Lane Departure Road Safety Audit for Thatcher Street in Brockton and East Bridgewater, Massachusetts

Prepared by
Old Colony Planning Council
and
University of Massachusetts Traffic Safety Research Program

umass Safe
Traffic Safety Research Program

Prepared for

Massachusetts Highway Department

MASS HIGHWAY

Federal Highway Administration

U.S. Department of Transportation
Federal Highway Administration

May 2008

1.0 Introduction to Road Safety Audits & Lane Departure Crashes in Massachusetts

The Federal Highway Administration 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 an RSA is to *identify potential safety issues and possible opportunities for safety improvements* considering all roadway users. Specific objectives of an RSA include, but are not limited to the following:

- Minimizing the risk and severity of road crashes that may be affected by the existing or future roadway at a specific location or nearby network; and
- Improving the awareness of safe design practices which are likely to result in safety benefits based upon potential safety concerns.

Although RSA's have been employed in other countries for some time, they are being fully embraced across the United States as a low cost opportunity to make significant safety improvements at any number of stages ranging from project development and planning through existing operation. Furthermore, RSA's have proven to be effective on projects of all shapes and sizes. The RSA program here in the Commonwealth presents a unique and exciting opportunity for improvements in roadway safety.

The RSA program in Massachusetts is being implemented in accordance with the Commonwealth's role as a lead state in preventing run-off the road (lane departure) crashes and in conjunction with the Strategic Highway Safety Plan (SHSP). Lane departure crashes are a notable problem area for Massachusetts, especially for crashes with high injury severities. Between 2002 and 2004, lane departure crashes accounted for nearly 20 percent of all crashes in Massachusetts and approximately one-quarter of crashes involving an incapacitating injury. Almost one-half of fatal crashes between 2002 and 2004 were lane departure crashes. As the crash severity increases, so too does the percent of crashes that are lane departures, as shown in Figure 1.

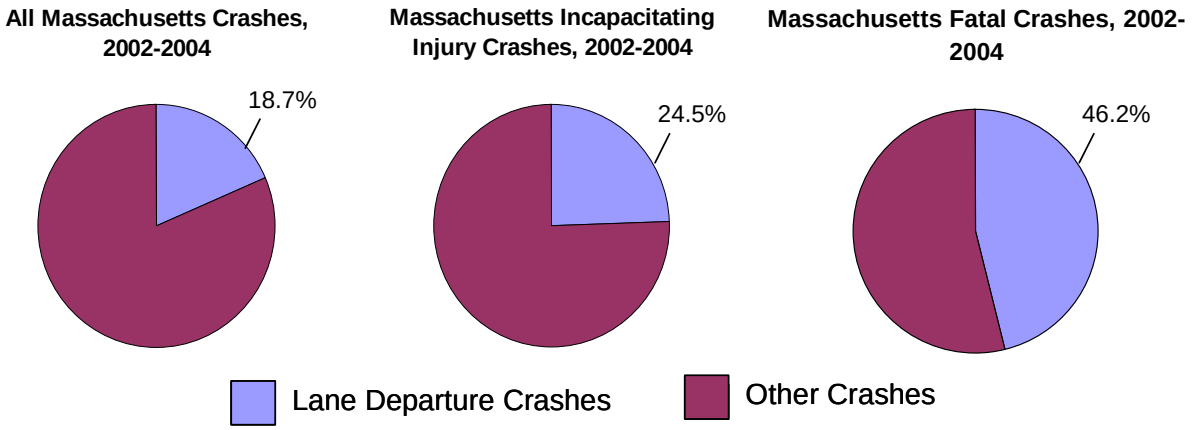

Figure 1. Relationship between Lane Departure Crashes and Injury Severity

In an effort to combat the lane departure problem, a strategy was developed for the SHSP to identify hot spot lane departure locations, perform road safety audits, and implement low-cost comprehensive countermeasures. The following report summarizes the findings of a RSA focused on lane departure crashes (LD-RSA) along Thatcher Street, which extends between East Bridgewater and Brockton, Massachusetts.

2.0 Background Material for Thatcher Street

Thatcher Street is a 2.1 mile long collector roadway that connects Pine Street in Brockton, Massachusetts and Summer Street in East Bridgewater, Massachusetts. The City of Brockton and Town of East Bridgewater are located in Plymouth County in eastern Massachusetts with approximate populations of 95,000 and 14,000, respectively. Thatcher Street is one lane in each direction; however, there are observable differences in both land usage and roadway characteristics on either side of the town line, which cuts through Thatcher Street. For example, there are more adjoining side streets and adjacent residences along the Brockton section of the roadway. By comparison, the East Bridgewater segment of Thatcher Street has limited residences and/or businesses and no adjoining side streets. Some of the major landmarks along Thatcher Street include a landfill facility and Massasoit Community College, which is a major traffic generator. From a geometry perspective, there is one slight vertical curve (Brockton side) and 2 horizontal curves (one in each Brockton and East Bridgewater). Throughout, Thatcher Street has 12 foot lanes, and despite marked edgelines, there are limited shoulders. A typical view of Thatcher Street is shown in Figure 2, and some of the major characteristics are summarized in Figure 3.

Figure 2. View of Thatcher Street

The LD-RSA for Thatcher Street was held on December 4, 2007 at the Old Colony Planning Council in Brockton, Massachusetts. In total, 26 team members participated in the road safety audit as listed in Table 1. As indicated in Table 1, representatives were present from Federal, State, Regional and Local agencies and included a cross-section of engineering/planning, education, and enforcement expertise.

