BOSTON REGION METROPOLITAN PLANNING ORGANIZATION

State Transportation Building
Ten Park Plaza, Suite 2150
Boston, MA 02116-3968
Tel. (617) 973-7100
Fax (617) 973-8855
TTY (617) 973-7089
www.bostonmpo.org

Richard A. Davey
MassDOT Secretary and CEO
and MPO Chairman

Karl H. Quackenbush
Executive Director, MPO Staff

MEMORANDUM

DATE **April 19, 2012**

TO **Boston Region Metropolitan Planning Organization**

FROM **Mark Abbott**

RE **Arterial Traffic Signal Improvements and Coordination Study: Randolph**

BACKGROUND

This study was recommended by the Boston Region MPO's Congestion Management Process and was funded by the MPO in the federal fiscal year (FFY) 2010 Unified Planning Work Program.

Traffic signal coordination or synchronization promotes efficient traffic flow along an arterial roadway. Typically, arterial flow quality and efficiency is dictated by the level of service at traffic signals and the degree of coordination between them. Generally traffic flow can be improved by coordination when the signals are located within one-quarter of a mile of each other. Where traffic signals are coordinated, traffic moves in platoons along the road and, at certain speeds, can proceed through intersections without braking or stopping. In coordination, side street traffic and pedestrians must be considered, so that their needs for service through the coordinated intersections are met. A side benefit of coordination is enhanced safety through more efficient management and operation of the arterial signal systems.

The study's overall purpose was to evaluate three or four groups of arterial signalized intersections, consisting of two to three intersections each, throughout the region and to develop recommendations for improvements. The improvements were focused primarily on traffic signal coordination aimed at improving traffic flow and safety along the arterials. As part of the traffic signal coordination strategy, staff also considered geometric improvements and traffic signal design changes at the selected locations.

The process for selecting the groups of intersections for this study began with identifying traffic signals at intersections that are a quarter mile or less apart and that were included in the "Conceptual" or the "Pre-TIP" project category in the FFYs 2009–11 Transportation Improvement Program (TIP). Each location's crash history was also examined. In addition, staff asked MassDOT's Highway Division District 4 to suggest locations that they thought would be appropriate. A table showing the resultant universe of potential signal coordination locations is provided as Appendix A; correspondence with the District 4 traffic engineer is

provided as Appendix B. The locations were then examined to verify from a technical standpoint that signal coordination could potentially be implemented at them.

The final four groups of intersections selected by staff and District 4 through this process were then discussed with the MassDOT District 4 traffic engineer and the towns where the intersections are located. The final four signal groupings selected for this study were:

- *Braintree*
  Washington Street at Common Street/President Road; at Route 3 southbound off-ramp; and at Independence Avenue/Church Street

- *Lexington/Bedford*
  Route 4/225 at Hartwell Avenue; at Shawsheen Road; and at Great Road Shopping Center

- *Randolph*
  Route 28 (as North Main Street) at Warren Street; at Memorial Parkway; and (as South Main Street) at North and Union streets

- *Weymouth*
  Route 53 at Mutton Lane and at Pleasant Street

This memorandum provides information, analysis, and recommendations for the intersections located in Randolph. Separate memoranda are provided for each of the signal groupings.

OVERVIEW OF THE STUDY AREA

The three Route 28 intersections chosen in Randolph (listed above) are shown in Figure 1. Staff selected these locations following discussions with MassDOT's Highway Division, District 4 traffic engineers, and Richard McCarthy, Randolph's Planning Director; relevant correspondence is provided in Appendix B.

These intersections are currently signalized and located close enough to each other for coordination to be feasible: from Warren Street to Memorial Parkway is 920 feet, and from Memorial Parkway to South Main Street/North Street is 280 feet. The functional classification of all of the three intersections' roadways is urban minor arterial, except for Memorial Parkway, which is an urban collector. Union Street and Warren Street are designated as Route 139 through these intersections, and Route 139 is a major east-west connector in this region.

Located between Warren Street and Memorial Parkway are two unsignalized intersections: Diauto Drive on the west side of Route 28 and Short Street on the east side. Both streets are one-way away from Route 28.

BOSTON REGION MPO

FIGURE 1
Study Area Intersections

N

Arterial Traffic Signal Improvements and Coordination: Randolph

blank back of Figure 1

There is on-street parking on both sides of Route 28 between Warren and Memorial Parkway, which is vital and consistent with the land use, which is predominantly commercial business. Between Memorial Parkway and South Main Street/North Street, on-street parking is prohibited.

OBJECTIVES OF THE STUDY

The objectives for the locations in Randolph were to determine whether signal coordination would, in fact, improve traffic operations and to identify other possible improvements that would reduce delays and enhance safety. Route 28 is Randolph's main street, and many local businesses are located along it. In addition to providing access to local business, Route 28 is a main corridor to I-93 to the north, resulting in considerable peak-direction traffic volumes (northbound in the AM peak and southbound in the PM peak). This traffic can cause unnecessary delays for both commuters and local residents. By improving peak-direction traffic flow with coordination, the overall traffic operations and travel time along Route 28 could improve.

EXISTING CONDITIONS

Note: Traffic volume data and crash analyses are provided in separate sections that follow.

Route 28 (North Main Street) at Warren Street

Layout

Though Route 28 and Warren Street form a three-way "T" intersection here, there is effectively a fourth approach across from Warren Street: an exit driveway for a Bank of America branch. The intersection is signalized.

The northbound Route 28 approach has two lanes: an exclusive left-turn lane and a through lane from which, beyond the intersection, right turns are allowed into the Bank of America entrance driveway. The southbound approach has two through lanes and one exclusive right-turn lane onto Warren Street. Both the northbound and southbound departures have two lanes.

The eastbound Warren Street approach consists of exclusive left- and right-turn lanes, which begin approximately 110 feet from the intersection. Warren Street has one departure lane. The approach and departure lanes are separated by a small raised median that is approximately 100 feet long.

Crosswalks are provided across all three approaches of the intersection. Sidewalks are present along both sides of Warren Street. Along Route 28, there are sidewalks on both sides from north of Warren Street to south of South Main/North Street.

Land Use

Located adjacent to the intersection are commercial businesses. Along the east side of the intersection is the Bank of America, which is directly across from Warren Street. The entrance

driveway is located north of the northbound approach's stop line. The exit for the bank is under signal control. On the northwest corner of the intersection is the Randolph Village shopping plaza, and on the southwest corner is a Walgreens.

Signal System

The intersection has a semi-actuated signal system with loop detectors provided on the Warren Street and bank exit approaches. It is designed as a three-phase signal operation, with an exclusive pedestrian phase provided upon pedestrian actuation. The northbound Route 28 approach is controlled by a lead protected/permitted phase to accommodate northbound left-turning vehicles. The exclusive pedestrian phase follows the northbound and southbound phases. The Warren Street and bank driveway signal phase is the final phase. The cycle length of the intersection is 83 seconds, with a 22-second pedestrian phase added upon pedestrian actuation.

The signal heads are post-mounted and located on all four corners of the intersection, with an additional signal head located on the Warren Street median island. The signal heads are standard three-section, 12-inch heads except for the southbound Route 28 approach. Pedestrian signals and push buttons are mounted on the signal posts.

Observations of Operation

Peak-hour observations of the intersection indicate that generally the intersection is operating acceptably. During both peak hours, there is queuing in both the northbound and southbound directions and left-turn queuing on Warren Street.

Route 28 (North Main Street) at Memorial Parkway

Layout

This intersection is a signalized three-legged "T" intersection with the northbound and southbound Route 28 approaches each consisting of two general-purpose lanes. The Memorial Parkway approach also consists of two lanes, exclusive left- and right-turn lanes that begin approximately 100 feet from the intersection.

Sidewalks are present along both sides of Route 28 and Memorial Parkway. Crosswalks are located across all three approaches.

Land Use

The land use located adjacent to the intersection is generally commercial but also includes Turner Library, located on the southwest corner. On the northwest corner is the Parthenon Restaurant. Randolph High School and the Randolph Fire Department are located on Memorial Parkway not far from the intersection.

Signal System

The signal heads for Route 28 are located on mast arms, which for the southbound approach extend from the southwest corner and for the northbound approach extend from mid-intersection on the east side of the intersection. The signal heads for Memorial Parkway are post-mounted and located on the east side of the intersection. The intersection's signal heads are generally three-section heads. A four-section head is provided to accommodate the northbound left turns and another four-section head to accommodate the Memorial Parkway right turns. Pedestrian push buttons and signal indications are provided for all pedestrian movements.

The intersection operates under a semi-actuated signal system, with loop detectors provided on the Memorial Parkway approach. The signal design is three-phase plus an exclusive pedestrian phase. The northbound approach has a leading protected/permitted phase for the left turns. With this phase there is an overlapping Memorial Parkway right-turn phase. This phase is followed by the permitted northbound and southbound phase. An exclusive pedestrian phase follows upon activation and is succeeded by the Memorial Parkway phase.

Observations of Operation

Peak-hour field observations of this intersection indicated that traffic operations are generally acceptable. A number of school-age pedestrians were observed crossing the intersection on the southern Route 28 crosswalk. The walk times at this intersection seem more than adequate to allow crossing.

Route 28 (North Main Street and South Main Street) at North and Union Streets

Layout

The intersection is four-legged; North Main Street (Route 28) is the southbound approach, South Main Street (Route 28) the eastbound, North Street the westbound, and Union Street the northbound.

The Union Street approach consists of two general-purpose lanes. The southbound approach opens up to three lanes after Memorial Parkway, with an exclusive right-turn lane, a through lane, and a shared left-turn/through lane. The eastbound approach has two lanes: an exclusive left-turn lane and a general-purpose lane. The westbound approach has two general-purpose lanes and a free median-divided right-turn lane that is approximately 50 feet long.

Sidewalks are present along both sides of Route 28, North Street, and Union Street. Crosswalks are present across all approaches of the intersection.

Land Use

The land use adjacent to the intersection is mixed. The First Congregational Church is located on the northwest corner. A small memorial park sits on the northeast corner of the intersection. On

the southwest corner is a historic public building, and on the southeast is a vacant commercial property.

Signal System

This intersection is a four-way signalized intersection with the signal heads located on a span wire that runs from the northwest corner to the southeast corner. There are also two post-mounted signal heads located, respectively, on the southwest corner and on the westbound median island. Post-mounted pedestrian heads are provided on the northwest and southeast corners. The signal head for the eastbound left-turns is four-section. All the other heads are standard three-section heads. Pedestrian push buttons and signal indications are provided for all pedestrian movements.

The intersection operates with a three-phase signal design, plus an exclusive pedestrian phase upon activation. The eastbound approach has a protected/permitted phase to accommodate the left-turning vehicles. The northbound and southbound approaches have concurrent phasing.

Observations of Operation

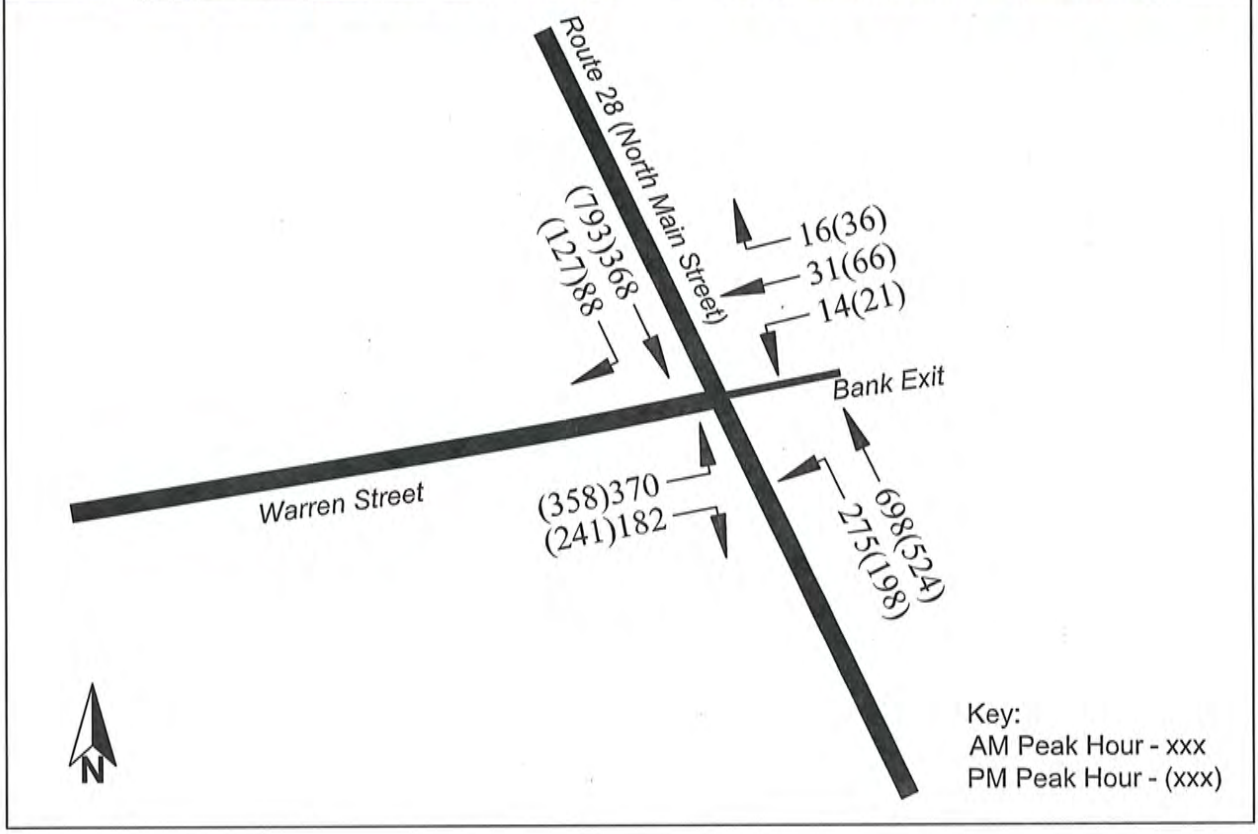
Peak-hour field observations of this intersection indicated that this is the busiest of the three intersections along Route 28 in the study area. The PM peak is the busier of the two peaks, and this is reflected in the traffic operations. During that period, heavy queuing is present on the southbound and eastbound approaches along Route 28, the major road.

TRAFFIC VOLUMES

Traffic volumes for the intersections were collected by conducting manual turning movement counts (TMCs) on June 17 and 25, 2009, by MPO staff. Figure 2 shows the traffic volumes for the Warren Street intersection, Figure 3 the volumes for the Memorial Parkway intersection, and Figure 4 the volumes for the South Main Street/North Street/Union Street intersection. Additional count data are in Appendix C.

CRASH ANALYSIS

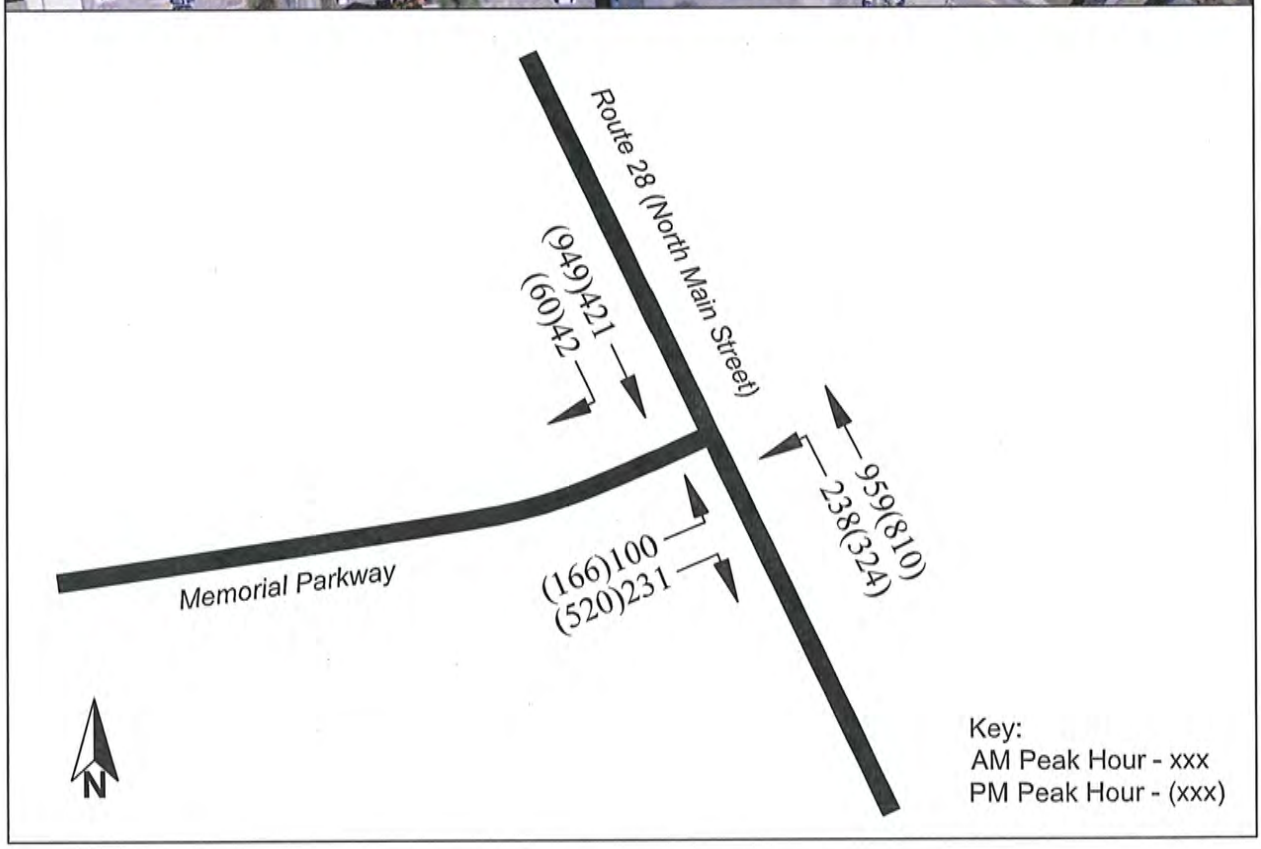
Staff gathered the most recent three years of crash data available for the three intersections from Registry of Motor Vehicle records. Tables 1, 2, and 3 provide the crash data for the Warren Street, Memorial Parkway, and South Main/North Street/Union Street intersections, respectively.



BOSTON REGION MPO

FIGURE 2
Route 28 at Warren Street: Traffic Volumes

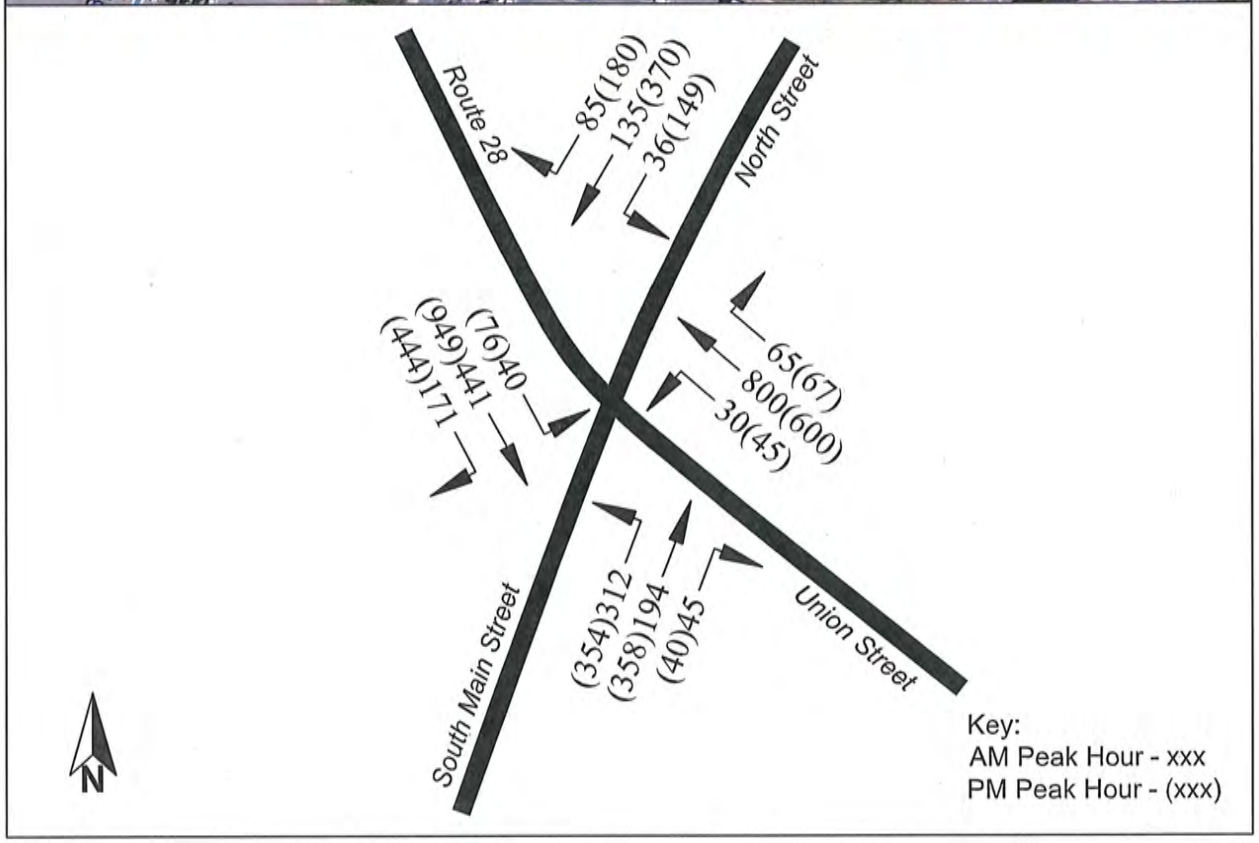
Arterial Traffic Signal Improvements and Coordination: Randolph



BOSTON REGION MPO

FIGURE 3
Route 28 at Memorial Parkway: Traffic Volumes

Arterial Traffic Signal Improvements and Coordination: Randolph



BOSTON REGION MPO

FIGURE 4
Route 28 at Union St./ North Main St.: Traffic Volumes

Arterial Traffic Signal Improvements and Coordination: Randolph

The Warren Street intersection had 43 crashes over the three-year period, averaging just over 14 crashes a year. The majority of the crashes resulted in property damage only, and most were of the angle or rear-end type. Angle and rear-end crashes are typical at signalized intersections. No pedestrian or bicyclist was involved in any of the crashes. Crash rates were calculated for the intersection using MassDOT's Intersection Crash Rate Worksheet (see Appendix D for crash worksheets). The resulting crash rate was 1.50, which is above the MassDOT Highway District 4 average of 0.78 for signalized intersections.

TABLE 1
Route 28 (NORTH MAIN STREET) at Warren Street:
Summary of RMV Crash Data (2005–2007)

					2005-2007	
		2005	2006	2007	Total	Average
Total Number of Crashes		**14**	**16**	**14**	**43**	**14**
Crash Severity	Property Damage Only	7	8	8	**23**	8
	Personal Injury	2	3	3	**8**	3
	Fatality	0	0	0	**0**	0
	Not Reported	5	5	3	**13**	4
Collision Type	Angle	5	6	8	**19**	6
	Rear-end	8	6	3	**17**	6
	Sideswipe	0	4	1	**5**	2
	Head-on	1	0	0	**1**	0
	Single Vehicle	0	0	1	**1**	0
	Not Reported	0	0	1	**1**	0
Roadway Conditions	Wet or icy pavement	4	3	4	**11**	4
	Dark/lighted	4	3	5	**12**	4
Weather Conditions	Clear	11	13	9	**33**	11
	Cloudy	1	1	1	**3**	1
	Rain	1	2	3	**6**	2
	Snow	0	0	0	**0**	0
Crashes during weekday peak periods[1]		3	0	2	**5**	2
Crashes involving pedestrian(s)		0	0	0	**0**	0
Crashes involving bicyclist(s)		0	0	0	**0**	0

1. Peak periods are from 7:00 to 9:00 AM and 4:00 to 6:00 PM.

The Memorial Parkway intersection had 19 crashes over the three-year period, averaging just over 6 crashes a year. The majority of the crashes for which crash severity was reported resulted in property damage only, and most were of the rear-end type. No pedestrian or bicyclist was involved in any of the crashes. Crash rates were calculated for the intersection using MassDOT's Intersection Crash Rate Worksheet. The resulting crash rate was 0.55, which is below the MassDOT Highway District 4 average of 0.78 for signalized intersections.

