



## BOSTON REGION METROPOLITAN PLANNING ORGANIZATION

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Stephanie Pollack, MassDOT Secretary and CEO and MPO Chair  
Karl H. Quackenbush, Executive Director, MPO Staff

### ***TECHNICAL MEMORANDUM***

**DATE:** December 6, 2018  
**TO:** Peter Lombardi, Town of Wenham  
**FROM:** Benjamin Erban and Chen-Yuan Wang, MPO Staff  
**RE:** Route 1A at Cherry Street, Monument Street, and Arbor Street in Wenham

This memorandum summarizes the analyses and improvement strategies for the downtown corridor of Wenham, where Route 1A (Main Street) intersects with Cherry Street, Monument Street, and Arbor Street. The document contains the following sections:

1. Study Background
2. Existing Facilities and Land Uses
3. Issues and Concerns
4. Existing Traffic Conditions
5. Crash Data Analysis
6. Existing Operations Analysis
7. Short-Term Improvement Alternatives
8. Long-Term Improvement Alternatives
9. Conclusions and Next Steps

It also includes technical appendices that contain data and methods applied in the study.

#### **1 STUDY BACKGROUND**

The purpose of the Safety and Operations Analyses at Selected Intersections study is to examine safety, operations, and mobility issues at major intersections in the Boston Region Metropolitan Planning Organization (MPO) region's arterial highways—areas where many crashes occur, that experience congestion during peak traffic periods, or are in need of improvements to accommodate heavy vehicles (buses and trucks) or nonmotorized transportation (bicyclists and pedestrians). For the past 10 years, the MPO has conducted these planning studies, which have been well received by the municipalities in the region. These studies give communities an opportunity to look at the needs of the selected locations, starting at the conceptual level, before they commit funds for design and engineering. Eventually, if the project qualifies for federal funds, the study's documentation also is useful to the Massachusetts Department of Transportation (MassDOT). These studies support the MPO's visions and goals, which include

increasing transportation safety, maintaining the transportation system, advancing mobility, and reducing congestion.

Following a selection process based on safety conditions, congested conditions, multimodal significance, regional significance, regional equity, and implementation potential, the following two locations from a short list of 10 intersections were approved for study by the MPO.<sup>1,2,3,4,5,6,7</sup>

1. Route 126 (Hartford Avenue) at Maple Street in Bellingham
2. Route 1A (Main Street) at Arbor Street, Monument Avenue, and Cherry Street in Wenham

This memo focuses on the site in Wenham. The location was selected to address several issues, including traffic congestion, traffic safety, and bicycle/pedestrian safety and access. The Wenham site also met the criterion of regional equity for this study and had strong support from community representatives and MassDOT District 4.

## 1.1 Public Participation

MPO staff discussed the safety and operations issues at the intersection and the scope of work for the study with the Town of Wenham, which expressed interest and willingness to participate in the study. An advisory task force—composed of representatives from the Town of Wenham and MassDOT—was established to guide this study. MPO staff met with the task force twice. The first meeting focused on the work scope and existing problems. In the second meeting, MPO

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<sup>1</sup> Safety Conditions: Location has a higher-than-average crash rate for its functional class, contains a Highway Safety Improvement Program (HSIP)-eligible crash cluster, contains a top-200 high crash location, or has a significant number of pedestrian and bicycle crashes (two or more per mile).

<sup>2</sup> Congested Conditions: Travel time index is at least 1.3.

<sup>3</sup> Multimodal Significance: Location carries bus route(s), is adjacent to a transit stop or station; supports bicycle or pedestrian activities or has an implementation project to support one or more of these activities; has need to accommodate pedestrians and bicyclists and improve transit; or high truck traffic serving regional commerce.

<sup>4</sup> Regional Significance: Location is in National Highway System; carries a significant portion of regional traffic (ADT >20,000); lies within 0.5 miles of Environmental Justice transportation analysis areas or zones; or is essential for the region's economic, cultural, or recreational development.

<sup>5</sup> Regional Equity: That is, it was important not to select 1) more than one location in a subregion and 2) a location in same subregion as in the preceding cycle of this study.

<sup>6</sup> Implementation Potential: Location is proposed or endorsed by its roadway administrative agency (agencies); proposed or endorsed by its subregion and is a priority for that subregion; or has strong support from other stakeholders.

<sup>7</sup> Safety and Operations Analyses at Selected Intersections: Federal Fiscal Year 2018, Technical Memorandum to the Boston Region Metropolitan Planning Organization. Seth Asante and Chen-Yuan Wang, January 18, 2018.

staff presented the existing conditions, analyses, proposed improvements, and received advice from the task force members. This report reflects the task force's feedback. Appendix A includes a list of task force members, information about the selection process, and comments about the study.

## **2 EXISTING FACILITIES AND LAND USES**

### **2.1 Roadway and Geometry**

The study area (shown in Figure 1) is located in the center of the Town of Wenham and covers a quarter-mile segment of Route 1A. Route 1A intersects three streets within this distance: Cherry Street and Monument Street, which approach from the west and end at T intersections, and Arbor Street, which approaches from the north and forms a four-way intersection with the much smaller Friend Court. All three of these intersections are unsignalized.

Route 1A is classified as an urban principal arterial, Friend Court is classified as a local street, and Cherry Street, Monument Street, and Arbor Street are all minor arterials. MassDOT has jurisdiction over Route 1A and the Town has jurisdiction over all other roadways. All road segments are single-lane except at the end of Arbor Street, where there is a marked turn bay for southbound traffic. The right-of-way varies from 50 feet to 55 feet within the study area. Sidewalks are present on all streets besides Friend Court but are on only one side of the road in many places. Ten-foot shoulders are present along much of Route 1A. Although not allowed, vehicles sometimes park in the shoulders, especially near the church and post office.

### **2.2 Land Uses**

The study corridor is part of the Wenham historic downtown and is adjacent to the Wenham Town Hall, Wenham Museum, and the First Church in Wenham. It is also home to several town services including the fire department, police station, and post office. There are some small businesses on Route 1A just north of the corridor as well as a teahouse off Monument Street. The property by the teahouse also hosts a day camp during summer months. Near the south end of the corridor across from Cherry Street is Maples, a retirement community.

There are several recreational attractions within one mile of the corridor, including the Wenham Country Club, Wenham Lake, Patton Park, and the Ipswich River Wildlife Sanctuary. The site is two miles (four minutes) from Route 128 and four miles (nine minutes) from Interstate 95 and Route 1. There is no local bus service, but the Newburyport/Rockport Line of the commuter rail has a stop two-thirds of a mile to the north (Hamilton/Wenham) and another stop one and one-half miles to the south (North Beverly).





**Figure 1**  
**Study Area**  
**Route 1A at Cherry Street, Monument Street, and Arbor Street in Wenham**



### 3 ISSUES AND CONCERNS

The Safety and Operations Analyses program examines safety, operational, and mobility concerns at major intersections within the Boston MPO. Each of these issues plays a role at the study location in Wenham.

#### *Traffic Safety*

The existing intersection geometry in the study area leads to several safety issues:

- High-volume unsignalized intersections like the three present at this location are prone to collisions stemming from failure to yield, confusion about right-of-way, and unexpected yielding.
- Tightly spaced intersections can cause weaving traffic and queue spillovers, making them difficult to navigate safely during high-traffic periods.
- Wide and poorly marked travel lanes encourage high speeds and use of the shoulder as a second travel lane. This behavior is especially dangerous to vehicles making turns from the opposite approach.
- Poor line of sight on the Cherry Street and Monument Street approaches make it difficult to enter Route 1A safely from those streets.
- Several driveways have outlets at or near the intersections in the study area. Clarifying or restricting traffic movement at these locations would reduce confusion and improve safety.

Many of these issues can be addressed by upgrading the existing infrastructure, which would improve safety for local users and through traffic alike.

#### *Traffic Operations*

Congestion is frequently observed during peak periods in the study area. At this location, the north-south Route 1A corridor intersects two other important traffic flows: Cherry Street, which carries traffic east-west to Danvers and Interstate 95, and Arbor Street, which extends north to Topsfield and several state parks. Monument Street branches from Cherry Street one-half mile from the study area and the east-west traffic flow is split between the Monument Street and Cherry Street intersections.

All three of the intersections in the study area are unsignalized, and consequently the side street approaches experience queueing and delay. Signalization at one or several of the intersections would have the potential to improve access from the side streets. Using multiple coordinated signals could further improve operations for all users by better managing the conflicting traffic flows through the tightly spaced intersections.

### ***Pedestrian and Bicycle Mobility***

This segment of Route 1A is nominally the center of Wenham and is adjacent to several attractors of foot traffic including the town hall, the Wenham Museum, a church, a retirement community, a post office, and several businesses. However, inadequate pedestrian amenities means pedestrian access to these sites is more difficult than it should be. The Town of Wenham is interested in improving the sidewalks and crossings at the study location to better fulfil its role as a historic downtown area.

The Route 1A corridor is also a popular recreational cyclist route, with groups meeting on weekends in the fire station driveway before setting out for rides. There are currently no bicycle amenities in the study area apart from a variable-width paved shoulder, and addressing these needs should be part of any design proposal.

### ***Emergency Vehicle Access***

The corridor is also adjacent to the Wenham Police Department and Wenham Fire Department, the latter of which has its driveway opening directly onto the intersection at Arbor Street. The Town of Wenham has expressed interest in improving the ability of emergency vehicles to travel safely and quickly through the study corridor.



**4 EXISTING TRAFFIC CONDITIONS**

**4.1 Daily Traffic Volumes**

MassDOT Highway Division's Traffic Data Collection section conducted automatic traffic recorder (ATR) counts over a three-day period from Monday November 27, 2017, to Thursday November 30, 2017. The counts collect traffic volumes, speeds, and classifications continuously over the collection period, and are used to determine the average weekday traffic (AWDT) of a roadway. Speed, volume, and classification counts were performed at five locations within the study area, and an additional four stations were set up to collect traffic volumes only.

The counts found the average daily traffic to be 15,000 to 20,000 vehicles per day on Route 1A (Main Street), 4,500 vehicles per day on Cherry Street, 3,800 vehicles per day on Monument Street, and 6,500 vehicles per day on Arbor Street. Heavy vehicle traffic was 1.9 percent of total traffic on Route 1A and 1.8 percent of total traffic on the side streets. More information on the volume and classification data can be found in Appendix B.

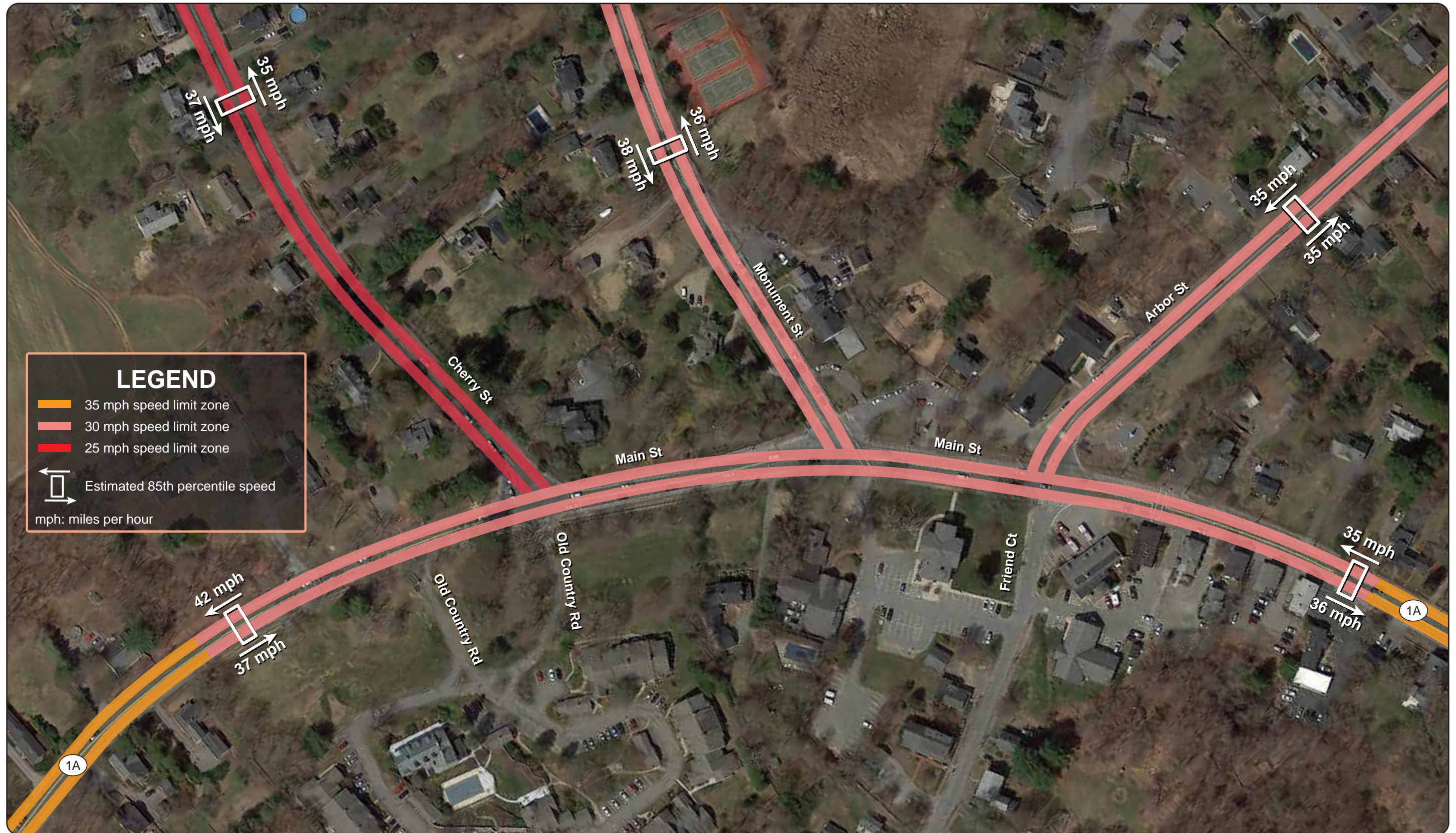
Travel speeds were also recorded and compared with speed regulations. The observed 85th-percentile speeds and posted speed limits within the study area are shown in Figure 2. The counts showed 85th-percentile speeds ranged from 35 miles per hour (mph) to 38 mph within the study area. Those speeds exceed the speed limits of 25 mph on Cherry Street and 30 mph elsewhere. The details of the speed calculations are also included in Appendix B.

**4.2 Turning Movement Volumes**

MassDOT Highway Division's Traffic Data Collection Section also collected turning-movement counts (TMC) in the study area on Wednesday November 29, 2017. The counts were conducted during the weekday AM peak travel period (7:00 AM–9:00 AM) and weekday PM peak travel period (4:00 PM–6:00 PM). The counts were conducted at each of the three intersections in the study area. Heavy vehicles such as school buses, transit buses, and trucks were counted separately. Pedestrian and bicycle counts were conducted simultaneously with the TMCs.

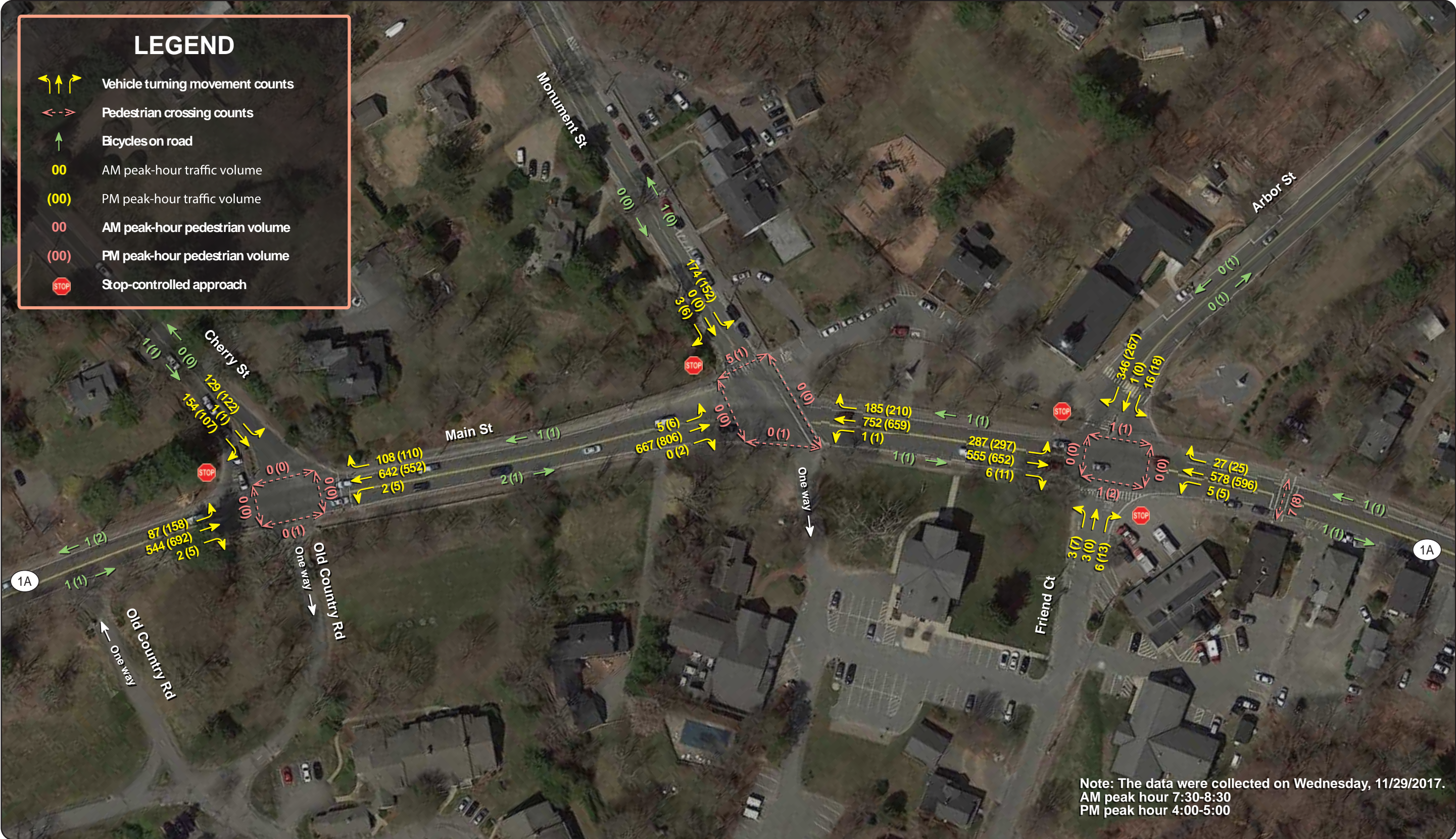
Figure 3 shows the peak hour turning movement, pedestrian, and bicycle volumes in the study area. The peak hours were 7:30 AM–8:30 AM for the morning peak and 4:00 PM–5:00 PM for the evening peak. There were only 17 total pedestrian crossing events observed during the four-hour observation interval, although pedestrian traffic would be expected to be higher during warmer months.





**Figure 2**  
Speed Regulations and Estimated 85th Percentile Speeds  
Route 1A at Cherry Street, Monument Street, and Arbor Street in Wenham





**Figure 3**  
**Weekday Peak-Hour Traffic, Pedestrian, and Bicycle Volumes**  
**Route 1A at Cherry Street, Monument Street, and Arbor Street in Wenham**



5 CRASH DATA ANALYSIS

5.1 Collision Trends

Ninety-two crashes were recorded by the Wenham Police Department over the seven-year period between 2011 and 2017. Table 1 separates these crashes by location and further breaks them down according to type of collision, severity, and factors that may have influenced the crash.

**Table 1**  
**2011–17 Crash Summary and Crash Rates**

<b>Intersection, Crash Variable</b>	<b>Arbor Street</b>	<b>Monument Street</b>	<b>Cherry Street</b>	<b>Entire Corridor</b>
<b>Crash Severity</b>	–	–	–	–
Non-fatal injury	6	6	5	17
Property damage only	21	23	28	72
Unknown	0	1	2	3
<b>Manner of Collision</b>	–	–	–	–
Angle	8	13	18	39
Head-on	1	0	0	1
Rear-end	10	9	9	28
Sideswipe, opposite direction	0	5	2	7
Sideswipe, same direction	5	0	1	6
Single vehicle crash	2	3	5	10
Unknown	1	0	0	1
<b>Road Surface Conditions</b>	–	–	–	–
Dry	20	20	27	67
Snow/Ice	0	2	2	4
Wet	7	8	6	21
<b>Ambient Light Conditions</b>	–	–	–	–
Dark - lighted roadway	3	4	4	11
Daylight	24	25	31	80
Other	0	1	0	1
<b>Weather Conditions</b>	–	–	–	–
Clear	20	17	28	65
Cloudy	3	5	2	10
Rain	4	5	3	12
Snow	0	3	2	5
<b>Bicyclist/Pedestrian Involved</b>	–	–	–	–
Bicyclist	0	1	1	2
Pedestrian	0	0	0	0
<b>Time Period<sup>a</sup></b>	–	–	–	–
Peak period	15	17	19	51
Off-peak period	12	13	16	41
<b>Total Crashes</b>	<b>27</b>	<b>30</b>	<b>35</b>	<b>92</b>
<b>Seven-year average (rounded)</b>	4	4	5	13
<b>Crash rate (calculated)</b>	0.44 <sup>b</sup>	0.58	0.72	9.45 <sup>c</sup>
<b>Crash rate (MassDOT District 4)</b>	0.57	0.57	0.57	3.49

<sup>a</sup> AM peak period = 7:00 AM–10:00 AM, PM peak period = 3:00 PM–6:00 PM  
<sup>b</sup> Crash rates for individual intersections use intersection crash rate, with units crashes per year per million entering vehicles  
<sup>c</sup> Crash rate for entire corridor uses corridor crash rate calculation, with units crashes per mile per year per million entering vehicles



Table 1 also compares the crash rates for both the individual intersections and the entire study corridor against average values. The crash rates for the three intersections give the number of crashes per year per million vehicles entering the intersection, and are compared against the 2016 District 4 average value for unsignalized intersections. The crash rate for the entire corridor gives the number of crashes per mile per year per million vehicles passing through the corridor, and is compared against the statewide average for all roadways with the same functional classification as Route 1A (Principal Arterial—Other). Worksheets detailing the crash-rate calculations can be found in Appendix C.

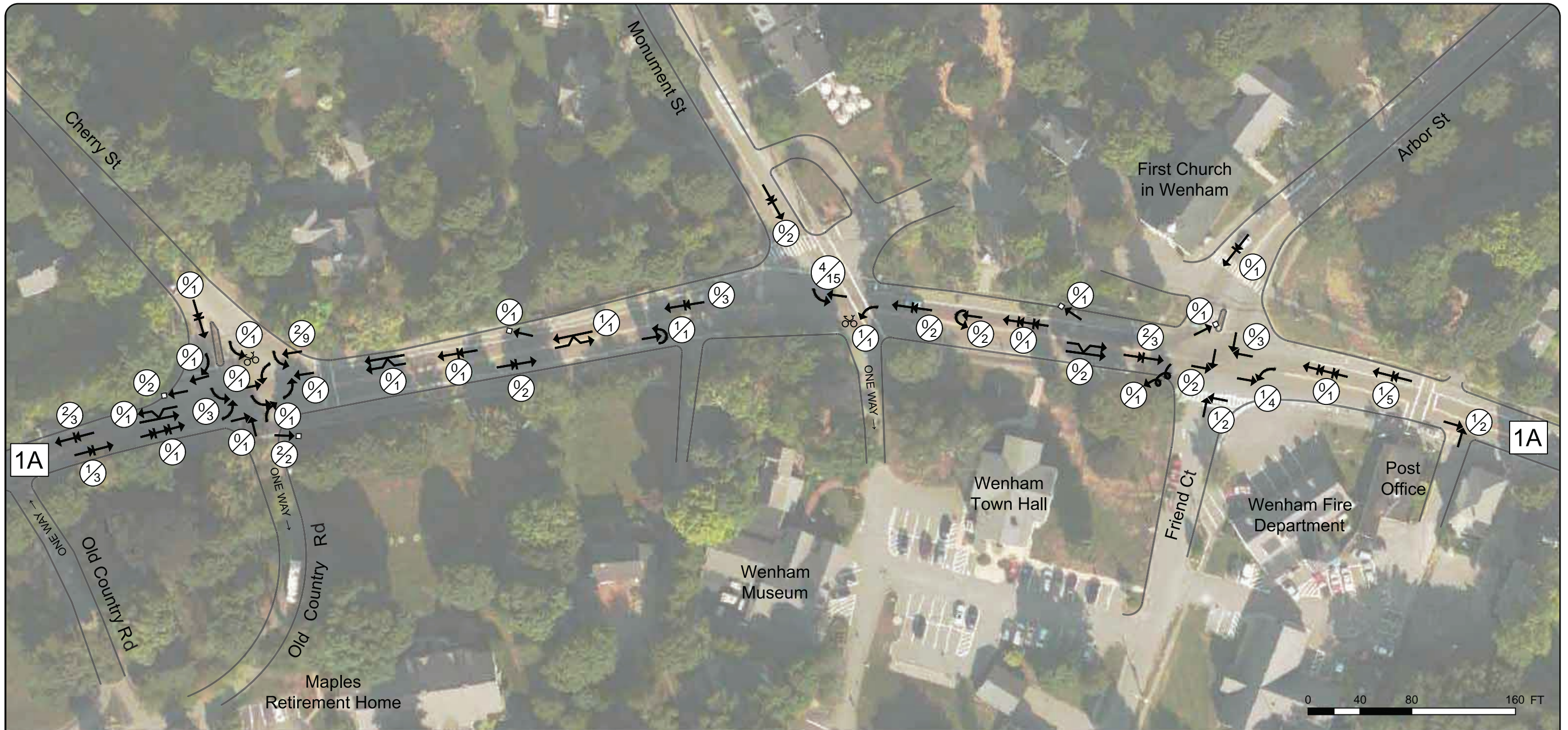
## 5.2 Collision Diagram

MPO staff also prepared a collision diagram for the study intersection to examine crash patterns. Police reports from the Wenham Police Department were obtained for the years 2011–17. Figure 4 shows the collision diagram. A second diagram containing index numbers that can be used to cross reference individual crash records is given in Appendix C.

## 5.3 Safety Analysis

The collision statistics and diagram show that turns are a safety issue at the unsignalized intersections within the corridor. Thirty-nine of the 92 collisions (42%) were angle crashes, and the collision diagram shows that most of these occurred when a vehicle turning left failed to yield to oncoming traffic. The single most dangerous maneuver was the left turn out of Monument Street, where 15 collisions occurred over the seven-year period. The turning distance from the marked stop line is nearly 100 feet, meaning drivers need a very long gap to execute the turn safely. During congested hours those gaps are scarce and impatient drivers may try to edge into traffic or cut across an oncoming vehicle.

The crash rate analysis showed that the Cherry Street intersection exceeded the District 4 average crash rate, while the Monument Street intersection was about equal to the district average crash rate. However, analyzing the study area as a corridor yields a corridor crash rate almost three times the statewide average for similar roadways (9.45 crashes per mile per year per million entering vehicles, compared to 3.49 crashes per mile per year per million entering vehicles). This result demonstrates that while these intersections might not represent a significant safety risk if they were on an isolated portion of Route 1A, when clustered within one-quarter mile of each other the frequency of collisions becomes a concern.



Symbols		Types of Crash		Severity
	Moving vehicle		Head on	 x : Number of injury crashes y : Total number of crashes
	Backing vehicle		Fixed object	
	Noninvolved vehicle		Bicycle	
	Pedestrian		Animal	
			Parked vehicle	
			Angle	
			Rear end	
			Sideswipe	
			Out of control	



**Figure 4**  
**Collision Diagram: Crash Data 2011-17**  
**Route 1A at Cherry Street, Monument Street, and Arbor Street in Wenham**

## 6 EXISTING OPERATIONS ANALYSIS

### 6.1 Intersection Level of Service

Using the data and information collected, MPO staff built a traffic analysis network (with Synchro)<sup>8</sup> for the AM and PM peak periods to assess the capacity and quality of traffic flow at the intersections. Staff conducted the analyses consistent with Highway Capacity Manual (HCM) methodologies.<sup>9</sup> The HCM methodology demonstrates the driving conditions at signalized and unsignalized intersections in terms of levels of service (LOS) ratings A through F. LOS A represents the best operating conditions (little to no delay), while LOS F represents the worst operating conditions (very long delay). LOS E represents operating conditions at capacity (limit of acceptable delay). Table 2 shows the control delays associated with each LOS for signalized and unsignalized intersections.

**Table 2  
Existing Conditions Levels of Service and Control Delays at Intersections**

Level of Service	Signalized Intersections Control Delay (seconds per vehicle)	Unsignalized Intersections Control Delay (seconds per vehicle)
A	≤ 10	≤ 10
B	> 10–20	> 10–15
C	> 20–35	> 15–25
D	> 35–55	> 25–35
E	> 55–80	> 35–50
F	> 80	> 50

Table 3 presents peak-hour performance in terms of LOS, delay (average delay, seconds per vehicle), and queues (95th percentile queue length, feet) for existing conditions. The results show that vehicles face delays of more than three minutes on all side street approaches, which is well above the acceptable limit. More detail on the analyses can be found in Appendix D.

<sup>8</sup> Trafficware Inc., Synchro Studio 9, Synchro plus SimTraffic, Build 914, Sugar Land, Texas.

<sup>9</sup> Highway Capacity Manual, HCM 2010, Volume 3: Interrupted Flow, Transportation Research Board of the National Academies, Washington DC, December 2010.



**Table 3  
Existing Peak Hour Levels of Service**

Intersection		AM LOS	AM Delay	AM Queue	PM LOS	PM Delay	PM Queue
<b>1A at Arbor Street</b>	-	-	-	-	-	-	-
Route 1A Northbound	L	A	8.4	44	A	8.5	42
Route 1A Northbound	TR	A	8.4	44	A	8.5	42
Route 1A Southbound	L	A	0.5	1	A	0.2	1
Route 1A Southbound	TR	A	0.5	1	A	0.2	1
Arbor Street	LT	F	>180	586	F	>180	561
Arbor Street	R	F	>180	586	F	>180	561
Friend Court	LTR	F	>180	95	F	>180	125
<b>Intersection Total</b>	-	<b>F</b>	<b>65.8</b>	-	<b>F</b>	<b>74.1</b>	-
<b>1A at Monument Street</b>	-	-	-	-	-	-	-
Route 1A Northbound	L	A	0.4	1	A	0.3	1
Route 1A Northbound	TR	A	0.4	1	A	0.3	1
Route 1A Southbound	LTR	A	0.1	0	A	0.2	0
Monument Street	LT	F	>180	431	F	>180	346
Monument Street	R	F	>180	431	F	>180	346
<b>Intersection Total</b>	-	<b>F</b>	<b>50.3</b>	-	<b>E</b>	<b>33.3</b>	-
<b>1A at Cherry Street</b>	-	-	-	-	-	-	-
Route 1A Northbound	L	A	3.3	11	A	4.7	18
Route 1A Northbound	TR	A	3.3	11	A	4.7	18
Route 1A Southbound	TR	A	0.1	0	A	0.2	1
Cherry Street	LT	F	>180	576	F	>180	560
Cherry Street	R	F	>180	576	F	>180	560
<b>Intersection Total</b>	-	<b>F</b>	<b>74.1</b>	-	<b>F</b>	<b>85.8</b>	-

L = Left turning traffic. LOS = Level of Service. LT = Left and through traffic. LTR = Left, through, and right traffic. R = Right turning traffic. TR = Through and right traffic.

### 6.2 Signal Warrants

MPO staff also performed Signal Warrant Analysis using the methodology from the *Manual on Uniform Traffic Control Devices*.<sup>10</sup> Staff reviewed Warrant 1 (eight-hour vehicular volume), Warrant 2 (four-hour vehicular volume), Warrant 3 (peak-hour vehicular volume), Warrant 4 (pedestrian volume), and Warrant 7 (crash history). All three intersections were found to warrant a traffic signal based on each of the volume criteria (Warrants 1-3), and the intersection at Cherry Street additionally was found to satisfy the criteria based on collision history. Table 4 shows a summary of the analysis, and full details are provided in Appendix E.

<sup>10</sup> Chapter 4C Traffic Control Signal Needs Studies, *Manual on Uniform Traffic Control Devices*, 2009 Edition with Revisions 1 and 2, Federal Highway Administration, US Department of Transportation, May 2012.

**Table 4  
Summary of Signal Warrant Analysis**

<b>Intersection</b>	<b>Warrant 1</b> 8-hour volume	<b>Warrant 2</b> 4-hour volume	<b>Warrant 3</b> Peak-hour volume	<b>Warrant 4</b> Pedestrian Volume	<b>Warrant 7</b> Crash Experience
Route 1A at Arbor Street	Yes	Yes	Yes	No	No
Route 1A at Monument Street	Yes	Yes	Yes	No	No
Route 1A at Cherry Street	Yes	Yes	Yes	No	Yes

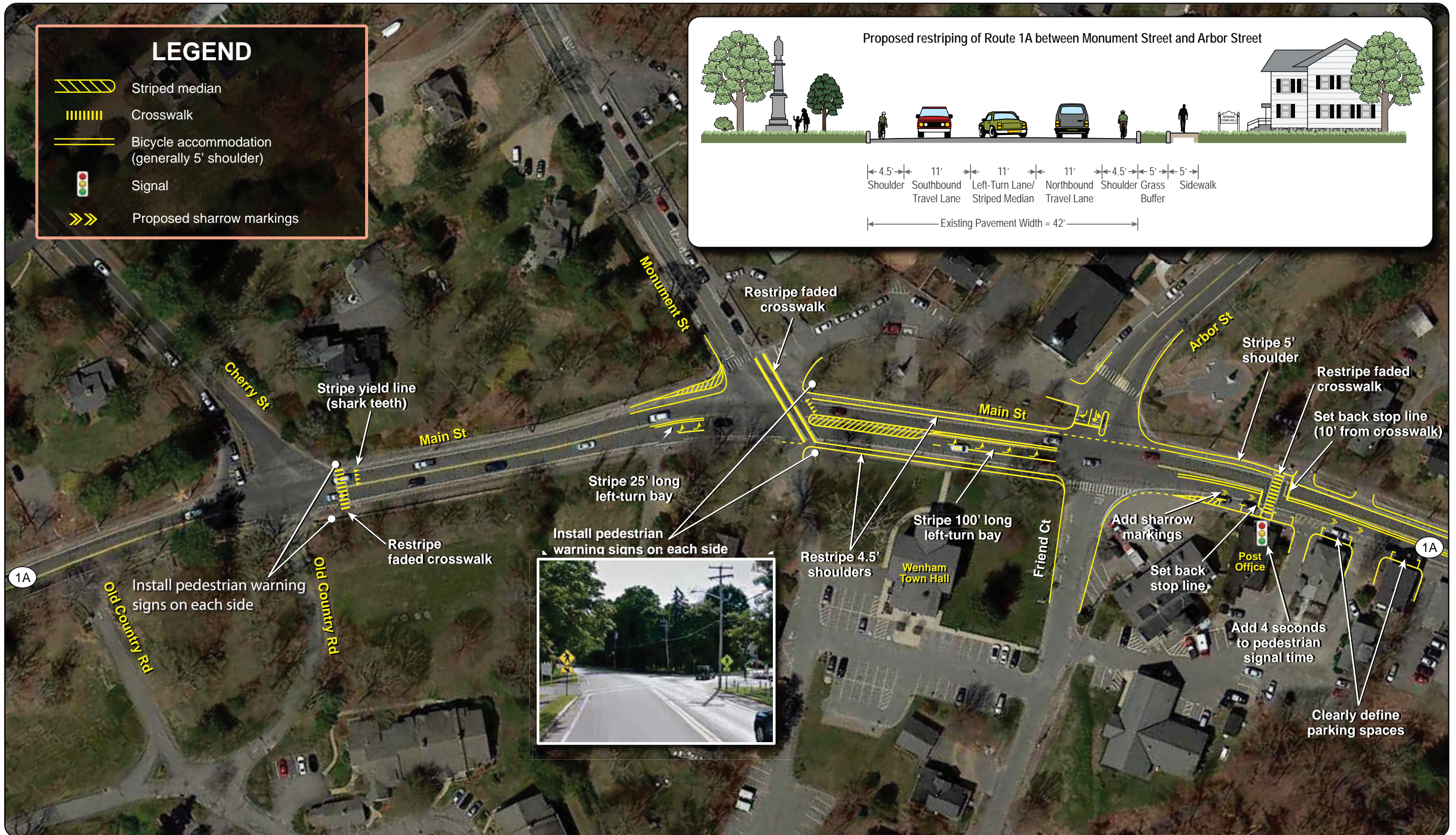
**7 SHORT-TERM IMPROVEMENT ALTERNATIVES**

MPO staff identified several short-term improvements that would address some of the issues identified in the study area. These proposals, which are shown in more detail in Figure 5, include the following:

- Restripe Route 1A between Cherry Street and Arbor Street to add a left-turn lane/median and to include shoulders for bicycle accommodation
- Increase pedestrian signal crossing time at the post office crosswalk
- Double up pedestrian crossing warning signs
- Add yield line (shark teeth) approaching Route 1A crosswalks
- Add a speed regulation sign (25 mph) on Cherry Street Eastbound east of Monument Street
- Clearly define on-street parking spaces

The short-term options make use of the existing pavement width to minimize construction time and cost. They could be implemented either as a stopgap measure while long-term alternatives are being funded and constructed, or as an alternative to the long-term proposals if the town chooses not to pursue any long-term options.





**Figure 5**  
**Proposed Short-Term Improvements**  
**Route 1A at Cherry Street, Monument Street, and Arbor Street in Wenham**



## 8 LONG-TERM IMPROVEMENT ALTERNATIVES

The existing conditions analysis described in the previous chapters strongly suggests that one or multiple traffic signals could improve the safety and operations within the study area. Consequently, MPO staff experimented with five improvement alternatives involving signalization and roadway reconstruction, along with a sixth that employs a roundabout control scheme. While these options would cost more and take longer to construct than the short-term alternatives discussed in the previous chapter, they also offer a greater potential to improve conditions along the corridor.

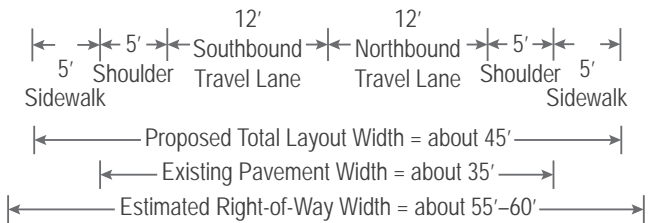
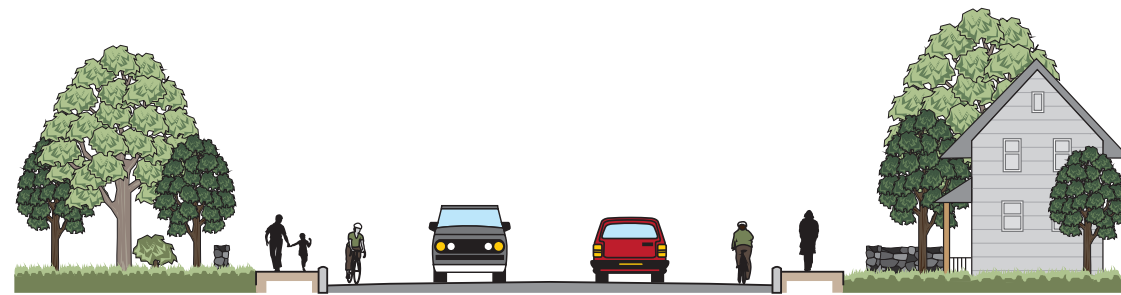
### 8.1 Proposed Cross-Section of All Alternatives

MPO staff recommends resurfacing the roadway across the length of the corridor with a new cross section that would address some of the safety and mobility issues. Figure 6 shows the proposed cross sections for different portions of Route 1A within the study area. These modifications address the following issues:

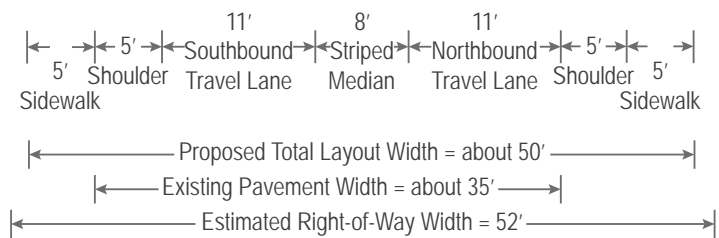
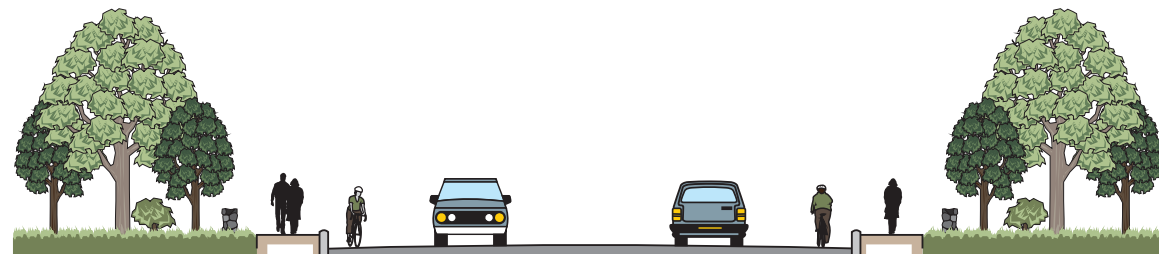
- Eliminate sidewalk gaps on Route 1A. There is currently no sidewalk on the west side of Route 1A south of Cherry Street and between Monument Street and Arbor Street.
- Ensure consistent five-foot shoulders along Route 1A for safe bicycle travel. The only exception would be at the north end of the corridor, where sharrows would be used instead to preserve the post office parking.
- Add left-turn lanes at locations with high left-turn volumes for improved safety and vehicle delay. Turn bays would be added:
  - On Route 1A northbound at all three intersections;
  - On Route 1A southbound at Arbor Street; and
  - On Cherry Street.Arbor Street already has a turn bay in the existing geometry, which would be restriped for clarity but not otherwise changed.
- Calm traffic speeds by reducing travel lanes to 12 feet with shoulders and striped medians.

Figure 6 also presents the approximate existing pavement width (based on aerial images) and right-of-way width (based on the town assessor's database). It shows that the recommended cross-section will likely require expansion of the paved surface, although the required width mostly falls within the available right-of-way. The only possible exception is on Route 1A south of Cherry Street, where the abutting properties are close to the edge of the road, especially the private residence on the south corner of Cherry Street and Route 1A.

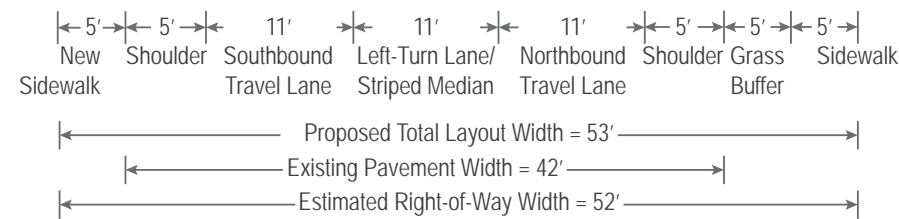
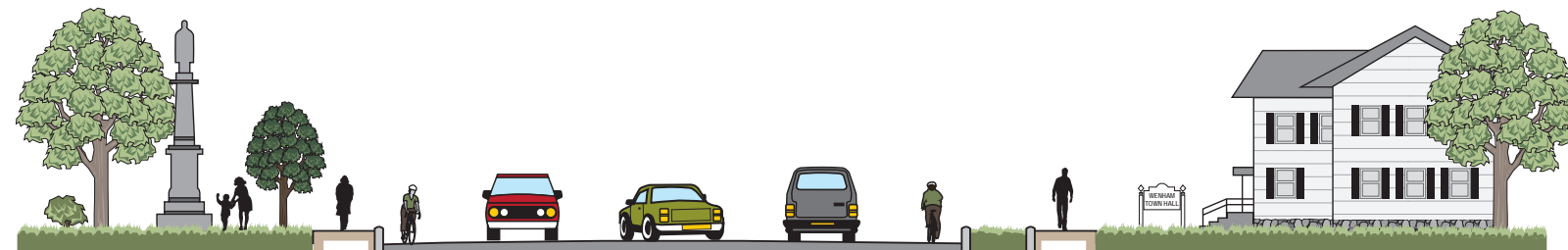
Proposed Route 1A cross-section in the vicinity



Proposed Route 1A cross-section between Cherry Street and Monument Street



Proposed Route 1A cross-section with a left-turn lane or striped median



**Figure 6**  
**Proposed Cross-Sections for Long-Term Improvements**  
**Route 1A at Cherry Street, Monument Street, and Arbor Street in Wenham**



## 8.2 Long-Term Improvement Alternatives

Although the issues present in the study area favor a long-term solution involving signalization, there are several options involving the number and placement of signals. MPO staff developed the following six alternatives to test different combinations of signals at the three intersections. The features and trade-offs of each alternative are discussed below.

### *Alternative 1: Signalize Arbor Street Intersection*

Figure 7 shows the proposed geometry of Alternative 1, which would only install a traffic signal at the Arbor Street intersection. The other two intersections in the study area would be updated with the proposed cross-sections but would remain stop-controlled.

Alternative 1 would:

- Improve operations and safety at the intersection with the highest vehicular volume.
- Provide protected crossings at the intersection with the most pedestrian traffic. A crosswalk with a protected phase on both Route 1A approaches would ensure easy access to the church, town hall, post office, and shops. The existing midblock crossing near the post office could be kept or removed.
- Allow safe and fast departure from the fire and police stations with emergency vehicle preemption. The stop line on Route 1A southbound would be set back in order to ensure a clear access area for emergency vehicles at the fire station.
- Fit easily within the available right-of-way.

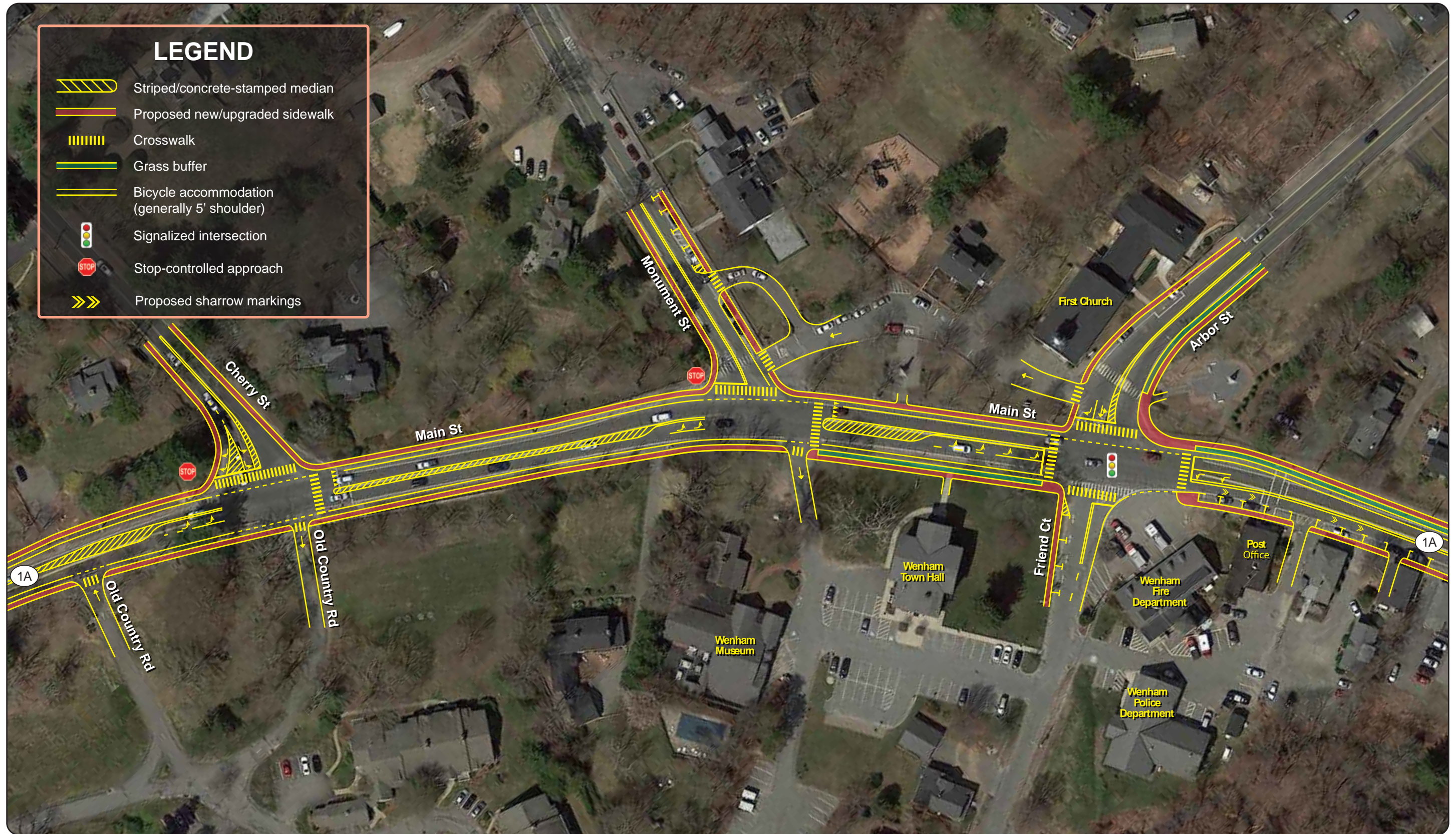
Drawbacks of Alternative 1 include:

- No safety or operations improvements on the other two intersections, which have more left-turns onto Route 1A.