Table 1 Participating Audit Team Members

Audit Team Members	Agency/Affiliation	Audit Team Members	Agency/Affiliation
Lilia Cabral	Southeast Regional Planning & Economic Development Commission	Joanne Telegen Weinstock	Executive Office of Transportation – Office of Planning
Neil Boudreau	Mass Highway – Traffic Engineering	John Mirabito	Beta Group
Maliha Akhtar	Mass Highway – Highway Design	Jed Cornock	Old Colony Planning Council
Lisa Schletzbaum	MassHighway – Safety Mgmt. Unit	Jim Noyes	Greenman-Pedersen
Jennifer Inzana	MassHighway – Safety Mgmt. Unit	Tom Reynolds	East Bridgewater – DPW
Tim White	Federal Highway Administration	John Haines	East Bridgewater – DPW
Ray Guarino	Old Colony Planning Council	Bruce Hughes	Old Colony Planning Council
Pat Ciaramella	Old Colony Planning Council	Paul Maloney	Federal Highway Administration
Dan Mulkern	Massachusetts State Police	Mike Thoreson	City of Brockton
Bill McNulty	Old Colony Planning Council	Emanuel Gomes	Brockton Police Department
Karen Winger	Old Colony Planning Council	Michael Knodler	University of Massachusetts
Robert Gregory	MassHighway – District 5	David Hurwitz	University of Massachusetts
Bonnie Polin	MassHighway – Safety Mgmt. Unit	Charles Kilmer	Old Colony Planning Council

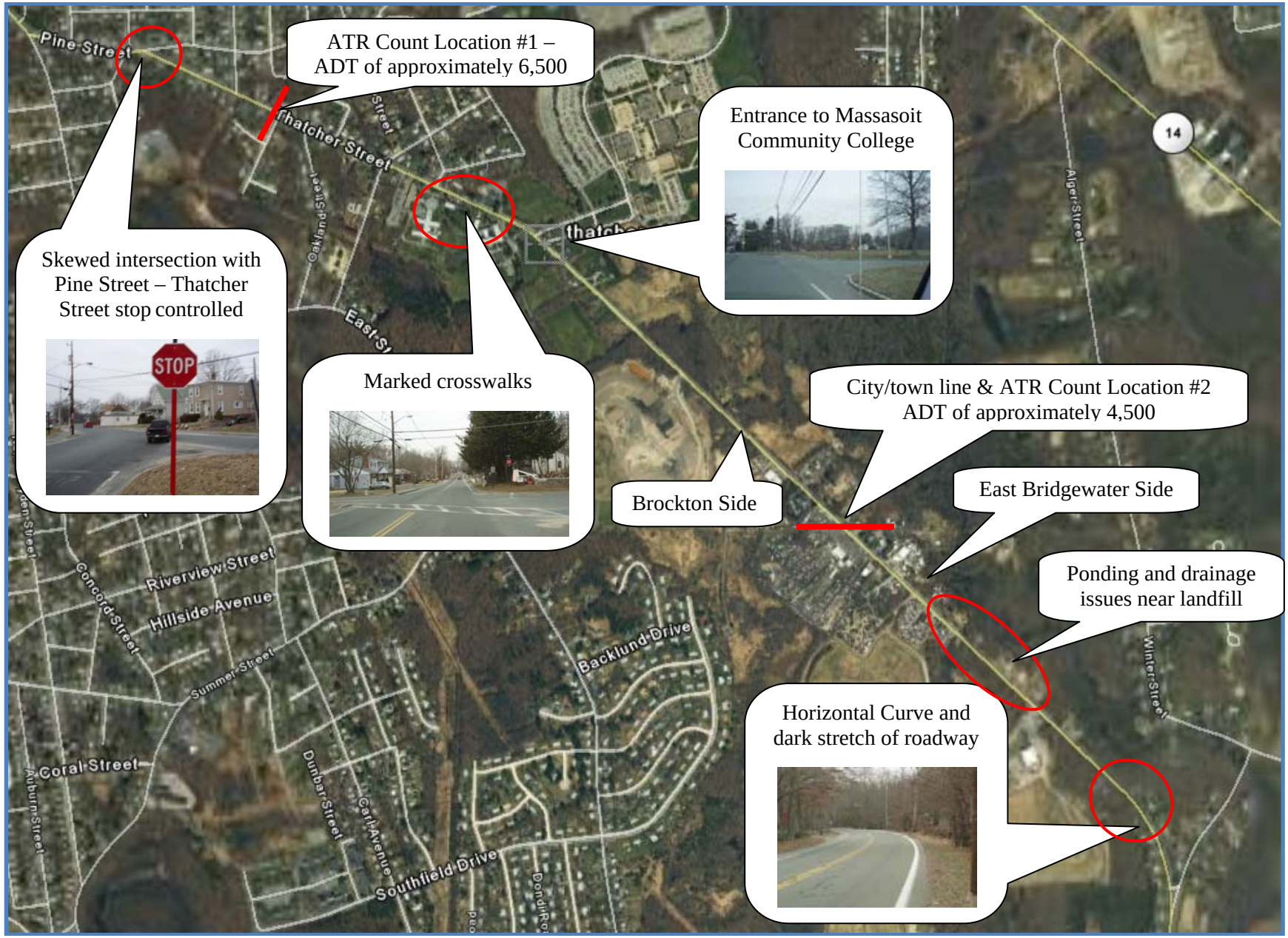

Figure 3 Characterization of Roadway Features for Thatcher Street.

