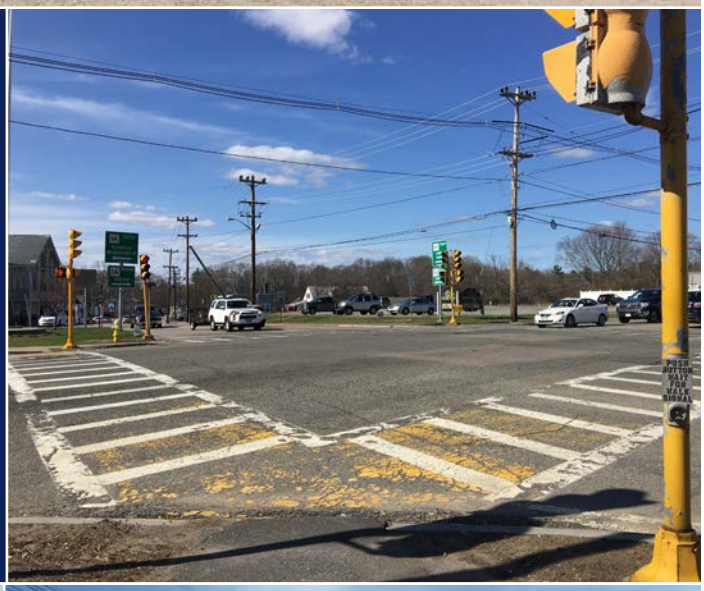
Route 1A Corridor Study in Wrentham



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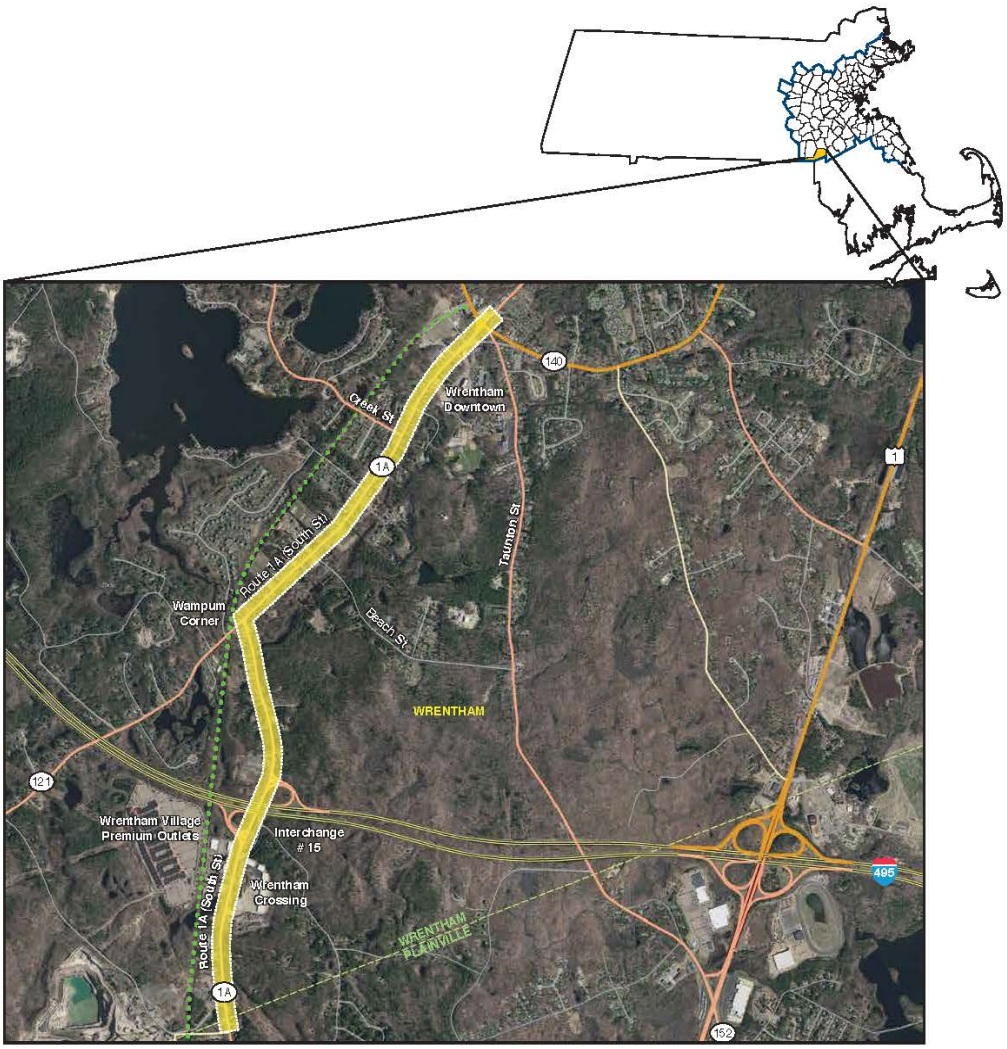

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Abstract

The Boston Region Metropolitan Planning Organization (MPO) selected Route 1A in Wrentham, Massachusetts, as the subject of a transportation corridor study following a comprehensive review of 25 corridors in the region. This 3.1-mile section of Route 1A, between the Wrentham Town Common and the Plainville town line, was selected because of the critical need for improvements on the corridor to address safety and mobility issues affecting motor-vehicle drivers, bicyclists, and pedestrians. The corridor has a high crash rate overall and contains several high-crash clusters in two distinct areas, near the Wrentham Common and the Wrentham Outlets commercial district south of Interstate 495.

MPO staff, working with a study advisory committee that included representatives of the Town of Wrentham and the Massachusetts Department of Transportation (MassDOT), collected data on crashes, traffic volumes and speeds, and other transportation data, conducted safety and operational analyses, and developed recommendations for short- and long-term improvements for the entire corridor. This report documents the analyses, proposed improvements, evaluations, and discussions by the advisory group members, and recommends steps toward implementation. It also includes technical appendices that contain the data and methods used in the study.

The benefits expected to result from implementing the major recommendations from this study include the following:

- Proposed improvement plans for the Wrentham Common area would improve intersection operations and traffic circulation in the area, reduce travel speeds on Common Street and Taunton Street, and enhance mobility and safety for pedestrians and cyclists.
- Proposed improvements for the I-495 commercial area would reduce traffic congestion on Route 1A and at the I-495 interchange during holidays and busy weekends and improve mobility and safety for all users.
- Proposed corridor reconstruction, including sidewalk additions and shoulder expansions, would improve accommodation and safety for pedestrians and cyclists and improve traffic operations.

This study offers a vision for the corridor's future development and presents a series of improvement measures for the corridor to operate safely and efficiently. Significant effort and collaboration on the part of all stakeholders, including the Town of Wrentham, residents, owners of adjacent developments, and MassDOT, will be required to achieve this vision.

TABLE OF CONTENTS PAGE

TABLE OF TABLES PAGE

TABLE OF FIGURES PAGE

APPENDIXES BEGINNING ON PAGE 62

Chapter 1—Introduction

1.1 STUDY BACKGROUND

During the development of the Unified Planning Work Program (UPWP) and the Long-Range Transportation Plan (LRTP), the Boston Region Metropolitan Planning Organization (MPO) conducts outreach to the public, municipalities, the Metropolitan Area Planning Council (MAPC) subregional groups, and the Massachusetts Department of Transportation (MassDOT) to gather feedback and identify transportation problems of concern. Many of the issues identified are related to bicycle and pedestrian accommodation, freight movement, traffic bottlenecks, safety of roadway users, and safe or convenient access for abutters along roadway corridors. These issues can affect not only safety and mobility on a roadway and its side streets, but also quality of life, economic development, and air quality.

To address identified concerns, the MPO conducts the *Addressing Safety, Mobility, and Access on Subregional Priority Roadways* study each year. The purpose of these studies is to identify roadway segments in the Boston region that are of concern to stakeholders, but that have not been identified in the LRTP regional needs assessment.[1] The *Subregional Priority Roadways* studies focus on arterial or collector roadways and result in recommendations for short- and long-term improvements. Funding for the *Route 1A Corridor Study in Wrentham* was documented in the federal fiscal year (FFY) 2017 UPWP and a work program approved by the MPO on December 1, 2016.[2]

1.2 STUDY OBJECTIVES

The *Route 1A Corridor Study in Wrentham* focused on issues related to safety, mobility, and access, as well as specific issues concerning bicycle and pedestrian transportation, multi-use trail feasibility, and other subjects raised by the stakeholders.

The objectives of the study were as follows:

- Identify the safety, mobility, access, and other transportation-related problems in the corridor
- Develop and evaluate potential multimodal transportation solutions to the problems, including pedestrian, bicycle, truck, and transit modes

[1] A work program for *Priority Corridors for LRTP Needs Assessment—FFY 2017* was submitted simultaneously to the Boston Region MPO.

[2] Unified Planning Work Program, Federal Fiscal Year 2017, endorsed by the Boston Region Metropolitan Planning Organization on July 28, 2016.

1.3 SELECTION PROCEDURE

The MPO selected the Route 1A corridor in Wrentham to study through a process that involved assessing potential study locations on 25 roadway corridors in the Boston region. The potential study locations were identified from various sources: suggestions heard during the outreach process for the FFY 2017 UPWP; concerns documented in meeting records from the UPWP outreach process during the past five years; and the MPO's Congestion Management Process (CMP). The MPO staff assembled detailed data about these roadways and evaluated them according to five selection criteria:

- *Safety Conditions*: The roadway has a high crash rate for its functional class, or a significant number (two or more per mile) of collisions involving pedestrians or bicyclists.
- *Multimodal Significance:* The roadway supports transit, bicycle, or pedestrian activity, or accommodates large numbers of heavy vehicles (trucks/buses).
- *Subregional Priority:* The roadway carries a significant proportion of subregional vehicle, bicycle, or pedestrian traffic and is essential for the subregion's economic, cultural, or recreational development.
- *Implementation Potential:* Roadway improvements are proposed or endorsed by the agency or agencies that administer the roadway and have strong support from stakeholders.
- *Regional Equity*: The roadway is situated in a subregion that has not been selected for the *Subregional Priority Roadways* study in the past two years[3].

The Route 1A corridor in Wrentham contains several high-crash locations that must be improved for the safety and mobility of motor-vehicle and truck drivers, transit riders, bicyclists, and pedestrians. Major portions of the corridor have the potential to be redesigned as a Complete Streets roadway.[4] Improvements to the study site are strongly supported by all stakeholders, including the Town of Wrentham and MassDOT.

[3] Details of the criteria and rating system may be found in the Central Transportation Planning Staff's technical memorandum "Selection of Study Location: FFY 2016 Addressing Safety, Mobility, and Access on Subregional Priority Roadways," February 17, 2016.

[4] According to Smart Growth America, a Complete Street is a street for everyone. Complete Streets are designed and operated to enable safe access for all users, including pedestrians, bicyclists, motorists, and transit riders, of all ages and abilities. Complete Streets allow for ease of crossing the street, walking to shops, and bicycling to work.

1.4 STUDY AREA AND DATA COLLECTION

The study area is a 3.1-mile section of Route 1A between Route 140 near the Wrentham Common to the Plainville town line. All segments of the corridor are under the jurisdiction of MassDOT Highway Division District 5.

At the request of MPO staff, MassDOT collected traffic volume data, spot speed data, and intersection turning movement counts (including pedestrian and bicycle movements and the percentage of heavy vehicles) for this study. The data were collected in spring 2017, between May 15 and May 21. The period covers week and weekend days for analysis purposes. MPO staff also collected information from the Town of Wrentham and MassDOT, including recent transportation and land-use studies, information about prospective developments, and multiple-year police crash reports.

1.5 STUDY ADVISORY COMMITTEE MEETINGS

During the course of the study, MPO staff worked closely with an advisory group whose members included representatives of the Town of Wrentham and MassDOT. (See Appendix A for a complete list of advisory committee members.) Two advisory committee meetings were held to guide and support the study.

In the first meeting (April 13, 2017), MPO staff introduced the study, received input about the corridor's issues and concerns, and coordinated data collection. In the second meeting (September 12, 2017), MPO staff reviewed the findings and the proposed improvements with advisory committee members. After the meetings, staff received comments and revised the proposed improvements accordingly.

Chapter 2—Existing Conditions and Issues

2.1 CORRIDOR LOCATION

Route 1A in Massachusetts is a 95-mile long state highway that runs north to south, from Salisbury Beach at the New Hampshire border to Attleboro at the Rhode Island border. Route 1A connects to four interstate highways (I-95, I-495, I-93, and I-90) and several state highways, and it serves many cities and towns, including Boston.

In Wrentham, Route 1A connects I-495 and Route 140 and carries a high proportion of regional traffic. It also is the most significant roadway in town that local residents frequently use to reach the downtown and adjacent communities.

The Route 1A study corridor, South Street, is approximately 3.1 miles from Route 140 near the Wrentham Common to the Plainville town. All segments of the corridor are classified as a minor urban arterial. As shown in Figure 1, the corridor connects I-495, Route 140 (principal urban arterial), and three other minor urban arterials, i.e., Route 121 (West Street), Taunton Street, and Creek Street.

2.2 TRANSIT SERVICE

The Greater Attleboro Taunton Regional Transit Authority (GATRA) provides bus service to 28 communities from Southern Norfolk County and Northern Bristol County to Plymouth County and in the South Shore area.

GATRA's Tri-Town Connector bus route runs between Norfolk Station on the Massachusetts Bay Transportation Authority (MBTA) commuter rail system to the Big Y Supermarket in the Town of Franklin via Route 1A and Route 140. Although the route does not travel in the study corridor, it has a major stop at the intersection of Route 1A and Route 140.

The Tri-Town Connector provides eleven round trips during weekdays (six in the morning and five in the afternoon) and eight round trips on Saturday. The frequency of service appears to be sufficient to meet demand, since the buses are not overcrowded.

2.3 PEDESTRIAN AND BICYCLE FACILITIES

Sidewalks exist on both sides of Route 1A in the downtown area of Wrentham from Route 140 to Randall Road. Sidewalks are present only on the north side Route 1A from Randall Road to the intersection of Route 1A at Route 121 (also

known as Wampum Corner). No sidewalks exist in the corridor south of Wampum Corner, except a limited section under the bridges of I-495. No bicycle lanes or separated bicycle lanes exist along the corridor. Roadway shoulders, generally two feet or less in width, are too narrow to accommodate bicycles.

There is an electric utility corridor running parallel to Route 1A from Route 140 to the Plainville town line via Wampum Corner and Wrentham Village Premium Outlets (Figure 1). This utility corridor, formerly the right-of-way of the Old Colony Railroad Wrentham Branch, is currently unpaved but graveled for utility maintenance. Since Route 140 is a designated regional bicycle route, residents in the region would benefit if the corridor could be developed into a safe multi-use trail.

MPO staff evaluated the pedestrian accommodation and safety improvement needs for the corridor by applying the Pedestrian Report Card Assessment tool that the MPO recently developed.[5] This tool can be used to grade a given roadway for the quality of pedestrian travel it provides. The assessment for Route 1A in Wrentham indicates that the corridor highly qualifies as in need of improvements for pedestrian accommodation and safety. Appendix B contains detailed results of the assessment.

2.4 ROADWAY CONDITIONS AND ADJACENT LAND USES

The roadway conditions and adjacent land uses of the corridor vary considerably. Based on the different land-use characteristics, the corridor may be divided into the three sections described below.

2.4.1 Route 1A from Route 140 to Creek Street

The section of Route 1A from Route 140 to Creek Street is about one-half mile in length and includes the intersections of Route 1A at Route 140 and at Creek Street. It is a two-lane roadway. The majority of the section is in the downtown business district between Route 140 and Randall Road. It contains a number of local stores, shops, restaurants, Town Hall, and the town's central open space, Wrentham Common, which occupies the area south of Route 1 near the Route 140 intersection. South of Randall Road, the adjacent land use is primarily residential.

Route 140 and Taunton Street join Route 1A and bring additional cross-town and local traffic to the Wrentham Common area. Traffic is busy during peak travel

[5] Pedestrian Level-of-Service Memorandum, Ryan Hicks and Casey-Marie Claude, Boston Region Metropolitan Organization, January 19, 2017.

hours, especially during the evening commuting hours. Pedestrians, attracted to Wrentham Common and Sweatt Park and the stores in the downtown area, are active during noontime and evening hours.

Sidewalks (five feet or more in width) exist on both sides along Route 1A from Route 140 to Randall Road. South of Randall Road, sidewalks exist only along the north side of the roadway. The sidewalks are separated from the roadway by a five-foot grass traffic buffer.

There are 50 on-street parking spaces along both sides of Route 1A from Wrentham Common to the Town Hall. More than half of them (30 spaces) are angle parking; all of these spaces are located on the north side adjacent to the local stores. The angle-parked vehicles block the views of drivers and crossing pedestrians, and vehicles backing out of the spaces often interfere with Route 1A traffic.

Route 1A at Route 140 is signalized but the signal control system is outdated. Route 1A at Common Street is unsignalized, with the Common Street approach under stop control. Common Street, connecting Route 1A and Route 140 diagonally, serves as a short cut between the two arterials. The stop-controlled Common Street is congested during weekday peak hours, especially in the evening.

Route 1A at Creek Street is unsignalized, with the Creek Street approach under stop control. Creek Street is a popular route that drivers traveling to and from Route 140 use to bypass the congested Route 1A/Route 140 intersection. The stop-controlled Creek Street approach is usually congested during peak hours.

2.4.2 Route 1A from Creek Street to I-495 Interchange

The section of Route 1A from Creek Street south to the I-495 interchange is about one and a half miles long. It is a two-lane roadway that passes through a primarily residential district, except for some commercial developments in the vicinity of Wampum Corner (the junction of Route 1A and Route 121).

Sidewalks (generally five feet wide) with five-foot grass buffers exist on the north side of Route 1A from Creek Street to Wampum Corner. South of Wampum Corner, no sidewalks exist on either side. There are no bike lanes and roadway shoulders are generally two feet or less in width.

There are two major intersections in this section of Route 1A. One, at the intersection of Route 1A and Route 121, has been recently signalized. Traffic is busy during peak hours, but the intersection generally operates acceptably with

no major congestion. Vehicles usually can pass the intersection within a signal cycle.

The other, at the intersection of Route 1A and Beach Street, is unsignalized, with the Beach Street approach under stop control. Beach Street is a local street connecting Route 1A and Taunton Street and is frequently used by drivers as a short cut to reach Route 1 to the south via Taunton Street. The stop-controlled Beach Street can be congested at times during the peak hours, especially in the evening.

2.4.3 Route 1A from I-495 Interchange to Plainville Town Line

The section of Route 1A from the I-495 northbound ramps to the Plainville town line is approximately one mile in length. The two-lane roadway widens to four lanes at the I-495 interchange and continues as four lanes through Wrentham Village Premium Outlets to Wrentham Crossing. South of the Wrentham Crossing intersection, it tapers down to two lanes to the Plainville town line.

The adjacent areas in this section of Route 1A are commercial and industrial districts. Wrentham Village Premium Outlets, a very popular large-scale outlet mall, dominates the area west and southwest of the I-495/Route 1A interchange. The mall contains more than 2,000 parking spaces and can only be accessed from Route 1A. Wrentham Crossing was developed recently and is still on the market for undetermined commercial uses. The areas south of Wrentham Crossing are mostly undeveloped land.

There are four signalized intersections in this section: Route 1A at the I-495 northbound ramps, Route 1A at the I-495 southbound ramps, Route 1A at Premium Outlets Boulevard, and Route 1A at Wrentham Crossing. Traffic signals at the four intersections are coordinated to advance Route 1A traffic flows.

Traffic at the I-495 interchange during weekday peak commuting hours is busy but not overly congested. However, during weekend peak shopping hours, traffic to and from the outlets mall is heavy and can at times affect the interchange operations. On holidays and significant weekends, such as the back-to-school weekend, the extensive traffic attracted by the mall can seriously affects the interchange operations.

2.5 ISSUES AND CONCERNS

Based on discussions with the study advisory committee members and data analyses, major issues and concerns of the corridor are as follows:

- The corridor has a high crash rate overall.

- There are high crash rates at major intersections in the section of the roadway adjacent to Wrentham Common and the section from I-495 to the Premium Outlets Boulevard.
- Traffic is congested during peak hours at major intersections near Wrentham Common.
- Traffic to Premium Outlets during weekend and holiday peak hours affects Route 1A and I-495 interchange operations.
- There are prospective business developments in the two already congested areas (Wrentham Downtown and the area south of I-495).
- Sidewalks do not exist throughout the entire corridor, but only in limited sections.
- The corridor lacks bicycle accommodations.
- Narrow roadway shoulders are two feet or less is width.

Issues and concerns about specific locations in the corridor, where analyses identified safety and operational problems, and the proposed improvements are summarized by location in Chapter 5.

Chapter 3—Roadway Operations Analysis

3.1 DAILY TRAFFIC VOLUMES

Daily traffic volumes are the fundamental data for analyzing traffic intensity and patterns in a roadway corridor. MassDOT conducted Automatic Traffic Recorder (ATR) traffic counts at a number of locations in the corridor and on adjacent streets during the weekday period of May 15 (Monday) to May 19 (Friday), 2017.

Figure 2 shows daily traffic volumes at these locations. The numbers in the graphic represent average daily directional volumes collected this May. The two tables in the graphic further summarize the data by count locations, directional split, combined volume of both directions, and adjusted annual average daily traffic (AADT).

The May counts show that the corridor carried a wide range of daily traffic volumes. The busiest section of Route 1A, between the I-495 southbound ramps and Premium Outlets Boulevard, carried nearly 25,000 vehicles per day. The section between downtown Wrentham and Wampum Corner carried about 17,000 to 19,000 vehicles per day. The section from Wampum Corner to I-495 carried about 13,500 vehicles per day, less than all other sections in the corridor.

Traffic volumes in May were somewhat higher than the annual average. Adjusted for the seasonal factors, the busiest section of Route 1A, between the I-495 southbound ramps and Premium Outlets Boulevard, carried about 23,000 AADT and the section between downtown Wrentham and Wampum Corner carried about 16,000 to 18,000 AADT.

3.2 INTERSECTION TRAFFIC, PEDESTRIAN, AND BICYCLE VOLUMES

In addition to daily traffic counts, MassDOT collected turning movement counts at major intersections in the study corridor, including vehicle movements (by vehicle types), bicycle movements, and pedestrian crossings. These data were collected during the morning peak period (7:00 AM – 9:00 AM) and the evening peak period (4:00 PM – 6:00 PM) on Thursday, May 18, 2017, and during the midday peak period (10:00 AM – 2:00 PM) on Saturday, May 20, 2017. MPO staff then identified the peak hour in each of the peak periods for use in various traffic operational analyses.

Figure 3 shows the weekday peak-hour traffic and pedestrian volumes at major intersections in the corridor. In general, the Route 1A intersections carried about 1,500 to 2,200 entering vehicles per AM or PM peak hour. The intersections of Route 1A at Route 140 and at Premium Outlets Boulevard carried about 500 more vehicles than the other intersections. Figure 3 also shows the weekday

traffic volumes at the three unsignalized intersections on the roadways around Wrentham Common. They all carried about 900 to 1,200 vehicles per peak hour. The pedestrian crossings mainly occurred at the intersections in the downtown area. There were nearly 40 pedestrian crossings at the Common Street intersection and about 10 crossings at the Route 140 intersection the PM peak hour.

The turning movement counts provide a snapshot of bicycle activities in the corridor. On Thursday, May 18, the corridor carried two to four bicycles in the AM peak hour and two to three bicycles in the PM peak hour. The bicyclists mostly traveled between downtown Wrentham and Wampum Corner; these trips were likely commuter trips. On Saturday, May 20, more bicycles (four to six per hour) were observed to travel in the corridor between 10:00 AM and 12:00 PM. Compared to the weekday counts, the Saturday counts show more bicycle activity in Wrentham Common area and the Route 1A section south of I-495. The turning movement counts were collected in the springtime. The corridor's pedestrian and bicycle volumes presumably would be higher in the summertime.

Figure 4 shows the Saturday peak-hour traffic and pedestrian volumes at selected intersections in the corridor. Most intersections in the downtown and Wrentham Common area carried less traffic (about 10 percent) in the Saturday peak-hour than in the weekday PM peak hour. The Common Street intersection had about 50 pedestrian crossings during the Saturday peak hour, more than the crossings in the weekday PM peak hour.

On Saturdays, traffic in the I-495 interchange area increases significantly during midday shopping hours. The intersections at the I-495 southbound ramps and Premium Outlets Boulevard carried about 30 to 42 percent more traffic in the Saturday peak hour than in the weekday PM peak hour.

It is essential to examine the amount of heavy-vehicle traffic in a study corridor, as an unusually high percentage of heavy vehicles (trucks and buses) may seriously affect roadway operations. The weekday turning movement counts by vehicle type indicate that, on average, at most intersections in the corridor heavy vehicles accounted for about five percent to 10 percent of the traffic in the AM peak hour and about one percent to two percent in the PM peak hour. The percentage of heavy-vehicle traffic was higher at the locations south of I-495, accounting for between eight to 16 percent of the traffic in the AM peak hour and two to three percent in the PM peak hour. The percentage of heavy-vehicle traffic in the Saturday peak hour was similar to that of the PM peak hour at all the major intersections.

Data on the percentage of heavy-vehicle traffic by direction of approach to the major intersections are counted in the traffic analyses and the traffic simulation

models used in this study. The capacity analyses detailed in the following sections indicate that the existing percentages do not seriously affect traffic operations at any of the intersections.

3.3 INTERSECTION CAPACITY ANALYSES

Based on the turning movement counts, MPO staff constructed peak-hour traffic models for the entire corridor and conducted capacity analyses for major intersections by using the Synchro traffic analysis and simulation program.[6] The model set consisted of weekday AM, weekday PM, and Saturday midday peak-hour models, with scenarios that assumed existing conditions and various proposed improvement alternatives.

Figure 5 shows the results of weekday AM and PM peak-hour capacity analyses for existing conditions at major intersections in the corridor and the level-of-service (LOS) each intersection provides. The LOS was determined based on criteria from the Highway Capacity Manual (HCM).[7] The HCM defines LOS—using a qualitative scale from A to F—for signalized and unsignalized intersections as a function of the average vehicle control delay.[8] For the intersections in a metropolitan urban area, LOS A, B, and C are considered desirable; LOS D and E are considered acceptable; and LOS F is considered undesirable.

The signalized intersections on the Route 1A corridor in Wrentham generally operate at LOS C or better in both the peak AM and PM hours, except the intersection of Route 1A at Route 140. The Route 140 intersection operates at LOS F in the PM peak hour. The poor LOS is mainly caused by traffic congestion on the Route 140 northbound approach and the average delay is estimated as more than two minutes per vehicle. The northbound approach has only one lane shared by all movements. Vehicles traveling through the intersection and those making right-turn movements are frequently blocked by left-turning vehicles. Details of the analyses for major intersections in the Synchro 2017 AM and PM models are included in Appendix C.

At the unsignalized intersection of Route 1A at Common Street, the westbound approach is estimated to operate at LOS F, with an average delay of more than

[6] Synchro Version 9.0 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.

[7] *Highway Capacity Manual 2010*, Transportation Research Board of the National Academies, Washington D. C.

[8] Control delay quantifies the increase in travel time that a vehicle experiences due to a traffic signal or other type of control. It also provides a surrogate measure for driver discomfort and fuel consumption.

two minutes in the AM and PM peak hours. MPO staff conducted a preliminary analysis of the need for a traffic signal at the intersection.[9] The analysis found that a traffic signal is justified at the intersection, as Warrant 1 (Eight-Hour Vehicular Volume) and Warrant 2 (Four-Hour Vehicular Volume) are satisfied based on the May counts. Appendix D contains the preliminary analysis of signal needs for this and other unsignalized intersections in the study corridor.[10]

Figure 6 shows Saturday midday peak-hour capacity analyses for existing conditions at selected intersections in the corridor. In the Wrentham Common and downtown areas, all the intersections operate at an acceptable LOS, including the intersections at Route 140 and at Common Street. However, the northbound approach of the Route 140 intersection and the westbound approach of the Common Street intersection operate at LOS F and there are noticeable delays.

In the commercial area around the 1-495 interchange, Saturday peak-hour traffic operations at major intersections deteriorate somewhat from the weekday PM peak hour. The intersection of Route 1A and the I-495 southbound ramps operates at acceptable LOS C, but vehicles on the eastbound left-turn approach (from I-495 southbound to Route 1A northbound) endure extensive delays. The intersection of Route 1A and Premium Outlets Boulevard operates at acceptable LOS C; however, the eastbound left-turn approach (from the mall to Route 1A northbound) operates at LOS E. The left-turning vehicles can use both the inside lane and the center lane (shared with through moving vehicles). The center lane is usually underutilized, however, because the lane designation signs are poorly placed and visitors to the area are not aware that they can turn from that lane.

Details of the analyses for major intersections in the Synchro Saturday midday peak-hour model are included in Appendix E.

3.4 ROADWAY TRAVEL SPEEDS

Wrentham residents have expressed concern about the travel speeds on the Route 1A corridor. In order to examine the prevailing travel speeds versus regulated speeds, MPO staff asked MassDOT to collect spot-speed data during the period when automatic traffic counts were being conducted, from May 15 to May 20, 2017.

[9] Chapter 4C Traffic Control Signal Needs Studies, *Manual on Uniform Traffic Control Devices*, 2009 Edition with Revisions 1 and 2, Federal Highway Administration, US Department of Transportation, May 2012.

[10] Warrant 1 requires that specific traffic conditions (observed vehicular volumes higher than specified minimum volumes) exist for each of any eight hours of an average day.

Figure 7 shows the existing speed regulations and estimated 85th percentile speed at selected locations in the corridor, based on spot-speed counts collected from automatic traffic recorders. The 85th percentile speed is the speed at or below which 85 percent of vehicles passing a given point are traveling, and is the principal value used to establish speed controls by the state.

Currently, the posted speed limit on most sections of the corridor is 40 miles per hour (mph) in both directions, except the sections in the downtown area and at Wampum Corner. The sections with other regulated travel speeds are as follows:

- Route 1A from the north of Route 140 to the north of Randall Road: 25 mph
- Route 1A from the north of Randall Road to the north of Creek Street: 35 mph
- Route 1A in the vicinity of Wampum Corner: 20 mph

Most of the speed limit signs for these regulations are placed appropriately along Route 1A, except one on the southbound approach toward Wampum Corner. There is a warning sign, stating “Reduced Speed Limit (20 mph) Ahead,” about 1,500 feet before Wampum Corner, but the speed limit sign itself is difficult for drivers to observe. The sign is located too far from the roadside and hidden by foliage from the adjacent property.

The estimated 85th percentile speeds recorded at the four selected locations on Route 1A generally were one to three mph higher than the regulated speeds, except at the section between Wampum Corner and I-495 where the 85th percentile speed was estimated to be six to seven mph higher than the regulated speed.

While the prevailing speeds in the corridor may appear high, the estimated speeds at the four locations indicate that they are all within the acceptable range.[11] No modifications of speed regulation in the corridor are currently proposed. Before any speed regulation could be changed, an engineering study, using speed data collected from radar or laser guns, would have to be undertaken.[12]

[11] Based on “Procedures for Speed Zoning on State and Municipal Roadways” (MassDOT Highway Division, May 2012), establishing speed regulations require that at speed observation locations, the established safe speed shall not be more than seven mph below the 85th percentile speed, and not higher than the 95th percentile speed.

[12] To establish or modify speed controls, MassDOT requires the collection of speed data by radar gun or laser gun at critical locations at intervals not to exceed 0.25 miles, in addition to vehicle trial runs in the study area.

Chapter 4—Crash Data Analysis

4.1 CRASH LOCATIONS AND CRASH CLUSTERS

Crash data are an essential resource for identifying safety and operational problems in a study area. Analyzing data on the number of crashes and types of collisions that occur at particular locations, and the circumstances under which crashes occur, such as the time of day and roadway surface conditions, also helps to develop improvement strategies. For this study, MPO staff collected two datasets:

- MassDOT Registry of Motor Vehicles (RMV) Division crash data for the years 2010 through 2014
- Crash reports from the Wrentham Police Department (WPD) for a three-year period – January 2014 to March 2017

Staff used the MassDOT data to examine crash locations and identify high-crash locations. The police crash reports were used to construct collision diagrams and estimate crash rates for identifying safety and operational problems at the major intersections and in different segments of the corridor.

Figure 8 shows the crash locations and crash clusters in the corridor, based on the MassDOT data. Based on MassDOT's crash cluster data for the years 2012 through 2014, there are five noticeable crash clusters.[13] The most significant cluster is at the intersection Route 1A and Premium Outlets Boulevard, where 97 crashes occurred in the three-year period. This location is ranked 22nd among the top 200 crash locations statewide in for that period. The value of the crash severity for this location, as estimated using the Equivalent Property Damage Only (EPDO) scale, is 181.[14]

The other four crash cluster locations are eligible to receive funding through MassDOT's Highway Safety Improvement Program (HSIP) because they are ranked in the top five percent of crash locations in the Boston Region MPO area, based on 2012–14 MassDOT crash cluster data. The four locations are as follows:

[13] A crash cluster is identified by mapping a circle with a 25-meter (82-foot) radius from each crash location, and observing where the spheres of two or more crashes overlap.

[14] MassDOT uses approximated EPDO values to rank the statewide top 200 crash locations. In the estimation, crashes that result in a fatality are weighted by 10, crashes that cause injury are weighted by five, and crashes that cause property damage only (or the severity of the crash is unknown), are not weighted.

- Route 1A at Route 140: EPDO value = 52
- Route 1A between the I-495 northbound and southbound ramps: EPDO value = 52[15]
- Route 1A at I-495 northbound ramps: EPDO value = 45
- Route 1A at I-495 southbound ramps: EPDO value = 44

4.2 CRASH RATES

MPO staff estimated that the entire 3.1-mile corridor has a crash rate of 4.53 crashes per million vehicle-miles traveled (MVMT), based on the recent three-year WPD crash reports and an average of the recently collected traffic counts. This crash rate is higher than the statewide average for minor principal arterials (3.70 crashes per MVMT, updated January 2017, based on 2014 crash data).

Further, staff estimated the corridor crash rates by four segments based on the adjacent land uses of the roadway. The segment crash rates are as follows:

- Route 1A from Route 140 to the south of Randall Road (mainly business districts): 7.38 crashes per MVMT
- Route 1A from the south of Randall Road to the north of the I-495 northbound ramps (mainly residential districts): 2.32 crashes per MVMT
- Route 1A from the north of the I-495 northbound ramps to the south of Premium Outlets Boulevard (mainly commercial districts): 9.33 crashes per MVMT
- Route 1A from the south of Premium Outlets Boulevard (mainly undeveloped lands): 1.87 crashes per MVMT

The crash rates for the segments in the business and commercial districts are much higher than the state average crash rate, especially the segment between I-495 and Premium Outlets Boulevard. Appendix F contains worksheets showing the crash rate calculations for the corridor segments.

Staff also estimated the crash rates at major intersections in the corridor and at Wrentham Common, based on the WPD data and the intersection traffic counts. The crash rate estimated for the signalized intersections are as follows:

- Route 1A at Route 140: 0.87 crashes per million entering vehicles (MEV)

[15] A further review of the crash data found that some crashes occurred on I-495 but were geocoded on Route 1A. Excluding those crashes, the section actually has an EPDO value of 39, instead of 52.

- Route 1A at Route 121: 0.78 crashes per MEV
- Route 1A at the I-495 northbound ramps: 0.91 crashes per MEV
- Route 1A at the I-495 southbound ramps: 1.96 crashes per MEV
- Route 1A at Premium Outlets Boulevard: 1.48 crashes per MEV

The average crash rate for signalized intersections in MassDOT District 5 is 0.76 crashes per MEV (updated February 2016, based on 2015 crash data). All the signalized intersections above have a crash rate higher than the district average. The crash rate for Route 1A at Route 121 is just above the district average. The two intersections in the I-495 commercial district, Route 1A at the I-495 southbound ramps and at Premium Outlets Boulevard, have a crash rate much higher than the district average.

The crash rate estimated for the unsignalized intersections in the corridor are as follows:

- Route 1A at Common Street: 0.98 crashes per MEV
- Common Street at Taunton Street: 0.97 crashes per MEV
- Common Street at Route 140: 0.67 crashes per MEV
- Route 1A at Creek Street: 0.57 crashes per MEV
- Route 1A at Beach Street: 0.49 crashes per MEV

The average crash rate for unsignalized intersections in MassDOT District 5 is 0.58 crashes per MEV. The three intersections at Wrentham Common—Route 1A at Common Street, Common Street at Taunton Street, and Common Street at Route 140—all have a crash rate higher than the district average. The Creek Street intersection has a crash rate almost equal to the district average. Appendix G contains worksheets showing the crash rate calculations for the intersections in the corridor.

4.3 PEDESTRIAN AND BICYCLE CRASHES

Figure 8 shows the locations of crashes in the corridor that involved pedestrians and bicyclists, based on both 2010–14 MassDOT crash data and 2014-16 WPD data.[16] In total, two pedestrian crashes and one bicycle crash were identified in the seven-year period. The locations, dates, times, and conditions of these crashes are summarized below.

[16] In this study, the term “pedestrian crashes” refers to crashes that involve at least one vehicle and one pedestrian; “bicycle crashes” refers to crashes that involve at least one vehicle and one bicycle. No crashes between at least one bicycle and one pedestrian were identified in the available data.

- Route 1A at Route 140: A pedestrian crash occurred on August 10, 2015, at 6:40 PM, on the southbound right-turn lane (Bank Street) involving a driver who fell out of his car after parking and was injured by another vehicle traveling on Bank Street.
- Route 1A southbound approach to Wampum Corner: A bicycle crash occurred on July 23, 2012, at 3:11 PM, involving a vehicle that sideswiped a bicyclist traveling in the same direction and causing injury.
- Route 1A at Premium Outlets Boulevard: A pedestrian crash with an injury occurred on July 14, 2012, at 1:43 PM, probably in the Premium Outlets parking lot, involving a vehicle that was backing up.

4.4 COLLISION DIAGRAMS AND CRASH STATISTICS

To investigate safety and operational problems further, MPO staff constructed collision diagrams for the entire corridor—for major intersections and roadway segments between those intersections—based on recent three-year WPD crash reports. The police crash reports, containing descriptions of how and where those crashes occurred, are useful in constructing collision diagrams.

Appendix H presents the collision diagrams for locations in the corridor. It also contains a series of tables summarizing the crash data used for each location. The summary statistics include crash severity (property damage only, non-fatal injury, fatality, or unknown), collision type (single-vehicle, rear-end, angle, sideswipe, head-on, rear-to-rear, or unknown), pedestrian or bicycle involvement, time of day, pavement conditions, and light conditions.

The collision diagrams are useful in identifying safety and operational problems at major intersections or roadway segments in the corridor. The identified problems are discussed in the context of proposed improvements in the next chapter.

Chapter 5—Proposed Improvements

Based on the analyses described in the previous chapters, MPO staff developed a series of short- and long-term improvements to address safety and operational problems on the Route 1A corridor in Wrentham. Short-term improvements generally can be implemented within two years at relatively low cost. Long-term improvements are more complicated and cover larger areas, and require intensive planning and design, and significant funding. As the corridor covers an extensive length of roadway with different land-use characteristics, we describe the proposed improvements in the three sections below.

5.1 ROUTE 1A FROM ROUTE 140 TO CREEK STREET

Table 1 lists the proposed short- and long-term improvements for the section of Route 1A from Route 140 (Franklin Street/East Street) to Creek Street, and documents the issues and concerns associated with this section of Route 1A. Recommendations are provided for the roadway section overall and for specific locations, as well as for roadway and intersections in and around Wrentham Common, as they are interrelated to the Route 1A operations in the downtown area.

Major issues and concerns in the section include the following:

- There are considerable traffic volumes on the two-lane section in the downtown business district during AM and PM peak hours.
- There are considerable traffic volumes on Route 140 and Taunton Street, joining Route 1A at Wrentham Common, during peak hours.
- Common Street, connecting Route 1A and Route 140 diagonally through Wrentham Common, becomes a cut-through route during peak hours with fasting moving traffic.
- Prospective developments on the north side of Route 1A are likely to increase traffic at the already congested intersections.
- There are high crash rates at the intersections of Route 1A and Route 140, Route 1A and Common Street, and at the intersections adjacent to Wrentham Common.
- Angle on-street parking interferes with Route 1A traffic and hinders the views of pedestrians and drivers.
- The roadway lacks separated bicycle accommodations.
- Traffic signals are not equipped with a preemption function for emergency vehicles.

- Approaching Route 1A on Creek Street, drivers' view to the stop sign is obscured by a tree and nearby vegetation.

Proposed short-term improvements for this section of Route 1A include the following:

- Double up stop signs, so that signs are on both the left and right sides of the street, to enhance drivers' views of the stop control at Creek Street.[17]
- Consider converting the existing two-way stop control to all-way stop control at the intersection of Taunton Street and Common Street (requires further engineering review).
- Consider converting the existing angle-parking to parallel parking (requires collaboration with the adjacent businesses).
- Change the traffic control on Common Street at Route 140 from "Yield" to "Stop."
- Stripe yield lines (shark teeth) at mid-block crosswalks to alert approaching drivers of pedestrians.
- Regularly maintain crosswalk pavement markings.

As shown in Figure 9, the proposed long-term improvements in the segment include the following:

- Further study and design the three proposed improvement plans for the roadways in the Wrentham Common and downtown area (described in Section 5.2).
- Reconstruct and upgrade the outdated signal system at the Route 140 intersection.
- Close Bank Street and redesign the area as a flag-pole square connecting Wrentham Common and Sweatt Park.
- Reconstruct the Common Street intersection.
- Rearrange on-street parking on the north side of Route 1A between Route 140 and Common Street.

[17] Doubling up of a standard regulatory, warning, or guide sign enhances the conspicuity of the standard sign by adding a second identical sign on the left-hand side of the roadway. It is permissible per the requirements of the *Manual on Uniform Traffic Control Devices* (MUTCD, Chapter 2: Section 2A.15) and the Federal Highway Administration's guidelines of Proven Safety Countermeasures. In this case, the sign on the left-hand side would supplement the obscured sign on the right-hand side.

- Reconstruct Route 1A from Randall Road to Creek Street by adding five-foot shoulders on both sides for bicycle accommodation, a five-foot grass buffer, and five-foot sidewalks on the south side for pedestrians.
- Reconstruct and signalize the Creek Street intersection.
- Include an emergency-vehicle preemption function in all the new and upgraded traffic signals.

5.2 LONG-TERM IMPROVEMENT PLANS FOR THE WRENTHAM COMMON AREA

MPO staff proposed three long-term improvement plans for the Wrentham Common area.

As shown in Figure 10, major components of the proposed Plan A improvements include the following:

- Reconstruct the Route 1A and Route 140 intersection by relocating the existing southbound right-turn lane (Bank Street) to Franklin Street and adding left-turn lanes on the northbound, southbound, and westbound approaches.
- Redesign the Bank Street area as a small square connecting Wrentham Common and Sweatt Park.
- Reconstruct and signalize the Route 1A and Common Street intersection (see Table 1 for the proposed major long-term improvement items at the intersection).
- Relocate David Brown Way to align with Taunton Street and intersect Route 140 perpendicularly (providing more park space on the Common).
- Convert the Taunton Street and Common Street intersection from two-way to all-way stop control.[18]
- Reconstruct the Route 140 and Common Street intersection by realigning Common Street, adding a left-turn bay on Route 140, and changing Common Street's operation from yield to stop control.
- Rearrange on-street parking on the north side of Route 1A.
- Add on-street parking spaces on Common Street and David Brown Way.

[18] A preliminary analysis of the intersection's hourly approaching volumes indicates that it meets the MUTCD criteria for a multiway stop control. The preliminary analysis is included in Appendix D.

As shown in Figure 11, major components of the proposed Plan B improvements include the following:

- Reconstruct the Route 1A and Route 140 intersection (as in Plan A).
- Redesign the Bank Street area (as in Plan A).
- Reconstruct and signalize the Route 1A and Common Street intersection.
- Relocate David Brown Way (similar to Plan A) and make the street one-way southbound only.
- Convert the Taunton Street and Common Street intersection from two-way to all-way stop control.
- Reconstruct and signalize the Route 140 and Common Street intersection.
- Rearrange on-street parking on the north side of Route 1A (as in Plan A).
- Add on-street parking spaces on Common Street and David Brown Way.

As shown in Figure 12, major components of the proposed Plan C improvements include the following:

- Reconstruct the Route 1A and Route 140 intersection by relocating the southbound right-turn lane, adding left-turn lanes on the northbound and westbound approaches, and adding a through and left-turn shared lane on the southbound approach.
- Redesign the Bank Street area (as in Plans A and B).
- Reconstruct the Route 1A and Common Street intersection, but maintain stop control.
- Relocate David Brown Way and signalize the intersection at Route 140.
- Disconnect Common Street from Route 140 by forming a cul-de-sac on Common Street.
- At the intersection of Taunton Street and Common Street, switch the two-way stop control from Taunton Street to Common Street.
- Rearrange on-street parking on the north side of Route 1A.
- Add on-street parking spaces on Common Street.

Staff developed and designed the three conceptual plans based on examination of projected future-year (2040) traffic volumes and capacity analyses resulting from Synchro models. Figure 13 shows the projected 2040 AM and PM traffic volumes at the major intersections in the Wrentham Common area assuming the

proposed roadway layout and traffic controls in the three improvement plans. Figure 14 shows the intersection capacity analyses at major intersections, based on the projected 2040 traffic volumes, for the three plans.

The projected 2040 traffic volumes represent about 12 percent total growth from the current year.[19] Traffic circulation patterns in the three plans are different because of each plan's individual street layout in and around Wrentham Common. The traffic pattern in Plan A would be similar to the existing conditions. The traffic pattern in Plan B would be slightly different from Plan A, as most of the northbound traffic on David Brown Way would divert to East Street northbound via Common Street southbound.

The traffic pattern in Plan C would be quite different from Plans A and B. As Common Street would be disconnected from Route 140, the majority traffic on the street would divert to South Street (Route 1A) and East Street (Route 140), via the intersection of Route 1A and Route 140. As a result, the intersection would require a larger layout than Plans A and B in order to accommodate the increased traffic.

As shown in Figure 14, the 2040 peak-hour capacity analyses indicate that major intersections in all the three proposed plans would all operate at desirable or acceptable LOS during peak traffic hours. In addition, the proposed stop control changes at the intersection of Common Street and Taunton Street would reduce travel speeds on Common Street and improve safety for all users, especially for pedestrians. Synchro capacity analysis reports for major intersections in the three proposed plans under the projected 2040 traffic conditions are included in Appendices I, J, and K.

Staff also examined the possibility of installing modern roundabouts at two intersections: Route 1A at Route 140, and Route 140 at Common Street. Preliminary Synchro tests of the Route 1A and Route 140 intersection indicate that a double-lane roundabout would be required for acceptable traffic circulation at that location. The roundabout would require an inscribe circle measuring about 170 to 180 feet in diameter. The circle would take up Bank Street and the flag-pole square. This option would require potential land taking at two corners of the intersection and the removal of some on-street parking.

[19] The traffic growth projection is based on the transportation-planning model recently developed for the MPO's Long-Range Transportation Plan. The model predicts that traffic in the Wrentham downtown area would increase 0.5 percent annually from 2017 to 2040 in both AM and PM peak periods.

Synchro tests of the Route 140 and Common Street intersection indicate that a single-lane roundabout would operate acceptably. However, the roundabout would require a 130-foot diameter inscribed circle (not including sidewalks). Although the intersection is located in a relatively wide section of Route 140, substantial land taking on adjacent properties would be required.

The analyses indicate that a modern roundabout may not be suitable at either of the two locations. Appendix L contains the preliminary analyses with draft conceptual layouts of the roundabout options.

Staff discussed the three proposed plans with the study advisory committee members at the September 12, 2017, meeting. The members generally favored Plan A or Plan B instead of Plan C, mainly because of the consideration that Plan C would increase traffic at the Route 1A and Route 140 intersection and would potentially require land taking from the Wrentham Common.

The option of turning Common Street into a one-way street was discussed, but this option was not favored because of the consideration that traffic would increase on Route 1A and Route 140 (in the direction opposite to the one-way street) and that the one-way operation would potentially allow for fast moving traffic.

Study advisory committee members also concurred that converting on-street angle parking to parallel parking has several advantages, despite that a number of parking spaces would be lost in the conversion, including reducing traffic congestion and crashes on Route 1A and improving safety and mobility for pedestrians. The loss of parking spaces would be compensated by the additional parking spaces proposed in the three long-term improvement plans. Also, more parking spaces adjacent to the downtown business district could be available from an improvement plan for the Town Hall parking lot.[20]

Reverse (back-in/head-out) angle parking was discussed in the meeting. This option is not a recommendation of this study because of the considerations of the high traffic volumes on Route 1A, the roadway's limited width, and drivers' unfamiliarity with this parking maneuver.[21] However, this type of parking does have an advantage: from the reverse angle parking position, drivers have a

[20] The Town plans to expand the parking lot and improve access to it if the adjacent commercial building and parking lot at the corner of Route 1A and Common Street becomes available.

[21] Similar to the regular angle parking, reverse angle parking spaces would still require a minimal clearance of 28 feet (18 feet for parking space plus 10 feet for back-in maneuvering) and would encroach on the right of way of Route 1A traffic.

better view of on-road bicycles. This option should be further explored at the design stage.

In summary, the three proposed plans would provide general functionality for motorists, slow down traffic on Common Street, and improve safety and mobility for all users at major intersections in the Wrentham Common and downtown area. At this preliminary planning stage, this study does not recommend a specific plan. The three proposed plans can be used by the Town to discuss and advance a final transportation improvement plan for the area.

5.3 ROUTE 1A FROM CREEK STREET TO I-495 INTERCHANGE

Table 2 lists the proposed short- and long-term improvements for the section of Route 1A from Creek Street to I-495. Major issues and concerns in the segment include the following:

- There is a high volume of commuter traffic during the AM and PM peak hours along this two-lane roadway in mostly residential areas.
- Sidewalks (with a five-foot grass traffic buffer) exist only on the north side of Route 1A from Creek Street to Wampum Corner.
- There are no sidewalks on either side of Route 1A from Wampum Corner to the I-495 interchange.
- The roadway lacks separated bicycle accommodations.
- The speed limit sign on Route 1A southbound toward Wampum Corner is located too far from the roadside and hidden by vegetation.
- Approaching Route 1A on Beach Street, drivers' views to the stop sign is obscured by a tree.

Proposed short-term improvements in the segment include the following:

- Double up stop signs, so that signs are on both the left and right sides of the street, to enhance drivers' views of the stop control at Beach Street.
- Improve pavement markings and sidewalk conditions at the Route 121 intersection.
- Regularly maintain roadway pavement.
- Regularly clear overgrown vegetation.
- Relocate the speed-limit sign on Route 1A southbound to a roadside location that is easy for drivers to observe.

As shown in Figure 15, proposed long-term improvements in the segment include the following:

- Reconstruct Route 1A from Creek Street to Route 121 by adding five-foot shoulders on both sides for bicycle accommodation, a five-foot grass buffer, and five-foot sidewalks on the south side for pedestrians.
- On Route 1A from Route 121 to the I-495 interchange, plan to include five-foot shoulders and five-foot sidewalks on both sides (five-foot grass buffers are desirable, at least on the north side, to accommodate the existing utility poles) when future reconstruction or development projects emerge.
- Add a southbound left-turn bay at the Beach Street intersection.
- Add a crosswalk at the Route 121 intersection and upgrade the sidewalks on the northwestern side to a standard five-foot clearance.

Staff reviewed the Town's on-line assessors' maps and estimated that the segments of Route 1A from Creek Street to Route 121 generally have a right-of-way width of about 55 to 60 feet and the segments from Route 121 to I-495 generally have wider right-of-way of about 60 to 70 feet. The proposed additional or new sidewalks and five-foot shoulders for bicycle accommodation would be feasible in most sections without land takings.

Staff proposes wide shoulders, instead of striped (designated) or separated bicycle lanes, for bicycle accommodation because they are more suitable for suburban arterials with low volumes of bicycle traffic. Also, shoulders can sometimes be used for school bus and emergency vehicle parking or for other temporary uses. Striped bicycle lanes would require additional treatments at intersections and crossing locations and they should be considered during the corridor design phase providing that the additional treatments at intersections can be addressed. Separated bicycle lanes would require additional right-of-way for the installation of protection measures, which is not available in most sections of the corridor.

5.4 ROUTE 1A FROM I-495 INTERCHANGE TO PLAINVILLE TOWN LINE

Table 3 lists the proposed short- and long-term improvements for the segment of Route 1A from the I-495 interchange to the Plainville town line. Major issues and concerns in the segment include the following:

- The four-lane section of Route 1A that runs through the business districts between the I-495 northbound ramps and Wrentham Crossing experiences busy traffic in the evening and weekend peak hours.

- Traffic to the Wrentham Village Premium Outlets seriously affects Route 1A and I-495 interchange operations during weekend and holiday peak hours.
- Traffic is projected to increase significantly with the Wrentham Crossing project already in place and potential developments of the currently vacant commercial-industrial districts.
- A new I-495 southbound slip on-ramp, a mitigation measure from the Wrentham Crossing project, is currently under 25 percent functional design. However, it may not completely mitigate the future traffic increase.
- The section of Route 1A between the I-495 northbound ramps and Premium Outlets Boulevard has a high crash rate.
- There have been a significant number of crashes at the intersections of the I-495 southbound ramps and Premium Outlets Boulevard.
- There are no sidewalks, except at a limited section under I-495 on both sides.
- The roadway lacks separated bicycle accommodations.

Proposed short-term improvements in the segment include the following:

- Continue monitoring crash conditions at the I-495 southbound ramps and the Premium Outlets Boulevard intersections, as MassDOT recently installed a new flashing yellow arrow signal display to improve safety for left-turning vehicles at the two intersections.
- Continue monitoring traffic conditions and crash data in this segment.
- Regularly maintain pavement markings.

As shown in Figures 16 and 17, proposed long-term improvements in the segment include the following:

- Implement additional mitigation measures in conjunction with the new I-495 slip ramp to improve traffic operations and pedestrian and bicycle accommodations. Proposed measures include the following:
    - Rearrange Route 1A travel lanes between I-495 and Premium Outlets Boulevard to provide a continuous right-turn lane from I-495 southbound merging with Route 1A southbound.
    - Add a travel lane on Premium Outlets Boulevard westbound.
    - Add a lane to the existing off-ramp from I-495 southbound to Route 1A northbound.

    - Rearrange Route 1A travel lanes to include five-foot shoulders on both sides for bicycle accommodation.
- Work with adjacent businesses to provide sidewalks for pedestrians.
- Conduct a comprehensive parking and traffic management study to improve parking and traffic circulation in the Premium Outlets mall.

During holidays and certain weekends, such as the back-to-school weekend, traffic operations at the I-495 interchange can be seriously affected by vehicles whose occupants are making shopping trips to the Premium Outlets mall. The proposed new I-495 southbound slip ramp alone would not completely mitigate traffic congestion in the area, especially the congestion on Route 1A southbound. Only one right-turn entry currently exists for all vehicles arriving at the mall from I-495 and Route 1A southbound. During peak shopping hours, an extensive traffic queue usually forms on the outside (rightmost) lane of Route 1A, frequently blocking vehicles on the I-495 southbound ramps and affecting traffic operations on the ramps.

The proposed continuous right-turn lane from I-495 southbound to Route 1A southbound, the double right-turn lanes to the mall, and the additional lane on Premium Outlets Boulevard would significantly reduce traffic congestion on Route 1A southbound. The continuous lane would allow vehicles coming from the I-495 southbound off-ramp direct access to the mall without making any lane changes or merging with Route 1A southbound traffic. Vehicles traveling from the ramp to Route 1A southbound would need to make only one lane change. Meanwhile, vehicles coming from the I-495 northbound off-ramp could stay on the second lane to enter the mall or to continue on Route 1A southbound.

The existing layout necessitates that all vehicles coming from the I-495 southbound off-ramp merge with Route 1A southbound traffic. Those vehicles heading to Route 1A southbound must change lanes in weaving conditions with the Route 1A traffic going to the mall. The proposed improvements would significantly improve safety in this section of Route 1A by reducing the merging activities and alleviating the weaving conditions. During the design phase, further analyses of the proposed improvements should be conducted to assess mobility and safety benefits and to identify any unforeseen safety deficiencies.

Another critical component for reducing Route 1A traffic congestion is the management of the mall's on-site traffic operations, parking, and traffic circulation. The two on-site traffic signals should be examined for optimization and potential coordination with the Route 1A signals. The mall's parking demand and supply should be examined and recurring traffic circulation in the mall area should be minimized.

Figure 18 shows the projected 2040 weekend peak-hour traffic volumes and intersection capacity analyses for a scenario that assumes implementation of the proposed long-term improvements. The projected 2040 traffic volumes represent about 32 percent total growth from the current year.[22] With the proposed improvements, both intersections at the I-495 interchange would operate at a desirable LOS and the Route 1A intersection at Wrentham Village Premium Outlets would operate at an acceptable LOS. Synchro capacity analysis reports for major intersections on Route 1A between I-495 and Premium Outlets Boulevard under the 2040 traffic conditions are included in Appendix M.

The analyses indicate that the combined improvements should improve traffic operations such that the future volumes of traffic can be processed effectively through the intersections. Staff also considered the possibility of constructing a direct link from the existing I-495 southbound off-ramp to Premium Outlets Boulevard or the main parking lot of Premium Village Outlets. This option would require a further study to examine its feasibility.[23]

5.5 POTENTIAL USE OF EXISTING UTILITY CORRIDOR AS A MULTI-USE TRAIL

As mentioned in Chapter 2, a utility corridor runs parallel to Route 1A from Route 140 to the Plainville town line. Residents in the region would benefit if the corridor were developed into a safe multi-use trail.

Major factors to consider regarding a multi-use trail in this location include the following:

- Most sections west of Creek Street are owned by the Massachusetts Electric Company.
- Other sections east of Creek Street are owned by private property owners.
- The corridor generally has a clearance of 25 feet or more between utility poles, with overhung utility lines on both sides, and is sufficiently wide for two-way movements.
- A trail would connect two major attractions: Route 140 (a regional bicycle route) and Premium Outlets (a popular shopping/dinning destination).

[22] The MPO's regional travel-demand model predicts that the area south of I-495 would experience significant traffic growth of about 1.5 percent annually from 2017 to 2040.

[23] The link would likely be a loop ramp. There are some constraints to building a ramp in this location, however, including the adjacent utility corridor and a small area of marsh and bog wetlands.

- Sidewalks and bicycle connections from adjacent roadways to the trail should be installed where feasible.
- Utility company and property owners may require additional precautions to preserve public safety and to clarify liability.

Successfully converting the utility corridor into a multi-use trail at this location would require the support of all stakeholders and the negotiation of usage and liability with the utility company and adjacent property owners.[24] MPO staff recommends a separate study to explore feasibility.

5.6 ANALYSES OF PROPOSED LONG-TERM IMPROVEMENTS UNDER PROJECTED FUTURE-YEAR (2040) TRAFFIC CONDITIONS

MPO staff constructed future-year traffic models, projecting to 2040, for the entire Route 1A corridor in Wrentham, based on the roadway layouts with the proposed long-term improvements. Staff conducted future-year traffic analyses based on traffic growth projections from the transportation-planning model recently developed for the MPO's Long-Range Transportation Plan. The analyses indicate that the proposed long-term improvements would allow Route 1A to operate adequately with the future-year traffic conditions.

Figure 19 shows the intersection capacity of major intersections in the corridor under the projected 2040 traffic conditions for the weekday AM and PM peak hours. With the proposed long-term improvements, all intersections would operate at a desirable LOS C or better during the weekday peak hours, except the Lincoln Street intersection (which would operate at an acceptable LOS D in the weekday AM peak hour) and the Farm Road intersection (which would operate at an acceptable LOS D in the weekday AM and Saturday midday peak hours).

Synchro capacity analysis reports of the major intersections in the corridor, except those in the Wrentham Common area, under the future-year weekday AM and PM peak hour conditions, are included in Appendix N. Note that the future-year capacity analysis reports for the intersections in the Wrentham Common area are included in Appendices I, J, and K.

[24] There are a number of examples of utility corridors redesigned as multi-use trails in the country, such as Power Trail near Fort Collins in Colorado and St. Ignace to Trout Lake Trail in Michigan. In Massachusetts, Eversource is currently working with Department Conservation and Recreation and local municipalities to develop some sections in the Massachusetts Central Rail Trail.

Chapter 6—Summary and Recommendations

This study performed a series of safety and operations analyses, identified safety and operational problems, and proposed a number of short- and long-term improvements to address identified problems in the Route 1A corridor in Wrentham.

The recommended key short-term improvements include the following:

- Relocate regulatory signs to suitable locations, including the stop sign on Creek Street and the 20 mph speed-limit sign near Wampum Corner.
- Install duplicate stop signs at Creek Street and at Beach Street.
- Consider converting on-street angle parking to parallel parking.
- Consider converting the stop control at the intersection of Common Street and Taunton Street from two-way to four-way stop control.
- Change the traffic control on Common Street at Route 140 from “Yield” to “Stop.”
- Regularly maintain roadway pavement markings.
- Trim overgrown vegetation at applicable locations.

These improvements could enhance safety for all users of Route 1A in Wrentham and improve traffic operations. With a high benefit/cost ratio, these short-term improvements should be considered and implemented as soon as the resources are available from highway maintenance or local Chapter 90 funding.

Significantly improving the safety, mobility, and access for all users would require a series of long-term improvements in the corridor, especially in the Wrentham Common area and in the commercial area south of I-495.

The benefits expected to result from implementing the major recommendations from this study include the following:

- Proposed improvement plans for the Wrentham Common area would improve intersection operations and traffic circulation in the area, reduce travel speeds on Common Street and Taunton Street, and enhance mobility and safety for pedestrians and cyclists.
- Proposed corridor reconstruction with sidewalk additions and shoulder expansions would improve accommodation and safety for pedestrians and cyclists and improve traffic operations.

- Proposed additional improvements to the planned new I-495 southbound on-ramp would reduce traffic congestion on Route 1A and at the I-495 interchange during holidays and significant weekends for shoppers, and improve mobility and safety for all users.

Based on the existing land uses and transportation conditions, the corridor can be divided into five project areas:

- Route 1A in the Wrentham downtown area
- Route 1A from Randall Road to Wampum Corner
- Route 1A from Wampum Corner to I-495
- Route 1A from I-495 to Wrentham Crossing
- Route 1A from Wrentham Crossing to the Plainville town line

The study advisory committee considers that three of the five areas are essential for the corridor's long-term development. The estimated costs of major reconstruction projects to improve these three sections of Route 1A are as follows:

- Wrentham Common and Downtown Area Transportation Improvements: $5.5 million to $7 million for Plan A or Plan B; and $6.5 million to $8 million for Plan C
- Route 1A Corridor Transportation Improvements from Randall Road to Wampum Corner: $3 million to $4 million
- Route 1A Corridor Transportation Improvements from I-495 to Wrentham Crossing: $7.5 million to $9.5 million [25]

Implementing these projects would require sufficient resources and coordination efforts. Depending on the available and potential resources and development opportunities, the Town of Wrentham could coordinate all stakeholders and prioritize these projects.

This study provides a vision for the corridor's long-term development and presents a series of improvement measures for the corridor that would allow it to operate safely and efficiently for motorists, bicyclists, and pedestrians. Achieving the vision will require significant effort and collaboration on the part of all stakeholders, including the Town, residents, owners of adjacent developments, and MassDOT.

[25] These costs estimates are based on the general expenses of similar projects. The estimates contain only design and construction costs, not right-of-way, utility relocation, or other contingency costs, and are based on 2017 dollars.

The process of implementing the improvements must ensure that all parties concur about how the recommendations should be realized in a resourceful and fiscally responsible manner. The Town must work with MassDOT District 5 to initiate the project, obtain favorable review from MassDOT's Project Review Committee, and identify potential funding resources by coordinating with MassDOT and the Boston Region MPO.

Appendix O details the various steps of MassDOT's project development process, including a schematic timetable. Information about the project development process also may be found on MassDOT's website, at http://www.massdot.state.ma.us/planning/Main/PlanningProcess/ProjectDevelopmentProcess.aspx and at http://www.massdot.state.ma.us/Portals/8/docs/designGuide/CH_2_a.pdf.

MassDOT recently developed an online tool for both state and municipal proponents to initiate roadway projects. The Massachusetts Project Intake Tool (MaPIT) is a web-based application designed to help proponents map, create, and initiate projects with available in-house Geographic Information System (GIS) resources. The tool can be accessed from the geoPass webpage of Massachusetts GIS for Transportation (geoDOT): https://massdothpi.esriemcs.com/mapit.

An introduction of the tool can be found at http://scoe.transportation.org/wp-content/uploads/sites/11/2017/08/CC1C-MaPIT%E2%80%94MassDOT%E2%80%99s-GIS-driven-Project-Initiation-and-Environmental-Screening-Tool.pdf.

