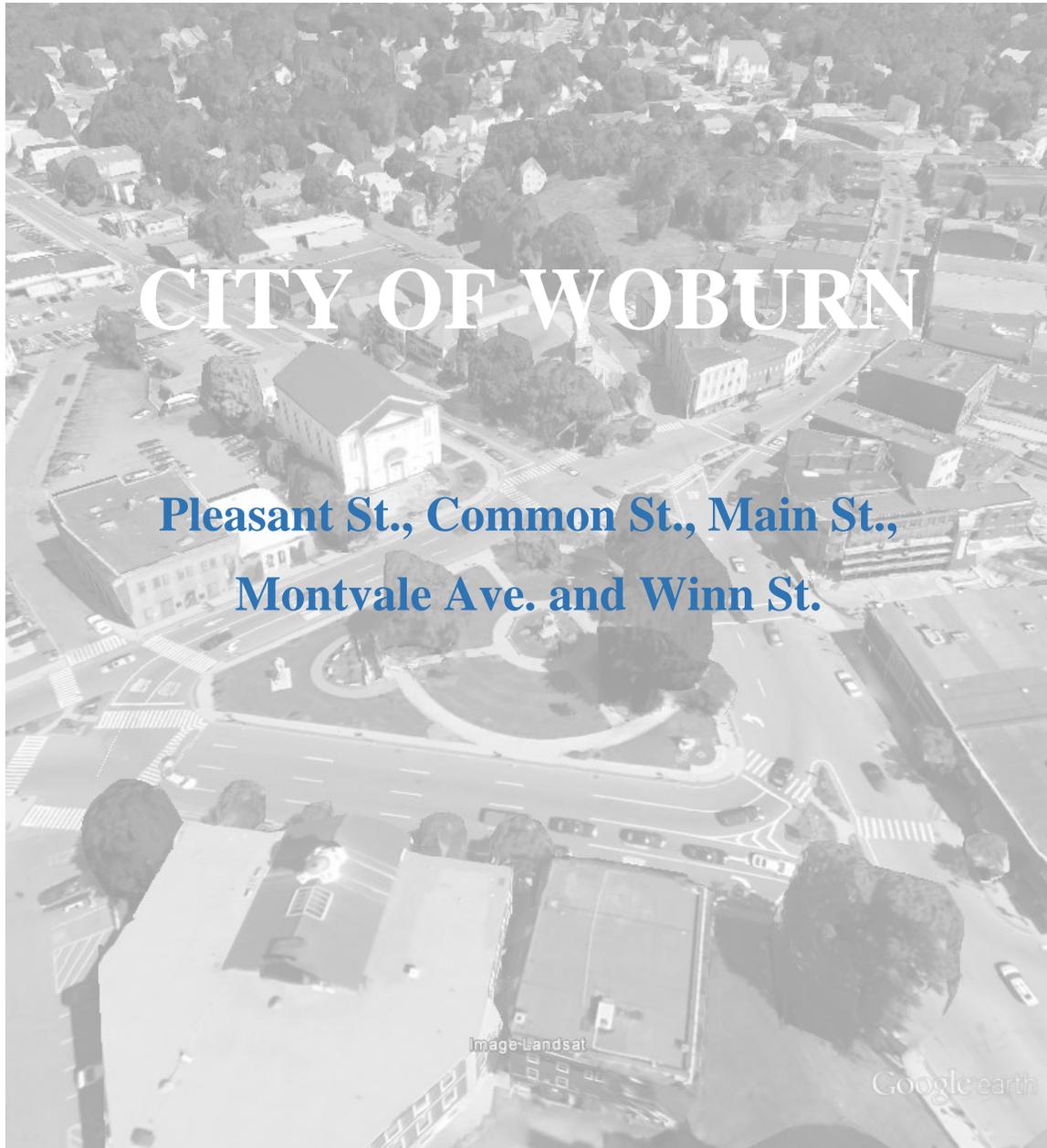


ROADWAY IMPROVEMENTS STUDY



Prepared by the City of Woburn Engineering Department, August, 2014

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Introduction: In the September of 1999, the Woburn Redevelopment Authority prepared a conceptual plan entitled, “Woburn Square Revitalization Plan. This plan was submitted to the City Council in 2000 for public comment. As part of the long term public space options, there was a conceptual plan to close off Common St. and create additional green space in front of City Hall. Traffic patterns were reviewed on a preliminary basis and the concept was determined to have potential. Excerpts from the 1999 plan are contained in Appendix A.

Due to other higher priority projects, the concept was not pursued further. Recently, the Woburn Engineering Department was contacted by the Woburn Redevelopment Authority and they requested that the original concept be reviewed, but with Common St. being used as a parking area for the downtown rather than additional park space. Working in conjunction with the Planning Department, the following study has been conducted.

Description of Existing Roadway Network through the Downtown: The Downtown area of Woburn, shown in figure 1, consists of three major intersections formed by the connections of five main roads. These roads include Main Street, Winn Street, Pleasant Street, Common Street, and Montvale Avenue. Approximately 52,000 vehicles use this network of roadways on a daily basis.



Figure 1
Locus Plan – Downtown Roadways

The first major intersection connects Main Street with Winn Street and Pleasant Street and is regulated by blinking red traffic lights. Vehicles traveling south on Main Street toward the

intersection have the option to take a sharp right onto Park Street, turn right onto Winn Street, or continue straight onto Pleasant Street. Park Street is a one-way street going north that receives all of its traffic from Main Street. Winn Street is a two lane road with a single shared lane in each direction, and cars on Winn Street must turn right onto Pleasant Street at the intersection.

