

ROAD SAFETY AUDIT

Route 128 at Route 62

Town of Danvers

December 27, 2013

Prepared For:
MassDOT Highway Division



Prepared By:
BETA Group, Inc.



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Project Data

A Road Safety Audit for the interchange of Route 128 and Route 62 (Elliott Street) was held on November 22, 2013 at Danvers Town Hall in Danvers, MA. As indicated in Table 1, the audit team consisted of representatives from State, Regional and Local agencies and included a cross-section of engineering, planning, emergency response and legislative expertise.

Table 1. Participating Audit Team Members

Audit Team Member	Agency/Affiliation
Lisa Schletzbaum	MassDOT Highway Division – Safety Section
Corey O'Connor	MassDOT Highway Division – Safety Section
Bonnie Polin	MassDOT Highway Division – Safety Section
Rep. Ted Speliotis	State Legislature
Bill Bates	Rep. Speliotis' Office
Yuan Liu	MassDOT Highway Division – Safety Section
Richard Rodgers	Town of Danvers – Town Engineer
David Lane	Town of Danvers – DPW Director
Mark Piccarini	Town of Danvers – Electric
Wayne Marquis	Town of Danvers – Town Manager
Michael Karas	MassDOT Highway Division – District 4
Dave Greenberg	VHB
Chenyuan Wang	Boston Region MPO
Neil Ouellette	Danvers Police Chief
Patrick Ambrose	Danvers Police – Captain
Sarah Slavin	Danvers Police
Michael Harvey	Massachusetts State Police
Greg Lucas	BETA Group, Inc.
Justin Curewitz	BETA Group, Inc.

Background

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. A Road Safety Audit was scheduled for the interchange of Route 128 and Route 62 (Elliott Street) because of the prevalence of crashes at the signalized intersection of the northbound ramps and Route 62 since the reconfiguration of the interchange ramps in 2012. The RSA is intended to identify potential short and long term safety improvements that can be made at the interchange.

Project Description

Route 62 (Elliott Street) is an east-west corridor functionally classified as an Urban Principal Arterial. Elliott Street carries Route 62 from an intersection with Conant Street and Poplar Street approximately 1,500 feet to the west of Route 128, to Beverly to the east of Route 128. Route 128 is a limited access highway functionally classified as a Principal Arterial, and is the primary connection from Danvers, Beverly and Peabody to Interstate 95 and to Boston. The Cummings Center is an approximate two million square foot office and commercial complex located approximately two miles east of Route 128 on Route 62, and Route 62 serves as the primary commuter route to and from the complex. Route 128 and the interchange ramps are under State jurisdiction; all other roadways including Route 62 are under Town of Danvers jurisdiction.

The interchanges of Route 128 at both Route 62 and Route 35 in Danvers were reconstructed between 2010 and 2012 to provide a typical diamond interchange at both intersecting routes. The new configuration of the interchange of Route 128 and Route 62 features direct connections to Route 62 and is shown in Figure 1. The previous configuration, shown in Figure 2, featured two separate sets of ramps between Route 128 northbound and Route 62; direct connections were provided to and from Route 62 eastbound, but connections to and from Route 62 westbound were via ramps that connected to Liberty Street, a local residential street with homes between the Route 128 ramps and a signalized intersection with Route 62. Ramps to and from Route 128 southbound connected to State Road, an Urban Minor Arterial that has an intersecting local residential street, Prospect Street, between the Route 128 ramps and an unsignalized intersection with Route 62.

Audit participants noted that the previous ramp configuration featured very short deceleration and acceleration lanes on Route 128, and that rear-end crashes on Route 128 due to slowing or queued vehicles were common. It was also noted that westbound vehicles which now turn left onto Route 128 southbound at a signalized intersection were previously required to turn right to travel up State Road to enter Route 128 southbound via a short ramp with no deceleration, and that the resultant queued traffic extended to Liberty Street at peak periods.

The reconstructed ramp configuration features a diamond interchange that has signalized intersections with the southbound ramps on the west side of Route 128 and the northbound ramps on the east side of Route 128. The northbound and southbound off-ramps from Route 128 both widen to provide two lanes, with left turns onto Route 62 accommodated via the traffic signal at each intersection and right turns



LEGEND



STUDY INTERSECTION



SCALE IN FEET: 1"=250'



Road Safety Audit
Route 128 at Route 62
Danvers, MA

Figure 1
Location Map



Road Safety Audit
Route 128 at Route 62
Danvers, MA

Figure 2
Previous Interchange
Configuration

under yield control. A triangular island at the end of the ramp separates left and right turning traffic. On-ramps onto Route 128 are also similarly configured on each side of Route 128; left turns from Route 128 are under signal control, while free right turns are allowed. The entering roadways for the on-ramps are separated by a triangular island and then merge, with the right turning traffic under yield control.

The ramp reconstruction project also included signalization of the intersection of State Road and Route 62, which along with the newly signalized ramp intersections and Liberty Street created four signalized intersections within less than 1,000 feet. It was noted that the new signals at State Road and at the Route 128 southbound ramps operate as one traffic signal system under one controller, while the new signals at the Route 128 northbound ramps and the reconstructed signals at Liberty Street operate under separate controllers. All three traffic signal systems are coordinated throughout the day, with different timing plans for the morning peak, afternoon peak and off-peak periods.

The newly reconstructed intersections provide a consistent four lane section for Route 62 from west of State Road to east of Liberty Street, with exclusive turn lanes provided within the four lane section at the Route 128 ramps. Route 62 eastbound provides two through lanes approaching State Road, with left turns to State Road accommodated from the shared left lane. Route 62 eastbound continues to provide two through lanes through the signalized intersection with the Route 128 southbound ramps, and then provides an exclusive left lane and a single through lane at the Route 128 northbound ramps. Route 62 eastbound continues to provide two through lanes departing the northbound ramp interchange, and then provides two through lanes and an exclusive right turn lane approaching Liberty Street. The two through lanes merge to a single eastbound lane departing Liberty Street.

Route 62 westbound provides a left turn lane and a single through lane approaching Liberty Street, and then provides two through lanes departing the intersection through the signalized intersection with the Route 128 northbound ramps. Route 62 westbound provides a left turn lane and a single through lane at the Route 128 southbound ramps, then provides two through lanes departing the intersection approaching State Road, and provides two through lanes which merge to a single westbound lane departing State Road.



Route 62 westbound at Route 128 northbound ramps

The closely spaced signalized intersections and traffic demands entering and exiting Route 128 create a complex timing and phasing plan intended to prevent queuing through the intersections or onto Route 128. Although the geometry of the northbound and southbound ramps is very similar, left turn phasing varies between the two intersections. Left turns from Route 62 eastbound to Route 128 northbound are accommodated by a lead phase, where a protected phase is provided first before the permissive phase. Left turns from Route 62 westbound to Route 128 southbound are accommodated by a lag phase, where permissive left turns are allowed in conjunction with the westbound through movement before a protected

phase is provided for the westbound left turn. Design phasing for the westbound left turn to the southbound ramp included a protected only left turn phase, but the permissive phase was added with timing adjustments in late 2012 to address queuing concerns. Lead phasing is more common for left turns at signalized intersections, but it was noted that the lag phasing for the westbound left turn was introduced to clear the left turn lane and reduce queuing and blocking of the northbound ramp intersection.

Crash data were provided for the intersection of Route 62 and the northbound ramps and show 56 crashes between June 2012 and October 2013. Crash data were provided by the Danvers Police Department and summarized by MassDOT; a collision diagram and crash summary are included in the Appendix. The time period was chosen to show crashes that have occurred since the new ramp configuration has been in place. Forty-seven of the 56 documented crashes occurred between an eastbound vehicle turning left onto Route 128 northbound and a westbound through vehicle. Fourteen of these crashes were noted as “courtesy crashes”, which are defined as crashes which occur when a non-involved mainline driver gives the right of way, contrary to the rules of the road, to another driver. Queues frequently exist in the left lane from the southbound ramp intersection through the northbound ramp intersection. Vehicles in this queue blocking the intersection may wave an opposing left turning vehicle along, only to have that vehicle struck by a vehicle traveling in the westbound through lane.