TABLE 2
Route 28 (NORTH MAIN STREET) and Memorial Parkway:
Summary of RMV Crash Data (2005–2007)

		2005	2006	2007	2005-2007 Total	2005-2007 Average
Total Number of Crashes		**9**	**4**	**6**	**19**	**6**
Crash Severity	Property Damage Only	3	1	4	**8**	3
	Personal Injury	2	2	0	**4**	1
	Fatality	0	0	0	**0**	0
	Not Reported	4	1	2	**7**	2
Collision Type	Angle	2	0	0	**2**	1
	Rear-end	4	4	4	**12**	4
	Sideswipe	3	0	2	**5**	2
	Head-on	0	0	0	**0**	0
	Single Vehicle	0	0	0	**0**	0
	Not Reported	0	0	0	**0**	0
Roadway Conditions	Wet or icy pavement	0	0	4	**4**	1
	Dark/lighted	3	2	3	**8**	3
Weather Conditions	Clear	8	3	3	**14**	5
	Cloudy	1	1	0	**2**	1
	Rain	0	0	3	**3**	1
	Snow	0	0	0	**0**	0
Crashes during weekday peak periods[1]		2	1	2	**5**	2
Crashes involving pedestrian(s)		0	0	0	**0**	0
Crashes involving bicyclist(s)		0	0	0	**0**	0

1. Peak periods are from 7:00 to 9:00 AM and 4:00 to 6:00 PM.

The South Main Street/North Street/Union Street intersection had a three-year total of 43 crashes, with a majority resulting in property damage only. Angle collisions were the primary crash type occurring at this intersection. Again, this probably can be attributed to the unprotected turning movements. The crash rate for this intersection was 0.97, which is above the 0.78 District 4 average for signalized intersections.

TABLE 3
Route 28 (NORTH MAIN STREET) and South Main/North/Union Streets:
Summary of RMV Crash Data (2005–2007)

		2005	2006	2007	3-Year Total	Average
Total Number of Crashes		**15**	**14**	**14**	**43**	**14**
Crash Severity	Property Damage Only	12	7	7	**26**	9
	Personal Injury	1	2	3	**6**	2
	Fatality	0	0	0	**0**	0
	Not Reported	2	5	4	**11**	4
Collision Type	Angle	7	5	6	**18**	6
	Rear-end	2	4	3	**9**	3
	Sideswipe	2	0	4	**6**	2
	Head-on	1	4	1	**6**	2
	Single Vehicle	1	0	0	**1**	0
	Not Reported	2	1	0	**3**	1
Roadway Conditions	Wet or icy pavement	4	4	4	**12**	4
	Dark/lighted	2	5	5	**12**	4
Weather Conditions	Clear	8	10	7	**25**	8
	Cloudy	2	0	2	**4**	1
	Rain	3	4	4	**11**	4
	Snow	2	0	0	**2**	1
Crashes during weekday peak periods[1]		5	2	4	**11**	4
Crashes involving pedestrian(s)		0	1	0	**1**	0
Crashes involving bicyclist(s)		0	0	0	**0**	0

1. Peak periods are from 7:00 to 9:00 AM and 4:00 to 6:00 PM.

DEVELOPMENT OF ALTERNATIVES

Staff examined various traffic signal design and lane use alternatives in conjunction with examining coordination between the three signalized intersections. The software Synchro 7[1] was the analysis tool staff used to examine coordination and other strategies.

The Route 28 corridor in Randolph is the town's center of activity. A report, *Town of Randolph Report,* prepared for the Town of Randolph by the Cecil Group in June 2006, included in Appendix B, made recommendations for improvements in and fostering the growth of downtown Randolph. One of the recommendations was to implement traffic calming to reduce speeds on North Main Street and facilitate commercial activities.

The commercial build-up along both sides of Route 28 limits the opportunities for improving traffic operations and increasing intersection capacity through lane additions at the intersections.

[1] Synchro by Trafficware; Version 7

However, the intersections at Warren Street and Memorial Parkway have acceptable levels of service in both peak hours. The South Main/North/Union intersection is the only one that operates poorly, and this occurs only during the PM peak hour.

The alternatives aim at improving operations, easing congestion, and efficiently moving the traffic along the corridor, all of which would improve access to commercial activities. They include signal phasing and timing optimization for improved operational efficiency, lane reallocation for improved traffic operations and safety, and signal coordination for improved traffic flow along the corridor.

Staff analyzed existing conditions and three alternatives:

- **Existing Geometry and Signal Design —** In this base-case scenario, signal timings and lane configurations at the three intersections are as they exist currently in the field (see existing conditions description above). Staff used the analysis results from this scenario to compare the alternatives.

- **Alternative 1: Existing Geometry with Optimized Timings —** In this option, staff optimized individually the signal timings at the three intersections to improve overall operations at each intersection without altering existing geometry.

- **Alternative 2: Existing Geometry with Coordinated Timings —** In this alternative, staff provided a coordinated signal plan for the intersections while maintaining the existing geometry and lane configurations. In the AM peak hour, coordination was optimized in the Route 28 northbound direction from the Union Street northbound movements through the Warren Street intersection. Coordination was optimized in the southbound direction during the PM peak hour from Warren Street through all the traffic movements at the South Main Street/North Street/Union Street intersection.

- **Alternative 3: South Main Street/North Street/Union Street Lane Reallocation with Coordinated Timings —** This alternative maintains the existing geometry and lane configurations at Warren Street and Memorial Parkway. At the South Main/North Street/Union Street intersection, staff examined many options to improve operations. To facilitate both intersection operations and coordination along the corridor, a second left-turn lane on the South Main Street approach was studied. This second lane is a reallocation of one of the departure lanes on South Main Street. As previously described, the North Street approach had contained two general-purpose lanes. The lane reallocation would require the lane use of the North Street approach to change to one through lane and one exclusive left-turn lane. The left lane was essentially a de facto left-turn lane and not being used by through traffic. The geometry of the northbound and southbound approaches would remain the same. Signal timings were then coordinated between the three intersections.

TRAFFIC OPERATIONS ANALYSIS

The traffic operations analysis for the intersections was conducted using Synchro 7.[2] Tables 4 and 5 show the results of the analyses for the AM and PM peak hours, respectively. Included in the analysis are estimates of energy measures of effectiveness, which provide information on energy savings and vehicle emissions. These are shown in Tables 6 and 7. Complete data from the Synchro capacity analysis are in Appendix E.

Existing Geometry and Signal Design

The existing-conditions analyses indicate that the Warren Street and Memorial Parkway intersections are each operating at an acceptable level of service (LOS) in both peak hours: LOS C (AM) and D (PM) at Warren Street and LOS B (AM) and C (PM) at Memorial Parkway. The only discernible problem that appears to be occurring at either of these two intersections, based on the analysis, is that the Warren Street approach in the PM peak hour operates at LOS E and has a queue of 575 feet or approximately 23 vehicles (25 feet per vehicle is used to equate queue distance to feet).

The South Main Street/North Street/Union Street intersection operates poorly in the PM peak hour: at LOS E with a volume-to-capacity (V/C) ratio of 1.02. In addition to the poor LOS, there are queue spillovers between the Memorial Parkway and South Main Street/North Street/Union Street intersections in both directions during the PM peak.

Alternative 1: Existing Geometry with Optimized Timings

The optimized timings at the intersections resulted in marginal improvements over existing conditions in both peak hours. Overall LOS at all three intersections remained the same. A marginal improvement of the overall V/C ratio occurred at the South Main Street/North Street/Union Street intersection. The results from this analysis indicate that, under the existing geometry, the existing signal design is optimum.

Alternative 2: Existing Geometry with Coordinated Timings

As explained earlier, the main benefit of coordinating signal systems is to provide smooth vehicle operations along a corridor. Traffic engineers accomplish this by designing signals in such a way that vehicles are processed through a series of intersections in platoons and travel along the corridor without stopping. As previously described, this alternative changes the timings at the intersections to accomplish such coordination.

When staff estimated the effects of a coordinated signal system, they found that operations overall remained relatively the same as under existing conditions. However, queuing along Route 28 was reduced. The main benefit of this alternative is with the progression or bandwidth[3]

[2] Synchro by Trafficware; Version 7.
[3] Bandwidth is the amount of green time available for vehicles to travel through intersections in a coordinated signal system.

provided to vehicles passing through all three intersections. In the AM peak, a bandwidth of 34 seconds is provided in the northbound direction. In the PM peak, bandwidths of 38 seconds and 39 seconds are provided in the northbound and southbound directions, respectively.

Alternative 3: South Main Street/North Street/Union Street Lane Reallocation with Coordinated Timings

The estimated operational improvements over existing conditions achieved at the individual intersections through this alternative are marginal. Again, the main benefit of coordination is the green bandwidth that is provided to vehicles traveling along the corridor. During the AM peak, a northbound bandwidth of 40 seconds is obtained through the three intersections. The PM peak has a bandwidth of 40 seconds as well in the southbound direction. Also, the addition of the second left-turn lane on the South Main Street approach allows the side street operations in the PM peak to improve from failing operations to LOS E.

CONCLUSIONS AND RECOMMENDATIONS

It was found that the Warren Street and Memorial Parkway intersections operated at acceptable levels of service under existing conditions. For this reason and because of adjacent development at these two intersections, staff limited its investigation of improvements for these locations to signal phasing and timing, and signal coordination. However, staff found that the South Main Street/North Street intersection had problems in the PM peak hour associated with the side street movements. Therefore, staff did not limit its investigation of improvements for this location to signal changes.

The alternatives analysis indicated that signal coordination would improve operations by easing congestion and reducing the number of stopping vehicles. It would also improve operations at the South Main Street/North Street/Union Street intersection. In addition, staff found that lane reallocation at that intersection would be worthwhile.

Based on these findings, staff recommend that the improvements included in Alternative 3, South Main Street/North Street/Union Street Lane Reallocation with Coordinated Timings, be implemented. On the North Street approach at the South Main Street/North Street intersection, the left general-purpose lane would be restriped as an exclusive left-turn lane. Since this movement would be a permitted movement, no signal head replacement would be necessary. At the South Main Street approach to the intersection, the left-most departure lane would be restriped as an exclusive left-turn approach lane, thus providing two left-turn lanes at this eastbound approach. A new signal head with a left-turn arrow would need to be provided because of the necessity of providing a protected movement for the double left turns. The northbound and southbound approaches would remain as they exist today.

This recommended alternative also does not impact pedestrians; the current pedestrian phasing and timing are maintained at all intersections. This is especially desirable because Randolph High School is located on Memorial Parkway.

This alternative, in addition to improving operations at the intersections, is the most fuel-efficient or emissions-friendly of the alternatives examined for both the individual intersections and the overall Route 28 corridor. As shown in Table 7, there is a significant reduction in the gallons of fuel consumed in the overall Route 28 corridor.

These improvements should be simple to implement and they are cost-effective as well. They require no land takings and can be accomplished with striping, signal timing changes, signing, and new signal heads. The only significant cost would be for the signal communication (interconnections between the three signals). The Town of Randolph should pursue implementation of these improvements in order to benefit travel operations along the main street in the town center. The improvements do not interfere with the plans for the town that are described in the Cecil Report. The progression of the traffic does not increase speeds along the corridor. Instead, it improves the flow of traffic and should ease congestion, making the town center more attractive as a destination.

TABLE 4
AM Peak Hour
Level-of-Service Summary

Intersection/Approach	Existing Conditions				Alternative 1				Alternative 2				Alternative 3			
	LOS	Delay[1]	V/C[2]	Q[3]	LOS	Delay	V/C	Q	LOS	Delay	V/C	Q	LOS	Delay	V/C	Q
Route 28 at Warren St																
Route 28 - NB	C	32.2	0.88	878	C	32.2	0.88	878	E	69.2	1.07	652	D	35.4	0.95	873
Route 28 - SB	C	24.3	0.33	178	C	24.3	0.33	178	C	23.9	0.37	126	C	29.8	0.35	178
Warren Street - EB	D	44.5	0.91	549	D	44.5	0.91	549	C	25.9	0.78	468	C	33.2	0.79	553
Bank Exit – WB	C	23.7	0.24	62	C	23.7	0.24	113	B	16.5	0.10	50	C	23.3	0.19	62
Overall	**C**	**33.4**	**0.89**	**-**	**C**	**33.4**	**0.89**	**-**	**D**	**45.7**	**0.93**	**-**	**C**	**33.2**	**0.88**	**-**
Route 28 at Memorial Parkway																
Route 28 - NB	A	7.2	0.65	196	B	11.8	0.73	544	A	9.0	0.71	566	A	3.8	0.64	33
Route 28 - SB	B	13.1	0.29	122	C	20.2	0.48	188	B	17.4	0.33	180	A	2.3	0.21	34
Memorial Parkway - EB	C	26.6	0.58	98	C	20.3	0.64	97	C	29.3	0.61	97	D	46.9	0.66	125
Overall	**B**	**12.8**	**0.63**	**-**	**B**	**15.5**	**0.70**	**-**	**B**	**15.4**	**0.69**	**-**	**B**	**13.0**	**0.64**	**-**
Route 28 at S. Main/North																
Union Street - NB	C	28.3	0.82	411	B	18.0	0.74	374	B	19.9	0.62	381	B	18.5	0.54	361
Route 28 - SB	C	21.3	0.60	227	B	13.6	0.50	184	A	6.3	0.41	81	A	8.6	0.35	142
South Main Street - EB	B	16.7	0.59	345	D	49.3	1.02	396	C	28.9	0.73	345	D	50.4	0.70	260
North Street – WB	C	21.7	0.48	111	B	15.2	0.42	83	C	27.3	0.64	85	D	40.7	0.72	182
Overall	**C**	**22.9**	**0.62**	**-**	**C**	**23.5**	**0.73**	**-**	**B**	**18.9**	**0.59**	**-**	**C**	**25.6**	**0.53**	**-**

1. Delay measured in seconds.
2. V/C = volume/capacity ratio.
3. 95% queue, measured in feet.

TABLE 5
PM Peak Hour
Level-of-Service Summary

Intersection/Approach	Existing Conditions				Alternative 1				Alternative 2				Alternative 3			
	LOS	Delay[1]	V/C[2]	Q[3]	LOS	Delay	V/C	Q	LOS	Delay	V/C	Q	LOS	Delay	V/C	Q
Route 28 at Warren St																
Route 28 - NB	C	26.9	0.82	531	D	39.8	0.96	582	D	37.0	0.92	582	D	39.9	0.74	545
Route 28 - SB	C	30.9	0.71	419	C	34.6	0.75	468	D	36.1	0.77	480	E	55.9	0.87	554
Warren Street - EB	E	66.3	1.05	575	D	43.6	0.92	554	D	41.1	0.92	554	D	38.3	0.86	583
Bank Exit – WB	C	25.0	0.26	119	C	23.2	0.23	116	C	23.2	0.23	116	C	27.4	0.22	124
Overall	**D**	**38.2**	**0.89**	**-**	**D**	**37.7**	**0.92**	**-**	**D**	**36.8**	**0.90**	**-**	**D**	**44.8**	**0.85**	**-**
Route 28 at Memorial Parkway																
Route 28 - NB	B	12.9	0.81	195	A	7.7	0.67	168	A	9.0	0.69	86	B	16.6	0.72	67
Route 28 - SB	B	19.2	0.64	326	C	29.2	0.77	478	D	38.9	0.85	562	B	12.4	0.73	686
Memorial Parkway - EB	D	44.7	0.73	154	D	39.3	0.88	174	D	30.8	0.68	168	D	46.5	0.67	213
Overall	**C**	**24.9**	**0.90**	**183**	**C**	**24.6**	**0.78**	**-**	**C**	**25.6**	**0.79**	**-**	**C**	**24.6**	**0.77**	**-**
Route 28 at S. Main/North																
Union Street - NB	C	25.6	0.67	319	C	31.7	0.68	385	C	33.5	0.76	287	D	43.6	0.80	379
Route 28 - SB	D	44.6	0.99	640	D	53.1	1.00	772	E	58.4	1.11	568	E	74.7	1.15	745
South Main Street - EB	D	44.3	0.97	446	E	72.0	1.12	563	F	91.3	1.22	494	D	49.4	0.84	428
North Street – WB	F	219.7	1.53	436	F	84.1	1.08	451	D	50.5	1.05	600	E	59.3	1.05	675
Overall	**E**	**77.1**	**1.02**	**-**	**E**	**59.2**	**0.98**	**-**	**E**	**58.6**	**1.07**	**-**	**E**	**60.7**	**1.02**	**-**

1. Delay measured in seconds.
2. V/C = volume/capacity ratio.
3. 95% queue, measured in feet.

TABLE 6
AM Peak Hour
Energy Measures of Effectiveness

Intersection/MOE's	Existing	Alt. 1	Alt. 2	Alt. 3
Route 28 at Warren St				
Fuel Consumed (gal)	33	33	35	32
Fuel Economy (mpg)	9.5	9.5	9.1	9.9
CO Emissions (kg)	2.32	2.32	2.43	2.24
NOx Emissions (kg)	0.45	0.45	0.47	0.43
VOC Emissions (kg)	0.54	0.54	0.56	0.52
Route 28 at Memorial Parkway				
Fuel Consumed (gal)	18	21	20	15
Fuel Economy (mpg)	12.1	10.2	10.9	14.7
CO Emissions (kg)	1.26	1.49	1.39	1.04
NOx Emissions (kg)	0.25	0.29	0.27	0.20
VOC Emissions (kg)	0.29	0.35	0.32	0.24
Route 28 at S. Main/North				
Fuel Consumed (gal)	30	30	27	30
Fuel Economy (mpg)	7.8	8.0	8.7	7.8
CO Emissions (kg)	2.11	2.06	1.88	2.10
NOx Emissions (kg)	0.41	0.40	0.37	0.41
VOC Emissions (kg)	0.49	0.48	0.44	0.49
Route 28 Arterial				
Fuel Consumed (gal)	43	45	45	36
Fuel Economy (mpg)	9.7	9.2	9.3	11.6
CO Emissions (kg)	2.98	3.15	3.12	2.48
NOx Emissions (kg)	0.58	0.61	0.61	0.48
VOC Emissions (kg)	0.69	0.73	0.72	0.58

TABLE 7
PM Peak Hour
Energy Measures of Effectiveness

Intersection/MOE's	Existing	Alt. 1	Alt. 2	Alt. 3
Route 28 at Warren St				
Fuel Consumed (gal)	39	39	44	43
Fuel Economy (mpg)	8.4	8.4	7.5	7.7
CO Emissions (kg)	2.75	2.76	3.06	2.99
NOx Emissions (kg)	0.53	0.54	0.59	0.58
VOC Emissions (kg)	0.64	0.64	0.71	0.69
Route 28 at Memorial Parkway				
Fuel Consumed (gal)	40	39	42	39
Fuel Economy (mpg)	9.4	9.7	9.1	9.8
CO Emissions (kg)	2.82	2.74	2.90	2.70
NOx Emissions (kg)	0.55	0.53	0.56	0.52
VOC Emissions (kg)	0.65	0.63	0.67	0.62
Route 28 at S. Main/North				
Fuel Consumed (gal)	114	111	129	73
Fuel Economy (mpg)	2.9	3.0	2.6	4.5
CO Emissions (kg)	7.96	7.73	9.02	5.12
NOx Emissions (kg)	1.55	1.50	1.75	1.00
VOC Emissions (kg)	1.84	1.79	2.09	1.19
Route 28 Arterial				
Fuel Consumed (gal)	106	115	143	81
Fuel Economy (mpg)	5.3	4.8	3.9	6.9
CO Emissions (kg)	7.40	8.06	10.03	5.63
NOx Emissions (kg)	1.44	1.57	1.95	1.10
VOC Emissions (kg)	1.72	1.87	2.32	1.30

Appendix A

Universe of Potential Signal Coordination Locations

Universe of Intersection Locations

Town/City	Location	2005-2007 # Crashes	EPDO*
Burlington	Route 3A @ Francis Wyman Rd. (Route 62)	3	3
Burlington	Route 3A @ Wilmington Rd. (Route 62)	3	15
Danvers	Conant St @ Poplar St.	2	6
Danvers	Conant St @ Elliott St	6	18
Hingham	Route 3A @ Kilby St	1	5
Hingham	Route 3 A @ Summer St	1	5
Bedford	**Route 4/225 @ Great Road Shopping Center**	**6**	**10**
Bedford	**Route 4/225 @ Shawsheen Rd**	**10**	**18**
Lexington	**Route 4/225 @ Hartwell Ave.**	**36**	**68**
Maynard	Acton St @ Main St and Summer St	5	5
Maynard	Acton St @ Powder Mill Rd	7	15
Randolph	**Route 28 @ Warren St**	**44**	**76**
Randolph	**Route 28 @ Memorial Ave**	**19**	**35**
Randolph	**Route 28 @ N. Main St**	**43**	**67**
Weymouth	**Route 53 @ Pleasant St**	**96**	**64**
Weymouth	**Route 53 @ Mutton Lane**	**28**	**40**
Braintree	**Washington St @ Common St**	**12**	**36**
Braintree	**Washington St @ Ramp E**	**22**	**62**
Braintree	**Washington St @ Independence Ave**	**14**	**26**
Peabody	Route 114 @ Cross St	6	10
Peabody	Route 114 @ North Shore Mall	7	7
Peabody	Route 114 @ Loris St	6	18

***EPDO - Equivalent Property Damage Only**

EPDO = 10*Fatal Crashes + 5*Injury Crashes + 1*Other Crashes (Property Damage Only or Not Reported)

Appendix B

Correspondence

Mark Abbott

From: Raphael, Connie (MHD) [Connie.Raphael@state.ma.us]
Sent: Monday, June 08, 2009 11:55 AM
To: Mark Abbott
Cc: Kulen, Raj (MHD)
Subject: RE: District 4 Arterial Intersections

Sorry for the delay in getting back to you. Our traffic engineers were out of the office most of last week.

We agree with the Route4/225 at Shawsheen Road and Home Goods plaza. The intersection at Hartwell Road is fairly far away and our concern there is back up toward Route 128. So if you include Hartwell be sure to check the queuing.

The Weymouth locations are another good choice.

Our traffic section has two other suggestions.

Braintree - Washington Street at Ramp E; Washington Street at Presidential/Common Street; and Washington Street at Church/Independence and Ramp F

Peabody - Route 114 at Cross; Route 114 at North Shore Mall; and Route 114 at Loris

Connie
-----Original Message-----
From: Mark Abbott [mailto:mabbott@ctps.org]
Sent: Monday, June 08, 2009 11:01 AM
To: 'Raphael, Connie (MHD)'
Subject: RE: District 4 Arterial Intersections

Connie,

Have you heard anything from Mike concerning any possible locations.

Two locations we've come up with are Route 4 in Lexington at Shawsheen Road and at the signal at the Home Goods shopping plaza. Also possibly inlcuding Brooksbie Road (unsignalized) and Hartwell Avenue. The other location is in Weymouth on Route 53 at Pleasant Street and at Mutton Lane signalized intersections. The Pleasant Street intersection is #70 on the MassHighway crash list.

What are you thoughts on these two locations.

Thanks,

Mark

-----Original Message-----
From: Raphael, Connie (MHD) [mailto:Connie.Raphael@state.ma.us]
Sent: Monday, June 01, 2009 3:33 PM
To: Mark Abbott
Subject: RE: District 4 Arterial Intersections

Hi Mark,

I referred the study material to Mike Karas, Manager of Traffic Operations. I will get back to you with any suggestions.