The section of Pleasant Street between Winn Street and Federal Street is a one-way road with three lanes of traffic traveling in a southwest direction. The two left lanes must turn left onto Common Street at an intersection regulated by a blinking red traffic light. The rightmost lane continues straight on Pleasant Street and cars can then turn right on Abbott Street or continue straight. It is noted that a dangerous weave occurs at the Winn Street intersection caused by some cars attempting to turn left onto Common Street and other cars trying to continue straight on Pleasant. East of Federal Street, Pleasant Street is a two lane roadway with single lanes going in each direction. Cars travelling east on Pleasant Street continue straight onto Common Street and can also turn right into the City Hall parking lot.

Abbott Street connects to Pleasant Street in a southeast direction and allows traffic to flow in both directions. Cars on Abbott Street can turn either left or right onto Pleasant Street.

Common Street is a one-way street with four lanes of traffic traveling in a southeast direction toward Main Street. The two left lanes are marked to turn left onto Main Street and are regulated by a traffic signal control that allows for a left turn on red signal after stopping. The lane second from the right is marked to continue straight onto Montvale Ave, and this intersection is regulated by traffic signal control. The rightmost lane is marked to turn right onto Main Street going south. Also, a dangerous weave occurs on this street when cars that turn left from Pleasant Street onto Common Street attempt to cross all four lanes in order to turn right on Main Street which causes traffic congestion.

Montvale Ave connects to Main Street in a southwest direction, and the intersection is regulated by traffic signal control. Cars on Montvale Ave must turn right onto Main Street at the intersection.

Traffic traveling north on Main Street connects to Montvale Ave at an intersection regulated by traffic signal control. Cars have the option to turn right onto Montvale Ave or continue north on Main Street. Those that continue north on Main Street merge with traffic coming from Common Street onto a three laned section of Main Street, and it is noted that this merge causes a dangerous weave. The weave occurs when cars travelling north on Main Street continue straight toward the Winn Street intersection while other cars coming from Common Street attempt to crossover to the right lane in order to go north on Main Street. The two left lanes connect to the intersection of Winn Street, Main Street, and Pleasant Street where the leftmost lane must turn left onto Pleasant Street and the other lane continues straight onto Winn Street. Vehicles in the right most lane of the three lane section can continue in a northeast direction on Main Street or can go north onto Park Street after stopping at a stop sign.

Factors That Affect Downtown Traffic: Traffic counts were obtained during the afternoon peak traffic hour of 4:30pm to 5:30 pm. There are many factors that can affect the volume of traffic within the study area. Main Street, Route 38 serves as an exit to I-95 which can face traffic backups due to accidents, rush hour traffic congestion, and road work, among other causes. When the highway system (Route 95 and Route 93) fails, aggrieved commuters have a tendency to use Main Street as an alternate route that parallels the highway network. Similarly, when there is congestion on Route 93 vehicles tend to exit the highway and use Montvale Ave as an alternative parallel route to the highway network.

Factors within the city can also have a major effect on the traffic volume under special circumstances. A possible detour, accident, or road work on surrounding roadways could force traffic in an alternative direction through the downtown traffic circle elevating traffic volumes, temporarily. For example, an occurrence in the 4 Corners intersection can have this effect on traffic volumes as Lexington Street becomes Pleasant which feeds into the traffic circle.

Existing Traffic Patterns: Throughout the traffic circle, weave patterns are created on Common Street, Main Street, and Pleasant Street during hours of high traffic. These weave patterns are created as vehicles traveling in the same direction on a roadway attempt to cross all lanes of traffic in the left or right direction. Weave patterns result in halted traffic flow and are a primary cause of accidents within the study area.

The Common Street weave pattern is created when vehicles that emerge onto Common St from Pleasant St and enter the traffic circle traveling in the northbound direction of Main Street while vehicles turning left from Common St onto Main St attempt to travel to Montvale Ave and southbound on Main Street.

The weave pattern at Pleasant Street is created as vehicles traveling in the southwest direction from Main St are met by vehicles emerging from both Winn Street and the traffic circle at Main Street. As vehicles traveling in the southwest direction continue onto to Pleasant St, vehicles from Winn attempt to cross all lanes of traffic to enter the traffic circle at Common Street while vehicles from the traffic circle at Main attempt to cross all lanes to continue onto to Pleasant St in the southwest direction.

The weave pattern on the Main Street side of the traffic circle is created as oncoming traffic emerging from Montvale Ave and the south end of Main Street cross lanes to enter Winn Street or Pleasant Street. These vehicles must cross through the line of traffic created by vehicles traveling from Common Street heading northbound to Main Street.

The traffic patterns through the downtown are less than desirable for safe traffic circulation. Motor vehicle accident occurrence locations, when taken in conjunction with existing traffic weave patterns obviate the less than safe driving conditions around the traffic circle.

Historical Crash Data in the Downtown: Crash data provided by the Woburn Police Department and summarized by the MassDOT shows 383 crashes over the course of a twelve year span beginning in November of 2001 and concluding in June of 2012. A collision diagram and crash summary with subsequent graphs are included below. Crash data obtained from MassDOT is contained in Appendix B.