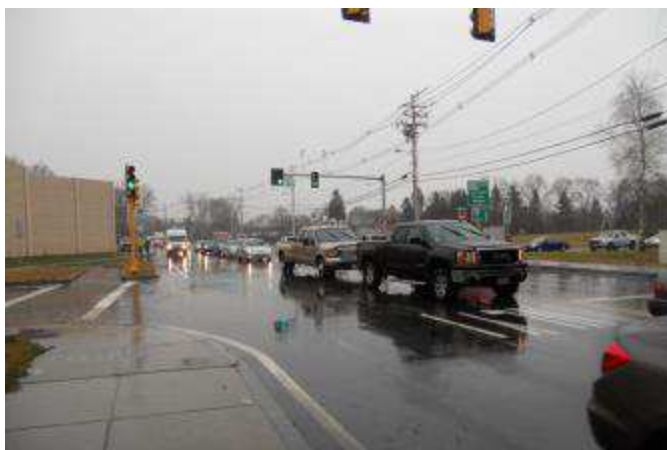
Four rear-end crashes on the westbound approach to the intersection can also be related to the eastbound left turn if a westbound driver stopped short to let an eastbound turning vehicle go.

Crash data were also presented by Danvers Police on the day of the audit showing 87 crashes were reported to police at the intersection of Route 128 and Route 62 between January 1, 2013 and October 31, 2013. Crashes were not located by ramp intersection location, but it was noted that 35 crashes involved a driver taking a left turn and 6 were identified as rear-end crashes. Police data also show 51 crashes in 2011 and 79 crashes in 2012 for a comparable 10-month period, illustrating an increase in crashes since the interchange was reconfigured.

Audit Observations

Following a brief introduction to the RSA process and a summary of existing geometry and crash information, the audit participants were asked to discuss issues that affect safety at the interchange of Route 128 and Route 62 (Elliott Street), with the discussion focused on the history of left turn crashes at the northbound ramp intersection but considering safety issues and concerns throughout the coordinated signal system. Audit participants then conducted a site visit as a group, at which time they offered observations on safety issues and concerns. A summary of those major safety considerations is as follows:

- **Traffic Congestion** – The volume of traffic and the presence of four closely spaced signalized intersections creates specific concerns related to traffic congestion and queuing which relate to the significant history of crashes between eastbound left turning vehicles and westbound through vehicles.
 - Queues from the Route 62 westbound left turn to Route 128 southbound extend through the signalized intersection at the Route 128 northbound ramps. This requires eastbound left turns to Route 128 northbound to pass through queued traffic in the left lane, which blocks visibility of westbound through vehicles in the right lane. This impaired visibility occurs when westbound drivers stop to show courtesy, but can also occur both when westbound drivers stop before entering the intersection to prevent blocking, or when an eastbound driver aggressively noses into westbound queued traffic.
 - Congestion creates increased levels of driver aggression. More aggressive drivers may take chances on unacceptable gaps, or may run the red light rather than waiting through the cycle for the next green indication. Driver aggression and red light running may be factors in the history of left turn crashes.
 - Westbound traffic queues at Liberty Street during the morning peak, and more aggressive drivers use the westbound left turn lane for Liberty Street as a through lane, cutting back into through traffic once they pass through the signal at Liberty Street.
- **Lane Configuration/Lane Trap** – Several issues discussed by audit participants related to lane configuration along the Route 62 corridor.



Queued westbound traffic blocking eastbound left turn during permissive phase

- The left turn lanes at both the northbound and southbound ramps are trap lanes, formed from through lanes at the previous intersection.
- Vehicles have been observed using the exclusive left turn lanes as through lanes. This can be accommodated because a two lane approach with a left turn lane and a single through lane is received by two through lanes on Route 62 westbound at Liberty Street and at the southbound ramps, and on Route 62 eastbound at the northbound ramps.



Left turn lane at Liberty Street aligns with through lane on departure side

- Signal Visibility – Several comments related to signal visibility were identified.
 - The bridge that carries Route 128 over Route 62 blocks visibility of overhead signal indications at both the northbound and southbound ramps. This is most noticeable for Route 62 eastbound approaching the northbound ramps due to the slight downhill grade of Route 62 through the intersections.
 - Supplemental left-side ground-mounted signal heads are provided for the eastbound approach at the northbound ramps and for the westbound approach at the southbound ramps, but are not visible until a vehicle is under the bridge. Visibility of these signal heads can be blocked entirely by larger vehicles.



Supplemental left side heads

- Roadway Geometry – The slight curve in the road, vertical curve crest and slight downhill grade of Route 62 heading east exacerbates concerns related to visibility of through vehicles due to queued vehicles at the northbound ramp intersection.
- Ramp Geometry – The northbound on-ramp is located very close to Route 128, likely due to grade restrictions and the proximity of homes on Liberty Street. A retaining wall with a noise barrier wall borders the eastern edge of the ramp. This results in a tight turn from the eastbound left turn lane to the northbound on-ramp. It is assumed that the eastbound stop line was located in its current position in order to maximize eastbound storage.
- Pedestrian Accommodations – It was noted that no pedestrian signals are provided for the crosswalk across the northbound on-ramps. Although it was not noted, the same is true of the crosswalks across the southbound on-ramps.

- Pedestrian Visibility – The retaining wall bordering the northbound on-ramp blocks the view of a pedestrian in the crosswalk from a vehicle entering the ramp from Route 62 westbound.
- Drainage – Ponding was observed along the west edge of the entry to the northbound on-ramp on the day of the audit. This creates a puddle right at the wheelchair ramp, and would create icing concerns for pedestrians during cold weather.



Potential Safety Enhancements

After the site visit, audit participants returned to the meeting location to discuss the safety issues and consider improvements. Audit participants were encouraged to consider both short and long term improvements for each issue. 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.

Table 2. Estimated Time Frame and Costs Breakdown

Time Frame		Costs	
Short-term	<1 year	Low	<\$10,000
Mid-term	1–3 years	Medium	\$10,000–\$50,000
Long-term	>3 years	High	>\$50,000

- Signal Phasing – Several potential improvements involved suggested phasing alternatives. Given the complexity of the coordinated signal system, any potential phasing or timing modifications require careful consideration of the impact on queues both at the intersection and system-wide. All improvements are short-term, low cost improvements except where noted.
 - Consider changing the Route 62 eastbound left to Route 128 northbound from protected/permissive to protected only phasing. It was noted that this change could create queues that block the Route 62 westbound left to Route 128 southbound. This improvement would likely have the greatest positive change on crash frequency, but would also have a significant impact on operations.
 - Introduce the flashing yellow arrow for protected/permissive operation. The flashing yellow arrow is included in the 2009 MUTCD and supplants the green ball indication for permissive operation. MassDOT will be retrofitting existing locations statewide with the flashing yellow arrow in the near future. A flashing yellow arrow should be considered at this location as a short-term improvement to address crashes occurring during permissive operation. This improvement was specifically discussed for the protected/permissive left turn from Route 62 eastbound to Route 128 northbound, but should be implemented at all protected/permissive turns within the coordinated system for consistency. It should be noted that the flashing yellow arrow operation would require maintaining two separate signal heads for through movements, and may result in increased loading on the mast arm, which would require a structural review. Introduction of the flashing yellow arrow should be supplemented with a local education program.
 - Consider adaptive signal control for the coordinated signal system. Adaptive control requires additional detection hardware and system software that can adjust timing based on real-time input regarding traffic volume and demand. The implementation of adaptive control is a medium cost improvement. The adaptive system could be used to adjust phasing as well as timing based on demand.

