

# ROAD SAFETY AUDIT

Boston Street at Proctor Street/Bridge Street and Essex  
Street at Boston Street to Jackson Street

City of Salem

April 2019

Prepared For:  
MassDOT



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## Background

The Federal Highway Administration (FHWA), defines a Road Safety Audit (RSA) as the formal safety examination of an existing or future road or intersection by an independent, multidisciplinary team. The purpose of a RSA is to identify potential safety issues and possible countermeasures to improve safety for all roadway users. As part of the Massachusetts Department of Transportation's (MassDOT) Road Safety Audit guidelines, RSAs are required for Highway Safety Improvement Program (HSIP) eligible locations and should be conducted prior to the development of the 25-percent design submission. This RSA evaluates the intersection of Boston Street at Proctor Street/Bridge Street and Goodhue Street and the Essex Street corridor from Boston Street to Jackson Street in Salem, Massachusetts, as shown in Figure 1.

## Project Data

A Road Safety Audit was conducted for both the intersection of Boston Street and Proctor Street/Bridge Street and Goodhue Street and the corridor of Essex Street from Boston Street to Jackson Street on April 8, 2019. The pre- and post-audit meetings were held at the Salem City Hall Annex located at 98 Washington Street. A copy of the agenda for the meeting is provided in Appendix A. The road safety audit team, as shown in Table 1, comprised of representatives from State, and local agencies, included a cross-section of engineers, planners, enforcement, and emergency response fields. A complete list of the contact information of all attendees can be found in Appendix B.

Table 1: Participating Audit Team Members

Audit Team Member	Agency/Affiliation
Amy Silbovitz	VHB, Inc.
Kirsten Braun	VHB, Inc.
Lori Aho	VHB, Inc.
Kevin Fitzgerald	MassDOT Traffic Safety
Christopher Falcos	MassDOT Traffic Safety
Tim Roberts	MassDOT D-4 Traffic
Eric Burkman	MBTA Service Planning
Chenyuan Wang	CTPS/Boston Region MPO
John Giardi	City of Salem Electrician
Gerry Giunta	City of Salem Fire Department
Tom Devine	City of Salem Planning Department
David Tucker	City of Salem Police Department
David Kucharsky	City of Salem Traffic and Parking
David Knowlton	City of Salem Engineering and DPS

Prior to the meeting, VHB distributed a copy of the agenda, crash diagrams, crash summary tables, and traffic volumes to all RSA attendees. Crash diagrams and summary tables for 2016-2018 were compiled from local crash reports obtained from the City of Salem Police Department. All attendees were encouraged to visit the study area intersections prior to the meeting.

The meeting at the Salem City Hall Annex started with a brief description of the agenda of the RSA meeting, followed by introductions and a description of the RSA process. During the pre-audit meeting, using the crash materials provided in advance, VHB facilitated the discussion of existing safety issues with all RSA attendees. RSA attendees were encouraged to bring their local knowledge and expertise to the discussion on existing safety and operational issues for the study area intersection.

Following the pre-audit meeting, the audit team visited the study areas as a group to identify additional safety concerns. After the field visit, the team returned to the Salem City Hall Annex to discuss potential solutions, ranging from short-term to long-term, and low cost to high cost countermeasures for each identified safety concern.

## Project Location and Description

**Boston Street** is classified as an urban principal arterial under the City of Salem jurisdiction. The surrounding area of Boston Street in the study area is primarily residential and commercial. Boston Street generally runs east-west, connecting to Essex Street in the east and the Peabody City Line in the west. Boston Street carries the designation of Massachusetts State Route 107 from Essex Street to Bridge Street. Bus service is provided along Boston Street by route #465 of the Massachusetts Bay Transportation Authority (MBTA). There is no posted speed limit along Boston Street. Sidewalks are provided along both sides of Boston Street throughout the study area and on-street parking is provided on both sides of the street intermittently throughout the study area.

### ***Boston Street at Bridge Street/Proctor Street and Goodhue Street***

Boston street intersects Proctor Street/Bridge Street to form a four-legged intersection. Just north of the intersection Goodhue Street intersects Bridge Street at approximately a 45-degree angle. Boston Street runs east-west while Proctor Street intersects Boston Street from the south and Bridge Street intersects Boston Street from the north. The westbound approach consists of a through/left-turn lane and a dedicated right-turn lane, while the eastbound approach consists of a dedicated left-turn lane and a through right-turn lane. The Bridge Street approach southbound is striped as a through/left-turn lane and a dedicated right-turn lane. The approach STOP bar is striped beyond Goodhue Street. The Goodhue Street approach and the Proctor Street approach south of the intersection are both one-way away from the intersection. Sidewalks are provided on both sides of all approaches with the exception of Goodhue Street which only has sidewalk on the north side of the road. Crosswalks are provided on all approaches except the eastbound approach.

### ***Boston Street at Pope Street***

Pope Street intersects Boston Street from the south to form a three-legged unsignalized intersection. Pope Street is STOP controlled while Boston Street operates freely. Pope Street is one-way towards Boston Street and consists of a dedicated right-turn lane and a dedicated left-turn lane. There are

sidewalks on both sides of all approaches. Crosswalks exist across Pope Street and on the western leg of the intersection. There are bus stops on both directions on Boston Street just west of the intersection.

**Essex Street** is classified as an urban principal arterial under the City of Salem jurisdiction. The surrounding area of Essex Street in the study area is a mix of residential and commercial. Essex Street runs in the north-south direction in the study area and connects Highland Avenue to downtown Salem. MBTA bus routes #450 and #456 provide service along Essex Street with a stop approximately 500 feet south of the intersection with Boston Street. There is no posted speed limit along Essex Street in the vicinity of the study area. Sidewalks are provided along both sides of Essex Street throughout the study area. On-street parking is provided near the intersection with Boston Street. In addition, a Zagster bike station was recently installed on the east side of Essex Street just north of Dalton Parkway.

#### ***Essex Street at Boston Street/ Driveway***

Boston Street intersects Essex Street from the west and a commercial driveway intersects Essex Street from the east to form a four-legged signalized intersection. The commercial driveway is one-way approaching the intersection. Essex Street at the intersection contains a center median of approximately 20-30 feet. The Boston Street eastbound approach consists of one left-turn lane and one right-turn lane. The commercial driveway westbound approach consists of one right-turn only lane. The Essex Street northbound approach consists of one left-turn lane and one through lane. The Essex Street southbound approach consists of one through lane and one right-turn lane. Sidewalks are provided on both sides of the Boston Street and Essex Street approaches. Crosswalks are located across the Boston Street eastbound approach and the Essex Street northbound approach. On-street parking is provided on both sides of Boston Street and Essex Street. Land use in the area is primarily residential and commercial.

#### ***Essex Street at Jackson Street/Dalton Parkway***

Jackson Street intersects Essex Street from the east forming a three-legged signalized intersection. In addition to Jackson Street Dalton Parkway intersects Essex Street from the northeast, however it is not included in the signal. Just south of the intersection Essex Street becomes Highland Avenue and a portion of the intersection is included in the school zone associated with Collins Middle School on the southeast corner of the intersection. The Highland Avenue approach northbound consists of a dedicated right-turn lane and a through lane. Essex Street southbound consists of a dedicated left-turn lane and a through lane. Jackson Street consists of a dedicated right and left-turn lane. Dalton Parkway intersects Essex Street just north of Jackson Street and consists of a dedicated right-turn lane under STOP control with a departure lane from the intersection just north of Jackson Street. There are sidewalks along both sides of Essex Street and Dalton Parkway and on the north side of Jackson Street. There are existing crosswalks across Highland Avenue, Jackson Street and Dalton Parkway.

## Crash Data

Crash data provided by the Salem Police Department show 42 crashes occurred at the intersection cluster of Boston Street at Proctor Street and Boston Street at Pope Street and 42 crashes occurred along Essex Street between its intersections with Boston Street and Jackson Street from January 2016 to December 2018. Crash data summaries and collision diagrams are provided in the Appendix.

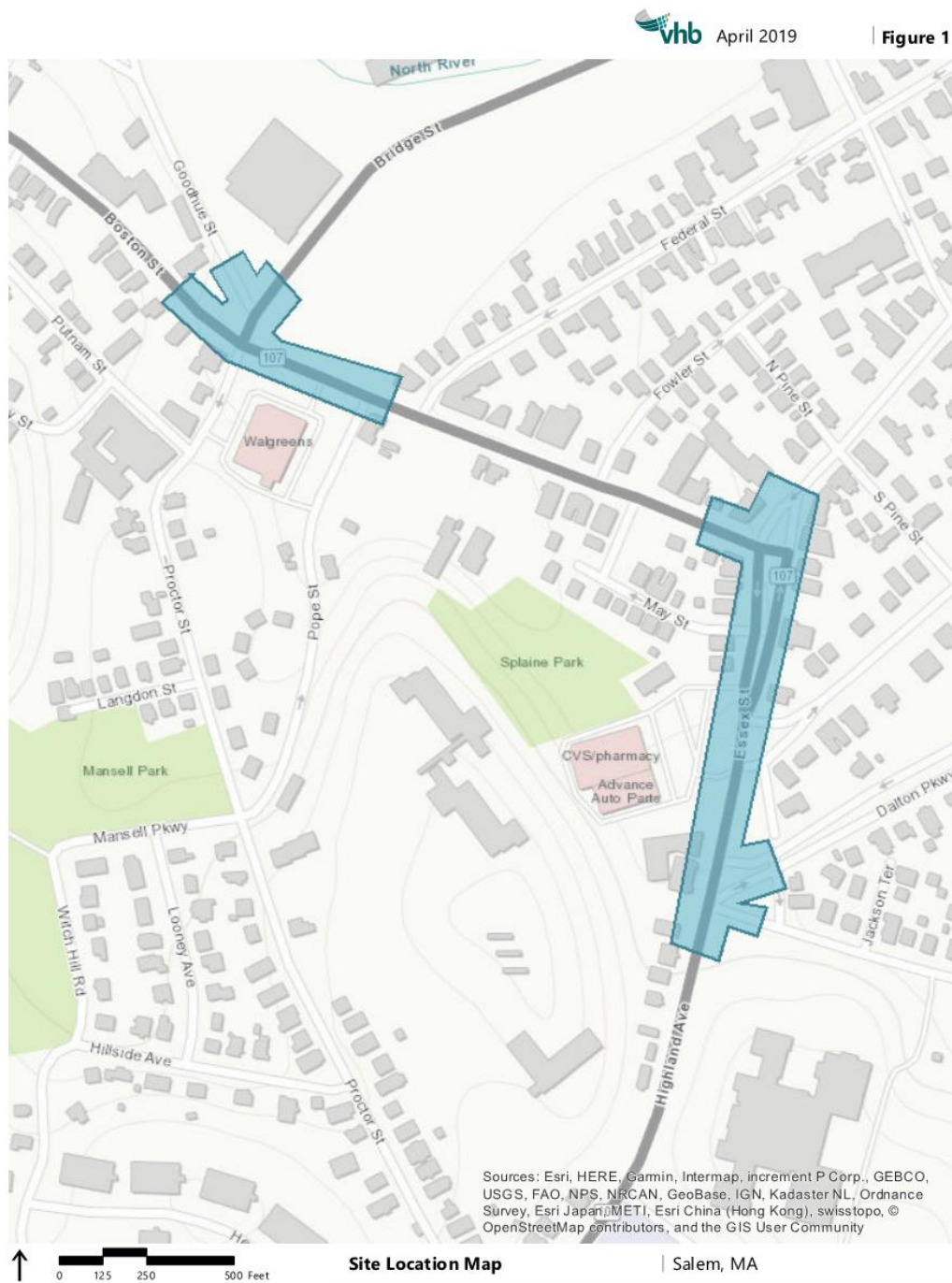
### **Boston Street at Bridge Street/Proctor Street**

The most prevalent crash type was angle type crashes, accounting for 43% of the total crashes at the intersection. Rear-end crashes were the second most frequent, accounting for 31% of crashes, and sideswipe same direction crashes were third, accounting for 12%. 48% of crashes at the intersection occurred during daylight, while 43% of crashes occurred during dark conditions on lighted roadways. Analysis of weather conditions found that 71% of crashes occurred during clear or cloudy conditions. 67% of crashes occurred on a dry road surface while 29% of crashes occurred on wet roadways. Additionally, there was an even spread of crashes amongst most days of the week, approximately 15-20%, with the exception of Thursday which experienced only 5% of the total crashes.