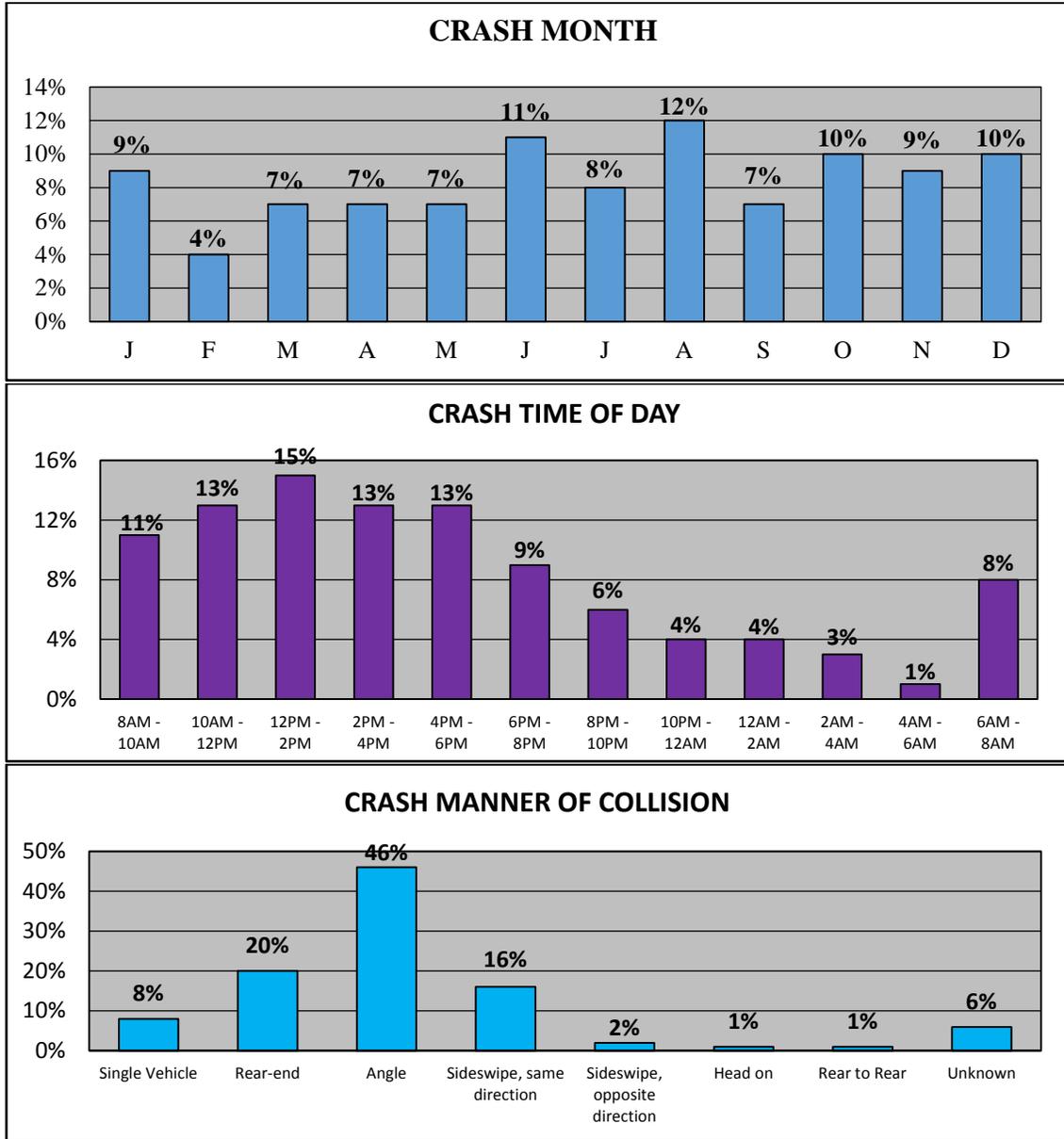
According to the provided crash data, the prevalent crash types were angled crashes. Out of the 383 crashes, 177 of those were angled, accounting for 46% of all crashes documented in the area. Single vehicle crashes occurred 30 times while 20% of the crashes, 78 total, were rear-end collisions. The rear end collisions, in all likelihood resulted from weave patterns in the traffic circle. Other crashes that occurred in this weave pattern and other sections of the traffic circle were sideswipes in the same and opposite direction, which totaled at 60 and 6, respectively. Head on and rear to rear collisions were limited, totaling 2% of all crashes with another 6% of all crashes being unknown or not reported. Although 11% of all crashes come within the weave pattern, 34% occurred in the Winn Street, Pleasant Street, Main Street location (area 9 on the map provided). As vehicles travel from Main in the southwest direction towards Pleasant, other vehicles are simultaneously traveling across this line of traffic to enter Winn from Main in the northwest direction or merging onto Pleasant from Main or Winn without traffic signals. This location had the highest percentage of all crashes followed by the Montvale Ave and Main Street location section of the traffic circle.

Crashes were evenly spread out over the course of the day and gradually decreased during the night-time and early morning hours with only one substantial spike during the morning commute. The afternoon period between 2pm and 4pm accounted for 13% of all crashes. The month of August saw the highest percentage of crashes with 12%, while February saw the lowest at 4%. Relative to weather, road surface, and light conditions; the data indicates that clear, dry roads during the daytime accounted for the highest percentage of crashes. This would indicate that roadway and light conditions were not a large factor in motor vehicle accidents.

The ages of drivers involved in crashes ranged from 16 to 84 with the highest percentage coming within the range of 25 to 34 year olds.