### *Alternative 2: Signalize Cherry Street Intersection*

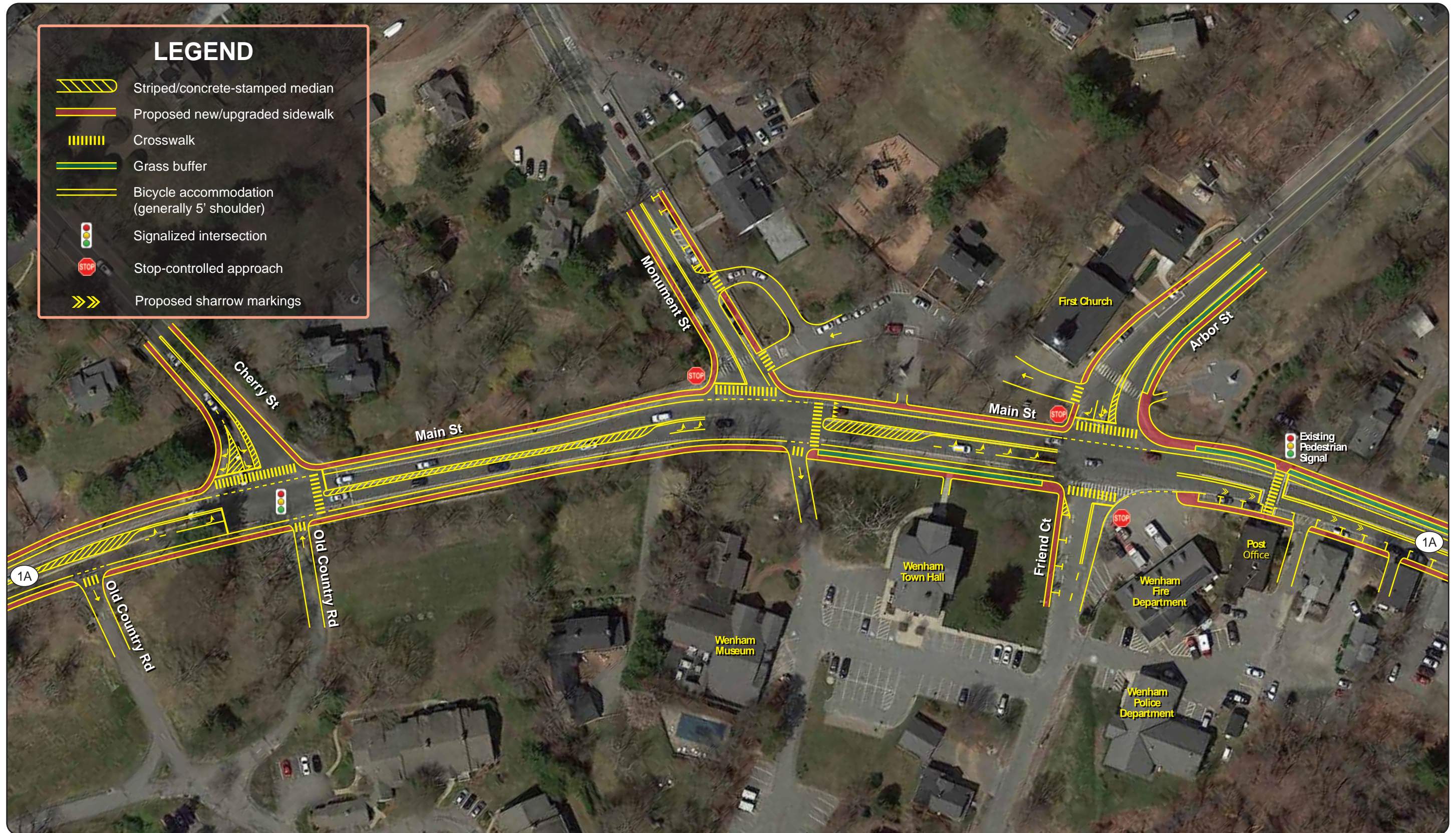
Figure 8 shows the proposed geometry of Alternative 2, which would install a traffic signal at the Cherry Street intersection. As in Alternative 1, the other two intersections would keep their stop control.





**Figure 7**  
**Long-Term Improvements Conceptual Plan: Alternative 1**  
**Route 1A at Cherry Street, Monument Street, and Arbor Street in Wenham**





**Figure 8**  
**Long-Term Improvements Conceptual Plan: Alternative 2**  
**Route 1A at Cherry Street, Monument Street, and Arbor Street in Wenham**



Alternative 2 would:

- Improve safety at the intersection with the highest crash rate.
- Improve operations at Monument Street by drawing away cut-through traffic. Currently, a significant portion of Cherry Street traffic heading to Route 1A northbound switches to Monument Street in an attempt to bypass congestion. Installing a signal at Cherry Street would reduce delay for Cherry Street traffic, making cutting through via Monument Street no longer the fastest option. MPO staff used user equilibrium analysis to estimate that 50 percent of left-turns at Monument Street would shift to Cherry Street under Alternative 2.<sup>11</sup>
- Add a second signalized pedestrian crossing at the south end of the corridor, which would complement the existing signalized pedestrian signal at the north end of the corridor near the post office.
- Improve the safety on Old Country Road, which is the driveway for the Maples Retirement Home. In Alternative 2, the one-way entrance that opens into the existing intersection would change to a one-way exit and would become a signalized approach. The entrance would become an easy right turn for northbound traffic, and turning southbound traffic could wait in the striped median.

Drawbacks of Alternative 2 include:

- Tight right-of-way near Cherry Street could influence constructability.
- No safety or operations impacts on the other two intersections.
- Lack of emergency vehicle preemption at the fire station.

### ***Alternative 3: Signalize and Coordinate Arbor Street and Monument Street Intersections***

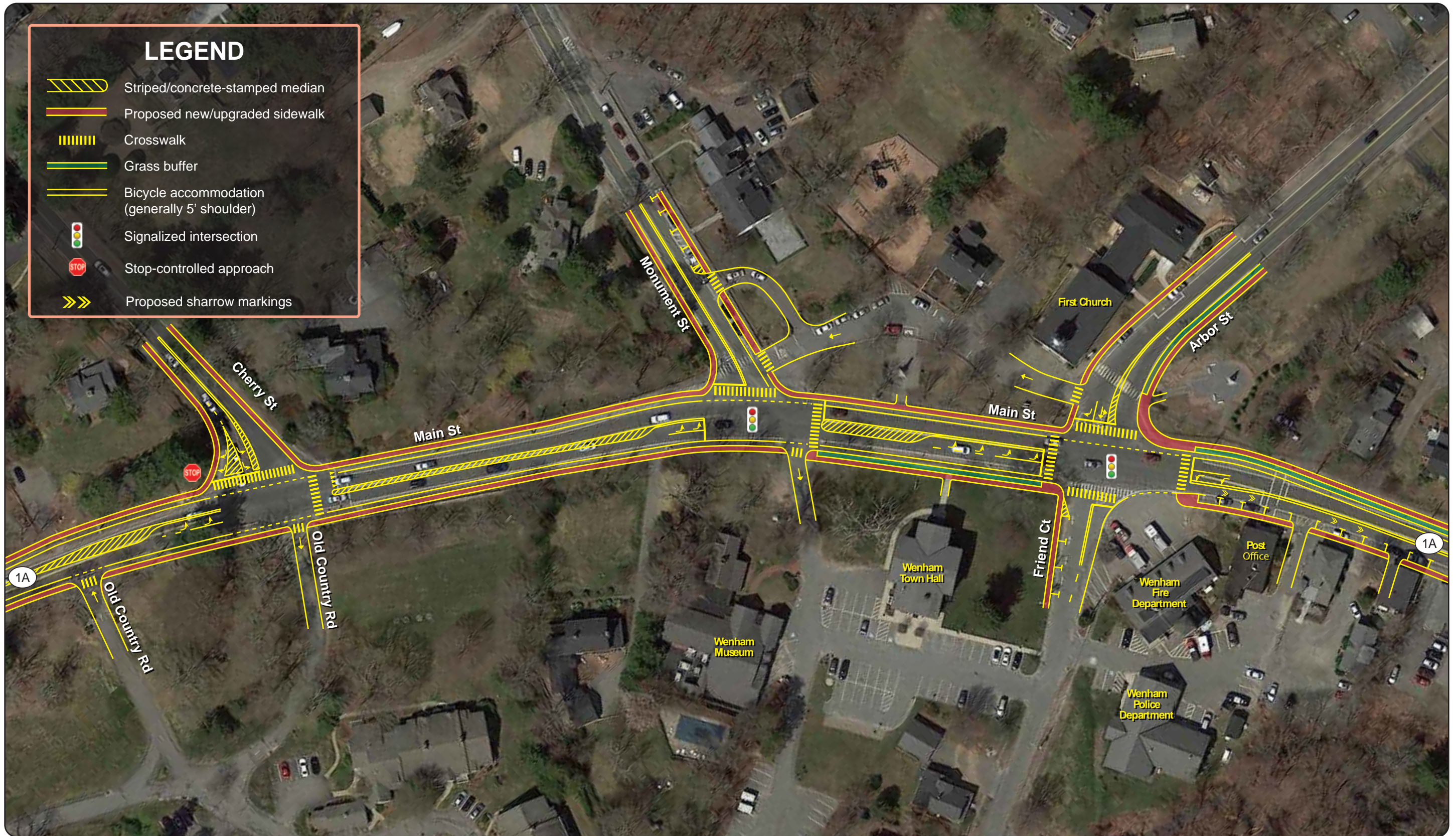
Alternatives 3 and 4 involve installing two signals to control traffic and improve safety. This would improve safety and operations for a larger portion of traffic inside the study area. However, a second signal would also represent a larger investment and require more adjustment for residents who are used to the existing configuration.

Figure 9 shows the proposed geometry of Alternative 3. In Alternative 3, two coordinated signals would be installed in the study corridor, with one at Monument Street and one at Arbor Street.

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<sup>11</sup>User equilibrium traffic assignment assumes that all users choose their own route towards their destination based on the travel time that will be consumed in different route options. The traffic volume assigned to each route is adjusted until the total travel time for each route is equal.





**Figure 9**  
**Long-Term Improvements Conceptual Plan: Alternative 3**  
**Route 1A at Cherry Street, Monument Street, and Arbor Street in Wenham**



Alternative 3 would:

- Allow for emergency vehicle preemption, as in Alternative 1.
- Improve safety for the dangerous left turn from Monument Street onto Route 1A northbound.
- Improve operations at Cherry Street. As mentioned in Alternative 2, many of the vehicles turning left onto Route 1A northbound can choose either Cherry Street or Monument Street depending on anticipated delay. A signal at Monument Street would have the opposite effect as Alternative 2 and would shift some left-turns from Cherry Street to Monument Street. User aquarium analysis suggested 60 percent of the left-turns from Cherry Street would use Monument Street under Alternative 3.

Drawbacks of Alternative 3 include:

- Two tightly spaced intersections (approximately 200 feet apart) might present queuing and coordination problems.
- Cut-through traffic on Monument Street would be encouraged. This would also increase the volume of left turns at the unsignalized intersection of Cherry Street and Monument Street, creating a potential safety risk.

#### ***Alternative 4A and Alternative 4B: Signalize and Coordinate Arbor Street and Cherry Street Intersections***

Figure 10 shows the proposed geometry of Alternative 4A and 4B. Both of these alternatives would install coordinated signals at the Cherry Street and Arbor Street intersections.

Alternative 4A would:

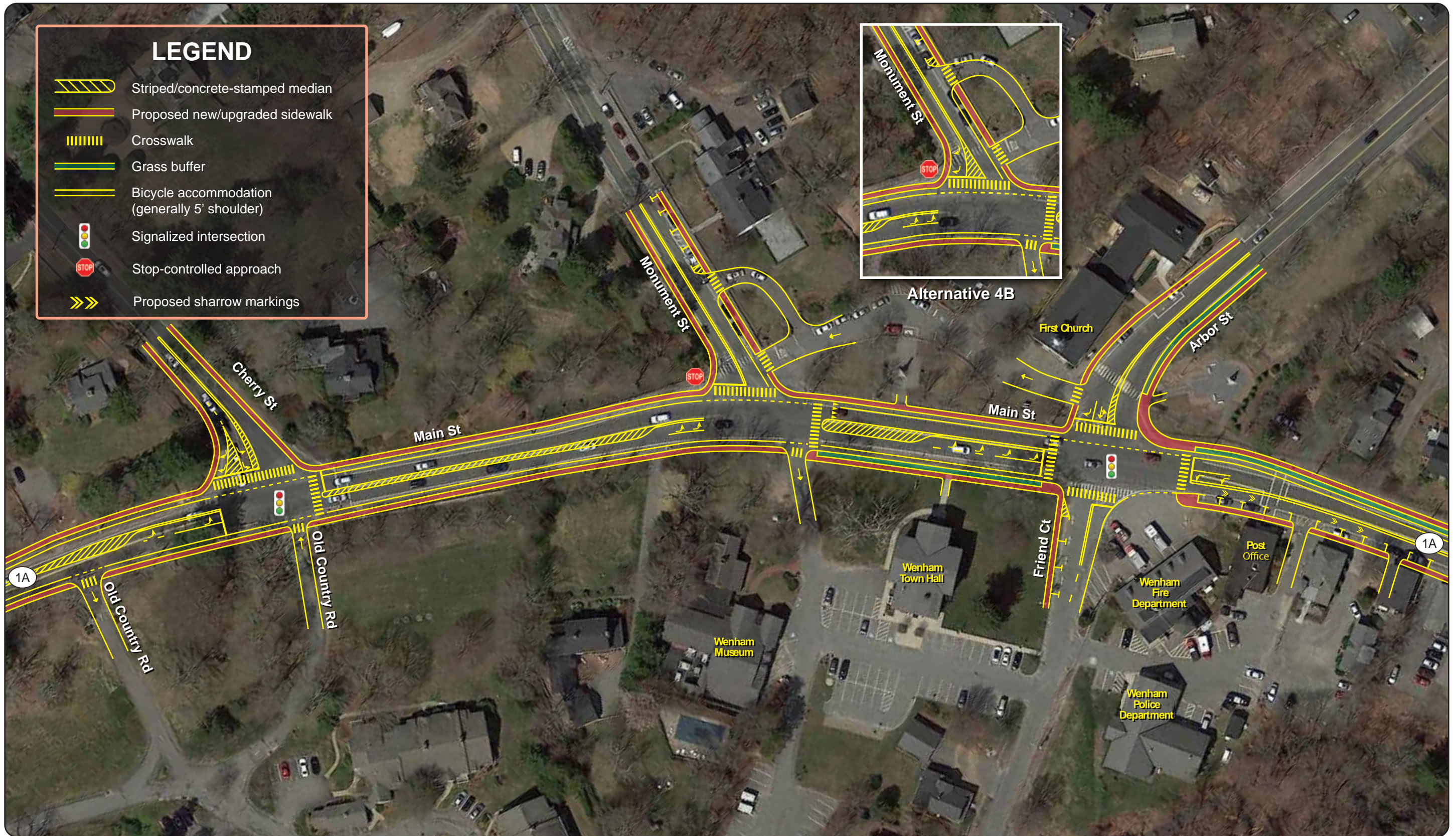
- Allow for emergency vehicle preemption, as in Alternative 1.
- Improve safety at the two busiest intersections, with additional effects felt at Monument Street due to 50 percent reduced cut-through traffic.
- Be easier to coordinate. The 1,000 feet between the two signals would be more than enough to prevent queues from spilling between intersections.

Drawbacks of Alternative 4A include:

- Tight right-of-way near Cherry Street could influence constructability.

Alternative 4B is a variant of Alternative 4A in which left turns from Monument Street would be completely prohibited. This traffic, which is mostly cut through, would be forced to use Cherry Street instead. The inset in Figure 10 shows the geometric modifications in Alternative 4B. Adding this restriction would be an option for the town if keeping the cut-through traffic off Monument Street is a priority. It would also improve safety at the Monument Street intersection without the cost of a signal by cutting entry volume.





**Figure 10**  
**Long-Term Improvements Conceptual Plan: Alternatives 4A (and 4B)**  
**Route 1A at Cherry Street, Monument Street, and Arbor Street in Wenham**



### ***Alternative 5: Signalize and Coordinate All Three Intersections***

Figure 11 shows the proposed geometry of Alternative 5, which would place coordinated traffic signals at all three intersections.

Alternative 5 would:

- Permit emergency vehicle preemption.
- Maximize protected crossing options for pedestrians.
- Improve turning safety by signalizing each approach.
- Allow town engineers to roughly control the traffic on Cherry Street and Monument Street by adjusting the respective green times at those approaches.

Drawbacks of Alternative 5 include:

- Tightly packed signals could cause confusion and delay for through traffic.

### ***Alternative 6: Install Modern Roundabouts at Arbor Street and Cherry Street Intersections***

MPO staff also wanted to consider using traffic circles as an alternative to signalized control. Figure 12 shows the geometry of Alternative 6, which would install modern roundabouts at Arbor Street and Cherry Street.

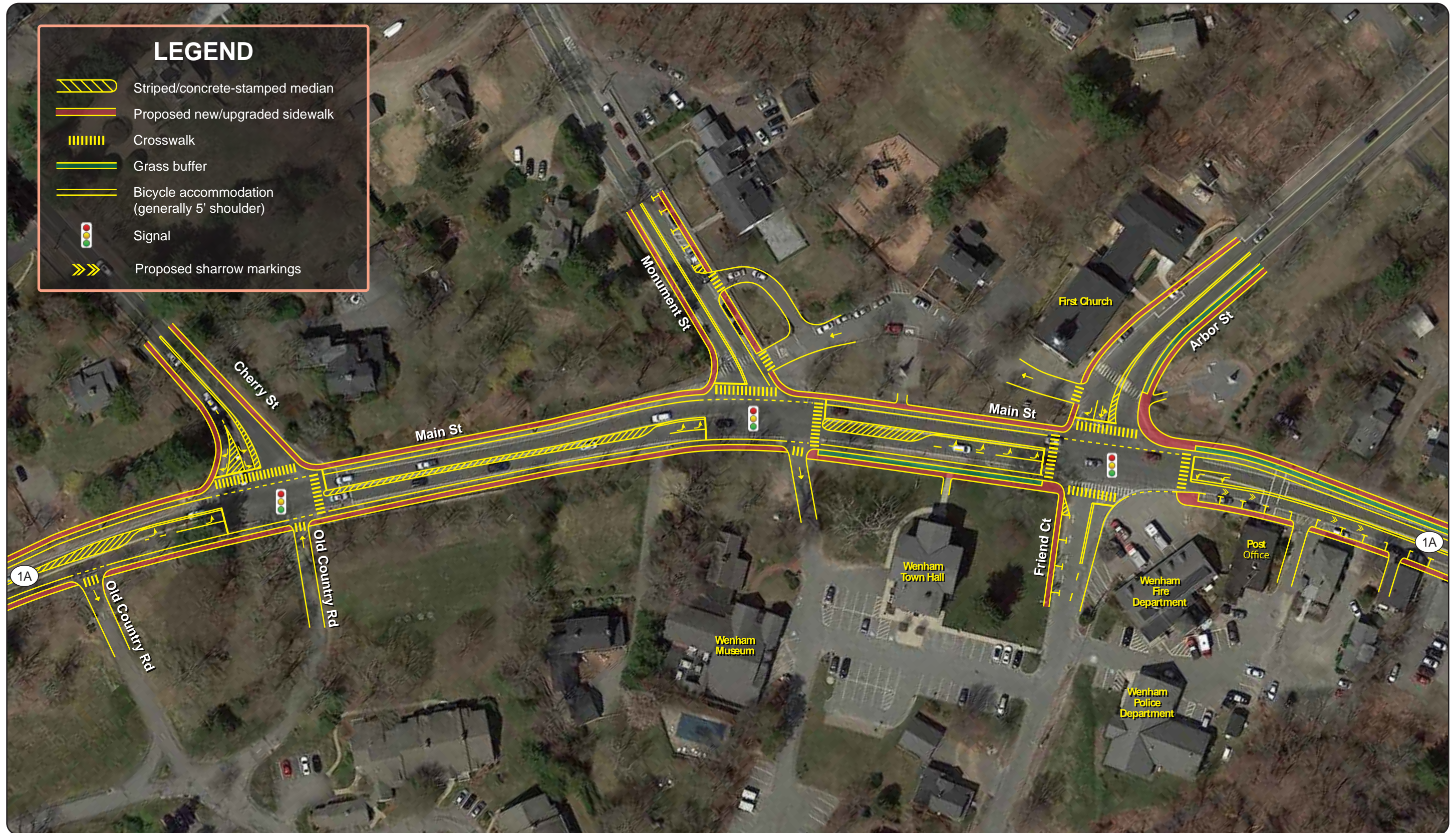
Alternative 6 would:

- Improve delay for left-turning traffic.

Drawbacks of Alternative 6 include:

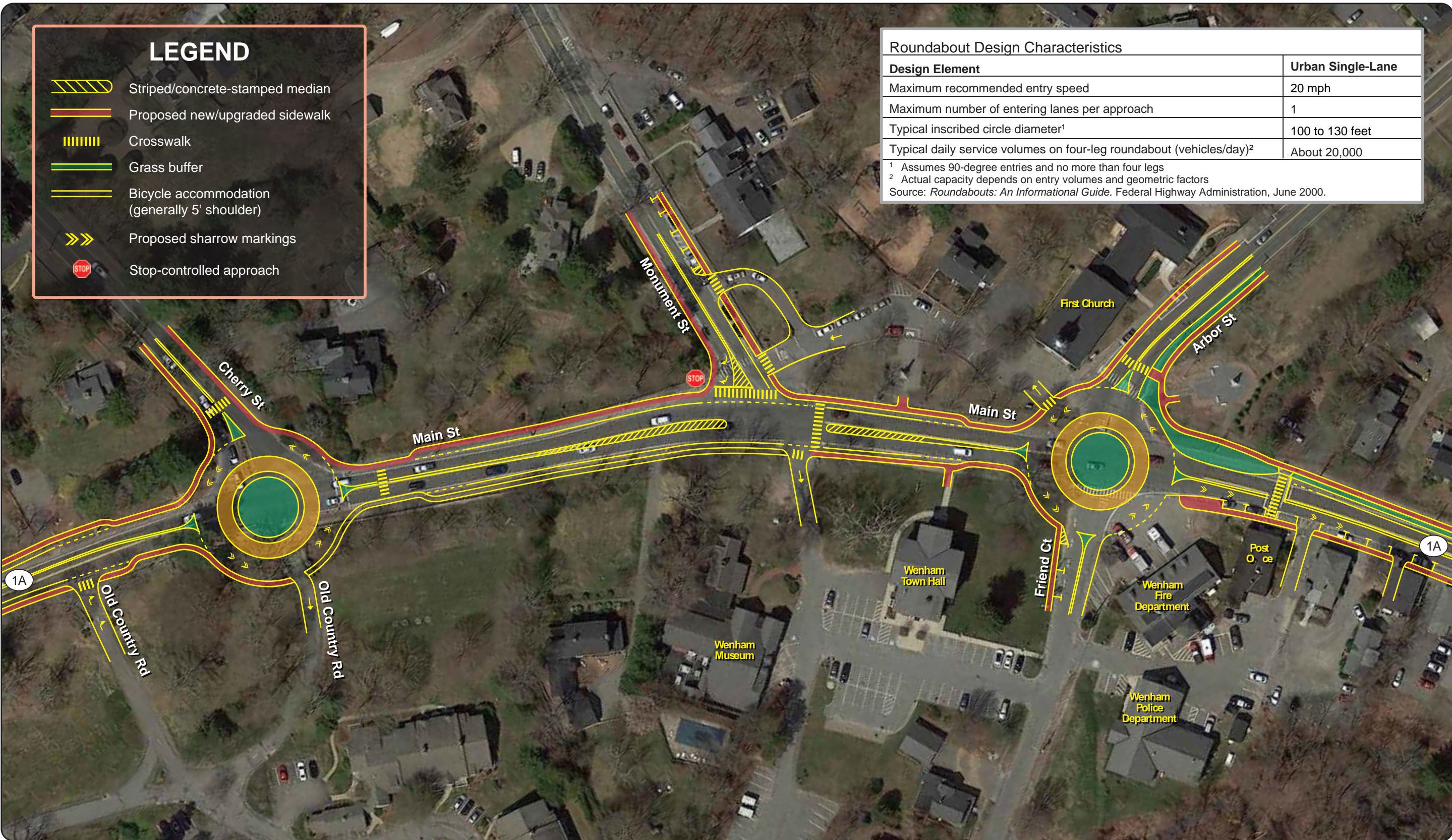
- Significant right-of-way impacts. The large radius required for this kind of traffic circle would greatly exceed the right-of-way and land takings would be necessary in several locations.
- Increased delay for Route 1A traffic. Typically, roundabouts are best suited for intersections with equal traffic on all approaches. Alternative 6 would improve delay for the side streets but would add delay to the much larger volume of Route 1A through traffic.
- Lack of bicycle accommodations. Geometric requirements of the roundabouts would not leave space for bicycle lanes.
- Obstruction of emergency vehicle access. The roundabout at Arbor Street would encroach on the fire station's driveway and make it difficult for emergency vehicles to exit.





**Figure 11**  
**Long-Term Improvements Conceptual Plan: Alternative 5**  
**Route 1A at Cherry Street, Monument Street, and Arbor Street in Wenham**





### LEGEND

-  Striped/concrete-stamped median
-  Proposed new/upgraded sidewalk
-  Crosswalk
-  Grass buffer
-  Bicycle accommodation (generally 5' shoulder)
-  Proposed sharrow markings
-  Stop-controlled approach

Roundabout Design Characteristics	
Design Element	Urban Single-Lane
Maximum recommended entry speed	20 mph
Maximum number of entering lanes per approach	1
Typical inscribed circle diameter <sup>1</sup>	100 to 130 feet
Typical daily service volumes on four-leg roundabout (vehicles/day) <sup>2</sup>	About 20,000

<sup>1</sup> Assumes 90-degree entries and no more than four legs  
<sup>2</sup> Actual capacity depends on entry volumes and geometric factors  
 Source: *Roundabouts: An Informational Guide*. Federal Highway Administration, June 2000.



**Figure 12**  
**Long-Term Improvements Conceptual Plan: Alternative 6**  
**Route 1A at Cherry Street, Monument Street, and Arbor Street in Wenham**



### 8.3 Level of Service of Long-Term Alternatives

MPO staff used Synchro traffic networks to model each of the long-term improvement alternatives. The capacity analysis was a particularly important tool for evaluating alternatives in this project because of the close proximity of the intersections in the study area. Tightly spaced intersections like these have complex interactions that can be difficult to anticipate using engineering judgment alone. MPO staff therefore used the traffic networks to verify that each proposed alternative would deliver the full operational benefits of signalization and provide the town with the largest possible impact from its investment.

Table 5 shows the AM peak hour level-of-service results and Table 6 shows the PM peak hour level-of-service results for the traffic network. All scenarios use 2025 traffic volumes based on regional growth predictions. For this seven-year window, the MPO regional model anticipates a uniform 2 percent growth inside the study area.<sup>12</sup>

As an additional check, MPO staff also tested the networks using SimTraffic simulations, which is a module included in the Trafficware Synchro 9 suite. Traffic simulations are a useful complement to the HCM methods because they provide a visual representation of system operations and because simulations can capture some aspects of complex traffic interactions that might be overlooked by the HCM formulas. For each scenario, MPO staff averaged the results of eight one-hour simulations with a 10-minute warmup period. The last row in Table 5 and Table 6 shows the average vehicle delay, which represents the total number of seconds an average vehicle experiences between the time it enters and the time it exits the study area.

In all cases, proposed traffic signals are fully actuated with exclusive pedestrian phasing. Signal cycle lengths were capped at 110 seconds to keep pedestrian delays low. Full details of the phasing, coordination, and analysis results are included in Appendix D.

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<sup>12</sup> The traffic growth projection is based on the transportation-planning model recently developed for the MPO's Long-Range Transportation Plan. The model predicts that traffic in the Wenham downtown area would increase 0.3 percent annually from 2018 to 2025 in both AM and PM peak periods.

**Table 5  
Level of Service of Proposed Alternatives: AM Peak Period**

Alternative	2025 No-Build			2025 Alternative 1			2025 Alternative 2			2025 Alternative 3			2025 Alternative 4A			2025 Alternative 4B			2025 Alternative 5			2025 Alternative 6			
	Continue existing operations			Signalize Arbor Street intersection			Signalize Cherry Street intersection			Signalize and coordinate Arbor Street and Monument Street intersections			Signalize and coordinate Arbor Street and Cherry Street intersections			Same as Alt. 4A and prohibit left turns on Monument Street			Signalize and coordinate all three intersections			Install modern roundabouts at Arbor Street and Cherry Street			
Street	LOS	Delay	95th Queue	LOS	Delay	95th Queue	LOS	Delay	95th Queue	LOS	Delay	95th Queue	LOS	Delay	95th Queue	LOS	Delay	95th Queue	LOS	Delay	95th Queue	LOS	Delay	95th Queue	
<b>1. Route 1A/Arbor Street</b>																									
Route 1A Northbound	L	A	8.7	46	B	12.6	#190	B	11.5	46	C	24.7	190	B	11.8	91	B	11.6	113	C	23.1	191	E	37.1	400
	TR	A	8.7	46	A	6.6	365	A	0.0	0	A	5.3	126	A	3.8	194	A	3.5	236	A	5.0	98	E	37.1	400
Route 1A Southbound	L	A	0.5	1	A	6.0	4	A	9.3	1	A	6.4	4	B	14.4	7	B	14.4	7	A	6.4	4	E	42.0	325
	TR	A	0.5	1	C	23.8	#600	A	0.0	0	B	19.4	#664	C	20.6	#677	C	20.6	#677	B	19.3	#664	E	42.0	325
Arbor Street	LT	F	>180	698	E	70.1	12	F	>180	789	E	59.2	14	E	59.2	14	E	59.2	14	E	59.2	14	D	32.6	200
	R	F	>180	698	A	5.8	52	F	>180	789	A	7.8	51	A	5.6	35	A	5.6	35	A	7.5	51	D	32.6	200
Friend Court	LTR	F	>180	103	D	42.3	10	F	>180	Err	D	38.2	11	D	37.0	10	D	37.0	10	D	38.2	11	A	9.9	0
<b>Intersection Total</b>		<b>F</b>	<b>93.1</b>		<b>B</b>	<b>14.1</b>		<b>F</b>	<b>&gt;180</b>		<b>B</b>	<b>14.5</b>		<b>B</b>	<b>12.0</b>		<b>B</b>	<b>11.9</b>		<b>B</b>	<b>14.0</b>		<b>E</b>	<b>37.4</b>	
<b>2. Route 1A/Monument Street</b>																									
Route 1A Northbound	L	A	0.4	1	B	12.2	1	B	11.0	1	A	8.2	6	B	12.1	1	B	12.1	1	A	3.4	m1	B	11.0	1
	TR	A	0.4	1	A	0.0	0	A	0.0	0	B	16.9	407	A	0.0	0	A	0.0	0	B	10.9	186	A	0.0	0
Route 1A Southbound	LTR	A	0.1	0	A	0.1	0	A	0.2	0	C	33.4	#1066	A	0.2	0	A	0.2	1	B	19.5	#1041	A	0.2	0
Monument Street	LT	F	>180	455	F	>180	Err	F	>180	282	D	45.8	#433	D	31.6	38				D	51.1	#338			
	R	F	>180	455	F	>180	Err	F	>180	282	A	0.0	0	D	31.6	38	C	21.5	3	A	0.0	0	C	17.1	2
<b>Intersection Total</b>		<b>F</b>	<b>55.9</b>		<b>F</b>	<b>&gt;180</b>		<b>E</b>	<b>35.9</b>		<b>C</b>	<b>29.2</b>		<b>A</b>	<b>1.3</b>		<b>A</b>	<b>0.3</b>		<b>B</b>	<b>19.4</b>		<b>A</b>	<b>0.2</b>	
<b>3. Route 1A/Cherry Street</b>																									
Route 1A Northbound	L	A	3.4	12	B	10.9	13	C	21.7	#68	B	11.2	14	C	26.7	#97	D	52.3	#103	A	9.3	51	F	58.2	450
	TR	A	3.4	12	A	0.0	0	B	13.2	404	A	0.0	0	B	17.2	422	C	23.8	422	A	9.6	350	F	58.2	450
Route 1A Southbound	TR	A	0.1	0	A	0.1	0	C	29.6	#882	A	0.1	0	D	38.6	#892	E	66.8	#879	A	9.4	m#722	D	26.8	300
Cherry Street	LT	F	>180	617	F	>180	722	E	58.6	#310	F	>180	497	D	53.4	#369	D	44.4	#482	E	65.6	#210	F	63.8	325
	R	F	>180	617	F	>180	722	C	21.2	120	F	>180	497	C	20.3	121	B	17.3	121	B	17.8	89	F	63.8	325
Old Country Road	LTR							C	28.0	4				C	26.8	4	C	24.8	4	C	33.6	4	B	10.6	0
<b>Intersection Total</b>		<b>F</b>	<b>84.1</b>		<b>F</b>	<b>131.1</b>		<b>C</b>	<b>26.2</b>		<b>F</b>	<b>73.2</b>		<b>C</b>	<b>31.4</b>		<b>D</b>	<b>44.9</b>		<b>B</b>	<b>14.4</b>		<b>E</b>	<b>46.8</b>	
<b>Simulation Average Delay</b>			<b>170.1</b>			<b>127.0</b>			<b>57.6</b>			<b>92.5</b>			<b>66.4</b>			<b>66.3</b>			<b>75.3</b>			<b>64.1</b>	

# = 95th percentile volume exceeds capacity, queue shown is after two cycles but may be longer. 95th Queue = 95th percentile queue length (feet). Delay = Average vehicle delay (seconds per vehicle). Err = Value exceeds constraints of HCM 2000 formulas. L = Left turning traffic. LOS = Level of Service. LT = Left and through traffic. LTR = Left, through, and right traffic. m = Volume for 95th percentile queue is metered by upstream signal. R = Right turning traffic. TR = Through and right traffic.

Note: Simulation average delay is calculated as the network-wide delay (seconds) experienced by an average simulation vehicle. Simulation results are averaged between eight 60-minute simulations, each with a 10-minute warm-up period.



**Table 6  
Level of Service of Proposed Alternatives: PM Peak Period**

Alternative	2025 No-Build			2025 Alternative 1			2025 Alternative 2			2025 Alternative 3			2025 Alternative 4A			2025 Alternative 4B			2025 Alternative 5			2025 Alternative 6			
	Continue existing operations			Signalize Arbor Street intersection			Signalize Cherry Street intersection			Signalize and coordinate Arbor Street and Monument Street intersections			Signalize and coordinate Arbor Street and Cherry Street intersections			Same as Alt. 4A and prohibit left turns on Monument Street			Signalize and coordinate all three intersections			Install modern roundabouts at Arbor Street and Cherry Street			
Street	LOS	Delay	95th Queue	LOS	Delay	95th Queue	LOS	Delay	95th Queue	LOS	Delay	95th Queue	LOS	Delay	95th Queue	LOS	Delay	95th Queue	LOS	Delay	95th Queue	LOS	Delay	95th Queue	
<b>1. Route 1A/Arbor Street</b>																									
Route 1A Northbound	L	A	8.9	44	B	15.5	#195	B	11.3	44	B	17.1	124	B	13.4	m81	B	13.9	m123	B	16.5	145	F	57.3	575
	TR	A	8.9	44	A	7.3	402	A	0.0	0	A	6.8	284	A	5.0	215	A	5.1	295	A	6.8	318	F	57.3	575
Route 1A Southbound	L	A	0.2	1	A	6.6	5	A	9.5	1	A	7.8	5	B	16.0	9	B	16.0	9	A	7.6	5	D	33.8	300
	TR	A	0.2	1	C	24.7	#587	A	0.0	0	C	20.5	#637	C	21.6	#594	C	21.6	#594	C	20.5	#637	D	33.8	300
Arbor Street	LT	F	>180	629	E	69.7	#75	F	>180	742	E	61.9	#64	E	61.9	#64	E	61.9	#64	E	61.9	#64	C	18.2	100
	R	F	>180	629	A	5.4	58	F	>180	742	A	7.7	60	A	5.7	43	A	5.7	43	A	7.4	60	C	18.2	100
Friend Court	LTR	F	>180	134	A	1.9	0	F	>180	145	A	2.2	0	A	2.2	0	A	2.2	0	A	2.2	0	B	11.8	0
<b>Intersection Total</b>		<b>F</b>	<b>92.3</b>		<b>B</b>	<b>14.6</b>		<b>F</b>	<b>138.9</b>		<b>B</b>	<b>13.6</b>		<b>B</b>	<b>12.5</b>		<b>B</b>	<b>12.6</b>		<b>B</b>	<b>13.5</b>		<b>E</b>	<b>42.9</b>	
<b>2. Route 1A/Monument Street</b>																									
Route 1A Northbound	L	A	0.3	1	B	11.1	1	B	10.1	1	A	7.8	7	B	11.0	1	B	11.0	1	A	5.0	m2	B	10.1	1
	TR	A	0.3	1	A	0.0	0	A	0.0	0	B	15.5	542	A	0.0	0	A	0.0	0	A	10.0	148	A	0.0	0
Route 1A Southbound	LTR	A	0.2	0	A	0.2	0	A	0.2	1	B	17.9	#963	A	0.2	1	A	0.3	1	B	12.2	#926	A	0.2	0
Monument Street	LT	F	>180	367	F	>180	495	F	>180	262	D	50.5	#370	D	28.5	30				E	55.0	#285			
	R	F	>180	367	F	>180	495	F	>180	262	A	0.2	0	D	28.5	30	C	20.1	5	A	0.3	0	C	16.4	4
<b>Intersection Total</b>		<b>E</b>	<b>37.3</b>		<b>F</b>	<b>93.9</b>		<b>D</b>	<b>33.1</b>		<b>C</b>	<b>20.7</b>		<b>A</b>	<b>1.1</b>		<b>A</b>	<b>0.3</b>		<b>B</b>	<b>14.8</b>		<b>A</b>	<b>0.3</b>	
<b>3. Route 1A/Cherry Street</b>																									
Route 1A Northbound	L	A	4.8	18	B	10.7	20	C	31.5	#166	B	10.7	20	C	22.7	#171	C	33.8	#209	A	9.8	85	F	90.2	650
	TR	A	4.8	18	A	0.0	0	B	14.5	#528	A	0.0	0	B	16.8	574	C	20.9	598	B	10.7	488	F	90.2	650
Route 1A Southbound	TR	A	0.3	1	A	0.3	1	C	30.2	#700	A	0.3	1	C	24.2	#767	D	38.5	#792	A	10.0	#688	C	22.0	225
Cherry Street	LT	F	>180	594	F	>180	Err	E	55.8	#277	F	>180	451	E	58.2	#340	D	51.4	#403	E	66.0	#199	C	24.1	150
	R	F	>180	594	F	>180	Err	B	11.0	52	F	>180	451	B	14.6	69	B	13.2	67	B	17.0	67	C	24.1	150
Old Country Road	LTR							B	19.9	3				C	22.5	4	C	20.9	3	C	27.5	4	B	12.2	0
<b>Intersection Total</b>		<b>F</b>	<b>96.4</b>		<b>F</b>	<b>&gt;180</b>		<b>C</b>	<b>26.0</b>		<b>F</b>	<b>81.5</b>		<b>C</b>	<b>25.0</b>		<b>C</b>	<b>32.0</b>		<b>B</b>	<b>15.0</b>		<b>F</b>	<b>51.8</b>	
<b>Simulation Average Delay</b>			<b>855.8</b>			<b>121.3</b>			<b>45.7</b>			<b>65.5</b>			<b>54.6</b>			<b>52.9</b>			<b>54.6</b>			<b>104.5</b>	

# = 95th percentile volume exceeds capacity, queue shown is after two cycles but may be longer. 95th Queue = 95th percentile queue length (feet). Delay = Average vehicle delay (seconds per vehicle). Err = Value exceeds constraints of HCM 2000 formulas. L = Left turning traffic. LOS = Level of Service. LT = Left and through traffic. LTR = Left, through, and right traffic. m = Volume for 95th percentile queue is metered by upstream signal. R = Right turning traffic. TR = Through and right traffic.

Note: Simulation average delay is calculated as the network-wide delay (seconds) experienced by an average simulation vehicle. Simulation results are averaged between eight 60-minute simulations, each with a 10-minute warm-up period.

The following conclusions can be drawn from Table 5 and Table 6.

- **2025 No-Build:** As with the existing conditions, the no-build case results in LOS F at all intersections, indicating unacceptable operations, especially on the side street approaches.
- **2025 Alternative 1:** Operations at the Arbor Street intersection are improved to LOS B, but the other two intersections remain at LOS F.
- **2025 Alternative 2:** Operations at the Cherry Street intersection improve to LOS C and Monument Street improves to LOS E/LOS D for the AM/PM peaks, respectively.
- **2025 Alternative 3:** Arbor Street improves to LOS B and Monument Street improves to LOS C. Meanwhile, despite a 60 percent reduction in volume, Cherry Street remains at LOS F. However, the 95th percentile queues show that queueing may prevent effective coordination under this configuration. The southbound queue at Monument Street is almost 1,000 feet at both peak hours, and there is only 200 available feet of storage space between the intersections. The simulation results bear out this conclusion and show much higher average delay for Alternative 3 than any of the other alternatives that use two signals.
- **2025 Alternative 4A:** All three intersections meet or exceed LOS C criteria, indicating satisfactory operations. The predicted queues should be well tolerated by the 700 feet of available queueing space between the two signals. The simulation results confirm that coordination runs smoothly in this scenario.
- **2025 Alternative 4B:** The results of Alternative 4B are approximately the same as Alternative 4A with the exception of slightly increased delay at Cherry Street caused by the diverted volume. This analysis confirms that prohibiting left turns from Monument Street is viable from an operations standpoint if the town wants to make this policy a priority.
- **2025 Alternative 5:** Every intersection operates at LOS B during both peak periods. Even though some of the queues are as long as in Alternative 3, the simulation results indicate smooth coordinated operations. Both analyses show that, despite the complexity of placing three traffic signals within one-quarter mile, coordination is still possible and Alternative 5 is a viable option. However, Alternative 5 doesn't appear to offer any performance advantage compared to the simpler two-signal alternatives.



- **2025 Alternative 6:** Although LOS at some intersections is improved when compared to the no-build case, Alternative 6 causes several of the Route 1A approaches to drop to LOS E or LOS F during both peak periods. This would introduce an unacceptable amount of delay for all through traffic and could cause queueing and delays with ripple effects beyond the study area.

#### 8.4 Summary of Long-Term Alternatives

Table 7 summarizes all the previously discussed characteristics of the different design alternatives.

**Table 7  
Evaluation of Long-Term Improvements Alternatives**

Objectives	Alternative 1 Signalize Arbor St. intersection	Alternative 2 Signalize Cherry St. intersection	Alternative 3 Signalize and coordinate Arbor St. and Monument St.	Alternative 4A Signalize and coordinate Arbor St. and Cherry St.	Alternative 4B Same as Alt. 4 and prohibit left turns on Monument St.	Alternative 5 Signalize and coordinate all three intersections	Alternative 6 Install modern roundabouts at Arbor St. and Cherry St.
Reduce traffic congestion at the three study intersections	○	○	◐	●	●	●	○
Maintain desirable traffic movements on Route 1a	○	○	○	○	○	○	◑
Improve the town's emergency responses	●	◇	●	●	●	●	●
Improve traffic operational safety	○	○	◐	●	●	●	◐
Improve pedestrian access and safety	○	○	◐	●	●	●	◇
Improve bicycle accommodation and safety	◐	◐	◐	◐	◐	◐	◇
Reduce traffic conflicts at Cherry/Monument intersection	◇	◐	◑	◐	●	◇	◐
Maintain convenient access for all traffic movements	◇	◇	○	○	○	○	○
Minimize right-of-way impacts	◇	○	○	○	○	○	●
Minimize construction costs	○	○	◑	◑	◑	●	●

**Legend**

 High improvement    
  Medium improvement    
  Low improvement    
  Neutral    
  Low regression    
  Medium regression    
  High regression

**Note:** All the alternatives are analyzed under future (2025) traffic conditions. The evaluation compares each alternative to the base case of 2025 no-build.



## 9 CONCLUSIONS AND NEXT STEPS

### 9.1 Conclusions

The above analyses support the need for renovations that would improve safety, operations, mobility, and emergency responsiveness at the study location.

Many of the issues present can be addressed by upgrading the pavement markings, signage, and lane configuration along the Route 1A corridor. MPO staff recommends repaving the corridor and updating the roadway cross-section as part of any selected design. The cross-sections in Figure 6 are tailored to the needs identified in the study and using a similar design would be recommended by MPO staff. However, the strategies employed in those cross-sections (tighter travel lanes, consistent shoulders for bicycles, installation of new sidewalks, clear striping and signage for pedestrian crossings, and marked turn bays) can also be adapted to other designs depending on the priorities of the town or factors such as budget, existing facilities, or available right-of-way.

The safety and operations analysis also demonstrated that signalization is warranted in the study region. Of the proposed alternatives, MPO staff recommends Alternative 4A (installation of signals at Cherry Street and Arbor Street) as the optimal solution. This alternative was shown to strike the best balance between the scope of issues addressed and the cost and complexity of the project. The Town of Wenham and MassDOT District 4 concurred that Alternative 4A is the preferred option, and MassDOT additionally expressed support for moving forward with some of the short-term improvements mentioned in the study. Comments on the proposed improvements from MassDOT and the Town are included in Appendix F.

### 9.2 Next Steps

MassDOT District 4 has jurisdiction of Route 1A and the intersections within the study corridor, and is responsible for renovations to improve safety, mobility, connectivity, and operations. This study gives the Town an opportunity to review the needs of the intersection and plan for design and engineering. The next step would be to select the preferred alternative that is sensitive to the goals and needs of stakeholders, and then advance the project through the planning process. These steps will depend upon cooperation between MassDOT, the Town of Wenham, and the MPO to begin the project notification and review process, and complete the project initiation form. After completing the initial steps, the Town of Wenham and MassDOT can start preliminary design and engineering to place the project in the Transportation Improvement Program. Transportation decision making is complex, and influenced by factors such as financial limitations and agency programmatic commitments. Project

development is the process that takes transportation improvements from concept to construction (see Appendix G for an overview of this process).

This study supports the MPO's visions and goals, which include increasing transportation safety, maintaining the transportation system, advancing mobility and access, reducing congestion, and expanding the opportunities for walking and bicycling, while also making them safer. If implemented, the improvements proposed in this report would increase traffic safety and modernize the roadway to accommodate all users.

cc: Sara Timoner, MassDOT District 4,  
John Gregg, MassDOT District 4



**APPENDIX A:  
COMMENTS AND SELECTION PROCESS**

## Study Advisory Meeting

### Wenham Intersections Safety and Operations Study

April 26, 2018

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## Summary of Findings and Proposed Improvements (DRAFT)

### Safety and Operations Analysis at Selected Intersections: Route 1A at Cherry Street, Monument Street, and Arbor Street in Wenham

Study Advisory Meeting 4/26/2018

DRAFT

#### Study Objectives

To perform various safety and operations analyses and identify short- and long-term improvements for all transportation modes, including pedestrians, bicycles, and trucks, at the selected intersections

#### Study Area

Route 1A (Main Street) from Cherry Street to Arbor Street/Friend Court, including the three intersections and their adjacent areas (**Figure 1**)

#### Existing Conditions

- Functional classes: urban principal arterial (Route 1A), minor arterials (Cherry Street, Monument Street, and Arbor Street), and local street (Friend Court)
- Route 1A (Main Street) average daily traffic: about 15,000 to 20,000 vehicles/day
  - Cherry Street: about 4,500 vehicles/day
  - Monument Street: about 3,800 vehicles/day
  - Arbor Street: about 6,500 vehicles/day
- Weekday peak-hour traffic, pedestrian, and bicycle volumes (**Figure 2**)
- Route 1A speed regulation: 30 MPH in the study area and 35 MPH in Wenham
  - Cherry Street speed regulation: 25 MPH and 35 MPH north of Monument Street
  - Monument Street speed regulation: 30 MPH
  - Arbor Street speed regulation: 30 MPH
- Crash Data Analysis
  - Collision Diagram: Wenham Police Department crash data 2011–17 (**Figure 3**)
  - Crash Statistics Summary: WPD crash data 2011–17 (**Appendix A**)
  - Intersection Crash Rates (**Appendix B**)
  - Corridor Crash Rate (**Appendix C**)
- Traffic Signal Needs Analysis (**Appendix D**)

#### Major Issues and Concerns

- Traffic congestions and delays at all three intersections
- High intersection crash rate at Cherry Street
- High corridor crash rate in the Route 1A study section
- Pedestrian crossing access and safety
- Bicycle accommodation and safety
- Town emergency response and operations
- Wide intersection layouts allowing fast traffic causing potential conflicts

## Proposed Short- and Long-Term Improvements

- **Horizon of improvements**
  - Short-term: under 2 years
  - Long-Term: more than 2 years
- **Short-Term Improvements (*Figure 4*)**
  - Restripe Route 1A between Cherry Street and Arbor Street to add a left-turn lane/median and to include shoulders for bicycle accommodation
  - Increase pedestrian signal crossing time at the post office crosswalk
  - Double up pedestrian crossing warning signs
  - Add yield line (shark teeth) approaching Route 1A crosswalks
  - Clearly define on-street parking spaces
- **Long-Term Improvement Alternatives**
  - Alternative 1: Signalize Arbor Street Intersection (*Figure 5*)
  - Alternative 2: Signalize Chery Street Intersection (*Figure 6*)
  - Alternative 3: Signalize and Coordinate Arbor Street and Monument Street Intersections (*Figure 7*)
  - Alternative 4A: Signalize and Coordinate Arbor Street and Cherry Street Intersections (*Figure 8*)
  - Alternative 4B: Same as alternative 4A and Prohibit Left Turns on Monument Street (*Figure 8*)
  - Alternative 5: Signalize and Coordinate All Three Intersections (*Figure 9*)
  - Alternative 6: Install Modern Roundabouts at Arbor Street and Cherry Street Intersections (*Figure 10*)
  - Proposed Route 1A Cross-Sections in the Study Area (*Figure 11*)

## Evaluation of Long-Term Improvement alternatives

- Summary of Synchro Analysis Results (*Tables 1 and 2*)
- Discussion of preferred Alternatives

CW/cw



**Study Advisory Meeting**  
 Wenham Intersections Safety and Operations Study  
 February 15, 2018

Name	Affiliation	Email
Peter Lombardi	Wenham Town Administrator	<a href="mailto:plombardi@wenhamma.gov">plombardi@wenhamma.gov</a>
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## **Study Scoping Meeting Summary (Draft)**

### **Safety and Operations Analysis at Selected Intersections Route 1A at Cherry Street, Monument Street, and Arbor Street in Wenham**

**Wenham Town Hall, Thursday, February 15, 2018**

#### **Meeting Participants**

Town of Wenham, MassDOT Office of Transportation Planning, MassDOT Highway Division District 4, and Central Transportation Planning Staff (see attached list of the study advisory members)

#### **Study Background**

This study builds on recommendations generated by the Boston Region Metropolitan Planning Organization's (MPO) Congestion Management Process (CMP) to address safety and congestion problems at intersections in the MPO area. Several similar studies were completed in previous funding years and received favorable responses from municipalities, which included appreciation of the MPO's assistance with the conceptual design of low-cost improvements and the planning and implementation processes.

The intersections selected for study in recent years under this program are:

- Broadway at Fourth and Fifth Street in Chelsea (2016)
- Route 114 (Andover Street) at Esquire Drive and Violet Road in Peabody (2016)
- Route 53 (Washington Street) and Broad Street in Weymouth (2014)
- Route 109 (Medway Road) and Kmart Driveway in Milford (2014)
- Route 109 (High Street) and Nahatan Street in Westwood (2014)
- Route 109 (High Street) and Pond Street in Westwood (2014)

Reports for these studies can be found on the MPO website:

[http://www.ctps.org/recent\\_studies#corridor\\_and\\_subarea](http://www.ctps.org/recent_studies#corridor_and_subarea)

#### **Study Objectives**

To perform various safety and operations analyses and identify short- and long-term improvements for all transportation modes, including pedestrians, bicycles, and trucks, at the selected intersections

#### **Study Area**

Route 1A (Main Street) from Cherry Street to Arbor Street/Friend Court, including the three intersections and their adjacent areas (Figure 1)



## **Roadway and Intersection Characteristics Overview**

- Functional classes: urban principal arterial (Route 1A), minor arterials (Cherry Street, Monument Street, and Arbor Street), and local street (Friend Court)
- Generally two-lane roadways in the study area
- Jurisdiction: MassDOT Highway Division District 4
- Route 1A (Main Street) average daily traffic: about 15,000 to 20,000 vehicles/day
- Cherry Street average daily traffic: about 4,500 vehicles/day
- Monument Street average daily traffic: about 3,800 vehicles/day
- Arbor Street average daily traffic: about 6,500 vehicles/day
- All three intersections are currently unsignalized, with stop controls on side streets
- Route 1A speed regulation: 30 MPH in the study area and 35 MPH in Wenham
- Cherry Street speed regulation: 25 MPH in the northbound direction, passing Monument Street 35 MPH (need to confirm these for the southbound direction)
- Monument Street regulation: 30 MPH
- Arbor Street speed regulation: 30 MPH
- Sidewalks exist on both sides of Route 1A, except the west side between Monument Street and Arbor Street.
- No dedicated bike lanes exist on all roadways.
- Roadway shoulders generally are two to four feet wide, except the Route 1A southbound section from the post office to Monument Street (eight to ten feet wide).
- Right-of-Way (based on MassDOT Roadway Inventory File): 52 feet wide (Route 1A), 40 feet wide (Cherry Street and Arbor Street), and 46 feet wide (Monument Street).
- Adjacent land uses: mainly residential, except a business district on the east side of Route 1A north of Friend Court
- On-street parking is allowed only on Route 1A northbound in the business district.
- Route 1A adjacent parcels are under the Historical District zoning.

