

ROAD SAFETY AUDIT

Bedford Street and Hartwell Avenue

Town of Lexington

November 2011

Prepared for:
Massachusetts Department of Transportation



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Background

The Town of Lexington, Massachusetts is currently planning for potential improvements to the Bedford Street (Route 4/225) and Hartwell Avenue corridors in an effort to address existing safety concerns and to prepare for increased development and density within the newly created Hartwell Avenue Transportation Management Overlay District (TMOD). The Town's planning effort is ongoing and included the preparation of a *Traffic Mitigation Plan for the Hartwell Avenue TMOD*, prepared by TetraTech in July 2010.

The Bedford Street and Hartwell Avenue corridors have several high crash locations. Three of the intersection along these corridors, including Bedford Street/I-95 Exit 31 ramps, Bedford Street/Eldred Street, and Bedford Street/Hartwell Avenue, have been identified as Highway Safety Improvement Program (HSIP) eligible crash clusters by the Massachusetts Department of Transportation (MassDOT) based on 2007-2009 crash history, indicating that they are within top 5% of high crash locations within the region.¹ The intersection of Bedford Street/Hartwell Avenue is also listed within the *Top 200 High Crash Intersection Locations 2007-2009* in Massachusetts. MassDOT has determined that the Town may be eligible to receive HSIP funding for reconstruction of these intersections if a Road Safety Audit (RSA) were conducted and the proposed design addresses key safety issues identified during the RSA.

As such, the Massachusetts Department of Transportation (MassDOT) conducted a RSA along the Bedford Street and Hartwell Avenue corridors with specific attention to five intersection locations along the Bedford Street and Hartwell Avenue corridors. The RSA focused on identification of safety issues. The hope is that safety issues that can be ameliorated with short-term measures can be done so under routine maintenance (MassDOT for Bedford Street and the Town of Lexington for Hartwell Avenue). Issues that would entail longer term solutions could be incorporated into design improvements.

Project Data

The audit team conducted an RSA along the Bedford Street and Hartwell Avenue corridors on Monday, November 28, 2011. The RSA agenda appears in **Appendix A. Table 1** lists the audit team members and their affiliations. **Appendix B** provides contact information for all team members.

Prior to the RSA, in order to begin assessing possible safety issues, the team reviewed collision diagrams, crash detail summaries based on crash records supplied by the Lexington Police Department, traffic volume data, and motor vehicle speed regulations. **Appendix C** provides the detailed crash data for the study area. Traffic volume data and speed regulations are presented in **Appendix D**.

¹ MassDOT Top High Crash Intersection Locations Interactive Map, <http://services.massdot.state.ma.us/maptemplate/TopCrashLocations/>, 2009 HSIP Clusters.

Table 1. Participating Audit Team Members

Audit Team Member	Agency/Affiliation
Bonnie Polin	MassDOT, Highway Division
Lisa Schletzbaum	MassDOT, Highway Division
Candas Esin	MassDOT, Highway Division
Constance Raphael	MassDOT, District 4 Planning
Hardy Patel	MassDOT, Highway Division
Michael O'Hara	MassDOT, District 4, Projects
Ranjit Siva	MassDOT, Highway Division
Sara Timoner	MassDOT, District 4 Traffic
Aaron Henry	Lexington Planning Department
Dave Cannon	Lexington DPW
John Livsey	Lexington Town Engineer
Manny Ferro	Lexington Police Department
Marc Valenti	Lexington Highway Superintendent
Chenyang Wang	Boston Region MPO
Promise Otaluka	FHWA MA-Division
Rick Bryant	Tetra Tech
Sasha Wood	Tetra Tech
Bridget Meyers	Howard/Stein-Hudson (HSH)
Joe SanClemente	Howard/Stein-Hudson (HSH)
Nate Cabral-Curtis	Howard/Stein-Hudson (HSH)

Project Location Description

The section of Bedford Street, between I-95 and Hartwell Avenue, and Hartwell Avenue in its entirety, is located in the Town of Lexington, Massachusetts, as shown in the aerial image in **Figure 1**. Bedford Street provides access to a hotel, commercial, and office uses along its south side and a mix of residential and commercial uses along its north side. Hartwell Avenue extends south from the intersection of Hartwell Avenue/Bedford Street to an entry gate for Hanscom Air Force Base (AFB). In addition to Hanscom AFB, Hartwell Avenue provides access to several office parks and, via Wood Street, the Massachusetts Institute of Technology (MIT) Lincoln Laboratory.

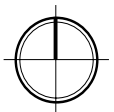
Road Safety Audit

Bedford Street and Hartwell Avenue, Lexington

Figure 1. Locus Map



Source: MassGIS



Not to scale.

The RSA focused on the following five intersection locations along the Bedford Street and Hartwell Avenue corridors:

Bedford Street (Route 4/225)/I-95 Exit 31 Ramps – is a clover-leaf interchange providing access to and from I-95 northbound and southbound. In the vicinity of the ramps, the Bedford Street eastbound and westbound travel lanes are separated by a raised median. The RSA initially focused on Bedford Street westbound at the I-95 southbound exit 31B off-ramp and Bedford Street eastbound at the I-95 southbound Exit 31A off-ramp; however, the team also made observations at Bedford Street eastbound at the I-95 northbound Exit 31A off-ramp.

Bedford Street (Route 4/225)/Eldred Street – is an unsignalized intersection with three approaches. Bedford Street eastbound consists of a shared left-turn/through lane and a through lane. Bedford Street westbound consists of a through lane and a shared through/right-turn lane. Eldred Street southbound operates under stop sign control and consists of a shared left-turn/right-turn lane. Left turns from this approach are prohibited between the hours of 7:00 -9:00 a.m. and 4:00-6:00 p.m.; however, during the RSA, team members commented that motorists sometimes violate this regulation. Separate entrance and exit driveways serving #420-430 Bedford Street are located opposite Eldred Street. Left-turns into the driveway from Bedford Street westbound are prohibited. In the vicinity of the intersection, sidewalks are provided on the north side of Bedford Street and on both sides of the Eldred Street. Massachusetts Bay Transportation Authority (MBTA) bus stops are located on the north side of Bedford Street just east of Eldred Street and on the south side of Bedford Street opposite Eldred Street. A crosswalk is provided across the Eldred Street southbound approach; however, no crosswalk is provided across Bedford Street.

Bedford Street (Route 4/225)/Hartwell Avenue – is a signalized intersection with four approaches. Bedford Street eastbound consists of two through lanes and a channelized, right-turn slip lane. The slip lane is a free movement. Bedford Street westbound consists of two through lanes. Left-turns onto Hartwell Avenue from Bedford Street westbound are prohibited and are facilitated by a “jug handle”, which is accessed approximately 400 feet east of the westbound approach. The jug handle consists of two lanes, which form the Hartwell Avenue southbound approach to the intersection, also process U-turns for motorists seeking to access Bedford Street eastbound; right turns onto Bedford Street westbound are prohibited. The jug handle also provides access to Drummer Boy Way, located approximately 150 feet northeast of Bedford Street, which serves as the access way for a private residential area. Hartwell Avenue northbound consists of one channelized left-turn lane and one channelized right-turn slip lane. The slip lane is yield-controlled. The traffic signal operates with three-phases: Bedford Street eastbound and westbound; a protected left-turn phase for Hartwell Avenue eastbound; and Hartwell Avenue northbound and southbound with permitted left-turns. A driveway serving #475 Bedford Street (Boston Sports Clubs) is located approximately 50 feet east of the entrance to the jug handle. A sidewalk is provided along the north side of Bedford Street and the west side of the Hartwell Avenue. A short segment of sidewalk/walkway is also provided along the east side of Hartwell Avenue providing connection into a wooded area between Hartwell Avenue and the Beth Israel Deaconess Medical Center/Children’s Hospital. No crosswalks are provided at the intersection. MBTA bus stops are located on both sides of Bedford Street between Hartwell Avenue and the entrance to the jug handle and generally have limited pedestrian accessibility.

Hartwell Avenue/Maguire Road/Composting Facility Driveway – is an unsignalized intersection with four approaches. The Maguire Road eastbound approach consists of a stop controlled shared left-turn/through lane and a yield controlled channelized right-turn lane. The compost facility driveway westbound approach operates under stop control and consists of a shared left-turn/through/right-turn lane. The Hartwell Avenue northbound approach consists of a dedicated left-turn lane (approximately 950 feet in length), a shared through/right-turn lane, and a bicycle lane. The Hartwell Avenue southbound approach consists of a dedicated left-turn lane, a through lane, a bicycle lane, and a channelized right-turn lane; however, as detailed below, the RSA team noted that pavement markings at the southbound approach are generally confusing/non-standard and may have been added in error in an effort to address peak-period traffic conditions. There are no pedestrian amenities at this location. The Minuteman Bikeway crosses Hartwell Avenue approximately 300 feet north of Maguire Road and is provided with a pedestrian-actuated traffic control signal.

Hartwell Avenue/Wood Street – is an unsignalized intersection with three approaches. The Wood Street westbound approach operates under stop control and consists of a shared left-turn/right-turn lane; however, at the time of the RSA, no stop line or stop sign (R1-1) was provided. The Hartwell Avenue northbound approach consists of a shared through/right-turn lane and a wide shoulder used as a bicycle lane. The Hartwell Avenue southbound approach consists of a shared left-turn/through lane and wide a shoulder used as a bicycle lane. A sidewalk is provided along the north side of Wood Street only, and no crosswalks are provided at the intersection. MBTA bus stops are located on both the north and south sides of the Wood Street just east of Hartwell Avenue.

These five intersections form the junctions of the following roadways, which are categorized according to MassDOT Office of Transportation Planning functional classifications:

Bedford Street (Route 4/225) is an urban principal arterial and falls under MassDOT jurisdiction within the project area. Bedford Street is an east-west roadway and is dedicated as Route 4 and Route 225. Within the study area, Bedford Street generally consists of two travel lanes, with no shoulder, in each direction and has numerous left-turn restrictions at many of the intersecting driveways and roadways. Sidewalks are generally provided along the north side of the roadway only and pedestrian crossings across Bedford Street are not provided within the study area. The speed limit on Bedford Street is 40 miles per hour (mph). MBTA bus routes #62 and #76 operate along Bedford Street Monday through Friday.

Eldred Street is an urban collector and owned by the Town of Lexington. Eldred Street runs east – west between Hartwell Avenue to the west and Grove Street to the east. The roadway consists of one travel lane in each direction. The speed limit along Eldred Street is posted at 30 mph.

Hartwell Avenue is an urban principal arterial owned by the Town of Lexington. Hartwell Avenue runs from Bedford Street in the north to Hanscom AFB in the south and has one travel lane in each direction. The speed limit on Hartwell Avenue is 40 mph. On-street bicycle lanes are generally provided on each side of the roadway to the south of the Minuteman Bikeway and sidewalks are not provided on either side of the roadway, with the exception of a short segment of sidewalk located on the west side of the roadway between Bedford Street and Westview Street. One pedestrian crossing is provided across Bedford Street

at the signalized intersection with the Minuteman Bikeway. The MBTA bus routes #62 and #76 operate along Hartwell Avenue on Saturdays only.

Maguire Road is an urban connector owned by the Town of Lexington. In the study area, Maguire Road runs east-west with a single travel lane in each direction between Hartwell Avenue to the east and the Bedford Town line to the west where Maguire Road turns into Summer Street.

Wood Street is an urban connector owned by the Town of Lexington. In the study area, Wood Street runs east-west with a single travel lane in each direction.

Road Safety Audit Observations

Based on field observations and discussion on Monday, November 28, 2011, the RSA team determined that the Bedford Street and Hartwell Avenue corridors have the following issues that negatively impact safety:

- Congestion during peak commuter periods and security checks;
- High travel speeds;
- Inconsistent left-turn restrictions;
- Limited visibility of signal indications;
- Limited pedestrian accommodations;
- Limited accessibility to MBTA bus stops;
- Unclear, inconsistent, and cluttered wayfinding and regulatory signage; and
- Unclear traffic circulation and turn restrictions.

The following sections describe in more detail the safety issues determined during the RSA. Several of these issues require further evaluation and design work to develop appropriate safety enhancements.

General Study Area Observations

The RSA team noted several general safety issues throughout the study area related to traffic circulation and signage, congestion, travel speeds, pedestrian accommodations, and bus stop locations, as described below.

Traffic Circulation and Signage

In an effort to reduce the incidence of angle and rear-end collisions throughout the Bedford Street corridor, left-turn restrictions have been put in place at many of the driveways and other intersecting roadways. However, the RSA team noted that left-turn restrictions are often inconsistent, with restrictions placed at some locations and not



General sign clutter and confusing U-turn signage

others and some with time restrictions and some without, which has significantly added to sign clutter, motorist confusion, and the need for constant enforcement by the Lexington Police Department.

In place of allowing left-turns, reversing direction along Bedford Street is facilitated by a jug handle at the intersection of Bedford Street/Hartwell Avenue and/or through the use of the I-95 ramp system. The RSA team noted that signage directing motorists to these alternatives is generally confusing and/or not provided. For example, the RSA team noted signage at the Quality Inn directs motorists traveling along Bedford Street westbound to “Take U-Turn Ahead” (likely intended to refer to the jug handle); however, U-turns are not allowed anywhere within the study area. Similarly, motorists traveling along Bedford Street eastbound are required to use the I-95 ramps to change direction; however, no signage is provided instructing motorists unfamiliar with the area how to use the ramps to accomplish this maneuver.

Several RSA members suggested the possibility of installing a median along Bedford Street to physically prohibit all left-turns; however, a place to reverse direction would be needed if a median were to be installed. More generally, the corridor is surfeited with guide signs, some of which are faded, contributing to visual white noise that causes many motorists to miss important visual cues, especially when confronted with high traffic volumes and speed conditions.

Lastly, a team member noted that there are currently no shoulders on either side of Bedford Street, which requires vehicles to slow down to make turns and also makes it difficult for vehicles to safely turn/back onto Bedford Street from small commercial and/or residential driveways. These factors may contribute to the occurrence of rear-end crashes along Bedford Street.

Traffic Congestion



High volumes and speeds are an issue throughout the corridor

Due to the numerous office and commercial uses, as well as Hanscom AFB and MIT Lincoln Laboratory, along the Bedford Street and Hartwell Avenue corridors, traffic volumes in the area generally intensify significantly during the weekday commuter peak periods, resulting in traffic congestion throughout the area. RSA team members noted that three of the office parks along Hartwell Avenue typically hire police details during the afternoon commuter peak period to facilitate vehicles exiting the parking areas onto Hartwell Avenue. Team members also noted that when security levels are raised at Hanscom AFB, vehicle queues from intensive gate-checks spill into the corridor and can extend beyond Bedford Street. In fact, security checks on a normal day at Hanscom AFB can result in traffic congestion and queuing throughout the corridor. RSA team members noted that the Town has tried to work with Hanscom AFB to implement flexible work hours for employees; however, AFB has indicated that attempts to allow flexible work hours were unsuccessful to meet the needs of their operations.

Travel Speeds



Non-standard advisory speed sign

The speed limit along Bedford Street and Hartwell Avenue are posted at 40 mph. One RSA team member commented that the posted limit on Bedford Street seems “a little high” and also noted that excessive speeding along Hartwell Avenue had been an issue in recent years until increased enforcement was put in place. A team member noted that the Lexington Police Department typically has several patrols enforcing travel speeds throughout the area during peak commuter periods as well as during the off-peak periods.

During the field visit, the RSA team also noted several speed signs along Hartwell Avenue that appeared to be non-standard, including one with white lettering on a red background indicating “Reduce Speed” and an advisory speed sign indicating “Public Advisory Under Mass. Law Speed Limit is 40 M.P.H. Strictly Enforced”. An RSA team member commented that these signs should be evaluated for conformance to Manual on Uniform Traffic Control (MUTCD) standards.

Pedestrian and Public Transit Accommodations

At several locations, RSA team members noted that MBTA bus stops have not been placed to maximize efficient loading/unloading and rider safety. In spite of obvious desire lines worn into the roadside grass, much of Hartwell Avenue and Bedford Street does not have sidewalks and/or pedestrian connections to bus stops. Where sidewalks are present, they appear to be non-ADA compliant. Sidewalks are generally provided along the north side of Bedford Street only; during the RSA, team members noted a pedestrian desire line worn in the grass in some locations along the south side of Bedford Street. No sidewalks are provided on either side of Hartwell Avenue with the exception of one segment of sidewalk located on the west side of the roadway between Bedford Street and Westview Street. No crosswalks are provided across Bedford Street and just one crosswalk (signalized) provides safe access across Hartwell Avenue at the Minuteman Bikeway.



Poor access to bus stops, no shelters, and no benches.

Intersection #1. Bedford Street/I-95, Exit 31 Ramps

The RSA team reviewed crash data at two of the ramp locations, including Bedford Street westbound at the I-95 southbound exit 31B off-ramp and Bedford Street eastbound at the I-95 southbound Exit 31A off-ramp (see **Figure 2**). The team also made observations at Bedford Street eastbound at the I-95 northbound Exit 31A off-ramp. The following details the team's observations at each of these three locations.

Bedford Street Westbound at I-95 Southbound Exit 31B Off-ramp:



The I-95 southbound off-ramp merging with Bedford Street westbound.

From June 2008 to September 2011, a total of 19 crashes were reported at this location (see **Figure 2A**). A majority of the crashes were rear-end type (13 or 68%) and occurred during daylight hours (13 of 13) and on dry pavement (10 of 13 or 77%). According to the RSA team, the off-ramp was recently reconfigured to flow freely onto Bedford Street without requiring a yield in an effort to reduce/eliminate the queuing onto I-95. This was accomplished by reducing the number of lanes on Bedford Street westbound from two lanes to one lane at the merge with the off-ramp.

Nonetheless, a yield sign remains in position at the top of the ramp creating confusion for motorists.

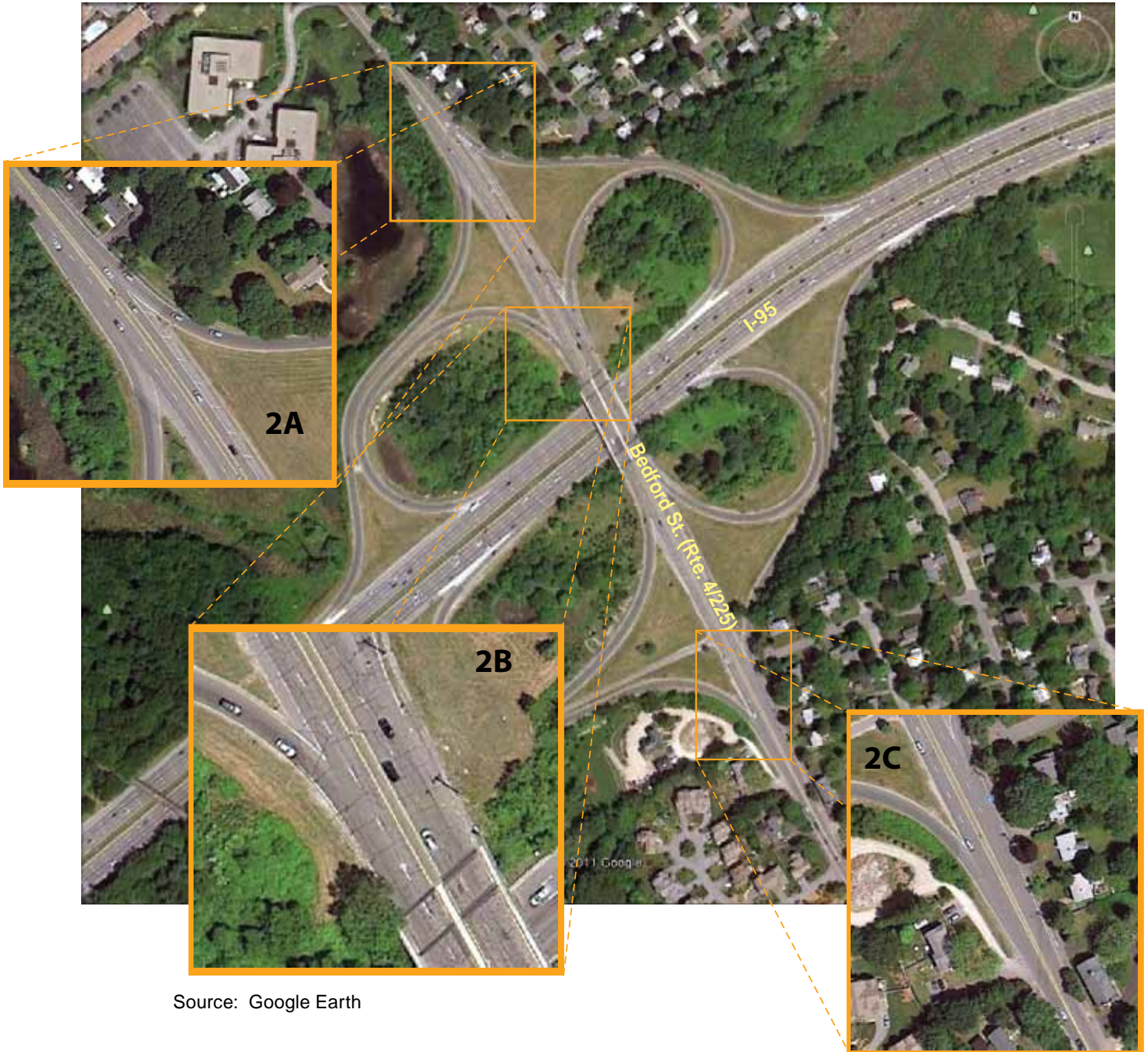
RSA team members commented that while the lane use change has generally been successful at improving merging conditions at the off-ramp, police and Town officials have observed issues with the merge as it forces drivers to stay to the left and then weave across traffic exiting the ramp to then turn right to access Eldred Street, located just 500 feet west downstream. This is a heavily used movement since a local school is accessed via Eldred Street. Buses also have difficulty merging into the right-hand southbound lane to stop for the bus stop located just north of Eldred Street. These observations are based on visual observations by public safety beyond the general complaints received by the public.

Lastly, the RSA team noted that the median separating Bedford Street eastbound and westbound traffic ends just 40 feet west of the off-ramp making it tempting for vehicles to make a U-turn at that location. An RSA team member commented that vehicles making this maneuver may have either taken the incorrect exit or are trying to avoid congestion on I-95 southbound. Of the 19 crashes reported at this location, 4 (or 21%) involved vehicles trying to make a U-turn around the median even though No U-Turn signage (R3-4) is currently posted.

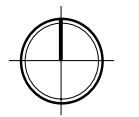
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Bedford Street and Hartwell Avenue, Lexington

Figure 2. Intersection 1: Bedford Street/I-95, Exit 31 Ramps



Source: Google Earth



Bedford Street Eastbound at I-95 Southbound Exit 31A Off-ramp:

At this location, 8 rear-end type crashes were reported during the same time period involving vehicles at the I-95 southbound off-ramp merging onto Bedford Street eastbound (see **Figure 2B**). Most crashes occurred during the early-to-mid morning hours and on dry pavement and were the result of driver inattention, following too closely, or aggressive driving behavior. The RSA team members noted that the acceleration lane is not defined, and thus traffic from the off-ramp must yield to eastbound traffic. It is likely that these crashes occurred when the first car in the queue on the ramp determines that the gap in mainline traffic is insufficient to safely merge, but the second car in the queue believes the first motorist should merge. Then, while watching the oncoming mainline traffic instead of the car at the head of the queue, the second motorist rear-ends the first.

Bedford Street Eastbound at I-95 Northbound Exit 31A Off-ramp:

While the RSA team did not review crash data for this intersection, an audit team member noted that the single lane I-95 northbound off-ramp merges onto Bedford Street eastbound at a point where Bedford Street eastbound is transitioning from two to one lane (see **Figure 2C**). As a result, three lanes of traffic (two lanes on Bedford Street eastbound and one lane on the off-ramp) are required to merge into just one lane. The audit team member noted that the transition from two to one lanes on Bedford Street eastbound should occur upstream of the off-ramp to reduce the amount of merging in this location.

