
Representing 39.6% of the total vehicles

Vehicles > 65 MPH
447
1.7%

Site Reference: 190020000034
Site ID: Station 2
Location: I-93 SB ramp to I-95
Direction: SOUTH
Lane: 1

File: comb..prn
City: Quincy
County: Ramp ID # 12077

TIME	30	35	40	45	50	55	60	65	70	75	80	85	90	91+	Total
01:00	4	0	0	4	45	196	204	137	67	22	5	0	0	1	685
02:00	2	0	1	8	26	95	130	118	71	20	3	1	0	0	475
03:00	1	0	0	3	12	50	118	114	53	25	16	2	0	1	395
04:00	0	0	0	3	5	46	66	70	32	29	7	3	1	3	265
05:00	0	0	0	4	8	22	56	74	39	24	10	2	0	0	239
06:00	1	0	1	1	6	29	65	94	82	58	15	2	0	0	354
07:00	4	0	0	4	19	85	159	214	105	56	23	4	0	1	674
08:00	3	0	0	8	39	180	310	264	120	49	7	1	0	1	982
09:00	4	1	7	26	103	437	356	236	93	18	4	0	0	0	1285
10:00	2	2	3	39	138	490	457	175	40	7	1	0	0	1	1355
11:00	6	29	131	417	543	321	108	34	4	2	0	0	0	1	1596
12:00	9	24	150	598	637	260	15	5	0	2	0	1	0	0	1701
13:00	53	70	149	480	620	305	23	7	1	0	0	0	1	1	1710
14:00	16	43	108	436	496	387	71	8	2	1	0	0	0	0	1568
15:00	20	68	132	472	561	305	58	17	4	1	0	0	0	0	1638
16:00	706	435	229	100	20	4	1	1	1	0	1	0	0	2	1500
17:00	561	260	335	284	47	9	2	0	1	1	0	0	0	1	1501
18:00	114	163	265	429	224	97	36	19	5	2	0	0	0	0	1354
19:00	4	11	31	180	374	558	277	65	7	1	1	0	0	0	1509
20:00	40	52	82	235	401	495	214	50	9	0	0	1	1	0	1580
21:00	3	3	21	111	348	539	265	93	28	11	1	0	0	0	1423
22:00	61	39	70	169	289	405	207	62	13	3	1	0	0	1	1320
23:00	4	0	3	84	302	473	260	83	26	3	0	1	1	1	1241
24:00	2	0	7	82	246	428	299	118	29	8	1	0	0	1	1221
DAY TOTAL	1620	1200	1725	4177	5509	6216	3757	2058	832	343	96	18	4	16	27571
PERCENTS	5.9%	4.4%	6.3%	15.2%	20.0%	22.6%	13.7%	7.4%	3.0%	1.2%	0.3%	0.0%	0.0%	0.0%	100%

Statistical Information...

15th Percentile Speed
38.8 mph

85th Percentile Speed
59.0 mph

Median Speed
49.6 mph

Average Speed
48.2 mph

10 MPH Pace Speed
45 mph to 55 mph
11725 vehicles in pace
Representing 42.5% of the total vehicles

Vehicles > 65 MPH
1309
4.7%

MassDOT Highway Division
SPEED SUMMARY
Sun 6/16/2019

STA. 2
LN. 2

Site Reference: 190020000034
Site ID: Station 2
Location: I-93 SB ramp to I-95
Direction: SOUTH
Lane: 2

File: comb..prn
City: Quincy
County: Ramp ID # 12077

TIME	30	35	40	45	50	55	60	65	70	75	80	85	90	91+	Total
01:00	0	0	3	15	50	199	310	219	82	29	11	0	0	0	918
02:00	0	1	5	4	37	145	227	180	84	42	12	3	0	0	740
03:00	0	0	0	1	25	51	151	178	102	47	20	2	0	4	581
04:00	1	0	0	4	9	42	83	101	68	45	6	1	1	1	362
05:00	0	0	1	0	15	43	65	61	40	12	9	0	0	0	246
06:00	0	0	0	0	1	17	60	92	92	62	16	5	0	0	345
07:00	3	0	0	9	13	30	48	183	159	94	41	9	2	1	592
08:00	2	0	0	0	1	39	139	279	210	140	49	10	7	2	878
09:00	0	0	0	0	9	64	294	381	250	114	26	2	0	0	1140
10:00	12	2	0	3	83	281	449	439	214	68	14	0	0	0	1565
11:00	5	27	43	115	276	577	508	244	103	28	4	3	0	0	1933
12:00	115	130	213	388	474	439	184	39	7	0	0	0	0	0	1989
13:00	130	77	147	344	635	486	99	3	2	2	0	0	0	0	1925
14:00	454	312	312	372	255	136	18	2	0	0	0	1	0	1	1863
15:00	222	168	146	203	304	366	211	47	2	4	0	0	0	0	1673
16:00	251	125	113	148	185	251	218	139	39	13	3	0	0	0	1485
17:00	60	83	137	398	557	474	140	32	3	1	1	0	0	0	1886
18:00	4	2	57	130	287	604	474	126	25	7	3	0	0	0	1719
19:00	32	22	79	188	368	527	331	109	15	5	3	0	0	0	1679
20:00	6	24	43	136	307	603	337	118	32	8	1	0	0	1	1616
21:00	0	9	27	105	278	505	352	144	29	8	3	1	0	0	1461
22:00	2	0	11	69	201	446	400	156	42	8	0	0	0	2	1337
23:00	0	1	2	12	62	206	325	214	81	18	9	1	0	1	932
24:00	0	0	1	22	39	176	251	200	95	23	5	1	0	0	813
DAY TOTAL	1299	983	1340	2666	4471	6707	5674	3686	1776	778	236	39	10	13	29678
PERCENTS	4.4%	3.4%	4.6%	9.0%	15.1%	22.6%	19.2%	12.4%	5.9%	2.6%	0.7%	0.1%	0.0%	0.0%	100%

Statistical Information...

15th Percentile Speed
41.6 mph

85th Percentile Speed
62.8 mph

Median Speed
53.1 mph

Average Speed
51.7 mph

10 MPH Pace Speed
50 mph to 60 mph
12381 vehicles in pace
Representing 41.7% of the total vehicles

Vehicles > 65 MPH
2852
9.6%

Site Reference: 190020000034
Site ID: Station 2
Location: I-93 SB ramp to I-95
Direction: SOUTH
Lane: 2

File: comb..prn
City: Quincy
County: Ramp ID # 12077

TIME	30	35	40	45	50	55	60	65	70	75	80	85	90	91+	Total
01:00	1	1	0	1	10	43	133	155	93	33	7	0	0	0	477
02:00	0	0	0	0	1	34	94	95	62	33	7	3	0	1	330
03:00	0	0	0	5	7	25	52	68	39	16	5	3	1	0	221
04:00	0	0	0	1	4	19	29	66	53	18	6	2	0	1	199
05:00	0	0	0	0	4	16	42	88	98	49	28	8	0	2	335
06:00	0	0	0	0	5	22	115	274	230	125	42	9	2	1	825
07:00	0	0	0	1	23	202	427	433	184	62	15	0	0	0	1347
08:00	2	5	12	28	44	230	479	393	141	51	16	0	0	0	1401
09:00	176	66	44	60	102	312	363	256	71	9	0	0	0	1	1460
10:00	0	0	2	47	135	330	424	303	101	20	5	1	0	1	1369
11:00	36	25	34	63	195	481	443	194	59	18	1	0	0	2	1551
12:00	70	69	107	253	297	426	284	172	51	14	1	0	0	0	1744
13:00	96	129	148	242	372	474	246	124	52	8	1	1	1	0	1894
14:00	97	100	209	321	374	471	267	74	26	9	2	1	0	1	1952
15:00	537	288	243	347	236	133	27	4	3	0	2	0	0	0	1820
16:00	983	217	147	63	24	7	0	1	0	0	0	0	0	1	1443
17:00	356	138	130	223	212	145	43	8	2	0	0	1	0	1	1259
18:00	6	24	88	397	384	236	53	17	2	2	2	0	0	0	1211
19:00	0	22	154	487	425	256	49	8	0	0	2	0	0	0	1403
20:00	1	1	39	185	328	667	461	203	41	12	2	0	0	0	1940
21:00	1	2	7	48	150	481	559	254	56	17	3	2	0	1	1581
22:00	3	2	10	68	151	467	459	187	53	14	6	0	0	0	1420
23:00	3	2	8	22	95	385	319	217	65	21	2	0	1	0	1140
24:00	1	0	0	14	39	193	308	258	117	48	7	0	0	1	986
DAY TOTAL	2369	1091	1382	2876	3617	6055	5676	3852	1599	579	162	31	5	14	29308
PERCENTS	8.1%	3.8%	4.8%	9.9%	12.4%	20.7%	19.3%	13.1%	5.4%	1.9%	0.5%	0.1%	0.0%	0.0%	100%

Statistical Information...

15th Percentile Speed
38.4 mph

85th Percentile Speed
62.4 mph

Median Speed
52.8 mph

Average Speed
50.1 mph

10 MPH Pace Speed
50 mph to 60 mph
11731 vehicles in pace
Representing 40.0% of the total vehicles

Vehicles > 65 MPH
2390
8.2%

Site Reference: 190020000034
Site ID: Station 2
Location: I-93 SB ramp to I-95
Direction: SOUTH
Lane: 2

File: comb..prn
City: Quincy
County: Ramp ID # 12077

TIME	30	35	40	45	50	55	60	65	70	75	80	85	90	91+	Total
01:00	0	0	1	4	12	79	154	151	73	32	9	0	0	1	516
02:00	0	0	1	1	10	40	97	117	71	20	15	1	0	1	374
03:00	0	0	0	0	6	28	66	72	51	25	8	1	0	0	257
04:00	1	0	1	0	2	14	51	67	37	27	13	2	0	1	216
05:00	0	0	0	1	6	18	81	111	73	51	20	5	3	0	369
06:00	0	0	0	1	0	37	126	252	224	118	32	6	1	2	799
07:00	0	0	0	10	62	257	460	390	192	66	17	3	0	1	1458
08:00	3	0	0	13	47	366	575	398	130	32	7	1	0	0	1572
09:00	0	2	8	31	91	455	570	271	85	19	2	0	0	0	1534
10:00	3	2	10	48	157	419	467	267	76	19	0	1	0	0	1469
11:00	0	0	3	52	180	504	487	222	68	7	2	0	0	0	1525
12:00	3	10	55	206	450	563	354	167	19	9	1	0	0	0	1837
13:00	745	378	177	146	56	42	28	12	4	1	0	0	0	0	1589
14:00	1015	135	145	96	27	4	0	0	1	0	0	0	0	0	1423
15:00	1188	100	45	13	1	1	1	0	0	0	0	0	0	0	1349
16:00	1120	41	20	3	1	0	1	0	0	0	0	0	0	0	1186
17:00	1169	37	9	15	6	3	1	0	0	0	0	0	0	0	1240
18:00	325	97	235	369	161	59	7	1	0	0	0	0	0	0	1254
19:00	17	69	358	729	305	88	12	0	1	0	0	1	1	0	1581
20:00	5	28	316	710	481	324	78	12	7	3	0	1	0	0	1965
21:00	3	7	17	89	283	640	439	168	59	7	2	0	0	0	1714
22:00	7	1	90	240	200	388	303	139	33	11	1	0	0	0	1413
23:00	2	2	5	18	112	379	366	174	54	15	6	0	0	0	1133
24:00	0	1	6	7	46	218	337	272	95	47	10	1	0	0	1040
DAY TOTAL	5606	910	1502	2802	2702	4926	5061	3263	1353	509	145	23	5	6	28813
PERCENTS	19.5%	3.2%	5.3%	9.8%	9.4%	17.1%	17.6%	11.3%	4.6%	1.7%	0.5%	0.0%	0.0%	0.0%	100%

Statistical Information...

15th Percentile Speed
23.1 mph

85th Percentile Speed
61.5 mph

Median Speed
50.9 mph

Average Speed
45.6 mph

10 MPH Pace Speed
50 mph to 60 mph
9987 vehicles in pace
Representing 34.6% of the total vehicles

Vehicles > 65 MPH
2041
7.1%

Site Reference: 190020000034
Site ID: Station 2
Location: I-93 SB ramp to I-95
Direction: SOUTH
Lane: 2

File: comb..prn
City: Quincy
County: Ramp ID # 12077

TIME	30	35	40	45	50	55	60	65	70	75	80	85	90	91+	Total
01:00	1	0	0	0	25	71	167	163	92	49	12	2	1	0	583
02:00	0	0	0	2	3	66	131	131	69	30	10	4	1	0	447
03:00	0	0	0	2	4	24	65	74	46	19	11	1	0	2	248
04:00	0	0	0	2	10	27	43	77	44	30	7	2	1	0	243
05:00	0	0	0	0	4	18	62	106	74	50	31	6	2	0	353
06:00	1	0	0	2	3	24	140	266	239	118	23	7	0	0	823
07:00	0	0	0	9	32	244	463	406	159	50	12	2	0	0	1377
08:00	116	26	25	59	124	347	477	260	82	23	3	0	0	0	1542
09:00	225	59	47	79	99	299	411	171	44	9	3	2	1	3	1452
10:00	24	13	5	30	128	376	501	221	60	19	2	0	0	1	1380
11:00	24	27	31	75	182	536	472	199	58	11	3	1	0	0	1619
12:00	215	212	215	248	297	380	175	56	11	5	3	0	0	0	1817
13:00	87	134	118	296	379	553	312	91	25	3	2	1	0	0	2001
14:00	14	28	133	430	522	604	203	52	12	2	1	2	1	0	2004
15:00	0	13	134	446	656	415	66	16	1	0	0	0	1	0	1748
16:00	471	32	145	366	206	115	21	7	1	2	0	0	2	0	1368
17:00	85	64	137	373	321	197	51	24	4	0	0	0	0	0	1256
18:00	9	11	59	294	405	318	111	25	7	3	0	0	0	0	1242
19:00	29	77	244	605	478	182	43	8	2	0	2	0	0	1	1671
20:00	10	43	203	606	626	358	93	26	10	1	0	0	0	0	1976
21:00	25	45	83	278	453	586	239	107	16	3	0	1	0	0	1836
22:00	0	1	16	126	274	558	345	165	49	17	3	1	0	1	1556
23:00	1	1	8	25	90	273	349	207	61	10	2	0	0	0	1027
24:00	2	4	15	59	154	307	242	143	29	8	1	0	1	1	966
DAY TOTAL	1339	790	1618	4412	5475	6878	5182	3001	1195	462	131	32	11	9	30535
PERCENTS	4.4%	2.6%	5.3%	14.5%	18.0%	22.6%	16.9%	9.8%	3.9%	1.5%	0.4%	0.1%	0.0%	0.0%	100%

Statistical Information...

15th Percentile Speed
41.0 mph

85th Percentile Speed
60.4 mph

Median Speed
51.2 mph

Average Speed
50.1 mph

10 MPH Pace Speed
45 mph to 55 mph
12353 vehicles in pace
Representing 40.4% of the total vehicles

Vehicles > 65 MPH
1840
6.0%

Site Reference: 190020000034
Site ID: Station 2
Location: I-93 SB ramp to I-95
Direction: SOUTH
Lane: 2

File: comb..prn
City: Quincy
County: Ramp ID # 12077

TIME	30	35	40	45	50	55	60	65	70	75	80	85	90	91+	Total
01:00	1	0	0	0	10	127	219	178	73	27	5	1	0	0	641
02:00	0	0	0	1	11	51	124	122	63	46	11	1	0	1	431
03:00	3	2	0	1	9	24	80	96	61	27	8	2	0	1	314
04:00	0	0	0	2	3	30	59	66	41	29	5	1	0	0	236
05:00	0	0	0	0	6	22	60	113	96	58	26	4	1	0	386
06:00	1	0	1	2	13	55	137	224	242	124	51	7	1	1	859
07:00	0	0	0	3	52	283	492	323	150	57	10	2	0	0	1372
08:00	1	0	0	12	102	479	515	227	71	17	1	0	0	0	1425
09:00	68	13	41	118	200	415	346	146	31	4	0	0	0	0	1382
10:00	0	1	19	79	261	519	288	78	18	5	0	0	0	0	1268
11:00	2	10	31	148	376	571	249	75	16	4	0	0	0	1	1483
12:00	109	98	234	438	426	229	59	21	1	0	0	0	0	0	1615
13:00	398	335	318	354	208	87	9	0	0	0	0	0	0	0	1709
14:00	767	312	221	182	83	52	5	2	0	0	0	0	0	0	1624
15:00	728	285	196	219	144	75	16	2	0	0	0	0	0	0	1665
16:00	772	95	92	84	24	10	1	0	0	0	0	0	0	0	1078
17:00	796	45	21	26	2	0	0	0	0	0	0	0	0	0	890
18:00	95	118	225	545	321	118	18	4	0	0	0	0	0	0	1444
19:00	32	73	278	661	363	124	19	3	1	0	0	0	0	0	1554
20:00	5	47	237	600	552	205	20	10	0	1	0	1	0	0	1678
21:00	2	9	66	270	433	557	300	78	17	2	0	1	0	0	1735
22:00	6	28	42	206	299	417	285	135	43	7	2	0	0	0	1470
23:00	3	3	28	101	240	506	357	136	47	8	1	0	0	0	1430
24:00	1	1	8	19	74	271	353	278	90	31	8	1	0	1	1136
DAY TOTAL	3790	1475	2058	4071	4212	5227	4011	2317	1061	447	128	21	2	5	28825
PERCENTS	13.2%	5.2%	7.2%	14.2%	14.7%	18.1%	13.9%	8.0%	3.6%	1.5%	0.4%	0.0%	0.0%	0.0%	100%

Statistical Information...

15th Percentile Speed
31.8 mph

85th Percentile Speed
59.6 mph

Median Speed
48.6 mph

Average Speed
45.8 mph

10 MPH Pace Speed
45 mph to 55 mph
9439 vehicles in pace
Representing 32.7% of the total vehicles

Vehicles > 65 MPH
1664
5.8%

Site Reference: 190020000034
Site ID: Station 2
Location: I-93 SB ramp to I-95
Direction: SOUTH
Lane: 2

File: comb..prn
City: Quincy
County: Ramp ID # 12077

TIME	30	35	40	45	50	55	60	65	70	75	80	85	90	91+	Total
01:00	2	0	3	2	21	113	228	166	105	37	12	2	0	1	692
02:00	0	0	0	1	19	53	128	129	75	47	11	2	0	1	466
03:00	0	1	2	7	19	78	120	122	46	25	9	0	0	1	430
04:00	0	0	0	0	11	49	74	66	40	16	1	0	0	1	258
05:00	0	0	1	14	19	63	72	66	32	21	5	0	0	0	293
06:00	0	0	0	25	69	230	218	104	39	8	0	0	0	0	693
07:00	2	6	21	41	172	465	357	123	31	9	1	1	0	0	1229
08:00	1	0	12	77	206	568	386	146	19	3	0	0	0	0	1418
09:00	1	0	5	43	188	584	432	124	21	13	0	0	0	2	1413
10:00	3	5	12	54	180	441	349	143	38	8	1	0	0	3	1237
11:00	3	8	51	219	427	516	303	72	18	1	0	0	0	0	1618
12:00	13	31	81	348	595	543	165	18	2	1	1	0	0	0	1798
13:00	98	51	237	513	464	369	110	15	2	0	0	0	0	0	1859
14:00	895	262	213	90	33	16	1	0	0	0	0	0	0	0	1510
15:00	901	168	176	124	53	12	2	1	0	0	0	0	0	0	1437
16:00	1155	106	15	2	0	1	0	0	0	0	0	0	0	0	1279
17:00	1138	34	7	4	0	2	1	0	0	0	0	0	0	0	1186
18:00	1020	58	30	11	1	0	0	0	0	0	0	0	0	0	1120
19:00	199	80	197	531	375	128	27	5	0	0	2	0	0	0	1544
20:00	2	15	140	475	523	501	123	26	2	1	1	0	0	0	1809
21:00	2	3	72	136	357	627	372	131	35	15	0	0	0	0	1750
22:00	10	5	11	48	244	639	404	168	50	10	0	0	0	1	1590
23:00	10	19	41	128	248	491	401	173	48	15	2	0	0	0	1576
24:00	2	0	3	51	153	507	536	203	86	25	3	1	0	0	1570
DAY TOTAL	5457	852	1330	2944	4377	6996	4809	2001	689	255	49	6	0	10	29775
PERCENTS	18.4%	2.9%	4.5%	9.9%	14.8%	23.5%	16.1%	6.7%	2.3%	0.8%	0.1%	0.0%	0.0%	0.0%	100%

Statistical Information...

15th Percentile Speed
24.6 mph

85th Percentile Speed
58.5 mph

Median Speed
49.9 mph

Average Speed
44.7 mph

10 MPH Pace Speed
50 mph to 60 mph
11805 vehicles in pace
Representing 39.6% of the total vehicles

Vehicles > 65 MPH
1009
3.4%

Site Reference: 190020000034
Site ID: Station 2
Location: I-93 SB ramp to I-95
Direction: SOUTH
Lane: 2

File: comb..prn
City: Quincy
County: Ramp ID # 12077

TIME	30	35	40	45	50	55	60	65	70	75	80	85	90	91+	Total
01:00	1	0	7	23	33	204	315	251	108	35	11	0	0	1	989
02:00	1	0	0	8	39	91	186	190	109	65	5	1	1	1	697
03:00	0	0	1	1	5	47	131	171	111	48	24	6	2	1	548
04:00	0	0	0	1	8	35	71	110	90	35	17	7	1	0	375
05:00	0	0	0	0	5	30	48	111	76	51	20	2	0	0	343
06:00	0	0	0	0	1	22	53	133	168	133	47	13	2	1	573
07:00	1	0	1	3	6	41	196	312	240	145	46	12	2	1	1006
08:00	3	0	0	9	28	157	350	404	239	121	33	3	1	1	1349
09:00	2	0	1	34	108	349	585	431	154	40	9	1	0	0	1714
10:00	4	0	1	23	134	513	650	333	117	18	4	1	0	0	1798
11:00	8	42	91	280	566	577	181	61	21	5	0	0	0	2	1834
12:00	7	23	161	422	690	497	84	20	2	0	0	0	0	1	1907
13:00	51	39	103	368	588	603	140	15	2	0	0	2	0	1	1912
14:00	46	51	114	300	519	607	174	40	3	2	0	0	1	2	1859
15:00	41	60	109	307	476	606	191	39	12	5	0	2	0	3	1851
16:00	835	378	263	118	46	10	2	1	1	0	0	0	0	0	1654
17:00	627	180	349	309	114	39	4	5	0	0	1	1	0	0	1629
18:00	120	136	221	305	212	159	99	42	9	6	0	0	0	0	1309
19:00	18	23	40	154	289	627	414	177	49	6	1	2	0	2	1802
20:00	45	74	91	189	346	675	387	145	38	8	0	1	0	0	1999
21:00	4	7	25	163	299	660	452	150	37	16	1	0	0	2	1816
22:00	140	28	83	182	330	551	270	103	24	7	3	0	0	0	1721
23:00	4	24	32	136	295	599	410	164	26	3	3	0	0	0	1696
24:00	2	9	27	101	241	590	472	173	47	8	5	1	0	0	1676
DAY TOTAL	1960	1074	1720	3436	5378	8289	5865	3581	1683	757	230	55	10	19	34057
PERCENTS	5.8%	3.2%	5.1%	10.1%	15.8%	24.4%	17.3%	10.5%	4.9%	2.2%	0.6%	0.1%	0.0%	0.0%	100%

Statistical Information...