Connie

-----Original Message-----
From: Mark Abbott [mailto:mabbott@ctps.org]

Sent: Monday, June 01, 2009 3:25 PM
To: Raphael, Connie (MHD)
Subject: District 4 Arterial Intersections

Connie,

We (CTPS) has a study to look at signal improvements and coordination at several locations. I've attached the scope of work that was approved for this study, so you can have a better understanding of the study.

Efi and I are wondering if you have any possible suggestions of intersections which we could include in this study. Please let me know.

Thanks,

Mark S. Abbott, P.E.
Central Transportation Planning Staff
10 Park Plaza, Suite 2150
Boston, MA. 02116
email: mabbott@ctps.org
phone: 617-973-7095
fax: 617-973-8855

Appendix C

Turning Movement Counts

CTPS
ARTERIAL INTERSECTIONS
Randolph
Route 28 at Warren Street

Counter:
Counted By: Tom Engle
Weather:
Other:

File Name : Route 28 at Warren Street - AM
Site Code : 06170201
Start Date : 06/17/2009
Page No : 1

Groups Printed- Cars - Trucks

	ROUTE 28 Northbound					ROUTE 28 Southbound					WARREN STREET Eastbound					BANK EXIT Westbound					
Start Time	Left	Thru	Right	Peds	App. Total	Left	Thru	Right	Peds	App. Total	Left	Thru	Right	Peds	App. Total	Left	Thru	Right	Peds	App. Total	Int. Total
Factor	1.0	1.0	1.0	1.0		1.0	1.0	1.0	1.0		1.0	1.0	1.0	1.0		1.0	1.0	1.0	1.0		
07:00 AM	73	199	0	1	273	0	102	25	1	128	92	0	40	1	133	2	4	3	0	9	543
07:15 AM	82	174	0	0	256	0	99	22	3	124	85	0	41	1	127	9	8	5	1	23	530
07:30 AM	55	173	0	0	228	0	79	27	1	107	88	0	48	1	137	1	12	6	3	22	494
07:45 AM	65	152	0	0	217	0	88	14	1	103	105	0	53	0	158	2	7	2	2	13	491
Total	275	698	0	1	974	0	368	88	6	462	370	0	182	3	555	14	31	16	6	67	2058
08:00 AM	64	165	0	0	229	0	76	23	2	101	113	0	41	4	158	4	8	3	1	16	504
08:15 AM	50	167	0	0	217	0	96	27	1	124	104	0	52	7	163	2	6	3	0	11	515
08:30 AM	61	154	0	0	215	0	98	21	0	119	80	0	44	0	124	1	7	1	1	10	468
08:45 AM	42	148	0	1	191	0	103	30	2	135	87	0	37	1	125	4	9	4	6	23	474
Total	217	634	0	1	852	0	373	101	5	479	384	0	174	12	570	11	30	11	8	60	1961
Grand Total	492	1332	0	2	1826	0	741	189	11	941	754	0	356	15	1125	25	61	27	14	127	4019
Apprch %	26.9	72.9	0.0	0.1		0.0	78.7	20.1	1.2		67.0	0.0	31.6	1.3		19.7	48.0	21.3	11.0		
Total %	12.2	33.1	0.0	0.0	45.4	0.0	18.4	4.7	0.3	23.4	18.8	0.0	8.9	0.4	28.0	0.6	1.5	0.7	0.3	3.2	

CTPS
ARTERIAL INTERSECTIONS
Randolph
Route 28 at Warren Street

File Name : Route 28 at Warren Street - AM
Site Code : 06170201
Start Date : 06/17/2009
Page No : 2

	ROUTE 28 Northbound					ROUTE 28 Southbound					WARREN STREET Eastbound					BANK EXIT Westbound					
Start Time	Left	Thru	Right	Peds	App. Total	Left	Thru	Right	Peds	App. Total	Left	Thru	Right	Peds	App. Total	Left	Thru	Right	Peds	App. Total	Int. Total
Peak Hour From 07:00 AM to 08:45 AM - Peak 1 of 1																					
Intersection	07:00 AM																				
Volume	275	698	0	1	974	0	368	88	6	462	370	0	182	3	555	14	31	16	6	67	2058
Percent	28.2	71.7	0.0	0.1		0.0	79.7	19.0	1.3		66.7	0.0	32.8	0.5		20.9	46.3	23.9	9.0		
07:00 Volume	73	199	0	1	273	0	102	25	1	128	92	0	40	1	133	2	4	3	0	9	543
Peak Factor																					0.948
High Int.	07:00 AM					07:00 AM					07:45 AM					07:15 AM					
Volume	73	199	0	1	273	0	102	25	1	128	105	0	53	0	158	9	8	5	1	23	
Peak Factor					0.892					0.902					0.878					0.728	

CTPS
ARTERIAL INTERSECTIONS
Randolph
Route 28 at Warren Street

File Name : Route 28 at Warren Street - AM
Site Code : 06170201
Start Date : 06/17/2009

Groups Printed- Trucks

	ROUTE 28 Northbound					ROUTE 28 Southbound					WARREN STREET Eastbound					BANK EXIT Westbound					
Start Time	Left	Thru	Right	Peds	App. Total	Left	Thru	Right	Peds	App. Total	Left	Thru	Right	Peds	App. Total	Left	Thru	Right	Peds	App. Total	Int. Total
Factor	1.0	1.0	1.0	1.0		1.0	1.0	1.0	1.0		1.0	1.0	1.0	1.0		1.0	1.0	1.0	1.0		
07:00 AM	6	12	0	0	18	0	4	3	0	7	2	0	2	0	4	0	0	0	0	0	29
07:15 AM	10	7	0	0	17	0	4	1	0	5	1	0	1	0	2	0	0	0	0	0	24
07:30 AM	1	7	0	0	8	0	7	2	0	9	2	0	2	0	4	0	0	0	0	0	21
07:45 AM	2	6	0	0	8	0	3	0	0	3	2	0	4	0	6	0	0	0	0	0	17
Total	19	32	0	0	51	0	18	6	0	24	7	0	9	0	16	0	0	0	0	0	91
08:00 AM	3	8	0	0	11	0	2	0	0	2	1	0	3	0	4	0	0	0	0	0	17
08:15 AM	1	8	0	0	9	0	7	0	0	7	4	0	8	0	12	0	0	0	0	0	28
08:30 AM	6	12	0	0	18	0	3	1	0	4	1	0	5	0	6	0	0	0	0	0	28
08:45 AM	7	6	0	0	13	0	2	3	0	5	2	0	5	0	7	0	0	0	0	0	25
Total	17	34	0	0	51	0	14	4	0	18	8	0	21	0	29	0	0	0	0	0	98
Grand Total	36	66	0	0	102	0	32	10	0	42	15	0	30	0	45	0	0	0	0	0	189
Apprch %	35.3	64.7	0.0	0.0		0.0	76.2	23.8	0.0		33.3	0.0	66.7	0.0		0.0	0.0	0.0	0.0		
Total %	19.0	34.9	0.0	0.0	54.0	0.0	16.9	5.3	0.0	22.2	7.9	0.0	15.9	0.0	23.8	0.0	0.0	0.0	0.0	0.0	

CTPS
ARTERIAL INTERSECTIONS
Randolph
Route 28 at Warren Street

File Name : Route 28 at Warren Street - AM
Site Code : 06170201
Start Date : 06/17/2009
Page No : 2

	ROUTE 28 Northbound					ROUTE 28 Southbound					WARREN STREET Eastbound					BANK EXIT Westbound					
Start Time	Left	Thru	Right	Peds	App. Total	Left	Thru	Right	Peds	App. Total	Left	Thru	Right	Peds	App. Total	Left	Thru	Right	Peds	App. Total	Int. Total
Peak Hour From 07:00 AM to 08:45 AM - Peak 1 of 1																					
Intersection	08:00 AM																				
Volume	17	34	0	0	51	0	14	4	0	18	8	0	21	0	29	0	0	0	0	0	98
Percent	33.3	66.7	0.0	0.0		0.0	77.8	22.2	0.0		27.6	0.0	72.4	0.0		0.0	0.0	0.0	0.0		
08:30 Volume	6	12	0	0	18	0	3	1	0	4	1	0	5	0	6	0	0	0	0	0	28
Peak Factor																					0.875
High Int.	08:30 AM					08:15 AM					08:15 AM					6:45:00 AM					
Volume	6	12	0	0	18	0	7	0	0	7	4	0	8	0	12						
Peak Factor					0.708					0.643					0.604						

CTPS
ARTERIAL INTERSECTIONS
Randolph
Route 28 at Warren Street

File Name : Route 28 at Warren Street - AM
Site Code : 06170201
Start Date : 06/17/2009
Page No : 1

Groups Printed- Bikes

	ROUTE 28 Northbound					ROUTE 28 Southbound					WARREN STREET Eastbound					BANK EXIT Westbound					
Start Time	Left	Thru	Right	Peds	App. Total	Left	Thru	Right	Peds	App. Total	Left	Thru	Right	Peds	App. Total	Left	Thru	Right	Peds	App. Total	Int. Total
Factor	1.0	1.0	1.0	1.0		1.0	1.0	1.0	1.0		1.0	1.0	1.0	1.0		1.0	1.0	1.0	1.0		
07:00 AM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
07:15 AM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
07:30 AM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
07:45 AM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
08:00 AM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
08:15 AM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
08:30 AM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
08:45 AM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Grand Total	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Apprch %	0.0	0.0	0.0	0.0		0.0	0.0	0.0	0.0		0.0	0.0	0.0	0.0		0.0	0.0	0.0	0.0		
Total %																					

CTPS
ARTERIAL INTERSECTIONS
Randolph
Route 28 at Warren Street

Counter:
Counted By: Tom Engle
Weather:
Other:

File Name : Route 28 at Warren Street - PM
Site Code : 06170202
Start Date : 06/17/2009
Page No : 1

Groups Printed- Cars - Truck

	ROUTE 28 Northbound					ROUTE 28 Southbound					WARREN STREET Eastbound					BANK EXIT Westbound					
Start Time	Left	Thru	Right	Peds	App. Total	Left	Thru	Right	Peds	App. Total	Left	Thru	Right	Peds	App. Total	Left	Thru	Right	Peds	App. Total	Int. Total
Factor	1.0	1.0	1.0	1.0		1.0	1.0	1.0	1.0		1.0	1.0	1.0	1.0		1.0	1.0	1.0	1.0		
04:00 PM	43	125	0	0	168	0	190	27	2	219	84	0	52	1	137	4	11	11	7	33	557
04:15 PM	64	129	0	1	194	0	214	23	4	241	76	0	53	4	133	6	10	8	7	31	599
04:30 PM	54	114	0	0	168	0	180	34	1	215	60	0	48	6	114	3	10	10	1	24	521
04:45 PM	56	120	0	3	179	0	198	35	2	235	85	0	45	2	132	3	14	10	0	27	573
Total	217	488	0	4	709	0	782	119	9	910	305	0	198	13	516	16	45	39	15	115	2250
05:00 PM	50	131	0	1	182	0	206	36	1	243	84	0	61	6	151	7	20	10	2	39	615
05:15 PM	48	149	0	0	197	0	208	28	0	236	99	0	76	2	177	8	23	7	4	42	652
05:30 PM	49	132	0	0	181	0	180	33	3	216	80	0	43	3	126	3	14	8	3	28	551
05:45 PM	51	112	0	0	163	0	199	30	3	232	95	0	61	2	158	3	9	11	2	25	578
Total	198	524	0	1	723	0	793	127	7	927	358	0	241	13	612	21	66	36	11	134	2396
Grand Total	415	1012	0	5	1432	0	1575	246	16	1837	663	0	439	26	1128	37	111	75	26	249	4646
Apprch %	29.0	70.7	0.0	0.3		0.0	85.7	13.4	0.9		58.8	0.0	38.9	2.3		14.9	44.6	30.1	10.4		
Total %	8.9	21.8	0.0	0.1	30.8	0.0	33.9	5.3	0.3	39.5	14.3	0.0	9.4	0.6	24.3	0.8	2.4	1.6	0.6	5.4	

CTPS
ARTERIAL INTERSECTIONS
Randolph
Route 28 at Warren Street

File Name : Route 28 at Warren Street - PM
Site Code : 06170202
Start Date : 06/17/2009

	ROUTE 28 Northbound					ROUTE 28 Southbound					WARREN STREET Eastbound					BANK EXIT Westbound					
Start Time	Left	Thru	Right	Peds	App. Total	Left	Thru	Right	Peds	App. Total	Left	Thru	Right	Peds	App. Total	Left	Thru	Right	Peds	App. Total	Int. Total
Peak Hour From 04:00 PM to 05:45 PM - Peak 1 of 1																					
Intersection	05:00 PM																				
Volume	198	524	0	1	723	0	793	127	7	927	358	0	241	13	612	21	66	36	11	134	2396
Percent	27.4	72.5	0.0	0.1		0.0	85.5	13.7	0.8		58.5	0.0	39.4	2.1		15.7	49.3	26.9	8.2		
05:15 Volume	48	149	0	0	197	0	208	28	0	236	99	0	76	2	177	8	23	7	4	42	652
Peak Factor																					0.919
High Int.	05:15 PM					05:00 PM					05:15 PM					05:15 PM					
Volume	48	149	0	0	197	0	206	36	1	243	99	0	76	2	177	8	23	7	4	42	
Peak Factor					0.918					0.954					0.864					0.798	

CTPS
ARTERIAL INTERSECTIONS
Randolph
Route 28 at Warren Street

File Name : Route 28 at Warren Street - PM
Site Code : 06170202
Start Date : 06/17/2009
Page No : 1

Groups Printed- Truck

	ROUTE 28 Northbound					ROUTE 28 Southbound					WARREN STREET Eastbound					BANK EXIT Westbound					
Start Time	Left	Thru	Right	Peds	App. Total	Left	Thru	Right	Peds	App. Total	Left	Thru	Right	Peds	App. Total	Left	Thru	Right	Peds	App. Total	Int. Total
Factor	1.0	1.0	1.0	1.0		1.0	1.0	1.0	1.0		1.0	1.0	1.0	1.0		1.0	1.0	1.0	1.0		
04:00 PM	1	3	0	0	4	0	6	0	0	6	0	0	3	0	3	0	0	0	0	0	13
04:15 PM	2	5	0	1	8	0	5	0	0	5	1	0	2	0	3	0	0	0	0	0	16
04:30 PM	1	4	0	0	5	0	4	0	1	5	1	0	1	0	2	0	0	0	0	0	12
04:45 PM	2	4	0	1	7	0	3	0	1	4	0	0	0	1	1	0	0	0	0	0	12
Total	6	16	0	2	24	0	18	0	2	20	2	0	6	1	9	0	0	0	0	0	53
05:00 PM	3	2	0	0	5	0	3	0	1	4	2	0	1	0	3	0	0	0	0	0	12
05:15 PM	0	4	0	0	4	0	4	1	0	5	0	0	4	0	4	0	0	0	0	0	13
05:30 PM	0	6	0	0	6	0	4	1	1	6	1	0	0	0	1	0	0	0	0	0	13
05:45 PM	2	2	0	0	4	0	4	1	0	5	0	0	2	0	2	0	0	0	0	0	11
Total	5	14	0	0	19	0	15	3	2	20	3	0	7	0	10	0	0	0	0	0	49
Grand Total	11	30	0	2	43	0	33	3	4	40	5	0	13	1	19	0	0	0	0	0	102
Apprch %	25.6	69.8	0.0	4.7		0.0	82.5	7.5	10.0		26.3	0.0	68.4	5.3		0.0	0.0	0.0	0.0		
Total %	10.8	29.4	0.0	2.0	42.2	0.0	32.4	2.9	3.9	39.2	4.9	0.0	12.7	1.0	18.6	0.0	0.0	0.0	0.0	0.0	

CTPS
ARTERIAL INTERSECTIONS
Randolph
Route 28 at Warren Street

File Name : Route 28 at Warren Street - PM
Site Code : 06170202
Start Date : 06/17/2009
Page No : 2

	ROUTE 28 Northbound					ROUTE 28 Southbound					WARREN STREET Eastbound					BANK EXIT Westbound					
Start Time	Left	Thru	Right	Peds	App. Total	Left	Thru	Right	Peds	App. Total	Left	Thru	Right	Peds	App. Total	Left	Thru	Right	Peds	App. Total	Int. Total
Peak Hour From 04:00 PM to 05:45 PM - Peak 1 of 1																					
Intersection	04:00 PM																				
Volume	6	16	0	2	24	0	18	0	2	20	2	0	6	1	9	0	0	0	0	0	53
Percent	25.0	66.7	0.0	8.3		0.0	90.0	0.0	10.0		22.2	0.0	66.7	11.1		0.0	0.0	0.0	0.0		
04:15 Volume	2	5	0	1	8	0	5	0	0	5	1	0	2	0	3	0	0	0	0	0	16
Peak Factor																					0.828
High Int.	04:15 PM					04:00 PM					04:00 PM					3:45:00 PM					
Volume	2	5	0	1	8	0	6	0	0	6	0	0	3	0	3						
Peak Factor					0.750					0.833					0.750						

CTPS
ARTERIAL INTERSECTIONS
Randolph
Route 28 at Warren Street

File Name : Route 28 at Warren Street - PM
Site Code : 06170202
Start Date : 06/17/2009
Page No : 1

Groups Printed- Bike

	ROUTE 28 Northbound					ROUTE 28 Southbound					WARREN STREET Eastbound					BANK EXIT Westbound					
Start Time	Left	Thru	Right	Peds	App. Total	Left	Thru	Right	Peds	App. Total	Left	Thru	Right	Peds	App. Total	Left	Thru	Right	Peds	App. Total	Int. Total
Factor	1.0	1.0	1.0	1.0		1.0	1.0	1.0	1.0		1.0	1.0	1.0	1.0		1.0	1.0	1.0	1.0		
04:00 PM	0	0	0	0	0	0	0	0	1	1	0	0	0	0	0	0	0	0	0	0	1
04:15 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
04:30 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
04:45 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total	0	0	0	0	0	0	0	0	1	1	0	0	0	0	0	0	0	0	0	0	1
05:00 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
05:15 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
05:30 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
05:45 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Grand Total	0	0	0	0	0	0	0	0	1	1	0	0	0	0	0	0	0	0	0	0	1
Apprch %	0.0	0.0	0.0	0.0		0.0	0.0	0.0	100.0		0.0	0.0	0.0	0.0		0.0	0.0	0.0	0.0		
Total %	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	100.0	100.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	

CTPS
ARTERIAL INTERSECTIONS
Randolph
Route 28 at Memorial Parkway

Counter: DB400
Counted By: MSA
Weather: Cloudy
Other:

File Name : Route 28 at Memorial Parkway - AM
Site Code : 06180903
Start Date : 06/18/2009
Page No : 1

Groups Printed- Cars - Trucks

	ROUTE 28 Northbound					ROUTE 28 Southbound					MEMORIAL PARKWAY Eastbound					
Start Time	Left	Thru	Right	Peds	App. Total	Left	Thru	Right	Peds	App. Total	Left	Thru	Right	Peds	App. Total	Int. Total
Factor	1.0	1.0	1.0	1.0		1.0	1.0	1.0	1.0		1.0	1.0	1.0	1.0		
07:00 AM	63	236	0	8	307	0	86	19	3	108	53	0	57	2	112	527
07:15 AM	61	264	0	10	335	0	85	4	1	90	26	0	46	3	75	500
07:30 AM	56	260	0	1	317	0	94	7	1	102	6	0	46	1	53	472
07:45 AM	72	257	0	2	331	0	90	12	5	107	15	0	47	0	62	500
Total	252	1017	0	21	1290	0	355	42	10	407	100	0	196	6	302	1999
08:00 AM	55	222	0	1	278	0	83	7	1	91	22	0	53	0	75	444
08:15 AM	63	231	0	2	296	0	117	8	0	125	23	0	49	4	76	497
08:30 AM	73	207	0	0	280	0	105	14	2	121	23	0	63	0	86	487
08:45 AM	61	183	0	0	244	0	85	5	0	90	24	0	55	0	79	413
Total	252	843	0	3	1098	0	390	34	3	427	92	0	220	4	316	1841
Grand Total	504	1860	0	24	2388	0	745	76	13	834	192	0	416	10	618	3840
Apprch %	21.1	77.9	0.0	1.0		0.0	89.3	9.1	1.6		31.1	0.0	67.3	1.6		
Total %	13.1	48.4	0.0	0.6	62.2	0.0	19.4	2.0	0.3	21.7	5.0	0.0	10.8	0.3	16.1	

CTPS
ARTERIAL INTERSECTIONS
Randolph
Route 28 at Memorial Parkway

File Name : Route 28 at Memorial Parkway - AM
Site Code : 06180903
Start Date : 06/18/2009

	ROUTE 28 Northbound					ROUTE 28 Southbound					MEMORIAL PARKWAY Eastbound					
Start Time	Left	Thru	Right	Peds	App. Total	Left	Thru	Right	Peds	App. Total	Left	Thru	Right	Peds	App. Total	Int. Total
Peak Hour From 07:00 AM to 08:45 AM - Peak 1 of 1																
Intersection	07:00 AM															
Volume	252	1017	0	21	1290	0	355	42	10	407	100	0	196	6	302	1999
Percent	19.5	78.8	0.0	1.6		0.0	87.2	10.3	2.5		33.1	0.0	64.9	2.0		
07:00 Volume	63	236	0	8	307	0	86	19	3	108	53	0	57	2	112	527
Peak Factor																0.948
High Int.	07:15 AM					07:00 AM					07:00 AM					
Volume	61	264	0	10	335	0	86	19	3	108	53	0	57	2	112	
Peak Factor					0.963					0.942					0.674	

CTPS
ARTERIAL INTERSECTIONS
Randolph
Route 28 at Memorial Parkway

File Name : Route 28 at Memorial Parkway - AM
Site Code : 06180903
Start Date : 06/18/2009
Page No : 1

Groups Printed- Trucks

	ROUTE 28 Northbound					ROUTE 28 Southbound					MEMORIAL PARKWAY Eastbound					
Start Time	Left	Thru	Right	Peds	App. Total	Left	Thru	Right	Peds	App. Total	Left	Thru	Right	Peds	App. Total	Int. Total
Factor	1.0	1.0	1.0	1.0		1.0	1.0	1.0	1.0		1.0	1.0	1.0	1.0		
07:00 AM	2	18	0	0	20	0	9	0	0	9	0	0	2	0	2	31
07:15 AM	5	14	0	0	19	0	10	0	0	10	0	0	1	0	1	30
07:30 AM	2	10	0	0	12	0	6	0	0	6	0	0	1	0	1	19
07:45 AM	1	8	0	0	9	0	9	0	0	9	1	0	1	0	2	20
Total	10	50	0	0	60	0	34	0	0	34	1	0	5	0	6	100
08:00 AM	3	16	0	0	19	0	7	0	0	7	0	0	4	0	4	30
08:15 AM	1	14	0	0	15	0	6	0	0	6	0	0	2	0	2	23
08:30 AM	1	16	0	0	17	0	8	0	0	8	0	0	5	0	5	30
08:45 AM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total	5	46	0	0	51	0	21	0	0	21	0	0	11	0	11	83
Grand Total	15	96	0	0	111	0	55	0	0	55	1	0	16	0	17	183
Apprch %	13.5	86.5	0.0	0.0		0.0	100.0	0.0	0.0		5.9	0.0	94.1	0.0		
Total %	8.2	52.5	0.0	0.0	60.7	0.0	30.1	0.0	0.0	30.1	0.5	0.0	8.7	0.0	9.3	

CTPS
ARTERIAL INTERSECTIONS
Randolph
Route 28 at Memorial Parkway

File Name : Route 28 at Memorial Parkway - AM
Site Code : 06180903
Start Date : 06/18/2009