## **MassDOT 2011–15 Crash Data Overview**

- Collision Diagram (see Figure 2)
- 55 crashes occurred in study area in the five-year period (Table 1), about evenly distributed at the three intersections (Tables 2–4)
- One bicycle crash and no pedestrian crashes.
- Individual intersection crash rates are generally near or slightly higher than the average for the unsignalized intersections in MassDOT District 4 (0.56 crashes per million entry vehicles).
- Route 1A Town Center segment crash rate: 7.91 crashes per million vehicle miles traveled (MVMT), much higher than the State average for urban principal arterials (3.23 crashes/MVMT)

## **Issues and Concerns**

- Traffic congestion and operations:
  - Route 1A, connecting Route 128 in Beverly, through Wenham, Hamilton, Ipswich, and Rowley, to Route 1 in Newburyport, is a significant roadway in the

region. During the AM and PM peak commuting hours, Route 1A traffic flows continuously. At the three unsignalized intersections, vehicles approaching Route 1A from the minor streets (Cherry Street, Monument Street, Arbor Street, and Friend Court) endure extensive delays. Traffic queues of ten or more vehicles are often observed.

- During the peak hours, left turns from Route 1A northbound to Cherry Street and to Arbor Street frequently block or interfere with Route 1A through traffic. The turns are difficult because of the continuous opposite traffic on Route 1A.
- Left turns from Route 1A southbound to Friend Court is also difficult because the opposite traffic often forms in two lanes (although the roadway striped as one) and occupies the intersection.
- Monument Street splits from Cherry Street about 2,000 feet north of Route 1A and is used as a short cut to Route 1A northbound. It is relatively straight and wide and the residents complain about speeding traffic.
- During peak hours, drivers take their chances in choosing between Cherry Street and Monument Street to Route 1A northbound. Both streets at Route 1A seem to be equally congested. Traffic count data show that the left-turn volumes at Monument Street are generally higher than that at Cherry Street.
- The three intersections are all relatively wide, creating long pedestrian crossing distances. Also the stop bars are rarely obeyed because drivers have to pull ahead in order to see traffic on Route 1A.
- Wenham Fire Station is located at the northeast corner of the intersection of Route 1A and Arbor Street/Friend Court. Wenham Police Department is located on Friend Court just next to the fire station. Under the current unsignalized intersection setting, it is very difficult for them to operate safely and efficiently when responding to emergencies. There is a critical need for a traffic control device with emergency vehicle preemption (Opticom) capable of stopping general traffic from all directions.
- The apron area in front of the fire station should be preserved for the maneuvers of fire engines and other emergency vehicles.
- The driveway in front of Wenham First Church is located close to Route 1A and is frequently used as a short cut to Monument Street, especially when Route 1A traffic is busy.
- In the summer, the church driveway is used as a drop-off/pick-up site for a popular summer camp. At the time, traffic at the intersection can be chaotic. Temporary signage has to be set up to prohibit left turns into the driveway directly from Route 1A and parents are advised to use Perkins Street (further north on Route 1A) and Arbor Street eastbound to the driveway. Some parents park in the town hall parking lot and walk with their children across Route 1A.
- An elementary school is located about 1,000 feet north of the Route 1A/Arbor intersection. During the school opening and closing hours (8:00–9:00 AM and 2:30–3:30 PM), the intersection can have a sudden surge of traffic by the school drop-off and pick-up trips. Some parents also used the church driveway to bypass Route 1A.
- During the summer, Route 1A traffic increases due to the trips to Crane Beach.



- Truck traffic issues: Route 1A truck traffic proportion seems to be high, as there is a major composting facility (Brick Ends Farm) in Hamilton. CTPS will examine the vehicle classification counts on Route 1A.
- Pedestrian and bicycle accommodations:
  - There are three crosswalks on Route 1A in this town center area: one on the north side of Cherry Street, one on Monument Street (north side), and one at the post office north of Arbor Street. Pedestrian crossings are generally difficult as Route 1 traffic is continuous and generally does not stop for pedestrian crossings, except the one at the post office.
  - The post office crosswalk is equipped with a traffic signal and pedestrian push buttons that can stop Route 1A traffic for pedestrian crossings. The pedestrian crossing time is about 15 seconds in total (eight seconds of “walk” plus seven seconds of “flashing don’t walk”). The time can be somewhat tight for seniors and children. MassDOT District 4 will examine the setting.
  - There is no crosswalk across Route 1A at Arbor Street. People who park in the town hall parking lot going to First Church or the nearby parks (the civil war memorial and the recently established veterans’ memorial) usually cross Route 1A near Arbor Street without using the marked crosswalks that are far away.
  - There is a sidewalk gap on the west side of Route 1A from Arbor Street to Monument Street.
  - Route 1A is a popular bicycle route to reach the beach areas in Ipswich, Newbury, and Newburyport. Cycling activities on Route 1A increases in the weekends and in the summer time. The area in front of the fire station is a popular gathering and rest spot by cyclists.
  - Outside the study area, Route 1A in Wenham generally contains shoulders of four to five feet on both sides to accommodate bicycles. In the study area, only the west side of Route 1A has wide shoulders to accommodate bicycles.
- Safety concerns and issues:
  - Pedestrian crossings on Route 1A is a major concern as described above.
  - Cyclists have to ride with traffic on Route 1A northbound due to the lack of bicycle accommodation.
  - At the Route 1A/Arbor Street intersection, the major concern is the operations of emergency vehicles and their potential conflicts with the approaching traffic on Route 1A.
  - At the Route 1A/Monument Street intersection, almost half of the crashes are left-turn crashes caused by aggressive left-turns from Monument Street.
  - At the Route 1A/Cherry Street intersection, the proportion of left-turn crashes is also relatively high. There are a number of rear end crashes possibly caused by left-turn blocking the through traffic.
- Business parking and access related issues:
  - On-street parking in the business district is somewhat tight and too close to Route 1A traffic stream.
  - People sometimes use the driveway next to the post office to as a cut-through from Route 1A southbound to access Friend Court or return to Route 1A northbound. This can interfere with the operations of emergency vehicles in the police station parking lot.

## **Study Process and Development of Potential Improvement Alternatives**

- Existing conditions AM and PM peak-hour Synchro models
- Base case (2025 no-build Synchro models)
- Traffic signal alternatives
  - One individual signal at Arbor Street/Friend Court
  - Two coordinated signals at Cherry Street and at Monument Street
  - Two coordinated signals at Cherry Street and at Arbor Street/Friend Court, with Monument Street left turns to Route 1A prohibited or being converted to one-way westbound operation
  - Three coordinated signals
- Preliminary analysis of modern roundabout alternative

## **Data Collection and Needs**

- Average weekday traffic, intersection turning movements (including pedestrians and bicycles), and spot speed studies were collected by MassDOT in last November and recently provided to CTPS
- Recent three-year crash reports (2014 January–2016 December) in the study area provided by Wenham Police Department
- Right-of-way information (to use the assessors' maps from the Town website)

## **Study Procedure and Schedule**

- Data collection and site investigations (January–February)
- Roadway existing conditions analysis, including Synchro traffic simulations (January–February)
- Crash data analysis, including crash statistics summary, collision diagrams, and review of hazardous locations (February–March)
- Development of short- and long-term improvement alternatives (March)
- Analysis and evaluation of improvement alternatives, through synchro tests and traffic simulations (March)
- Producing conceptual plans of proposed improvement alternatives (April)
- Review of findings and proposed improvement alternatives with the study advisory members (April)
- Revision and report drafting (May–June)
- Draft report review by the study advisory members (July)

Attachments

CW/cw





## BOSTON REGION METROPOLITAN PLANNING ORGANIZATION

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Stephanie Pollack, MassDOT Secretary and CEO and MPO Chair  
Karl H. Quackenbush, Executive Director, MPO Staff

### *TECHNICAL MEMORANDUM*

**DATE:** January 18, 2018  
**TO:** Boston Region MPO  
**FROM:** Seth Asante, Chen-Yuan Wang, and Ben Erban  
**RE:** Safety and Operations Analyses at Selected Intersections: Federal Fiscal Year 2018

#### 1 BACKGROUND

This memorandum presents the results of Task 1 (Select Study Locations) of the work program for Safety and Operations Analyses at Selected Intersections: Federal Fiscal Year (FFY) 2018.<sup>1</sup>

This study builds on recommendations generated by the Boston Region Metropolitan Planning Organization's (MPO) Congestion Management Process (CMP) to address safety and congestion problems at intersections in the MPO area. Several similar studies were completed in previous funding years and received favorable responses from municipalities, which included appreciation of the MPO's assistance with the conceptual design of low-cost improvements and the planning and implementation processes.

Previous studies examined large, complex intersections, simpler intersections, and locations that include two or more adjacent intersections. The focus for FFY 2018 is on simpler intersections. Locations that would potentially require major geometry redesigns, such as grade separation or adding travel lanes on an arterial roadway, were considered to be less suitable for this study.

As in the past, the basic requirement for a location to qualify as a study candidate is that it must be located on an arterial roadway in the Boston Region MPO where 1) it has safety and operational concerns and 2) the agencies and/or municipalities with jurisdiction over the roadway are committed to implementing recommended improvements.

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<sup>1</sup> Karl H. Quackenbush, CTPS Executive Director, memorandum of a work program to the Boston Region MPO, "Work Program for Safety and Operations Analyses at Selected Intersections," November 16, 2017.

## 2 SELECTION PROCEDURE

The study selection process consisted of the following four steps completed by the MPO:

- 1) Generate a list of potential intersection study locations then narrow it to 10 locations
- 2) Gather detailed data for each of the 10 locations
- 3) Apply specific criteria to examine potential study locations more closely
- 4) Score and rate the 10 locations, and assign low, medium, or high priority to each intersection location

### 2.1 Generating List of Potential Locations

MPO staff used the following sources to develop an initial list of nearly 50 potential study locations in the MPO area:

- FFY 2016 safety and operations list of potential candidates
- Suggested locations from Unified Planning Work Program outreach

The following exclusion criteria were developed to narrow the list of locations:

- Located in a municipality that has been selected for this study within the past three years
- Located in a subregion that has been well- or over-represented in past subregional priority corridor projects in terms of the proportion of population or Massachusetts Department of Transportation (MassDOT) top-200 high-crash locations in the region
- Studied by MPO staff or another agency; included in a Transportation Improvement Program (TIP) project with a status of “advertised” or “programmed,” or included in an active MassDOT or other agency project that is in design (at 25 percent or higher design status), in construction, or recently completed
- Considered part of a larger potential study area, such as a highway interchange or a long traffic corridor with an extensive area of congestion
- Considered not at-grade

### 2.2 Gathering Detailed Data

Staff gathered data to support the exclusion criteria and eliminated locations that were not suitable. The assembled data for 10 intersection locations in 10 municipalities in the MPO region are listed below.

- MassDOT’s 2015 Road Inventory File. To collect the following information for each major arterial segment in each intersection location: roadway jurisdiction, National Highway System (NHS) status, and annual average daily traffic (AADT)



- MassDOT's Transportation Data Management System. Recently updated AADT counts were retrieved from MassDOT's online database
- MassDOT's 2010–14 Crash Database. Identify high-crash locations and numbers of crashes
- MPO CMP Data on Arterial Congestion. Determine travel-time index (that is, travel time in the peak period divided by travel time in free-flow conditions) for each major arterial segment intersection location
- MPO Data on Bike Network Gaps and MassDOT Bike Facilities. Identify bicycle needs—including connectivity—and accommodation
- Data on Massachusetts Bay Transportation Authority (MBTA) Bus Service Performance and Passenger Load. Determine the percentage of bus trips that do not adhere to the schedule (late service) or to passenger load standards (crowding)
- Data on MBTA Subway and Commuter Rail Lines. Identify locations serving MBTA stations
- Data from the following sources were also included:
  - Data selected from MassDOT's project-information and roadway safety audit databases
  - The MPO's 2016–20 TIP projects
  - MPO planning (and other) studies
  - Municipal websites (to obtain data on projects, studies, and TIP projects planned or programmed for each arterial segment)

Table 1 (at the end of this memorandum) presents the data assembled for each intersection location, community, Metropolitan Area Planning Council (MAPC) subregion, MassDOT district office, jurisdiction, equivalent property damage only crashes, total crashes, fatal crashes, injury crashes, property damage only and non-reported crashes, bicycle and pedestrian crashes, top-200 crash clusters, crash clusters that are eligible for Highway Safety Improvement Program (HSIP) funding, transit routes, a list of relevant studies or projects, and staff comments. The table also shows the results of applying the selection criteria and the priority rating, which was performed in the fourth step of this process (described below).

### 2.3 Applying Criteria

MPO staff further examined the intersection locations by applying the five criteria cited below (each item is worth one point):

- *Safety Conditions, 0–2 Points*
  - Location has an estimated crash rate that is higher than the district average
  - Location has a significant number of pedestrian and bicycle crashes per year (more than three), or has truck traffic safety concerns

- *Multimodal Significance, 0–2 Points*
  - Location needs improved transit, bicycle, or pedestrian facilities
  - Location has a high volume of truck traffic serving regional commerce
  
- *Regional Significance, 0–2 Points*
  - Location carries a significant portion of regional traffic (AADT is greater than 15,000 on at least one intersecting road)
  - Location is essential for the region’s economic, cultural, or recreational development
  
- *Regional equity, 0–2 Points*
  - Location is in an MPO subregion that is at least slightly under-represented in previous safety and operations analyses in terms of the proportion of population or number of MassDOT top-200 high-crash locations in the region
  - Location is in an MPO subregion that is very under-represented in previous safety and operations analyses in terms of the proportion of population or number of MassDOT top-200 high-crash locations in the region
  
- *Implementation Potential, 0–2 Points*
  - Location has strong potential for implementation based on the urgent need for safety improvements
  - Location is proposed or endorsed by its roadway administrative agency or agencies and has strong support from other stakeholders (for example, municipalities, MassDOT, and subregions)

In addition, no two locations in the same town would be selected.

## 2.4 Scoring and Rating

Intersection locations with a score of four or fewer points were rated low priority; those with a score of five to seven points were rated medium priority; and those with a score of eight or more points were rated high priority. Five locations were given a high-priority rating and four a medium-priority rating by MPO staff based on safety, operations, multimodal and regional significance, and support from agencies and municipalities.

Staff examined the high-priority segments more closely. Locations within the following parameters were not suitable candidates for this cycle of safety and operations analyses:



- Locations that were recently or are currently under study
- Locations that exhibited a density of closely spaced intersections that suggest that a corridor study is needed
- Locations that were selected for the FFY 2018 Subregional Priority Corridors study

### 3 SELECTED INTERSECTIONS FOR STUDY

Based on the evaluation above, staff selected two intersections for study: 1) Route 1A (Main Street) at Cherry Street, Monument Street, and Arbor Street in Wenham; and 2) Route 126 (Hartford Avenue) at Maple Street in Bellingham.

- 1) *Route 1A (Main Street) at Cherry Street, Monument Street, and Arbor Street in Wenham:* The Town of Wenham and MassDOT District 4 requested MPO staff to study three major intersections on Route 1A from Cherry Street to Arbor Street. The primary issues raised were safety and operational concerns for users of all modes, including pedestrians and bicyclists.

The three intersections are located close to each other within a short distance of 750 feet and serve a high volume of traffic on the regional arterial of Route 1A corridor. Additionally, several properties are located adjacent to these intersections, including the town hall, police department, fire department, the Maples Retirement Home, and First Church. The combination of these factors has caused safety concerns for all the users, especially for residents frequently visiting the area.

All three intersections are currently unsignalized, and preliminary traffic signal needs analyses performed by MassDOT show that they satisfy the first three warrants of Manual on Uniform Traffic Control Devices. However, the three intersections should be further examined together in a comprehensive study under the existing town center context.

- 2) *Route 126 (Hartford Avenue) at Maple Street in Bellingham:* The Town of Bellingham requested MPO's assistance in addressing the safety and operational concerns at this intersection, especially on the truck operational and safety issues.

The Town expressed that the intersection at Hartford Avenue and Maple Street carries a high proportion of truck traffic and is undersized to accommodate large commercial vehicles safely and efficiently. The intersection is just one-half mile south of the interchange of Interstate 495 and Route 126, where a number of large commercial uses exist.

Meanwhile, a significant portion of Maple Street, currently zoned industrial, houses a power plant, multiple warehouses, mulch- and lumber-producing facilities, and vacant land for future developments.

In addition, an elementary school that serves all of North Bellingham is located on Route 126, less than 100 feet north of the intersection. The traffic and pedestrian access to the school should also be considered in further study. The intersection is suitable for this study because of the issues and concerns from these different travel modes.

Staff also evaluated the pedestrian accommodation and safety improvement needs for the two locations by applying the Pedestrian Report Card Assessment that the MPO recently developed.<sup>2</sup> The two selected locations are highly qualified for pedestrian accommodation or safety improvement requirements. Appendix A contains detailed results of the assessments.

#### 4 SUMMARY

The recommended intersection locations meet the selection criteria of this study because of their potential for safety and operations improvements. The work scope for this study assumed that “as many as three” locations would be selected. Staff selected two locations that contain a total of four intersections. Appendix B contains the support letters from MassDOT and stakeholders in Wenham and Bellingham.

Staff will submit these recommendations to the MPO for discussion. If the MPO endorses the study selections, staff will meet with officials from Wenham, Bellingham, and MassDOT to discuss study specifics, conduct field visits, collect data, and perform analyses.

SA/CW/BE/sa

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<sup>2</sup> Pedestrian Level-of-Service Memorandum, Ryan Hicks and Casey-Marie Claude, Boston Region Metropolitan Organization, January 19, 2017.



**TABLE 1. FFY 2018 Safety and Operations for Selected Intersections**  
Selected locations are highlighted in green

Location	Community	MAPC Subregion	MassDOT District	Jurisdiction	Street 1	Route 1	Street 2	Study, Project, or TIP Project	EPDO Crashes 2012-14	Total Crashes 2012-14	Injury Crashes 2012-14	Bike/Ped Crashes 2012-14	Top 200 Crash Clusters 2012-14	HSIP-eligible Crash Clusters 2012-14	Transit Routes	Safety Conditions	Multimodal Significance	Regional Significance	Regional Equity	Implementation Potential	Total Score	Rating	Comments
1	Wenham	NSTF	4	MassDOT	Main Street	Route 1A	Cherry Street Monument Street Arbor St / Friend Ct	None	76	36	10	1	0	0	None	2	2	2	2	2	10	High	Wenham and MassDOT District 4 requested MPO staff to study these three major intersections on Route 1A. The primary issues raised were safety and operational concerns for users of all modes, including pedestrians and bicyclists. To fully address these issues, the three intersections should be examined together under the existing town center context.
2	Bellingham	SWAP	3	Town	Hartford Avenue	Route 126	Maple Street	#604862: Bellingham- Ramp Construction and Relocation, I-495 At Route 126 (Hartford Avenue) (half a mile south of location) (TIP project, preliminary design phase, last update 2007) #605239: Bellingham- Franklin- Bridge Preservation - Hartford Ave over I-495 (half a mile south) (Complete 2012)	12	8	1	0	0	0	None	1	2	2	2	2	9	High	The Town of Bellingham requested MPO's assistance in addressing the safety and operational concerns at this intersection, especially on the truck operational and safety issues. A future study should also consider traffic and pedestrian safety from an elementary school adjacent to the intersection.
3	Danvers	NSTF	4	MassDOT	Andover Street	Route 114	Garden Street	Project 605383 Danvers- Peabody- Resurfacing and Related Work on Route 114 (completed in 2011)	97	37	15	1	1	1	None	2	2	2	1	1	8	High	This intersection was studied as part of the FFY 2011 Priority Corridors: Route 114 Study in Danvers. That study proposed improvements for addressing safety and operations at the intersection.
4	Cambridge	ICC	6	DCR and City	Mount Auburn Street and Fresh Pond Parkway	Route 3	Coolidge Hill Road	None	101	41	15	1	1	1	MBTA 71 and 73	2	2	2	2	0	8	High	Comments from MPO outreach indicate pedestrian safety issues and traffic congestion and operations concerns at Mount Auburn Street/Coolidge Hill Road. DCR interest is critical for this study due to the proximity of Route 3/Fresh Pond Parkway at Mount Auburn Street.
5	Marlborough	MetroWest	3	MassDOT	Boston Post Road West	Route 20	Northboro Road East (Shopping Plaza)	#601133: Marlborough- Roadway Reconstruction Including Signals, Route 20 (Boston Post Road) From The Northboro Ct To Felton St. (2004) #608467: Marlborough- Resurfacing And Related Work On Route 20 (Unknown Location) (Planned for 2019 TIP)	92	68	6	4	0	1	MWRTA Route 7	2	2	2	1	1	8	High	A Route 20 study in Marlborough is recommended for the MPO FFY 2016 Subregional Priority Corridors Study. This location was not selected because of the geographic equity consideration applied in the selection study locations.
6	Boston	ICC	6	DCR	Jamaicaway		Bynner Street	None	122	50	18	2	1	1	None	1	2	2	1	1	7	Medium	Potential candidate for a safety and operations study. The location is in the current list of Top 200 High-Crash Intersections. The City of Boston expressed interest, but the DCR did not indicate interest.
7	Salem	NSTF	4	Town	North Street	Route 114	Mason Street	#605332: Salem- Bridge Replacement, S-01-001, (St 114) North Street Over North River - Is just south of the intersection. (TIP project, begins 2021) #608521: Salem- Bridge Maintenance, S-01-018 (32), (St 114) North Street Over (St 107) Bridge Street and MBTA - a little further down (TIP project, begins 2018)	102	45	12	6	1	1	MBTA 465	1	2	2	1	1	7	Medium	This location was not selected because the crash cluster at this location includes two signalized intersections and four unsignalized intersections in a half-mile distance. An arterial segment study is more suitable for this location. In addition, a Route 1A study involving Swampscott, Salem, and Marblehead has been recommended for the MPO FFY 2016 Subregional Priority Corridors Study, and so, because of geographic equity considerations, this location is not recommended for that reason as well.
8	Boston	ICC	6	MassDOT	Columbia Road		Buttonwood Street	#603412: Boston- Traffic Signal And Safety Improvements, Route I-93 Ramps At Columbia Road - is adjacent to intersection. (Complete 2005)	79	27	13	0	0	1	MBTA 8, 18, and 41	2	1	1	2	1	7	Medium	Potential candidate for a safety and operations study. This unsignalized intersection is located between two busy and closely spaced signalized intersections.
9	Newton	ICC	6	City	Commonwealth Avenue	Route 30	Washington Street	None	22	14	2	1	0	0	MBTA 505	0	2	1	2	1	6	Medium	Potential candidate for a safety and operations analysis.
10	Sherborn	SWAP	3	Town	Washington Street	Route 16	S Main Street (Route 27)	None	46	18	7	0	0	1	None	1	1	1	1	0	4	Low	Location was studied by CTPS and VHB in 2002 and 2004. Improvements were not implemented. A UPWP comment suggested that this could be a good location for demand response signal.

**Acronyms and Abbreviations**  
 BAT = Brockton Area Transit Authority. CATA = Cape Ann Transit Authority. CTPS = Central Transportation Planning Staff. DCR = Department of Conservation and Recreation. EPDO = Equivalent property damage only. FFY = Federal fiscal year. HSIP = Highway Safety Improvement Program. ICC = Inner Core Committee. MAPC = Metropolitan Area Planning Council. MassDOT = Massachusetts Department of Transportation. MBTA = Massachusetts Bay Transportation Authority. MetroWest = MetroWest Regional Collaborative. MPO = Boston Region Metropolitan Planning Organization. MWRTA = MetroWest Regional Transit Authority. NSPC = North Suburban Planning Council. NSTF = North Shore Task Force. SWAP = South West Advisory Planning Committee. TIP = Transportation Improvement Program. TRIC = Three Rivers Interlocal Council. UPWP = Unified Planning Work Program.

**Selection Criteria**  
**Safety Conditions:** Intersection has a HSIP-eligible crash cluster, a top-200 high-crash location, and/or a significant number of or HSIP-eligible clusters of pedestrian or bicycle crashes.  
**Congested Conditions:** Intersection experiences delays during peak periods.  
**Multimodal Significance:** Intersection currently supports transit, bicycle or pedestrian activities, needs improved facilities for these activities, and/or has high truck traffic serving regional commerce.  
**Regional Significance:** Intersection is on the National Highway System, carries a significant proportion of regional traffic, lies within 0.5 miles of Environmental Justice transportation analysis zones, and/or is essential for the region's economic, cultural, or recreational development.  
**Regional Equity:** Intersection is underrepresented in previous safety and operations studies in terms of the proportion of population or number of top-200 high-crash locations.  
**Implementation Potential:** Intersection has strong potential for implementation based on the urgent need for safety improvements, is proposed or endorsed by its roadway administrative agency or agencies, and/or has strong support from other stakeholders.

**Notes**  
 1. Locations are in order of their ratings based on scoring from selection criteria.  
 2. EPDO Crash Rating = 10 \* Fatal Crashes + 5 \* Injury Crashes + 1 \* Other Crashes (Property Damage Only or Unknown Severity), based on MassDOT top-200 high-crash locations: 2012-14 crash data.  
 3. HSIP-eligible crash clusters are defined by MassDOT as crash clusters that rank within the top five percent of crash clusters for each Regional Planning Agency, based on the EDPO index. In the Boston region the 921 intersections in the top five percent have crash clusters with a minimum EDPO value of 42.

**Source:** Central Transportation Planning Staff.

## **SELECTION MEMO APPENDICES**





**Central Transportation Planning Staff (CTPS) to the Boston Region MPO:**  
[www.ctps.org](http://www.ctps.org) | 857.702.3700 | [ctps@ctps.org](mailto:ctps@ctps.org)

**Ryan Hicks, Congestion Management Process Manager:**  
[www.ctps.org/cmp](http://www.ctps.org/cmp) | 857.702.3661 | [rhicks@ctps.org](mailto:rhicks@ctps.org)

**Casey Claude, Bicycle and Pedestrian Program Manager:**  
[www.ctps.org/livability](http://www.ctps.org/livability) | 857.702.3707 | [cclaude@ctps.org](mailto:cclaude@ctps.org)

# Pedestrian Report Card Assessment (PRCA): Roadway Segment

## Roadway Segment Location

Route 1A from Cherry St. to Arbor St./Friend Ct.

Grading Categories	Score	Rating
Safety	2.4	Good
System Preservation	N/A	Poor
Capacity Management and Mobility	2.16	Fair
Economic Vitality	1.5	Poor

## Transportation Equity

High Priority Area	
Moderate Priority Area	
Not a Priority Area	✓

### Category Ratings

Good: Score of 2.3 or more (maximum 3.0)

Fair: Score is between 1.7 and 2.3

Poor: Score is 1.7 or less (minimum 0)

# Grading Categories: Scoring Breakdown Roadway Segment

Capacity Management and Mobility			
Performance Measure	Weight	Rating	Weighted Score
Sidewalk Presence	3	Fair	6
Crossing Opportunities	2	Good	6
Walkway Width	1	Poor	1
<b>Total</b>	<b>6</b>		<b>13</b>

Economic Vitality			
Performance Measure	Weight	Rating	Weighted Score
Pedestrian Volumes	1	Fair	2
Adjacent Bicycle Accommodations	1	Poor	1
<b>Total</b>	<b>2</b>		<b>3</b>

Category rating = total rating/total weight  
 Rating Score:  
 Good = 3  
 Fair = 2  
 Poor = 1

Safety			
Performance Measure	Weight	Rating	Weighted Score
Pedestrian Crashes	3	Good	9
Pedestrian-Vehicle Buffer	1	Poor	1
Vehicle Travel Speed	1	Fair	2
<b>Total</b>	<b>5</b>		<b>12</b>

System Preservation	
Performance Measure	Rating
Sidewalk Condition	<b>Poor</b>

Transportation Equity Priority	
Area Condition	Yes/No
Environmental Justice zone?	No
School or college within one-quarter mile?	Yes
More than 8.9% of population older than 75 years?	No
More than 27.5% of households do not own a vehicle?	No

Category Ratings  
 Good: Score of 2.3 or more (maximum 3.0)  
 Fair: Score is between 1.7 and 2.3  
 Poor: Score is 1.7 or less (minimum 0)



# Detailed Performance Measure Information: Roadway Segment

Goal	Performance Measure	Features of Analyzed Locations
<b>Mobility</b>	Sidewalk Presence	Sidewalk is present on one side of the street
	Crossing Opportunities	2 crossing opportunities/0.2 miles =10 crosswalks per mile
	Walkway Width	4-foot wide sidewalks
<b>Economic Vitality</b>	Pedestrian Volumes	15 pedestrians per hour
<b>Safety</b>	Adjacent Bicycle Accommodations	none
	Pedestrian Crashes	Not in HSIP cluster
	Pedestrian-Vehicle Buffer	3 feet buffers
	Vehicle Travel Speed	32 mph
<b>System Preservation</b>	Sidewalk Condition	Sidewalks are in poor condition



**Central Transportation Planning Staff (CTPS) to the Boston Region MPO:**  
[www.ctps.org](http://www.ctps.org) | 857.702.3700 | [ctps@ctps.org](mailto:ctps@ctps.org)

**Ryan Hicks, Congestion Management Process Manager:**  
[www.ctps.org/cmp](http://www.ctps.org/cmp) | 857.702.3661 | [rhicks@ctps.org](mailto:rhicks@ctps.org)

**Casey Claude, Bicycle and Pedestrian Program Manager:**  
[www.ctps.org/livability](http://www.ctps.org/livability) | 857.702.3707 | [cclaude@ctps.org](mailto:cclaude@ctps.org)

# Pedestrian Report Card Assessment (PRCA):

## Intersection

Intersection Location
Route 126 and Maple St.

Grading Categories	Score	Rating
Safety	1.87	Fair
System Preservation	N/A	Poor
Capacity Management and Mobility	1.57	Poor
Economic Vitality	N/A	Fair

Transportation Equity	
High Priority Area	
Moderate Priority Area	
Not a Priority Area	✓

Category Ratings  
 Good: Score of 2.3 or more (maximum 3.0)  
 Fair: Score is between 1.7 and 2.3  
 Poor: Score is 1.7 or less (minimum 0)



# Grading Categories: Scoring Breakdown Intersection

Capacity Management and Mobility			
Performance Measure	Weight	Rating	Weighted Score
Pedestrian Delay	3	Poor	3
Sidewalk Presence	2	Fair	4
Curb Ramps	1	Fair	2
Crossing Opportunities	1	Fair	2
<b>Total</b>	<b>7</b>		<b>11</b>

Economic Vitality	
Performance Measure	Rating
Pedestrian Volumes	Fair

Category rating = total rating/total weight  
 Rating Score:  
 Good = 3  
 Fair = 2  
 Poor = 1

Safety			
Performance Measure	Weight	Rating	Weighted Score
Sufficient Crossing Time (Index)	3	Poor	3
Pedestrian Crashes	3	Good	9
Pedestrian Signal Presence	1	Poor	1
Vehicle Travel Speed	1	Fair	2
<b>Total</b>	<b>8</b>		<b>15</b>

System Preservation	
Performance Measure	Rating
Sidewalk Condition	Poor

Transportation Equity Priority	
Area Condition	Yes/No
Environmental Justice zone?	No
School or college within a one-quarter mile?	Yes
More than 8.9% of population older than 75 years?	No
More than 27.5% of households do not own a vehicle?	No

Category Ratings  
 Good: Score of 2.3 or more (maximum 3.0)  
 Fair: Score is between 1.7 and 2.3  
 Poor: Score is 1.7 or less (minimum 0)

## Detailed Performance Measure Information: Intersection

Goal	Performance Measure	Features of Analyzed Locations
<b>Mobility</b>	Pedestrian Delay	Estimated cycle length = 150 seconds Estimated pedestrian walk/flashing don't walk time = 12 seconds Estimated pedestrian delay = 63.48 seconds
	Sidewalk Presence	Sidewalks present on all approaches
	Curb Ramps	Curb ramps are present on 2 of 3 approaches
	Crossing Opportunities	Crosswalks at 2 of 3 approaches
<b>Economic Vitality</b>	Pedestrian Volumes	Estimated 5 to 6 pedestrians per hour
<b>Safety</b>	Sufficient Crossing Time (Index)	50 feet crossing; 12 seconds allowed; 15 seconds needed
	Pedestrian Crashes	Not in HSIP cluster
	Pedestrian Signal Presence	Pedestrian signals are present on one approach. Concurrent pedestrian signal, right turn on red permitted
	Vehicle Travel Speed	31 mph
<b>System Preservation</b>	Sidewalk Condition	Sidewalks are in poor condition



Charles D. Baker, Governor  
Karyn E. Polito, Lieutenant Governor  
Stephanie Pollack, Secretary & CEO  
Jonathan L. Gulliver, Acting Highway Administrator



August 10, 2017

Mark Abbott, Manager  
Traffic Analysis and Design Group  
Central Transportation Planning Staff  
Boston Region Metropolitan Planning Organization  
10 Park Plaza, Suite 2150  
Boston, MA 02116-3968



Dear Mr. Abbott:

I am writing on behalf of MassDOT District 4 to express our support for further traffic analysis of three intersections on Main Street (Route 1A) in Wenham. These intersections are located at Cherry Street, Monument Street and Arbor Street/Friend Court.

The District's Traffic Operations Section had recently worked with the Town on a traffic signal warrant analysis of the three intersections. It was determined that MUTCD Warrants 1, 2 and 3 (volume-related warrants) were met. Since Warrants 1A and 1B, Eight-Hour Vehicular Volume, were satisfied for each of the locations, any of them would be solid candidates for a traffic signal.

To determine the true feasibility of such a project, further study in the form of a Functional Design Report (FDR) is needed. I understand that an FDR may be eligible for funding through a FY18 UPWP study entitled "Safety and Operations at Selected Locations" being conducted by your group. The Town is committed to improving safety in this area of Route 1A and is willing to complete 25% design for a project, if selected for the study. MassDOT District 4, therefore, believes that further study of the locations should be funded and completed.

Thank you for your consideration. If you have any further questions on this matter, please contact me at (781)641-8322.

Sincerely,

Paul D. Stedman  
District Highway Director

JEG/gb

cc: Peter Lombardi, Wenham Town Administrator  
Traffic File





The Commonwealth of Massachusetts  
MASSACHUSETTS SENATE  
OFFICE OF THE MINORITY LEADER



STATE HOUSE, ROOM 308  
BOSTON, MA 02133-1053  
TEL. (617) 722-1600  
FAX: (617) 722-1310

SENATOR BRUCE E. TARR  
MINORITY LEADER  
*First Essex and Middlesex*

August 1, 2017

BRUCE.TARR@MASENATE.GOV  
WWW.MASENATE.GOV

Mark Abbott, Manager  
Traffic Analysis and Design Group  
Central Transportation Planning Staff  
Boston Region Metropolitan Planning Organization  
Ten Park Plaza, Suite 2150  
Boston, MA 02116-3968

Dear Mr. Abbott,

I would like to take this opportunity to express my strong support for the Town of Wenham. In particular, the Board of Selectmen's recent funding request for further traffic analysis regarding three intersections on Main Street in downtown Wenham, located at Cherry Street, Monument Street, and Arbor Street / Friend Court.

Given that the Main Street corridor (Route 1A) is a state road, the town worked with MassDOT District 4 Traffic Operations to complete a traffic signal warrant analysis earlier this year, which resulted in positive findings. With that, I note that all three intersections on Main Street meet the MUTCD Signal Warrants 1, 2, and 3. Noting such, I believe the relative data sufficiently satisfies Warrant 1A and 1B for Eight-Hour Vehicular traffic, with any of these locations satisfying the requirements for signal installation.

Considering such, the town is in need of assistance in determining project feasibility, specifically a Functional Design Report (FDR), which may be funded through a FY18 UPWP Study (Safety and Operations at Selected Locations). When considering the town's demonstrated commitment to addressing public safety concerns related to traffic volume, together with the number of motor vehicle crash incidents in these locations on Route 1A, I firmly believe a comprehensive operational and safety analysis of these three intersections can/should be funded and completed.

I further note, if your office is able to support/fund conducting an FDR, the town agrees to be responsible for completing a 25% design to continue to move forward with this project. This, together with the town's ongoing efforts is just another example of their demonstrated and genuine commitment to public safety.

Accordingly, I seek your careful consideration of the Town of Wenham's request for FDR funding. Thank you for such, and please don't hesitate to contact me directly should you have any questions.

Sincerely,

Bruce E. Tarr  
State Senator  
Minority Leader



# Town of Wenham

Town Hall  
138 Main Street  
Wenham, MA 01984

Selectmen / Town Administrator  
TEL 978-468-5520 FAX 978-468-8014



August 1, 2017

Mark Abbott  
Manager, Traffic Analysis and Design Group  
Central Transportation Planning Staff  
Boston Region Metropolitan Planning Organization  
Ten Park Plaza, Suite 2150  
Boston, MA 02116-3968

Dear Mr. Abbott,

I am writing on behalf of the Board of Selectmen to express our strong support for further traffic analysis regarding three intersections on Main Street in downtown Wenham, located at Cherry Street, Monument Street, and Arbor Street / Friend Court. Since the Main Street corridor is also a state roadway, Route 1A, we worked with MassDOT District 4 Traffic Operations to complete a traffic signal warrant analysis earlier this year.

The attached findings from that report show that these three intersections on Main Street all meet the MUTCD Signal Warrants 1, 2, and 3. Since the data satisfies Warrant 1A and 1B for Eight-Hour Vehicular Volume, our understanding is that any of these locations would be strong candidates to have a signal installed. However, the Town now needs assistance in completing the next step to determine the feasibility of this project, a Functional Design Report (FDR).

According to our Town Administrator, this project may be eligible for funding through a FY18 UPWP study entitled "Safety and Operations at Selected Locations". Given the community's ongoing public safety concerns about traffic volume and accidents along this corridor on Route 1A, we hope that your office is able to support conducting an FDR so that a comprehensive operational and safety analysis of these three intersections can be completed. We understand that, if funded, conceptual alternatives would be included in the scope of work, but that the Town would then be responsible for completing 25% design to continue to move forward with this project.

Thank you for your consideration. Please contact our Town Administrator, Peter Lombardi, at 978-468-5520 x. 2 or [plombardi@wenhamma.gov](mailto:plombardi@wenhamma.gov) if you have any further questions.

Best regards,

Jack Wilhelm  
Chair, Wenham Board of Selectmen





## BELLINGHAM PLANNING DEPARTMENT

10 MECHANIC STREET BELLINGHAM, MASSACHUSETTS 02019  
(508) 657-2892 [Plan-zone@bellinghamma.org](mailto:Plan-zone@bellinghamma.org)

October 17, 2017

Mark Abbot  
Metropolitan Planning Organization  
Central Transportation Planning Staff  
State Transportation Building  
10 Park Plaza, Suite 2150  
Boston, MA 02116

Re: Technical Assistance Request – Roadway Intersection Redesign – Hartford Avenue and Maple Street

The Town of Bellingham respectfully requests technical assistance from the Central Transportation Planning Staff for the intersection redesign of Hartford Avenue and Maple Street.

Hartford Avenue at Exit 18 hosts a large inventory of commercial uses and, moving eastward, a dense residential area. In addition, a public elementary school, which services all of North Bellingham, and a small community center are located at the intersection of Hartford Avenue and Maple Street.

The intersection of Hartford Avenue and Maple Street operates well for standard motorized vehicles. However, it is over burdened by commercial vehicles. This cannot be avoided due to the proximity to I-495 and the Town's desire to retain significant acreage of industrial zoned parcels along Maple Street (See attached Zoning Map). Current industrial uses along Maple Street consist of a power plant, multiple warehouses exceeding 600,000 square feet of space, and large scale mulch and lumber hauling and production. These bring with them numerous trips by large tractor trailers.

Unfortunately this intersection is severally undersized to function properly for its desired use. The Town has recognized the need to upgrade Maple Street in order to sufficiently maintain industrial uses along this corridor. Through a public/private partnership, the town of Bellingham has begun the redesign process for the southern intersection of Maple Street and Route 140 and will be investing over \$2 Million dollars during the improvement and construction process. In a separate improvement project, the Town has invested over \$1 Million dollars to repave and correct drainage in a large section of Maple Street to better service the zoned uses. Improvement of the Hartford Avenue and Maple Street intersection is an important step in the improvement process to properly upgrade Maple Street to adequately service the industrial uses along this road and to allow large vehicles to access Route I-495 as quickly and safely as possible.

Town Officials will be available to assist and offer comments during the design process and to coordinate any public meetings that are required. Please do not hesitate to contact us if more information is necessary.

James S. Kupfer, MPA, AICP  
Town Planner/ Zoning Compliance Officer  
10 Mechanic Street  
Bellingham, MA 02019  
Phone: 508-657-2893  
[jkupfer@bellinghamma.org](mailto:jkupfer@bellinghamma.org)

Donald F. DiMartino  
DPW Director  
26 Blackstone Street  
Bellingham, MA 02019  
Phone - 508-966-5813  
[DDiMartino@bellinghamma.org](mailto:DDiMartino@bellinghamma.org)





# Town of Bellingham

## BOARD OF SELECTMEN

10 Mechanic Street

Bellingham, Massachusetts 02019

Tel: 508-966-5800 \* Fax: 508-966-4425

November 6, 2017

Mark Abbot  
Metropolitan Planning Organization  
Central Transportation Planning Staff  
State Transportation Building  
10 Park Plaza, Suite 2150  
Boston, MA 02116

Re: Technical Assistance Request – Roadway Intersection Redesign – Hartford Avenue and  
Maple Street

Dear Mr. Abbot:

The Town of Bellingham Board of Selectmen is writing to express our enthusiastic support for the Town's proposal "Roadway Intersection Redesign – Hartford Avenue and Maple Street".

This intersection is severely undersized to function properly for its desired use. The Town has recognized the need to upgrade Maple Street in order to sufficiently maintain industrial uses along this corridor as well as unlock future investment. Through a public/private partnership, the town of Bellingham has begun the redesign process for the southern intersection of Maple Street and Route 140 and will be investing over \$2 Million dollars during the improvement and construction process. In a separate improvement project, the Town has invested over \$1 Million dollars to repave and correct drainage in a large section of Maple Street to better service the zoned uses. Improvement of the Hartford Avenue and Maple Street intersection is an important step in the improvement process to properly upgrade Maple Street to adequately service the industrial uses along this road and to allow large vehicles to access Route I-495 as quickly and safely as possible.

The support of the Metropolitan Planning Organization and the Central Transportation Planning Staff will be critical to following through on this important project. Thank you in advance for considering our proposal.

Sincerely,

Michael J. Soter, Chairman  
Board of Selectmen

**APPENDIX B:  
TRAFFIC DATA COLLECTION**



# Route 1A in Wenham Turning Movement Count (TMC) Locations





**Study Name** Wenham - Route 1A at Cherry Street and Old Country Road TM1 TMC  
**Start Date** Wednesday, November 29, 2017 7:00 AM  
**End Date** Wednesday, November 29, 2017 6:00 PM  
**Site Code**

## Report Summary

Time Period	Class.	Southbound					Westbound					Northbound					Eastbound					Crosswalk								
		R	T	L	U	I	O	R	T	L	U	I	O	R	T	L	U	I	O	R	T	L	U	I	O	Total	Pedestrian	Total		
<b>Peak 1</b>	Motorcycles	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	N	0	0
Specified Period	%	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%	
7:00 AM - 9:00 AM	Cars	93	564	2	0	659	560	0	0	0	0	0	5	2	451	69	0	522	693	129	1	109	0	239	162	1420	E	0	0	
One Hour Peak	%	86%	88%	100%	0%	88%	83%	0%	0%	0%	0%	0%	100%	100%	83%	79%	0%	82%	87%	84%	100%	84%	0%	84%	83%	85%	0%	0%		
7:30 AM - 8:30 AM	Light Goods Vehi	12	60	0	0	72	87	0	0	0	0	0	0	0	71	15	0	86	78	18	0	16	0	34	27	192	S	0	0	
	%	11%	9%	0%	0%	10%	13%	0%	0%	0%	0%	0%	0%	0%	13%	17%	0%	14%	10%	12%	0%	12%	0%	12%	14%	12%	0%	0%		
	Buses	2	3	0	0	5	6	0	0	0	0	0	0	0	4	0	0	4	5	2	0	2	0	4	2	13	W	0	0	
	%	2%	0%	0%	0%	1%	1%	0%	0%	0%	0%	0%	0%	0%	1%	0%	0%	1%	1%	1%	0%	2%	0%	1%	1%	1%	0%	0%		
	Single-Unit Truc	0	14	0	0	14	16	0	0	0	0	0	0	0	15	2	0	17	18	4	0	1	0	5	2	36		0	0	
	%	0%	2%	0%	0%	2%	2%	0%	0%	0%	0%	0%	0%	0%	3%	2%	0%	3%	2%	3%	0%	1%	0%	2%	1%	2%				
	Articulated Truc	0	1	0	0	1	2	0	0	0	0	0	0	0	2	1	0	3	2	1	0	0	0	1	1	5				
	%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	1%	0%	0%	0%	1%	0%	0%	0%	0%	1%	0%				
	Motorcycles on Road	1	0	0	0	1	2	0	0	0	0	0	0	0	1	0	0	1	0	0	0	1	0	1	1	3				
	%	1%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	1%	0%	0%	1%	0%				
	<b>Total</b>	<b>108</b>	<b>642</b>	<b>2</b>	<b>0</b>	<b>752</b>	<b>673</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>5</b>	<b>2</b>	<b>544</b>	<b>87</b>	<b>0</b>	<b>633</b>	<b>796</b>	<b>154</b>	<b>1</b>	<b>129</b>	<b>0</b>	<b>284</b>	<b>195</b>	<b>1669</b>				
	PHF	0.75	0.93	0.5	0	0.95	0.86	0	0	0	0	0	0.62	0.5	0.83	0.84	0	0.84	0.94	0.88	0.25	0.95	0	0.9	0.8	0.93				
	Approach %					45%	40%						0%	0%				38%	48%					17%	12%					
<b>Peak 2</b>	Motorcycles	1	0	0	0	1	1	0	0	0	0	0	0	0	1	0	0	1	0	0	0	0	0	0	1	2	N	0	0	
Specified Period	%	1%	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%		
4:00 PM - 6:00 PM	Cars	103	485	5	0	593	731	0	0	0	0	0	11	5	621	142	0	768	584	99	1	110	0	210	245	1571	E	1	1	
One Hour Peak	%	94%	88%	100%	0%	89%	90%	0%	0%	0%	0%	0%	100%	100%	90%	90%	0%	90%	89%	93%	100%	90%	0%	91%	91%	90%	100%	0%		
4:00 PM - 5:00 PM	Light Goods Vehi	5	61	0	0	66	69	0	0	0	0	0	0	0	60	13	0	73	67	6	0	9	0	15	18	154	S	0	0	
	%	5%	11%	0%	0%	10%	8%	0%	0%	0%	0%	0%	0%	0%	9%	8%	0%	9%	10%	6%	0%	7%	0%	7%	7%	9%	0%	0%		
	Buses	0	0	0	0	0	1	0	0	0	0	0	0	0	1	0	0	1	0	0	0	0	0	0	0	1	W	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%		
	Single-Unit Truc	1	6	0	0	7	8	0	0	0	0	0	0	0	7	3	0	10	7	1	0	1	0	2	4	19		1	1	
	%	1%	1%	0%	0%	1%	1%	0%	0%	0%	0%	0%	0%	0%	1%	2%	0%	1%	1%	1%	0%	1%	0%	1%	1%	1%				
	Articulated Truc	0	0	0	0	0	3	0	0	0	0	0	0	0	1	0	0	1	0	0	0	2	0	2	0	3				
	%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	2%	0%	1%	0%	0%				
	Motorcycles on Road	0	0	0	0	0	1	0	0	0	0	0	0	0	1	0	0	1	1	1	0	0	0	1	0	2				
	%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	1%	0%	0%	0%	0%	0%	0%				
	<b>Total</b>	<b>110</b>	<b>552</b>	<b>5</b>	<b>0</b>	<b>667</b>	<b>814</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>11</b>	<b>5</b>	<b>692</b>	<b>158</b>	<b>0</b>	<b>855</b>	<b>659</b>	<b>107</b>	<b>1</b>	<b>122</b>	<b>0</b>	<b>230</b>	<b>268</b>	<b>1752</b>				
	PHF	0.83	0.91	0.62	0	0.95	0.93	0	0	0	0	0	0.46	0.42	0.94	0.96	0	0.95	0.92	0.86	0.25	0.87	0	0.91	0.97	0.94				
	Approach %					38%	46%						0%	1%				49%	38%					13%	15%					

**Study Name** Wenham - Route 1A at Monument Street and Parking Lot TM2 TMC  
**Start Date** Wednesday, November 29, 2017 7:00 AM  
**End Date** Wednesday, November 29, 2017 6:00 PM  
**Site Code**