15th Percentile Speed
40.5 mph

85th Percentile Speed
61.7 mph

Median Speed
52.1 mph

Average Speed
50.5 mph

10 MPH Pace Speed
50 mph to 60 mph
14154 vehicles in pace
Representing 41.5% of the total vehicles

Vehicles > 65 MPH
2754
8.1%

APPENDIX C

1. Crash tables

	A	B	G	H	J	K	M	N	O	Q	T	U
1	Study Location	Area of Crash	Crash Time	Is Peak?	Road Surface Conditions	Ambient Light Conditions	Manner of Collision	Crash Severity	Weather Conditions	Crash Number	Crash Year	Crash Date
2	Wilmington	I-93 Segment 7 (after second Exit 41 on-ramp)	1:40 PM	Off-peak	Dry	Daylight	Sideswipe, same direction	Property damage only (none injured)	Clear	3752697	2014	2014-03-04
3	Wilmington	I-93 Segment 7 (after second Exit 41 on-ramp)	12:25 PM	Off-peak	Unknown	Not reported	Not reported	Property damage only (none injured)	Unknown	3792552	2014	2014-03-21
4	Wilmington	I-93 Segment 7 (after second Exit 41 on-ramp)	8:45 AM	Peak	Wet	Daylight	Sideswipe, same direction	Property damage only (none injured)	Snow	3680696	2013	2013-12-09
5	Wilmington	Exit 40 merge	9:33 AM	Peak	Dry	Daylight	Rear-end	Non-fatal injury	Cloudy	4038992	2015	2015-05-02
6	Wilmington	Exit 40 merge	10:00 PM	Off-peak	Dry	Dark - roadway not lighted	Single vehicle crash	Non-fatal injury	Clear	4058519	2015	2015-05-22
7	Wilmington	Exit 40 merge	3:20 PM	Peak	Dry	Daylight	Rear-end	Property damage only (none injured)	Clear	4061157	2015	2015-07-07
8	Wilmington	Exit 40 merge	12:51 PM	Off-peak	Dry	Daylight	Single vehicle crash	Property damage only (none injured)	Clear	4164171	2016	2016-03-07
9	Wilmington	Exit 40 merge	12:50 PM	Off-peak	Dry	Daylight	Single vehicle crash	Non-fatal injury	Clear	3667330	2013	2013-11-26
10	Wilmington	Route 125 at Ballardville St	12:08 PM	Off-peak	Wet	Daylight	Angle	Property damage only (none injured)	Cloudy	4154894	2016	2016-02-16
11	Wilmington	Route 125 at Ballardville St	2:41 PM	Off-peak	Wet	Daylight	Unknown	Property damage only (none injured)	Clear	4301334	2016	2016-12-12
12	Wilmington	Route 125 at Ballardville St	2:39 PM	Off-peak	Wet	Daylight	Rear-end	Property damage only (none injured)	Rain	3999257	2015	2015-01-15
13	Wilmington	Route 125 at Ballardville St	8:26 AM	Peak	Wet	Daylight	Rear-end	Non-fatal injury	Cloudy	3367293	2012	2012-12-05
14	Wilmington	Route 125 at Ballardville St	3:38 PM	Peak	Dry	Daylight	Rear-end	Property damage only (none injured)	Clear	4096845	2015	2015-10-08
15	Wilmington	Route 125 at Ballardville St	9:09 AM	Peak	Dry	Daylight	Rear-end	Property damage only (none injured)	Clear	4141225	2016	2016-01-21
16	Wilmington	Route 125 at Ballardville St	8:04 AM	Peak	Dry	Daylight	Angle	Property damage only (none injured)	Clear	4187516	2016	2016-04-29
17	Wilmington	Route 125 at Ballardville St	5:25 PM	Peak	Dry	Daylight	Angle	Property damage only (none injured)	Clear	4245639	2016	2016-08-30
18	Wilmington	Route 125 at Ballardville St	8:41 AM	Peak	Dry	Daylight	Angle	Property damage only (none injured)	Clear	4284384	2016	2016-11-14
19	Wilmington	Route 125 at Ballardville St	1:58 PM	Off-peak	Dry	Daylight	Rear-end	Property damage only (none injured)	Cloudy	3367318	2013	2013-01-21
20	Wilmington	Route 125 at Ballardville St	1:11 PM	Off-peak	Dry	Daylight	Rear-end	Property damage only (none injured)	Clear	3829970	2014	2014-06-01
21	Wilmington	Route 125 at Ballardville St	9:20 AM	Peak	Dry	Daylight	Sideswipe, opposite direction	Property damage only (none injured)	Cloudy	4191147	2016	2016-05-13
22	Wilmington	Route 125 at Ballardville St	9:40 AM	Peak	Dry	Daylight	Rear-end	Property damage only (none injured)	Clear	4218786	2016	2016-06-30
23	Wilmington	Route 125 at Ballardville St	8:40 AM	Peak	Wet	Daylight	Single vehicle crash	Property damage only (none injured)	Cloudy	2934893	2012	2012-02-17
24	Wilmington	Route 125 at Ballardville St	10:23 AM	Off-peak	Wet	Daylight	Angle	Property damage only (none injured)	Rain	3116421	2012	2012-05-08
25	Wilmington	Route 125 at Ballardville St	11:03 AM	Off-peak	Dry	Daylight	Rear-end	Non-fatal injury	Cloudy	3412964	2013	2013-03-18
26	Wilmington	Route 125 at Ballardville St	6:21 AM	Peak	Dry	Dawn	Sideswipe, same direction	Property damage only (none injured)	Clear	3705609	2013	2013-10-28
27	Wilmington	Route 125 at Ballardville St	8:00 AM	Peak	Wet	Daylight	Rear-end	Property damage only (none injured)	Clear	3671711	2013	2013-12-04
28	Wilmington	Route 125 at Ballardville St	5:05 PM	Peak	Dry	Dusk	Rear-end	Non-fatal injury	Clear	3730942	2014	2014-02-04
29	Wilmington	Route 125 at Ballardville St	4:46 PM	Peak	Dry	Daylight	Angle	Property damage only (none injured)	Unknown	3743372	2014	2014-02-21
30	Wilmington	Route 125 at Ballardville St	8:49 AM	Peak	Dry	Daylight	Angle	Non-fatal injury	Clear	3818287	2014	2014-04-24
31	Wilmington	Route 125 at Ballardville St	8:55 AM	Peak	Dry	Daylight	Angle	Property damage only (none injured)	Clear	3949949	2014	2014-09-09
32	Wilmington	Route 125 at Ballardville St	8:00 AM	Peak	Dry	Daylight	Sideswipe, same direction	Property damage only (none injured)	Clear	4041862	2015	2015-05-14
33	Wilmington	Route 125 at Ballardville St	9:25 PM	Off-peak	Dry	Dark - unknown roadway lighting	Rear-end	Non-fatal injury	Clear	4058693	2015	2015-06-23
34	Wilmington	Route 125 at Ballardville St	1:50 PM	Off-peak	Dry	Daylight	Sideswipe, same direction	Property damage only (none injured)	Clear	4061355	2015	2015-07-10
35	Wilmington	Route 125 at Ballardville St	8:11 AM	Peak	Dry	Daylight	Rear-end	Property damage only (none injured)	Clear	4132764	2016	2016-01-05
36	Wilmington	Route 125 at Ballardville St	2:12 PM	Off-peak	Dry	Daylight	Rear-end	Property damage only (none injured)	Clear	4149330	2016	2016-01-27
37	Wilmington	Route 125 at Ballardville St	7:25 PM	Off-peak	Dry	Daylight	Sideswipe, same direction	Property damage only (none injured)	Clear	4219262	2016	2016-06-29

	A	B	G	H	J	K	M	N	O	Q	T	U
1	Study Location	Area of Crash	Crash Time	Is Peak?	Road Surface Conditions	Ambient Light Conditions	Manner of Collision	Crash Severity	Weather Conditions	Crash Number	Crash Year	Crash Date
38	Wilmington	Route 125 at Ballardville St	4:00 PM	Peak	Dry	Daylight	Rear-end	Non-fatal injury	Clear	4226863	2016	2016-07-23
39	Wilmington	Route 125 at Ballardville St	12:12 PM	Off-peak	Dry	Daylight	Rear-end	Property damage only (none injured)	Clear	4245641	2016	2016-08-31
40	Wilmington	Route 125 at Ballardville St	5:04 PM	Peak	Dry	Dark - lighted roadway	Sideswipe, same direction	Property damage only (none injured)	Clear	4301328	2016	2016-12-09
41	Wilmington	Route 125 at Ballardville St	9:22 AM	Peak	Dry	Daylight	Angle	Property damage only (none injured)	Clear	4284379	2016	2016-11-10
42	Wilmington	Route 125 at Ballardville St	4:57 PM	Peak	Dry	Dusk	Rear-end	Non-fatal injury	Clear	4288113	2016	2016-11-18
43	Wilmington	Route 125 at Ballardville St	1:48 PM	Off-peak	Wet	Daylight	Rear-end	Non-fatal injury	Cloudy	3968377	2014	2014-10-01
44	Wilmington	Route 125 at Ballardville St	7:55 AM	Peak	Wet	Daylight	Rear-end	Non-fatal injury	Clear	3298967	2012	2012-10-05
45	Wilmington	Route 125 at Ballardville St	8:35 PM	Off-peak	Dry	Dark - roadway not lighted	Head-on	Fatal injury	Cloudy	3374720	2013	2013-03-03
46	Wilmington	Route 125 at I-93 NB ramps	3:10 PM	Peak	Dry	Daylight	Rear-end	Non-fatal injury	Clear	3829341	2014	2014-02-14
47	Wilmington	Route 125 at I-93 NB ramps	4:07 AM	Off-peak	Dry	Dark - roadway not lighted	Single vehicle crash	Property damage only (none injured)	Clear	3509772	2013	2013-06-26
48	Wilmington	Route 125 at I-93 NB ramps	5:34 PM	Peak	Dry	Daylight	Angle	Property damage only (none injured)	Clear	3412999	2013	2013-04-24
49	Wilmington	I-93 Segment 6 (before second Exit 41 on-ramp)	9:20 PM	Off-peak	Dry	Dark - lighted roadway	Single vehicle crash	Non-fatal injury	Unknown	3729200	2014	2014-01-16
50	Wilmington	Route 125 at I-93 NB ramps	5:13 PM	Peak	Dry	Dark - roadway not lighted	Rear-end	Non-fatal injury	Clear	4127100	2015	2015-12-16
51	Wilmington	I-93 Segment 5 (before first Exit 41 on-ramp)	4:30 PM	Peak	Dry	Daylight	Rear-end	Property damage only (none injured)	Clear	4010731	2015	2015-02-20
52	Wilmington	Route 125 at I-93 NB ramps	8:35 AM	Peak	Wet	Daylight	Single vehicle crash	Property damage only (none injured)	Unknown	3414235	2013	2013-05-11
53	Wilmington	Route 125 at I-93 NB ramps	5:45 PM	Peak	Dry	Daylight	Rear-end	Non-fatal injury	Clear	4259043	2016	2016-10-04
54	Wilmington	Route 125 at I-93 NB ramps	6:00 PM	Peak	Dry	Dusk	Angle	Property damage only (none injured)	Clear	3984649	2014	2014-12-03
55	Wilmington	I-93 Segment 5 (before first Exit 41 on-ramp)	6:40 PM	Peak	Dry	Dark - roadway not lighted	Rear-end	Property damage only (none injured)	Cloudy	4109972	2015	2015-11-13
56	Wilmington	I-93 Segment 5 (before first Exit 41 on-ramp)	1:33 PM	Off-peak	Wet	Daylight	Single vehicle crash	Property damage only (none injured)	Unknown	3606315	2013	2013-10-04
57	Wilmington	I-93 Segment 5 (before first Exit 41 on-ramp)	3:08 AM	Off-peak	Dry	Dark - roadway not lighted	Single vehicle crash	Non-fatal injury	Clear	3274436	2012	2012-10-12
58	Wilmington	Exit 40 off-ramp	8:51 AM	Peak	Dry	Daylight	Single vehicle crash	Property damage only (none injured)	Cloudy	3375560	2012	2012-04-02
59	Wilmington	Exit 40 off-ramp	8:30 AM	Peak	Wet	Daylight	Rear-end	Property damage only (none injured)	Cloudy	3279863	2012	2012-10-03
60	Wilmington	I-93 Segment 4 (after Exit 41 off-ramp)	3:15 PM	Peak	Dry	Daylight	Rear-end	Property damage only (none injured)	Unknown	2869268	2012	2012-01-20
61	Wilmington	I-93 Segment 4 (after Exit 41 off-ramp)	4:30 PM	Peak	Dry	Daylight	Rear-end	Property damage only (none injured)	Cloudy	2914945	2012	2012-02-01
62	Wilmington	Exit 41 diverge	3:50 AM	Off-peak	Dry	Dark - roadway not lighted	Single vehicle crash	Property damage only (none injured)	Clear	3868054	2014	2014-06-07
63	Wilmington	Exit 41 diverge	2:34 PM	Off-peak	Dry	Daylight	Rear-end	Non-fatal injury	Clear	4263092	2016	2016-10-14
64	Wilmington	Exit 41 diverge	3:30 PM	Peak	Snow/Ice	Daylight	Single vehicle crash	Non-fatal injury	Snow	3375544	2012	2012-01-21
65	Wilmington	Exit 41 diverge	4:28 PM	Peak	Dry	Daylight	Single vehicle crash	Not Reported	Unknown	3101966	2012	2012-05-17
66	Wilmington	Exit 41 diverge	12:45 PM	Off-peak	Dry	Daylight	Single vehicle crash	Non-fatal injury	Clear	3210661	2012	2012-07-17
67	Wilmington	Exit 41 diverge	4:06 PM	Peak	Dry	Daylight	Single vehicle crash	Non-fatal injury	Clear	3266952	2012	2012-09-15
68	Wilmington	Exit 41 diverge	4:15 PM	Peak	Dry	Dark - roadway not lighted	Rear-end	Property damage only (none injured)	Clear	3290863	2012	2012-11-15
69	Wilmington	Exit 41 diverge	8:25 PM	Off-peak	Dry	Dark - roadway not lighted	Single vehicle crash	Property damage only (none injured)	Cloudy	3317430	2012	2012-12-18
70	Wilmington	Exit 41 diverge	2:09 PM	Off-peak	Dry	Daylight	Single vehicle crash	Non-fatal injury	Clear	3452992	2013	2013-05-18
71	Wilmington	Exit 41 diverge	1:30 PM	Off-peak	Dry	Daylight	Rear-end	Property damage only (none injured)	Clear	3584857	2013	2013-09-08
72	Wilmington	Exit 41 diverge	3:10 PM	Peak	Snow/Ice	Daylight	Single vehicle crash	Non-fatal injury	Snow	3371847	2013	2013-03-19
73	Wilmington	Exit 41 diverge	3:36 PM	Peak	Wet	Daylight	Rear-end	Property damage only (none injured)	Cloudy	3372959	2013	2013-03-06

	A	B	G	H	J	K	M	N	O	Q	T	U
1	Study Location	Area of Crash	Crash Time	Is Peak?	Road Surface Conditions	Ambient Light Conditions	Manner of Collision	Crash Severity	Weather Conditions	Crash Number	Crash Year	Crash Date
74	Wilmington	Exit 41 diverge	9:00 AM	Peak	Snow/Ice	Daylight	Angle	Property damage only (none injured)	Snow	3371276	2013	2013-03-08
75	Wilmington	Exit 41 diverge	2:15 AM	Off-peak	Dry	Dark - roadway not lighted	Rear-end	Non-fatal injury	Clear	3369869	2013	2013-03-17
76	Wilmington	Exit 41 diverge	4:47 PM	Peak	Dry	Daylight	Sideswipe, same direction	Property damage only (none injured)	Cloudy	3379666	2013	2013-03-29
77	Wilmington	Exit 41 diverge	2:10 PM	Off-peak	Dry	Daylight	Sideswipe, same direction	Property damage only (none injured)	Clear	3394427	2013	2013-04-10
78	Wilmington	Exit 41 diverge	2:10 PM	Off-peak	Dry	Daylight	Angle	Non-fatal injury	Clear	3425153	2013	2013-05-07
79	Wilmington	Exit 41 diverge	2:21 PM	Off-peak	Dry	Daylight	Rear-end	Non-fatal injury	Clear	3439969	2013	2013-05-27
80	Wilmington	Exit 41 diverge	5:20 PM	Peak	Wet	Daylight	Rear-end	Property damage only (none injured)	Rain	3501963	2013	2013-07-01
81	Wilmington	Exit 41 diverge	5:05 PM	Peak	Dry	Daylight	Angle	Property damage only (none injured)	Cloudy	3502057	2013	2013-07-07
82	Wilmington	Exit 41 diverge	8:03 AM	Peak	Dry	Daylight	Sideswipe, same direction	Property damage only (none injured)	Cloudy	3543034	2013	2013-07-22
83	Wilmington	Exit 41 diverge	10:19 AM	Off-peak	Snow/Ice	Daylight	Single vehicle crash	Non-fatal injury	Unknown	3685118	2013	2013-12-09
84	Wilmington	Exit 41 diverge	2:50 PM	Off-peak	Dry	Daylight	Rear-end	Property damage only (none injured)	Clear	3887785	2014	2014-07-24
85	Wilmington	Exit 41 diverge	3:22 PM	Peak	Dry	Daylight	Rear-end	Property damage only (none injured)	Clear	3795756	2014	2014-04-29
86	Wilmington	Exit 41 diverge	6:25 PM	Peak	Dry	Daylight	Rear-end	Property damage only (none injured)	Clear	3887782	2014	2014-07-17
87	Wilmington	Exit 41 diverge	2:35 PM	Off-peak	Wet	Daylight	Rear-end	Non-fatal injury	Rain	3907428	2014	2014-08-13
88	Wilmington	Exit 41 diverge	11:20 AM	Off-peak	Dry	Daylight	Single vehicle crash	Property damage only (none injured)	Clear	3959500	2014	2014-10-06
89	Wilmington	Exit 41 diverge	3:03 PM	Peak	Dry	Daylight	Rear-end	Property damage only (none injured)	Cloudy	3991837	2014	2014-12-30
90	Wilmington	Exit 41 diverge	5:14 PM	Peak	Dry	Dusk	Rear-end	Property damage only (none injured)	Clear	3997768	2015	2015-01-20
91	Wilmington	Exit 41 diverge	4:37 PM	Peak	Wet	Daylight	Single vehicle crash	Property damage only (none injured)	Cloudy	4012925	2015	2015-02-10
92	Wilmington	Exit 41 diverge	3:30 PM	Peak	Dry	Daylight	Single vehicle crash	Property damage only (none injured)	Clear	4008577	2015	2015-02-16
93	Wilmington	Exit 41 diverge	5:20 PM	Peak	Dry	Daylight	Rear-end	Non-fatal injury	Clear	4030660	2015	2015-03-26
94	Wilmington	Exit 41 diverge	7:50 PM	Off-peak	Dry	Dark - roadway not lighted	Single vehicle crash	Non-fatal injury	Clear	4033921	2015	2015-04-15
95	Wilmington	Exit 41 diverge	7:50 AM	Peak	Dry	Daylight	Rear-end	Non-fatal injury	Clear	4058514	2015	2015-05-06
96	Wilmington	Exit 41 diverge	2:45 PM	Off-peak	Dry	Daylight	Rear-end	Property damage only (none injured)	Clear	4041332	2015	2015-05-12
97	Wilmington	Exit 41 diverge	5:55 PM	Peak	Dry	Daylight	Sideswipe, same direction	Property damage only (none injured)	Clear	4047250	2015	2015-05-29
98	Wilmington	Exit 41 diverge	9:37 AM	Peak	Dry	Daylight	Single vehicle crash	Property damage only (none injured)	Clear	4063712	2015	2015-06-26
99	Wilmington	Exit 41 diverge	3:45 PM	Peak	Dry	Daylight	Rear-end	Property damage only (none injured)	Unknown	4076568	2015	2015-08-11
100	Wilmington	Exit 41 diverge	2:30 PM	Off-peak	Dry	Daylight	Rear-end	Property damage only (none injured)	Clear	4079535	2015	2015-08-17
101	Wilmington	Exit 41 diverge	5:45 PM	Peak	Dry	Daylight	Rear-end	Property damage only (none injured)	Clear	4082424	2015	2015-08-25
102	Wilmington	Exit 41 diverge	2:25 PM	Off-peak	Dry	Daylight	Rear-end	Non-fatal injury	Clear	4086715	2015	2015-09-18
103	Wilmington	Exit 41 diverge	6:25 PM	Peak	Dry	Dusk	Sideswipe, same direction	Property damage only (none injured)	Clear	4095280	2015	2015-09-30
104	Wilmington	Exit 41 diverge	1:02 AM	Off-peak	Dry	Dark - roadway not lighted	Single vehicle crash	Non-fatal injury	Clear	4118675	2015	2015-11-19
105	Wilmington	Exit 41 diverge	9:00 AM	Peak	Dry	Daylight	Sideswipe, same direction	Property damage only (none injured)	Cloudy	4118695	2015	2015-12-06
106	Wilmington	Exit 41 diverge	6:12 AM	Peak	Dry	Dark - roadway not lighted	Rear-end	Non-fatal injury	Clear	4124993	2015	2015-12-17
107	Wilmington	Exit 41 diverge	3:10 PM	Peak	Dry	Daylight	Rear-end	Property damage only (none injured)	Clear	4146377	2016	2016-02-04
108	Wilmington	Exit 41 diverge	2:30 PM	Off-peak	Dry	Daylight	Rear-end	Property damage only (none injured)	Clear	4155360	2016	2016-02-26
109	Wilmington	Exit 41 diverge	3:00 AM	Off-peak	Dry	Dark - roadway not lighted	Rear-end	Non-fatal injury	Clear	4170933	2016	2016-03-12