	ROUTE 28 Northbound					ROUTE 28 Southbound					MEMORIAL PARKWAY Eastbound					
Start Time	Left	Thru	Right	Peds	App. Total	Left	Thru	Right	Peds	App. Total	Left	Thru	Right	Peds	App. Total	Int. Total
Peak Hour From 07:00 AM to 08:45 AM - Peak 1 of 1																
Intersection	07:45 AM															
Volume	6	54	0	0	60	0	30	0	0	30	1	0	12	0	13	103
Percent	10.0	90.0	0.0	0.0		0.0	100.0	0.0	0.0		7.7	0.0	92.3	0.0		
08:30 Volume	1	16	0	0	17	0	8	0	0	8	0	0	5	0	5	30
Peak Factor																0.858
High Int.	08:00 AM					07:45 AM					08:30 AM					
Volume	3	16	0	0	19	0	9	0	0	9	0	0	5	0	5	
Peak Factor					0.789					0.833					0.650	

CTPS
ARTERIAL INTERSECTIONS
Randolph
Route 28 at Memorial Parkway

Counter: D-2792
Counted By: Tom Engle
Weather:
Other:

File Name : Route 28 at Memorial Parkway - PM
Site Code : 06250302
Start Date : 06/25/2009
Page No : 1

Groups Printed- Cars - Trucks

	ROUTE 28 Northbound					MEMORIAL PARKWAY Eastbound					Westbound					
Start Time	Left	Thru	Right	Peds	App. Total	Left	Thru	Right	Peds	App. Total	Left	Thru	Right	Peds	App. Total	Int. Total
Factor	1.0	1.0	1.0	1.0		1.0	1.0	1.0	1.0		1.0	1.0	1.0	1.0		
04:00 PM	53	172	0	1	226	0	188	14	7	209	23	0	105	1	129	564
04:15 PM	44	173	0	3	220	0	180	21	5	206	41	0	108	4	153	579
04:30 PM	77	183	0	4	264	0	188	7	7	202	37	0	97	6	140	606
04:45 PM	69	202	0	5	276	0	168	18	4	190	44	0	114	3	161	627
Total	243	730	0	13	986	0	724	60	23	807	145	0	424	14	583	2376
05:00 PM	66	165	0	1	232	0	210	16	1	227	41	0	117	3	161	620
05:15 PM	80	178	4	7	269	0	221	14	6	241	38	0	78	4	120	630
05:30 PM	71	173	0	8	252	0	204	12	6	222	43	0	132	3	178	652
05:45 PM	83	176	0	0	259	0	204	18	4	226	33	0	92	2	127	612
Total	300	692	4	16	1012	0	839	60	17	916	155	0	419	12	586	2514
Grand Total	543	1422	4	29	1998	0	1563	120	40	1723	300	0	843	26	1169	4890
Apprch %	27.2	71.2	0.2	1.5		0.0	90.7	7.0	2.3		25.7	0.0	72.1	2.2		
Total %	11.1	29.1	0.1	0.6	40.9	0.0	32.0	2.5	0.8	35.2	6.1	0.0	17.2	0.5	23.9	

CTPS
ARTERIAL INTERSECTIONS
Randolph
Route 28 at Memorial Parkway

File Name : Route 28 at Memorial Parkway - PM
Site Code : 06250302
Start Date : 06/25/2009
Page No : 2

	ROUTE 28 Northbound					MEMORIAL PARKWAY Eastbound					Westbound					
Start Time	Left	Thru	Right	Peds	App. Total	Left	Thru	Right	Peds	App. Total	Left	Thru	Right	Peds	App. Total	Int. Total
Peak Hour From 04:00 PM to 05:45 PM - Peak 1 of 1																
Intersection	04:45 PM															
Volume	286	718	4	21	1029	0	803	60	17	880	166	0	441	13	620	2529
Percent	27.8	69.8	0.4	2.0		0.0	91.3	6.8	1.9		26.8	0.0	71.1	2.1		
05:30 Volume	71	173	0	8	252	0	204	12	6	222	43	0	132	3	178	652
Peak Factor																0.970
High Int.	04:45 PM					05:15 PM					05:30 PM					
Volume	69	202	0	5	276	0	221	14	6	241	43	0	132	3	178	
Peak Factor					0.932					0.913					0.871	

CTPS
ARTERIAL INTERSECTIONS
Randolph
Route 28 at Memorial Parkway

File Name : Route 28 at Memorial Parkway - PM
Site Code : 06250302
Start Date : 06/25/2009

Groups Printed- Trucks

	ROUTE 28 Northbound					MEMORIAL PARKWAY Eastbound					Westbound					
Start Time	Left	Thru	Right	Peds	App. Total	Left	Thru	Right	Peds	App. Total	Left	Thru	Right	Peds	App. Total	Int. Total
Factor	1.0	1.0	1.0	1.0		1.0	1.0	1.0	1.0		1.0	1.0	1.0	1.0		
04:00 PM	2	5	0	0	7	0	9	0	1	10	1	0	3	0	4	21
04:15 PM	1	9	0	0	10	0	12	0	0	12	0	0	5	0	5	27
04:30 PM	1	12	0	0	13	0	6	1	0	7	0	0	3	0	3	23
04:45 PM	0	4	0	1	5	0	14	1	0	15	0	0	3	0	3	23
Total	4	30	0	1	35	0	41	2	1	44	1	0	14	0	15	94
05:00 PM	1	3	0	1	5	0	6	0	0	6	0	0	2	0	2	13
05:15 PM	0	2	0	0	2	0	9	1	0	10	0	0	0	0	0	12
05:30 PM	1	4	0	0	5	0	6	0	0	6	0	0	3	0	3	14
05:45 PM	0	5	0	0	5	0	6	0	0	6	0	0	0	0	0	11
Total	2	14	0	1	17	0	27	1	0	28	0	0	5	0	5	50
Grand Total	6	44	0	2	52	0	68	3	1	72	1	0	19	0	20	144
Apprch %	11.5	84.6	0.0	3.8		0.0	94.4	4.2	1.4		5.0	0.0	95.0	0.0		
Total %	4.2	30.6	0.0	1.4	36.1	0.0	47.2	2.1	0.7	50.0	0.7	0.0	13.2	0.0	13.9	

CTPS
ARTERIAL INTERSECTIONS
Randolph
Route 28 at Memorial Parkway

File Name : Route 28 at Memorial Parkway - PM
Site Code : 06250302
Start Date : 06/25/2009

	ROUTE 28 Northbound					MEMORIAL PARKWAY Eastbound					Westbound					
Start Time	Left	Thru	Right	Peds	App. Total	Left	Thru	Right	Peds	App. Total	Left	Thru	Right	Peds	App. Total	Int. Total
Peak Hour From 04:00 PM to 05:45 PM - Peak 1 of 1																
Intersection	04:00 PM															
Volume	4	30	0	1	35	0	41	2	1	44	1	0	14	0	15	94
Percent	11.4	85.7	0.0	2.9		0.0	93.2	4.5	2.3		6.7	0.0	93.3	0.0		
04:15 Volume	1	9	0	0	10	0	12	0	0	12	0	0	5	0	5	27
Peak Factor																0.870
High Int.	04:30 PM					04:45 PM					04:15 PM					
Volume	1	12	0	0	13	0	14	1	0	15	0	0	5	0	5	
Peak Factor					0.673					0.733					0.750	

CTPS
ARTERIAL INTERSECTIONS
Randolph
Route 28 at Memorial Parkway

File Name : Route 28 at Memorial Parkway - PM
Site Code : 06250302
Start Date : 06/25/2009

Groups Printed- Trucks - Bikes

	ROUTE 28 Northbound					MEMORIAL PARKWAY Eastbound					Westbound					
Start Time	Left	Thru	Right	Peds	App. Total	Left	Thru	Right	Peds	App. Total	Left	Thru	Right	Peds	App. Total	Int. Total
Factor	1.0	1.0	1.0	1.0		1.0	1.0	1.0	1.0		1.0	1.0	1.0	1.0		
04:00 PM	2	5	0	0	7	0	9	0	1	10	1	0	3	0	4	21
04:15 PM	1	10	0	0	11	0	12	0	0	12	0	0	5	0	5	28
04:30 PM	1	12	0	0	13	0	6	1	0	7	0	0	3	0	3	23
04:45 PM	0	4	0	1	5	0	15	1	0	16	0	0	3	0	3	24
Total	4	31	0	1	36	0	42	2	1	45	1	0	14	0	15	96
05:00 PM	1	3	0	1	5	0	6	0	0	6	0	0	2	0	2	13
05:15 PM	0	2	0	0	2	0	9	1	0	10	0	0	0	0	0	12
05:30 PM	1	4	0	0	5	0	6	0	0	6	0	0	3	0	3	14
05:45 PM	0	5	0	0	5	0	6	0	0	6	0	0	0	0	0	11
Total	2	14	0	1	17	0	27	1	0	28	0	0	5	0	5	50
Grand Total	6	45	0	2	53	0	69	3	1	73	1	0	19	0	20	146
Apprch %	11.3	84.9	0.0	3.8		0.0	94.5	4.1	1.4		5.0	0.0	95.0	0.0		
Total %	4.1	30.8	0.0	1.4	36.3	0.0	47.3	2.1	0.7	50.0	0.7	0.0	13.0	0.0	13.7	

CTPS
ARTERIAL INTERSECTIONS

Counter: D-2792
Counted By: Stanley Genthner
Weather:
Other:

Randolph
Route 28 at Union/North Streets

File Name : Route 28 at Union-North Streets - AM
Site Code : 06170111
Start Date : 06/17/2009
Page No : 1

Groups Printed- Cars - Trucks

	Union Street Northbound					Route 28 (North Main Street) Southbound					Route 28 (South Main Street) Eastbound					North Street Westbound					
Start Time	Left	Thru	Right	Peds	App. Total	Left	Thru	Right	Peds	App. Total	Left	Thru	Right	Peds	App. Total	Left	Thru	Right	Peds	App. Total	Int. Total
Factor	1.0	1.0	1.0	1.0		1.0	1.0	1.0	1.0		1.0	1.0	1.0	1.0		1.0	1.0	1.0	1.0		
07:00 AM	1	203	14	1	219	9	91	31	10	141	79	71	10	5	165	6	16	17	3	42	567
07:15 AM	7	209	12	4	232	15	115	40	6	176	85	79	10	3	177	6	21	24	6	57	642
07:30 AM	2	206	18	1	227	5	118	37	3	163	83	97	7	3	190	12	35	14	0	61	641
07:45 AM	10	193	17	1	221	15	127	37	4	183	90	95	11	0	196	8	46	21	2	77	677
Total	20	811	61	7	899	44	451	145	23	663	337	342	38	11	728	32	118	76	11	237	2527
08:00 AM	11	192	18	2	223	5	81	57	0	143	96	87	12	0	195	10	33	26	1	70	631
08:15 AM	5	183	17	3	208	10	112	53	2	177	83	81	11	2	177	9	22	21	1	53	615
08:30 AM	16	193	18	5	232	13	105	51	2	171	88	60	9	1	158	9	46	23	1	79	640
08:45 AM	27	154	10	2	193	20	79	60	3	162	99	58	13	2	172	21	50	28	8	107	634
Total	59	722	63	12	856	48	377	221	7	653	366	286	45	5	702	49	151	98	11	309	2520
Grand Total	79	1533	124	19	1755	92	828	366	30	1316	703	628	83	16	1430	81	269	174	22	546	5047
Apprch %	4.5	87.4	7.1	1.1		7.0	62.9	27.8	2.3		49.2	43.9	5.8	1.1		14.8	49.3	31.9	4.0		
Total %	1.6	30.4	2.5	0.4	34.8	1.8	16.4	7.3	0.6	26.1	13.9	12.4	1.6	0.3	28.3	1.6	5.3	3.4	0.4	10.8	

CTPS
ARTERIAL INTERSECTIONS
Randolph
Route 28 at Union/North Streets

File Name : Route 28 at Union-North Streets - AM
Site Code : 06170111
Start Date : 06/17/2009

	Union Street Northbound					Route 28 (North Main Street) Southbound					Route 28 (South Main Street) Eastbound					North Street Westbound					
Start Time	Left	Thru	Right	Peds	App. Total	Left	Thru	Right	Peds	App. Total	Left	Thru	Right	Peds	App. Total	Left	Thru	Right	Peds	App. Total	Int. Total
Peak Hour From 07:00 AM to 08:45 AM - Peak 1 of 1																					
Intersection	07:15 AM																				
Volume	30	800	65	8	903	40	441	171	13	665	354	358	40	6	758	36	135	85	9	265	2591
Percent	3.3	88.6	7.2	0.9		6.0	66.3	25.7	2.0		46.7	47.2	5.3	0.8		13.6	50.9	32.1	3.4		
07:45 Volume	10	193	17	1	221	15	127	37	4	183	90	95	11	0	196	8	46	21	2	77	677
Peak Factor																					0.957
High Int.	07:15 AM					07:45 AM					07:45 AM					07:45 AM					
Volume	7	209	12	4	232	15	127	37	4	183	90	95	11	0	196	8	46	21	2	77	
Peak Factor					0.973					0.908					0.967					0.860	

CTPS
ARTERIAL INTERSECTIONS
Randolph
Route 28 at Union/North Streets

File Name : Route 28 at Union-North Streets - AM
Site Code : 06170111
Start Date : 06/17/2009
Page No : 1

Groups Printed- Trucks

	Union Street Northbound					Route 28 (North Main Street) Southbound					Route 28 (South Main Street) Eastbound					North Street Westbound					
Start Time	Left	Thru	Right	Peds	App. Total	Left	Thru	Right	Peds	App. Total	Left	Thru	Right	Peds	App. Total	Left	Thru	Right	Peds	App. Total	Int. Total
Factor	1.0	1.0	1.0	1.0		1.0	1.0	1.0	1.0		1.0	1.0	1.0	1.0		1.0	1.0	1.0	1.0		
07:00 AM	0	15	2	0	17	1	7	1	0	9	4	1	1	0	6	1	0	2	0	3	35
07:15 AM	0	18	1	1	20	2	7	2	0	11	2	3	0	0	5	1	2	2	0	5	41
07:30 AM	0	5	2	0	7	2	7	1	0	10	3	3	0	0	6	3	3	0	0	6	29
07:45 AM	2	8	1	0	11	1	6	3	0	10	0	2	0	0	2	1	2	1	0	4	27
Total	2	46	6	1	55	6	27	7	0	40	9	9	1	0	19	6	7	5	0	18	132
08:00 AM	1	6	3	0	10	2	7	1	0	10	5	0	0	0	5	2	3	1	0	6	31
08:15 AM	2	9	2	0	13	1	12	2	0	15	2	1	1	0	4	2	2	0	0	4	36
08:30 AM	2	16	3	0	21	1	8	2	0	11	7	4	0	0	11	2	4	1	0	7	50
08:45 AM	4	12	1	0	17	1	5	1	0	7	2	2	0	0	4	3	5	2	0	10	38
Total	9	43	9	0	61	5	32	6	0	43	16	7	1	0	24	9	14	4	0	27	155
Grand Total	11	89	15	1	116	11	59	13	0	83	25	16	2	0	43	15	21	9	0	45	287
Apprch %	9.5	76.7	12.9	0.9		13.3	71.1	15.7	0.0		58.1	37.2	4.7	0.0		33.3	46.7	20.0	0.0		
Total %	3.8	31.0	5.2	0.3	40.4	3.8	20.6	4.5	0.0	28.9	8.7	5.6	0.7	0.0	15.0	5.2	7.3	3.1	0.0	15.7	

CTPS
ARTERIAL INTERSECTIONS
Randolph
Route 28 at Union/North Streets

File Name : Route 28 at Union-North Streets - AM
Site Code : 06170111
Start Date : 06/17/2009

	Union Street Northbound					Route 28 (North Main Street) Southbound					Route 28 (South Main Street) Eastbound					North Street Westbound					
Start Time	Left	Thru	Right	Peds	App. Total	Left	Thru	Right	Peds	App. Total	Left	Thru	Right	Peds	App. Total	Left	Thru	Right	Peds	App. Total	Int. Total
Peak Hour From 07:00 AM to 08:45 AM - Peak 1 of 1																					
Intersection	08:00 AM																				
Volume	9	43	9	0	61	5	32	6	0	43	16	7	1	0	24	9	14	4	0	27	155
Percent	14.8	70.5	14.8	0.0		11.6	74.4	14.0	0.0		66.7	29.2	4.2	0.0		33.3	51.9	14.8	0.0		
08:30 Volume	2	16	3	0	21	1	8	2	0	11	7	4	0	0	11	2	4	1	0	7	50
Peak Factor																					0.775
High Int.	08:30 AM					08:15 AM					08:30 AM					08:45 AM					
Volume	2	16	3	0	21	1	12	2	0	15	7	4	0	0	11	3	5	2	0	10	
Peak Factor					0.726					0.717					0.545					0.675	

CTPS
ARTERIAL INTERSECTIONS
Randolph
Route 28 at Union/North Streets

File Name : Route 28 at Union-North Streets - AM
Site Code : 06170111
Start Date : 06/17/2009

Groups Printed- Bikes

	Union Street Northbound					Route 28 (North Main Street) Southbound					Route 28 (South Main Street) Eastbound					North Street Westbound					
Start Time	Left	Thru	Right	Peds	App. Total	Left	Thru	Right	Peds	App. Total	Left	Thru	Right	Peds	App. Total	Left	Thru	Right	Peds	App. Total	Int. Total
Factor	1.0	1.0	1.0	1.0		1.0	1.0	1.0	1.0		1.0	1.0	1.0	1.0		1.0	1.0	1.0	1.0		
07:00 AM	0	0	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
07:15 AM	0	0	0	1	1	0	0	0	1	1	0	0	0	1	1	0	0	0	0	0	3
07:30 AM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
07:45 AM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total	0	0	0	2	2	0	0	0	1	1	0	0	0	1	1	0	0	0	0	0	4
08:00 AM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
08:15 AM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1
08:30 AM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
08:45 AM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1
Grand Total	0	0	0	2	2	0	0	0	1	1	0	0	0	1	1	0	0	0	1	1	5
Apprch %	0.0	0.0	0.0	100.0		0.0	0.0	0.0	100.0		0.0	0.0	0.0	100.0		0.0	0.0	0.0	100.0		
Total %	0.0	0.0	0.0	40.0	40.0	0.0	0.0	0.0	20.0	20.0	0.0	0.0	0.0	20.0	20.0	0.0	0.0	0.0	20.0	20.0	

CTPS
ARTERIAL INTERSECTIONS

Counter: D-2792
Counted By: Stanley Genthner
Weather:
Other:

Randolph
Route 28 at Union/North Streets

File Name : Route 28 at Union-North Streets - PM
Site Code : 06170112
Start Date : 06/17/2009
Page No : 1

Groups Printed- Cars - Trucks

	Union Street Northbound					Route 28 (North Main Street) Southbound					Route 28 (South Main Street) Eastbound					North Street Westbound					
Start Time	Left	Thru	Right	Peds	App. Total	Left	Thru	Right	Peds	App. Total	Left	Thru	Right	Peds	App. Total	Left	Thru	Right	Peds	App. Total	Int. Total
Factor	1.0	1.0	1.0	1.0		1.0	1.0	1.0	1.0		1.0	1.0	1.0	1.0		1.0	1.0	1.0	1.0		
04:00 PM	11	105	15	2	133	22	197	126	0	345	83	45	15	6	149	20	69	42	1	132	759
04:15 PM	19	93	11	3	126	19	187	86	1	293	46	41	11	3	101	23	72	33	1	129	649
04:30 PM	7	118	15	1	141	26	187	85	2	300	55	64	16	0	135	24	102	34	6	166	742
04:45 PM	11	144	21	2	178	17	227	113	0	357	71	49	13	0	133	41	94	42	2	179	847
Total	48	460	62	8	578	84	798	410	3	1295	255	199	55	9	518	108	337	151	10	606	2997
05:00 PM	11	131	20	0	162	14	259	116	4	393	79	41	8	0	128	35	90	45	4	174	857
05:15 PM	15	181	15	1	212	16	261	110	0	387	79	55	13	2	149	30	103	57	4	194	942
05:30 PM	8	144	11	4	167	29	202	105	6	342	83	49	11	3	146	43	83	36	3	165	820
05:45 PM	10	124	13	0	147	32	165	110	2	309	64	67	10	2	143	21	64	42	2	129	728
Total	44	580	59	5	688	91	887	441	12	1431	305	212	42	7	566	129	340	180	13	662	3347
Grand Total	92	1040	121	13	1266	175	1685	851	15	2726	560	411	97	16	1084	237	677	331	23	1268	6344
Apprch %	7.3	82.1	9.6	1.0		6.4	61.8	31.2	0.6		51.7	37.9	8.9	1.5		18.7	53.4	26.1	1.8		
Total %	1.5	16.4	1.9	0.2	20.0	2.8	26.6	13.4	0.2	43.0	8.8	6.5	1.5	0.3	17.1	3.7	10.7	5.2	0.4	20.0	

CTPS
ARTERIAL INTERSECTIONS
Randolph
Route 28 at Union/North Streets

File Name : Route 28 at Union-North Streets - PM
Site Code : 06170112
Start Date : 06/17/2009

	Union Street Northbound					Route 28 (North Main Street) Southbound					Route 28 (South Main Street) Eastbound					North Street Westbound					
Start Time	Left	Thru	Right	Peds	App. Total	Left	Thru	Right	Peds	App. Total	Left	Thru	Right	Peds	App. Total	Left	Thru	Right	Peds	App. Total	Int. Total
Peak Hour From 04:00 PM to 05:45 PM - Peak 1 of 1																					
Intersection	04:45 PM																				
Volume	45	600	67	7	719	76	949	444	10	1479	312	194	45	5	556	149	370	180	13	712	3466
Percent	6.3	83.4	9.3	1.0		5.1	64.2	30.0	0.7		56.1	34.9	8.1	0.9		20.9	52.0	25.3	1.8		
05:15 Volume	15	181	15	1	212	16	261	110	0	387	79	55	13	2	149	30	103	57	4	194	942
Peak Factor																					0.920
High Int.	05:15 PM					05:00 PM					05:15 PM					05:15 PM					
Volume	15	181	15	1	212	14	259	116	4	393	79	55	13	2	149	30	103	57	4	194	
Peak Factor					0.848					0.941					0.933					0.918	

CTPS
ARTERIAL INTERSECTIONS
Randolph
Route 28 at Union/North Streets

File Name : Route 28 at Union-North Streets - PM
Site Code : 06170112
Start Date : 06/17/2009
Page No : 1

Groups Printed- Trucks

	Union Street Northbound					Route 28 (North Main Street) Southbound					Route 28 (South Main Street) Eastbound					North Street Westbound					
Start Time	Left	Thru	Right	Peds	App. Total	Left	Thru	Right	Peds	App. Total	Left	Thru	Right	Peds	App. Total	Left	Thru	Right	Peds	App. Total	Int. Total
Factor	1.0	1.0	1.0	1.0		1.0	1.0	1.0	1.0		1.0	1.0	1.0	1.0		1.0	1.0	1.0	1.0		
04:00 PM	1	2	2	0	5	2	9	2	0	13	1	2	0	0	3	2	1	2	0	5	26
04:15 PM	4	2	0	0	6	1	8	1	0	10	3	4	1	0	8	0	1	0	0	1	25
04:30 PM	1	5	0	0	6	1	5	1	0	7	2	1	0	0	3	2	2	0	0	4	20
04:45 PM	3	2	1	0	6	1	4	3	0	8	1	2	1	0	4	1	0	1	0	2	20
Total	9	11	3	0	23	5	26	7	0	38	7	9	2	0	18	5	4	3	0	12	91
05:00 PM	1	4	0	0	5	0	4	2	0	6	2	0	1	0	3	0	0	1	0	1	15
05:15 PM	0	1	0	0	1	0	6	2	0	8	2	0	0	0	2	1	1	1	0	3	14
05:30 PM	0	3	1	0	4	0	2	3	0	5	4	0	0	0	4	2	0	0	0	2	15
05:45 PM	0	2	0	0	2	0	4	2	0	6	3	1	2	0	6	0	1	0	0	1	15
Total	1	10	1	0	12	0	16	9	0	25	11	1	3	0	15	3	2	2	0	7	59
Grand Total	10	21	4	0	35	5	42	16	0	63	18	10	5	0	33	8	6	5	0	19	150
Apprch %	28.6	60.0	11.4	0.0		7.9	66.7	25.4	0.0		54.5	30.3	15.2	0.0		42.1	31.6	26.3	0.0		
Total %	6.7	14.0	2.7	0.0	23.3	3.3	28.0	10.7	0.0	42.0	12.0	6.7	3.3	0.0	22.0	5.3	4.0	3.3	0.0	12.7	