Intersection #2. Bedford Street/Eldred Street

From September 2008 to September 2011, a total of 33 crashes were reported at this intersection. Of these, 10 (or 30%) were angle type crashes involving vehicles on Eldred Street southbound and Bedford Street westbound. The intersection of Bedford Street/Eldred Street is shown in **Figure 3**.

Several of these crashes (3 of 10 or 30%) occurred during the morning and evening hours when left-turns out of Eldred Street southbound are prohibited (7:00 -9:00 a.m. and 4:00-6:00 p.m.). Also reported at this location were four rear-end type crashes involving vehicles trying to make a left into Eldred Street from Bedford Street eastbound (3 of the 4 involved personal injury) and two crashes angle type crashes occurred involving vehicles making a left-turn into Eldred Street from Bedford Street eastbound with vehicles traveling along Bedford Street westbound.



Left turn prohibitions on the Eldred Street approach.

Team members noted that making left-turns at this intersection is generally difficult as motorists have to judge an adequate gap across multiple lanes of traffic. Team members also noted that the presence of a fence at the northwest and northeast corners of the intersection reduce sight lines for the Eldred Street southbound approach. This combined with high travel speeds along Bedford Street may have contributed to the crash history at this location.

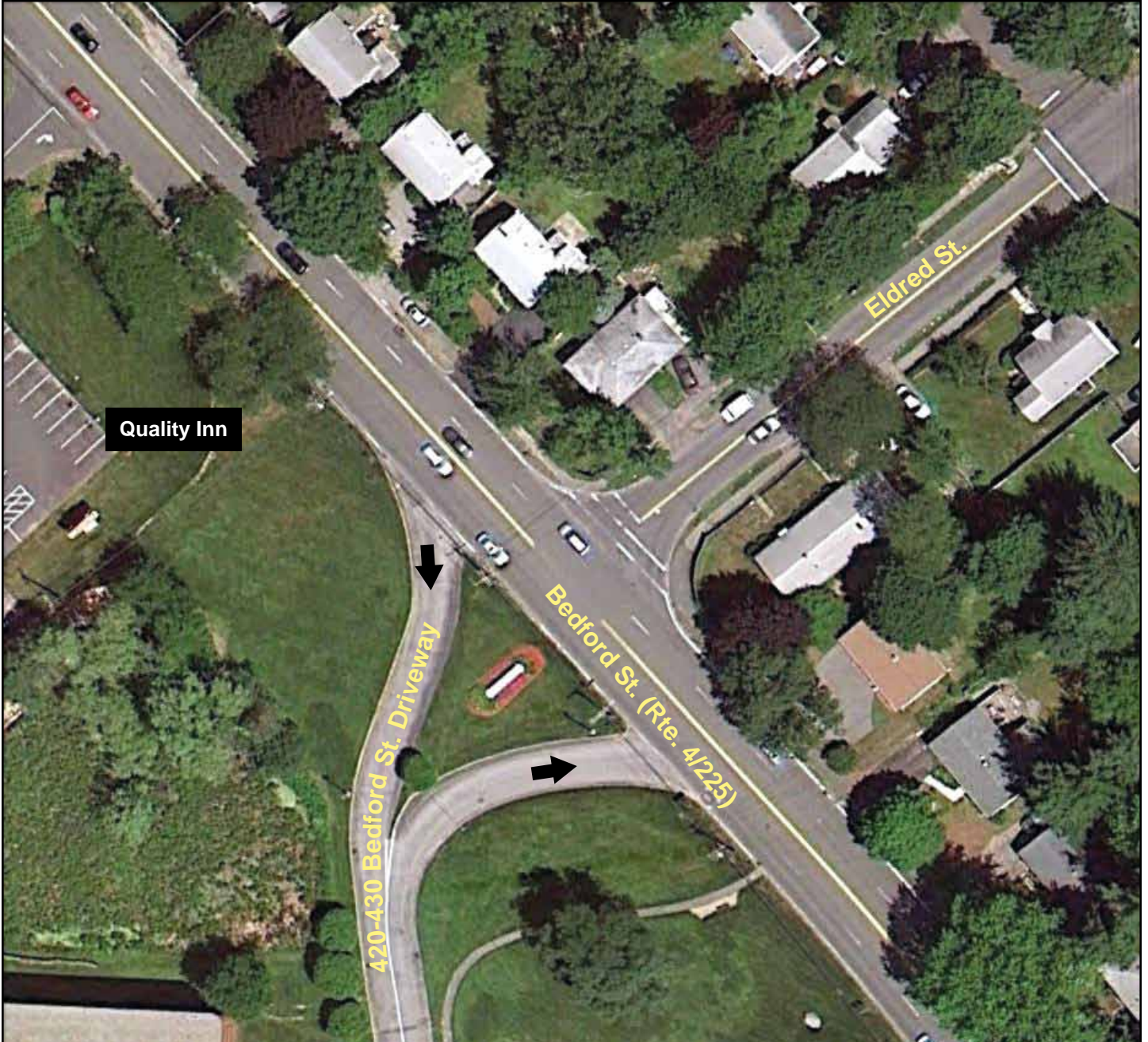
RSA team members noted that left-turn signage at this intersection is generally inconsistent, which may contribute to motorist confusion and in some cases motorists simply choosing to disobey the turn restrictions. For example, left turns out of Eldred Street southbound are prohibited only during certain hours; however, left-turns into Eldred Street from Bedford Street eastbound are not restricted. Meanwhile, left-turns both into and out of the driveway serving 420-430 Bedford Street (just across the street from Eldred Street) are prohibited; however, signage for the exit driveway is currently not provided, but is enforced by the Lexington Police Department.

One member of the RSA team commented that the Town is currently evaluating the feasibility of preventing all left turns along Bedford Street through the implementation of a raised concrete median. The team noted that if a median were to be installed that it should consider the needs of pedestrians and emergency vehicles.

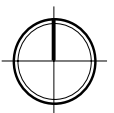
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Bedford Street and Hartwell Avenue, Lexington

Figure 3. Intersection 2: Bedford Street/Eldred Street



Source: Google Earth



Not to scale.



MBTA bus stop located on Bedford Street just to the east of Eldred Street.

Finally, MBTA bus stops are located just east of Eldred Street along both sides of Bedford Street; however, no crosswalks are provided across Bedford Street to allow passengers to safely access them. As a result, passengers choosing to walk to/from the residential neighborhood on the north side of roadway or one of the several businesses along the south side of the roadway must cross four lanes of traffic unprotected. In addition, no street lighting is currently provided at this location. RSA team members noted that these stops have fairly significant ridership during the afternoon commuter periods, particularly associated with workers in the adjacent hotel, restaurants, and office buildings primarily located along the south side of the roadway.

One RSA team member suggested that the bus stop located on the north side of Bedford Street could be made safer by moving it to the west of Eldred Street, so that it is further from the I-95 off-ramps and the resulting merging maneuvers described above. This may also keep passengers from trying to cross Bedford Street in front of the bus, out of view of unsuspecting motorists traveling along Bedford Street westbound.

Intersection #3. Bedford Street/Hartwell Avenue

The intersection of Bedford Street/Hartwell Avenue is the busiest in the study area in terms of traffic volume with between approximately 3,700 and 4,400 vehicles per hour (vph) entering the intersection during the peak periods. Much of the volume at this location is attributed to the various high intensity uses located along Hartwell Avenue including several office parks, MIT Lincoln Laboratories, Hanscom AFB, and the Lexington Recycling and Composting Facility. In the past three-year period, there have been 35 crashes reported at this location for which RSA team members noted that “aggressive driving, speeds, and volume” all play a role in the crash history at this location. Of the 35 crashes, 12 (or 34%) involved either red light violations; disregard of traffic signs, signals, or road markings; and/or other aggressive driving behavior. The Lexington Police Department representative noted that he and his officers write a fair number of traffic violations at this location. Some RSA members commented that the intersection should be either redesigned as a fly-over or given aesthetic treatments to warn drivers to slow down. The intersection is illustrated in **Figure 4**.

Signal Indications

During the field observations it was noted that all signal indications at the intersection are post-mounted. Thus, large trucks exiting Hartwell Avenue northbound or waiting in the Bedford Street westbound queue can block westbound motorists’ view of the signal indications. An RSA team member also noted that the signal indication for Hartwell Avenue southbound traffic, located on the northwest corner of the intersection, is twisted towards Bedford Street making it partially visible to the Bedford Street westbound approach. It is notable that four of the five angle crashes involving Bedford Street westbound and Hartwell Avenue southbound traffic were the result motorist disregard of the traffic signal; these crashes may have been the result of motorists traveling along Bedford Street westbound believing that they had a green light due to the twisted signal indication.



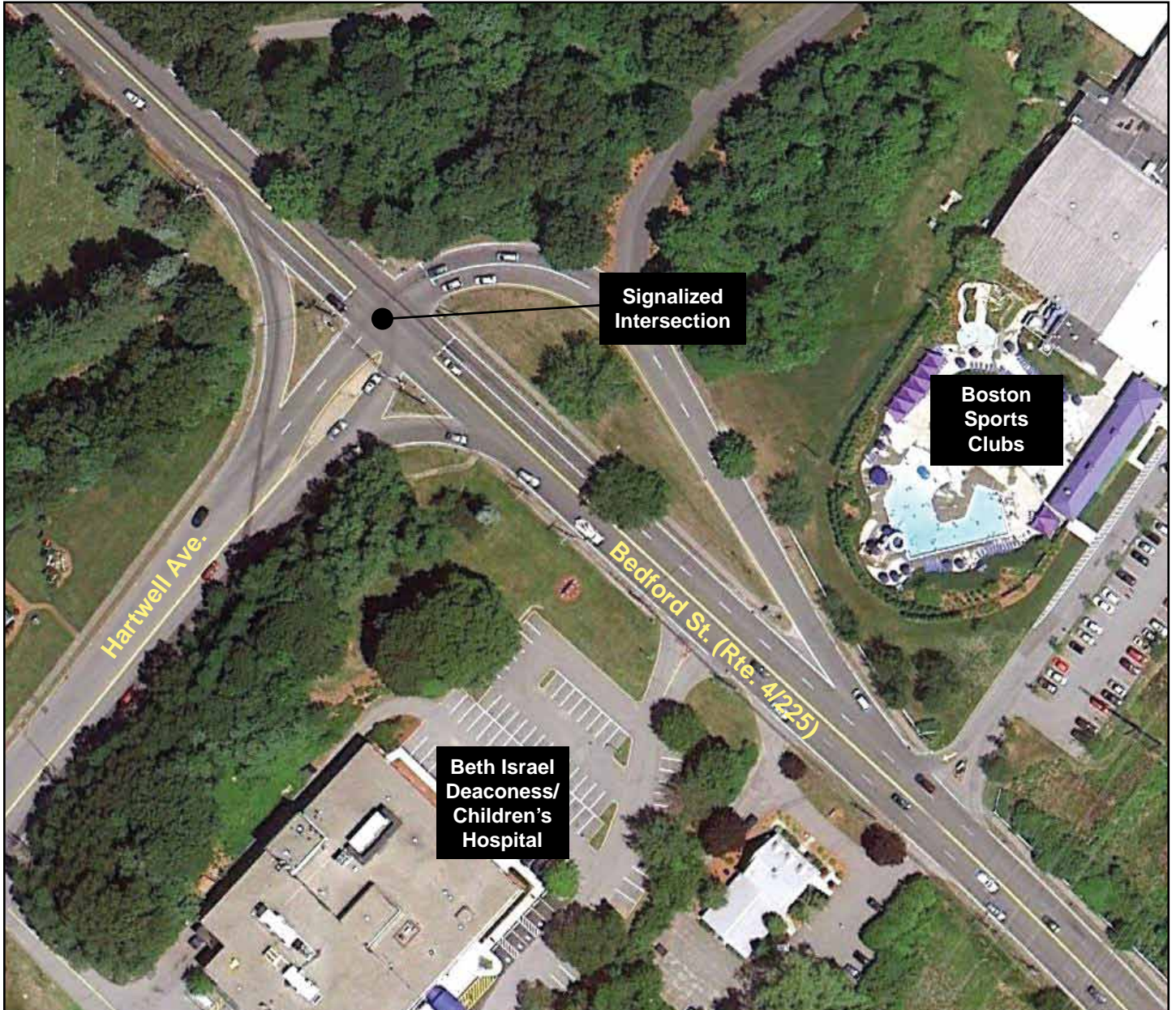
A truck exiting Hartwell Avenue and blocking the westbound signal heads on Bedford Street.

The audit team also noted that backplates are not provided for the east–west traffic signal indications at the intersection. As such, glare from the sun at dawn and dusk may contribute to the occurrence of red light running at this location.

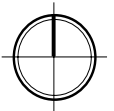
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Bedford Street and Hartwell Avenue, Lexington

Figure 4. Intersection 3: Bedford Street/Hartwell Avenue



Source: MassGIS



Not to scale.

Signage and Markings



Conflicting wayfinding signage at jug handle entrance.

There are significant numbers of regulatory and guide signs at this intersection, some of them badly worn and/or confusing, and they generally contribute to the overall sign clutter along the corridor. For example, guide signage at the jug handle for Hartwell Avenue is conflicting and directs motorists with both a right arrow and then a left arrow. In some cases, motorists seeking to access Hartwell Avenue, that see the right arrow sign first, end up turning right out of the jug-handle, prior to crossing Bedford Street, and into Drummer Boy Way, the access way for the private residential area.

Within the two-lane jug handle, the team noted that there is a complete absence of lane use pavement markings and signage, making it unclear which lane should be used to either access Hartwell Avenue or make a U-turn to reverse direction back onto Bedford Street eastbound. RSA team members noted that drivers in the right-hand (outside) lane will attempt to make a U-turn onto Bedford Street eastbound while drivers in the left-hand (inside) lane are attempting a southbound through movement onto Hartwell Avenue resulting in either a crash or a near-miss. Of the 35 crashes, two involved vehicles trying to make a U-turn from the right hand lane.

At the jug handle approach, signage prohibiting right turns (R3-1) onto Bedford Street is posted; however, team members noted that motorists traveling on Bedford Street westbound often attempt to skip the queue at the traffic signal by entering the jug handle and then ignore the signage and make a right-turn onto Bedford Street. Team members noted BSC members are told not to make this maneuver upon joining.



No lane designation signage or markings at the jug-handle southbound approach.

Other Circulation Issues

A driveway serving the Boston Sports Clubs (BSC) is located just 50 feet east of the entrance to the jug handle. The driveway has a raised island intended to allow only right-turns in and out; however signage prohibiting left-turns is only provided for exiting vehicles. Field observations

indicate that vehicles are currently making left turns around the island into the BSC from Bedford Street eastbound. According to the crash records, two angle crashes were reported involving motorists trying to make a left-turn into the BSC from Bedford Street eastbound.

Meanwhile, approximately 50 feet west of the entrance to the jug handle, left-turns both in and out of the driveway serving the Children's Hospital are prohibited. According to team members, motorists have been observed making a right turn out of the driveway onto Bedford Street eastbound and then attempting to make a left into the jug-handles from Bedford Street.

Pedestrian and Transit Accommodations

Pedestrian accommodations at the intersection are limited and provide poor connections to MBTA bus stops, which are located on both sides of Bedford Street, just east of Hartwell Avenue. There are no sidewalks on the south side of the roadway to provide connection to the bus. Meanwhile, a sidewalk is provided along the north side of the roadway; however, the bus stop is located in the center of the jug handle forcing passengers to cross either the entrance or exit to the jug handle unprotected, as no crosswalks are provided.



Sidewalk on the Bedford Street approach.

The team also noted a short segment of sidewalk at the southeast corner of the intersection leads to Bedford Street, from a wooded area, suggesting a pedestrian crossing across Bedford Street; however, no crosswalk or pedestrian signal indications are provided at the intersection. Further, a pedestrian crossing warning sign (W11-2) is also provided at this location.

Intersection #4. Hartwell Avenue/Maguire Road/Compost Facility Driveway

Approximately 3 to 4 years ago, the Town restriped Hartwell Avenue to reduce the number of travel lanes from two to one in each direction in an effort to formalize turning lanes, incorporate bicycle lanes, and reduce travel speeds (see **Figure 5**). While in the field, the audit team noted that the pavement markings along Hartwell Avenue southbound are generally confusing and appear to be non-standard per the Manual on Uniform Traffic Control Devices (MUTCD). North of Maguire Road, Hartwell Avenue southbound consists of one through lane and a bicycle lane. Approximately 250 feet north of Maguire Road, the bicycle lane ends abruptly and a right turn arrow has been painted on the right-hand side of what appears to be one wide travel lane, making it unclear how the bicycle lane transitions through this area and whether there is one or two southbound travel lanes for vehicles.



Confusing lane markings along Hartwell Avenue southbound.

Meanwhile, on the Hartwell Avenue southbound approach to the intersection, a left-turn arrow was added suggesting a dedicated left-turn lane, a through lane, and bicycle lane; however, there is inadequate width for the two travel lanes and the pavement markings appear to be non-standard. An RSA team member indicated that the left-turn arrow may have been added in error in an effort to address left-turns into the compost facility at peak demand times; however, the need for a dedicated



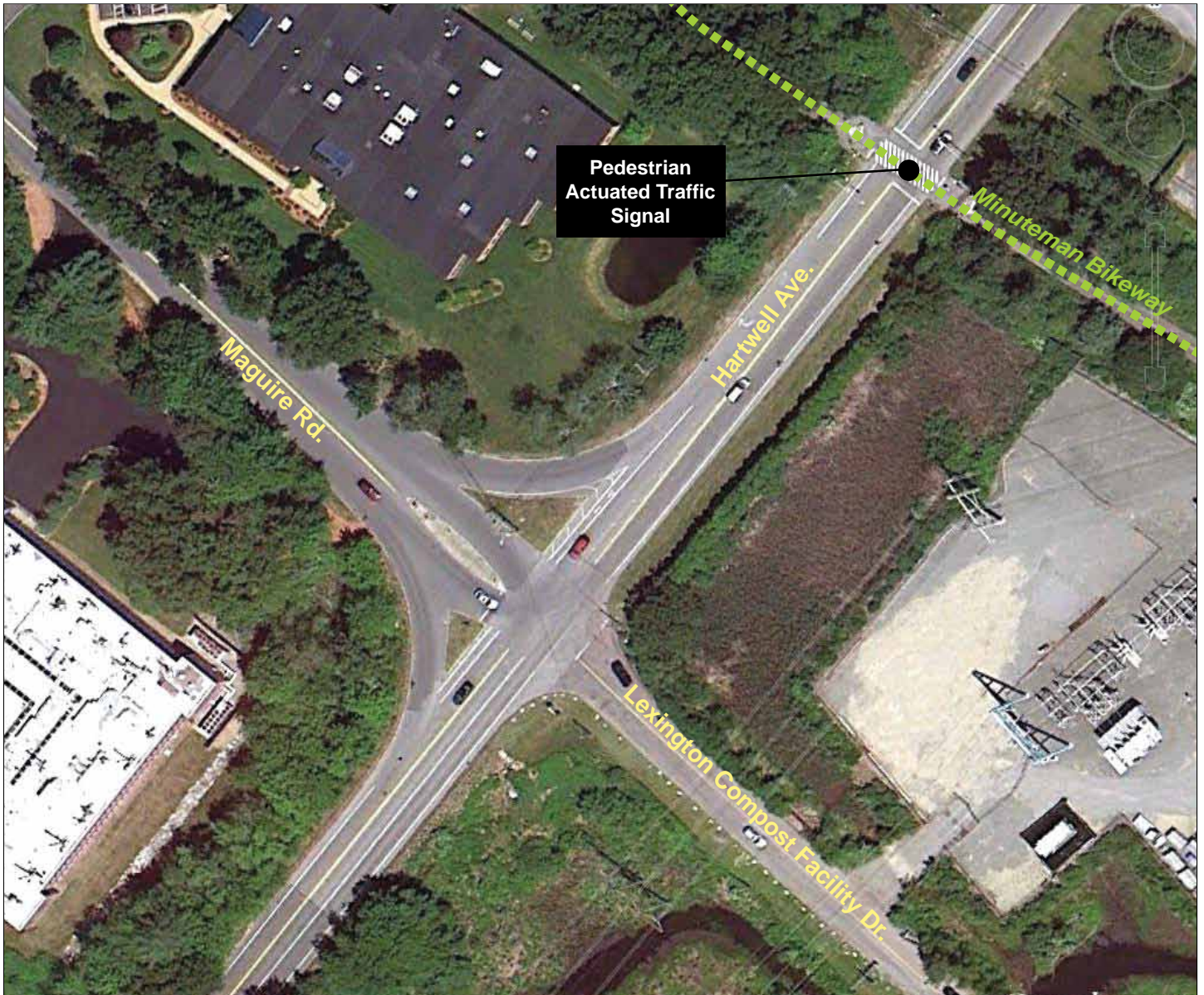
Incorrectly marked left turn lane.

left-turn lane is unclear and . The team noted that the need for a dedicated southbound left-turn lane should be evaluated and that the southbound approach should then be restriped to conform to MUTCD standards. Team members commented that either the bicycle lane may be shifted to the west to allow adequate room for dedicated left-turn and through lanes or the southbound lane should be restriped as shared left-turn/through lane if a left-turn lane is not warranted.

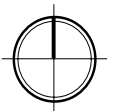
Road Safety Audit

Bedford Street and Hartwell Avenue, Lexington

**Figure 5. Intersection 4: Hartwell Avenue/Maguire Road/
Compost Facility Driveway**



Source: Google Earth



Not to scale.

Similarly, lane use along Hartwell Avenue northbound is not well marked and occasionally leads to vehicles choosing the incorrect lane. The Hartwell Avenue northbound approach consists of a long dedicated left-turn lane (approximately 950 feet in length), a shared through/right-turn lane, and a bicycle lane. Team members noted that motorists occasionally try to make a through movement from the left-turn lane at the intersection.

Of the 15 crashes at this location, four were rear-end type involving vehicles either making a right-turn out of Maguire Road or traveling along Hartwell Avenue southbound. These crashes may have been the result of congestion along the roadway caused during either Hanscom AFB security checks or during peak demand periods at one of the nearby office parks.

Intersection #5. Hartwell Avenue/Wood Street

Over the past three years there have been seven crashes reported at this intersection, including four rear-end, two angle, and one single vehicle crash involving a brake failure. The team made the following observations related to regulatory signage and markings, bus stop locations, street signage, and pedestrian conditions. The intersection is illustrated in **Figure 6**.

Regulatory Signage and Markings

An RSA team member noted that the Wood Street westbound approach was stop controlled in years past; however, the sign (R1-1) and stop line are no longer in place. One angle type crash was reported at this intersection involving a left-turning vehicle from Wood Street westbound that failed to yield the right of way to a second vehicle traveling along Hartwell Avenue northbound. It is unknown if the stop sign was in place at the time of this crash.



The Wood Street approach without stop sign and bus stops

The team noted that the presence of a large boulder at the northeast corner of the intersection would likely limit the visibility of a stop sign if it were in place at the proposed location at the intersection approach. Team members suggested that warning signage, such as Stop Ahead (W3-1) could be put in place in advance of the stop sign to alert motorists on the Wood Street approach.

Based on a review of the Lexington code, Town Engineering staff determined that this location is currently not a town-approved stop-controlled intersection and that installation of stop control signage, and/or pavement markings and supplemental signage, would require further evaluation. The presence of the large boulder on the corner of the intersection would also need to be taken into consideration.

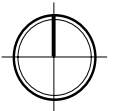
Road Safety Audit

Bedford Street and Hartwell Avenue, Lexington

Figure 6. Intersection 5: Hartwell Avenue/Wood Street



Source: Google Earth



Not to scale.

Bus Stop Locations

MBTA bus stops are located on both sides of Wood Street just east of the intersection. An RSA



team member noted that the placement of these stops is not ideal since the bus has no choice but to use the whole lane when stopping; however, it was noted that these stops are only served on Saturdays, lowering their potential impact to peak traffic conditions. Motorists approaching from the north along Hartwell Avenue may have difficulty seeing a bus stopped in the bus stop on Wood Street due to the presence of the large rock on the northeast corner of the intersection.