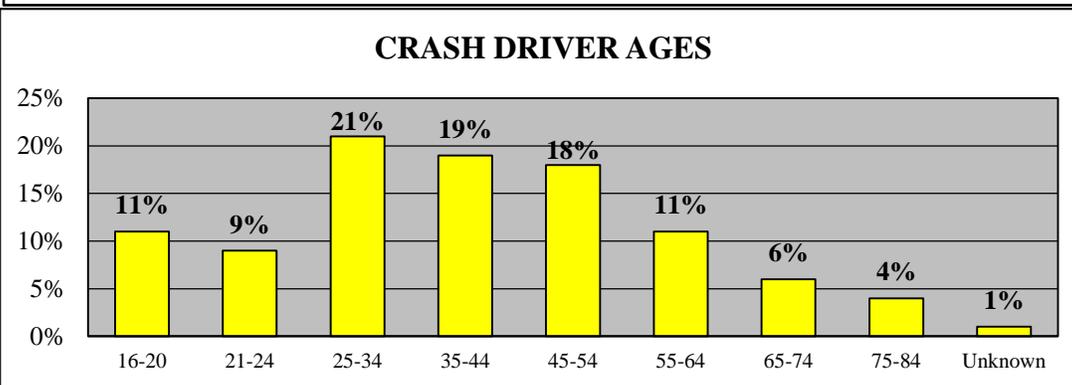
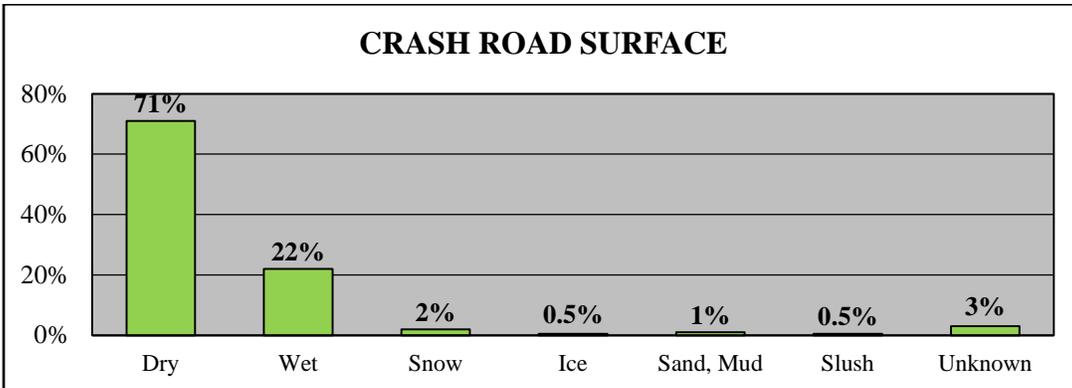
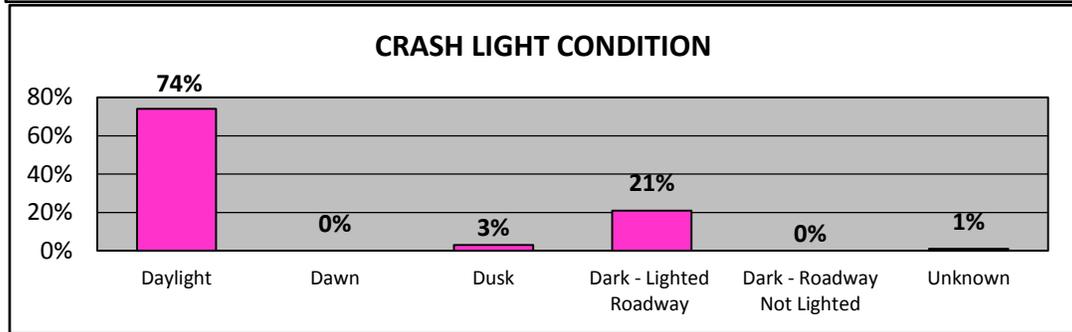
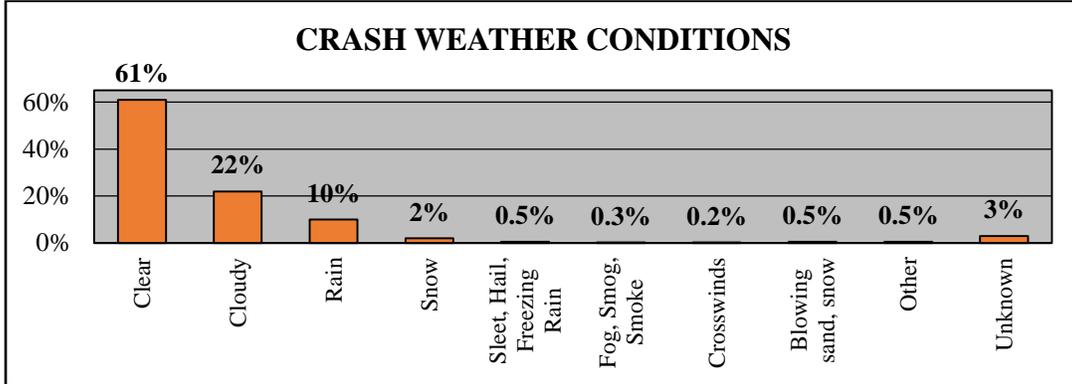
Speed regulation information was available for only a limited number of crashes in the crash data provided. The MassDOT states that the speed limit within a rotary is 20 mph. On the streets that feed into the rotary, such as Pleasant St, Montvale Ave, and Winn St, the crash report lists speed limits on these streets as 30 mph with it being reduced to 25 mph in the approaches to the rotary.