CTPS
ARTERIAL INTERSECTIONS
Randolph
Route 28 at Union/North Streets

File Name : Route 28 at Union-North Streets - PM
Site Code : 06170112
Start Date : 06/17/2009

	Union Street Northbound					Route 28 (North Main Street) Southbound					Route 28 (South Main Street) Eastbound					North Street Westbound					
Start Time	Left	Thru	Right	Peds	App. Total	Left	Thru	Right	Peds	App. Total	Left	Thru	Right	Peds	App. Total	Left	Thru	Right	Peds	App. Total	Int. Total
Peak Hour From 04:00 PM to 05:45 PM - Peak 1 of 1																					
Intersection	04:00 PM																				
Volume	9	11	3	0	23	5	26	7	0	38	7	9	2	0	18	5	4	3	0	12	91
Percent	39.1	47.8	13.0	0.0		13.2	68.4	18.4	0.0		38.9	50.0	11.1	0.0		41.7	33.3	25.0	0.0		
04:00 Volume	1	2	2	0	5	2	9	2	0	13	1	2	0	0	3	2	1	2	0	5	26
Peak Factor																					0.875
High Int.	04:15 PM					04:00 PM					04:15 PM					04:00 PM					
Volume	4	2	0	0	6	2	9	2	0	13	3	4	1	0	8	2	1	2	0	5	
Peak Factor					0.958					0.731					0.563					0.600	

CTPS
ARTERIAL INTERSECTIONS
Randolph
Route 28 at Union/North Streets

File Name : Route 28 at Union-North Streets - PM
Site Code : 06170112
Start Date : 06/17/2009
Page No : 1

Groups Printed- Bikes

	Union Street Northbound					Route 28 (North Main Street) Southbound					Route 28 (South Main Street) Eastbound					North Street Westbound					
Start Time	Left	Thru	Right	Peds	App. Total	Left	Thru	Right	Peds	App. Total	Left	Thru	Right	Peds	App. Total	Left	Thru	Right	Peds	App. Total	Int. Total
Factor	1.0	1.0	1.0	1.0		1.0	1.0	1.0	1.0		1.0	1.0	1.0	1.0		1.0	1.0	1.0	1.0		
04:00 PM	0	0	0	0	0	0	0	0	1	1	0	0	0	1	1	0	0	0	0	0	2
04:15 PM	0	0	0	1	1	0	0	0	0	0	0	0	0	1	1	0	0	0	0	0	2
04:30 PM	0	0	0	0	0	0	0	0	1	1	0	0	0	0	0	0	0	0	0	0	1
04:45 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1
Total	0	0	0	1	1	0	0	0	2	2	0	0	0	2	2	0	0	0	1	1	6
05:00 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
05:15 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
05:30 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
05:45 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	0	0	0	0	0	1
Total	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	0	0	0	0	0	1
Grand Total	0	0	0	1	1	0	0	0	2	2	0	0	0	3	3	0	0	0	1	1	7
Apprch %	0.0	0.0	0.0	100.0		0.0	0.0	0.0	100.0		0.0	0.0	0.0	100.0		0.0	0.0	0.0	100.0		
Total %	0.0	0.0	0.0	14.3	14.3	0.0	0.0	0.0	28.6	28.6	0.0	0.0	0.0	42.9	42.9	0.0	0.0	0.0	14.3	14.3	

Appendix D

MassDOT Intersection Crash Rate Worksheets

INTERSECTION CRASH RATE WORKSHEET

CITY/TOWN : Randolph COUNT DA˙ 6/17/2009

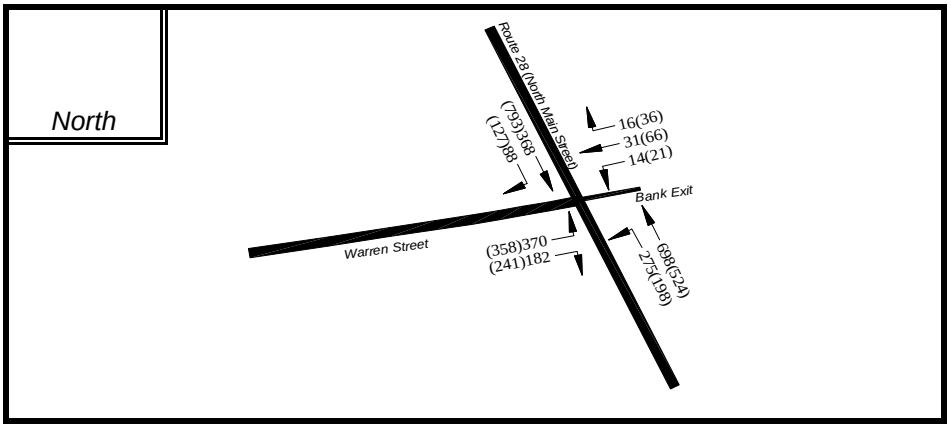
DISTRICT : 4 UNSIGNALIZED : SIGNALIZED : X

~ INTERSECTION DATA ~

MAJOR STREET : Route 28 (North Main Street)

MINOR STREET(S) : Warren Street

INTERSECTION DIAGRAM (Label Approaches)



PEAK HOUR VOLUMES

APPROACH :	1	2	3	4	5	Total Peak Hourly Approach Volume
DIRECTION :	NB	SB	EB	WB		
PEAK HOURLY VOLUMES (AM/PM)	722	920	599	123		2,364

" K " FACTOR : **0.090** INTERSECTION ADT (**V**) = TOTAL DAILY APPROACH VOLUME : **26,267**

TOTAL # OF CRASHES : 43 # OF YEARS : 3 AVERAGE # OF CRASHES PER YEAR (**A**) : **14.33**

CRASH RATE CALCULATION : **1.50** RATE = $\frac{(A * 1{,}000{,}000)}{(V * 365)}$

Comments : District 4 Average = 0.78

Project Title & Date: Arterial Intersections

INTERSECTION CRASH RATE WORKSHEET

CITY/TOWN : Randolph COUNT DA˙ 6/17/2009

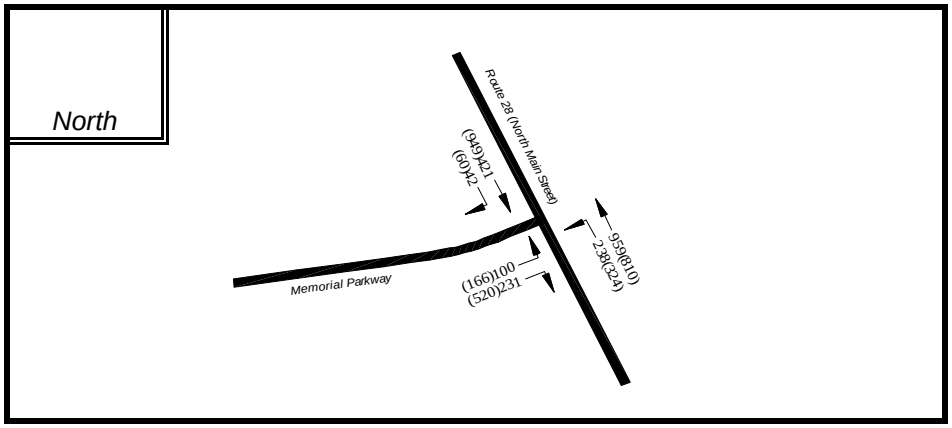
DISTRICT : 4 UNSIGNALIZED : SIGNALIZED : X

~ INTERSECTION DATA ~

MAJOR STREET : Route 28 (North Main Street)

MINOR STREET(S) : Memorial Parkway

INTERSECTION DIAGRAM (Label Approaches)



PEAK HOUR VOLUMES

APPROACH :	1	2	3	4	5	Total Peak Hourly Approach Volume
DIRECTION :	NB	SB	EB			
PEAK HOURLY VOLUMES (AM/PM)	1,134	1,009	686			**2,829**

" K " FACTOR :	**0.090**	INTERSECTION ADT (**V**) = TOTAL DAILY APPROACH VOLUME :			**31,433**
TOTAL # OF CRASHES :	19	# OF YEARS :	3	AVERAGE # OF CRASHES PER YEAR (**A**) :	**6.33**

CRASH RATE CALCULATION : **0.55** RATE = $\frac{(A * 1{,}000{,}000)}{(V * 365)}$

Comments : District 4 Average = 0.78

Project Title & Date: Arterial Intersections

INTERSECTION CRASH RATE WORKSHEET

CITY/TOWN : Randolph COUNT DA˙ 6/17/2009

DISTRICT : 4 UNSIGNALIZED : SIGNALIZED : X

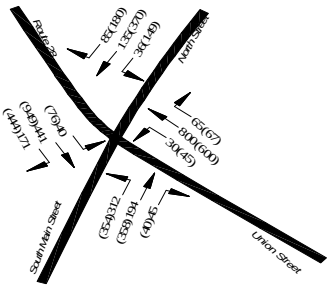
~ INTERSECTION DATA ~

MAJOR STREET : Route 28 (North Main Street)

MINOR STREET(S) : South Main Street/Union Street/North Street

INTERSECTION DIAGRAM (Label Approaches)

North



PEAK HOUR VOLUMES

APPROACH :	1	2	3	4	5	Total Peak Hourly Approach Volume
DIRECTION :	NB	SB	WB	SW		
PEAK HOURLY VOLUMES (AM/PM)	712	1,469	699	752		**3,632**

" K " FACTOR : **0.090** INTERSECTION ADT (**V**) = TOTAL DAILY APPROACH VOLUME : **40,356**

TOTAL # OF CRASHES : 43 # OF YEARS : 3 AVERAGE # OF CRASHES PER YEAR (**A**) : **14.33**

CRASH RATE CALCULATION : **0.97** RATE = $\frac{(A * 1{,}000{,}000)}{(V * 365)}$

Comments : District 4 Average = 0.78

Project Title & Date: Arterial Intersections

BOSTON REGION METROPOLITAN PLANNING ORGANIZATION

State Transportation Building
Ten Park Plaza, Suite 2150
Boston, MA 02116-3968
Tel. (617) 973-7100
Fax (617) 973-8855
TTY (617) 973-7089
www.bostonmpo.org

Richard A. Davey
MassDOT Secretary and CEO
and MPO Chairman

Karl H. Quackenbush
Executive Director, MPO Staff

MEMORANDUM

DATE **April 19, 2012**

TO **Boston Region Metropolitan Planning Organization**

FROM **Mark Abbott**

RE **Arterial Traffic Signal Improvements and Coordination Study: Weymouth**

BACKGROUND

This study was recommended by the Boston Region MPO's Congestion Management Process and was funded by the MPO in the federal fiscal year (FFY) 2010 Unified Planning Work Program.

Traffic signal coordination or synchronization promotes efficient traffic flow along an arterial roadway. Typically, arterial flow quality and efficiency is dictated by the level of service at traffic signals and the degree of coordination between them. Generally traffic flow can be improved by coordination when the signals are located within one-quarter of a mile of each other. Where traffic signals are coordinated, traffic moves in platoons along the road and, at certain speeds, can proceed through intersections without braking or stopping. In coordination, side street traffic and pedestrians must be considered, so that their needs for service through the coordinated intersections are met. A side benefit of coordination is enhanced safety through more efficient management and operation of the arterial signal systems.

The study's overall purpose was to evaluate three or four groups of arterial signalized intersections, consisting of two to three intersections each, throughout the region and to develop recommendations for improvements. The improvements were focused primarily on traffic signal coordination aimed at improving traffic flow and safety along the arterials. As part of the traffic signal coordination strategy, staff also considered geometric improvements and traffic signal design changes at the selected locations.

The process for selecting the groups of intersections for this study began with identifying traffic signals at intersections that are a quarter mile or less apart and that were included in the "Conceptual" or the "Pre-TIP" project category in the FFYs 2009–11 Transportation Improvement Program (TIP). Each location's crash history was also examined. In addition, staff asked MassDOT's Highway Division District 4 to suggest locations that they thought would be appropriate. A table showing the resultant universe of potential signal coordination locations is provided as Appendix A; correspondence with the District 4 traffic engineer is

provided as Appendix B. The locations were then examined to verify from a technical standpoint that signal coordination could potentially be implemented at them.

The final four groups of intersections selected by staff and District 4 through this process were then discussed with the MassDOT District 4 traffic engineer and the towns where the intersections are located. The final four signal groupings selected for this study were:

- *Braintree*
  Washington Street at Common Street/President Road; at Route 3 southbound off-ramp; and at Independence Avenue/Church Street

- *Lexington/Bedford*
  Route 4/225 at Hartwell Avenue; at Shawsheen Road; and at Great Road Shopping Center

- *Randolph*
  Route 28 (as North Main Street) at Warren Street; at Memorial Parkway; and (as South Main Street) at North and Union streets

- *Weymouth*
  Route 53 at Mutton Lane and at Pleasant Street

This memorandum provides information, analysis, and recommendations for the intersections located in Weymouth. Separate memoranda are provided for each of the signal groupings.

OVERVIEW OF THE STUDY AREA

The two Route 53 intersections chosen in Weymouth, Mutton Lane and Pleasant Street, are shown in Figure 1. They are currently signalized and are 0.16 miles (820 feet) apart. The functional classification of Route 53 and Pleasant Street is urban minor arterial. Mutton Lane is classified as a local road. Staff selected these locations following discussions with MassDOT's Highway Division, District 4, traffic engineers and George Bezkorovainy, Weymouth's Town Traffic Engineer; relevant correspondence is provided in Appendix B.

OBJECTIVES OF THE STUDY

The objectives for the locations in Weymouth were to assess whether signal coordination would, in fact, improve traffic operations and to identify other possible improvements that would reduce delays and enhance safety. Since Route 53 is a commuter route to Boston, peak traffic flows can cause delays for both commuters and local residents. This study investigated whether improving peak direction traffic flow with coordination would improve overall traffic operations and perceptions of travel time along Route 53.

BOSTON REGION MPO

FIGURE 1
Study Area Intersections

N

Arterial Traffic Signal Improvements and Coordination: Weymouth

blank back of Figure 1

EXISTING CONDITIONS

Note: Traffic volume data and crash analyses are provided in separate sections that follow.

Route 53 (Washington Street) at Mutton Lane

Layout

This is currently a four-way signalized intersection. The northbound and southbound Route 53 approaches have two general-purpose lanes. All movements are permitted on these approaches. On the southbound approach, the two lanes begin to be delineated approximately 75 feet from the stop line. The northbound approach has two lanes starting from the Pleasant Street intersection.

The eastbound Mutton Lane approach is a single lane with a shoulder. The shoulder width varies from ±7 feet at the intersection to ±1 foot farther away from the intersection. There is one departure lane on this leg of the intersection. The westbound Mutton Lane approach also contains one approach and one departure lane.

Crosswalks are provided across all four approaches. Sidewalks are present along both sides of Mutton Lane both east and west of the intersection. Along Route 53, sidewalks are present between the Mutton Lane and the Pleasant Street intersections on both sides of the street.

Land Use

Located on all four corners of the intersection are commercial businesses. On the northeast corner is Eastern Bank, on the southeast Basta Bar and Grill restaurant, on the northwest A&A Auto Radiator, and on the southwest Factory Collision and Restoration. A church is adjacent to the bank on Route 53 north of the intersection.

The land use along Route 53 between this intersection and the Pleasant Street intersection is mainly commercial, but a few residential buildings are mixed in. An Elks lodge is located on the western side of Route 53 approximately midway between the intersections with access to Route 53 and Pleasant Street.

Signal System

The intersection has a fully actuated signal system, with loop detectors provided on all approaches. It is designed as a three-phase signal operation with, additionally, an exclusive pedestrian phase provided upon pedestrian actuation. The southbound Route 53 approach traffic is controlled by a protected/permitted phase to accommodate left-turning vehicles followed by a phase for both northbound and southbound Route 53 movements proceeding concurrently. The Mutton Lane phase is a permitted phase for all movements in both directions. The cycle length of the intersection is 85 seconds, with 23-seconds added upon pedestrian phase actuation.

The signal heads are located on a span wire that runs from the northeastern corner of the intersection to the southwestern corner. The signal heads are standard three-section, 12-inch

heads, except for the southbound Route 53 approach, which has one five-section head. Pedestrian signals and push buttons are mounted on the span wire posts on all corners.

Observations of Operation

Peak-hour observations of the intersection indicate that generally it is operating acceptably. There is northbound queuing in the AM peak and southbound queuing in the PM peak, which is to be expected due to the nature of Route 53 in this area. Left-turning vehicles on Route 53 sometimes have difficulty making the turn due to the opposing through traffic. This is likely the cause of the number of rear-end and angle accidents identified in the crash analysis section.

Route 53 (Washington Street) at Pleasant Street

Layout

The Route 53 northbound and southbound approaches to the intersection consist of two general-purpose lanes each; on the northbound approach, the second lane does not begin until approximately 100 feet from the stop line.

The eastbound Pleasant Street approach has two lanes, with the delineation of the additional lane beginning approximately 60 feet from the stop line. Both lanes are general-purpose lanes. The westbound Pleasant Street approach has two lanes beginning approximately 100 feet from the stop line. Even though the approaches on Pleasant Street have two lanes, the departure lanes are essentially one lane (20 feet wide).

Crosswalks are provided on all four legs of the intersection. Sidewalks are present along both sides Route 53 and Pleasant Street.

Land Use

Two small shopping plazas are on the northeast and southwest corners of the intersection. A large storage facility, Extra Space Storage, is located on the southeast corner, and a residential property is located on the northwest corner.

Signal System

This is a four-way signalized intersection with the signal heads located on mast arms, which extend over Route 53 from the northwest and southeast corners of the intersection and control the Route 53 northbound and southbound approaches, respectively. An additional mast arm on the northeast corner provides signal indications for the eastbound Pleasant Street approach. A post-mounted signal head provides one of the signal indications for the westbound Pleasant Street approach. Pedestrian signal heads and push buttons are provided for all four crosswalks.

The intersection operates under a fully actuated signal system, with loop detectors provided on all approaches. It has two-phase signal operations, with concurrent pedestrian phases. The cycle

length of the intersection is 70 seconds, with both phases having maximum green times of 30 seconds.

Observations of Operation

Peak-hour field observations of this intersection indicated that traffic operations are generally acceptable. Queuing occurs in the peak directions along Route 53 during the peak hours; however, the queues are not excessive and do not spill back into another intersection. During both peak hours, queuing at the Pleasant Street approach is greater than at Mutton Lane due to the larger Pleasant Street volumes. The Route 53 left-turn movements have some difficulty, and this is the likely cause of the high number of rear-end and angle crashes (see crash analysis below).

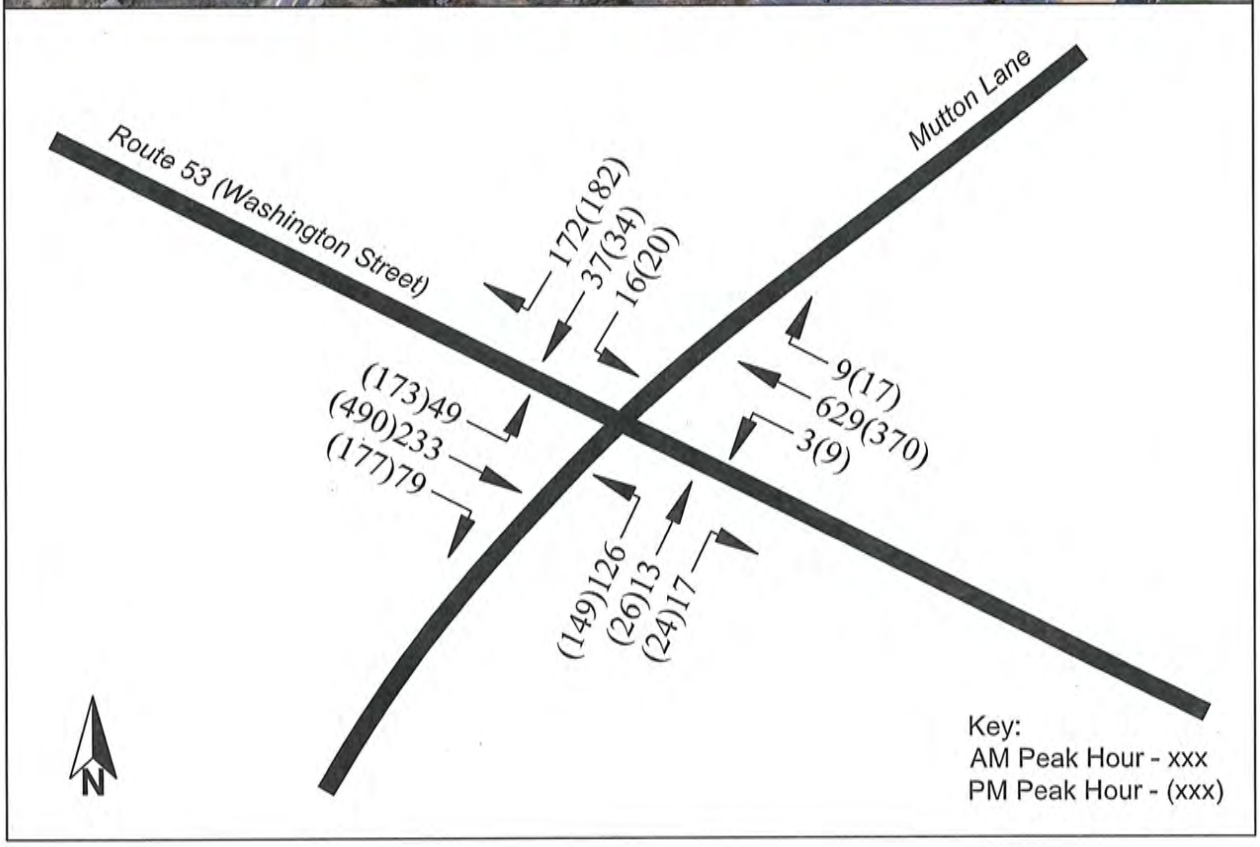
TRAFFIC VOLUMES

Traffic volumes for the intersections were collected via manual turning movement counts conducted on June 23, 2009, by MPO staff. Figure 2 shows the traffic volumes for the Mutton Lane intersection, Figure 3 those for the Pleasant Street intersection. Additional count data are in Appendix C.

CRASH ANALYSIS

Staff gathered the most recent three years of crash data for the two intersections that were available from Registry of Motor Vehicle records. Tables 1 and 2 provide the data for the Mutton Lane and Pleasant Street intersections, respectively.