Table 1.
Proposed Improvements: Route 1A from Route 140 to Creek Street

Location	Issues/Concerns	Short-Term Improvements	Long-Term Improvements
The section in general	• The two-lane section in the downtown business district has considerable traffic volumes during AM and PM peak hours • Route 140 and Taunton Street, joining Route 1A at Wrentham Common, has considerable traffic volumes during peak hours • Common Street, connecting Route 1A and Route 140 diagonally through Wrentham Common, becomes a cut-through route during peak hours with fast moving traffic • Prospective developments on the north side of Route 1A are likely to increase traffic at the already congested intersections • High crash rates at the intersections of Route 1A and Route 140, Route 1A and Common Street, and at the intersections adjacent to Wrentham Common • Angle on-street parking interferes with Route 1A traffic and hinders the views of pedestrians and drivers • Lack of separated bicycle accommodations • Traffic signals are not equipped with a preemption function for emergency vehicles	• Consider converting the existing two-way stop control to all-way stop control at the intersection of Taunton Street and Common Street (requires further engineering review) • Consider converting the existing angle-parking to parallel parking (requires collaboration with the adjacent businesses) • Change the traffic control on Common Street at Route 140 from Yield to Stop • Stripe yield lines (shark teeth) at mid-block crosswalks to alert approaching drivers of pedestrians • Regularly maintain crosswalk pavement markings • Double up stop signs, so that signs are on both the left and right sides of the street, to enhance drivers' views to the stop control at Creek Street	• Further study and design the three proposed improvement plans for the roadways in the Wrentham Common and downtown area • Reconstruct and upgrade the outdated signal system at the Route 140 intersection • Close Bank Street and redesign the area as a flag-pole square connecting Wrentham Common and Sweatt Park • Reconstruct the Common Street intersection • Rearrange on-street parking on the north side of Route 1A between Route 140 and Common Street • Reconstruct Route 1A from Randall Road to Creek Street by adding five-foot shoulders on both sides for bicycle accommodation, a five-foot grass buffer, and five-foot sidewalks on the south side for pedestrians • Reconstruct and signalize the Creek Street intersection • Include an emergency-vehicle preemption function in all the new and upgraded traffic signals
Route 1A at Route 140	• Large number of crashes (22 in the past three years) • Nearly 30% of the total crashes were left-turn crashes (there are no left-turn lanes) • Traffic congestion on almost all approaches, especially on Route 140 northbound, during PM peak hours • Outdated traffic signal equipment with low visibility of post-mounted signal indications • Southbound right-turn slip lane (Bank Street) allows fast moving traffic, causing unsafe conditions for pedestrians	• Consider striping a short left-turn bay on the northbound approach (requires further engineering review) • Regularly maintain crosswalk pavement markings	• Reconstruct the intersection with an expanded layout by adding left-turn lanes on the Route 140 approaches and Route 1A westbound (depending on the selection of Wrentham Common improvement plans) • Remove the right-turn slip lane and redesign the area as a small square connecting Wrentham Common and Sweatt Park • Upgrade the signal system with mast arms, new signal indications, and accessible count-down pedestrian signals • Relocate fire hydrants at the corners of the intersection
Route 1A at Common Street	• Traffic congestion on the stop-controlled Common Street during peak hours, especially in the afternoon • Drivers have difficulty viewing all other approaches because of the relatively large intersection layout • Wide eastbound right-turn radius allows for fast moving traffic and creates a long pedestrian crossing distance • Angle-parking interferes with intersection operations • 18 crashes in the past three years, three involving an angle-parked vehicle backing to Route 1A traffic	• Increase the size of the stop sign on Common Street • Consider converting angle-parking to parallel parking	• Reconstruct the intersection to have a smaller layout by reducing the right-turn curb radius and extending the sidewalk on the south side of Route 1A • Add a left-turn bay on both approaches of Route 1A • Signalize the intersection with accessible count-down pedestrian signals (Wrentham Common Plan A or B) • Maintain unsignalized (Wrentham Common Plan C) • Convert angle-parking to parallel parking
Common Street at Taunton Street/David Brown Way	• Traffic congestion on the stop-controlled Taunton Street during peak hours • High travel speeds on Common Street • 10 crashes in the past three years, four of them causing injuries • Crash rate higher than the average for District 5 unsignalized intersections • Poor sight distances, because of the skewed intersection layout, make it hard for drivers to see pedestrians • No crosswalk on Common Street westbound	• Consider converting the existing two-way stop control to all-way stop control (requires a further engineering study with updated traffic counts and examination of sight distances from all approaches) • Regularly maintain pavement markings	• Reconstruct the intersection to a regular layout by relocating David Brown Way, as in the proposed Wrentham Common improvement plans • Covert the stop control to all-way stop control (Wrentham Common Plan A or B) • Move the stop control from Common Street to Taunton Street/David Brown Way (Wrentham Common Plan C) • Add crosswalk on Common Street westbound after the intersection reconstruction

Location	Issues/Concerns	Short-Term Improvements	Long-Term Improvements
Common Street at Route 140	• Intersection layout similar to a highway merging ramp allowing Common Street traffic to enter Route 140 at high speeds (currently under Yield control) • Intersection layout makes left turns from Route 140 dangerous as there are potential high-speed conflicts between left-turning vehicles and through-moving vehicles on Route 140 • nine crashes in the past three years, four of them left-turn crashes • Crash rate higher than the average for District 5 unsignalized intersections • Poor sight distance toward Route 140 from Common Street	• Change the traffic control on Common Street at Route 140 from Yield to Stop • Regularly maintain pavement markings	• Reconstruct the intersection by realigning Common Street so that it intersects Route 140 perpendicularly (Wrentham Plan A or B) • Change the intersection to stop control and add a crosswalk on Common Street (Wrentham Plan A) • Signalize the intersection and add crosswalks on Common Street and Route 140 (Wrentham Plan B) • Disconnect Common Street from Route 140 by forming a cul-de-sac on Common Street (Wrentham Plan C)
David Brown Way at Route 140	• David Brown Way cuts through Wrentham Common diagonally and intersects with Route 140 in a wide angle, allowing vehicles to make right turns from Route 140 at fast speeds • Intersection location is very close to the intersection of Route 1A and Route 140 and affects its operation • Most crashes occurring at this intersection have probably been miscoded as Route 1A/Route 140 crashes • Only one crash identified from Wrentham Police Department crash reports	• Increase the size of the stop sign on David Brown Way • Regularly maintain pavement markings	• Realign David Brown Way to intersect perpendicularly with Route 140 • Maintain stop control or convert to a traffic signal control, depending on the selection of Wrentham Common improvement plans • Reconstruct the intersection according to Wrentham Common improvement plans
Route 1A at Creek Street	• Stop sign located away from the stop line and obscured by a tree and nearby vegetation • Traffic congestion on the stop-controlled Creek Street during peak hours • Difficult and unsafe left turns to and from Creek Street • 11 crashes in the past three years, seven involving a vehicle turning to or from Creek Street • Faded stop-line and crosswalk pavement markings	• Relocate the stop sign closer to the stop line • Add (double up) a stop sign on the left side of Creek Street to enhance drivers' views of the stop control • Stripe the faded pavement markings • Trim overgrown vegetation at the corners of Creek Street	• Reconstruct the intersection by adding a left-turn bay on Route 1A eastbound and on Creek Street • Signalize the intersection with accessible count-down pedestrian signals • Add a crosswalk on Route 1A under the signalization

Table 2.
Proposed Improvements: Route 1A from Creek Street to I-495 Interchange

Location	Issues/Concerns	Short-Term Improvements	Long-Term Improvements
The section in general	• Two-lane section in mostly residential area, except a business district located at the junction of Route 121 (Wampum Corner) • High proportion of commuter traffic during AM and PM peak hours • Sidewalks (with a five-foot grass traffic buffer) exist only on the north side of Route 1A from Creek Street to Wampum Corner • No sidewalks on either side of Route 1A from Wampum Corner to the I-495 interchange • Lack of separated bicycle accommodations • Speed limit sign on Route 1A southbound toward Wampum Corner is located too far from the roadside and hidden in vegetation	• Double up stop signs, so that signs are on both the left and right sides of the street, to enhance drivers' views of from the stop control on Beach Street • Improve pavement markings and sidewalk conditions at the Route 121 intersection • Regularly maintain roadway pavement markings • Regularly clear overgrown vegetation • Relocate the speed limit sign on Route 1A southbound to a roadside location where it is easy for drivers to observe	• Reconstruct Route 1A from Creek Street to Route 121 by adding five-foot shoulders on both sides of Route 1A for bicycle accommodation, a five-foot grass buffer, and five-foot sidewalks on the south side for pedestrians • On Route 1A from Route 121 to the I-495 interchange, plan to include five-foot shoulders and five-foot sidewalks on both sides (five-foot grass buffers are desirable, at least on the north side, to accommodate the existing utility poles) when future reconstruction or development projects emerge • Add a southbound left-turn bay at the Beach Street intersection • Add a crosswalk at the Route 121 intersection and upgrade the sidewalks on the northwestern side to standard five-foot clearance
Route 1A at Beach Street	• Approaching Route 1A on Beach Street, drivers' view to the stop sign is obscured by a tree • Traffic congestion on the stop-controlled Beach Street during peak hours, mainly in the afternoon • Difficult and unsafe left turns to and from Beach Street • Nine crashes in the past three years, four involving a vehicle from Beach Street colliding with a vehicle traveling straight on Route 1A • Faded stop line on Beach Street	• Add a stop sign on the left side of Beach Street • Restripe the faded stop line • Trim overgrown vegetation on the corners of Beach Street	• As part of the corridor reconstruction plan, add a left-turn bay on Route 1A southbound and on Beach Street • Continue monitoring traffic conditions and crash data at the intersection • Consider a traffic signal if traffic and safety conditions seriously deteriorate
Route 1A at Route 121 (West Street)	• No crosswalk exists on the Route 1A northbound approach or on the south side of Route 1A and Route 121 • 19 crashes in the past three years in the intersection vicinity • Nearly half of the crashes (eight) are related to a vehicle turning to or from the adjacent businesses • Four crashes involved a vehicle turning to or from the adjacent gas station • Driveways at the gas station are wide and undefined, with one located very close to the intersection • Sidewalks near the gas station are absent because of the wide driveway openings • Signal system has bicycle sensing capacity, but there are no pavement markings indicating bicycle waiting areas • Some sidewalks on the northwestern side of the intersection are narrow asphalt strips	• Recently signalized intersection operating at desirable level of services during peak hours • No proposed changes of intersection operations • Consider narrowing the driveway at the gas station and making the one close to the intersection "right-out" only and leave the other one open to all traffic • Restripe the faded pavement markings for bicycle green light waiting areas	• As part of the roadway reconstruction plan, add a crosswalk on the Route 1A northbound approach with necessary curb ramps and pedestrian signals and push buttons • Upgrade the sidewalks on the northwestern side of Route 1A (from the gas station to Riverside Drive) to standard five-foot clearance • Continue monitoring traffic conditions and crash data for necessary improvements (evaluations show that the intersection capacity is acceptable under 2040 predicted traffic volumes)

Table 3.
Proposed Improvements: Route 1A from I-495 Interchange to Plainville Town Line

Location	Issues/Concerns	Short-Term Improvements	Long-Term Improvements

The section in general	• Four-lane section of Route 1A that runs through the business districts between the I-495 northbound ramps and Wrentham Crossing experiences busy traffic in the evening and weekend peak hours
	• Traffic to Wrentham Village Premium Outlets seriously affects Route 1A and I-495 interchange operations during weekend and holiday peak hours
	• Traffic is projected to increase significantly with the Wrentham Crossing project already in place and potential developments of the currently vacant commercial-industrial districts
	• New I-495 southbound slip on-ramp, as a mitigation measure from the Wrentham Crossing project, currently under 25% functional design
	• High crash rate in the section between the I-495 northbound ramps and Premium Outlets Boulevard
	• Large number of crashes at the intersections of the I-495 southbound ramps and Premium Outlets Boulevard
	• No sidewalks, except a limited section under I-495
	• Lack of separated bicycle accommodations
		• Continue monitoring crash conditions at the I-495 southbound ramps and the Premium Outlets Boulevard intersections, as MassDOT recently installed a new flashing yellow arrow signal display to improve safety for left-turning vehicles at two intersections
		• Continue monitoring traffic conditions and crash data in this section
		• Regularly maintain pavement markings
			• Propose additional mitigation measures in conjunction with the new I-495 southbound slip ramp to improve traffic operations and pedestrian and bicycle accommodations, these measures include the following:
			  • Rearrange Route 1A travel lanes between I-495 and Premium Outlets Boulevard to provide a continuous right-turn lane from I-495 southbound merging with Route 1A southbound
			  • Add a travel lane on Premium Outlets Boulevard westbound
			  • Add a lane to the existing off-ramp from I-495 southbound to Route 1A northbound
			  • Rearrange Route 1A travel lanes to include five-foot shoulders on both sides for bicycle accommodation
			• Work with adjacent businesses to provide sidewalks for pedestrians
			• Conduct a comprehensive parking and traffic management study to improve parking and traffic circulation in the Premium Outlets mall

Route 1A at I-495 Southbound Ramps	• Traffic operating acceptably during weekday peak hours, but usually affected by spill-back queues from the Premium Outlets during weekend peak hours • Very large number of crashes—46 crashes in the past three years and 13 of them resulted from conflicts between left-turning vehicles from Route 1A northbound and southbound through traffic	• Continue monitoring crash conditions in light of the recently installed flashing yellow arrow display to improve safety for left-turning vehicles on Route 1A northbound • Continue monitoring traffic conditions and crash data at the intersection	• Construct a new I-495 southbound slip on-ramp and close the existing loop on-ramp (from the Wrentham Crossing project) • Add a lane to the existing off-ramp from I-495 southbound to Route 1A northbound • Rearrange Route 1A northbound travel lanes • Redesign and re-coordinate traffic signal
Route 1A at Premium Outlets Boulevard	• Traffic operating acceptably during weekday peak hours, but congested during weekend peak hours • Large number of crashes—36 crashes in the past three years and 22 of them resulted from conflicts between left-turning vehicles from Route 1A northbound and southbound through traffic • Premium Outlets Boulevard is frequently congested during peak shopping hours and hinders Route 1A traffic from entering the mall • Premium Outlets Boulevard eastbound center lane is usually underused by left-turning traffic exiting the mall	• Continue monitoring crash conditions in light of the recently installed flashing yellow arrow display to improve safety for left-turning vehicles on Route 1A northbound • Examine the two traffic signals at the mall and explore the potential of optimizing and coordinating them with the signal at this intersection • Advise Premium Outlets to add a travel lane on Premium Outlets Boulevard westbound • Move the lane designation sign, which is obscured by vegetation, on the boulevard eastbound to a more observable location	• Add a travel lane on Premium Outlets Boulevard westbound (this can also be considered as a short-term measure to somewhat mitigate the current traffic congestions) • Work with Premium Outlets and request a comprehensive parking and traffic management study to improve parking and traffic circulation around the mall • Consult with Premium Outlets regarding adding sidewalks on Route 1A in conjunction with the future I-495 southbound slip ramp project • Redesign and re-coordinate traffic signal
Route 1A at I-495 Northbound Ramps	• Traffic operating desirably during weekday and weekend peak hours • 18 crashes in the past three years and 12 of the crashes (seven causing injuries) were conflicts between left-turning vehicles from Route 1A southbound and northbound through traffic • No exclusive southbound left-turn lane and signal phase	• Continue monitoring traffic conditions and crash data at the intersection	• As part of the corridor reconstruction plan (I-495 southbound ramps to Premium Outlets Boulevard), consider adding an exclusive southbound left-turn lane or changing the southbound inside through lane to exclusive left-turn lane (requires a further engineering study and modifications of Route 1A southbound layout and signal indications) • Redesign and re-coordinate traffic signal

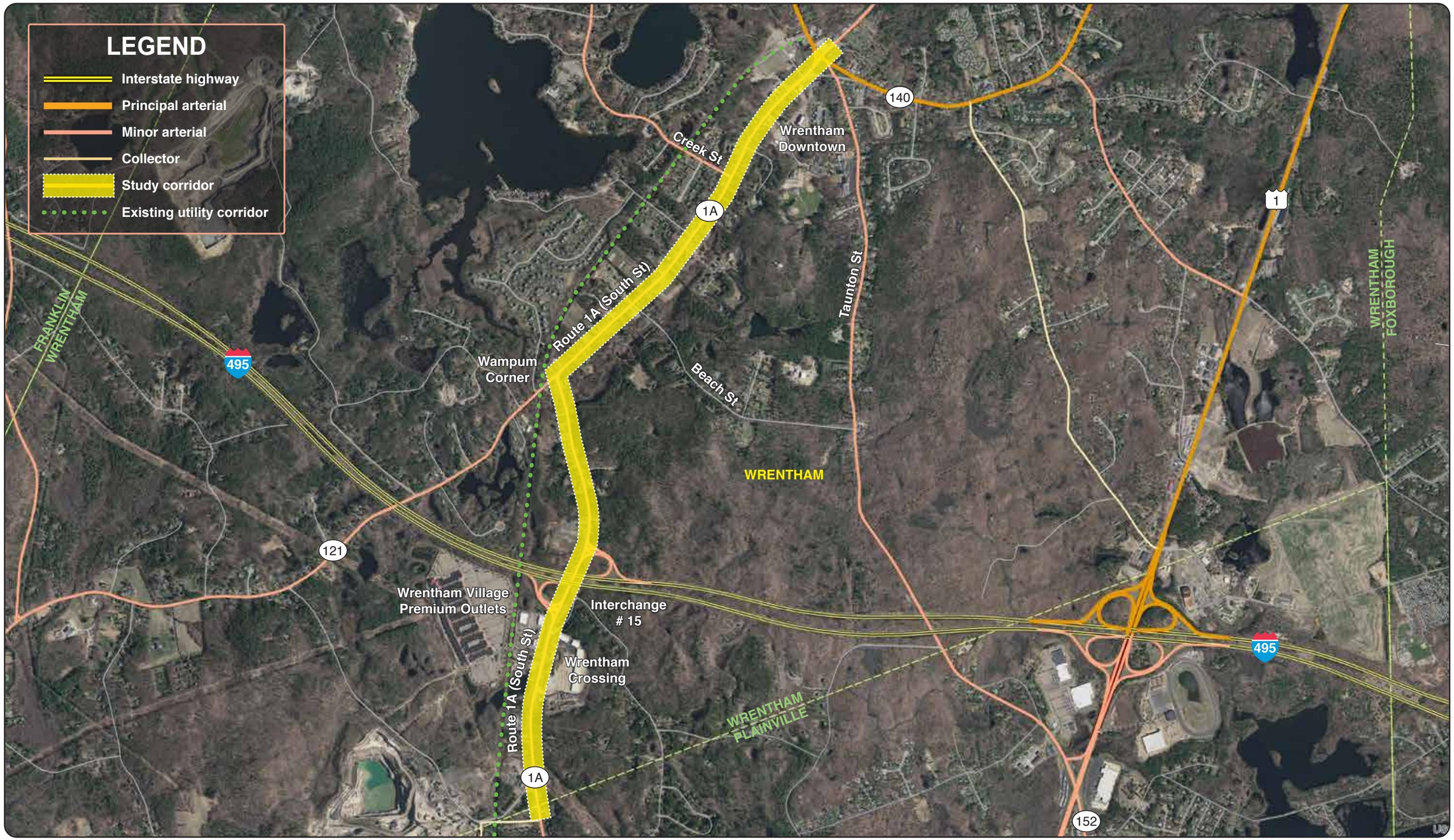

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Figure 1
Study Area Map
Route 1A in Wrentham

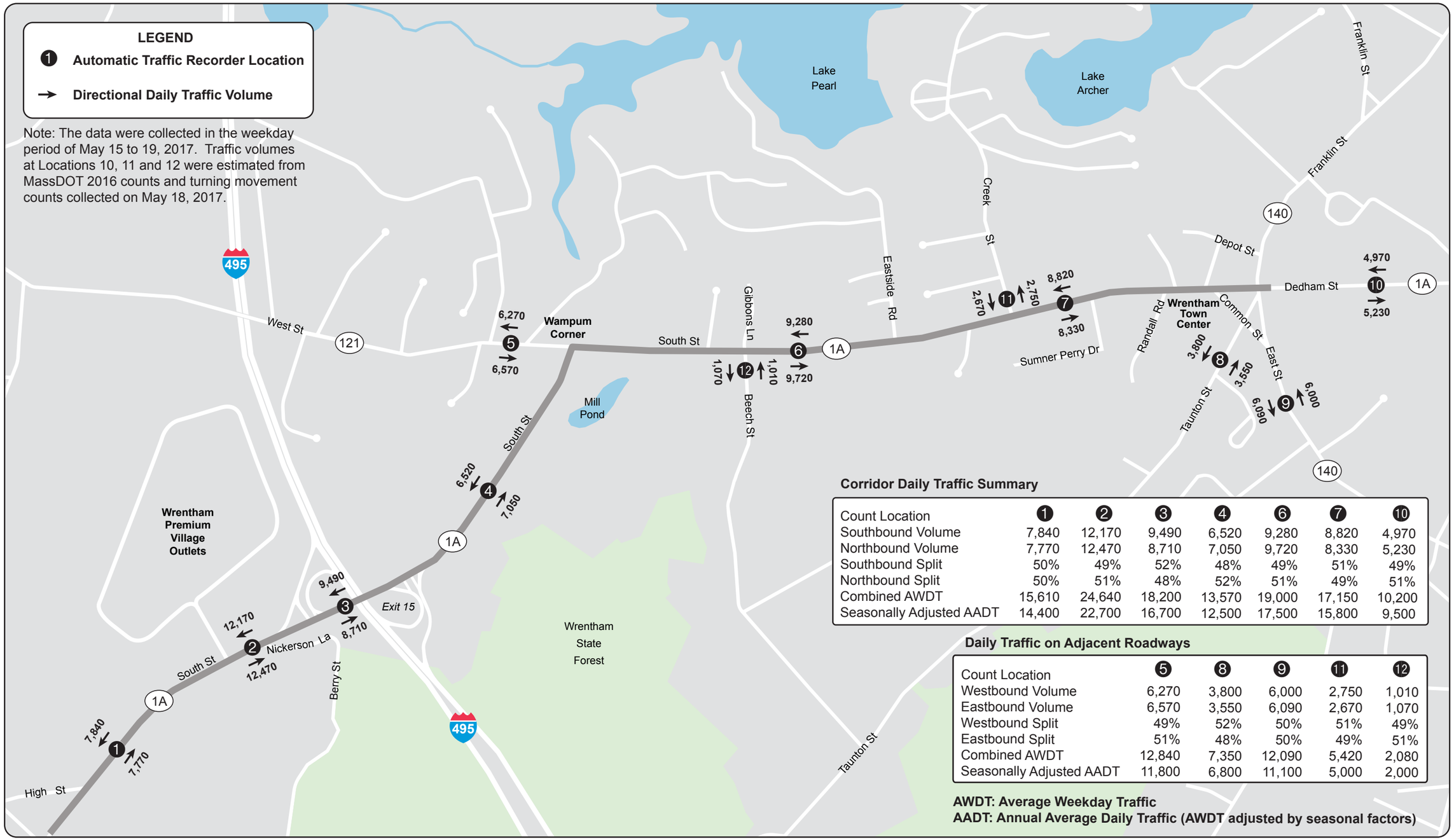
Addressing Safety, Mobility, and Access on Subregional Priority Roadways

LEGEND

1 **Automatic Traffic Recorder Location**

→ **Directional Daily Traffic Volume**

Note: The data were collected in the weekday period of May 15 to 19, 2017. Traffic volumes at Locations 10, 11 and 12 were estimated from MassDOT 2016 counts and turning movement counts collected on May 18, 2017.



Corridor Daily Traffic Summary

Count Location	1	2	3	4	6	7	10
Southbound Volume	7,840	12,170	9,490	6,520	9,280	8,820	4,970
Northbound Volume	7,770	12,470	8,710	7,050	9,720	8,330	5,230
Southbound Split	50%	49%	52%	48%	49%	51%	49%
Northbound Split	50%	51%	48%	52%	51%	49%	51%
Combined AWDT	15,610	24,640	18,200	13,570	19,000	17,150	10,200
Seasonally Adjusted AADT	14,400	22,700	16,700	12,500	17,500	15,800	9,500

Daily Traffic on Adjacent Roadways

Count Location	5	8	9	11	12
Westbound Volume	6,270	3,800	6,000	2,750	1,010
Eastbound Volume	6,570	3,550	6,090	2,670	1,070
Westbound Split	49%	52%	50%	51%	49%
Eastbound Split	51%	48%	50%	49%	51%
Combined AWDT	12,840	7,350	12,090	5,420	2,080
Seasonally Adjusted AADT	11,800	6,800	11,100	5,000	2,000

AWDT: Average Weekday Traffic
AADT: Annual Average Daily Traffic (AWDT adjusted by seasonal factors)

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Figure 2
Daily Traffic Volumes
Route 1A in Wrentham

Addressing Safety, Mobility, and Access on Subregional Priority Roadways

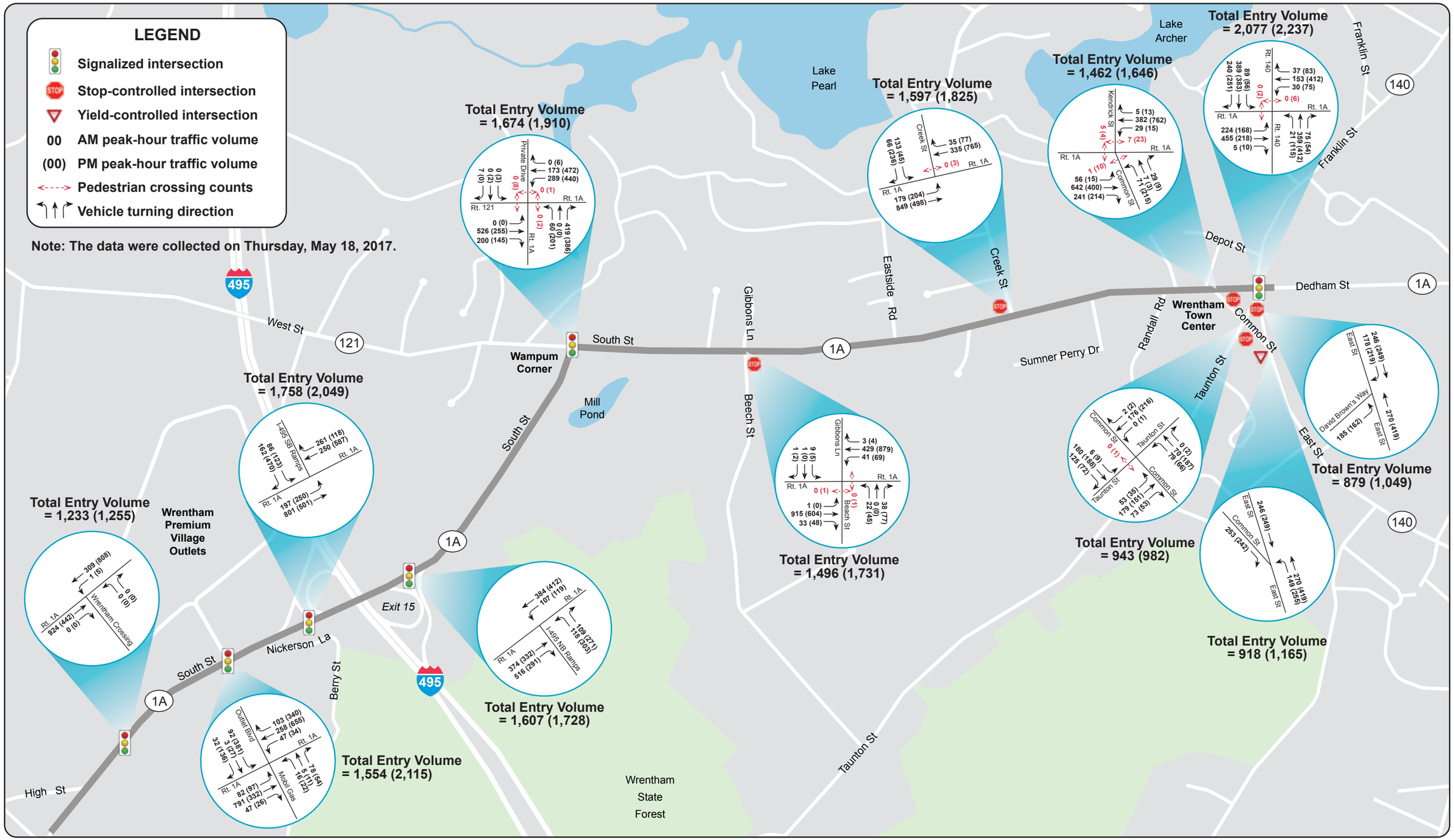

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Figure 3
Weekday Peak-Hour Traffic Volumes and Pedestrian-Crossing at Major Intersections
Route 1A in Wrentham

Addressing Safety, Mobility, and Access on Subregional Priority Roadways

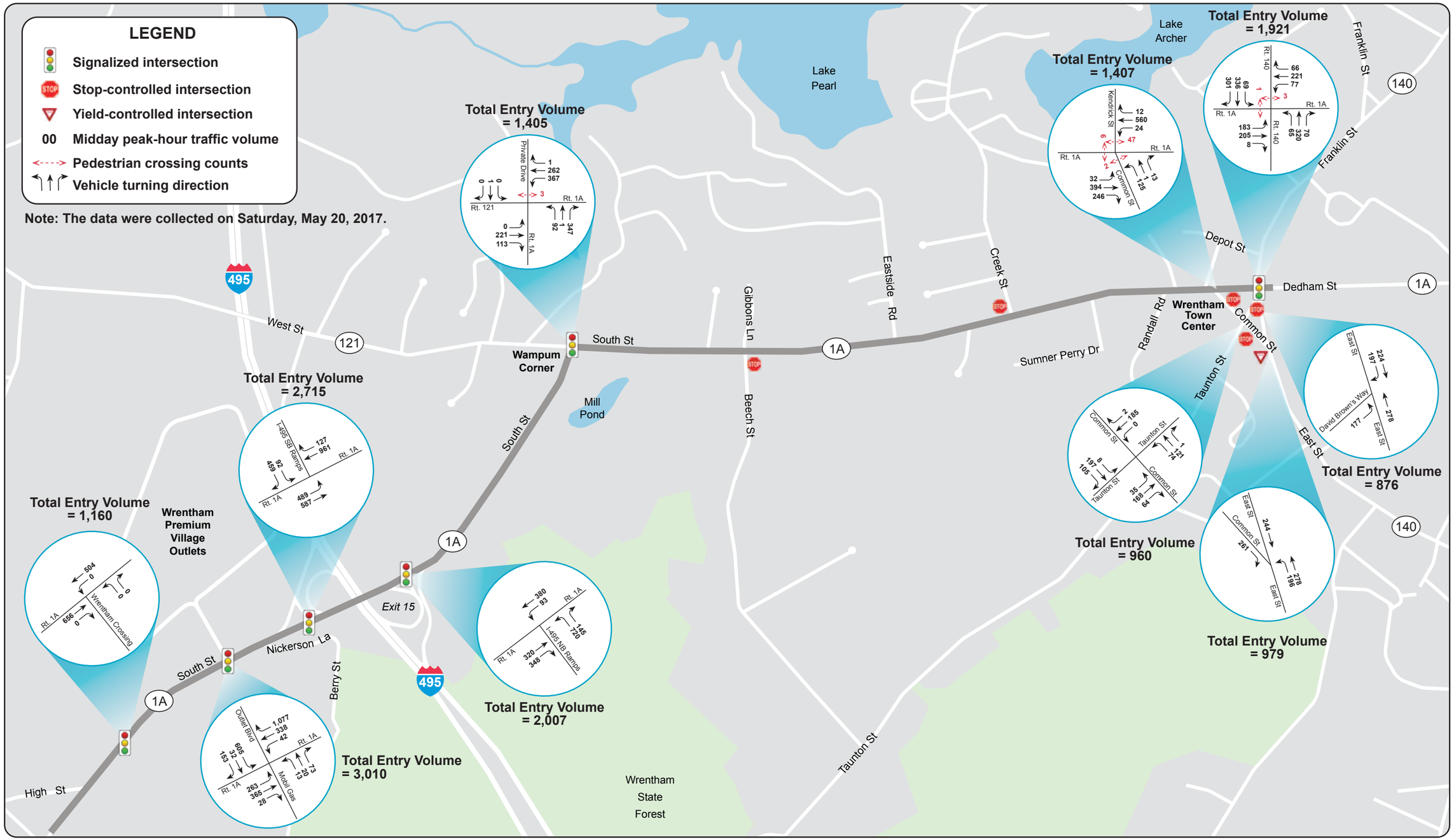

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Figure 4
Saturday Peak-Hour Traffic Volumes and Pedestrian-Crossing at Selected Intersections
Route 1A in Wrentham

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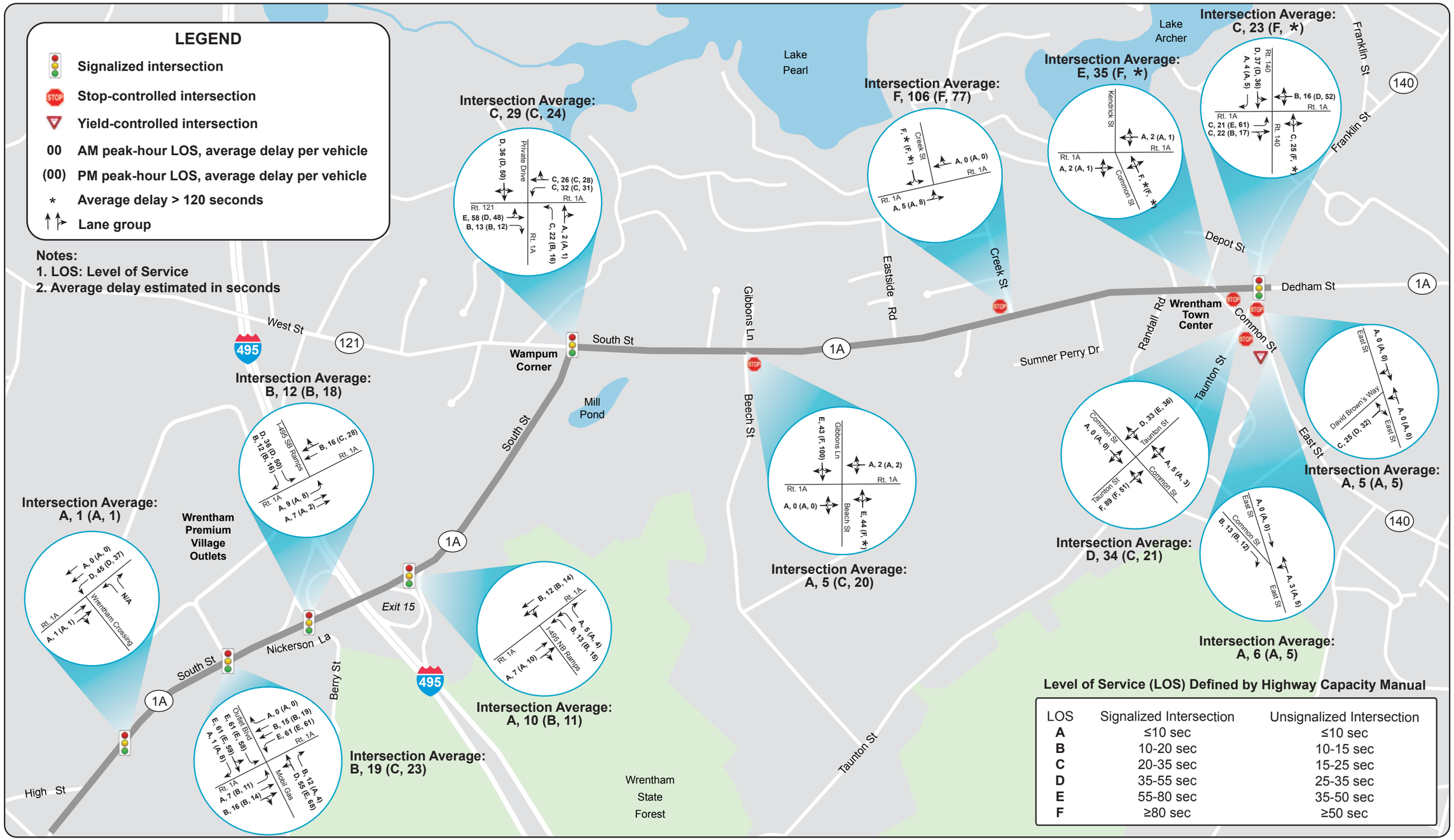

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Figure 5
Weekday Intersection Capacity Analyses
Route 1A in Wrentham

Addressing Safety, Mobility, and Access on Subregional Priority Roadways

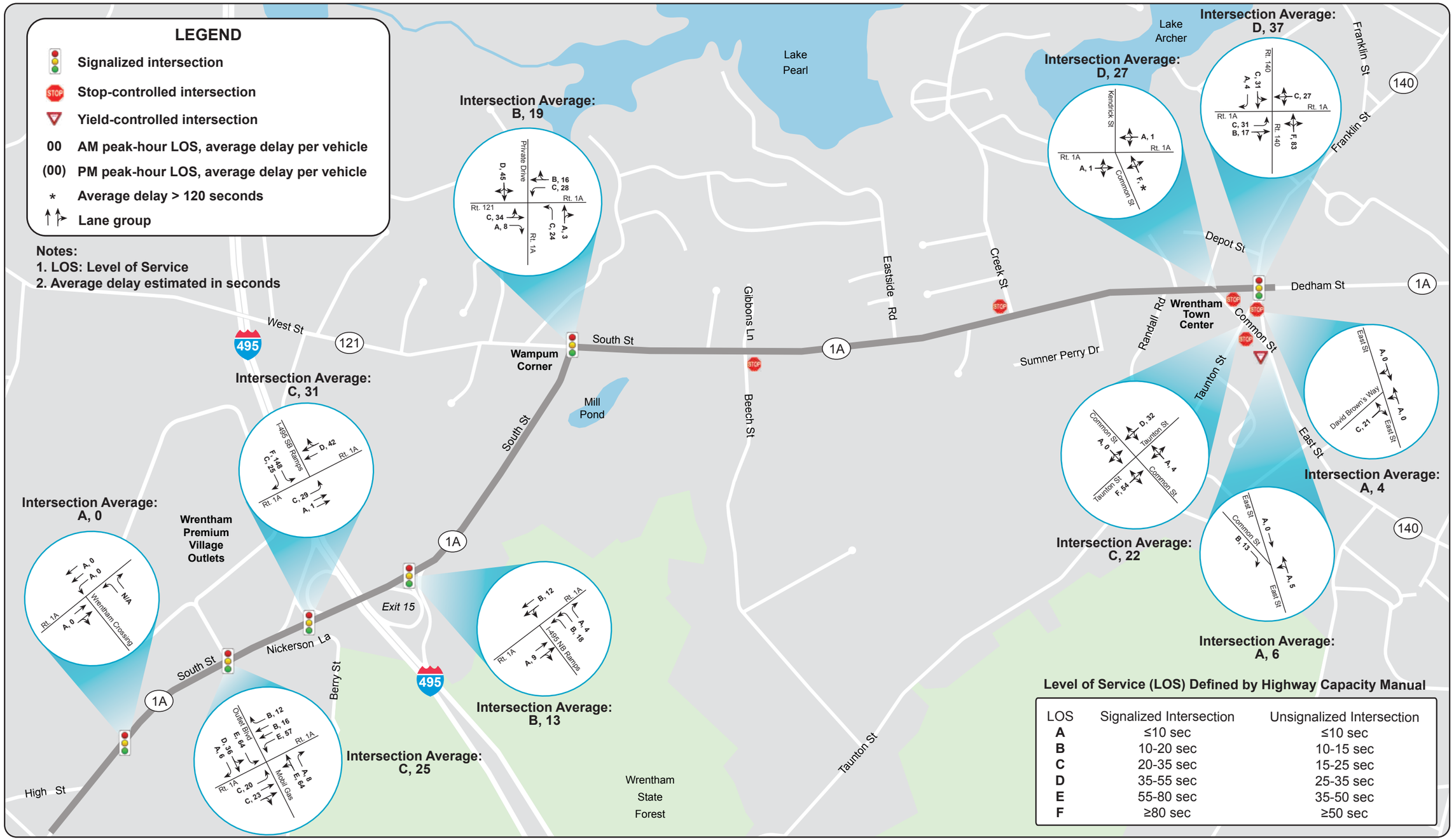

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Figure 6
Saturday Intersection Capacity Analyses
Route 1A in Wrentham

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Figure 7
Speed Regulations and Estimated 85th Percentile Speeds
Route 1A in Wrentham

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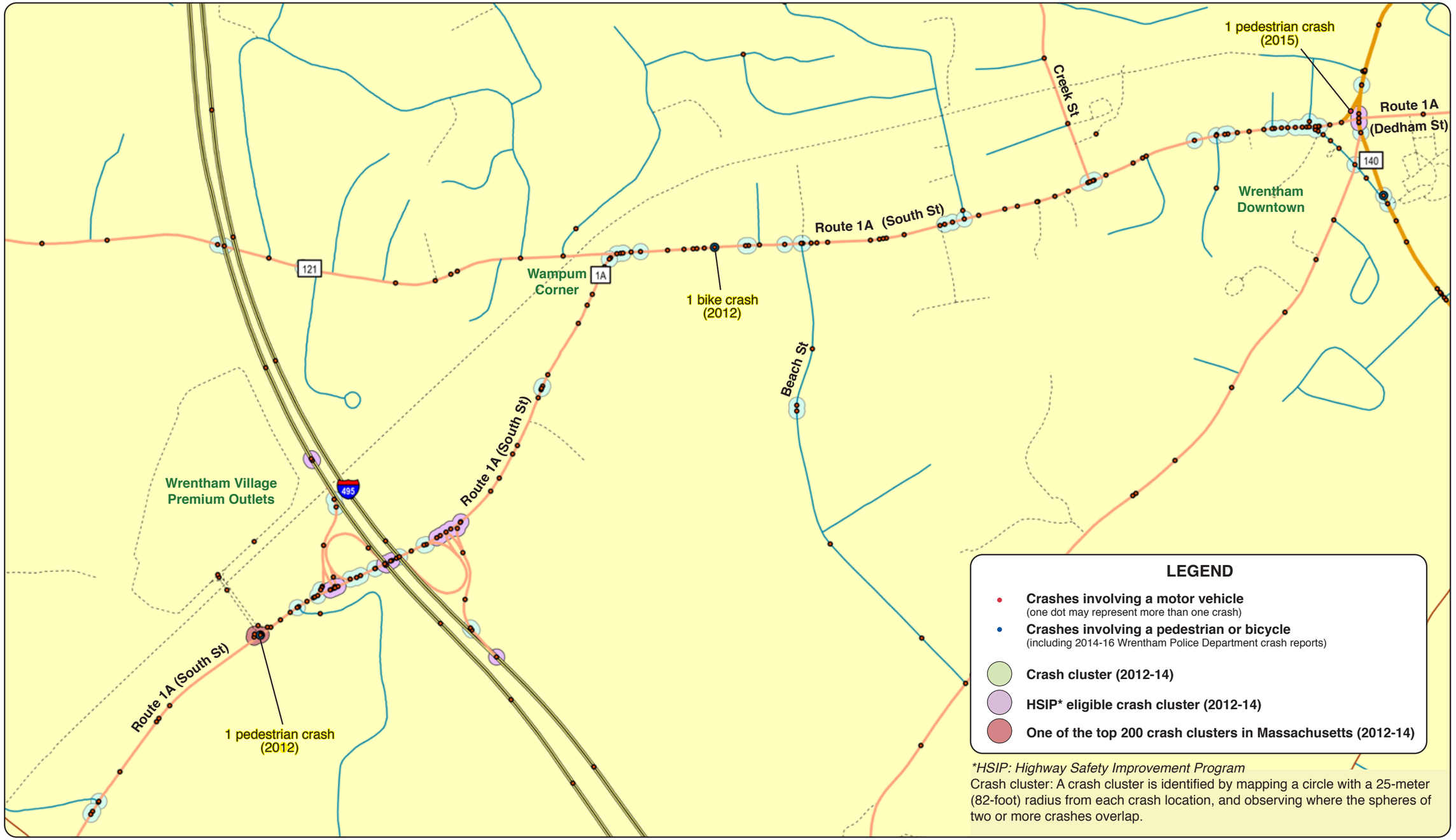

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Figure 8
Crash Locations (MassDOT Crash Data 2010-14)
Route 1A in Wrentham

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Mobility, and Access on
Subregional Priority Roadways

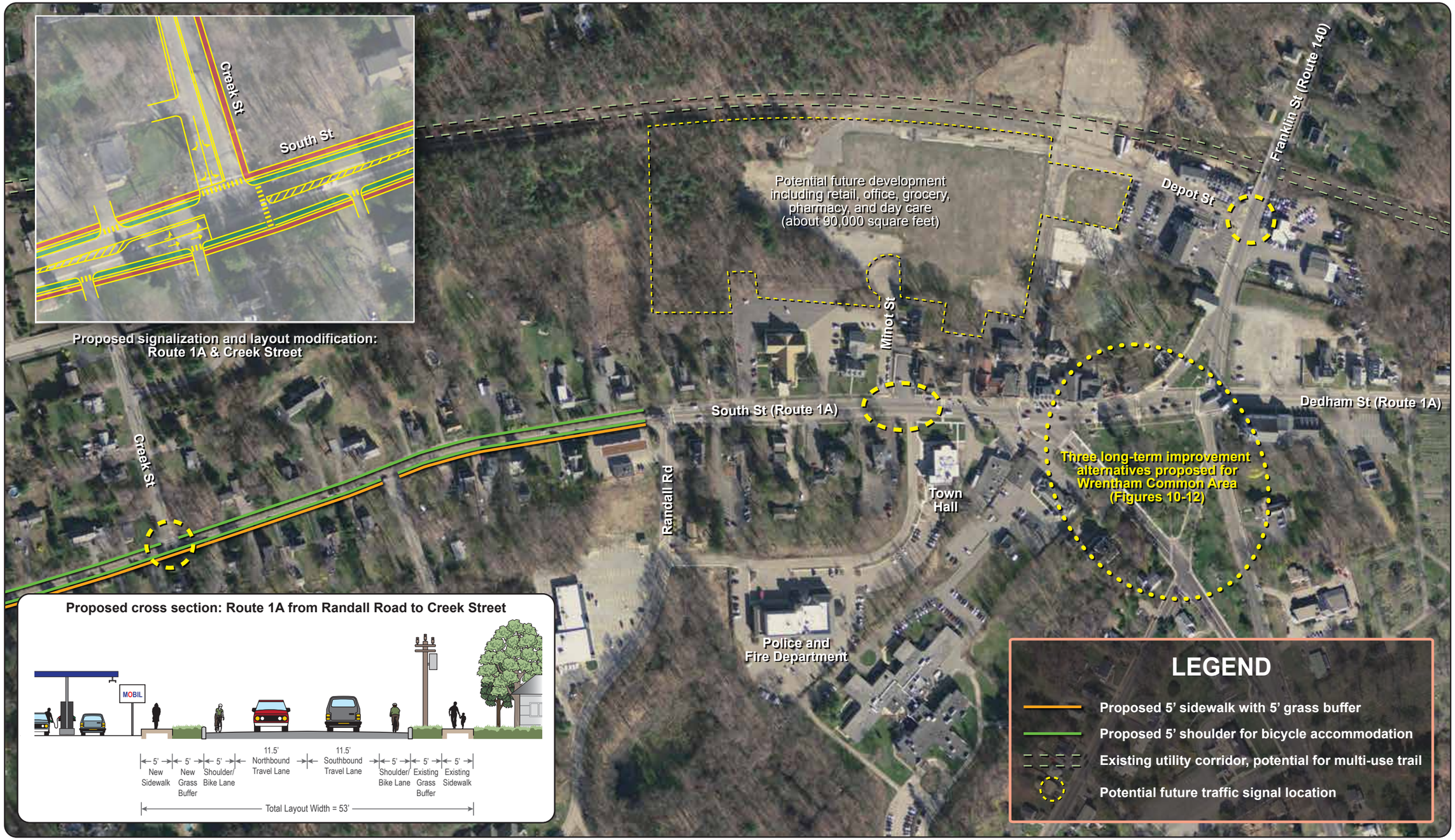

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Figure 9
Proposed Long-Term Improvements: Route 1A from Route 140 to Creek Street
Route 1A in Wrentham

Addressing Safety,
Mobility, and Access on
Subregional Priority Roadways

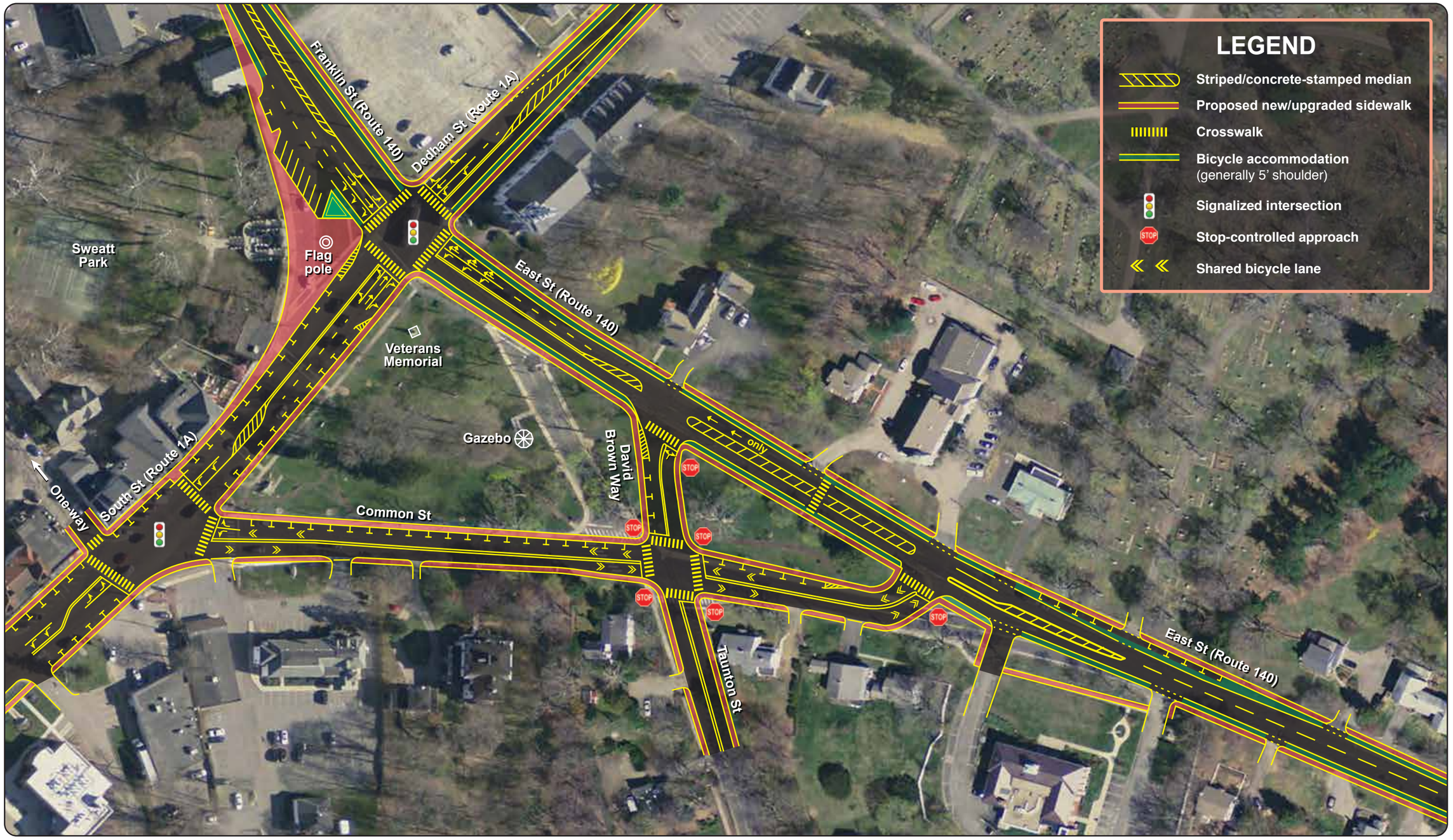

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Figure 10
Proposed Long-Term Improvements: Wrentham Common Area Plan A
Route 1A in Wrentham

Addressing Safety, Mobility, and Access on Subregional Priority Roadways

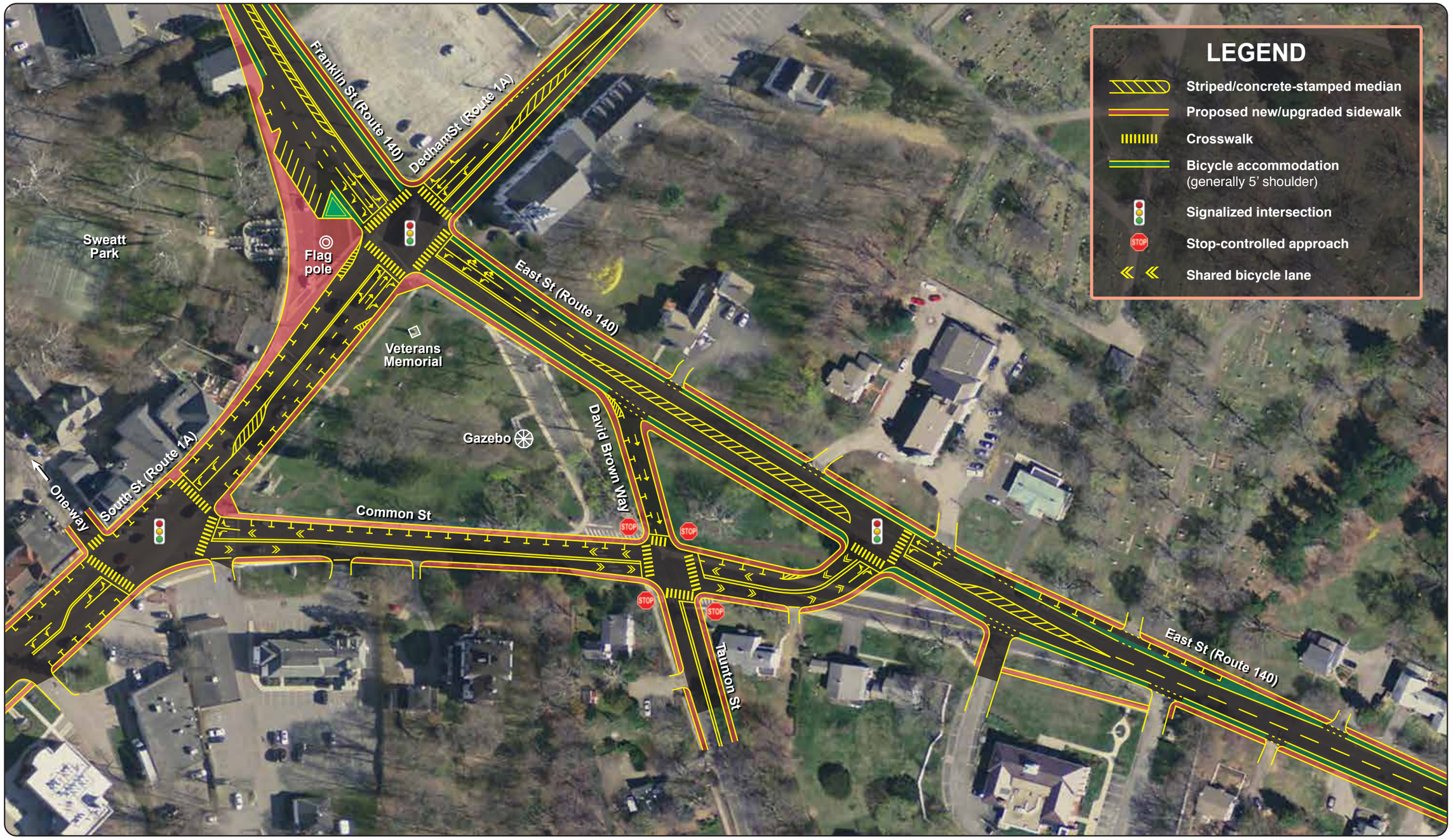

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Figure 11
Proposed Long-Term Improvements: Wrentham Common Area Plan B
Route 1A in Wrentham

Addressing Safety, Mobility, and Access on Subregional Priority Roadways

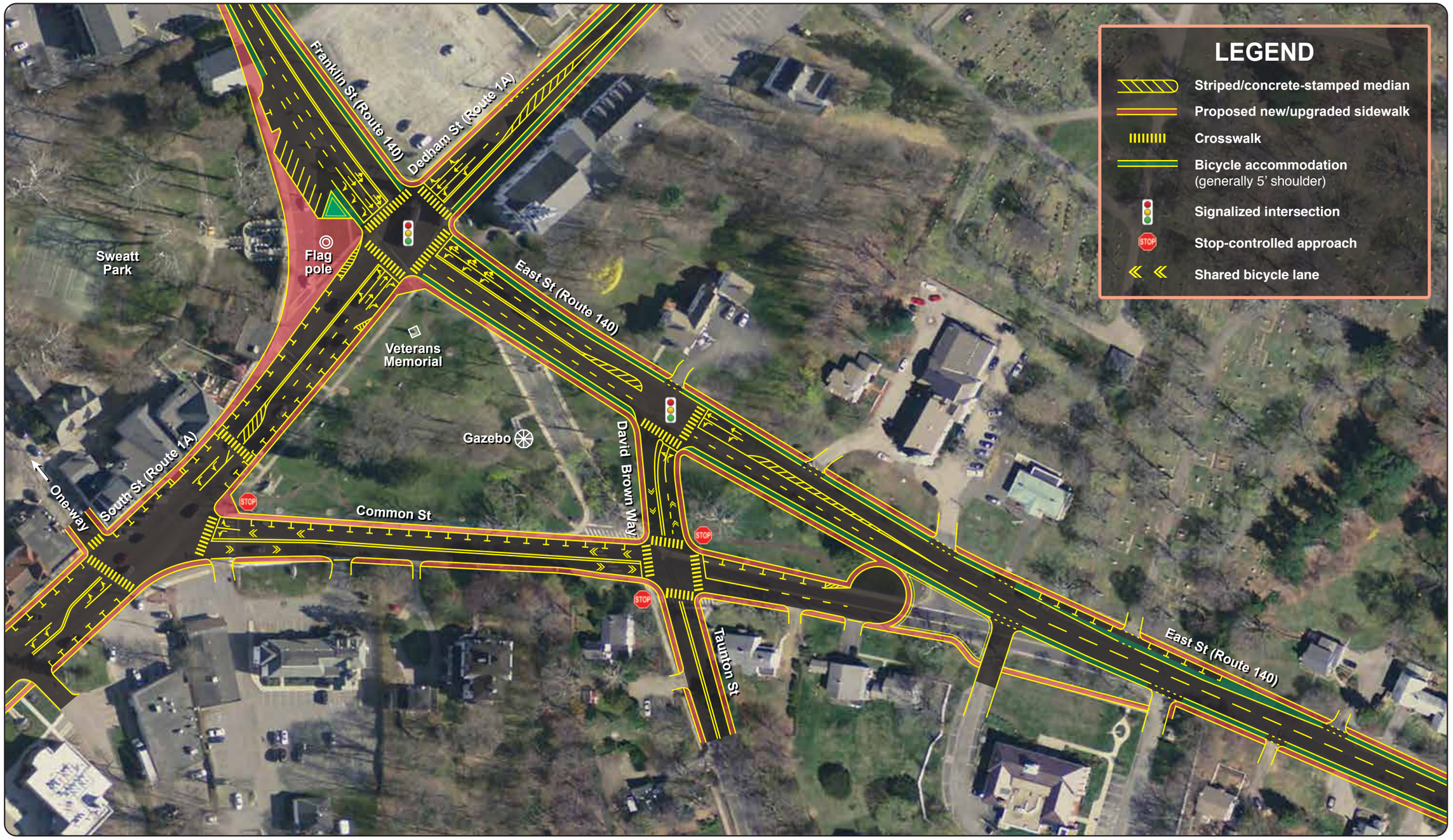

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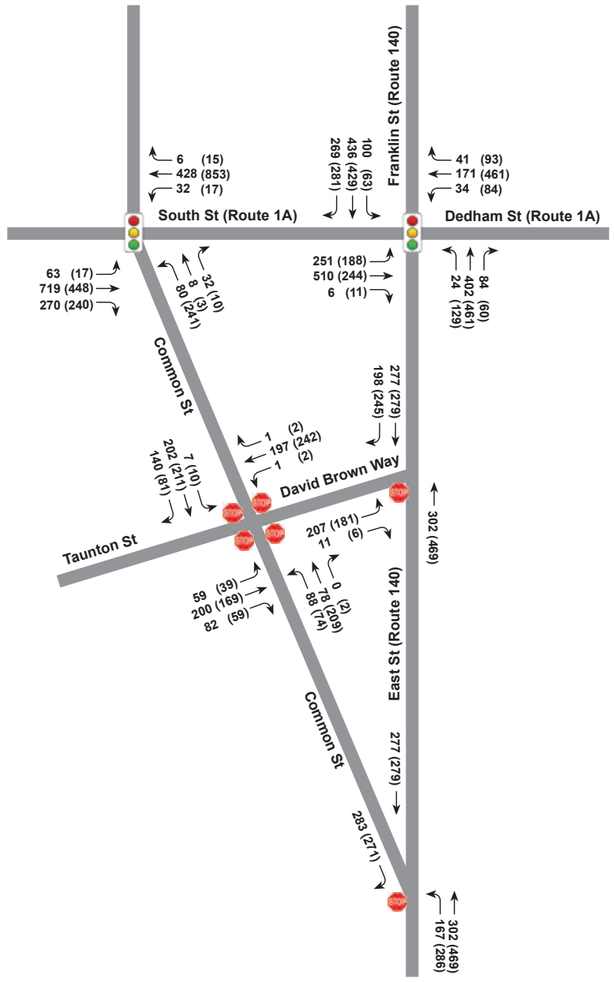
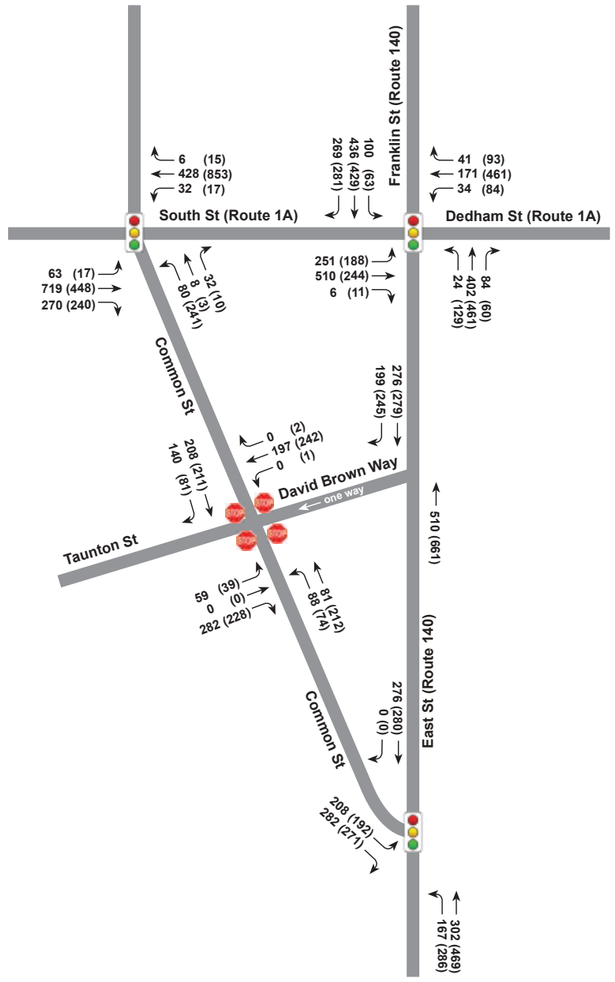
Figure 12
Proposed Long-Term Improvements: Wrentham Common Area Plan C
Route 1A in Wrentham

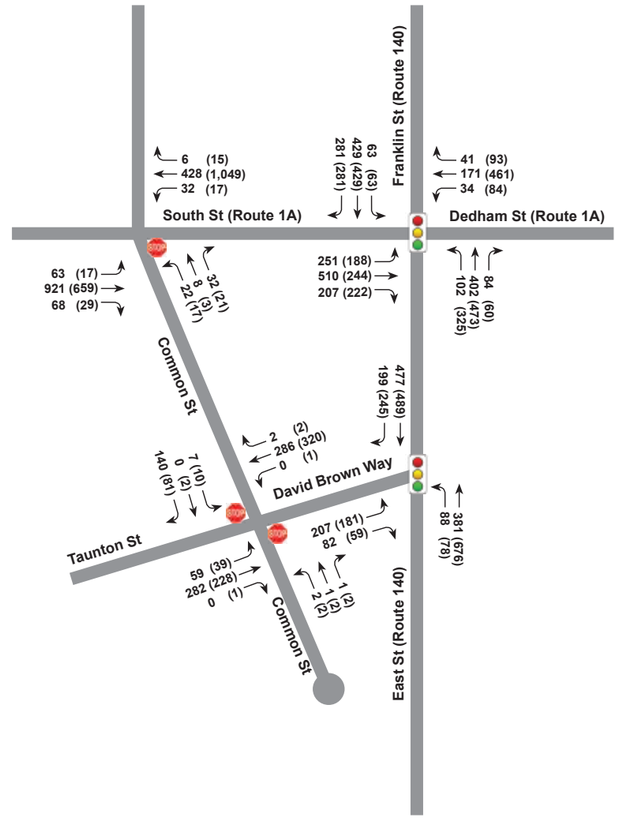
Addressing Safety, Mobility, and Access on Subregional Priority Roadways



Improvement Plan A



Improvement Plan B



Improvement Plan C

LEGEND

- Signalized intersection
- Stop-controlled intersection
- 00 AM peak-hour traffic volume
- (00) PM peak-hour traffic volume
- Vehicle turning direction

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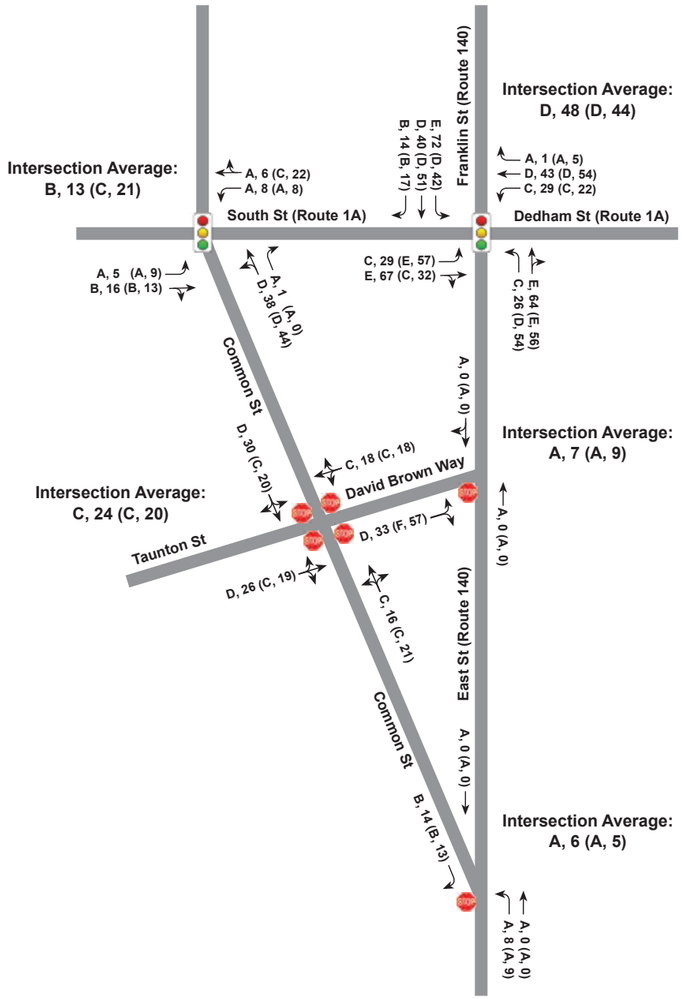
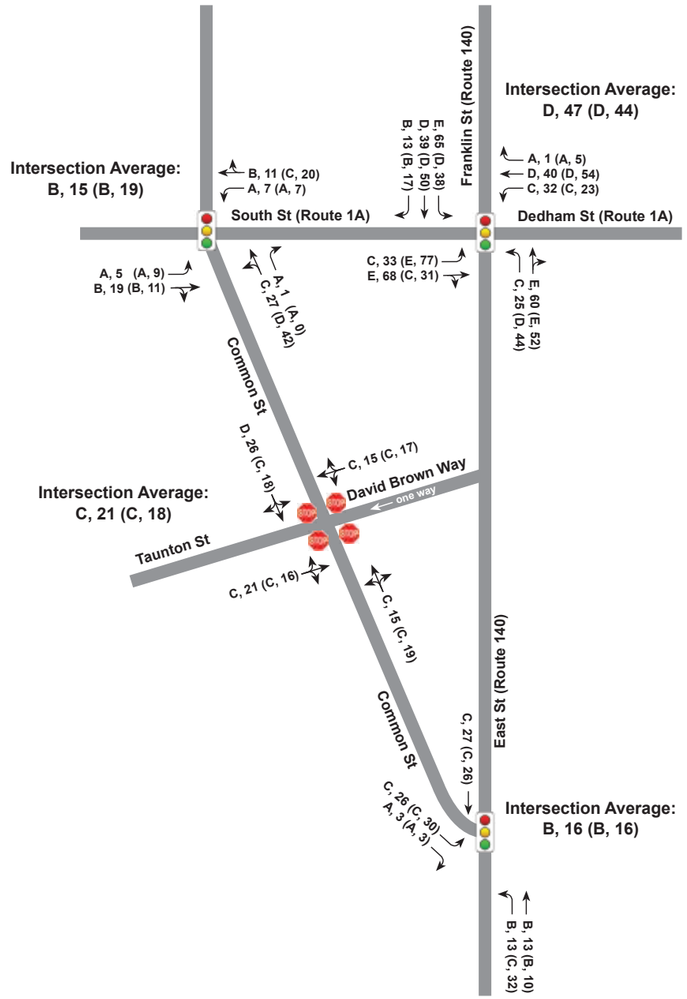
Figure 13
Projected 2040 Weekday Peak-HourTraffic Volumes: Wrentham Common Area Improvement Plans
Route 1A in Wrentham

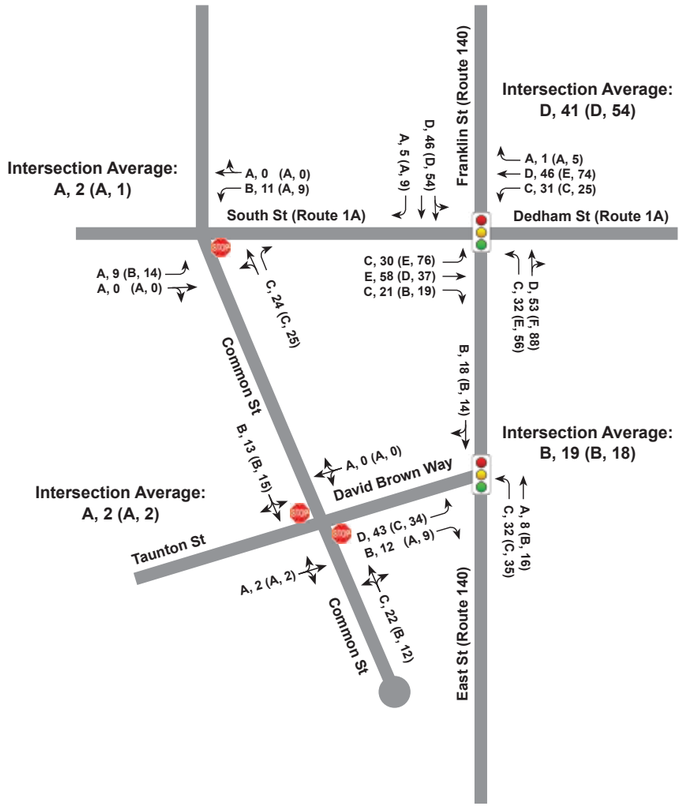
Addressing Safety, Mobility, and Access on Subregional Priority Roadways



Improvement Plan A



Improvement Plan B



Improvement Plan C

LEGEND

- Signalized intersection
- Stop-controlled intersection
- 00 AM peak-hour LOS, average delay per vehicle
- (00) PM peak-hour LOS, average delay per vehicle
- Lane group

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Figure 14
2040 Weekday Peak-Hour Intersection Capacity Analyses: Wrentham Common Area Improvement Plans
Route 1A in Wrentham

Addressing Safety, Mobility, and Access on Subregional Priority Roadways

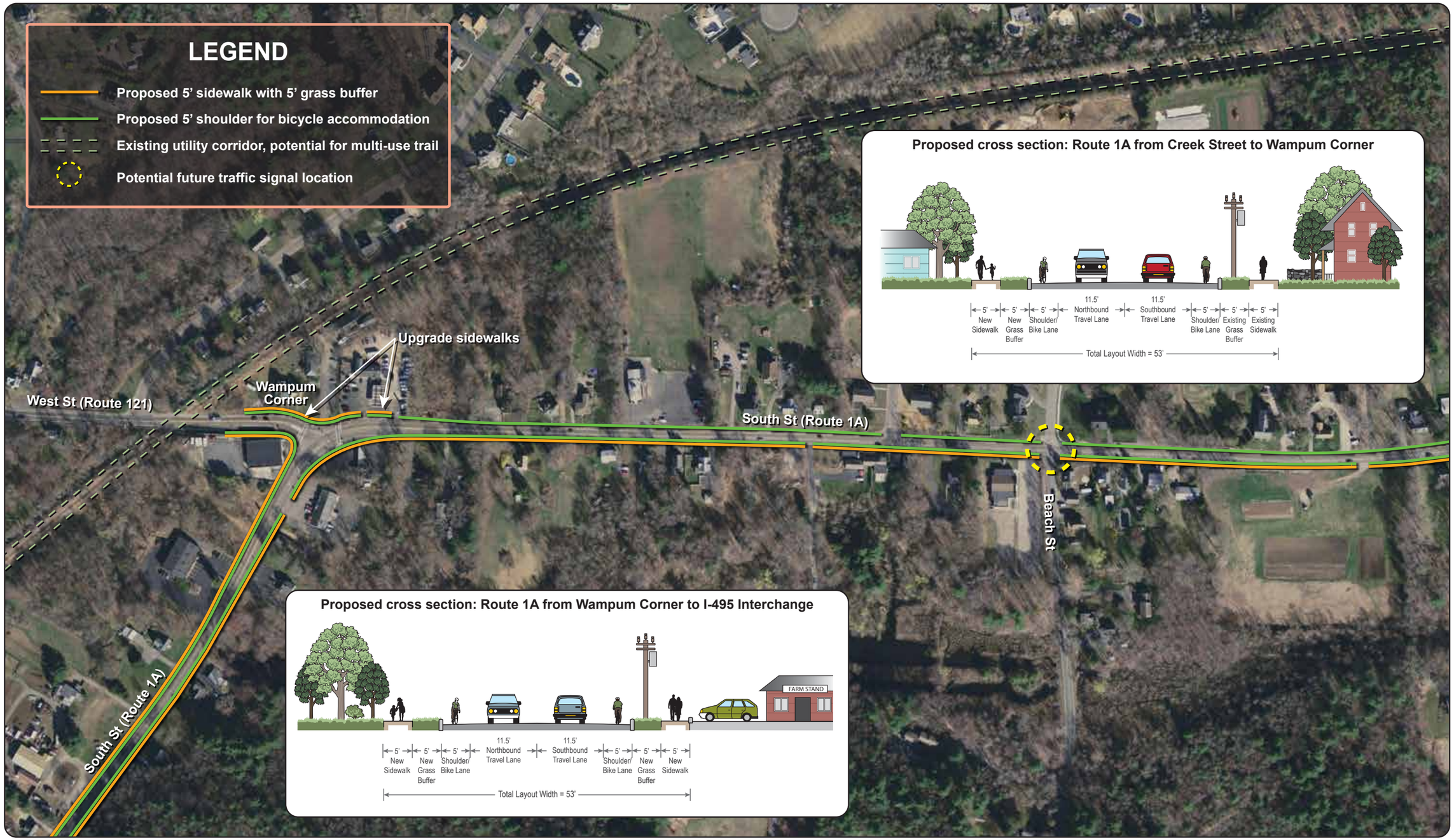

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Figure 15
Proposed Long-Term Improvements: Route 1A from Creek Street to I-495 Interchange
Route 1A in Wrentham

Addressing Safety, Mobility, and Access on Subregional Priority Roadways

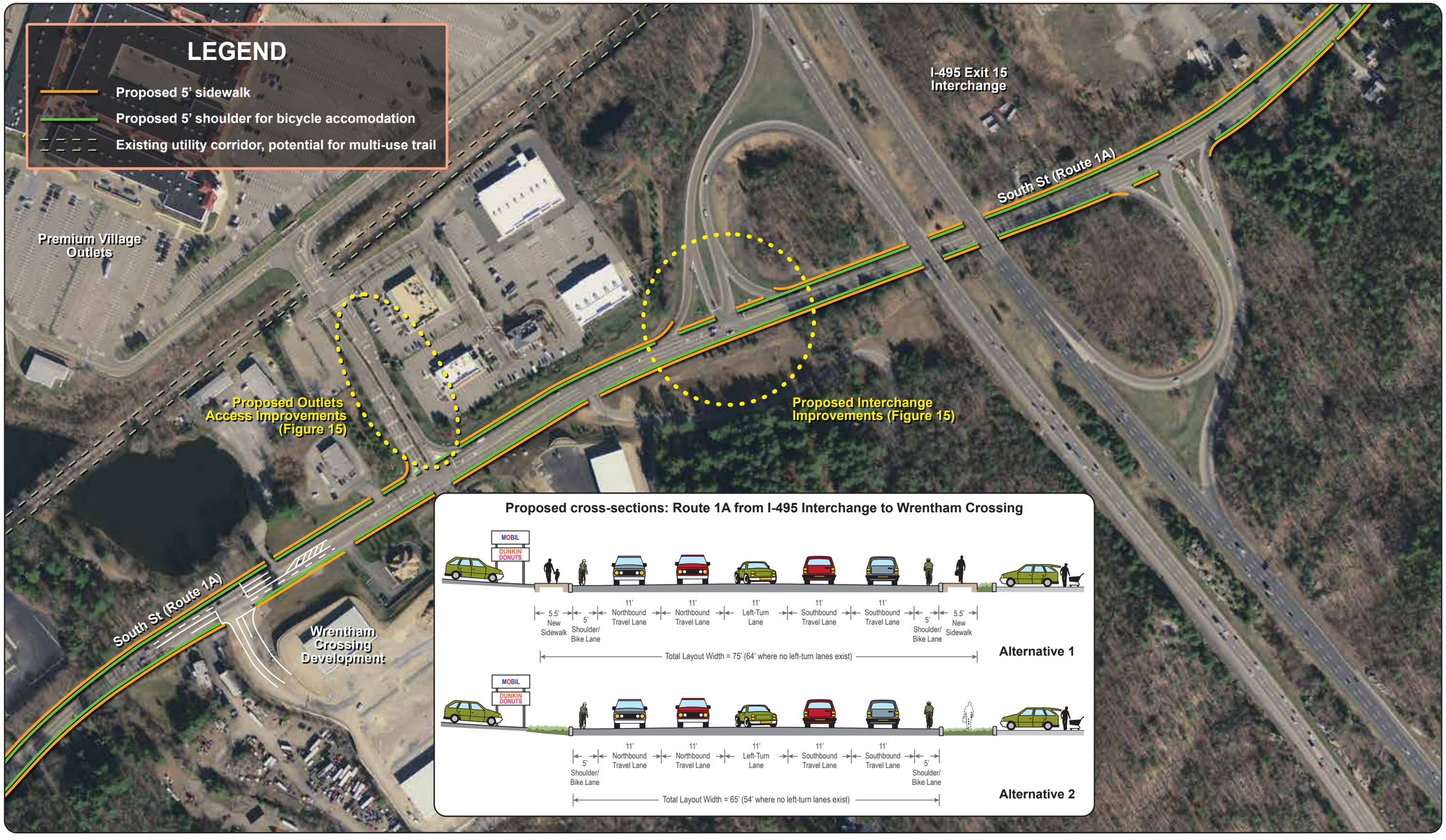

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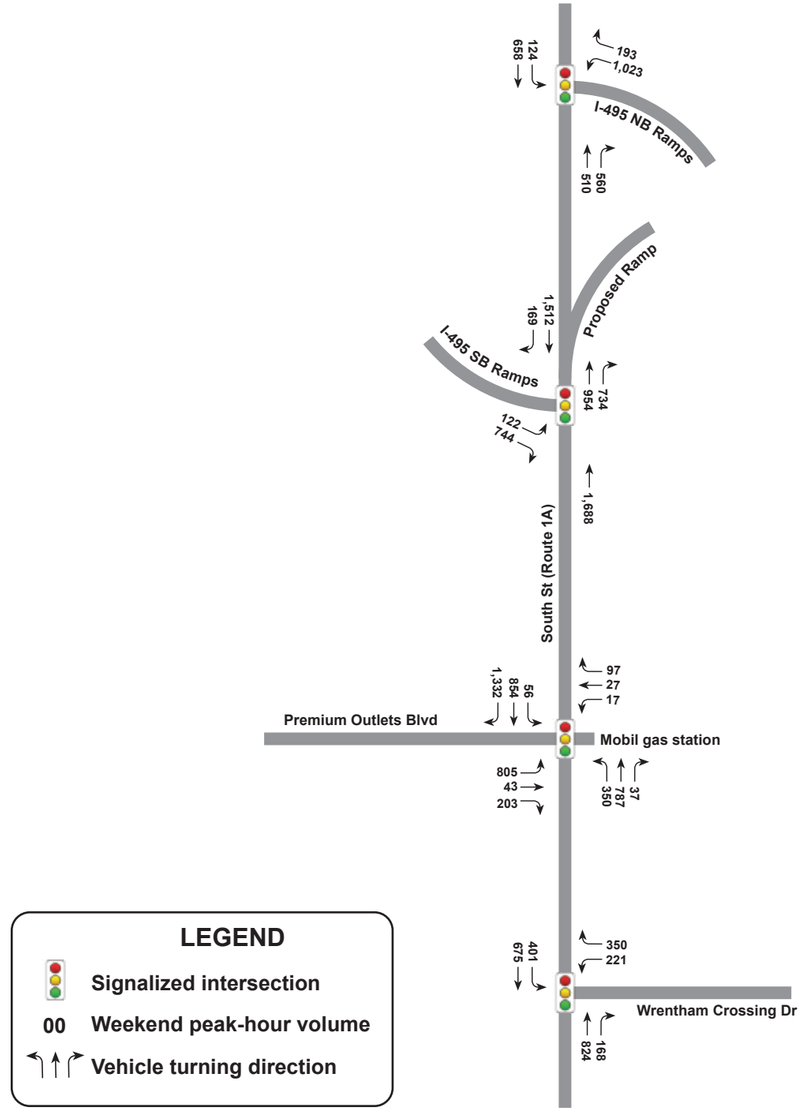
Figure 16
Proposed Long-Term Improvements: Route 1A from I-495 Interchange to Plainville Town Line
Route 1A in Wrentham