	A	B	G	H	J	K	M	N	O	Q	T	U
1	Study Location	Area of Crash	Crash Time	Is Peak?	Road Surface Conditions	Ambient Light Conditions	Manner of Collision	Crash Severity	Weather Conditions	Crash Number	Crash Year	Crash Date
110	Wilmington	Exit 41 diverge	6:28 PM	Peak	Wet	Dark - roadway not lighted	Rear-end	Property damage only (none injured)	Rain	4277199	2016	2016-10-21
111	Wilmington	Exit 41 diverge	3:14 PM	Peak	Dry	Daylight	Rear-end	Property damage only (none injured)	Clear	4225013	2016	2016-07-25
112	Wilmington	Exit 41 diverge	3:45 PM	Peak	Dry	Daylight	Rear-end	Property damage only (none injured)	Unknown	4225876	2016	2016-07-29
113	Wilmington	Exit 41 diverge	11:06 PM	Off-peak	Dry	Dark - roadway not lighted	Rear-end	Property damage only (none injured)	Clear	4231281	2016	2016-08-05
114	Wilmington	Exit 41 diverge	2:30 PM	Off-peak	Dry	Daylight	Rear-end	Property damage only (none injured)	Cloudy	4232428	2016	2016-08-12
115	Wilmington	Exit 41 diverge	1:23 AM	Off-peak	Wet	Dark - roadway not lighted	Single vehicle crash	Not Reported	Rain	4246651	2016	2016-08-22
116	Wilmington	Exit 41 diverge	3:25 PM	Peak	Dry	Daylight	Rear-end	Property damage only (none injured)	Clear	4250351	2016	2016-09-15
117	Wilmington	Exit 41 diverge	1:10 PM	Off-peak	Dry	Daylight	Rear-end	Property damage only (none injured)	Clear	4251667	2016	2016-09-17
118	Wilmington	Exit 41 diverge	3:00 PM	Peak	Dry	Daylight	Rear-end	Non-fatal injury	Clear	4259039	2016	2016-09-20
119	Wilmington	Exit 41 diverge	2:49 PM	Off-peak	Dry	Daylight	Rear-end	Non-fatal injury	Clear	4285466	2016	2016-10-12
120	Wilmington	Exit 41 diverge	12:09 AM	Off-peak	Dry	Dark - roadway not lighted	Sideswipe, same direction	Property damage only (none injured)	Clear	4264687	2016	2016-10-15
121	Wilmington	Exit 41 diverge	8:16 AM	Peak	Dry	Daylight	Angle	Non-fatal injury	Clear	4280713	2016	2016-11-02
122	Wilmington	Exit 41 diverge	8:20 AM	Peak	Dry	Daylight	Rear-end	Property damage only (none injured)	Clear	4286590	2016	2016-11-02
123	Wilmington	Exit 41 diverge	9:00 AM	Peak	Dry	Daylight	Rear-end	Property damage only (none injured)	Clear	4286635	2016	2016-11-08
124	Wilmington	Exit 41 diverge	2:50 PM	Off-peak	Dry	Daylight	Rear-end	Property damage only (none injured)	Clear	4282098	2016	2016-11-10
125	Wilmington	Exit 41 diverge	8:45 AM	Peak	Dry	Daylight	Rear-end	Property damage only (none injured)	Cloudy	4311477	2016	2016-12-06
126	Wilmington	Exit 41 diverge	3:45 PM	Peak	Dry	Daylight	Rear-end	Property damage only (none injured)	Clear	3959836	2014	2014-09-17
127	Wilmington	Exit 41 diverge	8:58 AM	Peak	Dry	Daylight	Rear-end	Property damage only (none injured)	Clear	3340523	2013	2013-01-11
128	Wilmington	Exit 41 diverge	10:33 AM	Off-peak	Dry	Daylight	Rear-end	Property damage only (none injured)	Clear	3783775	2014	2014-04-01
129	Wilmington	Exit 41 diverge	7:09 AM	Peak	Dry	Daylight	Sideswipe, same direction	Property damage only (none injured)	Clear	4094461	2015	2015-09-21
130	Wilmington	Exit 41 diverge	4:00 PM	Peak	Dry	Daylight	Rear-end	Property damage only (none injured)	Unknown	4058716	2015	2015-06-16
131	Wilmington	I-93 Segment 3 (between Exit 40 and Exit 41)	5:40 PM	Peak	Dry	Daylight	Sideswipe, same direction	Property damage only (none injured)	Cloudy	4070516	2015	2015-08-04
132	Wilmington	I-93 Segment 3 (between Exit 40 and Exit 41)	8:20 AM	Peak	Dry	Daylight	Rear-end	Property damage only (none injured)	Unknown	3664712	2013	2013-11-21
133	Wilmington	I-93 Segment 3 (between Exit 40 and Exit 41)	11:02 PM	Off-peak	Wet	Dark - lighted roadway	Sideswipe, same direction	Non-fatal injury	Rain	3427876	2013	2013-05-24
134	Wilmington	I-93 Segment 3 (between Exit 40 and Exit 41)	3:25 PM	Peak	Dry	Daylight	Rear-end	Non-fatal injury	Cloudy	3795758	2014	2014-04-30
135	Wilmington	I-93 Segment 3 (between Exit 40 and Exit 41)	5:01 PM	Peak	Dry	Daylight	Rear-end	Non-fatal injury	Clear	3870855	2014	2014-06-20
136	Wilmington	Exit 40 merge	2:50 AM	Off-peak	Dry	Dark - lighted roadway	Sideswipe, same direction	Property damage only (none injured)	Clear	4311467	2016	2016-12-24
137	Wilmington	I-93 Segment 2 (before Exit 40 on-ramp)	2:50 PM	Off-peak	Dry	Daylight	Angle	Property damage only (none injured)	Clear	4132767	2016	2016-01-06
138	Wilmington	I-93 Segment 2 (before Exit 40 on-ramp)	7:59 AM	Peak	Dry	Daylight	Single vehicle crash	Property damage only (none injured)	Clear	4248720	2016	2016-09-11
139	Wilmington	I-93 Segment 2 (before Exit 40 on-ramp)	5:28 AM	Off-peak	Dry	Dark - roadway not lighted	Single vehicle crash	Property damage only (none injured)	Clear	3298840	2012	2012-12-09
140	Wilmington	I-93 Segment 2 (before Exit 40 on-ramp)	5:45 PM	Peak	Dry	Daylight	Rear-end	Property damage only (none injured)	Clear	3588308	2013	2013-09-13
141	Wilmington	I-93 Segment 2 (before Exit 40 on-ramp)	2:50 PM	Off-peak	Dry	Daylight	Rear-end	Property damage only (none injured)	Unknown	3372288	2013	2013-03-20
142	Wilmington	I-93 Segment 2 (before Exit 40 on-ramp)	2:45 PM	Off-peak	Dry	Daylight	Angle	Property damage only (none injured)	Clear	3481928	2013	2013-06-23
143	Wilmington	I-93 Segment 2 (before Exit 40 on-ramp)	4:19 PM	Peak	Dry	Daylight	Rear-end	Property damage only (none injured)	Clear	3799235	2014	2014-01-20
144	Wilmington	I-93 Segment 2 (before Exit 40 on-ramp)	3:39 PM	Peak	Wet	Daylight	Rear-end	Property damage only (none injured)	Clear	3730081	2014	2014-01-27
145	Wilmington	I-93 Segment 2 (before Exit 40 on-ramp)	2:53 PM	Off-peak	Dry	Daylight	Rear-end	Property damage only (none injured)	Clear	4141204	2016	2016-01-12

	A	B	G	H	J	K	M	N	O	Q	T	U
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146	Wilmington	I-93 Segment 2 (before Exit 40 on-ramp)	6:03 PM	Peak	Dry	Daylight	Angle	Non-fatal injury	Cloudy	4228564	2016	2016-07-28
147	Wilmington	I-93 Segment 2 (before Exit 40 on-ramp)	5:20 AM	Off-peak	Dry	Dark - roadway not lighted	Rear-end	Property damage only (none injured)	Unknown	3252543	2012	2012-09-16
148	Wilmington	I-93 Segment 2 (before Exit 40 on-ramp)	12:08 PM	Off-peak	Dry	Daylight	Angle	Property damage only (none injured)	Clear	3602528	2013	2013-09-19
149	Wilmington	I-93 Segment 2 (before Exit 40 on-ramp)	7:54 PM	Off-peak	Dry	Dark - lighted roadway	Angle	Non-fatal injury	Cloudy	3941716	2014	2014-08-22
150	Wilmington	I-93 Segment 2 (before Exit 40 on-ramp)	3:34 PM	Peak	Dry	Daylight	Single vehicle crash	Property damage only (none injured)	Clear	3720524	2014	2014-01-20
151	Wilmington	Exit 40 on-ramp	11:37 AM	Off-peak	Dry	Daylight	Rear-end	Property damage only (none injured)	Clear	3168166	2012	2012-02-23
152	Wilmington	Exit 40 off-ramp	11:40 PM	Off-peak	Snow/Ice	Dark - lighted roadway	Single vehicle crash	Property damage only (none injured)	Unknown	3367261	2013	2013-03-07
153	Wilmington	Exit 40 off-ramp	11:29 PM	Off-peak	Dry	Dark - unknown roadway lighting	Single vehicle crash	Property damage only (none injured)	Cloudy	3850241	2014	2014-06-12
154	Wilmington	Exit 40 off-ramp	9:40 AM	Peak	Dry	Daylight	Single vehicle crash	Property damage only (none injured)	Unknown	3215949	2012	2012-07-04
155	Wilmington	Exit 40 diverge	6:11 AM	Peak	Dry	Dark - roadway not lighted	Single vehicle crash	Non-fatal injury	Cloudy	2894051	2012	2012-01-22
156	Wilmington	Exit 40 diverge	2:17 PM	Off-peak	Wet	Daylight	Rear-end	Property damage only (none injured)	Unknown	3604395	2013	2013-10-04
157	Wilmington	Exit 40 diverge	12:18 PM	Off-peak	Snow/Ice	Daylight	Single vehicle crash	Property damage only (none injured)	Snow	3362802	2013	2013-02-17
158	Wilmington	Exit 40 diverge	3:55 PM	Peak	Wet	Dusk	Rear-end	Property damage only (none injured)	Rain	3713445	2014	2014-01-06
159	Wilmington	Exit 40 diverge	11:11 PM	Off-peak	Dry	Dark - lighted roadway	Rear-end	Property damage only (none injured)	Unknown	3794740	2014	2014-04-24
160	Wilmington	Exit 40 diverge	9:02 AM	Peak	Dry	Daylight	Single vehicle crash	Non-fatal injury	Unknown	3867488	2014	2014-06-27
161	Wilmington	Exit 40 diverge	2:35 PM	Off-peak	Dry	Daylight	Angle	Property damage only (none injured)	Clear	3869351	2014	2014-06-28
162	Wilmington	Exit 40 diverge	9:35 PM	Off-peak	Wet	Dark - roadway not lighted	Single vehicle crash	Property damage only (none injured)	Rain	3987436	2014	2014-12-23
163	Wilmington	Exit 40 diverge	3:00 PM	Peak	Wet	Daylight	Rear-end	Property damage only (none injured)	Rain	3999799	2015	2015-01-12
164	Wilmington	Exit 40 diverge	4:40 AM	Off-peak	Dry	Dark - roadway not lighted	Single vehicle crash	Property damage only (none injured)	Clear	4024118	2015	2015-03-20
165	Wilmington	Exit 40 diverge	9:08 AM	Peak	Dry	Daylight	Angle	Non-fatal injury	Unknown	4028915	2015	2015-03-20
166	Wilmington	Exit 40 diverge	9:35 PM	Off-peak	Dry	Dark - roadway not lighted	Angle	Non-fatal injury	Unknown	4030736	2015	2015-03-21
167	Wilmington	Exit 40 diverge	3:55 PM	Peak	Dry	Daylight	Rear-end	Non-fatal injury	Clear	4027365	2015	2015-03-31
168	Wilmington	Exit 40 diverge	4:45 PM	Peak	Dry	Dark - roadway not lighted	Single vehicle crash	Property damage only (none injured)	Clear	4119723	2015	2015-12-09
169	Wilmington	Exit 40 diverge	6:55 PM	Peak	Dry	Dark - unknown roadway lighting	Single vehicle crash	Non-fatal injury	Cloudy	4131981	2015	2015-12-26
170	Wilmington	Exit 40 diverge	3:00 PM	Peak	Dry	Daylight	Single vehicle crash	Property damage only (none injured)	Clear	4165145	2016	2016-03-16
171	Wilmington	Exit 40 diverge	4:30 PM	Peak	Dry	Daylight	Rear-end	Property damage only (none injured)	Cloudy	4219952	2016	2016-06-28
172	Wilmington	Exit 40 diverge	7:50 PM	Off-peak	Dry	Dark - roadway not lighted	Rear-end	Property damage only (none injured)	Clear	4191975	2016	2016-05-06
173	Wilmington	Exit 40 diverge	8:40 PM	Off-peak	Dry	Dark - roadway not lighted	Sideswipe, same direction	Non-fatal injury	Clear	4193354	2016	2016-05-11
174	Wilmington	Exit 40 diverge	5:55 PM	Peak	Dry	Daylight	Rear-end	Property damage only (none injured)	Clear	4195143	2016	2016-05-12
175	Wilmington	Exit 40 diverge	7:00 PM	Peak	Dry	Daylight	Rear-end	Property damage only (none injured)	Clear	4218755	2016	2016-06-10
176	Wilmington	Exit 40 diverge	5:35 PM	Peak	Dry	Daylight	Rear-end	Property damage only (none injured)	Cloudy	4203970	2016	2016-06-13
177	Wilmington	Exit 40 diverge	3:00 PM	Peak	Dry	Daylight	Rear-end	Property damage only (none injured)	Cloudy	4225021	2016	2016-07-28
178	Wilmington	Exit 40 diverge	5:55 PM	Peak	Dry	Daylight	Rear-end	Property damage only (none injured)	Clear	4227763	2016	2016-08-02
179	Wilmington	Exit 40 diverge	10:20 AM	Off-peak	Dry	Daylight	Angle	Non-fatal injury	Clear	4291906	2016	2016-11-01
180	Wilmington	Exit 40 diverge	8:36 PM	Off-peak	Dry	Dark - roadway not lighted	Rear-end	Property damage only (none injured)	Clear	4285953	2016	2016-11-13
181	Wilmington	Exit 40 diverge	9:26 PM	Off-peak	Snow/Ice	Dark - lighted roadway	Sideswipe, same direction	Property damage only (none injured)	Snow	4324755	2016	2016-12-29

	A	B	G	H	J	K	M	N	O	Q	T	U
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182	Wilmington	Exit 40 diverge	4:39 PM	Peak	Dry	Dusk	Sideswipe, same direction	Non-fatal injury	Clear	4132039	2016	2016-01-07
183	Wilmington	Exit 40 diverge	7:46 PM	Off-peak	Dry	Daylight	Sideswipe, same direction	Non-fatal injury	Clear	4218777	2016	2016-06-25

	A	B	G	H	J	K	M	N	O	Q	T	U
1	Study Location	Area of Crash	Crash Time	Is Peak?	Road Surface Conditions	Ambient Light Conditions	Manner of Collision	Crash Severity	Weather Conditions	Crash Number	Crash Year	Crash Date
184	Quincy	I-93 Segment 1 (over traffic circle)	4:25 AM	Off-peak	Dry	Dark - lighted roadway	Single vehicle crash	Property damage only (none injured)	Unknown	4149066	2016	2016-01-26
185	Quincy	I-93 Segment 1 (over traffic circle)	7:40 PM	Off-peak	Dry	Daylight	Rear-end	Property damage only (none injured)	Clear	3484089	2013	2013-06-14
186	Quincy	Exit 8 on-ramp	12:19 PM	Off-peak	Dry	Daylight	Angle	Non-fatal injury	Clear	4160084	2016	2016-03-02
187	Quincy	I-93 Segment 2 (ahead of Exit 8 on-ramp)	11:14 PM	Off-peak	Wet	Dark - lighted roadway	Angle	Property damage only (none injured)	Rain	3863457	2014	2014-06-13
188	Quincy	I-93 Segment 2 (ahead of Exit 8 on-ramp)	9:03 PM	Off-peak	Dry	Dark - lighted roadway	Sideswipe, same direction	Non-fatal injury	Clear	4203426	2016	2016-05-25
189	Quincy	Exit 8 merge	9:05 AM	Peak	Snow/Ice	Daylight	Single vehicle crash	Non-fatal injury	Cloudy	3730358	2014	2014-01-04
190	Quincy	Exit 8 merge	3:10 PM	Peak	Dry	Daylight	Rear-end	Property damage only (none injured)	Clear	4039055	2015	2015-04-15
191	Quincy	Exit 8 merge	8:07 AM	Peak	Dry	Daylight	Angle	Property damage only (none injured)	Clear	4220945	2016	2016-05-31
192	Quincy	Exit 8 merge	6:23 PM	Peak	Wet	Dark - lighted roadway	Angle	Property damage only (none injured)	Rain	3384663	2013	2013-03-06
193	Quincy	I-93 Segment 3 (after Exit 8 on-ramp)	1:05 PM	Off-peak	Wet	Daylight	Single vehicle crash	Non-fatal injury	Rain	3491318	2013	2013-06-13
194	Quincy	I-93 Segment 3 (after Exit 8 on-ramp)	8:35 AM	Peak	Dry	Daylight	Rear-end	Property damage only (none injured)	Clear	4124999	2015	2015-12-16
195	Quincy	I-93 Segment 3 (after Exit 8 on-ramp)	5:52 PM	Peak	Dry	Daylight	Rear-end	Property damage only (none injured)	Clear	3893451	2014	2014-07-31
196	Quincy	I-93 Segment 4 (near HOV lane merge)	3:00 PM	Peak	Wet	Daylight	Rear-end	Property damage only (none injured)	Clear	4237590	2016	2016-08-04
197	Quincy	I-93 Segment 4 (near HOV lane merge)	7:10 PM	Off-peak	Dry	Daylight	Rear-end	Property damage only (none injured)	Clear	4235196	2016	2016-08-23
198	Quincy	HOV lane merge	10:10 AM	Off-peak	Dry	Daylight	Single vehicle crash	Property damage only (none injured)	Clear	3793362	2014	2014-04-16
199	Quincy	I-93 Segment 5 (ahead of Exit 7 diverge)	2:13 AM	Off-peak	Dry	Dark - lighted roadway	Single vehicle crash	Property damage only (none injured)	Clear	4134751	2016	2016-01-09
200	Quincy	I-93 Segment 5 (ahead of Exit 7 diverge)	8:36 AM	Peak	Wet	Daylight	Rear-end	Non-fatal injury	Rain	3475968	2013	2013-06-11
201	Quincy	I-93 Segment 5 (ahead of Exit 7 diverge)	3:20 PM	Peak	Dry	Daylight	Sideswipe, same direction	Property damage only (none injured)	Clear	3384447	2012	2012-09-20
202	Quincy	I-93 Segment 5 (ahead of Exit 7 diverge)	5:33 PM	Peak	Dry	Daylight	Sideswipe, same direction	Property damage only (none injured)	Clear	3162992	2012	2012-07-08
203	Quincy	Exit 7 diverge	12:25 AM	Off-peak	Dry	Dark - lighted roadway	Sideswipe, same direction	Property damage only (none injured)	Clear	4155214	2016	2016-02-23
204	Quincy	Exit 7 diverge	7:19 PM	Off-peak	Dry	Daylight	Rear-end	Property damage only (none injured)	Clear	3863449	2014	2014-05-13
205	Quincy	Exit 7 diverge	4:17 PM	Peak	Dry	Daylight	Rear-end	Property damage only (none injured)	Clear	4062538	2015	2015-05-27
206	Quincy	Exit 7 diverge	4:10 PM	Peak	Dry	Daylight	Single vehicle crash	Not Reported	Clear	4048083	2015	2015-05-29
207	Quincy	Exit 7 diverge	3:00 AM	Off-peak	Dry	Dark - lighted roadway	Single vehicle crash	Non-fatal injury	Clear	4108224	2015	2015-10-18
208	Quincy	Exit 7 diverge	3:30 PM	Peak	Dry	Daylight	Angle	Property damage only (none injured)	Clear	4250337	2016	2016-08-31
209	Quincy	Exit 7 diverge	2:40 AM	Off-peak	Dry	Dark - lighted roadway	Single vehicle crash	Non-fatal injury	Clear	3381453	2012	2012-02-01
210	Quincy	Exit 7 diverge	8:17 AM	Peak	Dry	Daylight	Rear-end	Property damage only (none injured)	Clear	3381575	2012	2012-04-11
211	Quincy	Exit 7 diverge	7:21 PM	Off-peak	Dry	Dark - lighted roadway	Rear-end	Property damage only (none injured)	Unknown	3647651	2013	2013-10-19
212	Quincy	Exit 7 diverge	8:38 AM	Peak	Dry	Daylight	Rear-end	Non-fatal injury	Clear	3208033	2012	2012-05-15
213	Quincy	Exit 7 diverge	7:50 AM	Peak	Dry	Daylight	Sideswipe, same direction	Property damage only (none injured)	Clear	3421265	2013	2013-04-26
214	Quincy	Exit 7 diverge	7:10 PM	Off-peak	Dry	Dark - lighted roadway	Angle	Non-fatal injury	Clear	3963794	2014	2014-09-26
215	Quincy	Exit 7 diverge	4:00 PM	Peak	Dry	Dark - lighted roadway	Rear-end	Property damage only (none injured)	Clear	3985720	2014	2014-12-02
216	Quincy	Exit 7 diverge	3:25 AM	Off-peak	Dry	Dark - lighted roadway	Rear-end	Non-fatal injury	Cloudy	3541450	2013	2013-07-27
217	Quincy	Exit 7 diverge	1:50 AM	Off-peak	Snow/Ice	Dark - lighted roadway	Single vehicle crash	Property damage only (none injured)	Snow	3384348	2012	2012-03-03
218	Quincy	Exit 7 diverge	1:44 PM	Off-peak	Dry	Daylight	Rear-end	Non-fatal injury	Clear	2854032	2012	2012-01-02
219	Quincy	Exit 7 diverge	11:44 AM	Off-peak	Dry	Daylight	Angle	Property damage only (none injured)	Clear	2900658	2012	2012-01-08

	A	B	G	H	J	K	M	N	O	Q	T	U
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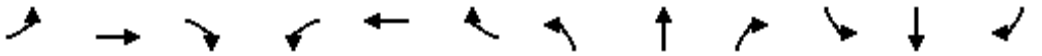
220	Quincy	Exit 7 diverge	12:51 PM	Off-peak	Dry	Daylight	Rear-end	Non-fatal injury	Clear	2890194	2012	2012-01-25
221	Quincy	Exit 7 diverge	11:00 PM	Off-peak	Dry	Dark - lighted roadway	Sideswipe, same direction	Property damage only (none injured)	Clear	3061894	2012	2012-03-16
222	Quincy	Exit 7 diverge	6:39 AM	Peak	Dry	Daylight	Single vehicle crash	Property damage only (none injured)	Clear	3389298	2012	2012-07-15
223	Quincy	Exit 7 diverge	1:40 PM	Off-peak	Dry	Daylight	Rear-end	Property damage only (none injured)	Clear	2939680	2012	2012-02-20
224	Quincy	Exit 7 diverge	12:00 AM	Off-peak	Dry	Dark - lighted roadway	Single vehicle crash	Not Reported	Cloudy	3000832	2012	2012-02-25
225	Quincy	Exit 7 diverge	5:10 PM	Peak	Dry	Daylight	Rear-end	Not Reported	Cloudy	3102080	2012	2012-05-05
226	Quincy	Exit 7 diverge	9:19 AM	Peak	Wet	Daylight	Single vehicle crash	Not Reported	Rain	3113847	2012	2012-05-16
227	Quincy	Exit 7 diverge	5:05 PM	Peak	Dry	Daylight	Sideswipe, same direction	Property damage only (none injured)	Cloudy	3154606	2012	2012-06-23
228	Quincy	Exit 7 diverge	9:40 PM	Off-peak	Dry	Dark - lighted roadway	Angle	Property damage only (none injured)	Unknown	3207191	2012	2012-07-20
229	Quincy	Exit 7 diverge	2:07 PM	Off-peak	Dry	Daylight	Sideswipe, same direction	Property damage only (none injured)	Clear	3289050	2012	2012-10-26
230	Quincy	Exit 7 diverge	12:00 AM	Off-peak	Dry	Dark - lighted roadway	Single vehicle crash	Property damage only (none injured)	Clear	3289110	2012	2012-11-12
231	Quincy	Exit 7 diverge	11:50 PM	Off-peak	Dry	Dark - roadway not lighted	Angle	Property damage only (none injured)	Clear	3292059	2012	2012-11-14
232	Quincy	Exit 7 diverge	3:30 PM	Peak	Dry	Daylight	Single vehicle crash	Non-fatal injury	Clear	3330247	2012	2012-12-31
233	Quincy	Exit 7 diverge	3:30 PM	Peak	Dry	Daylight	Rear-end	Property damage only (none injured)	Clear	3607513	2013	2013-09-27
234	Quincy	Exit 7 diverge	10:30 AM	Off-peak	Dry	Daylight	Sideswipe, same direction	Not Reported	Clear	3655412	2013	2013-10-03
235	Quincy	Exit 7 diverge	8:50 AM	Peak	Dry	Daylight	Angle	Property damage only (none injured)	Clear	3362870	2013	2013-02-22
236	Quincy	Exit 7 diverge	11:30 PM	Off-peak	Snow/Ice	Dark - lighted roadway	Single vehicle crash	Property damage only (none injured)	Snow	3390860	2013	2013-03-27
237	Quincy	Exit 7 diverge	9:52 AM	Peak	Dry	Daylight	Sideswipe, same direction	Property damage only (none injured)	Clear	3359757	2013	2013-02-07
238	Quincy	Exit 7 diverge	4:30 PM	Peak	Dry	Daylight	Rear-end	Non-fatal injury	Clear	3376175	2013	2013-03-10
239	Quincy	Exit 7 diverge	1:41 PM	Off-peak	Dry	Daylight	Rear-end	Property damage only (none injured)	Clear	3391936	2013	2013-03-21
240	Quincy	Exit 7 diverge	2:16 PM	Off-peak	Dry	Daylight	Rear-end	Non-fatal injury	Clear	3377191	2013	2013-03-24
241	Quincy	Exit 7 diverge	12:00 AM	Off-peak	Dry	Dark - lighted roadway	Single vehicle crash	Non-fatal injury	Clear	3381638	2013	2013-04-05
242	Quincy	Exit 7 diverge	8:45 AM	Peak	Dry	Daylight	Rear-end	Non-fatal injury	Clear	3430374	2013	2013-05-03
243	Quincy	Exit 7 diverge	9:00 PM	Off-peak	Dry	Dark - lighted roadway	Sideswipe, same direction	Property damage only (none injured)	Clear	3430681	2013	2013-05-04
244	Quincy	Exit 7 diverge	3:28 PM	Peak	Dry	Daylight	Rear-end	Property damage only (none injured)	Clear	3453240	2013	2013-05-30
245	Quincy	Exit 7 diverge	4:39 PM	Peak	Dry	Daylight	Rear-end	Non-fatal injury	Unknown	3510837	2013	2013-07-03
246	Quincy	Exit 7 diverge	6:25 PM	Peak	Dry	Daylight	Rear-end	Property damage only (none injured)	Clear	3556656	2013	2013-08-05
247	Quincy	Exit 7 diverge	3:20 PM	Peak	Dry	Daylight	Rear-end	Property damage only (none injured)	Unknown	3580257	2013	2013-08-20
248	Quincy	Exit 7 diverge	11:30 AM	Off-peak	Dry	Daylight	Rear-end	Non-fatal injury	Clear	3611135	2013	2013-09-22
249	Quincy	Exit 7 diverge	11:15 AM	Off-peak	Dry	Daylight	Angle	Property damage only (none injured)	Clear	3611145	2013	2013-10-03
250	Quincy	Exit 7 diverge	4:42 AM	Off-peak	Dry	Dark - lighted roadway	Single vehicle crash	Property damage only (none injured)	Clear	3623834	2013	2013-10-26
251	Quincy	Exit 7 diverge	11:20 AM	Off-peak	Wet	Daylight	Not reported	Property damage only (none injured)	Clear	3710829	2013	2013-12-19
252	Quincy	Exit 7 diverge	11:32 PM	Off-peak	Wet	Dark - lighted roadway	Angle	Property damage only (none injured)	Rain	3726184	2014	2014-01-10
253	Quincy	Exit 7 diverge	10:50 PM	Off-peak	Dry	Dark - lighted roadway	Single vehicle crash	Property damage only (none injured)	Clear	3772811	2014	2014-03-07
254	Quincy	Exit 7 diverge	8:34 AM	Peak	Dry	Daylight	Rear-end	Non-fatal injury	Clear	3772813	2014	2014-03-08
255	Quincy	Exit 7 diverge	4:05 PM	Peak	Dry	Daylight	Rear-end	Property damage only (none injured)	Clear	3974039	2014	2014-11-14