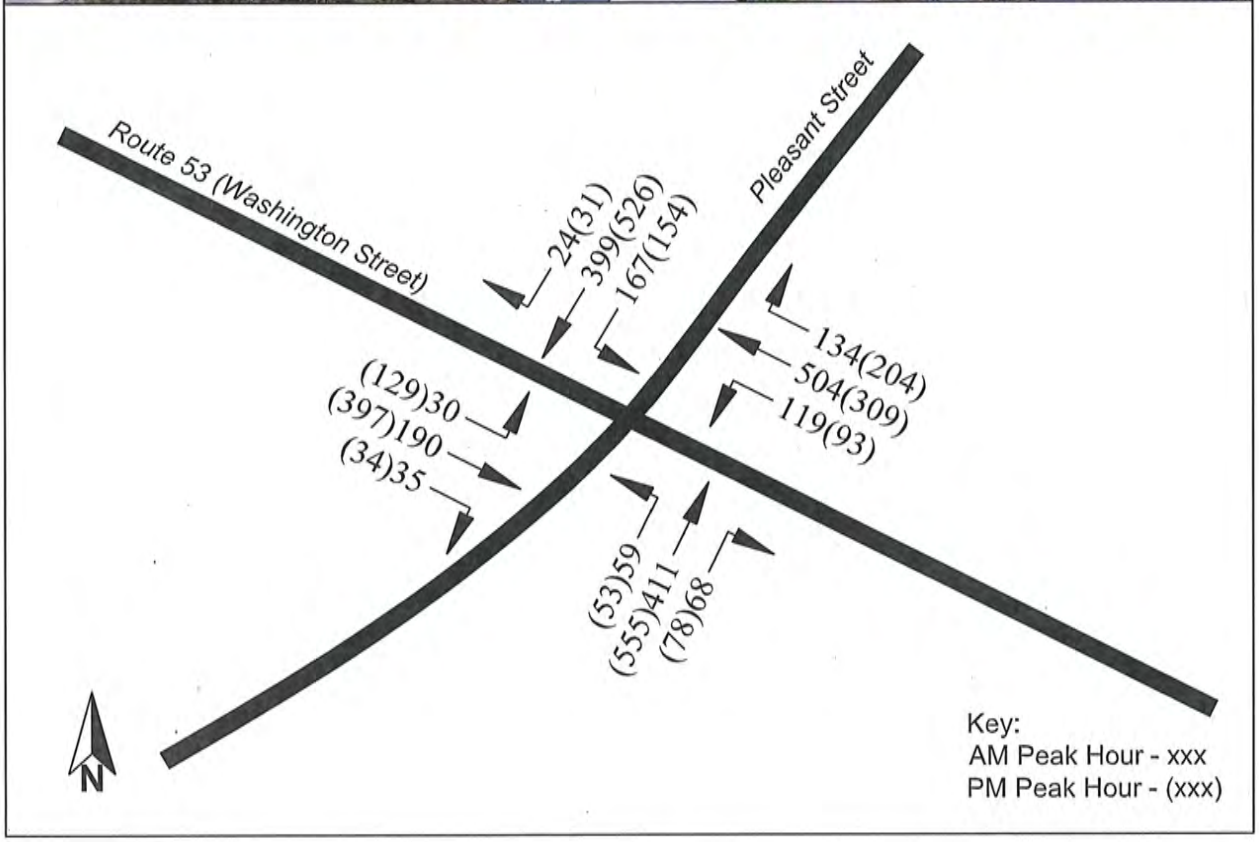
The Mutton Lane intersection had 28 crashes over the three-year period, averaging just over 9 crashes a year. The majority of the crashes resulted in property damage only, and most were the angle or rear-end type. The rear-end crashes are typical at signalized intersections, and the angle crashes are probably a result of the unprotected turning movements at the intersection. These types of accidents are particularly associated with congested intersections. No pedestrian or bicyclist was involved in any of the crashes. The crash rate for the Mutton Lane intersection, calculated using MassDOT's Intersection Crash Rate Worksheet (see Appendix D for crash worksheets), was 1.38, which is above the MassDOT Highway District 4 average of 0.78 for signalized intersections.



BOSTON REGION MPO

FIGURE 2
Route 53 at Mutton Lane: Traffic Volumes

Arterial Traffic Signal Improvements and Coordination: Weymouth



BOSTON REGION MPO

FIGURE 3
Route 53 at Pleasant Street: Traffic Volumes

Arterial Traffic Signal Improvements and Coordination: Weymouth

TABLE 1
Route 53 and Mutton Lane:
Summary of RMV Crash Data (2005–2007)

		2005	2006	2007	2005-2007 Total	2005-2007 Average
Total Number of Crashes		**10**	**9**	**9**	**28**	**9**
Crash Severity	Property Damage Only	8	7	8	**23**	8
	Personal Injury	2	1	0	**3**	1
	Fatality	0	0	0	**0**	0
	Not Reported	0	1	1	**2**	1
Collision Type	Angle	6	0	3	**9**	3
	Rear-end	0	7	3	**10**	3
	Sideswipe	2	1	2	**5**	2
	Head-on	1	0	0	**1**	0
	Single Vehicle	0	1	1	**2**	1
	Not Reported	1	0	0	**1**	0
Roadway Conditions	Wet or icy pavement	3	2	1	**6**	2
	Dark/lighted	4	0	0	**4**	1
Weather Conditions	Clear	6	6	8	**20**	7
	Cloudy	1	1	0	**2**	1
	Rain	2	2	0	**4**	1
	Snow	0	0	1	**1**	0
Crashes during weekday peak periods[1]		2	1	1	**4**	1
Crashes involving pedestrian(s)		0	0	0	**0**	0
Crashes involving bicyclist(s)		0	0	0	**0**	0

1. Peak periods are from 7:00 to 9:00 AM and 4:00 to 6:00 PM.

The Pleasant Street intersection has a three-year total of 96 crashes, with a majority resulting in property damage only. Information provided by Weymouth states that recently crash numbers had declined after MassDOT Highway Division installed back plates for the signal heads. The installation of the back plates reduced glare and could have helped drivers see the signal indications more clearly. Angle collisions are the predominant type of crash: 66 occurred at this intersection. Again, this probably can be attributed to the unprotected turning movements. The crash rate for this intersection is 3.08, well over the 0.78 District 4 average for signalized intersections.

TABLE 2
Route 53 and Pleasant Street:
Summary of RMV Crash Data (2005–2007)

		2005	2006	2007	2005-2007 Total	2005-2007 Average
Total Number of Crashes		**28**	**37**	**31**	**96**	**32**
Crash Severity	Property Damage Only	22	24	22	**68**	23
	Personal Injury	5	11	7	**23**	8
	Fatality	0	0	0	**0**	0
	Not Reported	1	2	2	**5**	2
Collision Type	Angle	14	31	21	**66**	22
	Rear-end	5	2	3	**10**	3
	Sideswipe	4	4	3	**11**	4
	Head-on	3	0	1	**4**	1
	Single Vehicle	1	0	2	**3**	1
	Not Reported	1	0	1	**2**	1
Roadway Conditions	Wet or icy pavement	11	8	8	**27**	9
	Dark/lighted	3	4	5	**12**	4
Weather Conditions	Clear	18	26	24	**68**	23
	Cloudy	2	4	2	**8**	3
	Rain	8	6	3	**17**	6
	Snow	0	1	1	**2**	1
Crashes during weekday peak periods[1]		11	6	10	**27**	9
Crashes involving pedestrian(s)		0	0	0	**0**	0
Crashes involving bicyclist(s)		0	0	0	**0**	0

1. Peak periods are from 7:00 to 9:00 AM and 4:00 to 6:00 PM.

DEVELOPMENT OF ALTERNATIVES

Staff examined various traffic signal designs and lane use alternatives in conjunction with examining coordination between the two signalized intersections. The software SYNCHRO 7[1] was the analysis tool staff used to examine coordination and other strategies. Data from the Synchro capacity analysis are in Appendix E.

Two of the alternatives involve change of lane assignment in the roadway geometry, deemed necessary in order to improve traffic operations and safety. In addition, the results of the safety analysis indicated that improvements were necessary to manage better the left-turning vehicles at both intersections and reduce angle crashes. Also, from the operations analysis it was apparent that the design of various alternatives should be particularly sensitive to potential impacts on side street operations. All of the alternatives that include signal coordination also include optimization of signal phasing and timing for improved operational efficiency.

[1] Synchro by Trafficware, Version 7.

Staff analyzed existing conditions and six alternatives:

- **Existing Geometry and Signal Design —** In this base-case scenario, signal timings and lane configurations at both intersections are as they exist currently in the field (see existing-condition description above.) Staff used the analysis results from this scenario for comparing the alternatives.

- **Alternative 1: Existing Geometry with Optimized Timings —** In this option, staff simply optimized individually the signal timings at both intersections to improve overall operations at each intersection without altering existing geometry.

- **Alternative 2: Protected/Permitted Phases —** To address the problem of angle crashes, detected earlier in the safety analysis, staff modified the signal design and lane use at the intersections to incorporate the following:
  - Protected/permitted phase at Mutton Lane eastbound approach to accommodate the left turns
  - Protected/permitted phases at both approaches of Pleasant Street
  - Protected/permitted phase at the Route 53/Pleasant Street intersection to accommodate the left turns at the northbound Route 53 approach in the AM peak hour and the left turns at the southbound approach in the PM peak hour

- **Alternative 3: Exclusive Left-Turn Lane at Westbound Pleasant Street —** The following design elements were included in this option:
  - Alter the lane use of the westbound Pleasant Street approach from two general-purpose lanes to an exclusive left-turn lane and one general-purpose lane
  - Modify the signal design to allow for a protected/permitted phase for Pleasant Street westbound in both peak hours
  - Modify the signal design so that the Route 53 northbound approach at Pleasant Street has a protected/permitted phase in the AM peak hour
  - Modify the signal design to allow for a protected/permitted phase in the PM peak hour for the Route 53 southbound approach at Pleasant Street
  - Modify the signal design to allow for a protected/permitted phase at the Mutton Lane eastbound approach in both peak hours, to accommodate the left turns

- **Alternative 4: Existing Geometry with Coordinated Signals** — In this alternative, staff maintained the existing geometry and lane configuration at both intersections and provided a coordinated signal plan for the two intersections. Coordination was optimized in the Route 53 northbound direction during the AM peak hour and in the southbound direction during the PM peak hour.

- **Alternative 5: Protective/Permitted Phases with Coordinated Signals —** This alternative includes all the elements of Alternative 2, excluding the permitted/protected phase in the southbound direction of Route 53 at Pleasant Street in the PM peak hour. Coordination was optimized in the Route 53 northbound direction during the AM peak hour and in the southbound direction during the PM peak hour.

- **Alternative 6: Pleasant Street Exclusive Left-Turn Lane with Coordinated Signals —** This alternative is the same as Alternative 5 except that the northbound Route 53 approach at Pleasant Street has a protected/permitted advance signal phase. Coordination was optimized in the Route 53 northbound direction during the AM peak hour and in the southbound direction during the PM peak hour.

TRAFFIC OPERATIONS ANALYSIS

The traffic operations analysis for the intersections was conducted using Synchro 7.[2] Tables 3 and 4 show the results of the analyses for the AM and PM peak hours, respectively. Included in the analysis are estimates of energy measures of effectiveness, which provide information on energy savings and vehicle emissions. These are shown in Tables 5 and 6. Complete data from the Synchro capacity analysis are in Appendix E.

Existing Geometry and Signal Design

The existing-conditions analyses for the intersections indicate that each operates at an acceptable level of service (LOS) in both peak hours: LOS B (AM) and C (PM) at Pleasant Street and LOS C (AM) and C (PM) at Mutton Lane. The only discernable problem that may be occurring is at the Route 53 southbound approach of the Mutton Lane intersection, where the analysis indicates a queue in the PM peak hour of 458 feet or approximately 18 vehicles (25 feet per vehicle is used to equate queue length to feet). The worst LOS on any of the approaches is LOS D on Mutton Lane eastbound during both peak hours. Queue analysis indicates that the queues consist of 7–9 vehicles in the AM and 10 vehicles in the PM.

Alternative 1: Existing Geometry with Optimized Timings

The optimized timings at both intersections resulted in marginal improvements over existing conditions in both peak hours. The LOS D on the Mutton Lane eastbound approach improves to LOS C in the AM but remains LOS D in the PM. The heavy queuing on Route 53 southbound improves by two vehicles.

The results from this analysis indicate that, under the existing geometry, the existing signal design is already optimum in terms of traffic operations. However, maintaining the existing phasing would not be effective in addressing the safety issues related to left-turning vehicles. Some protection for left-turning vehicles must be sought in subsequent alternatives.

Alternative 2: Protected/Permitted Phases

In this alternative, where staff examined permitted/protected phases with optimization, peak-hour intersection operations, when compared to existing conditions, improved marginally: to LOS B (AM) and B (PM) at Pleasant Street and to LOS B (AM) and C (PM) at Mutton Lane. Queuing at both intersections would remain essentially the same as in the existing conditions.

[2] Synchro by Trafficware, Version 7.

The main benefit of adding the protected/permitted phasing is not to operations but to safety. The additional phasing is expected to help alleviate the problem of angle crashes.

Alternative 3: Exclusive Left-Turn Lane at Westbound Pleasant Street

Operations improve only marginally and actually get somewhat worse in the PM peak hour, even though this alternative provides an exclusive left-turn lane on the Pleasant Street westbound approach. The peak-hour levels of service are B (AM) and C (PM) at Pleasant Street and B (AM) and C (PM) at Mutton Lane.

Due to the heavy left turns occurring on the westbound Pleasant Street approach during both peak hours, the left-most lane is essentially used as a de facto left-turn lane in the existing conditions and was analyzed as such. However, delineating the lane as a left-turn lane and providing a protected/permitted phase could help with safety concerns.

Alternative 4: Existing Geometry with Coordinated Signals

This alternative only changes the existing timings as needed to accomplish the coordination. As shown in the results, the eastbound Mutton Lane is penalized by the coordination. However in the AM peak, northbound progression (bandwidth[3]) for vehicles due to the coordination is 28 seconds. In the southbound direction a 29 second bandwidth is provided by the coordination for the PM peak hour.

Alternative 5: Protective/Permitted Phases with Coordinated Signals

This alternative's results indicate 24 second northbound bandwidth availability in the AM and 29 seconds southbound in the PM peak. However, as with the existing conditions, the vehicle progression for Route 53 comes at the detriment for the Mutton Lane eastbound movement.

Alternative 6: Pleasant Street Exclusive Left-Turn Lane with Coordinated Signals

In this alternative, the improvements and the coordination provide an AM peak northbound bandwidth of 26 seconds and a PM peak southbound bandwidth of 36 seconds. The Mutton Lane eastbound approach improves compared to Alternative 5, but it still operates below how it does under existing conditions.

CONCLUSIONS AND RECOMMENDATIONS

It was found that both intersections operated at acceptable levels of service under existing conditions. Staff investigated improvements related to lane use, signal phasing and timing, signal coordination, and safety.

[3] Bandwidth – The amount of green time available for vehicles to travel through both intersections in a coordinated signal system.

The results of the alternatives analysis indicated that moderate improvements to the operations that would improve safety can be accomplished with signal timing changes and lane reassignment. Signal coordination, while it would provide adequate bandwidths for directional progression, would negatively impact the eastbound Mutton Lane movement. Based on this finding, coordination is not warranted for these intersections. (Proximity between intersections is not the sole criterion for coordination; analysis must be sensitive to other criteria, including impacts on side-street delays and queues.)

For these reasons, staff recommend that the improvements described in Alternative 3, Exclusive Left-Turn Lane at Westbound Pleasant Street, be implemented. Requirements for implementation would include the following:

- The Pleasant Street intersection would require the addition of three new five-section signal heads, one for the Route 53 northbound approach, one for the Route 53 southbound approach, and one for the Pleasant Street westbound approach.

- The Mutton Lane intersection would require a new five-section signal head on the Mutton Lane eastbound approach to allow for the new protected/permitted phase that would help with left turns there.

This recommended alternative does not negatively impact pedestrians: pedestrian phasing and timing are maintained.

Although this alternative improves the operations of the intersection, it is not the most fuel-efficient or emissions-friendly of the alternatives. However, overall traffic operations and safety may need to take precedence over these other factors. This alternative should help alleviate some of the crash problems at both intersections, particularly the Pleasant Street intersection, where there are a high number of angle crashes. Delineating one of the Pleasant Street westbound approach lanes as a left-turn lane should help with sideswipe crashes in the westbound direction that are due to the single departure lane for this approach.

These improvements should be simple to implement and cost-effective. They require no land takings and can be accomplished with striping, signal timing changes, signing, and new signal heads. The Town of Weymouth should pursue implementation of these improvements in order to make travel operations along Route 53 safer.

TABLE 3
AM Peak Hour
Level-of-Service Summary

Intersection/Approach	Existing Conditions				Alternative 1				Alternative 2				Alternative 3			
	LOS	Delay[1]	V/C[2]	Q[3]	LOS	Delay	V/C	Q	LOS	Delay	V/C	Q	LOS	Delay	V/C	Q
Route 53 at Pleasant St																
Route 53 - NB	B	14.2	0.62	205	B	13.7	0.64	172	B	13.6	0.67	179	B	14.9	0.68	173
Route 53 - SB	A	9.6	0.20	56	A	9.1	0.10	47	A	9.9	0.22	50	B	10.8	0.22	48
Pleasant Street - EB	B	16.9	0.56	124	B	15.4	0.56	113	B	14.3	0.53	110	C	28.2	0.81	168
Pleasant Street – WB	C	23.5	0.80	167	C	21.7	0.79	152	B	18.9	0.75	147	B	16.8	0.64	214
Overall	**B**	**16.9**	**0.70**	**-**	**B**	**15.8**	**0.70**	**-**	**B**	**14.8**	**0.70**	**-**	**B**	**18.2**	**0.75**	**-**
Route 53 at Mutton Ln																
Route 53 - NB	B	14.2	0.42	249	B	15.4	0.50	201	B	18.4	0.52	228	B	18.4	0.52	228
Route 53 - SB	B	12.5	0.29	132	B	13.1	0.34	105	B	15.8	0.36	120	B	15.8	0.36	120
Mutton Lane - EB	D	52.4	0.82	183	C	33.1	0.72	181	C	25.1	0.55	151	C	25.1	0.55	151
Mutton Lane - WB	C	28.5	0.30	119	C	21.2	0.23	85	C	21.0	0.24	99	C	21.0	0.24	99
Overall	**C**	**20.6**	**0.54**	**-**	**B**	**17.8**	**0.58**	**-**	**B**	**18.9**	**0.53**	**-**	**B**	**18.9**	**0.53**	**-**

Intersection/Approach	Existing Conditions				Alternative 4				Alternative 5				Alternative 6			
	LOS	Delay[1]	V/C[2]	Q[3]	LOS	Delay	V/C	Q	LOS	Delay	V/C	Q	LOS	Delay	V/C	Q
Route 53 at Pleasant St																
Route 53 - NB	B	14.2	0.62	205	B	15.7	0.57	205	B	19.1	0.65	171	B	14.8	0.70	173
Route 53 - SB	A	9.6	0.20	56	B	15.8	0.19	56	B	13.5	0.21	50	B	11.1	0.23	48
Pleasant Street - EB	B	16.9	0.56	124	C	25.1	0.61	183	C	33.8	0.78	110	C	25.0	0.78	168
Pleasant Street – WB	C	23.5	0.80	167	C	34.8	0.84	167	B	19.8	0.62	147	B	16.1	0.65	214
Overall	**B**	**16.9**	**0.70**	**-**	**C**	**23.2**	**0.68**	**-**	**C**	**22.2**	**0.71**	**-**	**B**	**17.2**	**0.76**	**-**
Route 53 at Mutton Ln																
Route 53 - NB	B	14.2	0.42	249	A	5.9	0.41	249	A	8.9	0.42	228	A	9.6	0.39	228
Route 53 - SB	B	12.5	0.29	132	B	11.9	0.28	132	B	11.0	0.28	120	B	12.9	0.28	120
Mutton Lane - EB	D	52.4	0.82	183	E	75.2	0.92	183	F	116.6	1.06	151	E	66.7	0.85	151
Mutton Lane - WB	C	28.5	0.30	119	C	29.6	0.26	119	C	28.1	0.30	79	D	35.2	0.31	99
Overall	**C**	**20.6**	**0.54**	**-**	**B**	**19.6**	**0.56**	**-**	**C**	**25.5**	**0.59**	**-**	**C**	**21.4**	**0.53**	**-**

1. Delay measured in seconds.
2. V/C = volume/capacity ratio.
3. 95% queue, measured in feet.

TABLE 4
PM Peak Hour
Level-of-Service Summary

Intersection/Approach	Existing Conditions LOS	Delay[1]	V/C[2]	Q[3]	Alternative 1 LOS	Delay	V/C	Q	Alternative 2 LOS	Delay	V/C	Q	Alternative 3 LOS	Delay	V/C	Q
Route 53 at Pleasant St																
Route 53 - NB	B	15.5	0.54	134	B	15.3	0.58	124	B	15.5	0.57	121	B	15.9	0.58	121
Route 53 - SB	B	17.8	0.64	158	B	18.6	0.70	156	B	16.0	0.68	140	B	16.6	0.69	141
Pleasant Street - EB	B	17.1	0.63	167	B	13.8	0.60	136	B	14.7	0.61	147	D	37.8	0.92	229
Pleasant Street – WB	C	30.0	0.89	256	C	22.2	0.85	194	C	24.2	0.86	228	C	21.3	0.80	350
Overall	**C**	**20.5**	**0.76**	**-**	**B**	**17.6**	**0.77**	**-**	**B**	**17.8**	**0.77**	**-**	**C**	**23.2**	**0.83**	**-**
Route 53 at Mutton Ln																
Route 53 - NB	B	15.1	0.28	146	B	14.1	0.30	126	B	16.2	0.31	139	B	16.2	0.31	139
Route 53 - SB	C	25.0	0.81	458	C	25.4	0.85	399	C	30.4	0.87	440	C	30.4	0.87	440
Mutton Lane - EB	D	46.3	0.80	258	D	48.5	0.85	254	C	35.0	0.72	241	C	35.0	0.72	241
Mutton Lane - WB	C	26.9	0.28	125	C	23.3	0.26	103	C	24.0	0.27	121	C	24.0	0.27	121
Overall	**C**	**25.7**	**0.81**	**-**	**C**	**25.4**	**0.85**	**-**	**C**	**26.8**	**0.81**	**-**	**C**	**26.8**	**0.81**	**-**

Intersection/Approach	Existing Conditions LOS	Delay[1]	V/C[2]	Q[3]	Alternative 4 LOS	Delay	V/C	Q	Alternative 5 LOS	Delay	V/C	Q	Alternative 6 LOS	Delay	V/C	Q
Route 53 at Pleasant St																
Route 53 - NB	B	15.5	0.54	134	B	14.1	0.58	134	B	16.2	0.58	121	B	19.6	0.59	121
Route 53 - SB	B	17.8	0.64	158	B	16.4	0.70	158	B	18.8	0.71	140	A	7.3	0.67	141
Pleasant Street - EB	B	17.1	0.63	167	B	13.0	0.62	167	C	31.6	0.88	197	E	57.2	0.98	229
Pleasant Street – WB	C	30.0	0.89	256	C	22.5	0.86	296	C	20.0	0.78	228	C	25.8	0.75	350
Overall	**C**	**20.5**	**0.76**	**-**	**B**	**16.7**	**0.78**	**-**	**C**	**21.8**	**0.74**	**-**	**C**	**28.4**	**0.77**	**-**
Route 53 at Mutton Ln																
Route 53 - NB	B	15.1	0.28	146	B	10.9	0.26	146	B	10.9	0.25	139	C	23.5	0.28	139
Route 53 - SB	C	25.0	0.81	458	C	20.3	0.73	458	C	21.8	0.71	440	C	22.5	0.79	440
Mutton Lane - EB	D	46.3	0.80	258	F	103.2	1.02	258	F	86.8	0.95	241	E	67.4	0.92	241
Mutton Lane - WB	C	26.9	0.28	125	C	31.5	0.30	25	D	36.7	0.34	121	C	27.4	0.28	121
Overall	**C**	**25.7**	**0.81**	**-**	**C**	**30.2**	**0.82**	**-**	**C**	**29.6**	**0.79**	**-**	**C**	**29.1**	**0.83**	**-**

1. Delay measured in seconds.
2. V/C = volume/capacity ratio.
3. 95% queue, measured in feet.

TABLE 5
AM Peak Hour
Energy Measures of Effectiveness

Intersection/MOEs	Existing	Alt. 1	Alt. 2	Alt. 3	Alt. 4	Alt. 5	Alt. 6
Route 53 at Pleasant St							
Fuel Consumed (gal)	32.00	31.00	31.00	33.00	35.00	34.00	33.00
Fuel Economy (mpg)	12.00	12.20	12.30	11.50	11.00	11.20	11.70
CO Emissions (kg)	2.23	2.20	2.19	2.33	2.43	2.41	2.29
NOx Emissions (kg)	0.43	0.43	0.43	0.45	0.47	0.47	0.45
VOC Emissions (kg)	0.52	0.51	0.51	0.54	0.56	0.56	0.53
Route 53 at Mutton Ln							
Fuel Consumed (gal)	19.00	18.00	19.00	19.00	17.00	19.00	18.00
Fuel Economy (mpg)	11.40	11.80	11.50	11.50	12.80	11.60	11.80
CO Emissions (kg)	1.32	1.28	1.32	2.33	2.43	1.30	1.28
NOx Emissions (kg)	0.26	0.25	0.26	0.45	0.47	0.25	0.25
VOC Emissions (kg)	0.31	0.30	0.31	0.54	0.56	0.30	0.30
Route 53 Arterial							
Fuel Consumed (gal)	24.00	24.00	25.00	25.00	22.00	23.00	23.00
Fuel Economy (mpg)	13.40	13.30	12.80	12.80	14.60	14.00	13.70
CO Emissions (kg)	1.66	1.67	1.74	1.74	1.52	1.59	1.62
NOx Emissions (kg)	0.32	0.33	0.34	0.34	0.30	0.31	0.32
VOC Emissions (kg)	0.38	0.39	0.40	0.40	0.35	0.37	0.38