Crash Data Summary Tables and Charts Woburn Center



Crash Data Summary and Tables

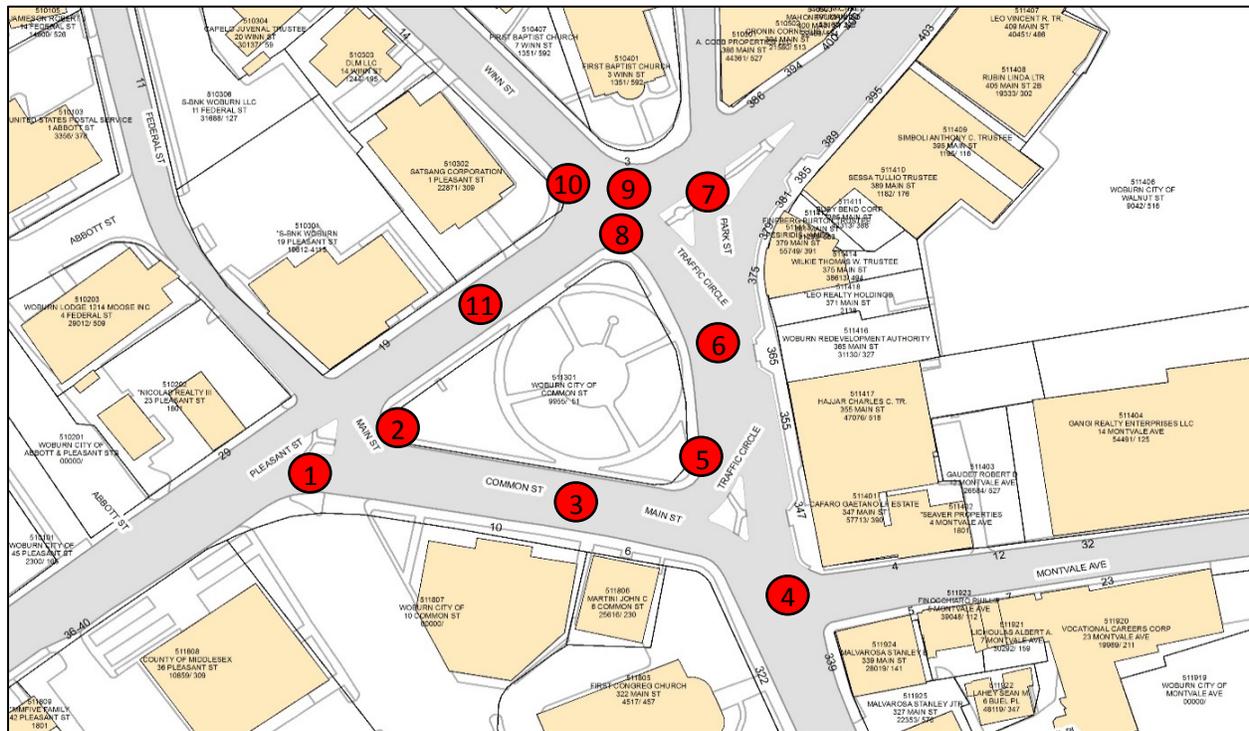
Woburn Center Rotary



It is interesting to note that the majority of vehicle crashes occurred during daylight hours with favorable roadway conditions.

As shown in the following graphic, vehicle crashes were fairly evenly distributed around the three roadways with a significantly higher incidence of crashes at the intersection of Winn St, Main St and Pleasant St. The majority of the crashes occurred when there was no traffic officer controlling the intersection. Vehicles attempting to traverse this intersection must cross two lanes of traffic and in some cases, a driver's vision is screened by a vehicle in the adjoining lane.

Figure 2
Location of Vehicular Crashes
Woburn Center



The location and type of crash associated with each location is identified in the following tables.

| AREA | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 |
|------------|----|----|----|-----|-----|-----|----|----|-----|----|----|
| CRASHES | 21 | 5 | 19 | 47 | 39 | 43 | 4 | 21 | 132 | 27 | 25 |
| PERCENTAGE | 6% | 1% | 5% | 12% | 10% | 11% | 1% | 6% | 34% | 7% | 7% |

Vehicle Crash Locations

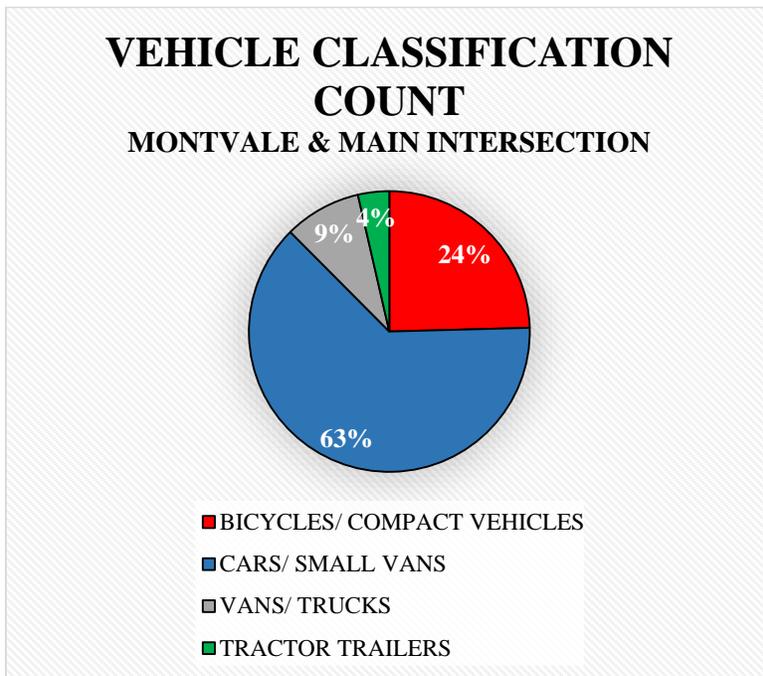
| AREA | LOCATION |
|------|----------------------|
| 1 | PLEASANT/COMMON |
| 2 | PLEASANT/COMMON/MAIN |
| 3 | COMMON |
| 4 | MONTVALE/MAIN |
| 5 | COMMON/MAIN |
| 6 | MAIN |
| 7 | MAIN/PARK |
| 8 | MAIN/PLEASANT |
| 9 | MAIN/WINN/PLEASANT |
| 10 | WINN/PLEASANT |
| 11 | PLEASANT |

In order to fully understand how crashes occur, it was necessary to review traffic volumes and vehicle turning movements for the study area.

