



# BOSTON REGION METROPOLITAN PLANNING ORGANIZATION

Richard A. Davey, MassDOT Secretary and CEO and MPO Chairman  
Karl H. Quackenbush, Executive Director, MPO Staff

## MEMORANDUM

**DATE:** December 19, 2013  
**TO:** MassDOT Highway Division District 3  
Town of Milford  
**FROM:** Chen-Yuan Wang  
Boston Region Metropolitan Planning Organization Staff  
**RE:** Community Transportation Technical Assistance Program—Town of Milford

### 1 INTRODUCTION

The Community Transportation Technical Assistance Program (CTTAP) provides technical analysis and advice about local transportation issues to municipal officials. Staff members of the Boston Region Metropolitan Planning Organization (MPO) and the Metropolitan Area Planning Council (MAPC) assist with this program. As requested by the Town of Milford, the purpose of this study was to examine safety and operations at the intersection of Route 140 at South Main Street in Milford, and to explore potential improvements; specifically, to determine whether congestion at the intersection study could be relieved without major geometric modifications.

This intersection is under the jurisdiction of the Massachusetts Department of Transportation (MassDOT) Highway Division District 3. MPO staff met with MassDOT District 3 and Milford officials on May 16, 2013 to observe traffic conditions at the site and discuss issues and concerns. This memorandum contains a summary of existing conditions, list of issues and concerns, analysis of traffic and crash data, and recommended improvements.

Participating in the May 16 site visit were:

- Joseph R. Frawley, MassDOT District 3 Traffic Engineer
- Larry L. Dunkin, Milford Town Planner
- Vonnie M. Reis, Milford Town Engineer
- Chen-Yuan Wang, Boston Region MPO staff

### 2 EXISTING CONDITIONS

The intersection of Route 140 at South Main Street is located in a commercial area about a mile south of Milford Town Hall. It is a signalized intersection delineated by a somewhat irregular shape. Route 140—residing at Cape Road and South Main Street and running in the southeast-northwest direction—is the

major street of the intersection. Coming from the north, South Main Street intersects Route 140 at a skewed angle. Connected to the intersection from the southwest is a driveway of the adjacent CVS and Papa Gino's businesses.

As shown in Figure 1, Route 140 is a two-lane principal arterial. The northwest-bound approach to the intersection (South Main Street) is divided by a long triangular traffic island. The right lane continues as South Main Street and is controlled by a pair of yield signs, not within the control of the intersection's traffic signal. The regular-sized yield signs are not obvious from a distance at this wide approach. The left lane connects to Cape Road at the intersection and is widened to include a left-turn bay that accesses the adjacent CVS/Papa Gino's (Figure 2).

The Route 140 southeast-bound approach (Cape Road) also has a single lane. At the intersection, it widens to include a left-turn bay that accesses South Main Street northbound and a short channelized right-turn lane, which accesses CVS/Papa Gino's. South Main Street, also classified as a principal arterial, has one lane approaching the intersection from the north. It is mainly used as a through- and left-turn shared lane with a very short right-turn channelized turnoff. The CVS driveway contains two 10-foot lanes: one for through- and left-turn movements and the other for right turns only (Figure 3).

The traffic signal for the intersection operates in four phases: 1) a leading left-turn protected phase for Route 140 in both directions; 2) a concurrent phase for Route 140 in both directions with left turns permitted; 3) a split phase for the northbound lane (CVS driveway); and 4) a split phase for the southbound lane (South Main Street).

There are crosswalks across Cape Road and the CVS driveway but none across South Main Street. Pedestrian signals operate concurrently with traffic phases that do not conflict with the crossings when they are actuated. The crossing of the main section of Cape Road operates concurrently with the southbound traffic signal; and the crossing of the right-turn channelized turnoff to Cape Road is concurrent with the northbound traffic signal. No pedestrian signals are installed for crossing the CVS driveway.

Sidewalks exist on both sides of Cape Road and South Main Street north of the intersection, but they are discontinued on both sides of Route 140 (South Main Street) south of the intersection.