## Report Summary

Time Period	Class.	Southbound				Westbound				Northbound				Eastbound				Crosswalk							
		R	T	L	U	I	O	I	O	R	T	L	U	I	O	R	T	L	U	I	O	Total	Pedestria	Total	
<b>Peak 1</b>	Motorcycles	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	N	0	0
Specified Period	%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%		0%	
7:00 AM - 9:00 AM	Cars	165	663	0	0	828	686	0	2	2	551	6	0	559	667	4	0	135	0	139	171	1526	E	0	0
One Hour Peak	%	83%	88%	0%	0%	87%	83%	0%	50%	67%	84%	86%	0%	84%	88%	100%	0%	80%	0%	80%	83%	85%		0%	
7:45 AM - 8:45 AM	Light Goods Vehi	27	72	1	0	100	105	0	2	1	80	1	0	82	72	0	0	25	0	25	28	207	S	0	0
	%	14%	10%	100%	0%	11%	13%	0%	50%	33%	12%	14%	0%	12%	10%	0%	0%	15%	0%	14%	14%	12%		0%	
	Buses	1	2	0	0	3	5	0	0	0	4	0	0	4	2	0	0	1	0	1	1	8	W	4	4
	%	1%	0%	0%	0%	0%	1%	0%	0%	0%	1%	0%	0%	1%	0%	0%	0%	1%	0%	1%	0%	0%		100%	
	Single-Unit Truc	4	13	0	0	17	24	0	0	0	16	0	0	16	13	0	0	8	0	8	4	41		4	4
	%	2%	2%	0%	0%	2%	3%	0%	0%	0%	2%	0%	0%	2%	2%	0%	0%	5%	0%	5%	2%	2%			
	Articulated Truc	0	2	0	0	2	2	0	0	0	2	0	0	2	2	0	0	0	0	0	0	4			
	%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%			
	Motorcycles on Roa	1	1	0	0	2	1	0	0	0	1	0	0	1	1	0	0	0	0	0	1	3			
	%	1%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%			
	<b>Total</b>	<b>198</b>	<b>753</b>	<b>1</b>	<b>0</b>	<b>952</b>	<b>823</b>	<b>0</b>	<b>4</b>	<b>3</b>	<b>654</b>	<b>7</b>	<b>0</b>	<b>664</b>	<b>757</b>	<b>4</b>	<b>0</b>	<b>169</b>	<b>0</b>	<b>173</b>	<b>205</b>	<b>1789</b>			
	PHF	0.85	0.95	0.25	0	0.93	0.88	0	0.33	0.25	0.85	0.58	0	0.86	0.96	0.5	0	0.78	0	0.77	0.84	0.94			
	Approach %					53%	46%	0%	0%					37%	42%					10%	11%				
<b>Peak 2</b>	Motorcycles	0	0	0	0	0	1	0	0	0	1	0	0	1	0	0	0	0	0	0	0	1	N	0	0
Specified Period	%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%		0%	
4:00 PM - 6:00 PM	Cars	183	585	1	1	770	861	0	3	2	732	4	0	738	590	5	0	128	0	133	187	1641	E	0	0
One Hour Peak	%	87%	89%	100%	50%	88%	90%	0%	100%	100%	91%	67%	0%	91%	89%	83%	0%	84%	0%	84%	87%	89%		0%	
4:00 PM - 5:00 PM	Light Goods Vehi	25	68	0	1	94	84	0	0	0	61	2	0	63	68	0	0	22	0	22	27	179	S	0	0
	%	12%	10%	0%	50%	11%	9%	0%	0%	0%	8%	33%	0%	8%	10%	0%	0%	14%	0%	14%	13%	10%		0%	
	Buses	1	0	0	0	1	1	0	0	0	1	0	0	1	0	0	0	0	0	0	1	2	W	1	1
	%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%		100%	
	Single-Unit Truc	1	4	0	0	5	9	0	0	0	7	0	0	7	5	1	0	2	0	3	1	15		1	1
	%	0%	1%	0%	0%	1%	1%	0%	0%	0%	1%	0%	0%	1%	1%	17%	0%	1%	0%	2%	0%	1%			
	Articulated Truc	0	1	0	0	1	3	0	0	0	3	0	0	3	1	0	0	0	0	0	0	4			
	%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%			
	Motorcycles on Roa	0	1	0	0	1	1	0	0	0	1	0	0	1	1	0	0	0	0	0	0	2			
	%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%			
	<b>Total</b>	<b>210</b>	<b>659</b>	<b>1</b>	<b>2</b>	<b>872</b>	<b>960</b>	<b>0</b>	<b>3</b>	<b>2</b>	<b>806</b>	<b>6</b>	<b>0</b>	<b>814</b>	<b>665</b>	<b>6</b>	<b>0</b>	<b>152</b>	<b>0</b>	<b>158</b>	<b>216</b>	<b>1844</b>			
	PHF	0.83	0.94	0.25	0.25	0.91	0.93	0	0.38	0.5	0.92	0.75	0	0.92	0.94	0.38	0	0.86	0	0.86	0.83	0.92			
	Approach %					47%	52%	0%	0%					44%	36%					9%	12%				

**Study Name** Wenham - Route 1A at Arbor Street and Friend Court TM3 TMC  
**Start Date** Wednesday, November 29, 2017 7:00 AM  
**End Date** Wednesday, November 29, 2017 6:00 PM  
**Site Code**

## Report Summary

Time Period	Class.	Southbound					Southwestbound					Northbound					Northeastbound					Crosswalk							
		BR	T	HL	U	I	O	HR	T	BL	U	I	O	BR	T	HL	U	I	O	HR	T	BL	U	I	O	Total	Pedestria	Total	
<b>Peak 1</b>	Motorcycles	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	N	1	1
Specified Period	%	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%		100%	
7:00 AM - 9:00 AM	Cars	302	1	10	0	313	282	21	496	4	0	521	496	5	3	2	0	10	10	5	481	258	0	744	800	1588	NE	0	0
One Hour Peak	%	87%	100%	63%	0%	86%	89%	78%	86%	80%	0%	85%	86%	83%	100%	67%	0%	83%	83%	83%	87%	90%	0%	88%	86%	87%		0%	
7:30 AM - 8:30 AM	Light Goods Vehi	36	0	4	0	40	25	5	62	0	0	67	56	0	0	1	0	1	1	1	52	20	0	73	99	181	S	1	1
	%	10%	0%	25%	0%	11%	8%	19%	11%	0%	0%	11%	10%	0%	0%	33%	0%	8%	8%	17%	9%	7%	0%	9%	11%	10%		100%	
	Buses	2	0	0	0	2	6	1	4	0	0	5	2	0	0	0	0	0	0	0	2	5	0	7	6	14	SW	0	0
	%	1%	0%	0%	0%	1%	2%	4%	1%	0%	0%	1%	0%	0%	0%	0%	0%	0%	0%	0%	0%	2%	0%	1%	1%	1%		0%	
	Single-Unit Truc	5	0	1	0	6	4	0	14	1	0	15	17	0	0	0	0	0	1	0	16	4	0	20	19	41		2	2
	%	1%	0%	6%	0%	2%	1%	0%	2%	20%	0%	2%	3%	0%	0%	0%	0%	0%	8%	0%	3%	1%	0%	2%	2%	2%			
	Articulated Truc	1	0	1	0	2	0	0	0	0	0	0	4	0	0	0	0	0	0	0	3	0	0	3	1	5			
	%	0%	0%	6%	0%	1%	0%	0%	0%	0%	0%	0%	1%	0%	0%	0%	0%	0%	0%	0%	1%	0%	0%	0%	0%	0%			
	Motorcycles on Road	0	0	0	0	0	0	0	2	0	0	2	2	1	0	0	0	1	0	0	1	0	0	1	2	4			
	%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	17%	0%	0%	0%	8%	0%	0%	0%	0%	0%	0%	0%	0%			
	<b>Total</b>	<b>346</b>	<b>1</b>	<b>16</b>	<b>0</b>	<b>363</b>	<b>317</b>	<b>27</b>	<b>578</b>	<b>5</b>	<b>0</b>	<b>610</b>	<b>577</b>	<b>6</b>	<b>3</b>	<b>3</b>	<b>0</b>	<b>12</b>	<b>12</b>	<b>6</b>	<b>555</b>	<b>287</b>	<b>0</b>	<b>848</b>	<b>927</b>	<b>1833</b>			
	PHF	0.84	0.25	0.67	0	0.83	0.89	0.68	0.91	0.31	0	0.89	0.9	0.5	0.38	0.75	0	0.6	0.5	0.75	0.9	0.84	0	0.9	0.95	0.95			
	Approach %					20%	17%					33%	31%					1%	1%					46%	51%				
<b>Peak 2</b>	Motorcycles	0	0	0	0	0	1	0	0	0	0	0	2	0	0	0	0	0	0	2	1	0	3	0	3	N	1	1	
Specified Period	%	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%		100%	
4:00 PM - 6:00 PM	Cars	223	0	17	0	240	294	20	551	5	0	576	638	13	0	7	0	20	16	11	608	274	0	893	781	1729	NE	0	0
One Hour Peak	%	84%	0%	94%	0%	84%	91%	80%	92%	100%	0%	92%	93%	100%	0%	100%	0%	100%	100%	100%	93%	92%	0%	93%	90%	91%		0%	
4:00 PM - 5:00 PM	Light Goods Vehi	42	0	1	0	43	23	4	40	0	0	44	32	0	0	0	0	0	0	0	31	19	0	50	82	137	S	2	2
	%	16%	0%	6%	0%	15%	7%	16%	7%	0%	0%	7%	5%	0%	0%	0%	0%	0%	0%	0%	5%	6%	0%	5%	9%	7%		100%	
	Buses	0	0	0	0	0	1	0	1	0	0	1	1	0	0	0	0	0	0	0	1	1	0	2	1	3	SW	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%	
	Single-Unit Truc	1	0	0	0	1	2	0	4	0	0	4	6	0	0	0	0	0	0	0	6	2	0	8	5	13		3	3
	%	0%	0%	0%	0%	0%	1%	0%	1%	0%	0%	1%	1%	0%	0%	0%	0%	0%	0%	0%	1%	1%	0%	1%	1%	1%			
	Articulated Truc	0	0	0	0	0	0	0	0	0	0	0	3	0	0	0	0	0	0	0	3	0	0	3	0	3			
	%	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%			
	Motorcycles on Road	1	0	0	0	1	1	1	0	0	0	1	1	0	0	0	0	0	0	0	1	0	0	1	1	3			
	%	0%	0%	0%	0%	0%	0%	4%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%			
	<b>Total</b>	<b>267</b>	<b>0</b>	<b>18</b>	<b>0</b>	<b>285</b>	<b>322</b>	<b>25</b>	<b>596</b>	<b>5</b>	<b>0</b>	<b>626</b>	<b>683</b>	<b>13</b>	<b>0</b>	<b>7</b>	<b>0</b>	<b>20</b>	<b>16</b>	<b>11</b>	<b>652</b>	<b>297</b>	<b>0</b>	<b>960</b>	<b>870</b>	<b>1891</b>			
	PHF	0.88	0	0.56	0	0.91	0.9	0.78	0.93	0.62	0	0.93	0.88	0.46	0	0.58	0	0.62	0.67	0.69	0.89	0.88	0	0.94	0.92	0.93			
	Approach %					15%	17%					33%	36%					1%	1%					51%	46%				

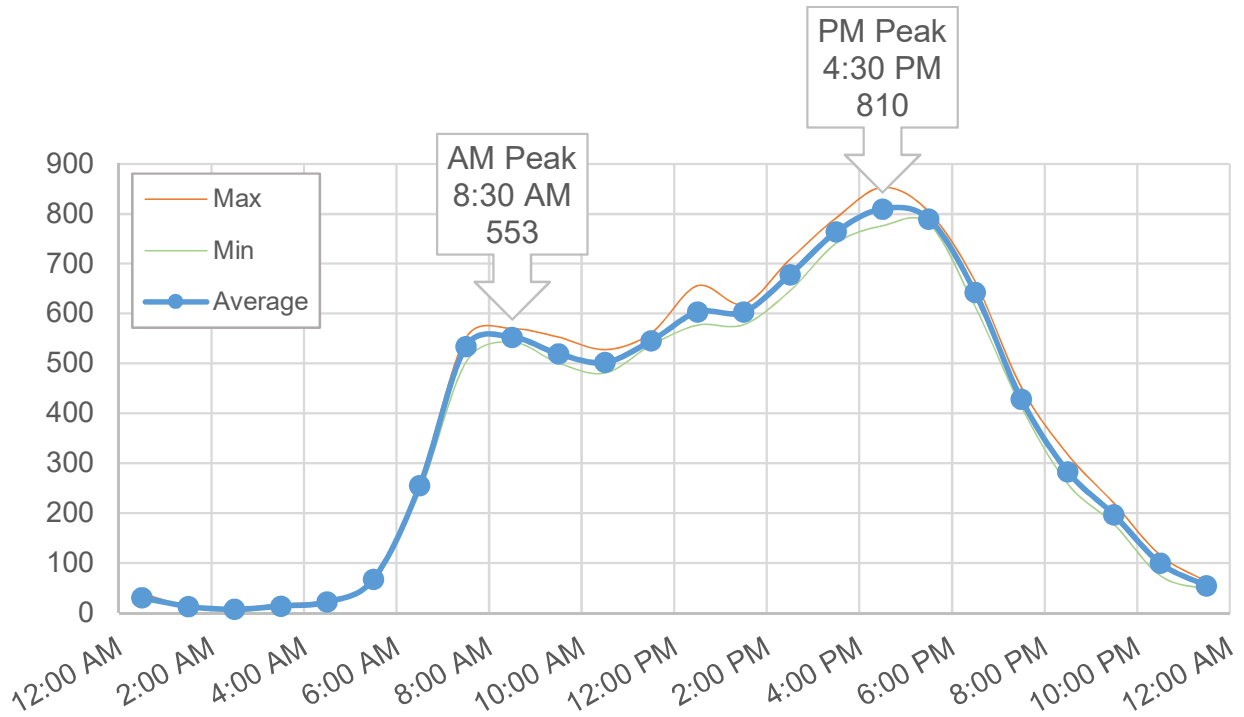


# Route 1A in Wenham Automatic Traffic Recorder (ATR) Locations



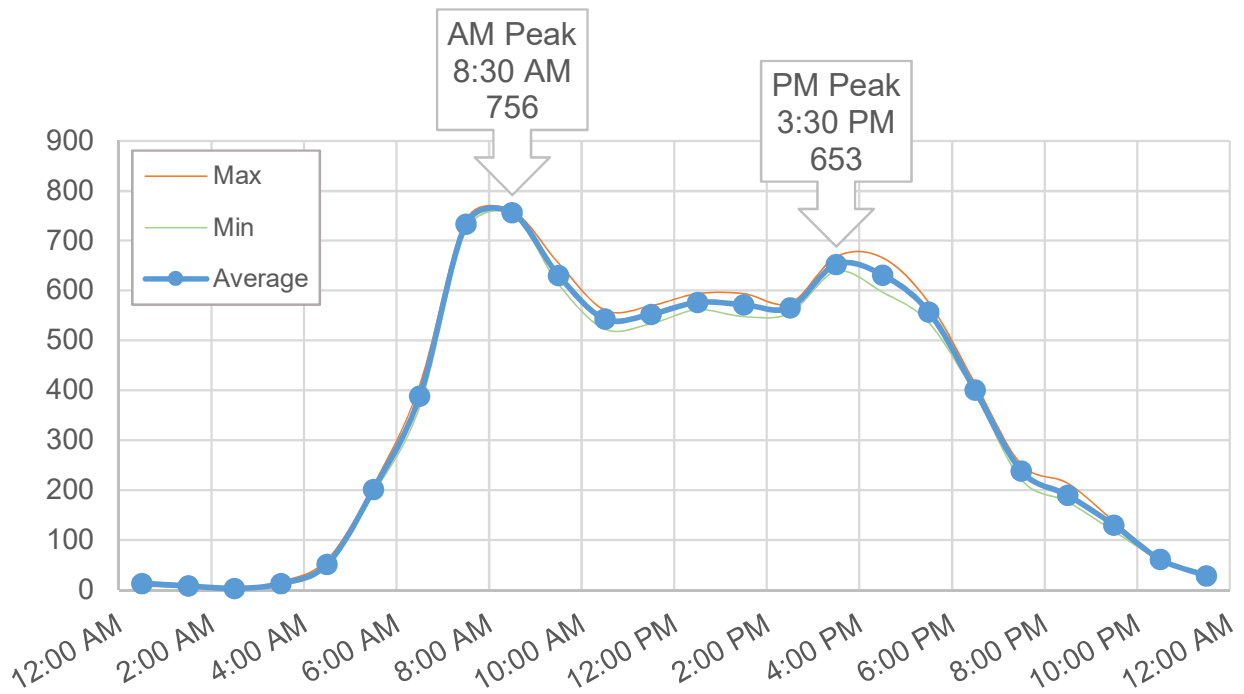
## Location 1 NB Rte. 1A South of Cherry

Time	Mon 11-27	Tue 11-28	Wed 11-29	Thu 11-30	Average
12:00 AM		25	29	39	31
1:00 AM		14	13	13	13
2:00 AM		10	9	4	8
3:00 AM		12	13	18	14
4:00 AM		26	21	21	23
5:00 AM		65	71	68	68
6:00 AM		264	259	243	255
7:00 AM		548	552	503	534
8:00 AM		543	570	546	553
9:00 AM		501	504	553	519
10:00 AM	528	481	498		502
11:00 AM	539	537	561		546
12:00 PM	577	577	656		603
1:00 PM	613	578	619		603
2:00 PM	680	709	646		678
3:00 PM	741	792	759		764
4:00 PM	776	801	853		810
5:00 PM	780	785	804		790
6:00 PM	650	614	664		643
7:00 PM	413	421	452		429
8:00 PM	259	318	274		284
9:00 PM	178	193	220		197
10:00 PM	75	109	116		100
11:00 PM	47	54	63		55
<b>Total</b>	<b>6,856</b>	<b>8,977</b>	<b>9,226</b>	<b>2,008</b>	<b>9,022</b>



## Location 1 SB Rte. 1A South of Cherry St

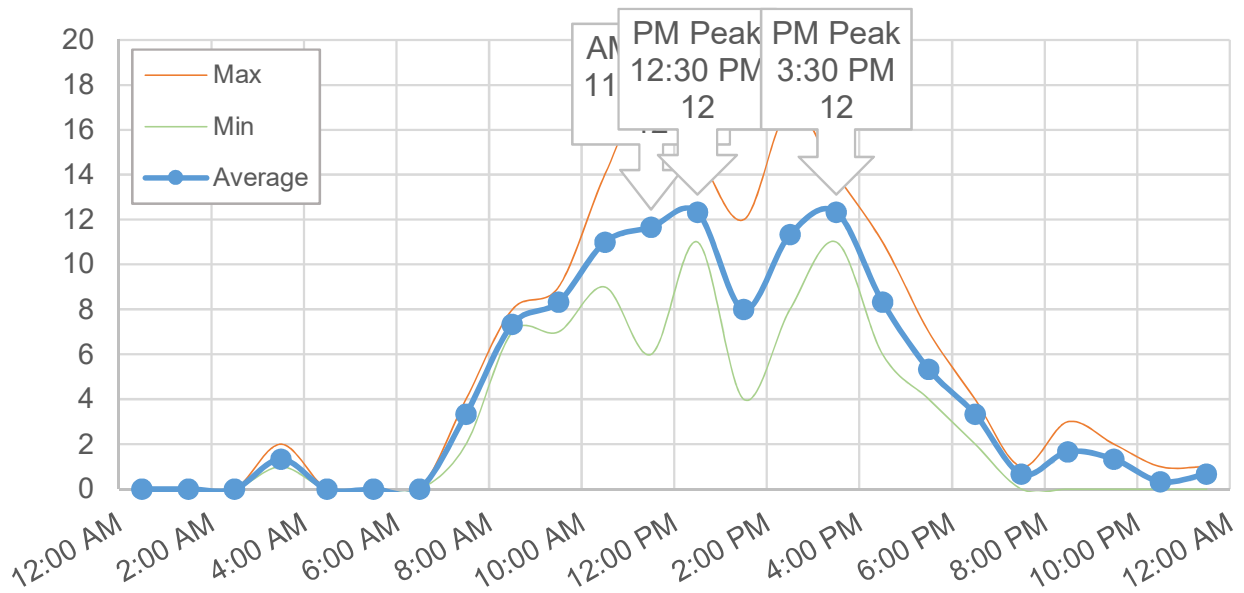
Time	Mon 11-27	Tue 11-28	Wed 11-29	Thu 11-30	Average
12:00 AM		8	17	16	14
1:00 AM		9	5	11	8
2:00 AM		3	4	4	4
3:00 AM		17	10	12	13
4:00 AM		61	47	48	52
5:00 AM		210	193	202	202
6:00 AM		411	368	388	389
7:00 AM		721	737	742	733
8:00 AM		760	753	756	756
9:00 AM		613	623	655	630
10:00 AM	561	546	523		543
11:00 AM	534	555	570		553
12:00 PM	574	562	594		577
1:00 PM	574	548	594		572
2:00 PM	568	575	555		566
3:00 PM	668	652	639		653
4:00 PM	631	597	666		631
5:00 PM	536	576	559		557
6:00 PM	397	392	414		401
7:00 PM	221	243	252		239
8:00 PM	179	177	214		190
9:00 PM	138	118	135		130
10:00 PM	60	61	64		62
11:00 PM	27	26	33		29
<b>Total</b>	<b>5,668</b>	<b>8,441</b>	<b>8,569</b>	<b>2,834</b>	<b>8,504</b>





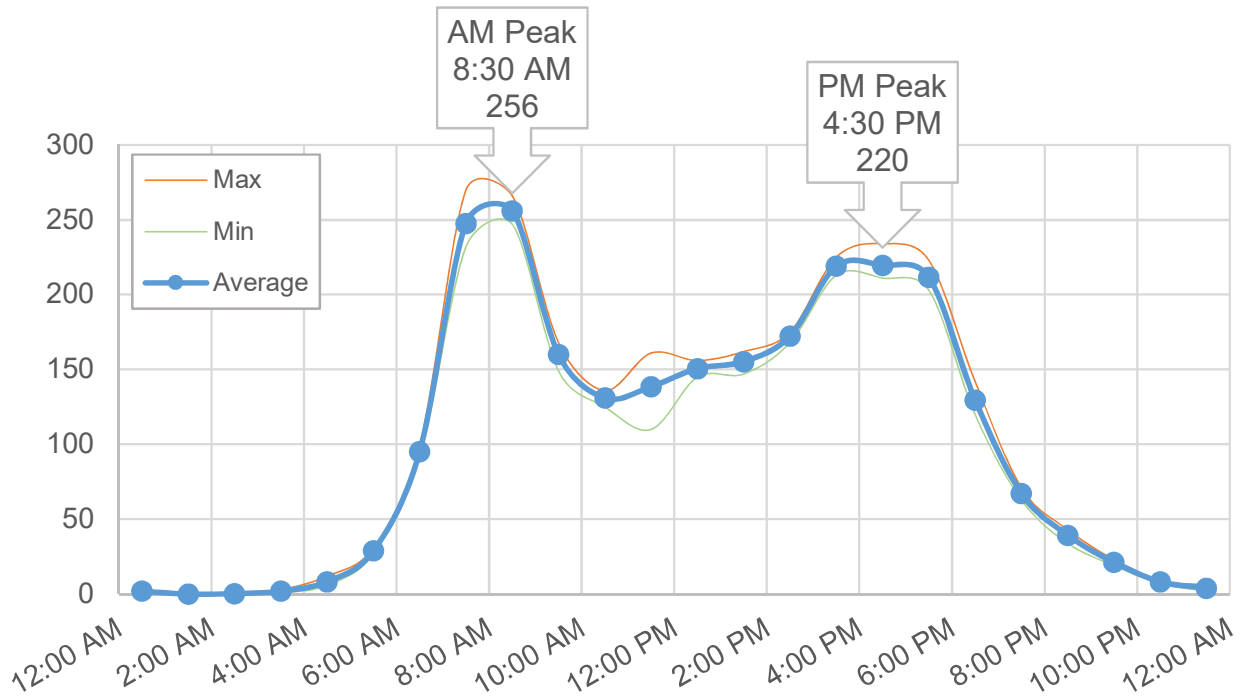
## Location 2 EB Old Country Rd. East of Maples Retirement Home

Time	Mon 11-27	Tue 11-28	Wed 11-29	Thu 11-30	Average
12:00 AM		0	0	0	0
1:00 AM		0	0	0	0
2:00 AM		0	0	0	0
3:00 AM		1	1	2	1
4:00 AM		0	0	0	0
5:00 AM		0	0	0	0
6:00 AM		0	0	0	0
7:00 AM		2	4	4	3
8:00 AM		7	8	7	7
9:00 AM		9	9	7	8
10:00 AM	9	10	14		11
11:00 AM	18	6	11		12
12:00 PM	15	11	11		12
1:00 PM	4	12	8		8
2:00 PM	8	17	9		11
3:00 PM	11	14	12		12
4:00 PM	8	6	11		8
5:00 PM	7	5	4		5
6:00 PM	2	4	4		3
7:00 PM	1	1	0		1
8:00 PM	0	2	3		2
9:00 PM	0	2	2		1
10:00 PM	0	1	0		0
11:00 PM	1	0	1		1
<b>Total</b>	<b>84</b>	<b>110</b>	<b>112</b>	<b>20</b>	<b>109</b>



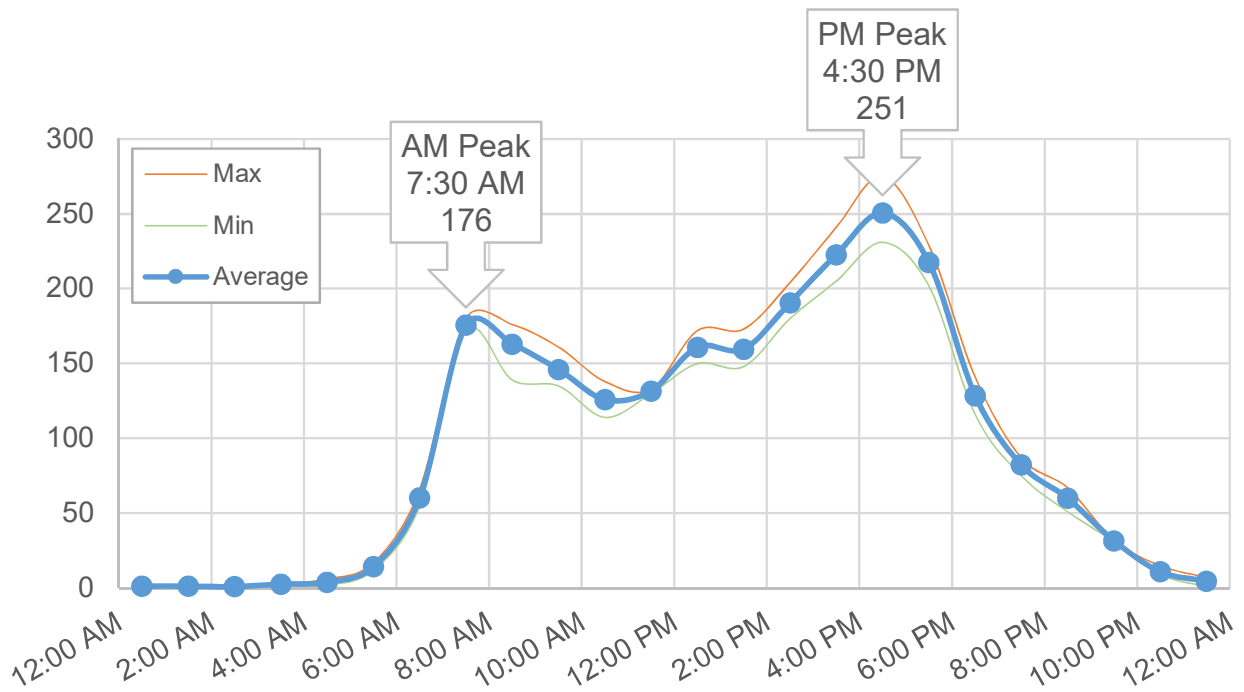
## Location 3 EB Cherry St. Between Rte. 1A And Cedar St.

Time	Mon 11-27	Tue 11-28	Wed 11-29	Thu 11-30	Average
12:00 AM		2	3	1	2
1:00 AM		0	0	0	0
2:00 AM		0	0	1	0
3:00 AM		3	2	1	2
4:00 AM		7	6	12	8
5:00 AM		31	27	29	29
6:00 AM		92	95	99	95
7:00 AM		241	270	232	248
8:00 AM		266	247	255	256
9:00 AM		168	149	163	160
10:00 AM	132	136	125		131
11:00 AM	110	161	145		139
12:00 PM	151	145	156		151
1:00 PM	147	162	157		155
2:00 PM	174	168	175		172
3:00 PM	219	225	213		219
4:00 PM	214	211	234		220
5:00 PM	203	223	209		212
6:00 PM	120	127	142		130
7:00 PM	71	63	68		67
8:00 PM	41	34	43		39
9:00 PM	19	23	22		21
10:00 PM	7	9	9		8
11:00 PM	2	4	6		4
<b>Total</b>	<b>1,610</b>	<b>2,501</b>	<b>2,503</b>	<b>793</b>	<b>2,469</b>



## Location 3 WB Cherry St. Between Rte. 1A And Cedar St.

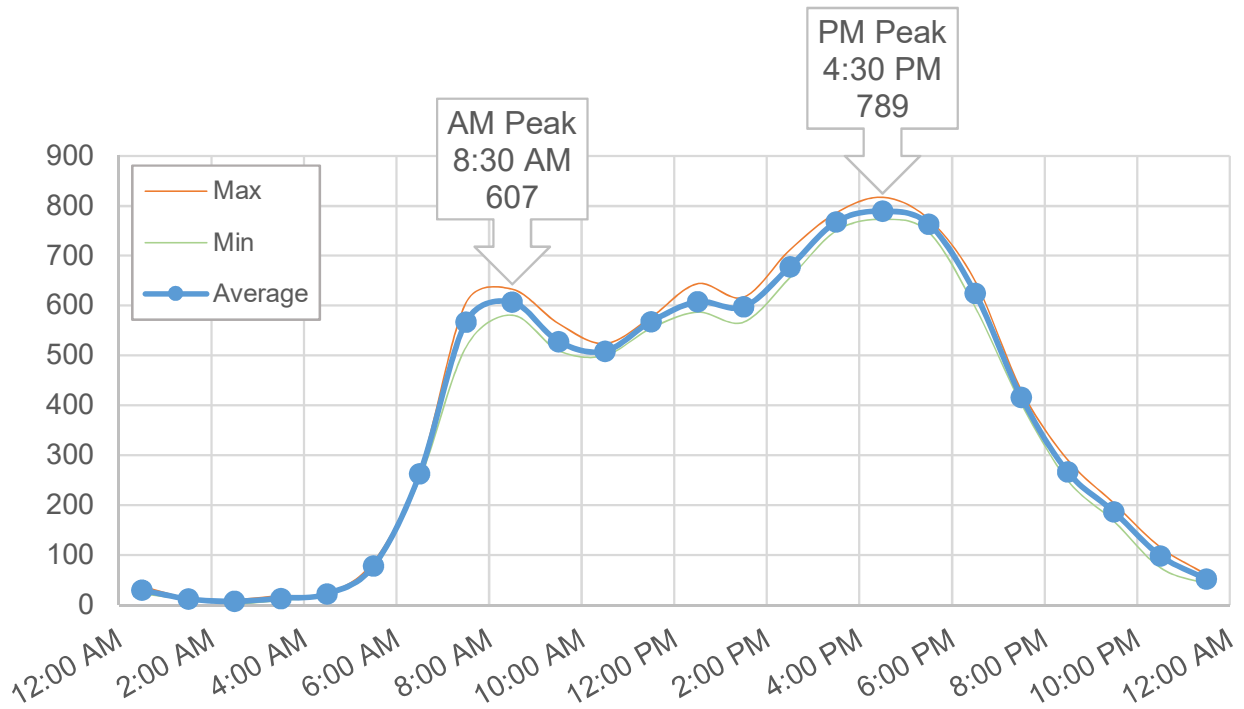
Time	Mon 11-27	Tue 11-28	Wed 11-29	Thu 11-30	Average
12:00 AM		2	1	1	1
1:00 AM		0	2	2	1
2:00 AM		0	1	2	1
3:00 AM		3	3	2	3
4:00 AM		2	4	6	4
5:00 AM		14	17	12	14
6:00 AM		55	66	60	60
7:00 AM		180	171	176	176
8:00 AM		176	174	139	163
9:00 AM		161	142	135	146
10:00 AM	138	126	114		126
11:00 AM	132	133	130		132
12:00 PM	150	161	172		161
1:00 PM	148	158	173		160
2:00 PM	188	180	204		191
3:00 PM	205	241	222		223
4:00 PM	231	246	275		251
5:00 PM	202	229	222		218
6:00 PM	129	116	141		129
7:00 PM	75	87	85		82
8:00 PM	51	67	62		60
9:00 PM	32	31	32		32
10:00 PM	9	15	9		11
11:00 PM	6	1	7		5
<b>Total</b>	<b>1,696</b>	<b>2,384</b>	<b>2,429</b>	<b>535</b>	<b>2,348</b>





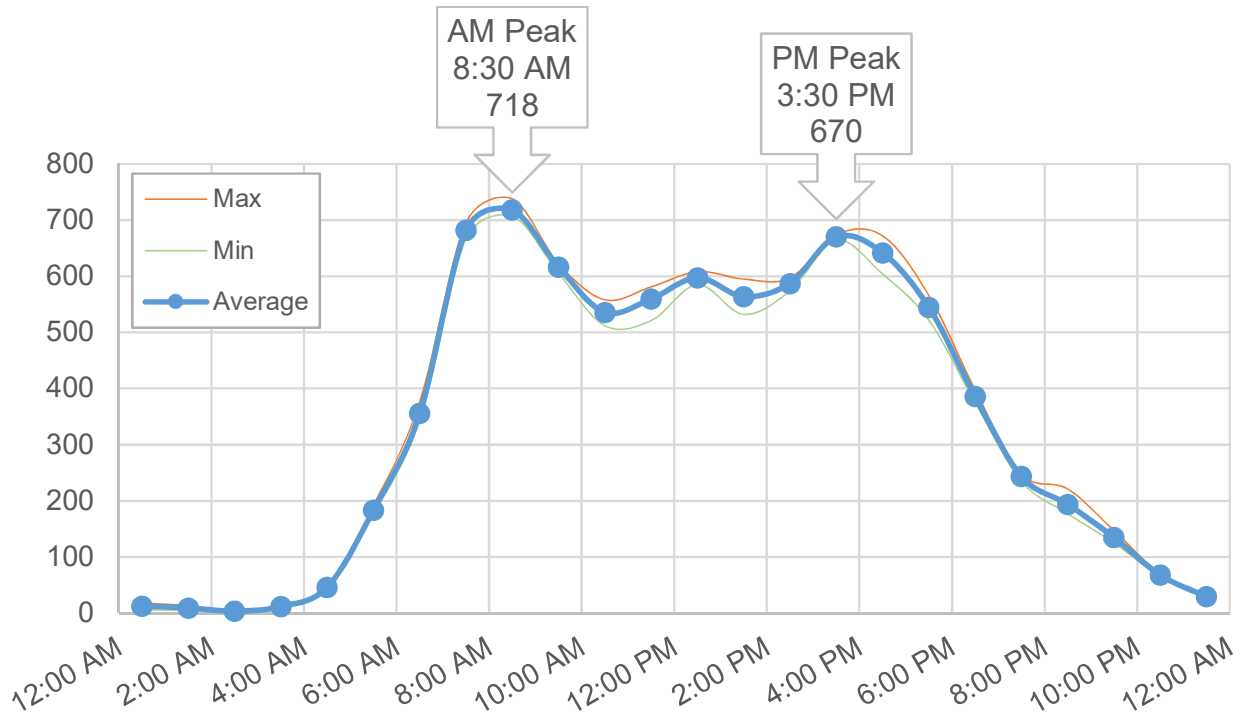
## Location 4 NB Rte. 1A Between Cherry St. And Monument St.

Time	Mon 11-27	Tue 11-28	Wed 11-29	Thu 11-30	Average
12:00 AM		23	30	38	30
1:00 AM		14	11	12	12
2:00 AM		11	9	3	8
3:00 AM		10	12	19	14
4:00 AM		24	21	23	23
5:00 AM		75	73	87	78
6:00 AM		270	267	252	263
7:00 AM		579	606	517	567
8:00 AM		581	633	608	607
9:00 AM		511	510	564	528
10:00 AM		500	503	524	509
11:00 AM		555	577	573	568
12:00 PM	587	592	644		608
1:00 PM	609	567	617		598
2:00 PM	667	712	656		678
3:00 PM	750	786	768		768
4:00 PM	773	778	817		789
5:00 PM	747	773	770		763
6:00 PM	630	597	649		625
7:00 PM	417	403	430		417
8:00 PM	250	291	260		267
9:00 PM	168	189	204		187
10:00 PM	75	106	116		99
11:00 PM	42	54	61		52
<b>Total</b>	<b>5,715</b>	<b>9,001</b>	<b>9,244</b>	<b>3,220</b>	<b>9,060</b>



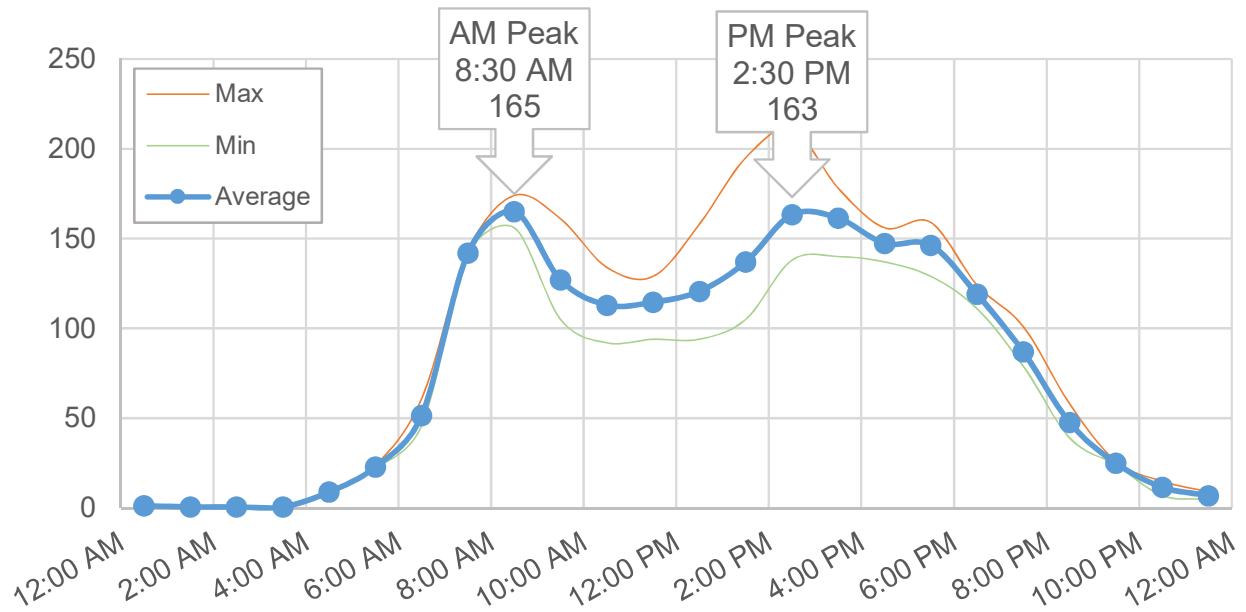
## Location 4 SB Rte. 1A Between Cherry St. And Monument St.

Time	Mon 11-27	Tue 11-28	Wed 11-29	Thu 11-30	Average
12:00 AM		6	14	18	13
1:00 AM		10	5	13	9
2:00 AM		4	3	4	4
3:00 AM		14	10	11	12
4:00 AM		50	44	44	46
5:00 AM		192	177	181	183
6:00 AM		376	343	348	356
7:00 AM		695	667	685	682
8:00 AM		709	738	707	718
9:00 AM		606	622	621	616
10:00 AM		558	512	538	536
11:00 AM		521	577	581	560
12:00 PM	585	599	608		597
1:00 PM	565	532	595		564
2:00 PM	574	591	597		587
3:00 PM	673	674	664		670
4:00 PM	649	604	672		642
5:00 PM	522	566	546		545
6:00 PM	384	375	398		386
7:00 PM	235	248	247		243
8:00 PM	177	184	221		194
9:00 PM	147	125	132		135
10:00 PM	67	66	70		68
11:00 PM	30	28	30		29
<b>Total</b>	<b>4,608</b>	<b>8,333</b>	<b>8,492</b>	<b>3,751</b>	<b>8,395</b>



## Location 5 EB Monument St. West of Route 1A

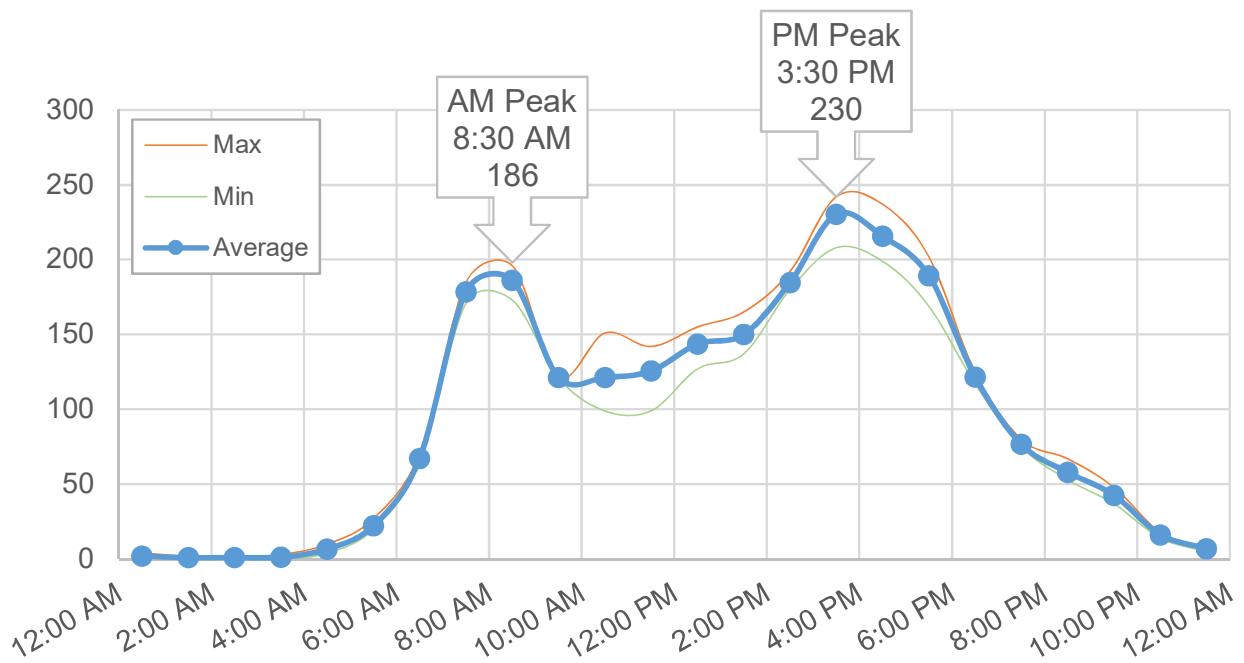
Time	Mon 11-27	Tue 11-28	Wed 11-29	Thu 11-30	Average
12:00 AM		2	2	0	1
1:00 AM		0	1	1	1
2:00 AM		0	1	1	1
3:00 AM		1	0	1	1
4:00 AM		10	8	9	9
5:00 AM		23	24	22	23
6:00 AM		61	46	48	52
7:00 AM		141	142	143	142
8:00 AM		165	174	156	165
9:00 AM		161	105	115	127
10:00 AM		134	92	113	113
11:00 AM	94	121	129		115
12:00 PM	94	110	158		121
1:00 PM	111	105	195		137
2:00 PM	141	138	211		163
3:00 PM	140	166	178		161
4:00 PM	149	137	156		147
5:00 PM	159	151	129		146
6:00 PM	111	122	124		119
7:00 PM	81	79	101		87
8:00 PM	39	58	46		48
9:00 PM	25	24	26		25
10:00 PM	7	15	13		12
11:00 PM	7	5	9		7
<b>Total</b>	<b>1,158</b>	<b>1,929</b>	<b>2,070</b>	<b>609</b>	<b>1,922</b>





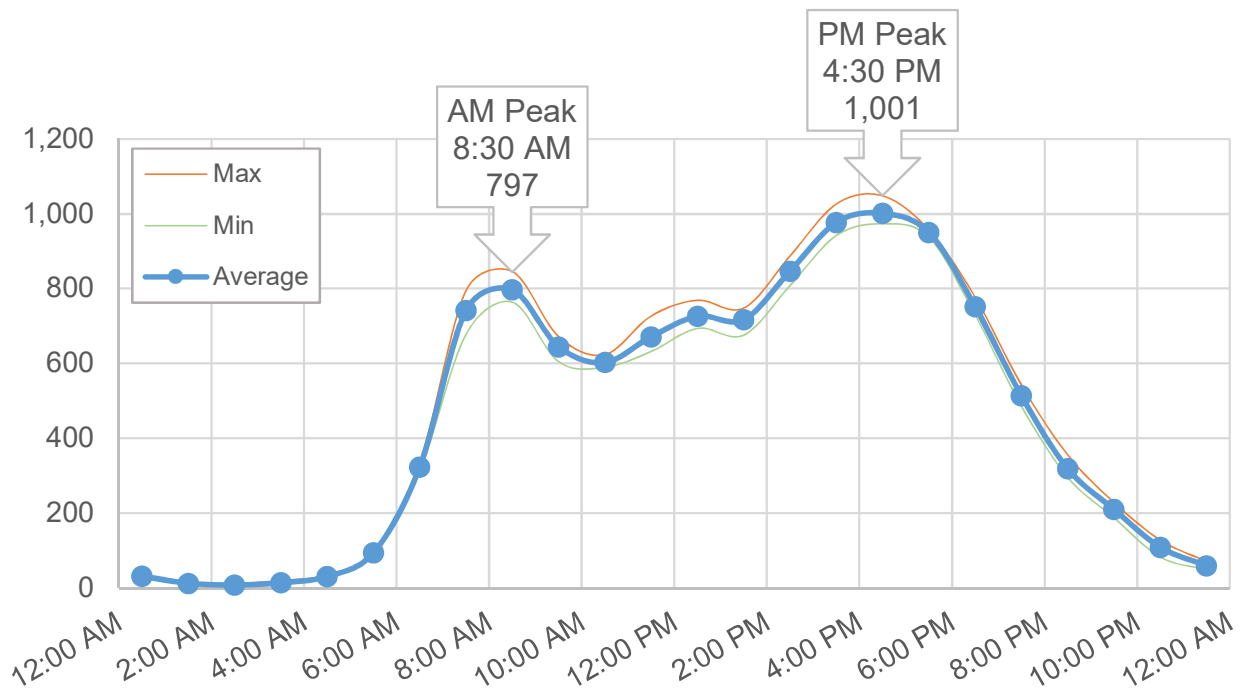
## Location 5 WB Monument St. West of Route 1A

Time	Mon 11-27	Tue 11-28	Wed 11-29	Thu 11-30	Average
12:00 AM		4	1	1	2
1:00 AM		1	0	2	1
2:00 AM		1	0	2	1
3:00 AM		1	0	3	1
4:00 AM		4	10	6	7
5:00 AM		20	20	27	22
6:00 AM		65	71	66	67
7:00 AM		180	171	185	179
8:00 AM		190	196	173	186
9:00 AM		122	121	121	121
10:00 AM		151	99	114	121
11:00 AM	99	142	136		126
12:00 PM	127	149	155		144
1:00 PM	137	148	165		150
2:00 PM	182	180	192		185
3:00 PM	241	242	208		230
4:00 PM	199	211	237		216
5:00 PM	169	202	197		189
6:00 PM	123	125	117		122
7:00 PM	75	80	75		77
8:00 PM	53	54	67		58
9:00 PM	43	37	48		43
10:00 PM	14	18	17		16
11:00 PM	5	8	8		7
<b>Total</b>	<b>1,467</b>	<b>2,335</b>	<b>2,311</b>	<b>700</b>	<b>2,271</b>



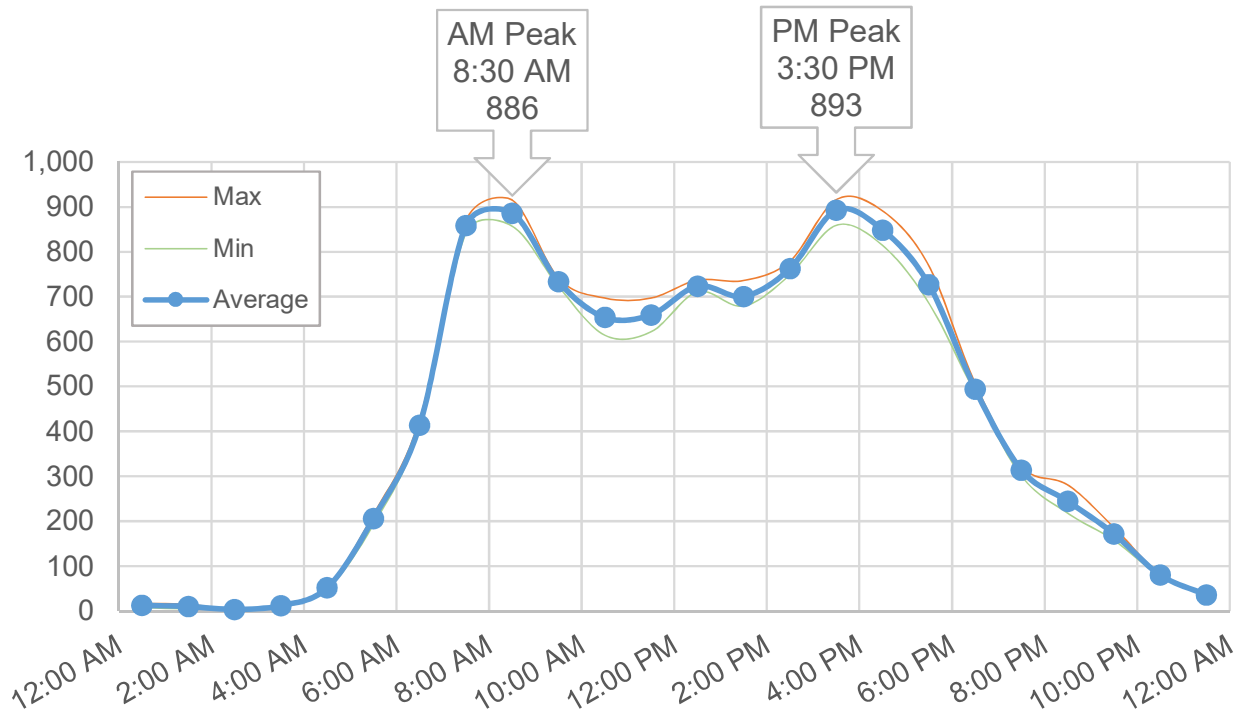
## Location 6 NB Rte. 1A Between Monument St. And Arbor St.