	A	B	G	H	J	K	M	N	O	Q	T	U
1	Study Location	Area of Crash	Crash Time	Is Peak?	Road Surface Conditions	Ambient Light Conditions	Manner of Collision	Crash Severity	Weather Conditions	Crash Number	Crash Year	Crash Date
256	Quincy	Exit 7 diverge	2:10 AM	Off-peak	Dry	Dark - lighted roadway	Single vehicle crash	Property damage only (none injured)	Clear	3792026	2014	2014-04-21
257	Quincy	Exit 7 diverge	6:40 PM	Peak	Wet	Daylight	Single vehicle crash	Non-fatal injury	Rain	3902045	2014	2014-07-14
258	Quincy	Exit 7 diverge	10:58 AM	Off-peak	Dry	Daylight	Sideswipe, same direction	Property damage only (none injured)	Clear	3908557	2014	2014-08-04
259	Quincy	Exit 7 diverge	5:12 PM	Peak	Dry	Daylight	Rear-end	Property damage only (none injured)	Clear	3909153	2014	2014-08-07
260	Quincy	Exit 7 diverge	6:45 AM	Peak	Dry	Daylight	Single vehicle crash	Property damage only (none injured)	Clear	3909154	2014	2014-08-08
261	Quincy	Exit 7 diverge	11:37 PM	Off-peak	Dry	Dark - lighted roadway	Rear-end	Non-fatal injury	Unknown	3935855	2014	2014-08-17
262	Quincy	Exit 7 diverge	2:08 PM	Off-peak	Dry	Daylight	Rear-end	Property damage only (none injured)	Clear	3922844	2014	2014-08-21
263	Quincy	Exit 7 diverge	6:20 PM	Peak	Dry	Daylight	Rear-end	Property damage only (none injured)	Clear	3928331	2014	2014-09-05
264	Quincy	Exit 7 diverge	10:48 PM	Off-peak	Dry	Dark - lighted roadway	Rear-end	Property damage only (none injured)	Clear	3962816	2014	2014-10-09
265	Quincy	Exit 7 diverge	12:24 PM	Off-peak	Dry	Daylight	Rear-end	Property damage only (none injured)	Clear	3977440	2014	2014-11-22
266	Quincy	Exit 7 diverge	12:00 AM	Off-peak	Wet	Dark - lighted roadway	Rear-end	Property damage only (none injured)	Rain	3987225	2014	2014-12-07
267	Quincy	Exit 7 diverge	9:45 PM	Off-peak	Dry	Dark - lighted roadway	Rear-end	Property damage only (none injured)	Clear	4011973	2014	2014-12-14
268	Quincy	Exit 7 diverge	10:35 AM	Off-peak	Dry	Daylight	Sideswipe, same direction	Non-fatal injury	Cloudy	4024370	2015	2015-03-20
269	Quincy	Exit 7 diverge	9:05 PM	Off-peak	Snow/Ice	Dark - lighted roadway	Rear-end	Non-fatal injury	Snow	4012964	2015	2015-02-08
270	Quincy	Exit 7 diverge	4:50 PM	Peak	Dry	Daylight	Rear-end	Property damage only (none injured)	Clear	4037235	2015	2015-04-06
271	Quincy	Exit 7 diverge	1:35 AM	Off-peak	Dry	Dark - lighted roadway	Sideswipe, same direction	Property damage only (none injured)	Clear	4031392	2015	2015-04-11
272	Quincy	Exit 7 diverge	4:35 PM	Peak	Dry	Daylight	Rear-end	Property damage only (none injured)	Clear	4037452	2015	2015-04-13
273	Quincy	Exit 7 diverge	11:50 AM	Off-peak	Dry	Daylight	Rear-end	Property damage only (none injured)	Clear	4046705	2015	2015-05-23
274	Quincy	Exit 7 diverge	12:50 AM	Off-peak	Dry	Dark - lighted roadway	Angle	Non-fatal injury	Clear	4085525	2015	2015-08-26
275	Quincy	Exit 7 diverge	1:35 PM	Off-peak	Dry	Daylight	Rear-end	Property damage only (none injured)	Clear	4099952	2015	2015-10-12
276	Quincy	Exit 7 diverge	6:20 PM	Peak	Dry	Daylight	Rear-end	Property damage only (none injured)	Clear	4065328	2015	2015-07-07
277	Quincy	Exit 7 diverge	3:06 PM	Peak	Dry	Daylight	Rear-end	Non-fatal injury	Clear	4065876	2015	2015-07-16
278	Quincy	Exit 7 diverge	5:45 PM	Peak	Wet	Daylight	Rear-end	Property damage only (none injured)	Clear	4084975	2015	2015-08-29
279	Quincy	Exit 7 diverge	11:29 PM	Off-peak	Dry	Dark - lighted roadway	Rear-end	Property damage only (none injured)	Cloudy	4099176	2015	2015-09-21
280	Quincy	Exit 7 diverge	3:10 AM	Off-peak	Dry	Dark - lighted roadway	Rear-end	Non-fatal injury	Clear	4089288	2015	2015-09-25
281	Quincy	Exit 7 diverge	1:32 AM	Off-peak	Dry	Dark - lighted roadway	Rear-end	Property damage only (none injured)	Clear	4104890	2015	2015-10-09
282	Quincy	Exit 7 diverge	7:15 PM	Off-peak	Wet	Dark - lighted roadway	Sideswipe, same direction	Property damage only (none injured)	Clear	4121124	2015	2015-11-28
283	Quincy	Exit 7 diverge	5:20 PM	Peak	Dry	Dark - lighted roadway	Rear-end	Property damage only (none injured)	Clear	4135117	2015	2015-12-28
284	Quincy	Exit 7 diverge	6:43 PM	Peak	Dry	Dark - lighted roadway	Rear-end	Property damage only (none injured)	Clear	4134715	2015	2015-12-30
285	Quincy	Exit 7 diverge	1:55 PM	Off-peak	Dry	Daylight	Rear-end	Property damage only (none injured)	Cloudy	4141149	2016	2016-01-16
286	Quincy	Exit 7 diverge	4:11 PM	Peak	Dry	Daylight	Rear-end	Property damage only (none injured)	Cloudy	4143218	2016	2016-01-02
287	Quincy	Exit 7 diverge	2:15 PM	Off-peak	Wet	Daylight	Rear-end	Property damage only (none injured)	Snow	4152580	2016	2016-02-08
288	Quincy	Exit 7 diverge	6:47 AM	Peak	Dry	Daylight	Sideswipe, same direction	Property damage only (none injured)	Clear	4164398	2016	2016-03-12
289	Quincy	Exit 7 diverge	11:50 AM	Off-peak	Wet	Daylight	Rear-end	Property damage only (none injured)	Cloudy	4169147	2016	2016-03-15
290	Quincy	Exit 7 diverge	7:30 PM	Off-peak	Dry	Dark - lighted roadway	Rear-end	Non-fatal injury	Cloudy	4175021	2016	2016-04-11
291	Quincy	Exit 7 diverge	7:38 PM	Off-peak	Wet	Dark - lighted roadway	Sideswipe, same direction	Non-fatal injury	Rain	4186159	2016	2016-04-12

	A	B	G	H	J	K	M	N	O	Q	T	U
1	Study Location	Area of Crash	Crash Time	Is Peak?	Road Surface Conditions	Ambient Light Conditions	Manner of Collision	Crash Severity	Weather Conditions	Crash Number	Crash Year	Crash Date
292	Quincy	Exit 7 diverge	4:00 PM	Peak	Dry	Daylight	Rear-end	Property damage only (none injured)	Clear	4177270	2016	2016-04-14
293	Quincy	Exit 7 diverge	8:20 AM	Peak	Dry	Daylight	Rear-end	Non-fatal injury	Clear	4220955	2016	2016-06-08
294	Quincy	Exit 7 diverge	1:18 PM	Off-peak	Dry	Daylight	Rear-end	Property damage only (none injured)	Clear	4220974	2016	2016-06-19
295	Quincy	Exit 7 diverge	6:19 PM	Peak	Dry	Daylight	Sideswipe, same direction	Property damage only (none injured)	Clear	4226497	2016	2016-07-06
296	Quincy	Exit 7 diverge	8:02 PM	Off-peak	Dry	Daylight	Sideswipe, same direction	Property damage only (none injured)	Clear	4224577	2016	2016-07-07
297	Quincy	Exit 7 diverge	11:15 PM	Off-peak	Dry	Dark - lighted roadway	Sideswipe, same direction	Property damage only (none injured)	Unknown	4246657	2016	2016-08-30
298	Quincy	Exit 7 diverge	12:00 PM	Off-peak	Dry	Daylight	Rear-end	Property damage only (none injured)	Cloudy	4245884	2016	2016-09-04
299	Quincy	Exit 7 diverge	5:39 PM	Peak	Dry	Daylight	Sideswipe, same direction	Property damage only (none injured)	Cloudy	4245601	2016	2016-09-06
300	Quincy	Exit 7 diverge	5:05 PM	Peak	Dry	Daylight	Rear-end	Property damage only (none injured)	Clear	4250342	2016	2016-09-08
301	Quincy	Exit 7 diverge	10:45 AM	Off-peak	Dry	Daylight	Rear-end	Property damage only (none injured)	Clear	4276584	2016	2016-11-01
302	Quincy	Exit 7 diverge	12:58 PM	Off-peak	Dry	Daylight	Rear-end	Non-fatal injury	Cloudy	4277246	2016	2016-11-03
303	Quincy	Exit 7 diverge	2:10 PM	Off-peak	Dry	Daylight	Rear-end	Property damage only (none injured)	Cloudy	4291883	2016	2016-11-19
304	Quincy	Exit 7 diverge	1:45 PM	Off-peak	Dry	Daylight	Rear-end	Property damage only (none injured)	Clear	4313065	2016	2016-12-03
305	Quincy	Exit 7 diverge	11:56 AM	Off-peak	Dry	Daylight	Rear-end	Property damage only (none injured)	Clear	4313019	2016	2016-12-14
306	Quincy	Exit 7 diverge	10:47 PM	Off-peak	Dry	Dark - lighted roadway	Single vehicle crash	Property damage only (none injured)	Unknown	4313119	2016	2016-12-24
307	Quincy	Exit 7 diverge	9:00 PM	Off-peak	Wet	Dark - lighted roadway	Single vehicle crash	Non-fatal injury	Unknown	3984905	2014	2014-12-10
308	Quincy	Exit 7 diverge	9:56 PM	Off-peak	Wet	Dark - lighted roadway	Rear-end	Non-fatal injury	Rain	4062116	2015	2015-06-27
309	Quincy	Exit 7 diverge	1:40 PM	Off-peak	Dry	Daylight	Rear-end	Non-fatal injury	Clear	3545935	2013	2013-07-17
310	Quincy	Exit 7 diverge	4:54 AM	Off-peak	Wet	Dark - lighted roadway	Single vehicle crash	Non-fatal injury	Rain	4262971	2016	2016-10-01
311	Quincy	I-93 Segment 6 (shortly after Exit 7 split)	3:33 PM	Peak	Unknown	Not reported	Not reported	Property damage only (none injured)	Unknown	3826940	2014	2014-05-27
312	Quincy	I-93 Segment 6 (shortly after Exit 7 split)	8:00 AM	Peak	Dry	Daylight	Rear-end	Non-fatal injury	Clear	4160026	2016	2016-02-17
313	Quincy	I-93 Segment 6 (shortly after Exit 7 split)	5:15 PM	Peak	Dry	Daylight	Sideswipe, same direction	Property damage only (none injured)	Unknown	3376197	2013	2013-03-25
314	Quincy	I-93 Segment 6 (shortly after Exit 7 split)	7:00 PM	Peak	Dry	Dark - lighted roadway	Rear-end	Non-fatal injury	Clear	3354879	2013	2013-02-14
315	Quincy	I-93 Segment 6 (shortly after Exit 7 split)	4:45 PM	Peak	Dry	Daylight	Rear-end	Property damage only (none injured)	Clear	3391082	2013	2013-02-06

APPENDIX D

1. HCS printouts



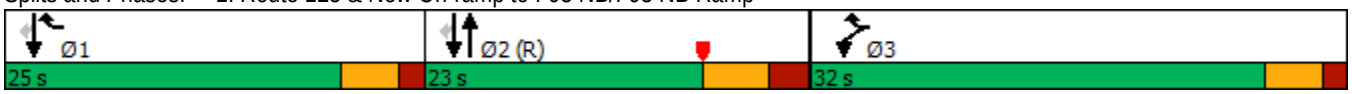
Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	0	0	0	184	0	893	0	276	41	0	1373	639
Future Volume (vph)	0	0	0	184	0	893	0	276	41	0	1373	639
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Storage Length (ft)	0		0	0		150	0		0	0		400
Storage Lanes	0		0	1		1	0		0	0		1
Taper Length (ft)	25			25			25			25		
Right Turn on Red			Yes			Yes			Yes			Yes
Link Speed (mph)		30			30			30			30	
Link Distance (ft)		405			717			1086			800	
Travel Time (s)		9.2			16.3			24.7			18.2	
Peak Hour Factor	0.92	0.92	0.92	0.82	0.92	0.93	0.92	0.78	0.85	0.92	0.84	0.76
Heavy Vehicles (%)	2%	2%	2%	0%	2%	4%	2%	4%	2%	2%	1%	2%
Shared Lane Traffic (%)												
Lane Group Flow (vph)	0	0	0	224	0	960	0	402	0	0	1635	841
Turn Type				Prot		custom		NA			NA	Perm
Protected Phases				3		1 3		2			1 2	
Permitted Phases												1 2
Detector Phase				3		1		2			2	
Switch Phase												
Minimum Initial (s)				6.0				8.0				
Minimum Split (s)				12.0				14.5				
Total Split (s)				32.0				23.0				
Total Split (%)				40.0%				28.8%				
Yellow Time (s)				3.5				4.0				
All-Red Time (s)				1.5				2.5				
Lost Time Adjust (s)				-1.0				-2.5				
Total Lost Time (s)				4.0				4.0				
Lead/Lag								Lag				
Lead-Lag Optimize?								Yes				
Recall Mode				Min				C-Min				
Act Effct Green (s)				15.4		34.5		37.5			56.6	56.6
Actuated g/C Ratio				0.19		0.43		0.47			0.71	0.71
v/c Ratio				0.65		0.72		0.25			0.65	0.62
Control Delay				37.9		16.1		12.1			6.1	1.1
Queue Delay				0.0		0.0		0.0			0.0	0.0
Total Delay				37.9		16.1		12.1			6.1	1.1
LOS				D		B		B			A	A
Approach Delay					20.2			12.1			4.4	
Approach LOS					C			B			A	
Queue Length 50th (ft)				104		156		67			104	0
Queue Length 95th (ft)				142		197		93			m240	m2
Internal Link Dist (ft)		325			637			1006			720	
Turn Bay Length (ft)						150						400
Base Capacity (vph)				631		1513		1612			2528	1365
Starvation Cap Reductn				0		0		0			0	0
Spillback Cap Reductn				0		2		36			0	0
Storage Cap Reductn				0		0		0			0	0
Reduced v/c Ratio				0.35		0.64		0.26			0.65	0.62

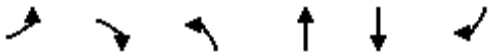
Lane Group	Ø1
Lane Configurations	
Traffic Volume (vph)	
Future Volume (vph)	
Ideal Flow (vphpl)	
Storage Length (ft)	
Storage Lanes	
Taper Length (ft)	
Right Turn on Red	
Link Speed (mph)	
Link Distance (ft)	
Travel Time (s)	
Peak Hour Factor	
Heavy Vehicles (%)	
Shared Lane Traffic (%)	
Lane Group Flow (vph)	
Turn Type	
Protected Phases	1
Permitted Phases	
Detector Phase	
Switch Phase	
Minimum Initial (s)	14.0
Minimum Split (s)	20.0
Total Split (s)	25.0
Total Split (%)	31%
Yellow Time (s)	3.5
All-Red Time (s)	1.5
Lost Time Adjust (s)	
Total Lost Time (s)	
Lead/Lag	Lead
Lead-Lag Optimize?	Yes
Recall Mode	None
Act Effct Green (s)	
Actuated g/C Ratio	
v/c Ratio	
Control Delay	
Queue Delay	
Total Delay	
LOS	
Approach Delay	
Approach LOS	
Queue Length 50th (ft)	
Queue Length 95th (ft)	
Internal Link Dist (ft)	
Turn Bay Length (ft)	
Base Capacity (vph)	
Starvation Cap Reductn	
Spillback Cap Reductn	
Storage Cap Reductn	
Reduced v/c Ratio	

Intersection Summary		
Area Type:	Other	
Cycle Length: 80		
Actuated Cycle Length: 80		
Offset: 0 (0%), Referenced to phase 2:NBSB, Start of Yellow		
Natural Cycle: 60		
Control Type: Actuated-Coordinated		
Maximum v/c Ratio: 0.72		
Intersection Signal Delay: 9.8		Intersection LOS: A
Intersection Capacity Utilization 54.8%		ICU Level of Service A
Analysis Period (min) 15		

m Volume for 95th percentile queue is metered by upstream signal.

Splits and Phases: 1: Route 125 & New On-ramp to I-93 NB/I-93 NB Ramp



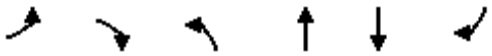


Lane Group	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Traffic Volume (vph)	121	104	22	188	541	1001
Future Volume (vph)	121	104	22	188	541	1001
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Storage Length (ft)	0	200	0			0
Storage Lanes	2	1	1			1
Taper Length (ft)	25		25			
Right Turn on Red		Yes				Yes
Link Speed (mph)	30			30	30	
Link Distance (ft)	707			588	1086	
Travel Time (s)	16.1			13.4	24.7	
Peak Hour Factor	0.66	0.90	0.79	0.81	0.79	0.77
Heavy Vehicles (%)	10%	0%	0%	1%	1%	1%
Shared Lane Traffic (%)						
Lane Group Flow (vph)	183	116	28	232	685	1300
Turn Type	Prot	custom	D.P+P	NA	NA	custom
Protected Phases	3	1 2 3!	1!	1 2	2!	1 2 3!
Permitted Phases			2			
Detector Phase	3		1	2	2	
Switch Phase						
Minimum Initial (s)	9.0		7.0		10.0	
Minimum Split (s)	14.5		12.0		15.0	
Total Split (s)	25.0		15.0		40.0	
Total Split (%)	31.3%		18.8%		50.0%	
Yellow Time (s)	2.0		3.5		4.0	
All-Red Time (s)	3.5		1.5		1.0	
Lost Time Adjust (s)	-1.5		-1.0		-1.0	
Total Lost Time (s)	4.0		4.0		4.0	
Lead/Lag			Lead		Lag	
Lead-Lag Optimize?			Yes		Yes	
Recall Mode	None		None		C-Min	
Act Effct Green (s)	11.3	80.0	59.1	60.7	55.9	80.0
Actuated g/C Ratio	0.14	1.00	0.74	0.76	0.70	1.00
v/c Ratio	0.41	0.07	0.05	0.16	0.52	0.81
Control Delay	34.0	0.1	2.9	3.1	5.8	9.4
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	34.0	0.1	2.9	3.1	5.8	9.4
LOS	C	A	A	A	A	A
Approach Delay	20.8			3.1	8.1	
Approach LOS	C			A	A	
Queue Length 50th (ft)	44	0	3	23	75	231
Queue Length 95th (ft)	51	0	8	42	115	209
Internal Link Dist (ft)	627			508	1006	
Turn Bay Length (ft)		200				
Base Capacity (vph)	835	1615	608	1426	1314	1599
Starvation Cap Reductn	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0
Reduced v/c Ratio	0.22	0.07	0.05	0.16	0.52	0.81

Intersection Summary		
Area Type:	Other	
Cycle Length: 80		
Actuated Cycle Length: 80		
Offset: 14 (18%), Referenced to phase 2:NBSB, Start of Yellow		
Natural Cycle: 65		
Control Type: Actuated-Coordinated		
Maximum v/c Ratio: 0.81		
Intersection Signal Delay: 9.1	Intersection LOS: A	
Intersection Capacity Utilization 74.5%	ICU Level of Service D	
Analysis Period (min) 15		

! Phase conflict between lane groups.

Splits and Phases: 2: Route 125 & I-93 SB Ramp



Lane Group	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Traffic Volume (vph)	338	1255	214	938	779	61
Future Volume (vph)	338	1255	214	938	779	61
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Storage Length (ft)	0	200	250			0
Storage Lanes	1	1	1			0
Taper Length (ft)	25		25			
Right Turn on Red		Yes				Yes
Link Speed (mph)	30			30	30	
Link Distance (ft)	690			800	604	
Travel Time (s)	15.7			18.2	13.7	
Peak Hour Factor	0.72	0.77	0.91	0.92	0.88	0.73
Heavy Vehicles (%)	1%	1%	15%	2%	2%	5%
Shared Lane Traffic (%)						
Lane Group Flow (vph)	469	1630	235	1020	969	0
Turn Type	Prot	pt+ov	custom	NA	NA	
Protected Phases	3	1 3	1	1 2	2	
Permitted Phases			1			
Detector Phase	3	1	1	2	2	
Switch Phase						
Minimum Initial (s)	4.0		8.0		10.0	
Minimum Split (s)	10.5		15.0		20.0	
Total Split (s)	22.0		24.0		34.0	
Total Split (%)	27.5%		30.0%		42.5%	
Yellow Time (s)	3.5		3.5		4.0	
All-Red Time (s)	3.0		3.5		1.5	
Lost Time Adjust (s)	-2.5		-3.0		-1.5	
Total Lost Time (s)	4.0		4.0		4.0	
Lead/Lag			Lead		Lag	
Lead-Lag Optimize?						
Recall Mode	None		None		C-Min	
Act Effct Green (s)	18.7	42.7	20.0	53.3	29.3	
Actuated g/C Ratio	0.23	0.53	0.25	0.67	0.37	
v/c Ratio	1.12	1.06	0.31	0.82	0.75	
Control Delay	113.6	60.4	21.4	12.9	26.2	
Queue Delay	0.0	0.0	0.0	0.0	0.0	
Total Delay	113.6	60.4	21.4	12.9	26.2	
LOS	F	E	C	B	C	
Approach Delay	72.3			14.5	26.2	
Approach LOS	E			B	C	
Queue Length 50th (ft)	~283	~513	32	350	212	
Queue Length 95th (ft)	#326	#494	60	482	274	
Internal Link Dist (ft)	610			720	524	
Turn Bay Length (ft)		200	250			
Base Capacity (vph)	418	1540	761	1257	1315	
Starvation Cap Reductn	0	0	0	0	0	
Spillback Cap Reductn	0	0	0	0	0	
Storage Cap Reductn	0	0	0	0	0	
Reduced v/c Ratio	1.12	1.06	0.31	0.81	0.74	

Intersection Summary		
Area Type:	Other	
Cycle Length: 80		
Actuated Cycle Length: 80		
Offset: 0 (0%), Referenced to phase 2:NBSB, Start of Yellow		
Natural Cycle: 80		
Control Type: Actuated-Coordinated		
Maximum v/c Ratio: 1.12		
Intersection Signal Delay: 45.2		Intersection LOS: D
Intersection Capacity Utilization 74.8%		ICU Level of Service D
Analysis Period (min) 15		

~ Volume exceeds capacity, queue is theoretically infinite.
Queue shown is maximum after two cycles.