- Consider varying phasing plans by time of day. This was discussed for the protected/permissive left turn from Route 62 eastbound to Route 128 northbound. This potential improvement would allow protected/permissive phasing during peak demand periods, but allow protected-only phasing during off-peak periods. It was noted that varying phasing plans by time of day is feasible in modern traffic controllers, but is not typically implemented due to the impact to driver expectations. Regular users are known to react to their expectation of the phase order of the traffic signal, and varying that phase order may create adverse effects. This improvement should be carefully considered in conjunction with MassDOT.
- Signal Equipment – Several suggested improvements involve the introduction of additional equipment aimed at providing improved visibility and awareness of signal indications.
 - Provide an illuminated “RED SIGNAL AHEAD” sign for the Route 62 eastbound approach in advance of the bridge. An illuminated Red Signal Ahead sign would alert drivers both to the presence and current indication of the traffic signal. The sign should be located after the mast arm for eastbound traffic at the southbound ramp intersection, but in advance of the bridge facing eastbound traffic. This is a short-term, medium cost improvement.
 - Provide supplemental signal heads for Route 62 on the right side of the roadway. It was noted that left side signal heads are not visible to vehicles in the right lane when queues exist in the left lane. Supplemental heads should be provided on the right side for the approaches traveling under the bridge – eastbound at the northbound ramps, and westbound at the southbound ramps. This is a short-term, medium cost improvement.
 - Consider mounting overhead signals horizontally. Horizontal placement of signal heads is not typically done in Massachusetts, but is allowed by the MUTCD. This is a short-term, medium cost improvement. This improvement should only be applied to the signal heads on each side of the bridge facing traffic passing under the bridge.
- Move “Left Lane Must Turn Left” signs to the opposite side of the bridge. It was noted that signs at the stop line do little to warn of the left lane trap for through traffic, and that signs should be located in advance of the bridge to provide additional advance warning. It should be noted that an advance “Left Lane Must Turn Left” sign is located facing eastbound traffic on the far side of the southbound ramp intersection; this sign is intended for the left lane under the bridge, and should be relocated closer to the bridge abutment so that the message is presented after a vehicle has cleared the southbound ramp intersection. This is a short-term, low cost improvement.
- Introduce local education initiatives aimed at increasing safety by preventing “courtesy crashes”. Educational outreach should include social media, the town website, and local newspapers. This is a short-term, low cost improvement.

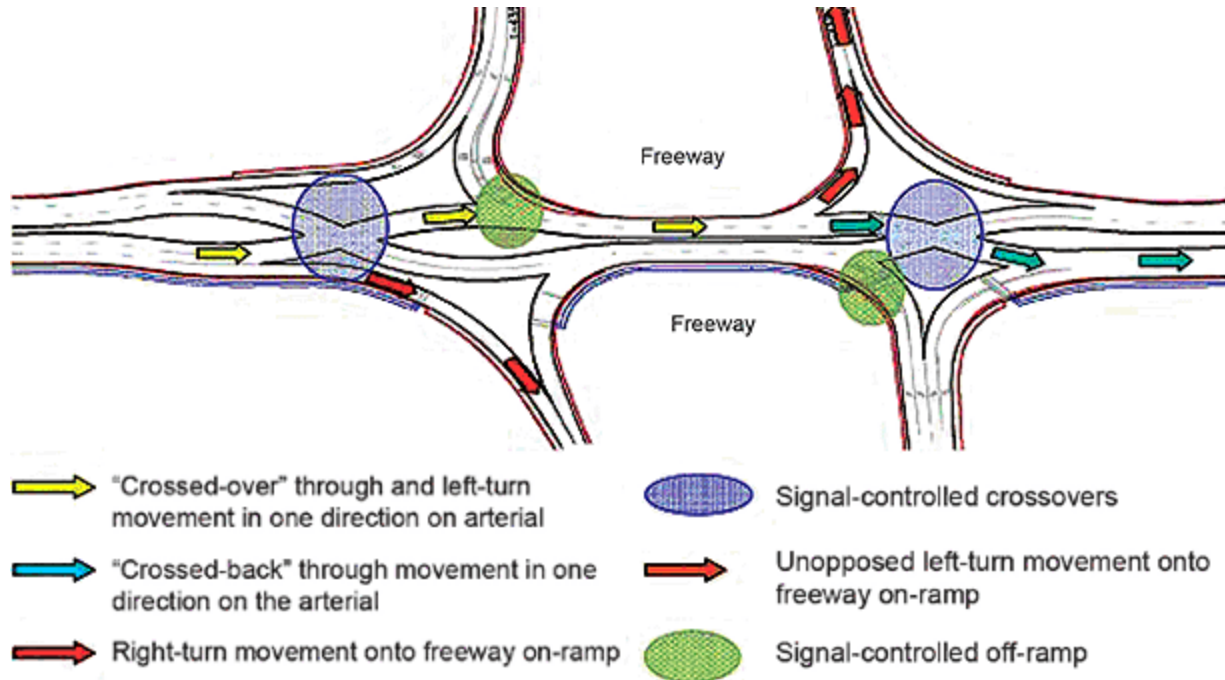


- Lane, Pavement Marking and Geometric Adjustments – Several improvements listed below involve adjustments to lane assignments, introduction of painted or raised islands, or geometric changes.
 - Install overhead lane use signs on the bridge to reinforce intended lane assignments. This is a short-term, low cost improvement which is already planned for implementation.
 - Consider overhead guide signs in advance of the approaches to designate which lane traffic should be in. This potential short-term, medium cost improvement requires careful consideration to avoid further confusion based on the varied lane assignments through the area.
 - Install a painted or raised island for the left lane departing intersections where an exclusive left turn lane exists. This would reinforce the concept of a single through lane at each of these intersections, and would discourage drivers from using the left lane as a through lane as they do today because of the presence of a two lane departure. This improvement should be considered for Route 62 westbound departing both Liberty Street and the southbound ramp intersection, and for Route 62 eastbound departing the northbound ramp intersection. Painted islands are a short-term, low cost improvement; raised islands would be a short-term, medium cost improvement.
 - Allow through movements from the left turn lanes at the ramp intersections. This improvement would eliminate the lane trap by allowing through movements from both lanes in both directions through the ramp intersections. It was noted that there is no practical need to restrict through movements from these lanes, since a receiving lane exists opposite the left lane at both intersections. This is a short-term, low cost improvement that requires consideration of the impact on safety as well as on phasing, timing and queuing. It should be noted that traffic demand may dictate that the lane operates as a de facto left turn lane, which would result in stacked vehicles waiting to make a left turn and introduce a desire for a through vehicle in the left lane to shift to the right lane, although both lanes allow through movements. This could in turn result in an increase in sideswipe crashes. Allowing through movements from the left lanes would also eliminate the flashing yellow arrow as a potential improvement.
 - Widen the northbound off-ramp to allow dual left turns. This potential improvement was discussed at the audit but would require converting the westbound left turn lane to a through lane at the southbound ramps, and could require widening of the departure lanes at the northbound ramps to accommodate larger turning vehicles. This improvement is not recommended due to the potential adverse affect on safety.
 - Modify the northbound on-ramp to eliminate the island. This would shift the entry point for northbound traffic to the east, which would increase the turning radius and visibility for eastbound left turns. This adjustment would also eliminate the merge area for entering traffic and could require bringing the right turn from Route 62 westbound under signal control, which may create undesirable operational impacts for Route 62 approaching Liberty Street from the east. This improvement would also require relocating the post-mounted signal heads for the northbound off-ramp, which are located within the existing

island. This is a mid-term, high cost improvement that requires careful consideration of potential operational impacts.