Time	Mon 11-27	Tue 11-28	Wed 11-29	Thu 11-30	Average
12:00 AM		25	33	37	32
1:00 AM		14	11	14	13
2:00 AM		11	10	4	8
3:00 AM		11	13	20	15
4:00 AM		35	28	31	31
5:00 AM		94	95	96	95
6:00 AM		336	320	314	323
7:00 AM		752	795	678	742
8:00 AM		764	846	781	797
9:00 AM		658	605	672	645
10:00 AM		590	595	624	603
11:00 AM	632	656	727		672
12:00 PM	694	716	769		726
1:00 PM	728	676	748		717
2:00 PM	844	887	808		846
3:00 PM	942	1,026	963		977
4:00 PM	983	973	1,048		1,001
5:00 PM	957	956	938		950
6:00 PM	750	730	777		752
7:00 PM	513	486	543		514
8:00 PM	296	356	306		319
9:00 PM	188	215	229		211
10:00 PM	83	117	128		109
11:00 PM	49	59	71		60
<b>Total</b>	<b>7,659</b>	<b>11,143</b>	<b>11,406</b>	<b>3,271</b>	<b>11,160</b>



## Location 6 SB Rte. 1A Between Monument St. And Arbor St.

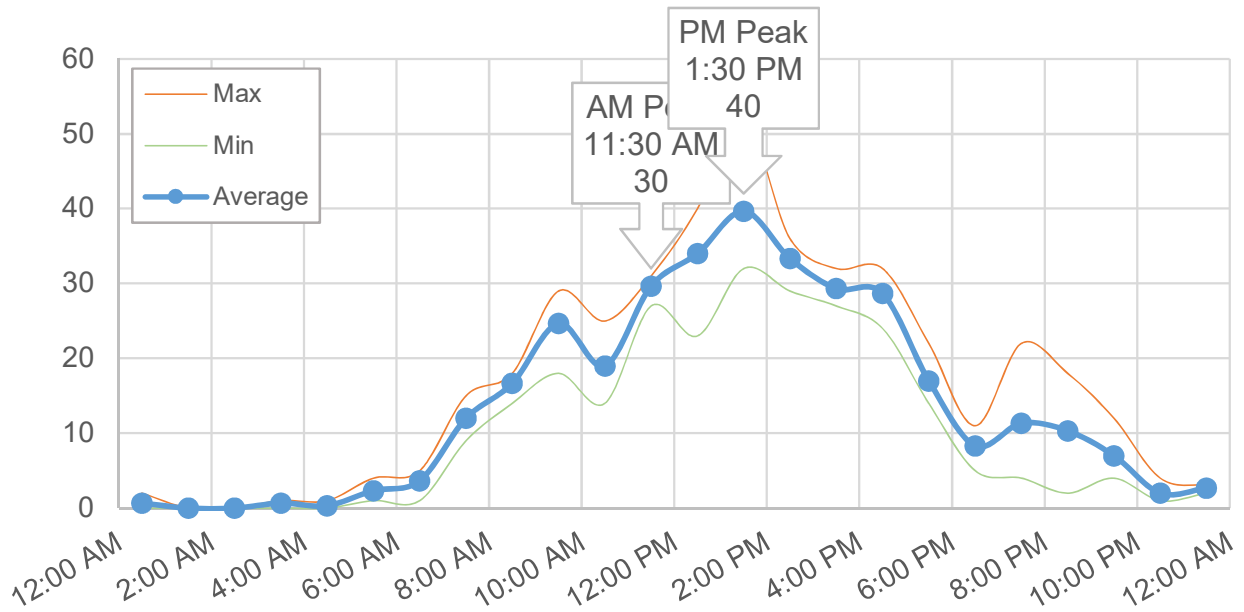
Time	Mon 11-27	Tue 11-28	Wed 11-29	Thu 11-30	Average
12:00 AM		8	14	17	13
1:00 AM		11	5	15	10
2:00 AM		4	4	4	4
3:00 AM		15	9	13	12
4:00 AM		55	52	49	52
5:00 AM		215	193	211	206
6:00 AM		427	407	409	414
7:00 AM		864	842	870	859
8:00 AM		885	915	857	886
9:00 AM		723	736	741	733
10:00 AM		697	614	651	654
11:00 AM	622	660	697		660
12:00 PM	711	723	737		724
1:00 PM	687	679	736		701
2:00 PM	749	760	779		763
3:00 PM	916	903	859		893
4:00 PM	841	814	891		849
5:00 PM	686	769	727		727
6:00 PM	490	486	507		494
7:00 PM	301	322	320		314
8:00 PM	218	235	281		245
9:00 PM	186	158	172		172
10:00 PM	78	81	82		80
11:00 PM	34	35	39		36
<b>Total</b>	<b>6,519</b>	<b>10,529</b>	<b>10,618</b>	<b>3,837</b>	<b>10,501</b>





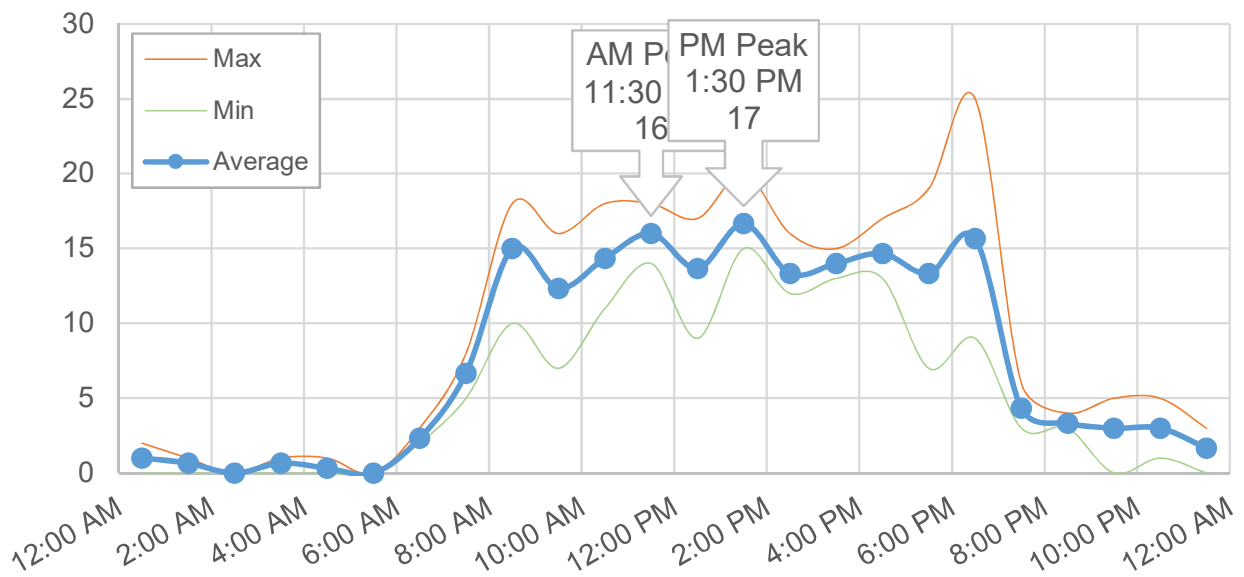
## Location 7 NB Friend Court South of Route 1A

Time	Mon 11-27	Tue 11-28	Wed 11-29	Thu 11-30	Average
12:00 AM		0	0	2	1
1:00 AM		0	0	0	0
2:00 AM		0	0	0	0
3:00 AM		1	1	0	1
4:00 AM		0	0	1	0
5:00 AM		2	4	1	2
6:00 AM		1	5	5	4
7:00 AM		15	9	12	12
8:00 AM		14	18	18	17
9:00 AM		29	27	18	25
10:00 AM		14	18	25	19
11:00 AM	31	31	27		30
12:00 PM	23	39	40		34
1:00 PM	32	35	52		40
2:00 PM	29	36	35		33
3:00 PM	27	32	29		29
4:00 PM	30	32	24		29
5:00 PM	14	22	15		17
6:00 PM	5	9	11		8
7:00 PM	4	22	8		11
8:00 PM	11	2	18		10
9:00 PM	5	12	4		7
10:00 PM	4	1	1		2
11:00 PM	3	2	3		3
<b>Total</b>	<b>218</b>	<b>351</b>	<b>349</b>	<b>82</b>	<b>333</b>



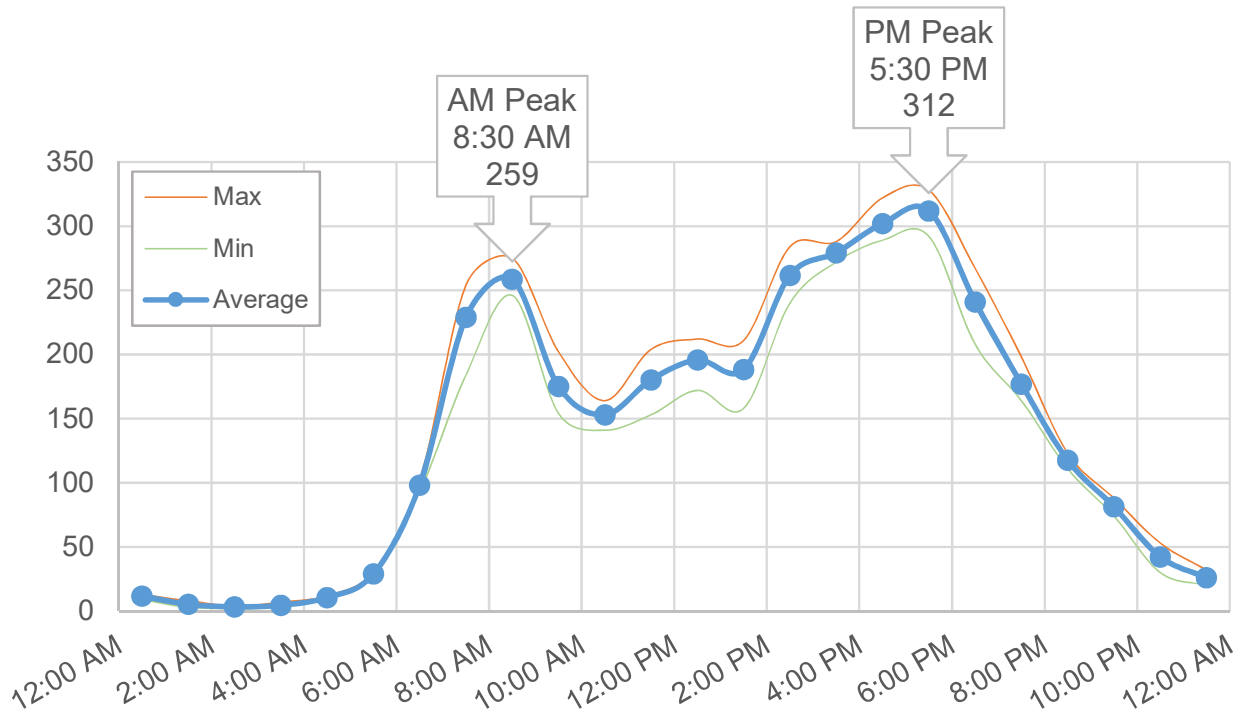
## Location 7 SB Friend Court South of Route 1A

Time	Mon 11-27	Tue 11-28	Wed 11-29	Thu 11-30	Average
12:00 AM		1	2	0	1
1:00 AM		1	0	1	1
2:00 AM		0	0	0	0
3:00 AM		1	1	0	1
4:00 AM		0	0	1	0
5:00 AM		0	0	0	0
6:00 AM		2	3	2	2
7:00 AM		7	5	8	7
8:00 AM		10	17	18	15
9:00 AM		16	14	7	12
10:00 AM		11	18	14	14
11:00 AM	16	14	18		16
12:00 PM	9	15	17		14
1:00 PM	15	15	20		17
2:00 PM	12	12	16		13
3:00 PM	15	14	13		14
4:00 PM	17	14	13		15
5:00 PM	7	19	14		13
6:00 PM	9	13	25		16
7:00 PM	4	3	6		4
8:00 PM	4	3	3		3
9:00 PM	4	5	0		3
10:00 PM	5	3	1		3
11:00 PM	2	0	3		2
<b>Total</b>	<b>119</b>	<b>179</b>	<b>209</b>	<b>51</b>	<b>186</b>



## Location 8 NB Arbor St. Between Edde Ave And Rte. 1A

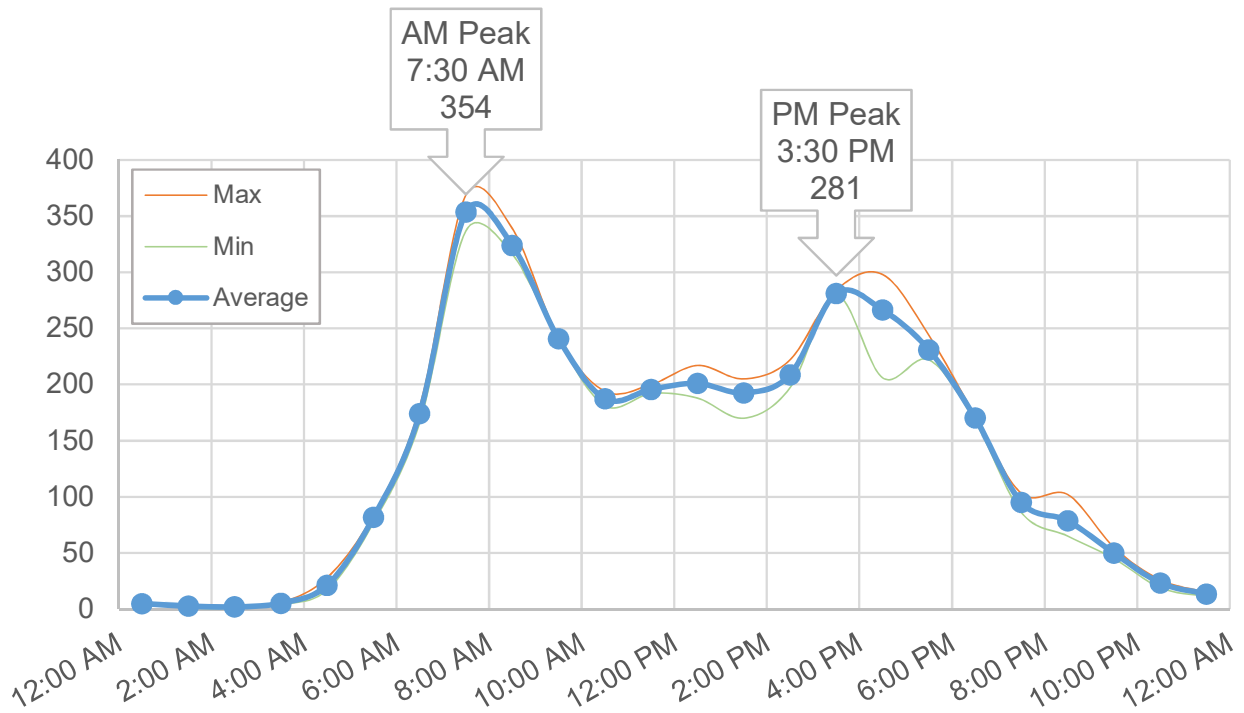
Time	Mon 11-27	Tue 11-28	Wed 11-29	Thu 11-30	Average
12:00 AM		13	9	13	12
1:00 AM		5	8	3	5
2:00 AM		4	4	2	3
3:00 AM		4	3	7	5
4:00 AM		12	10	10	11
5:00 AM		28	28	31	29
6:00 AM		93	100	102	98
7:00 AM		249	254	184	229
8:00 AM		255	275	246	259
9:00 AM		169	154	202	175
10:00 AM		164	141	154	153
11:00 AM	153	184	204		180
12:00 PM	172	203	212		196
1:00 PM	196	158	211		188
2:00 PM	261	284	240		262
3:00 PM	288	278	272		279
4:00 PM	295	289	322		302
5:00 PM	292	316	328		312
6:00 PM	267	208	248		241
7:00 PM	169	164	198		177
8:00 PM	123	119	111		118
9:00 PM	74	82	88		81
10:00 PM	30	44	53		42
11:00 PM	20	26	32		26
<b>Total</b>	<b>2,340</b>	<b>3,351</b>	<b>3,505</b>	<b>954</b>	<b>3,383</b>





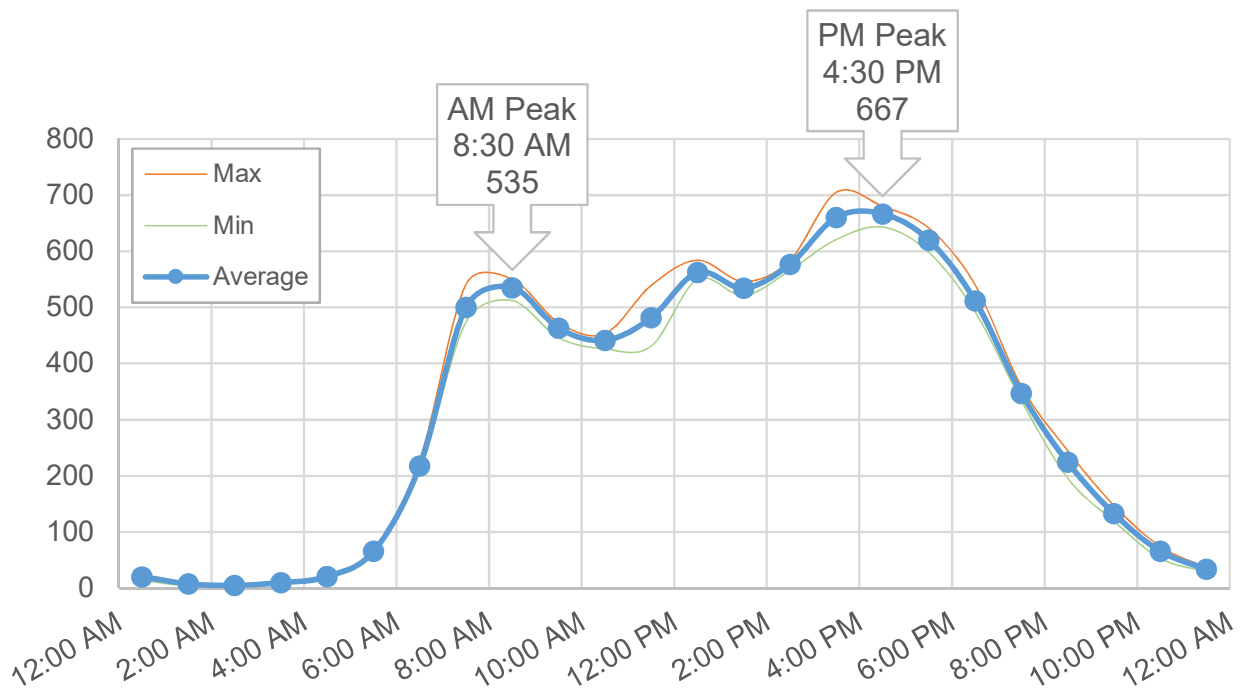
## Location 8 SB Arbor St. Between Edde Ave And Rte. 1A

Time	Mon 11-27	Tue 11-28	Wed 11-29	Thu 11-30	Average
12:00 AM		5	5	5	5
1:00 AM		4	1	3	3
2:00 AM		1	3	2	2
3:00 AM		6	4	6	5
4:00 AM		28	19	17	21
5:00 AM		84	77	84	82
6:00 AM		176	166	180	174
7:00 AM		355	369	337	354
8:00 AM		339	316	317	324
9:00 AM		241	239	242	241
10:00 AM		181	187	194	187
11:00 AM	200	195	192		196
12:00 PM	198	188	217		201
1:00 PM	170	205	203		193
2:00 PM	197	207	222		209
3:00 PM	281	284	279		281
4:00 PM	298	206	295		266
5:00 PM	222	244	227		231
6:00 PM	172	172	167		170
7:00 PM	96	86	103		95
8:00 PM	65	69	102		79
9:00 PM	55	45	50		50
10:00 PM	25	26	19		23
11:00 PM	14	11	15		13
<b>Total</b>	<b>1,993</b>	<b>3,358</b>	<b>3,477</b>	<b>1,387</b>	<b>3,405</b>



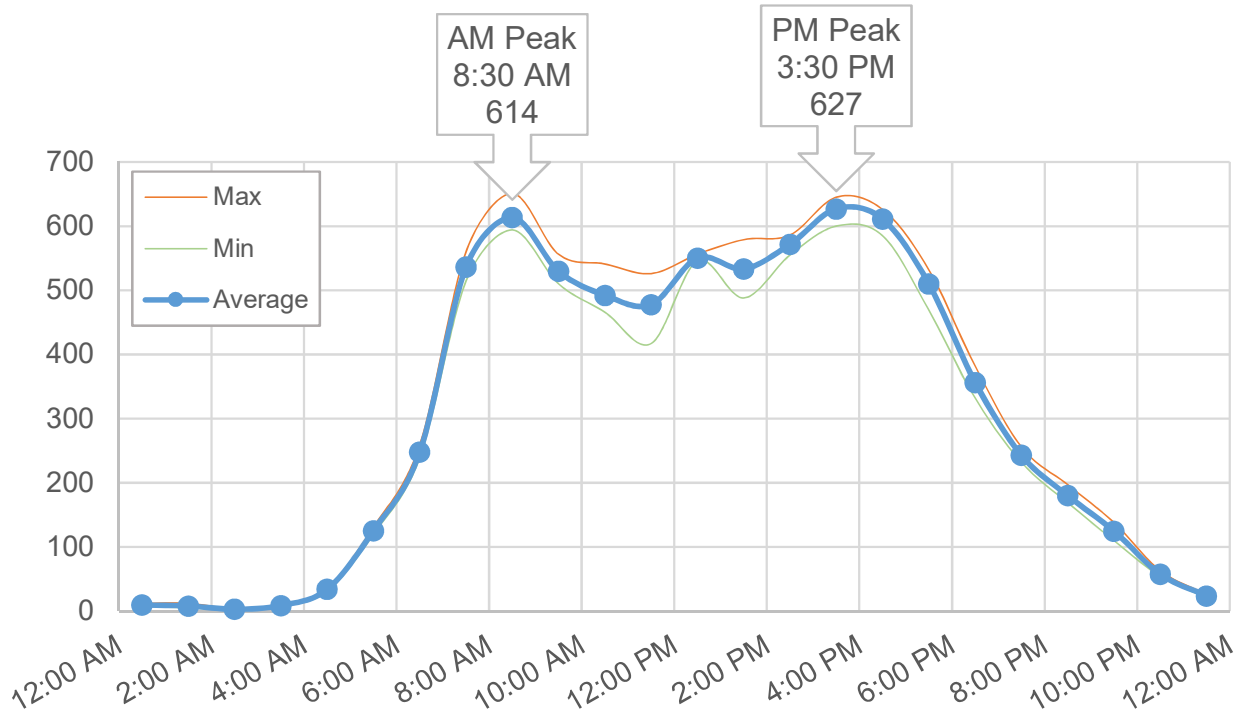
## Location 9 NB Rte. 1A Between Arbor St. And Perkins St.

Time	Mon 11-27	Tue 11-28	Wed 11-29	Thu 11-30	Average
12:00 AM		14	23	24	20
1:00 AM		10	4	9	8
2:00 AM		6	7	2	5
3:00 AM		8	10	11	10
4:00 AM		23	18	21	21
5:00 AM		66	70	61	66
6:00 AM		228	215	210	218
7:00 AM		485	541	474	500
8:00 AM		512	550	544	535
9:00 AM		471	446	473	463
10:00 AM		426	445	453	441
11:00 AM	431	474	539		481
12:00 PM	550	553	584		562
1:00 PM	521	536	546		534
2:00 PM	580	584	566		577
3:00 PM	621	705	655		660
4:00 PM	680	643	677		667
5:00 PM	641	620	598		620
6:00 PM	492	504	540		512
7:00 PM	348	334	359		347
8:00 PM	196	245	232		224
9:00 PM	119	132	147		133
10:00 PM	53	71	74		66
11:00 PM	29	36	36		34
<b>Total</b>	<b>5,261</b>	<b>7,686</b>	<b>7,882</b>	<b>2,282</b>	<b>7,704</b>



## Location 9 SB Rte. 1A Between Arbor St. And Perkins St.

Time	Mon 11-27	Tue 11-28	Wed 11-29	Thu 11-30	Average
12:00 AM		7	10	12	10
1:00 AM		7	5	12	8
2:00 AM		3	2	4	3
3:00 AM		10	7	9	9
4:00 AM		31	35	36	34
5:00 AM		131	120	125	125
6:00 AM		259	239	245	248
7:00 AM		535	514	560	536
8:00 AM		596	651	594	614
9:00 AM		510	523	556	530
10:00 AM		541	466	470	492
11:00 AM	417	490	526		478
12:00 PM	546	549	556		550
1:00 PM	533	488	579		533
2:00 PM	574	586	555		572
3:00 PM	645	636	600		627
4:00 PM	585	622	626		611
5:00 PM	469	532	529		510
6:00 PM	355	332	382		356
7:00 PM	256	241	232		243
8:00 PM	169	174	197		180
9:00 PM	138	110	126		125
10:00 PM	54	56	63		58
11:00 PM	21	26	24		24
<b>Total</b>	<b>4,762</b>	<b>7,472</b>	<b>7,567</b>	<b>2,623</b>	<b>7,475</b>

























































**APPENDIX C:  
CRASH DATA ANALYSIS**





Symbols		Types of Crash		Severity	
Moving Vehicle	Parked Vehicle	Head On	Sideswipe	Injury Accident	Fatal Accident
Backing Vehicle	Fixed Object	Angle	Out of Control		
Non-Involved Vehicle	Bicycle	Rear End			
Pedestrian	Animal				

**Figure C-1**  
**Collision Diagram: Crash Data 2011-2017**  
**Route 1A at Cherry Street, Monument Street, and Arbor Street in Wenham**



Index	Nearest Intersection	Crash Number	Crash Date	Crash Time	Road Surface Conditions	Weather Conditions	Ambient Light Conditions	Cyclist or Pedestrian	Manner of Collision	Crash Severity	Address	Vehicle Travelled Direction	Vehicle Action
1	Route 1A at Cherry Street	2738566	2011-01-08	12:31 PM	Snow/Ice	Snow	Daylight		Rear-end	Property damage o	10 Feet S F	V1:Northbound / V2:Northbound / V3	V1: Slowing or stopped in traffic / V2:Slowing or stopped in traffic
2	Route 1A at Cherry Street	2738293	2011-01-08	12:43 PM	Snow/Ice	Snow	Daylight		Single vehicle crash	Property damage o	Main St	V1:Southbound	V1: Travelling straight ahead
3	Route 1A at Cherry Street	2738294	2011-01-14	8:43 AM	Wet	Clear	Daylight		Rear-end	Property damage o	Main St / C	V1:Southbound / V2:Southbound	V1: Slowing or stopped in traffic / V2:Travelling straight ahead
4	Route 1A at Monument Street	2738698	2011-03-07	2:25 PM	Dry	Cloudy	Daylight		Single vehicle crash	Non-fatal injury	Main St / N	V1:Southbound / V2:Northbound	V1: Travelling straight ahead / V2:Turning left
5	Route 1A at Arbor Street/Friend Court	3347954	2011-04-08	3:00 PM	Dry	Clear	Daylight		Sideswipe, same direction	Property damage o	Main Stree	V1:Northbound / V2:Northbound	V1: Entering traffic lane / V2:Travelling straight ahead
6	Route 1A at Cherry Street	2740518	2011-06-22	3:06 PM	Wet	Rain	Daylight		Angle	Non-fatal injury	Main St / C	V1:Southbound / V2:Eastbound	V1: Travelling straight ahead / V2:Turning left
7	Route 1A at Cherry Street	2740520	2011-06-23	3:56 PM	Wet	Rain	Daylight		Sideswipe, opposite direction	Non-fatal injury	Main St / C	V1:Northbound / V2:Westbound / V3:	V1: Turning left / V2:Turning left / V3:Travelling straight ahead
8	Route 1A at Cherry Street	2740556	2011-06-30	4:08 PM	Dry	Clear	Daylight		Angle	Property damage o	Main Stree	V1:Southbound / V2:Eastbound	V1: Travelling straight ahead / V2:Entering traffic lane
9	Route 1A at Cherry Street	2751063	2011-07-16	2:19 PM	Dry	Clear	Daylight		Angle	Property damage o	Main Stree	V1:Southbound / V2:Eastbound	V1: Travelling straight ahead / V2:Turning left
10	Route 1A at Cherry Street	2751062	2011-07-16	2:22 PM	Dry	Clear	Daylight		Rear-end	Non-fatal injury	Main Stree	V1:Southbound / V2:Southbound	V1: Travelling straight ahead / V2:Travelling straight ahead
11	Route 1A at Cherry Street	2756826	2011-08-06	3:01 PM	Dry	Clear	Daylight		Rear-end	Property damage o	Main St Rte	V1:Southbound / V2:Southbound	V1: Travelling straight ahead / V2:Unknown
12	Route 1A at Monument Street	2791345	2011-10-17	12:37 PM	Dry	Clear	Daylight		Angle	Property damage o	Main St / N	V1:Southbound / V2:Eastbound	V1: Travelling straight ahead / V2:Travelling straight ahead
13	Route 1A at Cherry Street	2816990	2011-11-25	4:59 PM	Dry	Clear	Dark - lighted roadway		Angle	Property damage o	Main St / C	V1:Northbound / V2:Eastbound	V1: Turning left / V2:Turning left
14	Route 1A at Monument Street	2847255	2011-12-05	4:29 PM	Dry	Clear	Dark - lighted roadway		Angle	Property damage o	Main St / N	V1:Southbound / V2:Eastbound	V1: Travelling straight ahead / V2:Turning left
15	Route 1A at Cherry Street	2847225	2011-12-06	9:40 AM	Wet	Rain	Daylight		Rear-end	Property damage o	Main St / C	V1:Northbound / V2:Northbound	V1: Slowing or stopped in traffic / V2:Travelling straight ahead
16	Route 1A at Cherry Street	2847256	2011-12-10	4:26 PM	Dry	Clear	Dark - lighted roadway		Angle	Property damage o	Main St / C	V1:Southbound / V2:Northbound	V1: Travelling straight ahead / V2:Turning left
17	Route 1A at Arbor Street/Friend Court	2847226	2011-12-11	7:08 PM	Dry	Clear	Dark - lighted roadway		Angle	Property damage o	Arbor St / N	V1:Southbound / V2:Eastbound	V1: Travelling straight ahead / V2:Travelling straight ahead
18	Route 1A at Arbor Street/Friend Court	2847258	2011-12-23	3:19 PM	Dry	Clear	Daylight		Rear-end	Non-fatal injury	Main St	V1:Southbound / V2:Southbound	V1: Slowing or stopped in traffic / V2:Travelling straight ahead
19	Route 1A at Arbor Street/Friend Court	2937924	2012-02-18	4:45 PM	Dry	Clear	Daylight		Sideswipe, same direction	Property damage o	Main St Rte	V1:Southbound / V2:Southbound	V1: Turning right / V2:Travelling straight ahead
20	Route 1A at Monument Street	3655619	2012-06-13	4:45 PM	Wet	Rain	Daylight		Angle	Non-fatal injury	Main St / N	V1:Southbound / V2:Eastbound	V1: Travelling straight ahead / V2:Turning left
21	Route 1A at Monument Street	3655513	2012-07-24	3:09 PM	Wet	Rain	Other		Rear-end	Property damage o	Monument	V1:Southbound / V2:Southbound	V1: Slowing or stopped in traffic / V2:Travelling straight ahead
22	Route 1A at Monument Street	3655622	2012-08-01	5:38 PM	Wet	Rain	Daylight		Angle	Property damage o	Main St / N	V1:Southbound / V2:Eastbound	V1: Travelling straight ahead / V2:Turning left
23	Route 1A at Cherry Street	3655625	2012-08-29	1:33 PM	Dry	Clear	Daylight		Angle	Property damage o	Main St Rte	V1:Northbound / V2:Westbound	V1: Turning left / V2:Turning left
24	Route 1A at Arbor Street/Friend Court	3626768	2012-10-14	2:45 PM	Wet	Cloudy	Daylight		Rear-end	Property damage o	Main St	V1:Southbound / V2:Southbound / V3	V1: Travelling straight ahead / V2:Travelling straight ahead / V3:Tr
25	Route 1A at Arbor Street/Friend Court	3626693	2012-11-20	4:08 PM	Dry	Clear	Daylight		Rear-end	Property damage o	Monument	V1:Southbound / V2:Southbound	V1: Slowing or stopped in traffic / V2:Travelling straight ahead
26	Route 1A at Arbor Street/Friend Court	3626771	2012-12-06	11:12 AM	Dry	Clear	Daylight		Rear-end	Non-fatal injury	Main St Rte	V1:Northbound / V2:Northbound	V1: Travelling straight ahead / V2:Turning right
27	Route 1A at Cherry Street	3626776	2013-01-14	7:21 PM	Dry	Clear	Dark - lighted roadway		Rear-end	Non-fatal injury	Main St / C	V1:Northbound / V2:Northbound	V1: Turning left / V2:Travelling straight ahead
28	Route 1A at Cherry Street	3481902	2013-03-15	3:57 PM	Dry	Clear	Daylight		Sideswipe, same direction	Property damage o	Main St / C	V1:Southbound / V2:Southbound	V1: Travelling straight ahead / V2:Travelling straight ahead
29	Route 1A at Cherry Street	3627046	2013-05-13	3:33 PM	Dry	Clear	Daylight		Angle	Property damage o	Main Stree	V1:Eastbound / V2:Southbound	V1: Turning left / V2:Travelling straight ahead
30	Route 1A at Arbor Street/Friend Court	3626700	2013-06-13	3:57 PM	Wet	Rain	Daylight		Angle	Non-fatal injury	Main St	V1:Northbound / V2:Northbound / V3	V1: Travelling straight ahead / V2:Turning left / V3:Parked
31	Route 1A at Monument Street	3655523	2013-07-16	9:30 AM	Dry	Clear	Daylight		Angle	Property damage o	Main St / N	V1:Southbound / V2:Northbound	V1: Entering traffic lane / V2:Travelling straight ahead
32	Route 1A at Arbor Street/Friend Court	3626777	2013-09-23	12:07 PM	Dry	Clear	Daylight		Head-on	Non-fatal injury	Main St / F	V1:Southbound / V2:Northbound	V1: Turning left / V2:Overtaking/passing
33	Route 1A at Arbor Street/Friend Court	3655720	2013-10-06	8:36 AM	Wet	Rain	Daylight		Rear-end	Non-fatal injury	Main Stree	V1:Northbound / V2:Northbound	V1: Turning left / V2:Travelling straight ahead
34	Route 1A at Monument Street	3655637	2013-10-16	9:05 AM	Dry	Cloudy	Daylight		Angle	Property damage o	Monument	V1:Northbound / V2:Southbound	V1: Turning left / V2:Travelling straight ahead
35	Route 1A at Arbor Street/Friend Court	3718704	2014-01-15	6:26 PM	Wet	Clear	Dark - lighted roadway		Unknown	Property damage o	Main St / A	V1:Westbound / V2:Northbound / V3:	V1: Parked / V2:Travelling straight ahead / V3:Travelling straight a
36	Route 1A at Monument Street	3730113	2014-02-05	7:58 AM	Snow/Ice	Snow	Daylight		Single vehicle crash	Property damage o	Main Stree	V1:Southbound	V1: Travelling straight ahead
37	Route 1A at Arbor Street/Friend Court	3735170	2014-02-12	1:05 PM	Dry	Clear	Daylight		Rear-end	Property damage o	Main St	V1:Southbound / V2:Southbound	V1: Slowing or stopped in traffic / V2:Travelling straight ahead
38	Route 1A at Arbor Street/Friend Court	3783084	2014-03-11	2:44 PM	Dry	Clear	Daylight		Sideswipe, same direction	Property damage o	Main St / A	V1:Northbound / V2:Northbound	V1: Turning left / V2:Travelling straight ahead
39	Route 1A at Arbor Street/Friend Court	3787071	2014-04-10	7:33 AM	Dry	Clear	Daylight		Angle	Property damage o	Main St / F	V1:Southbound / V2:Northbound	V1: Travelling straight ahead / V2:Travelling straight ahead
40	Route 1A at Cherry Street	3797041	2014-05-01	5:13 PM	Dry	Clear	Daylight		Angle	Property damage o	Main St / C	V1:Northbound / V2:Eastbound	V1: Travelling straight ahead / V2:Turning left
41	Route 1A at Arbor Street/Friend Court	3809141	2014-05-20	3:27 PM	Dry	Cloudy	Daylight		Angle	Property damage o	Main Stree	V1:Eastbound / V2:Northbound	V1: Travelling straight ahead / V2:Travelling straight ahead
42	Route 1A at Cherry Street	3809142	2014-05-22	1:00 PM	Dry	Clear	Daylight		Rear-end	Non-fatal injury	Main St Rte	V1:Southbound / V2:Southbound	V1: Slowing or stopped in traffic / V2:Travelling straight ahead
43	Route 1A at Monument Street	3875838	2014-07-06	9:03 AM	Dry	Clear	Daylight	cyc	Single vehicle crash	Non-fatal injury	Parking Lot	V1:Southbound	V1: Turning left
44	Route 1A at Arbor Street/Friend Court	3925231	2014-07-15	4:28 PM	Dry	Clear	Daylight		Single vehicle crash	Property damage o	Main St / A	V1:Northbound	V1: Turning left
45	Route 1A at Cherry Street	3925232	2014-08-08	11:23 AM	Dry	Clear	Daylight		Angle	Property damage o	Main St / C	V1:Northbound / V2:Eastbound	V1: Turning left / V2:Turning left
46	Route 1A at Arbor Street/Friend Court	3925234	2014-08-23	3:50 PM	Dry	Clear	Daylight		Rear-end	Property damage o	50 Feet W	V1:Westbound / V2:Westbound	V1: Travelling straight ahead / V2:Travelling straight ahead
47	Route 1A at Monument Street	3966096	2014-09-30	7:45 AM	Wet	Rain	Daylight		Rear-end	Property damage o	Main Stree	V1:Southbound / V2:Southbound / V3	V1: Travelling straight ahead / V2:Travelling straight ahead / V3:Tr
48	Route 1A at Cherry Street	3957314	2014-10-07	3:30 PM	Dry	Cloudy	Daylight		Angle	Property damage o	Main St / C	V1:Northbound / V2:Westbound	V1: Turning left / V2:Travelling straight ahead
49	Route 1A at Monument Street	3970733	2014-10-27	4:36 PM	Dry	Clear	Daylight		Angle	Property damage o	Main St / N	V1:Northbound / V2:Southbound	V1: Turning left / V2:Travelling straight ahead
50	Route 1A at Arbor Street/Friend Court	3982340	2014-11-26	2:20 PM	Wet	Rain	Daylight		Angle	Property damage o	Main St Rte	V1:Southbound / V2:Eastbound	V1: Travelling straight ahead / V2:Turning right
51	Route 1A at Monument Street	4006711	2015-02-11	6:06 PM	Wet	Snow	Dark - lighted roadway		Rear-end	Property damage o	50 Feet S F	V1:Southbound / V2:Southbound	V1: Travelling straight ahead / V2:Travelling straight ahead
52	Route 1A at Monument Street	4028896	2015-04-01	7:18 AM	Dry	Clear	Daylight		Angle	Property damage o	Main St / N	V1:Southbound / V2:Eastbound	V1: Travelling straight ahead / V2:Turning left
53	Route 1A at Cherry Street	4035063	2015-04-23	6:01 PM	Dry	Clear	Daylight		Angle	Property damage o	Main St / C	V1:Southbound / V2:Eastbound	V1: Travelling straight ahead / V2:Entering traffic lane
54	Route 1A at Monument Street	4042243	2015-05-16	12:28 PM	Dry	Clear	Daylight		Sideswipe, opposite direction	Non-fatal injury	Main Stree	V1:Northbound / V2:Southbound	V1: Travelling straight ahead / V2:Travelling straight ahead
55	Route 1A at Monument Street	4095257	2015-10-08	6:35 PM	Dry	Clear	Daylight		Sideswipe, opposite direction	Property damage o	Main St Rte	V1:Southbound / V2:Northbound	V1: Travelling straight ahead / V2:Turning left
56	Route 1A at Cherry Street	-	2015-02-11	6:06 PM	Wet	Clear	Dark - lighted roadway		Rear-end	Property damage o -			V1: Travelling straight ahead
57	Route 1A at Monument Street	-	2015-04-01	7:18 AM	Dry	Clear	Daylight		Angle	Property damage o -			V1: Travelling straight ahead
58	Route 1A at Monument Street	-	2015-04-05	1:49 PM	Dry	Cloudy	Daylight		Angle	Possible	-		V1: Making U-turn
59	Route 1A at Monument Street	-	2015-04-07	12:51 PM	Wet	Cloudy	Daylight		Rear-end	Property damage o -			V1: Travelling straight ahead
60	Route 1A at Cherry Street	-	2015-04-23	6:01 PM	Dry	Clear	Daylight		Angle	Property damage o -			V1: Travelling straight ahead
61	Route 1A at Monument Street	-	2015-10-08	6:35 PM	Dry	Clear	Daylight		Sideswipe, opposite direction	Property damage o -			V1: Travelling straight ahead
62	Route 1A at Arbor Street/Friend Court	-	2016-01-20	7:08 AM	Dry	Clear	Daylight		Angle	Property damage o -			V1: Travelling straight ahead



Index	Nearest Intersection	Crash Number	Crash Date	Crash Time	Road Surface Conditions	Weather Conditions	Ambient Light Conditions	Cyclist or Pedestrian	Manner of Collision	Crash Severity	Address	Vehicle Travelled Direction	Vehicle Action
63	Route 1A at Monument Street	-	2016-02-05	12:23 PM	Snow/Ice	Snow	Daylight		Rear-end	Property damage o -			V1: Travelling straight ahead
64	Route 1A at Cherry Street	-	2016-03-01	5:00 PM	Dry	Clear	Daylight		Angle	Property damage o -			V1: Travelling straight ahead
65	Route 1A at Arbor Street/Friend Court	-	2016-03-19	10:47 PM	Dry	Clear	Dark - lighted roadway		Single vehicle crash	Property damage o -			V1: Turning right
66	Route 1A at Cherry Street	-	2016-04-25	7:56 AM	Dry	Clear	Daylight	cyc	Angle	Property damage o -			V1: Turning left
67	Route 1A at Arbor Street/Friend Court	-	2016-06-28	5:37 PM	Dry	Clear	Daylight		Rear-end	Property damage o -			V1: Slowing or stopped
68	Route 1A at Monument Street	-	2016-07-19	9:12 AM	Dry	Clear	Daylight		Rear-end	Property damage o -			V1: Slowing or stopped
69	Route 1A at Cherry Street	-	2016-08-29	5:52 PM	Dry	Clear	Daylight		Angle	Property damage o -			V1: Turning left
70	Route 1A at Cherry Street	-	2016-08-31	1:29 PM	Dry	Clear	Daylight		Rear-end	Property damage o -			V1: Travelling straight ahead
71	Route 1A at Monument Street	-	2016-10-07	7:00 PM	Dry	Clear	Dark - lighted roadway		Angle	Non-fatal injury -			V1: Turning left
72	Route 1A at Arbor Street/Friend Court	-	2016-10-11	10:12 AM	Dry	Clear	Daylight		Angle	Property damage o -			V1: Travelling straight ahead
73	Route 1A at Monument Street	-	2016-11-05	11:43 AM	Dry	Clear	Daylight		Rear-end	Property damage o -			V1: Travelling straight ahead
74	Route 1A at Monument Street	-	2016-11-14	4:11 PM	Dry	Clear	Daylight		Angle	Non-fatal injury -			V1: Turning left
75	Route 1A at Monument Street	-	2016-12-30	4:35 PM	Dry	Clear	Dark - lighted roadway		Sideswipe, opposite direc	Property damage o -			V1: Making U-turn
76	Route 1A at Monument Street	-	2017-01-06	12:16 PM	Wet	Clear	Daylight		Angle	Property damage o -			V1: Travelling straight ahead
77	Route 1A at Cherry Street	-	2017-01-09	11:19 AM	Dry	Clear	Daylight		Angle	Property damage o -			V1: Turning right
78	Route 1A at Cherry Street	-	2017-01-10	7:48 AM	Sand, mud, dirt, oil, g	Clear	Daylight		Single vehicle crash	Property damage o -			V1: Travelling straight ahead
79	Route 1A at Arbor Street/Friend Court	-	2017-01-26	12:57 PM	Wet	Cloudy	Daylight		Rear-end	Property damage o -			V1: Slowing or stopped
80	Route 1A at Monument Street	-	2017-04-21	1:45 PM	Wet	Rain	Daylight		Sideswipe, opposite direc	Property damage o -			V1: Travelling straight ahead
81	Route 1A at Arbor Street/Friend Court	-	2017-04-21	3:25 PM	Wet	Rain	Daylight		Rear-end	Property damage o -			V1: Slowing or stopped
82	Route 1A at Cherry Street	-	2017-05-04	10:38 AM	Dry	Clear	Daylight		Single vehicle crash	Unknown -			V1: Travelling straight ahead
83	Route 1A at Arbor Street/Friend Court	-	2017-06-03	9:20 AM	Dry	Clear	Daylight		Sideswipe, same directio	Property damage o -			V1: Travelling straight ahead
84	Route 1A at Cherry Street	-	2017-06-28	9:10 AM	Dry	Clear	Daylight		Sideswipe, opposite direc	Property damage o -			V1: Entering traffic lane
85	Route 1A at Monument Street	-	2017-07-19	9:02 AM	Dry	Clear	Daylight		Rear-end	Property damage o -			V1: Turning right
86	Route 1A at Cherry Street	-	2017-08-11	12:22 PM	Dry	Clear	Daylight		Angle	Property damage o -			V1: Travelling straight ahead
87	Route 1A at Cherry Street	-	2017-08-19	7:48 AM	Wet	Cloudy	Daylight		Single vehicle crash	Unknown -			V1: Travelling straight ahead
88	Route 1A at Cherry Street	-	2017-09-02	2:30 PM	Dry	Clear	Daylight		Single vehicle crash	Property damage o -			V1: Turning right
89	Route 1A at Arbor Street/Friend Court	-	2017-11-09	8:00 AM	Dry	Clear	Daylight		Angle	Property damage o -			V1: Travelling straight ahead
90	Route 1A at Arbor Street/Friend Court	-	2017-11-21	11:45 AM	Dry	Clear	Daylight		Sideswipe, same directio	Non-fatal injury -			V1: Turning left
91	Route 1A at Monument Street	-	2017-12-05	9:45 AM	Dry	Cloudy	Daylight		Rear-end	Property damage o -			V1: Turning left
92	Route 1A at Cherry Street	-	2017-12-15	9:45 AM	Dry	Clear	Daylight		Angle	Property damage o -			V1: Entering traffic lane

**Table C-1**  
**Crash Statistics: Route 1A at Arbor Street/Friend Court**  
**Wenham Police Department Crash Data 2011-2017**

<b>Statistics Period</b>	<b>2011</b>	<b>2012</b>	<b>2013</b>	<b>2014</b>	<b>2015</b>	<b>2016</b>	<b>2017</b>	<b>Total</b>	<b>Annual Avg.</b>
<b>Total number of crashes</b>	3	4	3	8	0	4	5	27	3.9
<b>Severity</b>									
Property damage only	0	0	0	0	0	0	0	0	0.0
Non-fatal injury	1	1	3	0	0	0	1	6	0.9
Fatality	0	0	0	0	0	0	0	0	0.0
Not reported/unknown	0	0	0	0	0	0	0	0	0.0
<b>Collision type</b>									
Single vehicle	0	0	0	1	0	1	0	2	0.3
Rear-end	1	3	1	2	0	1	2	10	1.4
Angle	1	0	1	3	0	2	1	8	1.1
Sideswipe, same direction	1	1	0	1	0	0	2	5	0.7
Sideswipe, opposite direction	0	0	0	0	0	0	0	0	0.0
Head-on	0	0	1	0	0	0	0	1	0.1
Rear-to-rear	0	0	0	0	0	0	0	0	0.0
Not reported/unknown	0	0	0	1	0	0	0	1	0.1
<b>Involved pedestrian(s)</b>	0	0	0	0	0	0	0	0	0.0
<b>Involved cyclist(s)</b>	0	0	0	0	0	0	0	0	0.0
<b>Occurred during weekday peak periods *</b>	0	1	1	3	0	3	1	9	1.3
<b>Wet or icy pavement conditions</b>	0	1	2	2	0	0	2	7	1.0
<b>Dark conditions (lit or unlit)</b>	1	0	0	1	0	1	0	3	0.4

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

**Table C-2**  
**Crash Statistics: Route 1A at Monument Street**  
**Wenham Police Department Crash Data 2011-2017**

<b>Statistics Period</b>	<b>2011</b>	<b>2012</b>	<b>2013</b>	<b>2014</b>	<b>2015</b>	<b>2016</b>	<b>2017</b>	<b>Total</b>	<b>Annual Avg.</b>
<b>Total number of crashes</b>	3	3	2	4	8	6	4	30	4.3
<b>Severity</b>									
Property damage only	0	0	0	0	0	0	0	0	0.0
Non-fatal injury	1	1	0	1	1	2	0	6	0.9
Fatality	0	0	0	0	0	0	0	0	0.0
Not reported/unknown	0	0	0	0	0	0	0	0	0.0
<b>Collision type</b>									
Single vehicle	1	0	0	2	0	0	0	3	0.4
Rear-end	0	1	0	1	2	3	2	9	1.3
Angle	2	2	2	1	3	2	1	13	1.9
Sideswipe, same direction	0	0	0	0	0	0	0	0	0.0
Sideswipe, opposite direction	0	0	0	0	3	1	1	5	0.7
Head-on	0	0	0	0	0	0	0	0	0.0
Rear-to-rear	0	0	0	0	0	0	0	0	0.0
Not reported/unknown	0	0	0	0	0	0	0	0	0.0
<b>Involved pedestrian(s)</b>	0	0	0	0	0	0	0	0	0.0
<b>Involved cyclist(s)</b>	0	0	0	1	0	0	0	1	0.1
<b>Occurred during weekday peak periods *</b>	1	2	2	3	3	3	2	16	2.3
<b>Wet or icy pavement conditions</b>	0	3	0	2	2	1	2	10	1.4
<b>Dark conditions (lit or unlit)</b>	1	0	0	0	1	2	0	4	0.6

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

**Table C-3**  
**Crash Statistics: Route 1A at Cherry Street**  
**Wenham Police Department Crash Data 2011-2017**

<b>Statistics Period</b>	<b>2011</b>	<b>2012</b>	<b>2013</b>	<b>2014</b>	<b>2015</b>	<b>2016</b>	<b>2017</b>	<b>Total</b>	<b>Annual Avg.</b>
<b>Total number of crashes</b>	12	1	3	4	3	4	8	35	5.0
<b>Severity</b>									
Property damage only	0	0	0	0	0	0	0	0	0.0
Non-fatal injury	3	0	1	1	0	0	0	5	0.7
Fatality	0	0	0	0	0	0	0	0	0.0
Not reported/unknown	0	0	0	0	0	0	2	2	0.3
<b>Collision type</b>									
Single vehicle	1	0	0	0	0	0	4	5	0.7
Rear-end	5	0	1	1	1	1	0	9	1.3
Angle	5	1	1	3	2	3	3	18	2.6
Sideswipe, same direction	0	0	1	0	0	0	0	1	0.1
Sideswipe, opposite direction	1	0	0	0	0	0	1	2	0.3
Head-on	0	0	0	0	0	0	0	0	0.0
Rear-to-rear	0	0	0	0	0	0	0	0	0.0
Not reported/unknown	0	0	0	0	0	0	0	0	0.0
<b>Involved pedestrian(s)</b>	0	0	0	0	0	0	0	0	0.0
<b>Involved cyclist(s)</b>	0	0	0	0	0	1	0	1	0.1
<b>Occurred during weekday peak periods *</b>	5	0	2	2	3	3	3	18	2.6
<b>Wet or icy pavement conditions</b>	6	0	0	0	1	0	2	9	1.3
<b>Dark conditions (lit or unlit)</b>	2	0	1	0	1	0	0	4	0.6

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



**Table C-4**  
**Crash Statistics: Corridor Totals**  
**Wenham Police Department Crash Data 2011-2017**

<b>Statistics Period</b>	<b>2011</b>	<b>2012</b>	<b>2013</b>	<b>2014</b>	<b>2015</b>	<b>2016</b>	<b>2017</b>	<b>Total</b>	<b>Annual Avg.</b>
<b>Total number of crashes</b>	18	8	8	16	11	14	17	92	13.1
<b>Severity</b>									
Property damage only	0	0	0	0	0	0	0	0	0.0
Non-fatal injury	5	2	4	2	1	2	1	17	2.4
Fatality	0	0	0	0	0	0	0	0	0.0
Not reported/unknown	0	0	0	0	0	0	2	2	0.3
<b>Collision type</b>									
Single vehicle	2	0	0	3	0	1	4	10	1.4
Rear-end	6	4	2	4	3	5	4	28	4.0
Angle	8	3	4	7	5	7	5	39	5.6
Sideswipe, same direction	1	1	1	1	0	0	2	6	0.9
Sideswipe, opposite direction	1	0	0	0	3	1	2	7	1.0
Head-on	0	0	1	0	0	0	0	1	0.1
Rear-to-rear	0	0	0	0	0	0	0	0	0.0
Not reported/unknown	0	0	0	1	0	0	0	1	0.1
<b>Involved pedestrian(s)</b>	0	0	0	0	0	0	0	0	0.0
<b>Involved cyclist(s)</b>	0	0	0	1	0	1	0	2	0.3
<b>Occurred during weekday peak periods *</b>	6	3	5	8	6	9	6	43	6.1
<b>Wet or icy pavement conditions</b>	6	4	2	4	3	1	6	26	3.7
<b>Dark conditions (lit or unlit)</b>	4	0	1	1	2	3	0	11	1.6