95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

Splits and Phases: 3: Route 125 & Ballardvale Street

Location 1 - I-93 Northbound between Exit 40 (Route 2) and Exit 41 (Route 125)
Freeway Merge, Diverge, and Weave Analyses

HCS7 Freeway Merge Report

Project Information			
Analyst	Ben Erban	Date	4/25/2019
Agency	CTPS	Analysis Year	2019
Jurisdiction	MassDOT District 4	Time Period Analyzed	AM Peak Hour 7:00-8:00
Project Description	Wilmington - Exit 40 On-Ramp from Route 62 - Low Cost Freeway Bottlenecks	Unit	United States Customary

Geometric Data		
	Freeway	Ramp
Number of Lanes (N), ln	4	1
Free-Flow Speed (FFS), mi/h	75.4	30.0
Segment Length (L) / Acceleration Length (LA),ft	1200	300
Terrain Type	Level	Level
Percent Grade, %	-	-
Segment Type / Ramp Side	Freeway	Right

Adjustment Factors		
Driver Population	Mostly Familiar	Mostly Familiar
Weather Type	Non-Severe Weather	Non-Severe Weather
Incident Type	No Incident	-
Final Speed Adjustment Factor (SAF)	0.975	0.975
Final Capacity Adjustment Factor (CAF)	0.968	0.968
Demand Adjustment Factor (DAF)	1.000	1.000

Demand and Capacity		
Demand Volume (Vi)	4950	450
Peak Hour Factor (PHF)	0.95	0.95
Total Trucks, %	5.00	5.00
Single-Unit Trucks (SUT), %	-	-
Tractor-Trailers (TT), %	-	-
Heavy Vehicle Adjustment Factor (fHV)	0.952	0.952
Flow Rate (vi),pc/h	5473	498
Capacity (c), pc/h	9293	1839
Volume-to-Capacity Ratio (v/c)	0.64	0.27

Speed and Density			
Upstream Equilibrium Distance (LEQ), ft	-	Number of Outer Lanes on Freeway (NO)	2
Distance to Upstream Ramp (LUP), ft	-	Speed Index (MS)	0.361
Downstream Equilibrium Distance (LEQ), ft	-	Flow Outer Lanes (vOA), pc/h/ln	1642
Distance to Downstream Ramp (LDOWN), ft	-	On-Ramp Influence Area Speed (SR), mi/h	62.1
Prop. Freeway Vehicles in Lane 1 and 2 (PFM)	0.156	Outer Lanes Freeway Speed (SO), mi/h	69.4
Flow in Lanes 1 and 2 (v12), pc/h	2189	Ramp Junction Speed (S), mi/h	65.9
Flow Entering Ramp-Infl. Area (vR12), pc/h	2687	Average Density (D), pc/mi/ln	22.7
Level of Service (LOS)	C	Density in Ramp Influence Area (DR), pc/mi/ln	24.4

Service Volume Table

Target LOS	A	B	C	D	E
Freeway					
Max Service Flow Rate (MSF), pc/h/ln	410	1077	1603	2067	2130
Service Flow Rate (SF), veh/h	1560	4100	6104	7870	8110
Service Volume, veh/h	1482	3895	5799	7477	7704
One Direction DSV, 1000 veh/day	15	39	58	75	77
Bi-Directional DSV, 1000 veh/day	27	71	105	136	140
Ramp					
Max Service Flow Rate (MSF), pc/h/ln	149	392	583	752	774
Service Flow Rate (SF), veh/h	142	373	555	715	737
Service Volume, veh/h	135	354	527	680	700
One Direction DSV, 1000 veh/day	1	4	5	7	7

Design Analysis Table

Freeway Lanes, ln	2	2	3	3	4	4	5	5
Ramp Lanes, ln	1	2	1	2	1	2	1	2
Density, pc/mi/ln	-	-	32.2	31.9	22.7	22.5	17.9	17.8
LOS	F	F	D	D	C	C	C	B

HCS7 Freeway Merge Report

Project Information			
Analyst	Ben Erban	Date	4/25/2019
Agency	CTPS	Analysis Year	2019
Jurisdiction	MassDOT District 4	Time Period Analyzed	PM Peak Hour 5:00-6:00
Project Description	Wilmington - Exit 40 On-Ramp from Route 62 - Low Cost Freeway Bottlenecks	Unit	United States Customary

Geometric Data		
	Freeway	Ramp
Number of Lanes (N), ln	4	1
Free-Flow Speed (FFS), mi/h	75.4	30.0
Segment Length (L) / Acceleration Length (LA),ft	1200	300
Terrain Type	Level	Level
Percent Grade, %	-	-
Segment Type / Ramp Side	Freeway	Right

Adjustment Factors		
Driver Population	Mostly Familiar	Mostly Familiar
Weather Type	Non-Severe Weather	Non-Severe Weather
Incident Type	No Incident	-
Final Speed Adjustment Factor (SAF)	0.975	0.975
Final Capacity Adjustment Factor (CAF)	0.968	0.968
Demand Adjustment Factor (DAF)	1.000	1.000

Demand and Capacity		
Demand Volume (Vi)	7200	350
Peak Hour Factor (PHF)	0.95	0.95
Total Trucks, %	3.00	3.00
Single-Unit Trucks (SUT), %	-	-
Tractor-Trailers (TT), %	-	-
Heavy Vehicle Adjustment Factor (fHV)	0.971	0.971
Flow Rate (vi),pc/h	7805	379
Capacity (c), pc/h	9293	1839
Volume-to-Capacity Ratio (v/c)	0.88	0.21

Speed and Density			
Upstream Equilibrium Distance (LEQ), ft	-	Number of Outer Lanes on Freeway (NO)	2
Distance to Upstream Ramp (LUP), ft	-	Speed Index (MS)	0.433
Downstream Equilibrium Distance (LEQ), ft	-	Flow Outer Lanes (vOA), pc/h/ln	2342
Distance to Downstream Ramp (LDOWN), ft	-	On-Ramp Influence Area Speed (SR), mi/h	59.9
Prop. Freeway Vehicles in Lane 1 and 2 (PFM)	0.170	Outer Lanes Freeway Speed (SO), mi/h	66.7
Flow in Lanes 1 and 2 (v12), pc/h	3122	Ramp Junction Speed (S), mi/h	63.6
Flow Entering Ramp-Infl. Area (vR12), pc/h	3501	Average Density (D), pc/mi/ln	32.2
Level of Service (LOS)	D	Density in Ramp Influence Area (DR), pc/mi/ln	30.8

Service Volume Table

Target LOS	A	B	C	D	E
Freeway					
Max Service Flow Rate (MSF), pc/h/ln	458	1173	1746	2216	-
Service Flow Rate (SF), veh/h	1778	4554	6781	8605	-
Service Volume, veh/h	1689	4327	6442	8175	-
One Direction DSV, 1000 veh/day	17	43	64	82	-
Bi-Directional DSV, 1000 veh/day	31	79	117	149	-
Ramp					
Max Service Flow Rate (MSF), pc/h/ln	89	228	340	431	-
Service Flow Rate (SF), veh/h	86	221	330	418	-
Service Volume, veh/h	82	210	313	397	-
One Direction DSV, 1000 veh/day	1	2	3	4	-

HCS7 Freeway Diverge Report

Project Information			
Analyst	Ben Erban	Date	4/25/2019
Agency	CTPS	Analysis Year	2019
Jurisdiction	MassDOT District 4	Time Period Analyzed	AM Peak Period 7:00-8:00
Project Description	Wilmington - Exit 41 Off-Ramp to Route 125 - Low Cost Freeway Bottlenecks	Unit	United States Customary

Geometric Data		
	Freeway	Ramp
Number of Lanes (N), ln	4	1
Free-Flow Speed (FFS), mi/h	75.4	30.0
Segment Length (L) / Deceleration Length (LA),ft	875	400
Terrain Type	Level	Level
Percent Grade, %	-	-
Segment Type / Ramp Side	Freeway	Right

Adjustment Factors		
Driver Population	Mostly Familiar	Mostly Familiar
Weather Type	Non-Severe Weather	Non-Severe Weather
Incident Type	No Incident	-
Final Speed Adjustment Factor (SAF)	0.975	0.975
Final Capacity Adjustment Factor (CAF)	0.968	0.968
Demand Adjustment Factor (DAF)	1.000	1.000

Demand and Capacity		
Demand Volume (v_i)	5400	750
Peak Hour Factor (PHF)	0.95	0.95
Total Trucks, %	5.00	5.00
Single-Unit Trucks (SUT), %	-	-
Tractor-Trailers (TT), %	-	-
Heavy Vehicle Adjustment Factor (f_{HV})	0.952	0.952
Flow Rate (v_i),pc/h	5971	829
Capacity (c), pc/h	9293	1839
Volume-to-Capacity Ratio (v/c)	0.64	0.45

Speed and Density			
Upstream Equilibrium Distance (L_{EQ}), ft	-	Number of Outer Lanes on Freeway (N_O)	2
Distance to Upstream Ramp (L_{UP}), ft	-	Speed Index (D_S)	0.578
Downstream Equilibrium Distance (L_{EQ}), ft	-	Flow Outer Lanes (v_{OA}), pc/h/ln	1450
Distance to Downstream Ramp (L_{DOWN}), ft	-	Off-Ramp Influence Area Speed (S_R), mi/h	55.3
Prop. Freeway Vehicles in Lane 1 and 2 (P_{FD})	0.436	Outer Lanes Freeway Speed (S_O), mi/h	78.9
Flow in Lanes 1 and 2 (v_{12}), pc/h	3071	Ramp Junction Speed (S), mi/h	64.7
Flow Entering Ramp-Infl. Area (v_{R12}), pc/h	-	Average Density (D), pc/mi/ln	23.1
Level of Service (LOS)	C	Density in Ramp Influence Area (D_R), pc/mi/ln	27.1

Service Volume Table

Target LOS	A	B	C	D	E
Freeway					
Max Service Flow Rate (MSF), pc/h/ln	520	1091	1545	1940	2323
Service Flow Rate (SF), veh/h	1981	4154	5882	7389	8847
Service Volume, veh/h	1882	3946	5587	7020	8404
One Direction DSV, 1000 veh/day	19	39	56	70	84
Bi-Directional DSV, 1000 veh/day	34	72	102	128	153
Ramp					
Max Service Flow Rate (MSF), pc/h/ln	289	606	858	1078	1291
Service Flow Rate (SF), veh/h	275	577	817	1026	1229
Service Volume, veh/h	261	548	776	975	1167
One Direction DSV, 1000 veh/day	3	5	8	10	12

Design Analysis Table

Freeway Lanes, ln	2	2	3	3	4	4	5	5
Ramp Lanes, ln	1	2	1	2	1	2	1	2
Density, pc/mi/ln	-	-	32.4	32.0	23.1	22.3	18.5	17.7
LOS	F	F	D	C	C	B	C	B

HCS7 Freeway Diverge Report

Project Information			
Analyst	Ben Erban	Date	4/25/2019
Agency	CTPS	Analysis Year	2019
Jurisdiction	MassDOT District 4	Time Period Analyzed	PM Peak Period 5:00-6:00
Project Description	Wilmington - Exit 41 Off-Ramp to Route 125 - Low Cost Freeway Bottlenecks	Unit	United States Customary

Geometric Data		
	Freeway	Ramp
Number of Lanes (N), ln	4	1
Free-Flow Speed (FFS), mi/h	75.4	30.0
Segment Length (L) / Deceleration Length (LA),ft	875	400
Terrain Type	Level	Level
Percent Grade, %	-	-
Segment Type / Ramp Side	Freeway	Right

Adjustment Factors		
Driver Population	Mostly Familiar	Mostly Familiar
Weather Type	Non-Severe Weather	Non-Severe Weather
Incident Type	No Incident	-
Final Speed Adjustment Factor (SAF)	0.975	0.975
Final Capacity Adjustment Factor (CAF)	0.968	0.968
Demand Adjustment Factor (DAF)	1.000	1.000

Demand and Capacity		
Demand Volume (Vi)	7550	1050
Peak Hour Factor (PHF)	0.95	0.95
Total Trucks, %	3.00	3.00
Single-Unit Trucks (SUT), %	-	-
Tractor-Trailers (TT), %	-	-
Heavy Vehicle Adjustment Factor (fHV)	0.971	0.971
Flow Rate (vi),pc/h	8185	1138
Capacity (c), pc/h	9293	1839
Volume-to-Capacity Ratio (v/c)	0.88	0.62

Speed and Density			
Upstream Equilibrium Distance (LEQ), ft	-	Number of Outer Lanes on Freeway (NO)	2
Distance to Upstream Ramp (LUP), ft	-	Speed Index (DS)	0.606
Downstream Equilibrium Distance (LEQ), ft	-	Flow Outer Lanes (vOA), pc/h/ln	1988
Distance to Downstream Ramp (LDOWN), ft	-	Off-Ramp Influence Area Speed (SR), mi/h	54.4
Prop. Freeway Vehicles in Lane 1 and 2 (PFD)	0.436	Outer Lanes Freeway Speed (SO), mi/h	76.8
Flow in Lanes 1 and 2 (v12), pc/h	4210	Ramp Junction Speed (S), mi/h	63.4
Flow Entering Ramp-Infl. Area (vR12), pc/h	-	Average Density (D), pc/mi/ln	32.3
Level of Service (LOS)	E	Density in Ramp Influence Area (DR), pc/mi/ln	36.9

Service Volume Table

Target LOS	A	B	C	D	E
Freeway					
Max Service Flow Rate (MSF), pc/h/ln	521	1092	1544	1939	2323
Service Flow Rate (SF), veh/h	2025	4242	5998	7530	9023
Service Volume, veh/h	1924	4029	5699	7153	8572
One Direction DSV, 1000 veh/day	19	40	57	72	86
Bi-Directional DSV, 1000 veh/day	35	73	104	130	156
Ramp					
Max Service Flow Rate (MSF), pc/h/ln	290	608	859	1078	1292
Service Flow Rate (SF), veh/h	282	590	834	1047	1255
Service Volume, veh/h	268	560	793	995	1192
One Direction DSV, 1000 veh/day	3	6	8	10	12

HCS7 Freeway Merge Report

Project Information			
Analyst	Ben Erban	Date	4/25/2019
Agency	CTPS	Analysis Year	2030
Jurisdiction	MassDOT District 4	Time Period Analyzed	AM Peak Hour 7:00-8:00
Project Description	Wilmington - Exit 40 On-Ramp from Route 62 - Low Cost Freeway Bottlenecks	Unit	United States Customary

Geometric Data		
	Freeway	Ramp
Number of Lanes (N), ln	4	1
Free-Flow Speed (FFS), mi/h	75.4	30.0
Segment Length (L) / Acceleration Length (LA),ft	1200	300
Terrain Type	Level	Level
Percent Grade, %	-	-
Segment Type / Ramp Side	Freeway	Right

Adjustment Factors		
Driver Population	Mostly Familiar	Mostly Familiar
Weather Type	Non-Severe Weather	Non-Severe Weather
Incident Type	No Incident	-
Final Speed Adjustment Factor (SAF)	0.975	0.975
Final Capacity Adjustment Factor (CAF)	0.968	0.968
Demand Adjustment Factor (DAF)	1.000	1.000

Demand and Capacity		
Demand Volume (Vi)	5170	470
Peak Hour Factor (PHF)	0.95	0.95
Total Trucks, %	5.00	5.00
Single-Unit Trucks (SUT), %	-	-
Tractor-Trailers (TT), %	-	-
Heavy Vehicle Adjustment Factor (fHV)	0.952	0.952
Flow Rate (vi),pc/h	5716	520
Capacity (c), pc/h	9293	1839
Volume-to-Capacity Ratio (v/c)	0.67	0.28

Speed and Density			
Upstream Equilibrium Distance (LEQ), ft	-	Number of Outer Lanes on Freeway (NO)	2
Distance to Upstream Ramp (LUP), ft	-	Speed Index (MS)	0.368
Downstream Equilibrium Distance (LEQ), ft	-	Flow Outer Lanes (vOA), pc/h/ln	1715
Distance to Downstream Ramp (LDOWN), ft	-	On-Ramp Influence Area Speed (SR), mi/h	61.9
Prop. Freeway Vehicles in Lane 1 and 2 (PFM)	0.153	Outer Lanes Freeway Speed (SO), mi/h	69.1
Flow in Lanes 1 and 2 (v12), pc/h	2286	Ramp Junction Speed (S), mi/h	65.7
Flow Entering Ramp-Infl. Area (vR12), pc/h	2806	Average Density (D), pc/mi/ln	23.7
Level of Service (LOS)	C	Density in Ramp Influence Area (DR), pc/mi/ln	25.3

Service Volume Table

Target LOS	A	B	C	D	E
Freeway					
Max Service Flow Rate (MSF), pc/h/ln	410	1077	1603	2067	2130
Service Flow Rate (SF), veh/h	1560	4100	6104	7870	8110
Service Volume, veh/h	1482	3895	5799	7477	7704
One Direction DSV, 1000 veh/day	15	39	58	75	77
Bi-Directional DSV, 1000 veh/day	27	71	105	136	140
Ramp					
Max Service Flow Rate (MSF), pc/h/ln	149	392	583	752	774
Service Flow Rate (SF), veh/h	142	373	555	715	737
Service Volume, veh/h	135	354	527	680	700
One Direction DSV, 1000 veh/day	1	4	5	7	7

Design Analysis Table

Freeway Lanes, ln	2	2	3	3	4	4	5	5
Ramp Lanes, ln	1	2	1	2	1	2	1	2
Density, pc/mi/ln	-	-	34.0	33.7	23.7	23.6	18.7	18.6
LOS	F	F	D	D	C	C	C	B

HCS7 Freeway Merge Report

Project Information			
Analyst	Ben Erban	Date	4/25/2019
Agency	CTPS	Analysis Year	2030
Jurisdiction	MassDOT District 4	Time Period Analyzed	PM Peak Hour 5:00-6:00
Project Description	Wilmington - Exit 40 On-Ramp from Route 62 - Low Cost Freeway Bottlenecks	Unit	United States Customary

Geometric Data		
	Freeway	Ramp
Number of Lanes (N), ln	4	1
Free-Flow Speed (FFS), mi/h	75.4	30.0
Segment Length (L) / Acceleration Length (LA),ft	1200	300
Terrain Type	Level	Level
Percent Grade, %	-	-
Segment Type / Ramp Side	Freeway	Right

Adjustment Factors		
Driver Population	Mostly Familiar	Mostly Familiar
Weather Type	Non-Severe Weather	Non-Severe Weather
Incident Type	No Incident	-
Final Speed Adjustment Factor (SAF)	0.975	0.975
Final Capacity Adjustment Factor (CAF)	0.968	0.968
Demand Adjustment Factor (DAF)	1.000	1.000

Demand and Capacity		
Demand Volume (Vi)	7480	400
Peak Hour Factor (PHF)	0.95	0.95
Total Trucks, %	3.00	3.00
Single-Unit Trucks (SUT), %	-	-
Tractor-Trailers (TT), %	-	-
Heavy Vehicle Adjustment Factor (fHV)	0.971	0.971
Flow Rate (vi),pc/h	8109	434
Capacity (c), pc/h	9293	1839
Volume-to-Capacity Ratio (v/c)	0.92	0.24

Speed and Density			
Upstream Equilibrium Distance (LEQ), ft	-	Number of Outer Lanes on Freeway (NO)	2
Distance to Upstream Ramp (LUP), ft	-	Speed Index (MS)	0.458
Downstream Equilibrium Distance (LEQ), ft	-	Flow Outer Lanes (vOA), pc/h/ln	2433
Distance to Downstream Ramp (LDOWN), ft	-	On-Ramp Influence Area Speed (SR), mi/h	59.1
Prop. Freeway Vehicles in Lane 1 and 2 (PFM)	0.164	Outer Lanes Freeway Speed (SO), mi/h	66.2
Flow in Lanes 1 and 2 (v12), pc/h	3244	Ramp Junction Speed (S), mi/h	62.9
Flow Entering Ramp-Infl. Area (vR12), pc/h	3678	Average Density (D), pc/mi/ln	34.0
Level of Service (LOS)	D	Density in Ramp Influence Area (DR), pc/mi/ln	32.2

Service Volume Table

Target LOS	A	B	C	D	E
Freeway					
Max Service Flow Rate (MSF), pc/h/ln	444	1162	1732	2205	-
Service Flow Rate (SF), veh/h	1725	4512	6727	8565	-
Service Volume, veh/h	1639	4287	6391	8137	-
One Direction DSV, 1000 veh/day	16	43	64	81	-
Bi-Directional DSV, 1000 veh/day	30	78	116	148	-
Ramp					
Max Service Flow Rate (MSF), pc/h/ln	95	249	371	472	-
Service Flow Rate (SF), veh/h	92	241	360	458	-
Service Volume, veh/h	88	229	342	435	-
One Direction DSV, 1000 veh/day	1	2	3	4	-

Design Analysis Table

Freeway Lanes, ln	2	2	3	3	4	4	5	5
Ramp Lanes, ln	1	2	1	2	1	2	1	2
Density, pc/mi/ln	-	-	-	-	34.0	33.8	26.0	25.9
LOS	F	F	F	F	D	D	C	C

HCS7 Freeway Diverge Report

Project Information			
Analyst	Ben Erban	Date	4/25/2019
Agency	CTPS	Analysis Year	2030
Jurisdiction	MassDOT District 4	Time Period Analyzed	AM Peak Period 7:00-8:00
Project Description	Wilmington - Exit 41 Off-Ramp - Low Cost Freeway Bottlenecks	Unit	United States Customary

Geometric Data		
	Freeway	Ramp
Number of Lanes (N), ln	4	1
Free-Flow Speed (FFS), mi/h	75.4	30.0
Segment Length (L) / Deceleration Length (LA),ft	875	400
Terrain Type	Level	Level
Percent Grade, %	-	-
Segment Type / Ramp Side	Freeway	Right

Adjustment Factors		
Driver Population	Mostly Familiar	Mostly Familiar
Weather Type	Non-Severe Weather	Non-Severe Weather
Incident Type	No Incident	-
Final Speed Adjustment Factor (SAF)	0.975	0.975
Final Capacity Adjustment Factor (CAF)	0.968	0.968
Demand Adjustment Factor (DAF)	1.000	1.000

Demand and Capacity		
Demand Volume (Vi)	5640	800
Peak Hour Factor (PHF)	0.95	0.95
Total Trucks, %	5.00	5.00
Single-Unit Trucks (SUT), %	-	-
Tractor-Trailers (TT), %	-	-
Heavy Vehicle Adjustment Factor (fHV)	0.952	0.952
Flow Rate (vi),pc/h	6236	885
Capacity (c), pc/h	9293	1839
Volume-to-Capacity Ratio (v/c)	0.67	0.48

Speed and Density			
Upstream Equilibrium Distance (LEQ), ft	-	Number of Outer Lanes on Freeway (NO)	2
Distance to Upstream Ramp (LUP), ft	-	Speed Index (DS)	0.583
Downstream Equilibrium Distance (LEQ), ft	-	Flow Outer Lanes (vOA), pc/h/ln	1509
Distance to Downstream Ramp (LDOWN), ft	-	Off-Ramp Influence Area Speed (SR), mi/h	55.1
Prop. Freeway Vehicles in Lane 1 and 2 (PFD)	0.436	Outer Lanes Freeway Speed (SO), mi/h	78.6
Flow in Lanes 1 and 2 (v12), pc/h	3218	Ramp Junction Speed (S), mi/h	64.4
Flow Entering Ramp-Infl. Area (vR12), pc/h	-	Average Density (D), pc/mi/ln	24.2
Level of Service (LOS)	D	Density in Ramp Influence Area (DR), pc/mi/ln	28.3

Service Volume Table

Target LOS	A	B	C	D	E
Freeway					
Max Service Flow Rate (MSF), pc/h/ln	518	1087	1539	1932	2323
Service Flow Rate (SF), veh/h	1973	4141	5862	7359	8847
Service Volume, veh/h	1875	3934	5569	6991	8404
One Direction DSV, 1000 veh/day	19	39	56	70	84
Bi-Directional DSV, 1000 veh/day	34	72	101	127	153
Ramp					
Max Service Flow Rate (MSF), pc/h/ln	294	617	873	1096	1318
Service Flow Rate (SF), veh/h	280	587	832	1044	1255
Service Volume, veh/h	266	558	790	992	1192
One Direction DSV, 1000 veh/day	3	6	8	10	12

Design Analysis Table

Freeway Lanes, ln	2	2	3	3	4	4	5	5
Ramp Lanes, ln	1	2	1	2	1	2	1	2
Density, pc/mi/ln	-	-	33.9	33.6	24.2	23.4	19.4	18.6
LOS	F	F	D	C	D	B	C	B