- Move the westbound stop line at the northbound ramp intersection back (east) approximately 50 feet. This would provide additional visibility of approaching traffic for eastbound left turns, especially when drivers do not queue through the intersection. This short-term, low cost improvement should be considered in conjunction with updated “Do Not Block Intersection” signage and markings.
- Install “Do Not Block Intersection” signs and markings for Route 62 westbound at the northbound ramp intersection. An R10-7 “Do Not Block Intersection” should be installed at or near the westbound stop line, and markings should be applied in accordance with Figure 3B-18 of the Manual on Uniform Traffic Control Devices (MUTCD). This is a short-term, low cost improvement.
- Provide a pedestrian phase across the northbound on-ramps. Pedestrian signal heads should be installed at appropriate locations. It was suggested that the pedestrian phase could be concurrent with the northbound off-ramp vehicle phase. This is a mid-term, medium cost improvement.
- Relocate the wheelchair ramp on the east side of the northbound on-ramp. The ramp can be relocated further south so that approaching vehicles have a clearer view of a pedestrian in the crosswalk. This short-term, medium cost improvement would increase pedestrian crossing distance, but improve safety by increasing visibility of the pedestrian.
- Investigate drainage deficiencies, and modify pavement grades to prevent ponding and puddles. This is a short-term, potentially medium cost improvement.
- Long-term Improvements – Two improvement strategies identified by the audit team represent long-term considerations that would require significant reconstruction and cost.
 - Replace the bridge carrying Route 128 over Route 62. This improvement would allow introduction of a five or six lane cross section for Route 62 under Route 128, which would allow two consistent through lanes with dedicated left turn lanes at the ramp intersections.
 - Consider the feasibility of a diverging diamond interchange. A diverging diamond interchange (DDI), also known as a double crossover diamond interchange, allows traffic to cross to the opposite side of the roadway to pass under the highway overpass. This results in the unusual situation of traffic driving on the opposite side of the road between the two ramp intersections. The key benefit is that it reduces the number of conflict points at each ramp intersection and allows left turns to enter the highway with no opposing or conflicting traffic. It also allows for simplification of signal control, which allows for a reduction in cycle length. The image below is taken from a technical summary of the FHWA report *Alternative Intersections/Interchanges: Information Report (AIIR) (FHWA-HRT-09-060)*. It should be noted that this has significant geometric implications

to provide proper shift distances, and may not be feasible given the short distance between the ramp intersections and the adjacent intersections.



Summary of Road Safety Audit

Table 3 summarizes potential recommendations discussed by the audit team. The recommendations are categorized based on the potential safety payoff, as well as by time frame and cost. The safety payoff is a qualitative judgment of the effectiveness of the potential safety improvements. Each recommendation has a responsibility assigned to it stating whether MassDOT or the Town of Danvers would be responsible for implementing the recommended improvement.

Table 3. Potential Safety Enhancement Summary

Safety Issue	Safety Enhancement	Responsibility	Safety Payoff	Time Frame	Cost
Traffic Congestion	Consider changing the Route 62 eastbound left to Route 128 northbound from protected/permissive to protected only phasing.	MassDOT	High	Short-term	Low
Traffic Congestion	Introduce the flashing yellow arrow for protected/permissive phasing.	MassDOT	Low	Short-term	TBD
Traffic Congestion	Consider adaptive signal control for the coordinated signal system. Adaptive control can potentially be used to adjust phasing as well as timing.	MassDOT	Medium	Short-term	Medium
Traffic Congestion	Consider varying phasing plans by time of day.	MassDOT	High	Short-term	Low
Signal Visibility	Provide an illuminated “RED SIGNAL AHEAD” sign for the Route 62 eastbound approach in advance of the bridge.	MassDOT	Medium	Short-term	\$15,000
Signal Visibility	Provide supplemental signal heads for Route 62 on the right side of the roadway.	MassDOT	Medium	Short-term	\$15,000
Signal Visibility	Consider mounting overhead signals horizontally.	MassDOT	Medium	Short-term	\$15,000
Lane Configuration Lane Trap	Move “Left Lane Must Turn Left” signs to the opposite side of the bridge.	MassDOT	Low	Short-term	\$500
Traffic Congestion	Introduce local education initiatives aimed at increasing safety by preventing “courtesy crashes”.	Town	Medium	Short-term	\$0 (Use of police & Town resources)
Lane Configuration Lane Trap	Install overhead lane use signs on the bridge to reinforce intended lane assignments. This is already planned for implementation.	MassDOT	Medium	Short-term	\$2,000
Lane Configuration Lane Trap	Consider overhead guide signs in advance of the approaches to designate which lane traffic should be in.	MassDOT	Medium	Short-term	\$25,000
Lane Configuration Lane Trap	Install a painted or raised island for the left lane departing intersection where an exclusive left turn lane exists.	MassDOT	Medium	Short-term	Low (Paint) Medium (Raised)
Lane Configuration Lane Trap	Allow through movements from the left turn lanes at the ramp intersections. (This may conflict with other recommendations such as the flashing yellow arrow.)	MassDOT	Medium	Short-term	\$2,000
Ramp Geometry	Modify the northbound on-ramp to eliminate the island.	MassDOT	Medium	Mid-term	\$100,000

Table 3. Potential Safety Enhancement Summary

Safety Issue	Safety Enhancement	Responsibility	Safety Payoff	Time Frame	Cost
Ramp Geometry	Modify the westbound stop line at the northbound ramp intersection back (east) approximately 50 feet.	MassDOT	Medium	Short-term	\$500
Traffic Congestion, Ramp Geometry	Install “Do Not Block Intersection” signs and markings for Route 62 westbound at the northbound ramp intersection.	MassDOT	High	Short-term	\$5,000
Pedestrian Accommodations	Provide a pedestrian phase across the northbound on-ramps.	MassDOT	Low	Mid-term	\$15,000
Pedestrian Visibility	Relocate the wheelchair ramp on the east side of the northbound on-ramps.	MassDOT	Medium	Short-term	\$15,000
Drainage	Investigate drainage deficiencies, and modify pavement grades to prevent ponding and puddles.	MassDOT	Low	Mid-term	\$25,000
Traffic Congestion, Lane Configuration, Lane Trap, Ramp Geometry	Replace the bridge carrying Route 128 over Route 62.	MassDOT	High	Long-term	High
Traffic Congestion, Lane Configuration, Lane Trap, Ramp Geometry	Consider the feasibility of a diverging diamond interchange.	MassDOT	High	Long-term	High

Appendix A. RSA Meeting Agenda

Agenda

Road Safety Audit

Danvers, MA

Route 128 at Route 62

Meeting Location: Danvers Town Hall
Selectman Meeting Room
1 Sylvan Street, Danvers, MA
Friday, November 22, 2013
10:00 AM – 12:00 noon

Type of meeting: High Crash Location – Road Safety Audit
Attendees: Invited Participants to Comprise a Multidisciplinary Team
Please bring: Thoughts and Enthusiasm!!

10:00 AM Welcome and Introductions

10:15 AM Discussion of Safety Issues

- Crash history, Speed Regulations – provided in advance
- Existing Geometries and Conditions

11:00 AM Site Visit

- Drive to the ramps of Route 128 at Route 62
- As a group, identify areas for improvement

11:30 AM Discussion of Potential Improvements

- Discuss observations and finalize safety issue areas
- Discuss potential improvements and finalize recommendations

12:00 noon Adjourn for the Day – but the RSA has not ended

Instructions for Participants:

- Before attending the RSA on November 22nd, participants are encouraged to drive/walk 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

Participating Audit Team Members

Date: November 22, 2013

Location: Danvers – Route 128 at Route 62

Audit Team Member	Agency/Affiliation	Email Address	Phone Number
Greg Lucas	BETA	GLucas@BETA-Inc.com	781-255-1982
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Rep. Ted Speliotis	State	Theodore.Speliotis@mahouse.gov	617-722-2410
Corey O'Connor	MassDOT – Safety	Corey.oconnor@state.ma.us	857-368-9638
Yuan Liu	MassDOT – Safety	Yuan.Liu@state.ma.us	857-368-9638
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Michael Karas	MassDOT D4	Mike.Karas@dot.state.ma.us	781-641-8484
Dave Greenberg	VHB	DGreenberg@VHB.com	617-590-4910
Chenyuan Wang	Boston Region MPO	CWang@ctps.org	617-973-8009
Bonnie Polin	MassDOT – Safety	Bonnie.polin@state.ma.us	857-368-9636
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Patrick Ambrose	Danvers PD	pambrose@mail.danvers-ma.org	978-774-1213 x121
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Michael Harvey	Mass State Police	Tharvsta@comcast.net	508-843-8950