Addressing Safety, Mobility, and Access on Subregional Priority Roadways

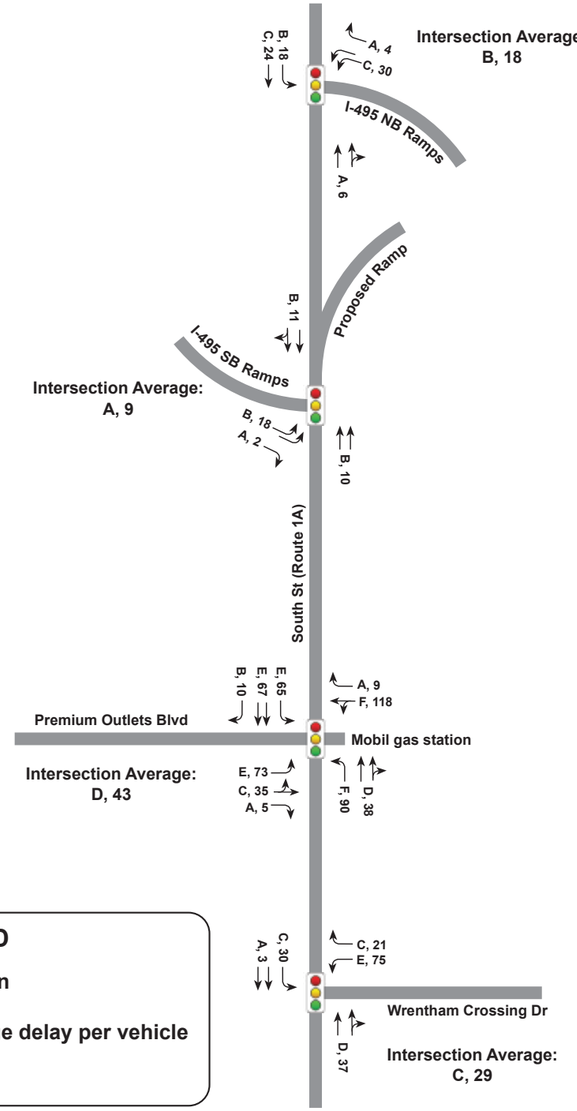
BOSTON REGION MPO

Figure 17
Proposed Long-Term Improvements: Route 1A from I-495 Interchange to Premium Outlets Boulevard Route 1A in Wrentham

Addressing Safety, Mobility, and Access on Subregional Priority Roadways



Projected Traffic Volumes



Intersection Capacity Analyses

BOSTON REGION MPO

Figure 18
Projected 2040 Weekend Peak-Hour Traffic Volumes and Intersection Capacity Analyses with Proposed Improvements:
Route 1A at I-495 Interchange and Premium Outlets Boulevard
Route 1A in Wrentham

Addressing Safety, Mobility, and Access on Subregional Priority Roadways

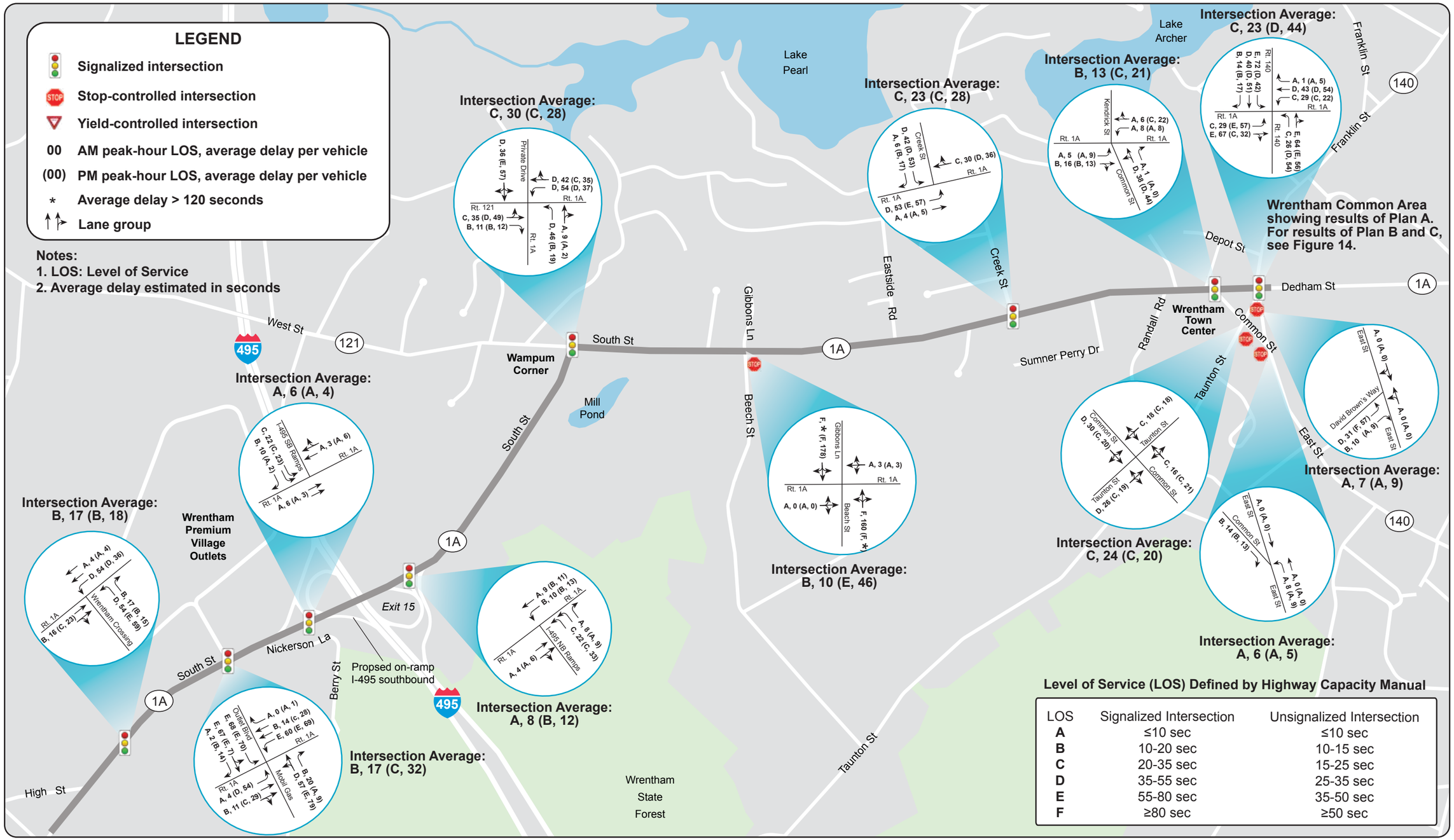


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Figure 19
2040 Weekday Intersection Capacity Analyses with Proposed Long-term Improvements
Route 1A in Wrentham

Addressing Safety, Mobility, and Access on Subregional Priority Roadways

Appendices

Appendix A. Participants in Study Advisory Committee Meetings, April 13–September 12, 2017

Appendix B. Pedestrian Report Card Assessment

Appendix C. Intersection Capacity Analyses, Weekday AM/PM Peak Hour, 2017 Existing Conditions

Appendix D. Preliminary Traffic-Signal and Multiway-Stop Warrants Analyses

Appendix E. Intersection Capacity Analyses, Saturday Midday Peak Hour, 2017 Existing Conditions

Appendix F. Corridor and Segment Crash-Rate Worksheets

Appendix G. Intersection Crash-Rate Worksheets

Appendix H. Collision Diagrams and Crash Statistics

Appendix I. Intersection Capacity Analyses, Weekday AM/PM Peak Hour—Projected 2040 Traffic Conditions under Wrentham Common Improvement Plan A

Appendix J. Intersection Capacity Analyses, Weekday AM/PM Peak Hour—Projected 2040 Traffic Conditions under Wrentham Common Improvement Plan B

Appendix K. Intersection Capacity Analyses, Weekday AM/PM Peak Hour—Projected 2040 Traffic Conditions under Wrentham Common Improvement Plan C

Appendix L. Preliminary Analyses of Modern Roundabout Option, Route 1A at Route 140 and Route 140 at Common Street in Wrentham

Appendix M. Intersection Capacity Analyses, Weekend Peak Hour—Projected 2040 Traffic Conditions with Proposed Improvements for Route 1A from I-495 to Premium Outlets Boulevard

Appendix N. Intersection Capacity Analyses, Weekday AM/PM Peak Hour—Projected 2040 Traffic Conditions with Proposed Improvements

Appendix O. MassDOT Project Development Process

APPENDIX A

Participants of Study Advisory Meetings
April 13–September 12, 2017

Study Advisory Meeting

Route 1A Subregional Corridor Study in Wrentham

April 13 and September 12, 2017

Name	Affiliation	Email
Jerome P. McGovern	Wrentham Board of Selectmen, Chairman	mcgovernjj@comcast.net
William F. Ketcham	Wrentham Town Administrator	wketcham@wrentham.ma.us
Deirdre Foley	Wrentham Economic Development Commission, Vice-Chair	deirdre.foley@hotmail.com
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Ken Jefferson	Wrentham Fire Department	kjefferson@fire.wrentham.ma.us
Michael Lavin	Wrentham Public Works Superintendent	mlavin@wrentham.ma.us
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Barbara LaChance	Mass DOT District 5	Barbara.LaChance@DOT.state.ma.us
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APPENDIX B

Pedestrian Report Card Assessment

Route 1A from Plainville town line to Route 140 in Wrentham

Performance Measure Scores

Performance Measure	Features	Goal	Weight	Unweighted Score	Weighted Score
Sidewalk Presence	Sidewalks are present on Less than 50% of the corridor (one side of the stree and in a short section in Wrentham Center (on both sides).	Capacity Management and Mobility	3	1	3
Crossing Opportunities	Total 8 crosswalks in 3.1 miles = 2.6 crosswalks per mile	Capacity Management and Mobility	2	1	2
Walkway Width	Very few sidewalks are at least 5 feet wide on either side of the street	Capacity Management and Mobility	1	1	1
Pedestrian Volumes	Estimated 60 or more pedestrians in Downtown Wrentham	Economic Vitality	1	3	3
Adjacent Bicycle Accommodations	None	Economic Vitality	1	1	1
Pedestrian Crashes	No HSIP pedestrian clusters	Safety	3	3	9
Average Vehicle Travel Speeds	40 MPH (miles per hour)	Safety	1	1	1
Vehicle-Pedestrian Buffer	3' buffers	Safety	1	1	1
Sidewalk Condition	Sidewalks are not in fair condition on one side of the street and not present on other side.	System Preservation	1	1	1
Transportation Equity Factor	Two out of four factors (schools nearby, high presence of senior citizens)	N/A	N/A		

The weighted scores of all the performance measures within the same category are averaged and given a grade of poor, fair, or good based on the average weighted category score. The average weighted scores are classified as follows:

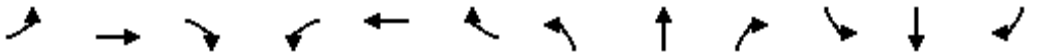
- Good – Score is 2.3 or more (maximum 3.0).
- Fair – Score is between 1.7 and 2.3.
- Poor – Score is 1.7 or less (maximum 0).

Pedestrian Report Card Assessment

Goal	weight points	weighted score	Final score	Rating
Capacity Management and Mobility	6	6	1.0	Poor
Economic Vitality	2	4	2.0	Fair
Safety	5	11	2.2	Fair
System Preservation	1	1	1.0	Poor

APPENDIX C

Intersection Capacity Analyses
Weekday AM/PM Peak Hour
2017 Existing Conditions



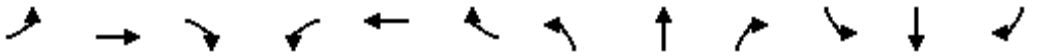
Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	224	455	5	30	153	37	21	359	75	89	389	240
Future Volume (vph)	224	455	5	30	153	37	21	359	75	89	389	240
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Storage Length (ft)	100		0	0		0	0		50	0		160
Storage Lanes	1		0	0		0	0		0	0		1
Taper Length (ft)	100			25			25			25		
Right Turn on Red			Yes			Yes			Yes			Yes
Link Speed (mph)		30			30			30			30	
Link Distance (ft)		462			799			154			1055	
Travel Time (s)		10.5			18.2			3.5			24.0	
Peak Hour Factor	0.83	0.83	0.83	0.83	0.83	0.83	0.80	0.80	0.80	0.94	0.94	0.94
Heavy Vehicles (%)	7%	7%	7%	18%	18%	18%	3%	3%	3%	5%	5%	5%
Shared Lane Traffic (%)												
Lane Group Flow (vph)	270	554	0	0	265	0	0	569	0	0	509	255
Turn Type	Perm	NA		Perm	NA		Perm	NA		Perm	NA	Perm
Protected Phases		1			1			3			3	
Permitted Phases	1			1			3			3		3
Detector Phase	1	1		1	1		3	3		3	3	3
Switch Phase												
Minimum Initial (s)	12.0	12.0		12.0	12.0		12.0	12.0		12.0	12.0	12.0
Minimum Split (s)	17.0	17.0		17.0	17.0		17.0	17.0		17.0	17.0	17.0
Total Split (s)	33.0	33.0		33.0	33.0		32.0	32.0		32.0	32.0	32.0
Total Split (%)	38.8%	38.8%		38.8%	38.8%		37.6%	37.6%		37.6%	37.6%	37.6%
Yellow Time (s)	4.0	4.0		4.0	4.0		4.0	4.0		4.0	4.0	4.0
All-Red Time (s)	1.0	1.0		1.0	1.0		1.0	1.0		1.0	1.0	1.0
Lost Time Adjust (s)	0.0	0.0			0.0			0.0			0.0	0.0
Total Lost Time (s)	5.0	5.0			5.0			5.0			5.0	5.0
Lead/Lag	Lead	Lead		Lead	Lead							
Lead-Lag Optimize?												
Recall Mode	Min	Min		Min	Min		None	None		None	None	None
Act Effct Green (s)	27.7	27.7			27.7			27.0			27.0	27.0
Actuated g/C Ratio	0.43	0.43			0.43			0.42			0.42	0.42
v/c Ratio	0.61	0.73			0.47			0.77			0.88	0.33
Control Delay	21.3	22.4			15.9			25.2			37.0	4.0
Queue Delay	0.0	0.0			0.0			0.0			0.0	0.0
Total Delay	21.3	22.4			15.9			25.2			37.0	4.0
LOS	C	C			B			C			D	A
Approach Delay		22.1			15.9			25.2			26.0	
Approach LOS		C			B			C			C	
Queue Length 50th (ft)	78	173			67			183			179	6
Queue Length 95th (ft)	135	248			113			248			#354	44
Internal Link Dist (ft)		382			719			74			975	
Turn Bay Length (ft)	100											160
Base Capacity (vph)	451	767			573			735			581	776
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	0.60	0.72			0.46			0.77			0.88	0.33

Lane Group	Ø2
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	2
Permitted Phases	
Detector Phase	
Switch Phase	
Minimum Initial (s)	1.0
Minimum Split (s)	20.0
Total Split (s)	20.0
Total Split (%)	24%
Yellow Time (s)	2.0
All-Red Time (s)	0.0
Lost Time Adjust (s)	
Total Lost Time (s)	
Lead/Lag	Lag
Lead-Lag Optimize?	
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: 85		
Actuated Cycle Length: 64.7		
Natural Cycle: 120		
Control Type: Actuated-Uncoordinated		
Maximum v/c Ratio: 0.88		
Intersection Signal Delay: 23.4		Intersection LOS: C
Intersection Capacity Utilization 102.9%		ICU Level of Service G
Analysis Period (min) 15		

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

Splits and Phases: Route 140 & Route 1A



Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	168	218	10	75	412	83	115	412	54	56	383	251
Future Volume (vph)	168	218	10	75	412	83	115	412	54	56	383	251
Confl. Peds. (#/hr)	6					6	2					2
Peak Hour Factor	0.85	0.85	0.85	0.85	0.85	0.85	0.92	0.92	0.92	0.84	0.84	0.84
Heavy Vehicles (%)	2%	2%	2%	2%	2%	2%	1%	1%	1%	2%	2%	2%
Shared Lane Traffic (%)												
Lane Group Flow (vph)	198	268	0	0	671	0	0	632	0	0	523	299
Turn Type	Perm	NA		Perm	NA		Perm	NA		Perm	NA	Perm
Protected Phases		1			1			3			3	
Permitted Phases	1			1			3			3		3
Detector Phase	1	1		1	1		3	3		3	3	3
Switch Phase												
Minimum Initial (s)	12.0	12.0		12.0	12.0		12.0	12.0		12.0	12.0	12.0
Minimum Split (s)	17.0	17.0		17.0	17.0		17.0	17.0		17.0	17.0	17.0
Total Split (s)	33.0	33.0		33.0	33.0		32.0	32.0		32.0	32.0	32.0
Total Split (%)	38.8%	38.8%		38.8%	38.8%		37.6%	37.6%		37.6%	37.6%	37.6%
Yellow Time (s)	4.0	4.0		4.0	4.0		4.0	4.0		4.0	4.0	4.0
All-Red Time (s)	1.0	1.0		1.0	1.0		1.0	1.0		1.0	1.0	1.0
Lost Time Adjust (s)	0.0	0.0			0.0			0.0			0.0	0.0
Total Lost Time (s)	5.0	5.0			5.0			5.0			5.0	5.0
Lead/Lag	Lead	Lead		Lead	Lead							
Lead-Lag Optimize?												
Recall Mode	Min	Min		Min	Min		None	None		None	None	None
Act Effct Green (s)	28.3	28.3			28.3			27.3			27.3	27.3
Actuated g/C Ratio	0.41	0.41			0.41			0.40			0.40	0.40
v/c Ratio	0.88	0.35			0.97			1.85			0.85	0.39
Control Delay	60.9	17.1			52.0			414.9			36.4	5.4
Queue Delay	0.0	0.0			0.0			0.0			0.0	0.0
Total Delay	60.9	17.1			52.0			414.9			36.4	5.4
LOS	E	B			D			F			D	A
Approach Delay		35.7			52.0			414.9			25.1	
Approach LOS		D			D			F			C	
Queue Length 50th (ft)	67	67			238			~390			175	8
Queue Length 95th (ft)	#233	166			#597			#770			#448	57
Internal Link Dist (ft)		392			719			77			975	
Turn Bay Length (ft)	100											160
Base Capacity (vph)	225	761			689			341			615	771
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	0.88	0.35			0.97			1.85			0.85	0.39

Intersection Summary
Cycle Length: 85
Actuated Cycle Length: 69
Natural Cycle: 150
Control Type: Actuated-Uncoordinated
Maximum v/c Ratio: 1.85

Lane Group	Ø2
Lane Configurations	
Traffic Volume (vph)	
Future Volume (vph)	
Confl. Peds. (#/hr)	
Peak Hour Factor	
Heavy Vehicles (%)	
Shared Lane Traffic (%)	
Lane Group Flow (vph)	
Turn Type	
Protected Phases	2
Permitted Phases	
Detector Phase	
Switch Phase	
Minimum Initial (s)	1.0
Minimum Split (s)	20.0
Total Split (s)	20.0
Total Split (%)	24%
Yellow Time (s)	2.0
All-Red Time (s)	0.0
Lost Time Adjust (s)	
Total Lost Time (s)	
Lead/Lag	Lag
Lead-Lag Optimize?	
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	

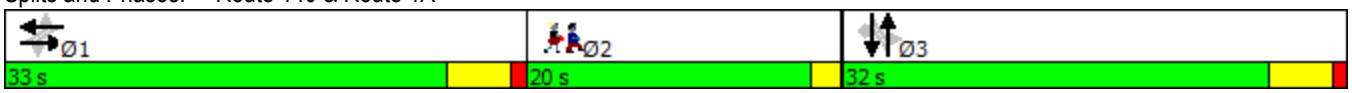
Intersection Summary

Intersection Signal Delay: 129.1	Intersection LOS: F
Intersection Capacity Utilization 114.3%	ICU Level of Service H
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: Route 140 & Route 1A



Unsignalized Intersection Capacity Analysis
Common St & Route 1A & Kendrick St

09/26/2017

Movement	EBL	EBT	EBR	WBL	WBT	WBR	SBL	SBR	NWL	NWR	NWR2
Lane Configurations											
Traffic Volume (veh/h)	56	642	241	29	382	5	0	0	71	7	29
Future Volume (Veh/h)	56	642	241	29	382	5	0	0	71	7	29
Sign Control		Free			Free		Stop		Stop		
Grade		0%			0%		0%		0%		
Peak Hour Factor	0.89	0.89	0.89	0.83	0.83	0.83	0.92	0.92	0.65	0.65	0.65
Hourly flow rate (vph)	63	721	271	35	460	6	0	0	109	11	45
Pedestrians		7			7		7		7		
Lane Width (ft)		12.0			12.0		0.0		12.0		
Walking Speed (ft/s)		3.5			3.5		3.5		3.5		
Percent Blockage		1			1		0		1		
Right turn flare (veh)											
Median type		None			None						
Median storage veh)											
Upstream signal (ft)					462						
pX, platoon unblocked											
vC, conflicting volume	473			999			1665	477	1530	1532	870
vC1, stage 1 conf vol											
vC2, stage 2 conf vol											
vCu, unblocked vol	473			999			1665	477	1530	1532	870
tC, single (s)	4.1			4.2			6.5	6.2	7.2	6.6	6.3
tC, 2 stage (s)											
tF (s)	2.2			2.3			4.0	3.3	3.6	4.1	3.4
p0 queue free %	94			95			100	100	0	89	87
cM capacity (veh/h)	1073			658			86	584	84	101	340

Direction, Lane #	EB 1	WB 1	NW 1
Volume Total	1055	501	165
Volume Left	63	35	109
Volume Right	271	6	45
cSH	1073	658	108
Volume to Capacity	0.06	0.05	1.53
Queue Length 95th (ft)	5	4	306
Control Delay (s)	1.6	1.5	352.0
Lane LOS	A	A	F
Approach Delay (s)	1.6	1.5	352.0
Approach LOS			F

Intersection Summary			
Average Delay	35.2		
Intersection Capacity Utilization	87.8%	ICU Level of Service	E
Analysis Period (min)	15		

HCM Unsignalized Intersection Capacity Analysis
Common St & Route 1A & Kendrick St

09/26/2017

Movement	EBL	EBT	EBR	WBL	WBT	WBR	SBL	SBR	NWL	NWR	NWR2
Lane Configurations											
Traffic Volume (veh/h)	15	400	214	15	762	13	0	0	215	3	9
Future Volume (Veh/h)	15	400	214	15	762	13	0	0	215	3	9
Sign Control		Free			Free		Stop		Stop		
Grade		0%			0%		0%		0%		
Peak Hour Factor	0.93	0.93	0.93	0.91	0.91	0.91	0.92	0.92	0.89	0.89	0.89
Hourly flow rate (vph)	16	430	230	16	837	14	0	0	242	3	10
Pedestrians		4					23		10		
Lane Width (ft)		12.0					0.0		12.0		
Walking Speed (ft/s)		3.5					3.5		3.5		
Percent Blockage		0					0		1		
Right turn flare (veh)										2	2
Median type		None			None						
Median storage veh)											
Upstream signal (ft)					472						
pX, platoon unblocked	0.71						0.71	0.71	0.71	0.71	
vC, conflicting volume	874			670			1601	871	1467	1493	555
vC1, stage 1 conf vol											
vC2, stage 2 conf vol											
vCu, unblocked vol	617			670			1643	612	1453	1490	555
tC, single (s)	4.1			4.1			6.5	6.2	7.1	6.5	6.2
tC, 2 stage (s)											
tF (s)	2.2			2.2			4.0	3.3	3.5	4.0	3.3
p0 queue free %	98			98			100	100	0	96	98
cM capacity (veh/h)	686			916			67	348	73	84	528

Direction, Lane #	EB 1	WB 1	NW 1
Volume Total	676	867	255
Volume Left	16	16	242
Volume Right	230	14	10
cSH	686	916	76
Volume to Capacity	0.02	0.02	3.36
Queue Length 95th (ft)	2	1	Err
Control Delay (s)	0.6	0.5	Err
Lane LOS	A	A	F
Approach Delay (s)	0.6	0.5	Err
Approach LOS			F

Intersection Summary			
Average Delay	1418.6		
Intersection Capacity Utilization	67.0%	ICU Level of Service	C
Analysis Period (min)	15		

Unsignalized Intersection Capacity Analysis
Taunton St & Common St

09/25/2017

Movement	NBL	NBT	NBR	SBL	SBT	SBR	SEL	SET	SER	NWL	NWT	NWR
Lane Configurations												
Traffic Volume (veh/h)	53	179	73	0	176	2	6	180	125	79	70	0
Future Volume (Veh/h)	53	179	73	0	176	2	6	180	125	79	70	0
Sign Control		Stop			Stop			Free			Free	
Grade		0%			0%			0%			0%	
Peak Hour Factor	0.88	0.88	0.88	0.84	0.84	0.84	0.81	0.81	0.81	0.81	0.81	0.81
Hourly flow rate (vph)	60	203	83	0	210	2	7	222	154	98	86	0
Pedestrians												
Lane Width (ft)												
Walking Speed (ft/s)												
Percent Blockage												
Right turn flare (veh)												
Median type								None			None	
Median storage veh)												
Upstream signal (ft)												
pX, platoon unblocked												
vC, conflicting volume	702	595	299	780	672	86	86			376		
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	702	595	299	780	672	86	86			376		
tC, single (s)	7.1	6.5	6.2	7.2	6.6	6.3	4.1			4.2		
tC, 2 stage (s)												
tF (s)	3.5	4.0	3.3	3.6	4.1	3.4	2.2			2.3		
p0 queue free %	63	46	89	100	37	100	100			92		
cM capacity (veh/h)	163	379	738	145	332	946	1492			1156		

Direction, Lane #	NB 1	SB 1	SE 1	NW 1
Volume Total	346	212	383	184
Volume Left	60	0	7	98
Volume Right	83	2	154	0
cSH	340	334	1492	1156
Volume to Capacity	1.02	0.63	0.00	0.08
Queue Length 95th (ft)	294	103	0	7
Control Delay (s)	88.9	32.7	0.2	4.8
Lane LOS	F	D	A	A
Approach Delay (s)	88.9	32.7	0.2	4.8
Approach LOS	F	D		

Intersection Summary				
Average Delay	34.3			
Intersection Capacity Utilization	65.0%	ICU Level of Service	C	
Analysis Period (min)	15			

HCM Unsignalized Intersection Capacity Analysis
Taunton St/David Brown's Way & Common St

09/26/2017

Movement	NBL	NBT	NBR	SBL	SBT	SBR	SEL	SET	SER	NWL	NWT	NWR
Lane Configurations												
Traffic Volume (veh/h)	35	151	53	1	216	2	9	188	72	66	187	2
Future Volume (Veh/h)	35	151	53	1	216	2	9	188	72	66	187	2
Sign Control		Stop			Stop			Free			Free	
Grade		0%			0%			0%			0%	
Peak Hour Factor	0.89	0.89	0.89	0.90	0.90	0.90	0.91	0.91	0.91	0.87	0.87	0.87
Hourly flow rate (vph)	39	170	60	1	240	2	10	207	79	76	215	2
Pedestrians		1										
Lane Width (ft)		12.0										
Walking Speed (ft/s)		3.5										
Percent Blockage		0										
Right turn flare (veh)												
Median type								None			None	
Median storage veh)												
Upstream signal (ft)												
pX, platoon unblocked												
vC, conflicting volume	758	636	248	780	675	216	217			287		
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	758	636	248	780	675	216	217			287		
tC, single (s)	7.1	6.5	6.2	7.1	6.5	6.2	4.1			4.1		
tC, 2 stage (s)												
tF (s)	3.5	4.0	3.3	3.5	4.0	3.3	2.2			2.2		
p0 queue free %	72	54	92	99	31	100	99			94		
cM capacity (veh/h)	138	369	790	176	350	824	1359			1274		

Direction, Lane #	NB 1	SB 1	SE 1	NW 1
Volume Total	269	243	296	293
Volume Left	39	1	10	76
Volume Right	60	2	79	2
cSH	328	350	1359	1274
Volume to Capacity	0.82	0.69	0.01	0.06
Queue Length 95th (ft)	175	124	1	5
Control Delay (s)	51.0	35.5	0.3	2.5
Lane LOS	F	E	A	A
Approach Delay (s)	51.0	35.5	0.3	2.5
Approach LOS	F	E		

Intersection Summary				
Average Delay	21.0			
Intersection Capacity Utilization	66.4%	ICU Level of Service	C	
Analysis Period (min)	15			

Movement	NBL	NBT	SBT	SBR	SEL	SER
Lane Configurations						
Traffic Volume (veh/h)	149	270	246	0	0	253
Future Volume (Veh/h)	149	270	246	0	0	253
Sign Control		Free	Free		Yield	
Grade		0%	0%		0%	
Peak Hour Factor	0.83	0.83	0.83	0.83	0.83	0.83
Hourly flow rate (vph)	180	325	296	0	0	305
Pedestrians						
Lane Width (ft)						
Walking Speed (ft/s)						
Percent Blockage						
Right turn flare (veh)						
Median type		None	None			
Median storage veh)						
Upstream signal (ft)			796			
pX, platoon unblocked						
vC, conflicting volume	296				981	296
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	296				981	296
tC, single (s)	4.2				6.5	6.3
tC, 2 stage (s)						
tF (s)	2.3				3.6	3.4
p0 queue free %	85				100	58
cM capacity (veh/h)	1232				230	729

Direction, Lane #	NB 1	SB 1	SE 1
Volume Total	505	296	305
Volume Left	180	0	0
Volume Right	0	0	305
cSH	1232	1700	729
Volume to Capacity	0.15	0.17	0.42
Queue Length 95th (ft)	13	0	52
Control Delay (s)	4.0	0.0	13.4
Lane LOS	A		B
Approach Delay (s)	4.0	0.0	13.4
Approach LOS			B

Intersection Summary			
Average Delay		5.5	
Intersection Capacity Utilization		42.1%	ICU Level of Service A
Analysis Period (min)		15	

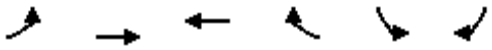
Movement	NBL	NBT	SBT	SBR	SEL	SER
Lane Configurations						
Traffic Volume (veh/h)	255	419	249	0	0	242
Future Volume (Veh/h)	255	419	249	0	0	242
Sign Control		Free	Free		Yield	
Grade		0%	0%		0%	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	277	455	271	0	0	263
Pedestrians						
Lane Width (ft)						
Walking Speed (ft/s)						
Percent Blockage						
Right turn flare (veh)						
Median type		None	None			
Median storage veh)						
Upstream signal (ft)			806			
pX, platoon unblocked						
vC, conflicting volume	271				1280	271
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	271				1280	271
tC, single (s)	4.1				6.4	6.2
tC, 2 stage (s)						
tF (s)	2.2				3.5	3.3
p0 queue free %	79				100	66
cM capacity (veh/h)	1292				144	768

Direction, Lane #	NB 1	SB 1	SE 1
Volume Total	732	271	263
Volume Left	277	0	0
Volume Right	0	0	263
cSH	1292	1700	768
Volume to Capacity	0.21	0.16	0.34
Queue Length 95th (ft)	20	0	38
Control Delay (s)	4.8	0.0	12.1
Lane LOS	A		B
Approach Delay (s)	4.8	0.0	12.1
Approach LOS			B

Intersection Summary			
Average Delay		5.3	
Intersection Capacity Utilization		55.9%	ICU Level of Service B
Analysis Period (min)		15	

Unsignalized Intersection Capacity Analysis
Route 1A & Creek Street

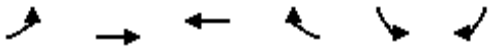
09/25/2017



Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Traffic Volume (veh/h)	179	849	335	35	133	66
Future Volume (Veh/h)	179	849	335	35	133	66
Sign Control		Free	Free		Stop	
Grade		0%	0%		0%	
Peak Hour Factor	0.86	0.86	0.76	0.76	0.86	0.86
Hourly flow rate (vph)	208	987	441	46	155	77
Pedestrians						
Lane Width (ft)						
Walking Speed (ft/s)						
Percent Blockage						
Right turn flare (veh)						
Median type		None	None			
Median storage veh)						
Upstream signal (ft)						
pX, platoon unblocked						
vC, conflicting volume	487				1867	464
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	487				1867	464
tC, single (s)	4.1				6.5	6.3
tC, 2 stage (s)						
tF (s)	2.2				3.6	3.4
p0 queue free %	80				0	87
cM capacity (veh/h)	1066				61	584

Direction, Lane #	EB 1	WB 1	SB 1
Volume Total	1195	487	232
Volume Left	208	0	155
Volume Right	0	46	77
cSH	1066	1700	87
Volume to Capacity	0.20	0.29	2.65
Queue Length 95th (ft)	18	0	550
Control Delay (s)	5.1	0.0	850.8
Lane LOS	A		F
Approach Delay (s)	5.1	0.0	850.8
Approach LOS			F

Intersection Summary			
Average Delay	106.3		
Intersection Capacity Utilization	95.7%	ICU Level of Service	F
Analysis Period (min)	15		



Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Traffic Volume (veh/h)	204	498	765	77	45	236
Future Volume (Veh/h)	204	498	765	77	45	236
Sign Control		Free	Free		Stop	
Grade		0%	0%		0%	
Peak Hour Factor	0.92	0.92	0.87	0.87	0.85	0.85
Hourly flow rate (vph)	222	541	879	89	53	278
Pedestrians					3	
Lane Width (ft)					12.0	
Walking Speed (ft/s)					3.5	
Percent Blockage					0	
Right turn flare (veh)						
Median type		None	None			
Median storage veh)						
Upstream signal (ft)						
pX, platoon unblocked						
vC, conflicting volume	971				1912	926
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	971				1912	926
tC, single (s)	4.1				6.4	6.2
tC, 2 stage (s)						
tF (s)	2.2				3.5	3.3
p0 queue free %	69				0	15
cM capacity (veh/h)	712				52	326

Direction, Lane #	EB 1	WB 1	SB 1
Volume Total	763	968	331
Volume Left	222	0	53
Volume Right	0	89	278
cSH	712	1700	176
Volume to Capacity	0.31	0.57	1.88
Queue Length 95th (ft)	33	0	611
Control Delay (s)	7.6	0.0	460.9
Lane LOS	A		F
Approach Delay (s)	7.6	0.0	460.9
Approach LOS			F

Intersection Summary			
Average Delay	76.8		
Intersection Capacity Utilization	109.5%	ICU Level of Service	H
Analysis Period (min)	15		

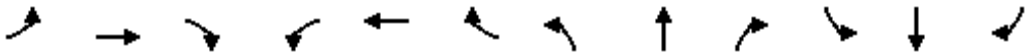
Unsignalized Intersection Capacity Analysis
Route 1A & Beach Street

09/25/2017

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	4	915	33	41	429	3	22	0	38	9	1	1
Future Volume (Veh/h)	4	915	33	41	429	3	22	0	38	9	1	1
Sign Control		Free			Free			Stop			Stop	
Grade		0%			0%			0%			0%	
Peak Hour Factor	0.86	0.86	0.86	0.86	0.86	0.86	0.79	0.79	0.79	0.55	0.55	0.55
Hourly flow rate (vph)	5	1064	38	48	499	3	28	0	48	16	2	2
Pedestrians												
Lane Width (ft)												
Walking Speed (ft/s)												
Percent Blockage												
Right turn flare (veh)												
Median type		None			None							
Median storage veh)												
Upstream signal (ft)												
pX, platoon unblocked												
vC, conflicting volume	502			1102			1692	1691	1083	1738	1708	500
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	502			1102			1692	1691	1083	1738	1708	500
tC, single (s)	4.1			4.2			7.2	6.6	6.3	7.2	6.6	6.3
tC, 2 stage (s)												
tF (s)	2.2			2.3			3.6	4.1	3.4	3.6	4.1	3.4
p0 queue free %	100			92			56	100	81	68	98	100
cM capacity (veh/h)	1047			601			63	80	251	50	80	557

Direction, Lane #	EB 1	WB 1	NB 1	SB 1
Volume Total	1107	550	76	20
Volume Left	5	48	28	16
Volume Right	38	3	48	2
cSH	1047	601	120	57
Volume to Capacity	0.00	0.08	0.63	0.35
Queue Length 95th (ft)	0	6	81	32
Control Delay (s)	0.2	2.2	76.5	98.8
Lane LOS	A	A	F	F
Approach Delay (s)	0.2	2.2	76.5	98.8
Approach LOS			F	F

Intersection Summary			
Average Delay	5.2		
Intersection Capacity Utilization	63.3%	ICU Level of Service	B
Analysis Period (min)	15		



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	1	604	48	69	876	4	45	0	77	5	0	2
Future Volume (Veh/h)	1	604	48	69	876	4	45	0	77	5	0	2
Sign Control		Free			Free			Stop			Stop	
Grade		0%			0%			0%			0%	
Peak Hour Factor	0.97	0.97	0.97	0.88	0.88	0.88	0.76	0.76	0.76	0.58	0.58	0.58
Hourly flow rate (vph)	1	623	49	78	995	5	59	0	101	9	0	3
Pedestrians		1			1			1				
Lane Width (ft)		12.0			12.0			12.0				
Walking Speed (ft/s)		3.5			3.5			3.5				
Percent Blockage		0			0			0				
Right turn flare (veh)												
Median type		None			None							
Median storage veh)												
Upstream signal (ft)												
pX, platoon unblocked												
vC, conflicting volume	1000			673			1808	1806	650	1905	1828	998
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	1000			673			1808	1806	650	1905	1828	998
tC, single (s)	4.1			4.1			7.1	6.5	6.2	7.1	6.5	6.2
tC, 2 stage (s)												
tF (s)	2.2			2.2			3.5	4.0	3.3	3.5	4.0	3.3
p0 queue free %	100			92			0	100	79	77	100	99
cM capacity (veh/h)	692			922			57	73	472	39	71	298

Direction, Lane #	EB 1	WB 1	NB 1	SB 1
Volume Total	673	1078	160	12
Volume Left	1	78	59	9
Volume Right	49	5	101	3
cSH	692	922	128	49
Volume to Capacity	0.00	0.08	1.25	0.24
Queue Length 95th (ft)	0	7	250	20
Control Delay (s)	0.0	2.4	226.9	99.7
Lane LOS	A	A	F	F
Approach Delay (s)	0.0	2.4	226.9	99.7
Approach LOS			F	F

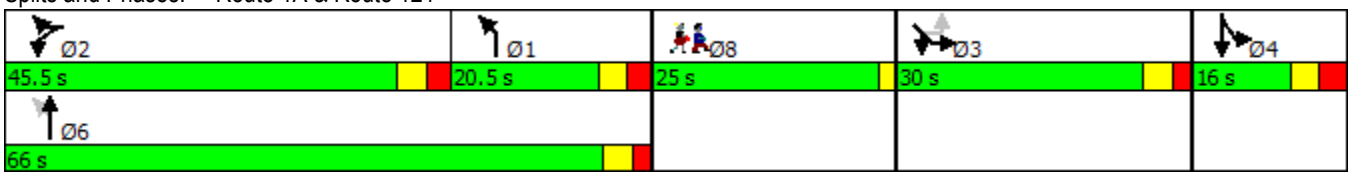
Intersection Summary			
Average Delay	20.9		
Intersection Capacity Utilization	102.4%	ICU Level of Service	G
Analysis Period (min)	15		

Lane Group	WBL	WBR	NBL	NBT	NBR	SBL	SBT	SBR	SEL	SER	Ø8
Lane Configurations											
Traffic Volume (vph)	289	173	60	0	419	0	0	7	526	200	
Future Volume (vph)	289	173	60	0	419	0	0	7	526	200	
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	
Storage Length (ft)	0	0	150		0	0		0	0	200	
Storage Lanes	1	1	1		0	0		0	1	1	
Taper Length (ft)	25		25			25			25		
Right Turn on Red					Yes			Yes		Yes	
Link Speed (mph)	30			30			30		30		
Link Distance (ft)	228			938			493		596		
Travel Time (s)	5.2			21.3			11.2		13.5		
Peak Hour Factor	0.91	0.91	0.87	0.87	0.87	0.92	0.92	0.35	0.86	0.86	
Heavy Vehicles (%)	12%	12%	8%	8%	8%	2%	2%	14%	2%	2%	
Shared Lane Traffic (%)											
Lane Group Flow (vph)	318	190	69	482	0	0	20	0	612	233	
Turn Type	Prot	Prot	pm+pt	NA			NA		Prot	Prot	
Protected Phases	2!	2!	1	6!		4	4		3	3	8
Permitted Phases			6!								
Detector Phase	2	2	1	6		4	4		3	3	
Switch Phase											
Minimum Initial (s)	15.0	15.0	8.0	15.0		6.0	6.0		8.0	8.0	5.0
Minimum Split (s)	21.0	21.0	14.0	20.0		12.0	12.0		13.0	13.0	25.0
Total Split (s)	45.5	45.5	20.5	66.0		16.0	16.0		30.0	30.0	25.0
Total Split (%)	33.2%	33.2%	15.0%	48.2%		11.7%	11.7%		21.9%	21.9%	18%
Yellow Time (s)	3.0	3.0	3.0	3.0		3.0	3.0		3.0	3.0	2.0
All-Red Time (s)	2.5	2.5	2.5	2.0		3.0	3.0		2.0	2.0	0.0
Lost Time Adjust (s)	0.0	0.0	0.0	0.0			0.0		0.0	0.0	
Total Lost Time (s)	5.5	5.5	5.5	5.0			6.0		5.0	5.0	
Lead/Lag	Lead	Lead	Lag								
Lead-Lag Optimize?	Yes	Yes	Yes								
Recall Mode	Min	Min	None	Min		None	None		None	None	None
Act Effct Green (s)	21.7	21.7	34.3	32.5			6.3		26.2	26.2	
Actuated g/C Ratio	0.30	0.30	0.47	0.44			0.09		0.36	0.36	
v/c Ratio	0.67	0.44	0.25	0.48			0.02		0.97	0.36	
Control Delay	31.6	26.3	21.8	1.8			0.0		57.9	13.1	
Queue Delay	0.0	0.0	0.0	0.0			0.0		0.0	0.0	
Total Delay	31.6	26.3	21.8	1.8			0.0		57.9	13.1	
LOS	C	C	C	A			A		E	B	
Approach Delay	29.6			4.3					45.5		
Approach LOS	C			A					D		
Queue Length 50th (ft)	118	65	15	0			0		261	32	
Queue Length 95th (ft)	240	144	42	0			0		#624	106	
Internal Link Dist (ft)	148			858			413		516		
Turn Bay Length (ft)			150							200	
Base Capacity (vph)	924	827	448	1349			864		634	648	
Starvation Cap Reductn	0	0	0	0			0		0	0	
Spillback Cap Reductn	0	0	0	0			0		0	0	
Storage Cap Reductn	0	0	0	0			0		0	0	
Reduced v/c Ratio	0.34	0.23	0.15	0.36			0.02		0.97	0.36	

Intersection Summary		
Area Type:	Other	
Cycle Length: 137		
Actuated Cycle Length: 73.1		
Natural Cycle: 125		
Control Type: Actuated-Uncoordinated		
Maximum v/c Ratio: 0.97		
Intersection Signal Delay: 29.0		Intersection LOS: C
Intersection Capacity Utilization 84.0%		ICU Level of Service E
Analysis Period (min) 15		

\# 95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.
! Phase conflict between lane groups.

Splits and Phases: Route 1A & Route 121



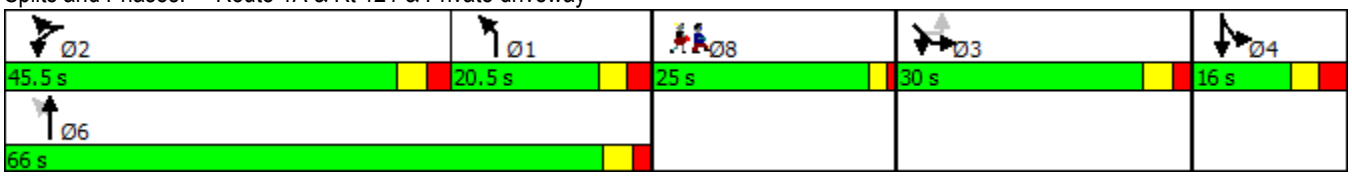
Lane Group	WBL	WBR	WBR2	NBL	NBT	NBR	SBL	SBT	SBR	SEL	SER	Ø8
Lane Configurations												
Traffic Volume (vph)	440	472	6	201	0	386	3	2	0	255	145	
Future Volume (vph)	440	472	6	201	0	386	3	2	0	255	145	
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	
Storage Length (ft)	0	0		150		0	0		0	0	200	
Storage Lanes	1	1		1		0	0		0	1	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)	223				1040			190		596		
Travel Time (s)	5.1				23.6			4.3		13.5		
Confl. Peds. (#/hr)			1	8		2	2		8			
Peak Hour Factor	0.84	0.84	0.84	0.90	0.90	0.90	0.62	0.62	0.62	0.69	0.69	
Heavy Vehicles (%)	1%	1%	1%	2%	2%	2%	17%	17%	17%	2%	2%	
Shared Lane Traffic (%)												
Lane Group Flow (vph)	524	569	0	223	429	0	0	8	0	370	210	
Turn Type	Prot	Prot		pm+pt	NA		Split	NA		Prot	Prot	
Protected Phases	2!	2!		1	6!		4	4		3	3	8
Permitted Phases				6!								
Detector Phase	2	2		1	6		4	4		3	3	
Switch Phase												
Minimum Initial (s)	15.0	15.0		8.0	15.0		6.0	6.0		8.0	8.0	5.0
Minimum Split (s)	21.0	21.0		14.0	20.5		12.0	12.0		13.0	13.0	25.0
Total Split (s)	45.5	45.5		20.5	66.0		16.0	16.0		30.0	30.0	25.0
Total Split (%)	33.2%	33.2%		15.0%	48.2%		11.7%	11.7%		21.9%	21.9%	18%
Yellow Time (s)	3.0	3.0		3.0	3.0		3.0	3.0		3.0	3.0	2.0
All-Red Time (s)	2.5	2.5		2.5	2.0		3.0	3.0		2.0	2.0	1.0
Lost Time Adjust (s)	0.0	0.0		0.0	0.0			0.0		0.0	0.0	
Total Lost Time (s)	5.5	5.5		5.5	5.0			6.0		5.0	5.0	
Lead/Lag	Lead	Lead		Lag								
Lead-Lag Optimize?	Yes	Yes		Yes								
Recall Mode	Min	Min		None	Min		None	None		None	None	None
Act Effct Green (s)	40.8	40.8		54.6	55.1			6.2		25.5	25.5	
Actuated g/C Ratio	0.42	0.42		0.57	0.57			0.06		0.26	0.26	
v/c Ratio	0.69	0.76		0.32	0.37			0.08		0.79	0.39	
Control Delay	31.2	27.6		16.0	0.9			50.4		48.4	11.8	
Queue Delay	0.0	0.0		0.0	0.0			0.0		0.0	0.0	
Total Delay	31.2	27.6		16.0	0.9			50.4		48.4	11.8	
LOS	C	C		B	A			D		D	B	
Approach Delay	29.3				6.1			50.4		35.2		
Approach LOS	C				A			D		D		
Queue Length 50th (ft)	221	195		52	0			4		188	19	
Queue Length 95th (ft)	#557	#530		181	0			16		#336	48	
Internal Link Dist (ft)	143				960			110		516		
Turn Bay Length (ft)				150							200	
Base Capacity (vph)	755	751		837	1230			166		467	538	
Starvation Cap Reductn	0	0		0	0			0		0	0	
Spillback Cap Reductn	0	0		0	0			0		0	0	
Storage Cap Reductn	0	0		0	0			0		0	0	

Lane Group	WBL	WBR	WBR2	NBL	NBT	NBR	SBL	SBT	SBR	SEL	SER	Ø8
Reduced v/c Ratio	0.69	0.76		0.27	0.35			0.05		0.79	0.39	

Intersection Summary			
Area Type:	Other		
Cycle Length: 137			
Actuated Cycle Length: 96.5			
Natural Cycle: 115			
Control Type: Actuated-Uncoordinated			
Maximum v/c Ratio: 0.79			
Intersection Signal Delay: 24.3		Intersection LOS: C	
Intersection Capacity Utilization 75.5%		ICU Level of Service D	
Analysis Period (min) 15			

\# 95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.
! Phase conflict between lane groups.

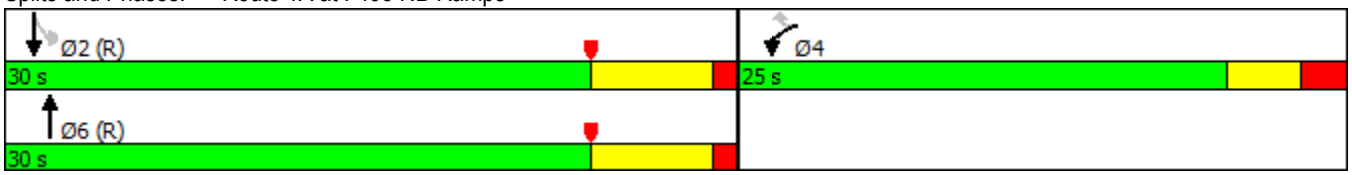
Splits and Phases: Route 1A & Rt 121 & Private driveway



Lane Group	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Traffic Volume (vph)	118	109	374	516	107	383
Future Volume (vph)	118	109	374	516	107	383
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Storage Length (ft)	200	300		0	0	
Storage Lanes	1	1		0	0	
Taper Length (ft)	25				0	
Right Turn on Red		Yes		Yes		
Link Speed (mph)	30		30			30
Link Distance (ft)	627		1275			363
Travel Time (s)	14.3		29.0			8.3
Peak Hour Factor	0.95	0.95	0.91	0.91	0.86	0.86
Heavy Vehicles (%)	16%	16%	6%	6%	9%	9%
Shared Lane Traffic (%)						
Lane Group Flow (vph)	124	115	978	0	0	569
Turn Type	Prot	Perm	NA		Perm	NA
Protected Phases	4		6			2
Permitted Phases		4			2	
Detector Phase	4	4	6		2	2
Switch Phase						
Minimum Initial (s)	18.0	18.0	21.0		21.0	21.0
Minimum Split (s)	23.0	23.0	27.0		27.0	27.0
Total Split (s)	25.0	25.0	30.0		30.0	30.0
Total Split (%)	45.5%	45.5%	54.5%		54.5%	54.5%
Yellow Time (s)	3.0	3.0	5.0		5.0	5.0
All-Red Time (s)	2.0	2.0	1.0		1.0	1.0
Lost Time Adjust (s)	0.0	0.0	0.0			0.0
Total Lost Time (s)	5.0	5.0	6.0			6.0
Lead/Lag						
Lead-Lag Optimize?						
Recall Mode	None	None	C-Max		C-Max	C-Max
Act Effct Green (s)	18.0	18.0	31.8			31.8
Actuated g/C Ratio	0.33	0.33	0.58			0.58
v/c Ratio	0.13	0.22	0.48			0.48
Control Delay	13.4	4.6	7.4			11.5
Queue Delay	0.0	0.0	0.0			0.0
Total Delay	13.4	4.6	7.4			11.5
LOS	B	A	A			B
Approach Delay	9.2		7.4			11.5
Approach LOS	A		A			B
Queue Length 50th (ft)	14	0	174			66
Queue Length 95th (ft)	29	28	280			102
Internal Link Dist (ft)	547		1195			283
Turn Bay Length (ft)	200	300				
Base Capacity (vph)	1097	579	2036			1177
Starvation Cap Reductn	0	0	0			0
Spillback Cap Reductn	0	0	0			0
Storage Cap Reductn	0	0	0			0
Reduced v/c Ratio	0.11	0.20	0.48			0.48

Intersection Summary		
Area Type:	Other	
Cycle Length: 55		
Actuated Cycle Length: 55		
Offset: 0 (0%), Referenced to phase 2:SBTL and 6:NBT, Start of Yellow, Master Intersection		
Natural Cycle: 50		
Control Type: Actuated-Coordinated		
Maximum v/c Ratio: 0.48		
Intersection Signal Delay: 9.0		Intersection LOS: A
Intersection Capacity Utilization 73.6%		ICU Level of Service D
Analysis Period (min) 15		

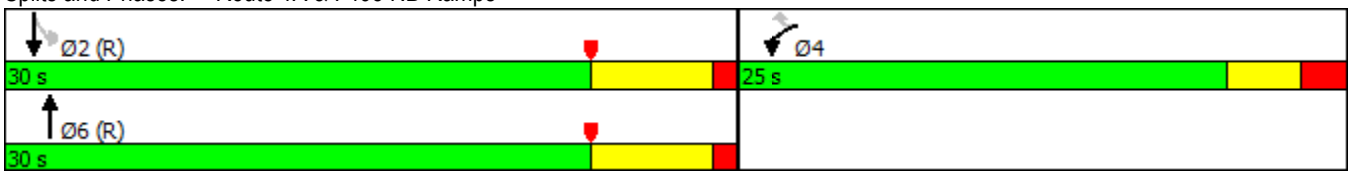
Splits and Phases: Route 1A at I-495 NB Ramps

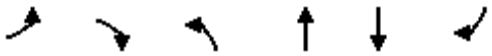


Lane Group	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Traffic Volume (vph)	303	271	332	291	119	412
Future Volume (vph)	303	271	332	291	119	412
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Storage Length (ft)	200	300		0	0	
Storage Lanes	1	1		0	0	
Taper Length (ft)	25				0	
Right Turn on Red		Yes		Yes		
Link Speed (mph)	30		30			30
Link Distance (ft)	627		1275			363
Travel Time (s)	14.3		29.0			8.3
Peak Hour Factor	0.98	0.98	0.83	0.83	0.81	0.81
Heavy Vehicles (%)	3%	3%	2%	2%	2%	2%
Shared Lane Traffic (%)						
Lane Group Flow (vph)	309	277	751	0	0	656
Turn Type	Prot	Perm	NA		Perm	NA
Protected Phases	4		6			2
Permitted Phases		4			2	
Detector Phase	4	4	6		2	2
Switch Phase						
Minimum Initial (s)	18.0	18.0	21.0		21.0	21.0
Minimum Split (s)	23.0	23.0	27.0		27.0	27.0
Total Split (s)	25.0	25.0	30.0		30.0	30.0
Total Split (%)	45.5%	45.5%	54.5%		54.5%	54.5%
Yellow Time (s)	3.0	3.0	5.0		5.0	5.0
All-Red Time (s)	2.0	2.0	1.0		1.0	1.0
Lost Time Adjust (s)	0.0	0.0	0.0			0.0
Total Lost Time (s)	5.0	5.0	6.0			6.0
Lead/Lag						
Lead-Lag Optimize?						
Recall Mode	None	None	C-Max		C-Max	C-Max
Act Effct Green (s)	18.0	18.0	26.0			26.0
Actuated g/C Ratio	0.33	0.33	0.47			0.47
v/c Ratio	0.28	0.40	0.43			0.61
Control Delay	14.5	4.1	9.4			13.8
Queue Delay	0.0	0.0	0.0			0.0
Total Delay	14.5	4.1	9.4			13.8
LOS	B	A	A			B
Approach Delay	9.6		9.4			13.8
Approach LOS	A		A			B
Queue Length 50th (ft)	37	0	76			77
Queue Length 95th (ft)	63	42	85			105
Internal Link Dist (ft)	547		1195			283
Turn Bay Length (ft)	200	300				
Base Capacity (vph)	1236	746	1740			1074
Starvation Cap Reductn	0	0	0			0
Spillback Cap Reductn	0	0	0			0
Storage Cap Reductn	0	0	0			0
Reduced v/c Ratio	0.25	0.37	0.43			0.61

Intersection Summary		
Area Type:	Other	
Cycle Length: 55		
Actuated Cycle Length: 55		
Offset: 0 (0%), Referenced to phase 2:SBTL and 6:NBT, Start of Yellow, Master Intersection		
Natural Cycle: 50		
Control Type: Actuated-Coordinated		
Maximum v/c Ratio: 0.61		
Intersection Signal Delay: 10.9	Intersection LOS: B	
Intersection Capacity Utilization 65.2%	ICU Level of Service C	
Analysis Period (min) 15		

Splits and Phases: Route 1A & I-495 NB Ramps

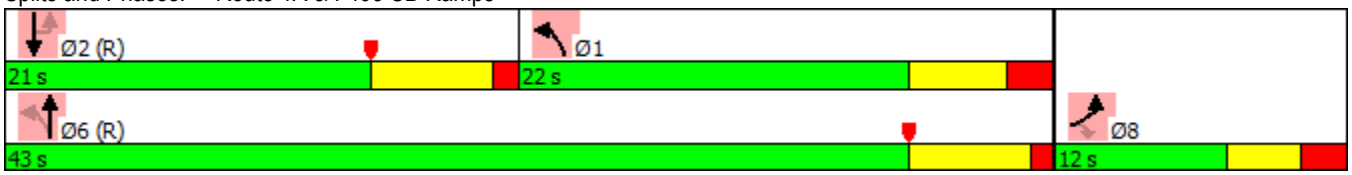


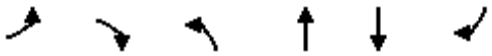


Lane Group	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Traffic Volume (vph)	86	162	197	801	250	261
Future Volume (vph)	86	162	197	801	250	261
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Storage Length (ft)	0	280	0			0
Storage Lanes	1	1	1			0
Taper Length (ft)	0		25			
Right Turn on Red		Yes				Yes
Link Speed (mph)	30			40	40	
Link Distance (ft)	604			409	1275	
Travel Time (s)	13.7			7.0	21.7	
Peak Hour Factor	0.78	0.78	0.86	0.86	0.85	0.85
Heavy Vehicles (%)	14%	14%	7%	7%	11%	11%
Shared Lane Traffic (%)						
Lane Group Flow (vph)	110	208	229	931	601	0
Turn Type	Prot	Perm	pm+pt	NA	NA	
Protected Phases	8		1	6	2	
Permitted Phases		8	6			
Detector Phase	8	8	1	6	2	
Switch Phase						
Minimum Initial (s)	5.0	5.0	6.0	10.0	10.0	
Minimum Split (s)	10.0	10.0	12.0	16.0	16.0	
Total Split (s)	12.0	12.0	22.0	43.0	21.0	
Total Split (%)	21.8%	21.8%	40.0%	78.2%	38.2%	
Yellow Time (s)	3.0	3.0	4.0	5.0	5.0	
All-Red Time (s)	2.0	2.0	2.0	1.0	1.0	
Lost Time Adjust (s)	0.0	0.0	0.0	0.0	0.0	
Total Lost Time (s)	5.0	5.0	6.0	6.0	6.0	
Lead/Lag			Lag		Lead	
Lead-Lag Optimize?						
Recall Mode	None	None	None	C-Max	C-Max	
Act Effct Green (s)	6.7	6.7	37.3	37.3	15.3	
Actuated g/C Ratio	0.12	0.12	0.68	0.68	0.28	
v/c Ratio	0.57	0.59	0.31	0.41	0.57	
Control Delay	36.0	11.7	9.5	7.2	15.6	
Queue Delay	0.0	0.0	0.0	0.0	0.0	
Total Delay	36.0	11.7	9.5	7.2	15.6	
LOS	D	B	A	A	B	
Approach Delay	20.1			7.7	15.6	
Approach LOS	C			A	B	
Queue Length 50th (ft)	35	0	68	169	41	
Queue Length 95th (ft)	65	33	94	211	90	
Internal Link Dist (ft)	524			329	1195	
Turn Bay Length (ft)		280				
Base Capacity (vph)	201	361	748	2286	1056	
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	0.55	0.58	0.31	0.41	0.57	

Intersection Summary		
Area Type:	Other	
Cycle Length: 55		
Actuated Cycle Length: 55		
Offset: 0 (0%), Referenced to phase 2:SBTU and 6:NBTL, Start of Yellow		
Natural Cycle: 40		
Control Type: Actuated-Coordinated		
Maximum v/c Ratio: 0.59		
Intersection Signal Delay: 11.8		Intersection LOS: B
Intersection Capacity Utilization 56.4%		ICU Level of Service B
Analysis Period (min) 15		

Splits and Phases: Route 1A & I-495 SB Ramps

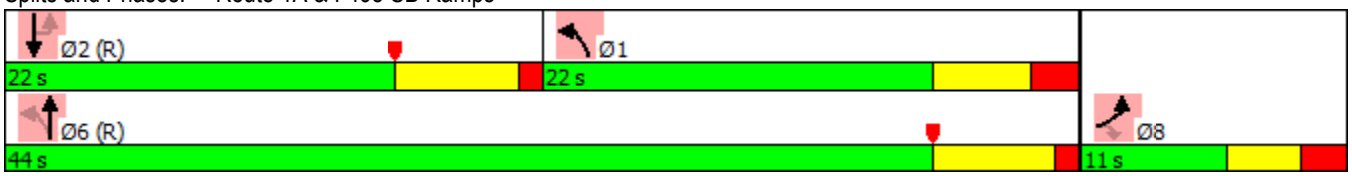


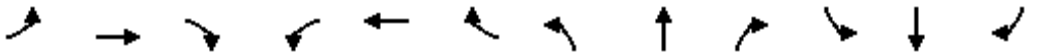


Lane Group	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Traffic Volume (vph)	123	470	250	501	587	118
Future Volume (vph)	123	470	250	501	587	118
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Storage Length (ft)	0	280	0			0
Storage Lanes	1	1	1			0
Taper Length (ft)	0		25			
Right Turn on Red		Yes				Yes
Link Speed (mph)	30			30	30	
Link Distance (ft)	604			409	1275	
Travel Time (s)	13.7			9.3	29.0	
Peak Hour Factor	0.86	0.86	0.89	0.89	0.88	0.88
Heavy Vehicles (%)	2%	2%	1%	1%	2%	2%
Shared Lane Traffic (%)						
Lane Group Flow (vph)	143	547	281	563	801	0
Turn Type	Prot	Perm	pm+pt	NA	NA	
Protected Phases	8		1	6	2	
Permitted Phases		8	6			
Detector Phase	8	8	1	6	2	
Switch Phase						
Minimum Initial (s)	5.0	5.0	6.0	10.0	10.0	
Minimum Split (s)	10.0	10.0	12.0	16.0	16.0	
Total Split (s)	11.0	11.0	22.0	44.0	22.0	
Total Split (%)	20.0%	20.0%	40.0%	80.0%	40.0%	
Yellow Time (s)	3.0	3.0	4.0	5.0	5.0	
All-Red Time (s)	2.0	2.0	2.0	1.0	1.0	
Lost Time Adjust (s)	0.0	0.0	0.0	0.0	0.0	
Total Lost Time (s)	5.0	5.0	6.0	6.0	6.0	
Lead/Lag			Lag		Lead	
Lead-Lag Optimize?						
Recall Mode	None	None	None	C-Max	C-Max	
Act Effct Green (s)	6.0	6.0	38.0	38.0	16.0	
Actuated g/C Ratio	0.11	0.11	0.69	0.69	0.29	
v/c Ratio	0.74	0.83	0.40	0.23	0.77	
Control Delay	50.2	16.2	8.1	2.1	27.5	
Queue Delay	0.0	0.0	0.0	0.0	0.0	
Total Delay	50.2	16.2	8.1	2.1	27.5	
LOS	D	B	A	A	C	
Approach Delay	23.3			4.1	27.5	
Approach LOS	C			A	C	
Queue Length 50th (ft)	47	0	48	13	96	
Queue Length 95th (ft)	#116	#105	62	10	#126	
Internal Link Dist (ft)	524			329	1195	
Turn Bay Length (ft)		280				
Base Capacity (vph)	193	660	711	2469	1034	
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	0.74	0.83	0.40	0.23	0.77	

Intersection Summary		
Area Type:	Other	
Cycle Length: 55		
Actuated Cycle Length: 55		
Offset: 0 (0%), Referenced to phase 2:SBTU and 6:NBTL, Start of Yellow		
Natural Cycle: 60		
Control Type: Actuated-Coordinated		
Maximum v/c Ratio: 0.83		
Intersection Signal Delay: 17.8	Intersection LOS: B	
Intersection Capacity Utilization 58.3%	ICU Level of Service B	
Analysis Period (min) 15		
# 95th percentile volume exceeds capacity, queue may be longer.		
Queue shown is maximum after two cycles.		