Traffic Counts and Turning Movements: Traffic data for the downtown area was collected for the vehicle turning movements and through traffic at each intersection. Base data was obtained for the intersection of Montvale Ave and Main Street using newly installed Aldis traffic camera and GridSmart software which counts the total volume of traffic over the entire day, determines the peak hour traffic volumes, the turning movement of each vehicle, and type of vehicle. Additional data was collected at different locations around the traffic circle to supplement the data gathered by the Aldis camera at the Montvale Ave intersection. These manual traffic counts were performed during the peak PM Period. The manual traffic counts recorded the total number of vehicles travelling south on Main St. toward the intersection with Winn St., and whether those vehicles turned right onto Winn St. or continued straight onto Pleasant St. A traffic count was also performed on all vehicles turning right from Winn St. onto Pleasant St. and which vehicles traveled west on Pleasant St. or turned left onto Common St. Counts were obtained for traffic traveling west on Pleasant St. and bearing right onto Common St. These vehicles were in turn further defined by which vehicles turned left to go north on Main St. or turned right toward the intersection with Montvale Ave. and Main St. A final traffic count observed all of the traffic travelling north on Main St. toward the Winn St. intersection and noted whether the cars turned left at the intersection onto Pleasant St., continued straight through the intersection to Winn St., bare right onto Park St., or turned right headed north on Main St. All of this data was then analyzed to calculate the current turning movements at the existing downtown traffic circle, and was also used to accurately predict the turning movements of vehicles at the proposed downtown intersections. Diagrams of these turning movements can be found in Appendix C.

Vehicle Distribution: The detection camera at the intersection of Montvale Ave. and Main St. classified the 188,000 vehicles that passed through the intersection during an 8 day period that began on June 8, 2014. As depicted below, non-truck traffic accounted for 87% of the vehicles with the balance classified as utility vans and box trucks (9%) and tractor trailers (4%).

| DATE | MOTORCYCLES/ COMPACT VEHICLES | CARS/ SMALL VANS | VANS/ TRUCKS | TRACTOR TRAILERS |
|-----------|-------------------------------------|---------------------|--------------|------------------|
| 27-May-14 | 6977 | 16671 | 2261 | 976 |
| 28-May-14 | 7609 | 16344 | 2188 | 921 |
| 29-May-14 | 6608 | 17723 | 2281 | 912 |
| 30-May-14 | 7339 | 17545 | 2127 | 1005 |
| 31-May-14 | 4792 | 13108 | 2726 | 997 |
| 01-Jun-14 | 4197 | 12267 | 1836 | 683 |
| 02-Jun-14 | 6042 | 16835 | 2158 | 840 |
| 03-Jun-14 | 2701 | 8028 | 1100 | 439 |
| TOTALS | 46265 | 118521 | 16677 | 6773 |



Traffic Simulation for Existing Roadway: Using all of the data collected above, a CORSIM traffic model was developed to show the queues during the peak PM hour. The figure below is a snapshot of the simulation during the peak PM hour when traffic is most congested.

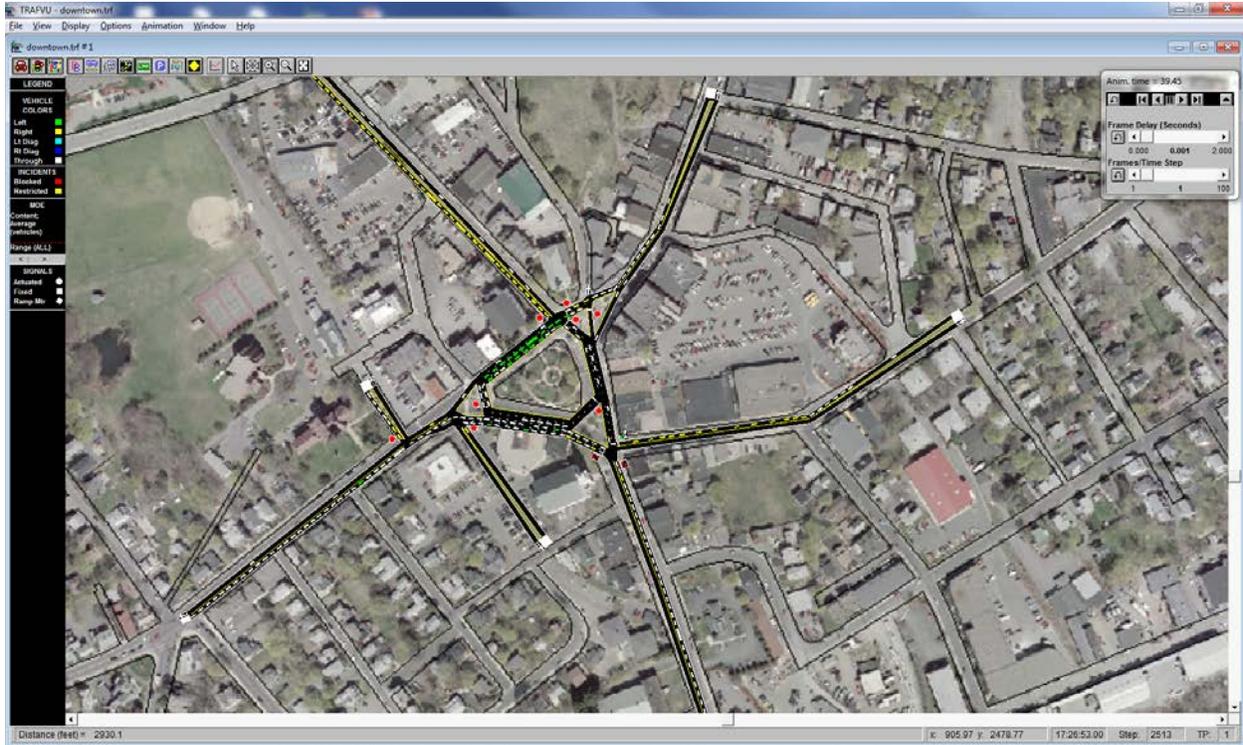


Figure 3
Peak PM Hour Traffic Simulation – Existing Conditions

As depicted in the simulation, traffic queues extend along Pleasant St. to the traffic signal at Arlington Rd. The traffic on the southerly portion of Main St. extends past St. Charles in the south end. Traffic queues on Montvale extend beyond Prospect St. and the queue on Winn St. is past Harrison Ave. This is a typical traffic congestion condition that occurs during the peak PM hour between 4:30 and 5:30 almost every weekday afternoon.