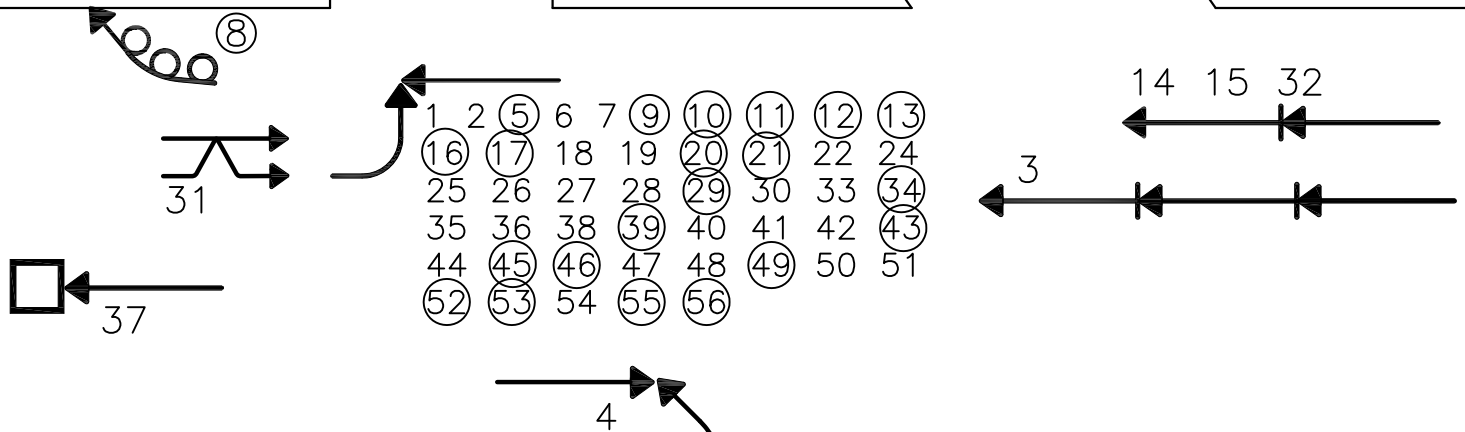
Appendix C. Detailed Crash Data

COLLISION DIAGRAM

TIME PERIOD ANALYZED: June 2012 - October 2013
 SOURCE OF CRASH REPORTS: Danvers Police Department
 DATE PREPARED: November 21, 2013
 PREPARED BY: Peter Calves, Carley Prztstac, CO

*NOT TO SCALE

Route 128
NB On-Ramp



Route 62 (Elliott Street)

Route 128
NB Off-Ramp

23

SYMBOLS

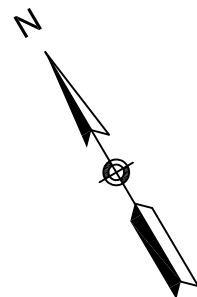
TYPES OF CRASH

SEVERITY

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

- Head on
- Rear End
- Angle
- Turning Movement
- Sideswipe
- Out of Control

- Injury
- Fatal



Crash Data Summary Table

Route 128 NB Ramps at Route 62 (Elliott Street), Danvers, MA

June 2012 - October 2013

Crash Diagram Ref #	Crash Date <i>m/d/y</i>	Crash Day	Time of Day	Manner of Collision <i>Type</i>	Light Condition <i>Type</i>	Weather Condition <i>Type</i>	Road Surface <i>Type</i>	Driver Contributing Code <i>Type</i>	Ages			Comments
									D1	D2	D3	
1	6/25/12	Monday	5:03 PM	Angle	Daylight	Clear	Dry	Inattention	70	38		Courtesy Crash
2	6/26/12	Tuesday	5:11 PM	Angle	Daylight	Clear	Dry	Failed to yield right of way	36	21		Courtesy Crash
5	7/30/12	Monday	1:56 PM	Angle	Daylight	Clear	Dry	Failed to yield right of way	29	24		Active construction zone
6	7/24/12	Tuesday	4:11 PM	Angle	Daylight	Clear	Dry	Failed to yield right of way	61	76		Both stated they had green light
7	8/5/12	Sunday	2:01 PM	Angle	Daylight	Clear	Dry	Unknown	50	52		Left turn had green arrow
8	8/6/12	Monday	11:46 AM	Single Vehicle Crash	Daylight	Clear	Other	Over-correcting/over-steering	24			Operator was headed West on Elliott Street when she was cut off by another car taking a right from the left lane onto 128N and lost control
9	8/11/12	Saturday	1:15 PM	Angle	Daylight	Clear	Dry	Failed to yield right of way	37	57		Witness say vehicle 1 was speeding
10	8/11/12	Saturday	3:43 PM	Angle	Daylight	Clear	Dry	Failed to yield right of way	47	67		Both operators have green lights
11	8/14/12	Tuesday	11:16 AM	Angle	Daylight	Clear	Dry	Failed to yield right of way	46	17		
12	8/27/13	Tuesday	7:00 AM	Angle	Daylight	Clear	Dry	Failed to yield right of way	50	32		
13	9/14/12	Friday	8:16 PM	Angle	Dark - lighted roadway	Clear	Dry	Failed to yield right of way	44	51		
14	9/20/12	Thursday	8:59 AM	Rear-end	Daylight	Clear	Dry	Followed too closely	50	20		Vehicle 1 stopped for a red light traveling west on Elliott Street and was struck in the rear by vehicle 2
15	10/14/12	Sunday	2:27 AM	Rear-end	Dark - lighted roadway	Clear	Dry	Other improper action	35	23		Vehicle 2 was stopped at a red light before the onramp to 128N and was struck from behind, Vehicle 1 stated she thought the intersection was different-recent construction
16	10/16/12	Tuesday	8:57 AM	Head on	Daylight	Clear	Dry	Failed to yield right of way	20	48		Both stated they had green light
17	10/22/12	Monday	5:27 PM	Angle	Daylight	Clear	Dry	Failed to yield right of way	33	30		
18	10/24/12	Wednesday	7:03 AM	Angle	Daylight	Clear	Dry	No Improper Driving	40	32		
19	10/24/12	Wednesday	12:44 PM	Angle	Daylight	Clear	Dry	Unknown	34	27		Courtesy Crash
20	10/26/12	Friday	1:28 PM	Angle	Daylight	Clear	Dry	Inattention	70	51		
21	10/27/12	Saturday	1:16 AM	Angle	Dark - lighted roadway	Clear	Dry	Failed to yield right of way	20	62		
22	10/28/12	Sunday	11:48 AM	Angle	Daylight	Rain	Wet	No Improper Driving	59	26		Both stated they had green light
23	11/19/12	Monday	10:06 AM	Rear-end	Daylight	Clear	Dry	Inattention	32	75		Vehicle 2 rear ended vehicle 1 at a stoplight between RT 128N off ramp and Elliott St
24	12/3/12	Monday	4:15 PM	Angle	Daylight	Clear	Dry	Failed to yield right of way	49	35		
25	12/18/12	Tuesday	9:40 AM	Single Vehicle Crash	Daylight	Rain	Wet	Operating Vehicle in erratic, reckless, careless, negligent, or aggressive manner	20	45		
26	12/21/12	Friday	3:23 PM	Angle	Daylight	Clear	Wet	Failed to yield right of way	17	19		
27	1/7/13	Monday	6:20 PM	Angle	Dark - lighted roadway	Clear	Dry	Failed to yield right of way	29	46		
28	1/8/13	Tuesday	1:49 PM	Angle	Daylight	Unknown	Dry	Failed to yield right of way	63	52		
29	1/10/13	Thursday	7:12 PM	Angle	Dark - roadway not lighted	Clear	Dry	Failed to yield right of way	74	35		Courtesy Crash