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

## INTERSECTION CRASH RATE WORKSHEET

CITY/TOWN : Wenham COUNT DATE : 11/29/2017

DISTRICT : 4 UNSIGNALIZED :  SIGNALIZED :

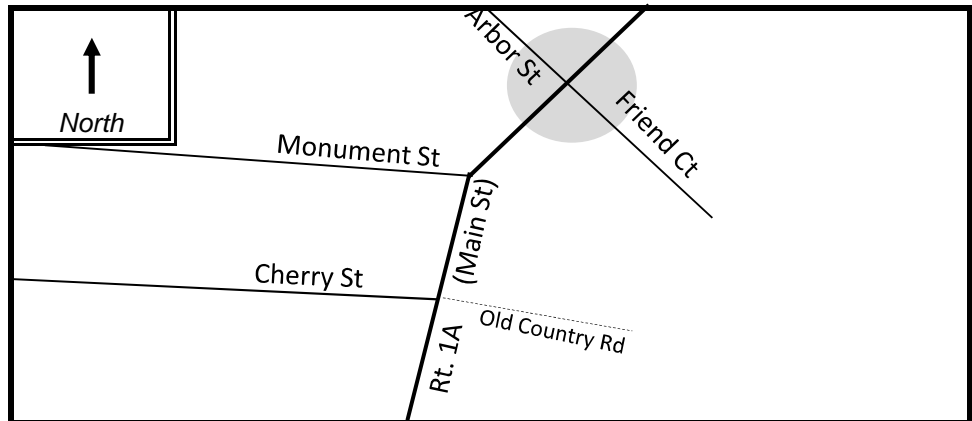
~ INTERSECTION DATA ~

MAJOR STREET : Route 1A (Main Street)

MINOR STREET(S) : Arbor Street

Friend Court

**INTERSECTION  
 DIAGRAM**  
 (Label Approaches)



**PEAK HOUR VOLUMES**

APPROACH :	1	2	3	4	5	<b>Total Peak Hourly Approach Volume</b>
DIRECTION :	NB	SB	EB	WB		
PEAK HOURLY VOLUMES (AM/PM) :	904	618	324	328		<b>2,174</b>

" K " FACTOR :  INTERSECTION ADT ( V ) = TOTAL DAILY APPROACH VOLUME :

TOTAL # OF CRASHES :  # OF YEARS :  AVERAGE # OF CRASHES PER YEAR ( A ) :

**CRASH RATE CALCULATION :**

**0.44**

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

Comments : 2016 District 4 average for unsignalized intersections = 0.57

Project Title & Date: Safety and Operations Analysis at Selected Intersections in Wenham

## INTERSECTION CRASH RATE WORKSHEET

CITY/TOWN : Wenham COUNT DATE : 11/29/2017

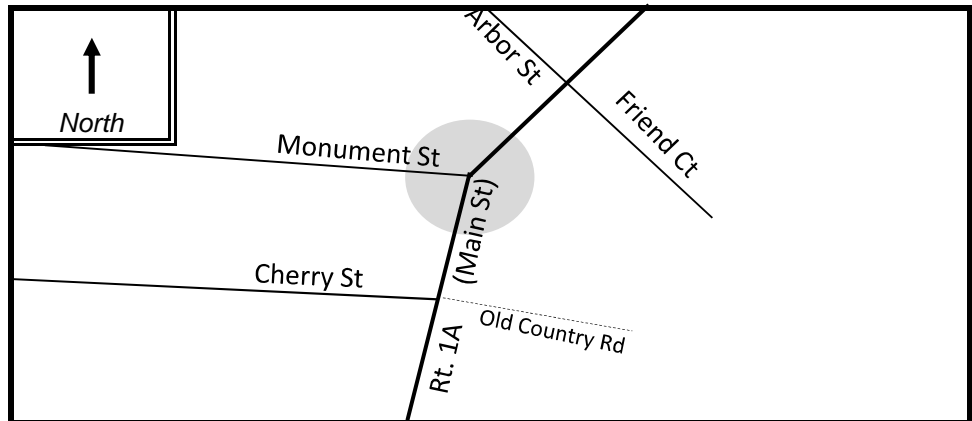
DISTRICT : 4 UNSIGNALIZED :  SIGNALIZED :

~ INTERSECTION DATA ~

MAJOR STREET : Route 1A (Main Street)

MINOR STREET(S) : Monument Street

**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) :	743	904	168			1,815

" K " FACTOR :  INTERSECTION ADT ( V ) = TOTAL DAILY APPROACH VOLUME :

TOTAL # OF CRASHES :  # OF YEARS :  AVERAGE # OF CRASHES PER YEAR ( A ) :

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

Comments : 2016 District 4 average for unsignalized intersections = 0.57

Project Title & Date: Safety and Operations Analysis at Selected Intersections in Wenham

## INTERSECTION CRASH RATE WORKSHEET

CITY/TOWN : Wenham COUNT DATE : 11/29/2017

DISTRICT : 4 UNSIGNALIZED :  SIGNALIZED :

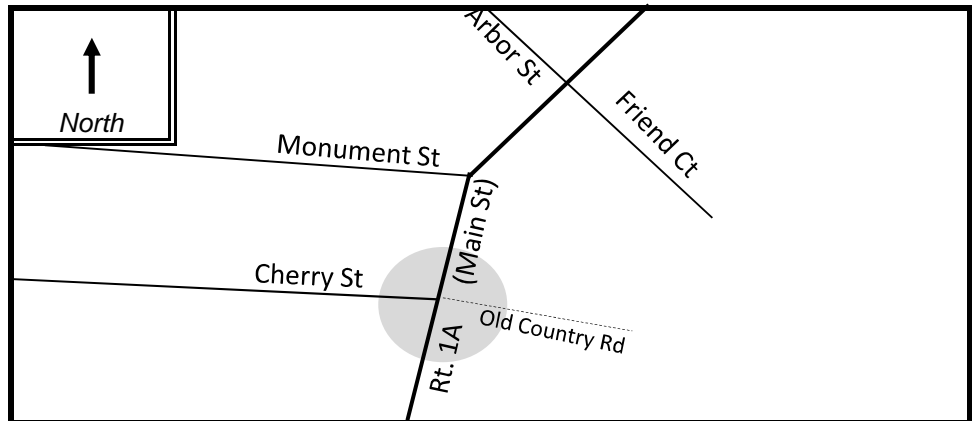
~ INTERSECTION DATA ~

MAJOR STREET : Route 1A (Main Street)

MINOR STREET(S) : Cherry Street

Old Country Road

**INTERSECTION  
 DIAGRAM**  
 (Label Approaches)



**PEAK HOUR VOLUMES**

APPROACH :	1	2	3	4	5	<b>Total Peak Hourly Approach Volume</b>
DIRECTION :	NB	SB	EB			
PEAK HOURLY VOLUMES (AM/PM) :	744	710	257			<b>1,711</b>

" K " FACTOR :  INTERSECTION ADT ( V ) = TOTAL DAILY APPROACH VOLUME :

TOTAL # OF CRASHES :  # OF YEARS :  AVERAGE # OF CRASHES PER YEAR ( A ) :

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

Comments : 2016 District 4 average for unsignalized intersections = 0.57

Project Title & Date: Safety and Operations Analysis at Selected Intersections in Wenham



## SEGMENT CRASH RATE WORKSHEET

CITY/TOWN : Wenham COUNT DATE : 11/29/2017

DISTRICT : 4

~ SEGMENT DATA ~

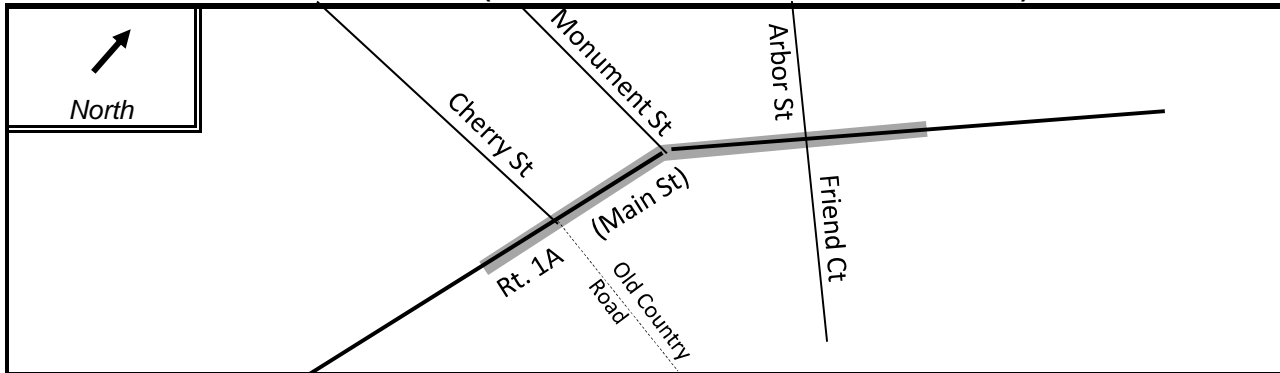
ROADWAY NAME: Route 1A (Main Street)

START POINT: North of Arbor Street

END POINT: South of Cherry Street

FUNCTIONAL CLASSIFICATION OF ROADWAY: Principal Arterial - Other

ROADWAY DIAGRAM (LABEL ROADWAY AND CROSS STREETS)



AVERAGE DAILY TRAFFIC

SEGMENT LENGTH IN MILES ( L ): **0.22**

AVERAGE DAILY TRAFFIC VOLUME ( V ): 17,500

TOTAL # OF CRASHES: **92**

# OF YEARS : **7**

AVERAGE # OF CRASHES PER YEAR ( A ): **13.14**

CRASH RATE CALCULATION : **9.45**

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

Comments : 2016 State Average for Urban Principal Arterial - Other = 3.49

Project Title & Date: Safety and Operations Analysis at Selected Intersections in Wenham

**APPENDIX D:  
INTERSECTION LEVELS OF SERVICE**

Lanes, Volumes, Timings  
 1: Main St (1A) & Arbor St/Friend Ct

07/23/2018



Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	16	1	346	3	3	6	287	555	6	5	578	27
Future Volume (vph)	16	1	346	3	3	6	287	555	6	5	578	27
Ideal Flow (vphp)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Storage Length (ft)	0		50	0		0	30		0	15		0
Storage Lanes	0		1	0		0	0		0	0		0
Taper Length (ft)	0			0			25			25		
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Ped Bike Factor												
Frt			0.850		0.932			0.999			0.992	
Flt Protected		0.959			0.992			0.983			0.999	
Satd. Flow (prot)	0	1639	1583	0	1757	0	0	1801	0	0	1820	0
Flt Permitted		0.959			0.992			0.983			0.999	
Satd. Flow (perm)	0	1639	1583	0	1757	0	0	1801	0	0	1820	0
Link Speed (mph)		30			30			30			30	
Link Distance (ft)		2388			2408			313			2230	
Travel Time (s)		54.3			54.7			7.1			50.7	
Confl. Peds. (#/hr)							1		1	1		1
Peak Hour Factor	0.67	0.25	0.84	0.75	0.38	0.50	0.84	0.90	0.75	0.31	0.91	0.68
Heavy Vehicles (%)	13%	0%	2%	0%	0%	0%	3%	4%	0%	20%	3%	4%
Adj. Flow (vph)	24	4	412	4	8	12	342	617	8	16	635	40
Shared Lane Traffic (%)												
Lane Group Flow (vph)	0	28	412	0	24	0	0	967	0	0	691	0
Enter Blocked Intersection	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Lane Alignment	Left	Left	Right	Left	Left	Right	Left	Left	Right	Left	Left	Right
Median Width(ft)		0			0			0			0	
Link Offset(ft)		-10			0			-4			0	
Crosswalk Width(ft)		16			16			16			16	
Two way Left Turn Lane												
Headway Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Sign Control		Stop			Stop			Free			Free	



















Intersection Summary

Area Type:	Other
Control Type:	Unsignalized
Intersection Capacity Utilization	91.1%
ICU Level of Service	F
Analysis Period (min)	15

# HCM Unsignalized Intersection Capacity Analysis

## 1: Main St (1A) & Arbor St/Friend Ct

07/23/2018

												
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	16	1	346	3	3	6	287	555	6	5	578	27
Future Volume (Veh/h)	16	1	346	3	3	6	287	555	6	5	578	27
Sign Control		Stop			Stop			Free			Free	
Grade		0%			0%			0%			0%	
Peak Hour Factor	0.67	0.25	0.84	0.75	0.38	0.50	0.84	0.90	0.75	0.31	0.91	0.68
Hourly flow rate (vph)	24	4	412	4	8	12	342	617	8	16	635	40
Pedestrians		1			1							
Lane Width (ft)		12.0			12.0							
Walking Speed (ft/s)		3.5			3.5							
Percent Blockage		0			0							
Right turn flare (veh)			2									
Median type								None			None	
Median storage (veh)												
Upstream signal (ft)												
pX, platoon unblocked												
vC, conflicting volume	2009	1998	656	2201	2014	622	676			626		
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	2009	1998	656	2201	2014	622	676			626		
tC, single (s)	7.2	6.5	6.2	7.1	6.5	6.2	4.1			4.3		
tC, 2 stage (s)												
tF (s)	3.6	4.0	3.3	3.5	4.0	3.3	2.2			2.4		
p0 queue free %	0	89	11	0	78	98	62			98		
cM capacity (veh/h)	23	37	465	2	36	490	910			874		
<b>Direction, Lane #</b>	<b>EB 1</b>	<b>WB 1</b>	<b>NB 1</b>	<b>SB 1</b>								
Volume Total	440	24	967	691								
Volume Left	24	4	342	16								
Volume Right	412	12	8	40								
cSH	309	12	910	874								
Volume to Capacity	1.43	1.92	0.38	0.02								
Queue Length 95th (ft)	586	95	44	1								
Control Delay (s)	241.3	1042.1	8.4	0.5								
Lane LOS	F	F	A	A								
Approach Delay (s)	241.3	1042.1	8.4	0.5								
Approach LOS	F	F										
<b>Intersection Summary</b>												
Average Delay			65.8									
Intersection Capacity Utilization			91.1%		ICU Level of Service				F			
Analysis Period (min)			15									



HCM 2010 TWSC  
 1: Main St (1A) & Arbor St/Friend Ct

07/23/2018

Intersection												
Int Delay, s/veh	37											
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		↔	↔		↔			↔			↔	
Traffic Vol, veh/h	16	1	346	3	3	6	287	555	6	5	578	27
Future Vol, veh/h	16	1	346	3	3	6	287	555	6	5	578	27
Conflicting Peds, #/hr	0	0	0	0	0	0	1	0	1	1	0	1
Sign Control	Stop	Stop	Stop	Stop	Stop	Stop	Free	Free	Free	Free	Free	Free
RT Channelized	-	-	None	-	-	None	-	-	None	-	-	None
Storage Length	-	-	50	-	-	-	-	-	-	-	-	-
Veh in Median Storage, #	-	0	-	-	0	-	-	0	-	-	0	-
Grade, %	-	0	-	-	0	-	-	0	-	-	0	-
Peak Hour Factor	67	25	84	75	38	50	84	90	75	31	91	68
Heavy Vehicles, %	13	0	2	0	0	0	3	4	0	20	3	4
Mvmt Flow	24	4	412	4	8	12	342	617	8	16	635	40

Major/Minor	Minor2		Minor1		Major1		Major2					
Conflicting Flow All	2002	1997	656	1994	2013	622	676	0	0	626	0	0
Stage 1	688	688	-	1305	1305	-	-	-	-	-	-	-
Stage 2	1314	1309	-	689	708	-	-	-	-	-	-	-
Critical Hdwy	7.23	6.5	6.22	7.1	6.5	6.2	4.13	-	-	4.3	-	-
Critical Hdwy Stg 1	6.23	5.5	-	6.1	5.5	-	-	-	-	-	-	-
Critical Hdwy Stg 2	6.23	5.5	-	6.1	5.5	-	-	-	-	-	-	-
Follow-up Hdwy	3.617	4	3.318	3.5	4	3.3	2.227	-	-	2.38	-	-
Pot Cap-1 Maneuver	41	61	465	46	59	490	911	-	-	875	-	-
Stage 1	419	450	-	199	232	-	-	-	-	-	-	-
Stage 2	184	231	-	439	441	-	-	-	-	-	-	-
Platoon blocked, %								-	-	-	-	-
Mov Cap-1 Maneuver	~ 16	25	465	~ 2	24	490	911	-	-	875	-	-
Mov Cap-2 Maneuver	~ 16	25	-	~ 2	24	-	-	-	-	-	-	-
Stage 1	177	437	-	84	98	-	-	-	-	-	-	-
Stage 2	70	98	-	48	428	-	-	-	-	-	-	-

Approach	EB	WB	NB	SB
HCM Control Delay, s	94.8	\$ 1373.9	4	0.2
HCM LOS	F	F		

Minor Lane/Major Mvmt	NBL	NBT	NBR	EBLn1	EBLn2	WBLn1	SBL	SBT	SBR
Capacity (veh/h)	911	-	-	17	465	10	875	-	-
HCM Lane V/C Ratio	0.375	-	-	1.64	0.886	2.389	0.018	-	-
HCM Control Delay (s)	11.3	0	-	\$ 781.5	48	\$ 1373.9	9.2	0	-
HCM Lane LOS	B	A	-	F	E	F	A	A	-
HCM 95th %tile Q(veh)	1.8	-	-	4	9.5	4	0.1	-	-

Notes  
 -: Volume exceeds capacity    \$: Delay exceeds 300s    +: Computation Not Defined    \*: All major volume in platoon

## Lanes, Volumes, Timings

### 2: Main St (1A) & Monument St/Wenham Town Hall

07/23/2018



Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		↕	↗					↕			↕	
Traffic Volume (vph)	174	0	3	0	0	0	5	667	0	1	752	185
Future Volume (vph)	174	0	3	0	0	0	5	667	0	1	752	185
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Storage Length (ft)	0		15	0		0	15		0	0		0
Storage Lanes	0		1	0		0	0		0	0		0
Taper Length (ft)	0			0			25			0		
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Ped Bike Factor												
Frt			0.850								0.971	
Flt Protected		0.950						0.999				
Satd. Flow (prot)	0	1703	1615	0	0	0	0	1840	0	0	1805	0
Flt Permitted		0.950						0.999				
Satd. Flow (perm)	0	1703	1615	0	0	0	0	1840	0	0	1805	0
Link Speed (mph)		30			30			30			30	
Link Distance (ft)		2613			509			460			313	
Travel Time (s)		59.4			11.6			10.5			7.1	
Confl. Peds. (#/hr)							5					5
Peak Hour Factor	0.81	0.92	0.38	0.25	0.25	0.25	0.63	0.87	0.92	0.25	0.95	0.86
Heavy Vehicles (%)	6%	2%	0%	0%	0%	0%	20%	3%	0%	0%	2%	3%
Adj. Flow (vph)	215	0	8	0	0	0	8	767	0	4	792	215
Shared Lane Traffic (%)												
Lane Group Flow (vph)	0	215	8	0	0	0	0	775	0	0	1011	0
Enter Blocked Intersection	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Lane Alignment	Left	Left	Right	Left	Left	Right	Left	Left	Right	Left	Left	Right
Median Width(ft)		0			0			0			0	
Link Offset(ft)		0			30			0			0	
Crosswalk Width(ft)		16			16			16			16	
Two way Left Turn Lane												
Headway Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Turning Speed (mph)	25		9	15		9	15		9	15		9
Sign Control		Stop			Stop			Free			Free	

#### Intersection Summary

Area Type:	Other
Control Type:	Unsignalized
Intersection Capacity Utilization	67.9%
Analysis Period (min)	15
	ICU Level of Service C

# HCM Unsignalized Intersection Capacity Analysis

## 2: Main St (1A) & Monument St/Wenham Town Hall

07/23/2018



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		↕	↗					↕			↕	
Traffic Volume (veh/h)	174	0	3	0	0	0	5	667	0	1	752	185
Future Volume (Veh/h)	174	0	3	0	0	0	5	667	0	1	752	185
Sign Control		Stop			Stop			Free			Free	
Grade		0%			0%			0%			0%	
Peak Hour Factor	0.81	0.92	0.38	0.25	0.25	0.25	0.63	0.87	0.92	0.25	0.95	0.86
Hourly flow rate (vph)	215	0	8	0	0	0	8	767	0	4	792	215
Pedestrians		5										
Lane Width (ft)		12.0										
Walking Speed (ft/s)		3.5										
Percent Blockage		0										
Right turn flare (veh)			1									
Median type								None			None	
Median storage (veh)												
Upstream signal (ft)												
pX, platoon unblocked												
vC, conflicting volume	1696	1696	904	1694	1803	767	1012			767		
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	1696	1696	904	1694	1803	767	1012			767		
tC, single (s)	*6.0	6.5	*6.5	7.1	6.5	6.2	4.3			4.1		
tC, 2 stage (s)												
tF (s)	3.6	4.0	3.3	3.5	4.0	3.3	2.4			2.2		
p0 queue free %	0	100	97	100	100	100	99			100		
cM capacity (veh/h)	121	91	312	71	79	405	616			856		
<b>Direction, Lane #</b>	<b>EB 1</b>	<b>NB 1</b>	<b>SB 1</b>									
Volume Total	223	775	1011									
Volume Left	215	8	4									
Volume Right	8	0	215									
cSH	124	616	856									
Volume to Capacity	1.80	0.01	0.00									
Queue Length 95th (ft)	431	1	0									
Control Delay (s)	451.4	0.4	0.1									
Lane LOS	F	A	A									
Approach Delay (s)	451.4	0.4	0.1									
Approach LOS	F											
<b>Intersection Summary</b>												
Average Delay			50.3									
Intersection Capacity Utilization			67.9%			ICU Level of Service				C		
Analysis Period (min)			15									

\* User Entered Value

Intersection												
Int Delay, s/veh	70.8											
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		↕	↗					↕			↕	
Traffic Vol, veh/h	174	0	3	0	0	0	5	667	0	1	752	185
Future Vol, veh/h	174	0	3	0	0	0	5	667	0	1	752	185
Conflicting Peds, #/hr	0	0	0	0	0	0	5	0	0	0	0	5
Sign Control	Stop	Stop	Stop	Stop	Stop	Stop	Free	Free	Free	Free	Free	Free
RT Channelized	-	-	None	-	-	None	-	-	None	-	-	None
Storage Length	-	-	15	-	-	-	-	-	-	-	-	-
Veh in Median Storage, #	-	0	-	-	-	-	-	0	-	-	0	-
Grade, %	-	0	-	-	0	-	-	0	-	-	0	-
Peak Hour Factor	81	92	38	25	25	25	63	87	92	25	95	86
Heavy Vehicles, %	6	2	0	0	0	0	20	3	0	0	2	3
Mvmt Flow	215	0	8	0	0	0	8	767	0	4	792	215

Major/Minor	Minor2			Major1			Major2					
Conflicting Flow All	1695	1695	904				1012	0	0	767	0	0
Stage 1	912	912	-				-	-	-	-	-	-
Stage 2	783	783	-				-	-	-	-	-	-
Critical Hdwy	6.46	6.52	6.2				4.3	-	-	4.1	-	-
Critical Hdwy Stg 1	5.46	5.52	-				-	-	-	-	-	-
Critical Hdwy Stg 2	5.46	5.52	-				-	-	-	-	-	-
Follow-up Hdwy	3.554	4.018	3.3				2.38	-	-	2.2	-	-
Pot Cap-1 Maneuver	~ 100	93	338				619	-	-	856	-	-
Stage 1	385	353	-				-	-	-	-	-	-
Stage 2	444	404	-				-	-	-	-	-	-
Platoon blocked, %								-	-		-	-
Mov Cap-1 Maneuver	~ 96	0	336				619	-	-	856	-	-
Mov Cap-2 Maneuver	~ 96	0	-				-	-	-	-	-	-
Stage 1	379	0	-				-	-	-	-	-	-
Stage 2	432	0	-				-	-	-	-	-	-

Approach	EB	NB	SB
HCM Control Delay, s\$	637.7	0.1	0
HCM LOS	F		

Minor Lane/Major Mvmt	NBL	NBT	NBR	EBLn1	EBLn2	SBL	SBT	SBR
Capacity (veh/h)	619	-	-	96	336	856	-	-
HCM Lane V/C Ratio	0.013	-	-	2.238	0.023	0.005	-	-
HCM Control Delay (s)	10.9	0	-	\$ 660.5	16	9.2	0	-
HCM Lane LOS	B	A	-	F	C	A	A	-
HCM 95th %tile Q(veh)	0	-	-	19.1	0.1	0	-	-

Notes  
 -: Volume exceeds capacity    \$: Delay exceeds 300s    +: Computation Not Defined    \*: All major volume in platoon



Lanes, Volumes, Timings  
 3: Main St (1A) & Cherry St/Old Country Rd

07/23/2018



Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		↖	↗					↕			↕	
Traffic Volume (vph)	129	1	154	0	0	0	87	544	2	2	642	108
Future Volume (vph)	129	1	154	0	0	0	87	544	2	2	642	108
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Storage Length (ft)	0		15	0		0	15		0	0		0
Storage Lanes	0		1	0		0	0		0	0		0
Taper Length (ft)	0			0			25			0		
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Frt			0.850					0.999			0.977	
Flt Protected		0.954						0.993				
Satd. Flow (prot)	0	1778	1538	0	0	0	0	1815	0	0	1805	0
Flt Permitted		0.954						0.993				
Satd. Flow (perm)	0	1778	1538	0	0	0	0	1815	0	0	1805	0
Link Speed (mph)		30			30			30			30	
Link Distance (ft)		2702			575			3735			460	
Travel Time (s)		61.4			13.1			84.9			10.5	
Peak Hour Factor	0.95	0.25	0.88	0.92	0.25	0.25	0.84	0.83	0.50	0.50	0.93	0.75
Heavy Vehicles (%)	2%	0%	5%	2%	0%	0%	3%	4%	0%	0%	3%	2%
Adj. Flow (vph)	136	4	175	0	0	0	104	655	4	4	690	144
Shared Lane Traffic (%)												
Lane Group Flow (vph)	0	140	175	0	0	0	0	763	0	0	838	0
Enter Blocked Intersection	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Lane Alignment	Left	Left	Right	Left	Left	Right	Left	Left	Right	Left	Left	Right
Median Width(ft)		0			0			0			0	
Link Offset(ft)		0			16			0			0	
Crosswalk Width(ft)		16			16			16			16	
Two way Left Turn Lane												
Headway Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Sign Control		Stop			Stop			Free			Free	

Intersection Summary

Area Type:	Other
Control Type:	Unsignalized
Intersection Capacity Utilization	91.2%
ICU Level of Service	F
Analysis Period (min)	15

# HCM Unsignalized Intersection Capacity Analysis

## 3: Main St (1A) & Cherry St/Old Country Rd

07/23/2018



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		↖	↗					↕			↕	
Traffic Volume (veh/h)	129	1	154	0	0	0	87	544	2	2	642	108
Future Volume (Veh/h)	129	1	154	0	0	0	87	544	2	2	642	108
Sign Control		Stop			Stop			Free			Free	
Grade		0%			0%			0%			0%	
Peak Hour Factor	0.95	0.25	0.88	0.92	0.25	0.25	0.84	0.83	0.50	0.50	0.93	0.75
Hourly flow rate (vph)	136	4	175	0	0	0	104	655	4	4	690	144
Pedestrians												
Lane Width (ft)												
Walking Speed (ft/s)												
Percent Blockage												
Right turn flare (veh)			1									
Median type								None			None	
Median storage (veh)												
Upstream signal (ft)												
pX, platoon unblocked												
vC, conflicting volume	1635	1637	762	1724	1707	657	834			659		
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	1635	1637	762	1724	1707	657	834			659		
tC, single (s)	*6.5	*6.2	*6.0	7.1	6.5	6.2	4.1			4.1		
tC, 2 stage (s)												
tF (s)	3.5	4.0	3.3	3.5	4.0	3.3	2.2			2.2		
p0 queue free %	0	96	59	100	100	100	87			100		
cM capacity (veh/h)	96	101	422	36	80	468	795			939		

Direction, Lane #	EB 1	NB 1	SB 1
Volume Total	315	763	838
Volume Left	136	104	4
Volume Right	175	4	144
cSH	172	795	939
Volume to Capacity	1.83	0.13	0.00
Queue Length 95th (ft)	576	11	0
Control Delay (s)	442.6	3.3	0.1
Lane LOS	F	A	A
Approach Delay (s)	442.6	3.3	0.1
Approach LOS	F		

Intersection Summary		
Average Delay		74.1
Intersection Capacity Utilization	91.2%	ICU Level of Service
Analysis Period (min)		15

\* User Entered Value

**Intersection**

Int Delay, s/veh 31.9

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		↕	↕					↕			↕	
Traffic Vol, veh/h	129	1	154	0	0	0	87	544	2	2	642	108
Future Vol, veh/h	129	1	154	0	0	0	87	544	2	2	642	108
Conflicting Peds, #/hr	0	0	0	0	0	0	0	0	0	0	0	0
Sign Control	Stop	Stop	Stop	Stop	Stop	Stop	Free	Free	Free	Free	Free	Free
RT Channelized	-	-	None	-	-	None	-	-	None	-	-	None
Storage Length	-	-	15	-	-	-	-	-	-	-	-	-
Veh in Median Storage, #	-	0	-	-	-	-	-	0	-	-	0	-
Grade, %	-	0	-	-	0	-	-	0	-	-	0	-
Peak Hour Factor	95	25	88	92	25	25	84	83	50	50	93	75
Heavy Vehicles, %	2	0	5	2	0	0	3	4	0	0	3	2
Mvmt Flow	136	4	175	0	0	0	104	655	4	4	690	144

Major/Minor	Minor2			Major1			Major2					
Conflicting Flow All	1635	1637	762				834	0	0	659	0	0
Stage 1	770	770	-				-	-	-	-	-	-
Stage 2	865	867	-				-	-	-	-	-	-
Critical Hdwy	6.42	6.5	6.25				4.13	-	-	4.1	-	-
Critical Hdwy Stg 1	5.42	5.5	-				-	-	-	-	-	-
Critical Hdwy Stg 2	5.42	5.5	-				-	-	-	-	-	-
Follow-up Hdwy	3.518	4	3.345				2.227	-	-	2.2	-	-
Pot Cap-1 Maneuver	~ 111	102	400				795	-	-	939	-	-
Stage 1	457	413	-				-	-	-	-	-	-
Stage 2	412	373	-				-	-	-	-	-	-
Platoon blocked, %								-	-		-	-
Mov Cap-1 Maneuver	~ 87	0	400				795	-	-	939	-	-
Mov Cap-2 Maneuver	~ 87	0	-				-	-	-	-	-	-
Stage 1	453	0	-				-	-	-	-	-	-
Stage 2	327	0	-				-	-	-	-	-	-

Approach	EB	NB	SB
HCM Control Delay, s	190.7	1.4	0
HCM LOS	F		

Minor Lane/Major Mvmt	NBL	NBT	NBR	EBLn1	EBLn2	SBL	SBT	SBR
Capacity (veh/h)	795	-	-	87	400	939	-	-
HCM Lane V/C Ratio	0.13	-	-	1.607	0.438	0.004	-	-
HCM Control Delay (s)	10.2	0	-	403.3	20.8	8.8	0	-
HCM Lane LOS	B	A	-	F	C	A	A	-
HCM 95th %tile Q(veh)	0.4	-	-	11.3	2.2	0	-	-

**Notes**

~: Volume exceeds capacity    \$: Delay exceeds 300s    +: Computation Not Defined    \*: All major volume in platoon

Lanes, Volumes, Timings  
 1: Main St (1A) & Arbor St/Friend Ct

07/23/2018



Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		↕	↗		↕			↕			↕	
Traffic Volume (vph)	18	0	267	7	0	13	297	652	11	5	596	25
Future Volume (vph)	18	0	267	7	0	13	297	652	11	5	596	25
Ideal Flow (vphp)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Storage Length (ft)	0		50	0		0	30		0	15		0
Storage Lanes	0		1	0		0	0		0	0		0
Taper Length (ft)	0			0			25			25		
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Ped Bike Factor												
Frt			0.850		0.905			0.998			0.994	
Flt Protected		0.950			0.985			0.985			0.999	
Satd. Flow (prot)	0	1805	1615	0	1694	0	0	1837	0	0	1869	0
Flt Permitted		0.950			0.985			0.985			0.999	
Satd. Flow (perm)	0	1805	1615	0	1694	0	0	1837	0	0	1869	0
Link Speed (mph)		30			30			30			30	
Link Distance (ft)		2388			2408			313			2230	
Travel Time (s)		54.3			54.7			7.1			50.7	
Confl. Peds. (#/hr)							1		2	2		1
Peak Hour Factor	0.56	0.92	0.88	0.58	0.92	0.46	0.88	0.89	0.69	0.63	0.93	0.78
Heavy Vehicles (%)	0%	0%	0%	0%	0%	0%	1%	2%	0%	0%	1%	0%
Adj. Flow (vph)	32	0	303	12	0	28	338	733	16	8	641	32
Shared Lane Traffic (%)												
Lane Group Flow (vph)	0	32	303	0	40	0	0	1087	0	0	681	0
Enter Blocked Intersection	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Lane Alignment	Left	Left	Right	Left	Left	Right	Left	Left	Right	Left	Left	Right
Median Width(ft)		0			0			0			0	
Link Offset(ft)		-10			0			-4			0	
Crosswalk Width(ft)		16			16			16			16	
Two way Left Turn Lane												
Headway Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Sign Control		Stop			Stop			Free			Free	

Intersection Summary



















Area Type:	Other
Control Type:	Unsignalized
Intersection Capacity Utilization	102.2%
ICU Level of Service	G
Analysis Period (min)	15



# HCM Unsignalized Intersection Capacity Analysis

## 1: Main St (1A) & Arbor St/Friend Ct

07/23/2018

												
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	18	0	267	7	0	13	297	652	11	5	596	25
Future Volume (Veh/h)	18	0	267	7	0	13	297	652	11	5	596	25
Sign Control		Stop			Stop			Free			Free	
Grade		0%			0%			0%			0%	
Peak Hour Factor	0.56	0.92	0.88	0.58	0.92	0.46	0.88	0.89	0.69	0.63	0.93	0.78
Hourly flow rate (vph)	32	0	303	12	0	28	338	733	16	8	641	32
Pedestrians		1			2							
Lane Width (ft)		12.0			12.0							
Walking Speed (ft/s)		3.5			3.5							
Percent Blockage		0			0							
Right turn flare (veh)			2									
Median type								None			None	
Median storage (veh)												
Upstream signal (ft)												
pX, platoon unblocked												
vC, conflicting volume	2119	2101	658	2244	2109	743	674			751		
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	2119	2101	658	2244	2109	743	674			751		
tC, single (s)	7.1	6.5	6.2	7.1	6.5	6.2	4.1			4.1		
tC, 2 stage (s)												
tF (s)	3.5	4.0	3.3	3.5	4.0	3.3	2.2			2.2		
p0 queue free %	0	100	35	0	100	93	63			99		
cM capacity (veh/h)	25	33	467	8	32	418	921			866		
Direction, Lane #	EB 1	WB 1	NB 1	SB 1								
Volume Total	335	40	1087	681								
Volume Left	32	12	338	8								
Volume Right	303	28	16	32								
cSH	200	24	921	866								
Volume to Capacity	1.67	1.66	0.37	0.01								
Queue Length 95th (ft)	561	125	42	1								
Control Delay (s)	365.8	668.6	8.5	0.2								
Lane LOS	F	F	A	A								
Approach Delay (s)	365.8	668.6	8.5	0.2								
Approach LOS	F	F										
Intersection Summary												
Average Delay			74.1									
Intersection Capacity Utilization			102.2%		ICU Level of Service	G						
Analysis Period (min)			15									

HCM 2010 TWSC  
 1: Main St (1A) & Arbor St/Friend Ct

07/23/2018

Intersection												
Int Delay, s/veh	32.3											
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		↕	↗		↕			↕			↕	
Traffic Vol, veh/h	18	0	267	7	0	13	297	652	11	5	596	25
Future Vol, veh/h	18	0	267	7	0	13	297	652	11	5	596	25
Conflicting Peds, #/hr	0	0	0	0	0	0	1	0	2	2	0	1
Sign Control	Stop	Stop	Stop	Stop	Stop	Stop	Free	Free	Free	Free	Free	Free
RT Channelized	-	-	None	-	-	None	-	-	None	-	-	None
Storage Length	-	-	50	-	-	-	-	-	-	-	-	-
Veh in Median Storage, #	-	0	-	-	0	-	-	0	-	-	0	-
Grade, %	-	0	-	-	0	-	-	0	-	-	0	-
Peak Hour Factor	56	92	88	58	92	46	88	89	69	63	93	78
Heavy Vehicles, %	0	0	0	0	0	0	1	2	0	0	1	0
Mvmt Flow	32	0	303	12	0	28	338	733	16	8	641	32

Major/Minor	Minor2		Minor1		Major1		Major2					
Conflicting Flow All	2104	2100	658	2091	2108	743	674	0	0	751	0	0
Stage 1	674	674	-	1418	1418	-	-	-	-	-	-	-
Stage 2	1430	1426	-	673	690	-	-	-	-	-	-	-
Critical Hdwy	7.1	6.5	6.2	7.1	6.5	6.2	4.11	-	-	4.1	-	-
Critical Hdwy Stg 1	6.1	5.5	-	6.1	5.5	-	-	-	-	-	-	-
Critical Hdwy Stg 2	6.1	5.5	-	6.1	5.5	-	-	-	-	-	-	-
Follow-up Hdwy	3.5	4	3.3	3.5	4	3.3	2.209	-	-	2.2	-	-
Pot Cap-1 Maneuver	38	52	468	39	52	418	922	-	-	868	-	-
Stage 1	448	457	-	171	205	-	-	-	-	-	-	-
Stage 2	169	203	-	448	449	-	-	-	-	-	-	-
Platoon blocked, %								-	-	-	-	-
Mov Cap-1 Maneuver	~ 17	19	468	~ 7	19	417	922	-	-	868	-	-
Mov Cap-2 Maneuver	~ 17	19	-	~ 7	19	-	-	-	-	-	-	-
Stage 1	166	450	-	63	76	-	-	-	-	-	-	-
Stage 2	58	75	-	155	442	-	-	-	-	-	-	-

Approach	EB	WB	NB	SB
HCM Control Delay, s	108.3	\$ 721.2	3.5	0.1
HCM LOS	F	F		

Minor Lane/Major Mvmt	NBL	NBT	NBR	EBLn1	EBLn2	WBLn1	SBL	SBT	SBR
Capacity (veh/h)	922	-	-	17	468	23	868	-	-
HCM Lane V/C Ratio	0.366	-	-	1.891	0.648	1.753	0.009	-	-
HCM Control Delay (s)	11.1	0	-	\$ 886.6	25.8	\$ 721.2	9.2	0	-
HCM Lane LOS	B	A	-	F	D	F	A	A	-
HCM 95th %tile Q(veh)	1.7	-	-	4.5	4.5	5.1	0	-	-

Notes  
 -: Volume exceeds capacity    \$: Delay exceeds 300s    +: Computation Not Defined    \*: All major volume in platoon

Lanes, Volumes, Timings  
 2: Main St (1A) & Monument St/Wenham Town Hall

07/23/2018



Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		↕	↗					↕			↕	
Traffic Volume (vph)	152	0	6	0	0	0	6	806	2	1	659	210
Future Volume (vph)	152	0	6	0	0	0	6	806	2	1	659	210
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Storage Length (ft)	0		15	0		0	15		0	0		0
Storage Lanes	0		1	0		0	0		0	0		0
Taper Length (ft)	0			0			25			0		
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Ped Bike Factor												
Frt			0.850					0.999			0.964	
Flt Protected		0.950										
Satd. Flow (prot)	0	1787	1380	0	0	0	0	1880	0	0	1814	0
Flt Permitted		0.950										
Satd. Flow (perm)	0	1787	1380	0	0	0	0	1880	0	0	1814	0
Link Speed (mph)		30			30			30			30	
Link Distance (ft)		2613			509			460			313	
Travel Time (s)		59.4			11.6			10.5			7.1	
Confl. Peds. (#/hr)							1					1
Peak Hour Factor	0.86	0.92	0.38	0.25	0.25	0.25	0.75	0.92	0.50	0.25	0.94	0.83
Heavy Vehicles (%)	1%	2%	17%	0%	0%	0%	0%	1%	0%	0%	1%	1%
Adj. Flow (vph)	177	0	16	0	0	0	8	876	4	4	701	253
Shared Lane Traffic (%)												
Lane Group Flow (vph)	0	177	16	0	0	0	0	888	0	0	958	0
Enter Blocked Intersection	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Lane Alignment	Left	Left	Right	Left	Left	Right	Left	Left	Right	Left	Left	Right
Median Width(ft)		0			0			0			0	
Link Offset(ft)		0			30			0			0	
Crosswalk Width(ft)		16			16			16			16	
Two way Left Turn Lane												
Headway Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Turning Speed (mph)	25		9	15		9	15		9	15		9
Sign Control		Stop			Stop			Free			Free	

**Intersection Summary**  
 Area Type: Other  
 Control Type: Unsignalized  
 Intersection Capacity Utilization 63.2% ICU Level of Service B  
 Analysis Period (min) 15

# HCM Unsignalized Intersection Capacity Analysis

## 2: Main St (1A) & Monument St/Wenham Town Hall

07/23/2018



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		↖	↗					↕			↕	
Traffic Volume (veh/h)	152	0	6	0	0	0	6	806	2	1	659	210
Future Volume (Veh/h)	152	0	6	0	0	0	6	806	2	1	659	210
Sign Control		Stop			Stop			Free			Free	
Grade		0%			0%			0%			0%	
Peak Hour Factor	0.86	0.92	0.38	0.25	0.25	0.25	0.75	0.92	0.50	0.25	0.94	0.83
Hourly flow rate (vph)	177	0	16	0	0	0	8	876	4	4	701	253
Pedestrians		1										
Lane Width (ft)		12.0										
Walking Speed (ft/s)		3.5										
Percent Blockage		0										
Right turn flare (veh)			1									
Median type								None			None	
Median storage (veh)												
Upstream signal (ft)												
pX, platoon unblocked												
vC, conflicting volume	1730	1732	828	1738	1857	878	955			880		
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	1730	1732	828	1738	1857	878	955			880		
tC, single (s)	*6.0	6.5	*6.5	7.1	6.5	6.2	4.1			4.1		
tC, 2 stage (s)												
tF (s)	3.5	4.0	3.5	3.5	4.0	3.3	2.2			2.2		
p0 queue free %	0	100	95	100	100	100	99			99		
cM capacity (veh/h)	117	86	338	65	73	350	727			777		

Direction, Lane #	EB 1	NB 1	SB 1
Volume Total	193	888	958
Volume Left	177	8	4
Volume Right	16	4	253
cSH	124	727	777
Volume to Capacity	1.56	0.01	0.01
Queue Length 95th (ft)	346	1	0
Control Delay (s)	349.1	0.3	0.2
Lane LOS	F	A	A
Approach Delay (s)	349.1	0.3	0.2
Approach LOS	F		

Intersection Summary		
Average Delay		33.3
Intersection Capacity Utilization	63.2%	ICU Level of Service
Analysis Period (min)		15
		B

\* User Entered Value



Intersection												
Int Delay, s/veh	44.3											
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		↕	↗					↕			↕	
Traffic Vol, veh/h	152	0	6	0	0	0	6	806	2	1	659	210
Future Vol, veh/h	152	0	6	0	0	0	6	806	2	1	659	210
Conflicting Peds, #/hr	0	0	0	0	0	0	1	0	0	0	0	1
Sign Control	Stop	Stop	Stop	Stop	Stop	Stop	Free	Free	Free	Free	Free	Free
RT Channelized	-	-	None	-	-	None	-	-	None	-	-	None
Storage Length	-	-	15	-	-	-	-	-	-	-	-	-
Veh in Median Storage, #	-	0	-	-	-	-	-	0	-	-	0	-
Grade, %	-	0	-	-	0	-	-	0	-	-	0	-
Peak Hour Factor	86	92	38	25	25	25	75	92	50	25	94	83
Heavy Vehicles, %	1	2	17	0	0	0	0	1	0	0	1	1
Mvmt Flow	177	0	16	0	0	0	8	876	4	4	701	253

Major/Minor	Minor2			Major1			Major2					
Conflicting Flow All	1731	1733	829				955	0	0	880	0	0
Stage 1	837	837	-				-	-	-	-	-	-
Stage 2	894	896	-				-	-	-	-	-	-
Critical Hdwy	6.41	6.52	6.37				4.1	-	-	4.1	-	-
Critical Hdwy Stg 1	5.41	5.52	-				-	-	-	-	-	-
Critical Hdwy Stg 2	5.41	5.52	-				-	-	-	-	-	-
Follow-up Hdwy	3.509	4.018	3.453				2.2	-	-	2.2	-	-
Pot Cap-1 Maneuver	~ 97	88	349				728	-	-	777	-	-
Stage 1	427	382	-				-	-	-	-	-	-
Stage 2	401	359	-				-	-	-	-	-	-
Platoon blocked, %							-	-	-	-	-	-
Mov Cap-1 Maneuver	~ 94	0	349				728	-	-	777	-	-
Mov Cap-2 Maneuver	~ 94	0	-				-	-	-	-	-	-
Stage 1	421	0	-				-	-	-	-	-	-
Stage 2	392	0	-				-	-	-	-	-	-

Approach	EB	NB	SB
HCM Control Delay, s/\$	468.6	0.1	0
HCM LOS	F		

Minor Lane/Major Mvmt	NBL	NBT	NBR	EBLn1	EBLn2	SBL	SBT	SBR
Capacity (veh/h)	728	-	-	94	349	777	-	-
HCM Lane V/C Ratio	0.011	-	-	1.88	0.045	0.005	-	-
HCM Control Delay (s)	10	0	-	\$ 509	15.8	9.7	0	-
HCM Lane LOS	B	A	-	F	C	A	A	-
HCM 95th %tile Q(veh)	0	-	-	14.8	0.1	0	-	-

Notes  
 -: Volume exceeds capacity    \$: Delay exceeds 300s    +: Computation Not Defined    \*: All major volume in platoon

Lanes, Volumes, Timings  
 3: Main St (1A) & Cherry St/Old Country Rd

07/23/2018



Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		↕	↗					↕			↕	
Traffic Volume (vph)	122	1	107	0	0	0	158	692	5	5	552	110
Future Volume (vph)	122	1	107	0	0	0	158	692	5	5	552	110
Ideal Flow (vphp)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Storage Length (ft)	0		15	0		0	15		0	0		0
Storage Lanes	0		1	0		0	0		0	0		0
Taper Length (ft)	0			0			25			0		
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Ped Bike Factor												
Frt			0.850					0.998			0.976	
Flt Protected		0.954						0.991			0.999	
Satd. Flow (prot)	0	1778	1599	0	0	0	0	1857	0	0	1834	0
Flt Permitted		0.954						0.991			0.999	
Satd. Flow (perm)	0	1778	1599	0	0	0	0	1857	0	0	1834	0
Link Speed (mph)		30			30			30			30	
Link Distance (ft)		2702			575			3735			460	
Travel Time (s)		61.4			13.1			84.9			10.5	
Confl. Peds. (#/hr)									1	1		
Peak Hour Factor	0.87	0.25	0.86	0.92	0.25	0.25	0.96	0.94	0.42	0.63	0.91	0.83
Heavy Vehicles (%)	2%	0%	1%	2%	0%	0%	2%	1%	0%	0%	1%	1%
Adj. Flow (vph)	140	4	124	0	0	0	165	736	12	8	607	133
Shared Lane Traffic (%)												
Lane Group Flow (vph)	0	144	124	0	0	0	0	913	0	0	748	0
Enter Blocked Intersection	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Lane Alignment	Left	Left	Right	Left	Left	Right	Left	Left	Right	Left	Left	Right
Median Width(ft)		0			0			0			0	
Link Offset(ft)		0			16			0			0	
Crosswalk Width(ft)		16			16			16			16	
Two way Left Turn Lane												
Headway Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Sign Control		Stop			Stop			Free			Free	

Intersection Summary

Area Type:	Other
Control Type:	Unsignalized
Intersection Capacity Utilization	98.3%
ICU Level of Service	F
Analysis Period (min)	15

# HCM Unsignalized Intersection Capacity Analysis

## 3: Main St (1A) & Cherry St/Old Country Rd

07/23/2018



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	122	1	107	0	0	0	158	692	5	5	552	110
Future Volume (Veh/h)	122	1	107	0	0	0	158	692	5	5	552	110
Sign Control		Stop			Stop			Free			Free	
Grade		0%			0%			0%			0%	
Peak Hour Factor	0.87	0.25	0.86	0.92	0.25	0.25	0.96	0.94	0.42	0.63	0.91	0.83
Hourly flow rate (vph)	140	4	124	0	0	0	165	736	12	8	607	133
Pedestrians												1
Lane Width (ft)												0.0
Walking Speed (ft/s)												3.5
Percent Blockage												0
Right turn flare (veh)			1									
Median type								None				None
Median storage (veh)												
Upstream signal (ft)												
pX, platoon unblocked												
vC, conflicting volume	1762	1768	674	1826	1829	743	740			749		
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	1762	1768	674	1826	1829	743	740			749		
tC, single (s)	*6.5	*6.2	*6.0	7.1	6.5	6.2	4.1			4.1		
tC, 2 stage (s)												
tF (s)	3.5	4.0	3.3	3.5	4.0	3.3	2.2			2.2		
p0 queue free %	0	95	74	100	100	100	81			99		
cM capacity (veh/h)	76	78	475	36	62	418	867			869		
<b>Direction, Lane #</b>	<b>EB 1</b>	<b>NB 1</b>	<b>SB 1</b>									
Volume Total	268	913	748									
Volume Left	140	165	8									
Volume Right	124	12	133									
cSH	125	867	869									
Volume to Capacity	2.15	0.19	0.01									
Queue Length 95th (ft)	560	18	1									
Control Delay (s)	601.3	4.7	0.2									
Lane LOS	F	A	A									
Approach Delay (s)	601.3	4.7	0.2									
Approach LOS	F											
<b>Intersection Summary</b>												
Average Delay			85.8									
Intersection Capacity Utilization			98.3%			ICU Level of Service				F		
Analysis Period (min)			15									