### **Essex Street at Boston Street and Jackson Street**

The most prevalent crash type was angle type crashes, accounting for 38% of the total crashes at the intersection. Rear-end crashes were the second most frequent, accounting for 36% of crashes, and sideswipe same direction crashes were third, accounting for 17%. 69% of crashes at the intersection occurred during daylight, while 14% of crashes occurred during dark conditions on lighted roadways. Analysis of weather conditions found that 74% of crashes occurred during clear or cloudy conditions. 69% of crashes occurred on a dry road surface while 26% of crashes occurred on wet roadways. Additionally, there was an even spread of crashes amongst most days of the week, approximately 15-20%, with the exception of Wednesday and Sunday which experienced only 7% and 10% of the total crashes, respectively.

Figure 1: Locus Map



**Road Safety Audit Locations**



## Audit Observations and Potential Safety Enhancements

During the RSA meeting, prior to the field visit, a brief introduction of the RSA process was presented to the audit team members. Following this brief presentation, the members of the audit team were asked to discuss the existing issues that may affect safety at the intersection using the provided crash data and summaries. The audit team then visited the study area intersection, at which time observations of various safety concerns and deficiencies were identified and documented. Provided below is a list of the safety concerns that were identified during the RSA for the intersections along with potential enhancements identified during the RSA.

### **Boston Street at Bridge Street/Proctor Street**

#### **Safety Issue #1: Pavement Markings**

Observations during the field walk noted faded pavement markings throughout the whole intersection, particularly on the eastbound and westbound approaches. Approaches to the intersection lack lane use arrows, likely leading to an increased number of sideswipe crashes. In addition, crosswalk pavement markings are significantly faded.

Also noted by audit participants was that the lane width on the east leg of Boston Street near the intersection is extremely wide for the one lane section of roadway and likely should be defined using shoulder pavement markings. Approaching each leg of the intersection the striping to delineate each lane is completely worn away. All approaches to the intersection consist of two lanes and without the striping it is difficult for motorists to determine which lane to be in. Furthermore, it was noted during the pre-audit meeting that there is a large number of vehicles turning right from Boston Street westbound to either Goodhue Street or to Bridge Street.

Approximately 250 feet east is the intersection of Pope Street and Boston Street. This intersection is often affected by queues at the intersection of Boston Street and Proctor Street. 14 crashes have occurred at this intersection, including 12 angle crashes, one rear-end crash and one crash with a cyclist. Vehicles exiting Pope Street and turning left onto Boston Street have a hard time getting out into the roadway and often have to accept smaller gaps in the heavy traffic stream to make the turn. It should also be noted that during the field walk audit members noticed vehicles not observing lane designations, with several motorists turning left from the right-turn lane on Pope Street.

While on the field walk it was noted by audit participants that the bus stops along both Boston Street were poorly



**Image 1: Worn Pavement Markings on Boston Street Eastbound**



**Image 2: Wide Travel Lanes on Boston Street**

marked. This may lead to parked vehicles encroaching on the bus stop and in turn forcing buses to stop in vehicle travel lanes.

**Proposed Enhancements:**

- Consider re-striping the existing pavement markings within the intersection and provide lane use arrows on all approaches to provide better lane definition and clarify which movements can be made from each lane.
- Consider restriping lane designations at Pope Street.
- Consider striping shoulders in locations where lane widths are wide enough to be misconstrued as multiple lane travel. Additionally, striped shoulders will help decrease travel speeds.
- Consider shifting the double yellow centerline on Boston Street westbound south to accommodate two right turn lanes (one to Goodhue Street and the other to Bridge Street) and one through-left turn lane.
- Consider adding pavement markings to enhance bus stop visibility.

**Safety Issue #2: Pedestrian Accommodations**

During the field walk audit participants noted that the signal at Boston Street and Proctor Street/Bridge Street does not have any pedestrian signal equipment for a pedestrian phase. Faded crosswalk pavement markings and pedestrian signage exists on Boston Street near the crosswalk on the east side of the intersection while there is no pedestrian signage on the pedestrian crossings at Bridge Street and Proctor Street. There is no pedestrian crossing on the west side of the intersection.

Pedestrian crossing pavement markings are extremely worn on all approaches. Additionally, a number of wheelchair ramps within the intersection are not ADA compliant. An additional pedestrian crossing has been installed north of the intersection of Bridge Street and Boston Street at Bridge Street and Goodhue Street. A pedestrian crossing exists across Goodhue Street however, there is no sidewalk on the south side of the street. It was noted by audit members that there is a residential development underway northeast of the intersection of Goodhue Street and Bridge Street. This gap in sidewalk on the south side of Goodhue Street between the residential development and Bridge Street may potentially pose a future risk as increased pedestrian traffic on Goodhue Street is anticipated.

Also noted was that the pedestrian crossings on Boston Street were particularly long with no pedestrian refuge areas. Additionally, the curbing along most legs of the intersection had no reveal and was almost nearly level with the roadway surface. The southwest corner of the intersection had a number of obstructions in the sidewalk including traffic signal equipment, utility poles and signage. These obstructions in addition to the building abutting the sidewalk create a narrow pinch point for pedestrians.



**Image 3: Faded Crosswalk on Boston Street with Pedestrian Signing**

**Proposed Enhancements:**

- Reconstruct wheelchair ramps throughout the intersection to meet ADA compliance.

- Consider consolidating the crosswalk across Bridge Street at the signal and the crosswalk just to the north at Goodhue Street into one crosswalk.
- Consider adding a crosswalk along the western approach to the intersection.
- Consider installing pedestrian signal equipment and incorporating a pedestrian phase to the signal.
- Consider repainting all crosswalks and providing proper maintenance to ensure crosswalks remain visible.
- Consider tightening up the intersection to shorten pedestrian crossings or consider adding pedestrian refuge areas in between long crossings.
- Consider reconstructing the curbing throughout the intersection.
- Consider removing the number of obstructions on the southwest corner of the intersection that narrow the pedestrian walkway.

### **Safety Issue #3: Signal Phasing and Equipment**

The audit team noted concerns with the signal equipment and phasing in the field. It was noted that left turns from Boston Street currently operate as permissive and sightlines are often limited for vehicles attempting to make a left-turn. Vehicles turning left from Boston Street westbound are not able to see opposing through vehicles due to conflicting left-turns blocking their view. The Boston Street eastbound leg also approaches the intersection on a downgrade with slight horizontal curvature. In the pre-audit meeting, audit members noted that a number of angle collisions have occurred within the intersection due to these unsafe left turn movements.

As previously noted in Safety Issue #1, there were eight angle crashes at the intersection of Pope Street and Boston Street. All crashes involved a left turning vehicle from Pope Street onto Boston Street. Due to the high volume on Boston Street motorists have a difficult time safely exiting Pope Street to Boston Street as there are not sufficient gaps in traffic. Furthermore, it should be noted that a development is proposed on the vacant lot located on the northeast corner of the intersection of Boston Street and Bridge Street. The access/egress for this lot is proposed to be opposite Pope Street creating a four-legged intersection.

### **Proposed Enhancements:**

- Consider updating the signals to meet current standards including an overhead signal head per lane. Ensure that any signal upgrades are compatible with MBTA and MassDOT specifications for transit signal priority.
- Consider implementing back plates with retroreflective borders on all signal heads to improve visibility. Reanalyze mast arms to determine if they are able to accommodate the increased load.
- Consider installing a median island on Pope Street to encourage vehicles to make the proper turning movement from the proper lane.
- Consider implementing a flashing yellow arrow to the signals.
- Consider changing the signal phasing from permissive left turn movements to protected left turn movements to reduce angle crashes within the intersection.
- Consider signalizing the intersection of Pope Street and Boston Street and coordinate the signal with the Boston Street and Proctor Street/Bridge Street intersection to reduce the number of angle collisions here occurring at Pope Street.

- Consider installing pedestrian signal equipment to the intersection and introducing a pedestrian phase to the signal.
- Consider reversing the directionality of Pope Street and Proctor Street with Pope Street becoming one-way southbound and Proctor Street becoming one-way northbound to reduce angle crashes at Pope Street.

#### **Safety Issue #4: Lack of or Improper Signage**

It was noted during the field walk that a majority of signs at the intersection are incorrectly positioned, often facing the opposite direction of the roadway. Additionally, a number of signs are not MUTCD standard signs and are either missing words or faded. Audit members also noted that there was a large amount of sign clutter in the field which may lead to driver confusion as they approach and enter the intersection.

Pedestrian crossings are located on the northbound, westbound and southbound approaches to the intersection. Pedestrian crossing signage (W11-2) is located on the westbound approach only. The northbound approach to the intersection is one way away from the intersection. However, it was noted during the pre-audit meeting that a number of wrong way crashes have occurred between the Walgreens parking lot and the intersection. Audit team members noted that some vehicles exiting Putnam Street travel the wrong way down Proctor Street to enter the Walgreens parking lot.

Approaching the intersection from each leg there is no lane use signage. 12-percent of the total crashes at the intersection were sideswipe same direction crashes. These crashes were mostly due to last minute lane changes as motorists approach the intersection and aren't sure what lane to be in.

During the field walk audit members noted that there is no pedestrian signage at the intersection of Pope Street and Boston Street. During the pre-audit meeting it was noted that a bicyclist was hit in the crosswalk across Pope Street. Furthermore, there is only one STOP sign (R1-1) on the righthand side of the approach which may encourage motorists to turn left from Pope Street onto Boston Street from the righthand turn lane.

As noted in the pavement markings section, bus stops along Boston Street are poorly marked. It was noted that currently there is one sign for the bus stops at the beginning of the stop with no sign on the back end of the stop leading to parked vehicles encroaching on the bus stop and forcing the bus to stop in the travel lanes. It was also noted that the bus stopping at Boston Street and Federal Street has to cut across traffic to go straight through the Boston Street and Bridge Street signal. This stop may benefit from relocating to the far side of the intersection.



**Image 4: Missing Advance Lane Use Signage on Boston Street**



**Image 5: Missing STOP Sign on Pope Street**



### **Proposed Enhancements:**

- Consider removing unnecessary signage throughout the intersection to reduce sign clutter.
- Consider adding a stop sign on the left-hand side of the Pope Street approach to Boston Street.
- Consider adding pedestrian signage (R1-6, W11-2, R1-5) to the study area (both at the signalized and unsignalized intersection) to highlight pedestrian activity in the area. This would be a temporary solution at the signalized intersection until pedestrian signals can be added.
- Maintain existing signage and consider updating worn and faded signage to MUTCD standard signs.
- Consider installing advance lane use signage on all approaches to the intersection.
- Consider relocating the bus stop to the far side of the intersection.
- Consider updating bus stop signage to include signs on both the front and back ends of the bus stop. Ensure that MBTA bus stops meet design guidelines for stop length and far side location.

## **Essex Street at Boston Street to Jackson Street**

### **Safety Issue #1: Pavement Markings**

During the field walk participants observed extremely worn pavement markings throughout the Essex Street corridor. In some locations the lane use at intersections was unclear. At the firehouse the “do not block the box” pavement markings have faded and often vehicles queue for the signal within the box, blocking the firehouse exit.

It was noted during the field walk that Essex Street is not striped as one or two lanes in both the northbound and southbound directions, particularly in the vicinity of the CVS. Currently there exists a small sign on Essex Street southbound telling motorists that it operates as single lane, however the lane is particularly wide without striped shoulders, leading motorists to believe it may operate as two lanes. Traveling northbound Essex Street is meant to be two lanes, however lane lines and shoulders are not striped to delineate each lane.

Similar to the intersection of Boston Street and Bridge Street the bus stops along Essex Street are poorly defined. There are currently no pavement markings to mark out the total area of the bus stop causing parked motorists to regularly encroach on the bus stops forcing the bus to stop in the travel lane.