Crash Data Summary Table

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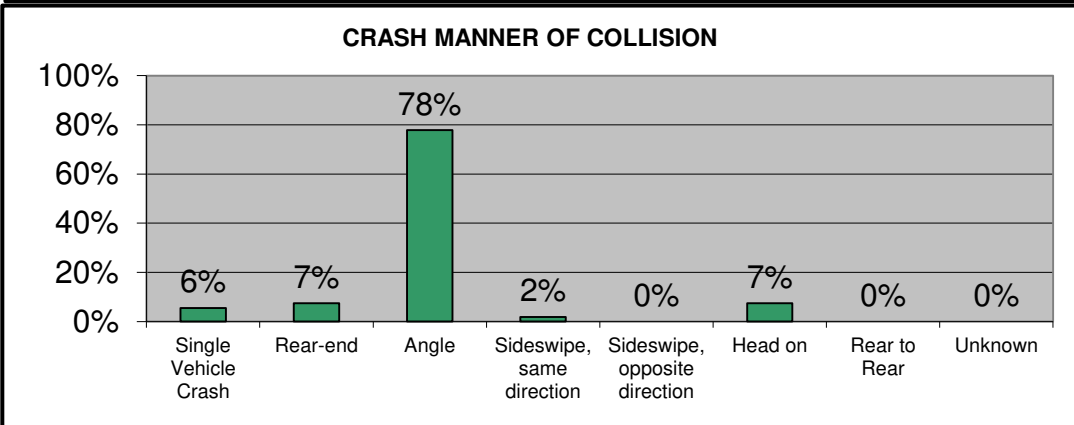
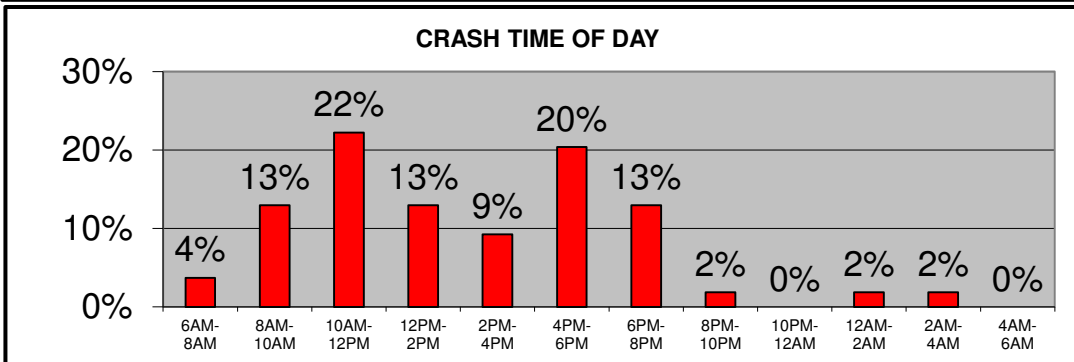
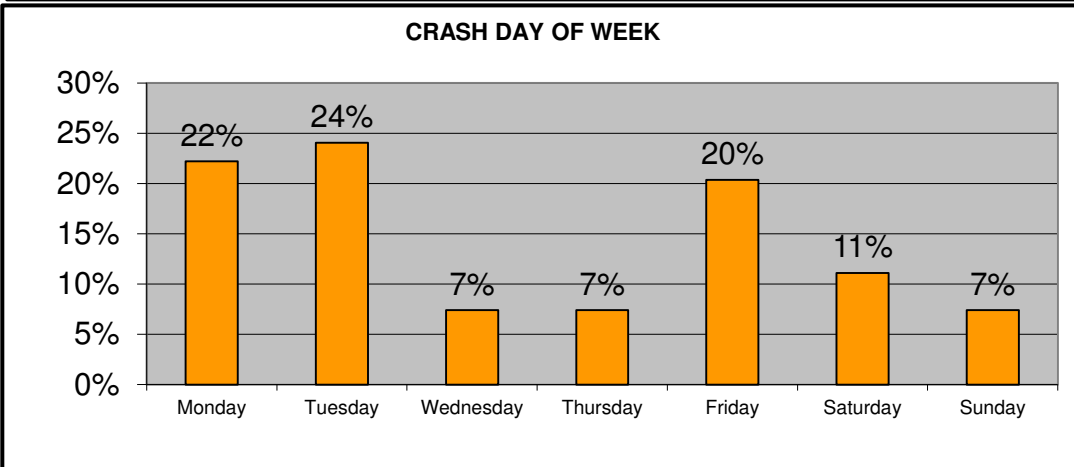
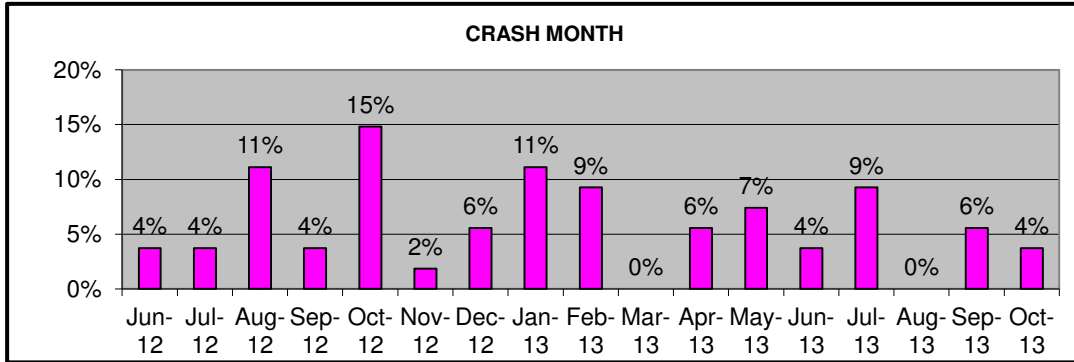
June 2012 - October 2013

Crash Diagram Ref #	Crash Date	Crash Day	Time of Day	Manner of Collision	Light Condition	Weather Condition	Road Surface	Driver Contributing Code	Ages			Comments
									Type	Type	Type	
30	1/11/13	Friday	6:10 PM	Angle	Unknown	Unknown	Unknown	Failed to yield right of way	21	45		
31	1/17/13	Thursday	8:31 AM	Sideswipe, same direction	Daylight	Clear	Dry	Failure to keep in proper lane or running off road	49	29		uninvolved vehicle caused V1 to swerve into V2's lane
32	2/1/13	Friday	2:01 PM	Rear-end	Daylight	Clear	Dry	Distracted	23	33		Rear end in traffic, Op 1 didn't see V2
33	2/18/13	Monday	11:27 AM	Angle	Daylight	Clear	Dry	Inattention	53	51		
34	2/18/13	Monday	4:09 PM	Angle	Daylight	Clear	Dry	Inattention	36	22	43	left turn vs thru movement, V3 rear ends V2 after being hit by V1
35	2/19/13	Tuesday	5:34 PM	Head on	Dark - lighted roadway	Cloudy	Wet	Failed to yield right of way	38	54		
36	2/23/13	Saturday	4:55 PM	Angle	Dusk	Cloudy	Dry	Failed to yield right of way	81	40		Courtesy Crash
37	3/8/13	Friday	9:27 AM	Single Vehicle Crash	Daylight	Snow	Snow	Inattention	33			Truck failed to retract bed fully, struck overpass
38	4/19/13	Friday	11:28 AM	Angle	Daylight	Clear	Dry	Failed to yield right of way	61	19		
39	4/26/13	Friday	6:09 PM	Angle	Unknown	Unknown	Unknown	Failed to yield right of way	36	67		
40	4/26/13	Friday	7:01 PM	Angle	Dawn	Clear	Dry	Inattention	32	64		Courtesy Crash
41	5/12/13	Sunday	12:52 PM	Angle	Daylight	Clear	Dry	Visibility Obstructed	53	25		Courtesy Crash
42	5/16/13	Thursday	10:38 AM	Angle	Daylight	Cloudy	Dry	Other improper action	20	67		Op 2 didn't see V1
43	5/20/13	Monday	8:32 AM	Angle	Daylight	Cloudy	Wet	Failed to yield right of way	22	62		Op 2 didn't see V1
44	5/29/13	Wednesday	5:59 PM	Head on	Daylight	Clear	Dry	Failed to yield right of way	47	23		Courtesy Crash
45	6/1/13	Saturday	4:00 PM	Angle	Daylight	Clear	Dry	Failed to yield right of way	51	58		
46	6/18/13	Tuesday	6:18 PM	Head on	Daylight	Rain	Wet	Failed to yield right of way	47	37		
47	7/2/13	Tuesday	9:20 AM	Angle	Daylight	Clear	Dry	Visibility Obstructed	36	48		Courtesy Crash
48	7/8/13	Monday	10:21 AM	Angle	Daylight	Clear	Dry	Failed to yield right of way	48	68		Courtesy Crash
49	7/9/13	Tuesday	5:05 PM	Angle	Daylight	Clear	Dry	Failed to yield right of way	64	36		
50	7/10/13	Wednesday	11:32 AM	Angle	Daylight	Clear	Dry	Operating Vehicle in erratic, reckless, careless, negligent, or aggressive manner	19	62		
51	7/23/13	Tuesday	11:58 AM	Angle	Daylight	Cloudy	Dry	Failed to yield right of way	20	25		Courtesy Crash
52	9/13/13	Friday	11:24 AM	Angle	Daylight	Clear	Wet	Failed to yield right of way	53	20		Courtesy Crash
53	9/13/13	Friday	12:35 PM	Angle	Daylight	Clear	Dry	Failed to yield right of way	26	72		Courtesy Crash
54	9/14/13	Saturday	11:56 AM	Angle	Daylight	Clear	Dry	Failed to yield right of way	33	59		Courtesy Crash
55	10/7/13	Monday	3:55 PM	Angle	Daylight	Cloudy	Wet	Failed to yield right of way	19	27		
56	10/8/13	Tuesday	6:42 PM	Angle	Dusk	Clear	Dry	Made an improper turn	25	42		