Audit team members were asked to visit the site in advance of the meeting to familiarize themselves with the roadway attributes and characteristics. A copy of the meeting agenda and instructions, as well as a packet of pertinent information, were distributed to meeting invitees prior to the meeting (this information is included in the Appendix of this report). Specifically, the additional information provided was pertinent to the LD-RSA safety initiative and included traffic volumes and speeds, as well as a description of relevant crashes, which are summarized below:

- Figure 4 presents an hourly distribution of traffic volumes along Thatcher Street collected as part of the Old Colony Planning Council (OCPC) traffic count program on Wednesday, October 6, 2004 at two locations (see Figure 3 for locations). As shown, the average daily traffic varies by almost 2,000 vehicles per day between the two count locations, with approximately 6,500 vehicles just south of the intersection with Pine Street and only 4,500 near the city/town line. Also worth noting is that the traffic volumes are fairly balanced directionally at both locations.
- Observed vehicle speeds were also recorded as part of the OCPC study, as summarized in Table 2 below. There are no official speed zone regulations for Thatcher Street in either Brockton or East Bridgewater, which implies that the actual speed limit is prima facie in nature and would be 30 mph. There is existing signage in Brockton that expresses this condition. In East Bridgewater there is actually an unauthorized speed limit sign posted at 35 mph.

Table 2 Summary of OCPC Speed and Heavy Vehicle Data for Thatcher Street

Speed Characteristic	ATR Count Location	
	South of Pine Street	City/Town Line
Average	32 mph	38 mph
85th Percentile	38 mph	45 mph
10 mph Pace	31-40 mph	36-45 mph
% of vehicles in pace	64.1%	66.1%
% heavy vehicles	6.49%	4.36%

- From 2004 to 2007 there were 49 total reported crashes, and 7 lane departure crashes along Thatcher Street. A more comprehensive summary of the crashes are included in the Appendix; however, some of the key observations include the following:
    - 78 percent (38 crashes) of all crashes occurred during daylight conditions. By comparison, 71 percent (5 crashes) of lane departure crashes occurred at night;
    - 33 percent (16 crashes) of all crashes and 71 percent (5 crashes) of lane departure crashes involved only a single vehicle;
    - Six of the lane departure crashes resulted in a vehicle hitting either a tree or utility pole, and each of the seven lane departure crashes resulted in a non-fatal injury;
    - 43 percent (21 crashes) of the total crashes involved a driver less than 24 years of age; however, only one of the lane departure crashes involved a driver less than 24; and
    - For three of the lane departure crashes, the driver contributing code was reported as either exceeded the authorized speed limit or driving too fast for conditions.

Additional resources made available to the team during the audit meeting included large scale aerial images, provided by the OCPC, and field videos from several drives along Thatcher Street that were used in aiding the discussion of specific roadway elements. Also available were possible resources including the AASHTO Strategic Highway Safety Plan and the related National Cooperative Highway Research Program (NCHRP) 500 series reports.