TABLE 6
PM Peak Hour
Energy Measures of Effectiveness

Intersection/MOEs	Existing	Alt. 1	Alt. 2	Alt. 3	Alt. 4	Alt. 5	Alt. 6
Route 53 at Pleasant St							
Fuel Consumed (gal)	39.00	38.00	38.00	42.00	37.00	41.00	43.00
Fuel Economy (mpg)	11.10	11.60	11.40	10.40	11.70	10.70	10.10
CO Emissions (kg)	2.73	2.63	2.67	2.92	2.59	2.85	3.01
NOx Emissions (kg)	0.53	0.51	0.52	0.57	0.50	0.55	0.59
VOC Emissions (kg)	0.63	0.61	0.62	0.68	0.60	0.66	0.70
Route 53 at Mutton Ln							
Fuel Consumed (gal)	26.00	26.00	26.00	26.00	26.00	26.00	27.00
Fuel Economy (mpg)	10.00	10.10	9.80	9.80	10.00	9.90	9.60
CO Emissions (kg)	1.80	1.79	1.84	1.84	1.81	1.82	1.87
NOx Emissions (kg)	0.35	0.35	0.36	0.36	0.35	0.35	0.36
VOC Emissions (kg)	0.42	0.42	0.43	0.43	0.42	0.42	0.43
Route 53 Arterial							
Fuel Consumed (gal)	23.00	23.00	23.00	23.00	22.00	22.00	22.00
Fuel Economy (mpg)	13.00	12.80	12.80	12.70	13.50	13.00	13.10
CO Emissions (kg)	1.57	1.59	1.59	1.60	1.51	1.56	1.56
NOx Emissions (kg)	0.31	0.31	0.31	0.31	0.29	0.30	0.30
VOC Emissions (kg)	0.36	0.37	0.37	0.37	0.35	0.36	0.36

Appendix A

Universe of Potential Signal Coordination Locations

Universe of Intersection Locations

Town/City	Location	2005-2007 # Crashes	EPDO*
Burlington	Route 3A @ Francis Wyman Rd. (Route 62)	3	3
Burlington	Route 3A @ Wilmington Rd. (Route 62)	3	15
Danvers	Conant St @ Poplar St.	2	6
Danvers	Conant St @ Elliott St	6	18
Hingham	Route 3A @ Kilby St	1	5
Hingham	Route 3 A @ Summer St	1	5
Bedford	**Route 4/225 @ Great Road Shopping Center**	**6**	**10**
Bedford	**Route 4/225 @ Shawsheen Rd**	**10**	**18**
Lexington	**Route 4/225 @ Hartwell Ave.**	**36**	**68**
Maynard	Acton St @ Main St and Summer St	5	5
Maynard	Acton St @ Powder Mill Rd	7	15
Randolph	**Route 28 @ Warren St**	**44**	**76**
Randolph	**Route 28 @ Memorial Ave**	**19**	**35**
Randolph	**Route 28 @ N. Main St**	**43**	**67**
Weymouth	**Route 53 @ Pleasant St**	**96**	**64**
Weymouth	**Route 53 @ Mutton Lane**	**28**	**40**
Braintree	**Washington St @ Common St**	**12**	**36**
Braintree	**Washington St @ Ramp E**	**22**	**62**
Braintree	**Washington St @ Independence Ave**	**14**	**26**
Peabody	Route 114 @ Cross St	6	10
Peabody	Route 114 @ North Shore Mall	7	7
Peabody	Route 114 @ Loris St	6	18

***EPDO - Equivalent Property Damage Only**

EPDO = 10*Fatal Crashes + 5*Injury Crashes + 1*Other Crashes (Property Damage Only or Not Reported)

Appendix B

Correspondence

Mark Abbott

From: Raphael, Connie (MHD) [Connie.Raphael@state.ma.us]
Sent: Monday, June 08, 2009 11:55 AM
To: Mark Abbott
Cc: Kulen, Raj (MHD)
Subject: RE: District 4 Arterial Intersections

Sorry for the delay in getting back to you. Our traffic engineers were out of the office most of last week.

We agree with the Route4/225 at Shawsheen Road and Home Goods plaza. The intersection at Hartwell Road is fairly far away and our concern there is back up toward Route 128. So if you include Hartwell be sure to check the queuing.

The Weymouth locations are another good choice.

Our traffic section has two other suggestions.

Braintree - Washington Street at Ramp E; Washington Street at Presidential/Common Street; and Washington Street at Church/Independence and Ramp F

Peabody - Route 114 at Cross; Route 114 at North Shore Mall; and Route 114 at Loris

Connie
-----Original Message-----
From: Mark Abbott [mailto:mabbott@ctps.org]
Sent: Monday, June 08, 2009 11:01 AM
To: 'Raphael, Connie (MHD)'
Subject: RE: District 4 Arterial Intersections

Connie,

Have you heard anything from Mike concerning any possible locations.

Two locations we've come up with are Route 4 in Lexington at Shawsheen Road and at the signal at the Home Goods shopping plaza. Also possibly inlcuding Brooksbie Road (unsignalized) and Hartwell Avenue. The other location is in Weymouth on Route 53 at Pleasant Street and at Mutton Lane signalized intersections. The Pleasant Street intersection is #70 on the MassHighway crash list.

What are you thoughts on these two locations.

Thanks,

Mark

-----Original Message-----
From: Raphael, Connie (MHD) [mailto:Connie.Raphael@state.ma.us]
Sent: Monday, June 01, 2009 3:33 PM
To: Mark Abbott
Subject: RE: District 4 Arterial Intersections

Hi Mark,

I referred the study material to Mike Karas, Manager of Traffic Operations. I will get back to you with any suggestions.

Connie

-----Original Message-----
From: Mark Abbott [mailto:mabbott@ctps.org]

Sent: Monday, June 01, 2009 3:25 PM
To: Raphael, Connie (MHD)
Subject: District 4 Arterial Intersections

Connie,

We (CTPS) has a study to look at signal improvements and coordination at several locations. I've attached the scope of work that was approved for this study, so you can have a better understanding of the study.

Efi and I are wondering if you have any possible suggestions of intersections which we could include in this study. Please let me know.

Thanks,

Mark S. Abbott, P.E.
Central Transportation Planning Staff
10 Park Plaza, Suite 2150
Boston, MA. 02116
email: mabbott@ctps.org
phone: 617-973-7095
fax: 617-973-8855

Appendix C

Turning Movement Counts

CTPS
ARTERIAL INTERSECTIONS
Weymouth
Route 53 at Mutton Lane

Counter: D4-2791
Counted By: Tom Engle
Weather:
Other:

File Name : Route 53 at Mutton Lane - PM
Site Code : 06230802
Start Date : 06/23/2009
Page No : 1

Groups Printed- Cars - Trucks

	ROUTE 53 Northbound					ROUTE 53 Southbound					MUTTON LANE Eastbound					MUTTON LANE Westbound					
Start Time	Left	Thru	Right	Peds	App. Total	Left	Thru	Right	Peds	App. Total	Left	Thru	Right	Peds	App. Total	Left	Thru	Right	Peds	App. Total	Int. Total
Factor	1.0	1.0	1.0	1.0		1.0	1.0	1.0	1.0		1.0	1.0	1.0	1.0		1.0	1.0	1.0	1.0		
04:00 PM	2	87	2	0	91	36	114	32	0	182	42	4	10	0	56	0	10	37	0	47	376
04:15 PM	1	96	5	0	102	48	131	33	1	213	44	7	7	0	58	8	11	46	0	65	438
04:30 PM	2	92	4	0	98	43	98	39	0	180	40	5	3	0	48	6	6	48	0	60	386
04:45 PM	5	81	4	0	90	45	136	53	2	236	24	6	5	0	35	3	9	50	0	62	423
Total	10	356	15	0	381	172	479	157	3	811	150	22	25	0	197	17	36	181	0	234	1623
05:00 PM	1	101	4	0	106	37	125	52	0	214	41	8	9	0	58	3	8	38	0	49	427
05:15 PM	2	85	9	0	96	31	122	45	0	198	44	3	6	0	53	4	5	44	0	53	400
05:30 PM	4	86	5	1	96	46	134	35	1	216	34	5	6	1	46	5	14	46	1	66	424
05:45 PM	1	76	1	1	79	38	108	37	0	183	45	7	2	1	55	5	7	49	0	61	378
Total	8	348	19	2	377	152	489	169	1	811	164	23	23	2	212	17	34	177	1	229	1629
Grand Total	18	704	34	2	758	324	968	326	4	1622	314	45	48	2	409	34	70	358	1	463	3252
Apprch %	2.4	92.9	4.5	0.3		20.0	59.7	20.1	0.2		76.8	11.0	11.7	0.5		7.3	15.1	77.3	0.2		
Total %	0.6	21.6	1.0	0.1	23.3	10.0	29.8	10.0	0.1	49.9	9.7	1.4	1.5	0.1	12.6	1.0	2.2	11.0	0.0	14.2	

CTPS
ARTERIAL INTERSECTIONS
Weymouth
Route 53 at Mutton Lane

File Name : Route 53 at Mutton Lane - PM
Site Code : 06230802
Start Date : 06/23/2009

	ROUTE 53 Northbound					ROUTE 53 Southbound					MUTTON LANE Eastbound					MUTTON LANE Westbound					
Start Time	Left	Thru	Right	Peds	App. Total	Left	Thru	Right	Peds	App. Total	Left	Thru	Right	Peds	App. Total	Left	Thru	Right	Peds	App. Total	Int. Total
Peak Hour From 04:00 PM to 05:45 PM - Peak 1 of 1																					
Intersection	04:15 PM																				
Volume	9	370	17	0	396	173	490	177	3	843	149	26	24	0	199	20	34	182	0	236	1674
Percent	2.3	93.4	4.3	0.0		20.5	58.1	21.0	0.4		74.9	13.1	12.1	0.0		8.5	14.4	77.1	0.0		
04:15 Volume	1	96	5	0	102	48	131	33	1	213	44	7	7	0	58	8	11	46	0	65	438
Peak Factor																					0.955
High Int.	05:00 PM					04:45 PM					04:15 PM					04:15 PM					
Volume	1	101	4	0	106	45	136	53	2	236	44	7	7	0	58	8	11	46	0	65	
Peak Factor					0.934					0.893					0.858					0.908	

CTPS
ARTERIAL INTERSECTIONS
Weymouth
Route 53 at Mutton Lane

File Name : Route 53 at Mutton Lane - PM
Site Code : 06230802
Start Date : 06/23/2009
Page No : 1

Groups Printed- Trucks

	ROUTE 53 Northbound					ROUTE 53 Southbound					MUTTON LANE Eastbound					MUTTON LANE Westbound					
Start Time	Left	Thru	Right	Peds	App. Total	Left	Thru	Right	Peds	App. Total	Left	Thru	Right	Peds	App. Total	Left	Thru	Right	Peds	App. Total	Int. Total
Factor	1.0	1.0	1.0	1.0		1.0	1.0	1.0	1.0		1.0	1.0	1.0	1.0		1.0	1.0	1.0	1.0		
04:00 PM	0	2	0	0	2	0	2	0	0	2	0	0	0	0	0	0	0	1	0	1	5
04:15 PM	0	3	0	0	3	0	1	0	1	2	1	0	0	0	1	1	0	0	0	1	7
04:30 PM	0	2	0	0	2	1	1	0	0	2	1	0	0	0	1	0	1	1	0	2	7
04:45 PM	0	1	0	0	1	0	1	0	0	1	0	0	0	0	0	0	0	0	0	0	2
Total	0	8	0	0	8	1	5	0	1	7	2	0	0	0	2	1	1	2	0	4	21
05:00 PM	0	0	0	0	0	0	0	0	0	0	1	0	0	0	1	1	0	0	0	1	2
05:15 PM	0	1	0	0	1	0	1	0	0	1	0	0	0	0	0	0	0	1	0	1	3
05:30 PM	0	1	0	1	2	0	1	0	1	2	0	0	0	1	1	1	0	1	0	2	7
05:45 PM	0	1	0	0	1	0	2	0	0	2	1	0	0	0	1	0	0	0	0	0	4
Total	0	3	0	1	4	0	4	0	1	5	2	0	0	1	3	2	0	2	0	4	16
Grand Total	0	11	0	1	12	1	9	0	2	12	4	0	0	1	5	3	1	4	0	8	37
Apprch %	0.0	91.7	0.0	8.3		8.3	75.0	0.0	16.7		80.0	0.0	0.0	20.0		37.5	12.5	50.0	0.0		
Total %	0.0	29.7	0.0	2.7	32.4	2.7	24.3	0.0	5.4	32.4	10.8	0.0	0.0	2.7	13.5	8.1	2.7	10.8	0.0	21.6	

CTPS
ARTERIAL INTERSECTIONS
Weymouth
Route 53 at Mutton Lane

File Name : Route 53 at Mutton Lane - PM
Site Code : 06230802
Start Date : 06/23/2009
Page No : 2

	ROUTE 53 Northbound					ROUTE 53 Southbound					MUTTON LANE Eastbound					MUTTON LANE Westbound					
Start Time	Left	Thru	Right	Peds	App. Total	Left	Thru	Right	Peds	App. Total	Left	Thru	Right	Peds	App. Total	Left	Thru	Right	Peds	App. Total	Int. Total
Peak Hour From 04:00 PM to 05:45 PM - Peak 1 of 1																					
Intersection	04:00 PM																				
Volume	0	8	0	0	8	1	5	0	1	7	2	0	0	0	2	1	1	2	0	4	21
Percent	0.0	100.0	0.0	0.0		14.3	71.4	0.0	14.3		100.0	0.0	0.0	0.0		25.0	25.0	50.0	0.0		
04:30 Volume	0	2	0	0	2	1	1	0	0	2	1	0	0	0	1	0	1	1	0	2	7
Peak Factor																					0.750
High Int.	04:15 PM					04:00 PM					04:15 PM					04:30 PM					
Volume	0	3	0	0	3	0	2	0	0	2	1	0	0	0	1	0	1	1	0	2	
Peak Factor					0.667					0.875					0.500					0.500	

CTPS
ARTERIAL INTERSECTIONS
Weymouth
Route 53 at Mutton Lane

File Name : Route 53 at Mutton Lane - PM
Site Code : 06230802
Start Date : 06/23/2009
Page No : 1

Groups Printed- Bikes

	ROUTE 53 Northbound					ROUTE 53 Southbound					MUTTON LANE Eastbound					MUTTON LANE Westbound					
Start Time	Left	Thru	Right	Peds	App. Total	Left	Thru	Right	Peds	App. Total	Left	Thru	Right	Peds	App. Total	Left	Thru	Right	Peds	App. Total	Int. Total
Factor	1.0	1.0	1.0	1.0		1.0	1.0	1.0	1.0		1.0	1.0	1.0	1.0		1.0	1.0	1.0	1.0		
04:00 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
04:15 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
04:30 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
04:45 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
05:00 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
05:15 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
05:30 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
05:45 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Grand Total	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Apprch %	0.0	0.0	0.0	0.0		0.0	0.0	0.0	0.0		0.0	0.0	0.0	0.0		0.0	0.0	0.0	0.0		
Total %																					

CTPS
ARTERIAL INTERSECTIONS
Weymouth
Route 53 at Mutton Lane

Counter: D4-2791
Counted By: Tom Engle
Weather:
Other:

File Name : Route 53 at Mutton Lane - AM
Site Code : 06230801
Start Date : 06/23/2009
Page No : 1

Groups Printed- Cars - Trucks

	ROUTE 53 Northbound					ROUTE 53 Southbound					MUTTON LANE Eastbound					MUTTON LANE Westbound					
Start Time	Left	Thru	Right	Peds	App. Total	Left	Thru	Right	Peds	App. Total	Left	Thru	Right	Peds	App. Total	Left	Thru	Right	Peds	App. Total	Int. Total
Factor	1.0	1.0	1.0	1.0		1.0	1.0	1.0	1.0		1.0	1.0	1.0	1.0		1.0	1.0	1.0	1.0		
07:00 AM	0	120	2	0	122	9	35	8	0	52	21	0	2	1	24	3	2	36	0	41	239
07:15 AM	2	142	3	0	147	10	50	15	0	75	35	8	8	0	51	2	3	53	0	58	331
07:30 AM	1	151	2	0	154	11	52	14	0	77	31	3	5	0	39	2	11	48	0	61	331
07:45 AM	0	161	2	0	163	12	59	25	0	96	32	3	4	0	39	4	12	38	0	54	352
Total	3	574	9	0	586	42	196	62	0	300	119	14	19	1	153	11	28	175	0	214	1253
08:00 AM	1	171	2	0	174	13	58	21	1	93	35	2	5	0	42	6	7	50	0	63	372
08:15 AM	1	146	3	0	150	13	64	19	1	97	28	5	3	0	36	4	7	36	0	47	330
08:30 AM	0	101	1	0	102	21	54	23	0	98	32	8	1	1	42	2	7	42	0	51	293
08:45 AM	1	109	4	0	114	8	74	21	0	103	36	2	5	3	46	4	8	39	0	51	314
Total	3	527	10	0	540	55	250	84	2	391	131	17	14	4	166	16	29	167	0	212	1309
Grand Total	6	1101	19	0	1126	97	446	146	2	691	250	31	33	5	319	27	57	342	0	426	2562
Apprch %	0.5	97.8	1.7	0.0		14.0	64.5	21.1	0.3		78.4	9.7	10.3	1.6		6.3	13.4	80.3	0.0		
Total %	0.2	43.0	0.7	0.0	44.0	3.8	17.4	5.7	0.1	27.0	9.8	1.2	1.3	0.2	12.5	1.1	2.2	13.3	0.0	16.6	

CTPS
ARTERIAL INTERSECTIONS
Weymouth
Route 53 at Mutton Lane

File Name : Route 53 at Mutton Lane - AM
Site Code : 06230801
Start Date : 06/23/2009

	ROUTE 53 Northbound					ROUTE 53 Southbound					MUTTON LANE Eastbound					MUTTON LANE Westbound					
Start Time	Left	Thru	Right	Peds	App. Total	Left	Thru	Right	Peds	App. Total	Left	Thru	Right	Peds	App. Total	Left	Thru	Right	Peds	App. Total	Int. Total
Peak Hour From 07:00 AM to 08:45 AM - Peak 1 of 1																					
Intersection	07:15 AM																				
Volume	4	625	9	0	638	46	219	75	1	341	133	16	22	0	171	14	33	189	0	236	1386
Percent	0.6	98.0	1.4	0.0		13.5	64.2	22.0	0.3		77.8	9.4	12.9	0.0		5.9	14.0	80.1	0.0		
08:00 Volume	1	171	2	0	174	13	58	21	1	93	35	2	5	0	42	6	7	50	0	63	372
Peak Factor																					0.931
High Int.	08:00 AM					07:45 AM					07:15 AM					08:00 AM					
Volume	1	171	2	0	174	12	59	25	0	96	35	8	8	0	51	6	7	50	0	63	
Peak Factor					0.917					0.888					0.838					0.937	

CTPS
ARTERIAL INTERSECTIONS
Weymouth
Route 53 at Mutton Lane

File Name : Route 53 at Mutton Lane - AM
Site Code : 06230801
Start Date : 06/23/2009
Page No : 1

Groups Printed- Trucks

	ROUTE 53 Northbound					ROUTE 53 Southbound					MUTTON LANE Eastbound					MUTTON LANE Westbound					
Start Time	Left	Thru	Right	Peds	App. Total	Left	Thru	Right	Peds	App. Total	Left	Thru	Right	Peds	App. Total	Left	Thru	Right	Peds	App. Total	Int. Total
Factor	1.0	1.0	1.0	1.0		1.0	1.0	1.0	1.0		1.0	1.0	1.0	1.0		1.0	1.0	1.0	1.0		
07:00 AM	0	6	0	0	6	0	0	1	0	1	0	0	0	0	0	1	0	0	0	1	8
07:15 AM	0	4	0	0	4	3	1	0	0	4	0	0	0	0	0	0	0	0	0	0	8
07:30 AM	1	8	0	0	9	1	6	0	0	7	0	0	0	0	0	1	0	2	0	3	19
07:45 AM	0	10	0	0	10	1	9	1	0	11	2	0	0	0	2	0	0	1	0	1	24
Total	1	28	0	0	29	5	16	2	0	23	2	0	0	0	2	2	0	3	0	5	59
08:00 AM	0	17	0	0	17	2	4	0	0	6	2	0	0	0	2	1	1	0	0	2	27
08:15 AM	0	11	0	0	11	1	5	1	0	7	1	0	0	0	1	0	0	0	0	0	19
08:30 AM	0	12	0	0	12	0	9	1	0	10	0	1	0	0	1	0	1	3	0	4	27
08:45 AM	0	10	0	0	10	0	4	2	0	6	1	0	0	0	1	2	0	0	0	2	19
Total	0	50	0	0	50	3	22	4	0	29	4	1	0	0	5	3	2	3	0	8	92
Grand Total	1	78	0	0	79	8	38	6	0	52	6	1	0	0	7	5	2	6	0	13	151
Apprch %	1.3	98.7	0.0	0.0		15.4	73.1	11.5	0.0		85.7	14.3	0.0	0.0		38.5	15.4	46.2	0.0		
Total %	0.7	51.7	0.0	0.0	52.3	5.3	25.2	4.0	0.0	34.4	4.0	0.7	0.0	0.0	4.6	3.3	1.3	4.0	0.0	8.6	

CTPS
ARTERIAL INTERSECTIONS
Weymouth
Route 53 at Mutton Lane

File Name : Route 53 at Mutton Lane - AM
Site Code : 06230801
Start Date : 06/23/2009

	ROUTE 53 Northbound					ROUTE 53 Southbound					MUTTON LANE Eastbound					MUTTON LANE Westbound					
Start Time	Left	Thru	Right	Peds	App. Total	Left	Thru	Right	Peds	App. Total	Left	Thru	Right	Peds	App. Total	Left	Thru	Right	Peds	App. Total	Int. Total
Peak Hour From 07:00 AM to 08:45 AM - Peak 1 of 1																					
Intersection	07:45 AM																				
Volume	0	50	0	0	50	4	27	3	0	34	5	1	0	0	6	1	2	4	0	7	97
Percent	0.0	100.0	0.0	0.0		11.8	79.4	8.8	0.0		83.3	16.7	0.0	0.0		14.3	28.6	57.1	0.0		
08:30 Volume	0	12	0	0	12	0	9	1	0	10	0	1	0	0	1	0	1	3	0	4	27
Peak Factor																					0.898
High Int.	08:00 AM					07:45 AM					07:45 AM					08:30 AM					
Volume	0	17	0	0	17	1	9	1	0	11	2	0	0	0	2	0	1	3	0	4	
Peak Factor					0.735					0.773					0.750					0.438	

CTPS
ARTERIAL INTERSECTIONS
Weymouth
Route 53 at Mutton Lane

File Name : Route 53 at Mutton Lane - AM
Site Code : 06230801
Start Date : 06/23/2009
Page No : 1