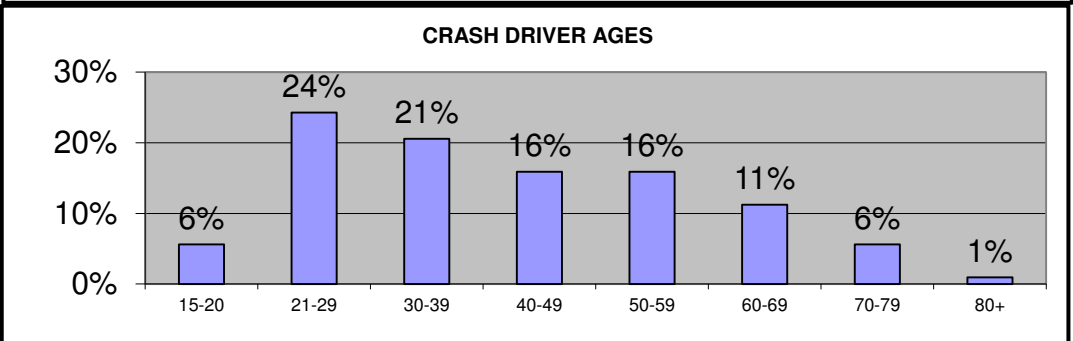
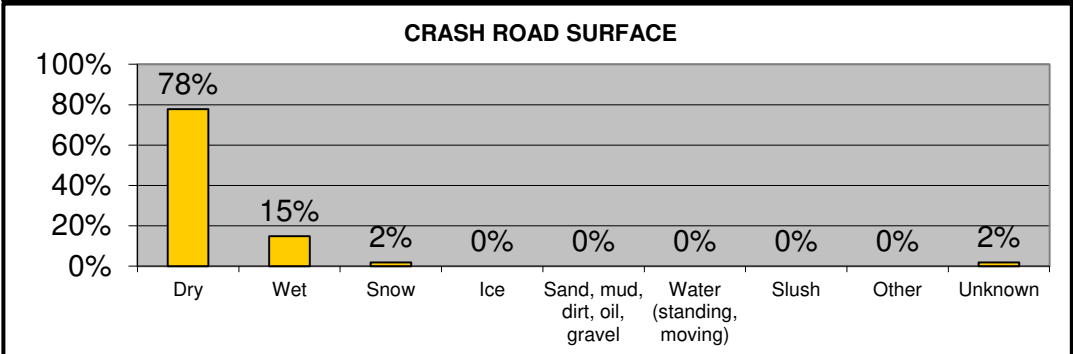
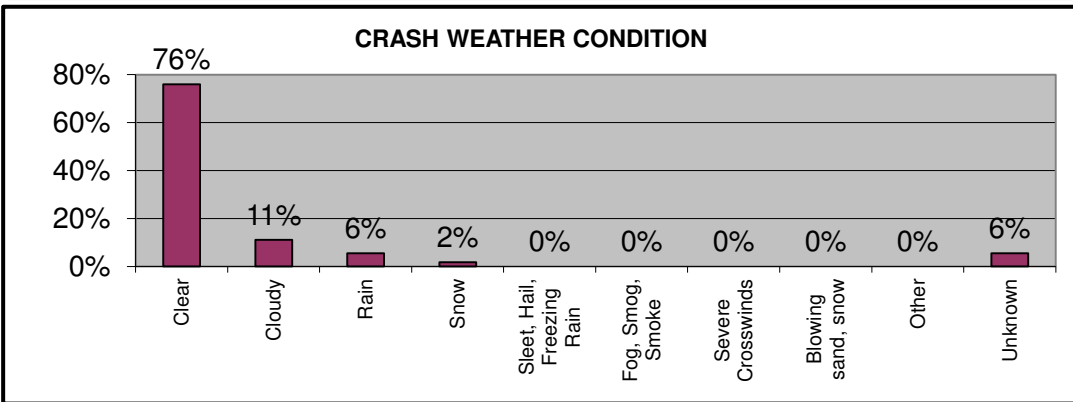
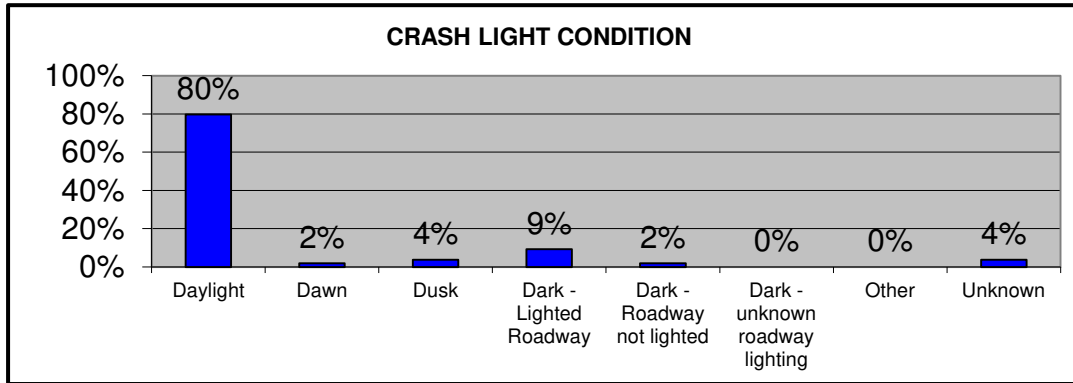
*Courtesy Crash - A term used to describe a crash that occurs subsequent to a non-involved mainline driver who gives the right of way, contrary to the rules of the road, to another driver.

Summary based on Crash Reports obtained from the Danvers Police Department.