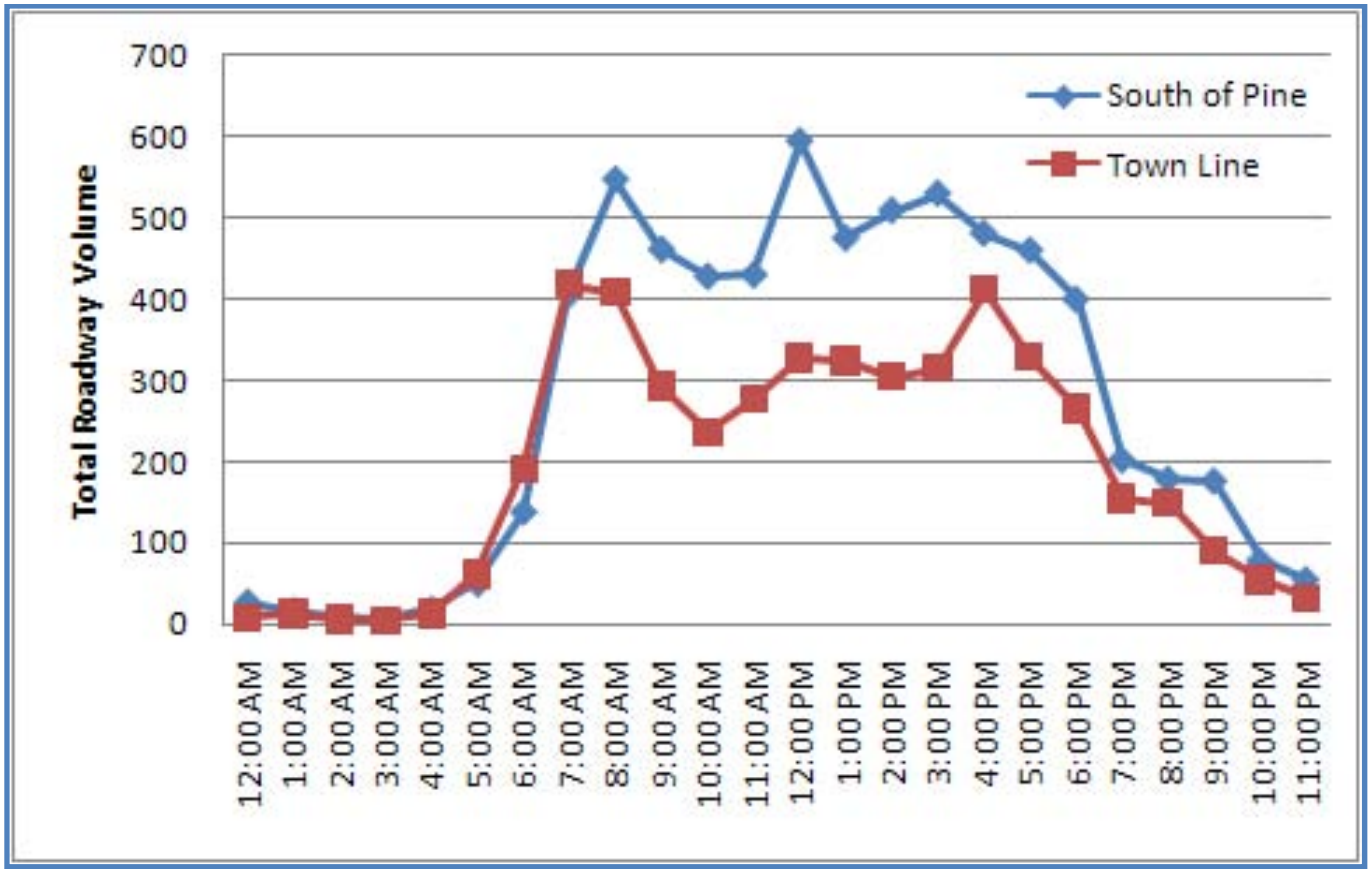

Figure 4 Hourly Distributions of Volumes for Thatcher Street.

3.0 Characterization of Major Traffic Safety Challenges

Following a brief introduction to the RSA process in general, the meeting participants were asked to summarize and characterize potential safety considerations along Thatcher Street. The initial characterization of the major safety considerations focused on several key elements.

- The entrance to Massasoit Community College was immediately cited as a potential safety concern. Specifically noted was that the intersection, which is actually two smaller intersections because of the two access drives (see Figure 5), is on a horizontal curve that inhibits sight distance. The concern was enhanced given the traffic volumes, and in particular, the younger driver volumes, at this location.
- The horizontal curve at the southern portion of Thatcher Street was also cited as a safety concern. RSA team members noted the limited amount of delineation and close proximity of roadside hazards through this curve.

Figure 5 Horizontal Curve at Entrance to Massasoit Community College

- Roadside hazards in general were mentioned as a safety concern along the roadside. For a significant portion of Thatcher Street, utility poles and trees are frequently observed within 4 to 5 feet of the travelled way. An example of this is the utility pole near the town line that is actually located within the curb line as shown in Figure 6. Similarly, there is a significant amount of roadside vegetation in close proximity the roadway, specifically in the areas south of Massasoit Community College.

Figure 6 Hazardous Utility Pole

- Another major concern was overall speeds along the corridor, which was reported anecdotally by RSA team members and verified with observed data from the OCPC study. Near the town line, which is a relatively straight and level section, the 85th percentile speed was 45 mph. This value is approximately 15 mph above the prima facie limit for this segment. Related to this were reports of several RSA team members that cited frequent tailgating throughout this corridor, and passing of vehicles even though passing is prohibited. As previously noted, there are currently speed limit signs in East Bridgewater posted at 35 mph; however, these are not official regulations and should be removed.
- Drainage problems, and the resulting ponding, were mentioned as a safety concern. The area of primary concern was near the landfill facility. There is currently signage in both travel directions, which alerts motorists of possible flooding.
- Adding to the overall safety concern was the extent to which Thatcher Street is being used as a cut-through for vehicles avoiding other congested areas. It was also speculated by several RSA team members that the increasing popularity of this cut-through coupled with increasing congestion throughout the region will add to the current safety challenges.
- Other significant factors mentioned at the outset of the meeting that are discussed in further detail later in this report also included the following:
    - Roadway lighting;
    - Condition of existing pavement markings and signage;
    - Presence of crosswalks in potentially dangerous locations; and
    - Presence of large heavy vehicle volumes within the corridor.

4.0 Summary of Short Term Recommendations for Thatcher Street

The formal review of potential safety concerns along Thatcher Street was completed by the entire audit team. Following identification of a potential safety issue, the dialogue subsequently focused on possible countermeasures with some preliminary discussion regarding the feasibility of implementation (timeframe and cost) as well as the potential payoff of safety benefits. Given the potential for an immediate impact, there was an added focus on short term (less than 1 year) and low cost (less than $10,000) improvements that could be completed quickly and have a positive safety impact. Resulting recommendations for immediate actions along Thatcher Street are outlined below.

- The initial short term recommendation was for an expanded study of crashes along the corridor. At the time of the meeting, the specific locations of the corridor crashes were not immediately known. The RSA team recommended geo-locating crashes to verify that the safety concerns identified at the meeting were indeed related to the crashes. Similarly, it was recommended that given the somewhat small sample size (49 crashes), the crash report narratives be utilized

to develop a more comprehensive understanding of crashes. For example, some RSA team members felt that some of the safety issues attributed to the college may not actually be a result of the college itself.