### **Proposed Enhancements:**

- Consider striping the shoulders to define and narrow travel lanes, particularly on Essex Street southbound.
- Consider re-striping all existing pavement markings throughout the corridor and implement lane use arrows to define lane usage on intersecting side streets.
- Repaint the “do not block the box” pavement marking in front of the firehouse to prevent vehicles from stopping in front of the firehouse exit.
- Consider striping Essex Street to formalize the two travel lanes northbound and reduce the frequency of sideswipe and angle collisions.



**Image 6: Wide Travel Lane on Essex Street Southbound**

- Consider adding pavement markings to define the bus stops along the corridor.

### **Safety Issue #2: Signal Timing and Equipment**

During the field walk audit team members noted a number of deficiencies regarding the traffic signal timing and outdated equipment. At the intersection of Boston Street and Essex Street the green arrow for the left turn movement from Essex Street to Boston Street is dim and likely not easily visible to motorists. Furthermore, it was noted that the traffic signal for the firehouse and the Boston Street intersection could benefit from improved coordination; under current conditions the firehouse signal turns red at the same time as the Essex Street northbound approach goes to red reducing queueing space on the northbound approach. Additionally, when the Essex Street northbound approach has a green signal the firehouse signal flashes green. This signal operation violates MUTCD emergency pre-emption signal standards which state that the emergency signal should be either green or flashing yellow between emergency vehicle actuations.

Further down Essex Street at the intersection with Jackson Street, the audit team noted that Dalton Parkway was not included in the signal. Considering the proximity of Jackson Street to Dalton Parkway it seemed this traffic control may be confusing to motorists entering or exiting Dalton Parkway.

Also observed by audit members was that the clearance times at the intersection of Jackson Street and Essex Street were considerably short and likely a contributing factor to the number of rear-ends that have occurred at the intersection. The signals at this location appear to be piecemealed together and none of the signal heads contained backplates. Furthermore, per MUTCD standards, there should be an overhead signal in addition to the signal mounted to the post section of the mast arm for the southbound through traffic.



**Image 7: Proximity of Dalton Parkway to Jackson Street Traffic Signal**

Both intersections were also noted to be lacking appropriate ADA accommodations, including pedestrian push buttons. All the traffic signal heads do not contain back plates or retro reflectivity. It was also observed that both the intersections of Boston Street at Essex Street and Jackson Street at Essex Street contained loop detection.

### **Proposed Enhancements:**

- Consider including Dalton Parkway in the existing Jackson Street signal and coordinating that signal with the Boston Street intersection.
- Coordinate firehouse signal better with the Boston Street signal to allow Essex Street traffic to clear.
- Consider changing the flashing green light at the firehouse signal to a flashing yellow or steady green light to reiterate that motorists may travel through to the light at Boston Street.
- Consider updating the intersections of Boston Street at Essex Street and Jackson Street at Essex Street from loop detection to video detection.
- Consider updating the clearance time intervals at the Jackson Street and Essex Street intersection to reduce the frequency of rear-end crashes.

**Final Report**

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- Consider adding pedestrian ADA push buttons at traffic signals within the corridor.
- Consider installing new traffic controllers and mast arms along the corridor and incorporating transit signal priority. Ensure any signal upgrades are compatible with MBTA and MassDOT specifications for transit signal priority.
- Evaluate the need for turning lanes at signalized intersections.
- Consider implementing back plates with retroreflective borders on all signal heads to improve visibility.
- Consider updating traffic signal lights to LEDs and maintain lights to ensure all are working properly.

**Safety Issue #3: Pedestrian Accommodations**

There is a lack of pedestrian accommodations along the Essex Street corridor which creates a safety concern for pedestrians wishing to traverse the corridor. Sidewalks are provided along both sides of Essex Street. A crosswalk is provided across Essex Street in the vicinity of Warren Street to the CVS parking lot. Non MUTCD signage is provided on the east side of the crosswalk and no signage is provided on the western side making the crosswalk less noticeable to motorists.

At the Boston Street intersection with Essex Street crosswalks exist on the southern and western approaches to the intersection, however there is no pedestrian accommodations on the north side of the intersection. Also noted during the field walk was that there is no sidewalk on the south side of Jackson Street near Collins Middle School, there is sidewalk however on the north side with a crosswalk across Jackson Street.



**Image 8: Pedestrian Crossing from Warren Street to CVS Parking Lot**

**Proposed Enhancements:**

- Consider updating the pedestrian crossing at Warren Street/ CVS to an RRFB or install flashing LED pedestrian signage.
- Consider updating existing crossings to current standards, including adding ADA ramps, warning panels and pedestrian signals with countdown timers.
- Consider adding a crosswalk on the north side of the intersection of Boston Street and Essex Street.
- Reevaluate right turn volumes from Essex Street to Boston Street and consider installing a curb extension to shorten the pedestrian crossing.

#### **Safety Issue #4: Lack of or Improper Signage**

During the field walk audit members noted that similar to the intersection of Boston Street at Proctor Street/Bridge Street the Essex Street corridor had a large amount of sign clutter. Most signs were not MUTCD standard signs and several were faded and missing words. A majority of crosswalks were missing pedestrian signage and the right turn from Dalton Parkway to Essex Street was missing a STOP sign. Sections of Dalton Parkway and Warren Street operate as one-way however there was no signage to notify drivers.



**Image 9: Missing STOP Sign Dalton Parkway**

During the pre-audit meeting it was mentioned by audit members that a number of vehicles attempting to turn left onto Boston Street from Essex Street will travel through the intersection and make a u-turn around the Joseph Hodge Choate statue to then turn right onto Boston Street. This move is due to driver frustration at the signal with large queues forming in the left turn lane as a result of inadequate green time not clearing the queue each cycle. Additionally, the left turn operates as protected only due to poor sightlines created by the statue on the median island.

As noted in the Boston Street at Bridge Street signage section, the bus stops along Essex Street are lacking a back-end sign. Under current conditions signage only exists at the front of the bus stop therefore not defining the total length of the bus stop. Parked vehicles regularly encroach on the bus stop forcing buses to make stops in the travel lanes.

#### **Proposed Enhancements:**

- Consider removing unnecessary signage to alleviate sign clutter and updating signage along the corridor to MUTCD standard signage.
- Consider installing signage near the Joseph Hodge Choate statue to prevent u-turns onto Boston Street from Essex Street.
- Consider relocating the bus stop to the far-side of Essex Street and Warren Street. This relocation will improve pedestrian visibility and eliminate the conflict between a bus pulling out of the current stop and right-turning traffic onto Warren St crossing over the path of the departing bus.
- Consider providing consistent signage throughout the Essex Street corridor for all crosswalks.
- Consider providing one-way signage on the one-way sections of Dalton Parkway and Warren Street.
- Add STOP sign (R1-1) to the Dalton Parkway right turn onto Essex Street.
- Consider updating bus stop signage to include signs at the beginning and end of each bus stop.
- Consider relocating the memorial statue on the median island to improve sight lines and allow the left turn from Essex Street to Boston Street to operate as protected/permissive. This modification may reduce the desire for motorists to make a u-turn around the statue.

#### **Safety Issue #5: Access and Roadway Geometry**

During the pre-audit meeting members noted that there were seven angle crashes that occurred at the intersection of Essex Street and Warren Street. Six of these crashes occurred when vehicles were attempting to turn left from Essex Street southbound onto Warren Street and one occurred when a



vehicle was turning out of Warren Street. These crashes were due to insufficient gaps in traffic forcing vehicles to accept smaller gaps.

While on the field walk audit, members noticed a WB-67 turning from Boston Street to Essex Street, the WB-67 turned right from the left-turn lane onto Boston Street and drove over the median island. The existing geometry of the intersection does not properly accommodate large vehicles, which in turn may lead to sideswipe collisions.

There are currently two CVS driveways that provide full access to the parking lot. Audit members noted that sightlines exiting the parking lot are limited due to parked vehicles near the entrances. Additionally, the high volume of vehicles on Essex Street cause drivers exiting the CVS to be more aggressive getting out of the parking lot leading to a higher frequency of angle crashes.

**Proposed Enhancements:**

- Consider prohibiting left turns from Warren Street to Essex Street to prevent angle crashes due to high volumes and speeds on Essex Street.
- Consider cutting back the southernmost island at the intersection of Boston Street and Essex Street to allow large trucks to make right turns from the right-hand lane and not the left-hand lane.
- Consider changing the southernmost CVS driveway to exit only and maintain full access at the easternmost driveway. Restrict parking proximity to the entrance to improve sightlines for motorists.

## Summary of Road Safety Audit

Following the site visit and discussion of existing safety issues, audit team members were asked to consider various safety related improvements. The audit team members were encouraged to consider both short-term and long-term improvements for each of the existing safety issues. Each improvement considered has been categorized as short-term, mid-term, or long-term based on the definitions shown in Table 2. Additionally, a cost category has been assigned to each improvement based on the parameters set forth in Table 2. The safety payoff is a subjective judgement of the potential effectiveness of the safety recommendations listed below.

Table 2: Estimated Time Frame and Costs Breakdown

Time Frame		Costs	
Short-Term	<1 Year	Low	≤\$10,000
Mid-Term	1-3 Years	Medium	\$10,001-\$50,000
Long-Term	>3 Years	High	>\$50,000

A list of each potential safety enhancement for the audit area is provided below in Tables 3 and 4.

Table 3: Potential Safety Enhancement Summary  
Boston Street at Proctor Street

Safety Issue	Potential Safety Enhancement	Safety Payoff	Time Frame	Cost	Jurisdiction
<b>Pavement Markings</b>	Consider restriping all existing pavement markings within the intersection and provide lane use arrows on all approaches.	Medium	Short-Term	Low	City of Salem
	Consider restriping lane use arrows on Pope Street.	Medium	Short-Term	Low	City of Salem
	Consider striping shoulders on Boston Street.	Medium	Short-Term	Low	City of Salem
	Consider shifting the double yellow centerline on Boston Street to accommodate two right turn lanes from Boston Street westbound to Bridge Street and Goodhue Street and one through-left turn lane.	Low	Mid-Term	High	City of Salem
	Consider adding bus stop pavement markings to enhance bus stop visibility.	Low	Short-Term	Low	MBTA
<b>Pedestrian Accommodations</b>	Install detectable warning panels for the existing wheelchair ramps to meet ADA compliance.	Low	Short-Term	Low	City of Salem
	Consider consolidating the crosswalk across Bridge Street at the signal and the crosswalk just to the north at Goodhue Street into one crosswalk.	Low	Short-Term	Low	City of Salem
	Consider repainting all crosswalks and providing proper maintenance.	Medium	Short-Term	Low	City of Salem

Safety Issue	Potential Safety Enhancement	Safety Payoff	Time Frame	Cost	Jurisdiction
	Consider installing pedestrian signal equipment and implementing a pedestrian phase into the signal.	High	Long-Term	High	City of Salem
	Consider tightening up the intersection to reduce pedestrian crossing lengths or consider adding pedestrian refuge islands.	Medium	Mid-Term	Medium	City of Salem
	Consider reconstructing the curbing throughout the intersection to provide adequate reveal.	Low	Short-Term	Low	City of Salem
	Consider adding a crosswalk to the western approach to the intersection.	Low	Short-Term	Low	City of Salem
	Consider removing some of the obstructions on the southwest corner of the intersection to prevent a pinch point in the pedestrian walkway.	Low	Short-Term	Low	City of Salem
	Consider adding pedestrian signage (R1-6, W11-2, R1-5) to corridor to highlight pedestrian activity in the area.	Low	Short-Term	Low	City of Salem
<b>Signal Phasing and Equipment</b>	Consider implementing back plates with retroreflective borders on all signal heads to improve visibility.	Low	Short-Term	Low	City of Salem
	Consider installing a median island on Pope Street to encourage vehicles to make the proper turning movement from the proper lane.	Low	Mid-Term	Medium	City of Salem