In addition to CVS and Papa Gino's, the intersection is surrounded by a number of businesses. North of the intersection, a restaurant is under construction to replace a former gasoline station. A few stores, including a popular sandwich shop, share a parking lot northeast of the intersection. South of the intersection, a major shopping center, Milford Square, is located on the east side of Route 140. Its driveway, controlled by a stop sign, is located on



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**FIGURE 1**  
**Existing Intersection Layout and Adjacent Developments**  
**Route 140 at South Main Street, Milford**

CTTAP  
FFY 2013



**FIGURE 2**  
**South Main Street Northbound Approach**



**FIGURE 3**  
**CVS Driveway at the Intersection of Route 140 and South Main Street**

Route 140 about 200 feet south of this intersection. On the opposite side of the driveway is an entry-only driveway to a McDonald's restaurant on the west side of Route 140. A right-turn only exit from the CVS is also located just north of the McDonald's entrance. The exit's do-not-enter sign is facing Route 140 southeast bound instead of the driveway, which could be potentially confusing to drivers.

### 3 ISSUES AND CONCERNS

Milford town officials cited two major problems concerning this intersection: 1) traffic congestion during the morning and evening peak hours, especially in the evening and for the southbound approach of South Main Street; and 2) large number of crashes in the vicinity.

Below is a list of issues and concerns about this intersection:

- Traffic congestion at the intersection during peak hours, especially in the evening and for the southbound approach
- Large number of crashes and high crash rate
- Through traffic on the northbound approach of South Main Street not yielding to traffic from other approaches (potential for crashes)
- Lack of crosswalks for pedestrians on South Main Street
- Discontinued sidewalks south of the intersection
- Poor location of some of the many traffic control signs in the vicinity (potential for driver confusion)

### 4 CRASH DATA ANALYSIS

MPO staff collected two sets of the most recent available crash data: 1) MassDOT's Registry of Motor Vehicles (RMV) 2008–2010 crash data; and 2) crash reports provided by the Milford Police Department from 2008–2012. Table 1 summarizes the crash statistics at the intersection based on the available data. On average, approximately 12 crashes occurred at the intersection each year. About 20% of the total crashes resulted in personal injuries. Crash types consist of 47% rear-end collisions, 30% angle collisions, 7% sideswipe collisions, 5% single-vehicle collisions, and 8% unknown. No crashes involved pedestrians and one crash involved a bicycle. Slightly more than 20% of the total crashes occurred during peak periods, which is considered normal for signalized intersections.

**TABLE 1**  
**Intersection Crash Statistics**  
**MassDOT Crash Data 2008–10 and Milford Police Crash Reports 2008–12**

Statistics Period	2008	2009	2010	2011	2012	5-Year Total	Annual Average
<b>Total Number of Crashes</b>	<b>12</b>	<b>21</b>	<b>20</b>	<b>7</b>	<b>4</b>	<b>64</b>	<b>12.8</b>
<b>Crash Severity:</b>	--	--	--	--	--	--	--
Property Damage Only	8	16	13	5	3	45	9.0
Non-Fatal Injury	3	3	4	2	1	13	2.6
Fatality	0	0	0	0	0	0	0.0
Not Reported/Unknown	1	2	3	0	0	6	1.2
<b>Collision Type:</b>	--	--	--	--	--	--	--
Single Vehicle	1	3	0	0	1	5	1.0
Rear-End	6	8	10	3	1	28	5.6
Angle	3	7	6	1	1	18	3.6
Sideswipe, Same Direction	0	1	2	3	1	7	1.4
Sideswipe, Opposite Direction	0	0	0	0	0	0	0.0
Head-On	0	0	0	0	0	0	0.0
Rear-to-Rear	0	1	2	0	0	3	0.6
Not Reported/Unknown	0	1	0	0	0	1	0.2
Involved Pedestrian(s)	0	0	0	0	0	0	0.0
Involved Cyclist(s)	1	0	0	0	0	1	0.2
Occurred During Weekday Peak Periods*	4	3	3	1	2	13	2.6
Wet or Icy Pavement Conditions	1	3	7	2	0	13	2.6
Dark Conditions (Lit or Unlit)	2	6	5	1	0	14	2.8

\* Peak periods are defined as 7:00–10:00 AM and 3:30–6:30 PM.

Crash rate<sup>1</sup> is an effective tool for examining the relative safety of a location. Based on the crash and traffic data collected for a recent study<sup>2</sup> for the Town of Milford, the crash rate for this intersection was calculated as 1.51 (see Appendix A). This is higher than the average crash rate for signalized locations

<sup>1</sup> Crash rates are estimated based on crash frequency (crashes per year) and vehicle exposure (traffic volumes or miles traveled). Crash rates are expressed as “crashes per million entering vehicles” for intersection locations and as “crashes per million miles traveled” for roadway segments.