- Install "Curve Ahead" warning signs and chevrons for each direction ahead of the two horizontal curves described previously. Signs should be placed in advance of the curve to allow adequate response time for motorists. To further enhance the delineation, roadside reflectors and/or chevrons should be considered as budget permits.
- For roadway delineation, an additional recommendation is the installation of 6-inch pavement markings on the Brockton side of the road. The wider markings are already in place on along Thatcher Street in East Bridgewater, and this difference is noticeable.
- Given the reported prevalence of high speeds among the lane departure crashes, it is recommended that Thatcher Street be considered as a high speed enforcement area. It is also recommended that current speed data collection be completed by either the City of Brockton, Town of East Bridgewater, or with the aid of the OCPC to track current operating speeds throughout the year; this may also prove useful in the establishment of enforcement thresholds. Installation of solar powered radar detector signs at key locations to bring awareness to the operator though the instant message "YOUR SPEED IS __" may assist in reducing in speed violations. A recommendation was also made for the use of a portable speed trailer to aid with the speed education and enforcement.
- Although there is appropriate signage alerting motorists of the presence of crosswalks just north of the college entrance, the limited sight distance provided by the vertical curve is a concern (see Figure 7). Some consideration may be given to the removal or relocation of this particular crosswalk based upon a study of pedestrian usage. If the crosswalk is considered vital, future thought may be given to added pedestrian conspicuity or speed control (e.g. bulb outs).

Figure 7 Sight Limited Crosswalk

- The condition for a majority of signage along Thatcher Street is to some extent faded, not highly retroreflective, vandalized, or obstructed by vegetation. All signs on both sides of the city/town line should be inspected and replaced as necessary. Some examples are pictured in Figure 8.

Figure 8 Example of Sign Conditions

- As noted, there are no current approved speed regulations for Thatcher Street. Currently, existing signage with a posted 35 mph speed limit are located in the East Bridgewater portion of the roadway (see Figure 9). These signs should be removed. The current speed limit is governed by the prima facie limit of 30 mph for a thickly settled area. Moving forward, a recommendation may be to have the segment studied and petition for a speed zone.
- The condition of the roadside was noted as a concern. There are several specific aspects that warrant further consideration, including, but not necessarily limited to edge drop-off, utility poles, trees, and vegetation in general as shown in Figure 10. With respect to the utility poles, some currently have reflectors while others do not. It is recommended that longer range plans for the removal or relocation of hazardous utility poles be developed; however, in the interim it is recommended that improved reflectorization be added to the poles, specifically in the southern, darker stretches where there is no curbing. Overall it is recommended that the roadside be improved to minimize the aspects of edge drop off, thus improving the likelihood of a vehicle being able to maintain control at the roadside. However, it is recognized that this is particularly tied to improved drainage as discussed previously. Lastly, it is recommended that hazardous trees be removed and that vegetation be maintained.

Figure 9 Inappropriate Speed Limit Sign

Figure 10 Example of Potentially Hazardous Roadside Elements

5.0 Summary of Additional Thatcher Street Countermeasures

Although an emphasis was placed upon short term and low cost improvements that could be carried out immediately, the focus of the team was not limited solely to those countermeasures. The following section details countermeasures discussed by the team, which are reflective of all costs and timeframes and includes both general (entire corridor) and specific safety opportunities. Please note that with respect to the timeframe, there are some unknown variables that must be further explored. Additionally, some of the potential treatments discussed are experimental in nature and will likely result in an unknown level of safety benefits. Several definitions exist for low, mid, and high cost as well as for short, mid and long term implementation timeframes. For purposes of this report, low cost improvements will be under $10,000, mid costs will be under $50,000, and high costs will be above $50,000. From a timeframe perspective, short term will refer to less than 1 year, while mid and long term will refer to countermeasures that will take 1 to 3, and greater than 3 years, respectively.

Potential Safety Issue	Possible Countermeasures	Implementation Timeframe & Cost	Potential Safety Payoff	Agencies Involved in Implementation	Photos
Speed-related issues along Thatcher Street corridor	Continue and expand upon a concentrated enforcement and educational (i.e. speed feedback, community meetings, etc) effort.	Short Term & Low/Mid Cost	Mid	Brockton, East Bridgewater, OCPC, Highway Safety Division (HSD) & MassHighway District 5	
	Investigate and explore possible low-cost speed-related strategies such as optical speed bars.	Short Term & Low Cost	Experimental		
	Implement established traffic calming measures to meet specific needs. A candidate location would be bulb outs in the vicinity of the pedestrian crossings, or entrance to Massasoit Community College.	Long Term & Mid/High Cost	High		
	Remove all unauthorized white and black speed limit signs, which are not official regulations. May consider developing established speed zones.	Short Term & Low Cost	Low		
	Monitor speeds and traffic volumes	Short Term & Low Cost	Low		
Continued maintenance	The pavement condition, drainage, and coverage resulting from brush needs to be maintained as these are critical to roadway safety.	Short Term & Low Cost	Mid	Brockton & East Bridgewater	

Potential Safety Issue	Possible Countermeasures	Implementation Timeframe & Cost	Potential Safety Payoff	Agencies Involved in Implementation	Photos
Horizontal curve delineation	Upgrade curve warning signage (current faded or non-existent) and install chevrons and roadside reflectors for both horizontal curves.	Short Term & Low/Mid Cost	Mid	Brockton & East Bridgewater	
Presence of utility poles within the roadway clear zone	Reflectorize utility poles.	Short Term & Low Cost	Low	Brockton, East Bridgewater, OCPC & Utilities	
	Work with utility company to remove utility poles from clear zone.	Long Term & Mid/High Cost	Mid		
Minimize edge drop-off and maintain roadside	Maintain and fill roadside as needed to prevent edge drop-off. Clear debris and vegetation in close proximity to the roadside.	Short Term & Low Cost	Low	Brockton & East Bridgewater	
Evaluate safe crossing opportunities for pedestrians	Determine if existing crosswalks are needed or recommended. If yes, identify opportunities to improve visibility, including possible relocation.	Short Term & Low Cost	Low/Mid	City of Brockton & Massasoit Community College	
Improve existing signage	Throughout the corridor there are numerous signs that are not highly retroreflective (retroreflective signs must meet new MUTCD standards). These signs are faded, vandalized, or obstructed and should be replaced.	Short Term & Low Cost	Low/Mid	Brockton & East Bridgewater	