Proposed Changes to Traffic Circulation and Parking: In light of the existing traffic congestion, high vehicular crash rates, difficult turning movements and lack of proper traffic controls within the study area, the engineering department looked at modifications to the existing roadways. Working with the conceptual plan developed in 1999, lanes were laid out to provide for traffic demands which would result from the elimination of Common St. as a roadway. This portion of Common St would be converted to a parking lot between City Hall and the Common.

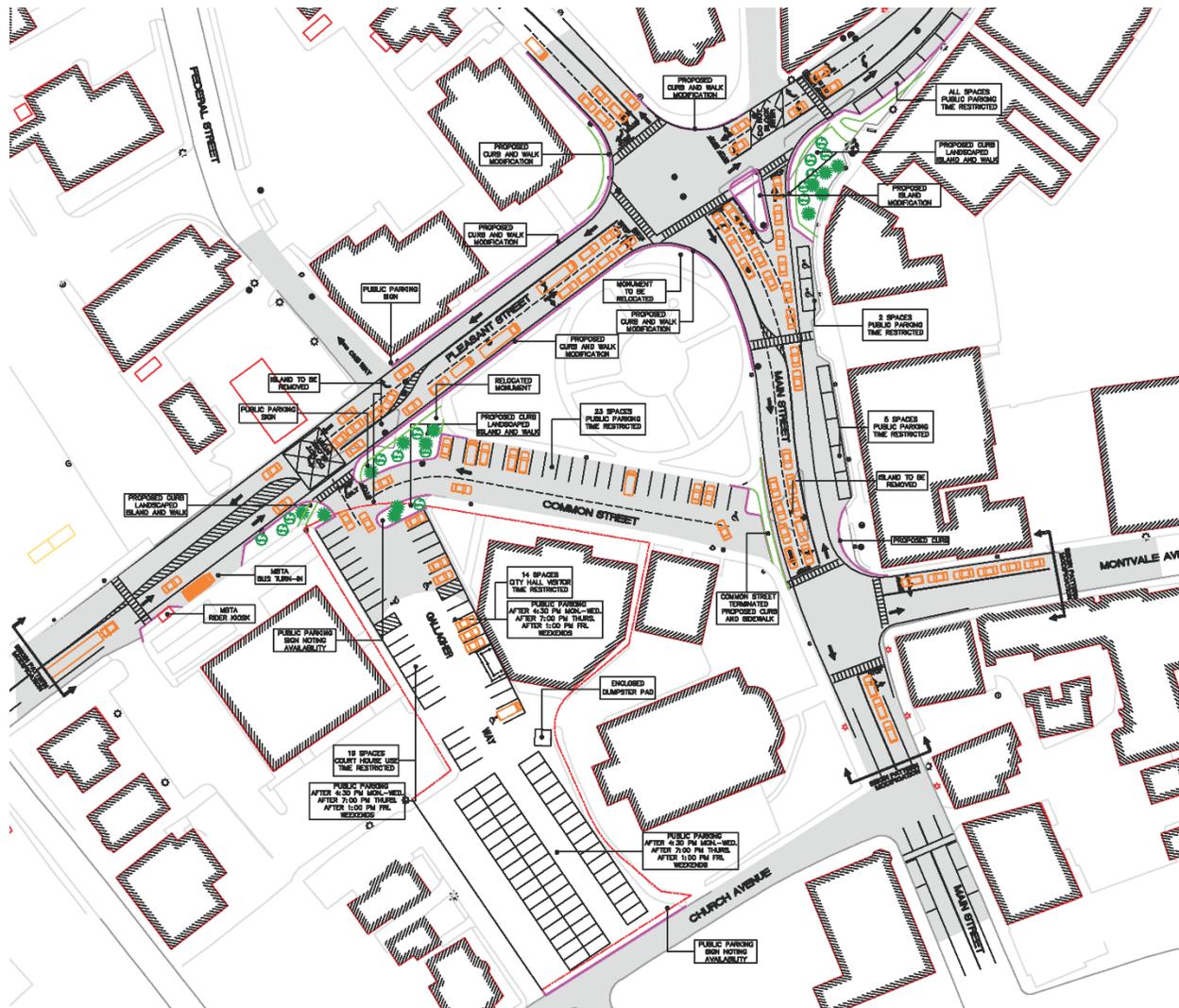


Figure 4
Conceptual Geometric Changes to Roadway Network

As indicated in the above graphic, Pleasant St. would become a two way street with separate turning and through lanes at the intersection of Winn St. and Main St. Similarly, Main St. between Winn St. and Montvale Ave. would have two lanes in each direction to allow for stacking and dedicated turns. The intersection of Winn St., Main St. and Pleasant would receive new traffic signals which would coordinate with the traffic signal at Main St. at Montvale Ave. Coordinated traffic signals would process traffic in the more efficient manner than the existing antiquated traffic controls. This would include the installation of pedestrian crossing signals with audible, count down signage. The bus stop currently located in front of City Hall would be relocated to the front of the Court House where a bus stop pocket would be provided to allow traffic to flow unimpeded by the bus traffic. There is sufficient room for a bus kiosk as well.

Traffic Model of Proposed Roadway Improvements: The CORSIM traffic model was used to show the queues during the peak PM hour, with the new roadway configurations. The figure below is a snapshot of the simulation during the peak hour when traffic is most congested.