Safety Issue	Potential Safety Enhancement	Safety Payoff	Time Frame	Cost	Jurisdiction
	Consider changing the signal phasing from permissive left turn movements to protected left turn movements to reduce angle crashes within the intersection.	High	Long-Term	High	City of Salem
	Consider signaling the intersection of Pope Street and Boston Street and coordinate the signal with the Boston Street and Proctor Street/Bridge Street intersection.	High	Long-Term	High	City of Salem
	Consider updating the signals to meet current standards including an overhead signal head per lane and ensure signal upgrades are compatible with MBTA and MassDOT specifications for transit signal priority.	Medium	Long-Term	High	City of Salem
	Consider implementing a flashing yellow signal head to the intersection.	Low	Short-Term	Medium	City of Salem
	Consider reversing the directionality of Pope Street and Proctor Street with Pope Street becoming one-way southbound and Proctor Street becoming one-way northbound to reduce angle crashes at Pope Street.	High	Long-Term	High	City of Salem
<b>Signage</b>	Consider removing unnecessary signage throughout the intersection to reduce sign clutter.	Low	Short-Term	Low	City of Salem
	Consider adding a stop sign on the left-hand side of the Pope Street approach to Boston Street.	Medium	Short-Term	Low	City of Salem
	Maintain existing signage and consider updating worn and faded signage to MUTCD standard signs.	Low	Short-Term	Low	City of Salem

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Safety Issue	Potential Safety Enhancement	Safety Payoff	Time Frame	Cost	Jurisdiction
	Consider installing advance lane use signage on all approaches to the intersection.	Medium	Short-Term	Low	City of Salem
	Consider relocating the bus stop on the westbound approach to the far side of the intersection of Boston Street and Pope Street.	Low	Short-Term	Low	MBTA
	Consider adding signage to define the front and back-ends of bus stops. Ensure MBTA stops meet design guidelines for stop length and far-side location.	Low	Short-Term	Low	MBTA

**Table 4: Potential Safety Enhancement Summary  
Essex Street at Boston Street to Jackson Street**

<b>Safety Issue</b>	<b>Potential Safety Enhancement</b>	<b>Safety Payoff</b>	<b>Time Frame</b>	<b>Cost</b>	<b>Jurisdiction</b>
<b>Pavement Markings</b>	Consider striping the shoulders to define and narrow travel lanes, particularly on Essex Street southbound.	Medium	Short-Term	Low	City of Salem
	Consider re-striping all existing pavement markings throughout the corridor and implement lane use arrows.	Medium	Short-Term	Low	City of Salem
	Repaint the “do not block the box” pavement marking in front of the firehouse to prevent vehicles from stopping in front of the firehouse exit.	Medium	Short-Term	Low	City of Salem
	Consider striping Essex Street to formalize the two travel lanes northbound and reduce the frequency of sideswipe and angle collisions.	High	Short-Term	Low	City of Salem
	Consider installing bus stop pavement markings to help define the bus stop area.	Low	Short-Term	Low	MBTA
<b>Pedestrian Accommodations</b>	Install detectable warning panels for the existing wheelchair ramps to meet ADA compliance.	Low	Short-Term	Low	City of Salem
	Consider updating the pedestrian crossing at Warren Street/CVS to an RRFB or install flashing LED pedestrian signage.	High	Mid-Term	High	City of Salem
	Consider adding pedestrian accommodations on the north side of the intersection of Boston Street and Essex Street.	Medium	Short-Term	Median	City of Salem
	Reevaluate right turn volumes from Essex Street to Boston Street and consider installing a	Medium	Mid-Term	Medium	City of Salem

Safety Issue	Potential Safety Enhancement	Safety Payoff	Time Frame	Cost	Jurisdiction
	curb extension to shorten the pedestrian crossing.				
<b>Signal Phasing and Equipment</b>	Consider including Dalton Parkway in the existing Jackson Street signal and coordinating that signal with the Boston Street intersection.	High	Long-Term	High	City of Salem
	Coordinate firehouse signal better with the Boston Street signal to allow Essex Street traffic to clear.	High	Mid-Term	Medium	City of Salem
	Consider changing the flashing green light at the firehouse signal to a flashing yellow or steady green light.	Medium	Mid-Term	Medium	City of Salem
	Consider updating the intersections of Boston Street at Essex Street and Jackson Street at Essex Street from loop detection to video detection.	Low	Mid-Term	Medium	City of Salem
	Consider updating the clearance time intervals at the Jackson Street and Essex Street intersection.	Medium	Short-Term	Low	City of Salem
	Consider adding pedestrian ADA push buttons at traffic signals within the corridor.	Low	Mid-Term	Medium	City of Salem
	Consider installing new traffic controllers and mast arms along the corridor and incorporating transit signal priority. Ensure any signal upgrades are compatible with MBTA and MassDOT specifications for transit signal priority.	Medium	Long-Term	High	City of Salem
	Consider implementing back plates with retroreflective borders on all signal heads.	Low	Short-Term	Low	City of Salem

Safety Issue	Potential Safety Enhancement	Safety Payoff	Time Frame	Cost	Jurisdiction
	Consider updating traffic signal lights to LEDs and maintain lights to ensure all are working properly.	Medium	Short-Term	Low	City of Salem
<b>Signage</b>	Consider removing unnecessary signage to alleviate sign clutter and updating signage along the corridor to MUTCD standard signage.	Low	Short-Term	Low	City of Salem
	Consider installing signage near the Joseph Hodge Choate statue to prevent u-turns onto Boston Street from Essex Street.	Medium	Short-Term	Low	City of Salem
	Consider relocating the bus stop to the left-hand side of the fire station.	Low	Mid-Term	Low	MBTA
	Add STOP sign (R1-1) to the Dalton Parkway right turn onto Essex Street.	Medium	Short-Term	Low	City of Salem
	Consider providing one-way signage on the one-way sections of Dalton Parkway and Warren Street.	Low	Short-Term	Low	City of Salem
	Consider installing signage on both the front-end and back-end of the bus stops.	Low	Short-Term	Low	MBTA
<b>Roadway Geometry and Access</b>	Consider prohibiting left turns from Essex Street to Warren Street	Medium	Short-Term	Low	City of Salem
	Consider relocating the median island statue at Boston Street and Essex Street to improve sightlines and incorporate protected/permissive phasing for the left turn to Boston Street.	Medium	Mid-Term	Medium	City of Salem
	Consider cutting back the southernmost island at the intersection of Boston Street and Essex Street to allow large trucks to make right turns	Medium	Mid-Term	High	City of Salem



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Safety Issue	Potential Safety Enhancement	Safety Payoff	Time Frame	Cost	Jurisdiction
	from the right-hand lane and not the left-hand lane.				
	Consider changing the westernmost CVS driveway to exit only and maintain full access at the easternmost driveway. Restrict parking proximity to the entrance	Medium	Short-Term	Low	City of Salem

## Appendix A. RSA Meeting Agenda

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# Agenda

## Road Safety Audit

Salem

**Boston Street at Bridge Street/Proctor Street  
and Essex Street from Boston Street to Jackson  
Street**

Meeting Location: Salem City Hall Annex  
Conference Room, 2<sup>nd</sup> Floor  
98 Washington Street, Salem, MA 01970

April 8, 2019

9:30 AM – 12:30 PM

Type of meeting:

High Crash Location – Road Safety Audit

Attendees:

Invited Participants to Comprise a Multidisciplinary Team

Please bring:

Thoughts and Enthusiasm!!

9:30 AM

Welcome and Introductions

9:45 AM

Review of Site Specific Material

- Crash Summaries – provided in advance
- Existing Geometries and Conditions

10:30 AM

Visit the Site

- Drive to Boston Street at Proctor Street/Bridge Street and Essex Street between Boston Street and Jackson Street
- As a group, identify areas for improvement

12:00 PM

Post Visit Discussion / Completion of RSA

- Discuss observations and finalize findings
- Discuss potential improvements and finalize recommendations

12:30 PM

Adjourn for the Day – but the RSA has not ended

### Instructions for Participants:

- Before attending the RSA on April 8, 2019 participants are encouraged to drive through the intersection and complete/consider elements on the RSA Prompt List with a focus on safety.
- All participants will be actively involved in the process throughout. Participants are encouraged to come with thoughts and ideas, but are reminded that the synergy that develops and respect for others' opinions are key elements to the success of the overall RSA process.
- After the RSA meeting, participants will be asked to comment and respond to the document materials to assure it is reflective of the RSA completed by the multidisciplinary team.

## Appendix B. RSA Audit Team Contact List





























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## Participating Audit Team Members

Audit Team Member	Agency/Affiliation	Email Address
Amy Silbovitz	VHB, Inc.	<a href="mailto:asilbovitz@vhb.com">asilbovitz@vhb.com</a>
Kirsten Braun	VHB, Inc.	<a href="mailto:kbraun@vhb.com">kbraun@vhb.com</a>
Lori Aho	VHB, Inc.	<a href="mailto:laho@vhb.com">laho@vhb.com</a>
Kevin Fitzgerald	MassDOT Traffic Safety	<a href="mailto:Kevin.T.Fitzgerald@dot.state.ma.us">Kevin.T.Fitzgerald@dot.state.ma.us</a>
Christopher Falcos	MassDOT Traffic Safety	<a href="mailto:Christopher.falcos@dot.state.ma.us">Christopher.falcos@dot.state.ma.us</a>
Tim Roberts	MassDOT D-4 Traffic	<a href="mailto:Timothy.roberts@dot.state.ma.us">Timothy.roberts@dot.state.ma.us</a>
Eric Burkman	MBTA Service Planning	<a href="mailto:eburkman@mbta.com">eburkman@mbta.com</a>
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Tom Devine	City of Salem Planning Department	<a href="mailto:tdevine@salem.com">tdevine@salem.com</a>
David Tucker	City of Salem Police Department	<a href="mailto:dmtucker@salempd.net">dmtucker@salempd.net</a>
David Kucharsky	City of Salem Traffic and Parking	<a href="mailto:dkucharsky@salem.com">dkucharsky@salem.com</a>
David Knowlton	City of Salem Engineering and DPS	<a href="mailto:dknowlton@salem.com">dknowlton@salem.com</a>

## Appendix C. Detailed Crash Data

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SYMBOLS				TYPES OF CRASH				SEVERITY		TRAFFIC CONTROL	
<div>InvolvedNon-Involved</div>											
			Pedestrian								
			Bicycle								
			Animal								
			Direction of Motion								
			Parked Vehicle								
			Fixed Object								