Pedestrian desire lines on Hartwell Avenue west of Wood Street.

Street Name Plaque

An RSA member noted that the visibility of the Wood Street sign plaque from Hartwell Avenue is limited since it is located on a utility pole offset from the edge of the roadway.

Pedestrian Accommodations

Sidewalks are not provided at the intersection with the exception of a short segment of sidewalk on the northeast corner of the intersection. Crosswalks are also not provided at the intersection. While pedestrian activity in the area is limited, the team noted pedestrian desire lines worn in the grass near the intersection, suggest some pedestrian demand exists – much of it likely associated with the bus stops.

Summary of Safety Observations

Based on its observations and discussions, the RSA team identified the safety issues along the Bedford Street and Hartwell Avenue corridors in the Town of Lexington, Massachusetts. Further evaluation and design work may be necessary to develop safety enhancements.

The safety issues are summarized in **Table 2**. Ideally MassDOT can correct those issues on Bedford Street that are relatively short-term and low cost during routine maintenance. Similarly, the Town of Lexington can do the same on Hartwell Avenue. The more involved longer-term improvements can be incorporated in the design.

Table 2. Summary of Safety Observations

Location	Safety Observation
General Study Area Observations	1. Sign Clutter
	2. Inconsistent left-turn restrictions
	3. Unclear wayfinding signage
	4. No shoulders on Bedford Street.
	5. Traffic congestion, particularly during security checks for Hanscom AFB and afternoon peak periods for the nearby office uses, which can add to driver frustration and aggressive driving behavior.
	6. High travel speeds along Bedford Street and Hartwell Avenue and the need for constant enforcement.
	7. Supplemental speed signage along Bedford Street appears to be non-standard and should be checked for conformance to current MUTCD specifications.
	8. Limited pedestrian accommodations (i.e., sidewalks and safe crossing locations).
	9. Limited accessibility to MBTA bus stops
Intersection #1: Bedford Street/I-95, Exit 31 Ramps	10. Merge area along Bedford Street westbound between I-95 southbound Exit 31B off-ramp and Eldred Street.
	11. U-Turns at Bedford Street westbound where median ends approximately 40 feet west of I-95 southbound Exit 31B off-ramp (prohibited movement).
	12. Lack of acceleration lane to facilitate merge at Bedford Street eastbound at I-95 southbound exit 31A off-ramp.
	13. Three lanes merging into one lane at Bedford Street eastbound at I-95 northbound exit 31A off-ramp.
Intersection #2: Bedford Street/Eldred Street	14. Inconsistent left-turn restrictions and driver disobedience of current restrictions.
	15. Fence at the northwest and northeast corners of the intersection reduce sight lines at the Eldred Street southbound approach.
	16. Bus stop location along Bedford Street westbound conflicts with merging area between I-95 ramps and Eldred Street.
	17. No safe pedestrian access across Bedford Street linking bus stop locations, the residential neighborhood, and area businesses.

Table 2. Summary of Safety Observations (continued)

Location	Safety Observation
Intersection #3: Bedford Street/Hartwell Avenue	18. Visibility of post mounted signal indications is limited.
	19. No backplates to reduce solar glare for east-west facing signal indications.
	20. Sign clutter, incorrect signage, confusing/conflicting signage, and outdated/worn signage.
	21. No lane use designation signage or pavement markings at the jug handle southbound approach.
	22. Inconsistent left-turn restrictions and driver disobedience of current restrictions.
	23. Red-light violations.
	24. Use of jug handle to avoid Bedford Street westbound queue.
	25. Limited pedestrian accommodations.
Intersection #4: Hartwell Avenue /Maguire Road/Compost Facility Driveway	26. Very limited pedestrian access to bus stops.
	27. Confusing and incorrect pavement markings at Hartwell Avenue southbound approach.
	28. Hartwell Avenue northbound lane use designations are unclear.
Intersection #5: Hartwell Avenue/Wood Street	29. Congestion along Harwell Avenue related to either Hanscom AFB security checks and/or during peak demand periods at one of the nearby office parks.
	30. Wood Street southbound missing stop sign (R1-1) and stop line; however, this location is currently not a town-approved stop controlled intersection. Further consideration would be needed to determine the appropriateness of providing stop signage and pavement markings and any advance warning signage (e.g., Stop Ahead W3-1).
	31. Awkward placement of bus stops.
	32. Limited visibility of Wood Street sign plaque from Hartwell Avenue.
	33. Limited pedestrian accommodations.

Appendix A. RSA Meeting Agenda

Agenda

Road Safety Audit Lexington

5 Intersections along Bedford Street & Hartwell Avenue

Meeting Location: Samuel Hadley Public Services Building
201 Bedford Street, Rm 202
Monday, November 28, 2011
10:00 AM – 12:30 PM

Type of meeting: High Crash Locations – 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 Review of Site Specific Material

- Crash Data, Volume Summaries & Speed Regulation – provided in advance
- Existing Geometries and Conditions
- Discuss crash trends

10:45 AM Visit the Site

- View the 5 high crash intersections (see “Crash Overview Map” for list of intersections included in the RSA) as a group
- As a group, identify areas for improvement

11:30 AM Post Visit Discussion / Completion of RSA

- Discuss how the observed safety issues relate to the crash trends

12:30 PM Adjourn for the Day – but the RSA has not ended

Instructions for Participants:

- Before attending the RSA on November 28th, participants are encouraged to drive/walk through the intersections/corridor 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

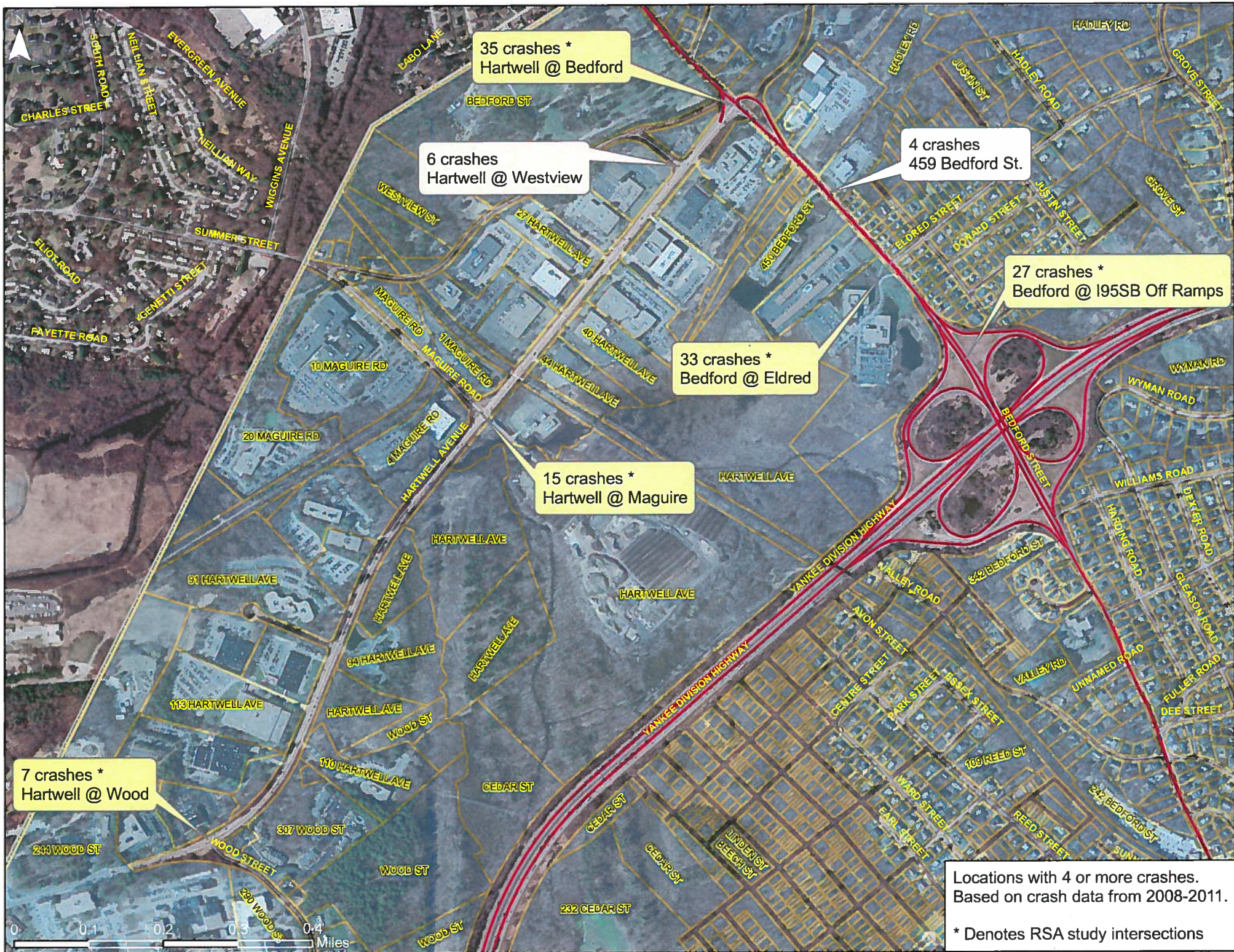
Participating Audit Team Members

Date: Monday, November 28, 2011

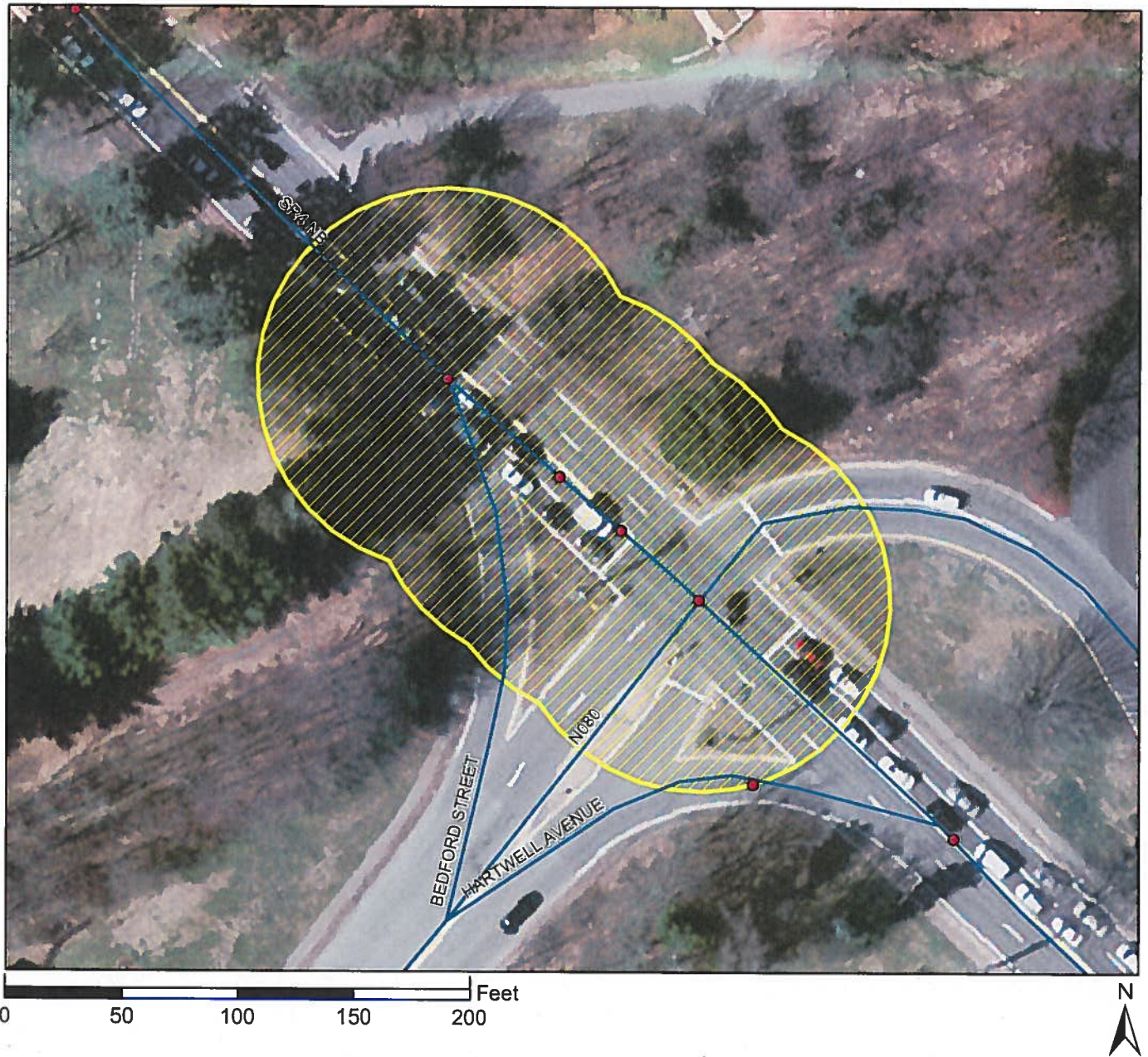
Location: Samuel Hadley Public Services Bldg, 201 Bedford Street, Lexington, MA

Audit Team Members	Agency/Affiliation	E-mail Address	Phone Number
Bonnie Polin	MassDOT, Highway Division	bonnie.polin@state.ma.us	617-973-7991
Lisa Schletzbaum	MassDOT, Highway Division	lisa.schletzbaum@state.ma.us	617-973-7685
Candas Esin	MassDOT, Highway Division	Candas.esin@state.ma.us	617-888-3857
Constance Raphael	MassDOT, District 4 Planning	connie.raaphael@state.ma.us	781-641-8468
Hardy Patel	MassDOT, Highway Division	Hasmukh.patel@state.ma.us	617-973-7728
Michael O'Hara	MassDOT, District 4, Projects	michael.o'hara@state.ma.us	781-641-8300
Ranjit Siva	MassDOT, Highway Division	ranjit.sivasubra@state.ma.us	617-973-7373
Sara Timoner	MassDOT, District 4 Traffic	sara.timoner@state.ma.us	781-641-8435
Aaron Henry	Lexington Planning Department	ahenry@lexingtonma.gov	781-862-0510 x246
Dave Cannon	Lexington DPW	dcannon@lexingtonma.gov	781-274-8323
John Livsey	Lexington Town Engineer	jlivsey@lexingtonma.gov	781-274-8311
Manny Ferro	Lexington Police Department	mferro@lexingtonma.gov	781-863-9307
Marc Valenti	Lexington Highway Superintendent	mvalenti@lexingtonma.gov	781-274-8357
Chenyang Wang	Boston Region MPO	cwang@ctps.org	617-973-8009
Promise Otaluka	FHWA MA-Division	promise.otaluka@dot.gov	617-494-2528
Rick Bryant	Tetra Tech	rick.bryant@tetrattech.com	617-733-6040
Sasha Wood	Tetra Tech	sasha.wood@tetrattech.com	508-903-2010
Bridget Meyers	Howard/Stein-Hudson (HSH)	bmyers@hshassoc.com	617-348-3325
Joe SanClemente	Howard/Stein-Hudson (HSH)	js@hshassoc.com	617-348-3334
Nate Cabral-Curtis	Howard/Stein-Hudson (HSH)	ncabral-curtis@hshassoc.com	617-348-3336

Appendix C. Detailed Crash Data



Top Crash Intersections 2007-2009



RANK
179

LEXINGTON

BEDFORD STREET ROUTE 4
HARTWELL AVENUE

MassDOT District 4
RPA MAPC
EPDO 105
Number of Fatal Crashes 0
Number of Injury Crashes 15
Number of Non-Injury Crashes 30
Total Crashes 45

Legend

- Crash Locations 2007-2009
- ~ Local Roads
- ~ All Functional Classification Except Local Roads
- ▨ Top Crash Intersections

COLLISION DIAGRAM

 CITY/TOWN : LEXINGTON

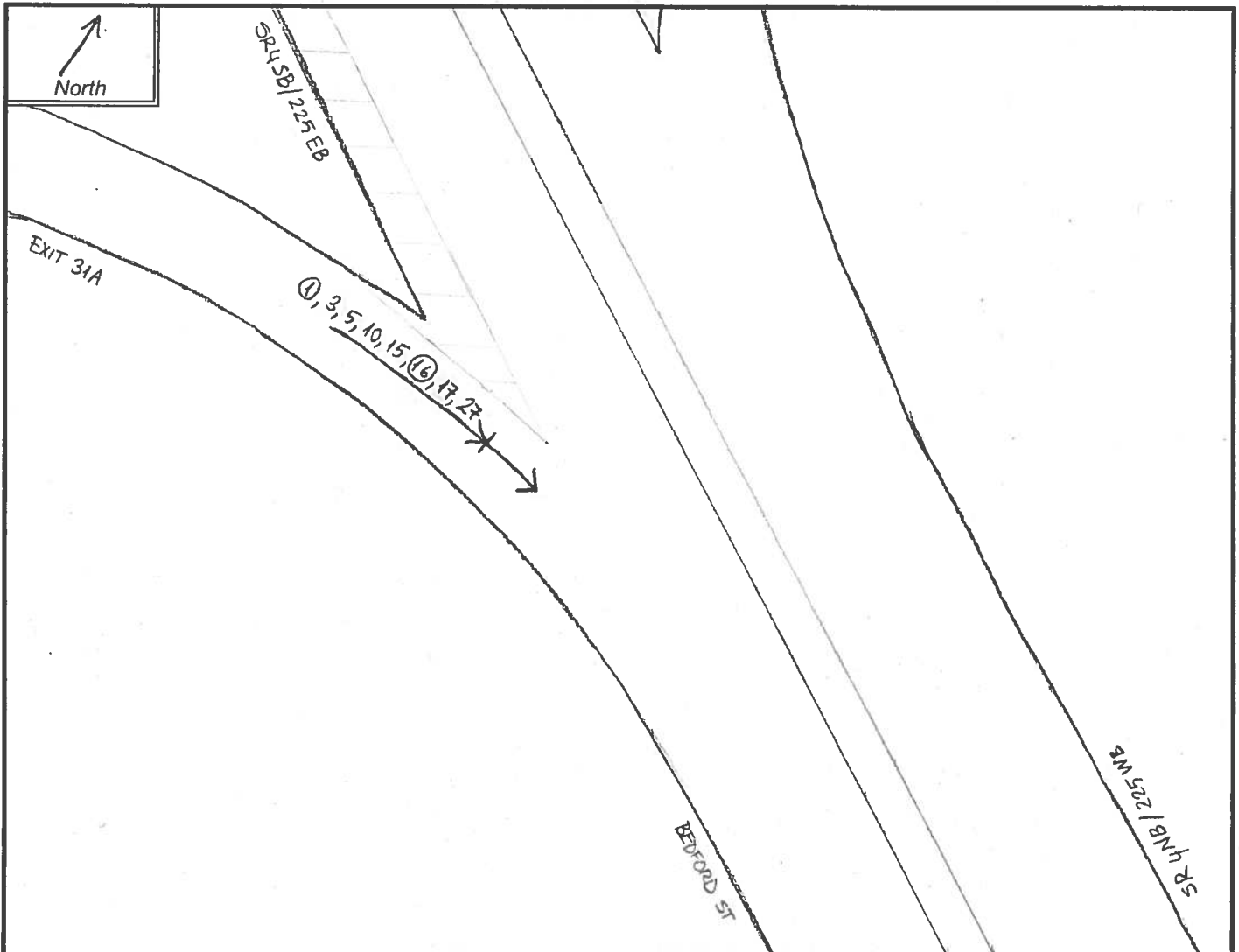
 DATE PREPARED: 11/16/2011

















 REGION: MAPC

 PREPARED BY: CANDASESIN

 ROADWAY NAMES: RAMP - RT 95 SB TO RTS 4SB & 225 EB - EXIT 31A

 TIME PERIOD ANALYZED: JUNE 5, 2008 - SEPTEMBER 20, 2011

 SOURCE OF CRASH REPORTS: LEXINGTON POLICE DEPARTMENT


SYMBOLS	TYPES OF CRASH	SEVERITY
 Moving Vehicle  Backing Vehicle  Non-Involved Vehicle  Pedestrian  Parked Vehicle  Fixed Object  Bicycle  Animal	 Head On  Angle  Turning Move  Rear End  Sideswipe  Out of Control	 Injury Accident  Fatal Accident

COLLISION DIAGRAM

CITY/TOWN: LEXINGTON

DATE PREPARED: 11/16/2011

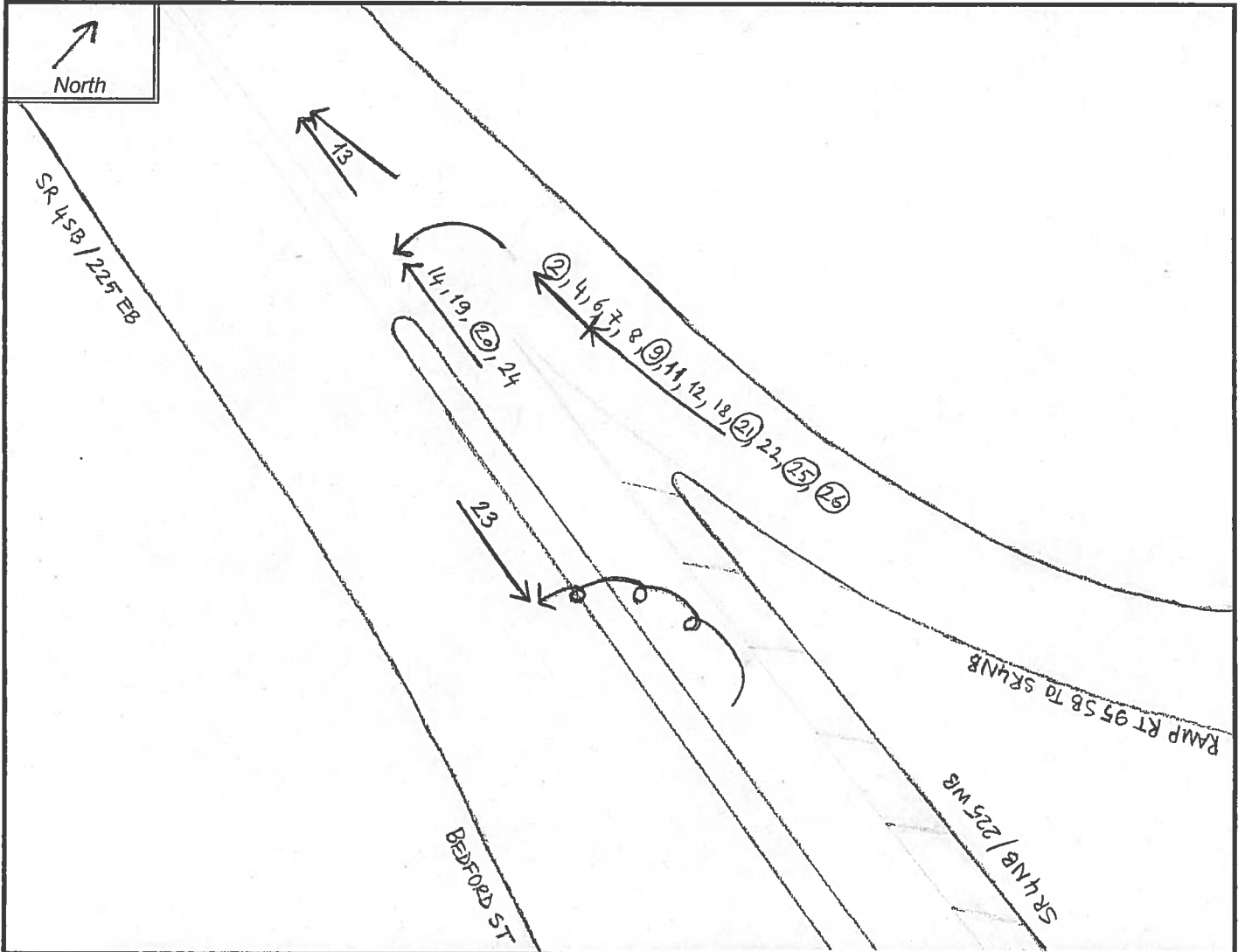
REGION: MAPC













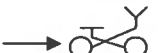

PREPARED BY: CANDAS ESIN

ROADWAY NAMES: RAMP RT 95 SB TO SR 4NB & 225WB - EXIT 31B

TIME PERIOD ANALYZED: SEPTEMBER 15, 2008 - SEPTEMBER, 2011

SOURCE OF CRASH REPORTS: LEXINGTON POLICE DEPARTMENT



SYMBOLS		TYPES OF CRASH		SEVERITY
	Moving Vehicle		Head On	○ Injury Accident
	Backing Vehicle		Angle	
	Non-Involved Vehicle		Turning Move	○ Fatal Accident
	Pedestrian		Rear End	
	Parked Vehicle		Sideswipe	
	Fixed Object		Out of Control	
	Bicycle			
	Animal			