\* User Entered Value

**Intersection**

Int Delay, s/veh	57.9											
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		↕	↗					↕			↕	
Traffic Vol, veh/h	122	1	107	0	0	0	158	692	5	5	552	110
Future Vol, veh/h	122	1	107	0	0	0	158	692	5	5	552	110
Conflicting Peds, #/hr	0	0	0	0	0	0	0	0	1	1	0	0
Sign Control	Stop	Stop	Stop	Stop	Stop	Stop	Free	Free	Free	Free	Free	Free
RT Channelized	-	-	None	-	-	None	-	-	None	-	-	None
Storage Length	-	-	15	-	-	-	-	-	-	-	-	-
Veh in Median Storage, #	-	0	-	-	-	-	-	0	-	-	0	-
Grade, %	-	0	-	-	0	-	-	0	-	-	0	-
Peak Hour Factor	87	25	86	92	25	25	96	94	42	63	91	83
Heavy Vehicles, %	2	0	1	2	0	0	2	1	0	0	1	1
Mvmt Flow	140	4	124	0	0	0	165	736	12	8	607	133

Major/Minor	Minor2			Major1			Major2					
Conflicting Flow All	1760	1767	673				739	0	0	749	0	0
Stage 1	689	689	-				-	-	-	-	-	-
Stage 2	1071	1078	-				-	-	-	-	-	-
Critical Hdwy	6.42	6.5	6.21				4.12	-	-	4.1	-	-
Critical Hdwy Stg 1	5.42	5.5	-				-	-	-	-	-	-
Critical Hdwy Stg 2	5.42	5.5	-				-	-	-	-	-	-
Follow-up Hdwy	3.518	4	3.309				2.218	-	-	2.2	-	-
Pot Cap-1 Maneuver	~ 93	85	457				867	-	-	869	-	-
Stage 1	498	450	-				-	-	-	-	-	-
Stage 2	329	297	-				-	-	-	-	-	-
Platoon blocked, %								-	-		-	-
Mov Cap-1 Maneuver	~ 62	0	457				867	-	-	869	-	-
Mov Cap-2 Maneuver	~ 62	0	-				-	-	-	-	-	-
Stage 1	490	0	-				-	-	-	-	-	-
Stage 2	222	0	-				-	-	-	-	-	-

Approach	EB	NB	SB
HCM Control Delay, s\$	409.2	1.8	0.1
HCM LOS	F		

Minor Lane/Major Mvmt	NBL	NBT	NBR	EBLn1	EBLn2	SBL	SBT	SBR
Capacity (veh/h)	867	-	-	62	457	869	-	-
HCM Lane V/C Ratio	0.19	-	-	2.326	0.272	0.009	-	-
HCM Control Delay (s)	10.1	0	-	\$ 748.6	15.8	9.2	0	-
HCM Lane LOS	B	A	-	F	C	A	A	-
HCM 95th %tile Q(veh)	0.7	-	-	14.1	1.1	0	-	-

**Notes**  
 -: Volume exceeds capacity    \$: Delay exceeds 300s    +: Computation Not Defined    \*: All major volume in platoon



Lanes, Volumes, Timings  
 1: Main St (1A) & Arbor St/Friend Ct

07/23/2018



Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		↖	↗		↔			↕			↕	
Traffic Volume (vph)	16	1	346	3	3	6	287	555	6	5	578	27
Future Volume (vph)	16	1	346	3	3	6	287	555	6	5	578	27
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Storage Length (ft)	0		50	0		0	30		0	15		0
Storage Lanes	0		1	0		0	0		0	0		0
Taper Length (ft)	0			0			25			25		
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Ped Bike Factor												
Frt			0.850		0.932			0.999			0.992	
Flt Protected		0.959			0.992			0.983			0.999	
Satd. Flow (prot)	0	1639	1583	0	1757	0	0	1801	0	0	1820	0
Flt Permitted		0.959			0.992			0.983			0.999	
Satd. Flow (perm)	0	1639	1583	0	1757	0	0	1801	0	0	1820	0
Link Speed (mph)		30			30			30			30	
Link Distance (ft)		2388			2408			313			2230	
Travel Time (s)		54.3			54.7			7.1			50.7	
Confl. Peds. (#/hr)							1		1	1		1
Peak Hour Factor	0.67	0.25	0.84	0.75	0.38	0.50	0.84	0.90	0.75	0.31	0.91	0.68
Growth Factor	102%	102%	102%	102%	102%	102%	102%	102%	102%	102%	102%	102%
Heavy Vehicles (%)	13%	0%	2%	0%	0%	0%	3%	4%	0%	20%	3%	4%
Adj. Flow (vph)	24	4	420	4	8	12	349	629	8	16	648	41
Shared Lane Traffic (%)												
Lane Group Flow (vph)	0	28	420	0	24	0	0	986	0	0	705	0
Enter Blocked Intersection	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Lane Alignment	Left	Left	Right	Left	Left	Right	Left	Left	Right	Left	Left	Right
Median Width(ft)		0			0			0			0	
Link Offset(ft)		-10			0			-4			0	
Crosswalk Width(ft)		16			16			16			16	
Two way Left Turn Lane												
Headway Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Sign Control		Stop			Stop			Free			Free	



















Intersection Summary

Area Type:	Other
Control Type:	Unsignalized
Intersection Capacity Utilization	92.8%
ICU Level of Service	F
Analysis Period (min)	15

# HCM Unsignalized Intersection Capacity Analysis

## 1: Main St (1A) & Arbor St/Friend Ct

07/23/2018

												
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	16	1	346	3	3	6	287	555	6	5	578	27
Future Volume (Veh/h)	16	1	346	3	3	6	287	555	6	5	578	27
Sign Control		Stop			Stop			Free			Free	
Grade		0%			0%			0%			0%	
Peak Hour Factor	0.67	0.25	0.84	0.75	0.38	0.50	0.84	0.90	0.75	0.31	0.91	0.68
Hourly flow rate (vph)	24	4	420	4	8	12	349	629	8	16	648	41
Pedestrians		1			1							
Lane Width (ft)		12.0			12.0							
Walking Speed (ft/s)		3.5			3.5							
Percent Blockage		0			0							
Right turn flare (veh)			2									
Median type								None			None	
Median storage (veh)												
Upstream signal (ft)												
pX, platoon unblocked												
vC, conflicting volume	2048	2038	670	2244	2054	634	690			638		
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	2048	2038	670	2244	2054	634	690			638		
tC, single (s)	7.2	6.5	6.2	7.1	6.5	6.2	4.1			4.3		
tC, 2 stage (s)												
tF (s)	3.6	4.0	3.3	3.5	4.0	3.3	2.2			2.4		
p0 queue free %	0	88	8	0	76	98	61			98		
cM capacity (veh/h)	21	34	457	2	34	482	899			864		
<b>Direction, Lane #</b>	<b>EB 1</b>	<b>WB 1</b>	<b>NB 1</b>	<b>SB 1</b>								
Volume Total	448	24	986	705								
Volume Left	24	4	349	16								
Volume Right	420	12	8	41								
cSH	273	8	899	864								
Volume to Capacity	1.64	2.86	0.39	0.02								
Queue Length 95th (ft)	698	103	46	1								
Control Delay (s)	337.8	1708.8	8.7	0.5								
Lane LOS	F	F	A	A								
Approach Delay (s)	337.8	1708.8	8.7	0.5								
Approach LOS	F	F										
<b>Intersection Summary</b>												
Average Delay			93.1									
Intersection Capacity Utilization			92.8%			ICU Level of Service			F			
Analysis Period (min)			15									

HCM 2010 TWSC  
 1: Main St (1A) & Arbor St/Friend Ct

07/23/2018

Intersection												
Int Delay, s/veh	40.6											
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		↕	↕		↕			↕			↕	
Traffic Vol, veh/h	16	1	346	3	3	6	287	555	6	5	578	27
Future Vol, veh/h	16	1	346	3	3	6	287	555	6	5	578	27
Conflicting Peds, #/hr	0	0	0	0	0	0	1	0	1	1	0	1
Sign Control	Stop	Stop	Stop	Stop	Stop	Stop	Free	Free	Free	Free	Free	Free
RT Channelized	-	-	None	-	-	None	-	-	None	-	-	None
Storage Length	-	-	50	-	-	-	-	-	-	-	-	-
Veh in Median Storage, #	-	0	-	-	0	-	-	0	-	-	0	-
Grade, %	-	0	-	-	0	-	-	0	-	-	0	-
Peak Hour Factor	67	25	84	75	38	50	84	90	75	31	91	68
Heavy Vehicles, %	13	0	2	0	0	0	3	4	0	20	3	4
Mvmt Flow	24	4	420	4	8	12	349	629	8	16	648	41

Major/Minor	Minor2		Minor1		Major1		Major2					
Conflicting Flow All	2042	2037	669	2034	2053	634	689	0	0	638	0	0
Stage 1	702	702	-	1331	1331	-	-	-	-	-	-	-
Stage 2	1340	1335	-	703	722	-	-	-	-	-	-	-
Critical Hdwy	7.23	6.5	6.22	7.1	6.5	6.2	4.13	-	-	4.3	-	-
Critical Hdwy Stg 1	6.23	5.5	-	6.1	5.5	-	-	-	-	-	-	-
Critical Hdwy Stg 2	6.23	5.5	-	6.1	5.5	-	-	-	-	-	-	-
Follow-up Hdwy	3.617	4	3.318	3.5	4	3.3	2.227	-	-	2.38	-	-
Pot Cap-1 Maneuver	39	57	458	43	56	483	901	-	-	865	-	-
Stage 1	412	443	-	192	226	-	-	-	-	-	-	-
Stage 2	178	225	-	431	434	-	-	-	-	-	-	-
Platoon blocked, %								-	-	-	-	-
Mov Cap-1 Maneuver	~ 14	22	458	~ 2	22	483	901	-	-	865	-	-
Mov Cap-2 Maneuver	~ 14	22	-	~ 2	22	-	-	-	-	-	-	-
Stage 1	165	429	-	77	90	-	-	-	-	-	-	-
Stage 2	63	90	-	34	421	-	-	-	-	-	-	-

Approach	EB		WB		NB		SB	
HCM Control Delay, s	110.5		\$ 1395.1		4.1		0.2	
HCM LOS	F		F					

Minor Lane/Major Mvmt	NBL	NBT	NBR	EBLn1	EBLn2	WBLn1	SBL	SBT	SBR
Capacity (veh/h)	901	-	-	15	458	10	865	-	-
HCM Lane V/C Ratio	0.387	-	-	1.896	0.917	2.437	0.019	-	-
HCM Control Delay (s)	11.5	0	-	\$ 941.9	54.2	\$ 1395.1	9.2	0	-
HCM Lane LOS	B	A	-	F	F	F	A	A	-
HCM 95th %tile Q(veh)	1.8	-	-	4.2	10.4	4.1	0.1	-	-

Notes  
 -: Volume exceeds capacity    \$: Delay exceeds 300s    +: Computation Not Defined    \*: All major volume in platoon

# Lanes, Volumes, Timings

## 2: Main St (1A) & Monument St/Wenham Town Hall

07/23/2018



Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		↕	↗					↕			↕	
Traffic Volume (vph)	174	0	3	0	0	0	5	667	0	1	752	185
Future Volume (vph)	174	0	3	0	0	0	5	667	0	1	752	185
Ideal Flow (vphp)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Storage Length (ft)	0		15	0		0	15		0	0		0
Storage Lanes	0		1	0		0	0		0	0		0
Taper Length (ft)	0			0			25			0		
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Ped Bike Factor												
Frt			0.850								0.971	
Flt Protected		0.950						0.999				
Satd. Flow (prot)	0	1703	1615	0	0	0	0	1840	0	0	1805	0
Flt Permitted		0.950						0.999				
Satd. Flow (perm)	0	1703	1615	0	0	0	0	1840	0	0	1805	0
Link Speed (mph)		30			30			30			30	
Link Distance (ft)		2613			509			460			313	
Travel Time (s)		59.4			11.6			10.5			7.1	
Confl. Peds. (#/hr)							5					5
Peak Hour Factor	0.81	0.92	0.38	0.25	0.25	0.25	0.63	0.87	0.92	0.25	0.95	0.86
Growth Factor	102%	102%	102%	102%	102%	102%	102%	102%	102%	102%	102%	102%
Heavy Vehicles (%)	6%	2%	0%	0%	0%	0%	20%	3%	0%	0%	2%	3%
Adj. Flow (vph)	219	0	8	0	0	0	8	782	0	4	807	219
Shared Lane Traffic (%)												
Lane Group Flow (vph)	0	219	8	0	0	0	0	790	0	0	1030	0
Enter Blocked Intersection	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Lane Alignment	Left	Left	Right	Left	Left	Right	Left	Left	Right	Left	Left	Right
Median Width(ft)		0			0			0			0	
Link Offset(ft)		0			30			0			0	
Crosswalk Width(ft)		16			16			16			16	
Two way Left Turn Lane												
Headway Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Turning Speed (mph)	25		9	15		9	15		9	15		9
Sign Control		Stop			Stop			Free			Free	

### Intersection Summary

Area Type:	Other
Control Type:	Unsignalized
Intersection Capacity Utilization	69.1%
ICU Level of Service	C
Analysis Period (min)	15



# HCM Unsignalized Intersection Capacity Analysis

## 2: Main St (1A) & Monument St/Wenham Town Hall

07/23/2018



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		↕	↗					↕			↕	
Traffic Volume (veh/h)	174	0	3	0	0	0	5	667	0	1	752	185
Future Volume (Veh/h)	174	0	3	0	0	0	5	667	0	1	752	185
Sign Control		Stop			Stop			Free			Free	
Grade		0%			0%			0%			0%	
Peak Hour Factor	0.81	0.92	0.38	0.25	0.25	0.25	0.63	0.87	0.92	0.25	0.95	0.86
Hourly flow rate (vph)	219	0	8	0	0	0	8	782	0	4	807	219
Pedestrians		5										
Lane Width (ft)		12.0										
Walking Speed (ft/s)		3.5										
Percent Blockage		0										
Right turn flare (veh)			1									
Median type								None			None	
Median storage (veh)												
Upstream signal (ft)												
pX, platoon unblocked												
vC, conflicting volume	1728	1728	922	1726	1837	782	1031			782		
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	1728	1728	922	1726	1837	782	1031			782		
tC, single (s)	*6.0	6.5	*6.5	7.1	6.5	6.2	4.3			4.1		
tC, 2 stage (s)												
tF (s)	3.6	4.0	3.3	3.5	4.0	3.3	2.4			2.2		
p0 queue free %	0	100	97	100	100	100	99			100		
cM capacity (veh/h)	116	86	305	67	75	397	606			845		

Direction, Lane #	EB 1	NB 1	SB 1
Volume Total	227	790	1030
Volume Left	219	8	4
Volume Right	8	0	219
cSH	119	606	845
Volume to Capacity	1.91	0.01	0.00
Queue Length 95th (ft)	455	1	0
Control Delay (s)	502.2	0.4	0.1
Lane LOS	F	A	A
Approach Delay (s)	502.2	0.4	0.1
Approach LOS	F		

Intersection Summary		
Average Delay		55.9
Intersection Capacity Utilization	69.1%	ICU Level of Service C
Analysis Period (min)		15

\* User Entered Value

**Intersection**

Int Delay, s/veh 79.2

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		↕	↗					↕			↕	
Traffic Vol, veh/h	174	0	3	0	0	0	5	667	0	1	752	185
Future Vol, veh/h	174	0	3	0	0	0	5	667	0	1	752	185
Conflicting Peds, #/hr	0	0	0	0	0	0	5	0	0	0	0	5
Sign Control	Stop	Stop	Stop	Stop	Stop	Stop	Free	Free	Free	Free	Free	Free
RT Channelized	-	-	None	-	-	None	-	-	None	-	-	None
Storage Length	-	-	15	-	-	-	-	-	-	-	-	-
Veh in Median Storage, #	-	0	-	-	-	-	-	0	-	-	0	-
Grade, %	-	0	-	-	0	-	-	0	-	-	0	-
Peak Hour Factor	81	92	38	25	25	25	63	87	92	25	95	86
Heavy Vehicles, %	6	2	0	0	0	0	20	3	0	0	2	3
Mvmt Flow	219	0	8	0	0	0	8	782	0	4	807	219

Major/Minor	Minor2			Major1			Major2					
Conflicting Flow All	1728	1728	922				1032	0	0	782	0	0
Stage 1	930	930	-				-	-	-	-	-	-
Stage 2	798	798	-				-	-	-	-	-	-
Critical Hdwy	6.46	6.52	6.2				4.3	-	-	4.1	-	-
Critical Hdwy Stg 1	5.46	5.52	-				-	-	-	-	-	-
Critical Hdwy Stg 2	5.46	5.52	-				-	-	-	-	-	-
Follow-up Hdwy	3.554	4.018	3.3				2.38	-	-	2.2	-	-
Pot Cap-1 Maneuver	~ 95	88	330				608	-	-	845	-	-
Stage 1	378	346	-				-	-	-	-	-	-
Stage 2	436	398	-				-	-	-	-	-	-
Platoon blocked, %								-	-		-	-
Mov Cap-1 Maneuver	~ 91	0	328				608	-	-	845	-	-
Mov Cap-2 Maneuver	~ 91	0	-				-	-	-	-	-	-
Stage 1	372	0	-				-	-	-	-	-	-
Stage 2	424	0	-				-	-	-	-	-	-

Approach	EB	NB	SB
HCM Control Delay, s\$	714.1	0.1	0
HCM LOS	F		

Minor Lane/Major Mvmt	NBL	NBT	NBR	EBLn1	EBLn2	SBL	SBT	SBR
Capacity (veh/h)	608	-	-	91	328	845	-	-
HCM Lane V/C Ratio	0.013	-	-	2.408	0.025	0.005	-	-
HCM Control Delay (s)	11	0	-	\$ 739.7	16.3	9.3	0	-
HCM Lane LOS	B	A	-	F	C	A	A	-
HCM 95th %tile Q(veh)	0	-	-	20.1	0.1	0	-	-

**Notes**  
 -: Volume exceeds capacity    \$: Delay exceeds 300s    +: Computation Not Defined    \*: All major volume in platoon

Lanes, Volumes, Timings  
 3: Main St (1A) & Cherry St/Old Country Rd

07/23/2018



Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		↖	↗					↕			↕	
Traffic Volume (vph)	129	1	154	0	0	0	87	544	2	2	642	108
Future Volume (vph)	129	1	154	0	0	0	87	544	2	2	642	108
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Storage Length (ft)	0		15	0		0	15		0	0		0
Storage Lanes	0		1	0		0	0		0	0		0
Taper Length (ft)	0			0			25			0		
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Frt			0.850					0.999			0.977	
Flt Protected		0.954						0.993				
Satd. Flow (prot)	0	1778	1538	0	0	0	0	1815	0	0	1805	0
Flt Permitted		0.954						0.993				
Satd. Flow (perm)	0	1778	1538	0	0	0	0	1815	0	0	1805	0
Link Speed (mph)		30			30			30			30	
Link Distance (ft)		2702			575			3735			460	
Travel Time (s)		61.4			13.1			84.9			10.5	
Peak Hour Factor	0.95	0.25	0.88	0.92	0.25	0.25	0.84	0.83	0.50	0.50	0.93	0.75
Growth Factor	102%	102%	102%	102%	102%	102%	102%	102%	102%	102%	102%	102%
Heavy Vehicles (%)	2%	0%	5%	2%	0%	0%	3%	4%	0%	0%	3%	2%
Adj. Flow (vph)	139	4	179	0	0	0	106	669	4	4	704	147
Shared Lane Traffic (%)												
Lane Group Flow (vph)	0	143	179	0	0	0	0	779	0	0	855	0
Enter Blocked Intersection	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Lane Alignment	Left	Left	Right	Left	Left	Right	Left	Left	Right	Left	Left	Right
Median Width(ft)		0			0			0			0	
Link Offset(ft)		0			16			0			0	
Crosswalk Width(ft)		16			16			16			16	
Two way Left Turn Lane												
Headway Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Sign Control		Stop			Stop			Free			Free	

Intersection Summary

Area Type:	Other
Control Type:	Unsignalized
Intersection Capacity Utilization	92.8%
ICU Level of Service	F
Analysis Period (min)	15

# HCM Unsignalized Intersection Capacity Analysis

## 3: Main St (1A) & Cherry St/Old Country Rd

07/23/2018



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		↔	↔					↕			↕	
Traffic Volume (veh/h)	129	1	154	0	0	0	87	544	2	2	642	108
Future Volume (Veh/h)	129	1	154	0	0	0	87	544	2	2	642	108
Sign Control		Stop			Stop			Free			Free	
Grade		0%			0%			0%			0%	
Peak Hour Factor	0.95	0.25	0.88	0.92	0.25	0.25	0.84	0.83	0.50	0.50	0.93	0.75
Hourly flow rate (vph)	139	4	179	0	0	0	106	669	4	4	704	147
Pedestrians												
Lane Width (ft)												
Walking Speed (ft/s)												
Percent Blockage												
Right turn flare (veh)			1									
Median type								None			None	
Median storage (veh)												
Upstream signal (ft)												
pX, platoon unblocked												
vC, conflicting volume	1668	1670	778	1760	1742	671	851			673		
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	1668	1670	778	1760	1742	671	851			673		
tC, single (s)	*6.5	*6.2	*6.0	7.1	6.5	6.2	4.1			4.1		
tC, 2 stage (s)												
tF (s)	3.5	4.0	3.3	3.5	4.0	3.3	2.2			2.2		
p0 queue free %	0	96	57	100	100	100	86			100		
cM capacity (veh/h)	91	96	414	32	75	460	783			927		
<b>Direction, Lane #</b>	<b>EB 1</b>	<b>NB 1</b>	<b>SB 1</b>									
Volume Total	322	779	855									
Volume Left	139	106	4									
Volume Right	179	4	147									
cSH	164	783	927									
Volume to Capacity	1.97	0.14	0.00									
Queue Length 95th (ft)	617	12	0									
Control Delay (s)	502.5	3.4	0.1									
Lane LOS	F	A	A									
Approach Delay (s)	502.5	3.4	0.1									
Approach LOS	F											
<b>Intersection Summary</b>												
Average Delay			84.1									
Intersection Capacity Utilization			92.8%			ICU Level of Service				F		
Analysis Period (min)			15									

\* User Entered Value



**Intersection**

Int Delay, s/veh	36.4											
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		↕	↗					↕			↕	
Traffic Vol, veh/h	129	1	154	0	0	0	87	544	2	2	642	108
Future Vol, veh/h	129	1	154	0	0	0	87	544	2	2	642	108
Conflicting Peds, #/hr	0	0	0	0	0	0	0	0	0	0	0	0
Sign Control	Stop	Stop	Stop	Stop	Stop	Stop	Free	Free	Free	Free	Free	Free
RT Channelized	-	-	None	-	-	None	-	-	None	-	-	None
Storage Length	-	-	15	-	-	-	-	-	-	-	-	-
Veh in Median Storage, #	-	0	-	-	-	-	-	0	-	-	0	-
Grade, %	-	0	-	-	0	-	-	0	-	-	0	-
Peak Hour Factor	95	25	88	92	25	25	84	83	50	50	93	75
Heavy Vehicles, %	2	0	5	2	0	0	3	4	0	0	3	2
Mvmt Flow	139	4	179	0	0	0	106	669	4	4	704	147

Major/Minor	Minor2			Major1			Major2					
Conflicting Flow All	1668	1670	778				851	0	0	673	0	0
Stage 1	786	786	-				-	-	-	-	-	-
Stage 2	882	884	-				-	-	-	-	-	-
Critical Hdwy	6.42	6.5	6.25				4.13	-	-	4.1	-	-
Critical Hdwy Stg 1	5.42	5.5	-				-	-	-	-	-	-
Critical Hdwy Stg 2	5.42	5.5	-				-	-	-	-	-	-
Follow-up Hdwy	3.518	4	3.345				2.227	-	-	2.2	-	-
Pot Cap-1 Maneuver	~ 106	97	392				783	-	-	927	-	-
Stage 1	449	406	-				-	-	-	-	-	-
Stage 2	405	366	-				-	-	-	-	-	-
Platoon blocked, %								-	-		-	-
Mov Cap-1 Maneuver	~ 82	0	392				783	-	-	927	-	-
Mov Cap-2 Maneuver	~ 82	0	-				-	-	-	-	-	-
Stage 1	445	0	-				-	-	-	-	-	-
Stage 2	318	0	-				-	-	-	-	-	-

Approach	EB	NB	SB
HCM Control Delay, s	218.1	1.4	0
HCM LOS	F		

Minor Lane/Major Mvmt	NBL	NBT	NBR	EBLn1	EBLn2	SBL	SBT	SBR
Capacity (veh/h)	783	-	-	82	392	927	-	-
HCM Lane V/C Ratio	0.135	-	-	1.739	0.455	0.004	-	-
HCM Control Delay (s)	10.3	0	-	\$ 464.1	21.6	8.9	0	-
HCM Lane LOS	B	A	-	F	C	A	A	-
HCM 95th %tile Q(veh)	0.5	-	-	12	2.3	0	-	-

**Notes**  
 -: Volume exceeds capacity    \$: Delay exceeds 300s    +: Computation Not Defined    \*: All major volume in platoon

Lanes, Volumes, Timings  
 1: Main St (1A) & Arbor St/Friend Ct

07/23/2018



Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		↕	↗		↕			↕			↕	
Traffic Volume (vph)	18	0	267	7	0	13	297	652	11	5	596	25
Future Volume (vph)	18	0	267	7	0	13	297	652	11	5	596	25
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Storage Length (ft)	0		50	0		0	30		0	15		0
Storage Lanes	0		1	0		0	0		0	0		0
Taper Length (ft)	0			0			25			25		
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Ped Bike Factor												
Frt			0.850		0.905			0.998			0.994	
Flt Protected		0.950			0.986			0.985			0.999	
Satd. Flow (prot)	0	1805	1615	0	1695	0	0	1837	0	0	1869	0
Flt Permitted		0.950			0.986			0.985			0.999	
Satd. Flow (perm)	0	1805	1615	0	1695	0	0	1837	0	0	1869	0
Link Speed (mph)		30			30			30			30	
Link Distance (ft)		2388			2408			313			2230	
Travel Time (s)		54.3			54.7			7.1			50.7	
Confl. Peds. (#/hr)							1		2	2		1
Peak Hour Factor	0.56	0.92	0.88	0.58	0.92	0.46	0.88	0.89	0.69	0.63	0.93	0.78
Growth Factor	102%	102%	102%	102%	102%	102%	102%	102%	102%	102%	102%	102%
Heavy Vehicles (%)	0%	0%	0%	0%	0%	0%	1%	2%	0%	0%	1%	0%
Adj. Flow (vph)	33	0	309	12	0	29	344	747	16	8	654	33
Shared Lane Traffic (%)												
Lane Group Flow (vph)	0	33	309	0	41	0	0	1107	0	0	695	0
Enter Blocked Intersection	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Lane Alignment	Left	Left	Right	Left	Left	Right	Left	Left	Right	Left	Left	Right
Median Width(ft)		0			0			0			0	
Link Offset(ft)		-10			0			-4			0	
Crosswalk Width(ft)		16			16			16			16	
Two way Left Turn Lane												
Headway Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Sign Control		Stop			Stop			Free			Free	



















Intersection Summary

Area Type:	Other
Control Type:	Unsignalized
Intersection Capacity Utilization	104.1%
Analysis Period (min)	15
	ICU Level of Service G

# HCM Unsignalized Intersection Capacity Analysis

## 1: Main St (1A) & Arbor St/Friend Ct

07/23/2018

												
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	18	0	267	7	0	13	297	652	11	5	596	25
Future Volume (Veh/h)	18	0	267	7	0	13	297	652	11	5	596	25
Sign Control		Stop			Stop			Free			Free	
Grade		0%			0%			0%			0%	
Peak Hour Factor	0.56	0.92	0.88	0.58	0.92	0.46	0.88	0.89	0.69	0.63	0.93	0.78
Hourly flow rate (vph)	33	0	309	12	0	29	344	747	16	8	654	33
Pedestrians		1			2							
Lane Width (ft)		12.0			12.0							
Walking Speed (ft/s)		3.5			3.5							
Percent Blockage		0			0							
Right turn flare (veh)			2									
Median type								None			None	
Median storage (veh)												
Upstream signal (ft)												
pX, platoon unblocked												
vC, conflicting volume	2160	2140	672	2286	2149	757	688			765		
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	2160	2140	672	2286	2149	757	688			765		
tC, single (s)	7.1	6.5	6.2	7.1	6.5	6.2	4.1			4.1		
tC, 2 stage (s)												
tF (s)	3.5	4.0	3.3	3.5	4.0	3.3	2.2			2.2		
p0 queue free %	0	100	33	0	100	93	62			99		
cM capacity (veh/h)	23	30	459	6	30	410	910			856		
<b>Direction, Lane #</b>	<b>EB 1</b>	<b>WB 1</b>	<b>NB 1</b>	<b>SB 1</b>								
Volume Total	342	41	1107	695								
Volume Left	33	12	344	8								
Volume Right	309	29	16	33								
cSH	181	21	910	856								
Volume to Capacity	1.89	1.93	0.38	0.01								
Queue Length 95th (ft)	629	134	44	1								
Control Delay (s)	461.7	821.6	8.9	0.2								
Lane LOS	F	F	A	A								
Approach Delay (s)	461.7	821.6	8.9	0.2								
Approach LOS	F	F										
<b>Intersection Summary</b>												
Average Delay			92.3									
Intersection Capacity Utilization			104.1%			ICU Level of Service			G			
Analysis Period (min)			15									

**Intersection**

Int Delay, s/veh 43.1

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		↕	↗		↕			↕			↕	
Traffic Vol, veh/h	18	0	267	7	0	13	297	652	11	5	596	25
Future Vol, veh/h	18	0	267	7	0	13	297	652	11	5	596	25
Conflicting Peds, #/hr	0	0	0	0	0	0	1	0	2	2	0	1
Sign Control	Stop	Stop	Stop	Stop	Stop	Stop	Free	Free	Free	Free	Free	Free
RT Channelized	-	-	None	-	-	None	-	-	None	-	-	None
Storage Length	-	-	50	-	-	-	-	-	-	-	-	-
Veh in Median Storage, #	-	0	-	-	0	-	-	0	-	-	0	-
Grade, %	-	0	-	-	0	-	-	0	-	-	0	-
Peak Hour Factor	56	92	88	58	92	46	88	89	69	63	93	78
Heavy Vehicles, %	0	0	0	0	0	0	1	2	0	0	1	0
Mvmt Flow	33	0	309	12	0	29	344	747	16	8	654	33

Major/Minor	Minor2		Minor1		Major1		Major2					
Conflicting Flow All	2145	2141	671	2132	2150	757	687	0	0	765	0	0
Stage 1	687	687	-	1446	1446	-	-	-	-	-	-	-
Stage 2	1458	1454	-	686	704	-	-	-	-	-	-	-
Critical Hdwy	7.1	6.5	6.2	7.1	6.5	6.2	4.11	-	-	4.1	-	-
Critical Hdwy Stg 1	6.1	5.5	-	6.1	5.5	-	-	-	-	-	-	-
Critical Hdwy Stg 2	6.1	5.5	-	6.1	5.5	-	-	-	-	-	-	-
Follow-up Hdwy	3.5	4	3.3	3.5	4	3.3	2.209	-	-	2.2	-	-
Pot Cap-1 Maneuver	36	49	460	36	49	411	912	-	-	857	-	-
Stage 1	440	450	-	165	199	-	-	-	-	-	-	-
Stage 2	163	197	-	441	443	-	-	-	-	-	-	-
Platoon blocked, %								-	-	-	-	-
Mov Cap-1 Maneuver	~ 16	17	460	~ 5	17	410	912	-	-	857	-	-
Mov Cap-2 Maneuver	~ 16	17	-	~ 5	17	-	-	-	-	-	-	-
Stage 1	151	443	-	56	68	-	-	-	-	-	-	-
Stage 2	52	67	-	142	436	-	-	-	-	-	-	-

Approach	EB	WB	NB	SB
HCM Control Delay, s	118.7	\$ 1204.2	3.5	0.1
HCM LOS	F	F		

Minor Lane/Major Mvmt	NBL	NBT	NBR	EBLn1	EBLn2	WBLn1	SBL	SBT	SBR
Capacity (veh/h)	912	-	-	16	460	16	857	-	-
HCM Lane V/C Ratio	0.377	-	-	2.049	0.673	2.571	0.009	-	-
HCM Control Delay (s)	11.3	0	-	\$ 979.1	27	\$ 1204.2	9.2	0	-
HCM Lane LOS	B	A	-	F	D	F	A	A	-
HCM 95th %tile Q(veh)	1.8	-	-	4.7	4.9	5.8	0	-	-

**Notes**  
 -: Volume exceeds capacity    \$: Delay exceeds 300s    +: Computation Not Defined    \*: All major volume in platoon



# Lanes, Volumes, Timings

## 2: Main St (1A) & Monument St/Wenham Town Hall

07/23/2018



Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		↕	↗					↕			↕	
Traffic Volume (vph)	152	0	6	0	0	0	6	806	2	1	659	210
Future Volume (vph)	152	0	6	0	0	0	6	806	2	1	659	210
Ideal Flow (vphp)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Storage Length (ft)	0		15	0		0	15		0	0		0
Storage Lanes	0		1	0		0	0		0	0		0
Taper Length (ft)	0			0			25			0		
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Ped Bike Factor												
Frt			0.850					0.999			0.964	
Flt Protected		0.950										
Satd. Flow (prot)	0	1787	1380	0	0	0	0	1880	0	0	1814	0
Flt Permitted		0.950										
Satd. Flow (perm)	0	1787	1380	0	0	0	0	1880	0	0	1814	0
Link Speed (mph)		30			30			30			30	
Link Distance (ft)		2613			509			460			313	
Travel Time (s)		59.4			11.6			10.5			7.1	
Confl. Peds. (#/hr)							1					1
Peak Hour Factor	0.86	0.92	0.38	0.25	0.25	0.25	0.75	0.92	0.50	0.25	0.94	0.83
Growth Factor	102%	102%	102%	102%	102%	102%	102%	102%	102%	102%	102%	102%
Heavy Vehicles (%)	1%	2%	17%	0%	0%	0%	0%	1%	0%	0%	1%	1%
Adj. Flow (vph)	180	0	16	0	0	0	8	894	4	4	715	258
Shared Lane Traffic (%)												
Lane Group Flow (vph)	0	180	16	0	0	0	0	906	0	0	977	0
Enter Blocked Intersection	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Lane Alignment	Left	Left	Right	Left	Left	Right	Left	Left	Right	Left	Left	Right
Median Width(ft)		0			0			0			0	
Link Offset(ft)		0			30			0			0	
Crosswalk Width(ft)		16			16			16			16	
Two way Left Turn Lane												
Headway Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Turning Speed (mph)	25		9	15		9	15		9	15		9
Sign Control		Stop			Stop			Free			Free	

### Intersection Summary

Area Type:	Other
Control Type:	Unsignalized
Intersection Capacity Utilization	64.4%
ICU Level of Service	C
Analysis Period (min)	15

# HCM Unsignalized Intersection Capacity Analysis

## 2: Main St (1A) & Monument St/Wenham Town Hall

07/23/2018



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		↕	↗					↕			↕	
Traffic Volume (veh/h)	152	0	6	0	0	0	6	806	2	1	659	210
Future Volume (Veh/h)	152	0	6	0	0	0	6	806	2	1	659	210
Sign Control		Stop			Stop			Free			Free	
Grade		0%			0%			0%			0%	
Peak Hour Factor	0.86	0.92	0.38	0.25	0.25	0.25	0.75	0.92	0.50	0.25	0.94	0.83
Hourly flow rate (vph)	180	0	16	0	0	0	8	894	4	4	715	258
Pedestrians		1										
Lane Width (ft)		12.0										
Walking Speed (ft/s)		3.5										
Percent Blockage		0										
Right turn flare (veh)			1									
Median type								None			None	
Median storage (veh)												
Upstream signal (ft)												
pX, platoon unblocked												
vC, conflicting volume	1765	1767	845	1772	1894	896	974			898		
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	1765	1767	845	1772	1894	896	974			898		
tC, single (s)	*6.0	6.5	*6.5	7.1	6.5	6.2	4.1			4.1		
tC, 2 stage (s)												
tF (s)	3.5	4.0	3.5	3.5	4.0	3.3	2.2			2.2		
p0 queue free %	0	100	95	100	100	100	99			99		
cM capacity (veh/h)	112	82	331	61	69	342	715			765		

Direction, Lane #	EB 1	NB 1	SB 1
Volume Total	196	906	977
Volume Left	180	8	4
Volume Right	16	4	258
cSH	118	715	765
Volume to Capacity	1.66	0.01	0.01
Queue Length 95th (ft)	367	1	0
Control Delay (s)	393.4	0.3	0.2
Lane LOS	F	A	A
Approach Delay (s)	393.4	0.3	0.2
Approach LOS	F		

Intersection Summary		
Average Delay		37.3
Intersection Capacity Utilization	64.4%	ICU Level of Service C
Analysis Period (min)		15

\* User Entered Value

Intersection												
Int Delay, s/veh	49.2											
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		↕	↗					↕			↕	
Traffic Vol, veh/h	152	0	6	0	0	0	6	806	2	1	659	210
Future Vol, veh/h	152	0	6	0	0	0	6	806	2	1	659	210
Conflicting Peds, #/hr	0	0	0	0	0	0	1	0	0	0	0	1
Sign Control	Stop	Stop	Stop	Stop	Stop	Stop	Free	Free	Free	Free	Free	Free
RT Channelized	-	-	None	-	-	None	-	-	None	-	-	None
Storage Length	-	-	15	-	-	-	-	-	-	-	-	-
Veh in Median Storage, #	-	0	-	-	-	-	-	0	-	-	0	-
Grade, %	-	0	-	-	0	-	-	0	-	-	0	-
Peak Hour Factor	86	92	38	25	25	25	75	92	50	25	94	83
Heavy Vehicles, %	1	2	17	0	0	0	0	1	0	0	1	1
Mvmt Flow	180	0	16	0	0	0	8	894	4	4	715	258

Major/Minor	Minor2			Major1			Major2					
Conflicting Flow All	1765	1767	845				974	0	0	898	0	0
Stage 1	853	853	-				-	-	-	-	-	-
Stage 2	912	914	-				-	-	-	-	-	-
Critical Hdwy	6.41	6.52	6.37				4.1	-	-	4.1	-	-
Critical Hdwy Stg 1	5.41	5.52	-				-	-	-	-	-	-
Critical Hdwy Stg 2	5.41	5.52	-				-	-	-	-	-	-
Follow-up Hdwy	3.509	4.018	3.453				2.2	-	-	2.2	-	-
Pot Cap-1 Maneuver	~ 93	84	341				716	-	-	765	-	-
Stage 1	419	376	-				-	-	-	-	-	-
Stage 2	393	352	-				-	-	-	-	-	-
Platoon blocked, %							-	-	-	-	-	-
Mov Cap-1 Maneuver	~ 90	0	341				716	-	-	765	-	-
Mov Cap-2 Maneuver	~ 90	0	-				-	-	-	-	-	-
Stage 1	414	0	-				-	-	-	-	-	-
Stage 2	384	0	-				-	-	-	-	-	-

Approach	EB	NB	SB
HCM Control Delay, s/\$	520.5	0.1	0
HCM LOS	F		

Minor Lane/Major Mvmt	NBL	NBT	NBR	EBLn1	EBLn2	SBL	SBT	SBR
Capacity (veh/h)	716	-	-	90	341	765	-	-
HCM Lane V/C Ratio	0.011	-	-	2.003	0.047	0.005	-	-
HCM Control Delay (s)	10.1	0	-	\$ 565.6	16.1	9.7	0	-
HCM Lane LOS	B	A	-	F	C	A	A	-
HCM 95th %tile Q(veh)	0	-	-	15.6	0.1	0	-	-

Notes  
 -: Volume exceeds capacity    \$: Delay exceeds 300s    +: Computation Not Defined    \*: All major volume in platoon

Lanes, Volumes, Timings  
 3: Main St (1A) & Cherry St/Old Country Rd

07/23/2018



Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		↖	↗					↕			↕	
Traffic Volume (vph)	122	1	107	0	0	0	158	692	5	5	552	110
Future Volume (vph)	122	1	107	0	0	0	158	692	5	5	552	110
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Storage Length (ft)	0		15	0		0	15		0	0		0
Storage Lanes	0		1	0		0	0		0	0		0
Taper Length (ft)	0			0			25			0		
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Ped Bike Factor												
Frt			0.850					0.998			0.976	
Flt Protected		0.954						0.991			0.999	
Satd. Flow (prot)	0	1778	1599	0	0	0	0	1857	0	0	1834	0
Flt Permitted		0.954						0.991			0.999	
Satd. Flow (perm)	0	1778	1599	0	0	0	0	1857	0	0	1834	0
Link Speed (mph)		30			30			30			30	
Link Distance (ft)		2702			575			3735			460	
Travel Time (s)		61.4			13.1			84.9			10.5	
Confl. Peds. (#/hr)									1	1		
Peak Hour Factor	0.87	0.25	0.86	0.92	0.25	0.25	0.96	0.94	0.42	0.63	0.91	0.83
Growth Factor	102%	102%	102%	102%	102%	102%	102%	102%	102%	102%	102%	102%
Heavy Vehicles (%)	2%	0%	1%	2%	0%	0%	2%	1%	0%	0%	1%	1%
Adj. Flow (vph)	143	4	127	0	0	0	168	751	12	8	619	135
Shared Lane Traffic (%)												
Lane Group Flow (vph)	0	147	127	0	0	0	0	931	0	0	762	0
Enter Blocked Intersection	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Lane Alignment	Left	Left	Right	Left	Left	Right	Left	Left	Right	Left	Left	Right
Median Width(ft)		0			0			0			0	
Link Offset(ft)		0			16			0			0	
Crosswalk Width(ft)		16			16			16			16	
Two way Left Turn Lane												
Headway Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Sign Control		Stop			Stop			Free			Free	

Intersection Summary

Area Type:	Other
Control Type:	Unsignalized
Intersection Capacity Utilization	100.0%
ICU Level of Service	G
Analysis Period (min)	15



# HCM Unsignalized Intersection Capacity Analysis

## 3: Main St (1A) & Cherry St/Old Country Rd

07/23/2018



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		↔	↔					↕			↕	
Traffic Volume (veh/h)	122	1	107	0	0	0	158	692	5	5	552	110
Future Volume (Veh/h)	122	1	107	0	0	0	158	692	5	5	552	110
Sign Control		Stop			Stop			Free			Free	
Grade		0%			0%			0%			0%	
Peak Hour Factor	0.87	0.25	0.86	0.92	0.25	0.25	0.96	0.94	0.42	0.63	0.91	0.83
Hourly flow rate (vph)	143	4	127	0	0	0	168	751	12	8	619	135
Pedestrians												1
Lane Width (ft)												0.0
Walking Speed (ft/s)												3.5
Percent Blockage												0
Right turn flare (veh)			1									
Median type								None			None	
Median storage (veh)												
Upstream signal (ft)												
pX, platoon unblocked												
vC, conflicting volume	1796	1802	686	1862	1864	758	754			764		
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	1796	1802	686	1862	1864	758	754			764		
tC, single (s)	*6.5	*6.2	*6.0	7.1	6.5	6.2	4.1			4.1		
tC, 2 stage (s)												
tF (s)	3.5	4.0	3.3	3.5	4.0	3.3	2.2			2.2		
p0 queue free %	0	95	73	100	100	100	80			99		
cM capacity (veh/h)	72	74	467	33	59	410	856			858		
<b>Direction, Lane #</b>	<b>EB 1</b>	<b>NB 1</b>	<b>SB 1</b>									
Volume Total	274	931	762									
Volume Left	143	168	8									
Volume Right	127	12	135									
cSH	119	856	858									
Volume to Capacity	2.31	0.20	0.01									
Queue Length 95th (ft)	594	18	1									
Control Delay (s)	675.2	4.8	0.3									
Lane LOS	F	A	A									
Approach Delay (s)	675.2	4.8	0.3									
Approach LOS	F											
<b>Intersection Summary</b>												
Average Delay			96.4									
Intersection Capacity Utilization			100.0%			ICU Level of Service				G		
Analysis Period (min)			15									

\* User Entered Value

**Intersection**

Int Delay, s/veh 67.1

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		↕	↗					↕			↕	
Traffic Vol, veh/h	122	1	107	0	0	0	158	692	5	5	552	110
Future Vol, veh/h	122	1	107	0	0	0	158	692	5	5	552	110
Conflicting Peds, #/hr	0	0	0	0	0	0	0	0	1	1	0	0
Sign Control	Stop	Stop	Stop	Stop	Stop	Stop	Free	Free	Free	Free	Free	Free
RT Channelized	-	-	None	-	-	None	-	-	None	-	-	None
Storage Length	-	-	15	-	-	-	-	-	-	-	-	-
Veh in Median Storage, #	-	0	-	-	-	-	-	0	-	-	0	-
Grade, %	-	0	-	-	0	-	-	0	-	-	0	-
Peak Hour Factor	87	25	86	92	25	25	96	94	42	63	91	83
Heavy Vehicles, %	2	0	1	2	0	0	2	1	0	0	1	1
Mvmt Flow	143	4	127	0	0	0	168	751	12	8	619	135

Major/Minor	Minor2			Major1			Major2					
Conflicting Flow All	1796	1803	686				754	0	0	764	0	0
Stage 1	703	703	-				-	-	-	-	-	-
Stage 2	1093	1100	-				-	-	-	-	-	-
Critical Hdwy	6.42	6.5	6.21				4.12	-	-	4.1	-	-
Critical Hdwy Stg 1	5.42	5.5	-				-	-	-	-	-	-
Critical Hdwy Stg 2	5.42	5.5	-				-	-	-	-	-	-
Follow-up Hdwy	3.518	4	3.309				2.218	-	-	2.2	-	-
Pot Cap-1 Maneuver	~ 88	80	449				856	-	-	858	-	-
Stage 1	491	443	-				-	-	-	-	-	-
Stage 2	321	290	-				-	-	-	-	-	-
Platoon blocked, %								-	-		-	-
Mov Cap-1 Maneuver	~ 57	0	449				856	-	-	858	-	-
Mov Cap-2 Maneuver	~ 57	0	-				-	-	-	-	-	-
Stage 1	483	0	-				-	-	-	-	-	-
Stage 2	212	0	-				-	-	-	-	-	-

Approach	EB	NB	SB
HCM Control Delay, s\$	475.1	1.8	0.1
HCM LOS	F		

Minor Lane/Major Mvmt	NBL	NBT	NBR	EBLn1	EBLn2	SBL	SBT	SBR
Capacity (veh/h)	856	-	-	57	449	858	-	-
HCM Lane V/C Ratio	0.196	-	-	2.581	0.283	0.009	-	-
HCM Control Delay (s)	10.2	0	-	\$ 871	16.1	9.2	0	-
HCM Lane LOS	B	A	-	F	C	A	A	-
HCM 95th %tile Q(veh)	0.7	-	-	15	1.1	0	-	-

**Notes**

~: Volume exceeds capacity    \$: Delay exceeds 300s    +: Computation Not Defined    \*: All major volume in platoon

Lanes, Volumes, Timings  
 1: Main St (1A) & Arbor St/Friend Ct

07/23/2018



Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		↖	↗		↔		↖	↗		↖	↗	
Traffic Volume (vph)	16	1	346	3	3	6	287	555	6	5	578	27
Future Volume (vph)	16	1	346	3	3	6	287	555	6	5	578	27
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Storage Length (ft)	0		50	0		0	100		0	40		0
Storage Lanes	0		1	0		0	1		0	1		0
Taper Length (ft)	0			0			25			25		
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Ped Bike Factor							1.00	1.00		1.00	1.00	
Frt			0.850		0.932			0.998			0.991	
Flt Protected		0.959			0.992		0.950			0.950		
Satd. Flow (prot)	0	1639	1583	0	1757	0	1752	1824	0	1504	1825	0
Flt Permitted							0.176			0.423		
Satd. Flow (perm)	0	1710	1583	0	1771	0	325	1824	0	669	1825	0
Right Turn on Red			Yes			Yes			Yes			Yes
Satd. Flow (RTOR)			420		12			1			4	
Link Speed (mph)		30			30			30			30	
Link Distance (ft)		2388			2408			316			2230	
Travel Time (s)		54.3			54.7			7.2			50.7	
Confl. Peds. (#/hr)							1		1	1		1
Peak Hour Factor	0.67	0.25	0.84	0.75	0.38	0.50	0.84	0.90	0.75	0.31	0.91	0.68
Growth Factor	102%	102%	102%	102%	102%	102%	102%	102%	102%	102%	102%	102%
Heavy Vehicles (%)	13%	0%	2%	0%	0%	0%	3%	4%	0%	20%	3%	4%
Adj. Flow (vph)	24	4	420	4	8	12	349	629	8	16	648	41
Shared Lane Traffic (%)												
Lane Group Flow (vph)	0	28	420	0	24	0	349	637	0	16	689	0
Enter Blocked Intersection	No	No	No	No	No	No	No	No	No	No	No	No
Lane Alignment	Left	Left	Right	Left	Left	Right	Left	Left	Right	Left	Left	Right
Median Width(ft)		0			0			12			12	
Link Offset(ft)		0			-10			6			0	
Crosswalk Width(ft)		16			16			16			16	
Two way Left Turn Lane												
Headway Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Number of Detectors	1	1	2	1	2		1	2		1	2	
Detector Template	Left	Left	Thru	Left	Thru		Left	Thru		Left	Thru	
Leading Detector (ft)	20	20	100	20	100		20	100		20	100	
Trailing Detector (ft)	0	0	0	0	0		0	0		0	0	
Detector 1 Position(ft)	0	0	0	0	0		0	0		0	0	
Detector 1 Size(ft)	20	20	6	20	6		20	6		20	6	
Detector 1 Type	Cl+Ex	Cl+Ex	Cl+Ex	Cl+Ex	Cl+Ex		Cl+Ex	Cl+Ex		Cl+Ex	Cl+Ex	
Detector 1 Channel												
Detector 1 Extend (s)	0.0	0.0	0.0	0.0	0.0		0.0	0.0		0.0	0.0	
Detector 1 Queue (s)	0.0	0.0	0.0	0.0	0.0		0.0	0.0		0.0	0.0	
Detector 1 Delay (s)	0.0	0.0	0.0	0.0	0.0		0.0	0.0		0.0	0.0	
Detector 2 Position(ft)			94		94			94			94	
Detector 2 Size(ft)			6		6			6			6	
Detector 2 Type			Cl+Ex		Cl+Ex			Cl+Ex			Cl+Ex	
Detector 2 Channel												
Detector 2 Extend (s)			0.0		0.0			0.0			0.0	

Lanes, Volumes, Timings  
1: Main St (1A) & Arbor St/Friend Ct

07/23/2018

Lane Group	Ø9
Lane Configurations	
Traffic Volume (vph)	
Future Volume (vph)	
Ideal Flow (vphpl)	
Storage Length (ft)	
Storage Lanes	
Taper Length (ft)	
Lane Util. Factor	
Ped Bike Factor	
Frt	
Flt Protected	
Satd. Flow (prot)	
Flt Permitted	
Satd. Flow (perm)	
Right Turn on Red	
Satd. Flow (RTOR)	
Link Speed (mph)	
Link Distance (ft)	
Travel Time (s)	
Confl. Peds. (#/hr)	
Peak Hour Factor	
Growth Factor	
Heavy Vehicles (%)	
Adj. Flow (vph)	
Shared Lane Traffic (%)	
Lane Group Flow (vph)	
Enter Blocked Intersection	
Lane Alignment	
Median Width(ft)	
Link Offset(ft)	
Crosswalk Width(ft)	
Two way Left Turn Lane	
Headway Factor	
Number of Detectors	
Detector Template	
Leading Detector (ft)	
Trailing Detector (ft)	
Detector 1 Position(ft)	
Detector 1 Size(ft)	
Detector 1 Type	
Detector 1 Channel	
Detector 1 Extend (s)	
Detector 1 Queue (s)	
Detector 1 Delay (s)	
Detector 2 Position(ft)	
Detector 2 Size(ft)	
Detector 2 Type	
Detector 2 Channel	
Detector 2 Extend (s)	

Lanes, Volumes, Timings  
 1: Main St (1A) & Arbor St/Friend Ct

07/23/2018



Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Turn Type	Perm	NA	pm+ov	Perm	NA		pm+pt	NA		pm+pt	NA	
Protected Phases		6	7		2		7	4		3	8	
Permitted Phases	6		6	2			4			8		
Detector Phase	6	6	7	2	2		7	4		3	8	
Switch Phase												
Minimum Initial (s)	1.0	1.0	1.0	1.0	1.0		1.0	1.0		1.0	1.0	
Minimum Split (s)	6.0	6.0	6.0	6.0	6.0		6.0	6.0		6.0	6.0	
Total Split (s)	7.0	7.0	20.0	7.0	7.0		20.0	53.0		8.0	41.0	
Total Split (%)	7.8%	7.8%	22.2%	7.8%	7.8%		22.2%	58.9%		8.9%	45.6%	
Maximum Green (s)	2.0	2.0	15.0	2.0	2.0		15.0	48.0		3.0	36.0	
Yellow Time (s)	3.0	3.0	3.0	3.0	3.0		3.0	3.0		3.0	3.0	
All-Red Time (s)	2.0	2.0	2.0	2.0	2.0		2.0	2.0		2.0	2.0	
Lost Time Adjust (s)		0.0	0.0		0.0		0.0	0.0		0.0	0.0	
Total Lost Time (s)		5.0	5.0		5.0		5.0	5.0		5.0	5.0	
Lead/Lag			Lead				Lead	Lag		Lead	Lag	
Lead-Lag Optimize?			Yes				Yes	Yes		Yes	Yes	
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0		3.0	3.0		3.0	3.0	
Recall Mode	None	None	None	None	None		None	None		None	None	
Walk Time (s)												
Flash Dont Walk (s)												
Pedestrian Calls (#/hr)												
Act Effect Green (s)		2.1	19.5		2.1		52.2	53.7		34.2	31.1	
Actuated g/C Ratio		0.03	0.30		0.03		0.81	0.84		0.53	0.48	
v/c Ratio		0.50	0.54		0.35		0.57	0.42		0.04	0.78	
Control Delay		70.1	5.8		42.3		12.6	6.6		6.0	23.8	
Queue Delay		0.0	0.0		0.0		0.0	0.0		0.0	0.0	
Total Delay		70.1	5.8		42.3		12.6	6.6		6.0	23.8	
LOS		E	A		D		B	A		A	C	
Approach Delay		9.9			42.3			8.7			23.4	
Approach LOS		A			D			A			C	
90th %ile Green (s)	2.0	2.0	15.0	2.0	2.0		15.0	48.0		3.0	36.0	
90th %ile Term Code	Max	Max	Max	Max	Max		Max	Hold		Max	Max	
70th %ile Green (s)	2.0	2.0	15.0	2.0	2.0		15.0	56.0		0.0	36.0	
70th %ile Term Code	Max	Max	Max	Max	Max		Max	Hold		Skip	Max	
50th %ile Green (s)	2.0	2.0	15.0	2.0	2.0		15.0	53.9		0.0	33.9	
50th %ile Term Code	Max	Max	Max	Hold	Hold		Max	Hold		Skip	Gap	
30th %ile Green (s)	0.0	0.0	15.0	0.0	0.0		15.0	46.2		0.0	26.2	
30th %ile Term Code	Skip	Skip	Max	Skip	Skip		Max	Hold		Skip	Gap	
10th %ile Green (s)	0.0	0.0	15.0	0.0	0.0		15.0	41.3		0.0	21.3	
10th %ile Term Code	Skip	Skip	Max	Skip	Skip		Max	Hold		Skip	Gap	
Stops (vph)		14	39		8		90	176		3	425	
Fuel Used(gal)		1	7		0		2	3		0	16	
CO Emissions (g/hr)		44	504		26		138	220		8	1125	
NOx Emissions (g/hr)		9	98		5		27	43		1	219	
VOC Emissions (g/hr)		10	117		6		32	51		2	261	
Dilemma Vehicles (#)		0	0		0		0	0		0	0	
Queue Length 50th (ft)		12	0		5		26	41		1	198	
Queue Length 95th (ft)		12	52		10		#190	365		4	#600	
Internal Link Dist (ft)		2308			2328			236			2150	



Lanes, Volumes, Timings  
 1: Main St (1A) & Arbor St/Friend Ct

07/23/2018

Lane Group	Ø9
Turn Type	
Protected Phases	9
Permitted Phases	
Detector Phase	
Switch Phase	
Minimum Initial (s)	1.0
Minimum Split (s)	22.0
Total Split (s)	22.0
Total Split (%)	24%
Maximum Green (s)	20.0
Yellow Time (s)	2.0
All-Red Time (s)	0.0
Lost Time Adjust (s)	
Total Lost Time (s)	
Lead/Lag	
Lead-Lag Optimize?	
Vehicle Extension (s)	3.0
Recall Mode	None
Walk Time (s)	9.0
Flash Dont Walk (s)	11.0
Pedestrian Calls (#/hr)	10
Act Effct Green (s)	
Actuated g/C Ratio	
v/c Ratio	
Control Delay	
Queue Delay	
Total Delay	
LOS	
Approach Delay	
Approach LOS	
90th %ile Green (s)	20.0
90th %ile Term Code	Ped
70th %ile Green (s)	0.0
70th %ile Term Code	Skip
50th %ile Green (s)	0.0
50th %ile Term Code	Skip
30th %ile Green (s)	0.0
30th %ile Term Code	Skip
10th %ile Green (s)	0.0
10th %ile Term Code	Skip
Stops (vph)	
Fuel Used(gal)	
CO Emissions (g/hr)	
NOx Emissions (g/hr)	
VOC Emissions (g/hr)	
Dilemma Vehicles (#)	
Queue Length 50th (ft)	
Queue Length 95th (ft)	
Internal Link Dist (ft)	

Lanes, Volumes, Timings  
 1: Main St (1A) & Arbor St/Friend Ct

07/23/2018



Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Turn Bay Length (ft)			50				100			40		
Base Capacity (vph)		56	773		69		615	1500		397	1080	
Starvation Cap Reductn		0	0		0		0	0		0	0	
Spillback Cap Reductn		0	0		0		0	0		0	0	
Storage Cap Reductn		0	0		0		0	0		0	0	
Reduced v/c Ratio		0.50	0.54		0.35		0.57	0.42		0.04	0.64	

Intersection Summary

Area Type:	Other
Cycle Length:	90
Actuated Cycle Length:	64.3
Natural Cycle:	90
Control Type:	Actuated-Uncoordinated
Maximum v/c Ratio:	0.78
Intersection Signal Delay:	14.1
Intersection LOS:	B
Intersection Capacity Utilization:	70.4%
ICU Level of Service:	C
Analysis Period (min):	15
90th %ile Actuated Cycle:	90
70th %ile Actuated Cycle:	68
50th %ile Actuated Cycle:	65.9
30th %ile Actuated Cycle:	51.2
10th %ile Actuated Cycle:	46.3
# 95th percentile volume exceeds capacity, queue may be longer. Queue shown is maximum after two cycles.	