<sup>2</sup> Phase I – Milford Veterans Memorial Drive Extension, Fay, Spofford & Thorndike, October 16, 2012.

in MassDOT Highway Division District 3, which is estimated to be 0.89.<sup>3</sup> Note that the crashes geocoded at this intersection also include crashes at the driveways of Milford Square Shopping center and the adjacent businesses.

Based on the Milford Police Department crash reports, MPO staff constructed a collision diagram for the intersection (see Figure 4). The diagram shows a range of different types of collisions occurring at different locations, with no noticeable crash patterns. The most problematic location, the yield sign northbound on South Main Street, does not have a high number of crashes. In the five-year data shown in Table 1, three rear-end crashes (with no personal injuries) were related to an approaching vehicle failing to yield or stopping too late.

## 5 INTERSECTION CAPACITY ANALYSIS

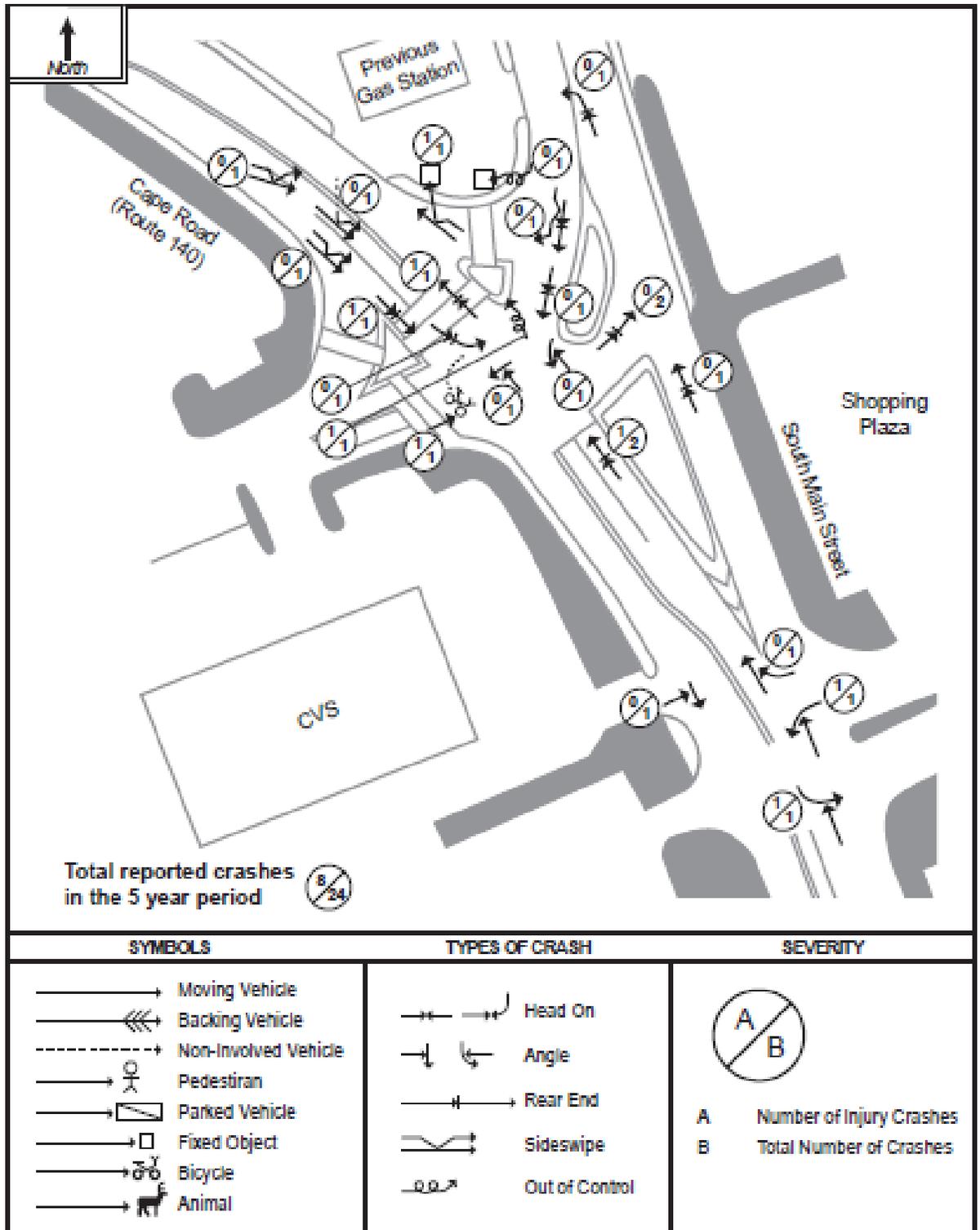
The intersection capacity analysis, modeled as a fully actuated individual intersection, was based on turning-movement counts collected on June 7, 2012. The counts, including bicycle movements and pedestrian crossings, were collected in the morning (AM) peak period from 7:00 to 9:00 and in the evening (PM) peak period from 4:00 to 6:00. The data indicate that the intersection carried about 1,800 vehicles in the AM peak hour from 7:45 to 8:45, and about 2,100 vehicles in the PM peak hour from 5:00 to 6:00 (see Appendix B for detailed 15-minute breakdowns of both peak periods). There were about three-to-five pedestrians and about two-to-three bicycles crossing the intersection during each of the two-hour peak traffic periods. Heavy vehicles comprised about three percent of total traffic in the AM peak hour and about one percent in the PM peak hour.