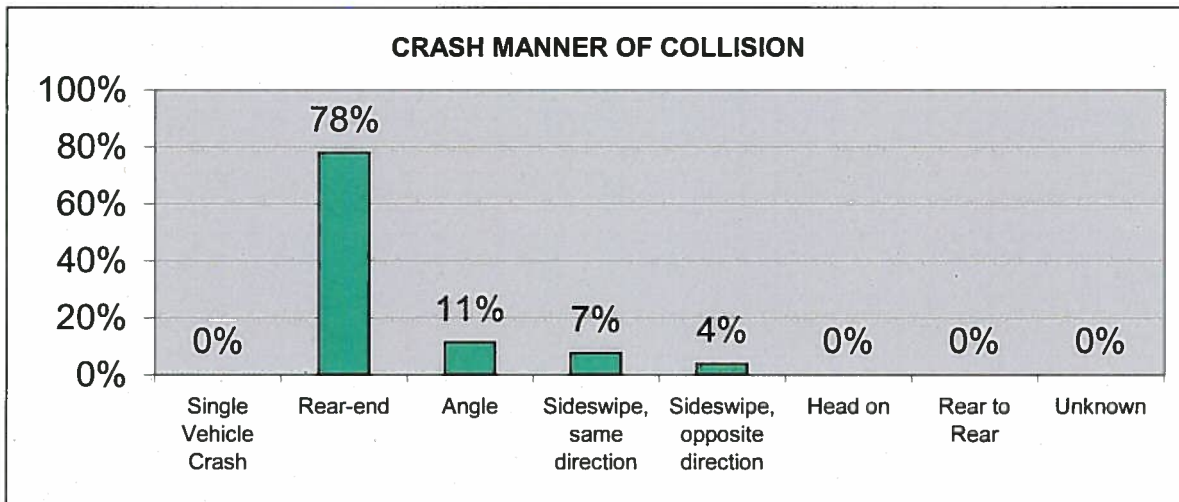
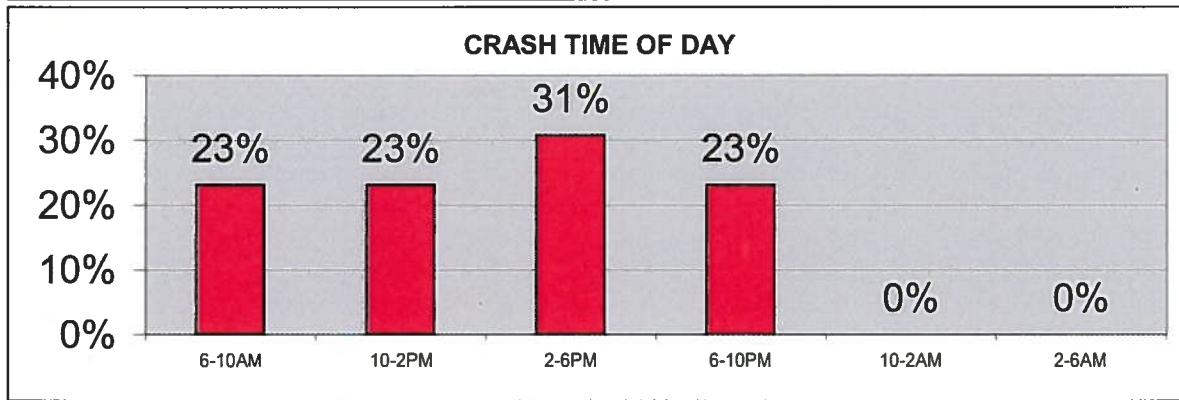
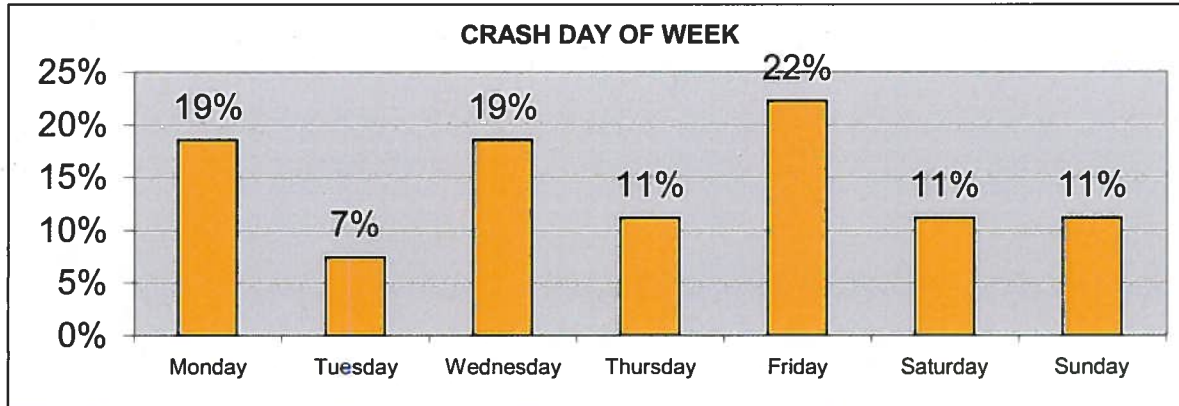
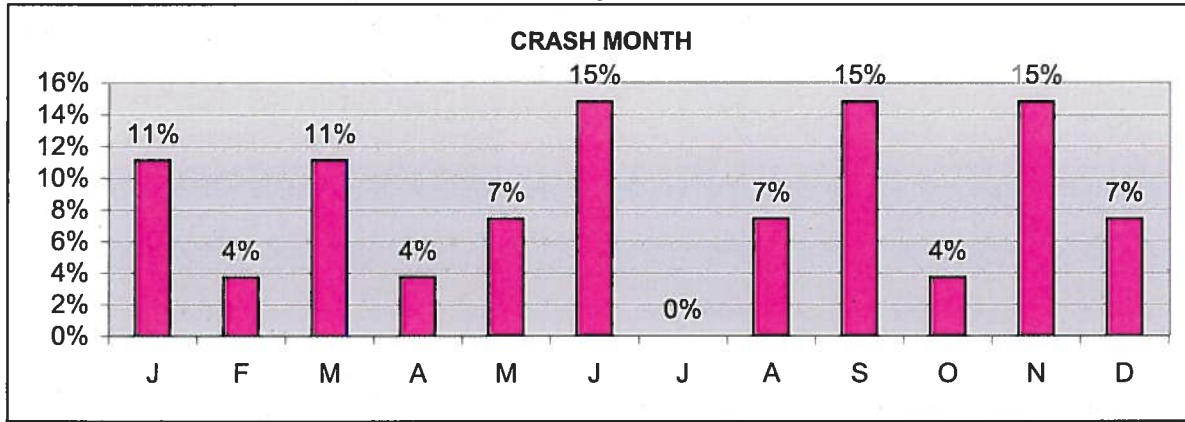
Crash Data Summary Table

Interstate 95 SB Ramps 31A & 31B to Bedford St.; Lexington, MA
June 5, 2008 - September 20, 2011

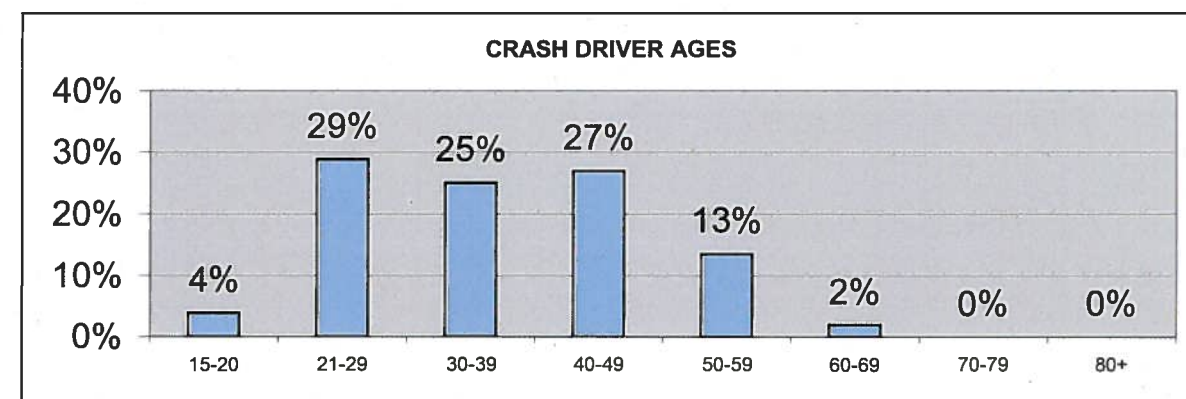
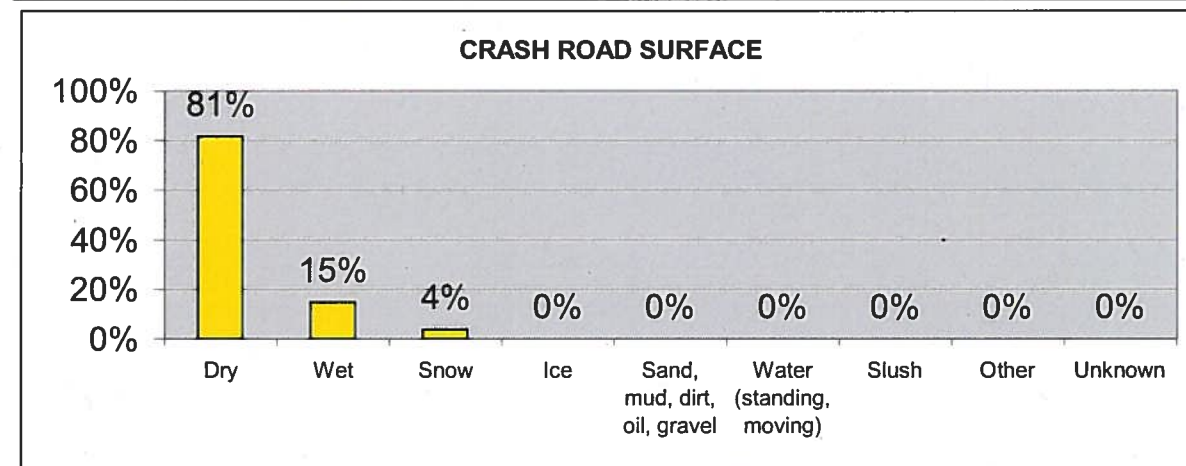
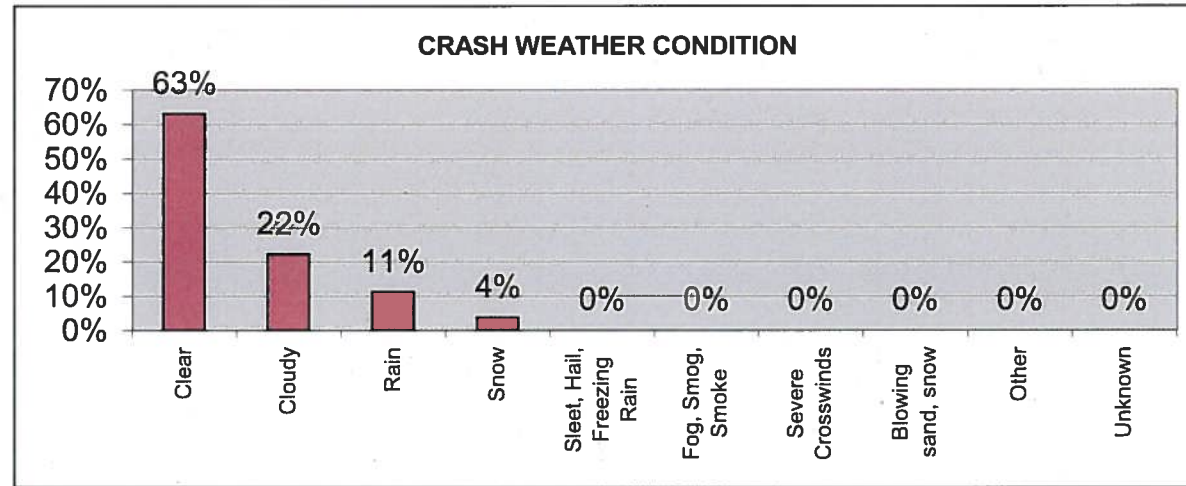
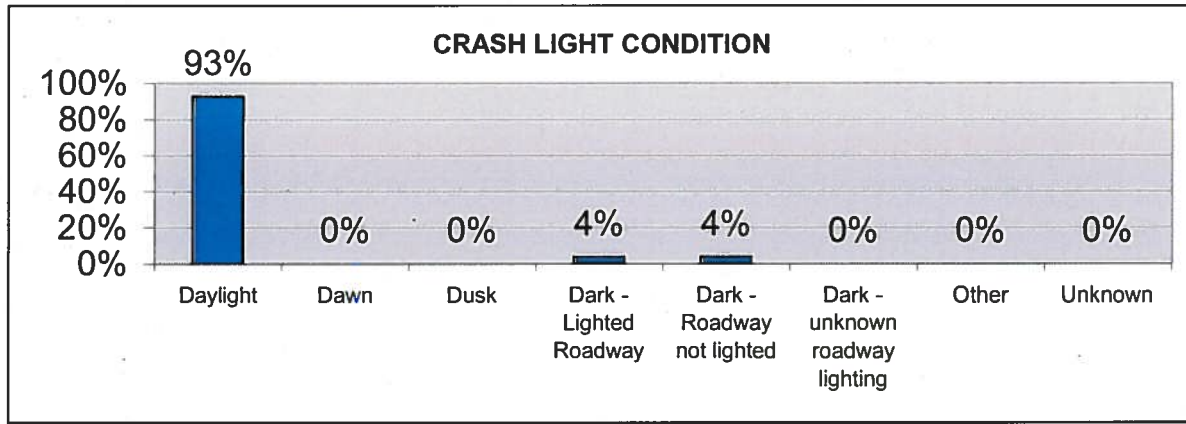
Crash #	Crash Date	Crash Day	Time of Day	Manner of Collision	Light Condition	Weather Condition	Road Surface	Driver Contributing Code		Ages				Comments
								Type	Type	D1	D2	D3	D4	
1	6/5/08	Thursday	9:53 AM	Rear-end	Daylight	Clear	Dry	Followed too closely	51	31				
2	9/15/08	Monday	1:02 PM	Rear-end	Daylight	Clear	Dry	No Improper Driving	47	52				
3	9/24/08	Wednesday	11:21 AM	Rear-end	Daylight	Clear	Dry	careless, negligent, or aggressive manner	39	27				
4	11/8/08	Saturday	8:43 AM	Rear-end	Daylight	Cloudy	Dry	inattention	19	33				
5	11/21/08	Friday	2:46 PM	Rear-end	Daylight	Clear	Dry	Followed too closely	44	19				
6	12/26/08	Friday	10:55 AM	Rear-end	Daylight	Clear	Dry	Unknown	26	unk				Hit and run
7	1/23/09	Friday	7:59 AM	Rear-end	Daylight	Clear	Dry	inattention	49	44				
8	1/25/09	Sunday	1:01 PM	Rear-end	Daylight	Clear	Dry	Other improper action	29	42				
9	2/1/09	Sunday	1:18 PM	Rear-end	Daylight	Clear	Dry	Other improper action	34	55				
10	3/30/09	Monday	3:36 PM	Rear-end	Daylight	Cloudy	Dry	Other improper action	24	21				
11	4/21/09	Tuesday	2:24 PM	Rear-end	Daylight	Rain	Wet	Other improper action	29	32				
12	5/29/09	Friday	8:17 AM	Rear-end	Daylight	Cloudy	Wet	road markings	49	38				
13	8/5/09	Wednesday	6:34 PM	Angle	Daylight	Clear	Dry	running off road	49	46				
14	10/10/09	Saturday	2:29 PM	Angle	Daylight	Clear	Dry	road markings	31	37				
15	11/12/09	Thursday	6:47 PM	Rear-end	Dark - roadway not lighted	Cloudy	Dry	inattention	27	32				
16	12/10/09	Thursday	2:29 PM	Rear-end	Daylight	Clear	Dry	Followed too closely	48	58				
17	3/12/10	Friday	4:34 PM	Rear-end	Daylight	Clear	Dry	inattention	35	46				
18	5/9/10	Sunday	3:10 PM	Rear-end	Daylight	Clear	Dry	Followed too closely	48	37				
19	6/2/10	Wednesday	6:03 PM	Sideswipe, same direction	Daylight	Clear	Dry	road markings	29	28				
20	6/28/10	Monday	6:23 AM	Sideswipe, same direction	Daylight	Clear	Dry	Made an improper turn	25	48				
21	9/17/10	Friday	11:20 AM	Rear-end	Daylight	Rain	Wet	Followed too closely	46	51				
22	11/27/10	Saturday	3:30 PM	Rear-end	Daylight	Clear	Dry	Followed too closely	56	23				
23	1/12/11	Wednesday	7:40 AM	Sideswipe, opposite direction	Daylight	Snow	Dry	Driving too fast for conditions	68	20				Slippery road conditions
24	3/30/11	Wednesday	8:02 PM	Angle	Dark - lighted roadway	Clear	Dry	Unknown	23	unk				Hit and run
25	6/6/11	Monday	6:17 PM	Rear-end	Daylight	Clear	Dry	inattention	58	29				
26	8/15/11	Monday	6:27 PM	Rear-end	Daylight	Rain	Wet	careless, negligent, or aggressive manner	28	39				
27	9/20/11	Tuesday	4:00 PM	Rear-end	Daylight	Cloudy	Dry	inattention	32	46				

Summary based on Crash Reports obtained from the Lexington Police Department

Crash Data Summary Tables and Charts



Crash Data Summary Tables and Charts



COLLISION DIAGRAM

 CITY/TOWN : LEXINGTON

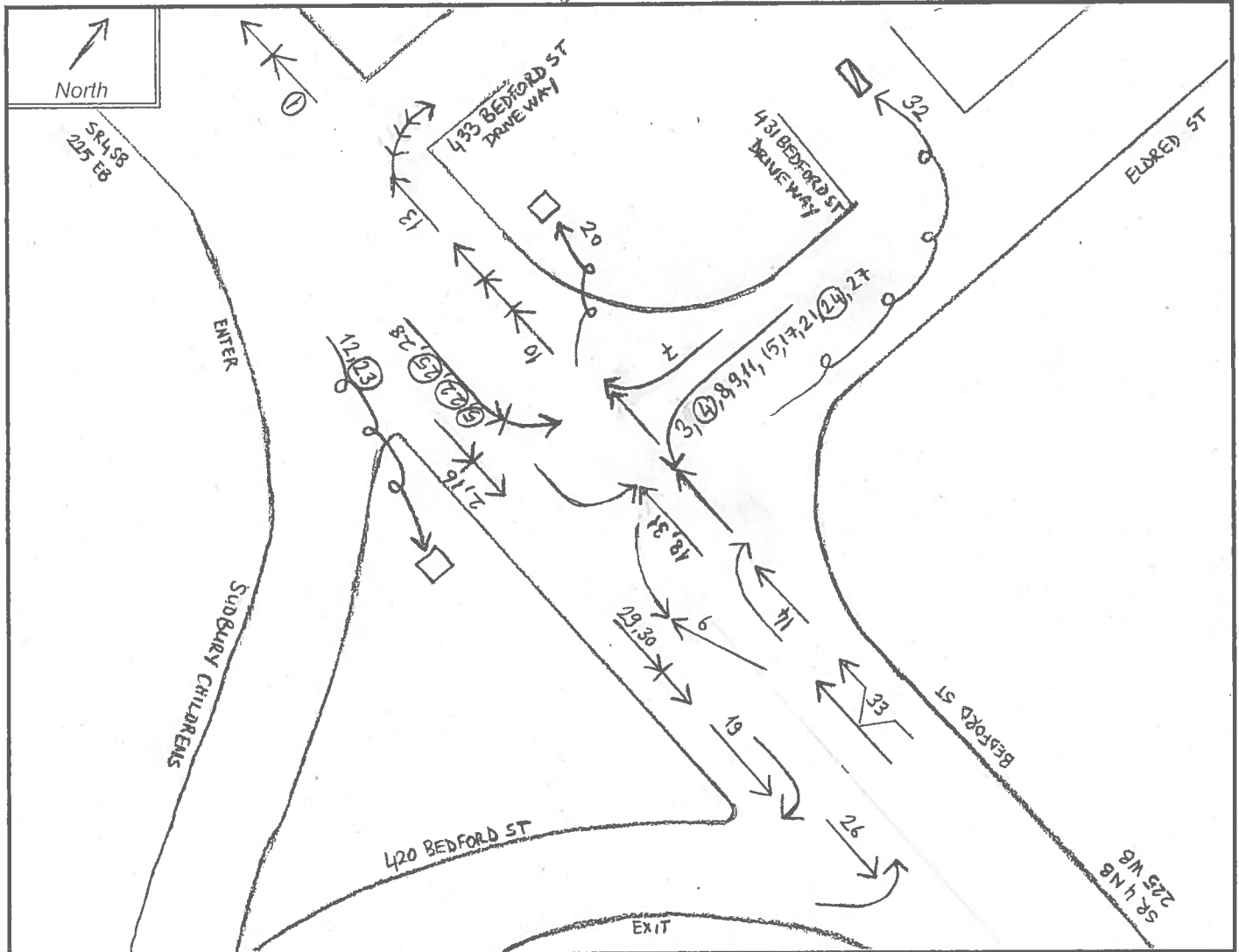
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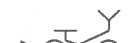









 REGION: MAPC

 PREPARED BY: Candice Esn

 ROADWAY NAMES: BEDFORD ST AND ELDRED ST

 TIME PERIOD ANALYZED: September 17, 2008 - September 13, 2011

 SOURCE OF CRASH REPORTS: Lexington Police Department


SYMBOLS	TYPES OF CRASH	SEVERITY
 Moving Vehicle  Backing Vehicle  Non-Involved Vehicle  Pedestrian  Parked Vehicle  Fixed Object  Bicycle  Animal	 Head On  Angle  Turning Move  Rear End  Sideswipe  Out of Control	 Injury Accident  Fatal Accident