Potential Safety Issue	Possible Countermeasures	Implementation Timeframe & Cost	Potential Safety Payoff	Agencies Involved in Implementation	Photos
Pavement markings	In Brockton, upgrade to 6-inch pavement markings. In both communities, consider highly reflective pavement markings for added roadway delineation.	Short Term & Mid/High Cost	Mid	Brockton & East Bridgewater	
Dark stretches of Roadway	Consider the installation of improved roadway lighting in areas with significant tree cover. Currently there are lights on every other utility pole.	Long Term & Mid/High Cost	Mid	Brockton & East Bridgewater	
Improve area with flooding and drainage problems	Develop long term measures to improve drainage in this area near the landfill.	Long Term & High Cost	Mid/High	Brockton & East Bridgewater	
Side street conspicuity	Given the frequency of side streets on the Brockton portion of Thatcher Street, it is recommended that improved (i.e. larger font, added conspicuity) street signs be installed.	Short Term & Low Cost	Low	City of Brockton	
Entrance to Massasoit Community College	Consider long term strategies that may improve safety and efficiency at this location, which has limited sight distance. Considerations may include a roundabout, changing existing flows (i.e. 1 drive entrance, 1 exit), or adding turn lanes.	Long Term & Mid/High Cost	Mid/High	City of Brockton & Massasoit Community College	

6.0 Discussion

With respect to the safety improvement opportunities described in the previous section, it is important to consider the following: 1) many treatments are both low cost and short term and 2) there is a complementary nature of many of the safety strategies in that one improvement will aid with multiple safety issues. This document provides a series of specific recommendations that warrant short term implementation, it should be noted that the approach towards improved safety is dynamic in nature and warrants revisiting over time.

Several additional topics that were discussed at the audit meeting and warrant consideration include the following:

- The intersection with Pine Street at the northern end of Thatcher Street is a safety concern. Specifically, the intersection is skewed, and at this intersection Thatcher Street traffic is required to stop. Although enhancements have been made to the current stop control (see Figure 11), more conspicuity is recommended. Possible countermeasure considerations include advance warning signage, advance "STOP AHEAD" pavement markings, or a flashing beacon (either stop sign mounted or overhead).

Figure 11 Existing Pine Street Stop Control

- The presence of commercial vehicles was also mentioned as a potential concern; however, the prevailing notion was that little could be done about this travel pattern. Future consideration may include a truck exclusion route for a portion of Thatcher Street or added speed enforcement of for commercial vehicles. An immediate short term recommendation is to quantify current commercial vehicle speeds.
- Also noted was the increasing potential for cut through traffic that is attempting to by-pass other congested areas. It is recommended that this be studied (annual volumes and possible O/D study,) and/or tracked over time to determine any potential impact. Future traffic calming considerations may be explored if this does appear to be a problem along Thatcher Street.

7.0 Appendix A: Distributed RSA Meeting Materials

Materials provided to RSA team members in advance of the meeting included the following:

1. Agenda
2. RSA and Lane Departure Introduction
3. Tabulated Crash Summary (Total and Lane Departure Crashes)
4. LD-RSA Checklist

Agenda

Road Safety Audit

Brockton / East Bridgewater – Thatcher Street

Meeting Location: Old Colony Planning Council
70 School Street, Brockton
Tuesday, December 4, 2007
9:00 – 11:00 AM

Type of meeting:	**Lane Departure – Road Safety Audit**
Attendees:	**Invited Participants to Comprise a Multidisciplinary Team**
Please bring:	**Thoughts and Enthusiasm!!**
9:00 AM	**Welcome and Introductions**
9:15 AM	**Introduction to Road Safety Audits and Lane Departure Crashes**
9:30 AM	**Review of Site Specific Material** • Crash & Volume – provided in advance • Existing Geometries and Conditions • Video and Images
10:00 AM	**Completion of RSA** • Identification of Safety Concerns – using checklists as a guide • Identification of Possible Countermeasures
11:00 AM	**Adjourn for the Day – but the RSA has not ended**

Instructions for Participants:

- **Before attending the RSA on December 4th participants are encouraged to drive Thatcher Street within Brockton and East Bridgewater and complete/consider elements on the RSA advisory checklist with a focus on safety factors affecting roadway departure crashes.**
- **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 initial 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.**