Splits and Phases: Route 1A & I-495 SB Ramps



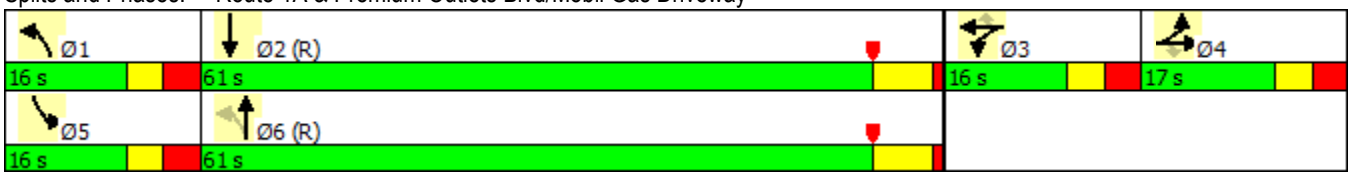


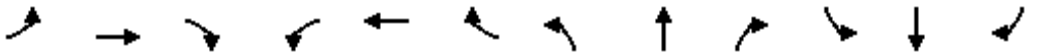
Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	92	3	32	16	5	78	82	791	47	47	258	103
Future Volume (vph)	92	3	32	16	5	78	82	791	47	47	258	103
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Storage Length (ft)	0		250	0		0	230		0	0		0
Storage Lanes	1		1	0		1	1		0	1		1
Taper Length (ft)	0			0			25			0		
Right Turn on Red			Yes			Yes			Yes			Yes
Link Speed (mph)		30			30			40			40	
Link Distance (ft)		721			236			646			291	
Travel Time (s)		16.4			5.4			11.0			5.0	
Peak Hour Factor	0.69	0.69	0.69	0.65	0.65	0.65	0.91	0.91	0.91	0.91	0.91	0.91
Heavy Vehicles (%)	9%	9%	9%	15%	15%	15%	8%	8%	8%	17%	17%	17%
Shared Lane Traffic (%)	49%											
Lane Group Flow (vph)	68	69	46	0	33	120	90	921	0	52	284	113
Turn Type	Split	NA	Perm	Split	NA	Perm	pm+pt	NA		Prot	NA	Free
Protected Phases	4	4		3	3		1	6		5	2	
Permitted Phases			4			3	6					Free
Detector Phase	4	4	4	3	3	3	1	6		5	2	
Switch Phase												
Minimum Initial (s)	6.0	6.0	6.0	5.0	5.0	5.0	5.0	10.0		5.0	10.0	
Minimum Split (s)	12.0	12.0	12.0	11.0	11.0	11.0	11.0	16.0		11.0	16.0	
Total Split (s)	17.0	17.0	17.0	16.0	16.0	16.0	16.0	61.0		16.0	61.0	
Total Split (%)	15.5%	15.5%	15.5%	14.5%	14.5%	14.5%	14.5%	55.5%		14.5%	55.5%	
Yellow Time (s)	3.0	3.0	3.0	3.0	3.0	3.0	3.0	5.0		3.0	5.0	
All-Red Time (s)	3.0	3.0	3.0	3.0	3.0	3.0	3.0	1.0		3.0	1.0	
Lost Time Adjust (s)	0.0	0.0	0.0		0.0	0.0	0.0	0.0		0.0	0.0	
Total Lost Time (s)	6.0	6.0	6.0		6.0	6.0	6.0	6.0		6.0	6.0	
Lead/Lag	Lag	Lag	Lag	Lead	Lead	Lead	Lead	Lag		Lead	Lag	
Lead-Lag Optimize?												
Recall Mode	None	None	None	None	None	None	None	C-Max		None	C-Max	
Act Effct Green (s)	9.5	9.5	9.5		7.7	7.7	71.5	65.0		8.5	66.0	110.0
Actuated g/C Ratio	0.09	0.09	0.09		0.07	0.07	0.65	0.59		0.08	0.60	1.00
v/c Ratio	0.50	0.51	0.17		0.30	0.51	0.13	0.47		0.44	0.15	0.08
Control Delay	60.6	60.8	1.4		54.8	11.9	7.2	16.0		60.8	14.7	0.1
Queue Delay	0.0	0.0	0.0		0.0	0.0	0.0	0.0		0.0	0.0	0.0
Total Delay	60.6	60.8	1.4		54.8	11.9	7.2	16.0		60.8	14.7	0.1
LOS	E	E	A		D	B	A	B		E	B	A
Approach Delay		45.8			21.2			15.2			16.3	
Approach LOS		D			C			B			B	
Queue Length 50th (ft)	48	49	0		23	0	20	207		37	52	0
Queue Length 95th (ft)	73	73	0		39	0	41	287		m63	82	0
Internal Link Dist (ft)		641			156			566			211	
Turn Bay Length (ft)			250				230					
Base Capacity (vph)	159	160	284		144	263	734	1964		141	1851	1380
Starvation Cap Reductn	0	0	0		0	0	0	0		0	0	0
Spillback Cap Reductn	0	0	0		0	0	0	0		0	0	0
Storage Cap Reductn	0	0	0		0	0	0	0		0	0	0
Reduced v/c Ratio	0.43	0.43	0.16		0.23	0.46	0.12	0.47		0.37	0.15	0.08

Intersection Summary	
Area Type:	Other
Cycle Length: 110	
Actuated Cycle Length: 110	
Offset: 3 (3%), Referenced to phase 2:SBT and 6:NBTL, Start of Yellow	
Natural Cycle: 60	
Control Type: Actuated-Coordinated	
Maximum v/c Ratio: 0.51	
Intersection Signal Delay: 19.1	Intersection LOS: B
Intersection Capacity Utilization 51.8%	ICU Level of Service A
Analysis Period (min) 15	

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

Splits and Phases: Route 1A & Premium Outlets Blvd/Mobil Gas Driveway



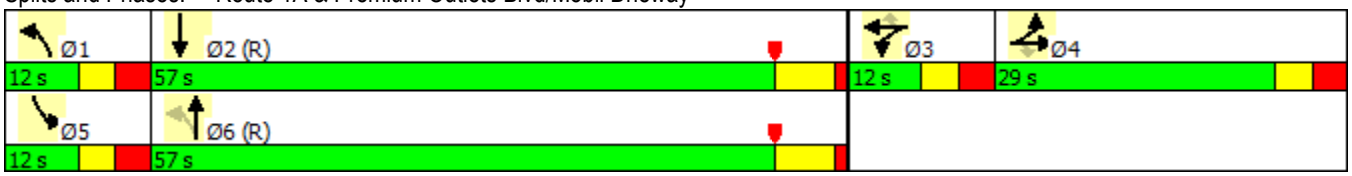


Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	381	27	136	22	11	54	97	332	26	34	655	340
Future Volume (vph)	381	27	136	22	11	54	97	332	26	34	655	340
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Storage Length (ft)	0		250	0		0	230		0	0		0
Storage Lanes	1		1	0		1	1		0	1		1
Taper Length (ft)	0			0			25			0		
Right Turn on Red			Yes			Yes			Yes			Yes
Link Speed (mph)		30			30			40			40	
Link Distance (ft)		659			195			646			291	
Travel Time (s)		15.0			4.4			11.0			5.0	
Peak Hour Factor	0.88	0.88	0.88	0.70	0.70	0.70	0.94	0.94	0.94	0.87	0.87	0.87
Heavy Vehicles (%)	0%	0%	0%	2%	2%	2%	4%	4%	4%	3%	3%	3%
Shared Lane Traffic (%)	47%											
Lane Group Flow (vph)	229	235	155	0	47	77	103	381	0	39	753	391
Turn Type	Split	NA	Perm	Split	NA	Perm	pm+pt	NA		Prot	NA	Free
Protected Phases	4	4		3	3		1	6		5	2	
Permitted Phases			4			3	6					Free
Detector Phase	4	4	4	3	3	3	1	6		5	2	
Switch Phase												
Minimum Initial (s)	6.0	6.0	6.0	5.0	5.0	5.0	5.0	10.0		5.0	10.0	
Minimum Split (s)	12.0	12.0	12.0	11.0	11.0	11.0	11.0	16.0		11.0	16.0	
Total Split (s)	29.0	29.0	29.0	12.0	12.0	12.0	12.0	57.0		12.0	57.0	
Total Split (%)	26.4%	26.4%	26.4%	10.9%	10.9%	10.9%	10.9%	51.8%		10.9%	51.8%	
Yellow Time (s)	3.0	3.0	3.0	3.0	3.0	3.0	3.0	5.0		3.0	5.0	
All-Red Time (s)	3.0	3.0	3.0	3.0	3.0	3.0	3.0	1.0		3.0	1.0	
Lost Time Adjust (s)	0.0	0.0	0.0		0.0	0.0	0.0	0.0		0.0	0.0	
Total Lost Time (s)	6.0	6.0	6.0		6.0	6.0	6.0	6.0		6.0	6.0	
Lead/Lag	Lag	Lag	Lag	Lead	Lead	Lead	Lead	Lag		Lead	Lag	
Lead-Lag Optimize?												
Recall Mode	None	None	None	None	None	None	None	C-Max		None	C-Max	
Act Effct Green (s)	19.6	19.6	19.6		5.9	5.9	65.2	61.2		6.4	56.1	110.0
Actuated g/C Ratio	0.18	0.18	0.18		0.05	0.05	0.59	0.56		0.06	0.51	1.00
v/c Ratio	0.75	0.76	0.37		0.49	0.34	0.27	0.20		0.39	0.42	0.25
Control Delay	58.0	59.0	8.6		67.8	4.1	11.0	13.9		60.9	18.9	0.2
Queue Delay	0.0	0.0	0.0		0.0	0.0	0.0	0.0		0.0	0.0	0.0
Total Delay	58.0	59.0	8.6		67.8	4.1	11.0	13.9		60.9	18.9	0.2
LOS	E	E	A		E	A	B	B		E	B	A
Approach Delay		46.0			28.2			13.3			14.1	
Approach LOS		D			C			B			B	
Queue Length 50th (ft)	161	165	0		33	0	30	80		25	205	0
Queue Length 95th (ft)	238	245	50		56	0	57	113		m34	253	m0
Internal Link Dist (ft)		579			115			566			211	
Turn Bay Length (ft)			250				230					
Base Capacity (vph)	358	361	460		98	227	385	1915		103	1788	1568
Starvation Cap Reductn	0	0	0		0	0	0	0		0	0	0
Spillback Cap Reductn	0	0	0		0	0	0	0		0	0	0
Storage Cap Reductn	0	0	0		0	0	0	0		0	0	0
Reduced v/c Ratio	0.64	0.65	0.34		0.48	0.34	0.27	0.20		0.38	0.42	0.25

Intersection Summary		
Area Type:	Other	
Cycle Length: 110		
Actuated Cycle Length: 110		
Offset: 9 (8%), Referenced to phase 2:SBT and 6:NBTL, Start of Yellow		
Natural Cycle: 60		
Control Type: Actuated-Coordinated		
Maximum v/c Ratio: 0.76		
Intersection Signal Delay: 22.9	Intersection LOS: C	
Intersection Capacity Utilization 56.4%	ICU Level of Service B	
Analysis Period (min) 15		

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

Splits and Phases: Route 1A & Premium Outlets Blvd/Mobil Drieway

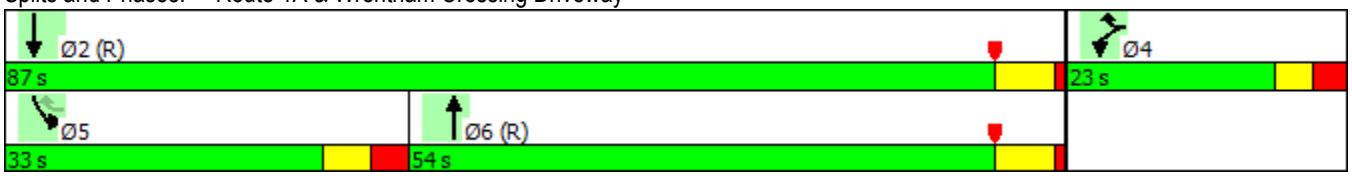


Lane Group	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Traffic Volume (vph)	0	0	924	0	1	308
Future Volume (vph)	0	0	924	0	1	308
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Storage Length (ft)	0	0		0	250	
Storage Lanes	1	1		0	1	
Taper Length (ft)	0				25	
Right Turn on Red		Yes		Yes		
Link Speed (mph)	30		30			30
Link Distance (ft)	466		1292			646
Travel Time (s)	10.6		29.4			14.7
Peak Hour Factor	0.92	0.92	0.91	0.91	0.90	0.90
Heavy Vehicles (%)	2%	2%	7%	7%	17%	17%
Shared Lane Traffic (%)						
Lane Group Flow (vph)	0	0	1015	0	1	342
Turn Type	Prot	custom	NA		Prot	NA
Protected Phases	4	4	6		5	2
Permitted Phases		5				
Detector Phase	4	4	6		5	2
Switch Phase						
Minimum Initial (s)	8.0	8.0	10.0		8.0	10.0
Minimum Split (s)	14.0	14.0	16.0		15.0	16.0
Total Split (s)	23.0	23.0	54.0		33.0	87.0
Total Split (%)	20.9%	20.9%	49.1%		30.0%	79.1%
Yellow Time (s)	3.0	3.0	5.0		4.0	5.0
All-Red Time (s)	3.0	3.0	1.0		3.0	1.0
Lost Time Adjust (s)	0.0	0.0	0.0		0.0	0.0
Total Lost Time (s)	6.0	6.0	6.0		7.0	6.0
Lead/Lag			Lag		Lead	
Lead-Lag Optimize?						
Recall Mode	None	None	C-Max		None	C-Max
Act Effct Green (s)			105.8		8.0	110.0
Actuated g/C Ratio			0.96		0.07	1.00
v/c Ratio			0.31		0.01	0.11
Control Delay			1.0		40.0	0.1
Queue Delay			0.0		0.0	0.0
Total Delay			1.0		40.0	0.1
LOS			A		D	A
Approach Delay			1.0			0.2
Approach LOS			A			A
Queue Length 50th (ft)			0		1	0
Queue Length 95th (ft)			100		m3	0
Internal Link Dist (ft)	386		1212			566
Turn Bay Length (ft)					250	
Base Capacity (vph)			3245		364	3085
Starvation Cap Reductn			0		0	0
Spillback Cap Reductn			0		0	0
Storage Cap Reductn			0		0	0
Reduced v/c Ratio			0.31		0.00	0.11

Intersection Summary	
Area Type:	Other
Cycle Length: 110	
Actuated Cycle Length: 110	
Offset: 66 (60%), Referenced to phase 2:SBT and 6:NBT, Start of Yellow	
Natural Cycle: 55	
Control Type: Actuated-Coordinated	
Maximum v/c Ratio: 0.31	
Intersection Signal Delay: 0.8	Intersection LOS: A
Intersection Capacity Utilization 30.5%	ICU Level of Service A
Analysis Period (min) 15	

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

Splits and Phases: Route 1A & Wrentham Crossing Driveway

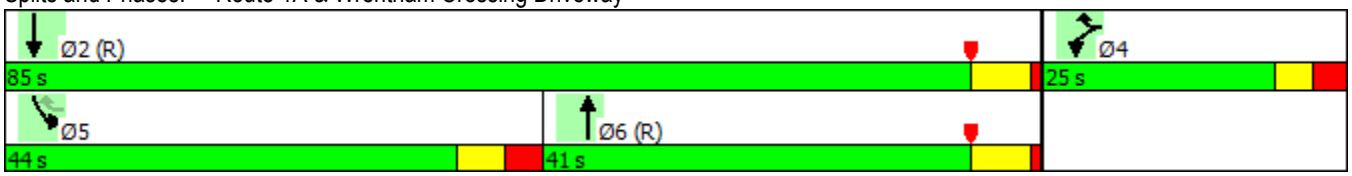


Lane Group	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Traffic Volume (vph)	0	0	442	0	5	808
Future Volume (vph)	0	0	442	0	5	808
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Storage Length (ft)	0	0		0	250	
Storage Lanes	1	1		0	1	
Taper Length (ft)	0				25	
Right Turn on Red		Yes		Yes		
Link Speed (mph)	30		30			30
Link Distance (ft)	456		1293			646
Travel Time (s)	10.4		29.4			14.7
Peak Hour Factor	0.92	0.92	0.94	0.94	0.95	0.95
Heavy Vehicles (%)	2%	2%	4%	4%	3%	3%
Shared Lane Traffic (%)						
Lane Group Flow (vph)	0	0	470	0	5	851
Turn Type	Prot	custom	NA		Prot	NA
Protected Phases	4	4	6		5	2
Permitted Phases		5				
Detector Phase	4	4	6		5	2
Switch Phase						
Minimum Initial (s)	8.0	8.0	10.0		8.0	10.0
Minimum Split (s)	14.0	14.0	16.0		15.0	16.0
Total Split (s)	25.0	25.0	41.0		44.0	85.0
Total Split (%)	22.7%	22.7%	37.3%		40.0%	77.3%
Yellow Time (s)	3.0	3.0	5.0		4.0	5.0
All-Red Time (s)	3.0	3.0	1.0		3.0	1.0
Lost Time Adjust (s)	0.0	0.0	0.0		0.0	0.0
Total Lost Time (s)	6.0	6.0	6.0		7.0	6.0
Lead/Lag			Lag		Lead	
Lead-Lag Optimize?						
Recall Mode	None	None	C-Max		None	C-Max
Act Effct Green (s)			105.8		8.0	110.0
Actuated g/C Ratio			0.96		0.07	1.00
v/c Ratio			0.14		0.04	0.24
Control Delay			0.7		39.6	0.2
Queue Delay			0.0		0.0	0.0
Total Delay			0.7		39.6	0.2
LOS			A		D	A
Approach Delay			0.7			0.4
Approach LOS			A			A
Queue Length 50th (ft)			0		4	0
Queue Length 95th (ft)			40		m8	0
Internal Link Dist (ft)	376		1213			566
Turn Bay Length (ft)					250	
Base Capacity (vph)			3338		589	3505
Starvation Cap Reductn			0		0	0
Spillback Cap Reductn			0		0	0
Storage Cap Reductn			0		0	0
Reduced v/c Ratio			0.14		0.01	0.24

Intersection Summary		
Area Type:	Other	
Cycle Length: 110		
Actuated Cycle Length: 110		
Offset: 0 (0%), Referenced to phase 2:SBT and 6:NBT, Start of Yellow		
Natural Cycle: 45		
Control Type: Actuated-Coordinated		
Maximum v/c Ratio: 0.24		
Intersection Signal Delay: 0.5		Intersection LOS: A
Intersection Capacity Utilization 27.3%		ICU Level of Service A
Analysis Period (min) 15		

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

Splits and Phases: Route 1A & Wrentham Crossing Driveway



APPENDIX D

Preliminary Traffic-Signal and Multiway-Stop Warrants Analyses

Route 1A at Common Street
Route 1A at Creek Street
Route 1A at Beach Street
Common Street at Taunton Street (Multiway-Stop Analysis)

Table D-1
Summary of Hourly Volumes and Warrant Analyses
Route 1A (South Street) at Common Street, Wrentham

Hourly period starting	Route 1A (main street)		Common St (minor street)	Sum of main street	Maximum of minor street	Volumes above the required minimum on main/minor street		
	SB[1]	NB[2]	WB[3]			Warrant 1	Warrant 2	Warrant 7
6:00	145	704	75	849	75	√		In the recent 12-month period, 4 crashes are considered correctable by a traffic signal.
7:00	361	901	142	1262	142	√	√	
8:00	338	775	140	1112	140	√	√	
9:00	301	449	112	749	112			
10:00	357	400	117	757	117	√		
11:00	365	432	120	796	120	√		
12:00	421	464	129	884	129	√	√	
13:00	394	472	124	866	124	√		
14:00	579	541	173	1120	173	√	√	
15:00	686	504	172	1190	172	√	√	
16:00	704	491	180	1195	180	√	√	
17:00	717	467	200	1184	200	√	√	
18:00	474	385	168	859	168	√	√	
19:00	277	243	104	519	104			
						MET	**MET**	

[1] Used average of S16-043-350-01 SB recorded between 11/30/16 and 12/1/16 (South St)

[2] Used average of S16-043-350-01 NB recorded between 11/30/16 and 12/1/16 (South St) scaled by 84.3% based on TMCs to reflect higher SB volumes south of the intersection than north of it

[3] Used average of S16-043-350-04 NB recorded between 11/30/16 and 12/1/16 (East St) with all hours scaled to give equivalent volumes from 7-9am and 4-6pm on both approaches

Warrants 1, 2, and 7 in MUTCD Chapter 4C were applied to this intersection.

Warrant 1 (8-Hour Volume) is fulfilled. It requires that the traffic conditions (observed vehicular volumes higher than the specified minimum volumes) exist for each of any 8 hours of an average day. The interruption of continuous traffic (Condition B) was applied in this case. The volume threshold for a major street (assuming one lane) is 750 vehicles per hour (vph) and for a minor street of one lane is 75 vph.

Warrant 2 (4-Hour Volume) is fulfilled. It requires that the traffic conditions (main street combined/minor street maximum volume falling above an applicable curve) exist for each of any 4 hours of an average day. The lower threshold volume for a minor street of one lane is 80 vph.

Warrant 7 (Crash Experience) is not fulfilled. 5 crashes were observed between April 2016 and March 2017, the most recent 12 months for which data is available. However, one was a rear-to-rear collision as a vehicle backed out of an adjacent parking space, which is not likely to be corrected by signalization.

Table D-2
Summary of Hourly Volumes and Warrant Analyses
Route 1A (South Street) at Creek Street, Wrentham

Hourly period starting	Route 1A (main street)		Creek St (minor street)	Sum of main street	Maximum of minor street	Volumes above the required minimum on main/minor street		
	SB[1]	NB[2]	EB[3]			Warrant 1[4]	Warrant 2[4]	Warrant 7
6:00	160	720	127	880	127	√		In the recent 12-month period, 4 crashes are considered correctable by a traffic signal.
7:00	366	900	212	1266	212	√	√	
8:00	380	711	195	1091	195	√	√	
9:00	305	420	162	725	162	√		
10:00	347	379	145	726	145			
11:00	378	396	170	774	170	√	√	
12:00	408	410	173	818	173	√	√	
13:00	498	428	156	926	156	√	√	
14:00	623	520	173	1143	173	√	√	
15:00	759	516	222	1275	222	√	√	
16:00	802	500	231	1302	231	√	√	
17:00	823	536	236	1359	236	√	√	
18:00	648	460	185	1108	185	√	√	
19:00	495	327	139	822	139	√		
						MET	**MET**	

[1] Used S17-018-350-07 SB recorded 5/18/17 (South St)

[2] Used S17-018-350-07 NB recorded 5/18/17 (South St). Analysis of TMC suggested that NB volumes were equivalent north and south of the intersection.

[3] Used average of 2 days from 6374 EB recorded 4/28/2015 and 4/29/2015 (Creek St) with all hours scaled to give equivalent volumes from 7-9am and 4-6pm on both approaches

[4] Used 100% columns for Warrant 1 and 2. The 85th-percentile speed is 37.8mph, which is lower than the 40mph threshold.

Warrants 1, 2, and 7 in MUTCD Chapter 4C were applied to this intersection.

Warrant 1 (8-Hour Volume) is fulfilled. It requires that the traffic conditions (observed vehicular volumes higher than the specified minimum volumes) exist for each of any 8 hours of an average day. The interruption of continuous traffic (Condition B) was applied in this case. The volume threshold for a major street (assuming one lane) is 750 vehicles per hour (vph) and for a minor street of one lane is 75 vph.

Warrant 2 (4-Hour Volume) is fulfilled. It requires that the traffic conditions (main street combined/minor street maximum volume falling above an applicable curve) exist for each of any 4 hours of an average day. The lower threshold volume for a minor street of one lane is 80 vph.

Warrant 7 (Crash Experience) is not fulfilled. 5 crashes were observed between April 2016 and March 2017, the most recent 12 months for which data is available. However, one was a rear-end due to congested traffic conditions, which is not likely to be corrected with signalization.

Table D-3
Summary of Hourly Volumes and Warrant Analyses
Route 1A (South Street) at Beach Street, Wrentham

Hourly period starting	Route 1A (main street)		Beach St (minor street)	Sum of main street	Maximum of minor street	Volumes above the required minimum on main/minor street		
	SB[1]	NB[2]	WB[3]			Warrant 1[4]	Warrant 2[4]	Warrant 7
6:00	219	727	69	946	69			In the recent 12-month period,3 crashes are considered correctable by a traffic signal.
7:00	471	928	98	1399	98	√	√	
8:00	426	706	97	1132	97	√	√	
9:00	374	454	71	828	71			
10:00	422	420	66	842	66			
11:00	428	407	80	835	80	√		
12:00	442	489	73	931	73			
13:00	509	482	82	991	82	√		
14:00	678	624	121	1302	121	√	√	
15:00	821	585	126	1406	126	√	√	
16:00	890	579	96	1469	96	√	√	
17:00	938	675	98	1613	98	√	√	
18:00	793	530	79	1323	79	√		
19:00	516	392	72	908	72			
						MET	**MET**	

[1] Used S17-018-350-06 SB recorded 5/18/17 (South St)

[2] Used S17-018-350-06 NB recorded 5/18/17 (South St) scaled by 97.4% based on TMCs to reflect higher NB volumes north of the intersection than south of it

[3] Used S17-018-350-08 NB recorded 5/18/17 (Taunton St) with all hours scaled to give equivalent volumes from 7-9am and 4-6pm on both approaches

[4] Used 100% columns for Warrant 1 and 2 even though speeds from count S17-018-350-08 for 5/18/17 showed 85th-percentile speeds of 40.5mph (exceeding the threshold of 40mph and therefore justifying use of the 70% column if necessary)

Warrants 1, 2, and 7 in MUTCD Chapter 4C were applied to this intersection.

Warrant 1 (8-Hour Volume) is fulfilled. It requires that the traffic conditions (observed vehicular volumes higher than the specified minimum volumes) exist for each of any 8 hours of an average day. The interruption of continuous traffic (Condition B) was applied in this case. The volume threshold for a major street (assuming one lane) is 750 vehicles per hour (vph) and for a minor street of one lane is 75 vph.

Warrant 2 (4-Hour Volume) is fulfilled. It requires that the traffic conditions (main street combined/minor street maximum volume falling above an applicable curve) exist for each of any 4 hours of an average day. The lower threshold volume for a minor street of one lane is 80 vph.

Warrant 7 (Crash Experience) is not fulfilled. Only 3 correctable crashes were observed between April 2016 and March 2017, the most recent 12 months for which data is available

Table D-4
Summary of Hourly Volumes and All-Way Stop Warrant Analyses
Common Street at Taunton Street, Wrentham

Hourly period starting	Common Street (main street)		Taunton Street / David Brown Way (minor street)		Sum of main street	Sum of minor street	MUTCD* Criteria 2B.07 C
	EB[1]	WB[1]	NB[2]	SB[3]			
6:00	184	75	200	34	259	235	
7:00	299	142	285	130	441	415	√
8:00	280	140	279	199	420	478	√
9:00	194	113	175	102	307	277	√
10:00	168	118	167	111	285	278	
11:00	194	120	199	117	313	316	√
12:00	200	129	193	120	329	313	√
13:00	194	125	205	104	318	309	√
14:00	241	173	339	188	415	527	√
15:00	271	173	301	193	444	494	√
16:00	234	180	277	180	414	457	√
17:00	224	200	270	196	424	466	√
18:00	165	168	190	146	333	336	√
19:00	112	104	187	112	216	299	
							MET

[1] Used average of S16-043-350-04 NB recorded between 11/30/16 and 12/1/16 (East St) with all hours scaled to give equivalent volumes from 7-9am and 4-6pm on both approaches

[2] Used S17-018-350-08 NB recorded 5/18/17 (Taunton St)

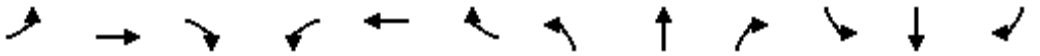
[3] Used S17-018-350-08 SB recorded 5/18/17 (Taunton St) with all hours scaled to give equivalent volumes from 7-9am and 4-6pm on both approaches

* Manual on Uniform Traffic Control Devices (MUTCD) All-Way Stop Traffic Volume Criteria 2B.07 C requires that

1) The vehicular volume entering the intersection from the major street approaches (total of both approaches) averages at least 300 vehicles per hour for any 8 hours of an average day; and
2) The combined vehicular, pedestrian, and bicycle volume entering the intersection from the minor street approaches (total of both approaches) averages at least 200 units per hour for the same eight hours, with an Average delay to to minor-street vehicular traffic of at least 30 seconds per vehicle during the highest hour; but
3) If the 85th-percentile approach speed of the minor-street traffic exceeds 40 mph, the minimum vehicular volume warrants are 70 percent of the values provided in Items 1) and 2).

APPENDIX E

Intersection Capacity Analyses
Saturday Midday Peak Hour
2017 Existing Conditions



Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	183	205	8	77	221	66	65	320	70	69	336	301
Future Volume (vph)	183	205	8	77	221	66	65	320	70	69	336	301
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Storage Length (ft)	100		0	0		0	0		60	0		160
Storage Lanes	1		0	0		0	0		0	0		1
Taper Length (ft)	100			25			25			25		
Right Turn on Red			Yes			Yes			Yes			Yes
Link Speed (mph)		30			30			30			30	
Link Distance (ft)		462			799			154			1055	
Travel Time (s)		10.5			18.2			3.5			24.0	
Confl. Peds. (#/hr)	3					3			1	1		
Peak Hour Factor	0.88	0.88	0.88	0.77	0.77	0.77	0.84	0.84	0.84	0.89	0.89	0.89
Heavy Vehicles (%)	2%	2%	2%	3%	3%	3%	2%	2%	2%	1%	1%	1%
Shared Lane Traffic (%)												
Lane Group Flow (vph)	208	242	0	0	473	0	0	541	0	0	456	338
Turn Type	Perm	NA		Perm	NA		Perm	NA		Perm	NA	Perm
Protected Phases		1			1			3			3	
Permitted Phases	1			1			3			3		3
Detector Phase	1	1		1	1		3	3		3	3	3
Switch Phase												
Minimum Initial (s)	12.0	12.0		12.0	12.0		12.0	12.0		12.0	12.0	12.0
Minimum Split (s)	17.0	17.0		17.0	17.0		17.0	17.0		17.0	17.0	17.0
Total Split (s)	33.0	33.0		33.0	33.0		32.0	32.0		32.0	32.0	32.0
Total Split (%)	38.8%	38.8%		38.8%	38.8%		37.6%	37.6%		37.6%	37.6%	37.6%
Yellow Time (s)	4.0	4.0		4.0	4.0		4.0	4.0		4.0	4.0	4.0
All-Red Time (s)	1.0	1.0		1.0	1.0		1.0	1.0		1.0	1.0	1.0
Lost Time Adjust (s)	0.0	0.0			0.0			0.0			0.0	0.0
Total Lost Time (s)	5.0	5.0			5.0			5.0			5.0	5.0
Lead/Lag	Lead	Lead		Lead	Lead							
Lead-Lag Optimize?												
Recall Mode	Min	Min		Min	Min		None	None		None	None	None
Act Effct Green (s)	28.3	28.3			28.3			27.3			27.3	27.3
Actuated g/C Ratio	0.41	0.41			0.41			0.40			0.40	0.40
v/c Ratio	0.65	0.32			0.73			1.07			0.77	0.40
Control Delay	31.2	16.7			26.9			83.1			30.7	4.0
Queue Delay	0.0	0.0			0.0			0.0			0.0	0.0
Total Delay	31.2	16.7			26.9			83.1			30.7	4.0
LOS	C	B			C			F			C	A
Approach Delay		23.4			26.9			83.1			19.3	
Approach LOS		C			C			F			B	
Queue Length 50th (ft)	61	59			141			~212			145	0
Queue Length 95th (ft)	#215	157			#313			#519			#417	55
Internal Link Dist (ft)		382			719			74			975	
Turn Bay Length (ft)	100											160
Base Capacity (vph)	318	761			649			507			596	836
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

Lane Group	Ø2
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)	
Confl. Peds. (#/hr)	
Peak Hour Factor	
Heavy Vehicles (%)	
Shared Lane Traffic (%)	
Lane Group Flow (vph)	
Turn Type	
Protected Phases	2
Permitted Phases	
Detector Phase	
Switch Phase	
Minimum Initial (s)	1.0
Minimum Split (s)	20.0
Total Split (s)	20.0
Total Split (%)	24%
Yellow Time (s)	2.0
All-Red Time (s)	0.0
Lost Time Adjust (s)	
Total Lost Time (s)	
Lead/Lag	Lag
Lead-Lag Optimize?	
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	

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Reduced v/c Ratio	0.65	0.32			0.73			1.07			0.77	0.40

Intersection Summary			
Area Type:	Other		
Cycle Length: 85			
Actuated Cycle Length: 69			
Natural Cycle: 120			
Control Type: Actuated-Uncoordinated			
Maximum v/c Ratio: 1.07			
Intersection Signal Delay: 37.0		Intersection LOS: D	
Intersection Capacity Utilization 94.1%		ICU Level of Service F	
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: Route 140 & Route 1A

HCM Unsignalized Intersection Capacity Analysis
Common St & Route 1A & Kendrick St

09/26/2017

Movement	EBL	EBT	EBR	WBL	WBT	WBR	SBL	SBR	NWL	NWR	NWR2
Lane Configurations											
Traffic Volume (veh/h)	32	394	246	24	560	12	0	0	125	1	13
Future Volume (Veh/h)	32	394	246	24	560	12	0	0	125	1	13
Sign Control		Free			Free		Stop		Stop		
Grade		0%			0%		0%		0%		
Peak Hour Factor	0.91	0.91	0.91	0.83	0.83	0.83	1.00	1.00	0.91	0.91	0.91
Hourly flow rate (vph)	35	433	270	29	675	14	0	0	137	1	14
Pedestrians		6			7		47		2		
Lane Width (ft)		12.0			12.0		0.0		12.0		
Walking Speed (ft/s)		3.5			3.5		3.5		3.5		
Percent Blockage		1			1		0		0		
Right turn flare (veh)											
Median type		None			None						
Median storage veh)											
Upstream signal (ft)					462						
pX, platoon unblocked	0.91						0.91	0.91	0.91	0.91	
vC, conflicting volume	736			705			1562	735	1386	1434	577
vC1, stage 1 conf vol											
vC2, stage 2 conf vol											
vCu, unblocked vol	659			705			1568	658	1375	1427	577
tC, single (s)	4.1			4.1			6.5	6.2	7.1	6.5	6.2
tC, 2 stage (s)											
tF (s)	2.2			2.2			4.0	3.3	3.5	4.0	3.3
p0 queue free %	96			97			100	100	0	99	97
cM capacity (veh/h)	840			887			93	418	104	113	510

Direction, Lane #	EB 1	WB 1	NW 1
Volume Total	738	718	152
Volume Left	35	29	137
Volume Right	270	14	14
cSH	840	887	112
Volume to Capacity	0.04	0.03	1.36
Queue Length 95th (ft)	3	3	261
Control Delay (s)	1.1	0.9	278.5
Lane LOS	A	A	F
Approach Delay (s)	1.1	0.9	278.5
Approach LOS			F

Intersection Summary			
Average Delay		27.2	
Intersection Capacity Utilization		64.2%	ICU Level of Service C
Analysis Period (min)		15	

HCM Unsignalized Intersection Capacity Analysis
Taunton St/David Brown's Way & Common St

09/26/2017

Movement	NBL	NBT	NBR	SBL	SBT	SBR	SEL	SET	SER	NWL	NWT	NWR
Lane Configurations												
Traffic Volume (veh/h)	35	168	64	0	185	2	8	197	105	74	121	1
Future Volume (Veh/h)	35	168	64	0	185	2	8	197	105	74	121	1
Sign Control		Stop			Stop			Free			Free	
Grade		0%			0%			0%			0%	
Peak Hour Factor	0.89	0.89	0.89	0.87	0.87	0.87	0.86	0.86	0.86	0.84	0.84	0.84
Hourly flow rate (vph)	39	189	72	0	213	2	9	229	122	88	144	1
Pedestrians												
Lane Width (ft)												
Walking Speed (ft/s)												
Percent Blockage												
Right turn flare (veh)												
Median type								None			None	
Median storage veh)												
Upstream signal (ft)												
pX, platoon unblocked												
vC, conflicting volume	737	629	290	795	690	144	145			351		
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	737	629	290	795	690	144	145			351		
tC, single (s)	7.1	6.5	6.2	7.1	6.5	6.2	4.1			4.1		
tC, 2 stage (s)												
tF (s)	3.5	4.0	3.3	3.5	4.0	3.3	2.2			2.2		
p0 queue free %	75	49	90	100	37	100	99			93		
cM capacity (veh/h)	157	368	749	155	339	903	1443			1208		

Direction, Lane #	NB 1	SB 1	SE 1	NW 1
Volume Total	300	215	360	233
Volume Left	39	0	9	88
Volume Right	72	2	122	1
cSH	350	341	1443	1208
Volume to Capacity	0.86	0.63	0.01	0.07
Queue Length 95th (ft)	199	101	0	6
Control Delay (s)	54.0	31.9	0.2	3.5
Lane LOS	F	D	A	A
Approach Delay (s)	54.0	31.9	0.2	3.5
Approach LOS	F	D		

Intersection Summary				
Average Delay	21.6			
Intersection Capacity Utilization	65.6%	ICU Level of Service	C	
Analysis Period (min)	15			

Movement	NBL	NBT	SBT	SBR	SEL	SER
Lane Configurations						
Traffic Volume (veh/h)	196	278	244	0	0	261
Future Volume (Veh/h)	196	278	244	0	0	261
Sign Control		Free	Free		Yield	
Grade		0%	0%		0%	
Peak Hour Factor	0.87	0.87	0.87	0.87	0.87	0.87
Hourly flow rate (vph)	225	320	280	0	0	300
Pedestrians						
Lane Width (ft)						
Walking Speed (ft/s)						
Percent Blockage						
Right turn flare (veh)						
Median type		None	None			
Median storage veh)						
Upstream signal (ft)			877			
pX, platoon unblocked						
vC, conflicting volume	280				1050	280
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	280				1050	280
tC, single (s)	4.1				6.4	6.2
tC, 2 stage (s)						
tF (s)	2.2				3.5	3.3
p0 queue free %	82				100	60
cM capacity (veh/h)	1277				206	756

Direction, Lane #	NB 1	SB 1	SE 1
Volume Total	545	280	300
Volume Left	225	0	0
Volume Right	0	0	300
cSH	1277	1700	756
Volume to Capacity	0.18	0.16	0.40
Queue Length 95th (ft)	16	0	48
Control Delay (s)	4.6	0.0	12.9
Lane LOS	A		B
Approach Delay (s)	4.6	0.0	12.9
Approach LOS			B

Intersection Summary			
Average Delay	5.6		
Intersection Capacity Utilization	45.0%	ICU Level of Service	A
Analysis Period (min)	15		

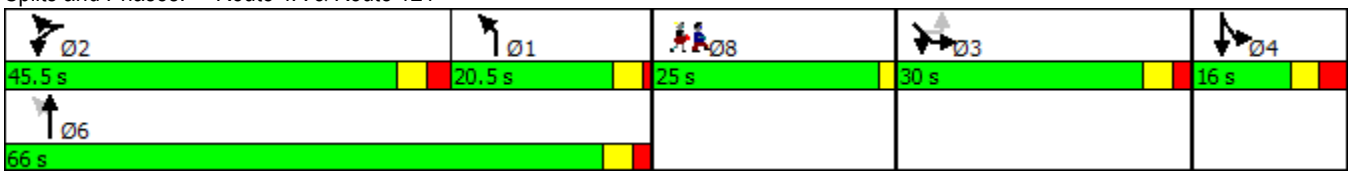
Lane Group	WBL	WBR	WBR2	NBL	NBT	NBR	SBL	SBT	SBR	SEL	SER	Ø8
Lane Configurations												
Traffic Volume (vph)	367	262	1	92	1	347	0	1	0	221	113	
Future Volume (vph)	367	262	1	92	1	347	0	1	0	221	113	
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	
Storage Length (ft)	0	0		150		0	0		0	0	200	
Storage Lanes	1	1		1		0	0		0	1	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)	248				928			183		596		
Travel Time (s)	5.6				21.1			4.2		13.5		
Confl. Peds. (#/hr)			3									
Peak Hour Factor	0.91	0.91	0.91	0.94	0.94	0.94	0.25	0.25	0.25	0.84	0.84	
Heavy Vehicles (%)	2%	2%	2%	2%	2%	2%	0%	0%	0%	2%	2%	
Shared Lane Traffic (%)												
Lane Group Flow (vph)	403	289	0	98	370	0	0	4	0	263	135	
Turn Type	Prot	Prot		pm+pt	NA			NA		Prot	Prot	
Protected Phases	2!	2!		1	6!		4	4		3	3	8
Permitted Phases				6!								
Detector Phase	2	2		1	6		4	4		3	3	
Switch Phase												
Minimum Initial (s)	15.0	15.0		8.0	15.0		6.0	6.0		8.0	8.0	5.0
Minimum Split (s)	21.0	21.0		14.0	20.5		12.0	12.0		13.0	13.0	25.0
Total Split (s)	45.5	45.5		20.5	66.0		16.0	16.0		30.0	30.0	25.0
Total Split (%)	33.2%	33.2%		15.0%	48.2%		11.7%	11.7%		21.9%	21.9%	18%
Yellow Time (s)	3.0	3.0		3.0	3.0		3.0	3.0		3.0	3.0	2.0
All-Red Time (s)	2.5	2.5		1.0	2.0		3.0	3.0		2.0	2.0	0.0
Lost Time Adjust (s)	0.0	0.0		0.0	0.0			0.0		0.0	0.0	
Total Lost Time (s)	5.5	5.5		4.0	5.0			6.0		5.0	5.0	
Lead/Lag	Lead	Lead		Lag								
Lead-Lag Optimize?	Yes	Yes		Yes								
Recall Mode	Min	Min		None	Min		None	None		None	None	None
Act Effct Green (s)	25.5	25.5		40.5	36.2			7.1		18.4	18.4	
Actuated g/C Ratio	0.36	0.36		0.58	0.51			0.10		0.26	0.26	
v/c Ratio	0.63	0.44		0.28	0.37			0.02		0.57	0.26	
Control Delay	28.1	15.7		24.0	3.1			45.0		34.3	8.3	
Queue Delay	0.0	0.0		0.0	0.0			0.0		0.0	0.0	
Total Delay	28.1	15.7		24.0	3.1			45.0		34.3	8.3	
LOS	C	B		C	A			D		C	A	
Approach Delay	23.0				7.5			45.0		25.4		
Approach LOS	C				A			D		C		
Queue Length 50th (ft)	121	44		14	0			1		84	0	
Queue Length 95th (ft)	424	204		83	56			4		286	45	
Internal Link Dist (ft)	168				848			103		516		
Turn Bay Length (ft)				150							200	
Base Capacity (vph)	1152	1071		593	1420			319		743	743	
Starvation Cap Reductn	0	0		0	0			0		0	0	
Spillback Cap Reductn	0	0		0	0			0		0	0	
Storage Cap Reductn	0	0		0	0			0		0	0	

Lane Group	WBL	WBR	WBR2	NBL	NBT	NBR	SBL	SBT	SBR	SEL	SER	Ø8
Reduced v/c Ratio	0.35	0.27		0.17	0.26			0.01		0.35	0.18	

Intersection Summary			
Area Type:	Other		
Cycle Length: 137			
Actuated Cycle Length: 70.4			
Natural Cycle: 95			
Control Type: Actuated-Uncoordinated			
Maximum v/c Ratio: 0.63			
Intersection Signal Delay: 19.0		Intersection LOS: B	
Intersection Capacity Utilization 67.0%		ICU Level of Service C	
Analysis Period (min) 15			

! Phase conflict between lane groups.

Splits and Phases: Route 1A & Route 121

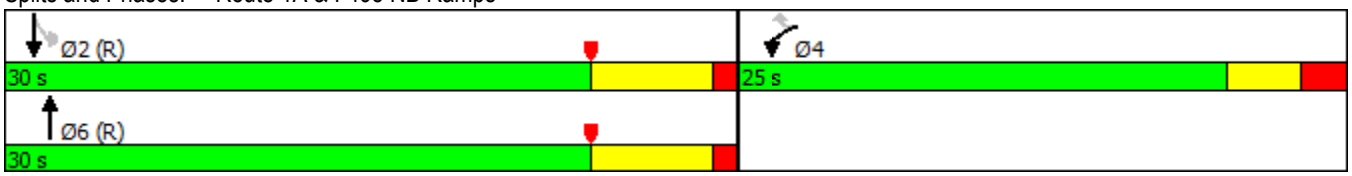


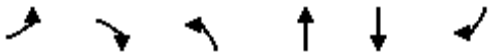
Lane Group	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Traffic Volume (vph)	720	145	320	348	93	380
Future Volume (vph)	720	145	320	348	93	380
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Storage Length (ft)	200	300		0	0	
Storage Lanes	1	1		0	0	
Taper Length (ft)	25				0	
Right Turn on Red		Yes		Yes		
Link Speed (mph)	30		40			40
Link Distance (ft)	627		1275			363
Travel Time (s)	14.3		21.7			6.2
Peak Hour Factor	0.99	0.99	0.96	0.96	0.90	0.90
Heavy Vehicles (%)	3%	3%	3%	3%	2%	2%
Shared Lane Traffic (%)						
Lane Group Flow (vph)	727	146	696	0	0	525
Turn Type	Prot	Perm	NA		Perm	NA
Protected Phases	4		6			2
Permitted Phases		4			2	
Detector Phase	4	4	6		2	2
Switch Phase						
Minimum Initial (s)	18.0	18.0	21.0		21.0	21.0
Minimum Split (s)	23.0	23.0	27.0		27.0	27.0
Total Split (s)	25.0	25.0	30.0		30.0	30.0
Total Split (%)	45.5%	45.5%	54.5%		54.5%	54.5%
Yellow Time (s)	3.0	3.0	5.0		5.0	5.0
All-Red Time (s)	2.0	2.0	1.0		1.0	1.0
Lost Time Adjust (s)	0.0	0.0	0.0			0.0
Total Lost Time (s)	5.0	5.0	6.0			6.0
Lead/Lag						
Lead-Lag Optimize?						
Recall Mode	None	None	C-Max		C-Max	C-Max
Act Effct Green (s)	18.8	18.8	25.2			25.2
Actuated g/C Ratio	0.34	0.34	0.46			0.46
v/c Ratio	0.63	0.23	0.42			0.45
Control Delay	17.9	3.8	9.3			12.0
Queue Delay	0.0	0.0	0.0			0.0
Total Delay	17.9	3.8	9.3			12.0
LOS	B	A	A			B
Approach Delay	15.5		9.3			12.0
Approach LOS	B		A			B
Queue Length 50th (ft)	102	0	107			55
Queue Length 95th (ft)	142	29	m132			96
Internal Link Dist (ft)	547		1195			283
Turn Bay Length (ft)	200	300				
Base Capacity (vph)	1236	663	1677			1155
Starvation Cap Reductn	0	0	0			0
Spillback Cap Reductn	0	0	0			0
Storage Cap Reductn	0	0	0			0
Reduced v/c Ratio	0.59	0.22	0.42			0.45

Intersection Summary		
Area Type:	Other	
Cycle Length: 55		
Actuated Cycle Length: 55		
Offset: 0 (0%), Referenced to phase 2:SBTL and 6:NBT, Start of Yellow, Master Intersection		
Natural Cycle: 50		
Control Type: Actuated-Coordinated		
Maximum v/c Ratio: 0.63		
Intersection Signal Delay: 12.6		Intersection LOS: B
Intersection Capacity Utilization 72.2%		ICU Level of Service C
Analysis Period (min) 15		

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

Splits and Phases: Route 1A & I-495 NB Ramps





Lane Group	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Traffic Volume (vph)	92	459	489	587	961	127
Future Volume (vph)	92	459	489	587	961	127
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Storage Length (ft)	0	280	0			0
Storage Lanes	1	1	1			0
Taper Length (ft)	0		25			
Right Turn on Red		Yes				Yes
Link Speed (mph)	30			40	40	
Link Distance (ft)	604			409	1275	
Travel Time (s)	13.7			7.0	21.7	
Peak Hour Factor	0.95	0.95	0.92	0.92	0.92	0.92
Heavy Vehicles (%)	2%	2%	3%	3%	2%	2%
Shared Lane Traffic (%)						
Lane Group Flow (vph)	97	483	532	638	1183	0
Turn Type	Prot	Perm	pm+pt	NA	NA	
Protected Phases	8		1	6	2	
Permitted Phases		8	6			
Detector Phase	8	8	1	6	2	
Switch Phase						
Minimum Initial (s)	5.0	5.0	6.0	10.0	10.0	
Minimum Split (s)	10.0	10.0	12.0	16.0	16.0	
Total Split (s)	11.0	11.0	52.0	99.0	47.0	
Total Split (%)	10.0%	10.0%	47.3%	90.0%	42.7%	
Yellow Time (s)	3.0	3.0	4.0	5.0	5.0	
All-Red Time (s)	2.0	2.0	2.0	1.0	1.0	
Lost Time Adjust (s)	0.0	0.0	0.0	0.0	0.0	
Total Lost Time (s)	5.0	5.0	6.0	6.0	6.0	
Lead/Lag			Lag		Lead	
Lead-Lag Optimize?						
Recall Mode	None	None	None	C-Max	C-Max	
Act Effct Green (s)	6.0	6.0	93.0	93.0	41.0	
Actuated g/C Ratio	0.05	0.05	0.85	0.85	0.37	
v/c Ratio	1.01	0.89	0.67	0.22	0.91	
Control Delay	147.6	24.5	28.8	0.9	41.5	
Queue Delay	0.0	0.0	0.0	0.0	0.0	
Total Delay	147.6	24.5	28.8	0.9	41.5	
LOS	F	C	C	A	D	
Approach Delay	45.1			13.6	41.5	
Approach LOS	D			B	D	
Queue Length 50th (ft)	~70	0	225	7	415	
Queue Length 95th (ft)	#181	#168	m285	m8	#542	
Internal Link Dist (ft)	524			329	1195	
Turn Bay Length (ft)		280				
Base Capacity (vph)	96	543	799	2963	1306	
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	1.01	0.89	0.67	0.22	0.91	

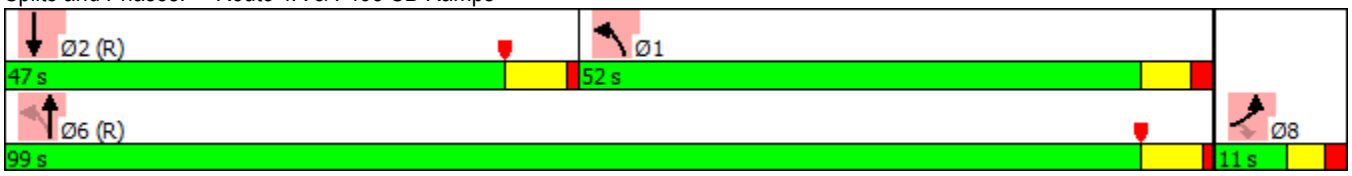
Intersection Summary	
Area Type:	Other
Cycle Length: 110	
Actuated Cycle Length: 110	
Offset: 12 (11%), Referenced to phase 2:SBT and 6:NBTL, Start of Yellow	
Natural Cycle: 80	
Control Type: Actuated-Coordinated	
Maximum v/c Ratio: 1.01	
Intersection Signal Delay: 31.1	Intersection LOS: C
Intersection Capacity Utilization 77.0%	ICU Level of Service D
Analysis Period (min) 15	

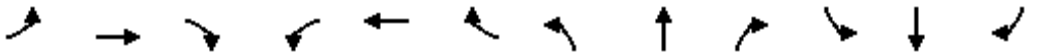
~ Volume exceeds capacity, queue is theoretically infinite.
Queue shown is maximum after two cycles.

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

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

Splits and Phases: Route 1A & I-495 SB Ramps





Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	605	32	153	13	20	73	263	365	28	42	338	1077
Future Volume (vph)	605	32	153	13	20	73	263	365	28	42	338	1077
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Storage Length (ft)	0		250	0		0	180		0	0		0
Storage Lanes	1		1	0		1	1		0	1		1
Taper Length (ft)	0			0			25			0		
Right Turn on Red			Yes			Yes			Yes			Yes
Link Speed (mph)		30			30			40			40	
Link Distance (ft)		710			187			646			291	
Travel Time (s)		16.1			4.3			11.0			5.0	
Peak Hour Factor	0.90	0.90	0.90	0.85	0.85	0.85	0.94	0.94	0.94	0.99	0.99	0.99
Heavy Vehicles (%)	0%	0%	0%	5%	5%	5%	5%	5%	5%	2%	2%	2%
Shared Lane Traffic (%)	30%											
Lane Group Flow (vph)	470	238	170	0	39	86	280	418	0	42	341	1088
Turn Type	Split	NA	Perm	Split	NA	pm+ov	pm+pt	NA		Prot	NA	Free
Protected Phases	4	4		3	3	5	1	6		5	2	
Permitted Phases			4			3	6					Free
Detector Phase	4	4	4	3	3	5	1	6		5	2	
Switch Phase												
Minimum Initial (s)	6.0	6.0	6.0	5.0	5.0	5.0	5.0	10.0		5.0	10.0	
Minimum Split (s)	12.0	12.0	12.0	11.0	11.0	11.0	11.0	16.0		11.0	16.0	
Total Split (s)	36.0	36.0	36.0	12.0	12.0	18.0	18.0	44.0		18.0	44.0	
Total Split (%)	32.7%	32.7%	32.7%	10.9%	10.9%	16.4%	16.4%	40.0%		16.4%	40.0%	
Yellow Time (s)	3.0	3.0	3.0	3.0	3.0	3.0	3.0	5.0		3.0	5.0	
All-Red Time (s)	3.0	3.0	3.0	3.0	3.0	3.0	3.0	1.0		3.0	1.0	
Lost Time Adjust (s)	0.0	0.0	0.0		0.0	0.0	0.0	0.0		0.0	0.0	
Total Lost Time (s)	6.0	6.0	6.0		6.0	6.0	6.0	6.0		6.0	6.0	
Lead/Lag	Lag	Lag	Lag	Lead	Lead	Lead	Lead	Lag		Lead	Lag	
Lead-Lag Optimize?												
Recall Mode	None	None	None	None	None	None	None	C-Max		None	C-Max	
Act Effct Green (s)	32.7	32.7	32.7		5.9	11.7	56.1	46.3		8.1	40.2	110.0
Actuated g/C Ratio	0.30	0.30	0.30		0.05	0.11	0.51	0.42		0.07	0.37	1.00
v/c Ratio	0.92	0.46	0.28		0.41	0.36	0.54	0.29		0.33	0.26	0.69
Control Delay	63.8	35.9	6.1		63.7	8.4	20.1	22.9		54.5	16.5	10.9
Queue Delay	0.0	0.0	0.0		0.0	0.0	0.0	0.0		0.0	0.0	0.0
Total Delay	63.8	35.9	6.1		63.7	8.4	20.1	22.9		54.5	16.5	10.9
LOS	E	D	A		E	A	C	C		D	B	B
Approach Delay		45.0			25.7			21.8			13.4	
Approach LOS		D			C			C			B	
Queue Length 50th (ft)	~352	149	0		27	0	112	105		24	97	608
Queue Length 95th (ft)	#578	232	51		59	19	170	153		m26	m105	m687
Internal Link Dist (ft)		630			107			566			211	
Turn Bay Length (ft)			250				180					
Base Capacity (vph)	510	515	600		96	294	521	1436		193	1293	1583
Starvation Cap Reductn	0	0	0		0	0	0	0		0	0	0
Spillback Cap Reductn	0	0	0		0	0	0	0		0	0	0
Storage Cap Reductn	0	0	0		0	0	0	0		0	0	0
Reduced v/c Ratio	0.92	0.46	0.28		0.41	0.29	0.54	0.29		0.22	0.26	0.69

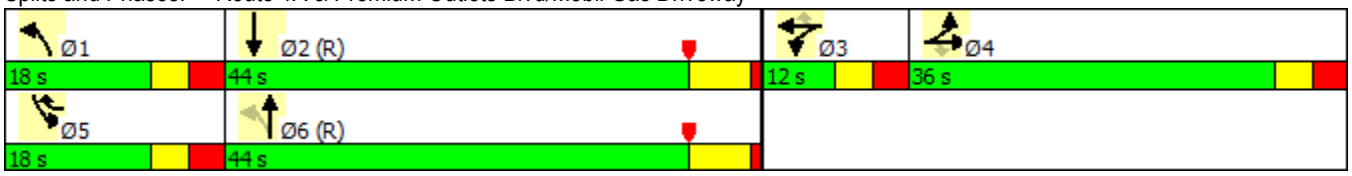
Intersection Summary		
Area Type:	Other	
Cycle Length: 110		
Actuated Cycle Length: 110		
Offset: 53 (48%), Referenced to phase 2:SBT and 6:NBTL, Start of Yellow		
Natural Cycle: 70		
Control Type: Actuated-Coordinated		
Maximum v/c Ratio: 0.92		
Intersection Signal Delay: 24.5		Intersection LOS: C
Intersection Capacity Utilization 63.2%		ICU Level of Service B
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.

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

Splits and Phases: Route 1A & Premium Outlets Blvd/Mobil Gas Driveway

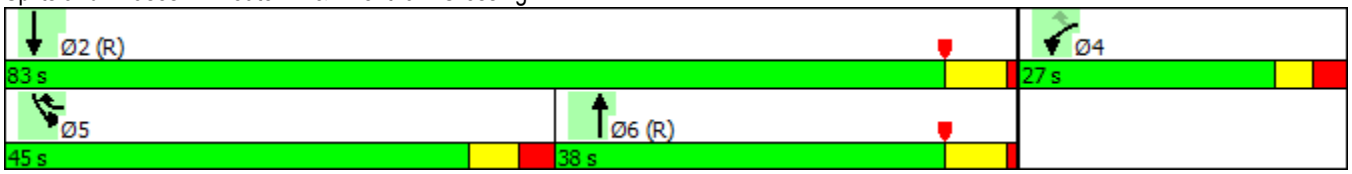


Lane Group	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Traffic Volume (vph)	0	0	656	0	0	504
Future Volume (vph)	0	0	656	0	0	504
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Storage Length (ft)	0	0		0	250	
Storage Lanes	1	1		0	1	
Taper Length (ft)	0				25	
Right Turn on Red		Yes		Yes		
Link Speed (mph)	30		40			40
Link Distance (ft)	454		212			646
Travel Time (s)	10.3		3.6			11.0
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Shared Lane Traffic (%)						
Lane Group Flow (vph)	0	0	713	0	0	548
Turn Type	Prot	pm+ov	NA		Prot	NA
Protected Phases	4	5	6		5	2
Permitted Phases		4				
Detector Phase	4	5	6		5	2
Switch Phase						
Minimum Initial (s)	8.0	8.0	10.0		8.0	10.0
Minimum Split (s)	14.0	15.0	16.0		15.0	16.0
Total Split (s)	27.0	45.0	38.0		45.0	83.0
Total Split (%)	24.5%	40.9%	34.5%		40.9%	75.5%
Yellow Time (s)	3.0	4.0	5.0		4.0	5.0
All-Red Time (s)	3.0	3.0	1.0		3.0	1.0
Lost Time Adjust (s)	0.0	0.0	0.0		0.0	0.0
Total Lost Time (s)	6.0	7.0	6.0		7.0	6.0
Lead/Lag		Lead	Lag		Lead	
Lead-Lag Optimize?						
Recall Mode	None	None	C-Max		None	C-Max
Act Effct Green (s)			110.0			110.0
Actuated g/C Ratio			1.00			1.00
v/c Ratio			0.20			0.15
Control Delay			0.1			0.2
Queue Delay			0.0			0.0
Total Delay			0.1			0.2
LOS			A			A
Approach Delay			0.1			0.2
Approach LOS			A			A
Queue Length 50th (ft)			0			0
Queue Length 95th (ft)			0			0
Internal Link Dist (ft)	374		132			566
Turn Bay Length (ft)						
Base Capacity (vph)			3539			3539
Starvation Cap Reductn			0			0
Spillback Cap Reductn			0			0
Storage Cap Reductn			0			0
Reduced v/c Ratio			0.20			0.15

Intersection Summary

Area Type:	Other	
Cycle Length: 110		
Actuated Cycle Length: 110		
Offset: 32 (29%), Referenced to phase 2:SBT and 6:NBT, Start of Yellow		
Natural Cycle: 45		
Control Type: Actuated-Coordinated		
Maximum v/c Ratio: 0.20		
Intersection Signal Delay: 0.2		Intersection LOS: A
Intersection Capacity Utilization 23.1%		ICU Level of Service A
Analysis Period (min) 15		

Splits and Phases: Route 1A & Wrentham Crossing



APPENDIX F

Corridor and Segment Crash-Rate Worksheets

SEGMENT CRASH RATE WORKSHEET

CITY/TOWN : Wrentham COUNT DATE : 5/15-21/2017

DISTRICT : 5

~ SEGMENT DATA ~

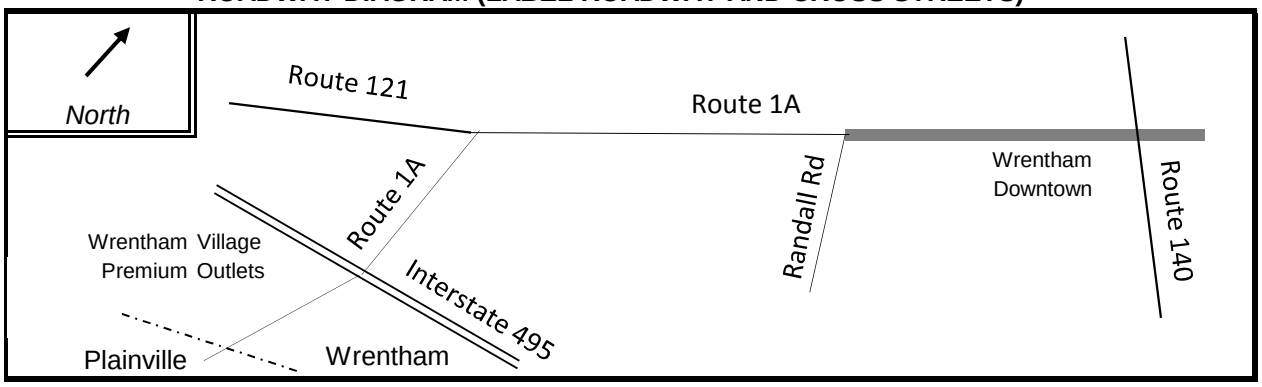
ROADWAY NAME: Route 1A Corridor Segment 1

START POINT: East of Route 140 (Frankin Street/East Street)

END POINT: West od Randall Road

FUNCTIONAL CLASSIFICATION OF ROADWAY: Urban Principal Arterial - Other

ROADWAY DIAGRAM (LABEL ROADWAY AND CROSS STREETS)



AVERAGE DAILY TRAFFIC

SEGMENT LENGTH IN MILES (**L**):	**0.35**
AVERAGE DAILY TRAFFIC VOLUME (**V**):	16,000

TOTAL # OF CRASHES:	49	# OF YEARS :	3.25	AVERAGE # OF CRASHES PER YEAR (**A**) :	**15.08**

CRASH RATE CALCULATION : **7.38**

$$\text{RATE} = \frac{(A * 1{,}000{,}000)}{(L * V * 365)}$$

Comments : 2014 State Average for Urban Minor Arterial = 3.70

Project Title & Date: Route 1A Corridor Study in Wrentham

SEGMENT CRASH RATE WORKSHEET

CITY/TOWN : Wrentham COUNT DATE : 5/15-21/2017

DISTRICT : 5

~ SEGMENT DATA ~

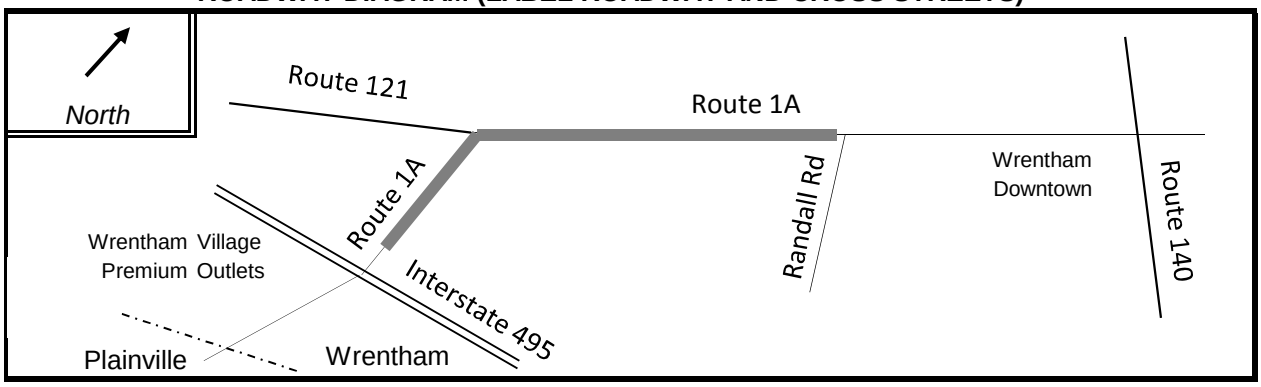
ROADWAY NAME: Route 1A Corridor Segment 2

START POINT: West od Randall Road

END POINT: North of I-95 Northbound Ramps

FUNCTIONAL CLASSIFICATION OF ROADWAY: Urban MinorArterial

ROADWAY DIAGRAM (LABEL ROADWAY AND CROSS STREETS)



AVERAGE DAILY TRAFFIC

SEGMENT LENGTH IN MILES (**L**):	**1.72**
AVERAGE DAILY TRAFFIC VOLUME (**V**):	15,850

TOTAL # OF CRASHES:	75	# OF YEARS :	3.25	AVERAGE # OF CRASHES PER YEAR (**A**) :	**23.08**

CRASH RATE CALCULATION : **2.32**

$$RATE = \frac{(A * 1{,}000{,}000)}{(L * V * 365)}$$

Comments : 2014 State Average for Urban Minor Arterial = 3.70

Project Title & Date: Route 1A Corridor Study in Wrentham

SEGMENT CRASH RATE WORKSHEET

CITY/TOWN : Wrentham COUNT DATE : 5/15-21/2017

DISTRICT : 5

~ SEGMENT DATA ~

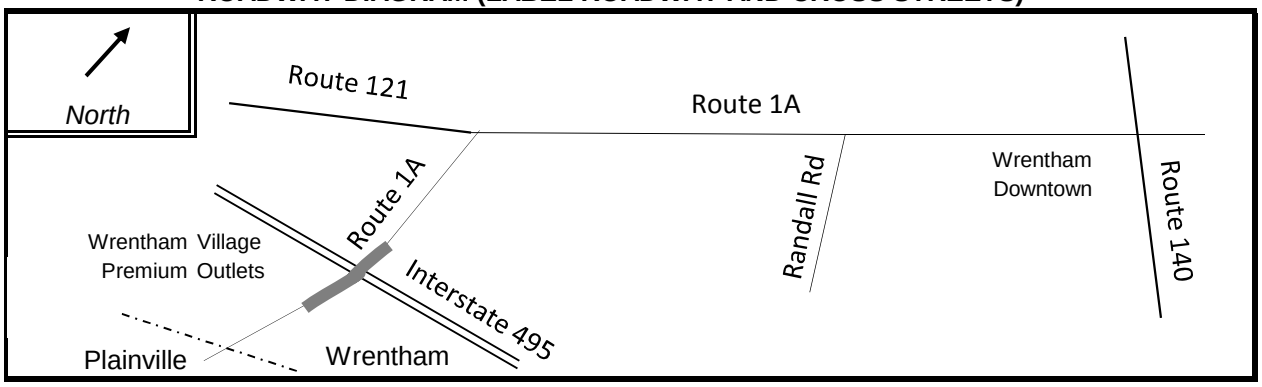
ROADWAY NAME: Route 1A Corridor Segment 3

START POINT: North of I-95 Northbound Ramps

END POINT: South of Premium Outlets Boulevard

FUNCTIONAL CLASSIFICATION OF ROADWAY: Urban Minor Arterial

ROADWAY DIAGRAM (LABEL ROADWAY AND CROSS STREETS)



AVERAGE DAILY TRAFFIC

SEGMENT LENGTH IN MILES (**L**):	**0.53**
AVERAGE DAILY TRAFFIC VOLUME (**V**):	18,750

TOTAL # OF CRASHES:	110	# OF YEARS :	3.25	AVERAGE # OF CRASHES PER YEAR (**A**) :	**33.85**

CRASH RATE CALCULATION : **9.33**

$$\text{RATE} = \frac{(A * 1{,}000{,}000)}{(L * V * 365)}$$

Comments : 2014 State Average for Urban Minor Arterial = 3.70

Project Title & Date: Route 1A Corridor Study in Wrentham

SEGMENT CRASH RATE WORKSHEET

CITY/TOWN : Wrentham COUNT DATE : 5/15-21/2017

DISTRICT : 5

~ SEGMENT DATA ~

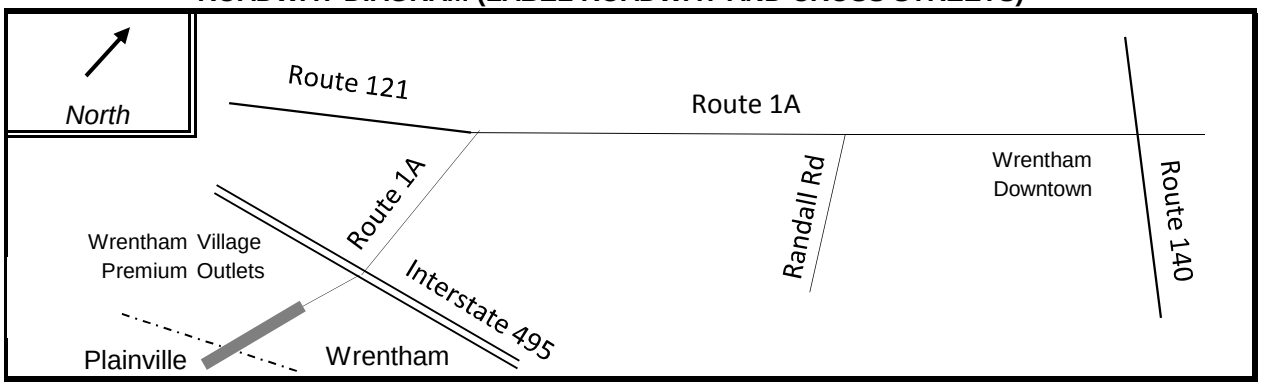
ROADWAY NAME: Route 1A Corridor Segment 4

START POINT: South of Premium Outlets Boulevard

END POINT: Plianville Town Line

FUNCTIONAL CLASSIFICATION OF ROADWAY: Urban Minor Arterial

ROADWAY DIAGRAM (LABEL ROADWAY AND CROSS STREETS)



AVERAGE DAILY TRAFFIC

SEGMENT LENGTH IN MILES (**L**):	**0.5**
AVERAGE DAILY TRAFFIC VOLUME (**V**):	14,400

TOTAL # OF CRASHES:	16	# OF YEARS :	3.25	AVERAGE # OF CRASHES PER YEAR (**A**) :	**4.92**

CRASH RATE CALCULATION : **1.87**

$$\text{RATE} = \frac{(A * 1{,}000{,}000)}{(L * V * 365)}$$

Comments : 2014 State Average for Urban Minor Arterial = 3.70

Project Title & Date: Route 1A Corridor Study in Wrentham

APPENDIX G

Intersection Crash-Rate Worksheets

INTERSECTION CRASH RATE WORKSHEET

CITY/TOWN : Wrentham COUNT DATE : 5/18/2017

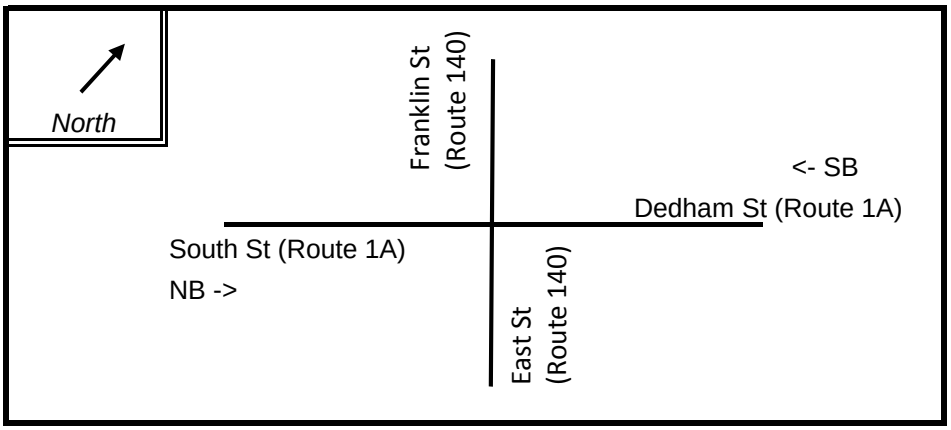
DISTRICT : 5 UNSIGNALIZED : SIGNALIZED : X

~ INTERSECTION DATA ~

MAJOR STREET : Route 1A (South Street/Dedham Street)

MINOR STREET(S) : Route 140 (Franklin Street/East Street)

INTERSECTION DIAGRAM



PEAK HOUR VOLUMES

APPROACH :	1	2	3	4	5	Total Peak Hourly Approach Volume
DIRECTION :	SB	EB	NB	WB		
PEAK HOURLY VOLUMES (PM) :	710	860	387	427		**2,384**

" K " FACTOR : **0.090** INTERSECTION ADT (**V**) = TOTAL DAILY APPROACH VOLUME : **26,489**

TOTAL # OF CRASHES : 22 # OF YEARS : 3 AVERAGE # OF CRASHES PER YEAR (**A**) : **7.33**

CRASH RATE CALCULATION : **0.87** RATE = $\frac{(A * 1{,}000{,}000)}{(V * 365)}$

Comments : 2015 Average Crash Rate for MassDOT District 5 Signalized Intersections = 0.76

Project Title & Date: Route 1A Corridor Study in Wrentham

INTERSECTION CRASH RATE WORKSHEET

CITY/TOWN : Wrentham COUNT DATE : 5/18/2017

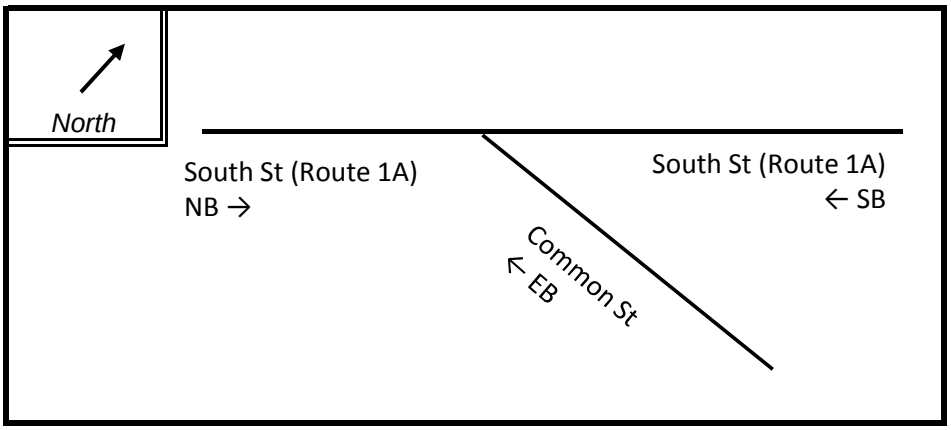
DISTRICT : 5 UNSIGNALIZED : X SIGNALIZED :

~ INTERSECTION DATA ~

MAJOR STREET : Route 1A (South Street)

MINOR STREET(S) : Common Street

INTERSECTION DIAGRAM



PEAK HOUR VOLUMES

APPROACH :	1	2	3	4	5	Total Peak Hourly Approach Volume
DIRECTION :	SB	EB	NB	WB		
PEAK HOURLY VOLUMES (PM) :	790	227	629			**1,646**

" K " FACTOR :	**0.090**	INTERSECTION ADT (**V**) = TOTAL DAILY APPROACH VOLUME :			**18,289**
TOTAL # OF CRASHES :	17	# OF YEARS :	3	AVERAGE # OF CRASHES PER YEAR (**A**) :	**5.67**

CRASH RATE CALCULATION : **0.98** RATE = $\frac{(A * 1{,}000{,}000)}{(V * 365)}$

Comments : 2015 Average Crash Rate for MassDOT District 5 Unsignalized Intersections = 0.58

Project Title & Date: Route 1A Corridor Study in Wrentham

INTERSECTION CRASH RATE WORKSHEET

CITY/TOWN : Wrentham COUNT DATE : 5/18/2017

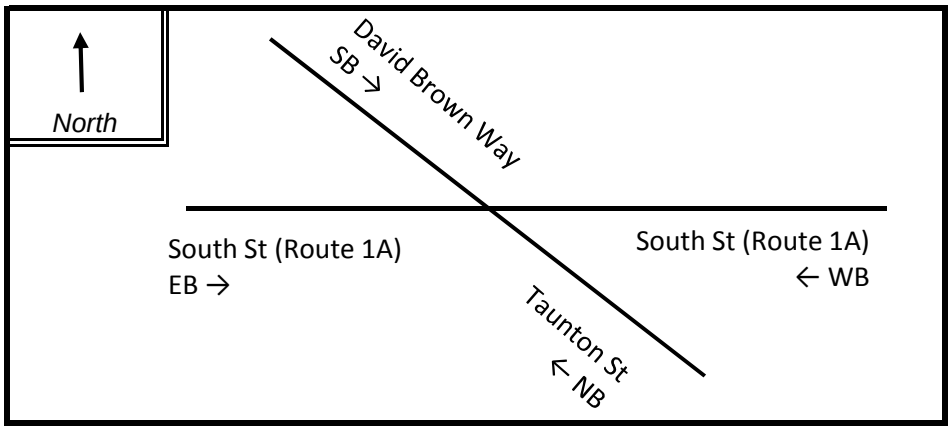
DISTRICT : 5 UNSIGNALIZED : X SIGNALIZED :

~ INTERSECTION DATA ~

MAJOR STREET : Common Street

MINOR STREET(S) : Taunton Street / David Brown Way

INTERSECTION DIAGRAM



PEAK HOUR VOLUMES

APPROACH :	1	2	3	4	5	Total Peak Hourly Approach Volume
DIRECTION :	SB	EB	NB	WB		
PEAK HOURLY VOLUMES (PM) :	219	269	239	251		**978**