Source of Crash Reports: Salem Police Department

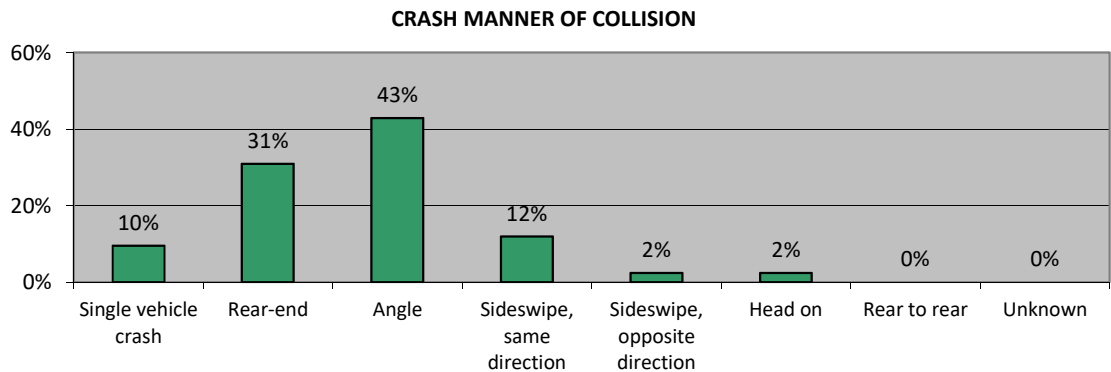
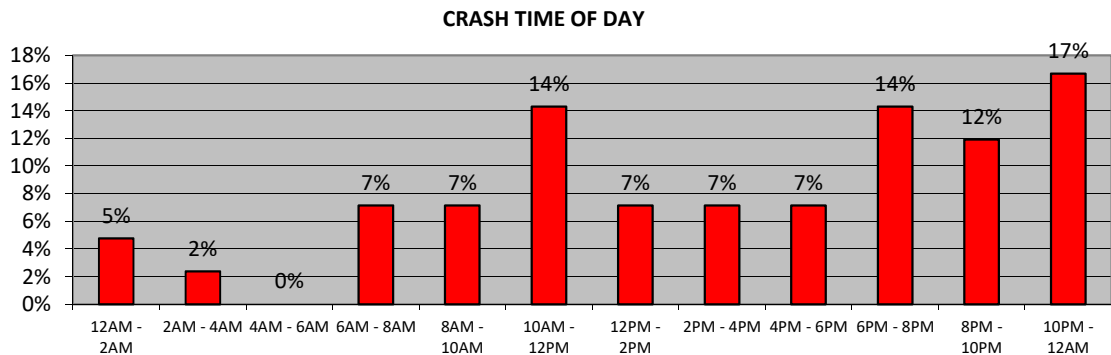
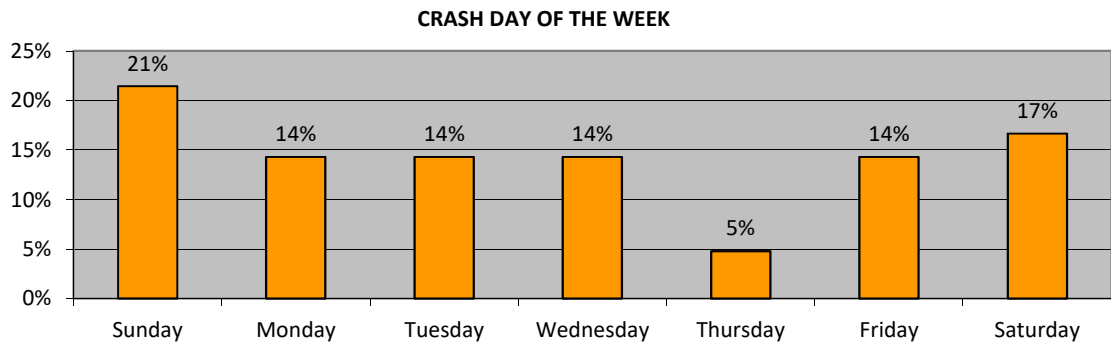
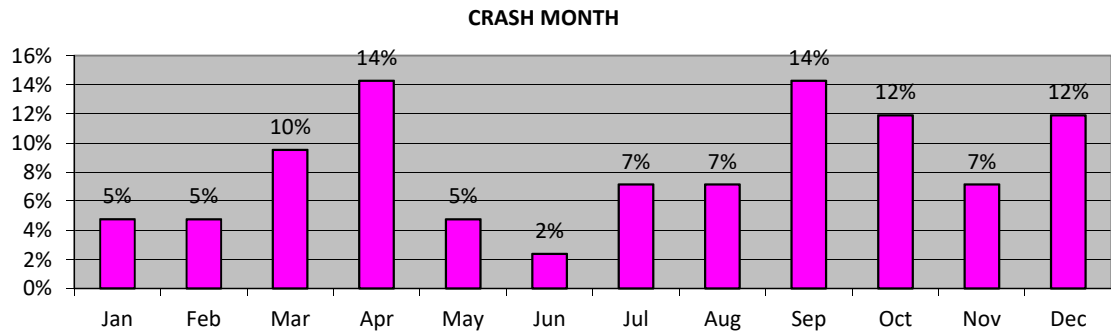


Crash Diagram (2016-2018 Crash Data)  
Boston Street at Proctor Street/Bridge Street

Salem, MA

## Crash Data Summary Charts

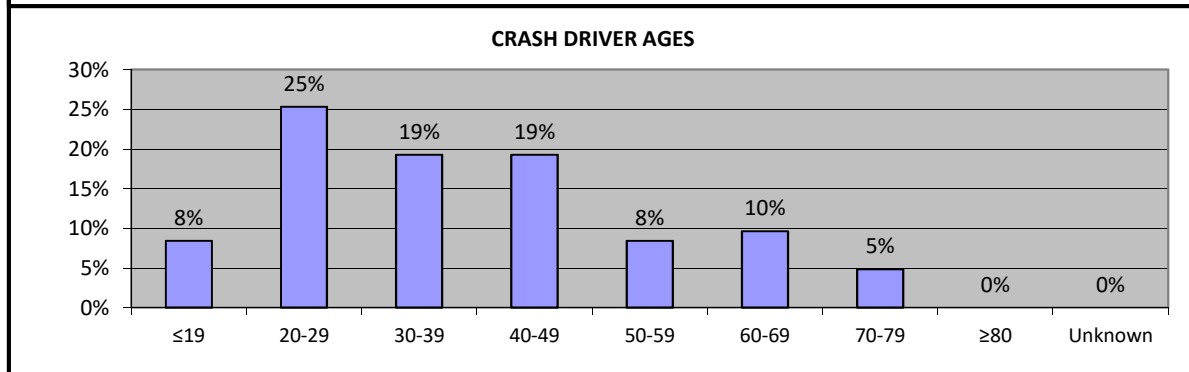
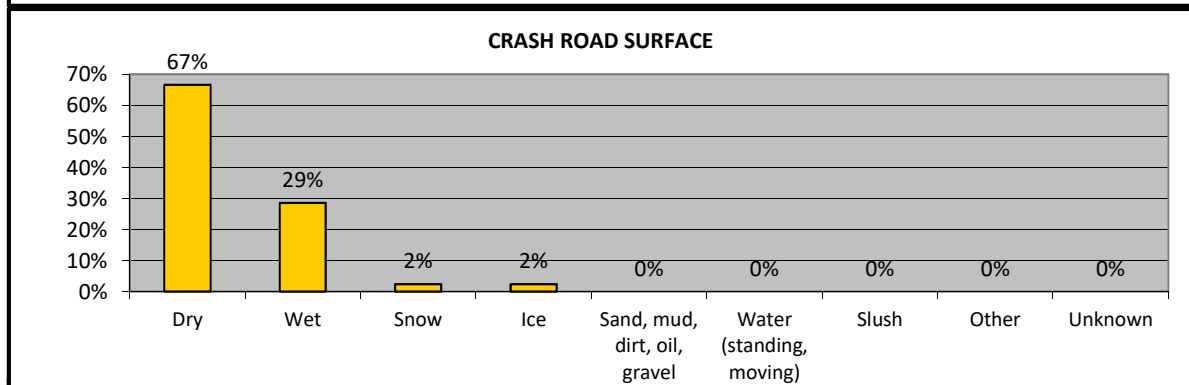
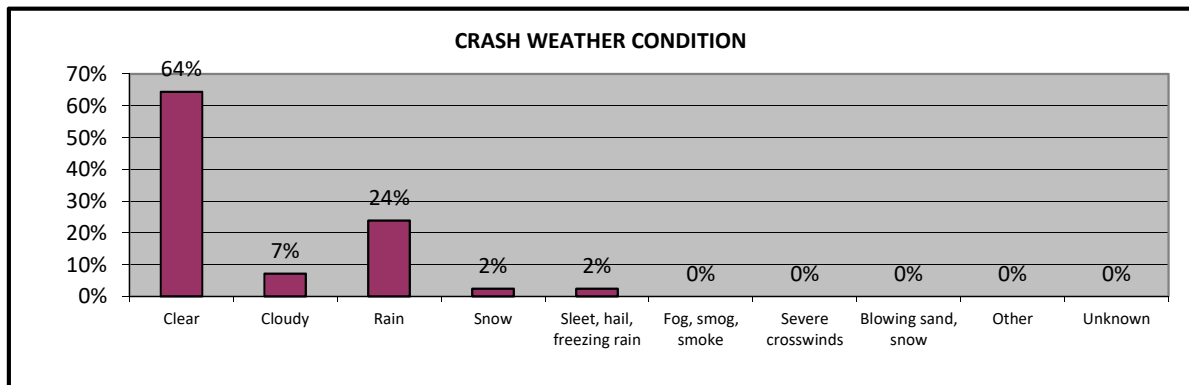
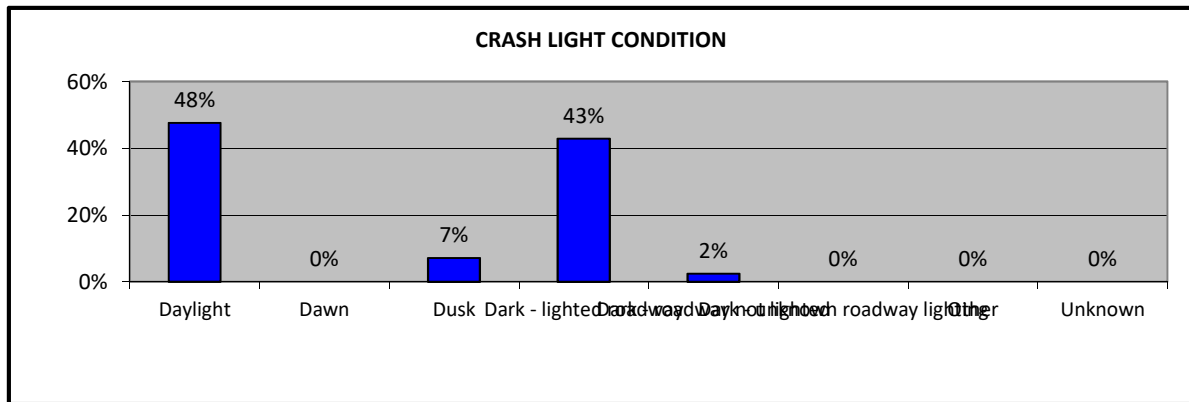
### Boston St. @ Proctor St., Salem, MA