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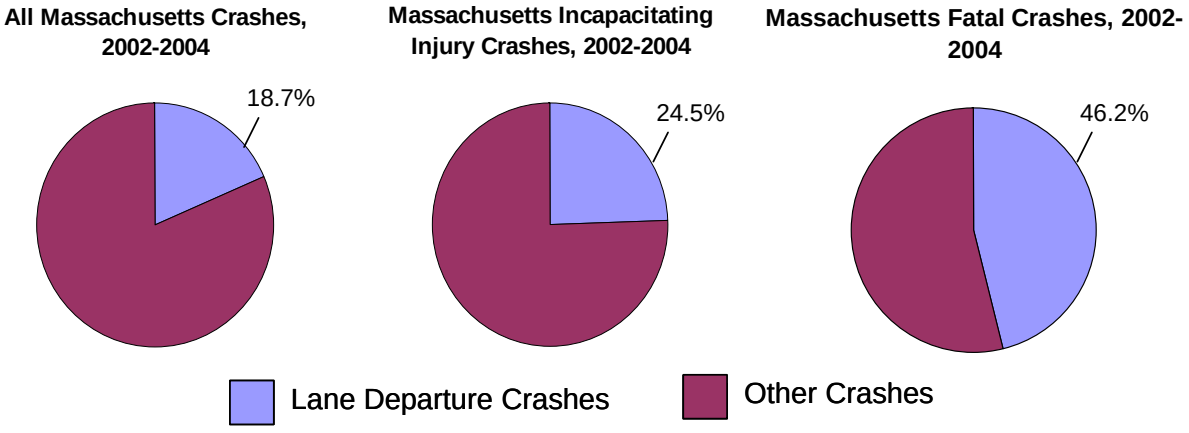

In an effort to combat the lane departure problem, a strategy was developed for the SHSP to identify hot spot lane departure location, perform road safety audits and implement low-cost comprehensive countermeasures.

THATCHER STREET ALL CRASH ANALYSIS
FROM 2004 TO 2007

ALL CRASH TOTAL	LIGHT CONDITION		
	DAYLIGHT	DUSK	DARK - ROADWAY LIGHTED
49	38	1	10
100%	78%	2%	20%

	WEATHER CONDITION				
	CLEAR	CLOUDY	RAIN	SNOW	FOG, SMOG, SMOKE
	32	7	7	2	1
	65%	14%	14%	4%	2%

	ROAD SURFACE					
	DRY	WET	SNOW	SLUSH	ICE	WATER (STANDING MOVING)
	30	14	1	1	1	2
	61%	29%	2%	2%	2%	4%

	MANNER OF COLLISION						
	SINGLE VEHICLE CRASH	REAR-END	ANGLE	SIDESWIPE SAME DIRECTION	SIDESWIPE OPPOSITE DIRECTION	HEAD-ON	NOT REPORTED
	16	9	11	2	3	2	1
	33%	18%	22%	4%	6%	4%	2%

	FIRST HARMFUL EVENT LOCATION				
	ROADWAY	ROADSIDE	SHOULDER UNPAVED	OUTSIDE ROADWAY	NOT REPORTED
	31	2	3	5	8
	63%	4%	6%	10%	16%

	FIRST HARMFUL EVENT									
	MOTOR VEHICLE IN TRAFFIC	PARKED MOTOR VEHICLE	PEDESTRIAN	ANIMAL - DEER	OTHER MOVEABLE OBJECT	TREE	CURB	UTILITY POLE	OVERTURN/ ROLLOVER	NOT REPORTED
	25	3	1	1	1	5	1	2	1	8
	51%	6%	2%	2%	2%	10%	2%	4%	2%	16%

DRIVER CONTRIBUTING CODE	DRIVER CONTRIBUTING CAUSE (WITH IMPROPER DRIVING KNOWN)								
	EXCEEDED AUTHORIZED SPEED LIMIT	DISREGARDED TRAFFIC SIGNS SIGNALS, ROAD MARKINGS	FAILED TO YIELD RIGHT OF WAY	FOLLOWED TOO CLOSELY	MADE AN IMPROPER TURN	DRIVING TOO FAST FOR CONDITION	WRONG SIDE OR WRONG WAY	FAILURE TO KEEP IN PROPER LANE	OPERATING VEHICLE IN ERRATIC, RECKLESS, CARELESS MANNER
	2	2	6	4	1	2	1	6	3
	5%	5%	12%	7%	2%	5%	2%	10%	5%

	SWERVING OR AVOIDING DUE TO WND, SLIPPERY SURFACE	INATTENTION	OTHER IMPROPER ACTION	NOT REPORTED	UNKNOWN
	1	3	3	17	7
	2%	5%	5%	28%	12%

	NUMBER OF CRASHES INVOVLING DRIVER BY AGE**		
	CRASHES WITH A DRIVER 24 AND UNDER	CRASHES WITH A DRIVER 65 AND OLDER	CRASHES WITH DRIVERS BETWEEN 25 AND 64
	21	5	27
	43%	10%	55%