Table 2 summarizes analysis results from Synchro<sup>4</sup> for existing conditions in the AM and PM peak hours. Analysis indicates that the intersection operates at acceptable level of service (LOS) D in the AM peak hour with an average delay of about 45 seconds per vehicle. In the PM peak hour, the intersection is estimated to operate at an undesirable LOS F with an average delay of more than 80 seconds per vehicle. Most of the delay accrues on the left-turn and

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<sup>3</sup> The average crash rates estimated by the MassDOT Highway Division (as of January 23, 2013) are based upon a database that contains intersection crash rates submitted to MassDOT as part of the review process for an Environmental Impact Report or Functional Design Report.

<sup>4</sup> Synchro Version 8 is developed and distributed by Trafficware Ltd. The software can perform capacity analysis and traffic simulation (when combined with SimTraffic) for an individual intersection or a series of intersections.



**FIGURE 4**  
**Intersection Collision Diagram**  
**Milford Police Crash Reports 2008–12**

through movements on the southbound (South Main Street) and northbound (the CVS driveway) approaches. (Detailed analysis parameters and results for the AM and PM peak hours are included in Appendix C.)

Using Synchro's signal optimization function, MPO staff tested a number of scenarios with no major modifications of the intersection layout and found that: 1) the signal-phasing sequence is appropriate for the existing layout; and 2) the intersection's operations could be improved by reassigning the two lanes of the CVS driveway to a left-turn exclusive lane and a through- and right-turn shared lane, and by slightly adjusting the signal timing. These modifications would slightly reduce the protected left-turn phase in both peak periods and slightly increase the southbound phase in the PM peak period.

Table 3 summarizes the proposed improvements in both the AM and PM peak hours. In the PM peak hour, the intersection's operations would improve from LOS F to LOS E, with an average reduction in delay of 20 seconds per vehicle. (Detailed signal-timing settings and analysis results for the proposed scenario in the both the AM and PM peak hours are shown in Appendix D.)

**TABLE 2**  
**Intersection Capacity Analysis, Existing Conditions**

<b>Street Name/Lane Group</b>	<b>Route 140 SE Bound /LT</b>	<b>Route 140 SE Bound/TH/RT</b>	<b>Route 140 NW Bound /LT</b>	<b>Route 140 NW Bound/TH/RT</b>	<b>S. Main St. SB/LT/TH</b>	<b>S. Main St. SB/RT</b>	<b>CVS Drive-way NB/LT/TH</b>	<b>CVS Drive-way NB/RT</b>	<b>Inter-section Average</b>
AM Peak Hour LOS	C	D	B	D	E	A	F	A	D
AM Peak Hour Delay (sec/veh)	24	43	19	46	56	4	136	1	45
PM Peak Hour LOS	C	D	B	E	F	A	F	A	F
PM Peak Hour Delay (sec/veh)	23	52	20	58	147	8	>180	1	81

**TABLE 3**  
**Intersection Capacity Analysis, Proposed Improvements**

<b>Street Name/Lane Group</b>	<b>Route 140 SE Bound /LT</b>	<b>Route 140 SE Bound/TH/RT</b>	<b>Route 140 NW Bound /LT</b>	<b>Route 140 NW Bound/TH/RT</b>	<b>S. Main St. SB/LT/TH</b>	<b>S. Main St. SB/RT</b>	<b>CVS Drive-way NB/LT/TH</b>	<b>CVS Drive-way NB/RT</b>	<b>Inter-section Average</b>
AM Peak Hour LOS	C	D	B	C	D	A	D	C	D
AM Peak Hour Delay (sec/veh)	24	41	19	35	456	4	44	28	37
PM Peak Hour LOS	C	E	C	E	F	A	E	C	E
PM Peak Hour Delay (sec/veh)	31	58	23	58	86	8	56	31	60