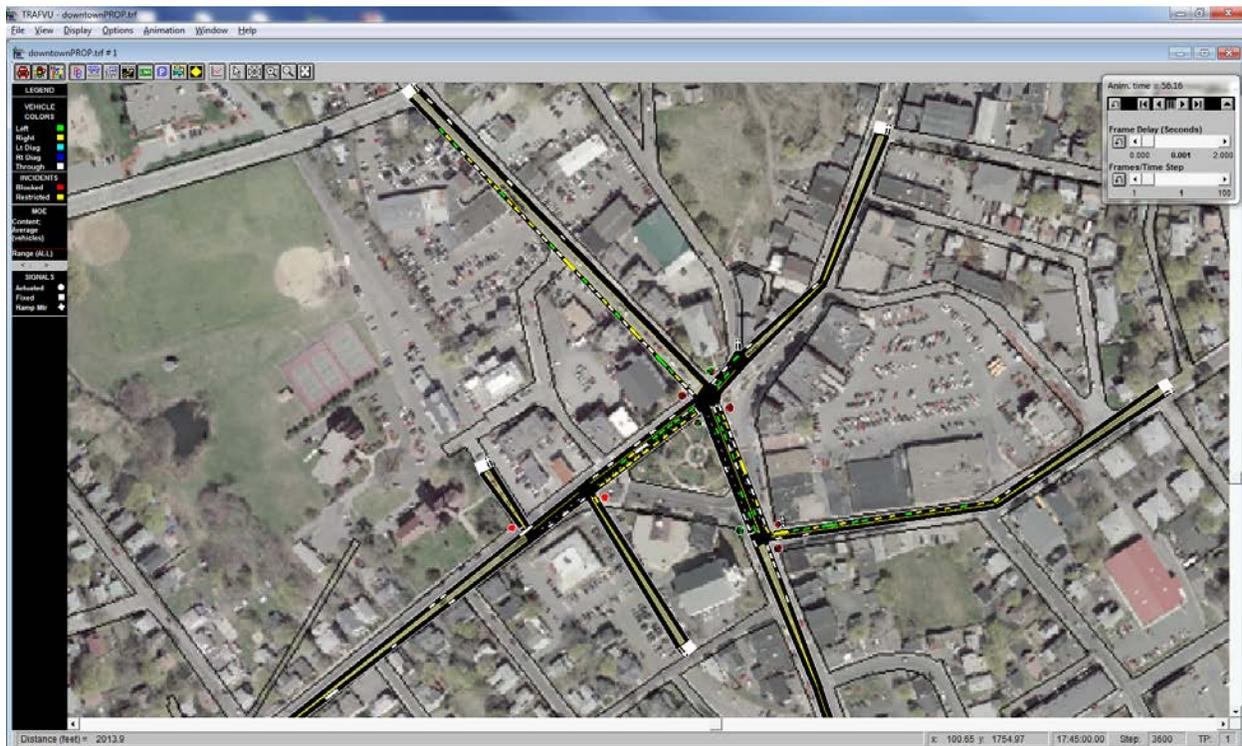


Figure 5
Peak PM Hour Traffic Simulation – After Geometric and Signal Improvements

As depicted in the simulation, traffic queues along Pleasant St. would be mitigated over the existing condition. The traffic on the southerly portion of Main St would also be substantially reduced. Traffic queues on Montvale Ave. would be only slightly less, but improved. Similarly,

the traffic queues on Winn St. would be less severe. Figure 5 represents projected traffic congestion conditions during the peak PM hour between 4:30 and 5:30 on weekdays.

The engineering department performed a cursory review of the traffic volumes and turning movements encountered during the AM peak hour period. Although the scope of this report did not include detailed evaluation of the traffic congestion found during that period, the traffic volumes were similar to the PM peak but in the opposite direction.

Conclusions and Recommendations: Based on the foregoing analysis, it is apparent that there is traffic congestion during the morning and evening rush hour periods. One does not have to be a traffic engineer to understand this fact, it merely takes a drive through the center during the morning between 7:00 and 8:30 AM or in the afternoon between 4:30 and 5:30 PM.

It takes only a leisurely drive around the Common to obviate the weaving problems associated with the rotary type of traffic circulation. When one considers the crash data taken in conjunction with the weaving patterns and unsignalized intersection at Winn St., the results are compelling.

The volumes of traffic that traverse the downtown on a daily basis exceed the capacity of the roadway network. The proposed improvements would have a beneficial impact on the flow of traffic, but there would always be times when traffic congestion would occur as a result of highway backups when traffic seeks alternative routes through local roads. Similarly, illegal parking events and truck deliveries along Main St. have a tendency to slow the flow of traffic. The overall benefits of the project are improved traffic flow, reduced motor vehicle crashes, improved bus service, improved pedestrian safety, and additional parking in the downtown. In addition there would be ancillary benefits in fuel savings and improved air quality which would result from improved traffic flow and reduced travel time through the downtown.

The project would be eligible for funding under Chapter 90 and the estimated cost of the improvements including design would be approximately \$350,000.00. The timing is such that this work could be made part of the 2015 downtown paving project.

The report provided is conceptual in nature and is not considered conclusive at this time. The analysis provided herein is intended to give sufficient information to determine whether it is feasible to move the proposal to the next level, wherein a functional design report can be prepared by a traffic consultant. The functional design report would detail the design steps necessary for the project, with the associated costs of implementation. At that point a final decision could be made to prepare designs for inclusion in next year's downtown pavement project.

Appendix A

Excerpts from the 1999 Downtown Revitalization Study

Appendix B

MassDOT Vehicle Crash Data

Appendix C

Traffic Counts and Turning Movements

Appendix D

GridSmart Data for Montvale Ave. at Main St. Traffic Signal