" K " FACTOR :	**0.090**	INTERSECTION ADT (**V**) = TOTAL DAILY APPROACH VOLUME :	**10,867**

TOTAL # OF CRASHES :	10	# OF YEARS :	3	AVERAGE # OF CRASHES PER YEAR (**A**) :	**3.33**

CRASH RATE CALCULATION : **0.97** RATE = $\frac{(A * 1{,}000{,}000)}{(V * 365)}$

Comments : 2015 Average Crash Rate for MassDOT District 5 Unsignalized Intersections = 0.58

Project Title & Date: Route 1A Corridor Study in Wrentham

INTERSECTION CRASH RATE WORKSHEET

CITY/TOWN : Wrentham COUNT DATE : 5/18/2017

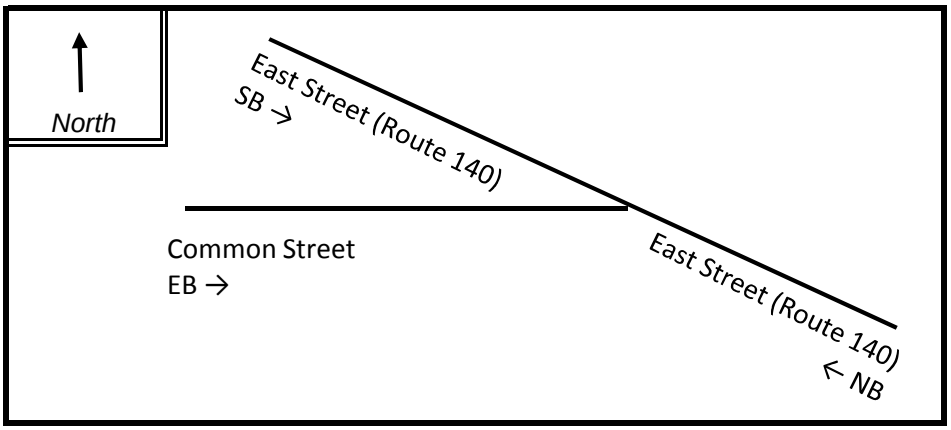
DISTRICT : 5 UNSIGNALIZED : X SIGNALIZED :

~ INTERSECTION DATA ~

MAJOR STREET : East Street (Route 140)

MINOR STREET(S) : Common Street

INTERSECTION DIAGRAM



PEAK HOUR VOLUMES

APPROACH :	1	2	3	4	5	Total Peak Hourly Approach Volume
DIRECTION :	SB	EB	NB	WB		
PEAK HOURLY VOLUMES (PM) :	249	242	674			**1,165**

" K " FACTOR : **0.090** INTERSECTION ADT (**V**) = TOTAL DAILY APPROACH VOLUME : **12,944**

TOTAL # OF CRASHES : 9 # OF YEARS : 3.25 AVERAGE # OF CRASHES PER YEAR (**A**) : **2.77**

CRASH RATE CALCULATION : **0.67** RATE = $\frac{(A * 1{,}000{,}000)}{(V * 365)}$

Comments : 2015 Average Crash Rate for MassDOT District 5 Unsignalized Intersections = 0.58

Project Title & Date: Route 1A Corridor Study in Wrentham

INTERSECTION CRASH RATE WORKSHEET

CITY/TOWN : Wrentham COUNT DATE : 5/18/2017

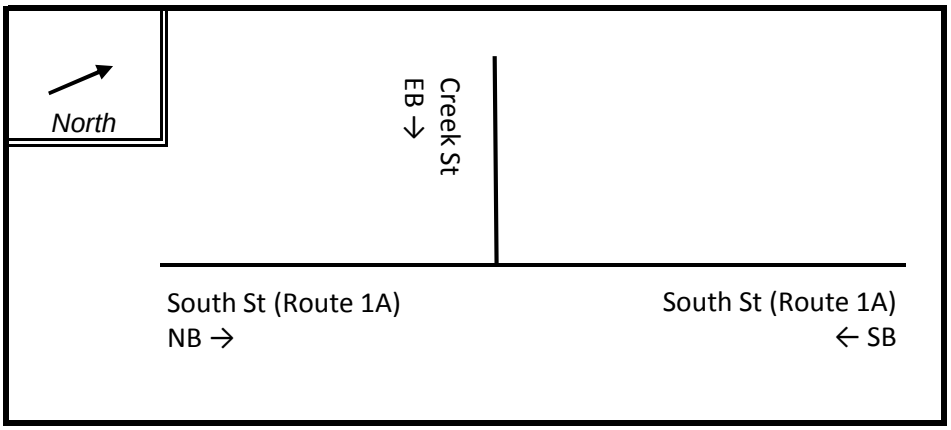
DISTRICT : 5 UNSIGNALIZED : X SIGNALIZED :

~ INTERSECTION DATA ~

MAJOR STREET : South Street (Route 1A)

MINOR STREET(S) : Creek Street

INTERSECTION DIAGRAM



PEAK HOUR VOLUMES

APPROACH :	1	2	3	4	5	Total Peak Hourly Approach Volume
DIRECTION :	SB	EB	NB	WB		
PEAK HOURLY VOLUMES (PM) :	842	281	702			**1,825**

" K " FACTOR : **0.090** INTERSECTION ADT (**V**) = TOTAL DAILY APPROACH VOLUME : **20,278**

TOTAL # OF CRASHES : 11 # OF YEARS : 3 AVERAGE # OF CRASHES PER YEAR (**A**) : **3.67**

CRASH RATE CALCULATION : **0.57** RATE = $\frac{(A * 1{,}000{,}000)}{(V * 365)}$

Comments : 2015 Average Crash Rate for MassDOT District 5 Unsignalized Intersections = 0.58

Project Title & Date: Route 1A Corridor Study in Wrentham

INTERSECTION CRASH RATE WORKSHEET

CITY/TOWN : Wrentham COUNT DATE : 5/18/2017

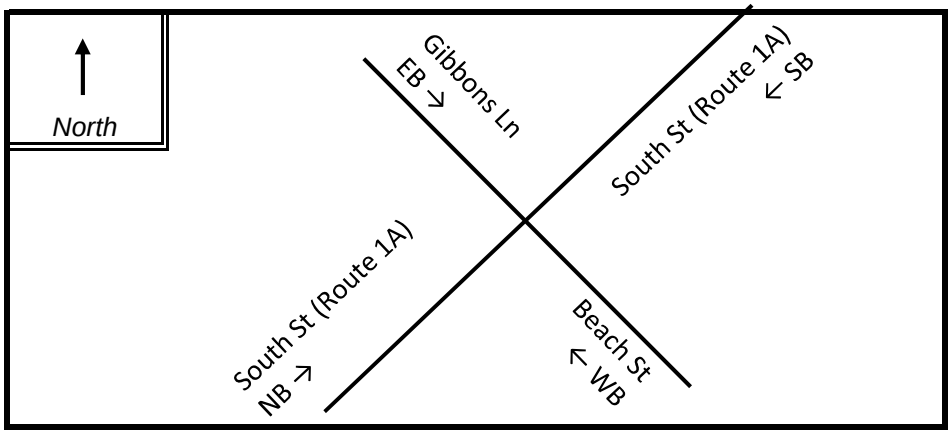
DISTRICT : 5 UNSIGNALIZED : X SIGNALIZED :

~ INTERSECTION DATA ~

MAJOR STREET : South Street (Route 1A)

MINOR STREET(S) : Beach Street/Gibbons Lane

INTERSECTION DIAGRAM



PEAK HOUR VOLUMES

APPROACH :	1	2	3	4	5	Total Peak Hourly Approach Volume
DIRECTION :	SB	EB	NB	WB		
PEAK HOURLY VOLUMES (PM) :	949	7	653	122		**1,731**

" K " FACTOR : **0.090** INTERSECTION ADT (**V**) = TOTAL DAILY APPROACH VOLUME : **19,233**

TOTAL # OF CRASHES : 9 # OF YEARS : 3 AVERAGE # OF CRASHES PER YEAR (**A**) : **3.00**

CRASH RATE CALCULATION : **0.49** RATE = $\frac{(A * 1{,}000{,}000)}{(V * 365)}$

Comments : 2015 Average Crash Rate for MassDOT District 5 Unsignalized Intersections = 0.58

Project Title & Date: Route 1A Corridor Study in Wrentham

INTERSECTION CRASH RATE WORKSHEET

CITY/TOWN : Wrentham COUNT DATE : 5/18/2017

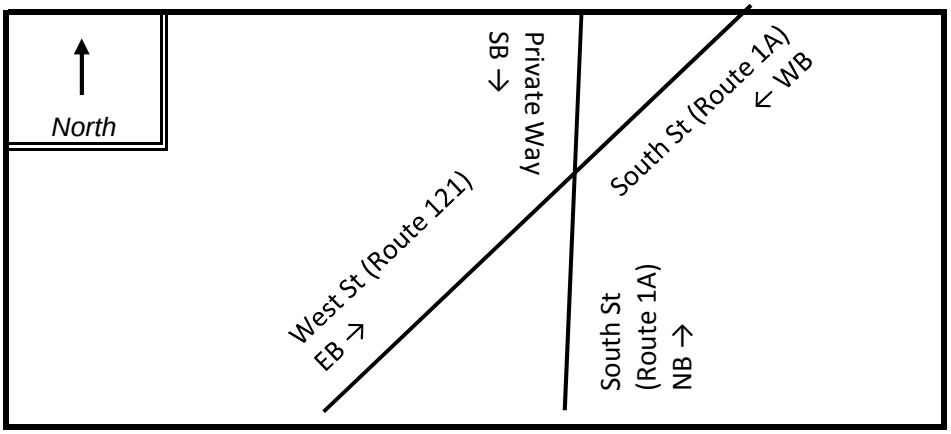
DISTRICT : 5 UNSIGNALIZED : SIGNALIZED : X

~ INTERSECTION DATA ~

MAJOR STREET : South Street (Route 1A)

MINOR STREET(S) : West St (Route 121)

INTERSECTION DIAGRAM (Label Approaches)



PEAK HOUR VOLUMES

APPROACH :	1	2	3	4	5	Total Peak Hourly Approach Volume
DIRECTION :	SB	EB	NB	WB		
PEAK HOURLY VOLUMES (PM) :	5	400	587	918		**1,910**

" K " FACTOR : **0.090** INTERSECTION ADT (**V**) = TOTAL DAILY APPROACH VOLUME : **21,222**

TOTAL # OF CRASHES : 17 # OF YEARS : 3.25 AVERAGE # OF CRASHES PER YEAR (**A**) : **5.23**

CRASH RATE CALCULATION : **0.78** RATE = $\frac{(A * 1{,}000{,}000)}{(V * 365)}$

Comments : 2015 Average Crash Rate for MassDOT District 5 Signalized Intersections = 0.76

Project Title & Date: Route 1A Corridor Study in Wrentham

INTERSECTION CRASH RATE WORKSHEET

CITY/TOWN : Wrentham COUNT DATE : 5/18/2017

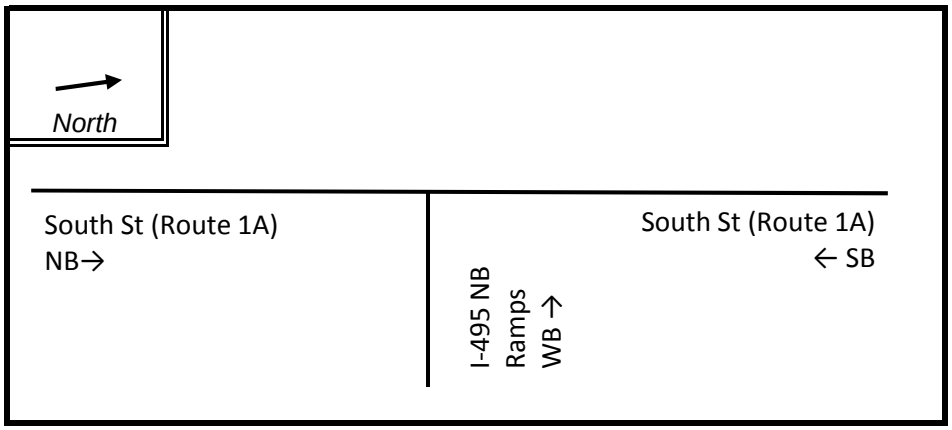
DISTRICT : 5 UNSIGNALIZED : SIGNALIZED : X

~ INTERSECTION DATA ~

MAJOR STREET : South Street (Route 1A)

MINOR STREET(S) : I--495 Northbound Ramps

INTERSECTION DIAGRAM (Label Approaches)



PEAK HOUR VOLUMES

APPROACH :	1	2	3	4	5	Total Peak Hourly Approach Volume
DIRECTION :	SB	EB	NB	WB		
PEAK HOURLY VOLUMES (PM) :	531		623	574		**1,728**

" K " FACTOR : **0.090** INTERSECTION ADT (**V**) = TOTAL DAILY APPROACH VOLUME : **19,200**

TOTAL # OF CRASHES : 18 # OF YEARS : 3.25 AVERAGE # OF CRASHES PER YEAR (**A**) : **5.54**

CRASH RATE CALCULATION : **0.91** RATE = $\frac{(A * 1{,}000{,}000)}{(V * 365)}$

Comments : 2015 Average Crash Rate for MassDOT District 5 Signalized Intersections = 0.76

Project Title & Date: Route 1A Corridor Study in Wrentham

INTERSECTION CRASH RATE WORKSHEET

CITY/TOWN : Wrentham COUNT DATE : 5/18/2017

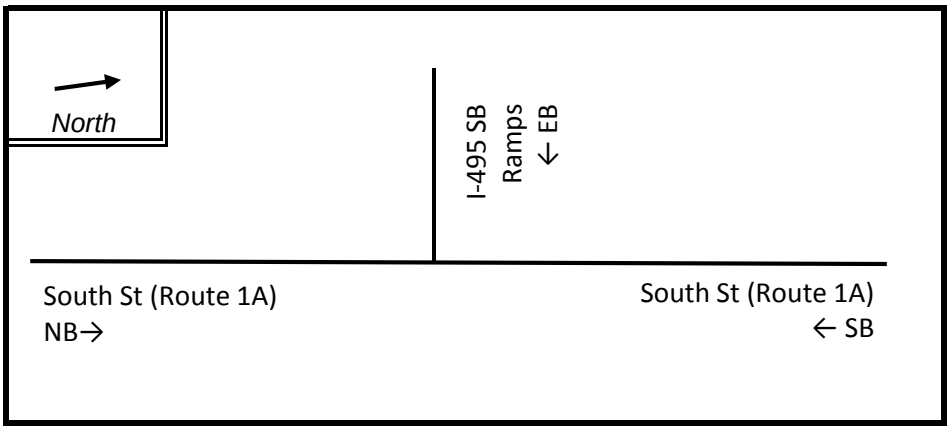
DISTRICT : 5 UNSIGNALIZED : SIGNALIZED : X

~ INTERSECTION DATA ~

MAJOR STREET : South Street (Route 1A)

MINOR STREET(S) : I--495 Southbound Ramps

INTERSECTION DIAGRAM (Label Approaches)



PEAK HOUR VOLUMES

APPROACH :	1	2	3	4	5	Total Peak Hourly Approach Volume
DIRECTION :	SB	EB	NB	WB		
PEAK HOURLY VOLUMES (PM) :	705	593	751			**2,049**

" K " FACTOR : **0.090** INTERSECTION ADT (**V**) = TOTAL DAILY APPROACH VOLUME : **22,767**

TOTAL # OF CRASHES : 46 # OF YEARS : 3.25 AVERAGE # OF CRASHES PER YEAR (**A**) : **14.15**

CRASH RATE CALCULATION : **1.96** RATE = $\frac{(A * 1{,}000{,}000)}{(V * 365)}$

Comments : 2015 Average Crash Rate for MassDOT District 5 Signalized Intersections = 0.76

Project Title & Date: Route 1A Corridor Study in Wrentham

INTERSECTION CRASH RATE WORKSHEET

CITY/TOWN : Wrentham COUNT DATE : 5/18/2017

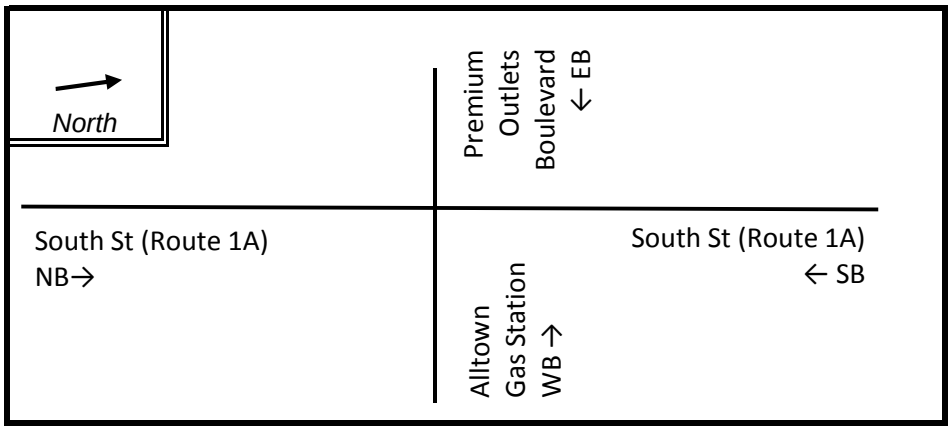
DISTRICT : 5 UNSIGNALIZED : SIGNALIZED : X

~ INTERSECTION DATA ~

MAJOR STREET : South Street (Route 1A)

MINOR STREET(S) : Premium Outlets Boulevard

INTERSECTION DIAGRAM (Label Approaches)



PEAK HOUR VOLUMES

APPROACH :	1	2	3	4	5	Total Peak Hourly Approach Volume
DIRECTION :	SB	EB	NB	WB		
PEAK HOURLY VOLUMES (PM) :	1,029	544	455	87		**2,115**

" K " FACTOR : **0.090** INTERSECTION ADT (**V**) = TOTAL DAILY APPROACH VOLUME : **23,500**

TOTAL # OF CRASHES : 36 # OF YEARS : 3.25 AVERAGE # OF CRASHES PER YEAR (**A**) : **11.08**

CRASH RATE CALCULATION : **1.48** RATE = $\frac{(A * 1{,}000{,}000)}{(V * 365)}$

Comments : 2015 Average Crash Rate for MassDOT District 5 Signalized Intersections = 0.76

Project Title & Date: Route 1A Corridor Study in Wrentham

APPENDIX H

Collision Diagrams and Crash Statistics
Major Intersections and Segments in the Corridor

Figure H-1
Collision Diagram: Route 1A at Route 140 (Franklin Street/East Street)
Wrentham Police Reports: January 2014 – March 2017

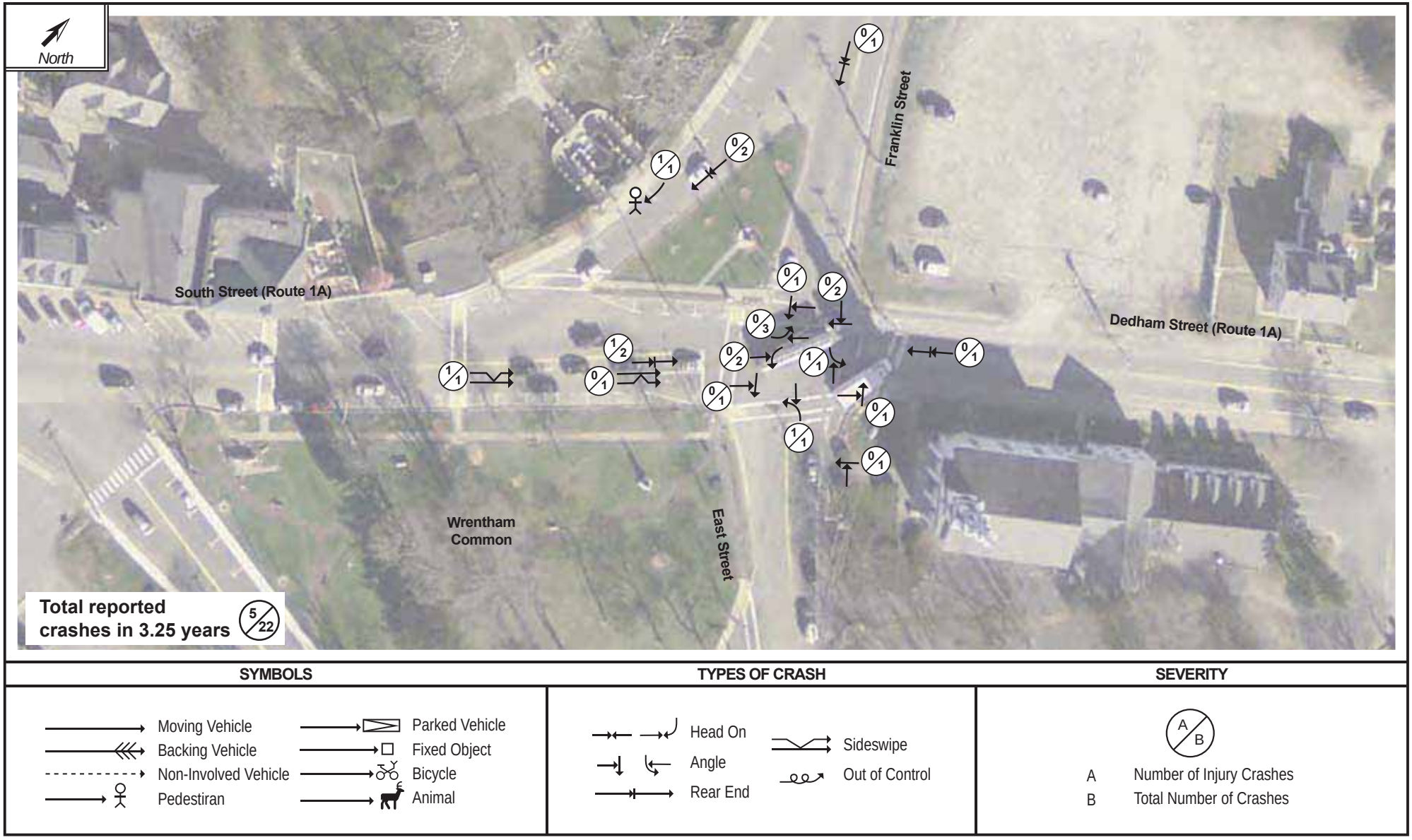
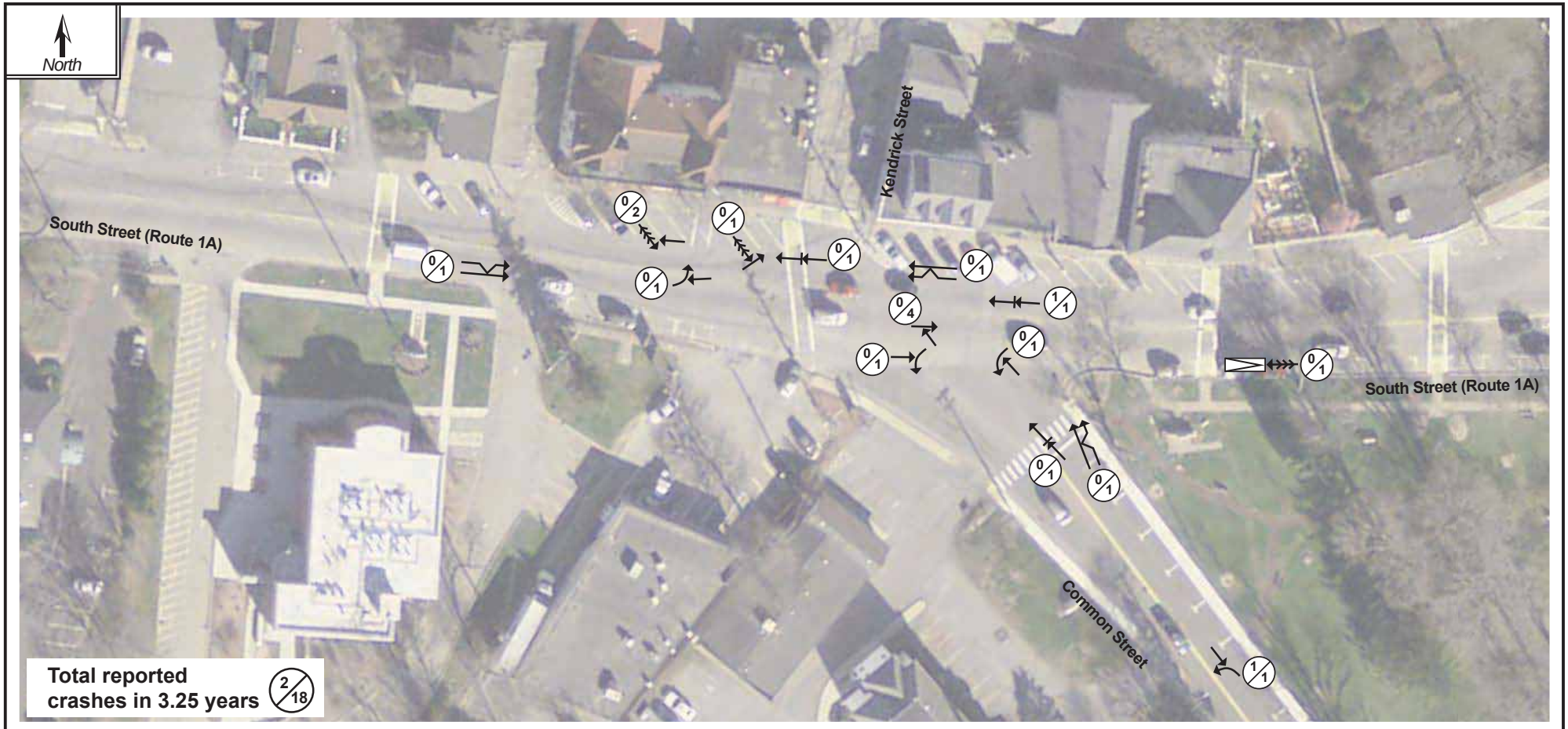


Figure H-2
Collision Diagram: Route 1A at Common Street
Wrentham Police Reports: January 2014 – March 2017

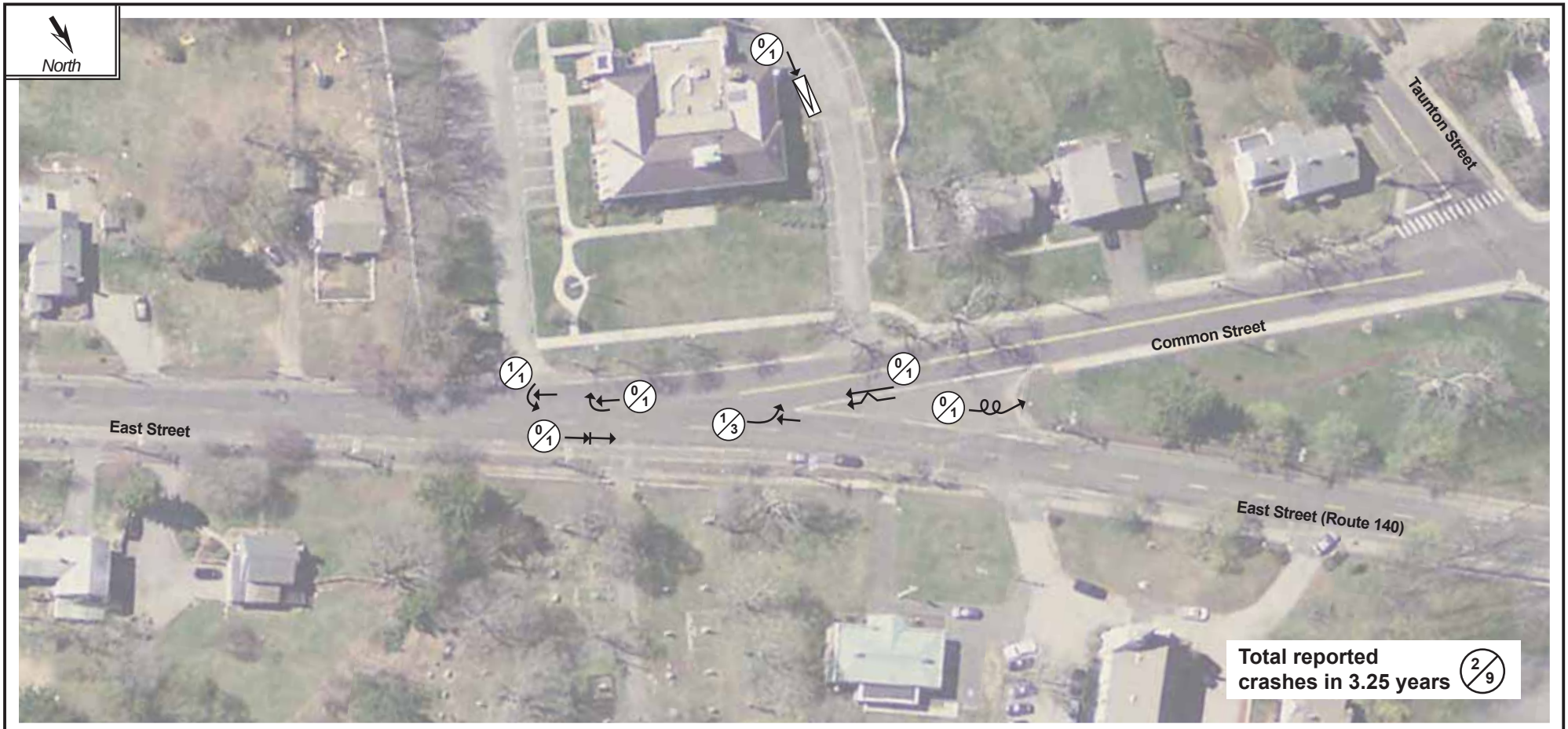


SYMBOLS		TYPES OF CRASH		SEVERITY	
Moving Vehicle	Parked Vehicle	Head On	Sideswipe	A/B	
Backing Vehicle	Fixed Object	Angle	Out of Control	A	Number of Injury Crashes
Non-Involved Vehicle	Bicycle	Rear End		B	Total Number of Crashes
Pedestiran	Animal				

Figure H-3
Collision Diagram: Common Street at Taunton Street
Wrentham Police Reports: January 2014 – March 2017

SYMBOLS	TYPES OF CRASH	SEVERITY
Moving Vehicle Backing Vehicle Non-Involved Vehicle Pedestiran Parked Vehicle Fixed Object Bicycle Animal	Head On Angle Rear End Sideswipe Out of Control	A/B A Number of Injury Crashes B Total Number of Crashes

Figure H-4
Collision Diagram: Common Street at East Street (Route 140)
Wrentham Police Reports: January 2014 – March 2017



SYMBOLS

- Moving Vehicle
- Backing Vehicle
- Non-Involved Vehicle
- Pedestiran
- Parked Vehicle
- Fixed Object
- Bicycle
- Animal

TYPES OF CRASH

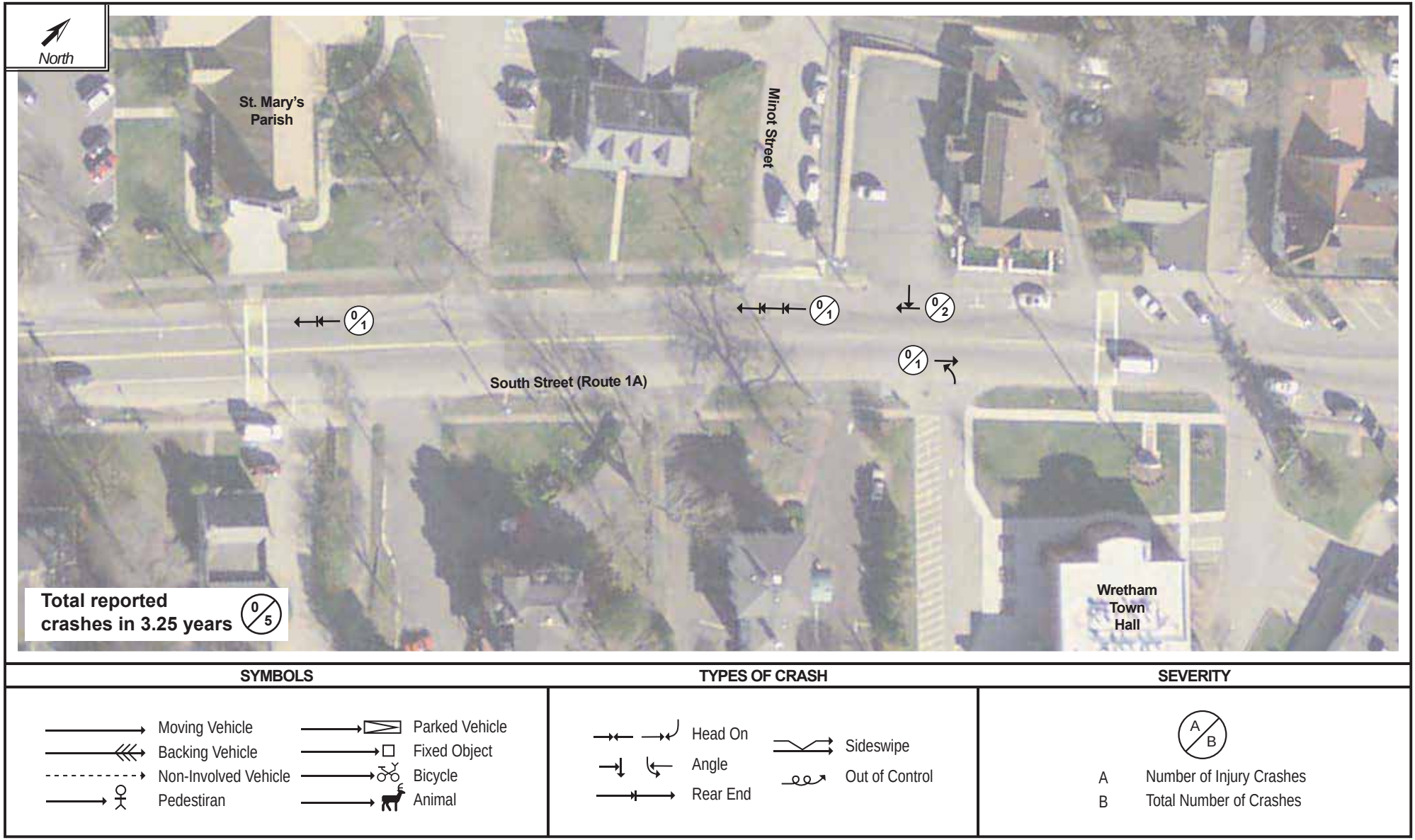
- Head On
- Angle
- Rear End
- Sideswipe
- Out of Control

SEVERITY

A/B

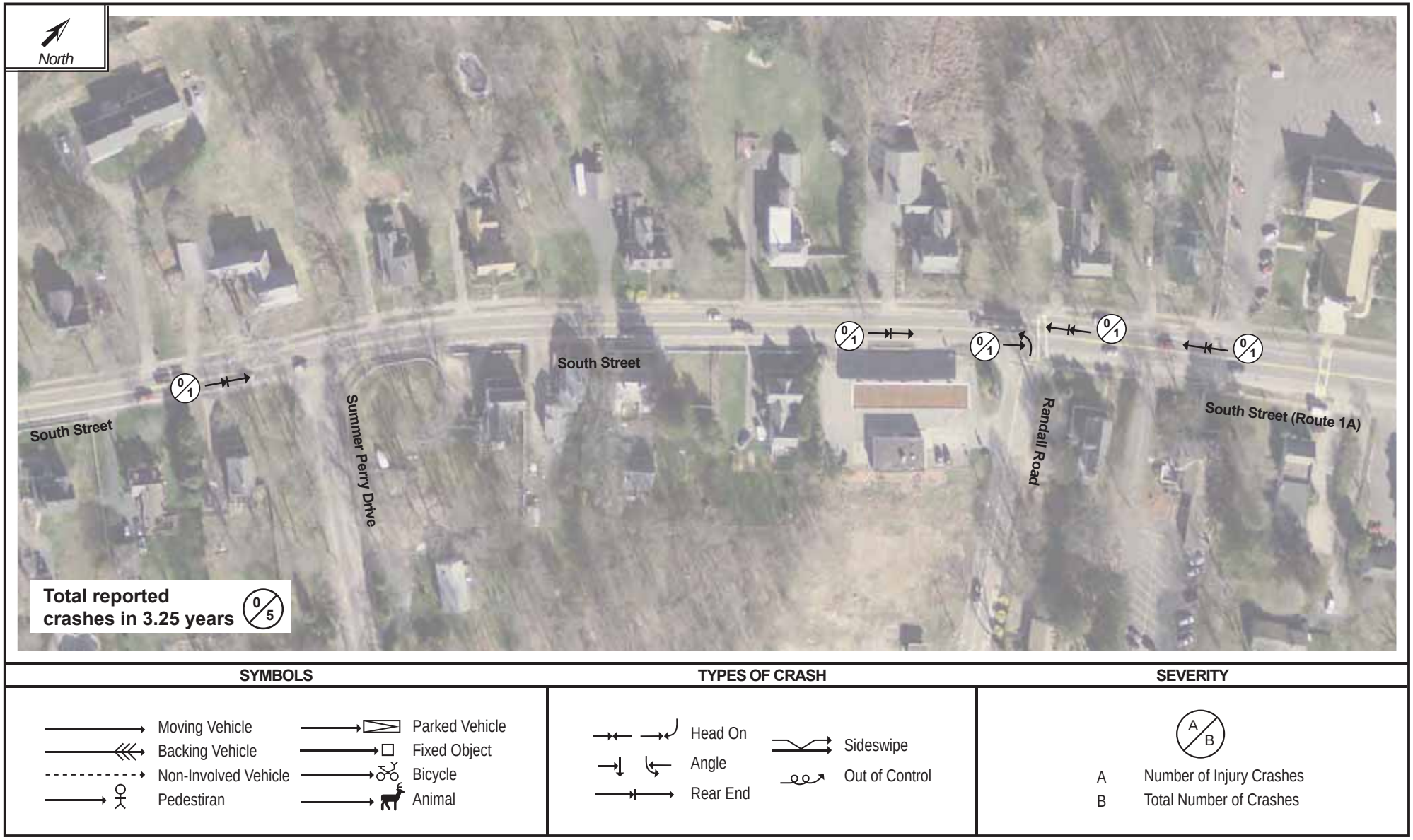
A Number of Injury Crashes
B Total Number of Crashes

Figure H-5
Collision Diagram: Route 1A in the Vicinity of Wrentham Town Hall
Wrentham Police Reports: January 2014 – March 2017



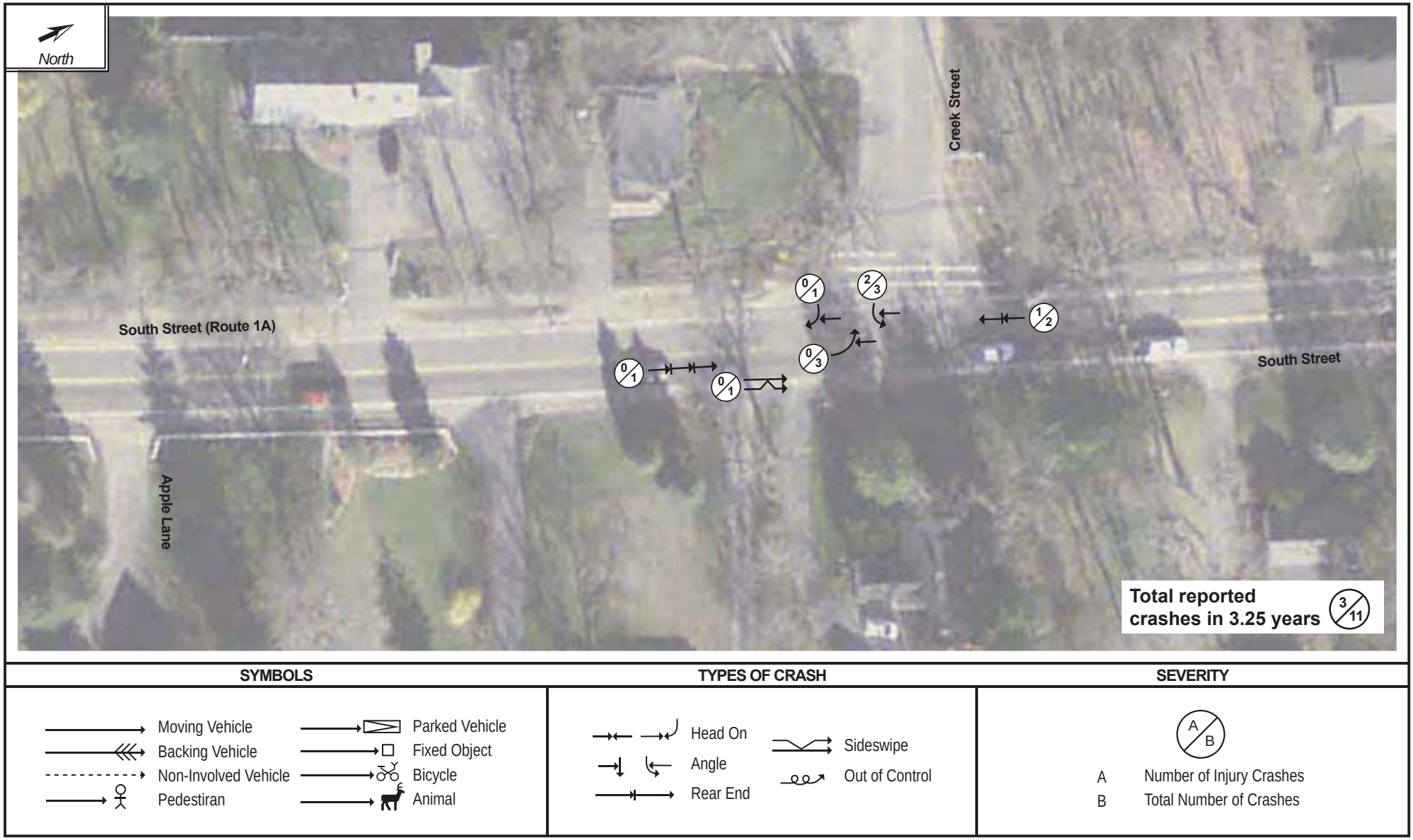
SYMBOLS	TYPES OF CRASH	SEVERITY
Moving Vehicle Backing Vehicle Non-Involved Vehicle Pedestiran Parked Vehicle Fixed Object Bicycle Animal	Head On Angle Rear End Sideswipe Out of Control	A/B A Number of Injury Crashes B Total Number of Crashes

Figure H-6
Collision Diagram: Route 1A at Randall Road and at Summer Perry Drive
Wrentham Police Reports: January 2014 – March 2017



SYMBOLS	TYPES OF CRASH	SEVERITY
Moving Vehicle Backing Vehicle Non-Involved Vehicle Pedestiran Parked Vehicle Fixed Object Bicycle Animal	Head On Angle Rear End Sideswipe Out of Control	A/B A Number of Injury Crashes B Total Number of Crashes

Figure H-7
Collision Diagram: Route 1A at Creek Street
Wrentham Police Reports: January 2014 – March 2017



SYMBOLS

- Moving Vehicle
- Backing Vehicle
- Non-Involved Vehicle
- Pedestiran
- Parked Vehicle
- Fixed Object
- Bicycle
- Animal

TYPES OF CRASH

- Head On
- Angle
- Rear End
- Sideswipe
- Out of Control

SEVERITY

A/B

A Number of Injury Crashes
B Total Number of Crashes

Figure H-8
Collision Diagram: Route 1A between Creek Street and Beach Street
Wrentham Police Reports: January 2014 – March 2017

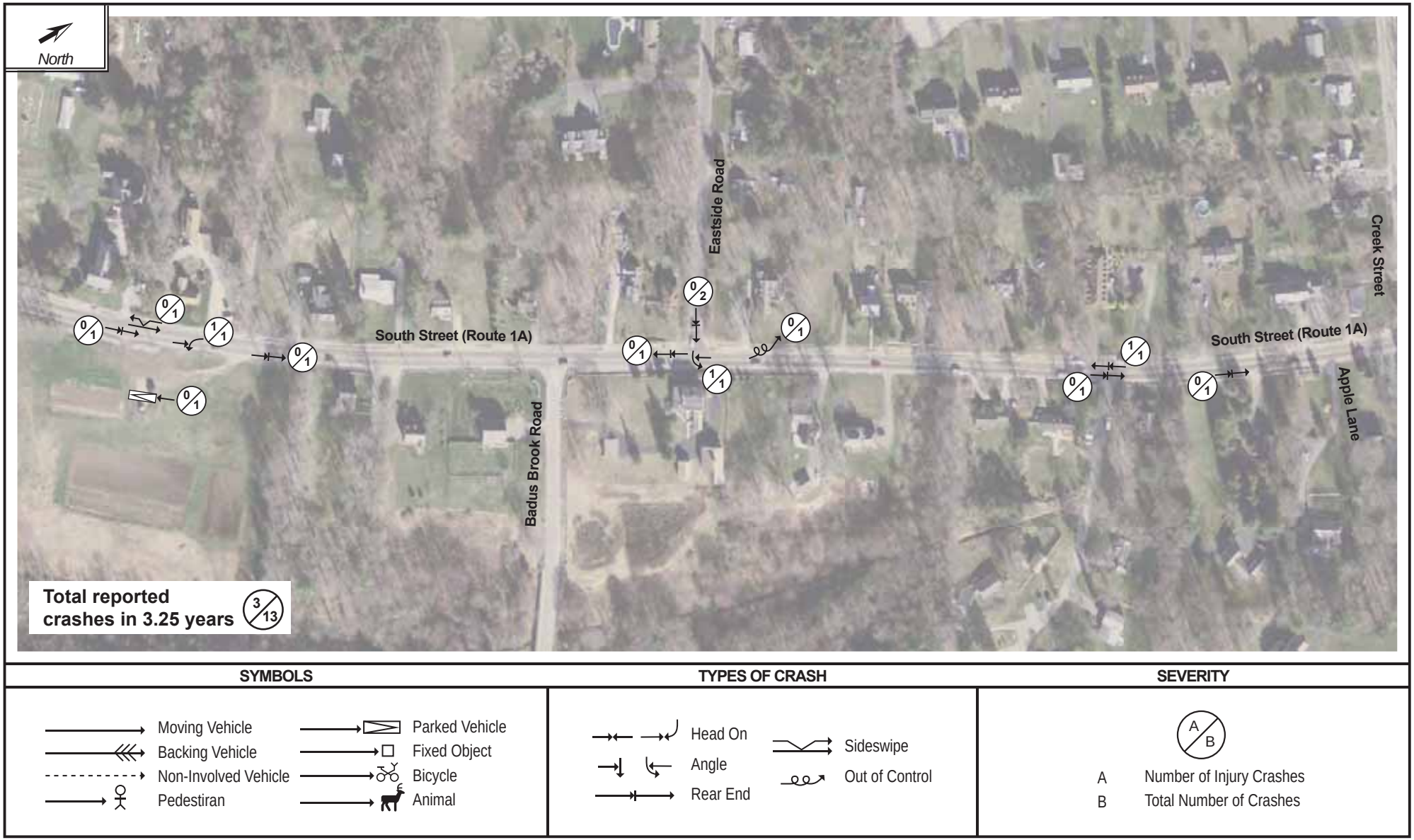
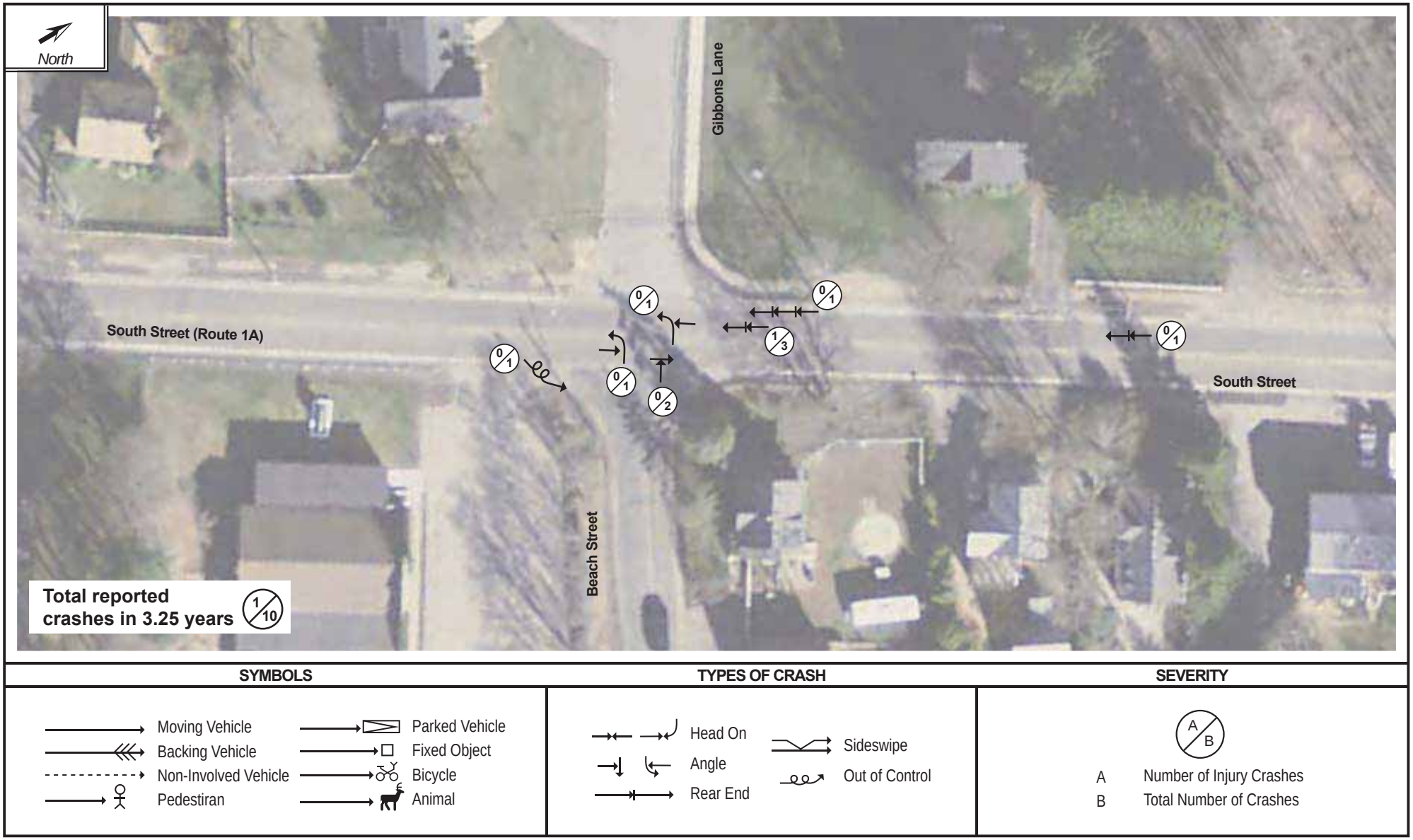


Figure H-9
Collision Diagram: Route 1A at Beach Street
Wrentham Police Reports: January 2014 – March 2017



SYMBOLS	TYPES OF CRASH	SEVERITY
Moving Vehicle Backing Vehicle Non-Involved Vehicle Pedestiran Parked Vehicle Fixed Object Bicycle Animal	Head On Angle Rear End Sideswipe Out of Control	A/B A Number of Injury Crashes B Total Number of Crashes

Figure H-10
Collision Diagram: Route 1A between Beach Street and West Street (Route 121)
Wrentham Police Reports: January 2014 – March 2017

SYMBOLS

- Moving Vehicle
- Backing Vehicle
- Non-Involved Vehicle
- Pedestiran
- Parked Vehicle
- Fixed Object
- Bicycle
- Animal

TYPES OF CRASH

- Head On
- Angle
- Rear End
- Sideswipe
- Out of Control

SEVERITY

A/B

A Number of Injury Crashes
B Total Number of Crashes

Figure H-11
Collision Diagram: Route 1A at Route 121 (West Street)
Wrentham Police Reports: January 2014 – March 2017

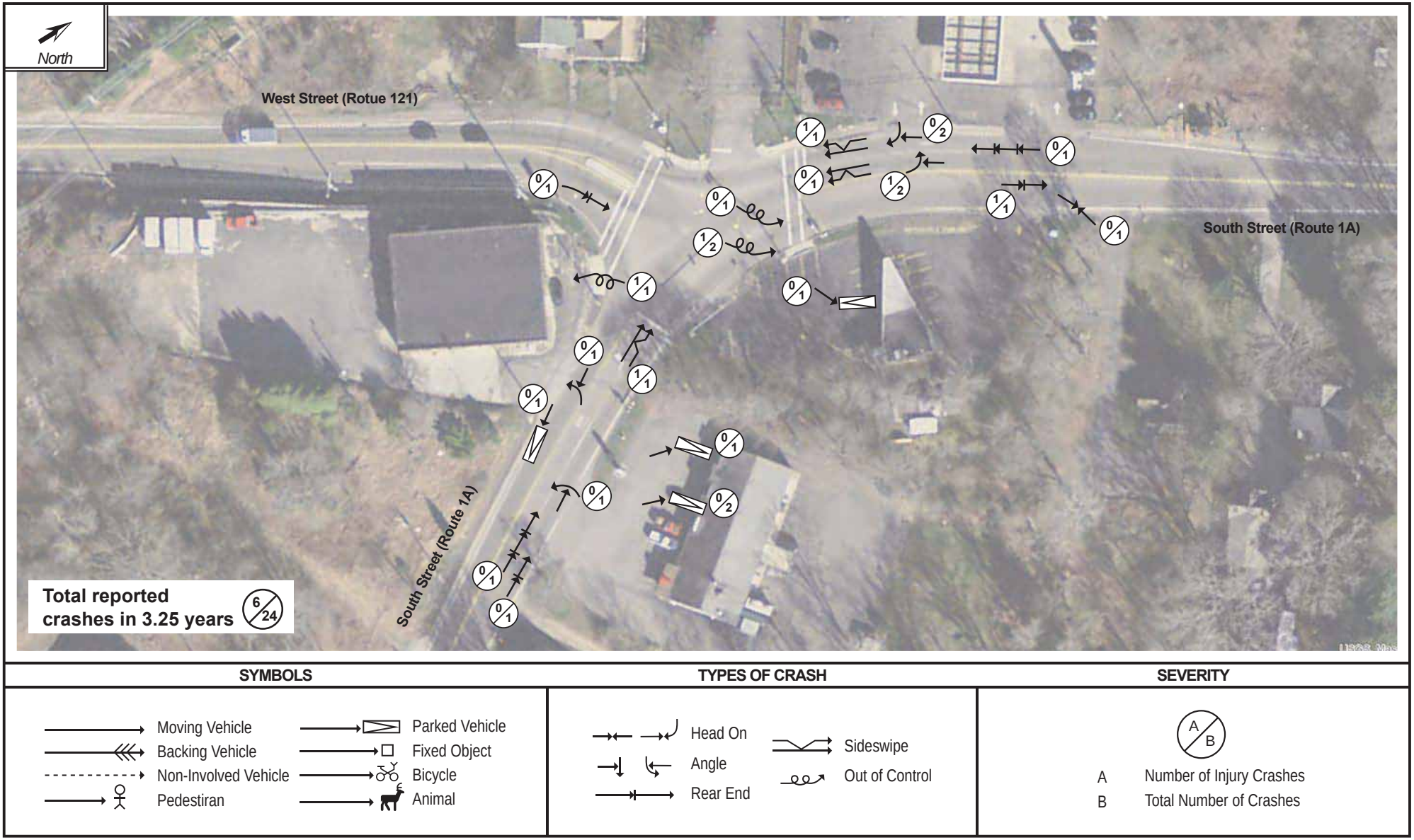


Figure H-12
Collision Diagram: Route 1A between Route 121 and I-495
Wrentham Police Reports: January 2014 – March 2017

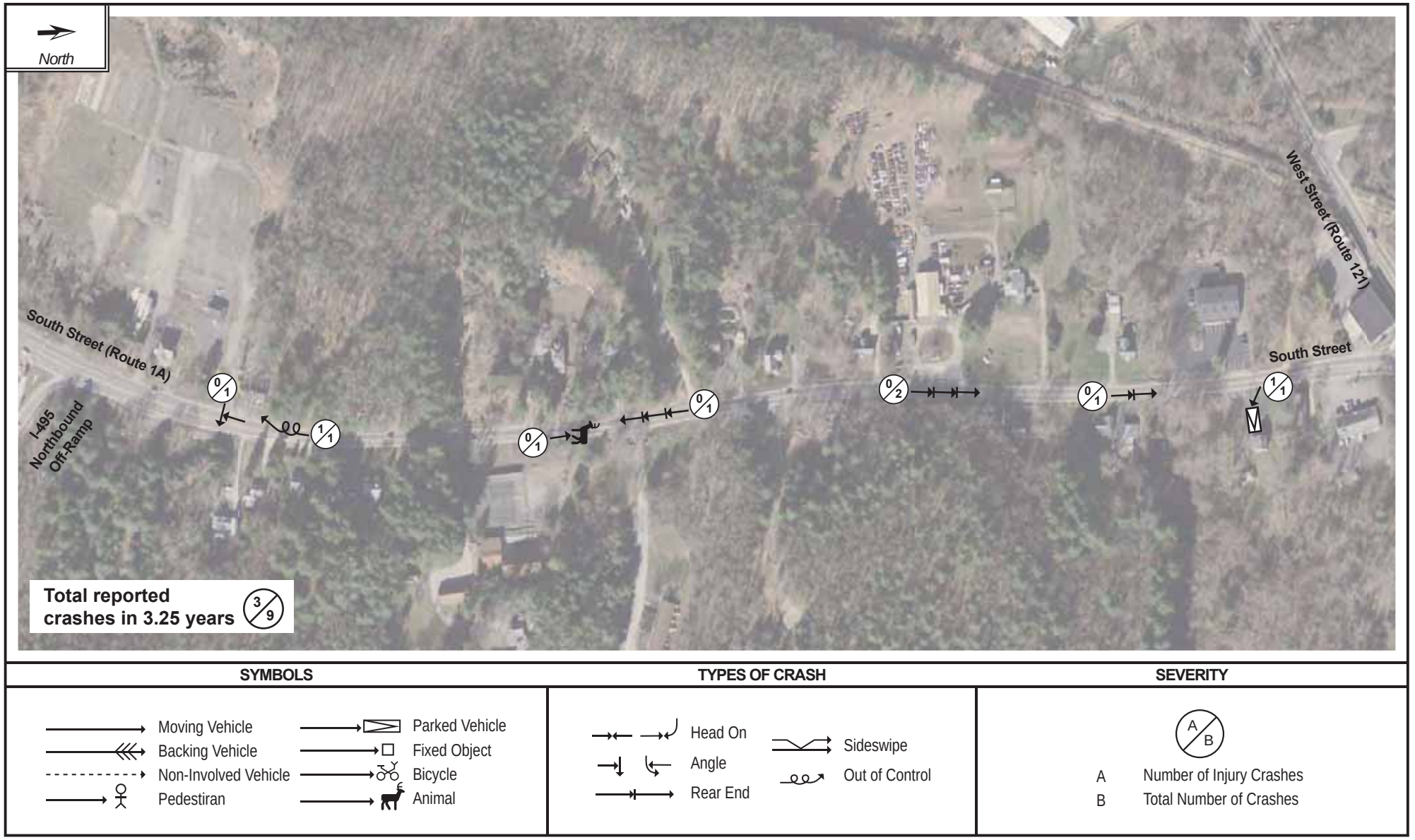
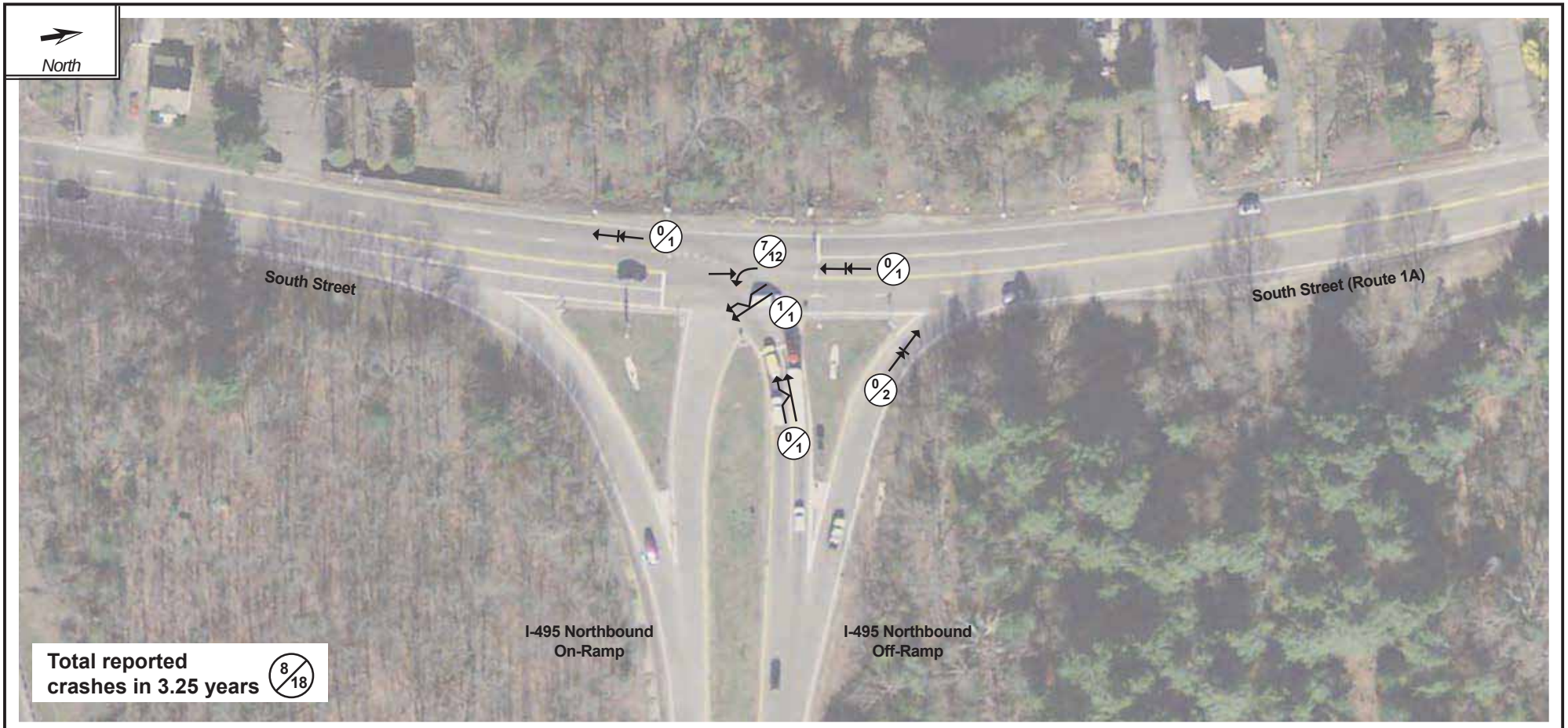
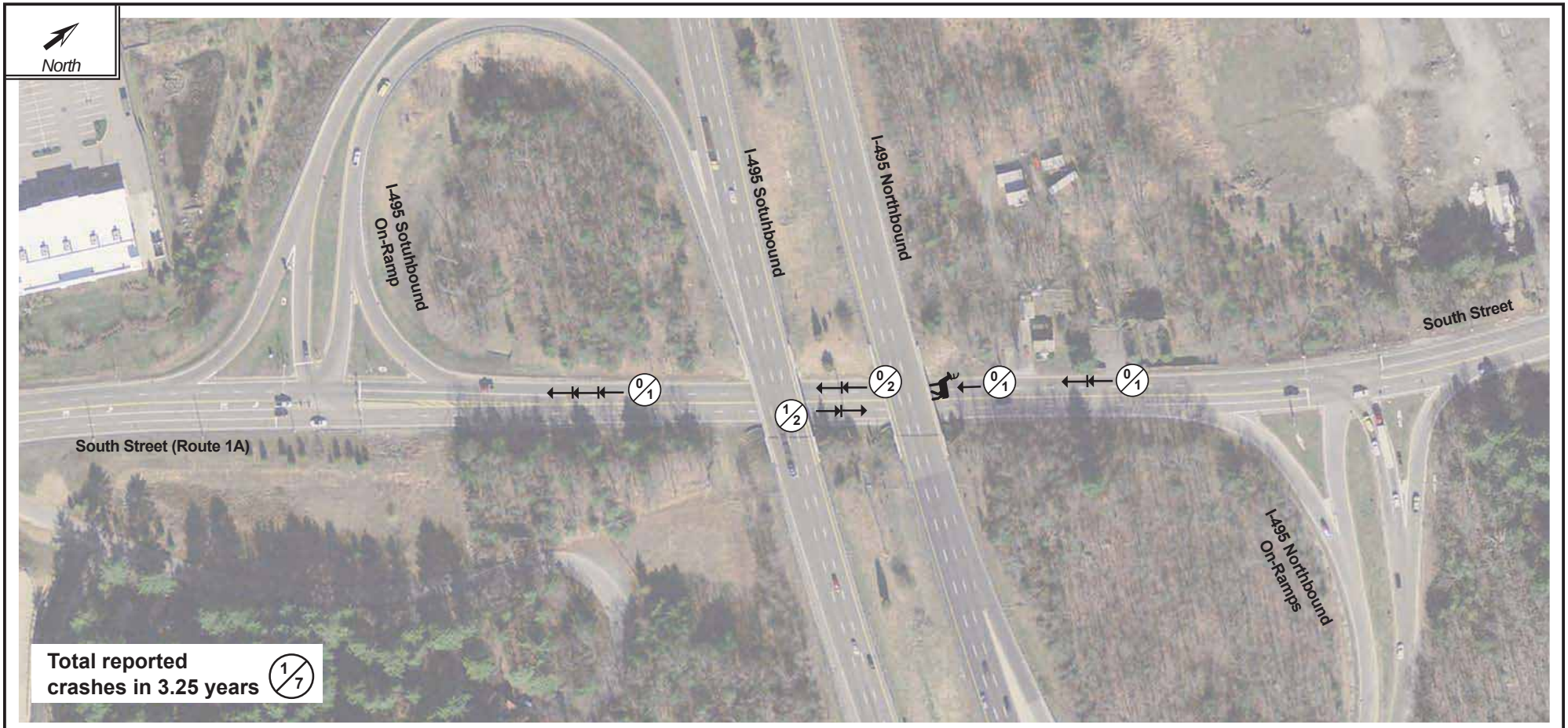


Figure H-13
Collision Diagram: Route 1A at I-495 Northbound Ramps
Wrentham Police Reports: January 2014 – March 2017



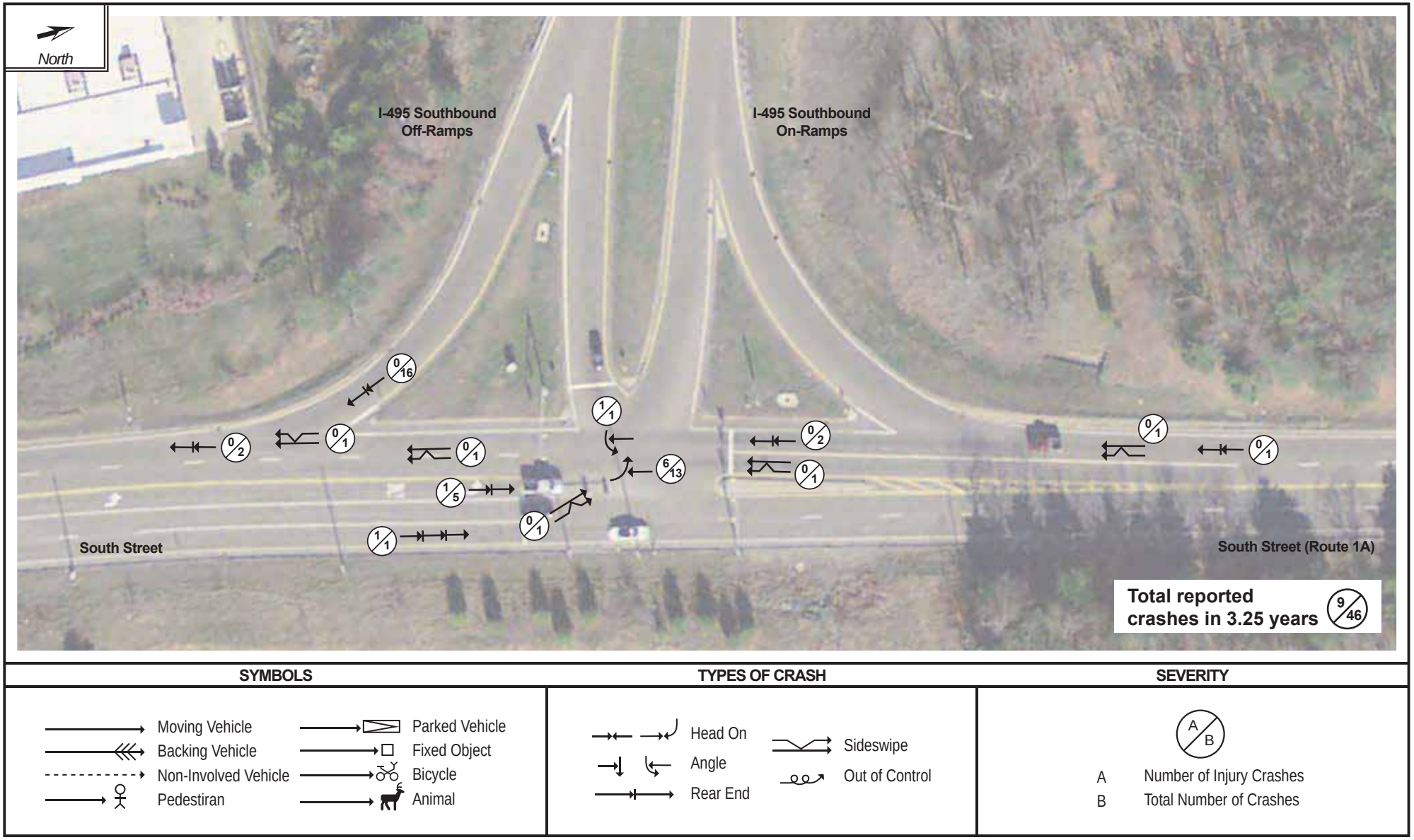
SYMBOLS	TYPES OF CRASH	SEVERITY
Moving Vehicle Backing Vehicle Non-Involved Vehicle Pedestiran Parked Vehicle Fixed Object Bicycle Animal	Head On Angle Rear End Sideswipe Out of Control	A/B A Number of Injury Crashes B Total Number of Crashes

Figure H-14
Collision Diagram: Route 1A between I-495 Northbound and Southbound Ramps
Wrentham Police Reports: January 2014 – March 2017



SYMBOLS	TYPES OF CRASH	SEVERITY
Moving Vehicle Backing Vehicle Non-Involved Vehicle Pedestiran Parked Vehicle Fixed Object Bicycle Animal	Head On Angle Rear End Sideswipe Out of Control	A/B A Number of Injury Crashes B Total Number of Crashes

Figure H-15
Collision Diagram: Route 1A at I-495 Southbound Ramps
Wrentham Police Reports: January 2014 – March 2017