## 6 IMPROVEMENT RECOMMENDATIONS

The study intersection is located in a commercial area that is congested during the PM peak hour and records a high number of crashes. The crash data analysis does not indicate any distinct collision types or crash patterns; and the yield-sign-controlled South Main Street northbound approach does not have an extremely high number of crashes. The crashes geocoded at the intersection include those occurring at the adjacent commercial driveways. The Town recently improved the controls at some of the driveways, especially at CVS and McDonalds. So, it appears that the number of crashes actually may be lessening. However, crash data should be examined continuously, especially when the 2011–2012 MassDOT RMV crash data are available.

The purpose of this study was to examine whether congestion at the intersection study could be relieved without major geometric modifications. Intersection capacity analysis indicates that the signal sequence and timing are appropriate under the existing layout; and there is limited room for signal optimization. One tested scenario may potentially improve congestion at the intersection. It consists of two components: 1) reassigning the two lanes of the CVS driveway into a left-turn exclusive lane and a through- and right-turn shared lane; and 2) adjusting the signal timing by a) slightly reducing the protected left-turn phase in both peak periods and b) slightly increasing the southbound phase in the PM peak period (see Appendix D).

The through movement from the CVS driveway aligns better on the right than on the left lane to South Main Street northbound (see Figure 2). The proposed lane reassignment would require pavement restriping and a few changes:

- Restripe the right lane with a through/right-turn arrow and the left lane with a left-turn-only arrow
- Change the two existing right-lane-must-turn-right signs to read “left lane must turn left”
- Mark “to South Main Street” on the right-lane pavement and “to Cape Road” on the left-lane pavement<sup>5</sup>

Additional short-term improvement recommendations in the intersection vicinity are:

- Increase the size of the two South Main Street northbound yield signs (see Figure 1) to 48”x48”x48”

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<sup>5</sup> This is an optional measure as the driveway length is limited. Some drivers may confuse the through movement to South Main Street northbound as a left turn. It would help to reduce confusion and potentially reduce some sideswipe collisions.

- Relocate the “left lane must turn left” sign currently placed to the south of the CVS exit-only driveway to about 20 feet north of the exit<sup>6</sup>
- Remove the do-not-enter sign on the same post of the left-lane-must-turn-left sign and place a do-not-enter sign on back of each sign (one stop sign and one no-left-turn arrow sign) currently posted at the CVS exit<sup>7</sup>

The study intersection’s pedestrian and bicycle facilities are insufficient. A number of long-term improvements should be considered when there are opportunities to reconstruct Route 140 and the intersection layout:

- Install a five-foot sidewalk on the north side of Route 140<sup>8</sup>
- Install a crosswalk across South Main Street at the intersection<sup>9</sup>
- Provide four-foot shoulders (at a minimum) for bicycles on both sides of Route 140
- Modify the two small triangular traffic islands on the Route 140 southeast-bound approach in order to slow traffic and shorten the pedestrian crossing distance<sup>10</sup>

CW/cw

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<sup>6</sup> The sign is intended for left turns to Milford Square Shopping Center. The current location is almost past the Center’s driveway, too late for drivers to see it.

<sup>7</sup> The do-not-enter sign is currently facing Route 140 southeast bound instead of the entrance of the driveway, which could potentially confuse drivers as to the entrance for McDonald’s. Placing them at the entrance of the CVS exit would not only reduce confusion for right turners but also would make the signs visible to the left turns from Route 140 southbound (avoiding confusion about the McDonald’s entrance).

<sup>8</sup> Preferably the sidewalk should continue from this intersection, passing Milford Square Shopping Center, to further south at the Big Lots Shopping Center. It would serve almost all the businesses in the area.

<sup>9</sup> The crosswalk could be located across the Route 140 northwest-bound approach and the South Main Street northbound approach. The installation should include pedestrian signal heads and a traffic signal head to control the traffic on the South Main Street northbound. Also, the intersection signal sequence and timing needs to be rearranged accordingly.

<sup>10</sup> The right-turn lane appears to be wide (20 feet or more) and the islands can be expanded somewhat, especially the one at the CVS driveway. Currently there is a do-not-enter sign facing the driveway at the turnoff (see Figure 2). A narrower opening with an appropriate division island design and pavement striping would reduce confusion.