## Crash Data Summary Charts

### Boston St. @ Proctor St., Salem, MA



# Crash Data Summary Table

Boston St. @ Proctor St., Salem, MA  
2016 - 2018

Crash Diagram Ref #	Crash Date	Month #	Day #	Crash Day	Time of Day	Hour #	Manner of Collision	Light Condition	Weather Condition	Road Surface	Driver Contributing Code	D1 Age	D2 Age	D3 Age	Comments
#	mm/dd/yy			Day	hh:mm		Type	Type	Type	Type	Type	#	#	#	
1	1/10/16	1	1	Sunday	5:04 PM		17 Rear-end	Dark - lighted roadway	Rain	Wet	Failed to yield right of way	43	38		MV1 slid on wet pavement when attempting to stop and rear-ended MV2.
2	2/7/16	2	1	Sunday	10:40 PM		22 Sideswipe, same direction	Dark - lighted roadway	Clear	Dry	Unknown	18	74		MV1 went to change lanes approaching Bridge St from Boston St when MV2 pulled up to the right side of MV1 and the two vehicles sideswiped eachother.
3	10/4/16	10	3	Tuesday	4:22 PM		16 Rear-end	Daylight	Clear	Dry	No improper driving	19	45		MV1 was approaching Bridge Street traveling westbound whne MV2 struck the rear of MV1.
4	10/17/16	10	2	Monday	7:22 AM		7 Rear-end	Daylight	Clear	Dry	No improper driving	29			MV1 rear-ended MV2 heacing inbound on Boston Street. MV2 drove away and could not be located.
5	11/23/16	11	4	Wednesday	11:40 PM		23 Sideswipe, same direction	Dark - lighted roadway	Clear	Dry	No improper driving	20	24		MV2 in the right turn lane and pulled into the thru lane at Boston St. @ Proctor/Bridge St. and sideswiped MV1 which was going straight on Boston St.
6	12/2/16	12	6	Friday	1:38 PM		13 Angle	Daylight	Clear	Dry	Failed to yield right of way	78	34		MV1 made a permitted left turn on Proctor/Bridge St @ Boston St intersection and MV2 struck MV1 as it went EB on Boston St.
7	12/6/16	12	3	Tuesday	9:10 AM		9 Rear-end	Daylight	Clear	Dry	Failed to yield right of way	31	69		MV1 turned left out of Pope St onto Boston St WB and was struck by MV2 traveling on Boston St EB.
8	1/7/17	1	7	Saturday	12:55 PM		12 Rear-end	Daylight	Snow	Snow	Swerving or avoiding due to wind, slippery surface, vehicle, object, non-motorist in roadway, etc.	20	37		MV1 attempted to stop at Boston St @ Proctor/Bridge St, but, due to snow, slid into the back of MV2.
9	3/3/17	3	6	Friday	10:55 PM		22 Rear-end	Dark - lighted roadway	Sleet, hail, freezing rain	Ice	Unknown	27	22		MV1 attempted to stop at Boston St @ Proctor/Bridge St, but, due to ice in the ROW, slid into the back of MV2.
10	3/21/17	3	3	Tuesday	6:21 AM		6 Single vehicle crash	Daylight	Clear	Dry	Unknown	26			MV1 was being followed closely by another vehicle and she hit the gas and veered off the road into a fence.
11	3/22/17	3	4	Wednesday	7:38 AM		7 Angle	Daylight	Clear	Dry	Other improper action	38	39		MV2 turned left from Pope St. on to Boston St. and the vehicle in front of MV1 on Boston St. was stopped. MV1 attempted to pass the vehicle on the shoulder and struck MV2.
12	4/25/17	4	3	Tuesday	11:37 PM		23 Angle	Dark - lighted roadway	Rain	Wet	Failed to yield right of way	25	69		MV2 turned left out of Pope St onto Boston St. EB and was struck by MV1 traveling on Boston St WB.
13	5/25/17	5	5	Thursday	8:31 AM		8 Rear-end	Daylight	Clear	Dry	Swerving or avoiding due to wind, slippery surface, vehicle, object, non-motorist in roadway, etc.	49	44		MV1 was turning out of Bridge St when they struck the rear end of MV2 who was parked and sticking out into the intersection.
14	7/10/17	7	2	Monday	10:28 AM		10 Angle	Daylight	Clear	Dry	Failed to yield right of way	46	46		MV2 drove straight through the intersection while MV1 thought they were turning right and MV1 who was turning left onto Bridge St was struck by MV2.
15	8/20/17	8	1	Sunday	11:47 AM		11 Rear-end	Daylight	Clear	Dry	No improper driving	79	37	23	MV2's driver took their eyes off the road, causing MV2 to rear-end MV1
16	8/28/17	8	2	Monday	8:28 PM		20 Angle	Dark - lighted roadway	Clear	Dry	Operating vehicle in erratic, reckless, careless, negligent, or aggressive manner	34	22		MV2 turned left out of Pope St onto Boston St. WB and was struck by MV1 traveling on Boston St EB.
17	9/3/17	9	1	Sunday	8:54 PM		20 Angle	Dark - lighted roadway	Rain	Wet	Failure to keep in proper lane or running off road	36	28		MV1 tried turning right onto Bridge St during a green light and MV2 struck MV1 as it took a left turn.
18	9/16/17	9	7	Saturday	3:00 PM		15 Single vehicle crash	Daylight	Clear	Dry	No improper driving	69			MV1 moved from Bridge St. to Proctor St. with a green light and collided with a cyclist running a red light from Boston St. to Bridge St.
19	9/22/17	9	6	Friday	2:30 AM		2 Angle	Dark - lighted roadway	Rain	Wet	Unknown	23	29		MV2 exited Proctor St. the wrong way and struck MV 1 which was headed EB on Boston St. MV2 then fled down Bridge St.
20	9/22/17	9	6	Friday	10:07 PM		22 Angle	Dark - lighted roadway	Rain	Wet	Failed to yield right of way	27	31		MV2 turned left out of Pope St onto Boston St WB and was struck by MV1 traveling on Boston St SB. MV2 then swerved into a small tree stump.
21	9/29/17	9	6	Friday	8:05 AM		8 Angle	Daylight	Clear	Dry	Failed to yield right of way	78	52		MV1 traveling outbound on Boston Street when MV2 attempted to go around a truck and struck MV1.
22	10/21/17	10	7	Saturday	5:53 PM		17 Angle	Dusk	Clear	Dry	No improper driving	23	47		Both MVs were traveling outbound on Boston St and stopped at the red light at Bridge St when the light turned green MV2 attempted to pass MV1 and struck MV1.
23	10/30/17	10	2	Monday	12:01 AM		Angle	Dark - lighted roadway	Rain	Wet	Failed to yield right of way	19	19		MV1 EB on Boston St. and MV2 failed to yield to MV1 while on Pope St. MV2 then struck MV1 from the side.
24	11/12/17	11	1	Sunday	10:03 AM		10 Angle	Daylight	Cloudy	Dry	Failed to yield right of way	32	46		MV1 EB on Boston St. from Walgreens parking lot and MV2 failed to yield to MV1 while on Pope St. MV2 then struck MV1 from the side.
25	12/2/17	12	7	Saturday	10:56 PM		22 Head on	Dark - lighted roadway	Clear	Dry	Unknown	23	46		MV2 was traveling on Boston St inbound when MV1 was turning onto Boston St from Pope St and collided with MV2.
26	12/30/17	12	7	Saturday	6:30 PM		18 Angle	Dark - lighted roadway	Clear	Dry	No improper driving	53			MV1 EB on Boston St. and MV2 failed to yield to MV1 while on Pope St. MV2 then struck MV1 from the side.
27	2/14/18	2	4	Wednesday	8:39 PM		20 Sideswipe, same direction	Dark - lighted roadway	Clear	Dry	Operating vehicle in erratic, reckless, careless, negligent, or aggressive manner	67			MV1 traveling on Bridge St when MV2 tried to pass MV1 and collided with MV1.
28	3/1/18	3	5	Thursday	10:10 PM		22 Rear-end	Dark - lighted roadway	Clear	Dry	Other improper action	53	32		On Bridge St MV2 rear ended MV1 at the traffic signal.
29	4/1/18	4	1	Sunday	6:52 PM		18 Sideswipe, same direction	Dusk	Clear	Dry	Wrong side or wrong way	32	35		MV1 was traveling on Proctor St from Boston St. when MV2 exited the Walgreens and proceeded to travel on Proctor St the wrong way and collided with MV1.
30	4/2/18	4	2	Monday	7:36 PM		19 Sideswipe, same direction	Dark - lighted roadway	Clear	Dry	Disregarded traffic signs, signals, road markings	57	33		MV1 in left turn lane WB on Boston St. @ Boston St. @ Proctor/Bridge St. intersection and turned into the thru lane, sideswiping MV2.
31	4/4/18	4	4	Wednesday	10:22 AM		10 Rear-end	Daylight	Cloudy	Wet	No improper driving	50	57		MV1 rear-ended by MV2 while approaching Boston St. @ Bridge/Proctor St. intersection.
32	4/23/18	4	2	Monday	7:46 PM		19 Single vehicle crash	Dusk	Clear	Dry	Emotional	18			MV was traveling the wrong way down Pope Street when she deliberately drove into a telephone pole.
33	4/25/18	4	4	Wednesday	3:01 PM		15 Rear-end	Daylight	Rain	Wet	No improper driving	41	67		MV1 traveling on Bridge St toward Goodhue when he rear ended MV2 at the traffic signal which then rear ended MV3.
34	5/22/18	5	3	Tuesday	12:50 PM		12 Angle	Daylight	Rain	Wet	Failed to yield right of way	48	62	21	MV1 EB on Boston St. struck MV2 as it was taking a permitted left turn onto Proctor St. SB.
35	6/30/18	6	7	Saturday	9:14 PM		21 Angle	Dark - roadway not lighted	Clear	Dry	No improper driving	48	41		MV1 was turning right off of Boston St heading towards Goodhue when MV2 was turning left off of Boston St onto Bridge St when the vehicles collided.
36	7/22/18	7	1	Sunday	6:28 PM		18 Angle	Daylight	Clear	Dry	Disregarded traffic signs, signals, road markings	32	47		MV2 EB on Boston St. and MV1 failed to yield to MV2 while on Pope St. MV1 then struck MV2 from the side.
37	7/22/18	7	1	Sunday	9:02 PM		21 Rear-end	Dark - lighted roadway	Clear	Wet	No improper driving	20	40		MV1 was traveling outboun on Boston St and was not paying attention and did not notice the light at Bridge St had turned red and rear-ended MV2.
38	8/21/18	8	3	Tuesday	10:51 AM		10 Sideswipe, opposite direction	Daylight	Cloudy	Dry	Failed to yield right of way	59	20		MV failed to yield to a bicyclist and struck them while exiting Pope St.

Boston St. @ Proctor St., Salem, MA  
2016 - 2018

Summaries based on crash reports obtained from the Salem Police Department.



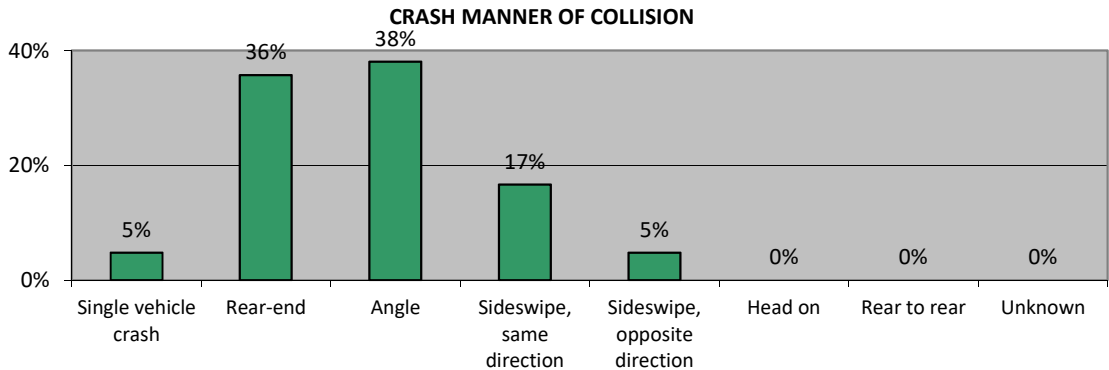
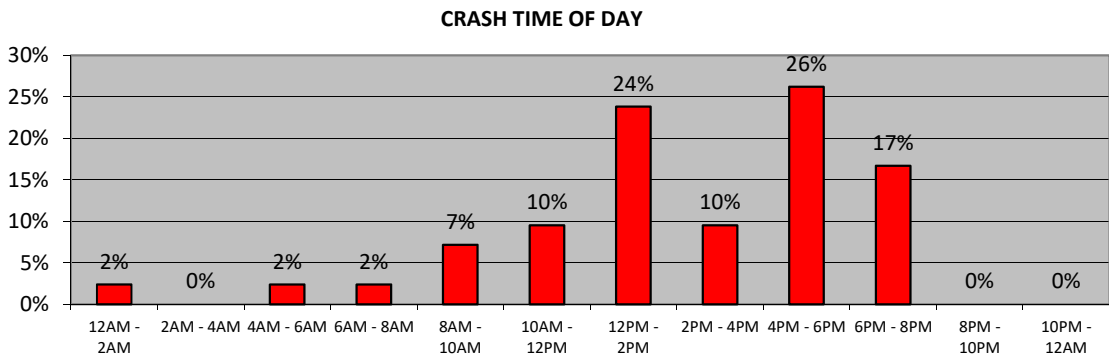
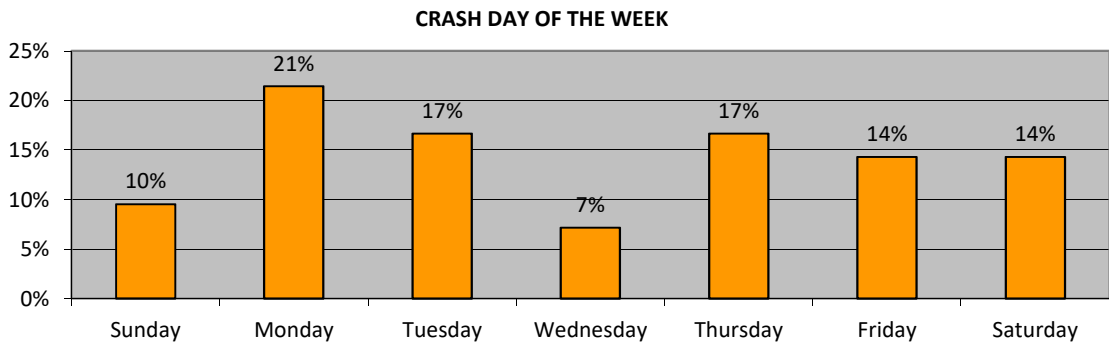
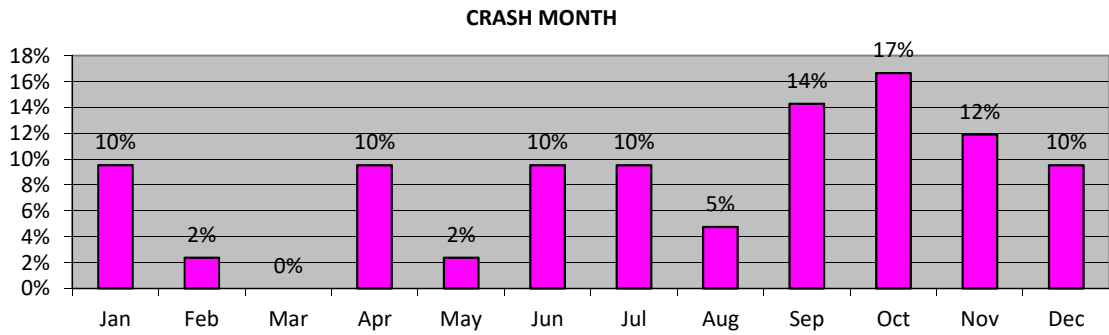