Crash Data Summary Table

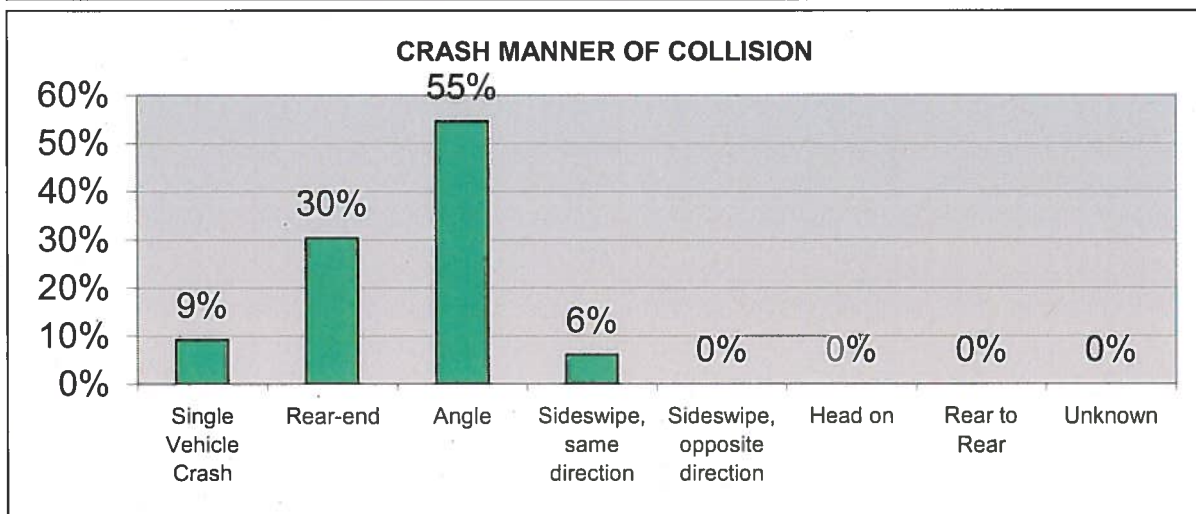
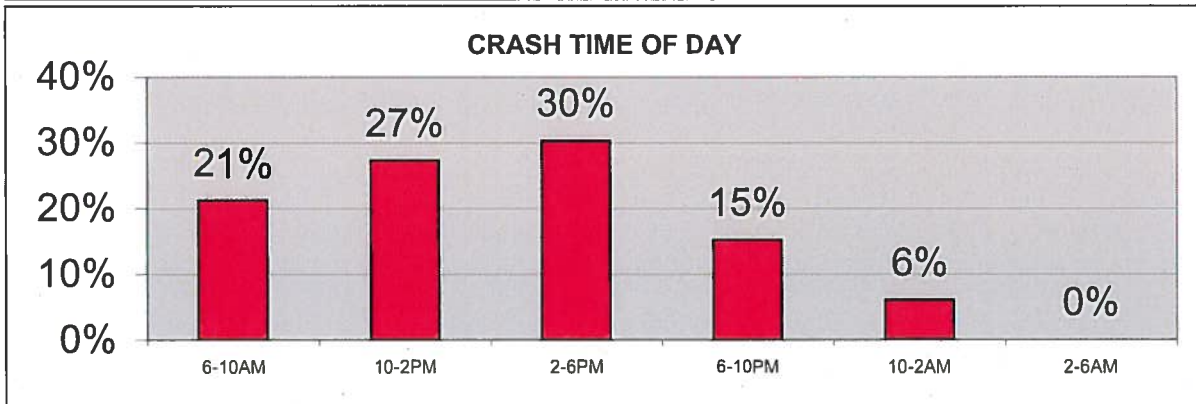
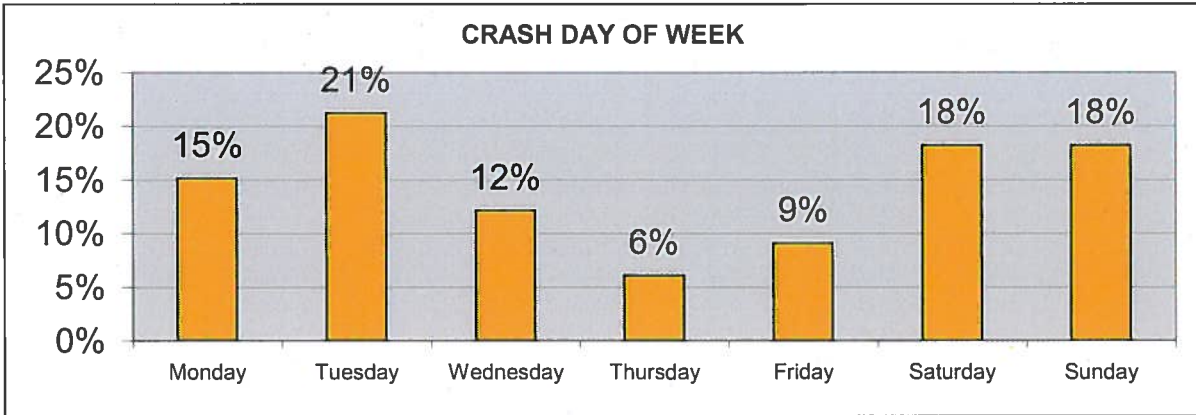
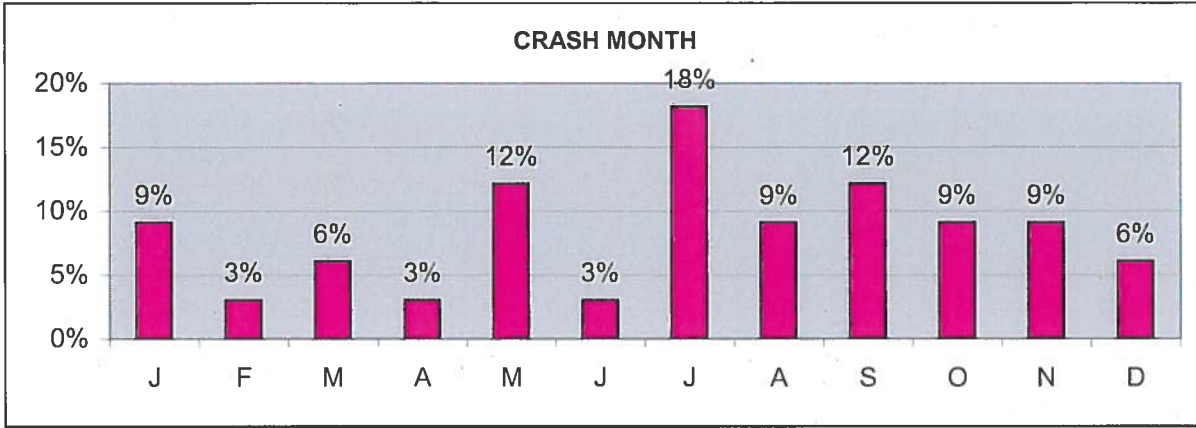
Intersection of Bedford St and Eldred St; Lexington, MA
September, 17, 2008 - September 13, 2011

Crash #	Crash Date	Time of Day	Manner of Collision	Light Condition	Weather Condition	Road Surface	Driver Contributing Code		Ages				Comments
							Type	Type	D1	D2	D3	D4	
1	9/17/08	9:18 AM	Rear-end	Daylight	Clear	Dry	Other improper action		52	45			Possible slippery conditions. Also, his first day driving 6 wheel cube van. Traffic officer was on duty at 420 Bedford St exit.
2	9/24/08	4:59 PM	Rear-end	Other	Cloudy	Wet	No Improper Driving		20	50			Disregarded No Left Turn Between 7AM-9AM sign
3	10/5/08	1:40 PM	Angle	Daylight	Clear	Dry	Other improper action		41	44			
4	10/10/08	8:32 AM	Angle	Daylight	Clear	Dry	Made an improper turn		46	47			
5	11/25/08	5:40 PM	Rear-end	Dark - lighted roadway	Rain	Wet	Operating Vehicle in erratic, reckless, careless, negligent, or aggressive manner		23	43			
6	3/26/09	1:58 PM	Angle	Daylight	Clear	Dry	No Improper Driving		42	unk			
7	4/6/09	5:40 PM	Sideswipe, same direction	Daylight	Rain	Wet	Disregarded traffic signs, signals, road markings		61	67			
8	7/7/09	2:46 PM	Angle	Daylight	Rain	Wet	Inattention		34	29			
9	7/18/09	5:27 PM	Angle	Daylight	Clear	Dry	Other improper action		44	19			
10	8/21/09	8:40 AM	Rear-end	Daylight	Clear	Dry	Other improper action		61	43	44		
11	9/30/09	8:51 AM	Angle	Daylight	Cloudy	Dry	Disregarded traffic signs, signals, road markings		33	78			Disregarded No Left Turn Between 7AM-9AM sign on Eldred St.
12	10/3/09	12:05 PM	Single Vehicle Crash	Daylight	Rain	Wet	Swerving or avoiding due to wind, slippery surface, vehicle, object, non-motors in roadway, etc.		65				Crashed into a telephone pole guide cable while swerving to avoid another vehicle.
13	11/14/09	7:19 PM	Angle	Dark - lighted roadway	Cloudy	Wet	Failed to yield to right of way		44	82			While V#1 attempting back up from #433 Bedford St drive-way, failed to use care backing
14	12/2/09	10:22 AM	Angle	Daylight	Cloudy	Dry	Failed to yield to right of way		34	49			
15	12/19/09	11:03 AM	Angle	Daylight	Cloudy	Dry	Failed to yield to right of way		62	56			
16	11/11/10	1:41 PM	Rear-end	Daylight	Clear	Dry	Followed too closely		37	67			
17	1/26/10	3:04 PM	Angle	Daylight	Cloudy	Dry	Failed to yield to right of way		27	50			
18	2/15/10	6:09 PM	Angle	Dark - lighted roadway	Clear	Dry	Failed to yield to right of way		27	85			
19	3/21/10	10:53 AM	Angle	Daylight	Clear	Dry	Failed to yield to right of way		39	49			V#2 tried to turn onto 420 Bedford St drive-way exit.
20	5/9/10	12:29 AM	Single Vehicle Crash	Dark - lighted roadway	Clear	Dry	Failure to keep in proper lane or running off road		32				For some unknown reason, operator lost control, went off road, struck Mass highway sign.
21	5/9/10	12:56 PM	Angle	Daylight	Clear	Dry	Operating Vehicle in erratic, reckless, careless, negligent, or aggressive manner		21	63			
22	5/18/10	8:55 PM	Rear-end	Dark - lighted roadway	Rain	Wet	Inattention		21	53			
23	7/1/10	9:01 AM	Single Vehicle Crash	Daylight	Clear	Dry	Failure to keep in proper lane or running off road		25				Cell phone distraction. Crashed into a telephone pole.
24	7/27/10	8:33 AM	Angle	Daylight	Clear	Dry	Disregarded traffic signs, signals, road markings		18	40			Disregarded No Left Turn Between 7AM-9AM sign on Eldred St.
25	8/16/10	10:07 PM	Rear-end	Dark - lighted roadway	Cloudy	Dry	Followed too closely		22	18			No left turn sign had been struck & was not present while vehicle was exiting 420 Bedford St drive-way.
26	8/22/10	2:22 PM	Angle	Daylight	Cloudy	Wet	Made an improper turn		18	38			Hlt and run
27	11/16/10	9:51 AM	Angle	Daylight	Cloudy	Wet	Failed to yield to right of way		38	unk			
28	1/16/11	12:35 PM	Rear-end	Daylight	Clear	Dry	Followed too closely		63	18			
29	5/9/11	5:08 PM	Rear-end	Daylight	Clear	Dry	Other improper action		62	26			A traffic officer was on duty at the 420 Bedford St drive-way exit.
30	6/22/11	3:53 PM	Rear-end	Daylight	Cloudy	Wet	Followed too closely		37	53			
31	7/1/11	3:34 PM	Angle	Daylight	Clear	Dry	Failed to yield to right of way		52	66			
32	7/23/11	8:11 PM	Angle	Dusk	Clear	Dry	Operating Vehicle in erratic, reckless, careless, negligent, or aggressive manner		62	82			
33	9/13/11	9:09 PM	Sideswipe, same direction	Dark - lighted roadway	Clear	Wet	Operating Vehicle in erratic, reckless, careless, negligent, or aggressive manner		61	43			

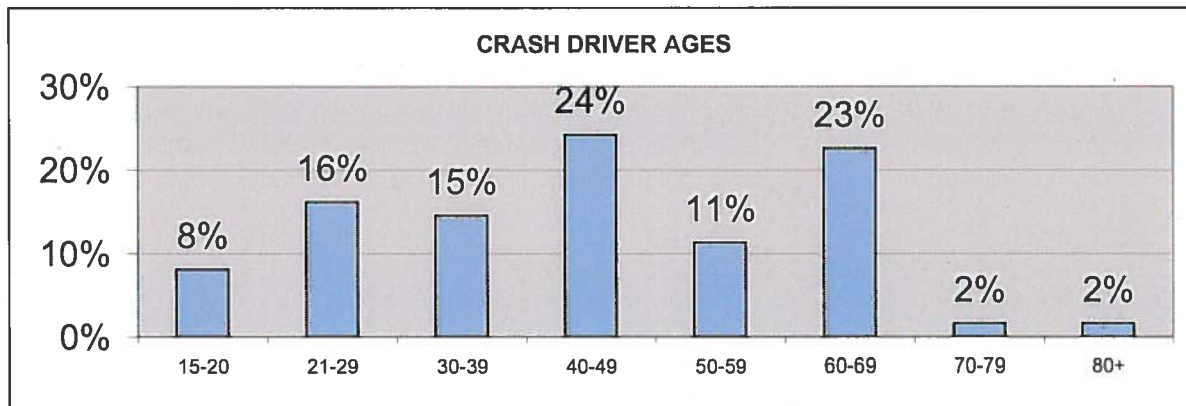
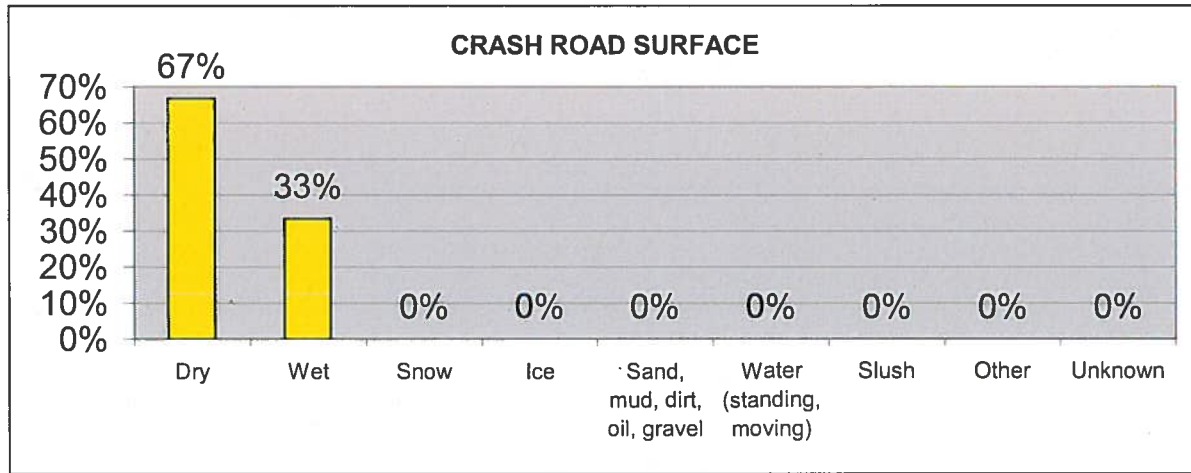
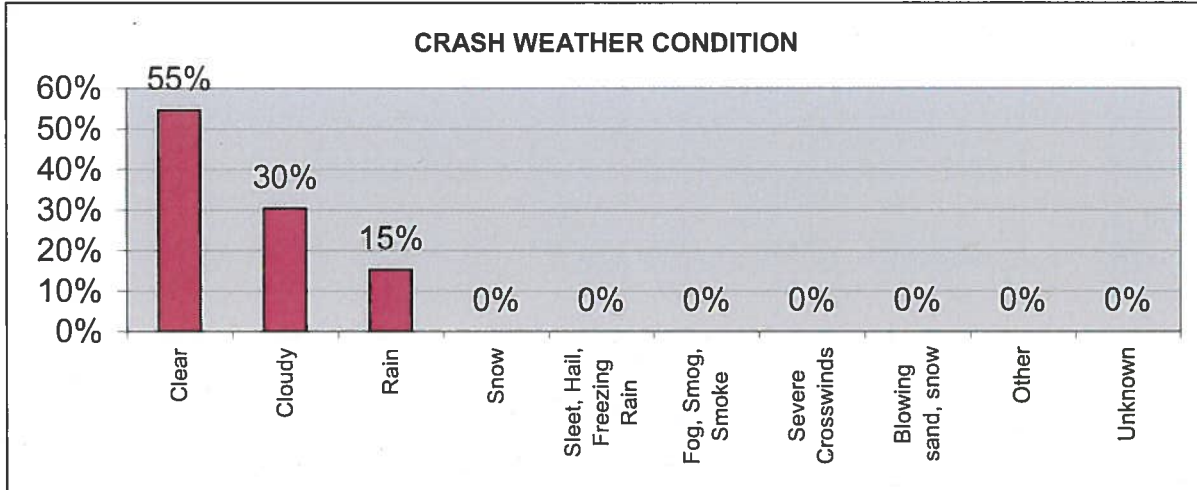
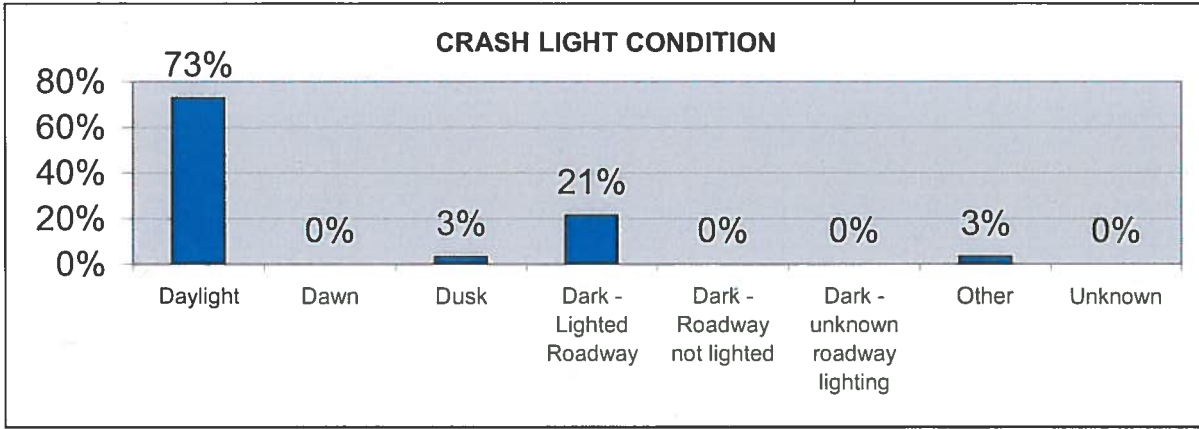
Out of Area

Summary based on Crash Reports obtained from the Lexington Police Department

Crash Data Summary Tables and Charts



Crash Data Summary Tables and Charts



COLLISION DIAGRAM

CITY/TOWN: LEXINGTON

DATE PREPARED: 11/14/2011

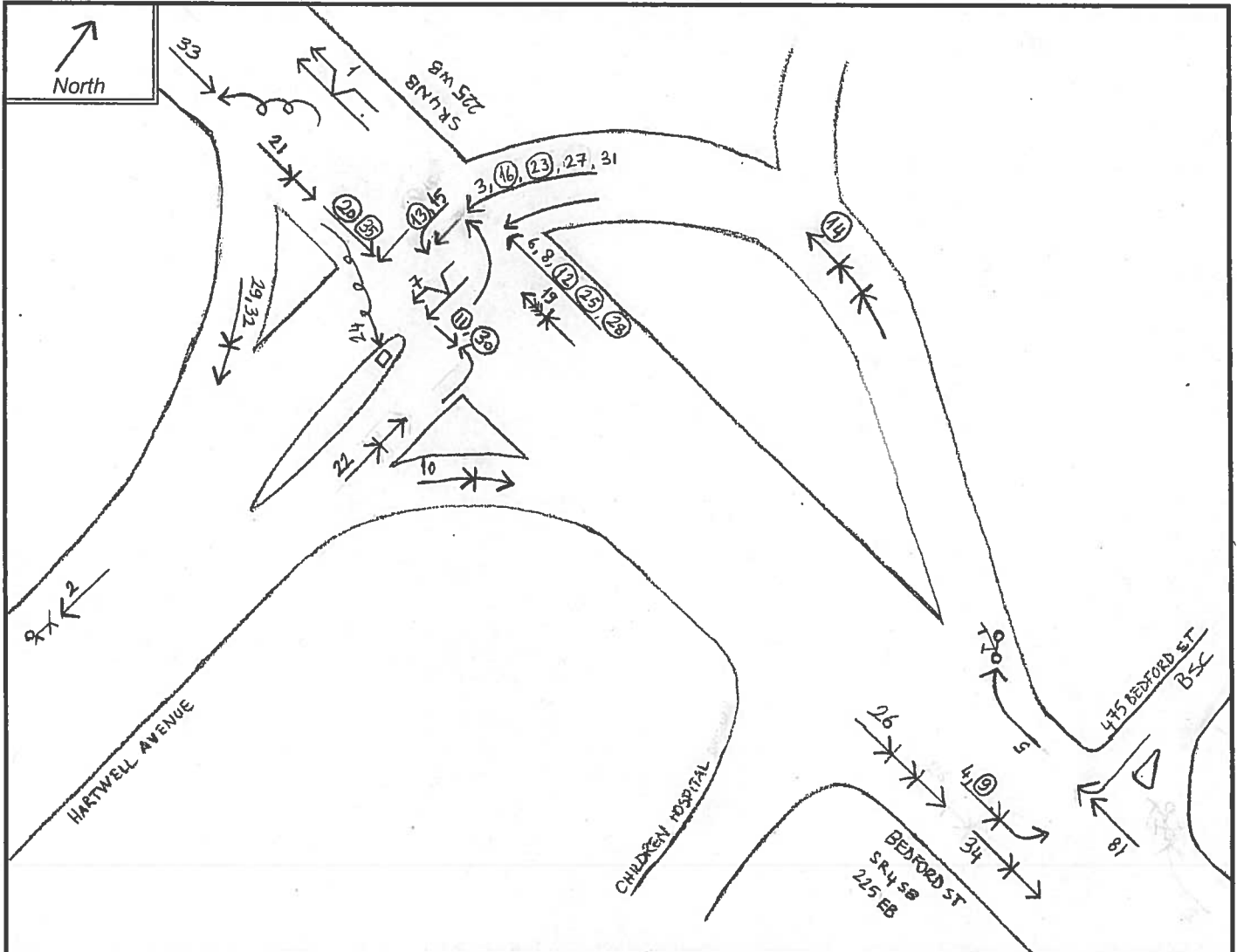
REGION: MARC

PREPARED BY: CANDAS ESIN

ROADWAY NAMES: BEDFORD ST AND HARTWELL AVENUE

TIME PERIOD ANALYZED: OCTOBER 3, 2008 - AUGUST 27, 2011

SOURCE OF CRASH REPORTS: LEXINGTON POLICE DEPARTMENT



SYMBOLS		TYPES OF CRASH		SEVERITY
	Moving Vehicle		Head On	
	Backing Vehicle		Angle	
	Non-Involved Vehicle		Turning Move	
	Pedestrian		Rear End	
	Parked Vehicle		Sideswipe	
	Fixed Object		Out of Control	
	Bicycle			
	Animal			

* Crash 17 could not be mapped.