Groups Printed- Bikes

	ROUTE 53 Northbound					ROUTE 53 Southbound					MUTTON LANE Eastbound					MUTTON LANE Westbound					
Start Time	Left	Thru	Right	Peds	App. Total	Left	Thru	Right	Peds	App. Total	Left	Thru	Right	Peds	App. Total	Left	Thru	Right	Peds	App. Total	Int. Total
Factor	1.0	1.0	1.0	1.0		1.0	1.0	1.0	1.0		1.0	1.0	1.0	1.0		1.0	1.0	1.0	1.0		
07:00 AM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
07:15 AM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
07:30 AM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
07:45 AM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
08:00 AM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
08:15 AM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
08:30 AM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
08:45 AM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Grand Total	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Apprch %	0.0	0.0	0.0	0.0		0.0	0.0	0.0	0.0		0.0	0.0	0.0	0.0		0.0	0.0	0.0	0.0		
Total %																					

CTPS
ARTERIAL INTERSECTIONS
Weymouth
Route 53 at Pleasant Street

Counter: D-2792
Counted By: Stanley Genthner
Weather:
Other:

File Name : Route 53 at Pleasant St - AM
Site Code : 06230911
Start Date : 06/23/2009

Groups Printed- Cars - Trucks

	ROUTE 53 Northbound					ROUTE 53 Southbound					PLEASANT STREET Eastbound					PLEASANT STREET Westbound					
Start Time	Left	Thru	Right	Peds	App. Total	Left	Thru	Right	Peds	App. Total	Left	Thru	Right	Peds	App. Total	Left	Thru	Right	Peds	App. Total	Int. Total
Factor	1.0	1.0	1.0	1.0		1.0	1.0	1.0	1.0		1.0	1.0	1.0	1.0		1.0	1.0	1.0	1.0		
07:00 AM	25	103	30	0	158	6	22	5	0	33	9	62	9	0	80	24	77	9	0	110	381
07:15 AM	16	116	31	1	164	8	49	4	0	61	10	115	16	0	141	31	77	5	0	113	479
07:30 AM	20	150	17	0	187	7	44	11	0	62	8	89	12	0	109	32	93	4	0	129	487
07:45 AM	36	137	33	0	206	6	48	8	1	63	17	108	16	0	141	45	112	4	0	161	571
Total	97	506	111	1	715	27	163	28	1	219	44	374	53	0	471	132	359	22	0	513	1918
08:00 AM	23	158	32	1	214	9	46	6	2	63	14	113	10	0	137	38	95	6	0	139	553
08:15 AM	23	130	39	0	192	8	49	12	0	69	17	91	28	1	137	34	93	5	0	132	530
08:30 AM	37	79	30	0	146	7	47	9	0	63	11	99	14	0	124	50	99	9	0	158	491
08:45 AM	27	100	28	1	156	13	67	11	0	91	16	91	23	1	131	39	113	3	0	155	533
Total	110	467	129	2	708	37	209	38	2	286	58	394	75	2	529	161	400	23	0	584	2107
Grand Total	207	973	240	3	1423	64	372	66	3	505	102	768	128	2	1000	293	759	45	0	1097	4025
Apprch %	14.5	68.4	16.9	0.2		12.7	73.7	13.1	0.6		10.2	76.8	12.8	0.2		26.7	69.2	4.1	0.0		
Total %	5.1	24.2	6.0	0.1	35.4	1.6	9.2	1.6	0.1	12.5	2.5	19.1	3.2	0.0	24.8	7.3	18.9	1.1	0.0	27.3	

CTPS
ARTERIAL INTERSECTIONS
Weymouth
Route 53 at Pleasant Street

File Name : Route 53 at Pleasant St - AM
Site Code : 06230911
Start Date : 06/23/2009
Page No : 2

	ROUTE 53 Northbound					ROUTE 53 Southbound					PLEASANT STREET Eastbound					PLEASANT STREET Westbound					
Start Time	Left	Thru	Right	Peds	App. Total	Left	Thru	Right	Peds	App. Total	Left	Thru	Right	Peds	App. Total	Left	Thru	Right	Peds	App. Total	Int. Total
Peak Hour From 07:00 AM to 08:45 AM - Peak 1 of 1																					
Intersection	07:45 AM																				
Volume	119	504	134	1	758	30	190	35	3	258	59	411	68	1	539	167	399	24	0	590	2145
Percent	15.7	66.5	17.7	0.1		11.6	73.6	13.6	1.2		10.9	76.3	12.6	0.2		28.3	67.6	4.1	0.0		
07:45 Volume	36	137	33	0	206	6	48	8	1	63	17	108	16	0	141	45	112	4	0	161	571
Peak Factor																					0.939
High Int.	08:00 AM					08:15 AM					07:45 AM					07:45 AM					
Volume	23	158	32	1	214	8	49	12	0	69	17	108	16	0	141	45	112	4	0	161	
Peak Factor					0.886					0.935					0.956					0.916	

CTPS
ARTERIAL INTERSECTIONS
Weymouth
Route 53 at Pleasant Street

File Name : Route 53 at Pleasant St - AM
Site Code : 06230911
Start Date : 06/23/2009
Page No : 1

Groups Printed- Trucks

	ROUTE 53 Northbound					ROUTE 53 Southbound					PLEASANT STREET Eastbound					PLEASANT STREET Westbound					
Start Time	Left	Thru	Right	Peds	App. Total	Left	Thru	Right	Peds	App. Total	Left	Thru	Right	Peds	App. Total	Left	Thru	Right	Peds	App. Total	Int. Total
Factor	1.0	1.0	1.0	1.0		1.0	1.0	1.0	1.0		1.0	1.0	1.0	1.0		1.0	1.0	1.0	1.0		
07:00 AM	1	3	4	0	8	1	0	0	0	1	3	2	2	0	7	0	2	0	0	2	18
07:15 AM	1	1	1	0	3	0	1	0	0	1	3	8	2	0	13	1	0	0	0	1	18
07:30 AM	0	8	1	0	9	1	4	2	0	7	4	4	2	0	10	0	4	0	0	4	30
07:45 AM	1	6	5	0	12	1	7	2	0	10	5	4	0	0	9	4	6	0	0	10	41
Total	3	18	11	0	32	3	12	4	0	19	15	18	6	0	39	5	12	0	0	17	107
08:00 AM	2	13	1	0	16	1	1	1	0	3	4	5	2	0	11	1	3	0	0	4	34
08:15 AM	1	6	2	0	9	1	2	0	0	3	4	5	3	1	13	0	3	0	0	3	28
08:30 AM	1	8	2	0	11	1	10	2	0	13	2	6	1	0	9	4	3	1	0	8	41
08:45 AM	0	8	2	0	10	2	0	5	0	7	1	1	0	0	2	1	4	1	0	6	25
Total	4	35	7	0	46	5	13	8	0	26	11	17	6	1	35	6	13	2	0	21	128
Grand Total	7	53	18	0	78	8	25	12	0	45	26	35	12	1	74	11	25	2	0	38	235
Apprch %	9.0	67.9	23.1	0.0		17.8	55.6	26.7	0.0		35.1	47.3	16.2	1.4		28.9	65.8	5.3	0.0		
Total %	3.0	22.6	7.7	0.0	33.2	3.4	10.6	5.1	0.0	19.1	11.1	14.9	5.1	0.4	31.5	4.7	10.6	0.9	0.0	16.2	

CTPS
ARTERIAL INTERSECTIONS
Weymouth
Route 53 at Pleasant Street

File Name : Route 53 at Pleasant St - AM
Site Code : 06230911
Start Date : 06/23/2009
Page No : 2

	ROUTE 53 Northbound					ROUTE 53 Southbound					PLEASANT STREET Eastbound					PLEASANT STREET Westbound					
Start Time	Left	Thru	Right	Peds	App. Total	Left	Thru	Right	Peds	App. Total	Left	Thru	Right	Peds	App. Total	Left	Thru	Right	Peds	App. Total	Int. Total
Peak Hour From 07:00 AM to 08:45 AM - Peak 1 of 1																					
Intersection	07:45 AM																				
Volume	5	33	10	0	48	4	20	5	0	29	15	20	6	1	42	9	15	1	0	25	144
Percent	10.4	68.8	20.8	0.0		13.8	69.0	17.2	0.0		35.7	47.6	14.3	2.4		36.0	60.0	4.0	0.0		
08:30 Volume	1	8	2	0	11	1	10	2	0	13	2	6	1	0	9	4	3	1	0	8	41
Peak Factor																					0.878
High Int.	08:00 AM					08:30 AM					08:15 AM					07:45 AM					
Volume	2	13	1	0	16	1	10	2	0	13	4	5	3	1	13	4	6	0	0	10	
Peak Factor					0.750					0.558					0.808					0.625	

CTPS
ARTERIAL INTERSECTIONS
Weymouth
Route 53 at Pleasant Street

File Name : Route 53 at Pleasant St - AM
Site Code : 06230911
Start Date : 06/23/2009
Page No : 1

Groups Printed- Bikes

	ROUTE 53 Northbound					ROUTE 53 Southbound					PLEASANT STREET Eastbound					PLEASANT STREET Westbound					
Start Time	Left	Thru	Right	Peds	App. Total	Left	Thru	Right	Peds	App. Total	Left	Thru	Right	Peds	App. Total	Left	Thru	Right	Peds	App. Total	Int. Total
Factor	1.0	1.0	1.0	1.0		1.0	1.0	1.0	1.0		1.0	1.0	1.0	1.0		1.0	1.0	1.0	1.0		
07:00 AM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
07:15 AM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
07:30 AM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
07:45 AM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
08:00 AM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
08:15 AM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
08:30 AM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
08:45 AM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Grand Total	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Apprch %	0.0	0.0	0.0	0.0		0.0	0.0	0.0	0.0		0.0	0.0	0.0	0.0		0.0	0.0	0.0	0.0		
Total %																					

CTPS
ARTERIAL INTERSECTIONS
Weymouth
Route 53 at Pleasant Street

Counter: D-2792
Counted By: Stanley Genthner
Weather:
Other:

File Name : route 53 at pleasant st - pm
Site Code : 06230912
Start Date : 06/23/2009
Page No : 1

Groups Printed- Cars - Trucks

	ROUTE 53 Northbound					ROUTE 53 Southbound					PLEASANT STREET Eastbound					PLEASANT STREET Westbound					
Start Time	Left	Thru	Right	Peds	App. Total	Left	Thru	Right	Peds	App. Total	Left	Thru	Right	Peds	App. Total	Left	Thru	Right	Peds	App. Total	Int. Total
Factor	1.0	1.0	1.0	1.0		1.0	1.0	1.0	1.0		1.0	1.0	1.0	1.0		1.0	1.0	1.0	1.0		
04:00 PM	23	81	53	2	159	23	93	3	0	119	10	111	20	2	143	40	123	11	0	174	595
04:15 PM	17	95	38	2	152	27	103	8	0	138	9	118	21	0	148	31	108	6	0	145	583
04:30 PM	17	88	47	1	153	19	90	8	0	117	9	126	20	0	155	42	162	3	0	207	632
04:45 PM	11	73	54	0	138	30	113	7	0	150	10	117	15	0	142	34	128	7	1	170	600
Total	68	337	192	5	602	99	399	26	0	524	38	472	76	2	588	147	521	27	1	696	2410
05:00 PM	37	88	55	0	180	31	102	14	0	147	16	141	19	0	176	40	120	13	0	173	676
05:15 PM	26	73	50	1	150	33	89	5	1	128	14	145	27	0	186	38	144	5	2	189	653
05:30 PM	19	75	45	2	141	35	93	8	1	137	13	152	17	3	185	42	134	6	0	182	645
05:45 PM	14	67	43	4	128	30	87	13	2	132	8	121	14	8	151	45	96	8	3	152	563
Total	96	303	193	7	599	129	371	40	4	544	51	559	77	11	698	165	494	32	5	696	2537
Grand Total	164	640	385	12	1201	228	770	66	4	1068	89	1031	153	13	1286	312	1015	59	6	1392	4947
Apprch %	13.7	53.3	32.1	1.0		21.3	72.1	6.2	0.4		6.9	80.2	11.9	1.0		22.4	72.9	4.2	0.4		
Total %	3.3	12.9	7.8	0.2	24.3	4.6	15.6	1.3	0.1	21.6	1.8	20.8	3.1	0.3	26.0	6.3	20.5	1.2	0.1	28.1	

CTPS
ARTERIAL INTERSECTIONS
Weymouth
Route 53 at Pleasant Street

File Name : route 53 at pleasant st - pm
Site Code : 06230912
Start Date : 06/23/2009
Page No : 2

	ROUTE 53 Northbound					ROUTE 53 Southbound					PLEASANT STREET Eastbound					PLEASANT STREET Westbound					
Start Time	Left	Thru	Right	Peds	App. Total	Left	Thru	Right	Peds	App. Total	Left	Thru	Right	Peds	App. Total	Left	Thru	Right	Peds	App. Total	Int. Total
Peak Hour From 04:00 PM to 05:45 PM - Peak 1 of 1																					
Intersection	04:45 PM																				
Volume	93	309	204	3	609	129	397	34	2	562	53	555	78	3	689	154	526	31	3	714	2574
Percent	15.3	50.7	33.5	0.5		23.0	70.6	6.0	0.4		7.7	80.6	11.3	0.4		21.6	73.7	4.3	0.4		
05:00 Volume	37	88	55	0	180	31	102	14	0	147	16	141	19	0	176	40	120	13	0	173	676
Peak Factor																					0.952
High Int.	05:00 PM					04:45 PM					05:15 PM					05:15 PM					
Volume	37	88	55	0	180	30	113	7	0	150	14	145	27	0	186	38	144	5	2	189	
Peak Factor					0.846					0.937					0.926					0.944	

CTPS
ARTERIAL INTERSECTIONS
Weymouth
Route 53 at Pleasant Street

File Name : route 53 at pleasant st - pm
Site Code : 06230912
Start Date : 06/23/2009
Page No : 1

Groups Printed- Trucks

	ROUTE 53 Northbound					ROUTE 53 Southbound					PLEASANT STREET Eastbound					PLEASANT STREET Westbound					
Start Time	Left	Thru	Right	Peds	App. Total	Left	Thru	Right	Peds	App. Total	Left	Thru	Right	Peds	App. Total	Left	Thru	Right	Peds	App. Total	Int. Total
Factor	1.0	1.0	1.0	1.0		1.0	1.0	1.0	1.0		1.0	1.0	1.0	1.0		1.0	1.0	1.0	1.0		
04:00 PM	1	1	0	0	2	1	1	0	0	2	1	1	2	0	4	1	5	0	0	6	14
04:15 PM	0	5	3	0	8	1	3	0	0	4	0	2	1	0	3	0	1	1	0	2	17
04:30 PM	0	2	1	0	3	0	2	0	0	2	0	2	1	0	3	0	1	0	0	1	9
04:45 PM	0	0	0	0	0	0	2	0	0	2	1	0	0	0	1	0	2	0	0	2	5
Total	1	8	4	0	13	2	8	0	0	10	2	5	4	0	11	1	9	1	0	11	45
05:00 PM	2	1	0	0	3	1	0	0	0	1	0	0	0	0	0	1	2	0	0	3	7
05:15 PM	0	0	0	0	0	0	1	0	0	1	1	1	0	0	2	2	0	0	0	2	5
05:30 PM	0	1	0	0	1	1	0	0	0	1	0	0	0	1	1	0	2	0	0	2	5
05:45 PM	0	1	1	0	2	0	1	0	0	1	0	0	2	0	2	1	2	0	0	3	8
Total	2	3	1	0	6	2	2	0	0	4	1	1	2	1	5	4	6	0	0	10	25
Grand Total	3	11	5	0	19	4	10	0	0	14	3	6	6	1	16	5	15	1	0	21	70
Apprch %	15.8	57.9	26.3	0.0		28.6	71.4	0.0	0.0		18.8	37.5	37.5	6.3		23.8	71.4	4.8	0.0		
Total %	4.3	15.7	7.1	0.0	27.1	5.7	14.3	0.0	0.0	20.0	4.3	8.6	8.6	1.4	22.9	7.1	21.4	1.4	0.0	30.0	

CTPS
ARTERIAL INTERSECTIONS
Weymouth
Route 53 at Pleasant Street

File Name : route 53 at pleasant st - pm
Site Code : 06230912
Start Date : 06/23/2009
Page No : 2

	ROUTE 53 Northbound					ROUTE 53 Southbound					PLEASANT STREET Eastbound					PLEASANT STREET Westbound					
Start Time	Left	Thru	Right	Peds	App. Total	Left	Thru	Right	Peds	App. Total	Left	Thru	Right	Peds	App. Total	Left	Thru	Right	Peds	App. Total	Int. Total
Peak Hour From 04:00 PM to 05:45 PM - Peak 1 of 1																					
Intersection	04:00 PM																				
Volume	1	8	4	0	13	2	8	0	0	10	2	5	4	0	11	1	9	1	0	11	45
Percent	7.7	61.5	30.8	0.0		20.0	80.0	0.0	0.0		18.2	45.5	36.4	0.0		9.1	81.8	9.1	0.0		
04:15 Volume	0	5	3	0	8	1	3	0	0	4	0	2	1	0	3	0	1	1	0	2	17
Peak Factor																					0.662
High Int.	04:15 PM					04:15 PM					04:00 PM					04:00 PM					
Volume	0	5	3	0	8	1	3	0	0	4	1	1	2	0	4	1	5	0	0	6	
Peak Factor					0.406					0.625					0.688					0.458	

CTPS
ARTERIAL INTERSECTIONS
Weymouth
Route 53 at Pleasant Street

File Name : route 53 at pleasant st - pm
Site Code : 06230912
Start Date : 06/23/2009
Page No : 1

Groups Printed- Bikes

	ROUTE 53 Northbound					ROUTE 53 Southbound					PLEASANT STREET Eastbound					PLEASANT STREET Westbound					
Start Time	Left	Thru	Right	Peds	App. Total	Left	Thru	Right	Peds	App. Total	Left	Thru	Right	Peds	App. Total	Left	Thru	Right	Peds	App. Total	Int. Total
Factor	1.0	1.0	1.0	1.0		1.0	1.0	1.0	1.0		1.0	1.0	1.0	1.0		1.0	1.0	1.0	1.0		
04:00 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
04:15 PM	0	0	0	0	0	0	0	0	1	1	0	0	0	1	1	0	0	0	0	0	2
04:30 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
04:45 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total	0	0	0	0	0	0	0	0	1	1	0	0	0	1	1	0	0	0	0	0	2
05:00 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
05:15 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	0	0	0	0	0	1
05:30 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	2	2
05:45 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	0	0	0	1	1	2
Total	0	0	0	0	0	0	0	0	0	0	0	0	0	2	2	0	0	0	3	3	5
Grand Total	0	0	0	0	0	0	0	0	1	1	0	0	0	3	3	0	0	0	3	3	7
Apprch %	0.0	0.0	0.0	0.0		0.0	0.0	0.0	100.0		0.0	0.0	0.0	100.0		0.0	0.0	0.0	100.0		
Total %	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	14.3	14.3	0.0	0.0	0.0	42.9	42.9	0.0	0.0	0.0	42.9	42.9	

Appendix D

MassDOT Intersection Crash Rate Worksheets

Moving Massachusetts Forward. massDOT Highway

INTERSECTION CRASH RATE WORKSHEET

CITY/TOWN : Weymouth COUNT DA 6/23/2009

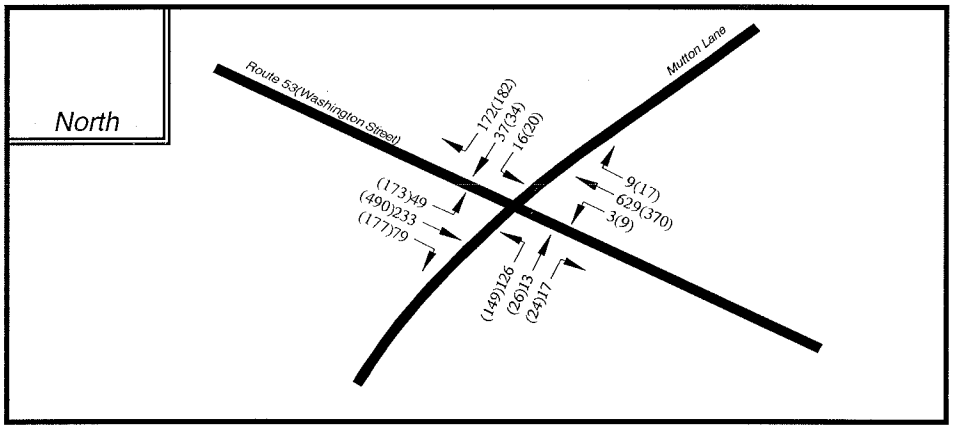
DISTRICT : 4 UNSIGNALIZED : SIGNALIZED : X

~ INTERSECTION DATA ~

MAJOR STREET : Route 53

MINOR STREET(S) : Mutton Lane

INTERSECTION DIAGRAM (Label Approaches)



PEAK HOUR VOLUMES

APPROACH :	1	2	3	4	5	Total Peak Hourly Approach Volume
DIRECTION :	NB	SB	EB	WB		
PEAK HOURLY VOLUMES (AM/PM)	396	840	199	236		1,671

" K " FACTOR :	0.090	INTERSECTION ADT (**V**) = TOTAL DAILY APPROACH VOLUME :			18,567
TOTAL # OF CRASHES :	28	# OF YEARS :	3	AVERAGE # OF CRASHES PER YEAR (**A**) :	9.33

CRASH RATE CALCULATION : 1.38 RATE = $\frac{(A * 1{,}000{,}000)}{(V * 365)}$

Comments : District 4 Average = 0.78

Project Title & Date: Arterial Intersections

Moving Massachusetts Forward. massDOT Highway

INTERSECTION CRASH RATE WORKSHEET

CITY/TOWN : Weymouth COUNT DA 6/23/2009

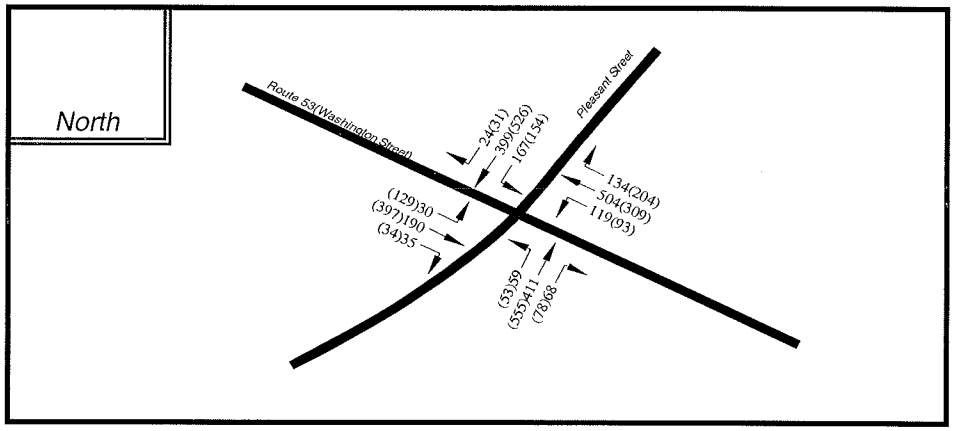
DISTRICT : 4 UNSIGNALIZED : SIGNALIZED : X

~ INTERSECTION DATA ~

MAJOR STREET : Route 53

MINOR STREET(S) : Pleasant Street

INTERSECTION DIAGRAM (Label Approaches)



PEAK HOUR VOLUMES

APPROACH :	1	2	3	4	5	Total Peak Hourly Approach Volume
DIRECTION :	NB	SB	EB	WB		
PEAK HOURLY VOLUMES (AM/PM)	606	560	686	711		2,563

" K " FACTOR : 0.090

INTERSECTION ADT (**V**) = TOTAL DAILY APPROACH VOLUME : 28,478

TOTAL # OF CRASHES : 96

OF YEARS : 3

AVERAGE # OF CRASHES PER YEAR (**A**) : 32.00

CRASH RATE CALCULATION : 3.08

RATE = $\frac{(A * 1{,}000{,}000)}{(V * 365)}$

Comments : District 4 Average = 0.78

Project Title & Date: Arterial Intersections