HCS7 Freeway Diverge Report

Project Information			
Analyst	Ben Erban	Date	4/25/2019
Agency	CTPS	Analysis Year	2030
Jurisdiction	MassDOT District 4	Time Period Analyzed	PM Peak Period 5:00-6:00
Project Description	Wilmington - Exit 41 Off-Ramp - Low Cost Freeway Bottlenecks	Unit	United States Customary

Geometric Data		
	Freeway	Ramp
Number of Lanes (N), ln	4	1
Free-Flow Speed (FFS), mi/h	75.4	30.0
Segment Length (L) / Deceleration Length (LA),ft	875	400
Terrain Type	Level	Level
Percent Grade, %	-	-
Segment Type / Ramp Side	Freeway	Right

Adjustment Factors		
Driver Population	Mostly Familiar	Mostly Familiar
Weather Type	Non-Severe Weather	Non-Severe Weather
Incident Type	No Incident	-
Final Speed Adjustment Factor (SAF)	0.975	0.975
Final Capacity Adjustment Factor (CAF)	0.968	0.968
Demand Adjustment Factor (DAF)	1.000	1.000

Demand and Capacity		
Demand Volume (Vi)	7880	1100
Peak Hour Factor (PHF)	0.95	0.95
Total Trucks, %	3.00	3.00
Single-Unit Trucks (SUT), %	-	-
Tractor-Trailers (TT), %	-	-
Heavy Vehicle Adjustment Factor (fHV)	0.971	0.971
Flow Rate (vi),pc/h	8542	1192
Capacity (c), pc/h	9293	1839
Volume-to-Capacity Ratio (v/c)	0.92	0.65

Speed and Density			
Upstream Equilibrium Distance (LEQ), ft	-	Number of Outer Lanes on Freeway (NO)	2
Distance to Upstream Ramp (LUP), ft	-	Speed Index (DS)	0.611
Downstream Equilibrium Distance (LEQ), ft	-	Flow Outer Lanes (vOA), pc/h/ln	2073
Distance to Downstream Ramp (LDOWN), ft	-	Off-Ramp Influence Area Speed (SR), mi/h	54.3
Prop. Freeway Vehicles in Lane 1 and 2 (PFD)	0.436	Outer Lanes Freeway Speed (SO), mi/h	76.4
Flow in Lanes 1 and 2 (v12), pc/h	4397	Ramp Junction Speed (S), mi/h	63.2
Flow Entering Ramp-Infl. Area (vR12), pc/h	-	Average Density (D), pc/mi/ln	33.8
Level of Service (LOS)	E	Density in Ramp Influence Area (DR), pc/mi/ln	38.5

Service Volume Table

Target LOS	A	B	C	D	E
Freeway					
Max Service Flow Rate (MSF), pc/h/ln	521	1091	1543	1938	2323
Service Flow Rate (SF), veh/h	2024	4236	5993	7525	9023
Service Volume, veh/h	1923	4024	5694	7149	8572
One Direction DSV, 1000 veh/day	19	40	57	71	86
Bi-Directional DSV, 1000 veh/day	35	73	104	130	156
Ramp					
Max Service Flow Rate (MSF), pc/h/ln	291	609	862	1082	1297
Service Flow Rate (SF), veh/h	283	591	837	1050	1260
Service Volume, veh/h	268	562	795	998	1197
One Direction DSV, 1000 veh/day	3	6	8	10	12

Design Analysis Table

Freeway Lanes, ln	2	2	3	3	4	4	5	5
Ramp Lanes, ln	1	2	1	2	1	2	1	2
Density, pc/mi/ln	-	-	-	-	33.8	33.0	27.0	26.0
LOS	F	F	F	F	E	C	D	C

HCS7 Freeway Weaving Report

Project Information

Analyst	Chen-Yuan Wang	Date	6/20/2019
Agency	CTPS	Analysis Year	2030
Jurisdiction	MassDOT District 4	Time Period Analyzed	AM Peak Hour 7:00-8:00
Project Description	I-93 Northbound Between Exit 40 and Exit 41 in Wilmington - Low Cst Freeway Bottlenecks	Unit	United States Customary

Geometric Data

Number of Lanes (N), ln	5	Segment Type	Freeway
Segment Length (L_S), ft	1200	Number of Maneuver Lanes (N_{WL}), ln	2
Weaving Configuration	One-Sided	Ramp-to-Freeway Lane Changes (LC_{RF}), lc	1
Terrain Type	Level	Freeway-to-Ramp Lane Changes (LC_{FR}), lc	1
Percent Grade, %	-	Ramp-to-Ramp Lane Changes (LC_{RR}), lc	0
Interchange Density (ID), int/mi	0.66	Cross Weaving Managed Lane	No

Adjustment Factors

Driver Population	Mostly Familiar	Final Speed Adjustment Factor (SAF)	0.975
Weather Type	Non-Severe Weather	Final Capacity Adjustment Factor (CAF)	0.968
Incident Type	No Incident	Demand Adjustment Factor (DAF)	1.000

Demand and Capacity

	FF	RF	RR	FR
Demand Volume (V_i), veh/h	4390	470	0	800
Peak Hour Factor (PHF)	0.95	0.95	0.95	0.95
Total Trucks, %	5.00	5.00	5.00	5.00
Heavy Vehicle Adjustment Factor (f_{HV})	0.952	0.952	0.952	0.952
Flow Rate (v_i), pc/h	4854	520	0	885

Weaving Flow Rate (v_w), pc/h	1405	Freeway Max Capacity (c_{IFL}), pc/h/ln	2400
Non-Weaving Flow Rate (v_{NW}), pc/h	4854	Density-Based Capacity (c_{IWL}), pc/h/ln	2126
Total Flow Rate (v), pc/h	6259	Demand Flow-Based Capacity (c_{IW}), pc/h	10714
Volume Ratio (VR)	0.224	Weaving Segment Capacity (c_W), veh/h	10120
Minimum Lane Change Rate (LC_{MIN}), lc/h	1405	Adjusted Weaving Area Capacity, pc/h	10290
Maximum Weaving Length (L_{MAX}), ft	4783	Volume-to-Capacity Ratio (v/c)	0.61

Speed and Density

Non-Weaving Vehicle Index (I_{NW})	384	Average Weaving Speed (S_W), mi/h	56.6
Non-Weaving Lane Change Rate (LC_{NW}), lc/h	687	Average Non-Weaving Speed (S_{NW}), mi/h	57.4
Weaving Lane Change Rate (LC_W), lc/h	1844	Average Speed (S), mi/h	57.2
Weaving Lane Change Rate (LC_{All}), lc/h	2531	Density (D), pc/mi/ln	21.9
Weaving Intensity Factor (W)	0.407	Level of Service (LOS)	C

Service Volume Table

Target LOS	A	B	C	D	E
Max Service Flow Rate (MSF), pc/h/ln	644	1162	1518	1789	2058
Service Flow Rate (SF), veh/h	3067	5531	7223	8517	9796
Service Volume, veh/h	2914	5254	6862	8092	9306
One Direction DSV, 1000 veh/day	29	53	69	81	93
Bi-Directional DSV, 1000 veh/day	53	96	125	147	169

Design Analysis Table

Number of Lanes, ln	3	4	5	6
Density, pc/mi/ln	-	27.9	21.9	18.0
LOS	F	C	C	B

HCS7 Freeway Weaving Report

Project Information

Analyst	Chen-Yuan Wang	Date	6/20/2019
Agency	CTPS	Analysis Year	2030
Jurisdiction	MassDOT District 4	Time Period Analyzed	PM Peak Hour 5:00-6:00
Project Description	I-93 Northbound Between Exit 40 and Exit 41 in Wilmington - Low Cst Freeway Bottlenecks	Unit	United States Customary

Geometric Data

Number of Lanes (N), ln	5	Segment Type	Freeway
Segment Length (L_S), ft	1200	Number of Maneuver Lanes (N_{WL}), ln	2
Weaving Configuration	One-Sided	Ramp-to-Freeway Lane Changes (LC_{RF}), lc	1
Terrain Type	Level	Freeway-to-Ramp Lane Changes (LC_{FR}), lc	1
Percent Grade, %	-	Ramp-to-Ramp Lane Changes (LC_{RR}), lc	0
Interchange Density (ID), int/mi	0.66	Cross Weaving Managed Lane	No

Adjustment Factors

Driver Population	Mostly Familiar	Final Speed Adjustment Factor (SAF)	0.975
Weather Type	Non-Severe Weather	Final Capacity Adjustment Factor (CAF)	0.968
Incident Type	No Incident	Demand Adjustment Factor (DAF)	1.000

Demand and Capacity

	FF	RF	RR	FR
Demand Volume (V_i), veh/h	6480	400	0	1100
Peak Hour Factor (PHF)	0.95	0.95	0.95	0.95
Total Trucks, %	3.00	3.00	3.00	3.00
Heavy Vehicle Adjustment Factor (f_{HV})	0.971	0.971	0.971	0.971
Flow Rate (v_i), pc/h	7025	434	0	1192

Weaving Flow Rate (v_w), pc/h	1626	Freeway Max Capacity (c_{IFL}), pc/h/ln	2400
Non-Weaving Flow Rate (v_{NW}), pc/h	7025	Density-Based Capacity (c_{IWL}), pc/h/ln	2154
Total Flow Rate (v), pc/h	8651	Demand Flow-Based Capacity (c_{IW}), pc/h	12766
Volume Ratio (VR)	0.188	Weaving Segment Capacity (c_W), veh/h	10458
Minimum Lane Change Rate (LC_{MIN}), lc/h	1626	Adjusted Weaving Area Capacity, pc/h	10425
Maximum Weaving Length (L_{MAX}), ft	4414	Volume-to-Capacity Ratio (v/c)	0.83

Speed and Density

Non-Weaving Vehicle Index (I_{NW})	556	Average Weaving Speed (S_W), mi/h	54.3
Non-Weaving Lane Change Rate (LC_{NW}), lc/h	1135	Average Non-Weaving Speed (S_{NW}), mi/h	53.5
Weaving Lane Change Rate (LC_W), lc/h	2065	Average Speed (S), mi/h	53.6
Weaving Lane Change Rate (LC_{All}), lc/h	3200	Density (D), pc/mi/ln	32.3
Weaving Intensity Factor (W)	0.490	Level of Service (LOS)	D

Service Volume Table

Target LOS	A	B	C	D	E
Max Service Flow Rate (MSF), pc/h/ln	653	1190	1552	1839	2085
Service Flow Rate (SF), veh/h	3168	5778	7535	8928	10123
Service Volume, veh/h	3010	5489	7158	8481	9617
One Direction DSV, 1000 veh/day	30	55	72	85	96
Bi-Directional DSV, 1000 veh/day	55	100	130	154	175

Design Analysis Table

Number of Lanes, ln	3	4	5	6
Density, pc/mi/ln	-	-	32.3	26.3
LOS	F	F	D	C

Location 2 - I-93 Southbound at the End of the HOV Zipper Lane
Freeway Merge, Diverge, and Weave Analyses

HCS7 Freeway Merge Report

Project Information			
Analyst	Ben Erban	Date	2/25/2019
Agency	CTPS	Analysis Year	2019
Jurisdiction	MassDOT District 6	Time Period Analyzed	4:00 to 5:00 PM
Project Description	Quincy - Exit 8 On-Ramp - Low Cost Freeway Bottlenecks Existing	Unit	United States Customary

Geometric Data		
	Freeway	Ramp
Number of Lanes (N), ln	4	1
Free-Flow Speed (FFS), mi/h	55.0	35.0
Segment Length (L) / Acceleration Length (LA),ft	1500	920
Terrain Type	Specific Grade	Specific Grade
Percent Grade, %	1.00	1.00
Segment Type / Ramp Side	Freeway	Right

Adjustment Factors		
Driver Population	Mostly Familiar	Mostly Familiar
Weather Type	Non-Severe Weather	Non-Severe Weather
Incident Type	No Incident	-
Final Speed Adjustment Factor (SAF)	1.000	1.000
Final Capacity Adjustment Factor (CAF)	1.000	1.000
Demand Adjustment Factor (DAF)	1.000	1.000

Demand and Capacity		
Demand Volume (Vi)	7000	700
Peak Hour Factor (PHF)	0.95	0.95
Total Trucks, %	2.00	0.00
Single-Unit Trucks (SUT), %	70	100
Tractor-Trailers (TT), %	30	0
Heavy Vehicle Adjustment Factor (fHV)	0.966	1.000
Flow Rate (vi),pc/h	7628	737
Capacity (c), pc/h	9000	2000
Volume-to-Capacity Ratio (v/c)	0.93	0.37

Speed and Density			
Upstream Equilibrium Distance (LEQ), ft	-	Number of Outer Lanes on Freeway (NO)	2
Distance to Upstream Ramp (LUP), ft	-	Speed Index (MS)	0.429
Downstream Equilibrium Distance (LEQ), ft	-	Flow Outer Lanes (vOA), pc/h/ln	2289
Distance to Downstream Ramp (LDOWN), ft	-	On-Ramp Influence Area Speed (SR), mi/h	49.4
Prop. Freeway Vehicles in Lane 1 and 2 (PFM)	0.126	Outer Lanes Freeway Speed (SO), mi/h	48.6
Flow in Lanes 1 and 2 (v12), pc/h	3051	Ramp Junction Speed (S), mi/h	49.0
Flow Entering Ramp-Infl. Area (vR12), pc/h	3788	Average Density (D), pc/mi/ln	42.7
Level of Service (LOS)	D	Density in Ramp Influence Area (DR), pc/mi/ln	29.0

Service Volume Table

Target LOS	A	B	C	D	E
Freeway					
Max Service Flow Rate (MSF), pc/h/ln	562	1319	1841	2045	-
Service Flow Rate (SF), veh/h	2170	5095	7114	7904	-
Service Volume, veh/h	2062	4840	6759	7508	-
One Direction DSV, 1000 veh/day	21	48	68	75	-
Bi-Directional DSV, 1000 veh/day	37	88	123	137	-
Ramp					
Max Service Flow Rate (MSF), pc/h/ln	217	510	711	790	-
Service Flow Rate (SF), veh/h	217	510	711	790	-
Service Volume, veh/h	206	484	676	751	-
One Direction DSV, 1000 veh/day	2	5	7	8	-

Design Analysis Table

Freeway Lanes, ln	2	2	3	3	4	4	5	5
Ramp Lanes, ln	1	2	1	2	1	2	1	2
Density, pc/mi/ln	-	-	-	-	42.7	42.5	32.9	32.7
LOS	F	F	F	F	D	C	C	B

HCS7 Freeway Merge Report

Project Information			
Analyst	Ben Erban	Date	2/25/2019
Agency	CTPS	Analysis Year	2019
Jurisdiction	MassDOT District 6	Time Period Analyzed	4:00 to 5:00 PM
Project Description	Quincy - Exit 8 On-Ramp - Low Cost Freeway Bottlenecks Alternative 1	Unit	United States Customary

Geometric Data		
	Freeway	Ramp
Number of Lanes (N), ln	4	1
Free-Flow Speed (FFS), mi/h	55.0	35.0
Segment Length (L) / Acceleration Length (LA),ft	1500	900
Terrain Type	Specific Grade	Specific Grade
Percent Grade, %	1.00	1.00
Segment Type / Ramp Side	Freeway	Right

Adjustment Factors		
Driver Population	Mostly Familiar	Mostly Familiar
Weather Type	Non-Severe Weather	Non-Severe Weather
Incident Type	No Incident	-
Final Speed Adjustment Factor (SAF)	1.000	1.000
Final Capacity Adjustment Factor (CAF)	1.000	1.000
Demand Adjustment Factor (DAF)	1.000	1.000

Demand and Capacity		
Demand Volume (Vi)	7500	700
Peak Hour Factor (PHF)	1.00	1.00
Total Trucks, %	2.00	0.00
Single-Unit Trucks (SUT), %	70	100
Tractor-Trailers (TT), %	30	0
Heavy Vehicle Adjustment Factor (fHV)	0.966	1.000
Flow Rate (vi),pc/h	7764	700
Capacity (c), pc/h	9000	2000
Volume-to-Capacity Ratio (v/c)	0.94	0.35

Speed and Density			
Upstream Equilibrium Distance (LEQ), ft	-	Number of Outer Lanes on Freeway (NO)	2
Distance to Upstream Ramp (LUP), ft	-	Speed Index (MS)	0.433
Downstream Equilibrium Distance (LEQ), ft	-	Flow Outer Lanes (vOA), pc/h/ln	2329
Distance to Downstream Ramp (LDOWN), ft	-	On-Ramp Influence Area Speed (SR), mi/h	49.4
Prop. Freeway Vehicles in Lane 1 and 2 (PFM)	0.130	Outer Lanes Freeway Speed (SO), mi/h	48.3
Flow in Lanes 1 and 2 (v12), pc/h	3106	Ramp Junction Speed (S), mi/h	48.8
Flow Entering Ramp-Infl. Area (vR12), pc/h	3806	Average Density (D), pc/mi/ln	43.4
Level of Service (LOS)	D	Density in Ramp Influence Area (DR), pc/mi/ln	29.3

Service Volume Table

Target LOS	A	B	C	D	E
Freeway					
Max Service Flow Rate (MSF), pc/h/ln	566	1327	1857	2058	-
Service Flow Rate (SF), veh/h	2186	5127	7175	7952	-
Service Volume, veh/h	2186	5127	7175	7952	-
One Direction DSV, 1000 veh/day	22	51	72	80	-
Bi-Directional DSV, 1000 veh/day	40	93	130	145	-
Ramp					
Max Service Flow Rate (MSF), pc/h/ln	204	479	670	742	-
Service Flow Rate (SF), veh/h	204	479	670	742	-
Service Volume, veh/h	204	479	670	742	-
One Direction DSV, 1000 veh/day	2	5	7	7	-

Design Analysis Table

Freeway Lanes, ln	2	2	3	3	4	4	5	5
Ramp Lanes, ln	1	2	1	2	1	2	1	2
Density, pc/mi/ln	-	-	-	-	43.4	43.2	33.3	33.2
LOS	F	F	F	F	D	C	C	B

HCS7 Freeway Merge Report

Project Information			
Analyst	Ben Erban	Date	2/25/2019
Agency	CTPS	Analysis Year	2019
Jurisdiction	MassDOT District 6	Time Period Analyzed	4:00 to 5:00 PM
Project Description	Quincy - Exit 8 On-Ramp - Low Cost Freeway Bottlenecks Alternative 2	Unit	United States Customary

Geometric Data		
	Freeway	Ramp
Number of Lanes (N), ln	4	1
Free-Flow Speed (FFS), mi/h	55.0	35.0
Segment Length (L) / Acceleration Length (LA),ft	1500	1500
Terrain Type	Specific Grade	Specific Grade
Percent Grade, %	1.00	1.00
Segment Type / Ramp Side	Freeway	Right

Adjustment Factors		
Driver Population	Mostly Familiar	Mostly Familiar
Weather Type	Non-Severe Weather	Non-Severe Weather
Incident Type	No Incident	-
Final Speed Adjustment Factor (SAF)	1.000	1.000
Final Capacity Adjustment Factor (CAF)	1.000	1.000
Demand Adjustment Factor (DAF)	1.000	1.000

Demand and Capacity		
Demand Volume (Vi)	7500	700
Peak Hour Factor (PHF)	1.00	1.00
Total Trucks, %	2.00	0.00
Single-Unit Trucks (SUT), %	70	100
Tractor-Trailers (TT), %	30	0
Heavy Vehicle Adjustment Factor (fHV)	0.966	1.000
Flow Rate (vi),pc/h	7764	700
Capacity (c), pc/h	9000	2000
Volume-to-Capacity Ratio (v/c)	0.94	0.35

Speed and Density			
Upstream Equilibrium Distance (LEQ), ft	-	Number of Outer Lanes on Freeway (NO)	2
Distance to Upstream Ramp (LUP), ft	-	Speed Index (MS)	0.391
Downstream Equilibrium Distance (LEQ), ft	-	Flow Outer Lanes (vOA), pc/h/ln	2329
Distance to Downstream Ramp (LDOWN), ft	-	On-Ramp Influence Area Speed (SR), mi/h	49.9
Prop. Freeway Vehicles in Lane 1 and 2 (PFM)	0.130	Outer Lanes Freeway Speed (SO), mi/h	48.3
Flow in Lanes 1 and 2 (v12), pc/h	3106	Ramp Junction Speed (S), mi/h	49.0
Flow Entering Ramp-Infl. Area (vR12), pc/h	3806	Average Density (D), pc/mi/ln	43.2
Level of Service (LOS)	C	Density in Ramp Influence Area (DR), pc/mi/ln	25.5

Service Volume Table

Target LOS	A	B	C	D	E
Freeway					
Max Service Flow Rate (MSF), pc/h/ln	585	1575	2058	-	-
Service Flow Rate (SF), veh/h	2261	6086	7952	-	-
Service Volume, veh/h	2261	6086	7952	-	-
One Direction DSV, 1000 veh/day	23	61	80	-	-
Bi-Directional DSV, 1000 veh/day	41	111	145	-	-
Ramp					
Max Service Flow Rate (MSF), pc/h/ln	211	568	742	-	-
Service Flow Rate (SF), veh/h	211	568	742	-	-
Service Volume, veh/h	211	568	742	-	-
One Direction DSV, 1000 veh/day	2	6	7	-	-

Design Analysis Table

Freeway Lanes, ln	2	2	3	3	4	4	5	5
Ramp Lanes, ln	1	2	1	2	1	2	1	2
Density, pc/mi/ln	-	-	-	-	43.2	43.2	33.2	33.2
LOS	F	F	F	F	C	C	B	B

HCS7 Freeway Merge Report

Project Information			
Analyst	Ben Erban	Date	2/25/2019
Agency	CTPS	Analysis Year	2019
Jurisdiction	MassDOT District 6	Time Period Analyzed	4:00 to 5:00 PM
Project Description	Quincy - Exit 8 On-Ramp - Low Cost Freeway Bottlenecks Alternative 3	Unit	United States Customary

Geometric Data		
	Freeway	Ramp
Number of Lanes (N), ln	4	1
Free-Flow Speed (FFS), mi/h	55.0	35.0
Segment Length (L) / Acceleration Length (LA),ft	1500	1500
Terrain Type	Specific Grade	Specific Grade
Percent Grade, %	1.00	1.00
Segment Type / Ramp Side	Freeway	Right

Adjustment Factors		
Driver Population	Mostly Familiar	Mostly Familiar
Weather Type	Non-Severe Weather	Non-Severe Weather
Incident Type	No Incident	-
Final Speed Adjustment Factor (SAF)	1.000	1.000
Final Capacity Adjustment Factor (CAF)	1.000	1.000
Demand Adjustment Factor (DAF)	1.000	1.000

Demand and Capacity		
Demand Volume (Vi)	7500	700
Peak Hour Factor (PHF)	1.00	1.00
Total Trucks, %	2.00	0.00
Single-Unit Trucks (SUT), %	70	100
Tractor-Trailers (TT), %	30	0
Heavy Vehicle Adjustment Factor (fHV)	0.966	1.000
Flow Rate (vi),pc/h	7764	700
Capacity (c), pc/h	9000	2000
Volume-to-Capacity Ratio (v/c)	0.94	0.35

Speed and Density			
Upstream Equilibrium Distance (LEQ), ft	-	Number of Outer Lanes on Freeway (NO)	2
Distance to Upstream Ramp (LUP), ft	-	Speed Index (MS)	0.391
Downstream Equilibrium Distance (LEQ), ft	-	Flow Outer Lanes (vOA), pc/h/ln	2329
Distance to Downstream Ramp (LDOWN), ft	-	On-Ramp Influence Area Speed (SR), mi/h	49.9
Prop. Freeway Vehicles in Lane 1 and 2 (PFM)	0.130	Outer Lanes Freeway Speed (SO), mi/h	48.3
Flow in Lanes 1 and 2 (v12), pc/h	3106	Ramp Junction Speed (S), mi/h	49.0
Flow Entering Ramp-Infl. Area (vR12), pc/h	3806	Average Density (D), pc/mi/ln	43.2
Level of Service (LOS)	C	Density in Ramp Influence Area (DR), pc/mi/ln	25.5

Service Volume Table

Target LOS	A	B	C	D	E
Freeway					
Max Service Flow Rate (MSF), pc/h/ln	585	1575	2058	-	-
Service Flow Rate (SF), veh/h	2261	6086	7952	-	-
Service Volume, veh/h	2261	6086	7952	-	-
One Direction DSV, 1000 veh/day	23	61	80	-	-
Bi-Directional DSV, 1000 veh/day	41	111	145	-	-
Ramp					
Max Service Flow Rate (MSF), pc/h/ln	211	568	742	-	-
Service Flow Rate (SF), veh/h	211	568	742	-	-
Service Volume, veh/h	211	568	742	-	-
One Direction DSV, 1000 veh/day	2	6	7	-	-