Crash Data Summary Table

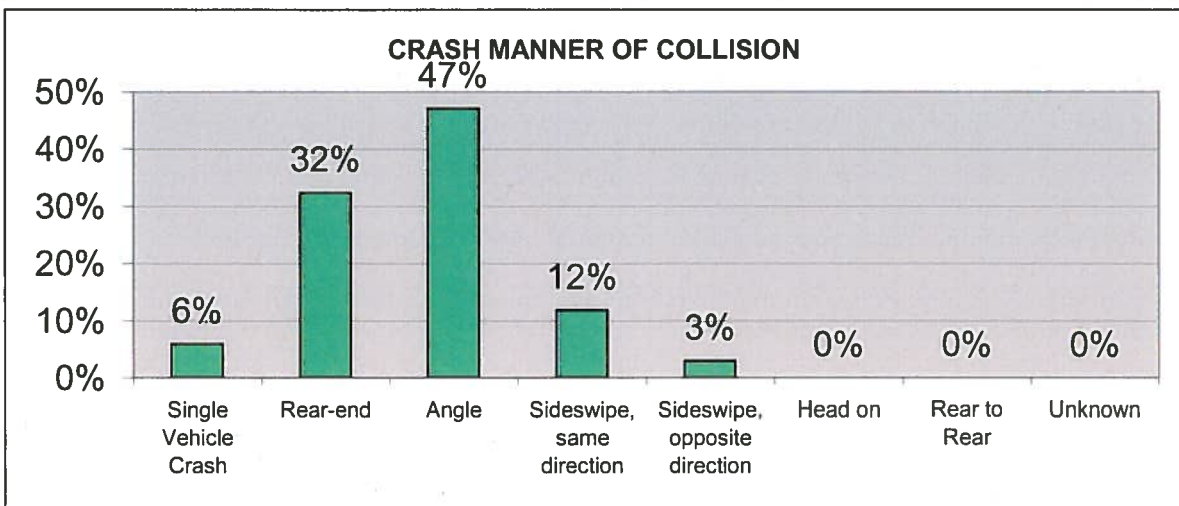
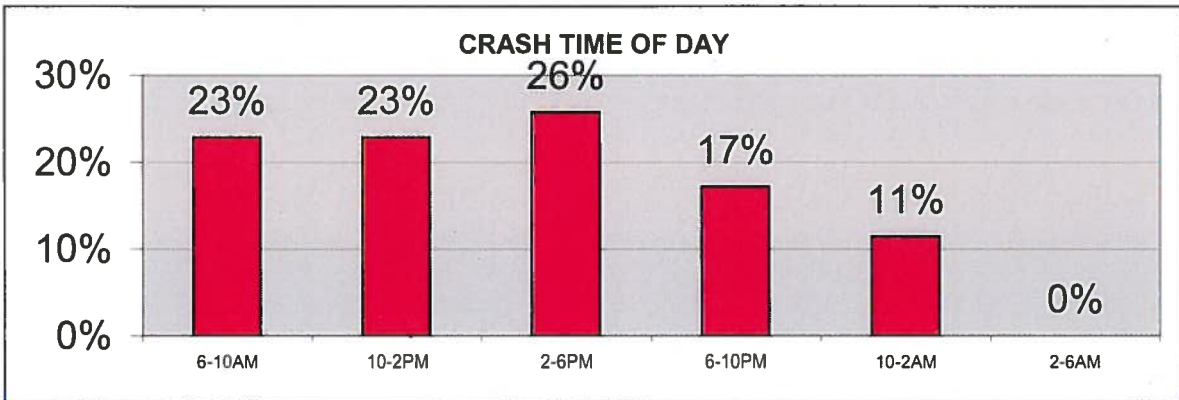
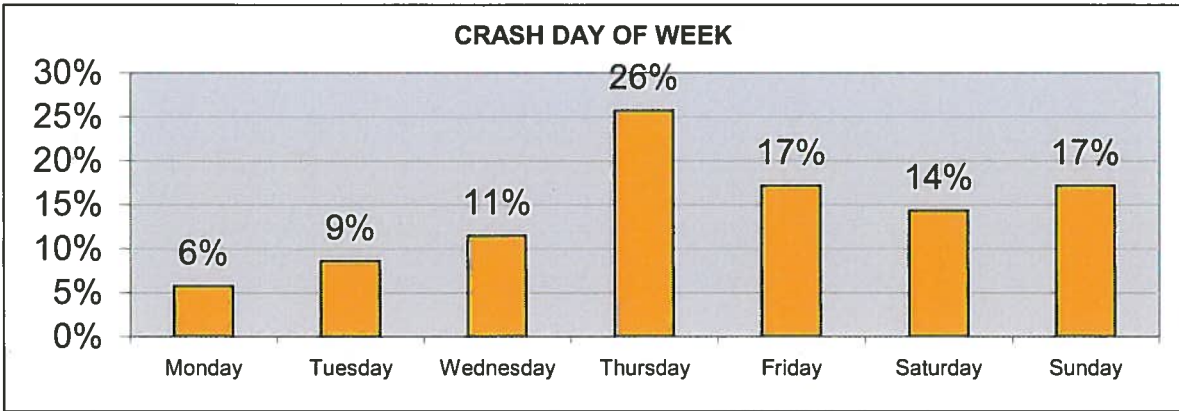
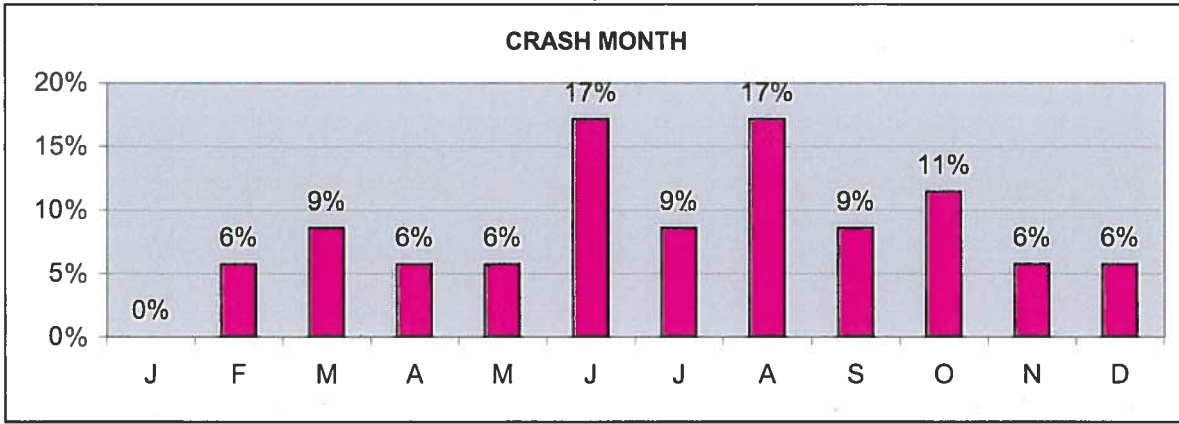
Intersection of Bedford St and Hartwell Ave; Lexington, MA
October 3, 2008 - August 27, 2011

Crash #	Crash Date	Crash Day	Time of Day	Manner of Collision	Light Condition	Weather Condition	Road Surface	Driver Contributing Code		Ages				Comments
								Type	Type	D1	D2	D3	D4	
1	10/3/08	Friday	5:20 PM	Sideswipe, same direction	Daylight	Clear	Dry	Failure to keep in proper lane or running off road		56	43			
2	11/20/08	Thursday	10:08 AM	Single Vehicle Crash	Daylight	Clear	Dry	No Improper Driving		42				Deer struck.
3	12/16/08	Thursday	11:42 AM	Angle	Daylight	Cloudy	Wet	Other improper action		60	34			
4	3/20/09	Friday	4:55 PM	Rear-end	Daylight	Clear	Dry	Other improper action		62	34			
5	3/31/09	Tuesday	8:55 AM	Angle	Daylight	Clear	Dry	No Improper Driving		55	37			Bicycle struck. Operator distracted by a cell phone conversation
6	4/11/09	Saturday	2:35 PM	Angle	Daylight	Rain	Wet	Cellular telephone		74	18			Hit and run.
7	5/14/09	Thursday	7:45 PM	Sideswipe, same direction	Dusk	Rain	Wet	Unknown		22	unk			Vehicle failed to slow or stop for red light.
8	6/19/09	Friday	9:15 PM	Angle	Dark - lighted roadway	Rain	Dry	Disregarded traffic signs, signals, road markings		45	unk			
9	6/21/09	Sunday	8:53 PM	Rear-end	Dark - lighted roadway	Rain	Wet	Operating Vehicle in erratic, reckless, careless, negligent, or aggressive manner		49	57			
10	7/21/09	Tuesday	11:27 PM	Rear-end	Dark - lighted roadway	Clear	Dry	Followed too closely		49	18			
11	8/2/09	Sunday	9:20 AM	Angle	Daylight	Clear	Dry	Disregarded traffic signs, signals, road markings		55	45			Both vehicle operators stated that they had green light.
12	8/30/09	Sunday	6:36 PM	Angle	Daylight	Clear	Dry	Disregarded traffic signs, signals, road markings		25	23	20	32	
13	9/12/09	Saturday	11:10 PM	Sideswipe, same direction	Dark - lighted roadway	Rain	Wet	Failed to yield to right of way		36	49			
14	9/18/09	Friday	1:24 PM	Rear-end	Daylight	Clear	Dry	Followed too closely		59	29	77		
15	10/26/09	Monday	4:30 PM	Sideswipe, same direction	Daylight	Clear	Dry	No Improper Driving		45				Hit and run.
16	11/15/09	Sunday	1:34 PM	Angle	Daylight	Cloudy	Dry	Failed to yield to right of way		44	17			
17	12/18/09	Friday	3:04 PM	Angle	Daylight	Cloudy	Dry	Operating Vehicle in erratic, reckless, careless, negligent, or aggressive manner		54	56			
18	4/6/10	Tuesday	6:27 AM	Angle	Daylight	Clear	Dry	careless, negligent, or aggressive manner		63	unk			Hit and run.
19	5/13/10	Thursday	12:00 PM	Rear-end	Daylight	Clear	Dry	Inattention						Traffic lights were not functioning properly.
20	6/7/10	Monday	6:01 AM	Angle	Daylight	Clear	Dry	Failed to yield to right of way		48	32			
21	7/23/10	Friday	3:53 PM	Rear-end	Daylight	Rain	Wet	Followed too closely		17	45			
22	8/4/10	Wednesday	5:06 PM	Rear-end	Daylight	Clear	Dry	Distractions		32	58			
23	8/5/10	Thursday	12:40 PM	Angle	Daylight	Clear	Dry	No Improper Driving		49	60			Crashed into a traffic light while swerving to avoid uninvolved vehicle. Operator went through a red light that he didn't see.
24	9/4/10	Saturday	12:47 PM	Single Vehicle Crash	Daylight	Clear	Dry	Disregarded traffic signs, signals, road markings		17				
25	10/21/10	Thursday	9:34 AM	Angle	Daylight	Cloudy	Dry	Disregarded traffic signs, signals, road markings		39	47			
26	10/28/10	Thursday	12:16 PM	Rear-end	Daylight	Cloudy	Dry	Swerving or avoiding due to wind, slippery surface, vehicle, object, non-motest in roadway, etc.		42	22	53		
27	2/3/11	Thursday	10:26 PM	Angle	Dark - lighted roadway	Cloudy	Dry	No Improper Driving		20	56			Officer stated that the operators did not see each other because of the extremely high snow banks on the road.
28	2/27/11	Sunday	3:00 PM	Angle	Daylight	Clear	Dry	Disregarded traffic signs, signals, road markings		39	33			Vehicle ran red light.
29	3/9/11	Wednesday	7:12 AM	Rear-end	Daylight	Clear	Dry	Other improper action		51	57			
30	6/19/11	Sunday	5:44 PM	Angle	Daylight	Clear	Dry	Inattention		24	77			Vehicle ran red light.
31	6/22/11	Wednesday	8:56 AM	Angle	Daylight	Cloudy	Dry	Failed to yield to right of way		47	20			
32	6/30/11	Thursday	7:30 AM	Rear-end	Daylight	Clear	Dry	Operating Vehicle in erratic, reckless, careless, negligent, or aggressive manner		31	32			
33	7/16/11	Saturday	9:14 PM	Sideswipe, opposite direction	Dark - roadway not lighted	Clear	Dry	Failure to keep in proper lane or running off road		49	25			Operator looked down at her cell phone for a moment and veered into oncoming traffic.
34	8/10/11	Wednesday	6:40 PM	Rear-end	Daylight	Clear	Dry	Operating Vehicle in erratic, reckless, careless, negligent, or aggressive manner		46	26			
35	8/27/11	Saturday	11:56 PM	Angle	Dark - lighted roadway	Rain	Wet	Disregarded traffic signs, signals, road markings		27	34	24		Vehicle ran red light.

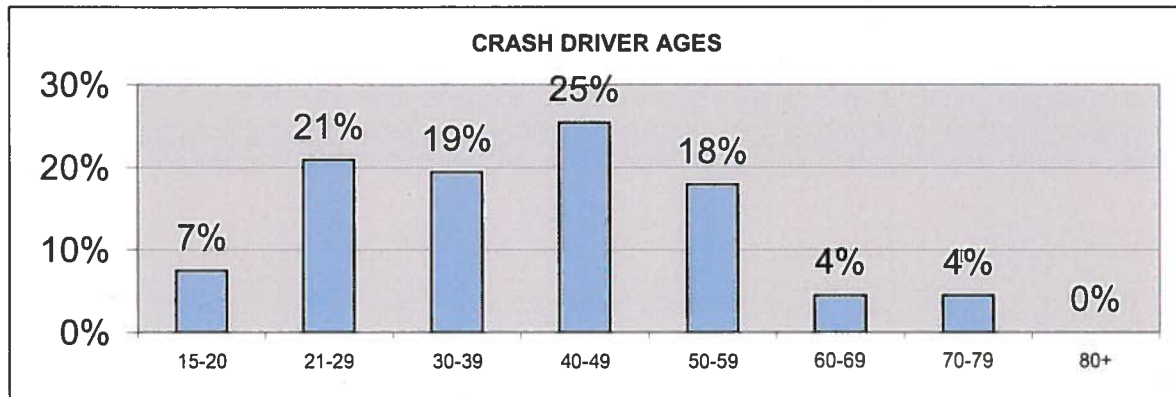
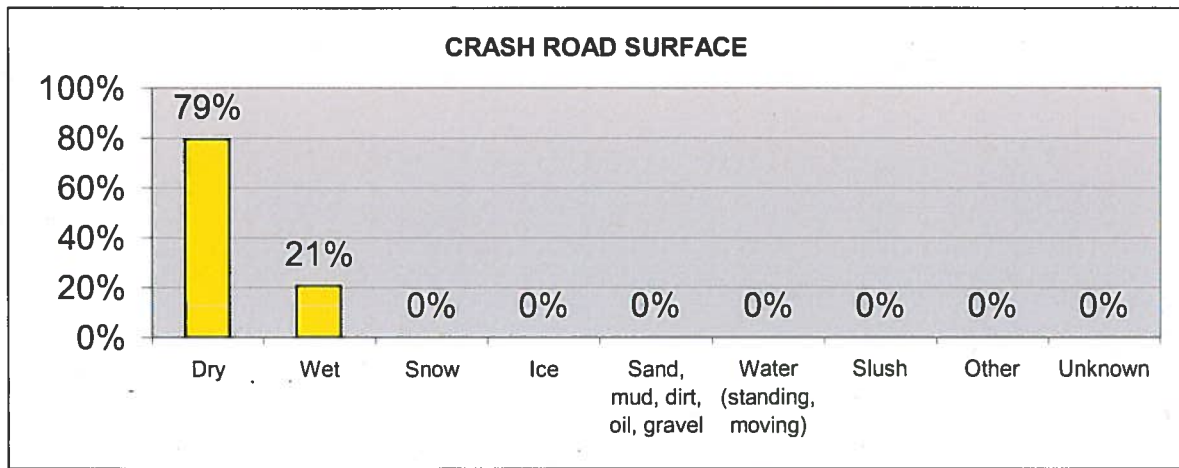
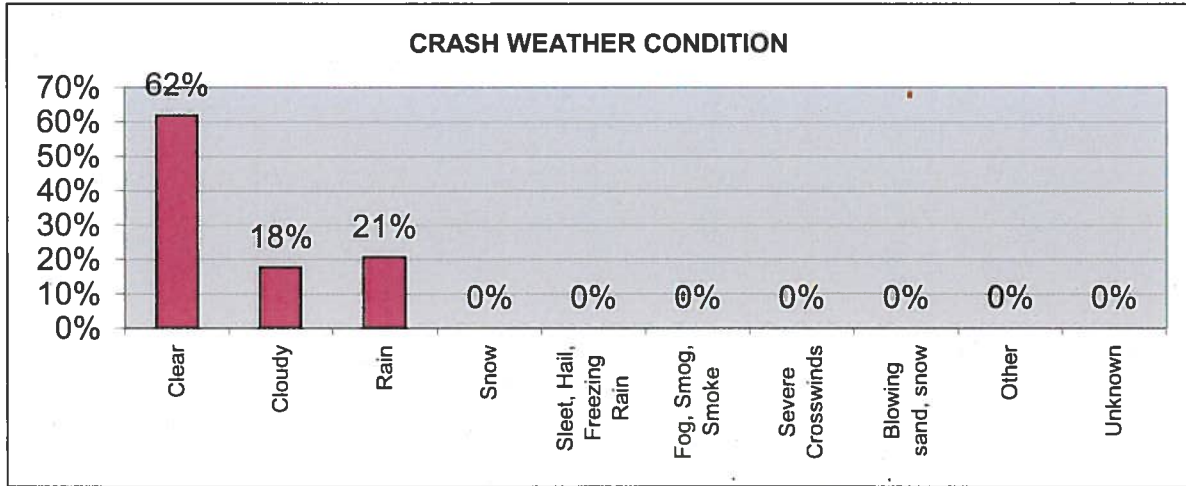
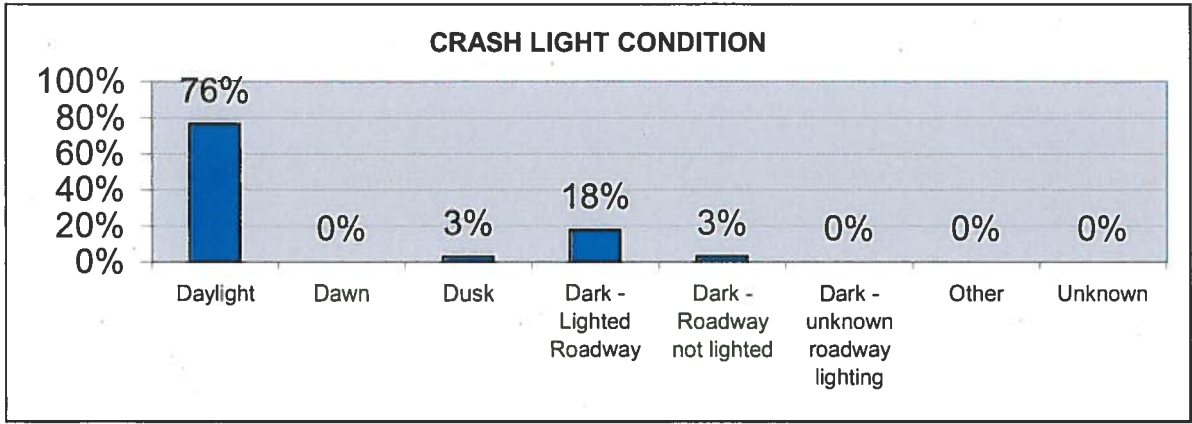
Out of Area

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

Crash Data Summary Tables and Charts



Crash Data Summary Tables and Charts



COLLISION DIAGRAM

CITY/TOWN : LEXINGTON

DATE PREPARED: 11/14/2011

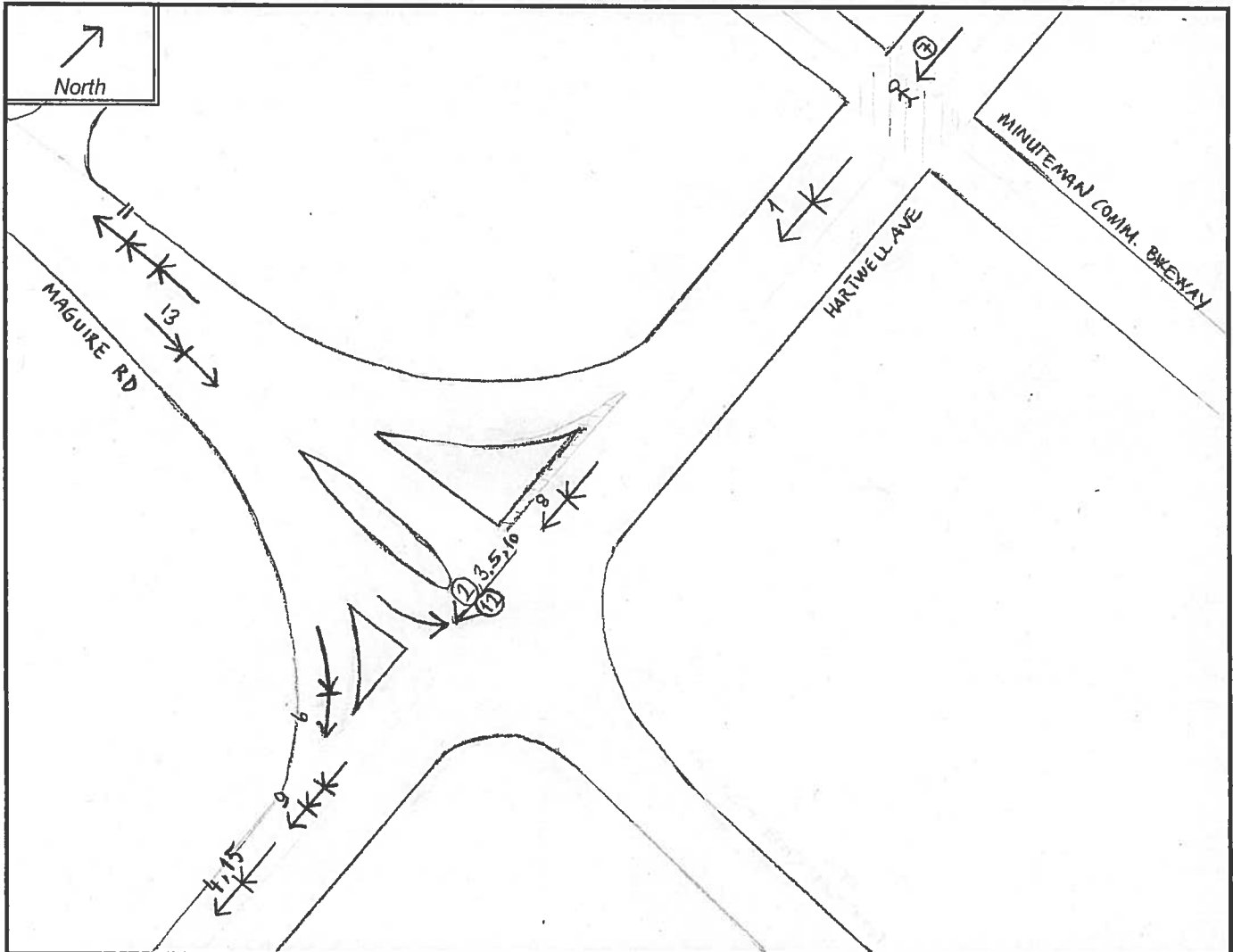
REGION: MAPC














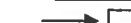


PREPARED BY: CANDAS ESIN

ROADWAY NAMES: HARTWELL AVENUE AND MAGUIRE ROAD

TIME PERIOD ANALYZED: OCTOBER 27, 2008 - APRIL 14, 2011

SOURCE OF CRASH REPORTS: LEXINGTON POLICE DEPARTMENT



SYMBOLS	TYPES OF CRASH	SEVERITY
 Moving Vehicle	 Head On	
 Backing Vehicle	 Angle	
 Non-Involved Vehicle	 Turning Move	 Injury Accident
 Pedestrian	 Rear End	
 Parked Vehicle	 Sideswipe	
 Fixed Object	 Out of Control	
 Bicycle		 Fatal Accident
 Animal		