Crash Diagram (2016-2018 Crash Data)  
Essex Street  
Boston Street to Jackson Street  
Salem, MA



## Crash Data Summary Charts

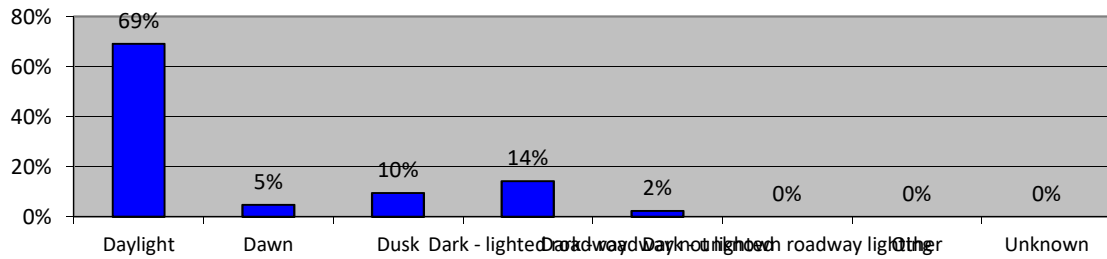
### Boston St. @ Essex St., Salem, MA



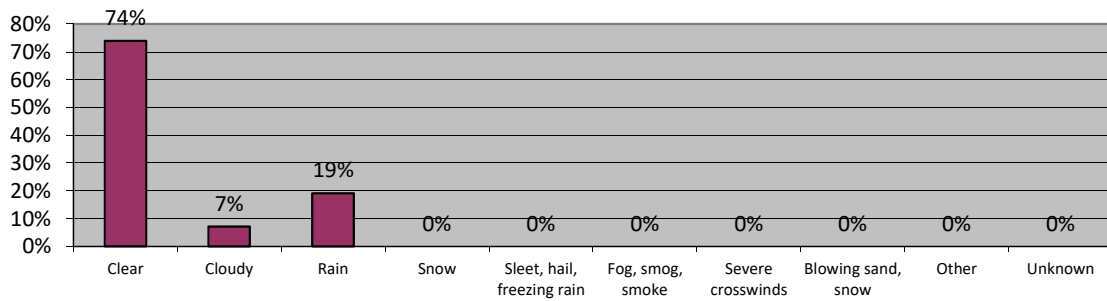
## Crash Data Summary Charts

### Boston St. @ Essex St., Salem, MA

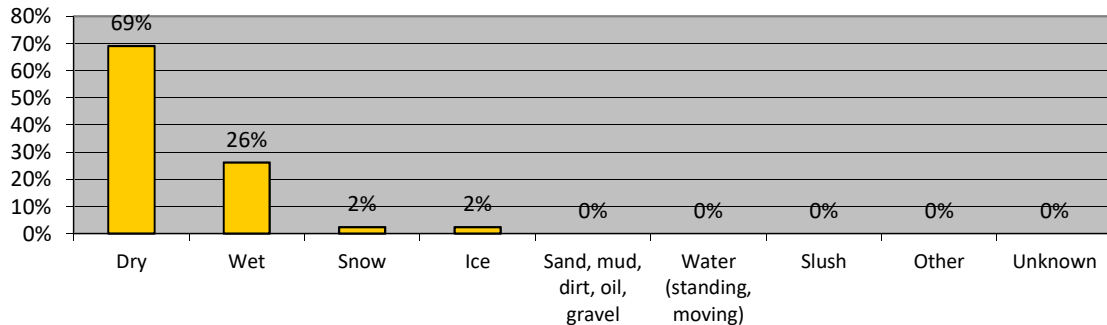
**CRASH LIGHT CONDITION**



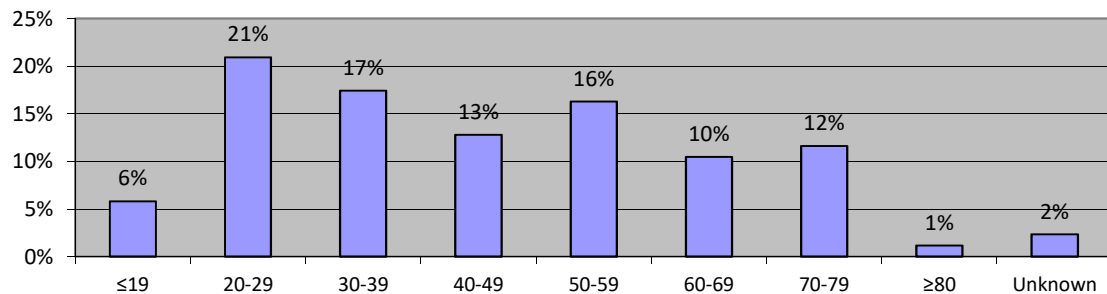
**CRASH WEATHER CONDITION**



**CRASH ROAD SURFACE**



**CRASH DRIVER AGES**



## Crash Data Summary Table

Boston St. @ Essex St., Salem, MA  
2016 - 2018

Crash Diagram Ref #	Crash Date	Month #	Day #	Crash Day	Time of Day	Hour #	Manner of Collision	Light Condition	Weather Condition	Road Surface	Driver Contributing Code	D1 Age	D2 Age	D3 Age	Comments
#	mm/dd/yy			Day	hh:mm		Type	Type	Type	Type	Type	#	#	#	
1	1/20/19	1	1	Sunday	1:20 PM		13 Rear-end	Daylight	Clear	Dry	Failed to yield right of way	40	30		MV1 stopped short and rear-ended MV2 near 426 Essex St.
2	04/12/16	4	3	Tuesday	12:59 PM		12 Sideswipe, same direction	Daylight	Rain	Wet	Failure to keep in proper lane or running off road	68	39		Both MVs traveling outbound on Essex when MV1 swerved into MV2s lane colliding with MV1.
3	04/14/16	4	5	Thursday	11:52 AM		11 Sideswipe, same direction	Daylight	Clear	Dry	Failed to yield right of way	21	75		MV1 turned from a parking spot onto Boston St. MV2 travelling straight on Boston St sideswiped MV1.
4	07/19/16	7	3	Tuesday	5:48 PM		17 Rear-end	Daylight	Clear	Dry	No improper driving	43	30		MV1 stopped for ped-xing and was rear-ended by MV2.
5	8/20/16	8	7	Saturday	11:57 AM		11 Angle	Daylight	Clear	Dry	Failed to yield right of way	54	71		MV1 turning left onto Jackson when struck by MV2 traveling inbound on Essex
6	09/10/16	9	7	Saturday	3:30 PM		15 Rear-end	Daylight	Clear	Dry	Unknown	17	66	30	MV1 rear-ended MV2 which in turn pushed MV2 into MV3.
7	09/10/16	9	7	Saturday	7:44 PM		19 Rear-end	Dark - lighted roadway	Clear	Dry	No improper driving	54	35		MV1 avoided a vehicle who cut them off. MV2 then rear-ended MV1.
8	09/12/16	9	2	Monday	6:16 PM		18 Sideswipe, opposite direction	Dawn	Clear	Dry	No improper driving	31	28		MV1 going WB on Boston St and MV2 made contact with the drivers side door of MV1 while turning towards Essex St.
9	09/13/16	9	3	Tuesday	5:05 PM		17 Rear-end	Daylight	Clear	Dry	Inattention	68	23		MV1 rear-ended MV2 on Jackson St when light turned green and MV2 started to accelerate.
10	10/3/16	10	2	Monday	10:42 AM		10 Rear-end	Daylight	Clear	Dry	No improper driving	56	43		MV1 traveling from Highland Ave to Jackson St while MV2 was traveling straight on Essex when MV1 clipped the bumper and rear tail light of MV2.
11	10/07/16	10	6	Friday	4:43 PM		16 Angle	Daylight	Clear	Dry	Unknown	66	36		MV2 was turning left onto Warran Street when they were struck by MV1 traveling inbound on Essex Street.
12	10/09/16	10	1	Sunday	7:08 PM		19 Sideswipe, same direction	Dark - lighted roadway	Rain	Wet	No improper driving	56	55		MV2 crossed over a solid white line to change lanes and hit MV1.
13	10/16/16	10	1	Sunday	1:43 PM		13 Rear-end	Daylight	Clear	Dry	No improper driving	42	22		MV1 made a right hand turn from Dalton Pkwy to Essex and was rear ended by MV2.
14	10/22/16	10	7	Saturday	4:30 PM		16 Angle	Dusk	Rain	Wet	No improper driving	28	27		MV1 was traveling outbound on Essex when MV2 exited the CVS parking lot and collided with MV1.
15	11/18/16	11	6	Friday	6:54 PM		18 Sideswipe, opposite direction	Daylight	Clear	Dry	Unknown	38	38		MV1 was traveling NB on Essex when they were struck by MV2 who was trying to turn left onto Warren Street
16	12/16/16	12	6	Friday	4:17 PM		16 Rear-end	Dusk	Clear	Ice	No improper driving	20	42		Both MVs were traveling inbound on Essex St near Boston St intersection MV2 slowed for traffic and MV1 rear-ended MV2
17	04/13/17	4	5	Thursday	12:19 PM		12 Rear-end	Daylight	Clear	Dry	Followed too closely	88	67		MV1 stopped to let 2 pedestrians cross when MV2 rear-ended MV1.
18	04/27/17	4	5	Thursday	7:58 AM		7 Angle	Daylight	Cloudy	Dry	Failed to yield right of way	60	20		MV1 was traveling inbound on Essex Street and collided with MV2 which was making a left turn from the outbound lane of Essex to Warren Street.
19	05/25/17	5	5	Thursday	12:10 PM		12 Angle	Daylight	Rain	Wet	Made an improper turn	42	19		Both MVs were traveling north on Essex, when MV1 made an unsafe lane change and made contact with MV2 (Bus).
20	06/16/17	6	6	Friday	4:04 PM		16 Angle	Daylight	Rain	Wet	Operating vehicle in erratic, reckless, careless, negligent, or aggressive manner	68	23		MV1 took a right turn from Essex to Boston St outbound and was sideswiped by MV2 pulling out of Mande's Pizza.
21	06/28/17	6	4	Wednesday	11:02 AM		11 Angle	Daylight	Clear	Dry	Failed to yield right of way	77	58		MV1 was traveling inbound on Essex Street and collided with MV2 which was making a left turn from the outbound lane of Essex to Warren Street.
22	7/19/17	7	4	Wednesday	12:32 PM		12 Rear-end	Daylight	Clear	Dry	Failed to yield right of way	33	54		MV1 was backing up to not block the intersection when the light turned red when MV2 was trying to drive around MV1 and the two vehicles collided.
23	09/19/17	9	3	Tuesday	3:22 PM		15 Rear-end	Daylight	Cloudy	Dry	Inattention	70	75	31	MV3 was traveling on Essex Street at the intersection of May Street when the signal turned green he pressed the gas and rear-ended MV2 which then rear-ended MV3.
24	10/24/17	10	3	Tuesday	7:26 PM		19 Sideswipe, same direction	Dark - lighted roadway	Clear	Dry	No improper driving	60	unknown		A tractor trailer hit a parked vehicle with the rear right quarter panel of the trailer. The parked vehicle was 2.5 feet away from the curb.
25	11/13/17	11	2	Monday	5:29 PM		17 Angle	Dark - roadway not lighted	Rain	Wet	No improper driving	44	22		MV1 WB on Boston St. was struck by MV2 which was emerging from the parking lot of 7 Boston St.
26	12/12/17	12	3	Tuesday	9:48 AM		9 Single vehicle crash	Daylight	Clear	Dry	Operating vehicle in erratic, reckless, careless, negligent, or aggressive manner	22			MV1 was traveling north on Essex near May Street and struck a light pole. Operating under influence of drugs.
27	12/29/17	12	6	Friday	4:18 PM		16 Sideswipe, same direction	Dusk	Clear	Dry	Other improper action	47	55		MV1 WB on Boston St. struck the open door of a parked car near 7 Boston St.
28	01/06/18	1	7	Saturday	6:58 PM		18 Rear-end	Dark - lighted roadway	Clear	Wet	Inattention	42	53		MV1 rear-ended by MV2 while approaching Boston @ Essex St. intersection.
29	01/08/18	1	2	Monday	3:46 PM		15 Angle	Daylight	Cloudy	Snow	Failed to yield right of way	19	19		MV1 (a police cruiser) was turning right from Dalton Pkwy onto Essex Street when MV1 struck MV2 (a school bus) traveling inbound on Essex St.
30	01/11/18	1	5	Thursday	5:10 PM		17 Rear-end	Dawn	Clear	Wet	No improper driving	72	68	56	MV1 was traveling outbound on Essex when they rear-ended MV2 who was waiting to turn left onto Jackson St. MV1 then rolled backward and collided with MV3.
31	02/04/18	2	1	Sunday	6:20 PM		18 Angle	Dusk	Rain	Wet	No improper driving	32	42		MV1 SB on Essex St. struck MV2 as it was taking a permitted left turn onto Boston St. WB.
32	06/11/18	6	2	Monday	8:57 AM		8 Rear-end	Daylight	Clear	Dry	Unknown	47	79		MVs were traveling inbound on Essex Street when MV1 rear-ended MV2 near May Street.
33	06/22/18	6	6	Friday	2:41 PM		14 Angle	Daylight	Clear	Dry	No improper driving	56	72		MV1 exiting right out of CVS when MV2, traveling outbound, attempted to go around his vehicle and struck the front.
34	07/02/18	7	2	Monday	9:51 AM		9 Angle	Daylight	Clear	Dry	No improper driving	54	38		MV2 (Tractor trailer) turned right in the left hand turning lane at the Boston St. @ Essex St. intersection. The trailer collided with MV1 in the right hand turning lane.
35	7/19/18	7	5	Thursday	1:17 PM		13 Angle	Daylight	Clear	Dry	Unknown	19	57		MV1 was traveling outbound on Essex Street and was attempting to make a left turn onto Warren Street when MV2 traveling inbound struck MV1.
36	8/22/18	8	4	Wednesday	4:54 PM		16 Sideswipe, same direction	Daylight	Clear	Dry	Unknown	27	23		MV1 was turning right onto Jackson St from Warren Ct when MV1 was passing another car and struck MV2.
37	09/17/18	9	2	Monday	4:38 PM		16 Rear-end	Daylight	Clear	Dry	Followed too closely	26	71		MV2 rear-ended by MV1 on WB Boston St. at Boston St. @ Essex St. intersection.
38	10/09/18	10	3	Tuesday	12:19 PM		12 Angle	Daylight	Clear	Dry	Failed to yield right of way	24	73		MV2 pulled out of CVS parking lot and struck MV1 traveling outbound on Essex Street.
39	11/15/18	11	5	Thursday	12:16 AM		Single vehicle crash	Dark - lighted roadway	Clear	Dry	Failure to keep in proper lane or running off road	35			MV lost control and struck a monument on Essex St just north of Boston St.
40	11/17/18	11	7	Saturday	4:02 AM		4 Sideswipe, same direction	Dark - lighted roadway	Clear	Wet	Emotional	20	unknown		MV1 was traveling on Essex St toward Beverly when it struck parked MV 2 and 3 in front of 405 Essex.
41	11/19/18	11	2	Monday	1:17 PM		13 Angle	Daylight	Rain	Wet	Failed to yield right of way	25	33		MV1 was traveling northbound on Essex St and was sideswiped by MV2 who was exiting Warren St and turning right.