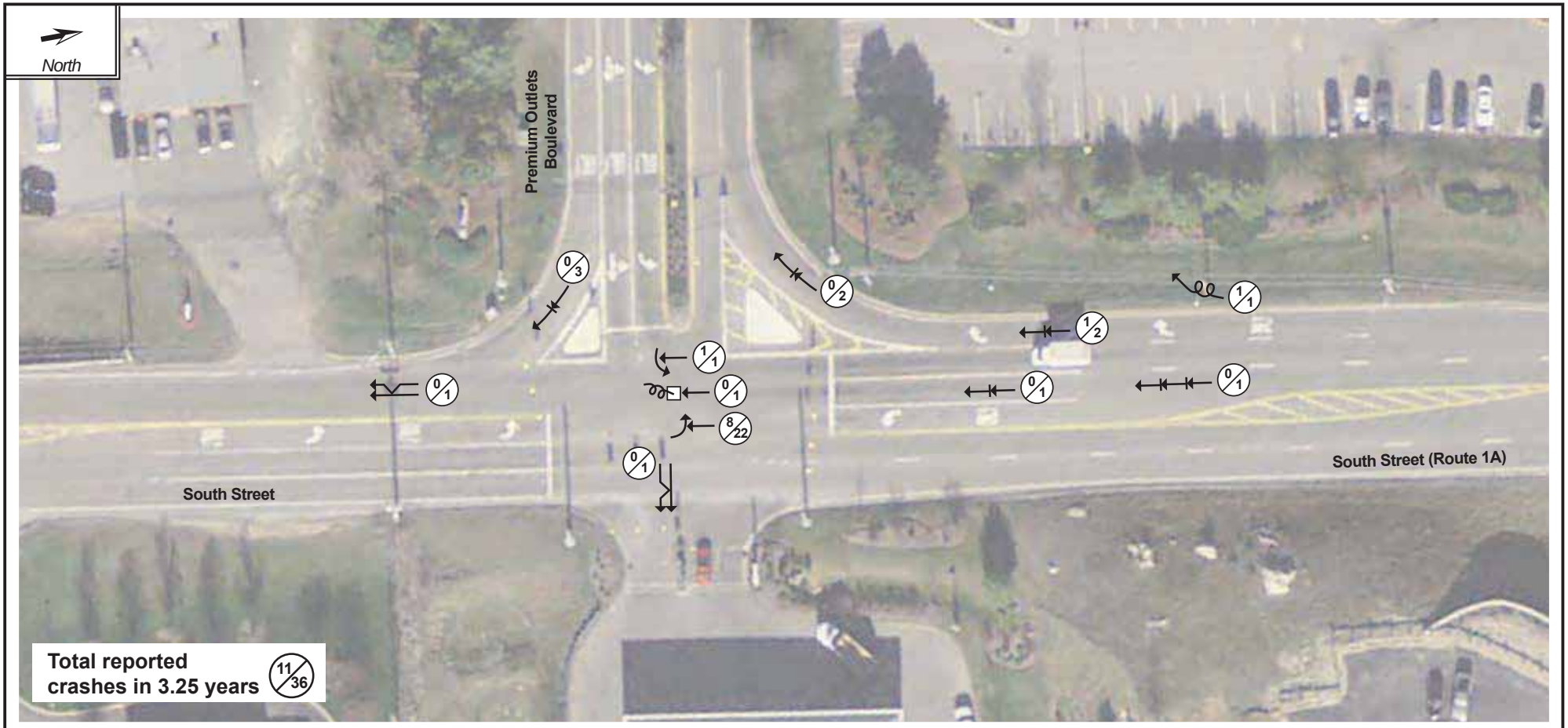


SYMBOLS	TYPES OF CRASH	SEVERITY
Moving Vehicle	Head On	A/B
Backing Vehicle	Angle	A Number of Injury Crashes
Non-Involved Vehicle	Rear End	B Total Number of Crashes
Pedestiran	Sideswipe	
Parked Vehicle	Out of Control	
Fixed Object		
Bicycle		
Animal		

Figure H-16
Collision Diagram: Route 1A at Nickerson Lane
Wrentham Police Reports: January 2014 – March 2017

SYMBOLS	TYPES OF CRASH	SEVERITY
Moving Vehicle Backing Vehicle Non-Involved Vehicle Pedestiran Parked Vehicle Fixed Object Bicycle Animal	Head On Angle Rear End Sideswipe Out of Control	A/B A Number of Injury Crashes B Total Number of Crashes

Figure H-17
Collision Diagram: Route 1A at Premium Outlets Boulevard
Wrentham Police Reports: January 2014 – March 2017



SYMBOLS

- Moving Vehicle
- Backing Vehicle
- Non-Involved Vehicle
- Pedestiran
- Parked Vehicle
- Fixed Object
- Bicycle
- Animal

TYPES OF CRASH

- Head On
- Angle
- Rear End
- Sideswipe
- Out of Control

SEVERITY

A/B

A Number of Injury Crashes
B Total Number of Crashes

Figure H-18
Collision Diagram: Route 1A between Premium Outlets Boulevard and High Street
Wrentham Police Reports: January 2014 – March 2017

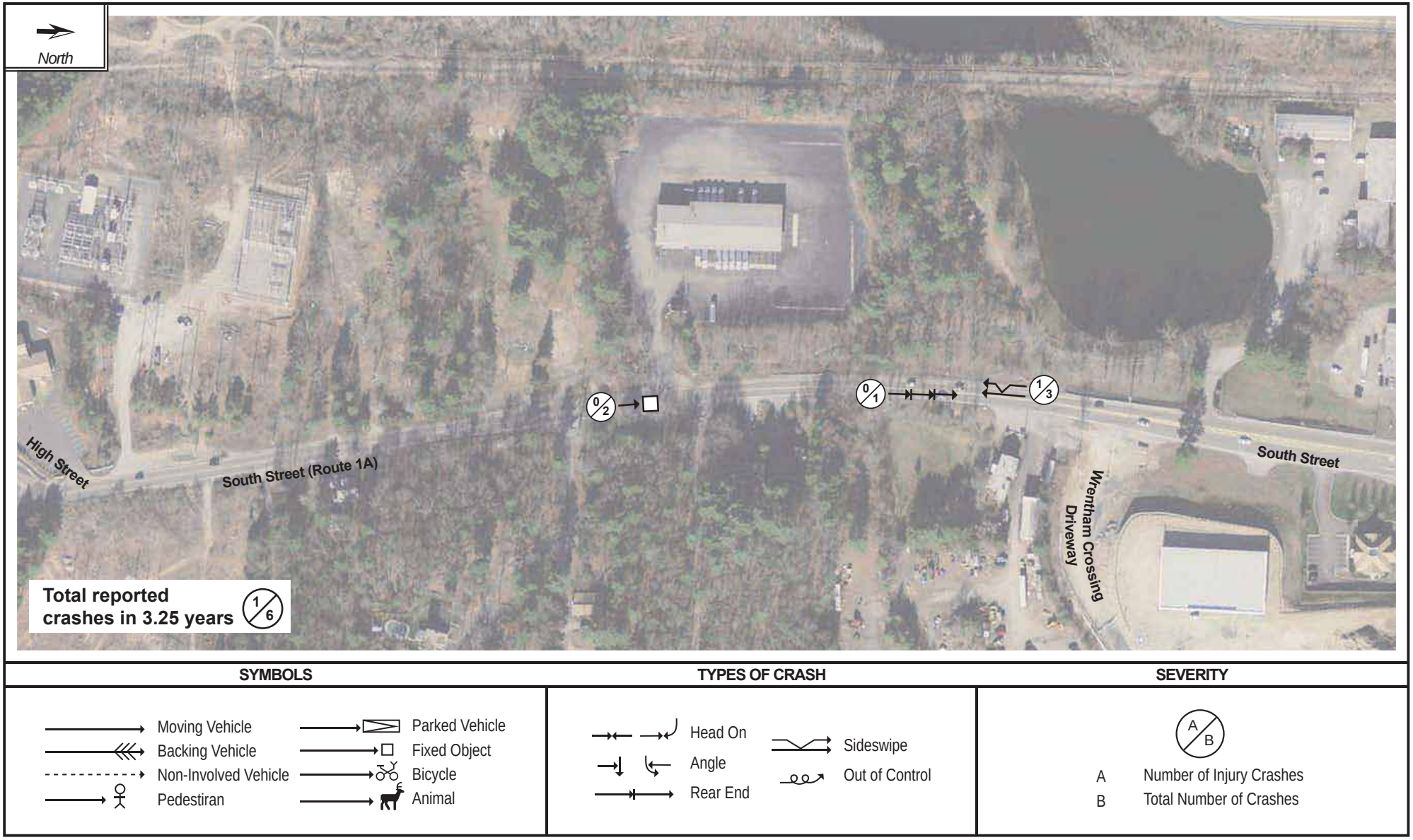
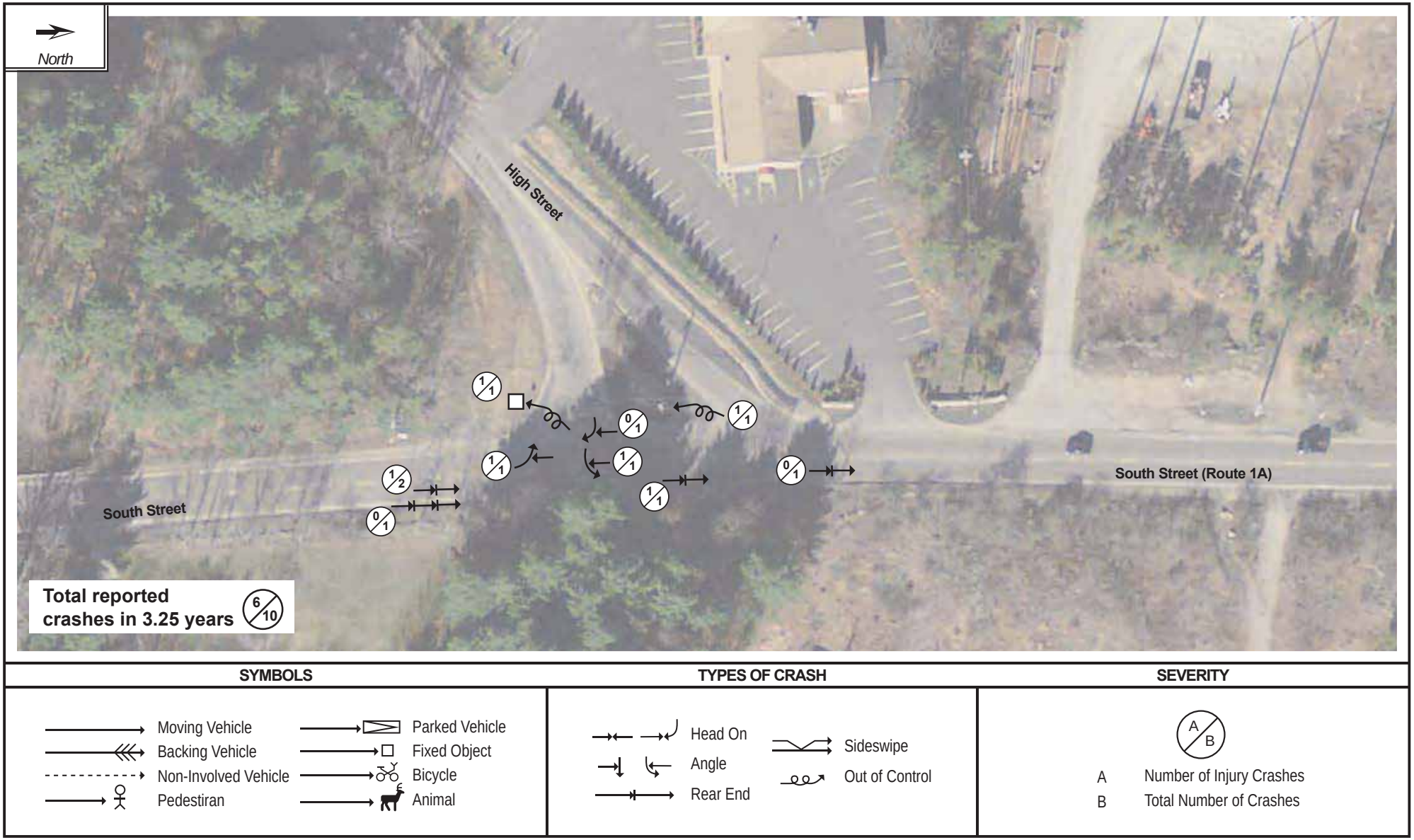


Figure H-19
Collision Diagram: Route 1A at High Street
Wrentham Police Reports: January 2014 – March 2017



SYMBOLS	TYPES OF CRASH	SEVERITY
Moving Vehicle Backing Vehicle Non-Involved Vehicle Pedestiran Parked Vehicle Fixed Object Bicycle Animal	Head On Angle Rear End Sideswipe Out of Control	A/B A Number of Injury Crashes B Total Number of Crashes

Table H-1
Crash Statistics: Route 1A at Route 140 (Franklin Street/East Street)
Wrentham Police Crash Data 2014-2017

Statistics Period		2014	2015	2016	2017 *	Total	Annual Avg.
Total number of crashes		7	8	7	0	22	6.8
Severity	Property damage only	3	6	5	0	14	4.3
	Non-fatal injury	2	2	1	0	5	1.5
	Fatality	0	0	0	0	0	0.0
	Not reported/unknown	2	0	1	0	3	0.9
Collision type	Single vehicle	0	1	0	0	1	0.3
	Rear-end	1	3	1	0	5	1.5
	Angle	5	1	6	0	12	3.7
	Sideswipe, same direction	0	2	0	0	2	0.6
	Sideswipe, opposite direction	0	1	0	0	1	0.3
	Head-on	0	0	0	0	0	0.0
	Rear-to-rear	0	0	0	0	0	0.0
	Not reported/unknown	1	0	0	0	1	0.3
Involved pedestrian(s)		0	1	0	0	1	0.3
Involved cyclist(s)		0	0	0	0	0	0.0
Occurred during weekday peak periods **		2	1	2	0	5	1.5
Wet or icy pavement conditions		5	0	1	0	6	1.8
Dark conditions (lit or unlit)		1	1	2	0	4	1.2

* 2017 data available for first 3 month only.

** Peak periods are defined as 7:00–10:00 AM and 3:30–6:30 PM.

Table H-2
Crash Statistics: Route 1A at Common Street
Wrentham Police Crash Data 2014-2017

Statistics Period		2014	2015	2016	2017 *	Total	Annual Avg.
Total number of crashes		5	7	5	1	18	5.5
Severity	Property damage only	2	5	5	1	13	4.0
	Non-fatal injury	1	1	0	0	2	0.6
	Fatality	0	0	0	0	0	0.0
	Not reported/unknown	2	1	0	0	3	0.9
Collision type	Single vehicle	0	0	0	0	0	0.0
	Rear-end	3	1	0	0	4	1.2
	Angle	1	4	2	1	8	2.5
	Sideswipe, same direction	0	1	2	0	3	0.9
	Sideswipe, opposite direction	1	0	0	0	1	0.3
	Head-on	0	1	0	0	1	0.3
	Rear-to-rear	0	0	1	0	1	0.3
	Not reported/unknown	0	0	0	0	0	0.0
Involved pedestrian(s)		0	0	0	0	0	0.0
Involved cyclist(s)		0	0	0	0	0	0.0
Occurred during weekday peak periods **		1	3	2	0	6	1.8
Wet or icy pavement conditions		2	3	0	0	5	1.5
Dark conditions (lit or unlit)		2	2	0	1	5	1.5

* 2017 data available for first 3 month only.

** Peak periods are defined as 7:00–10:00 AM and 3:30–6:30 PM.

Table H-3
Crash Statistics: Common Street at Taunton Street
Wrentham Police Crash Data 2014-2017

Statistics Period		2014	2015	2016	2017 *	Total	Annual Avg.
Total number of crashes		4	5	1	0	10	3.1
Severity	Property damage only	2	2	0	0	4	1.2
	Non-fatal injury	1	2	1	0	4	1.2
	Fatality	0	0	0	0	0	0.0
	Not reported/unknown	1	1	0	0	2	0.6
Collision type	Single vehicle	0	1	0	0	1	0.3
	Rear-end	1	2	0	0	3	0.9
	Angle	3	2	1	0	6	1.8
	Sideswipe, same direction	0	0	0	0	0	0.0
	Sideswipe, opposite direction	0	0	0	0	0	0.0
	Head-on	0	0	0	0	0	0.0
	Rear-to-rear	0	0	0	0	0	0.0
	Not reported/unknown	0	0	0	0	0	0.0
Involved pedestrian(s)		0	0	0	0	0	0.0
Involved cyclist(s)		0	0	0	0	0	0.0
Occurred during weekday peak periods **		1	2	1	0	4	1.2
Wet or icy pavement conditions		0	0	0	0	0	0.0
Dark conditions (lit or unlit)		0	2	0	0	2	0.6

* 2017 data available for first 3 month only.

** Peak periods are defined as 7:00–10:00 AM and 3:30–6:30 PM.

Table H-4
Crash Statistics: Common Street at East Street (Route 140)
Wrentham Police Crash Data 2014-2017

Statistics Period		2014	2015	2016	2017 *	Total	Annual Avg.
Total number of crashes		2	0	5	2	9	2.8
Severity	Property damage only	2	0	3	1	6	1.8
	Non-fatal injury	0	0	1	1	2	0.6
	Fatality	0	0	0	0	0	0.0
	Not reported/unknown	0	0	1	0	1	0.3
Collision type	Single vehicle	0	0	1	0	1	0.3
	Rear-end	1	0	1	0	2	0.6
	Angle	1	0	1	1	3	0.9
	Sideswipe, same direction	0	0	0	0	0	0.0
	Sideswipe, opposite direction	0	0	1	0	1	0.3
	Head-on	0	0	1	1	2	0.6
	Rear-to-rear	0	0	0	0	0	0.0
	Not reported/unknown	0	0	0	0	0	0.0
Involved pedestrian(s)		0	0	0	0	0	0.0
Involved cyclist(s)		0	0	0	0	0	0.0
Occurred during weekday peak periods **		0	0	1	0	1	0.3
Wet or icy pavement conditions		0	0	1	1	2	0.6
Dark conditions (lit or unlit)		0	0	0	1	1	0.3

* 2017 data available for first 3 month only.

** Peak periods are defined as 7:00–10:00 AM and 3:30–6:30 PM.

Table H-5
Crash Statistics: Route 1A in the Vicinity of Wrentham Town Hall
Wrentham Police Crash Data 2014-2017

Statistics Period		2014	2015	2016	2017 *	Total	Annual Avg.
Total number of crashes		2	1	1	1	5	1.5
Severity	Property damage only	1	1	1	0	3	0.9
	Non-fatal injury	0	0	0	0	0	0.0
	Fatality	0	0	0	0	0	0.0
	Not reported/unknown	1	0	0	1	2	0.6
Collision type	Single vehicle	0	0	0	0	0	0.0
	Rear-end	1	1	0	0	2	0.6
	Angle	1	0	1	1	3	0.9
	Sideswipe, same direction	0	0	0	0	0	0.0
	Sideswipe, opposite direction	0	0	0	0	0	0.0
	Head-on	0	0	0	0	0	0.0
	Rear-to-rear	0	0	0	0	0	0.0
	Not reported/unknown	0	0	0	0	0	0.0
Involved pedestrian(s)		0	0	0	0	0	0.0
Involved cyclist(s)		0	0	0	0	0	0.0
Occurred during weekday peak periods **		0	1	0	0	1	0.3
Wet or icy pavement conditions		1	0	0	1	2	0.6
Dark conditions (lit or unlit)		0	0	1	0	1	0.3

* 2017 data available for first 3 month only.

** Peak periods are defined as 7:00–10:00 AM and 3:30–6:30 PM.

Table H-6
Crash Statistics: Route 1A at Randall Road and at Summer Perry Drive
Wrentham Police Crash Data 2014-2017

Statistics Period		2014	2015	2016	2017 *	Total	Annual Avg.
Total number of crashes		4	1	0	0	5	1.5
Severity	Property damage only	3	1	0	0	4	1.2
	Non-fatal injury	0	0	0	0	0	0.0
	Fatality	0	0	0	0	0	0.0
	Not reported/unknown	1	0	0	0	1	0.3
Collision type	Single vehicle	0	0	0	0	0	0.0
	Rear-end	3	1	0	0	4	1.2
	Angle	1	0	0	0	1	0.3
	Sideswipe, same direction	0	0	0	0	0	0.0
	Sideswipe, opposite direction	0	0	0	0	0	0.0
	Head-on	0	0	0	0	0	0.0
	Rear-to-rear	0	0	0	0	0	0.0
	Not reported/unknown	0	0	0	0	0	0.0
Involved pedestrian(s)		0	0	0	0	0	0.0
Involved cyclist(s)		0	0	0	0	0	0.0
Occurred during weekday peak periods **		4	1	0	0	5	1.5
Wet or icy pavement conditions		2	0	0	0	2	0.6
Dark conditions (lit or unlit)		0	0	0	0	0	0.0

* 2017 data available for first 3 month only.

** Peak periods are defined as 7:00–10:00 AM and 3:30–6:30 PM.

Table H-7
Crash Statistics: Route 1A at Creek Street
Wrentham Police Crash Data 2014-2017

Statistics Period		2014	2015	2016	2017 *	Total	Annual Avg.
Total number of crashes		2	3	6	0	11	3.4
Severity	Property damage only	1	2	3	0	6	1.8
	Non-fatal injury	1	0	3	0	4	1.2
	Fatality	0	0	0	0	0	0.0
	Not reported/unknown	0	1	0	0	1	0.3
Collision type	Single vehicle	0	0	0	0	0	0.0
	Rear-end	1	1	1	0	3	0.9
	Angle	1	2	4	0	7	2.2
	Sideswipe, same direction	0	0	0	0	0	0.0
	Sideswipe, opposite direction	0	0	0	0	0	0.0
	Head-on	0	0	1	0	1	0.3
	Rear-to-rear	0	0	0	0	0	0.0
	Not reported/unknown	0	0	0	0	0	0.0
Involved pedestrian(s)		0	0	0	0	0	0.0
Involved cyclist(s)		0	0	0	0	0	0.0
Occurred during weekday peak periods **		0	2	2	0	4	1.2
Wet or icy pavement conditions		1	2	0	0	3	0.9
Dark conditions (lit or unlit)		0	2	0	0	2	0.6

* 2017 data available for first 3 month only.

** Peak periods are defined as 7:00–10:00 AM and 3:30–6:30 PM.

Table H-8
Crash Statistics: Route 1A between Creek Street and Beach Street
Wrentham Police Crash Data 2014-2017

Statistics Period		2014	2015	2016	2017 *	Total	Annual Avg.
Total number of crashes		4	5	4	0	13	4.0
Severity	Property damage only	1	4	3	0	8	2.5
	Non-fatal injury	3	1	1	0	5	1.5
	Fatality	0	0	0	0	0	0.0
	Not reported/unknown	0	0	0	0	0	0.0
Collision type	Single vehicle	1	0	0	0	1	0.3
	Rear-end	1	5	2	0	8	2.5
	Angle	0	0	1	0	1	0.3
	Sideswipe, same direction	0	0	0	0	0	0.0
	Sideswipe, opposite direction	0	0	1	0	1	0.3
	Head-on	1	0	0	0	1	0.3
	Rear-to-rear	0	0	0	0	0	0.0
	Not reported/unknown	1	0	0	0	1	0.3
Involved pedestrian(s)		0	0	0	0	0	0.0
Involved cyclist(s)		0	0	0	0	0	0.0
Occurred during weekday peak periods **		1	0	1	0	2	0.6
Wet or icy pavement conditions		1	0	1	0	2	0.6
Dark conditions (lit or unlit)		2	0	2	0	4	1.2

* 2017 data available for first 3 month only.

** Peak periods are defined as 7:00–10:00 AM and 3:30–6:30 PM.

Table H-9
Crash Statistics: Route 1A at Beach Street
Wrentham Police Crash Data 2014-2017

Statistics Period		2014	2015	2016	2017 *	Total	Annual Avg.
Total number of crashes		3	3	4	0	10	3.1
Severity	Property damage only	2	3	3	0	8	2.5
	Non-fatal injury	0	0	1	0	1	0.3
	Fatality	0	0	0	0	0	0.0
	Not reported/unknown	1	0	0	0	1	0.3
Collision type	Single vehicle	0	0	1	0	1	0.3
	Rear-end	2	1	2	0	5	1.5
	Angle	0	2	1	0	3	0.9
	Sideswipe, same direction	0	0	0	0	0	0.0
	Sideswipe, opposite direction	0	0	0	0	0	0.0
	Head-on	1	0	0	0	1	0.3
	Rear-to-rear	0	0	0	0	0	0.0
	Not reported/unknown	0	0	0	0	0	0.0
Involved pedestrian(s)		0	0	0	0	0	0.0
Involved cyclist(s)		0	0	0	0	0	0.0
Occurred during weekday peak periods **		0	2	0	0	2	0.6
Wet or icy pavement conditions		1	1	3	0	5	1.5
Dark conditions (lit or unlit)		0	1	1	0	2	0.6

* 2017 data available for first 3 month only.

** Peak periods are defined as 7:00–10:00 AM and 3:30–6:30 PM.

Table H-10
Crash Statistics: Route 1A between Beach Street and West Street (Route 121)
Wrentham Police Crash Data 2014-2017

Statistics Period		2014	2015	2016	2017 *	Total	Annual Avg.
Total number of crashes		3	2	2	0	7	2.2
Severity	Property damage only	1	1	1	0	3	0.9
	Non-fatal injury	0	1	0	0	1	0.3
	Fatality	0	0	0	0	0	0.0
	Not reported/unknown	2	0	1	0	3	0.9
Collision type	Single vehicle	0	1	0	0	1	0.3
	Rear-end	3	0	2	0	5	1.5
	Angle	0	1	0	0	1	0.3
	Sideswipe, same direction	0	0	0	0	0	0.0
	Sideswipe, opposite direction	0	0	0	0	0	0.0
	Head-on	0	0	0	0	0	0.0
	Rear-to-rear	0	0	0	0	0	0.0
	Not reported/unknown	0	0	0	0	0	0.0
Involved pedestrian(s)		0	0	0	0	0	0.0
Involved cyclist(s)		0	0	0	0	0	0.0
Occurred during weekday peak periods **		0	0	1	0	1	0.3
Wet or icy pavement conditions		0	0	0	0	0	0.0
Dark conditions (lit or unlit)		0	1	1	0	2	0.6

* 2017 data available for first 3 month only.

** Peak periods are defined as 7:00–10:00 AM and 3:30–6:30 PM.

Table H-11
Crash Statistics: Route 1A at Route 121 (West Street)
Wrentham Police Crash Data 2014-2017

Statistics Period		2014	2015	2016	2017 *	Total	Annual Avg.
Total number of crashes		8	5	7	3	23	7.1
Severity	Property damage only	4	4	5	3	16	4.9
	Non-fatal injury	3	1	2	0	6	1.8
	Fatality	0	0	0	0	0	0.0
	Not reported/unknown	1	0	0	0	1	0.3
Collision type	Single vehicle	1	0	1	0	2	0.6
	Rear-end	4	3	2	0	9	2.8
	Angle	3	1	3	2	9	2.8
	Sideswipe, same direction	0	1	0	0	1	0.3
	Sideswipe, opposite direction	0	0	0	1	1	0.3
	Head-on	0	0	1	0	1	0.3
	Rear-to-rear	0	0	0	0	0	0.0
	Not reported/unknown	0	0	0	0	0	0.0
Involved pedestrian(s)		0	0	0	0	0	0.0
Involved cyclist(s)		0	0	0	0	0	0.0
Occurred during weekday peak periods **		1	2	3	0	6	1.8
Wet or icy pavement conditions		0	3	2	0	5	1.5
Dark conditions (lit or unlit)		0	1	2	1	4	1.2

* 2017 data available for first 3 month only.

** Peak periods are defined as 7:00–10:00 AM and 3:30–6:30 PM.

Table H-12
Crash Statistics: Route 1A between Route 121 and I-495
Wrentham Police Crash Data 2014-2017

Statistics Period		2014	2015	2016	2017 *	Total	Annual Avg.
Total number of crashes		2	1	5	1	9	2.8
Severity	Property damage only	1	0	3	0	4	1.2
	Non-fatal injury	0	1	1	1	3	0.9
	Fatality	0	0	0	0	0	0.0
	Not reported/unknown	1	0	1	0	2	0.6
Collision type	Single vehicle	1	1	1	0	3	0.9
	Rear-end	0	0	4	1	5	1.5
	Angle	1	0	0	0	1	0.3
	Sideswipe, same direction	0	0	0	0	0	0.0
	Sideswipe, opposite direction	0	0	0	0	0	0.0
	Head-on	0	0	0	0	0	0.0
	Rear-to-rear	0	0	0	0	0	0.0
	Not reported/unknown	0	0	0	0	0	0.0
Involved pedestrian(s)		0	0	0	0	0	0.0
Involved cyclist(s)		0	0	0	0	0	0.0
Occurred during weekday peak periods **		1	0	2	1	4	1.2
Wet or icy pavement conditions		1	1	1	1	4	1.2
Dark conditions (lit or unlit)		1	0	1	0	2	0.6

* 2017 data available for first 3 month only.

** Peak periods are defined as 7:00–10:00 AM and 3:30–6:30 PM.

Table H-13
Crash Statistics: Route 1A at I-495 Northbound Ramps
Wrentham Police Crash Data 2014-2017

Statistics Period		2014	2015	2016	2017 *	Total	Annual Avg.
Total number of crashes		11	3	4	0	18	5.5
Severity	Property damage only	6	1	1	0	8	2.5
	Non-fatal injury	5	1	2	0	8	2.5
	Fatality	0	0	0	0	0	0.0
	Not reported/unknown	0	1	1	0	2	0.6
Collision type	Single vehicle	0	0	0	0	0	0.0
	Rear-end	3	1	0	0	4	1.2
	Angle	5	2	4	0	11	3.4
	Sideswipe, same direction	1	0	0	0	1	0.3
	Sideswipe, opposite direction	0	0	0	0	0	0.0
	Head-on	2	0	0	0	2	0.6
	Rear-to-rear	0	0	0	0	0	0.0
	Not reported/unknown	0	0	0	0	0	0.0
Involved pedestrian(s)		0	0	0	0	0	0.0
Involved cyclist(s)		0	0	0	0	0	0.0
Occurred during weekday peak periods **		2	1	1	0	4	1.2
Wet or icy pavement conditions		1	2	2	0	5	1.5
Dark conditions (lit or unlit)		3	2	1	0	6	1.8

* 2017 data available for first 3 month only.

** Peak periods are defined as 7:00–10:00 AM and 3:30–6:30 PM.

Table H-14
Crash Statistics: Route 1A between I-495 Northbound and Southbound Ramps
Wrentham Police Crash Data 2014-2017

Statistics Period		2014	2015	2016	2017 *	Total	Annual Avg.
Total number of crashes		4	2	0	1	7	2.2
Severity	Property damage only	3	1	0	1	5	1.5
	Non-fatal injury	1	0	0	0	1	0.3
	Fatality	0	0	0	0	0	0.0
	Not reported/unknown	0	1	0	0	1	0.3
Collision type	Single vehicle	0	1	0	0	1	0.3
	Rear-end	4	1	0	1	6	1.8
	Angle	0	0	0	0	0	0.0
	Sideswipe, same direction	0	0	0	0	0	0.0
	Sideswipe, opposite direction	0	0	0	0	0	0.0
	Head-on	0	0	0	0	0	0.0
	Rear-to-rear	0	0	0	0	0	0.0
	Not reported/unknown	0	0	0	0	0	0.0
Involved pedestrian(s)		0	0	0	0	0	0.0
Involved cyclist(s)		0	0	0	0	0	0.0
Occurred during weekday peak periods **		0	0	0	0	0	0.0
Wet or icy pavement conditions		1	0	0	0	1	0.3
Dark conditions (lit or unlit)		2	1	0	0	3	0.9

* 2017 data available for first 3 month only.

** Peak periods are defined as 7:00–10:00 AM and 3:30–6:30 PM.

Table H-15
Crash Statistics: Route 1A at I-495 Southbound Ramps
Wrentham Police Crash Data 2014-2017

Statistics Period		2014	2015	2016	2017 *	Total	Annual Avg.
Total number of crashes		12	11	16	7	46	14.2
Severity	Property damage only	8	5	12	5	30	9.2
	Non-fatal injury	2	2	3	2	9	2.8
	Fatality	0	0	0	0	0	0.0
	Not reported/unknown	2	4	1	0	7	2.2
Collision type	Single vehicle	0	0	1	0	1	0.3
	Rear-end	7	7	10	2	26	8.0
	Angle	4	3	5	5	17	5.2
	Sideswipe, same direction	1	0	0	0	1	0.3
	Sideswipe, opposite direction	0	1	0	0	1	0.3
	Head-on	0	0	0	0	0	0.0
	Rear-to-rear	0	0	0	0	0	0.0
	Not reported/unknown	0	0	0	0	0	0.0
Involved pedestrian(s)		0	0	0	0	0	0.0
Involved cyclist(s)		0	0	0	0	0	0.0
Occurred during weekday peak periods **		3	4	1	0	8	2.5
Wet or icy pavement conditions		2	3	4	1	10	3.1
Dark conditions (lit or unlit)		2	0	5	2	9	2.8

* 2017 data available for first 3 month only.

** Peak periods are defined as 7:00–10:00 AM and 3:30–6:30 PM.

Table H-16
Crash Statistics: Route 1A at Nickerson Lane
Wrentham Police Crash Data 2014-2017

Statistics Period		2014	2015	2016	2017 *	Total	Annual Avg.
Total number of crashes		1	1	1	0	3	0.9
Severity	Property damage only	1	0	1	0	2	0.6
	Non-fatal injury	0	0	0	0	0	0.0
	Fatality	0	0	0	0	0	0.0
	Not reported/unknown	0	1	0	0	1	0.3
Collision type	Single vehicle	0	0	0	0	0	0.0
	Rear-end	1	0	1	0	2	0.6
	Angle	0	1	0	0	1	0.3
	Sideswipe, same direction	0	0	0	0	0	0.0
	Sideswipe, opposite direction	0	0	0	0	0	0.0
	Head-on	0	0	0	0	0	0.0
	Rear-to-rear	0	0	0	0	0	0.0
	Not reported/unknown	0	0	0	0	0	0.0
Involved pedestrian(s)		0	0	0	0	0	0.0
Involved cyclist(s)		0	0	0	0	0	0.0
Occurred during weekday peak periods **		1	0	0	0	1	0.3
Wet or icy pavement conditions		0	0	0	0	0	0.0
Dark conditions (lit or unlit)		1	0	0	0	1	0.3

* 2017 data available for first 3 month only.

** Peak periods are defined as 7:00–10:00 AM and 3:30–6:30 PM.

Table H-17
Crash Statistics: Route 1A at Premium Outlets Boulevard
Wrentham Police Crash Data 2014-2017

Statistics Period		2014	2015	2016	2017 *	Total	Annual Avg.
Total number of crashes		10	10	12	4	36	11.1
Severity	Property damage only	2	5	6	3	16	4.9
	Non-fatal injury	8	2	1	1	12	3.7
	Fatality	0	0	0	0	0	0.0
	Not reported/unknown	0	3	5	0	8	2.5
Collision type	Single vehicle	1	1	1	1	4	1.2
	Rear-end	1	4	2	1	8	2.5
	Angle	6	5	7	1	19	5.8
	Sideswipe, same direction	0	0	2	0	2	0.6
	Sideswipe, opposite direction	0	0	0	1	1	0.3
	Head-on	2	0	0	0	2	0.6
	Rear-to-rear	0	0	0	0	0	0.0
	Not reported/unknown	0	0	0	0	0	0.0
Involved pedestrian(s)		0	0	0	0	0	0.0
Involved cyclist(s)		0	0	0	0	0	0.0
Occurred during weekday peak periods **		3	2	4	0	9	2.8
Wet or icy pavement conditions		4	0	0	2	6	1.8
Dark conditions (lit or unlit)		3	1	2	0	6	1.8

* 2017 data available for first 3 month only.

** Peak periods are defined as 7:00–10:00 AM and 3:30–6:30 PM.

Table H-18
Crash Statistics: Route 1A between Premium Outlets Boulevard and High Street
Wrentham Police Crash Data 2014-2017

Statistics Period		2014	2015	2016	2017 *	Total	Annual Avg.
Total number of crashes		0	3	3	0	6	1.8
Severity	Property damage only	0	1	2	0	3	0.9
	Non-fatal injury	0	1	0	0	1	0.3
	Fatality	0	0	0	0	0	0.0
	Not reported/unknown	0	1	1	0	2	0.6
Collision type	Single vehicle	0	1	1	0	2	0.6
	Rear-end	0	0	2	0	2	0.6
	Angle	0	1	0	0	1	0.3
	Sideswipe, same direction	0	0	0	0	0	0.0
	Sideswipe, opposite direction	0	1	0	0	1	0.3
	Head-on	0	0	0	0	0	0.0
	Rear-to-rear	0	0	0	0	0	0.0
	Not reported/unknown	0	0	0	0	0	0.0
Involved pedestrian(s)		0	0	0	0	0	0.0
Involved cyclist(s)		0	0	0	0	0	0.0
Occurred during weekday peak periods **		0	1	1	0	2	0.6
Wet or icy pavement conditions		0	2	0	0	2	0.6
Dark conditions (lit or unlit)		0	1	1	0	2	0.6

* 2017 data available for first 3 month only.

** Peak periods are defined as 7:00–10:00 AM and 3:30–6:30 PM.

Table H-19
Crash Statistics: Route 1A at High Street
Wrentham Police Crash Data 2014-2017

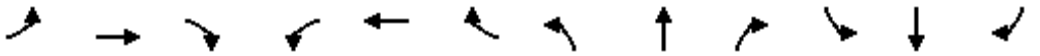
Statistics Period		2014	2015	2016	2017 *	Total	Annual Avg.
Total number of crashes		3	1	5	1	10	3.1
Severity	Property damage only	0	0	2	0	2	0.6
	Non-fatal injury	1	1	3	0	5	1.5
	Fatality	0	0	0	0	0	0.0
	Not reported/unknown	2	0	0	1	3	0.9
Collision type	Single vehicle	0	1	1	0	2	0.6
	Rear-end	1	0	3	0	4	1.2
	Angle	2	0	0	0	2	0.6
	Sideswipe, same direction	0	0	0	0	0	0.0
	Sideswipe, opposite direction	0	0	0	0	0	0.0
	Head-on	0	0	0	0	0	0.0
	Rear-to-rear	0	0	0	1	1	0.3
	Not reported/unknown	0	0	1	0	1	0.3
Involved pedestrian(s)		0	0	0	0	0	0.0
Involved cyclist(s)		0	0	0	0	0	0.0
Occurred during weekday peak periods **		1	0	0	1	2	0.6
Wet or icy pavement conditions		0	0	2	1	3	0.9
Dark conditions (lit or unlit)		0	1	2	1	4	1.2

* 2017 data available for first 3 month only.

** Peak periods are defined as 7:00–10:00 AM and 3:30–6:30 PM.

APPENDIX I

Intersection Capacity Analyses, 2040 Weekday AM/PM Peak Hour
Wrentham Common Improvement Plan A



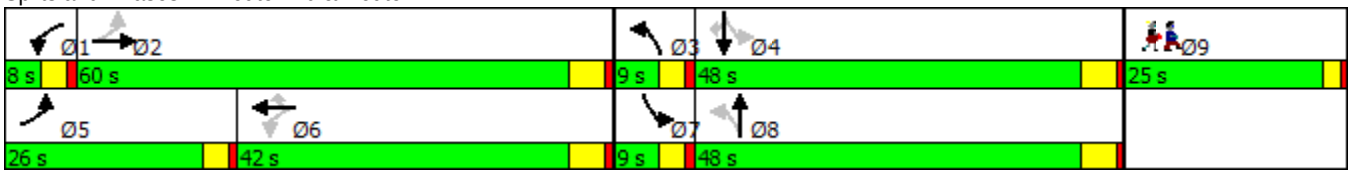
Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	224	455	5	30	153	37	21	359	75	89	389	240
Future Volume (vph)	224	455	5	30	153	37	21	359	75	89	389	240
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Storage Length (ft)	200		0	100		75	200		0	100		200
Storage Lanes	1		0	1		1	1		0	1		1
Taper Length (ft)	100			25			25			25		
Right Turn on Red			Yes			Yes			Yes			Yes
Link Speed (mph)		30			30			30			30	
Link Distance (ft)		463			568			368			1055	
Travel Time (s)		10.5			12.9			8.4			24.0	
Confl. Peds. (#/hr)	7		9	10		12	4		6	1		3
Peak Hour Factor	0.83	0.83	0.83	0.83	0.83	0.83	0.80	0.80	0.80	0.94	0.94	0.94
Growth Factor	112%	112%	112%	112%	112%	112%	112%	112%	112%	112%	112%	112%
Heavy Vehicles (%)	7%	7%	7%	18%	18%	18%	3%	3%	3%	5%	5%	5%
Shared Lane Traffic (%)												
Lane Group Flow (vph)	302	621	0	40	206	50	29	608	0	106	463	286
Turn Type	pm+pt	NA		pm+pt	NA	Perm	pm+pt	NA		pm+pt	NA	Perm
Protected Phases	5	2		1	6		3	8		7	4	
Permitted Phases	2			6		6	8			4		4
Detector Phase	5	2		1	6	6	3	8		7	4	4
Switch Phase												
Minimum Initial (s)	5.0	10.0		4.0	10.0	10.0	5.0	10.0		5.0	10.0	10.0
Minimum Split (s)	9.0	15.0		8.0	15.0	15.0	9.0	15.0		9.0	17.0	17.0
Total Split (s)	26.0	60.0		8.0	42.0	42.0	9.0	48.0		9.0	48.0	48.0
Total Split (%)	17.3%	40.0%		5.3%	28.0%	28.0%	6.0%	32.0%		6.0%	32.0%	32.0%
Yellow Time (s)	3.0	4.0		3.0	4.0	4.0	3.0	4.0		3.0	4.0	4.0
All-Red Time (s)	1.0	1.0		1.0	1.0	1.0	1.0	1.0		1.0	1.0	1.0
Lost Time Adjust (s)	0.0	0.0		0.0	0.0	0.0	0.0	0.0		0.0	0.0	0.0
Total Lost Time (s)	4.0	5.0		4.0	5.0	5.0	4.0	5.0		4.0	5.0	5.0
Lead/Lag	Lead	Lag		Lead	Lag	Lag	Lead	Lag		Lead	Lag	Lag
Lead-Lag Optimize?	Yes			Yes			Yes	Yes		Yes	Yes	Yes
Recall Mode	None	None		None	Min	Min	None	None		None	None	None
Act Effct Green (s)	56.5	49.3		37.5	32.4	32.4	49.8	43.7		51.6	47.8	47.8
Actuated g/C Ratio	0.46	0.40		0.31	0.27	0.27	0.41	0.36		0.42	0.39	0.39
v/c Ratio	0.60	0.87		0.32	0.48	0.11	0.11	0.94		0.82	0.65	0.41
Control Delay	27.6	47.9		28.5	42.9	0.5	25.7	63.8		72.1	40.0	13.9
Queue Delay	1.7	19.3		0.0	0.0	0.0	0.0	0.0		0.0	0.0	0.0
Total Delay	29.3	67.2		28.5	42.9	0.5	25.7	63.8		72.1	40.0	13.9
LOS	C	E		C	D	A	C	E		E	D	B
Approach Delay		54.8			33.8			62.0			35.3	
Approach LOS		D			C			E			D	
Queue Length 50th (ft)	141	425		16	130	0	13	466		50	318	54
Queue Length 95th (ft)	249	#693		42	230	0	36	#751		#190	#609	166
Internal Link Dist (ft)		383			488			288			975	
Turn Bay Length (ft)	200			100		75	200			100		200
Base Capacity (vph)	527	811		126	499	491	259	644		129	709	700
Starvation Cap Reductn	103	194		0	0	0	0	0		0	0	0
Spillback Cap Reductn	0	0		0	0	0	0	0		0	0	0

Lane Group	Ø9
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)	
Confl. Peds. (#/hr)	
Peak Hour Factor	
Growth Factor	
Heavy Vehicles (%)	
Shared Lane Traffic (%)	
Lane Group Flow (vph)	
Turn Type	
Protected Phases	9
Permitted Phases	
Detector Phase	
Switch Phase	
Minimum Initial (s)	5.0
Minimum Split (s)	25.0
Total Split (s)	25.0
Total Split (%)	17%
Yellow Time (s)	2.0
All-Red Time (s)	1.0
Lost Time Adjust (s)	
Total Lost Time (s)	
Lead/Lag	
Lead-Lag Optimize?	
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	

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Storage Cap Reductn	0	0		0	0	0	0	0		0	0	0
Reduced v/c Ratio	0.71	1.01		0.32	0.41	0.10	0.11	0.94		0.82	0.65	0.41

Intersection Summary			
Area Type:	Other		
Cycle Length: 150			
Actuated Cycle Length: 122			
Natural Cycle: 150			
Control Type: Actuated-Uncoordinated			
Maximum v/c Ratio: 0.94			
Intersection Signal Delay: 48.0		Intersection LOS: D	
Intersection Capacity Utilization 77.4%		ICU Level of Service D	
Analysis Period (min) 15			
# 95th percentile volume exceeds capacity, queue may be longer.			
Queue shown is maximum after two cycles.			

Splits and Phases: Route 140 & Route 1A



Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	168	218	10	75	412	83	115	412	54	56	383	251
Future Volume (vph)	168	218	10	75	412	83	115	412	54	56	383	251
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Storage Length (ft)	200		0	100		75	200		0	100		200
Storage Lanes	1		0	1		1	1		0	1		1
Taper Length (ft)	100			25			25			25		
Right Turn on Red			Yes			Yes			Yes			Yes
Link Speed (mph)		30			30			30			30	
Link Distance (ft)		463			568			368			1055	
Travel Time (s)		10.5			12.9			8.4			24.0	
Confl. Peds. (#/hr)	6					6	2					2
Peak Hour Factor	0.85	0.85	0.85	0.85	0.85	0.85	0.92	0.92	0.92	0.84	0.84	0.84
Growth Factor	112%	112%	112%	112%	112%	112%	112%	112%	112%	112%	112%	112%
Heavy Vehicles (%)	2%	2%	2%	2%	2%	2%	1%	1%	1%	2%	2%	2%
Shared Lane Traffic (%)												
Lane Group Flow (vph)	221	300	0	99	543	109	140	568	0	75	511	335
Turn Type	pm+pt	NA		pm+pt	NA	Perm	pm+pt	NA		pm+pt	NA	Perm
Protected Phases	5	2		1	6		3	8		7	4	
Permitted Phases	2			6		6	8			4		4
Detector Phase	5	2		1	6	6	3	8		7	4	4
Switch Phase												
Minimum Initial (s)	5.0	10.0		5.0	10.0	10.0	5.0	10.0		5.0	10.0	10.0
Minimum Split (s)	9.0	15.0		9.0	15.0	15.0	9.0	15.0		9.0	15.0	15.0
Total Split (s)	17.0	57.0		10.0	50.0	50.0	10.0	49.0		9.0	48.0	48.0
Total Split (%)	11.3%	38.0%		6.7%	33.3%	33.3%	6.7%	32.7%		6.0%	32.0%	32.0%
Yellow Time (s)	3.0	4.0		3.0	4.0	4.0	3.0	4.0		3.0	4.0	4.0
All-Red Time (s)	1.0	1.0		1.0	1.0	1.0	1.0	1.0		1.0	1.0	1.0
Lost Time Adjust (s)	0.0	0.0		0.0	0.0	0.0	0.0	0.0		0.0	0.0	0.0
Total Lost Time (s)	4.0	5.0		4.0	5.0	5.0	4.0	5.0		4.0	5.0	5.0
Lead/Lag	Lead	Lag		Lead	Lag	Lag	Lead	Lag		Lead	Lag	Lag
Lead-Lag Optimize?	Yes			Yes			Yes	Yes		Yes	Yes	Yes
Recall Mode	None	None		None	Min	Min	None	None		None	None	None
Act Effct Green (s)	61.3	50.3		50.3	43.2	43.2	51.3	44.2		49.3	43.2	43.2
Actuated g/C Ratio	0.48	0.40		0.40	0.34	0.34	0.40	0.35		0.39	0.34	0.34
v/c Ratio	0.86	0.41		0.23	0.86	0.18	0.76	0.88		0.55	0.81	0.51
Control Delay	57.4	30.7		22.1	54.3	4.8	53.7	56.1		42.1	50.7	17.1
Queue Delay	0.0	1.2		0.0	0.0	0.0	0.0	0.0		0.0	0.0	0.0
Total Delay	57.4	31.9		22.1	54.3	4.8	53.7	56.1		42.1	50.7	17.1
LOS	E	C		C	D	A	D	E		D	D	B
Approach Delay		42.7			42.9			55.6			37.8	
Approach LOS		D			D			E			D	
Queue Length 50th (ft)	108	166		41	394	0	69	424		35	372	81
Queue Length 95th (ft)	#286	286		90	#663	28	#201	#804		#84	#613	179
Internal Link Dist (ft)		383			488			288			975	
Turn Bay Length (ft)	200			100		75	200			100		200
Base Capacity (vph)	256	760		425	661	625	184	645		136	632	656
Starvation Cap Reductn	0	263		0	0	0	0	0		0	0	0
Spillback Cap Reductn	0	0		0	0	0	0	0		0	0	0

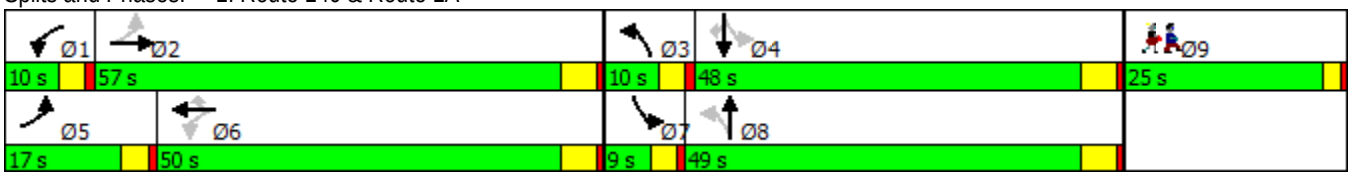
Lane Group	Ø9
Lane Configurations	
Traffic Volume (vph)	
Future Volume (vph)	
Ideal Flow (vphpl)	
Storage Length (ft)	
Storage Lanes	
Taper Length (ft)	
Right Turn on Red	
Link Speed (mph)	
Link Distance (ft)	
Travel Time (s)	
Confl. Peds. (#/hr)	
Peak Hour Factor	
Growth Factor	
Heavy Vehicles (%)	
Shared Lane Traffic (%)	
Lane Group Flow (vph)	
Turn Type	
Protected Phases	9
Permitted Phases	
Detector Phase	
Switch Phase	
Minimum Initial (s)	5.0
Minimum Split (s)	25.0
Total Split (s)	25.0
Total Split (%)	17%
Yellow Time (s)	2.0
All-Red Time (s)	1.0
Lost Time Adjust (s)	
Total Lost Time (s)	
Lead/Lag	
Lead-Lag Optimize?	
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	

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Storage Cap Reductn	0	0		0	0	0	0	0		0	0	0
Reduced v/c Ratio	0.86	0.60		0.23	0.82	0.17	0.76	0.88		0.55	0.81	0.51

Intersection Summary			
Area Type:	Other		
Cycle Length: 150			
Actuated Cycle Length: 127.3			
Natural Cycle: 150			
Control Type: Actuated-Uncoordinated			
Maximum v/c Ratio: 0.88			
Intersection Signal Delay: 44.3		Intersection LOS: D	
Intersection Capacity Utilization 81.8%		ICU Level of Service D	
Analysis Period (min) 15			

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

Splits and Phases: 1: Route 140 & Route 1A



Intersection Capacity Analysis
Common St & Route 1A & Kendrick St

09/26/2017

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	SBL	SBR	NWL	NWR	NWR2	Ø9
Lane Configurations												
Traffic Volume (vph)	56	642	241	29	382	5	0	0	71	7	29	
Future Volume (vph)	56	642	241	29	382	5	0	0	71	7	29	
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	
Storage Length (ft)	0		100	50		0	0	0	0	50		
Storage Lanes	1		0	1		0	0	0	1	1		
Taper Length (ft)	0			25			0		0			
Right Turn on Red			Yes			Yes		Yes			Yes	
Link Speed (mph)		30			30		30		30			
Link Distance (ft)		338			463		659		592			
Travel Time (s)		7.7			10.5		15.0		13.5			
Confl. Peds. (#/hr)			1	1		7			5			
Peak Hour Factor	0.89	0.89	0.89	0.83	0.83	0.83	0.25	0.25	0.92	0.92	0.92	
Growth Factor	112%	112%	112%	112%	112%	112%	112%	112%	112%	112%	112%	
Heavy Vehicles (%)	5%	5%	5%	10%	10%	10%	0%	0%	2%	2%	2%	
Shared Lane Traffic (%)											10%	
Lane Group Flow (vph)	70	1111	0	39	522	0	0	0	99	0	31	
Turn Type	Perm	NA		Perm	NA				Prot		Perm	
Protected Phases		2			6				3			9
Permitted Phases	2			6							2	
Detector Phase	2	2		6	6				3		2	
Switch Phase												
Minimum Initial (s)	5.0	5.0		5.0	5.0				5.0		5.0	5.0
Minimum Split (s)	10.0	10.0		10.0	10.0				10.0		10.0	25.0
Total Split (s)	65.0	65.0		65.0	65.0				10.0		65.0	25.0
Total Split (%)	65.0%	65.0%		65.0%	65.0%				10.0%		65.0%	25%
Yellow Time (s)	4.0	4.0		4.0	4.0				4.0		4.0	2.0
All-Red Time (s)	1.0	1.0		1.0	1.0				1.0		1.0	1.0
Lost Time Adjust (s)	0.0	0.0		0.0	0.0				0.0		0.0	
Total Lost Time (s)	5.0	5.0		5.0	5.0				5.0		5.0	
Lead/Lag												
Lead-Lag Optimize?												
Recall Mode	Min	Min		None	None				Min		Min	None
Act Effct Green (s)	60.6	60.6		60.6	60.6				5.0		60.6	
Actuated g/C Ratio	0.77	0.77		0.77	0.77				0.06		0.77	
v/c Ratio	0.11	0.84		0.21	0.40				0.61		0.03	
Control Delay	4.6	15.8		8.1	5.5				37.6		0.9	
Queue Delay	0.0	0.0		0.0	0.5				0.0		0.0	
Total Delay	4.6	15.8		8.1	6.0				37.6		0.9	
LOS	A	B		A	A				D		A	
Approach Delay		15.2			6.2				28.9			
Approach LOS		B			A				C			
Queue Length 50th (ft)	5	186		3	47				20		0	
Queue Length 95th (ft)	35	#946		27	204				#104		5	
Internal Link Dist (ft)		258			383		579		512			
Turn Bay Length (ft)				50							50	
Base Capacity (vph)	613	1327		187	1318				162		1163	
Starvation Cap Reductn	0	0		0	408				0		0	
Spillback Cap Reductn	0	0		0	0				0		0	

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	SBL	SBR	NWL	NWR	NWR2	Ø9
Storage Cap Reductn	0	0		0	0				0		0	
Reduced v/c Ratio	0.11	0.84		0.21	0.57				0.61		0.03	

Intersection Summary			
Area Type:	Other		
Cycle Length: 100			
Actuated Cycle Length: 79.2			
Natural Cycle: 100			
Control Type: Actuated-Uncoordinated			
Maximum v/c Ratio: 0.84			
Intersection Signal Delay: 13.4		Intersection LOS: B	
Intersection Capacity Utilization 68.2%		ICU Level of Service C	
Analysis Period (min) 15			

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

Splits and Phases: 2: Common St & Route 1A & Kendrick St

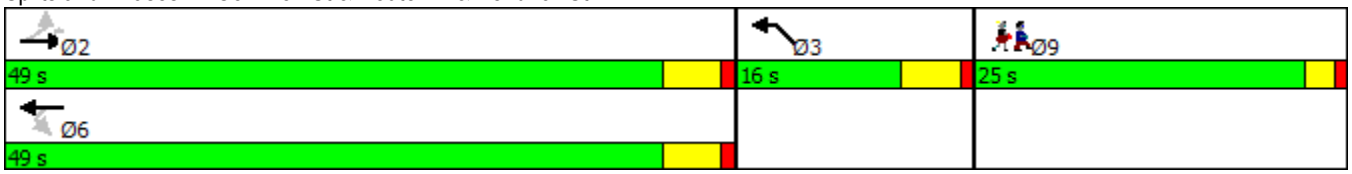
Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	SBL	SBR	NWL	NWR	NWR2	Ø9
Lane Configurations												
Traffic Volume (vph)	15	400	214	15	762	13	0	0	215	3	9	
Future Volume (vph)	15	400	214	15	762	13	0	0	215	3	9	
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	
Storage Length (ft)	0		100	50		0	0	0	0	50		
Storage Lanes	1		0	1		0	0	0	1	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)		338			463		659		592			
Travel Time (s)		7.7			10.5		15.0		13.5			
Confl. Peds. (#/hr)	23		10	10		23			4			
Peak Hour Factor	0.93	0.93	0.93	0.91	0.91	0.91	0.92	0.92	0.89	0.89	0.89	
Growth Factor	112%	112%	112%	112%	112%	112%	112%	112%	112%	112%	112%	
Heavy Vehicles (%)	1%	1%	1%	1%	1%	1%	2%	2%	1%	1%	1%	
Shared Lane Traffic (%)											10%	
Lane Group Flow (vph)	18	740	0	18	954	0	0	0	276	0	10	
Turn Type	Perm	NA		Perm	NA				Prot		Perm	
Protected Phases		2			6				3			9
Permitted Phases	2			6							2	
Detector Phase	2	2		6	6				3		2	
Switch Phase												
Minimum Initial (s)	5.0	5.0		5.0	5.0				5.0		5.0	5.0
Minimum Split (s)	10.0	10.0		10.0	10.0				10.0		10.0	25.0
Total Split (s)	49.0	49.0		49.0	49.0				16.0		49.0	25.0
Total Split (%)	54.4%	54.4%		54.4%	54.4%				17.8%		54.4%	28%
Yellow Time (s)	4.0	4.0		4.0	4.0				4.0		4.0	2.0
All-Red Time (s)	1.0	1.0		1.0	1.0				1.0		1.0	1.0
Lost Time Adjust (s)	0.0	0.0		0.0	0.0				0.0		0.0	
Total Lost Time (s)	5.0	5.0		5.0	5.0				5.0		5.0	
Lead/Lag												
Lead-Lag Optimize?												
Recall Mode	Min	Min		None	None				Min		Min	None
Act Effct Green (s)	44.6	44.6		44.6	44.6				11.1		44.6	
Actuated g/C Ratio	0.64	0.64		0.64	0.64				0.16		0.64	
v/c Ratio	0.11	0.64		0.06	0.79				0.81		0.01	
Control Delay	9.7	12.4		7.8	17.8				44.2		0.0	
Queue Delay	0.0	0.0		0.0	4.3				0.0		0.0	
Total Delay	9.7	12.4		7.8	22.1				44.2		0.0	
LOS	A	B		A	C				D		A	
Approach Delay		12.3			21.8				42.7			
Approach LOS		B			C				D			
Queue Length 50th (ft)	2	123		2	203				82		0	
Queue Length 95th (ft)	18	#468		16	#775				#270		0	
Internal Link Dist (ft)		258			383		579		512			
Turn Bay Length (ft)				50							50	
Base Capacity (vph)	163	1151		320	1206				339		999	
Starvation Cap Reductn	0	0		0	182				0		0	
Spillback Cap Reductn	0	0		0	0				0		0	

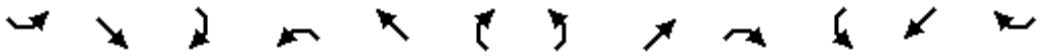
Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	SBL	SBR	NWL	NWR	NWR2	Ø9
Storage Cap Reductn	0	0		0	0				0		0	
Reduced v/c Ratio	0.11	0.64		0.06	0.93				0.81		0.01	

Intersection Summary			
Area Type:	Other		
Cycle Length: 90			
Actuated Cycle Length: 69.2			
Natural Cycle: 90			
Control Type: Actuated-Uncoordinated			
Maximum v/c Ratio: 0.81			
Intersection Signal Delay: 21.2		Intersection LOS: C	
Intersection Capacity Utilization 67.9%		ICU Level of Service C	
Analysis Period (min) 15			

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

Splits and Phases: Common St & Route 1A & Kendrick St

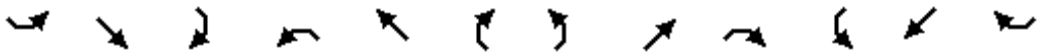




Movement	SEL	SET	SER	NWL	NWT	NWR	NEL	NET	NER	SWL	SWT	SWR
Lane Configurations												
Sign Control		Stop			Stop			Stop			Stop	
Traffic Volume (vph)	6	180	125	79	70	0	53	179	73	0	176	1
Future Volume (vph)	6	180	125	79	70	0	53	179	73	0	176	1
Peak Hour Factor	0.81	0.81	0.81	0.80	0.80	0.80	0.88	0.88	0.88	0.84	0.84	0.84
Hourly flow rate (vph)	8	249	173	111	98	0	67	228	93	0	235	1

Direction, Lane #	SE 1	NW 1	NE 1	SW 1
Volume Total (vph)	430	209	388	236
Volume Left (vph)	8	111	67	0
Volume Right (vph)	173	0	93	1
Hadj (s)	-0.15	0.16	-0.06	0.20
Departure Headway (s)	6.6	7.5	6.8	7.5
Degree Utilization, x	0.79	0.44	0.73	0.49
Capacity (veh/h)	430	411	496	422
Control Delay (s)	30.0	16.2	26.2	17.5
Approach Delay (s)	30.0	16.2	26.2	17.5
Approach LOS	D	C	D	C

Intersection Summary				
Delay		24.2		
Level of Service		C		
Intersection Capacity Utilization		71.1%	ICU Level of Service	C
Analysis Period (min)		15		



Movement	SEL	SET	SER	NWL	NWT	NWR	NEL	NET	NER	SWL	SWT	SWR
Lane Configurations												
Sign Control		Stop			Stop			Stop			Stop	
Traffic Volume (vph)	9	188	72	66	187	2	35	151	53	1	216	2
Future Volume (vph)	9	188	72	66	187	2	35	151	53	1	216	2
Peak Hour Factor	0.91	0.91	0.91	0.87	0.87	0.87	0.89	0.89	0.89	0.90	0.90	0.90
Hourly flow rate (vph)	11	231	89	85	241	3	44	190	67	1	269	2

Direction, Lane #	SE 1	NW 1	NE 1	SW 1
Volume Total (vph)	331	329	301	272
Volume Left (vph)	11	85	44	1
Volume Right (vph)	89	3	67	2
Hadj (s)	-0.14	0.08	-0.07	0.03
Departure Headway (s)	6.7	6.9	6.9	7.1
Degree Utilization, x	0.62	0.63	0.58	0.54
Capacity (veh/h)	490	473	470	453
Control Delay (s)	19.9	21.0	18.9	18.0
Approach Delay (s)	19.9	21.0	18.9	18.0
Approach LOS	C	C	C	C

Intersection Summary				
Delay	19.6			
Level of Service	C			
Intersection Capacity Utilization	72.8%	ICU Level of Service	C	
Analysis Period (min)	15			

Movement	NBL	NBT	SBT	SBR	SEL	SER
Lane Configurations						
Traffic Volume (veh/h)	149	270	247	0	0	253
Future Volume (Veh/h)	149	270	247	0	0	253
Sign Control		Free	Free		Stop	
Grade		0%	0%		0%	
Peak Hour Factor	0.80	0.80	0.94	0.25	0.25	0.81
Hourly flow rate (vph)	209	378	294	0	0	350
Pedestrians						
Lane Width (ft)						
Walking Speed (ft/s)						
Percent Blockage						
Right turn flare (veh)						
Median type		None	None			
Median storage veh)						
Upstream signal (ft)			809			
pX, platoon unblocked						
vC, conflicting volume	294				1090	294
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	294				1090	294
tC, single (s)	4.1				6.4	6.2
tC, 2 stage (s)						
tF (s)	2.2				3.5	3.3
p0 queue free %	83				100	53
cM capacity (veh/h)	1262				200	738

Direction, Lane #	NB 1	NB 2	SB 1	SE 1
Volume Total	209	378	294	350
Volume Left	209	0	0	0
Volume Right	0	0	0	350
cSH	1262	1700	1700	738
Volume to Capacity	0.17	0.22	0.17	0.47
Queue Length 95th (ft)	15	0	0	64
Control Delay (s)	8.4	0.0	0.0	14.2
Lane LOS	A			B
Approach Delay (s)	3.0		0.0	14.2
Approach LOS				B

Intersection Summary			
Average Delay	5.5		
Intersection Capacity Utilization	38.8%	ICU Level of Service	A
Analysis Period (min)	15		

Movement	NBL	NBT	SBT	SBR	SEL	SER
Lane Configurations						
Traffic Volume (veh/h)	255	419	249	0	0	242
Future Volume (Veh/h)	255	419	249	0	0	242
Sign Control		Free	Free		Stop	
Grade		0%	0%		0%	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	310	510	303	0	0	295
Pedestrians						
Lane Width (ft)						
Walking Speed (ft/s)						
Percent Blockage						
Right turn flare (veh)						
Median type		None	None			
Median storage veh)						
Upstream signal (ft)			809			
pX, platoon unblocked						
vC, conflicting volume	303				1433	303
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	303				1433	303
tC, single (s)	4.1				6.4	6.2
tC, 2 stage (s)						
tF (s)	2.2				3.5	3.3
p0 queue free %	75				100	60
cM capacity (veh/h)	1258				111	737

Direction, Lane #	NB 1	NB 2	SB 1	SE 1
Volume Total	310	510	303	295
Volume Left	310	0	0	0
Volume Right	0	0	0	295
cSH	1258	1700	1700	737
Volume to Capacity	0.25	0.30	0.18	0.40
Queue Length 95th (ft)	24	0	0	48
Control Delay (s)	8.8	0.0	0.0	13.1
Lane LOS	A			B
Approach Delay (s)	3.3		0.0	13.1
Approach LOS				B

Intersection Summary			
Average Delay	4.7		
Intersection Capacity Utilization	38.1%	ICU Level of Service	A
Analysis Period (min)	15		

Movement	NBL	NBT	SBT	SBR	NEL	NER
Lane Configurations						
Traffic Volume (veh/h)	0	270	247	177	185	10
Future Volume (Veh/h)	0	270	247	177	185	10
Sign Control		Free	Free		Stop	
Grade		0%	0%		0%	
Peak Hour Factor	0.25	0.80	0.94	0.84	0.88	0.25
Hourly flow rate (vph)	0	378	294	236	235	45
Pedestrians						
Lane Width (ft)						
Walking Speed (ft/s)						
Percent Blockage						
Right turn flare (veh)						
Median type		None	None			
Median storage veh)						
Upstream signal (ft)			368			
pX, platoon unblocked	0.78				0.78	0.78
vC, conflicting volume	530				790	412
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	261				593	111
tC, single (s)	4.1				6.4	6.2
tC, 2 stage (s)						
tF (s)	2.2				3.5	3.3
p0 queue free %	100				36	94
cM capacity (veh/h)	1030				365	743

Direction, Lane #	NB 1	SB 1	NE 1
Volume Total	378	530	280
Volume Left	0	0	235
Volume Right	0	236	45
cSH	1700	1700	398
Volume to Capacity	0.22	0.31	0.70
Queue Length 95th (ft)	0	0	131
Control Delay (s)	0.0	0.0	32.9
Lane LOS			D
Approach Delay (s)	0.0	0.0	32.9
Approach LOS			D

Intersection Summary			
Average Delay	7.8		
Intersection Capacity Utilization	45.5%	ICU Level of Service	A
Analysis Period (min)	15		

HCM Unsignalized Intersection Capacity Analysis

David Brown's Way & Route 140

09/26/2017

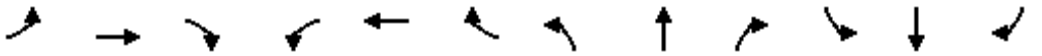
Movement	NBL	NBT	SBT	SBR	NEL	NER
Lane Configurations						
Traffic Volume (veh/h)	0	419	249	219	162	5
Future Volume (Veh/h)	0	419	249	219	162	5
Sign Control		Free	Free		Stop	
Grade		0%	0%		0%	
Peak Hour Factor	0.88	0.88	0.88	0.88	0.88	0.88
Hourly flow rate (vph)	0	533	317	279	206	6
Pedestrians						
Lane Width (ft)						
Walking Speed (ft/s)						
Percent Blockage						
Right turn flare (veh)						
Median type		None	None			
Median storage veh)						
Upstream signal (ft)			368			
pX, platoon unblocked	0.72				0.72	0.72
vC, conflicting volume	596				990	456
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	240				789	46
tC, single (s)	4.1				6.4	6.2
tC, 2 stage (s)						
tF (s)	2.2				3.5	3.3
p0 queue free %	100				20	99
cM capacity (veh/h)	956				259	737

Direction, Lane #	NB 1	SB 1	NE 1
Volume Total	533	596	212
Volume Left	0	0	206
Volume Right	0	279	6
cSH	1700	1700	264
Volume to Capacity	0.31	0.35	0.80
Queue Length 95th (ft)	0	0	156
Control Delay (s)	0.0	0.0	57.4
Lane LOS			F
Approach Delay (s)	0.0	0.0	57.4
Approach LOS			F

Intersection Summary			
Average Delay	9.1		
Intersection Capacity Utilization	46.7%	ICU Level of Service	A
Analysis Period (min)	15		

APPENDIX J

Intersection Capacity Analyses, 2040 Weekday AM/PM Peak Hour
Wrentham Common Improvement Plan B



Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	224	455	5	30	153	37	21	359	75	89	389	240
Future Volume (vph)	224	455	5	30	153	37	21	359	75	89	389	240
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Storage Length (ft)	200		0	100		75	250		0	100		200
Storage Lanes	1		0	1		1	1		0	1		1
Taper Length (ft)	100			25			25			25		
Right Turn on Red			Yes			Yes			Yes			Yes
Link Speed (mph)		30			30			30			30	
Link Distance (ft)		463			568			303			1055	
Travel Time (s)		10.5			12.9			6.9			24.0	
Confl. Peds. (#/hr)	7		9	10		12	4		6	1		3
Peak Hour Factor	0.83	0.83	0.83	0.83	0.83	0.83	0.80	0.80	0.80	0.94	0.94	0.94
Growth Factor	112%	112%	112%	112%	112%	112%	112%	112%	112%	112%	112%	112%
Heavy Vehicles (%)	7%	7%	7%	18%	18%	18%	3%	3%	3%	5%	5%	5%
Shared Lane Traffic (%)												
Lane Group Flow (vph)	302	621	0	40	206	50	29	608	0	106	463	286
Turn Type	pm+pt	NA		pm+pt	NA	Perm	pm+pt	NA		pm+pt	NA	Perm
Protected Phases	5	2		1	6		3	8		7	4	
Permitted Phases	2			6		6	8			4		4
Detector Phase	5	2		1	6	6	3	8		7	4	4
Switch Phase												
Minimum Initial (s)	5.0	10.0		3.0	10.0	10.0	5.0	10.0		5.0	10.0	10.0
Minimum Split (s)	9.0	15.0		7.0	15.0	15.0	9.0	15.0		9.0	15.0	15.0
Total Split (s)	20.0	60.0		7.0	47.0	47.0	9.0	49.0		9.0	49.0	49.0
Total Split (%)	13.3%	40.0%		4.7%	31.3%	31.3%	6.0%	32.7%		6.0%	32.7%	32.7%
Yellow Time (s)	3.0	4.0		3.0	4.0	4.0	3.0	4.0		3.0	4.0	4.0
All-Red Time (s)	1.0	1.0		1.0	1.0	1.0	1.0	1.0		1.0	1.0	1.0
Lost Time Adjust (s)	0.0	0.0		0.0	0.0	0.0	0.0	0.0		0.0	0.0	0.0
Total Lost Time (s)	4.0	5.0		4.0	5.0	5.0	4.0	5.0		4.0	5.0	5.0
Lead/Lag	Lead	Lag		Lead	Lag	Lag	Lead	Lag		Lead	Lag	Lag
Lead-Lag Optimize?	Yes			Yes			Yes	Yes		Yes	Yes	Yes
Recall Mode	None	None		None	Min	Min	None	None		None	None	None
Act Effct Green (s)	55.8	49.4		38.8	34.8	34.8	50.8	44.7		52.6	48.8	48.8
Actuated g/C Ratio	0.46	0.40		0.32	0.28	0.28	0.42	0.37		0.43	0.40	0.40
v/c Ratio	0.63	0.87		0.35	0.45	0.11	0.11	0.93		0.79	0.64	0.40
Control Delay	29.6	48.0		31.9	39.7	0.5	25.0	60.0		64.6	39.0	13.4
Queue Delay	3.5	20.1		0.0	0.0	0.0	0.0	0.0		0.0	0.0	0.0
Total Delay	33.1	68.2		31.9	39.7	0.5	25.0	60.0		64.6	39.0	13.4
LOS	C	E		C	D	A	C	E		E	D	B
Approach Delay		56.7			32.0			58.4			33.6	
Approach LOS		E			C			E			C	
Queue Length 50th (ft)	143	425		16	126	0	13	460		49	314	52
Queue Length 95th (ft)	253	#693		43	219	0	36	#738		#179	#596	162
Internal Link Dist (ft)		383			488			223			975	
Turn Bay Length (ft)	200			100		75	250			100		200
Base Capacity (vph)	485	809		113	561	538	268	657		135	721	711
Starvation Cap Reductn	106	194		0	0	0	0	0		0	0	0
Spillback Cap Reductn	0	0		0	0	0	0	0		0	0	0

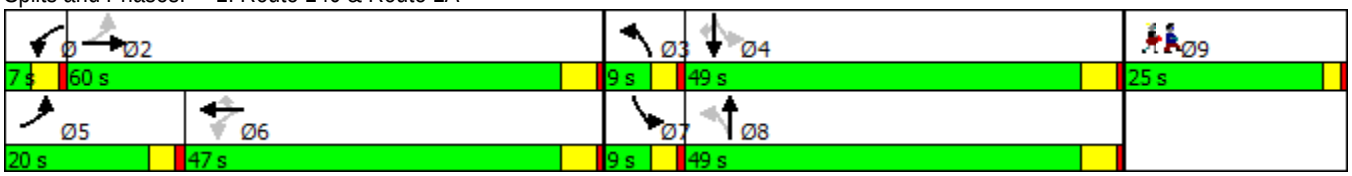
Lane Group	Ø9
Lane Configurations	
Traffic Volume (vph)	
Future Volume (vph)	
Ideal Flow (vphpl)	
Storage Length (ft)	
Storage Lanes	
Taper Length (ft)	
Right Turn on Red	
Link Speed (mph)	
Link Distance (ft)	
Travel Time (s)	
Confl. Peds. (#/hr)	
Peak Hour Factor	
Growth Factor	
Heavy Vehicles (%)	
Shared Lane Traffic (%)	
Lane Group Flow (vph)	
Turn Type	
Protected Phases	9
Permitted Phases	
Detector Phase	
Switch Phase	
Minimum Initial (s)	5.0
Minimum Split (s)	25.0
Total Split (s)	25.0
Total Split (%)	17%
Yellow Time (s)	2.0
All-Red Time (s)	1.0
Lost Time Adjust (s)	
Total Lost Time (s)	
Lead/Lag	
Lead-Lag Optimize?	
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	

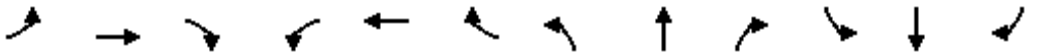
Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Storage Cap Reductn	0	0		0	0	0	0	0		0	0	0
Reduced v/c Ratio	0.80	1.01		0.35	0.37	0.09	0.11	0.93		0.79	0.64	0.40

Intersection Summary			
Area Type:	Other		
Cycle Length: 150			
Actuated Cycle Length: 122.3			
Natural Cycle: 150			
Control Type: Actuated-Uncoordinated			
Maximum v/c Ratio: 0.93			
Intersection Signal Delay: 47.1		Intersection LOS: D	
Intersection Capacity Utilization 77.4%		ICU Level of Service D	
Analysis Period (min) 15			

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

Splits and Phases: 1: Route 140 & Route 1A





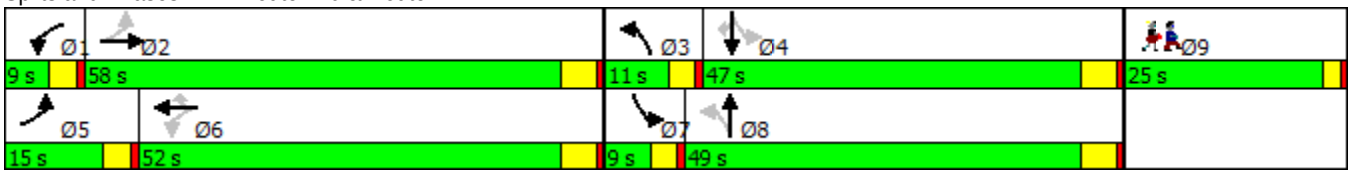
Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	168	218	10	75	412	83	115	412	54	56	383	251
Future Volume (vph)	168	218	10	75	412	83	115	412	54	56	383	251
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Storage Length (ft)	200		0	100		75	250		0	100		200
Storage Lanes	1		0	1		1	1		0	1		1
Taper Length (ft)	100			25			25			25		
Right Turn on Red			Yes			Yes			Yes			Yes
Link Speed (mph)		30			30			30			30	
Link Distance (ft)		463			568			274			1055	
Travel Time (s)		10.5			12.9			6.2			24.0	
Confl. Peds. (#/hr)	6					6	2					2
Peak Hour Factor	0.85	0.85	0.85	0.85	0.85	0.85	0.92	0.92	0.92	0.84	0.84	0.84
Growth Factor	112%	112%	112%	112%	112%	112%	112%	112%	112%	112%	112%	112%
Heavy Vehicles (%)	2%	2%	2%	2%	2%	2%	1%	1%	1%	2%	2%	2%
Shared Lane Traffic (%)												
Lane Group Flow (vph)	221	300	0	99	543	109	140	568	0	75	511	335
Turn Type	pm+pt	NA		pm+pt	NA	Perm	pm+pt	NA		pm+pt	NA	Perm
Protected Phases	5	2		1	6		3	8		7	4	
Permitted Phases	2			6		6	8			4		4
Detector Phase	5	2		1	6	6	3	8		7	4	4
Switch Phase												
Minimum Initial (s)	5.0	10.0		5.0	10.0	10.0	5.0	10.0		5.0	10.0	10.0
Minimum Split (s)	9.0	15.0		9.0	15.0	15.0	9.0	15.0		9.0	15.0	15.0
Total Split (s)	15.0	58.0		9.0	52.0	52.0	11.0	49.0		9.0	47.0	47.0
Total Split (%)	10.0%	38.7%		6.0%	34.7%	34.7%	7.3%	32.7%		6.0%	31.3%	31.3%
Yellow Time (s)	3.0	4.0		3.0	4.0	4.0	3.0	4.0		3.0	4.0	4.0
All-Red Time (s)	1.0	1.0		1.0	1.0	1.0	1.0	1.0		1.0	1.0	1.0
Lost Time Adjust (s)	0.0	0.0		0.0	0.0	0.0	0.0	0.0		0.0	0.0	0.0
Total Lost Time (s)	4.0	5.0		4.0	5.0	5.0	4.0	5.0		4.0	5.0	5.0
Lead/Lag	Lead	Lag		Lead	Lag	Lag	Lead	Lag		Lead	Lag	Lag
Lead-Lag Optimize?	Yes			Yes			Yes	Yes		Yes	Yes	Yes
Recall Mode	None	None		None	Min	Min	None	None		None	None	None
Act Effct Green (s)	58.1	48.0		48.0	41.9	41.9	52.5	44.4		48.4	42.4	42.4
Actuated g/C Ratio	0.47	0.39		0.39	0.34	0.34	0.42	0.36		0.39	0.34	0.34
v/c Ratio	0.96	0.42		0.25	0.86	0.18	0.69	0.86		0.50	0.80	0.51
Control Delay	77.2	30.5		22.8	53.8	4.6	44.2	52.1		37.5	49.9	17.4
Queue Delay	0.0	0.9		0.0	0.0	0.0	0.0	0.0		0.0	0.0	0.0
Total Delay	77.2	31.4		22.8	53.8	4.6	44.2	52.1		37.5	49.9	17.4
LOS	E	C		C	D	A	D	D		D	D	B
Approach Delay		50.8			42.6			50.6			37.0	
Approach LOS		D			D			D			D	
Queue Length 50th (ft)	109	163		41	383	0	67	415		34	368	82
Queue Length 95th (ft)	#308	283		90	#638	27	#189	#804		79	#626	183
Internal Link Dist (ft)		383			488			194			975	
Turn Bay Length (ft)	200			100		75	250			100		200
Base Capacity (vph)	231	797		403	711	663	203	663		151	635	657
Starvation Cap Reductn	0	263		0	0	0	0	0		0	0	0
Spillback Cap Reductn	0	0		0	0	0	0	0		0	0	0

Lane Group	Ø9
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)	
Confl. Peds. (#/hr)	
Peak Hour Factor	
Growth Factor	
Heavy Vehicles (%)	
Shared Lane Traffic (%)	
Lane Group Flow (vph)	
Turn Type	
Protected Phases	9
Permitted Phases	
Detector Phase	
Switch Phase	
Minimum Initial (s)	5.0
Minimum Split (s)	25.0
Total Split (s)	25.0
Total Split (%)	17%
Yellow Time (s)	2.0
All-Red Time (s)	1.0
Lost Time Adjust (s)	
Total Lost Time (s)	
Lead/Lag	
Lead-Lag Optimize?	
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	

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Storage Cap Reductn	0	0		0	0	0	0	0		0	0	0
Reduced v/c Ratio	0.96	0.56		0.25	0.76	0.16	0.69	0.86		0.50	0.80	0.51

Intersection Summary			
Area Type:	Other		
Cycle Length: 150			
Actuated Cycle Length: 124.2			
Natural Cycle: 150			
Control Type: Actuated-Uncoordinated			
Maximum v/c Ratio: 0.96			
Intersection Signal Delay: 44.3		Intersection LOS: D	
Intersection Capacity Utilization 81.8%		ICU Level of Service D	
Analysis Period (min) 15			
# 95th percentile volume exceeds capacity, queue may be longer.			
Queue shown is maximum after two cycles.			