CRASH #14 could not be mapped-

Crash Data Summary Table

Intersection of Hartwell Ave and Maguire Rd; Lexington, MA

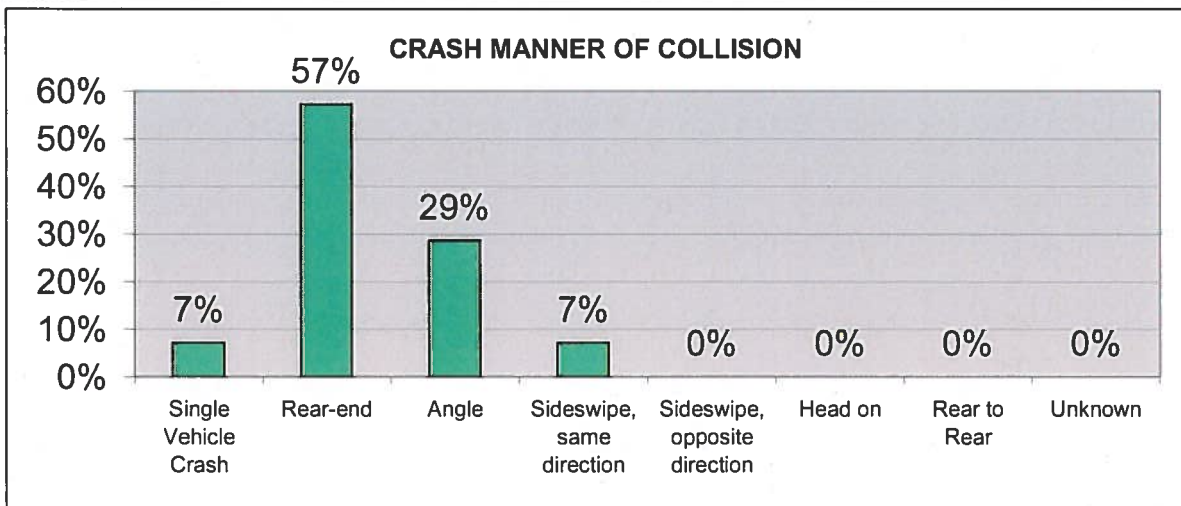
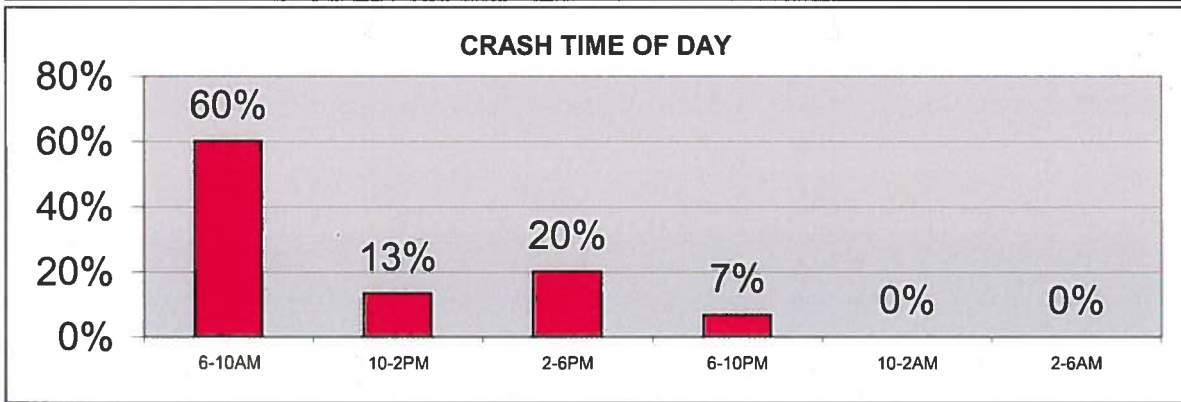
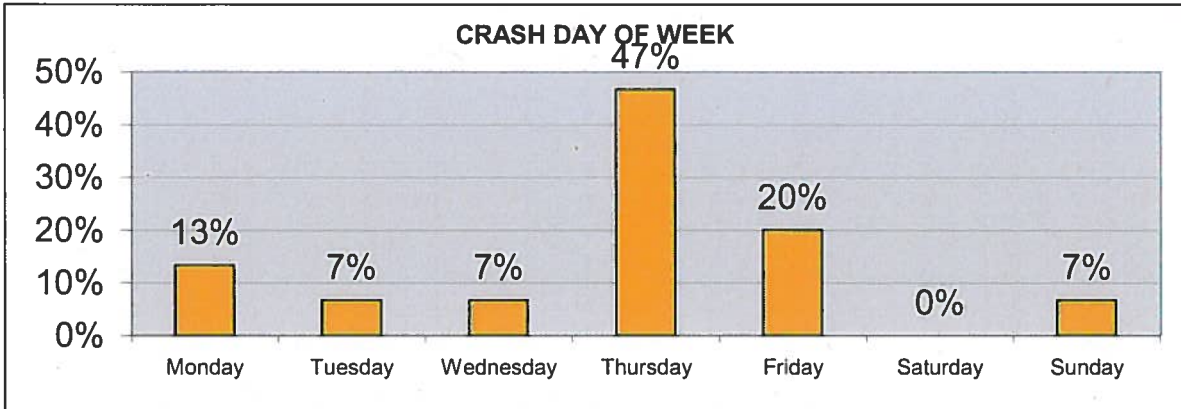
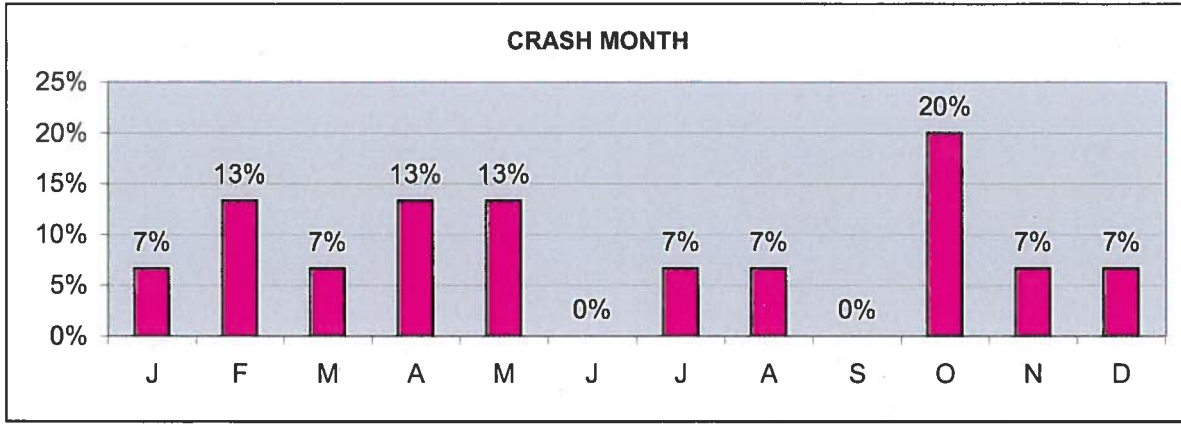
October 27, 2008 - April 14, 2011

Crash #	Crash Date	Crash Day	Time of Day	Manner of Collision	Light Condition	Weather Condition	Road Surface	Driver Contributing Code	Ages				Comments
									D1	D2	D3	D4	
1	10/27/08	Monday	7:42 AM	Rear-end	Daylight	Clear	Dry	Other improper action	61	43			
2	1/9/09	Friday	5:12 PM	Sideswipe, same direction	Dark - lighted roadway	Clear	Dry	Failed to yield to right of way	22	30			Operating vehicle without license.
3	5/28/09	Thursday	5:34 PM	Angle	Daylight	Cloudy	Wet	Failed to yield to right of way	21	46			
4	5/29/09	Friday	7:52 AM	Rear-end	Daylight	Clear	Dry	Inattention	43	31			
5	7/12/09	Sunday	7:15 AM	Angle	Daylight	Clear	Dry	Other improper action	21	42			
6	8/31/09	Monday	8:55 AM	Rear-end	Daylight	Clear	Dry	Inattention	46	41			Pedestrian struck at bike trail crossing. Pedestrian light in place but never activated by pedestrian.
7	2/5/10	Friday	7:35 PM	Single Vehicle Crash	Dark - lighted roadway	Cloudy	Dry	No Improper Driving	21	59			
8	2/11/10	Thursday	6:58 AM	Rear-end	Daylight	Clear	Dry	Operating Vehicle in erratic, reckless, careless, negligent, or aggressive manner	22	65			
9	3/25/10	Thursday	8:27 AM	Rear-end	Daylight	Clear	Dry	Followed too closely	44	28	62		
10	4/27/10	Tuesday	5:15 PM	Angle	Daylight	Rain	Wet	Failed to yield to right of way	17	30			
11	10/7/10	Thursday	8:00 AM	Rear-end	Daylight	Cloudy	Dry	Other improper action	34	38	60		
12	10/28/10	Thursday	1:45 PM	Angle	Daylight	Clear	Dry	Other improper action	33	24			Operator claims that he couldn't see clearly due to rain.
13	11/17/10	Wednesday	8:00 AM	Rear-end	Daylight	Rain	Wet	Other improper action	35	34			
14	12/16/10	Thursday	8:00 AM	Rear-end	Daylight	Clear	Dry	No Improper Driving	19	37			
15	4/14/11	Thursday	12:15 PM	Rear-end	Daylight	Clear	Dry	No Improper Driving					

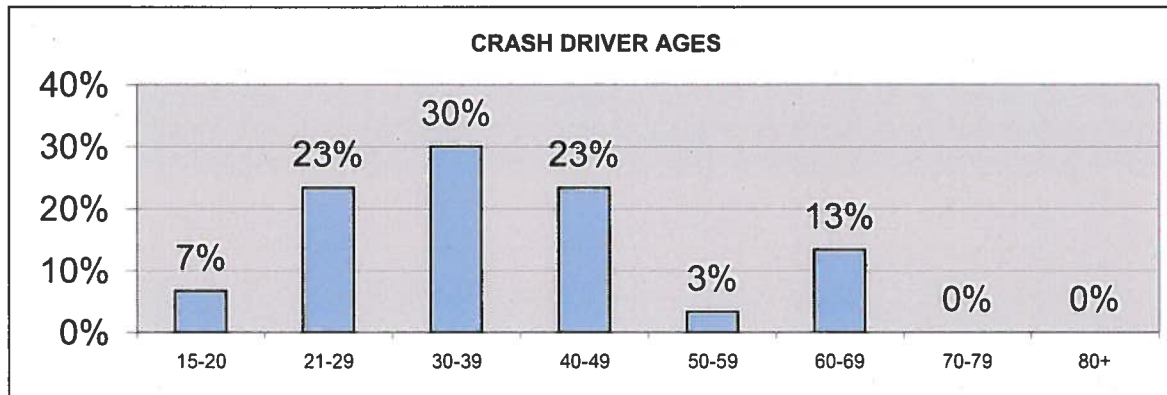
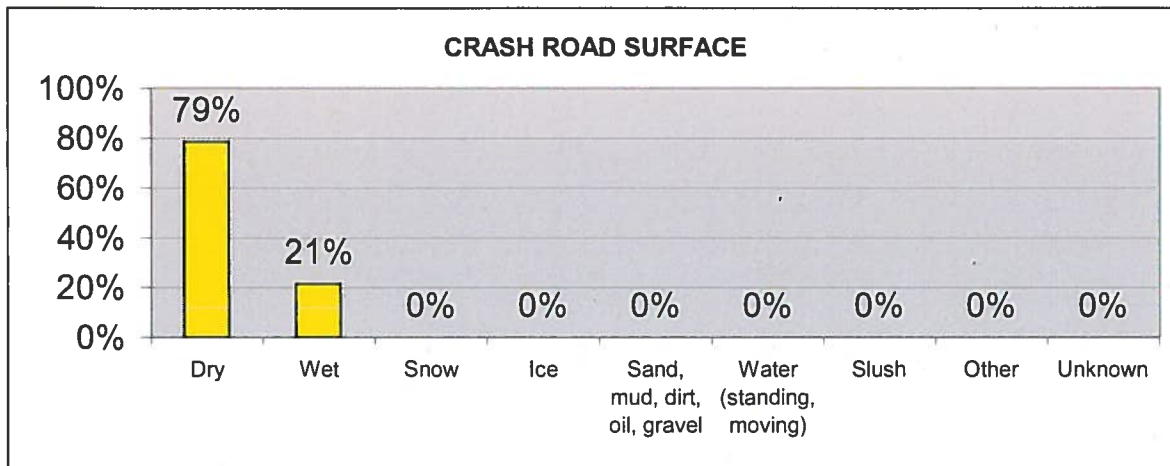
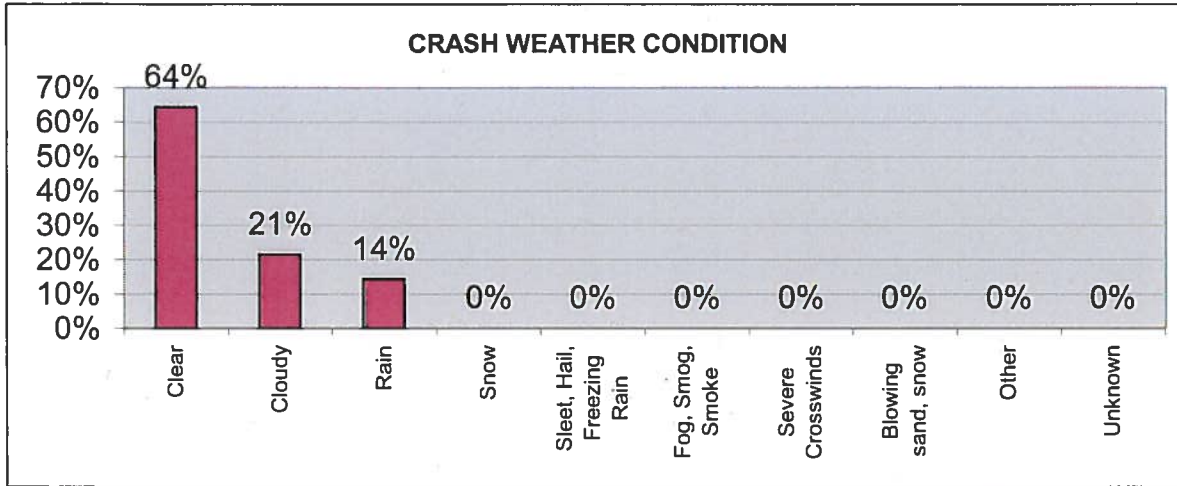
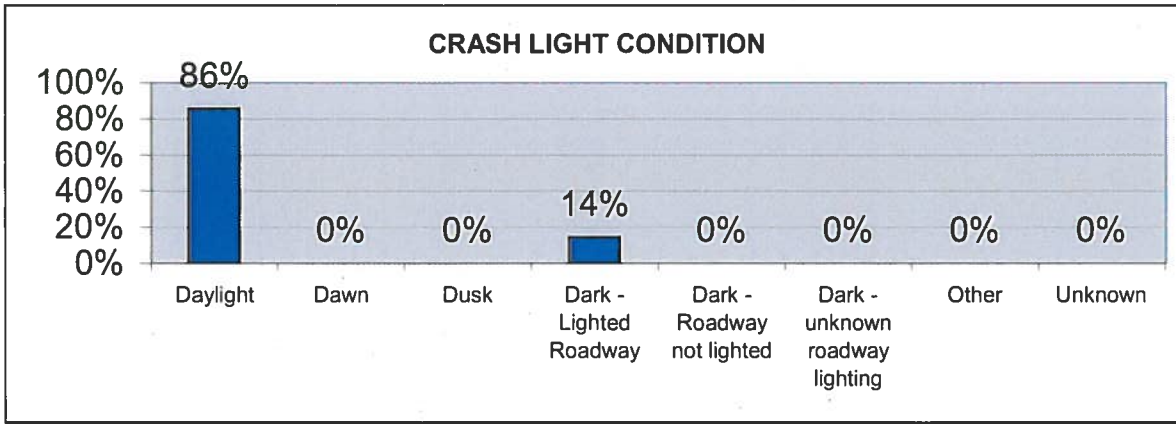
Out of Area

Summary based on Crash Reports obtained from the Lexington Police Department

Crash Data Summary Tables and Charts



Crash Data Summary Tables and Charts



COLLISION DIAGRAM

CITY/TOWN: LEXINGTON

DATE PREPARED: 11/14/2011

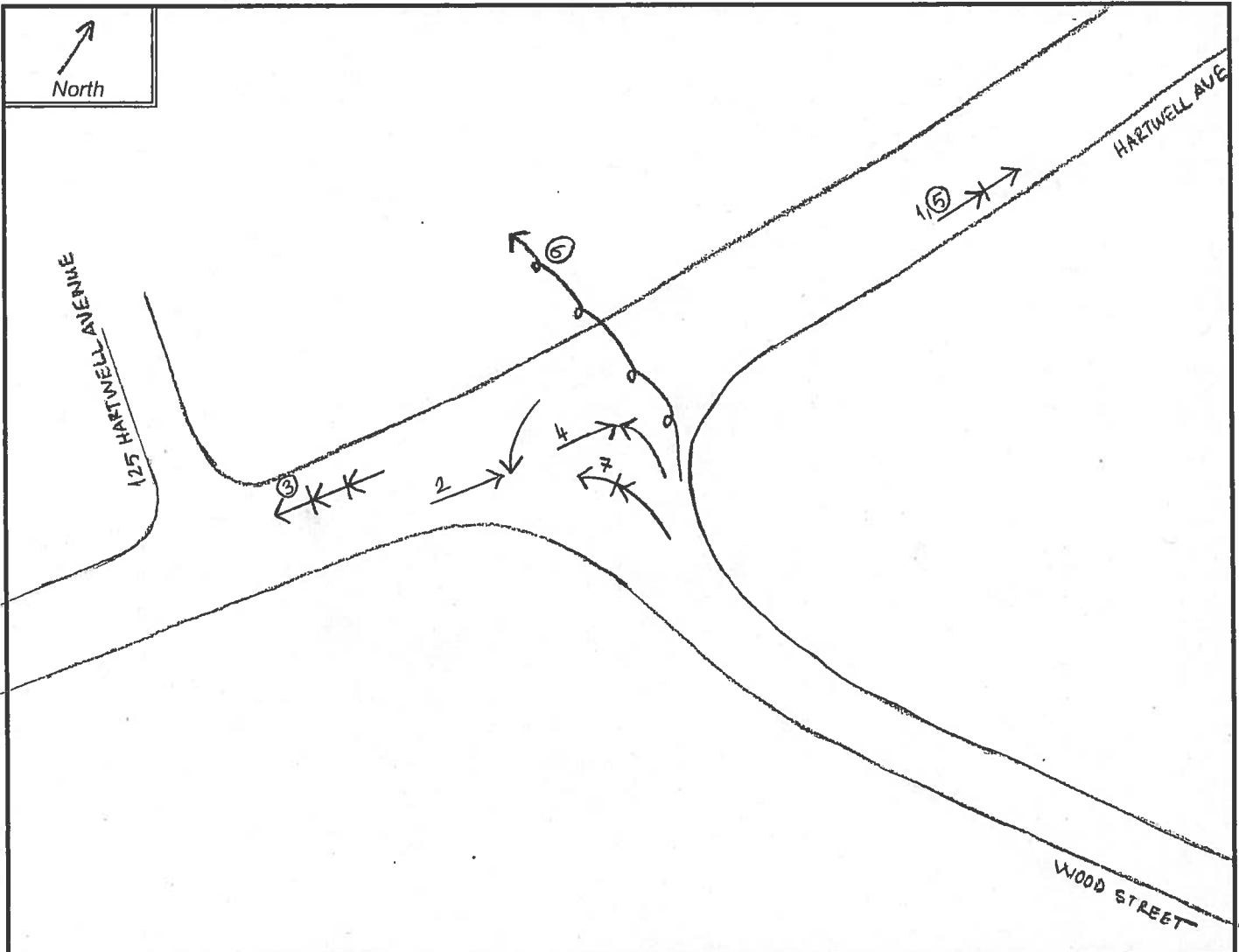
REGION: MAPC

PREPARED BY: CANDAS ESIN

ROADWAY NAMES: HARTWELL AVE AND WOOD ST

TIME PERIOD ANALYZED: NOVEMBER 20, 2008 - SEPTEMBER 29, 2011

SOURCE OF CRASH REPORTS: LEXINGTON POLICE DEPARTMENT



SYMBOLS	TYPES OF CRASH	SEVERITY

Crash Data Summary Table

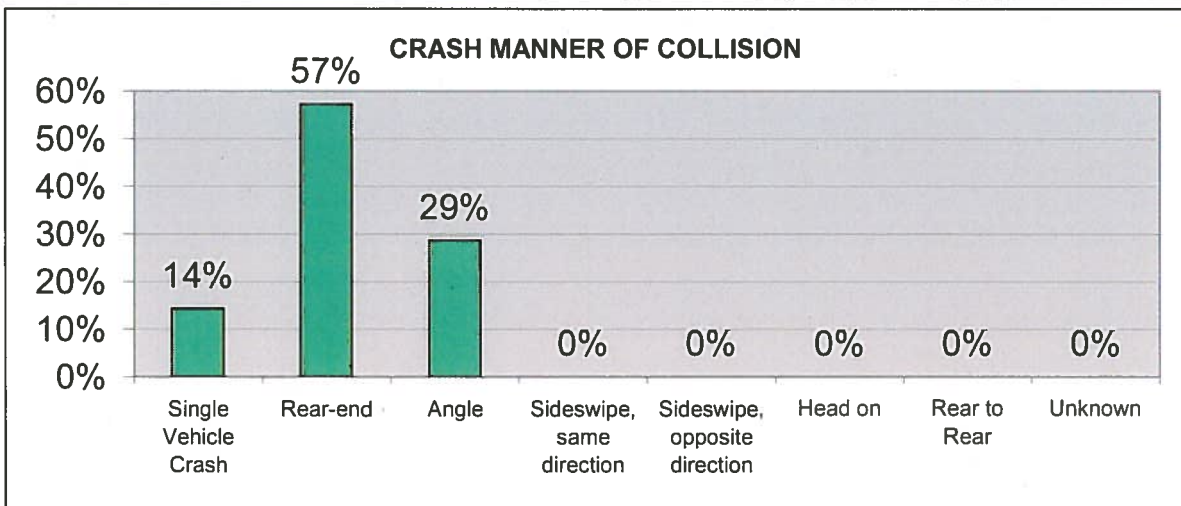
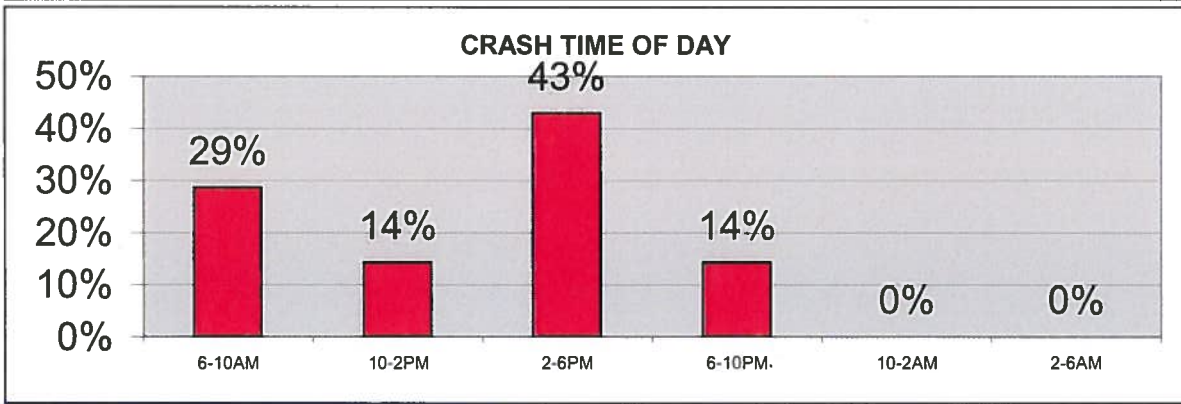
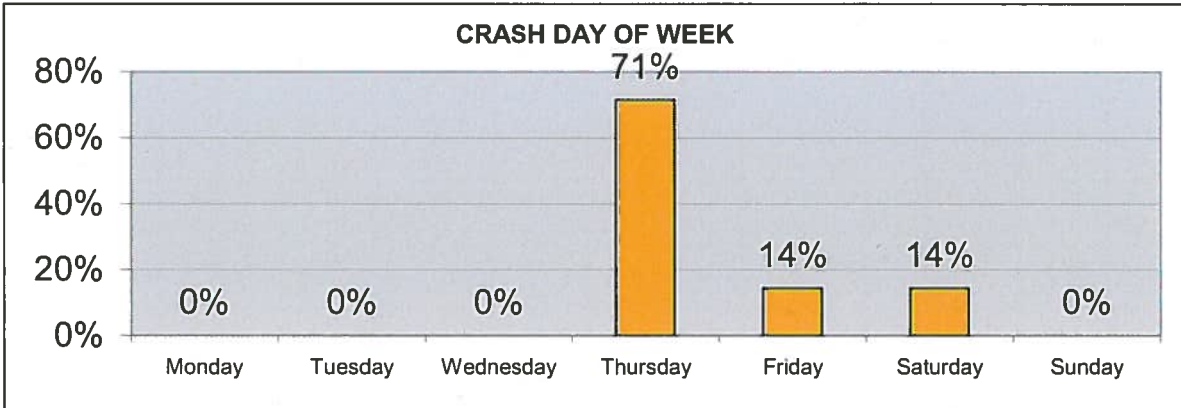
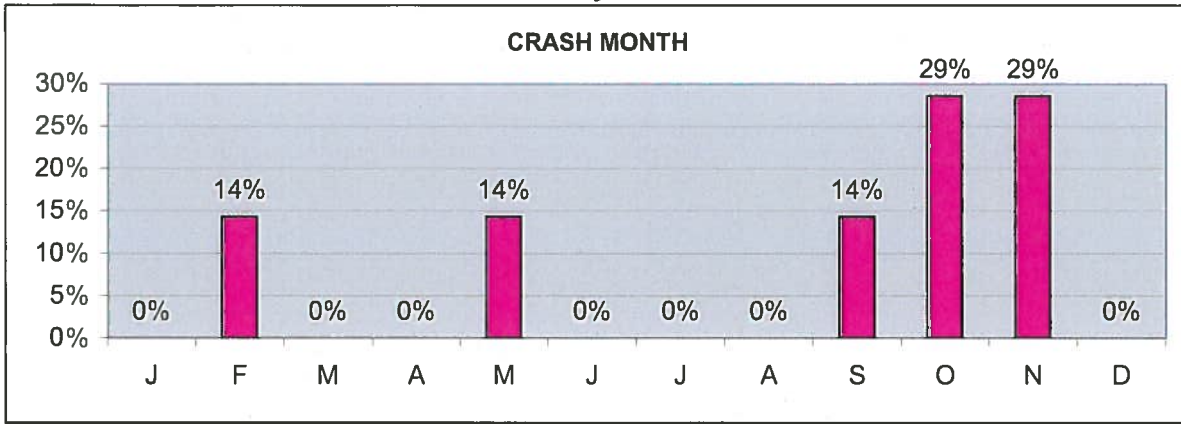
Intersection of Hartwell Ave and Wood St: Lexington, MA
November 20, 2008 - September 29, 2011