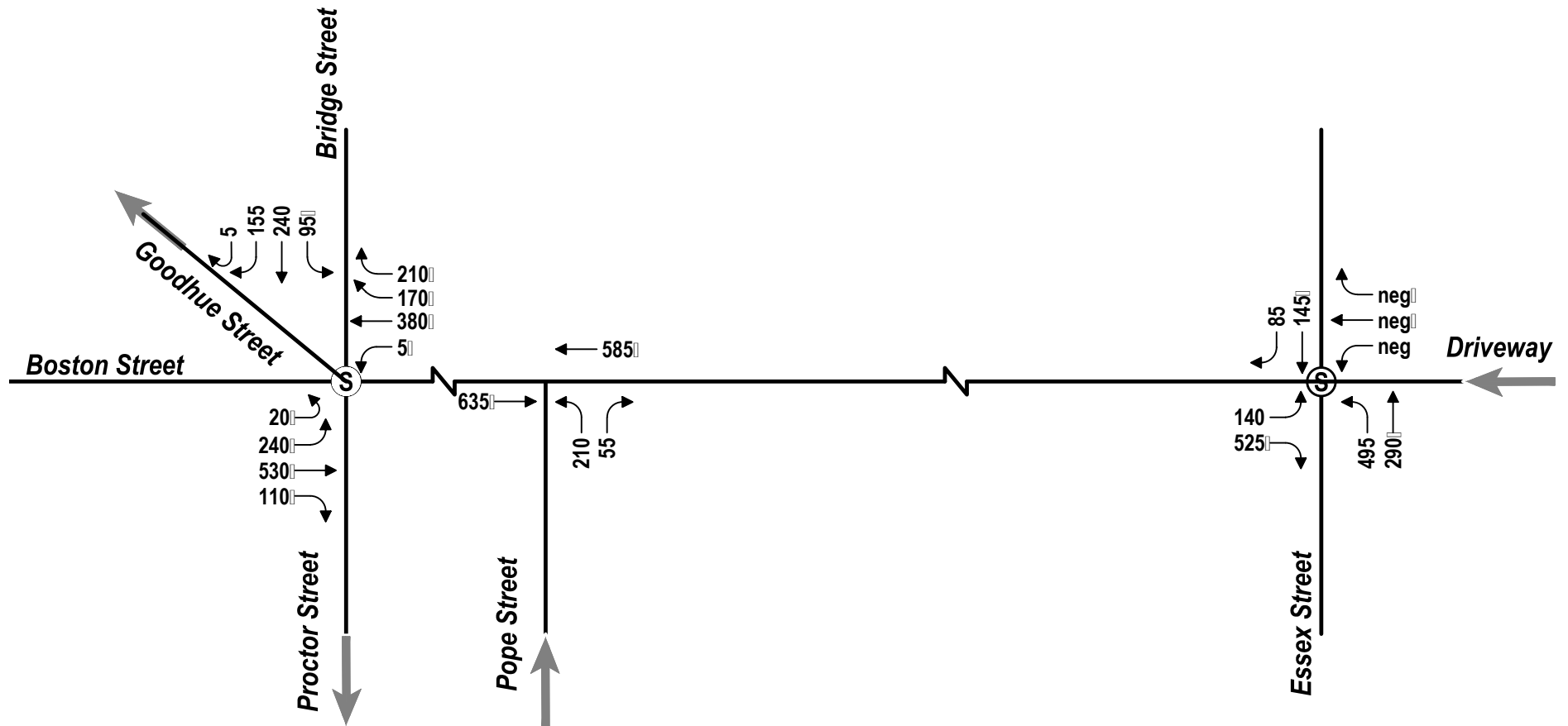
Boston St. @ Essex St., Salem, MA  
2016 - 2018

Summaries based on crash reports obtained from the Wakefield Police Department.



## Appendix D. Road Safety Audit References

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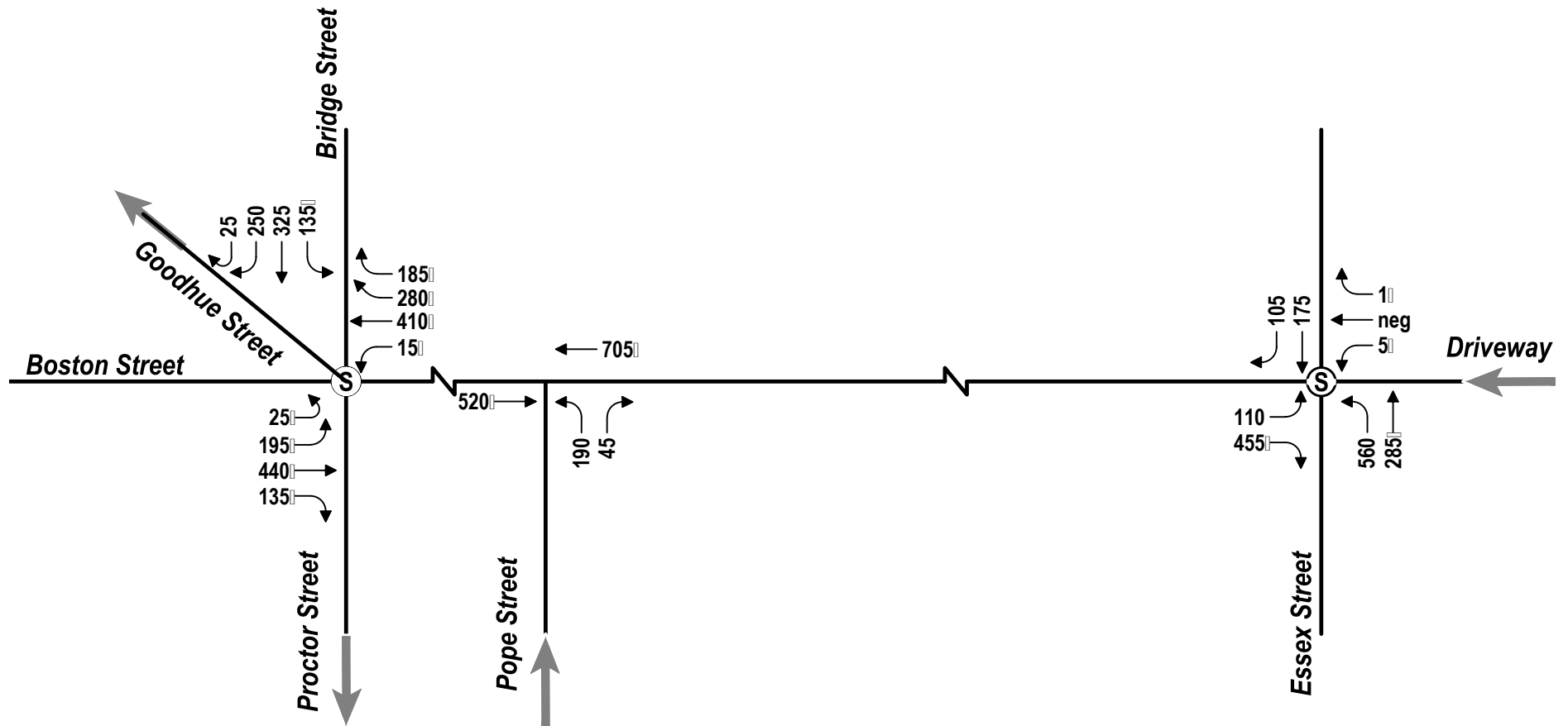


Not to Scale



2016 Existing Conditions  
Weekday Morning Peak Hour  
Boston Street - Complete Streets Development  
Salem, Massachusetts

**Figure 1**



Not to Scale



2016 Existing Conditions  
Weekday Evening Peak Hour  
Boston Street - Complete Streets Development  
Salem, Massachusetts

**Figure 2**

## Road Safety Audit References

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