Crash Data Summary Tables and Charts
Route 128 NB Ramps at Route 62 (Elliott Street), Danvers, MA



Crash Data Summary Tables and Charts
Route 128 NB Ramps at Route 62 (Elliott Street), Danvers, MA





Danvers Police Department

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November 21, 2013

To whom it may concern:

I queried all accidents that occurred at the intersection of Route 128 and Elliott St (Route 62) in Danvers between January 1, 2013 and October 31, 2013. 87 accidents have been reported to the Danvers Police Department at that location during the specified time frame. Of those 87, 35 identified an operator taking a left turn and 6 identified being rear-ended as the contributing factor. During the first 10 months of 2011 and 2012, there were 51 and 79 accidents, respectively, at that location. When compared to the average of 2011 & 2012, accidents in 2013 represent a 34% increase. Worth noting, the new on and off ramps began being used on or about June 1, 2012 and 67 of the 79 accidents that occurred from January – October 2012 happened after the on-ramps opened.

Please keep in mind that the Massachusetts State Police also respond to accidents that occur on the highways and state roads that run through Danvers. Also, when an operator calls 911 from their cell phone, the call is fielded initially by the Massachusetts State Police dispatch center. Accidents reported to the Massachusetts State Police are not included in the figures provided above.

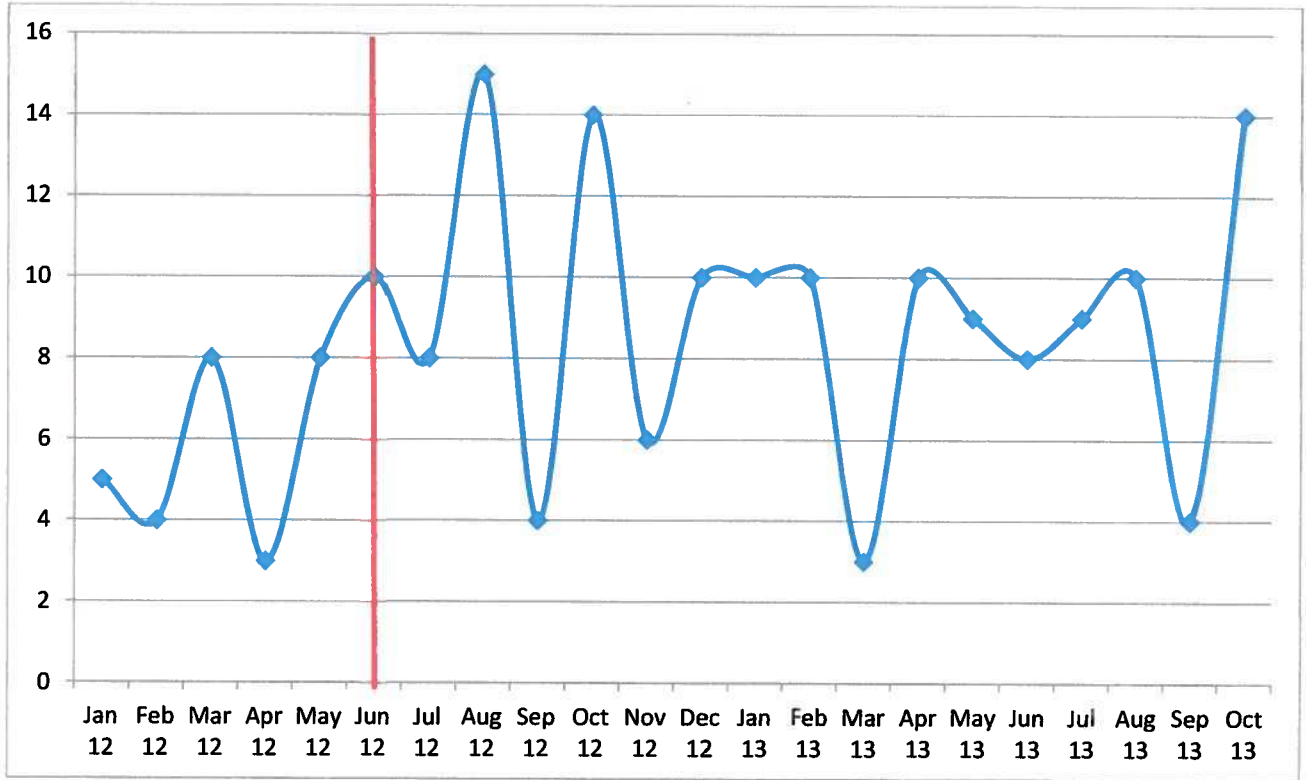
Also worth noting, the figures above represent only those accidents which the Danvers Police Department was called to. Often times, operators exchange information without the assistance of the police and turn in paper accident forms to the local police department at a later date, or directly to their insurance carriers. The Danvers Police Department does not currently have a way to query those by location or intersection.

Due to limitations of data collection, the figures provided above may include accidents that actually occurred on Route 128 which listed the Elliott St/Route 62 exit as the closest intersection. They also include accidents where the location was recorded to be Elliott St & State Rd and Elliott St & Liberty St as those intersections are often provided as the location. Please let me know if you have any further questions or require any further assistance on this matter.

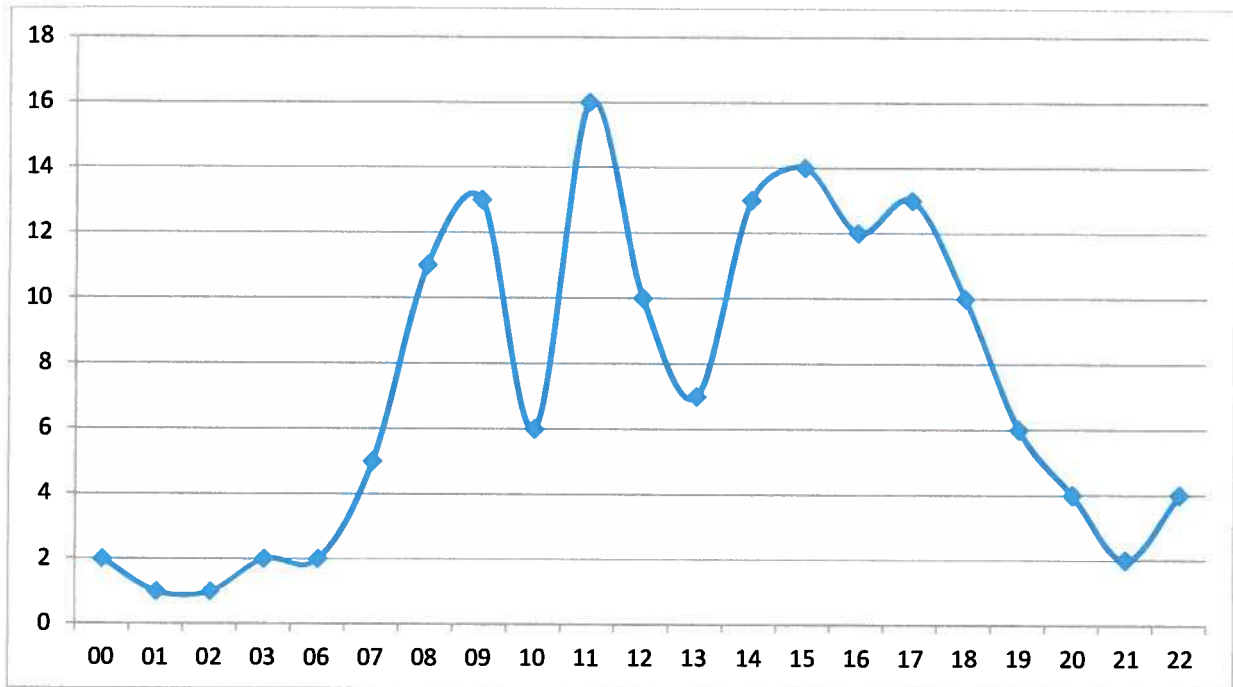
Thank you,

Sarah Slavin

Accidents at Route 128/Elliott St Intersection by Month



Accidents at Route 128/Elliott St Intersection by Time of Day, June 1, 2012-October 31, 2013



Accidents at Route 128/Elliott St Intersection by Time of Day, June 1, 2012-October 31, 2013