Splits and Phases: 1: Route 140 & Route 1A



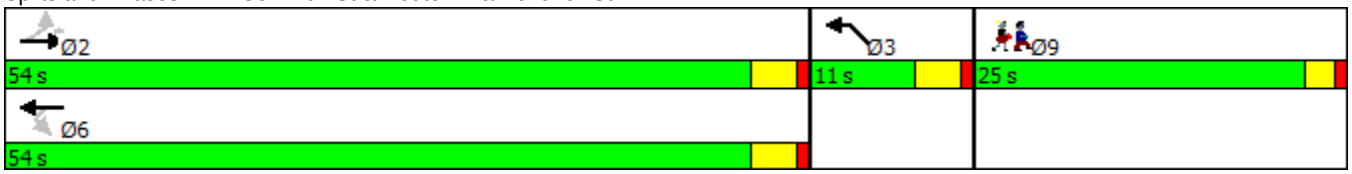
Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	SBL	SBR	NWL	NWR	NWR2	Ø9
Lane Configurations												
Traffic Volume (vph)	56	642	241	29	382	5	0	0	71	7	29	
Future Volume (vph)	56	642	241	29	382	5	0	0	71	7	29	
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	
Storage Length (ft)	50		0	50		0	0	0	0	50		
Storage Lanes	1		0	1		0	0	0	1	1		
Taper Length (ft)	0			25			0		0			
Right Turn on Red			Yes			Yes		Yes			Yes	
Link Speed (mph)		30			30		30		30			
Link Distance (ft)		338			463		659		562			
Travel Time (s)		7.7			10.5		15.0		12.8			
Confl. Peds. (#/hr)			1			7			5			
Peak Hour Factor	0.89	0.89	0.89	0.83	0.83	0.83	0.25	0.25	0.92	0.92	0.92	
Growth Factor	112%	112%	112%	112%	112%	112%	112%	112%	112%	112%	112%	
Heavy Vehicles (%)	5%	5%	5%	10%	10%	10%	0%	0%	2%	2%	2%	
Shared Lane Traffic (%)											10%	
Lane Group Flow (vph)	70	1111	0	39	522	0	0	0	99	0	31	
Turn Type	Perm	NA		Perm	NA				Prot		Perm	
Protected Phases		2			6				3			9
Permitted Phases	2			6							2	
Detector Phase	2	2		6	6				3		2	
Switch Phase												
Minimum Initial (s)	5.0	5.0		5.0	5.0				5.0		5.0	5.0
Minimum Split (s)	9.0	9.0		9.0	9.0				9.0		9.0	25.0
Total Split (s)	54.0	54.0		54.0	54.0				11.0		54.0	25.0
Total Split (%)	60.0%	60.0%		60.0%	60.0%				12.2%		60.0%	28%
Yellow Time (s)	3.0	3.0		3.0	3.0				3.0		3.0	2.0
All-Red Time (s)	1.0	1.0		1.0	1.0				1.0		1.0	1.0
Lost Time Adjust (s)	0.0	0.0		0.0	0.0				0.0		0.0	
Total Lost Time (s)	4.0	4.0		4.0	4.0				4.0		4.0	
Lead/Lag												
Lead-Lag Optimize?												
Recall Mode	Min	Min		None	None				Min		Min	None
Act Effct Green (s)	50.7	50.7		50.7	50.7				6.6		50.7	
Actuated g/C Ratio	0.74	0.74		0.74	0.74				0.10		0.74	
v/c Ratio	0.12	0.87		0.27	0.41				0.47		0.03	
Control Delay	5.2	18.6		11.7	6.2				26.9		1.4	
Queue Delay	0.0	0.0		0.0	0.4				0.0		0.0	
Total Delay	5.2	18.6		11.7	6.6				26.9		1.4	
LOS	A	B		B	A				C		A	
Approach Delay		17.8			6.9				20.8			
Approach LOS		B			A				C			
Queue Length 50th (ft)	5	186		3	47				19		0	
Queue Length 95th (ft)	36	#907		32	209				76		7	
Internal Link Dist (ft)		258			383		579		482			
Turn Bay Length (ft)	50			50							50	
Base Capacity (vph)	573	1281		147	1270				223		1121	
Starvation Cap Reductn	0	0		0	303				0		0	
Spillback Cap Reductn	0	0		0	0				0		0	

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	SBL	SBR	NWL	NWR	NWR2	Ø9
Storage Cap Reductn	0	0		0	0				0		0	
Reduced v/c Ratio	0.12	0.87		0.27	0.54				0.44		0.03	

Intersection Summary			
Area Type:	Other		
Cycle Length: 90			
Actuated Cycle Length: 68.7			
Natural Cycle: 100			
Control Type: Actuated-Uncoordinated			
Maximum v/c Ratio: 0.87			
Intersection Signal Delay: 14.7		Intersection LOS: B	
Intersection Capacity Utilization 66.5%		ICU Level of Service C	
Analysis Period (min) 15			

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

Splits and Phases: 2: Common St & Route 1A & Kendrick St



Intersection Capacity Analysis
Common St & Route 1A & Kendrick St

09/26/2017

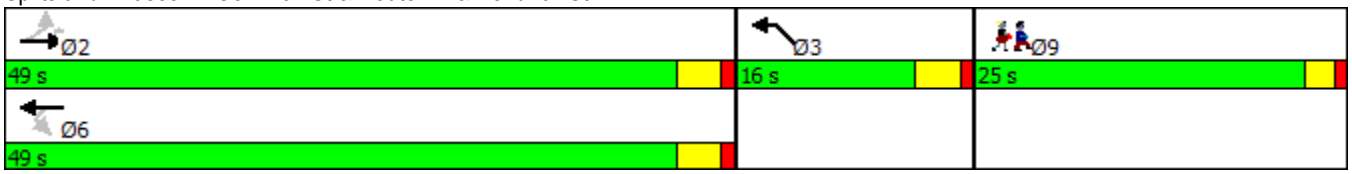
Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	SBL	SBR	NWL	NWR	NWR2	Ø9
Lane Configurations												
Traffic Volume (vph)	15	400	214	15	762	13	0	0	215	3	9	
Future Volume (vph)	15	400	214	15	762	13	0	0	215	3	9	
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	
Storage Length (ft)	50		0	50		0	0	0	0	50		
Storage Lanes	1		0	1		0	0	0	1	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)		338			463		659		563			
Travel Time (s)		7.7			10.5		15.0		12.8			
Confl. Peds. (#/hr)	23		10	10		23			4			
Peak Hour Factor	0.93	0.93	0.93	0.91	0.91	0.91	0.92	0.92	0.89	0.89	0.89	
Growth Factor	112%	112%	112%	112%	112%	112%	112%	112%	112%	112%	112%	
Heavy Vehicles (%)	1%	1%	1%	1%	1%	1%	2%	2%	1%	1%	1%	
Shared Lane Traffic (%)											10%	
Lane Group Flow (vph)	18	740	0	18	954	0	0	0	276	0	10	
Turn Type	Perm	NA		Perm	NA				Prot		Perm	
Protected Phases		2			6				3			9
Permitted Phases	2			6							2	
Detector Phase	2	2		6	6				3		2	
Switch Phase												
Minimum Initial (s)	5.0	5.0		5.0	5.0				5.0		5.0	5.0
Minimum Split (s)	9.0	9.0		9.0	9.0				9.0		9.0	25.0
Total Split (s)	49.0	49.0		49.0	49.0				16.0		49.0	25.0
Total Split (%)	54.4%	54.4%		54.4%	54.4%				17.8%		54.4%	28%
Yellow Time (s)	3.0	3.0		3.0	3.0				3.0		3.0	2.0
All-Red Time (s)	1.0	1.0		1.0	1.0				1.0		1.0	1.0
Lost Time Adjust (s)	0.0	0.0		0.0	0.0				0.0		0.0	
Total Lost Time (s)	4.0	4.0		4.0	4.0				4.0		4.0	
Lead/Lag												
Lead-Lag Optimize?												
Recall Mode	Min	Min		None	None				Min		Min	None
Act Effct Green (s)	45.6	45.6		45.6	45.6				12.2		45.6	
Actuated g/C Ratio	0.66	0.66		0.66	0.66				0.18		0.66	
v/c Ratio	0.11	0.63		0.06	0.77				0.78		0.01	
Control Delay	9.1	11.4		7.4	16.4				41.5		0.0	
Queue Delay	0.0	0.0		0.0	3.6				0.0		0.0	
Total Delay	9.1	11.4		7.4	20.0				41.5		0.0	
LOS	A	B		A	C				D		A	
Approach Delay		11.4			19.8				40.1			
Approach LOS		B			B				D			
Queue Length 50th (ft)	2	114		2	190				86		0	
Queue Length 95th (ft)	18	449		16	#762				#272		0	
Internal Link Dist (ft)		258			383		579		483			
Turn Bay Length (ft)	50			50							50	
Base Capacity (vph)	171	1177		326	1234				353		1016	
Starvation Cap Reductn	0	0		0	194				0		0	
Spillback Cap Reductn	0	0		0	0				0		0	

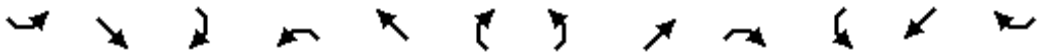
Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	SBL	SBR	NWL	NWR	NWR2	Ø9
Storage Cap Reductn	0	0		0	0				0		0	
Reduced v/c Ratio	0.11	0.63		0.06	0.92				0.78		0.01	

Intersection Summary			
Area Type:	Other		
Cycle Length: 90			
Actuated Cycle Length: 69.2			
Natural Cycle: 90			
Control Type: Actuated-Uncoordinated			
Maximum v/c Ratio: 0.78			
Intersection Signal Delay: 19.5		Intersection LOS: B	
Intersection Capacity Utilization 66.3%		ICU Level of Service C	
Analysis Period (min) 15			

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

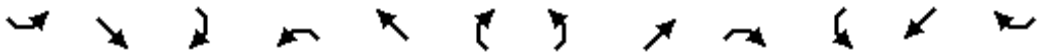
Splits and Phases: Common St & Route 1A & Kendrick St





Lane Group	SEL	SET	SER	NWL	NWT	NWR	NEL	NET	NER	SWL	SWT	SWR
Lane Configurations												
Traffic Volume (vph)	0	186	125	79	72	0	53	0	252	0	176	0
Future Volume (vph)	0	186	125	79	72	0	53	0	252	0	176	0
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Link Speed (mph)		30			30			30			30	
Link Distance (ft)		562			397			216			203	
Travel Time (s)		12.8			9.0			4.9			4.6	
Peak Hour Factor	0.92	0.81	0.81	0.80	0.80	0.92	0.88	0.92	0.88	0.92	0.92	0.92
Growth Factor	112%	112%	112%	112%	112%	112%	112%	112%	112%	112%	112%	112%
Heavy Vehicles (%)	2%	5%	5%	3%	3%	2%	3%	2%	3%	2%	2%	2%
Shared Lane Traffic (%)												
Lane Group Flow (vph)	0	430	0	0	212	0	0	388	0	0	214	0
Sign Control		Stop			Stop			Stop			Stop	

Intersection Summary			
Area Type:	Other		
Control Type: Unsignalized			
Intersection Capacity Utilization 73.1%		ICU Level of Service D	
Analysis Period (min) 15			



Movement	SEL	SET	SER	NWL	NWT	NWR	NEL	NET	NER	SWL	SWT	SWR
Lane Configurations												
Sign Control		Stop			Stop			Stop			Stop	
Traffic Volume (vph)	0	188	72	66	189	0	35	0	204	1	216	2
Future Volume (vph)	0	188	72	66	189	0	35	0	204	1	216	2
Peak Hour Factor	0.92	0.91	0.91	0.87	0.87	0.92	0.89	0.92	0.89	0.92	0.92	0.92
Hourly flow rate (vph)	0	231	89	85	243	0	44	0	257	1	263	2

Direction, Lane #	SE 1	NW 1	NE 1	SW 1
Volume Total (vph)	320	328	301	266
Volume Left (vph)	0	85	44	1
Volume Right (vph)	89	0	257	2
Hadj (s)	-0.15	0.09	-0.45	0.03
Departure Headway (s)	6.5	6.7	6.3	6.8
Degree Utilization, x	0.58	0.61	0.53	0.51
Capacity (veh/h)	502	493	503	464
Control Delay (s)	17.9	19.4	16.2	16.6
Approach Delay (s)	17.9	19.4	16.2	16.6
Approach LOS	C	C	C	C

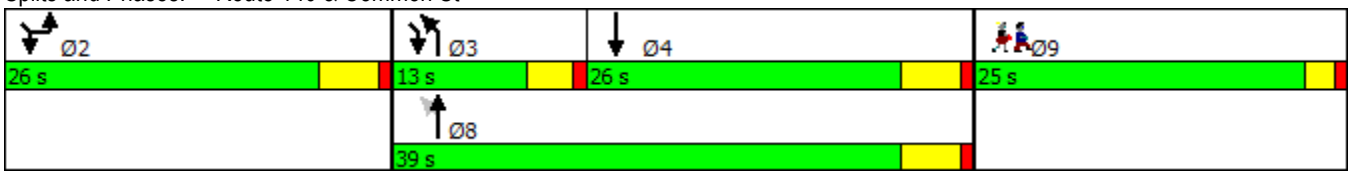
Intersection Summary				
Delay	17.6			
Level of Service	C			
Intersection Capacity Utilization	73.8%	ICU Level of Service	D	
Analysis Period (min)	15			

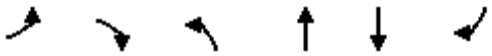
Lane Group	NBL	NBT	SBT	SBR	SEL	SER	Ø9
Lane Configurations							
Traffic Volume (vph)	149	270	246	0	186	252	
Future Volume (vph)	149	270	246	0	186	252	
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	
Storage Length (ft)	200			100	0	100	
Storage Lanes	1			0	1	1	
Taper Length (ft)	25				0		
Right Turn on Red				Yes		Yes	
Link Speed (mph)		30	30		30		
Link Distance (ft)		494	456		397		
Travel Time (s)		11.2	10.4		9.0		
Confl. Peds. (#/hr)				219	162		
Peak Hour Factor	0.80	0.80	0.94	0.94	0.81	0.81	
Growth Factor	112%	112%	112%	112%	112%	112%	
Heavy Vehicles (%)	3%	3%	5%	5%	5%	5%	
Shared Lane Traffic (%)							
Lane Group Flow (vph)	209	378	293	0	257	348	
Turn Type	pm+pt	NA	NA		Prot	pt+ov	
Protected Phases	3	8	4		2	2 3	9
Permitted Phases	8						
Detector Phase	3	8	4		2	2 3	
Switch Phase							
Minimum Initial (s)	4.0	4.0	4.0		4.0		5.0
Minimum Split (s)	8.0	9.0	9.0		9.0		25.0
Total Split (s)	13.0	39.0	26.0		26.0		25.0
Total Split (%)	14.4%	43.3%	28.9%		28.9%		28%
Yellow Time (s)	3.0	4.0	4.0		4.0		2.0
All-Red Time (s)	1.0	1.0	1.0		1.0		1.0
Lost Time Adjust (s)	0.0	0.0	0.0		0.0		
Total Lost Time (s)	4.0	5.0	5.0		5.0		
Lead/Lag	Lead		Lag				
Lead-Lag Optimize?	Yes		Yes				
Recall Mode	None	Min	None		Min		None
Act Effct Green (s)	28.4	27.3	14.5		14.1	26.9	
Actuated g/C Ratio	0.52	0.50	0.26		0.26	0.49	
v/c Ratio	0.41	0.41	0.61		0.58	0.37	
Control Delay	12.8	12.9	26.5		26.4	3.2	
Queue Delay	0.0	0.0	0.0		0.0	0.0	
Total Delay	12.8	12.9	26.5		26.4	3.2	
LOS	B	B	C		C	A	
Approach Delay		12.9	26.5		13.0		
Approach LOS		B	C		B		
Queue Length 50th (ft)	27	57	73		64	0	
Queue Length 95th (ft)	109	200	230		178	32	
Internal Link Dist (ft)		414	376		317		
Turn Bay Length (ft)	200					100	
Base Capacity (vph)	537	1235	748		710	954	
Starvation Cap Reductn	0	0	0		0	0	
Spillback Cap Reductn	0	0	0		0	0	

Lane Group	NBL	NBT	SBT	SBR	SEL	SER	Ø9
Storage Cap Reductn	0	0	0		0	0	
Reduced v/c Ratio	0.39	0.31	0.39		0.36	0.36	

Intersection Summary			
Area Type:	Other		
Cycle Length: 90			
Actuated Cycle Length: 54.9			
Natural Cycle: 70			
Control Type: Actuated-Uncoordinated			
Maximum v/c Ratio: 0.61			
Intersection Signal Delay: 15.6		Intersection LOS: B	
Intersection Capacity Utilization 47.0%		ICU Level of Service A	
Analysis Period (min) 15			

Splits and Phases: Route 140 & Common St





Lane Group	EBL	EBR	NBL	NBT	SBT	SBR	Ø9
Lane Configurations							
Traffic Volume (vph)	171	242	255	419	250	0	
Future Volume (vph)	171	242	255	419	250	0	
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	
Storage Length (ft)	0	100	200			100	
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)	366			494	442		
Travel Time (s)	8.3			11.2	10.0		
Peak Hour Factor	0.88	0.88	0.88	0.88	0.88	0.88	
Growth Factor	112%	112%	112%	112%	112%	112%	
Shared Lane Traffic (%)							
Lane Group Flow (vph)	218	308	325	533	318	0	
Turn Type	Prot	pt+ov	pm+pt	NA	NA		
Protected Phases	2	2 3	3	8	4		9
Permitted Phases			8				
Detector Phase	2	2 3	3	8	4		
Switch Phase							
Minimum Initial (s)	4.0		4.0	4.0	4.0		5.0
Minimum Split (s)	9.0		8.0	9.0	9.0		25.0
Total Split (s)	18.0		15.0	47.0	32.0		25.0
Total Split (%)	20.0%		16.7%	52.2%	35.6%		28%
Yellow Time (s)	4.0		3.0	4.0	4.0		2.0
All-Red Time (s)	1.0		1.0	1.0	1.0		1.0
Lost Time Adjust (s)	0.0		0.0	0.0	0.0		
Total Lost Time (s)	5.0		4.0	5.0	5.0		
Lead/Lag			Lead		Lag		
Lead-Lag Optimize?			Yes		Yes		
Recall Mode	Min		None	Min	None		None
Act Effct Green (s)	12.6	27.3	30.8	29.8	15.0		
Actuated g/C Ratio	0.23	0.49	0.55	0.54	0.27		
v/c Ratio	0.55	0.33	0.58	0.54	0.63		
Control Delay	29.9	3.4	13.9	12.3	25.6		
Queue Delay	0.0	0.0	0.0	0.0	0.0		
Total Delay	29.9	3.4	13.9	12.3	25.6		
LOS	C	A	B	B	C		
Approach Delay	14.4			12.9	25.6		
Approach LOS	B			B	C		
Queue Length 50th (ft)	57	0	44	88	85		
Queue Length 95th (ft)	#219	49	#160	287	217		
Internal Link Dist (ft)	286			414	362		
Turn Bay Length (ft)		100	200				
Base Capacity (vph)	438	929	581	1481	958		
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	0.50	0.33	0.56	0.36	0.33		

Intersection Summary		
Area Type:	Other	
Cycle Length: 90		
Actuated Cycle Length: 55.7		
Natural Cycle: 80		
Control Type: Actuated-Uncoordinated		
Maximum v/c Ratio: 0.63		
Intersection Signal Delay: 15.7		Intersection LOS: B
Intersection Capacity Utilization 52.8%		ICU Level of Service A
Analysis Period (min) 15		

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

Splits and Phases: Route 140 & Common St

APPENDIX K

Intersection Capacity Analyses, 2040 Weekday AM/PM Peak Hour
Wrentham Common Improvement Plan C

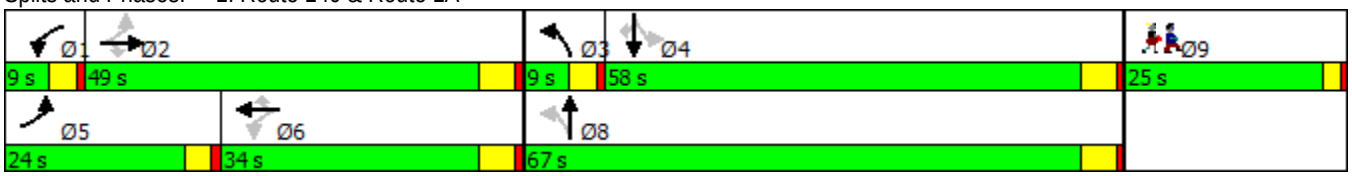
Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	224	455	185	30	153	37	91	359	75	89	389	240
Future Volume (vph)	224	455	185	30	153	37	91	359	75	89	389	240
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Storage Length (ft)	150		75	100		75	200		0	0		200
Storage Lanes	1		1	1		1	1		0	0		1
Taper Length (ft)	100			25			25			0		
Right Turn on Red			Yes			Yes			Yes			Yes
Link Speed (mph)		30			30			30			30	
Link Distance (ft)		444			799			317			1055	
Travel Time (s)		10.1			18.2			7.2			24.0	
Peak Hour Factor	0.83	0.83	0.83	0.83	0.83	0.83	0.80	0.80	0.80	0.94	0.94	0.94
Growth Factor	112%	112%	112%	112%	112%	112%	112%	112%	112%	112%	112%	112%
Heavy Vehicles (%)	7%	7%	7%	18%	18%	18%	3%	3%	3%	5%	5%	5%
Shared Lane Traffic (%)												
Lane Group Flow (vph)	302	614	250	40	206	50	127	608	0	0	569	286
Turn Type	pm+pt	NA	Perm	pm+pt	NA	Perm	pm+pt	NA		Perm	NA	Perm
Protected Phases	5	2		1	6		3	8			4	
Permitted Phases	2		2	6		6	8			4		4
Detector Phase	5	2	2	1	6	6	3	8		4	4	4
Switch Phase												
Minimum Initial (s)	4.0	1.0	1.0	4.0	12.0	12.0	4.0	12.0		12.0	12.0	12.0
Minimum Split (s)	8.0	20.0	20.0	8.0	17.0	17.0	8.0	17.0		17.0	17.0	17.0
Total Split (s)	24.0	49.0	49.0	9.0	34.0	34.0	9.0	67.0		58.0	58.0	58.0
Total Split (%)	16.0%	32.7%	32.7%	6.0%	22.7%	22.7%	6.0%	44.7%		38.7%	38.7%	38.7%
Yellow Time (s)	3.0	4.0	4.0	3.0	4.0	4.0	3.0	4.0		4.0	4.0	4.0
All-Red Time (s)	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0		1.0	1.0	1.0
Lost Time Adjust (s)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0			0.0	0.0
Total Lost Time (s)	4.0	5.0	5.0	4.0	5.0	5.0	4.0	5.0			5.0	5.0
Lead/Lag	Lead	Lag	Lag	Lead	Lag	Lag	Lead			Lag	Lag	Lag
Lead-Lag Optimize?	Yes						Yes			Yes	Yes	Yes
Recall Mode	None	None	None	Min	Min	Min	None	None		None	None	None
Act Effct Green (s)	54.8	44.7	44.7	37.4	31.3	31.3	52.6	51.5			42.4	42.4
Actuated g/C Ratio	0.46	0.38	0.38	0.31	0.26	0.26	0.44	0.43			0.36	0.36
v/c Ratio	0.60	0.92	0.40	0.32	0.49	0.11	0.43	0.78			0.82	0.39
Control Delay	30.5	57.7	21.1	31.5	45.9	0.5	26.3	36.8			46.4	4.8
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	6.5	16.0			0.0	0.0
Total Delay	30.5	57.7	21.1	31.5	45.9	0.5	32.8	52.9			46.4	4.8
LOS	C	E	C	C	D	A	C	D			D	A
Approach Delay		42.8			36.3			49.4			32.5	
Approach LOS		D			D			D			C	
Queue Length 50th (ft)	142	426	80	16	132	0	53	358			194	0
Queue Length 95th (ft)	282	#808	180	48	248	0	104	540			339	62
Internal Link Dist (ft)		364			719			237			975	
Turn Bay Length (ft)	150		75	100		75	200					200
Base Capacity (vph)	514	667	626	125	423	451	295	955			875	852
Starvation Cap Reductn	0	0	0	0	0	0	121	339			0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0			0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0			0	0

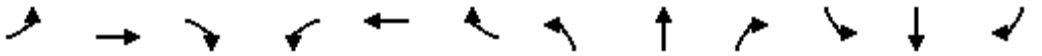
Lane Group	Ø9
Lane Configurations	
Traffic Volume (vph)	
Future Volume (vph)	
Ideal Flow (vphpl)	
Storage Length (ft)	
Storage Lanes	
Taper Length (ft)	
Right Turn on Red	
Link Speed (mph)	
Link Distance (ft)	
Travel Time (s)	
Peak Hour Factor	
Growth Factor	
Heavy Vehicles (%)	
Shared Lane Traffic (%)	
Lane Group Flow (vph)	
Turn Type	
Protected Phases	9
Permitted Phases	
Detector Phase	
Switch Phase	
Minimum Initial (s)	5.0
Minimum Split (s)	25.0
Total Split (s)	25.0
Total Split (%)	17%
Yellow Time (s)	2.0
All-Red Time (s)	1.0
Lost Time Adjust (s)	
Total Lost Time (s)	
Lead/Lag	
Lead-Lag Optimize?	
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	

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Reduced v/c Ratio	0.59	0.92	0.40	0.32	0.49	0.11	0.73	0.99			0.65	0.34

Intersection Summary			
Area Type:	Other		
Cycle Length: 150			
Actuated Cycle Length: 118.9			
Natural Cycle: 150			
Control Type: Actuated-Uncoordinated			
Maximum v/c Ratio: 0.92			
Intersection Signal Delay: 40.9		Intersection LOS: D	
Intersection Capacity Utilization 87.2%		ICU Level of Service E	
Analysis Period (min) 15			
# 95th percentile volume exceeds capacity, queue may be longer.			
Queue shown is maximum after two cycles.			

Splits and Phases: 1: Route 140 & Route 1A





Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	168	218	198	75	412	83	290	422	54	56	383	251
Future Volume (vph)	168	218	198	75	412	83	290	422	54	56	383	251
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Storage Length (ft)	150		75	100		75	200		0	0		200
Storage Lanes	1		1	1		1	1		0	0		1
Taper Length (ft)	100			25			25			25		
Right Turn on Red			Yes			Yes			Yes			Yes
Link Speed (mph)		30			30			30			30	
Link Distance (ft)		444			799			317			1055	
Travel Time (s)		10.1			18.2			7.2			24.0	
Confl. Peds. (#/hr)	6					6	2					2
Peak Hour Factor	0.85	0.85	0.85	0.85	0.85	0.85	0.92	0.92	0.92	0.84	0.84	0.84
Growth Factor	112%	112%	112%	112%	112%	112%	112%	112%	112%	112%	112%	112%
Heavy Vehicles (%)	2%	2%	2%	2%	2%	2%	1%	1%	1%	2%	2%	2%
Shared Lane Traffic (%)												
Lane Group Flow (vph)	221	287	261	99	543	109	353	580	0	0	586	335
Turn Type	pm+pt	NA	Perm	pm+pt	NA	Perm	pm+pt	NA		Perm	NA	Perm
Protected Phases	5	2		1	6		3	8			4	
Permitted Phases	2		2	6		6	8			4		4
Detector Phase	5	2	2	1	6	6	3	8		4	4	4
Switch Phase												
Minimum Initial (s)	5.0	10.0	10.0	5.0	10.0	10.0	5.0	10.0		10.0	10.0	10.0
Minimum Split (s)	9.0	15.0	15.0	9.0	15.0	15.0	9.0	15.0		15.0	15.0	15.0
Total Split (s)	17.0	49.0	49.0	12.0	44.0	44.0	23.0	64.0		41.0	41.0	41.0
Total Split (%)	11.3%	32.7%	32.7%	8.0%	29.3%	29.3%	15.3%	42.7%		27.3%	27.3%	27.3%
Yellow Time (s)	3.0	4.0	4.0	3.0	4.0	4.0	3.0	4.0		4.0	4.0	4.0
All-Red Time (s)	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0		1.0	1.0	1.0
Lost Time Adjust (s)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0			0.0	0.0
Total Lost Time (s)	4.0	5.0	5.0	4.0	5.0	5.0	4.0	5.0			5.0	5.0
Lead/Lag	Lead	Lag	Lag	Lead	Lag	Lag	Lead			Lag	Lag	Lag
Lead-Lag Optimize?	Yes						Yes			Yes	Yes	Yes
Recall Mode	None	None	None	Min	Min	Min	None	None		None	None	None
Act Effct Green (s)	57.2	44.4	44.4	48.0	39.2	39.2	60.2	59.2			36.1	36.1
Actuated g/C Ratio	0.44	0.34	0.34	0.37	0.30	0.30	0.47	0.46			0.28	0.28
v/c Ratio	0.93	0.45	0.42	0.25	0.96	0.20	0.88	0.68			0.82	0.51
Control Delay	75.8	36.9	19.7	25.1	74.3	5.4	49.3	33.6			54.4	9.0
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	6.5	54.0			0.0	0.0
Total Delay	75.8	36.9	19.7	25.1	74.3	5.4	55.7	87.6			54.4	9.0
LOS	E	D	B	C	E	A	E	F			D	A
Approach Delay		42.3			57.8			75.6			37.8	
Approach LOS		D			E			E			D	
Queue Length 50th (ft)	126	177	79	45	426	0	180	349			230	15
Queue Length 95th (ft)	#317	299	171	97	#738	30	#430	628			#355	79
Internal Link Dist (ft)		364			719			237			975	
Turn Bay Length (ft)	150		75	100		75	200					200
Base Capacity (vph)	237	640	625	394	564	550	400	850			718	654
Starvation Cap Reductn	0	0	0	0	0	0	26	386			0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0			0	0

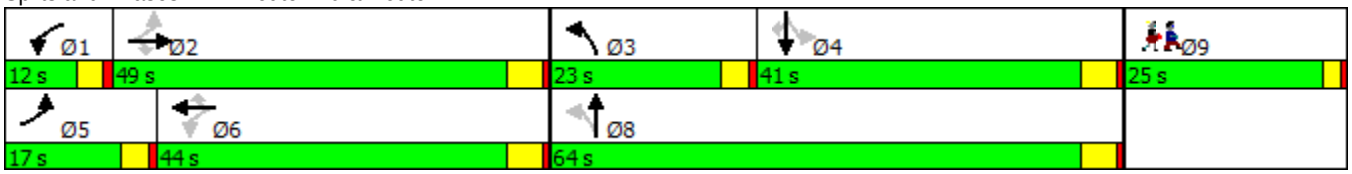
Lane Group	Ø9
Lane Configurations	
Traffic Volume (vph)	
Future Volume (vph)	
Ideal Flow (vphpl)	
Storage Length (ft)	
Storage Lanes	
Taper Length (ft)	
Right Turn on Red	
Link Speed (mph)	
Link Distance (ft)	
Travel Time (s)	
Confl. Peds. (#/hr)	
Peak Hour Factor	
Growth Factor	
Heavy Vehicles (%)	
Shared Lane Traffic (%)	
Lane Group Flow (vph)	
Turn Type	
Protected Phases	9
Permitted Phases	
Detector Phase	
Switch Phase	
Minimum Initial (s)	5.0
Minimum Split (s)	25.0
Total Split (s)	25.0
Total Split (%)	17%
Yellow Time (s)	2.0
All-Red Time (s)	1.0
Lost Time Adjust (s)	
Total Lost Time (s)	
Lead/Lag	
Lead-Lag Optimize?	
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	

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Storage Cap Reductn	0	0	0	0	0	0	0	0			0	0
Reduced v/c Ratio	0.93	0.45	0.42	0.25	0.96	0.20	0.94	1.25			0.82	0.51

Intersection Summary			
Area Type:	Other		
Cycle Length: 150			
Actuated Cycle Length: 129.2			
Natural Cycle: 150			
Control Type: Actuated-Uncoordinated			
Maximum v/c Ratio: 0.96			
Intersection Signal Delay: 53.7		Intersection LOS: D	
Intersection Capacity Utilization 92.8%		ICU Level of Service F	
Analysis Period (min) 15			

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

Splits and Phases: 1: Route 140 & Route 1A



HCM Unsignalized Intersection Capacity Analysis
Common St & Route 1A & Kendrick St

09/26/2017

Movement	EBL	EBT	EBR	WBL	WBT	WBR	SBL	SBR	NWL	NWR	NWR2
Lane Configurations											
Traffic Volume (veh/h)	56	822	61	29	382	5	0	0	20	7	29
Future Volume (Veh/h)	56	822	61	29	382	5	0	0	20	7	29
Sign Control		Free			Free		Stop		Stop		
Grade		0%			0%		0%		0%		
Peak Hour Factor	0.89	0.89	0.89	0.83	0.83	0.83	0.25	0.25	0.92	0.92	0.92
Hourly flow rate (vph)	70	1034	77	39	515	7	0	0	24	9	35
Pedestrians		5					7		1		
Lane Width (ft)		12.0					0.0		12.0		
Walking Speed (ft/s)		3.5					3.5		3.5		
Percent Blockage		0					0		0		
Right turn flare (veh)										2	2
Median type		None			TWLTL						
Median storage veh)					2						
Upstream signal (ft)					444						
pX, platoon unblocked	0.90						0.90	0.90	0.90	0.90	
vC, conflicting volume	529			1112			1856	530	1812	1820	1074
vC1, stage 1 conf vol							604		1214	1214	
vC2, stage 2 conf vol							1252		598	607	
vCu, unblocked vol	421			1112			1895	423	1846	1856	1074
tC, single (s)	4.1			4.2			6.5	6.2	7.1	6.5	6.2
tC, 2 stage (s)							5.5		6.1	5.5	
tF (s)	2.2			2.3			4.0	3.3	3.5	4.0	3.3
p0 queue free %	93			93			100	100	87	96	87
cM capacity (veh/h)	1010			599			175	569	182	202	267

Direction, Lane #	EB 1	EB 2	WB 1	WB 2	NW 1
Volume Total	70	1111	39	522	68
Volume Left	70	0	39	0	24
Volume Right	0	77	0	7	35
cSH	1010	1700	599	1700	386
Volume to Capacity	0.07	0.65	0.07	0.31	0.18
Queue Length 95th (ft)	6	0	5	0	16
Control Delay (s)	8.8	0.0	11.4	0.0	24.3
Lane LOS	A		B		C
Approach Delay (s)	0.5		0.8		24.3
Approach LOS					C

Intersection Summary			
Average Delay	1.5		
Intersection Capacity Utilization	62.6%	ICU Level of Service	B
Analysis Period (min)	15		

HCM Unsignalized Intersection Capacity Analysis
Common St & Route 1A & Kendrick St

09/26/2017

Movement	EBL	EBT	EBR	WBL	WBT	WBR	SBL	SBR	NWL	NWR	NWR2
Lane Configurations											
Traffic Volume (veh/h)	15	588	26	15	937	13	0	0	15	3	19
Future Volume (Veh/h)	15	588	26	15	937	13	0	0	15	3	19
Sign Control		Free			Free		Stop		Stop		
Grade		0%			0%		0%		0%		
Peak Hour Factor	0.93	0.93	0.93	0.91	0.91	0.91	0.92	0.92	0.89	0.89	0.89
Hourly flow rate (vph)	18	708	31	18	1153	16	0	0	19	4	24
Pedestrians		4					23		10		
Lane Width (ft)		12.0					0.0		12.0		
Walking Speed (ft/s)		3.5					3.5		3.5		
Percent Blockage		0					0		1		
Right turn flare (veh)										2	2
Median type		None			TWLTL						
Median storage veh)					2						
Upstream signal (ft)					444						
pX, platoon unblocked	0.58						0.58	0.58	0.58	0.58	
vC, conflicting volume	1192			749			2005	1188	1962	1998	734
vC1, stage 1 conf vol							1220		770	770	
vC2, stage 2 conf vol							785		1193	1228	
vCu, unblocked vol	973			749			2365	966	2292	2352	734
tC, single (s)	4.1			4.1			6.5	6.2	7.1	6.5	6.2
tC, 2 stage (s)							5.5		6.1	5.5	
tF (s)	2.2			2.2			4.0	3.3	3.5	4.0	3.3
p0 queue free %	96			98			100	100	86	97	94
cM capacity (veh/h)	416			856			155	180	138	143	418

Direction, Lane #	EB 1	EB 2	WB 1	WB 2	NW 1
Volume Total	18	739	18	1169	47
Volume Left	18	0	18	0	19
Volume Right	0	31	0	16	24
cSH	416	1700	856	1700	284
Volume to Capacity	0.04	0.43	0.02	0.69	0.17
Queue Length 95th (ft)	3	0	2	0	15
Control Delay (s)	14.0	0.0	9.3	0.0	24.8
Lane LOS	B		A		C
Approach Delay (s)	0.3		0.1		24.8
Approach LOS					C

Intersection Summary				
Average Delay	0.8			
Intersection Capacity Utilization	66.1%	ICU Level of Service		C
Analysis Period (min)	15			

HCM Unsignalized Intersection Capacity Analysis
Taunton St/David Brown's Way & Common St

09/26/2017

Movement	NBL	NBT	NBR	SBL	SBT	SBR	NEL	NET	NER	SWL	SWT	SWR
Lane Configurations												
Traffic Volume (veh/h)	2	1	1	6	0	125	53	252	0	0	255	2
Future Volume (Veh/h)	2	1	1	6	0	125	53	252	0	0	255	2
Sign Control		Stop			Stop			Free			Free	
Grade		0%			0%			0%			0%	
Peak Hour Factor	0.80	0.80	0.80	0.81	0.81	0.81	0.88	0.88	0.88	0.84	0.84	0.84
Hourly flow rate (vph)	3	1	1	8	0	173	67	321	0	0	340	3
Pedestrians												
Lane Width (ft)												
Walking Speed (ft/s)												
Percent Blockage												
Right turn flare (veh)												
Median type								None			None	
Median storage veh)												
Upstream signal (ft)											192	
pX, platoon unblocked												
vC, conflicting volume	970	798	321	798	796	342	343			321		
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	970	798	321	798	796	342	343			321		
tC, single (s)	7.1	6.5	6.2	7.1	6.5	6.2	4.1			4.2		
tC, 2 stage (s)												
tF (s)	3.5	4.0	3.3	3.5	4.0	3.3	2.2			2.3		
p0 queue free %	98	100	100	97	100	75	94			100		
cM capacity (veh/h)	167	300	718	287	299	694	1210			1185		

Direction, Lane #	NB 1	SB 1	NE 1	SW 1
Volume Total	5	181	388	343
Volume Left	3	8	67	0
Volume Right	1	173	0	3
cSH	220	653	1210	1185
Volume to Capacity	0.02	0.28	0.06	0.00
Queue Length 95th (ft)	2	28	4	0
Control Delay (s)	21.7	12.6	1.9	0.0
Lane LOS	C	B	A	
Approach Delay (s)	21.7	12.6	1.9	0.0
Approach LOS	C	B		

Intersection Summary				
Average Delay	3.4			
Intersection Capacity Utilization	52.3%	ICU Level of Service	A	
Analysis Period (min)	15			

HCM Unsignalized Intersection Capacity Analysis
Taunton St/David Brown's Way & Common St

09/26/2017

Movement	NBL	NBT	NBR	SBL	SBT	SBR	NEL	NET	NER	SWL	SWT	SWR
Lane Configurations												
Traffic Volume (veh/h)	2	2	2	9	2	72	35	204	1	1	286	2
Future Volume (Veh/h)	2	2	2	9	2	72	35	204	1	1	286	2
Sign Control		Stop			Stop			Free			Free	
Grade		0%			0%			0%			0%	
Peak Hour Factor	0.87	0.87	0.87	0.91	0.91	0.91	0.89	0.89	0.89	0.90	0.90	0.90
Hourly flow rate (vph)	3	3	3	11	2	89	44	257	1	1	356	2
Pedestrians								1				
Lane Width (ft)								12.0				
Walking Speed (ft/s)								3.5				
Percent Blockage								0				
Right turn flare (veh)												
Median type								None			None	
Median storage veh)												
Upstream signal (ft)											192	
pX, platoon unblocked												
vC, conflicting volume	796	706	258	709	705	358	358			258		
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	796	706	258	709	705	358	358			258		
tC, single (s)	7.1	6.5	6.2	7.1	6.5	6.2	4.1			4.1		
tC, 2 stage (s)												
tF (s)	3.5	4.0	3.3	3.5	4.0	3.3	2.2			2.2		
p0 queue free %	99	99	100	97	99	87	96			100		
cM capacity (veh/h)	257	347	781	337	349	688	1201			1307		

Direction, Lane #	NB 1	SB 1	NE 1	SW 1
Volume Total	9	102	302	359
Volume Left	3	11	44	1
Volume Right	3	89	1	2
cSH	372	608	1201	1307
Volume to Capacity	0.02	0.17	0.04	0.00
Queue Length 95th (ft)	2	15	3	0
Control Delay (s)	14.9	12.1	1.5	0.0
Lane LOS	B	B	A	A
Approach Delay (s)	14.9	12.1	1.5	0.0
Approach LOS	B	B		

Intersection Summary				
Average Delay	2.4			
Intersection Capacity Utilization	47.7%	ICU Level of Service	A	
Analysis Period (min)	15			

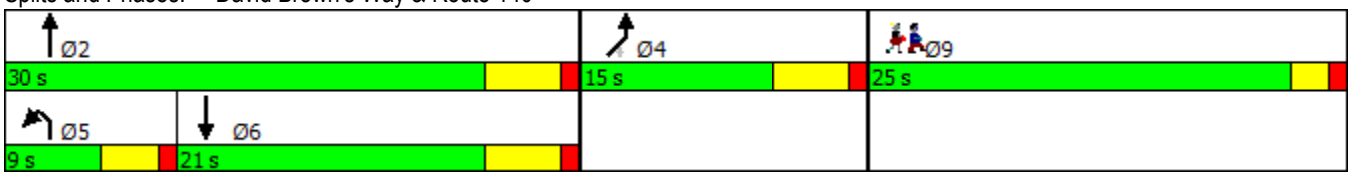
Lane Group	NBL	NBT	SBT	SBR	NEL	NER	Ø9
Lane Configurations							
Traffic Volume (vph)	79	340	426	178	185	73	
Future Volume (vph)	79	340	426	178	185	73	
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	
Storage Length (ft)	75			0	0	0	
Storage Lanes	1			0	1	1	
Taper Length (ft)	25				0		
Right Turn on Red				Yes		Yes	
Link Speed (mph)		30	30		30		
Link Distance (ft)		453	317		192		
Travel Time (s)		10.3	7.2		4.4		
Peak Hour Factor	0.80	0.80	0.94	0.84	0.88	0.88	
Growth Factor	112%	112%	112%	112%	112%	112%	
Heavy Vehicles (%)	3%	3%	5%	12%	3%	3%	
Shared Lane Traffic (%)							
Lane Group Flow (vph)	111	476	745	0	235	93	
Turn Type	Prot	NA	NA		Prot	Perm	
Protected Phases	5	2	6		4		9
Permitted Phases						4	
Detector Phase	5	2	6		4	4	
Switch Phase							
Minimum Initial (s)	4.0	4.0	4.0		4.0	4.0	5.0
Minimum Split (s)	8.0	9.0	9.0		9.0	9.0	25.0
Total Split (s)	9.0	30.0	21.0		15.0	15.0	25.0
Total Split (%)	12.9%	42.9%	30.0%		21.4%	21.4%	36%
Yellow Time (s)	3.0	4.0	4.0		4.0	4.0	2.0
All-Red Time (s)	1.0	1.0	1.0		1.0	1.0	1.0
Lost Time Adjust (s)	0.0	0.0	0.0		0.0	0.0	
Total Lost Time (s)	4.0	5.0	5.0		5.0	5.0	
Lead/Lag	Lead		Lag				
Lead-Lag Optimize?	Yes		Yes				
Recall Mode	None	Min	Min		None	None	None
Act Effct Green (s)	5.1	26.0	16.8		10.2	10.2	
Actuated g/C Ratio	0.10	0.52	0.34		0.21	0.21	
v/c Ratio	0.62	0.49	0.65		0.65	0.23	
Control Delay	42.6	11.9	17.5		31.8	7.7	
Queue Delay	0.0	0.0	0.0		0.0	0.0	
Total Delay	42.6	11.9	17.5		31.8	7.7	
LOS	D	B	B		C	A	
Approach Delay		17.7	17.5		25.0		
Approach LOS		B	B		C		
Queue Length 50th (ft)	28	63	67		55	0	
Queue Length 95th (ft)	#107	213	#228		#205	34	
Internal Link Dist (ft)		373	237		112		
Turn Bay Length (ft)	75						
Base Capacity (vph)	180	966	1151		361	397	
Starvation Cap Reductn	0	0	0		0	0	
Spillback Cap Reductn	0	0	0		0	0	
Storage Cap Reductn	0	0	0		0	0	

Lane Group	NBL	NBT	SBT	SBR	NEL	NER	Ø9
Reduced v/c Ratio	0.62	0.49	0.65		0.65	0.23	

Intersection Summary			
Area Type:	Other		
Cycle Length: 70			
Actuated Cycle Length: 49.6			
Natural Cycle: 70			
Control Type: Actuated-Uncoordinated			
Maximum v/c Ratio: 0.65			
Intersection Signal Delay: 19.0		Intersection LOS: B	
Intersection Capacity Utilization 47.6%		ICU Level of Service A	
Analysis Period (min) 15			

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

Splits and Phases: David Brown's Way & Route 140



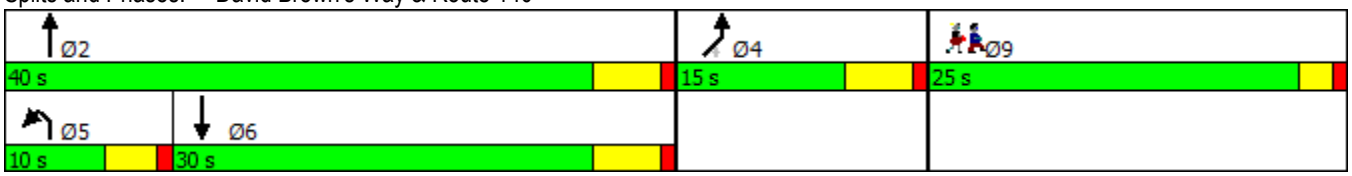
Lane Group	NBL	NBT	SBT	SBR	NEL	NER	Ø9
Lane Configurations							
Traffic Volume (vph)	70	604	437	219	162	53	
Future Volume (vph)	70	604	437	219	162	53	
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	
Storage Length (ft)	75			0	0	0	
Storage Lanes	1			0	1	1	
Taper Length (ft)	25				25		
Right Turn on Red				Yes		Yes	
Link Speed (mph)		30	30		30		
Link Distance (ft)		453	317		192		
Travel Time (s)		10.3	7.2		4.4		
Peak Hour Factor	0.88	0.88	0.88	0.88	0.88	0.88	
Growth Factor	112%	112%	112%	112%	112%	112%	
Heavy Vehicles (%)	1%	1%	1%	1%	1%	1%	
Shared Lane Traffic (%)							
Lane Group Flow (vph)	89	769	835	0	206	67	
Turn Type	Prot	NA	NA		Prot	Perm	
Protected Phases	5	2	6		4		9
Permitted Phases						4	
Detector Phase	5	2	6		4	4	
Switch Phase							
Minimum Initial (s)	4.0	4.0	4.0		4.0	4.0	5.0
Minimum Split (s)	8.0	9.0	9.0		9.0	9.0	25.0
Total Split (s)	10.0	40.0	30.0		15.0	15.0	25.0
Total Split (%)	12.5%	50.0%	37.5%		18.8%	18.8%	31%
Yellow Time (s)	3.0	4.0	4.0		4.0	4.0	2.0
All-Red Time (s)	1.0	1.0	1.0		1.0	1.0	1.0
Lost Time Adjust (s)	0.0	0.0	0.0		0.0	0.0	
Total Lost Time (s)	4.0	5.0	5.0		5.0	5.0	
Lead/Lag	Lead		Lag				
Lead-Lag Optimize?	Yes		Yes				
Recall Mode	None	Min	Min		None	None	None
Act Effct Green (s)	6.2	31.7	23.4		10.3	10.3	
Actuated g/C Ratio	0.11	0.57	0.42		0.19	0.19	
v/c Ratio	0.45	0.71	0.56		0.62	0.19	
Control Delay	34.9	16.0	13.9		34.0	9.4	
Queue Delay	0.0	0.0	0.0		0.0	0.0	
Total Delay	34.9	16.0	13.9		34.0	9.4	
LOS	C	B	B		C	A	
Approach Delay		17.9	13.9		27.9		
Approach LOS		B	B		C		
Queue Length 50th (ft)	24	127	80		53	0	
Queue Length 95th (ft)	#102	#520	210		#207	32	
Internal Link Dist (ft)		373	237		112		
Turn Bay Length (ft)	75						
Base Capacity (vph)	200	1229	1766		332	352	
Starvation Cap Reductn	0	0	59		0	0	
Spillback Cap Reductn	0	0	0		0	0	
Storage Cap Reductn	0	0	0		0	0	

Lane Group	NBL	NBT	SBT	SBR	NEL	NER	Ø9
Reduced v/c Ratio	0.45	0.63	0.49		0.62	0.19	

Intersection Summary			
Area Type:	Other		
Cycle Length: 80			
Actuated Cycle Length: 55.4			
Natural Cycle: 80			
Control Type: Actuated-Uncoordinated			
Maximum v/c Ratio: 0.71			
Intersection Signal Delay: 17.6		Intersection LOS: B	
Intersection Capacity Utilization 54.0%		ICU Level of Service A	
Analysis Period (min) 15			

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

Splits and Phases: David Brown's Way & Route 140



APPENDIX L

Preliminary Analyses of Roundabout Option:
Route 1A at Route 140 and
Route 140 at Common Street

Draft Diagram (1)

0 160 320 ft

(Scale not correct)

Double-Lane Modern Roundabout Foot-Print (170' D Inscribe Circle)

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Wrentham Route 1A/Route 140

Intersection	
Intersection Delay, s/veh	144.4
Intersection LOS	F

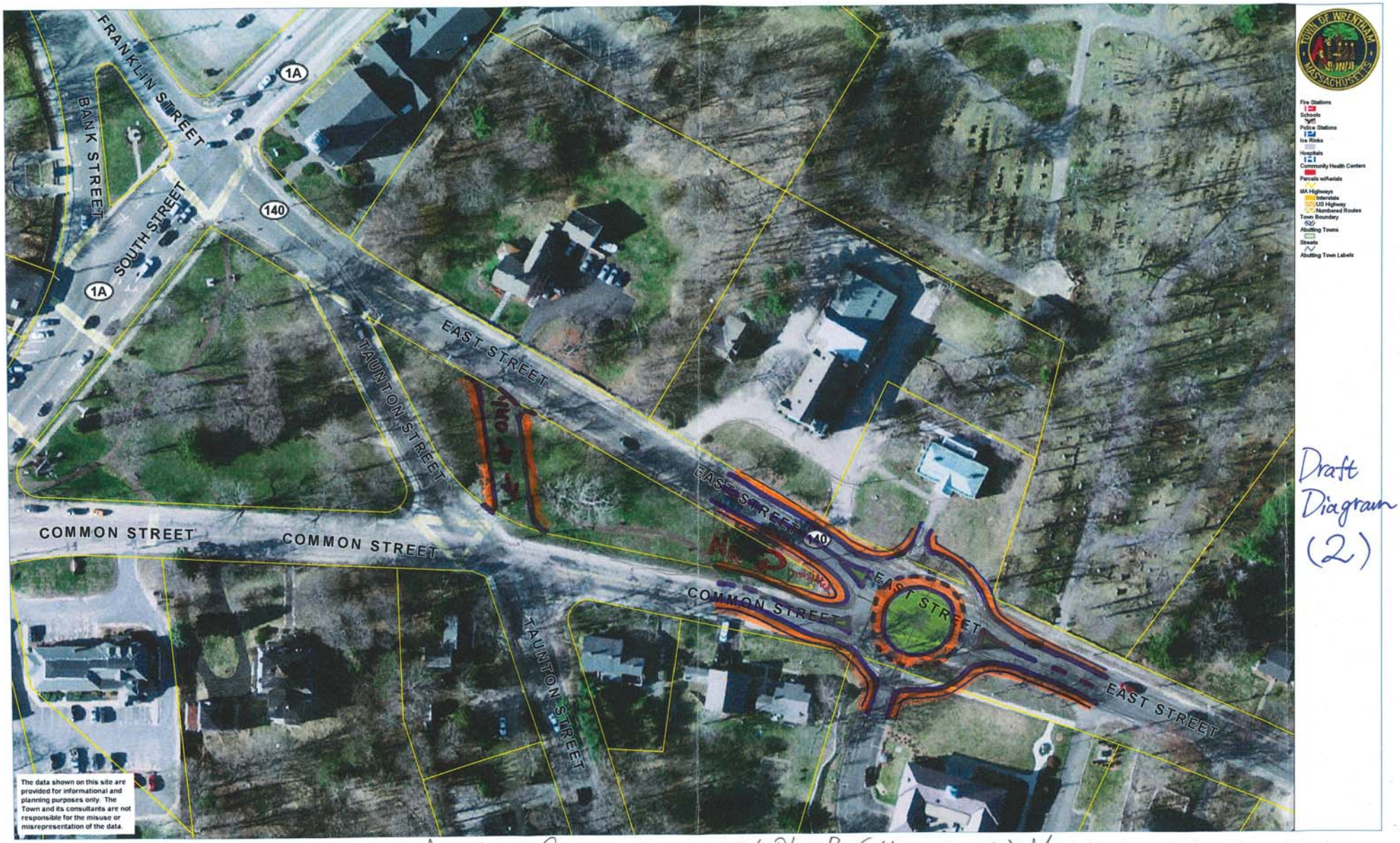
Approach	EB	WB	NB	SB
Entry Lanes	1	1	1	2
Conflicting Circle Lanes	1	1	1	1
Adj Approach Flow, veh/h	521	751	708	921
Demand Flow Rate, veh/h	531	766	715	939
Vehicles Circulating, veh/h	698	873	594	796
Vehicles Exiting, veh/h	1037	436	635	843
Follow-Up Headway, s	3.186	3.186	3.186	3.186
Ped Vol Crossing Leg, #/h	2	0	0	6
Ped Cap Adj	1.000	1.000	1.000	0.999
Approach Delay, s/veh	52.9	312.1	107.6	87.6
Approach LOS	F	F	F	F

Lane	Left	Left	Left	Left	Right
Designated Moves	LTR	LTR	LTR	LT	R
Assumed Moves	LTR	LTR	LTR	LT	R
RT Channelized					
Lane Util	1.000	1.000	1.000	0.636	0.364
Critical Headway, s	5.193	5.193	5.193	5.193	5.193
Entry Flow, veh/h	531	766	715	597	342
Cap Entry Lane, veh/h	562	472	624	510	510
Entry HV Adj Factor	0.982	0.981	0.990	0.981	0.980
Flow Entry, veh/h	521	751	708	586	335
Cap Entry, veh/h	552	463	618	500	499
V/C Ratio	0.945	1.623	1.146	1.173	0.672
Control Delay, s/veh	52.9	312.1	107.6	124.0	24.1
LOS	F	F	F	F	C
95th %tile Queue, veh	12	43	23	21	5

Intersection	
Intersection Delay, s/veh	39.1
Intersection LOS	E

Approach	EB	WB	NB	SB
Entry Lanes	2	2	2	2
Conflicting Circle Lanes	2	2	2	2
Adj Approach Flow, veh/h	521	751	708	921
Demand Flow Rate, veh/h	531	766	715	939
Vehicles Circulating, veh/h	698	873	594	796
Vehicles Exiting, veh/h	1037	436	635	843
Follow-Up Headway, s	3.186	3.186	3.186	3.186
Ped Vol Crossing Leg, #/h	2	0	0	6
Ped Cap Adj	0.999	1.000	1.000	0.999
Approach Delay, s/veh	10.9	76.8	19.9	39.2
Approach LOS	B	F	C	E

Lane	Left	Right	Left	Right	Left	Right	Left	Right
Designated Moves	L	TR	L	TR	L	TR	LT	R
Assumed Moves	L	TR	L	TR	L	TR	LT	R
RT Channelized								
Lane Util	0.424	0.576	0.132	0.868	0.197	0.803	0.636	0.364
Critical Headway, s	4.293	4.113	4.293	4.113	4.293	4.113	4.293	4.113
Entry Flow, veh/h	225	306	101	665	141	574	597	342
Cap Entry Lane, veh/h	669	693	587	613	724	746	622	647
Entry HV Adj Factor	0.982	0.981	0.980	0.981	0.993	0.990	0.981	0.980
Flow Entry, veh/h	221	300	99	652	140	568	586	335
Cap Entry, veh/h	657	680	575	601	719	738	610	633
V/C Ratio	0.336	0.442	0.172	1.084	0.195	0.770	0.961	0.529
Control Delay, s/veh	9.9	11.6	8.4	87.2	7.2	23.1	53.2	14.5
LOS	A	B	A	F	A	C	F	B
95th %tile Queue, veh	1	2	1	19	1	7	13	3



Draft Diagram (2)

0 100 200 ft (Scale Not Correct)

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Wrentham Common Improvement Plan B (Alternative 2) Variation

Single-lane (130'D) Modern Roundabout at Route 140/Common Street (Not Recommended)

Wrentham Common

Intersection	
Intersection Delay, s/veh	29.1
Intersection LOS	D

Approach	EB	NB	SB
Entry Lanes	1	1	1
Conflicting Circle Lanes	1	1	1
Adj Approach Flow, veh/h	526	858	318
Demand Flow Rate, veh/h	536	876	324
Vehicles Circulating, veh/h	324	222	331
Vehicles Exiting, veh/h	331	638	766
Follow-Up Headway, s	3.186	3.186	3.186
Ped Vol Crossing Leg, #/h	0	0	0
Ped Cap Adj	1.000	1.000	1.000
Approach Delay, s/veh	15.9	44.4	9.5
Approach LOS	C	E	A

Lane	Left	Left	Left
Designated Moves	LR	LT	T
Assumed Moves	LR	LT	T
RT Channelized			
Lane Util	1.000	1.000	1.000
Critical Headway, s	5.193	5.193	5.193
Entry Flow, veh/h	536	876	324
Cap Entry Lane, veh/h	817	905	812
Entry HV Adj Factor	0.981	0.980	0.980
Flow Entry, veh/h	526	858	318
Cap Entry, veh/h	802	887	796
V/C Ratio	0.656	0.968	0.399
Control Delay, s/veh	15.9	44.4	9.5
LOS	C	E	A
95th %tile Queue, veh	5	16	2

APPENDIX M

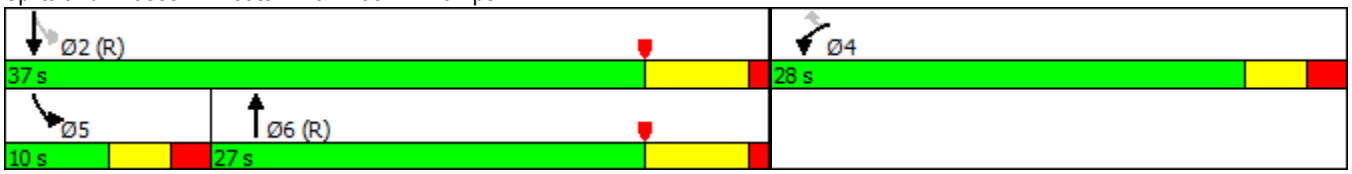
Intersection Capacity Analyses
2040 Weekend Midday Peak Hour
Route 1A from I-495 to Premium Outlets Boulevard
with Proposed Improvements

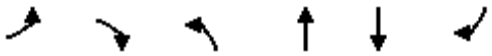
Lane Group	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Traffic Volume (vph)	1023	193	515	560	124	658
Future Volume (vph)	1023	193	515	560	124	658
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Storage Length (ft)	200	300		0	0	
Storage Lanes	1	1		0	1	
Taper Length (ft)	25				0	
Right Turn on Red		Yes		Yes		
Link Speed (mph)	30		40			40
Link Distance (ft)	627		1288			363
Travel Time (s)	14.3		22.0			6.2
Peak Hour Factor	0.99	0.99	0.96	0.96	0.90	0.90
Heavy Vehicles (%)	3%	3%	3%	3%	2%	2%
Shared Lane Traffic (%)						
Lane Group Flow (vph)	1033	195	1119	0	138	731
Turn Type	Prot	Perm	NA		pm+pt	NA
Protected Phases	4		6		5	2
Permitted Phases		4			2	
Detector Phase	4	4	6		5	2
Switch Phase						
Minimum Initial (s)	10.0	10.0	21.0		5.0	21.0
Minimum Split (s)	15.0	15.0	27.0		10.0	27.0
Total Split (s)	28.0	28.0	27.0		10.0	37.0
Total Split (%)	43.1%	43.1%	41.5%		15.4%	56.9%
Yellow Time (s)	3.0	3.0	5.0		3.0	5.0
All-Red Time (s)	2.0	2.0	1.0		2.0	1.0
Lost Time Adjust (s)	0.0	0.0	0.0		0.0	0.0
Total Lost Time (s)	5.0	5.0	6.0		5.0	6.0
Lead/Lag			Lag		Lead	
Lead-Lag Optimize?						
Recall Mode	None	None	C-Max		None	C-Max
Act Effct Green (s)	22.5	22.5	23.5		32.5	31.5
Actuated g/C Ratio	0.35	0.35	0.36		0.50	0.48
v/c Ratio	0.88	0.29	0.77		0.54	0.81
Control Delay	30.5	4.0	6.2		17.7	23.7
Queue Delay	0.0	0.0	0.0		0.0	0.0
Total Delay	30.5	4.0	6.2		17.7	23.7
LOS	C	A	A		B	C
Approach Delay	26.3		6.2			22.8
Approach LOS	C		A			C
Queue Length 50th (ft)	191	0	54		28	234
Queue Length 95th (ft)	#297	37	65		#58	#434
Internal Link Dist (ft)	547		1208			283
Turn Bay Length (ft)	200	300				
Base Capacity (vph)	1203	680	1454		254	903
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	0.86	0.29	0.77		0.54	0.81

Intersection Summary	
Area Type:	Other
Cycle Length: 65	
Actuated Cycle Length: 65	
Offset: 0 (0%), Referenced to phase 2:SBTL and 6:NBT, Start of Yellow, Master Intersection	
Natural Cycle: 60	
Control Type: Actuated-Coordinated	
Maximum v/c Ratio: 0.88	
Intersection Signal Delay: 18.4	Intersection LOS: B
Intersection Capacity Utilization 81.6%	ICU Level of Service D
Analysis Period (min) 15	

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

Splits and Phases: Route 1A & I-495 NB Ramps





Lane Group	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Traffic Volume (vph)	122	744	0	1688	1512	169
Future Volume (vph)	122	744	0	1688	1512	169
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Right Turn on Red		Yes				Yes
Link Speed (mph)	30			40	40	
Link Distance (ft)	398			412	1288	
Travel Time (s)	9.0			7.0	22.0	
Peak Hour Factor	0.95	0.95	0.92	0.92	0.92	0.92
Heavy Vehicles (%)	2%	2%	3%	3%	2%	2%
Shared Lane Traffic (%)						
Lane Group Flow (vph)	128	783	0	1835	1827	0
Turn Type	Prot	Free		NA	NA	
Protected Phases	8			6	2	
Permitted Phases		Free				
Detector Phase	8			6	2	
Switch Phase						
Minimum Initial (s)	18.0			10.0	10.0	
Minimum Split (s)	23.0			16.0	16.0	
Total Split (s)	23.0			42.0	42.0	
Total Split (%)	35.4%			64.6%	64.6%	
Yellow Time (s)	3.0			5.0	5.0	
All-Red Time (s)	2.0			1.0	1.0	
Lost Time Adjust (s)	0.0			0.0	0.0	
Total Lost Time (s)	5.0			6.0	6.0	
Lead/Lag						
Lead-Lag Optimize?						
Recall Mode	None			C-Max	C-Max	
Act Effct Green (s)	18.0	65.0		41.8	41.8	
Actuated g/C Ratio	0.28	1.00		0.64	0.64	
v/c Ratio	0.13	0.49		0.81	0.81	
Control Delay	18.2	1.1		10.0	11.0	
Queue Delay	0.0	0.0		0.0	0.0	
Total Delay	18.2	1.1		10.0	11.0	
LOS	B	A		B	B	
Approach Delay	3.5			10.0	11.0	
Approach LOS	A			B	B	
Queue Length 50th (ft)	19	0		116	188	
Queue Length 95th (ft)	38	0		m#181	#490	
Internal Link Dist (ft)	318			332	1208	
Turn Bay Length (ft)						
Base Capacity (vph)	950	1583		2254	2252	
Starvation Cap Reductn	0	0		0	0	
Spillback Cap Reductn	0	0		0	0	
Storage Cap Reductn	0	0		0	0	
Reduced v/c Ratio	0.13	0.49		0.81	0.81	

Intersection Summary	
Area Type:	Other

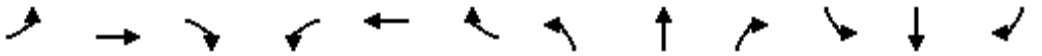
Cycle Length: 65	
Actuated Cycle Length: 65	
Offset: 47 (72%), Referenced to phase 2:SBT and 6:NBT, Start of Yellow	
Natural Cycle: 65	
Control Type: Actuated-Coordinated	
Maximum v/c Ratio: 0.81	
Intersection Signal Delay: 9.1	Intersection LOS: A
Intersection Capacity Utilization 71.3%	ICU Level of Service C
Analysis Period (min) 15	

\# 95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.
m Volume for 95th percentile queue is metered by upstream signal.