	CRASH SEVERITY	
	PROPERTY DAMAGE ONLY	NON-FATAL INJURY
	29	20
	59%	41%

* 2006 AND 2007 CRASH INFORMATION ARE NOT COMPLETE

** 5 CRASHES INVOLVED A DRIVER 24 OR YOUNGER AND A DRIVER 65 OR OLDER SO TOTALS OF CRASHES BY AGE IS GREATER THAN 49

THATCHER STREET LANE DEPARTURE CRASH ANALYSIS
FROM 2004 TO 2007

TOTAL NUMBER OF CRASHES ON THATCHER STREET=49
TOTAL LANE DEPARTURE CRASHES
7
14%

LIGHT CONDITION	
DAYLIGHT	DARK - ROADWAY LIGHTED
2	5
29%	71%

WEATHER CONDITION	
CLEAR	SNOW
6	1
86%	14%

ROAD SURFACE			
DRY	WET	SNOW	ICE
3	2	1	1
43%	29%	14%	14%

MANNER OF COLLISION		
SINGLE VEHICLE CRASH	SIDESWIPE SAME DIRECTION	HEAD-ON
5	1	1
71%	14%	14%

FIRST HARMFUL EVENT LOCATION		
ROADWAY	SHOULDER UNPAVED	OUTSIDE ROADWAY
2	1	4
29%	14%	57%

FIRST HARMFUL EVENT		
TREE	UTILITY POLE	OVERTURN/ROLLOVER
3	3	1
43%	43%	14%

DRIVER CONTRIBUTING CODE (WITH NO IMPROPER DRIVING KNOWN)					
EXCEEDED AUTHORIZED SPEED LIMIT	DRIVING TOO FAST FOR CONDITION	WRONG SIDE OR WRONG WAY	FAILURE TO KEEP IN PROPER LANE	SWERVING OR AVOIDING	OTHER IMPROPER ACTION
2	1	1	2	1	3
20%	10%	10%	20%	10%	30%

NUMBER OF CRASHES INVOVLING DRIVER BY AGE		
CRASHES WITH A DRIVER 24 AND UNDER	CRASHES WITH A DRIVER 65 AND OLDER	CRASHES WITH DRIVERS BETWEEN 25 AND 64
1	1	5
14%	14%	71%

CRASH SEVERITY
NON-FATAL INJURY
7
100%

GEOMETRIC DESIGN –	
Issue	**Comment**
A. Speed – (Design Speed; Speed Limit & Zoning; Sight Distance; Overtaking	
Are there speed-related issues along the corridor? Please consider the following elements: • Horizontal and vertical alignment; • Posted and advisory speeds • Driver compliance with speed limits • Approximate sight distance • Safety passing opportunities	
B. Road alignment and cross section	
With respect to the roadway alignment and cross-section please consider the appropriateness of the following elements: • Functional class (Urban Principal Arterial) • Delineation of alignment; • Widths (lanes, shoulders, medians); • Sight distance for access points; • Cross-slopes • Curbs and gutters Drainage features	
C. Intersections	
For intersections along the corridor please consider all potential safety issues. Some specific considerations should include the following: • Intersections fit alignment (i.e. curvature) • Traffic control devices'' alert motorists as necessary • Sight distance and sight lines seem appropriate • Vehicles can safely slow/stop for turns • Conflict point management • Adequate spacing for various vehicle types Capacity problems that result in safety problems	
D. Auxiliary lanes	
• Do auxiliary lanes appear to be adequate?	
• Could the taper locations and alignments be causing safety deficiencies? • Are should widths at merges causing safety deficiencies?	

E. Clear zones and crash barriers	
For the roadside the major considerations are clear zone issues and crash barriers. Consider the following: • Do there appear to be clear zones issues? — Are hazards located too close the road? — Are side slopes acceptable? • Are suitable crash barriers (i.e, guard rails, curbs, etc.) appropriate for minimizing crash severity? • Barrier features: end treatments, visibility, etc.	
F. Bridges and culverts – (if necessary)	
Are there specific issues related to bridges and culverts that may result in safety concerns?	
G. Pavement – (Defects, Skid Resistance, and Flooding)	
• Is the pavement free of defects including excessive roughness or rutting, potholes, loose material, edge drop-offs, etc.) that could result in safety problems (for example, loss of steering control)? • Does the pavement appear to have adequate skid resistance, particularly on curves, step grades and approaches to intersections? • Is the pavement free of areas where flooding or sheet flow of water could contribute to safety problems? • In general, is the pavement quality sufficient for safe travel of heavy and oversized vehicles?	
H. Lighting (Lighting and Glare)	
It is important to consider to the impacts of lighting. Some specifics include the following: Is lighting required and, if so, has it been adequately provided? Are there glare issues resulting from headlights during night time operations or from sunlight?	

TRAFFIC CONTROL DEVICES	
Issue	**Comment**
I. Signs	
Signage is a critical element in providing a safe roadway environment. Please consider the following: • Are all current signs visible? Are they conspicuous and clear? Are the correct signs used for each situation?	
• Are signs visible (consider both night and day)? • Does the retroreflectivity or illumination appear satisfactory? • Are there any concerns regarding sign supports?	
J. Traffic signals	
Although the focus of this RSA are lane departures, this does present an opportunity for us to consider any traffic signals. Specifically: • If present, do the traffic signals appear to be designed, installed, and operating correctly? • Is the controller located in a safe position? (where it is unlikely to be hit, but maintenance access is safe) • Is there adequate sight distance to the ends of possible vehicle queues?	
K. Marking and delineation	
• Is the line marking and delineation: — appropriate for the function of the road? — consistent along the route? — likely to be effective under all expected conditions? (day, night, wet, dry, fog, rising and setting sun, oncoming headlights, etc.) • Are centerlines, edgelines, and lane lines provided? If not, do drivers have adequate guidance?	

ROADWAY ACTIVITY	
Issue	**Comment**
With respect to roadway activity please consider safety elements related to the following: • Pedestrians • Bicycles • Public transportation vehicles and riders • Emergency vehicles • Commercial vehicles • Slow moving vehicles	

ENVIRONMENTAL CONSIDERATIONS	
Issue	**Comment**
Weather & Animals	
From an environmental perspective it is important to consider any potential impacts. Most notably is likely to be the impacts of weather or animals, including:	
• Possible effects of rain, fog, snow, ice, wind on design features. • Has snow fall accumulation been considered in the design (storage, sight distance around snowbanks, etc.)? • Are there any known animal travel/migration routes in surrounding areas which could affect design?	