Crash #	Date	Crash Day	Time of Day	Manner of Collision	Light Condition	Weather Condition	Road Surface	Driver Contributing Code	Ages				Comments
									D1	D2	D3	D4	
1	11/20/08	Thursday	5:12 PM	Rear-end	Dark - roadway not lighted	Clear	Dry	Operating Vehicle in erratic, reckless, careless, negligent, or aggressive manner	54	48			Operator stated she was tired and not paying attention
2	2/26/09	Thursday	6:19 PM	Angle	Dark - lighted roadway	Cloudy	Wet	Unknown	42	42			Operator stated that he was trying to get out of the way of an oncoming fire engine on Hartwell Ave.
3	5/15/09	Friday	8:04 AM	Rear-end	Daylight	Clear	Dry	Other improper action	20	50	41		
4	10/8/09	Thursday	8:09 AM	Angle	Daylight	Clear	Dry	Failed to yield to right of way	62	25			
5	11/12/09	Thursday	4:55 PM	Rear-end	Dark - lighted roadway	Clear	Dry	Followed too closely	59	43			
6	10/2/10	Saturday	3:11 PM	Single Vehicle Crash	Daylight	Clear	Dry	Operating defective equipment	56				Brake failure and unlicensed operation.
7	9/29/11	Thursday	1:34 PM	Rear-end	Daylight	Rain	Wet	Other improper action	26	49			

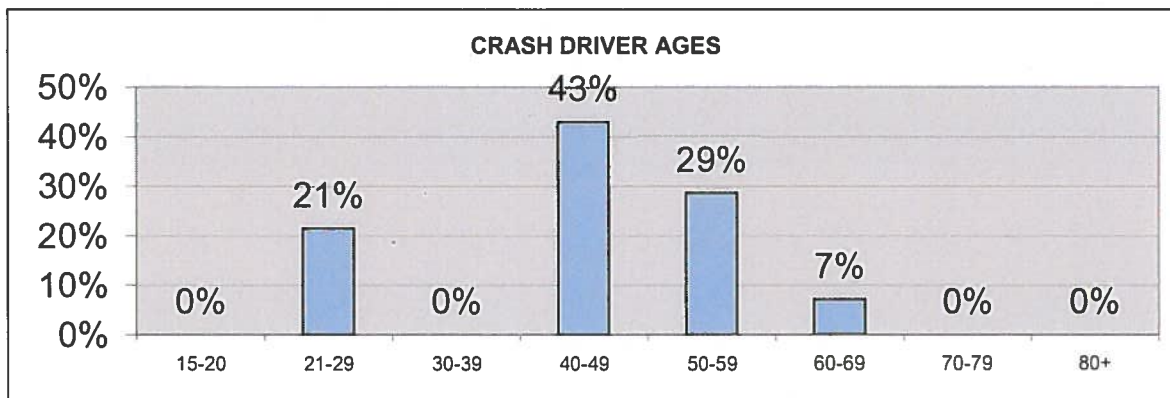
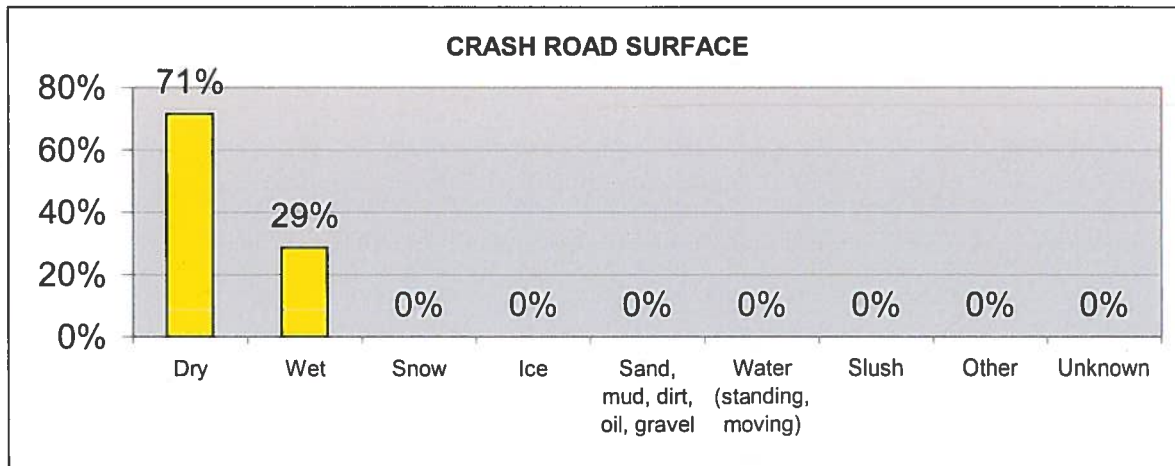
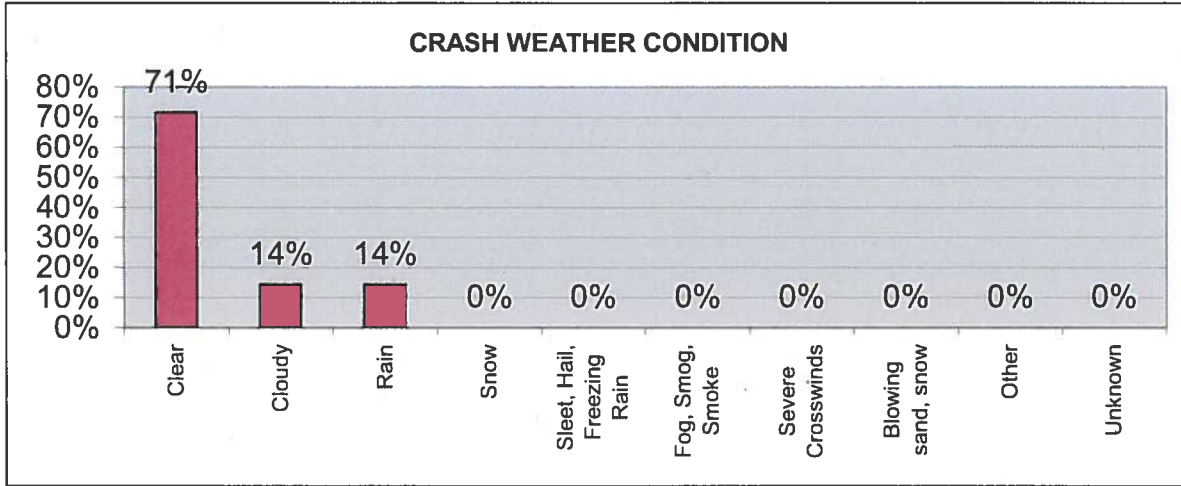
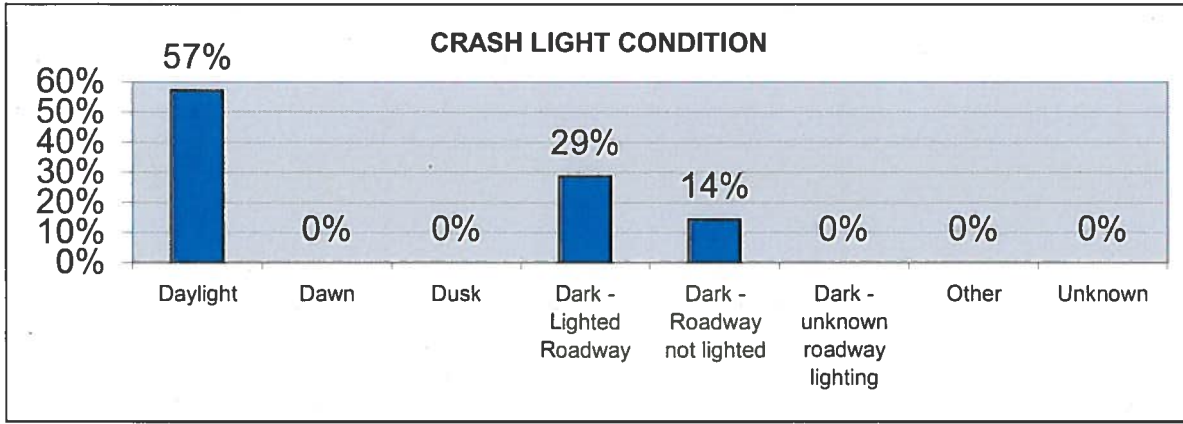
Out of Area

Summary based on Crash Reports obtained from the Lexington Police Department

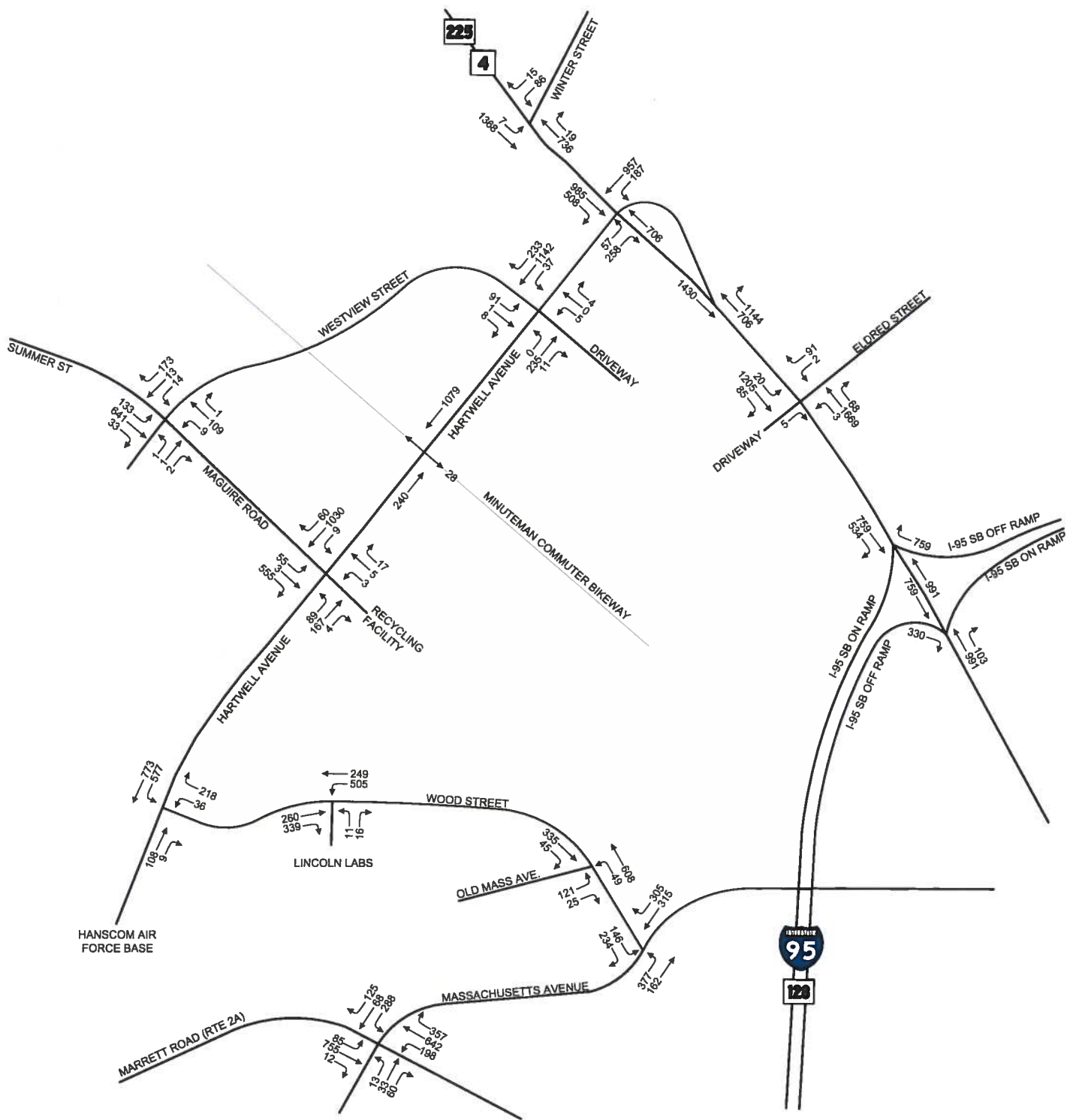
Crash Data Summary Tables and Charts



Crash Data Summary Tables and Charts



Appendix D. Additional Information



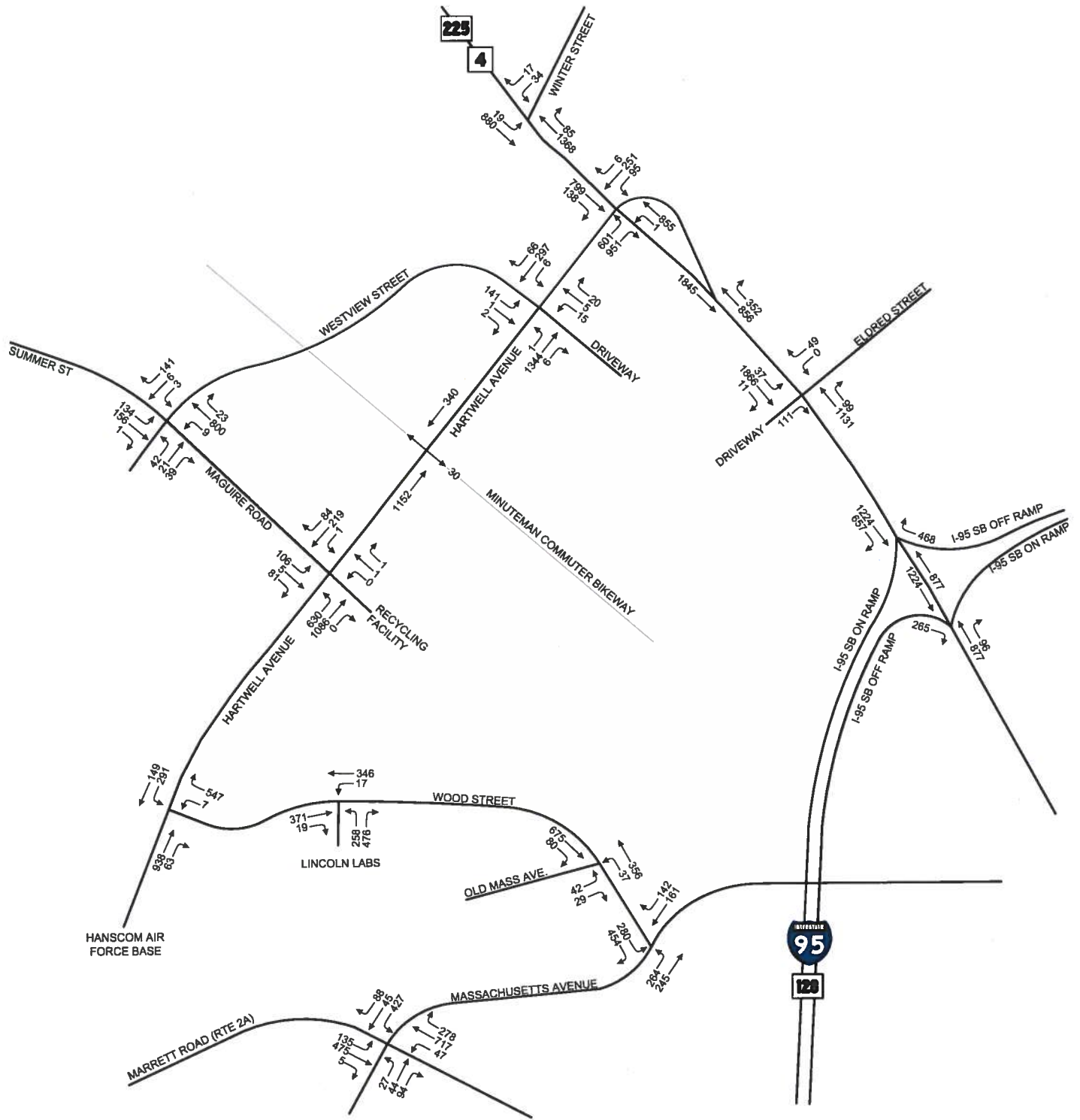
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Not to Scale

Hartwell Avenue Traffic Mitigation Plan
Lexington, Massachusetts

Existing Morning Peak Hour Traffic Volumes

Sept. 2009





Not to Scale

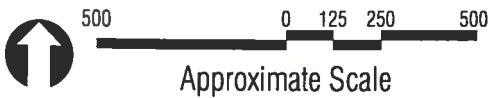


Hartwell Avenue Traffic Mitigation Plan
Lexington, Massachusetts

Existing Afternoon
Peak Hour Traffic Volumes

Sept 2009

Figure 7



Hartwell Avenue Traffic Mitigation Plan
Lexington, Massachusetts

Relative Afternoon Peak Hour
Traffic Volumes

THE COMMONWEALTH OF MASSACHUSETTS

DEPARTMENT OF PUBLIC WORKS

SPECIAL REGULATION GOVERNING THE SPEED OF MOTOR VEHICLES ONTOWN WAYS, IN THE TOWN OF LEXINGTON

June 16, 1965

SPECIAL SPEED REGULATION NO. 291

Highway Location: LEXINGTON

Authority in Control: TOWN OF LEXINGTON

Name of Highways: REED STREET, SIMONDS ROAD, ELDRED STREET, WORTHEN ROAD,
CONCORD AVENUE AND WINCHESTER DRIVE

In accordance with the provisions of Section 18 of Chapter 90 of the General Laws (Ter. Ed.), as amended by Section 2 of Chapter 564 of the Acts of 1948, the following Special Speed Regulation is hereby made by the Department of Public Works and the Registrar of Motor Vehicles, acting jointly, and shall be effective immediately upon compliance with the applicable provisions of the above-referenced Section 2.

The following designated speed limits are established at which motor vehicles may be operated in the areas described:

REED STREET - NORTHBOUND

Beginning at Bedford Street,
 thence northerly 0.08 miles at 25 miles per hour
 thence 0.68 " " 35 " " " " ending at Centre Street;
 the total distance being 0.76 miles.

REED STREET - SOUTHBOUND

Beginning at Centre Street,
 thence southerly 0.68 miles at 35 miles per hour
 thence 0.08 " " 25 " " " " ending at Bedford Street;
 the total distance being 0.76 miles.

SIMONDS ROAD - EASTBOUND

Beginning at Bedford Street,
 thence easterly 0.36 miles at 30 miles per hour
 thence 0.19 " " 20 " " " " ending at Burlington
 Street; the total distance being 0.55 miles.

SIMONDS ROAD - WESTBOUND

Beginning at Burlington Street,
 thence westerly 0.19 miles at 20 miles per hour
 thence 0.36 " " 30 " " " " ending at Bedford Street;
 the total distance being 0.55 miles.

ELDRED STREET - EASTBOUND

Beginning at Bedford Street,
thence easterly 0.45 miles at 30 miles per hour
the total distance being 0.45 miles.

ending at Grove Street;

ELDRED STREET - WESTBOUND

Beginning at Grove Street,
thence westerly 0.45 miles at 30 miles per hour
the total distance being 0.45 miles.

ending at Bedford Street;

WORTHEN ROAD - NORTHBOUND

Beginning at Sherburne Road,
thence northerly 0.18 miles at 25 miles per hour
thence 0.26 " " 30 " " "
" 0.52 " " 35 " " "
" 0.44 " " 30 " " "
the total distance being 1.40 miles.

ending at Bedford Street;

WORTHEN ROAD - SOUTHBOUND

Beginning at Bedford Street,
thence southerly 0.44 miles at 30 miles per hour
thence 0.52 " " 35 " " "
" 0.26 " " 30 " " "
" 0.18 " " 25 " " "
the total distance being 1.40 miles.

ending at Sherburne Road;

CONCORD AVENUE - EASTBOUND

Beginning at Cambridge-Concord Highway Route 2,
thence easterly 0.81 miles at 35 miles per hour
thence 0.16 " " 30 " " "
" 0.87 " " 35 " " "
" 0.41 " " 40 " " "
Town Line; the total distance being 2.25 miles.

ending at the Belmont

CONCORD AVENUE - WESTBOUND

Beginning at the Belmont Town Line,
thence westerly 0.41 miles at 40 miles per hour
thence 0.87 " " 35 " " "
" 0.16 " " 30 " " "
" 0.81 " " 35 " " "
Concord Highway, Route 2; the total distance being 2.25 miles.

ending at the Cambridge-

WINCHESTER DRIVE - EASTBOUND

Beginning at Lowell Street, Route 2A,
thence easterly 0.06 miles at 30 miles per hour
thence 0.62 " " 35 " " "
Town Line; the total distance being 0.68 miles.

ending at the Winchester

WINCHESTER DRIVE - WESTBOUND

Beginning at the Winchester Town Line,
thence westerly in Lexington
0.62 miles at 35 miles per hour
thence 0.06 " " 30 " " "
Route 2A; the total distance being 0.68 miles.

ending at Lowell Street.

Operation of a motor vehicle at a rate of speed in excess of these limits shall be prima facie evidence that such speed is greater than is reasonable and proper.

The provisions of this regulation shall not, however, abrogate in any sense Section 14 of Chapter 90.

The Department of Public Works and the Registrar of Motor Vehicles, acting jointly, do hereby certify in writing that this regulation is consistent with the public interests.

Standard signs must be erected at the beginning of each zone.

DEPARTMENT OF PUBLIC WORKS

Anthony C. Rosselli

James D. Fitzgerald

John D. Warner

Richard E. McLaughlin
Registrar of Motor Vehicles