Splits and Phases: Route 1A & I-495 SB Ramps

Intersection Capacity Analysis
Route 1A & Premium Outlets Blvd/Mobil Gas Driveway

09/26/2017



Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	805	43	203	17	27	97	350	787	37	56	854	1332
Future Volume (vph)	805	43	203	17	27	97	350	787	37	56	854	1332
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Storage Length (ft)	0		250	0		0	180		0	0		0
Storage Lanes	1		1	0		1	1		0	1		1
Taper Length (ft)	0			0			25			0		
Right Turn on Red			Yes			Yes			Yes			Yes
Link Speed (mph)		30			30			40			40	
Link Distance (ft)		508			187			626			311	
Travel Time (s)		11.5			4.3			10.7			5.3	
Peak Hour Factor	0.90	0.90	0.90	0.85	0.85	0.85	0.94	0.94	0.94	0.99	0.99	0.99
Heavy Vehicles (%)	0%	0%	0%	5%	5%	5%	5%	5%	5%	2%	2%	2%
Shared Lane Traffic (%)	30%											
Lane Group Flow (vph)	626	316	226	0	52	114	372	876	0	57	863	1345
Turn Type	Split	NA	Perm	Split	NA	pm+ov	pm+pt	NA		Prot	NA	Free
Protected Phases	4	4		3	3	5	1	6		5	2	
Permitted Phases			4			3	6					Free
Detector Phase	4	4	4	3	3	5	1	6		5	2	
Switch Phase												
Minimum Initial (s)	6.0	6.0	6.0	5.0	5.0	5.0	5.0	10.0		5.0	10.0	
Minimum Split (s)	12.0	12.0	12.0	11.0	11.0	11.0	11.0	16.0		11.0	16.0	
Total Split (s)	52.0	52.0	52.0	11.0	11.0	15.0	28.0	52.0		15.0	39.0	
Total Split (%)	40.0%	40.0%	40.0%	8.5%	8.5%	11.5%	21.5%	40.0%		11.5%	30.0%	
Yellow Time (s)	3.0	3.0	3.0	3.0	3.0	3.0	3.0	5.0		3.0	5.0	
All-Red Time (s)	3.0	3.0	3.0	3.0	3.0	3.0	3.0	1.0		3.0	1.0	
Lost Time Adjust (s)	0.0	0.0	0.0		0.0	0.0	0.0	0.0		0.0	0.0	
Total Lost Time (s)	6.0	6.0	6.0		6.0	6.0	6.0	6.0		6.0	6.0	
Lead/Lag	Lag	Lag	Lag	Lead	Lead	Lead	Lead	Lag		Lead	Lag	
Lead-Lag Optimize?												
Recall Mode	None	None	None	None	None	None	None	C-Max		None	C-Max	
Act Effct Green (s)	48.2	48.2	48.2		5.0	12.2	61.0	46.8		8.2	33.0	130.0
Actuated g/C Ratio	0.37	0.37	0.37		0.04	0.09	0.47	0.36		0.06	0.25	1.00
v/c Ratio	0.99	0.49	0.30		0.76	0.44	1.07	0.71		0.51	0.96	0.85
Control Delay	73.7	35.6	4.7		118.0	9.0	90.5	37.9		65.3	67.2	10.0
Queue Delay	0.0	0.0	0.0		0.0	0.0	0.0	0.0		0.0	0.0	0.0
Total Delay	73.7	35.6	4.7		118.0	9.0	90.5	37.9		65.3	67.2	10.0
LOS	E	D	A		F	A	F	D		E	E	B
Approach Delay		50.1			43.2			53.6			33.2	
Approach LOS		D			D			D			C	
Queue Length 50th (ft)	~594	220	0		44	0	~303	387		44	351	370
Queue Length 95th (ft)	#840	318	54		#110	18	#506	451		m65	#505	263
Internal Link Dist (ft)		428			107			546			231	
Turn Bay Length (ft)			250				180					
Base Capacity (vph)	635	641	741		68	267	348	1231		122	898	1583
Starvation Cap Reductn	0	0	0		0	0	0	0		0	0	0
Spillback Cap Reductn	0	0	0		0	0	0	0		0	0	0
Storage Cap Reductn	0	0	0		0	0	0	0		0	0	0
Reduced v/c Ratio	0.99	0.49	0.30		0.76	0.43	1.07	0.71		0.47	0.96	0.85

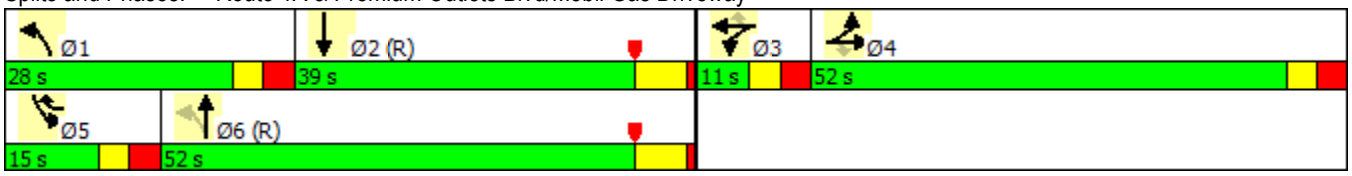
Intersection Summary		
Area Type:	Other	
Cycle Length: 130		
Actuated Cycle Length: 130		
Offset: 45 (35%), Referenced to phase 2:SBT and 6:NBTL, Start of Yellow		
Natural Cycle: 130		
Control Type: Actuated-Coordinated		
Maximum v/c Ratio: 1.07		
Intersection Signal Delay: 42.9		Intersection LOS: D
Intersection Capacity Utilization 88.1%		ICU Level of Service E
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.

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

Splits and Phases: Route 1A & Premium Outlets Blvd/Mobil Gas Driveway



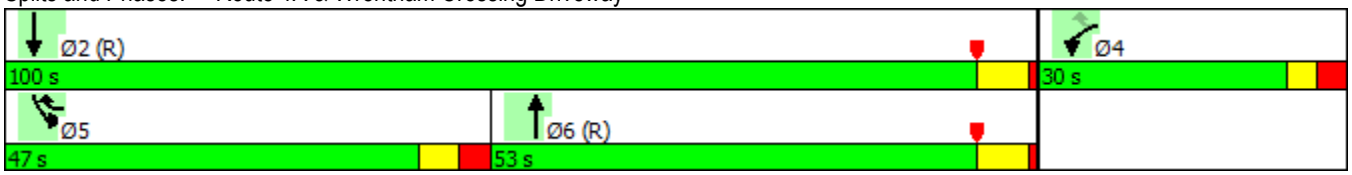
Lane Group	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Traffic Volume (vph)	221	350	824	168	401	675
Future Volume (vph)	221	350	824	168	401	675
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Storage Length (ft)	0	0		0	250	
Storage Lanes	1	1		0	1	
Taper Length (ft)	0				25	
Right Turn on Red		Yes		Yes		
Link Speed (mph)	30		40			40
Link Distance (ft)	454		212			626
Travel Time (s)	10.3		3.6			10.7
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Shared Lane Traffic (%)						
Lane Group Flow (vph)	240	380	1079	0	436	734
Turn Type	Prot	pm+ov	NA		Prot	NA
Protected Phases	4	5	6		5	2
Permitted Phases		4				
Detector Phase	4	5	6		5	2
Switch Phase						
Minimum Initial (s)	8.0	8.0	10.0		8.0	10.0
Minimum Split (s)	14.0	15.0	16.0		15.0	16.0
Total Split (s)	30.0	47.0	53.0		47.0	100.0
Total Split (%)	23.1%	36.2%	40.8%		36.2%	76.9%
Yellow Time (s)	3.0	4.0	5.0		4.0	5.0
All-Red Time (s)	3.0	3.0	1.0		3.0	1.0
Lost Time Adjust (s)	0.0	0.0	0.0		0.0	0.0
Total Lost Time (s)	6.0	7.0	6.0		7.0	6.0
Lead/Lag		Lead	Lag		Lead	
Lead-Lag Optimize?						
Recall Mode	None	None	C-Max		None	C-Max
Act Effct Green (s)	21.3	63.4	53.6		36.1	96.7
Actuated g/C Ratio	0.16	0.49	0.41		0.28	0.74
v/c Ratio	0.83	0.48	0.75		0.89	0.28
Control Delay	75.5	21.0	37.4		30.7	2.6
Queue Delay	0.0	0.0	0.0		0.0	0.0
Total Delay	75.5	21.0	37.4		30.7	2.6
LOS	E	C	D		C	A
Approach Delay	42.1		37.4			13.1
Approach LOS	D		D			B
Queue Length 50th (ft)	195	174	417		250	20
Queue Length 95th (ft)	#304	246	526		m418	m34
Internal Link Dist (ft)	374		132			546
Turn Bay Length (ft)					250	
Base Capacity (vph)	326	838	1435		544	2632
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	0.74	0.45	0.75		0.80	0.28

Intersection Summary

Area Type:	Other		
Cycle Length: 130			
Actuated Cycle Length: 130			
Offset: 122 (94%), Referenced to phase 2:SBT and 6:NBT, Start of Yellow			
Natural Cycle: 90			
Control Type: Actuated-Coordinated			
Maximum v/c Ratio: 0.89			
Intersection Signal Delay: 28.5		Intersection LOS: C	
Intersection Capacity Utilization 77.6%		ICU Level of Service D	
Analysis Period (min) 15			

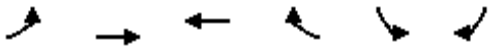
\# 95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.
m Volume for 95th percentile queue is metered by upstream signal.

Splits and Phases: Route 1A & Wrentham Crossing Driveway

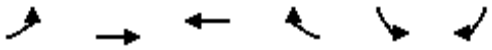


APPENDIX N

Intersection Capacity Analyses
Weekday AM/PM Peak Hour
Projected 2040 Traffic Conditions with Proposed Improvements



Lane Group	EBL	EBT	WBT	WBR	SBL	SBR	Ø9
Lane Configurations							
Traffic Volume (vph)	204	498	765	77	45	236	
Future Volume (vph)	204	498	765	77	45	236	
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	
Storage Length (ft)	75			0	0	75	
Storage Lanes	1			0	1	1	
Taper Length (ft)	0				0		
Right Turn on Red				Yes		Yes	
Link Speed (mph)		30	30		30		
Link Distance (ft)		762	621		1107		
Travel Time (s)		17.3	14.1		25.2		
Confl. Peds. (#/hr)	3			3			
Peak Hour Factor	0.92	0.92	0.87	0.87	0.85	0.85	
Growth Factor	112%	112%	112%	112%	112%	112%	
Heavy Vehicles (%)	1%	1%	1%	1%	1%	1%	
Shared Lane Traffic (%)							
Lane Group Flow (vph)	248	606	1084	0	59	311	
Turn Type	pm+pt	NA	NA		Prot	pm+ov	
Protected Phases	7	4	8		6	7	9
Permitted Phases	4					6	
Detector Phase	7	4	8		6	7	
Switch Phase							
Minimum Initial (s)	5.0	5.0	5.0		5.0	5.0	5.0
Minimum Split (s)	10.0	10.0	10.0		10.0	10.0	21.0
Total Split (s)	13.0	67.0	54.0		12.0	13.0	21.0
Total Split (%)	13.0%	67.0%	54.0%		12.0%	13.0%	21%
Yellow Time (s)	3.0	3.0	3.0		3.0	3.0	3.0
All-Red Time (s)	2.0	2.0	2.0		2.0	2.0	1.0
Lost Time Adjust (s)	0.0	0.0	0.0		0.0	0.0	
Total Lost Time (s)	5.0	5.0	5.0		5.0	5.0	
Lead/Lag	Lead		Lag			Lead	
Lead-Lag Optimize?	Yes		Yes			Yes	
Recall Mode	None	None	None		Min	None	None
Act Effct Green (s)	62.0	62.0	49.0		6.7	19.7	
Actuated g/C Ratio	0.79	0.79	0.62		0.09	0.25	
v/c Ratio	0.90	0.41	0.94		0.39	0.49	
Control Delay	53.4	3.6	30.4		42.0	6.1	
Queue Delay	0.0	0.0	0.0		0.0	0.0	
Total Delay	53.4	3.6	30.4		42.0	6.1	
LOS	D	A	C		D	A	
Approach Delay		18.1	30.4		11.8		
Approach LOS		B	C		B		
Queue Length 50th (ft)	70	68	433		28	0	
Queue Length 95th (ft)	#204	105	#716		60	48	
Internal Link Dist (ft)		682	541		1027		
Turn Bay Length (ft)	75					75	
Base Capacity (vph)	276	1482	1158		159	633	
Starvation Cap Reductn	0	0	0		0	0	
Spillback Cap Reductn	0	0	0		0	0	

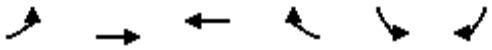


Lane Group	EBL	EBT	WBT	WBR	SBL	SBR	Ø9
Storage Cap Reductn	0	0	0		0	0	
Reduced v/c Ratio	0.90	0.41	0.94		0.37	0.49	

Intersection Summary			
Area Type:	Other		
Cycle Length: 100			
Actuated Cycle Length: 78.7			
Natural Cycle: 130			
Control Type: Actuated-Uncoordinated			
Maximum v/c Ratio: 0.94			
Intersection Signal Delay: 22.9		Intersection LOS: C	
Intersection Capacity Utilization 79.7%		ICU Level of Service D	
Analysis Period (min) 15			

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

Splits and Phases: 8: Route 1A & Creek Street



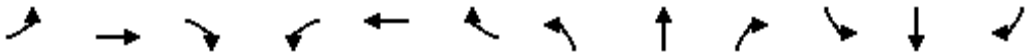
Lane Group	EBL	EBT	WBT	WBR	SBL	SBR	Ø9
Lane Configurations							
Traffic Volume (vph)	204	498	765	77	45	236	
Future Volume (vph)	204	498	765	77	45	236	
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	
Right Turn on Red				Yes		Yes	
Link Speed (mph)		30	30		30		
Link Distance (ft)		762	621		1107		
Travel Time (s)		17.3	14.1		25.2		
Confl. Peds. (#/hr)	3			3			
Peak Hour Factor	0.92	0.92	0.87	0.87	0.85	0.85	
Growth Factor	112%	112%	112%	112%	112%	112%	
Heavy Vehicles (%)	1%	1%	1%	1%	1%	1%	
Shared Lane Traffic (%)							
Lane Group Flow (vph)	248	606	1084	0	59	311	
Turn Type	pm+pt	NA	NA		Prot	Perm	
Protected Phases	7	4	8		6		9
Permitted Phases	4					6	
Detector Phase	7	4	8		6	6	
Switch Phase							
Minimum Initial (s)	5.0	5.0	5.0		5.0	5.0	5.0
Minimum Split (s)	10.0	10.0	10.0		10.0	10.0	21.0
Total Split (s)	17.0	85.0	68.0		14.0	14.0	21.0
Total Split (%)	14.2%	70.8%	56.7%		11.7%	11.7%	18%
Yellow Time (s)	3.0	3.0	3.0		3.0	3.0	2.0
All-Red Time (s)	2.0	2.0	2.0		2.0	2.0	1.0
Lost Time Adjust (s)	0.0	0.0	0.0		0.0	0.0	
Total Lost Time (s)	5.0	5.0	5.0		5.0	5.0	
Lead/Lag	Lead		Lag				
Lead-Lag Optimize?	Yes		Yes				
Recall Mode	None	None	None		Max	Max	None
Act Effct Green (s)	80.4	80.4	63.3		9.0	9.0	
Actuated g/C Ratio	0.78	0.78	0.62		0.09	0.09	
v/c Ratio	0.88	0.41	0.95		0.38	0.73	
Control Delay	57.1	5.4	36.3		53.4	16.7	
Queue Delay	0.0	0.0	0.0		0.0	0.0	
Total Delay	57.1	5.4	36.3		53.4	16.7	
LOS	E	A	D		D	B	
Approach Delay		20.4	36.3		22.6		
Approach LOS		C	D		C		
Queue Length 50th (ft)	101	81	541		36	0	
Queue Length 95th (ft)	#310	268	#1107		83	68	
Internal Link Dist (ft)		682	541		1027		
Turn Bay Length (ft)							
Base Capacity (vph)	283	1473	1146		157	424	
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	0.88	0.41	0.95		0.38	0.73	

Intersection Summary

Area Type:	Other		
Cycle Length: 120			
Actuated Cycle Length: 102.6			
Natural Cycle: 150			
Control Type: Actuated-Uncoordinated			
Maximum v/c Ratio: 0.95			
Intersection Signal Delay: 28.2		Intersection LOS: C	
Intersection Capacity Utilization 79.7%		ICU Level of Service D	
Analysis Period (min) 15			

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

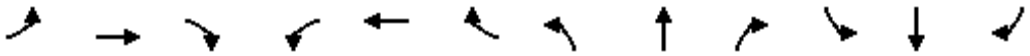
Splits and Phases: Route 1A & Creek Street



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	4	915	33	41	429	3	22	0	38	9	1	1
Future Volume (Veh/h)	4	915	33	41	429	3	22	0	38	9	1	1
Sign Control		Free			Free			Stop			Stop	
Grade		0%			0%			0%			0%	
Peak Hour Factor	0.86	0.86	0.86	0.86	0.86	0.86	0.79	0.79	0.79	0.55	0.55	0.55
Hourly flow rate (vph)	5	1192	43	53	559	4	31	0	54	18	2	2
Pedestrians												
Lane Width (ft)												
Walking Speed (ft/s)												
Percent Blockage												
Right turn flare (veh)												
Median type		None			None							
Median storage veh)												
Upstream signal (ft)												
pX, platoon unblocked												
vC, conflicting volume	563			1235			1892	1892	1214	1944	1912	561
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	563			1235			1892	1892	1214	1944	1912	561
tC, single (s)	4.1			4.2			7.2	6.6	6.3	7.2	6.6	6.3
tC, 2 stage (s)												
tF (s)	2.2			2.3			3.6	4.1	3.4	3.6	4.1	3.4
p0 queue free %	99			90			30	100	74	44	97	100
cM capacity (veh/h)	994			534			45	59	210	32	58	514

Direction, Lane #	EB 1	WB 1	WB 2	NB 1	SB 1
Volume Total	1240	53	563	85	22
Volume Left	5	53	0	31	18
Volume Right	43	0	4	54	2
cSH	994	534	1700	89	37
Volume to Capacity	0.01	0.10	0.33	0.95	0.60
Queue Length 95th (ft)	0	8	0	135	53
Control Delay (s)	0.2	12.5	0.0	167.0	199.7
Lane LOS	A	B		F	F
Approach Delay (s)	0.2	1.1		167.0	199.7
Approach LOS				F	F

Intersection Summary				
Average Delay	9.9			
Intersection Capacity Utilization	70.2%	ICU Level of Service		C
Analysis Period (min)	15			



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	1	604	48	69	876	4	45	0	77	5	0	2
Future Volume (Veh/h)	1	604	48	69	876	4	45	0	77	5	0	2
Sign Control		Free			Free			Stop			Stop	
Grade		0%			0%			0%			0%	
Peak Hour Factor	0.97	0.97	0.97	0.88	0.88	0.88	0.76	0.76	0.76	0.58	0.58	0.58
Hourly flow rate (vph)	1	697	55	88	1115	5	66	0	113	10	0	4
Pedestrians		1			1			1				
Lane Width (ft)		12.0			12.0			12.0				
Walking Speed (ft/s)		3.5			3.5			3.5				
Percent Blockage		0			0			0				
Right turn flare (veh)												
Median type		None			None							
Median storage veh)												
Upstream signal (ft)												
pX, platoon unblocked												
vC, conflicting volume	1120			753			2024	2024	726	2134	2048	1118
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	1120			753			2024	2024	726	2134	2048	1118
tC, single (s)	4.1			4.1			7.1	6.5	6.2	7.1	6.5	6.2
tC, 2 stage (s)												
tF (s)	2.2			2.2			3.5	4.0	3.3	3.5	4.0	3.3
p0 queue free %	100			90			0	100	74	59	100	98
cM capacity (veh/h)	624			861			39	52	427	25	51	254

Direction, Lane #	EB 1	WB 1	WB 2	NB 1	SB 1
Volume Total	753	88	1120	179	14
Volume Left	1	88	0	66	10
Volume Right	55	0	5	113	4
cSH	624	861	1700	92	33
Volume to Capacity	0.00	0.10	0.66	1.94	0.42
Queue Length 95th (ft)	0	9	0	382	35
Control Delay (s)	0.0	9.7	0.0	538.2	178.1
Lane LOS	A	A		F	F
Approach Delay (s)	0.0	0.7		538.2	178.1
Approach LOS				F	F

Intersection Summary			
Average Delay	46.3		
Intersection Capacity Utilization	77.8%	ICU Level of Service	D
Analysis Period (min)	15		

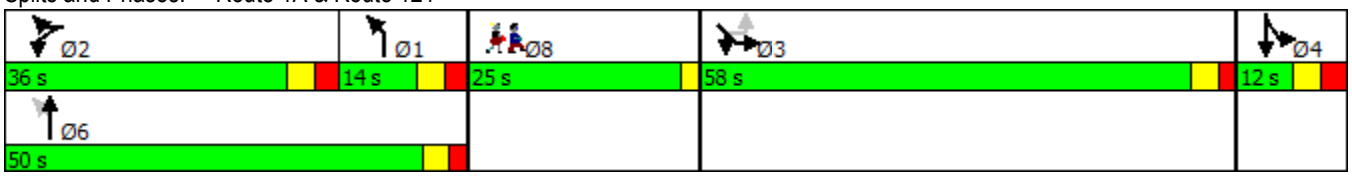
Lane Group	WBL	WBR	NBL	NBT	NBR	SBL	SBT	SBR	SEL	SER	Ø8
Lane Configurations											
Traffic Volume (vph)	289	173	60	0	419	0	0	7	526	200	
Future Volume (vph)	289	173	60	0	419	0	0	7	526	200	
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	
Storage Length (ft)	0	0	150		0	0		0	0	200	
Storage Lanes	1	1	1		0	0		0	1	1	
Taper Length (ft)	25		25			25			25		
Right Turn on Red					Yes			Yes		Yes	
Link Speed (mph)	30			30			30		30		
Link Distance (ft)	228			938			493		596		
Travel Time (s)	5.2			21.3			11.2		13.5		
Peak Hour Factor	0.91	0.91	0.87	0.87	0.87	0.92	0.92	0.35	0.86	0.86	
Growth Factor	112%	112%	112%	112%	112%	112%	112%	112%	112%	112%	
Heavy Vehicles (%)	12%	12%	8%	8%	8%	2%	2%	14%	2%	2%	
Shared Lane Traffic (%)											
Lane Group Flow (vph)	356	213	77	539	0	0	22	0	685	260	
Turn Type	Prot	Prot	pm+pt	NA			NA		Prot	Prot	
Protected Phases	2!	2!	1	6!		4	4		3	3	8
Permitted Phases			6!								
Detector Phase	2	2	1	6		4	4		3	3	
Switch Phase											
Minimum Initial (s)	15.0	15.0	8.0	15.0		3.0	3.0		8.0	8.0	5.0
Minimum Split (s)	21.0	21.0	14.0	20.0		12.0	12.0		13.0	13.0	25.0
Total Split (s)	36.0	36.0	14.0	50.0		12.0	12.0		58.0	58.0	25.0
Total Split (%)	24.8%	24.8%	9.7%	34.5%		8.3%	8.3%		40.0%	40.0%	17%
Yellow Time (s)	3.0	3.0	3.0	3.0		3.0	3.0		3.0	3.0	2.0
All-Red Time (s)	2.5	2.5	2.5	2.0		3.0	3.0		2.0	2.0	0.0
Lost Time Adjust (s)	0.0	0.0	0.0	0.0			0.0		0.0	0.0	
Total Lost Time (s)	5.5	5.5	5.5	5.0			6.0		5.0	5.0	
Lead/Lag	Lead	Lead	Lag								
Lead-Lag Optimize?	Yes	Yes	Yes								
Recall Mode	Min	Min	None	Min		None	None		None	None	None
Act Effct Green (s)	30.7	30.7	43.1	41.8			4.5		53.4	53.4	
Actuated g/C Ratio	0.28	0.28	0.39	0.38			0.04		0.48	0.48	
v/c Ratio	0.80	0.54	0.42	0.64			0.03		0.81	0.31	
Control Delay	54.1	42.1	46.3	9.4			0.0		35.4	10.6	
Queue Delay	0.0	0.0	0.0	0.0			0.0		0.0	0.0	
Total Delay	54.1	42.1	46.3	9.4			0.0		35.4	10.6	
LOS	D	D	D	A			A		D	B	
Approach Delay	49.6			14.0					28.6		
Approach LOS	D			B					C		
Queue Length 50th (ft)	259	141	38	48			0		458	56	
Queue Length 95th (ft)	#424	226	71	141			0		#596	107	
Internal Link Dist (ft)	148			858			413		516		
Turn Bay Length (ft)			150							200	
Base Capacity (vph)	445	398	189	872			848		850	830	
Starvation Cap Reductn	0	0	0	0			0		0	0	
Spillback Cap Reductn	0	0	0	0			0		0	0	
Storage Cap Reductn	0	0	0	0			0		0	0	

Lane Group	WBL	WBR	NBL	NBT	NBR	SBL	SBT	SBR	SEL	SER	Ø8
Reduced v/c Ratio	0.80	0.54	0.41	0.62			0.03		0.81	0.31	

Intersection Summary			
Area Type:	Other		
Cycle Length: 145			
Actuated Cycle Length: 111.2			
Natural Cycle: 145			
Control Type: Actuated-Uncoordinated			
Maximum v/c Ratio: 0.81			
Intersection Signal Delay: 29.7		Intersection LOS: C	
Intersection Capacity Utilization 92.5%		ICU Level of Service F	
Analysis Period (min) 15			

\# 95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.
! Phase conflict between lane groups.

Splits and Phases: Route 1A & Route 121



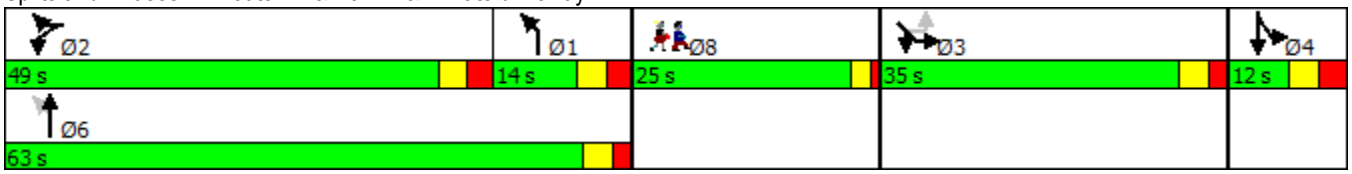
Lane Group	WBL	WBR	WBR2	NBL	NBT	NBR	SBL	SBT	SBR	SEL	SER	Ø8
Lane Configurations												
Traffic Volume (vph)	440	472	6	201	0	386	3	2	0	255	145	
Future Volume (vph)	440	472	6	201	0	386	3	2	0	255	145	
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	
Storage Length (ft)	0	0		150		0	0		0	0	200	
Storage Lanes	1	1		1		0	0		0	1	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)	223				1040			190		596		
Travel Time (s)	5.1				23.6			4.3		13.5		
Confl. Peds. (#/hr)			1	8		2	2		8			
Peak Hour Factor	0.84	0.84	0.84	0.90	0.90	0.90	0.62	0.62	0.62	0.69	0.69	
Growth Factor	112%	112%	112%	112%	112%	112%	112%	112%	112%	112%	112%	
Heavy Vehicles (%)	1%	1%	1%	2%	2%	2%	17%	17%	17%	2%	2%	
Shared Lane Traffic (%)												
Lane Group Flow (vph)	587	637	0	250	480	0	0	9	0	414	235	
Turn Type	Prot	Prot		pm+pt	NA		Split	NA		Prot	Prot	
Protected Phases	2!	2!		1	6!		4	4		3	3	8
Permitted Phases				6!								
Detector Phase	2	2		1	6		4	4		3	3	
Switch Phase												
Minimum Initial (s)	15.0	15.0		8.0	15.0		3.0	3.0		8.0	8.0	5.0
Minimum Split (s)	21.0	21.0		14.0	20.5		12.0	12.0		13.0	13.0	25.0
Total Split (s)	49.0	49.0		14.0	63.0		12.0	12.0		35.0	35.0	25.0
Total Split (%)	36.3%	36.3%		10.4%	46.7%		8.9%	8.9%		25.9%	25.9%	19%
Yellow Time (s)	3.0	3.0		3.0	3.0		3.0	3.0		3.0	3.0	2.0
All-Red Time (s)	2.5	2.5		2.5	2.0		3.0	3.0		2.0	2.0	1.0
Lost Time Adjust (s)	0.0	0.0		0.0	0.0			0.0		0.0	0.0	
Total Lost Time (s)	5.5	5.5		5.5	5.0			6.0		5.0	5.0	
Lead/Lag	Lead	Lead		Lag								
Lead-Lag Optimize?	Yes	Yes		Yes								
Recall Mode	Min	Min		None	Min		None	None		None	None	None
Act Effct Green (s)	44.2	44.2		58.0	58.5			5.1		30.5	30.5	
Actuated g/C Ratio	0.42	0.42		0.55	0.56			0.05		0.29	0.29	
v/c Ratio	0.78	0.85		0.40	0.43			0.12		0.81	0.40	
Control Delay	36.6	35.0		19.5	1.9			56.5		49.3	12.3	
Queue Delay	0.0	0.0		0.0	0.0			0.0		0.0	0.0	
Total Delay	36.6	35.0		19.5	1.9			56.5		49.3	12.3	
LOS	D	C		B	A			E		D	B	
Approach Delay	35.7				7.9			56.5		35.9		
Approach LOS	D				A			E		D		
Queue Length 50th (ft)	292	270		70	0			5		231	27	
Queue Length 95th (ft)	#684	#667		214	20			19		#376	55	
Internal Link Dist (ft)	143				960			110		516		
Turn Bay Length (ft)				150							200	
Base Capacity (vph)	753	751		634	1122			92		514	584	
Starvation Cap Reductn	0	0		0	0			0		0	0	
Spillback Cap Reductn	0	0		0	0			0		0	0	

Lane Group	WBL	WBR	WBR2	NBL	NBT	NBR	SBL	SBT	SBR	SEL	SER	Ø8
Storage Cap Reductn	0	0		0	0			0		0	0	
Reduced v/c Ratio	0.78	0.85		0.39	0.43			0.10		0.81	0.40	

Intersection Summary			
Area Type:	Other		
Cycle Length: 135			
Actuated Cycle Length: 104.9			
Natural Cycle: 135			
Control Type: Actuated-Uncoordinated			
Maximum v/c Ratio: 0.85			
Intersection Signal Delay: 28.1		Intersection LOS: C	
Intersection Capacity Utilization 83.0%		ICU Level of Service E	
Analysis Period (min) 15			

\# 95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.
! Phase conflict between lane groups.

Splits and Phases: Route 1A & Rt 121 & Private driveway



Lane Group	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Traffic Volume (vph)	183	145	482	668	142	571
Future Volume (vph)	183	145	482	668	142	571
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Storage Length (ft)	200	300		0	0	
Storage Lanes	1	1		0	1	
Taper Length (ft)	25				0	
Right Turn on Red		Yes		Yes		
Link Speed (mph)	30		30			30
Link Distance (ft)	627		1275			363
Travel Time (s)	14.3		29.0			8.3
Peak Hour Factor	0.95	0.95	0.91	0.91	0.86	0.86
Heavy Vehicles (%)	16%	16%	6%	6%	9%	9%
Shared Lane Traffic (%)						
Lane Group Flow (vph)	193	153	1264	0	165	664
Turn Type	Prot	Perm	NA		pm+pt	NA
Protected Phases	4		6		5	2
Permitted Phases		4			2	
Detector Phase	4	4	6		5	2
Switch Phase						
Minimum Initial (s)	10.0	10.0	21.0		5.0	21.0
Minimum Split (s)	15.0	15.0	27.0		9.5	27.0
Total Split (s)	15.0	15.0	28.0		12.0	40.0
Total Split (%)	27.3%	27.3%	50.9%		21.8%	72.7%
Yellow Time (s)	3.0	3.0	5.0		3.5	5.0
All-Red Time (s)	2.0	2.0	1.0		1.0	1.0
Lost Time Adjust (s)	0.0	0.0	0.0		0.0	0.0
Total Lost Time (s)	5.0	5.0	6.0		4.5	6.0
Lead/Lag			Lag		Lead	
Lead-Lag Optimize?			Yes		Yes	
Recall Mode	None	None	C-Max		None	C-Max
Act Effct Green (s)	10.0	10.0	24.5		35.5	34.0
Actuated g/C Ratio	0.18	0.18	0.45		0.65	0.62
v/c Ratio	0.35	0.40	0.70		0.49	0.62
Control Delay	21.8	8.0	4.3		10.1	9.6
Queue Delay	0.0	0.0	0.0		0.0	0.0
Total Delay	21.8	8.0	4.3		10.1	9.6
LOS	C	A	A		B	A
Approach Delay	15.7		4.3			9.7
Approach LOS	B		A			A
Queue Length 50th (ft)	28	0	47		17	112
Queue Length 95th (ft)	53	40	0		43	180
Internal Link Dist (ft)	547		1195			283
Turn Bay Length (ft)	200	300				
Base Capacity (vph)	548	378	1794		352	1077
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	0.35	0.40	0.70		0.47	0.62

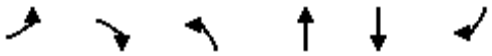
Intersection Summary		
Area Type:	Other	
Cycle Length: 55		
Actuated Cycle Length: 55		
Offset: 0 (0%), Referenced to phase 2:SBTL and 6:NBT, Start of Yellow, Master Intersection		
Natural Cycle: 60		
Control Type: Actuated-Coordinated		
Maximum v/c Ratio: 0.70		
Intersection Signal Delay: 7.7		Intersection LOS: A
Intersection Capacity Utilization 63.9%		ICU Level of Service B
Analysis Period (min) 15		

Splits and Phases: Route 1A & I-495 NB Ramps

Lane Group	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Traffic Volume (vph)	472	360	532	466	158	642
Future Volume (vph)	472	360	532	466	158	642
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Storage Length (ft)	200	300		0	0	
Storage Lanes	1	1		0	1	
Taper Length (ft)	25				0	
Right Turn on Red		Yes		Yes		
Link Speed (mph)	30		30			30
Link Distance (ft)	627		1275			363
Travel Time (s)	14.3		29.0			8.3
Peak Hour Factor	0.98	0.98	0.83	0.83	0.81	0.81
Heavy Vehicles (%)	3%	3%	2%	2%	2%	2%
Shared Lane Traffic (%)						
Lane Group Flow (vph)	482	367	1202	0	195	793
Turn Type	Prot	Perm	NA		pm+pt	NA
Protected Phases	4		6		5	2
Permitted Phases		4			2	
Detector Phase	4	4	6		5	2
Switch Phase						
Minimum Initial (s)	10.0	10.0	21.0		5.0	21.0
Minimum Split (s)	15.0	15.0	27.0		9.5	27.0
Total Split (s)	15.0	15.0	29.0		11.0	40.0
Total Split (%)	27.3%	27.3%	52.7%		20.0%	72.7%
Yellow Time (s)	3.0	3.0	5.0		3.5	5.0
All-Red Time (s)	2.0	2.0	1.0		1.0	1.0
Lost Time Adjust (s)	0.0	0.0	0.0		0.0	0.0
Total Lost Time (s)	5.0	5.0	6.0		4.5	6.0
Lead/Lag			Lag		Lead	
Lead-Lag Optimize?						
Recall Mode	None	None	C-Max		None	C-Max
Act Effct Green (s)	10.0	10.0	25.2		35.5	34.0
Actuated g/C Ratio	0.18	0.18	0.46		0.65	0.62
v/c Ratio	0.78	0.64	0.68		0.57	0.69
Control Delay	32.5	9.2	6.3		12.5	11.0
Queue Delay	0.0	0.0	0.0		0.0	0.0
Total Delay	32.5	9.2	6.3		12.5	11.0
LOS	C	A	A		B	B
Approach Delay	22.4		6.3			11.3
Approach LOS	C		A			B
Queue Length 50th (ft)	78	4	110		21	144
Queue Length 95th (ft)	#141	65	50		48	201
Internal Link Dist (ft)	547		1195			283
Turn Bay Length (ft)	200	300				
Base Capacity (vph)	618	573	1775		345	1151
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	0.78	0.64	0.68		0.57	0.69

Intersection Summary		
Area Type:	Other	
Cycle Length: 55		
Actuated Cycle Length: 55		
Offset: 0 (0%), Referenced to phase 2:SBTL and 6:NBT, Start of Yellow, Master Intersection		
Natural Cycle: 55		
Control Type: Actuated-Coordinated		
Maximum v/c Ratio: 0.78		
Intersection Signal Delay: 12.4	Intersection LOS: B	
Intersection Capacity Utilization 64.8%	ICU Level of Service C	
Analysis Period (min) 15		
# 95th percentile volume exceeds capacity, queue may be longer.		
Queue shown is maximum after two cycles.		

Splits and Phases: 4: Route 1A & I-495 NB Ramps

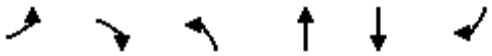


Lane Group	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Traffic Volume (vph)	114	259	0	1290	408	347
Future Volume (vph)	114	259	0	1290	408	347
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Right Turn on Red		Yes				Yes
Link Speed (mph)	30			40	40	
Link Distance (ft)	604			409	1275	
Travel Time (s)	13.7			7.0	21.7	
Peak Hour Factor	0.78	0.78	0.86	0.86	0.85	0.85
Heavy Vehicles (%)	14%	14%	7%	7%	11%	11%
Shared Lane Traffic (%)						
Lane Group Flow (vph)	146	332	0	1500	888	0
Turn Type	Prot	Perm		NA	NA	
Protected Phases	8			6	2	
Permitted Phases		8				
Detector Phase	8	8		6	2	
Switch Phase						
Minimum Initial (s)	5.0	5.0		10.0	10.0	
Minimum Split (s)	10.0	10.0		16.0	16.0	
Total Split (s)	17.0	17.0		38.0	38.0	
Total Split (%)	30.9%	30.9%		69.1%	69.1%	
Yellow Time (s)	3.0	3.0		5.0	5.0	
All-Red Time (s)	2.0	2.0		1.0	1.0	
Lost Time Adjust (s)	0.0	0.0		0.0	0.0	
Total Lost Time (s)	5.0	5.0		6.0	6.0	
Lead/Lag						
Lead-Lag Optimize?						
Recall Mode	None	None		C-Max	C-Max	
Act Effct Green (s)	8.4	8.4		35.6	35.6	
Actuated g/C Ratio	0.15	0.15		0.65	0.65	
v/c Ratio	0.31	0.67		0.69	0.42	
Control Delay	21.7	10.2		6.1	2.7	
Queue Delay	0.0	0.0		0.0	0.0	
Total Delay	21.7	10.2		6.1	2.7	
LOS	C	B		A	A	
Approach Delay	13.7			6.1	2.7	
Approach LOS	B			A	A	
Queue Length 50th (ft)	22	0		97	11	
Queue Length 95th (ft)	34	33		195	44	
Internal Link Dist (ft)	524			329	1195	
Turn Bay Length (ft)						
Base Capacity (vph)	670	568		2183	2103	
Starvation Cap Reductn	0	0		0	0	
Spillback Cap Reductn	0	0		0	0	
Storage Cap Reductn	0	0		0	0	
Reduced v/c Ratio	0.22	0.58		0.69	0.42	

Intersection Summary	
Area Type:	Other

Cycle Length: 55	
Actuated Cycle Length: 55	
Offset: 31 (56%), Referenced to phase 2:SBT and 6:NBT, Start of Yellow	
Natural Cycle: 50	
Control Type: Actuated-Coordinated	
Maximum v/c Ratio: 0.69	
Intersection Signal Delay: 6.3	Intersection LOS: A
Intersection Capacity Utilization 49.0%	ICU Level of Service A
Analysis Period (min) 15	

Splits and Phases: Route 1A & I-495 SB Ramps

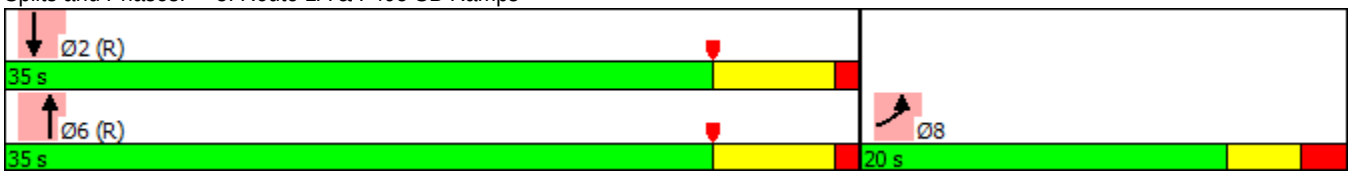


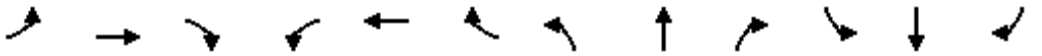
Lane Group	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Traffic Volume (vph)	164	716	0	1248	957	157
Future Volume (vph)	164	716	0	1248	957	157
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Right Turn on Red		Yes				Yes
Link Speed (mph)	30			30	30	
Link Distance (ft)	579			399	1275	
Travel Time (s)	13.2			9.1	29.0	
Peak Hour Factor	0.86	0.86	0.89	0.89	0.88	0.88
Heavy Vehicles (%)	2%	2%	1%	1%	2%	2%
Shared Lane Traffic (%)						
Lane Group Flow (vph)	191	833	0	1402	1266	0
Turn Type	Prot	Free		NA	NA	
Protected Phases	8			6	2	
Permitted Phases		Free				
Detector Phase	8			6	2	
Switch Phase						
Minimum Initial (s)	5.0			10.0	10.0	
Minimum Split (s)	20.0			20.0	20.0	
Total Split (s)	20.0			35.0	35.0	
Total Split (%)	36.4%			63.6%	63.6%	
Yellow Time (s)	3.0			5.0	5.0	
All-Red Time (s)	2.0			1.0	1.0	
Lost Time Adjust (s)	0.0			0.0	0.0	
Total Lost Time (s)	5.0			6.0	6.0	
Lead/Lag						
Lead-Lag Optimize?						
Recall Mode	None			C-Max	C-Max	
Act Effct Green (s)	8.4	55.0		39.0	39.0	
Actuated g/C Ratio	0.15	1.00		0.71	0.71	
v/c Ratio	0.36	0.53		0.55	0.51	
Control Delay	22.5	1.3		2.5	5.5	
Queue Delay	0.0	0.0		0.0	0.0	
Total Delay	22.5	1.3		2.5	5.5	
LOS	C	A		A	A	
Approach Delay	5.2			2.5	5.5	
Approach LOS	A			A	A	
Queue Length 50th (ft)	29	0		18	98	
Queue Length 95th (ft)	48	0		52	120	
Internal Link Dist (ft)	499			319	1195	
Turn Bay Length (ft)						
Base Capacity (vph)	936	1583		2536	2474	
Starvation Cap Reductn	0	0		0	0	
Spillback Cap Reductn	0	0		0	0	
Storage Cap Reductn	0	0		0	0	
Reduced v/c Ratio	0.20	0.53		0.55	0.51	

Intersection Summary	
Area Type:	Other

Cycle Length: 55	
Actuated Cycle Length: 55	
Offset: 27 (49%), Referenced to phase 2:SBT and 6:NBT, Start of Yellow	
Natural Cycle: 50	
Control Type: Actuated-Coordinated	
Maximum v/c Ratio: 0.55	
Intersection Signal Delay: 4.3	Intersection LOS: A
Intersection Capacity Utilization 48.3%	ICU Level of Service A
Analysis Period (min) 15	

Splits and Phases: 3: Route 1A & I-495 SB Ramps



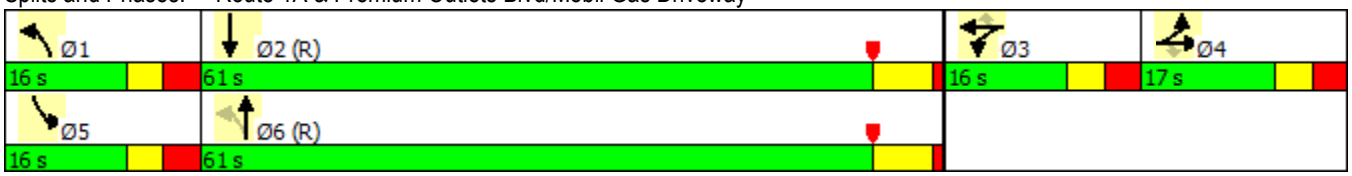


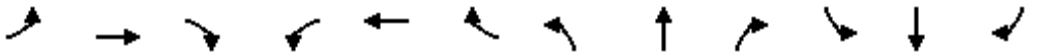
Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	122	4	43	21	7	104	109	1052	63	63	482	137
Future Volume (vph)	122	4	43	21	7	104	109	1052	63	63	482	137
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Storage Length (ft)	0		250	0		0	230		0	0		0
Storage Lanes	1		1	0		1	1		0	1		1
Taper Length (ft)	0			0			25			0		
Right Turn on Red			Yes			Yes			Yes			Yes
Link Speed (mph)		30			30			40			40	
Link Distance (ft)		721			236			646			291	
Travel Time (s)		16.4			5.4			11.0			5.0	
Peak Hour Factor	0.69	0.69	0.69	0.65	0.65	0.65	0.91	0.91	0.91	0.91	0.91	0.91
Heavy Vehicles (%)	9%	9%	9%	15%	15%	15%	8%	8%	8%	17%	17%	17%
Shared Lane Traffic (%)	48%											
Lane Group Flow (vph)	92	91	62	0	43	160	120	1225	0	69	530	151
Turn Type	Split	NA	Perm	Split	NA	Perm	pm+pt	NA		Prot	NA	Free
Protected Phases	4	4		3	3		1	6		5	2	
Permitted Phases			4			3	6					Free
Detector Phase	4	4	4	3	3	3	1	6		5	2	
Switch Phase												
Minimum Initial (s)	6.0	6.0	6.0	5.0	5.0	5.0	5.0	10.0		5.0	10.0	
Minimum Split (s)	12.0	12.0	12.0	11.0	11.0	11.0	11.0	16.0		11.0	16.0	
Total Split (s)	17.0	17.0	17.0	16.0	16.0	16.0	16.0	61.0		16.0	61.0	
Total Split (%)	15.5%	15.5%	15.5%	14.5%	14.5%	14.5%	14.5%	55.5%		14.5%	55.5%	
Yellow Time (s)	3.0	3.0	3.0	3.0	3.0	3.0	3.0	5.0		3.0	5.0	
All-Red Time (s)	3.0	3.0	3.0	3.0	3.0	3.0	3.0	1.0		3.0	1.0	
Lost Time Adjust (s)	0.0	0.0	0.0		0.0	0.0	0.0	0.0		0.0	0.0	
Total Lost Time (s)	6.0	6.0	6.0		6.0	6.0	6.0	6.0		6.0	6.0	
Lead/Lag	Lag	Lag	Lag	Lead	Lead	Lead	Lead	Lag		Lead	Lag	
Lead-Lag Optimize?												
Recall Mode	None	None	None	None	None	None	None	C-Max		None	C-Max	
Act Effct Green (s)	10.2	10.2	10.2		8.1	8.1	68.2	61.2		8.9	59.4	110.0
Actuated g/C Ratio	0.09	0.09	0.09		0.07	0.07	0.62	0.56		0.08	0.54	1.00
v/c Ratio	0.63	0.62	0.23		0.37	0.64	0.23	0.66		0.55	0.32	0.11
Control Delay	67.5	66.7	2.0		56.8	19.7	3.8	11.1		60.0	14.2	0.1
Queue Delay	0.0	0.0	0.0		0.0	0.0	0.0	0.0		0.0	0.0	0.0
Total Delay	67.5	66.7	2.0		56.8	19.7	3.8	11.1		60.0	14.2	0.1
LOS	E	E	A		E	B	A	B		E	B	A
Approach Delay		50.6			27.5			10.4			15.6	
Approach LOS		D			C			B			B	
Queue Length 50th (ft)	66	65	0		29	0	8	351		45	108	0
Queue Length 95th (ft)	93	92	0		46	14	15	217		m84	144	0
Internal Link Dist (ft)		641			156			566			211	
Turn Bay Length (ft)			250				230					
Base Capacity (vph)	160	161	284		144	273	555	1848		141	1667	1380
Starvation Cap Reductn	0	0	0		0	0	0	15		0	0	0
Spillback Cap Reductn	0	0	0		0	0	0	0		0	0	0
Storage Cap Reductn	0	0	0		0	0	0	0		0	0	0
Reduced v/c Ratio	0.57	0.57	0.22		0.30	0.59	0.22	0.67		0.49	0.32	0.11

Intersection Summary		
Area Type:	Other	
Cycle Length: 110		
Actuated Cycle Length: 110		
Offset: 36 (33%), Referenced to phase 2:SBT and 6:NBTL, Start of Yellow		
Natural Cycle: 65		
Control Type: Actuated-Coordinated		
Maximum v/c Ratio: 0.66		
Intersection Signal Delay: 17.2	Intersection LOS: B	
Intersection Capacity Utilization 60.4%	ICU Level of Service B	
Analysis Period (min) 15		

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

Splits and Phases: Route 1A & Premium Outlets Blvd/Mobil Gas Driveway



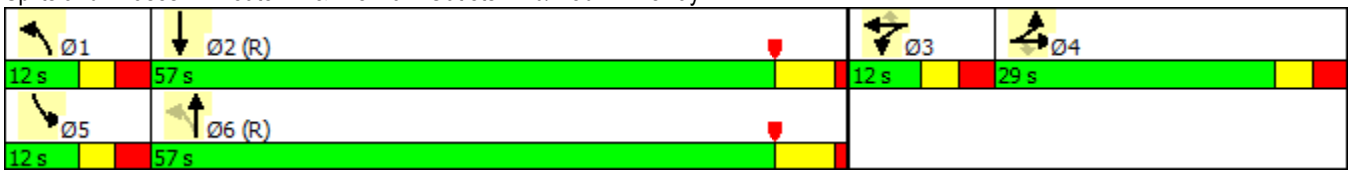


Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	507	36	181	29	15	72	129	687	35	45	1172	452
Future Volume (vph)	507	36	181	29	15	72	129	687	35	45	1172	452
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Storage Length (ft)	0		250	0		0	230		0	0		0
Storage Lanes	1		1	0		1	1		0	1		1
Taper Length (ft)	0			0			25			0		
Right Turn on Red			Yes			Yes			Yes			Yes
Link Speed (mph)		30			30			40			40	
Link Distance (ft)		659			195			646			246	
Travel Time (s)		15.0			4.4			11.0			4.2	
Peak Hour Factor	0.88	0.88	0.88	0.70	0.70	0.70	0.94	0.94	0.94	0.87	0.87	0.87
Heavy Vehicles (%)	0%	0%	0%	2%	2%	2%	4%	4%	4%	3%	3%	3%
Shared Lane Traffic (%)	47%											
Lane Group Flow (vph)	305	312	206	0	62	103	137	768	0	52	1347	520
Turn Type	Split	NA	Perm	Split	NA	Perm	pm+pt	NA		Prot	NA	Free
Protected Phases	4	4		3	3		1	6		5	2	
Permitted Phases			4			3	6					Free
Detector Phase	4	4	4	3	3	3	1	6		5	2	
Switch Phase												
Minimum Initial (s)	6.0	6.0	6.0	5.0	5.0	5.0	5.0	10.0		5.0	10.0	
Minimum Split (s)	12.0	12.0	12.0	11.0	11.0	11.0	11.0	16.0		11.0	16.0	
Total Split (s)	29.0	29.0	29.0	12.0	12.0	12.0	12.0	57.0		12.0	57.0	
Total Split (%)	26.4%	26.4%	26.4%	10.9%	10.9%	10.9%	10.9%	51.8%		10.9%	51.8%	
Yellow Time (s)	3.0	3.0	3.0	3.0	3.0	3.0	3.0	5.0		3.0	5.0	
All-Red Time (s)	3.0	3.0	3.0	3.0	3.0	3.0	3.0	1.0		3.0	1.0	
Lost Time Adjust (s)	0.0	0.0	0.0		0.0	0.0	0.0	0.0		0.0	0.0	
Total Lost Time (s)	6.0	6.0	6.0		6.0	6.0	6.0	6.0		6.0	6.0	
Lead/Lag	Lag	Lag	Lag	Lead	Lead	Lead	Lead	Lag		Lead	Lag	
Lead-Lag Optimize?												
Recall Mode	None	None	None	None	None	None	None	C-Max		None	C-Max	
Act Effct Green (s)	22.1	22.1	22.1		6.0	6.0	59.1	54.3		5.9	51.4	110.0
Actuated g/C Ratio	0.20	0.20	0.20		0.05	0.05	0.54	0.49		0.05	0.47	1.00
v/c Ratio	0.89	0.90	0.46		0.63	0.45	0.82	0.45		0.55	0.82	0.33
Control Delay	70.0	71.8	13.8		79.1	9.1	55.7	31.6		69.2	27.7	0.5
Queue Delay	0.0	0.0	0.0		0.0	0.0	0.0	0.0		0.0	0.0	0.0
Total Delay	70.0	71.8	13.8		79.1	9.1	55.7	31.6		69.2	27.7	0.5
LOS	E	E	B		E	A	E	C		E	C	A
Approach Delay		56.6			35.4			35.3			21.5	
Approach LOS		E			D			D			C	
Queue Length 50th (ft)	220	225	27		44	0	75	277		33	375	0
Queue Length 95th (ft)	#362	#372	88		68	0	#155	347		m#76	458	0
Internal Link Dist (ft)		579			115			566			166	
Turn Bay Length (ft)			250				230					
Base Capacity (vph)	358	361	464		98	227	168	1704		95	1638	1568
Starvation Cap Reductn	0	0	0		0	0	0	0		0	0	0
Spillback Cap Reductn	0	0	0		0	0	0	0		0	0	0
Storage Cap Reductn	0	0	0		0	0	0	0		0	0	0
Reduced v/c Ratio	0.85	0.86	0.44		0.63	0.45	0.82	0.45		0.55	0.82	0.33

Intersection Summary		
Area Type:	Other	
Cycle Length: 110		
Actuated Cycle Length: 110		
Offset: 80 (73%), Referenced to phase 2:SBT and 6:NBTL, Start of Yellow		
Natural Cycle: 90		
Control Type: Actuated-Coordinated		
Maximum v/c Ratio: 0.90		
Intersection Signal Delay: 32.9		Intersection LOS: C
Intersection Capacity Utilization 76.2%		ICU Level of Service D
Analysis Period (min) 15		

\# 95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.
m Volume for 95th percentile queue is metered by upstream signal.

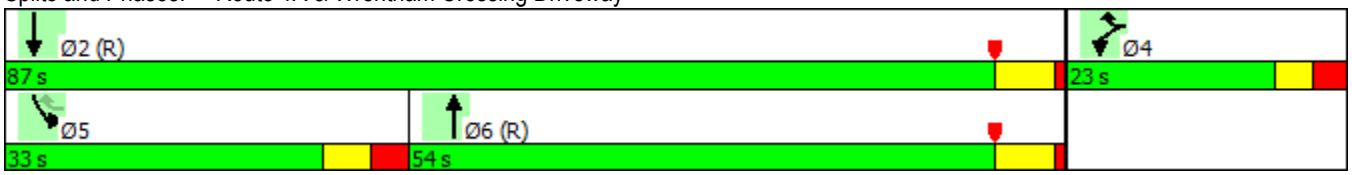
Splits and Phases: Route 1A & Premium Outlets Blvd/Mobil Driveway



Lane Group	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Traffic Volume (vph)	54	94	964	45	136	410
Future Volume (vph)	54	94	964	45	136	410
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Storage Length (ft)	0	0		0	250	
Storage Lanes	1	1		0	1	
Taper Length (ft)	0				25	
Right Turn on Red		Yes		Yes		
Link Speed (mph)	30		30			30
Link Distance (ft)	466		1292			646
Travel Time (s)	10.6		29.4			14.7
Peak Hour Factor	0.92	0.92	0.91	0.91	0.90	0.90
Heavy Vehicles (%)	2%	2%	7%	7%	17%	17%
Shared Lane Traffic (%)						
Lane Group Flow (vph)	59	102	1108	0	151	456
Turn Type	Prot	custom	NA		Prot	NA
Protected Phases	4	4	6		5	2
Permitted Phases		5				
Detector Phase	4	4	6		5	2
Switch Phase						
Minimum Initial (s)	8.0	8.0	10.0		8.0	10.0
Minimum Split (s)	14.0	14.0	16.0		15.0	16.0
Total Split (s)	23.0	23.0	54.0		33.0	87.0
Total Split (%)	20.9%	20.9%	49.1%		30.0%	79.1%
Yellow Time (s)	3.0	3.0	5.0		4.0	5.0
All-Red Time (s)	3.0	3.0	1.0		3.0	1.0
Lost Time Adjust (s)	0.0	0.0	0.0		0.0	0.0
Total Lost Time (s)	6.0	6.0	6.0		7.0	6.0
Lead/Lag			Lag		Lead	
Lead-Lag Optimize?						
Recall Mode	None	None	C-Max		None	C-Max
Act Effct Green (s)	9.6	32.6	65.4		16.0	88.4
Actuated g/C Ratio	0.09	0.30	0.59		0.15	0.80
v/c Ratio	0.39	0.20	0.56		0.67	0.18
Control Delay	54.3	16.9	15.8		54.3	3.5
Queue Delay	0.0	0.0	0.0		0.0	0.0
Total Delay	54.3	16.9	15.8		54.3	3.5
LOS	D	B	B		D	A
Approach Delay	30.6		15.8			16.1
Approach LOS	C		B			B
Queue Length 50th (ft)	40	31	228		108	39
Queue Length 95th (ft)	80	64	358		177	57
Internal Link Dist (ft)	386		1212			566
Turn Bay Length (ft)					250	
Base Capacity (vph)	273	494	1995		364	2480
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	0.22	0.21	0.56		0.41	0.18

Intersection Summary		
Area Type:	Other	
Cycle Length: 110		
Actuated Cycle Length: 110		
Offset: 25 (23%), Referenced to phase 2:SBT and 6:NBT, Start of Yellow		
Natural Cycle: 60		
Control Type: Actuated-Coordinated		
Maximum v/c Ratio: 0.67		
Intersection Signal Delay: 17.2		Intersection LOS: B
Intersection Capacity Utilization 58.1%		ICU Level of Service B
Analysis Period (min) 15		

Splits and Phases: Route 1A & Wrentham Crossing Driveway

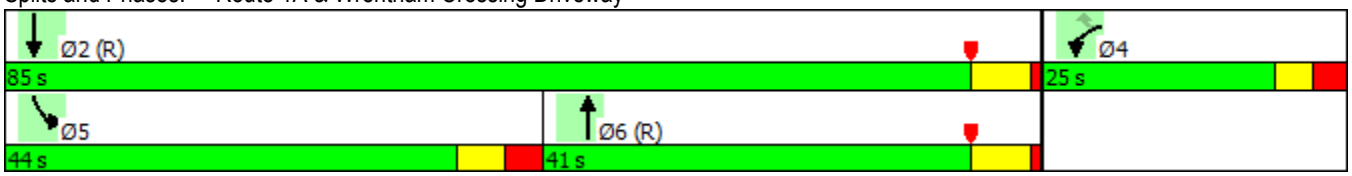


Lane Group	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Traffic Volume (vph)	148	245	606	100	301	1082
Future Volume (vph)	148	245	606	100	301	1082
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Storage Length (ft)	0	0		0	250	
Storage Lanes	1	1		0	1	
Taper Length (ft)	0				25	
Right Turn on Red		Yes		Yes		
Link Speed (mph)	30		30			30
Link Distance (ft)	456		1293			646
Travel Time (s)	10.4		29.4			14.7
Peak Hour Factor	0.92	0.92	0.94	0.94	0.95	0.95
Heavy Vehicles (%)	2%	2%	4%	4%	3%	3%
Shared Lane Traffic (%)						
Lane Group Flow (vph)	161	266	751	0	317	1139
Turn Type	Prot	Perm	NA		Prot	NA
Protected Phases	4		6		5	2
Permitted Phases		4				
Detector Phase	4	4	6		5	2
Switch Phase						
Minimum Initial (s)	8.0	8.0	10.0		8.0	10.0
Minimum Split (s)	14.0	14.0	16.0		15.0	16.0
Total Split (s)	25.0	25.0	41.0		44.0	85.0
Total Split (%)	22.7%	22.7%	37.3%		40.0%	77.3%
Yellow Time (s)	3.0	3.0	5.0		4.0	5.0
All-Red Time (s)	3.0	3.0	1.0		3.0	1.0
Lost Time Adjust (s)	0.0	0.0	0.0		0.0	0.0
Total Lost Time (s)	6.0	6.0	6.0		7.0	6.0
Lead/Lag			Lag		Lead	
Lead-Lag Optimize?						
Recall Mode	None	None	C-Max		None	C-Max
Act Effct Green (s)	14.8	14.8	50.8		25.3	83.2
Actuated g/C Ratio	0.13	0.13	0.46		0.23	0.76
v/c Ratio	0.68	0.60	0.48		0.79	0.43
Control Delay	59.1	11.1	23.0		35.8	3.1
Queue Delay	0.0	0.0	0.0		0.0	0.5
Total Delay	59.1	11.1	23.0		35.8	3.6
LOS	E	B	C		D	A
Approach Delay	29.2		23.0			10.6
Approach LOS	C		C			B
Queue Length 50th (ft)	109	0	184		152	56
Queue Length 95th (ft)	174	71	288		m168	162
Internal Link Dist (ft)	376		1213			566
Turn Bay Length (ft)					250	
Base Capacity (vph)	305	493	1580		589	2649
Starvation Cap Reductn	0	0	0		0	926
Spillback Cap Reductn	0	0	0		0	0
Storage Cap Reductn	0	0	0		0	0
Reduced v/c Ratio	0.53	0.54	0.48		0.54	0.66

Intersection Summary		
Area Type:	Other	
Cycle Length: 110		
Actuated Cycle Length: 110		
Offset: 23 (21%), Referenced to phase 2:SBT and 6:NBT, Start of Yellow		
Natural Cycle: 60		
Control Type: Actuated-Coordinated		
Maximum v/c Ratio: 0.79		
Intersection Signal Delay: 17.1		Intersection LOS: B
Intersection Capacity Utilization 60.6%		ICU Level of Service B
Analysis Period (min) 15		

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

Splits and Phases: Route 1A & Wrentham Crossing Driveway



APPENDIX O

MassDOT Project Development Process

Overview of the Project Development Process

Transportation decision-making is complex and can be influenced by legislative mandates, environmental regulations, financial limitations, agency programmatic commitments, and partnering opportunities. Decision-makers and reviewing agencies, when consulted early and often throughout the project development process, can ensure that all participants understand the potential impact these factors can have on project implementation. Project development is the process that takes a transportation improvement from concept through construction.

The MassDOT Highway Division has developed a comprehensive project development process which is contained in Chapter 2 of the *MassDOT Highway Division's Project Development and Design Guide*. The eight-step process covers a range of activities extending from identification of a project need, through completion of a set of finished contract plans, to construction of the project. The sequence of decisions made through the project development process progressively narrows the project focus and, ultimately, leads to a project that addresses the identified needs. The descriptions provided below are focused on the process for a highway project, but the same basic process will need to be followed for non-highway projects as well.

1. Needs Identification

For each of the locations at which an improvement is to be implemented, MassDOT leads an effort to define the problem, establishes project goals and objectives, and defines the scope of the planning needed for implementation. To that end, it has to complete a Project Need Form (PNF), which states in general terms the deficiencies or needs related to the transportation facility or location. The PNF documents the problems and explains why corrective action is needed. For this study, the information defining the need for the project will be drawn primarily, perhaps exclusively, from the present report. Also, at this point in the process, MassDOT meets with potential participants, such as the Metropolitan Planning Organization (MPO) and community members, to allow for an informal review of the project.

The PNF is reviewed by the MassDOT Highway Division district office whose jurisdiction includes the location of the proposed project. MassDOT also sends the PNF to the MPO, for informational purposes. The outcome of this step determines whether the project requires further planning, whether it is already well supported by prior planning studies, and, therefore, whether it is ready to move forward into the design phase, or whether it should be dismissed from further consideration.

2. Planning

This phase will likely not be required for the implementation of the improvements proposed in this planning study, as this planning report should constitute the outcome of this step. However, in general, the purpose of this implementation step is for the project proponent to identify issues, impacts, and approvals that may need to be obtained, so that the subsequent design and permitting processes are understood.

The level of planning needed will vary widely, based on the complexity of the project. Typical tasks include: define the existing context, confirm project need, establish goals and objectives, initiate public outreach, define the project, collect data, develop and analyze alternatives, make

recommendations, and provide documentation. Likely outcomes include consensus on the project definition to enable it to move forward into environmental documentation (if needed) and design, or a recommendation to delay the project or dismiss it from further consideration.

3. Project Initiation

At this point in the process, the proponent, MassDOT Highway Division, fills out a Project Initiation Form (PIF) for each improvement, which is reviewed by its Project Review Committee (PRC) and the MPO. The PRC is composed of the Chief Engineer, each District Highway Director, and representatives of the Project Management, Environmental, Planning, Right-of-Way, Traffic, and Bridge departments, and the MassDOT Federal Aid Program Office (FAPO). The PIF documents the project type and description, summarizes the project planning process, identifies likely funding and project management responsibility, and defines a plan for interagency and public participation. First the PRC reviews and evaluates the proposed project based on the MassDOT's statewide priorities and criteria. If the result is positive, MassDOT Highway Division moves the project forward to the design phase, and to programming review by the MPO. The PRC may provide a Project Management Plan to define roles and responsibilities for subsequent steps. The MPO review includes project evaluation based on the MPO's regional priorities and criteria. The MPO may assign project evaluation criteria score, a Transportation Improvement Program (TIP) year, a tentative project category, and a tentative funding category.

4. Environmental Permitting, Design, and Right-of-Way Process

This step has four distinct but closely integrated elements: public outreach, environmental documentation and permitting (if required), design, and right-of-way acquisition (if required). The outcome of this step is a fully designed and permitted project ready for construction. However, a project does not have to be fully designed in order for the MPO to program it in the TIP. The sections below provide more detailed information on the four elements of this step of the project development process.

Public Outreach

Continued public outreach in the design and environmental process is essential to maintain public support for the project and to seek meaningful input on the design elements. The public outreach is often in the form of required public hearings, but can also include less formal dialogues with those interested in and affected by a proposed project.

Environmental Documentation and Permitting

The project proponent, in coordination with the Environmental Services section of the MassDOT Highway Division, will be responsible for identifying and complying with all applicable federal, state, and local environmental laws and requirements. This includes determining the appropriate project category for both the Massachusetts Environmental Protection Act (MEPA) and the National Environmental Protection Act (NEPA). Environmental documentation and permitting is often completed in conjunction with the **Preliminary Design** phase described below.

Design
There are three major phases of design. The first is **Preliminary Design**, which is also referred to as the 25-percent submission. The major components of this phase include full survey of the project area, preparation of base plans, development of basic geometric layout, development of preliminary cost estimates, and submission of a functional design report. Preliminary Design, although not required to, is often completed in conjunction with the Environmental Documentation and Permitting. The next phase is **Final Design**, which is also referred to as the 75-percent and 100-percent submission. The major components of this phase include preparation of a subsurface exploratory plan (if required), coordination of utility relocations, development of traffic management plans through construction zones, development of final cost estimates, and refinement and finalization of the construction plans. Once Final Design is complete, a full set of **Plans, Specifications, and Estimates (PS&E)** is developed for the project.

Right-of-Way Acquisition
A separate set of Right-of-Way plans are required for any project that requires land acquisition or easements. The plans must identify the existing and proposed layout lines, easements, property lines, names of property owners, and the dimensions and areas of estimated takings and easements.

5. Programming (Identification of Funding)
Programming, which typically begins during the design phase, can actually occur at any time during the process, from planning to design. In this step, which is distinct from project initiation, the proponent requests that the MPO place the project in the region's Transportation Improvement Program (TIP). The proponent requesting the project's listing on the TIP can be the community or it can be one of the MPO member agencies (the Regional Planning Agency, MassDOT, and the Regional Transit Authority). The MPO then considers the project in terms of state and regional needs, evaluation criteria, and compliance with the regional Transportation Plan and decides whether to place it in the draft TIP for public review and then in the final TIP.

6. Procurement
Following project design and programming of a highway project, the MassDOT Highway Division publishes a request for proposals. It then reviews the bids and awards the contract to the qualified bidder with the lowest bid.

7. Construction
After a construction contract is awarded, MassDOT Highway Division and the contractor develop a public participation plan and a management plan for the construction process.

8. Project Assessment
The purpose of this step is to receive constituents' comments on the project development process and the project's design elements. MassDOT Highway Division can apply what is learned in this process to future projects.

Project Development Schematic Timetable

Description	Schedule Influence	Typical Duration
Step I: Problem/Need/Opportunity Identification The proponent completes a Project Need Form (PNF). This form is then reviewed by the MassDOT Highway District office which provides guidance to the proponent on the subsequent steps of the process.	The Project Need Form has been developed so that it can be prepared quickly by the proponent, including any supporting data that is readily available. The District office shall return comments to the proponent within one month of PNF submission.	1 to 3 months
Step II: Planning Project planning can range from agreement that the problem should be addressed through a clear solution to a detailed analysis of alternatives and their impacts.	For some projects, no planning beyond preparation of the Project Need Form is required. Some projects require a planning study centered on specific project issues associated with the proposed solution or a narrow family of alternatives. More complex projects will likely require a detailed alternatives analysis.	Project Planning Report: 3 to 24+ months
Step III: Project Initiation The proponent prepares and submits a Project Initiation Form (PIF) and a Transportation Evaluation Criteria (TEC) form in this step. The PIF and TEC are informally reviewed by the Metropolitan Planning Organization (MPO) and MassDOT Highway District office, and formally reviewed by the PRC.	The PIF includes refinement of the preliminary information contained in the PNF. Additional information summarizing the results of the planning process, such as the Project Planning Report, are included with the PIF and TEC. The schedule is determined by PRC staff review (dependent on project complexity) and meeting schedule.	1 to 4 months
Step IV: Design, Environmental, and Right of Way The proponent completes the project design. Concurrently, the proponent completes necessary environmental permitting analyses and files applications for permits. Any right of way needed for the project is identified and the acquisition process begins.	The schedule for this step is dependent upon the size of the project and the complexity of the design, permitting, and right-of-way issues. Design review by the MassDOT Highway district and appropriate sections is completed in this step.	3 to 48+ months
Step V: Programming The MPO considers the project in terms of its regional priorities and determines whether or not to include the project in the draft Regional Transportation Improvement Program (TIP) which is then made available for public comment. The TIP includes a project description and funding source.	The schedule for this step is subject to each MPO's programming cycle and meeting schedule. It is also possible that the MPO will not include a project in its Draft TIP based on its review and approval procedures.	3 to 12+ months
Step VI: Procurement The project is advertised for construction and a contract awarded.	Administration of competing projects can influence the advertising schedule.	1 to 12 months
Step VII: Construction The construction process is initiated including public notification and any anticipated public involvement. Construction continues to project completion.	The duration for this step is entirely dependent upon project complexity and phasing.	3 to 60+ months
Step VIII: Project Assessment The construction period is complete and project elements and processes are evaluated on a voluntary basis.	The duration for this step is dependent upon the proponent's approach to this step and any follow-up required.	1 month

Source: MassDOT Highway Division Project Development and Design Guide