Design Analysis Table

Freeway Lanes, ln	2	2	3	3	4	4	5	5
Ramp Lanes, ln	1	2	1	2	1	2	1	2
Density, pc/mi/ln	-	-	-	-	43.2	43.2	33.2	33.2
LOS	F	F	F	F	C	C	B	B

HCS7 Freeway Merge Report

Project Information			
Analyst	Ben Erban	Date	2/25/2019
Agency	CTPS	Analysis Year	2019
Jurisdiction	MassDOT District 6	Time Period Analyzed	4:00 to 5:00 PM
Project Description	Quincy - HOV Lane Merge - Low Cost Freeway Bottlenecks--Existing	Unit	United States Customary

Geometric Data		
	Freeway	Ramp
Number of Lanes (N), ln	4	1
Free-Flow Speed (FFS), mi/h	55.0	55.0
Segment Length (L) / Acceleration Length (LA),ft	1200	430
Terrain Type	Specific Grade	Specific Grade
Percent Grade, %	1.00	1.00
Segment Type / Ramp Side	Freeway	Left

Adjustment Factors		
Driver Population	Mostly Familiar	Mostly Familiar
Weather Type	Non-Severe Weather	Non-Severe Weather
Incident Type	No Incident	-
Final Speed Adjustment Factor (SAF)	1.000	1.000
Final Capacity Adjustment Factor (CAF)	1.000	1.000
Demand Adjustment Factor (DAF)	1.000	1.000

Demand and Capacity		
Demand Volume (Vi)	5500	1500
Peak Hour Factor (PHF)	0.95	0.95
Total Trucks, %	2.00	0.00
Single-Unit Trucks (SUT), %	70	100
Tractor-Trailers (TT), %	30	0
Heavy Vehicle Adjustment Factor (fHV)	0.966	1.000
Flow Rate (vi),pc/h	5993	1579
Capacity (c), pc/h	9000	2200
Volume-to-Capacity Ratio (v/c)	0.84	0.72

Speed and Density			
Upstream Equilibrium Distance (LEQ), ft	-	Number of Outer Lanes on Freeway (NO)	2
Distance to Upstream Ramp (LUP), ft	-	Speed Index (MS)	0.482
Downstream Equilibrium Distance (LEQ), ft	-	Flow Outer Lanes (vOA), pc/h/ln	1798
Distance to Downstream Ramp (LDOWN), ft	-	On-Ramp Influence Area Speed (SR), mi/h	48.7
Prop. Freeway Vehicles in Lane 3 and 4 (PFM)	0.020	Outer Lanes Freeway Speed (SO), mi/h	50.3
Flow in Lanes 3 and 4 (v34), pc/h	2397	Ramp Junction Speed (S), mi/h	49.4
Flow Entering Ramp-Infl. Area (vR34), pc/h	3976	Average Density (D), pc/mi/ln	38.3
Level of Service (LOS)	D	Density in Ramp Influence Area (DR), pc/mi/ln	33.1

Service Volume Table

Target LOS	A	B	C	D	E
Freeway					
Max Service Flow Rate (MSF), pc/h/ln	346	846	1242	1589	1768
Service Flow Rate (SF), veh/h	1338	3271	4800	6138	6831
Service Volume, veh/h	1271	3107	4560	5831	6489
One Direction DSV, 1000 veh/day	13	31	46	58	65
Bi-Directional DSV, 1000 veh/day	23	56	82	105	117
Ramp					
Max Service Flow Rate (MSF), pc/h/ln	365	892	1309	1674	1863
Service Flow Rate (SF), veh/h	365	892	1309	1674	1863
Service Volume, veh/h	347	847	1244	1590	1770
One Direction DSV, 1000 veh/day	3	8	12	16	18

Design Analysis Table

Freeway Lanes, ln	2	2	3	3	4	4	5	5
Ramp Lanes, ln	1	2	1	2	1	2	1	2
Density, pc/mi/ln	-	-	-	-	38.3	38.0	29.8	29.6
LOS	F	F	F	F	D	D	D	C

HCS7 Freeway Merge Report

Project Information

Analyst	Ben Erban	Date	2/25/2019
Agency	CTPS	Analysis Year	2019
Jurisdiction	MassDOT District 6	Time Period Analyzed	4:00 to 5:00 PM
Project Description	Quincy - HOV Lane Merge - Low Cost Freeway Bottlenecks--Alternative 1	Unit	United States Customary

Geometric Data

	Freeway	Ramp
Number of Lanes (N), ln	4	1
Free-Flow Speed (FFS), mi/h	55.0	55.0
Segment Length (L) / Acceleration Length (LA),ft	2400	1100
Terrain Type	Specific Grade	Specific Grade
Percent Grade, %	1.00	1.00
Segment Type / Ramp Side	Freeway	Left

Adjustment Factors

Driver Population	Mostly Familiar	Mostly Familiar
Weather Type	Non-Severe Weather	Non-Severe Weather
Incident Type	No Incident	-
Final Speed Adjustment Factor (SAF)	1.000	1.000
Final Capacity Adjustment Factor (CAF)	1.000	1.000
Demand Adjustment Factor (DAF)	1.000	1.000

Demand and Capacity

Demand Volume (Vi)	6000	1500
Peak Hour Factor (PHF)	1.00	1.00
Total Trucks, %	2.00	0.00
Single-Unit Trucks (SUT), %	70	100
Tractor-Trailers (TT), %	30	0
Heavy Vehicle Adjustment Factor (fHV)	0.966	1.000
Flow Rate (vi),pc/h	6211	1500
Capacity (c), pc/h	9000	2200
Volume-to-Capacity Ratio (v/c)	0.86	0.68

Speed and Density

Upstream Equilibrium Distance (LEQ), ft	-	Number of Outer Lanes on Freeway (NO)	2
Distance to Upstream Ramp (LUP), ft	-	Speed Index (MS)	0.410
Downstream Equilibrium Distance (LEQ), ft	-	Flow Outer Lanes (vOA), pc/h/ln	1864
Distance to Downstream Ramp (LDOWN), ft	-	On-Ramp Influence Area Speed (SR), mi/h	49.7
Prop. Freeway Vehicles in Lane 3 and 4 (PFM)	0.030	Outer Lanes Freeway Speed (SO), mi/h	50.1
Flow in Lanes 3 and 4 (v34), pc/h	2484	Ramp Junction Speed (S), mi/h	49.9
Flow Entering Ramp-Infl. Area (vR34), pc/h	3984	Average Density (D), pc/mi/ln	38.6
Level of Service (LOS)	D	Density in Ramp Influence Area (DR), pc/mi/ln	29.0

Service Volume Table

Target LOS	A	B	C	D	E
Freeway					
Max Service Flow Rate (MSF), pc/h/ln	529	1089	1497	1800	-
Service Flow Rate (SF), veh/h	2044	4206	5786	6955	-
Service Volume, veh/h	2044	4206	5786	6955	-
One Direction DSV, 1000 veh/day	20	42	58	70	-
Bi-Directional DSV, 1000 veh/day	37	76	105	126	-
Ramp					
Max Service Flow Rate (MSF), pc/h/ln	511	1052	1446	1739	-
Service Flow Rate (SF), veh/h	511	1052	1446	1739	-
Service Volume, veh/h	511	1052	1446	1739	-
One Direction DSV, 1000 veh/day	5	11	14	17	-

Design Analysis Table

Freeway Lanes, ln	2	2	3	3	4	4	5	5
Ramp Lanes, ln	1	2	1	2	1	2	1	2
Density, pc/mi/ln	-	-	-	-	38.6	38.4	30.1	29.9
LOS	F	F	F	F	D	C	C	C

Managed Lane Geometric Data

Managed Lane Type	Continuous Access	Free-Flow Speed (FFS), mi/h	75.4
Number of Managed Lanes, ln	1	Terrain Type	Level
Managed Lane Length, ft	5280	Percent Grade, %	-

Managed Lane Adjustment Factors

Driver Population	All Familiar	Driver Population CAF	1.000
Weather Type	Non-Severe Weather	Weather Type CAF	1.000
Driver Population SAF	1.000	Final Speed Adjustment Factor (SAF)	1.000
Weather Type SAF	1.000	Final Capacity Adjustment Factor (CAF)	1.000
Demand Adjustment Factor (DAF)	1.000		

Managed Lane Demand and Capacity

Volume (V_{ML}), veh/h	0	Heavy Vehicle Adjustment Factor (f_{HV})	1.000
Peak Hour Factor	0.94	Flow Rate ($V_{p,ML}$), pc/h/ln	0
Total Trucks, %	0.00	Capacity (c), pc/h/ln	1804
Single-Unit Trucks (SUT), %	-	Adjusted Cpacity (c_{adj}), pc/h/ln	1804
Tractor-Trailers (TT), %	-	Volume-to-Capacity Ratio (v/c)	0.00
Passenger Car Equivalent (E_T)	2.000		

Managed Lane Speed and Density

Breakpoint (BP_{ML})	500	Indicator Variable (I_c)	-
Speed 1 (S_1), mi/h	75.4	Average Speed (S_{ML}), mi/h	75.4
Speed 2 (S_2), mi/h	-	Density (D_{ML}), pc/mi/ln	0.0

HCS7 Freeway Merge Report

Project Information			
Analyst	Ben Erban	Date	2/25/2019
Agency	CTPS	Analysis Year	2019
Jurisdiction	MassDOT District 6	Time Period Analyzed	4:00 to 5:00 PM
Project Description	Quincy - HOV Lane Merge - Low Cost Freeway Bottlenecks--Alternative 2	Unit	United States Customary

Geometric Data		
	Freeway	Ramp
Number of Lanes (N), ln	4	1
Free-Flow Speed (FFS), mi/h	55.0	55.0
Segment Length (L) / Acceleration Length (LA),ft	2400	430
Terrain Type	Specific Grade	Specific Grade
Percent Grade, %	1.00	1.00
Segment Type / Ramp Side	Freeway	Left

Adjustment Factors		
Driver Population	Mostly Familiar	Mostly Familiar
Weather Type	Non-Severe Weather	Non-Severe Weather
Incident Type	No Incident	-
Final Speed Adjustment Factor (SAF)	1.000	1.000
Final Capacity Adjustment Factor (CAF)	1.000	1.000
Demand Adjustment Factor (DAF)	1.000	1.000

Demand and Capacity		
Demand Volume (Vi)	6000	1500
Peak Hour Factor (PHF)	1.00	1.00
Total Trucks, %	2.00	1.00
Single-Unit Trucks (SUT), %	70	100
Tractor-Trailers (TT), %	30	0
Heavy Vehicle Adjustment Factor (fHV)	0.966	0.983
Flow Rate (vi),pc/h	6211	1526
Capacity (c), pc/h	9000	2200
Volume-to-Capacity Ratio (v/c)	0.86	0.69

Speed and Density			
Upstream Equilibrium Distance (LEQ), ft	-	Number of Outer Lanes on Freeway (NO)	2
Distance to Upstream Ramp (LUP), ft	-	Speed Index (MS)	0.489
Downstream Equilibrium Distance (LEQ), ft	-	Flow Outer Lanes (vOA), pc/h/ln	1864
Distance to Downstream Ramp (LDOWN), ft	-	On-Ramp Influence Area Speed (SR), mi/h	48.6
Prop. Freeway Vehicles in Lane 3 and 4 (PFM)	0.027	Outer Lanes Freeway Speed (SO), mi/h	50.1
Flow in Lanes 3 and 4 (v34), pc/h	2484	Ramp Junction Speed (S), mi/h	49.3
Flow Entering Ramp-Infl. Area (vR34), pc/h	4010	Average Density (D), pc/mi/ln	39.2
Level of Service (LOS)	D	Density in Ramp Influence Area (DR), pc/mi/ln	33.4

Service Volume Table

Target LOS	A	B	C	D	E
Freeway					
Max Service Flow Rate (MSF), pc/h/ln	356	869	1275	1630	1800
Service Flow Rate (SF), veh/h	1376	3356	4926	6299	6955
Service Volume, veh/h	1376	3356	4926	6299	6955
One Direction DSV, 1000 veh/day	14	34	49	63	70
Bi-Directional DSV, 1000 veh/day	14	34	49	63	70
Ramp					
Max Service Flow Rate (MSF), pc/h/ln	350	854	1253	1602	1769
Service Flow Rate (SF), veh/h	344	839	1232	1575	1739
Service Volume, veh/h	344	839	1232	1575	1739
One Direction DSV, 1000 veh/day	3	8	12	16	17

Design Analysis Table

Freeway Lanes, ln	2	2	3	3	4	4	5	5
Ramp Lanes, ln	1	2	1	2	1	2	1	2
Density, pc/mi/ln	-	-	-	-	39.2	38.9	30.5	30.3
LOS	F	F	F	F	D	D	D	C

Managed Lane Geometric Data

Managed Lane Type	Continuous Access	Free-Flow Speed (FFS), mi/h	75.4
Number of Managed Lanes, ln	1	Terrain Type	Level
Managed Lane Length, ft	5280	Percent Grade, %	-

Managed Lane Adjustment Factors

Driver Population	All Familiar	Driver Population CAF	1.000
Weather Type	Non-Severe Weather	Weather Type CAF	1.000
Driver Population SAF	1.000	Final Speed Adjustment Factor (SAF)	1.000
Weather Type SAF	1.000	Final Capacity Adjustment Factor (CAF)	1.000
Demand Adjustment Factor (DAF)	1.000		

Managed Lane Demand and Capacity

Volume (V_{ML}), veh/h	0	Heavy Vehicle Adjustment Factor (f_{HV})	1.000
Peak Hour Factor	0.94	Flow Rate ($V_{p,ML}$), pc/h/ln	0
Total Trucks, %	0.00	Capacity (c), pc/h/ln	1804
Single-Unit Trucks (SUT), %	-	Adjusted Cpacity (c_{adj}), pc/h/ln	1804
Tractor-Trailers (TT), %	-	Volume-to-Capacity Ratio (v/c)	0.00
Passenger Car Equivalent (E_T)	2.000		

Managed Lane Speed and Density

Breakpoint (BP_{ML})	500	Indicator Variable (I_c)	-
Speed 1 (S_1), mi/h	75.4	Average Speed (S_{ML}), mi/h	75.4
Speed 2 (S_2), mi/h	-	Density (D_{ML}), pc/mi/ln	0.0

HCS7 Freeway Merge Report

Project Information			
Analyst	Ben Erban	Date	2/25/2019
Agency	CTPS	Analysis Year	2019
Jurisdiction	MassDOT District 6	Time Period Analyzed	4:00 to 5:00 PM
Project Description	Quincy - HOV Lane Merge - Low Cost Freeway Bottlenecks--Alternative 3	Unit	United States Customary

Geometric Data		
	Freeway	Ramp
Number of Lanes (N), ln	4	1
Free-Flow Speed (FFS), mi/h	55.0	55.0
Segment Length (L) / Acceleration Length (LA),ft	2400	1100
Terrain Type	Specific Grade	Specific Grade
Percent Grade, %	1.00	1.00
Segment Type / Ramp Side	Freeway	Left

Adjustment Factors		
Driver Population	Mostly Familiar	Mostly Familiar
Weather Type	Non-Severe Weather	Non-Severe Weather
Incident Type	No Incident	-
Final Speed Adjustment Factor (SAF)	1.000	1.000
Final Capacity Adjustment Factor (CAF)	1.000	1.000
Demand Adjustment Factor (DAF)	1.000	1.000

Demand and Capacity		
Demand Volume (Vi)	6000	1500
Peak Hour Factor (PHF)	1.00	1.00
Total Trucks, %	2.00	0.00
Single-Unit Trucks (SUT), %	70	100
Tractor-Trailers (TT), %	30	0
Heavy Vehicle Adjustment Factor (fHV)	0.966	1.000
Flow Rate (vi),pc/h	6211	1500
Capacity (c), pc/h	9000	2200
Volume-to-Capacity Ratio (v/c)	0.86	0.68

Speed and Density			
Upstream Equilibrium Distance (LEQ), ft	-	Number of Outer Lanes on Freeway (NO)	2
Distance to Upstream Ramp (LUP), ft	-	Speed Index (MS)	0.410
Downstream Equilibrium Distance (LEQ), ft	-	Flow Outer Lanes (vOA), pc/h/ln	1864
Distance to Downstream Ramp (LDOWN), ft	-	On-Ramp Influence Area Speed (SR), mi/h	49.7
Prop. Freeway Vehicles in Lane 3 and 4 (PFM)	0.030	Outer Lanes Freeway Speed (SO), mi/h	50.1
Flow in Lanes 3 and 4 (v34), pc/h	2484	Ramp Junction Speed (S), mi/h	49.9
Flow Entering Ramp-Infl. Area (vR34), pc/h	3984	Average Density (D), pc/mi/ln	38.6
Level of Service (LOS)	D	Density in Ramp Influence Area (DR), pc/mi/ln	29.0

Service Volume Table

Target LOS	A	B	C	D	E
Freeway					
Max Service Flow Rate (MSF), pc/h/ln	529	1089	1497	1800	-
Service Flow Rate (SF), veh/h	2044	4206	5786	6955	-
Service Volume, veh/h	2044	4206	5786	6955	-
One Direction DSV, 1000 veh/day	20	42	58	70	-
Bi-Directional DSV, 1000 veh/day	37	76	105	126	-
Ramp					
Max Service Flow Rate (MSF), pc/h/ln	511	1052	1446	1739	-
Service Flow Rate (SF), veh/h	511	1052	1446	1739	-
Service Volume, veh/h	511	1052	1446	1739	-
One Direction DSV, 1000 veh/day	5	11	14	17	-

Design Analysis Table

Freeway Lanes, ln	2	2	3	3	4	4	5	5
Ramp Lanes, ln	1	2	1	2	1	2	1	2
Density, pc/mi/ln	-	-	-	-	38.6	38.4	30.1	29.9
LOS	F	F	F	F	D	C	C	C

Managed Lane Geometric Data

Managed Lane Type	Continuous Access	Free-Flow Speed (FFS), mi/h	75.4
Number of Managed Lanes, ln	1	Terrain Type	Level
Managed Lane Length, ft	5280	Percent Grade, %	-

Managed Lane Adjustment Factors

Driver Population	All Familiar	Driver Population CAF	1.000
Weather Type	Non-Severe Weather	Weather Type CAF	1.000
Driver Population SAF	1.000	Final Speed Adjustment Factor (SAF)	1.000
Weather Type SAF	1.000	Final Capacity Adjustment Factor (CAF)	1.000
Demand Adjustment Factor (DAF)	1.000		

Managed Lane Demand and Capacity

Volume (V_{ML}), veh/h	0	Heavy Vehicle Adjustment Factor (f_{HV})	1.000
Peak Hour Factor	0.94	Flow Rate ($V_{p,ML}$), pc/h/ln	0
Total Trucks, %	0.00	Capacity (c), pc/h/ln	1804
Single-Unit Trucks (SUT), %	-	Adjusted Cpacity (c_{adj}), pc/h/ln	1804
Tractor-Trailers (TT), %	-	Volume-to-Capacity Ratio (v/c)	0.00
Passenger Car Equivalent (E_T)	2.000		

Managed Lane Speed and Density

Breakpoint (BP_{ML})	500	Indicator Variable (I_c)	-
Speed 1 (S_1), mi/h	75.4	Average Speed (S_{ML}), mi/h	75.4
Speed 2 (S_2), mi/h	-	Density (D_{ML}), pc/mi/ln	0.0

HCS7 Freeway Weaving Report

Project Information

Analyst	Ben Erban	Date	2/25/2019
Agency	CTPS	Analysis Year	2019
Jurisdiction	MassDOT District 6	Time Period Analyzed	
Project Description	Quincy - One-Sided Weave from HOV Lane to Route 3 - Existing	Unit	United States Customary

Geometric Data

Number of Lanes (N), ln	4	Segment Type	Freeway
Segment Length (L_S), ft	1900	Number of Maneuver Lanes (N_{WL}), ln	2
Weaving Configuration	One-Sided	Ramp-to-Freeway Lane Changes (LC_{RF}), lc	2
Terrain Type	Specific Grade	Freeway-to-Ramp Lane Changes (LC_{FR}), lc	0
Percent Grade, %	1.00	Ramp-to-Ramp Lane Changes (LC_{RR}), lc	0
Interchange Density (ID), int/mi	2.00	Cross Weaving Managed Lane	No

Adjustment Factors

Driver Population	All Familiar	Final Speed Adjustment Factor (SAF)	1.000
Weather Type	Non-Severe Weather	Final Capacity Adjustment Factor (CAF)	1.000
Incident Type	No Incident	Demand Adjustment Factor (DAF)	1.000

Demand and Capacity

	FF	RF	RR	FR
Demand Volume (V_i), veh/h	2500	700	600	2600
Peak Hour Factor (PHF)	1.00	1.00	1.00	1.00
Total Trucks, %	2.00	0.00	0.00	2.00
Heavy Vehicle Adjustment Factor (f_{HV})	0.970	1.000	1.000	0.968
Flow Rate (v_i), pc/h	2577	700	600	2686

Weaving Flow Rate (v_w), pc/h	3386	Freeway Max Capacity (c_{IFL}), pc/h/ln	2250
Non-Weaving Flow Rate (v_{NW}), pc/h	3177	Density-Based Capacity (c_{IWL}), pc/h/ln	1782
Total Flow Rate (v), pc/h	6563	Demand Flow-Based Capacity (c_{IW}), pc/h	4651
Volume Ratio (VR)	0.516	Weaving Segment Capacity (c_W), veh/h	4535
Minimum Lane Change Rate (LC_{MIN}), lc/h	0	Adjusted Weaving Area Capacity, pc/h	4651
Maximum Weaving Length (L_{MAX}), ft	8014	Volume-to-Capacity Ratio (v/c)	1.41

Speed and Density

Non-Weaving Vehicle Index (I_{NW})	-	Average Weaving Speed (S_W), mi/h	-
Non-Weaving Lane Change Rate (LC_{NW}), lc/h	-	Average Non-Weaving Speed (S_{NW}), mi/h	-
Weaving Lane Change Rate (LC_W), lc/h	-	Average Speed (S), mi/h	-
Weaving Lane Change Rate (LC_{All}), lc/h	-	Density (D), pc/mi/ln	-
Weaving Intensity Factor (W)	-	Level of Service (LOS)	F

Service Volume Table

Target LOS	A	B	C	D	E
Max Service Flow Rate (MSF), pc/h/ln	493	925	1163	1163	1163
Service Flow Rate (SF), veh/h	1912	3589	4511	4511	4511
Service Volume, veh/h	1912	3589	4511	4511	4511
One Direction DSV, 1000 veh/day	19	36	45	45	45
Bi-Directional DSV, 1000 veh/day	19	36	45	45	45

Design Analysis Table

Number of Lanes, ln	4	5	6	7
Density, pc/mi/ln	-	-	-	-
LOS	F	F	F	F

HCS7 Freeway Weaving Report

Project Information

Analyst	Ben Erban	Date	2/25/2019
Agency	CTPS	Analysis Year	2019
Jurisdiction	MassDOT District 6	Time Period Analyzed	
Project Description	Quincy - One-Sided Weave from HOV Lane to Route 3 - Alternative 1	Unit	United States Customary

Geometric Data

Number of Lanes (N), ln	4	Segment Type	Freeway
Segment Length (L_S), ft	2600	Number of Maneuver Lanes (N_{WL}), ln	2
Weaving Configuration	One-Sided	Ramp-to-Freeway Lane Changes (LC_{RF}), lc	2
Terrain Type	Specific Grade	Freeway-to-Ramp Lane Changes (LC_{FR}), lc	0
Percent Grade, %	2.00	Ramp-to-Ramp Lane Changes (LC_{RR}), lc	0
Interchange Density (ID), int/mi	2.00	Cross Weaving Managed Lane	No

Adjustment Factors

Driver Population	All Familiar	Final Speed Adjustment Factor (SAF)	1.000
Weather Type	Non-Severe Weather	Final Capacity Adjustment Factor (CAF)	1.000
Incident Type	No Incident	Demand Adjustment Factor (DAF)	1.000

Demand and Capacity

	FF	RF	RR	FR
Demand Volume (V_i), veh/h	2500	700	600	2600
Peak Hour Factor (PHF)	1.00	1.00	1.00	1.00
Total Trucks, %	2.00	0.00	0.00	2.00
Heavy Vehicle Adjustment Factor (f_{HV})	0.968	1.000	1.000	0.962
Flow Rate (v_i), pc/h	2583	700	600	2703
Weaving Flow Rate (v_w), pc/h	3403	Freeway Max Capacity (c_{IFL}), pc/h/ln		2250
Non-Weaving Flow Rate (v_{NW}), pc/h	3183	Density-Based Capacity (c_{IWL}), pc/h/ln		1835
Total Flow Rate (v), pc/h	6586	Demand Flow-Based Capacity (c_{IW}), pc/h		4642
Volume Ratio (VR)	0.517	Weaving Segment Capacity (c_W), veh/h		4512
Minimum Lane Change Rate (LC_{MIN}), lc/h	0	Adjusted Weaving Area Capacity, pc/h		4643
Maximum Weaving Length (L_{MAX}), ft	8026	Volume-to-Capacity Ratio (v/c)		1.42

Speed and Density

Non-Weaving Vehicle Index (I_{NW})	-	Average Weaving Speed (S_W), mi/h	-
Non-Weaving Lane Change Rate (LC_{NW}), lc/h	-	Average Non-Weaving Speed (S_{NW}), mi/h	-
Weaving Lane Change Rate (LC_W), lc/h	-	Average Speed (S), mi/h	-
Weaving Lane Change Rate (LC_{All}), lc/h	-	Density (D), pc/mi/ln	-
Weaving Intensity Factor (W)	-	Level of Service (LOS)	F

Service Volume Table

Target LOS	A	B	C	D	E
Max Service Flow Rate (MSF), pc/h/ln	494	929	1161	1161	1161
Service Flow Rate (SF), veh/h	1912	3596	4494	4494	4494
Service Volume, veh/h	1912	3596	4494	4494	4494
One Direction DSV, 1000 veh/day	19	36	45	45	45
Bi-Directional DSV, 1000 veh/day	35	65	82	82	82

Design Analysis Table

Number of Lanes, ln	4	5	6	7
Density, pc/mi/ln	-	-	-	-
LOS	F	F	F	F

HCS7 Freeway Weaving Report

Project Information

Analyst	Ben Erban	Date	2/25/2019
Agency	CTPS	Analysis Year	2019
Jurisdiction	MassDOT District 6	Time Period Analyzed	
Project Description	Quincy - One-Sided Weave from HOV Lane to Route 3 - Alternative 2	Unit	United States Customary

Geometric Data

Number of Lanes (N), ln	4	Segment Type	Freeway
Segment Length (L_S), ft	2600	Number of Maneuver Lanes (N_{WL}), ln	2
Weaving Configuration	One-Sided	Ramp-to-Freeway Lane Changes (LC_{RF}), lc	2
Terrain Type	Specific Grade	Freeway-to-Ramp Lane Changes (LC_{FR}), lc	0
Percent Grade, %	1.00	Ramp-to-Ramp Lane Changes (LC_{RR}), lc	0
Interchange Density (ID), int/mi	2.00	Cross Weaving Managed Lane	No

Adjustment Factors

Driver Population	All Familiar	Final Speed Adjustment Factor (SAF)	1.000
Weather Type	Non-Severe Weather	Final Capacity Adjustment Factor (CAF)	1.000
Incident Type	No Incident	Demand Adjustment Factor (DAF)	1.000

Demand and Capacity

	FF	RF	RR	FR
Demand Volume (V_i), veh/h	2500	700	600	2600
Peak Hour Factor (PHF)	1.00	1.00	1.00	1.00
Total Trucks, %	2.00	0.00	0.00	2.00
Heavy Vehicle Adjustment Factor (f_{HV})	0.968	1.000	1.000	0.968
Flow Rate (v_i), pc/h	2583	700	600	2686
Weaving Flow Rate (v_W), pc/h	3386	Freeway Max Capacity (c_{IFL}), pc/h/ln		2250
Non-Weaving Flow Rate (v_{NW}), pc/h	3183	Density-Based Capacity (c_{IWL}), pc/h/ln		1837
Total Flow Rate (v), pc/h	6569	Demand Flow-Based Capacity (c_{IW}), pc/h		4660
Volume Ratio (VR)	0.515	Weaving Segment Capacity (c_W), veh/h		4541
Minimum Lane Change Rate (LC_{MIN}), lc/h	0	Adjusted Weaving Area Capacity, pc/h		4661
Maximum Weaving Length (L_{MAX}), ft	8002	Volume-to-Capacity Ratio (v/c)		1.41

Speed and Density

Non-Weaving Vehicle Index (I_{NW})	-	Average Weaving Speed (S_W), mi/h	-
Non-Weaving Lane Change Rate (LC_{NW}), lc/h	-	Average Non-Weaving Speed (S_{NW}), mi/h	-
Weaving Lane Change Rate (LC_W), lc/h	-	Average Speed (S), mi/h	-
Weaving Lane Change Rate (LC_{All}), lc/h	-	Density (D), pc/mi/ln	-
Weaving Intensity Factor (W)	-	Level of Service (LOS)	F

Service Volume Table

Target LOS	A	B	C	D	E
Max Service Flow Rate (MSF), pc/h/ln	494	924	1165	1165	1165
Service Flow Rate (SF), veh/h	1912	3578	4512	4512	4512
Service Volume, veh/h	1912	3578	4512	4512	4512
One Direction DSV, 1000 veh/day	19	36	45	45	45
Bi-Directional DSV, 1000 veh/day	19	36	45	45	45

Design Analysis Table

Number of Lanes, ln	4	5	6	7
Density, pc/mi/ln	-	-	-	-
LOS	F	F	F	F

HCS7 Freeway Weaving Report

Project Information

Analyst	Ben Erban	Date	2/25/2019
Agency	CTPS	Analysis Year	2019
Jurisdiction	MassDOT District 6	Time Period Analyzed	
Project Description	Quincy - One-Sided Weave from HOV Lane to Route 3 - Alternative 3	Unit	United States Customary

Geometric Data

Number of Lanes (N), ln	5	Segment Type	Freeway
Segment Length (L_S), ft	2600	Number of Maneuver Lanes (N_{WL}), ln	2
Weaving Configuration	One-Sided	Ramp-to-Freeway Lane Changes (LC_{RF}), lc	2
Terrain Type	Specific Grade	Freeway-to-Ramp Lane Changes (LC_{FR}), lc	0
Percent Grade, %	1.00	Ramp-to-Ramp Lane Changes (LC_{RR}), lc	0
Interchange Density (ID), int/mi	2.00	Cross Weaving Managed Lane	No

Adjustment Factors

Driver Population	All Familiar	Final Speed Adjustment Factor (SAF)	1.000
Weather Type	Non-Severe Weather	Final Capacity Adjustment Factor (CAF)	1.000
Incident Type	No Incident	Demand Adjustment Factor (DAF)	1.000

Demand and Capacity

	FF	RF	RR	FR
Demand Volume (V_i), veh/h	2500	700	600	2600
Peak Hour Factor (PHF)	1.00	1.00	1.00	1.00
Total Trucks, %	2.00	0.00	0.00	2.00
Heavy Vehicle Adjustment Factor (f_{HV})	0.968	1.000	1.000	0.968
Flow Rate (v_i), pc/h	2583	700	600	2686
Weaving Flow Rate (v_W), pc/h	3386	Freeway Max Capacity (c_{IFL}), pc/h/ln		2250
Non-Weaving Flow Rate (v_{NW}), pc/h	3183	Density-Based Capacity (c_{IWL}), pc/h/ln		1837
Total Flow Rate (v), pc/h	6569	Demand Flow-Based Capacity (c_{IW}), pc/h		4660
Volume Ratio (VR)	0.515	Weaving Segment Capacity (c_W), veh/h		4541
Minimum Lane Change Rate (LC_{MIN}), lc/h	0	Adjusted Weaving Area Capacity, pc/h		4661
Maximum Weaving Length (L_{MAX}), ft	8002	Volume-to-Capacity Ratio (v/c)		1.41

Speed and Density

Non-Weaving Vehicle Index (I_{NW})	-	Average Weaving Speed (S_W), mi/h	-
Non-Weaving Lane Change Rate (LC_{NW}), lc/h	-	Average Non-Weaving Speed (S_{NW}), mi/h	-
Weaving Lane Change Rate (LC_W), lc/h	-	Average Speed (S), mi/h	-
Weaving Lane Change Rate (LC_{All}), lc/h	-	Density (D), pc/mi/ln	-
Weaving Intensity Factor (W)	-	Level of Service (LOS)	F

Service Volume Table

Target LOS	A	B	C	D	E
Max Service Flow Rate (MSF), pc/h/ln	484	907	932	932	932
Service Flow Rate (SF), veh/h	2340	4390	4512	4512	4512
Service Volume, veh/h	2340	4390	4512	4512	4512
One Direction DSV, 1000 veh/day	23	44	45	45	45
Bi-Directional DSV, 1000 veh/day	43	80	82	82	82

Design Analysis Table

Number of Lanes, ln	4	5	6	7
Density, pc/mi/ln	-	-	-	-
LOS	F	F	F	F

HCS7 Freeway Weaving Report

Project Information

Analyst	Ben Erban	Date	2/25/2019
Agency	CTPS	Analysis Year	2019
Jurisdiction	MassDOT District 6	Time Period Analyzed	
Project Description	Quincy - Two-Sided Weave from HOV Lane to I-93 SB (Ramp is I-93) - Existing	Unit	United States Customary

Geometric Data

Number of Lanes (N), ln	4	Segment Type	Freeway
Segment Length (L_S), ft	1900	Number of Maneuver Lanes (N_{WL}), ln	0
Weaving Configuration	Two-Sided	Ramp-to-Freeway Lane Changes (LC_{RF}), lc	1
Terrain Type	Specific Grade	Freeway-to-Ramp Lane Changes (LC_{FR}), lc	0
Percent Grade, %	1.00	Ramp-to-Ramp Lane Changes (LC_{RR}), lc	3
Interchange Density (ID), int/mi	2.00	Cross Weaving Managed Lane	No

Adjustment Factors

Driver Population	All Familiar	Final Speed Adjustment Factor (SAF)	1.000
Weather Type	Non-Severe Weather	Final Capacity Adjustment Factor (CAF)	1.000
Incident Type	No Incident	Demand Adjustment Factor (DAF)	1.000

Demand and Capacity

	FF	RF	RR	FR
Demand Volume (V_i), veh/h	2600	600	500	2600
Peak Hour Factor (PHF)	1.00	1.00	1.00	1.00
Total Trucks, %	2.00	0.00	0.00	2.00
Heavy Vehicle Adjustment Factor (f_{HV})	0.968	1.000	1.000	0.968
Flow Rate (v_i), pc/h	2686	600	500	2686

Weaving Flow Rate (v_w), pc/h	500	Freeway Max Capacity (c_{IFL}), pc/h/ln	2250
Non-Weaving Flow Rate (v_{NW}), pc/h	5972	Density-Based Capacity (c_{IWL}), pc/h/ln	1902
Total Flow Rate (v), pc/h	6472	Demand Flow-Based Capacity (c_{IW}), pc/h	-
Volume Ratio (VR)	0.077	Weaving Segment Capacity (c_W), veh/h	7406
Minimum Lane Change Rate (LC_{MIN}), lc/h	1500	Adjusted Weaving Area Capacity, pc/h	7608
Maximum Weaving Length (L_{MAX}), ft	6450	Volume-to-Capacity Ratio (v/c)	0.85

Speed and Density

Non-Weaving Vehicle Index (I_{NW})	-	Average Weaving Speed (S_W), mi/h	-
Non-Weaving Lane Change Rate (LC_{NW}), lc/h	-	Average Non-Weaving Speed (S_{NW}), mi/h	-
Weaving Lane Change Rate (LC_W), lc/h	-	Average Speed (S), mi/h	-
Weaving Lane Change Rate (LC_{All}), lc/h	-	Density (D), pc/mi/ln	-
Weaving Intensity Factor (W)	-	Level of Service (LOS)	F

Service Volume Table

Target LOS	A	B	C	D	E
Max Service Flow Rate (MSF), pc/h/ln	494	894	1175	1373	1902
Service Flow Rate (SF), veh/h	1911	3462	4550	5317	7365
Service Volume, veh/h	1911	3462	4550	5317	7365
One Direction DSV, 1000 veh/day	19	35	45	53	74
Bi-Directional DSV, 1000 veh/day	35	63	83	97	134

Design Analysis Table

Number of Lanes, ln	4	5	6	7
Density, pc/mi/ln	-	33.9	27.6	23.2
LOS	F	D	C	C

HCS7 Freeway Weaving Report

Project Information

Analyst	Ben Erban	Date	2/25/2019
Agency	CTPS	Analysis Year	2019
Jurisdiction	MassDOT District 6	Time Period Analyzed	
Project Description	Quincy - Two-Sided Weave from HOV Lane to I-93 SB (Ramp is I-93) - Alternative 1	Unit	United States Customary

Geometric Data

Number of Lanes (N), ln	4	Segment Type	Freeway
Segment Length (L_S), ft	2500	Number of Maneuver Lanes (N_{WL}), ln	0
Weaving Configuration	Two-Sided	Ramp-to-Freeway Lane Changes (LC_{RF}), lc	1
Terrain Type	Specific Grade	Freeway-to-Ramp Lane Changes (LC_{FR}), lc	0
Percent Grade, %	1.00	Ramp-to-Ramp Lane Changes (LC_{RR}), lc	3
Interchange Density (ID), int/mi	2.00	Cross Weaving Managed Lane	No

Adjustment Factors

Driver Population	All Familiar	Final Speed Adjustment Factor (SAF)	1.000
Weather Type	Non-Severe Weather	Final Capacity Adjustment Factor (CAF)	1.000
Incident Type	No Incident	Demand Adjustment Factor (DAF)	1.000

Demand and Capacity

	FF	RF	RR	FR
Demand Volume (V_i), veh/h	2600	600	500	2600
Peak Hour Factor (PHF)	1.00	1.00	1.00	1.00
Total Trucks, %	2.00	0.00	0.00	2.00
Heavy Vehicle Adjustment Factor (f_{HV})	0.968	1.000	1.000	0.968
Flow Rate (v_i), pc/h	2686	600	500	2686

Weaving Flow Rate (v_w), pc/h	500	Freeway Max Capacity (c_{IFL}), pc/h/ln	2250
Non-Weaving Flow Rate (v_{NW}), pc/h	5972	Density-Based Capacity (c_{IWL}), pc/h/ln	1948
Total Flow Rate (v), pc/h	6472	Demand Flow-Based Capacity (c_{IW}), pc/h	-
Volume Ratio (VR)	0.077	Weaving Segment Capacity (c_W), veh/h	7585
Minimum Lane Change Rate (LC_{MIN}), lc/h	1500	Adjusted Weaving Area Capacity, pc/h	7792
Maximum Weaving Length (L_{MAX}), ft	6450	Volume-to-Capacity Ratio (v/c)	0.83

Speed and Density

Non-Weaving Vehicle Index (I_{NW})	-	Average Weaving Speed (S_W), mi/h	-
Non-Weaving Lane Change Rate (LC_{NW}), lc/h	-	Average Non-Weaving Speed (S_{NW}), mi/h	-
Weaving Lane Change Rate (LC_W), lc/h	-	Average Speed (S), mi/h	-
Weaving Lane Change Rate (LC_{All}), lc/h	-	Density (D), pc/mi/ln	-
Weaving Intensity Factor (W)	-	Level of Service (LOS)	F

Service Volume Table

Target LOS	A	B	C	D	E
Max Service Flow Rate (MSF), pc/h/ln	494	899	1171	1379	1948
Service Flow Rate (SF), veh/h	1911	3479	4534	5338	7543
Service Volume, veh/h	1911	3479	4534	5338	7543
One Direction DSV, 1000 veh/day	19	35	45	53	75
Bi-Directional DSV, 1000 veh/day	35	63	82	97	137

Design Analysis Table

Number of Lanes, ln	4	5	6	7
Density, pc/mi/ln	-	33.8	27.5	23.2
LOS	F	D	C	C

Managed Lane Geometric Data

Managed Lane Type	Continuous Access	Free-Flow Speed (FFS), mi/h	75.4
Number of Managed Lanes, ln	1	Terrain Type	Level
Managed Lane Length, ft	5280	Percent Grade, %	-

Managed Lane Adjustment Factors

Driver Population	All Familiar	Driver Population CAF	1.000
Weather Type	Non-Severe Weather	Weather Type CAF	1.000
Driver Population SAF	1.000	Final Speed Adjustment Factor (SAF)	1.000
Weather Type SAF	1.000	Final Capacity Adjustment Factor (CAF)	1.000
Demand Adjustment Factor (DAF)	1.000		

Managed Lane Demand and Capacity

Volume (V_{ML}), veh/h	0	Heavy Vehicle Adjustment Factor (f_{HV})	1.000
Peak Hour Factor	0.94	Flow Rate ($V_{p,ML}$), pc/h/ln	0
Total Trucks, %	0.00	Capacity (c), pc/h/ln	1804
Single-Unit Trucks (SUT), %	-	Adjusted Cpacity (c_{adj}), pc/h/ln	1804
Tractor-Trailers (TT), %	-	Volume-to-Capacity Ratio (v/c)	0.00
Passenger Car Equivalent (E_T)	2.000		

Managed Lane Speed and Density

Breakpoint (BP_{ML})	500	Indicator Variable (I_c)	-
Speed 1 (S_1), mi/h	75.4	Average Speed (S_{ML}), mi/h	75.4
Speed 2 (S_2), mi/h	-	Density (D_{ML}), pc/mi/ln	0.0
Speed 3 (S_3), mi/h	-	Level of Service (LOS)	A

HCS7 Freeway Weaving Report

Project Information

Analyst	Ben Erban	Date	2/25/2019
Agency	CTPS	Analysis Year	2019
Jurisdiction	MassDOT District 6	Time Period Analyzed	
Project Description	Quincy - Two-Sided Weave from HOV Lane to I-93 SB (Ramp is I-93) - Alternative 2	Unit	United States Customary

Geometric Data

Number of Lanes (N), ln	4	Segment Type	Freeway
Segment Length (L_S), ft	1400	Number of Maneuver Lanes (N_{WL}), ln	0
Weaving Configuration	Two-Sided	Ramp-to-Freeway Lane Changes (LC_{RF}), lc	1
Terrain Type	Specific Grade	Freeway-to-Ramp Lane Changes (LC_{FR}), lc	0
Percent Grade, %	1.00	Ramp-to-Ramp Lane Changes (LC_{RR}), lc	3
Interchange Density (ID), int/mi	2.00	Cross Weaving Managed Lane	No

Adjustment Factors

Driver Population	All Familiar	Final Speed Adjustment Factor (SAF)	1.000
Weather Type	Non-Severe Weather	Final Capacity Adjustment Factor (CAF)	1.000
Incident Type	No Incident	Demand Adjustment Factor (DAF)	1.000

Demand and Capacity

	FF	RF	RR	FR
Demand Volume (V_i), veh/h	2600	600	500	2600
Peak Hour Factor (PHF)	1.00	1.00	1.00	1.00
Total Trucks, %	2.00	0.00	0.00	2.00
Heavy Vehicle Adjustment Factor (f_{HV})	0.968	1.000	1.000	0.968
Flow Rate (v_i), pc/h	2686	600	500	2686

Weaving Flow Rate (v_w), pc/h	500	Freeway Max Capacity (c_{IFL}), pc/h/ln	2250
Non-Weaving Flow Rate (v_{NW}), pc/h	5972	Density-Based Capacity (c_{IWL}), pc/h/ln	1864
Total Flow Rate (v), pc/h	6472	Demand Flow-Based Capacity (c_{IW}), pc/h	-
Volume Ratio (VR)	0.077	Weaving Segment Capacity (c_W), veh/h	7258
Minimum Lane Change Rate (LC_{MIN}), lc/h	1500	Adjusted Weaving Area Capacity, pc/h	7456
Maximum Weaving Length (L_{MAX}), ft	6450	Volume-to-Capacity Ratio (v/c)	0.87

Speed and Density

Non-Weaving Vehicle Index (I_{NW})	-	Average Weaving Speed (S_W), mi/h	-
Non-Weaving Lane Change Rate (LC_{NW}), lc/h	-	Average Non-Weaving Speed (S_{NW}), mi/h	-
Weaving Lane Change Rate (LC_W), lc/h	-	Average Speed (S), mi/h	-
Weaving Lane Change Rate (LC_{All}), lc/h	-	Density (D), pc/mi/ln	-
Weaving Intensity Factor (W)	-	Level of Service (LOS)	F

Service Volume Table

Target LOS	A	B	C	D	E
Max Service Flow Rate (MSF), pc/h/ln	492	894	1171	1382	1864
Service Flow Rate (SF), veh/h	1906	3463	4534	5353	7217
Service Volume, veh/h	1906	3463	4534	5353	7217
One Direction DSV, 1000 veh/day	19	35	45	54	72
Bi-Directional DSV, 1000 veh/day	35	63	82	97	131

Design Analysis Table

Number of Lanes, ln	4	5	6	7
Density, pc/mi/ln	-	33.6	27.4	23.0
LOS	F	D	C	C

HCS7 Freeway Weaving Report

Project Information

Analyst	Ben Erban	Date	2/25/2019
Agency	CTPS	Analysis Year	2019
Jurisdiction	MassDOT District 6	Time Period Analyzed	
Project Description	Quincy - Two-Sided Weave from HOV Lane to I-93 SB (Ramp is I-93) - Alternative 2	Unit	United States Customary

Geometric Data

Number of Lanes (N), ln	4	Segment Type	Freeway
Segment Length (L_S), ft	2000	Number of Maneuver Lanes (N_{WL}), ln	0
Weaving Configuration	Two-Sided	Ramp-to-Freeway Lane Changes (LC_{RF}), lc	1
Terrain Type	Specific Grade	Freeway-to-Ramp Lane Changes (LC_{FR}), lc	0
Percent Grade, %	1.00	Ramp-to-Ramp Lane Changes (LC_{RR}), lc	3
Interchange Density (ID), int/mi	2.00	Cross Weaving Managed Lane	No

Adjustment Factors

Driver Population	All Familiar	Final Speed Adjustment Factor (SAF)	1.000
Weather Type	Non-Severe Weather	Final Capacity Adjustment Factor (CAF)	1.000
Incident Type	No Incident	Demand Adjustment Factor (DAF)	1.000

Demand and Capacity

	FF	RF	RR	FR
Demand Volume (V_i), veh/h	2600	600	500	2600
Peak Hour Factor (PHF)	1.00	1.00	1.00	1.00
Total Trucks, %	2.00	0.00	0.00	2.00
Heavy Vehicle Adjustment Factor (f_{HV})	0.968	1.000	1.000	0.968
Flow Rate (v_i), pc/h	2686	600	500	2686

Weaving Flow Rate (v_w), pc/h	500	Freeway Max Capacity (c_{IFL}), pc/h/ln	2250
Non-Weaving Flow Rate (v_{NW}), pc/h	5972	Density-Based Capacity (c_{IWL}), pc/h/ln	1910
Total Flow Rate (v), pc/h	6472	Demand Flow-Based Capacity (c_{IW}), pc/h	-
Volume Ratio (VR)	0.077	Weaving Segment Capacity (c_W), veh/h	7437
Minimum Lane Change Rate (LC_{MIN}), lc/h	1500	Adjusted Weaving Area Capacity, pc/h	7640
Maximum Weaving Length (L_{MAX}), ft	6450	Volume-to-Capacity Ratio (v/c)	0.85

Speed and Density

Non-Weaving Vehicle Index (I_{NW})	-	Average Weaving Speed (S_W), mi/h	-
Non-Weaving Lane Change Rate (LC_{NW}), lc/h	-	Average Non-Weaving Speed (S_{NW}), mi/h	-
Weaving Lane Change Rate (LC_W), lc/h	-	Average Speed (S), mi/h	-
Weaving Lane Change Rate (LC_{All}), lc/h	-	Density (D), pc/mi/ln	-
Weaving Intensity Factor (W)	-	Level of Service (LOS)	F

Service Volume Table

Target LOS	A	B	C	D	E
Max Service Flow Rate (MSF), pc/h/ln	494	894	1175	1380	1910
Service Flow Rate (SF), veh/h	1911	3462	4550	5342	7396
Service Volume, veh/h	1911	3462	4550	5342	7396
One Direction DSV, 1000 veh/day	19	35	45	53	74
Bi-Directional DSV, 1000 veh/day	35	63	83	97	134

Design Analysis Table

Number of Lanes, ln	4	5	6	7
Density, pc/mi/ln	-	33.8	27.5	23.2
LOS	F	D	C	C