Splits and Phases: 1: Main St (1A) & Arbor St/Friend Ct



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Lane Group	Ø9
Turn Bay Length (ft)	
Base Capacity (vph)	
Starvation Cap Reductn	
Spillback Cap Reductn	
Storage Cap Reductn	
Reduced v/c Ratio	
Intersection Summary	

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# Lanes, Volumes, Timings

## 2: Main St (1A) & Monument St/Wenham Town Hall

07/23/2018



Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		↕	↗				↖	↗			↕	
Traffic Volume (vph)	174	0	3	0	0	0	5	667	0	1	752	185
Future Volume (vph)	174	0	3	0	0	0	5	667	0	1	752	185
Ideal Flow (vphp)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Storage Length (ft)	0		15	0		0	25		0	0		0
Storage Lanes	0		1	0		0	1		0	0		0
Taper Length (ft)	0			0			25			0		
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Ped Bike Factor												
Frt			0.850								0.971	
Flt Protected		0.950					0.950					
Satd. Flow (prot)	0	1703	1615	0	0	0	1504	1845	0	0	1805	0
Flt Permitted		0.950					0.950					
Satd. Flow (perm)	0	1703	1615	0	0	0	1504	1845	0	0	1805	0
Link Speed (mph)		30			30			30			30	
Link Distance (ft)		2613			509			460			316	
Travel Time (s)		59.4			11.6			10.5			7.2	
Confl. Peds. (#/hr)							5					5
Peak Hour Factor	0.81	0.92	0.38	0.92	0.25	0.25	0.63	0.87	0.92	0.25	0.95	0.86
Growth Factor	102%	102%	102%	102%	102%	102%	102%	102%	102%	102%	102%	102%
Heavy Vehicles (%)	6%	2%	0%	2%	0%	0%	20%	3%	0%	0%	2%	3%
Adj. Flow (vph)	219	0	8	0	0	0	8	782	0	4	807	219
Shared Lane Traffic (%)												
Lane Group Flow (vph)	0	219	8	0	0	0	8	782	0	0	1030	0
Enter Blocked Intersection	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Lane Alignment	Left	Left	Right	Left	Left	Right	Left	Left	Right	Left	Left	Right
Median Width(ft)		0			0			12			12	
Link Offset(ft)		0			30			0			0	
Crosswalk Width(ft)		16			16			16			16	
Two way Left Turn Lane												
Headway Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Turning Speed (mph)	25		9	15		9	15		9	15		9
Sign Control		Stop			Stop			Free			Free	

### Intersection Summary

Area Type:	Other
Control Type:	Unsignalized
Intersection Capacity Utilization	69.3%
ICU Level of Service	C
Analysis Period (min)	15

# HCM Unsignalized Intersection Capacity Analysis

## 2: Main St (1A) & Monument St/Wenham Town Hall

07/23/2018



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		↕	↗				↖	↖			↕	
Traffic Volume (veh/h)	174	0	3	0	0	0	5	667	0	1	752	185
Future Volume (Veh/h)	174	0	3	0	0	0	5	667	0	1	752	185
Sign Control		Stop			Stop			Free			Free	
Grade		0%			0%			0%			0%	
Peak Hour Factor	0.81	0.92	0.38	0.92	0.25	0.25	0.63	0.87	0.92	0.25	0.95	0.86
Hourly flow rate (vph)	219	0	8	0	0	0	8	782	0	4	807	219
Pedestrians		5										
Lane Width (ft)		12.0										
Walking Speed (ft/s)		3.5										
Percent Blockage		0										
Right turn flare (veh)			1									
Median type								None			None	
Median storage (veh)												
Upstream signal (ft)											316	
pX, platoon unblocked	0.69	0.69	0.69	0.69	0.69		0.69					
vC, conflicting volume	1728	1728	922	1726	1837	782	1031			782		
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	1830	1830	661	1829	1989	782	820			782		
tC, single (s)	*6.0	6.5	*6.5	7.1	6.5	6.2	4.3			4.1		
tC, 2 stage (s)												
tF (s)	3.6	4.0	3.3	3.5	4.0	3.3	2.4			2.2		
p0 queue free %	0	100	97	100	100	100	98			100		
cM capacity (veh/h)	70	51	303	39	41	397	505			845		

Direction, Lane #	EB 1	NB 1	NB 2	SB 1
Volume Total	227	8	782	1030
Volume Left	219	8	0	4
Volume Right	8	0	0	219
cSH	72	505	1700	845
Volume to Capacity	3.16	0.02	0.46	0.00
Queue Length 95th (ft)	Err	1	0	0
Control Delay (s)	Err	12.2	0.0	0.1
Lane LOS	F	B		A
Approach Delay (s)	Err	0.1		0.1
Approach LOS	F			

Intersection Summary			
Average Delay		1109.0	
Intersection Capacity Utilization		69.3%	ICU Level of Service C
Analysis Period (min)		15	

\* User Entered Value



**Intersection**

Int Delay, s/veh 77.9

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		↕	↗				↖	↘			↕	
Traffic Vol, veh/h	174	0	3	0	0	0	5	667	0	1	752	185
Future Vol, veh/h	174	0	3	0	0	0	5	667	0	1	752	185
Conflicting Peds, #/hr	0	0	0	0	0	0	5	0	0	0	0	5
Sign Control	Stop	Stop	Stop	Stop	Stop	Stop	Free	Free	Free	Free	Free	Free
RT Channelized	-	-	None	-	-	None	-	-	None	-	-	None
Storage Length	-	-	15	-	-	-	25	-	-	-	-	-
Veh in Median Storage, #	-	0	-	-	-	-	-	0	-	-	0	-
Grade, %	-	0	-	-	0	-	-	0	-	-	0	-
Peak Hour Factor	81	92	38	92	25	25	63	87	92	25	95	86
Heavy Vehicles, %	6	2	0	2	0	0	20	3	0	0	2	3
Mvmt Flow	219	0	8	0	0	0	8	782	0	4	807	219

Major/Minor	Minor2			Major1			Major2					
Conflicting Flow All	1728	1728	922				1032	0	0	782	0	0
Stage 1	930	930	-				-	-	-	-	-	-
Stage 2	798	798	-				-	-	-	-	-	-
Critical Hdwy	6.46	6.52	6.2				4.3	-	-	4.1	-	-
Critical Hdwy Stg 1	5.46	5.52	-				-	-	-	-	-	-
Critical Hdwy Stg 2	5.46	5.52	-				-	-	-	-	-	-
Follow-up Hdwy	3.554	4.018	3.3				2.38	-	-	2.2	-	-
Pot Cap-1 Maneuver	~ 95	88	330				608	-	-	845	-	-
Stage 1	378	346	-				-	-	-	-	-	-
Stage 2	436	398	-				-	-	-	-	-	-
Platoon blocked, %								-	-		-	-
Mov Cap-1 Maneuver	~ 92	0	328				608	-	-	845	-	-
Mov Cap-2 Maneuver	~ 92	0	-				-	-	-	-	-	-
Stage 1	372	0	-				-	-	-	-	-	-
Stage 2	428	0	-				-	-	-	-	-	-

Approach	EB	NB	SB
HCM Control Delay, s/\$	702.1	0.1	0
HCM LOS	F		

Minor Lane/Major Mvmt	NBL	NBT	NBR	EBLn1	EBLn2	SBL	SBT	SBR
Capacity (veh/h)	608	-	-	92	328	845	-	-
HCM Lane V/C Ratio	0.013	-	-	2.382	0.025	0.005	-	-
HCM Control Delay (s)	11	-	-	\$ 727.3	16.3	9.3	0	-
HCM Lane LOS	B	-	-	F	C	A	A	-
HCM 95th %tile Q(veh)	0	-	-	20	0.1	0	-	-

**Notes**

~: Volume exceeds capacity    \$: Delay exceeds 300s    +: Computation Not Defined    \*: All major volume in platoon

Lanes, Volumes, Timings  
 3: Main St (1A) & Cherry St/Old Country Rd

07/23/2018



Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		↕	↗				↖	↗			↕	
Traffic Volume (vph)	129	1	154	0	0	0	87	544	2	2	642	108
Future Volume (vph)	129	1	154	0	0	0	87	544	2	2	642	108
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Storage Length (ft)	0		50	0		0	75		0	0		0
Storage Lanes	0		1	0		0	1		0	0		0
Taper Length (ft)	0			0			25			0		
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Frt			0.850					0.999			0.977	
Flt Protected		0.954					0.950					
Satd. Flow (prot)	0	1778	1538	0	0	0	1752	1826	0	0	1805	0
Flt Permitted		0.954					0.950					
Satd. Flow (perm)	0	1778	1538	0	0	0	1752	1826	0	0	1805	0
Link Speed (mph)		30			30			30			30	
Link Distance (ft)		2702			575			3735			460	
Travel Time (s)		61.4			13.1			84.9			10.5	
Peak Hour Factor	0.95	0.25	0.88	0.92	0.25	0.25	0.84	0.83	0.50	0.50	0.93	0.75
Growth Factor	102%	102%	102%	102%	102%	102%	102%	102%	102%	102%	102%	102%
Heavy Vehicles (%)	2%	0%	5%	2%	0%	0%	3%	4%	0%	0%	3%	2%
Adj. Flow (vph)	139	4	179	0	0	0	106	669	4	4	704	147
Shared Lane Traffic (%)												
Lane Group Flow (vph)	0	143	179	0	0	0	106	673	0	0	855	0
Enter Blocked Intersection	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Lane Alignment	Left	Left	Right	Left	Left	Right	Left	Left	Right	Left	Left	Right
Median Width(ft)		0			0			12			12	
Link Offset(ft)		0			16			0			0	
Crosswalk Width(ft)		16			16			16			16	
Two way Left Turn Lane												
Headway Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Sign Control		Stop			Stop			Free			Free	

Intersection Summary

Area Type:	Other
Control Type:	Unsignalized
Intersection Capacity Utilization	84.9%
ICU Level of Service	E
Analysis Period (min)	15

# HCM Unsignalized Intersection Capacity Analysis

## 3: Main St (1A) & Cherry St/Old Country Rd

07/23/2018



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		↔	↔				↔	↔			↔	
Traffic Volume (veh/h)	129	1	154	0	0	0	87	544	2	2	642	108
Future Volume (Veh/h)	129	1	154	0	0	0	87	544	2	2	642	108
Sign Control		Stop			Stop			Free			Free	
Grade		0%			0%			0%			0%	
Peak Hour Factor	0.95	0.25	0.88	0.92	0.25	0.25	0.84	0.83	0.50	0.50	0.93	0.75
Hourly flow rate (vph)	139	4	179	0	0	0	106	669	4	4	704	147
Pedestrians												
Lane Width (ft)												
Walking Speed (ft/s)												
Percent Blockage												
Right turn flare (veh)			2									
Median type								None			None	
Median storage (veh)												
Upstream signal (ft)											776	
pX, platoon unblocked	0.77	0.77	0.77	0.77	0.77		0.77					
vC, conflicting volume	1666	1670	778	1760	1742	671	851			673		
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	1715	1720	566	1836	1813	671	661			673		
tC, single (s)	*6.5	*6.2	*6.0	7.1	6.5	6.2	4.1			4.1		
tC, 2 stage (s)												
tF (s)	3.5	4.0	3.3	3.5	4.0	3.3	2.2			2.2		
p0 queue free %	0	94	57	100	100	100	85			100		
cM capacity (veh/h)	65	68	417	22	52	460	714			927		

Direction, Lane #	EB 1	NB 1	NB 2	SB 1
Volume Total	322	106	673	855
Volume Left	139	106	0	4
Volume Right	179	0	4	147
cSH	124	714	1700	927
Volume to Capacity	2.59	0.15	0.40	0.00
Queue Length 95th (ft)	722	13	0	0
Control Delay (s)	792.4	10.9	0.0	0.1
Lane LOS	F	B		A
Approach Delay (s)	792.4	1.5		0.1
Approach LOS	F			

Intersection Summary			
Average Delay		131.1	
Intersection Capacity Utilization	84.9%		ICU Level of Service E
Analysis Period (min)	15		

\* User Entered Value

**Intersection**

Int Delay, s/veh	30.4											
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		↔	↔				↔	↔			↔	
Traffic Vol, veh/h	129	1	154	0	0	0	87	544	2	2	642	108
Future Vol, veh/h	129	1	154	0	0	0	87	544	2	2	642	108
Conflicting Peds, #/hr	0	0	0	0	0	0	0	0	0	0	0	0
Sign Control	Stop	Stop	Stop	Stop	Stop	Stop	Free	Free	Free	Free	Free	Free
RT Channelized	-	-	None	-	-	None	-	-	None	-	-	None
Storage Length	-	-	50	-	-	-	75	-	-	-	-	-
Veh in Median Storage, #	-	0	-	-	-	-	-	0	-	-	0	-
Grade, %	-	0	-	-	0	-	-	0	-	-	0	-
Peak Hour Factor	95	25	88	92	25	25	84	83	50	50	93	75
Heavy Vehicles, %	2	0	5	2	0	0	3	4	0	0	3	2
Mvmt Flow	139	4	179	0	0	0	106	669	4	4	704	147

Major/Minor	Minor2			Major1			Major2					
Conflicting Flow All	1668	1670	778				851	0	0	673	0	0
Stage 1	786	786	-				-	-	-	-	-	-
Stage 2	882	884	-				-	-	-	-	-	-
Critical Hdwy	6.42	6.5	6.25				4.13	-	-	4.1	-	-
Critical Hdwy Stg 1	5.42	5.5	-				-	-	-	-	-	-
Critical Hdwy Stg 2	5.42	5.5	-				-	-	-	-	-	-
Follow-up Hdwy	3.518	4	3.345				2.227	-	-	2.2	-	-
Pot Cap-1 Maneuver	~ 106	97	392				783	-	-	927	-	-
Stage 1	449	406	-				-	-	-	-	-	-
Stage 2	405	366	-				-	-	-	-	-	-
Platoon blocked, %								-	-		-	-
Mov Cap-1 Maneuver	~ 91	0	392				783	-	-	927	-	-
Mov Cap-2 Maneuver	~ 91	0	-				-	-	-	-	-	-
Stage 1	445	0	-				-	-	-	-	-	-
Stage 2	350	0	-				-	-	-	-	-	-

Approach	EB	NB	SB
HCM Control Delay, s	181.8	1.4	0
HCM LOS	F		

Minor Lane/Major Mvmt	NBL	NBT	NBR	EBLn1	EBLn2	SBL	SBT	SBR
Capacity (veh/h)	783	-	-	91	392	927	-	-
HCM Lane V/C Ratio	0.135	-	-	1.567	0.455	0.004	-	-
HCM Control Delay (s)	10.3	-	-	\$ 382.3	21.6	8.9	0	-
HCM Lane LOS	B	-	-	F	C	A	A	-
HCM 95th %tile Q(veh)	0.5	-	-	11.2	2.3	0	-	-

**Notes**  
 -: Volume exceeds capacity    \$: Delay exceeds 300s    +: Computation Not Defined    \*: All major volume in platoon

Lanes, Volumes, Timings  
 1: Main St (1A) & Arbor St/Friend Ct

07/23/2018



Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		↖	↗		↔		↖	↗		↖	↗	
Traffic Volume (vph)	18	0	267	7	0	13	297	652	11	5	596	25
Future Volume (vph)	18	0	267	7	0	13	297	652	11	5	596	25
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Storage Length (ft)	0		50	0		0	100		0	40		0
Storage Lanes	0		1	0		0	1		0	1		0
Taper Length (ft)	0			0			25			25		
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Ped Bike Factor							1.00	1.00		1.00	1.00	
Frt			0.850		0.905			0.997				0.993
Flt Protected		0.950			0.986		0.950			0.950		
Satd. Flow (prot)	0	1805	1615	0	1695	0	1787	1857	0	1805	1867	0
Flt Permitted							0.142			0.376		
Satd. Flow (perm)	0	1900	1615	0	1720	0	267	1857	0	714	1867	0
Right Turn on Red			Yes			Yes			Yes			Yes
Satd. Flow (RTOR)			309		170			2				3
Link Speed (mph)		30			30			30				30
Link Distance (ft)		2388			2408			316				2230
Travel Time (s)		54.3			54.7			7.2				50.7
Confl. Peds. (#/hr)							1		2	2		1
Peak Hour Factor	0.56	0.92	0.88	0.58	0.92	0.46	0.88	0.89	0.69	0.63	0.93	0.78
Growth Factor	102%	102%	102%	102%	102%	102%	102%	102%	102%	102%	102%	102%
Heavy Vehicles (%)	0%	0%	0%	0%	0%	0%	1%	2%	0%	0%	1%	0%
Adj. Flow (vph)	33	0	309	12	0	29	344	747	16	8	654	33
Shared Lane Traffic (%)												
Lane Group Flow (vph)	0	33	309	0	41	0	344	763	0	8	687	0
Enter Blocked Intersection	No	No	No	No	No	No	No	No	No	No	No	No
Lane Alignment	Left	Left	Right	Left	Left	Right	Left	Left	Right	Left	Left	Right
Median Width(ft)		0			0			12				12
Link Offset(ft)		0			-10			6				0
Crosswalk Width(ft)		16			16			16				16
Two way Left Turn Lane												
Headway Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Number of Detectors	1	1	2	1	2		1	2		1	2	
Detector Template	Left	Left	Thru	Left	Thru		Left	Thru		Left	Thru	
Leading Detector (ft)	20	20	100	20	100		20	100		20	100	
Trailing Detector (ft)	0	0	0	0	0		0	0		0	0	
Detector 1 Position(ft)	0	0	0	0	0		0	0		0	0	
Detector 1 Size(ft)	20	20	6	20	6		20	6		20	6	
Detector 1 Type	Cl+Ex	Cl+Ex	Cl+Ex	Cl+Ex	Cl+Ex		Cl+Ex	Cl+Ex		Cl+Ex	Cl+Ex	
Detector 1 Channel												
Detector 1 Extend (s)	0.0	0.0	0.0	0.0	0.0		0.0	0.0		0.0	0.0	
Detector 1 Queue (s)	0.0	0.0	0.0	0.0	0.0		0.0	0.0		0.0	0.0	
Detector 1 Delay (s)	0.0	0.0	0.0	0.0	0.0		0.0	0.0		0.0	0.0	
Detector 2 Position(ft)			94		94			94			94	
Detector 2 Size(ft)			6		6			6			6	
Detector 2 Type			Cl+Ex		Cl+Ex			Cl+Ex			Cl+Ex	
Detector 2 Channel												
Detector 2 Extend (s)			0.0		0.0			0.0			0.0	



Lanes, Volumes, Timings  
1: Main St (1A) & Arbor St/Friend Ct

07/23/2018

Lane Group	Ø9
Lane Configurations	
Traffic Volume (vph)	
Future Volume (vph)	
Ideal Flow (vphpl)	
Storage Length (ft)	
Storage Lanes	
Taper Length (ft)	
Lane Util. Factor	
Ped Bike Factor	
Frt	
Flt Protected	
Satd. Flow (prot)	
Flt Permitted	
Satd. Flow (perm)	
Right Turn on Red	
Satd. Flow (RTOR)	
Link Speed (mph)	
Link Distance (ft)	
Travel Time (s)	
Confl. Peds. (#/hr)	
Peak Hour Factor	
Growth Factor	
Heavy Vehicles (%)	
Adj. Flow (vph)	
Shared Lane Traffic (%)	
Lane Group Flow (vph)	
Enter Blocked Intersection	
Lane Alignment	
Median Width(ft)	
Link Offset(ft)	
Crosswalk Width(ft)	
Two way Left Turn Lane	
Headway Factor	
Number of Detectors	
Detector Template	
Leading Detector (ft)	
Trailing Detector (ft)	
Detector 1 Position(ft)	
Detector 1 Size(ft)	
Detector 1 Type	
Detector 1 Channel	
Detector 1 Extend (s)	
Detector 1 Queue (s)	
Detector 1 Delay (s)	
Detector 2 Position(ft)	
Detector 2 Size(ft)	
Detector 2 Type	
Detector 2 Channel	
Detector 2 Extend (s)	

Lanes, Volumes, Timings  
1: Main St (1A) & Arbor St/Friend Ct

07/23/2018



Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Turn Type	Perm	NA	pm+ov	Perm	NA		pm+pt	NA		pm+pt	NA	
Protected Phases		6	7		2		7	4		3	8	
Permitted Phases	6		6	2			4			8		
Detector Phase	6	6	7	2	2		7	4		3	8	
Switch Phase												
Minimum Initial (s)	1.0	1.0	1.0	1.0	1.0		1.0	1.0		1.0	1.0	
Minimum Split (s)	6.0	6.0	6.0	6.0	6.0		6.0	6.0		6.0	6.0	
Total Split (s)	7.0	7.0	20.0	7.0	7.0		20.0	55.0		6.0	41.0	
Total Split (%)	7.8%	7.8%	22.2%	7.8%	7.8%		22.2%	61.1%		6.7%	45.6%	
Maximum Green (s)	2.0	2.0	15.0	2.0	2.0		15.0	50.0		1.0	36.0	
Yellow Time (s)	3.0	3.0	3.0	3.0	3.0		3.0	3.0		3.0	3.0	
All-Red Time (s)	2.0	2.0	2.0	2.0	2.0		2.0	2.0		2.0	2.0	
Lost Time Adjust (s)		0.0	0.0		0.0		0.0	0.0		0.0	0.0	
Total Lost Time (s)		5.0	5.0		5.0		5.0	5.0		5.0	5.0	
Lead/Lag			Lead				Lead	Lag		Lead	Lag	
Lead-Lag Optimize?			Yes				Yes	Yes		Yes	Yes	
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0		3.0	3.0		3.0	3.0	
Recall Mode	None	None	None	None	None		None	None		None	None	
Walk Time (s)												
Flash Dont Walk (s)												
Pedestrian Calls (#/hr)												
Act Effct Green (s)		2.1	20.7		2.1		50.8	51.5		31.1	30.1	
Actuated g/C Ratio		0.03	0.32		0.03		0.79	0.80		0.48	0.47	
v/c Ratio		0.53	0.42		0.19		0.60	0.52		0.02	0.79	
Control Delay		69.7	5.4		1.9		15.5	7.3		6.6	24.7	
Queue Delay		0.0	0.0		0.0		0.0	0.0		0.0	0.0	
Total Delay		69.7	5.4		1.9		15.5	7.3		6.6	24.7	
LOS		E	A		A		B	A		A	C	
Approach Delay		11.6			1.9			9.9			24.5	
Approach LOS		B			A			A			C	
90th %ile Green (s)	2.0	2.0	15.0	2.0	2.0		15.0	50.0		1.0	36.0	
90th %ile Term Code	Max	Max	Max	Max	Max		Max	Max		Max	Max	
70th %ile Green (s)	2.0	2.0	15.0	2.0	2.0		15.0	55.9		0.0	35.9	
70th %ile Term Code	Max	Max	Max	Max	Max		Max	Hold		Skip	Gap	
50th %ile Green (s)	2.0	2.0	15.0	2.0	2.0		15.0	52.0		0.0	32.0	
50th %ile Term Code	Max	Max	Max	Max	Max		Max	Hold		Skip	Gap	
30th %ile Green (s)	2.0	2.0	15.0	2.0	2.0		15.0	46.9		0.0	26.9	
30th %ile Term Code	Max	Max	Max	Hold	Hold		Max	Hold		Skip	Gap	
10th %ile Green (s)	0.0	0.0	13.4	0.0	0.0		13.4	37.0		0.0	18.6	
10th %ile Term Code	Skip	Skip	Gap	Skip	Skip		Gap	Hold		Skip	Gap	
Stops (vph)		15	31		0		107	241		3	448	
Fuel Used(gal)		1	6		0		2	4		0	17	
CO Emissions (g/hr)		47	387		27		160	280		8	1167	
NOx Emissions (g/hr)		9	75		5		31	55		1	227	
VOC Emissions (g/hr)		11	90		6		37	65		2	270	
Dilemma Vehicles (#)		0	0		0		0	0		0	0	
Queue Length 50th (ft)		13	0		0		37	52		1	196	
Queue Length 95th (ft)		#75	58		0		#195	402		5	#587	
Internal Link Dist (ft)		2308			2328			236			2150	

Lanes, Volumes, Timings  
 1: Main St (1A) & Arbor St/Friend Ct

07/23/2018

Lane Group	Ø9
Turn Type	
Protected Phases	9
Permitted Phases	
Detector Phase	
Switch Phase	
Minimum Initial (s)	1.0
Minimum Split (s)	22.0
Total Split (s)	22.0
Total Split (%)	24%
Maximum Green (s)	20.0
Yellow Time (s)	2.0
All-Red Time (s)	0.0
Lost Time Adjust (s)	
Total Lost Time (s)	
Lead/Lag	
Lead-Lag Optimize?	
Vehicle Extension (s)	3.0
Recall Mode	None
Walk Time (s)	9.0
Flash Dont Walk (s)	11.0
Pedestrian Calls (#/hr)	15
Act Effct Green (s)	
Actuated g/C Ratio	
v/c Ratio	
Control Delay	
Queue Delay	
Total Delay	
LOS	
Approach Delay	
Approach LOS	
90th %ile Green (s)	20.0
90th %ile Term Code	Ped
70th %ile Green (s)	0.0
70th %ile Term Code	Skip
50th %ile Green (s)	0.0
50th %ile Term Code	Skip
30th %ile Green (s)	0.0
30th %ile Term Code	Skip
10th %ile Green (s)	0.0
10th %ile Term Code	Skip
Stops (vph)	
Fuel Used(gal)	
CO Emissions (g/hr)	
NOx Emissions (g/hr)	
VOC Emissions (g/hr)	
Dilemma Vehicles (#)	
Queue Length 50th (ft)	
Queue Length 95th (ft)	
Internal Link Dist (ft)	

Lanes, Volumes, Timings  
 1: Main St (1A) & Arbor St/Friend Ct

07/23/2018



Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Turn Bay Length (ft)			50				100			40		
Base Capacity (vph)		62	738		220		585	1501		362	1106	
Starvation Cap Reductn		0	0		0		0	0		0	0	
Spillback Cap Reductn		0	0		0		0	0		0	0	
Storage Cap Reductn		0	0		0		0	0		0	0	
Reduced v/c Ratio		0.53	0.42		0.19		0.59	0.51		0.02	0.62	

Intersection Summary

Area Type:	Other
Cycle Length:	90
Actuated Cycle Length:	64.6
Natural Cycle:	90
Control Type:	Actuated-Uncoordinated
Maximum v/c Ratio:	0.79
Intersection Signal Delay:	14.6
Intersection LOS:	B
Intersection Capacity Utilization:	70.6%
ICU Level of Service:	C
Analysis Period (min):	15
90th %ile Actuated Cycle:	90
70th %ile Actuated Cycle:	67.9
50th %ile Actuated Cycle:	64
30th %ile Actuated Cycle:	58.9
10th %ile Actuated Cycle:	42
#	95th percentile volume exceeds capacity, queue may be longer. Queue shown is maximum after two cycles.

Splits and Phases: 1: Main St (1A) & Arbor St/Friend Ct



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Lane Group	Ø9
Turn Bay Length (ft)	
Base Capacity (vph)	
Starvation Cap Reductn	
Spillback Cap Reductn	
Storage Cap Reductn	
Reduced v/c Ratio	
Intersection Summary	

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# Lanes, Volumes, Timings

## 2: Main St (1A) & Monument St/Wenham Town Hall

07/23/2018



Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		↕	↗				↖	↗			↕	
Traffic Volume (vph)	152	0	6	0	0	0	6	806	2	1	659	210
Future Volume (vph)	152	0	6	0	0	0	6	806	2	1	659	210
Ideal Flow (vphp)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Storage Length (ft)	0		15	0		0	25		0	0		0
Storage Lanes	0		1	0		0	1		0	0		0
Taper Length (ft)	0			0			25			0		
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Ped Bike Factor												
Frt			0.850					0.999			0.964	
Flt Protected		0.950					0.950					
Satd. Flow (prot)	0	1787	1380	0	0	0	1805	1879	0	0	1814	0
Flt Permitted		0.950					0.950					
Satd. Flow (perm)	0	1787	1380	0	0	0	1805	1879	0	0	1814	0
Link Speed (mph)		30			30			30			30	
Link Distance (ft)		2613			509			460			316	
Travel Time (s)		59.4			11.6			10.5			7.2	
Confl. Peds. (#/hr)							1					1
Peak Hour Factor	0.86	0.92	0.38	0.92	0.25	0.25	0.75	0.92	0.50	0.25	0.94	0.83
Growth Factor	102%	102%	102%	102%	102%	102%	102%	102%	102%	102%	102%	102%
Heavy Vehicles (%)	1%	2%	17%	2%	0%	0%	0%	1%	0%	0%	1%	1%
Adj. Flow (vph)	180	0	16	0	0	0	8	894	4	4	715	258
Shared Lane Traffic (%)												
Lane Group Flow (vph)	0	180	16	0	0	0	8	898	0	0	977	0
Enter Blocked Intersection	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Lane Alignment	Left	Left	Right	Left	Left	Right	Left	Left	Right	Left	Left	Right
Median Width(ft)		0			0			12			12	
Link Offset(ft)		0			30			0			0	
Crosswalk Width(ft)		16			16			16			16	
Two way Left Turn Lane												
Headway Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Turning Speed (mph)	25		9	15		9	15		9	15		9
Sign Control		Stop			Stop			Free			Free	

### Intersection Summary

Area Type:	Other
Control Type:	Unsignalized
Intersection Capacity Utilization	64.5%
ICU Level of Service	C
Analysis Period (min)	15

# HCM Unsignalized Intersection Capacity Analysis

## 2: Main St (1A) & Monument St/Wenham Town Hall

07/23/2018



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		↔	↔				↔	↔			↔	
Traffic Volume (veh/h)	152	0	6	0	0	0	6	806	2	1	659	210
Future Volume (Veh/h)	152	0	6	0	0	0	6	806	2	1	659	210
Sign Control		Stop			Stop			Free			Free	
Grade		0%			0%			0%			0%	
Peak Hour Factor	0.86	0.92	0.38	0.92	0.25	0.25	0.75	0.92	0.50	0.25	0.94	0.83
Hourly flow rate (vph)	180	0	16	0	0	0	8	894	4	4	715	258
Pedestrians		1										
Lane Width (ft)		12.0										
Walking Speed (ft/s)		3.5										
Percent Blockage		0										
Right turn flare (veh)			1									
Median type								None			None	
Median storage (veh)												
Upstream signal (ft)											316	
pX, platoon unblocked	0.67	0.67	0.67	0.67	0.67		0.67					
vC, conflicting volume	1763	1767	845	1772	1894	896	974			898		
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	1895	1901	517	1908	2091	896	711			898		
tC, single (s)	*6.0	6.5	*6.5	7.1	6.5	6.2	4.1			4.1		
tC, 2 stage (s)												
tF (s)	3.5	4.0	3.5	3.5	4.0	3.3	2.2			2.2		
p0 queue free %	0	100	95	100	100	100	99			99		
cM capacity (veh/h)	63	45	346	32	35	342	598			765		

Direction, Lane #	EB 1	NB 1	NB 2	SB 1
Volume Total	196	8	898	977
Volume Left	180	8	0	4
Volume Right	16	0	4	258
cSH	67	598	1700	765
Volume to Capacity	2.91	0.01	0.53	0.01
Queue Length 95th (ft)	495	1	0	0
Control Delay (s)	994.6	11.1	0.0	0.2
Lane LOS	F	B		A
Approach Delay (s)	994.6	0.1		0.2
Approach LOS	F			

Intersection Summary			
Average Delay		93.9	
Intersection Capacity Utilization	64.5%		ICU Level of Service C
Analysis Period (min)	15		

\* User Entered Value

Intersection												
Int Delay, s/veh	48.3											
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		↔	↔				↔	↔			↔	
Traffic Vol, veh/h	152	0	6	0	0	0	6	806	2	1	659	210
Future Vol, veh/h	152	0	6	0	0	0	6	806	2	1	659	210
Conflicting Peds, #/hr	0	0	0	0	0	0	1	0	0	0	0	1
Sign Control	Stop	Stop	Stop	Stop	Stop	Stop	Free	Free	Free	Free	Free	Free
RT Channelized	-	-	None	-	-	None	-	-	None	-	-	None
Storage Length	-	-	15	-	-	-	25	-	-	-	-	-
Veh in Median Storage, #	-	0	-	-	-	-	-	0	-	-	0	-
Grade, %	-	0	-	-	0	-	-	0	-	-	0	-
Peak Hour Factor	86	92	38	92	25	25	75	92	50	25	94	83
Heavy Vehicles, %	1	2	17	2	0	0	0	1	0	0	1	1
Mvmt Flow	180	0	16	0	0	0	8	894	4	4	715	258

Major/Minor	Minor2			Major1			Major2					
Conflicting Flow All	1765	1767	845				974	0	0	898	0	0
Stage 1	853	853	-				-	-	-	-	-	-
Stage 2	912	914	-				-	-	-	-	-	-
Critical Hdwy	6.41	6.52	6.37				4.1	-	-	4.1	-	-
Critical Hdwy Stg 1	5.41	5.52	-				-	-	-	-	-	-
Critical Hdwy Stg 2	5.41	5.52	-				-	-	-	-	-	-
Follow-up Hdwy	3.509	4.018	3.453				2.2	-	-	2.2	-	-
Pot Cap-1 Maneuver	~ 93	84	341				716	-	-	765	-	-
Stage 1	419	376	-				-	-	-	-	-	-
Stage 2	393	352	-				-	-	-	-	-	-
Platoon blocked, %								-	-		-	-
Mov Cap-1 Maneuver	~ 91	0	341				716	-	-	765	-	-
Mov Cap-2 Maneuver	~ 91	0	-				-	-	-	-	-	-
Stage 1	414	0	-				-	-	-	-	-	-
Stage 2	388	0	-				-	-	-	-	-	-

Approach	EB	NB	SB
HCM Control Delay, s\$	510.9	0.1	0
HCM LOS	F		

Minor Lane/Major Mvmt	NBL	NBT	NBR	EBLn1	EBLn2	SBL	SBT	SBR
Capacity (veh/h)	716	-	-	91	341	765	-	-
HCM Lane V/C Ratio	0.011	-	-	1.981	0.047	0.005	-	-
HCM Control Delay (s)	10.1	-	-	\$ 555.1	16.1	9.7	0	-
HCM Lane LOS	B	-	-	F	C	A	A	-
HCM 95th %tile Q(veh)	0	-	-	15.5	0.1	0	-	-

Notes  
 -: Volume exceeds capacity    \$: Delay exceeds 300s    +: Computation Not Defined    \*: All major volume in platoon

Lanes, Volumes, Timings  
 3: Main St (1A) & Cherry St/Old Country Rd

07/23/2018



Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		↖	↗				↖	↗			↕	
Traffic Volume (vph)	122	1	107	0	0	0	158	692	5	5	552	110
Future Volume (vph)	122	1	107	0	0	0	158	692	5	5	552	110
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Storage Length (ft)	0		50	0		0	75		0	0		0
Storage Lanes	0		1	0		0	1		0	0		0
Taper Length (ft)	0			0			25			0		
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Ped Bike Factor												
Frt			0.850					0.998			0.976	
Flt Protected		0.954					0.950				0.999	
Satd. Flow (prot)	0	1778	1599	0	0	0	1770	1878	0	0	1834	0
Flt Permitted		0.954					0.950				0.999	
Satd. Flow (perm)	0	1778	1599	0	0	0	1770	1878	0	0	1834	0
Link Speed (mph)		30			30			30			30	
Link Distance (ft)		2702			575			3735			460	
Travel Time (s)		61.4			13.1			84.9			10.5	
Confl. Peds. (#/hr)									1	1		
Peak Hour Factor	0.87	0.25	0.86	0.92	0.25	0.25	0.96	0.94	0.42	0.63	0.91	0.83
Growth Factor	102%	102%	102%	102%	102%	102%	102%	102%	102%	102%	102%	102%
Heavy Vehicles (%)	2%	0%	1%	2%	0%	0%	2%	1%	0%	0%	1%	1%
Adj. Flow (vph)	143	4	127	0	0	0	168	751	12	8	619	135
Shared Lane Traffic (%)												
Lane Group Flow (vph)	0	147	127	0	0	0	168	763	0	0	762	0
Enter Blocked Intersection	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Lane Alignment	Left	Left	Right	Left	Left	Right	Left	Left	Right	Left	Left	Right
Median Width(ft)		0			0			12			12	
Link Offset(ft)		0			16			0			0	
Crosswalk Width(ft)		16			16			16			16	
Two way Left Turn Lane												
Headway Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Sign Control		Stop			Stop			Free			Free	

Intersection Summary

Area Type:	Other
Control Type:	Unsignalized
Intersection Capacity Utilization	91.1%
ICU Level of Service	F
Analysis Period (min)	15

# HCM Unsignalized Intersection Capacity Analysis

## 3: Main St (1A) & Cherry St/Old Country Rd

07/23/2018



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		↔	↔				↔	↔			↔	
Traffic Volume (veh/h)	122	1	107	0	0	0	158	692	5	5	552	110
Future Volume (Veh/h)	122	1	107	0	0	0	158	692	5	5	552	110
Sign Control		Stop			Stop			Free			Free	
Grade		0%			0%			0%			0%	
Peak Hour Factor	0.87	0.25	0.86	0.92	0.25	0.25	0.96	0.94	0.42	0.63	0.91	0.83
Hourly flow rate (vph)	143	4	127	0	0	0	168	751	12	8	619	135
Pedestrians												1
Lane Width (ft)												0.0
Walking Speed (ft/s)												3.5
Percent Blockage												0
Right turn flare (veh)			2									
Median type								None				None
Median storage (veh)												
Upstream signal (ft)												776
pX, platoon unblocked	0.77	0.77	0.77	0.77	0.77		0.77					
vC, conflicting volume	1790	1802	686	1862	1864	758	754			764		
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	1878	1895	438	1972	1975	758	526			764		
tC, single (s)	*6.5	*6.2	*6.0	7.1	6.5	6.2	4.1			4.1		
tC, 2 stage (s)												
tF (s)	3.5	4.0	3.3	3.5	4.0	3.3	2.2			2.2		
p0 queue free %	0	92	74	100	100	100	79			99		
cM capacity (veh/h)	48	49	488	21	38	410	797			858		

Direction, Lane #	EB 1	NB 1	NB 2	SB 1
Volume Total	274	168	763	762
Volume Left	143	168	0	8
Volume Right	127	0	12	135
cSH	83	797	1700	858
Volume to Capacity	3.31	0.21	0.45	0.01
Queue Length 95th (ft)	Err	20	0	1
Control Delay (s)	Err	10.7	0.0	0.3
Lane LOS	F	B		A
Approach Delay (s)	Err	1.9		0.3
Approach LOS	F			

Intersection Summary			
Average Delay		1393.9	
Intersection Capacity Utilization		91.1%	ICU Level of Service
Analysis Period (min)		15	F

\* User Entered Value



**Intersection**

Int Delay, s/veh	49.5											
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		↔	↔				↔	↔			↔	
Traffic Vol, veh/h	122	1	107	0	0	0	158	692	5	5	552	110
Future Vol, veh/h	122	1	107	0	0	0	158	692	5	5	552	110
Conflicting Peds, #/hr	0	0	0	0	0	0	0	0	1	1	0	0
Sign Control	Stop	Stop	Stop	Stop	Stop	Stop	Free	Free	Free	Free	Free	Free
RT Channelized	-	-	None	-	-	None	-	-	None	-	-	None
Storage Length	-	-	50	-	-	-	75	-	-	-	-	-
Veh in Median Storage, #	-	0	-	-	-	-	-	0	-	-	0	-
Grade, %	-	0	-	-	0	-	-	0	-	-	0	-
Peak Hour Factor	87	25	86	92	25	25	96	94	42	63	91	83
Heavy Vehicles, %	2	0	1	2	0	0	2	1	0	0	1	1
Mvmt Flow	143	4	127	0	0	0	168	751	12	8	619	135

Major/Minor	Minor2			Major1			Major2		
Conflicting Flow All	1796	1803	686	754	0	0	764	0	0
Stage 1	703	703	-	-	-	-	-	-	-
Stage 2	1093	1100	-	-	-	-	-	-	-
Critical Hdwy	6.42	6.5	6.21	4.12	-	-	4.1	-	-
Critical Hdwy Stg 1	5.42	5.5	-	-	-	-	-	-	-
Critical Hdwy Stg 2	5.42	5.5	-	-	-	-	-	-	-
Follow-up Hdwy	3.518	4	3.309	2.218	-	-	2.2	-	-
Pot Cap-1 Maneuver	~ 88	80	449	856	-	-	858	-	-
Stage 1	491	443	-	-	-	-	-	-	-
Stage 2	321	290	-	-	-	-	-	-	-
Platoon blocked, %									
Mov Cap-1 Maneuver	~ 70	0	449	856	-	-	858	-	-
Mov Cap-2 Maneuver	~ 70	0	-	-	-	-	-	-	-
Stage 1	483	0	-	-	-	-	-	-	-
Stage 2	258	0	-	-	-	-	-	-	-

Approach	EB	NB	SB
HCM Control Delay, s	\$ 349	1.8	0.1
HCM LOS	F		

Minor Lane/Major Mvmt	NBL	NBT	NBR	EBLn1	EBLn2	SBL	SBT	SBR
Capacity (veh/h)	856	-	-	70	449	858	-	-
HCM Lane V/C Ratio	0.196	-	-	2.102	0.283	0.009	-	-
HCM Control Delay (s)	10.2	-	-	\$ 636.1	16.1	9.2	0	-
HCM Lane LOS	B	-	-	F	C	A	A	-
HCM 95th %tile Q(veh)	0.7	-	-	13.7	1.1	0	-	-

**Notes**

~: Volume exceeds capacity    \$: Delay exceeds 300s    +: Computation Not Defined    \*: All major volume in platoon

Lanes, Volumes, Timings  
 1: Main St (1A) & Arbor St/Friend Ct

07/23/2018



Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		↖	↗		↔		↖	↗		↖	↗	
Traffic Volume (vph)	16	1	346	3	3	6	287	555	6	5	578	27
Future Volume (vph)	16	1	346	3	3	6	287	555	6	5	578	27
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Storage Length (ft)	0		50	0		0	100		0	40		0
Storage Lanes	0		1	0		0	1		0	1		0
Taper Length (ft)	0			0			25			25		
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Ped Bike Factor												
Frt			0.850		0.932			0.998				0.991
Flt Protected		0.959			0.992		0.950			0.950		
Satd. Flow (prot)	0	1639	1583	0	1757	0	1752	1824	0	1504	1827	0
Flt Permitted		0.959			0.992		0.950			0.950		
Satd. Flow (perm)	0	1639	1583	0	1757	0	1752	1824	0	1504	1827	0
Link Speed (mph)		30			30			30				30
Link Distance (ft)		2388			2408			313				2230
Travel Time (s)		54.3			54.7			7.1				50.7
Confl. Peds. (#/hr)							1		1	1		1
Peak Hour Factor	0.67	0.25	0.84	0.75	0.38	0.50	0.84	0.90	0.75	0.31	0.91	0.68
Growth Factor	102%	102%	102%	102%	102%	102%	102%	102%	102%	102%	102%	102%
Heavy Vehicles (%)	13%	0%	2%	0%	0%	0%	3%	4%	0%	20%	3%	4%
Adj. Flow (vph)	24	4	420	4	8	12	349	629	8	16	648	41
Shared Lane Traffic (%)												
Lane Group Flow (vph)	0	28	420	0	24	0	349	637	0	16	689	0
Enter Blocked Intersection	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Lane Alignment	Left	Left	Right	Left	Left	Right	Left	Left	Right	Left	Left	Right
Median Width(ft)		0			0			12				12
Link Offset(ft)		-10			0			0				0
Crosswalk Width(ft)		16			16			16				16
Two way Left Turn Lane												
Headway Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Sign Control		Stop			Stop			Free				Free




















Intersection Summary

Area Type:	Other
Control Type:	Unsignalized
Intersection Capacity Utilization	67.9%
ICU Level of Service	C
Analysis Period (min)	15

# HCM Unsignalized Intersection Capacity Analysis

## 1: Main St (1A) & Arbor St/Friend Ct

07/23/2018

												
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	16	1	346	3	3	6	287	555	6	5	578	27
Future Volume (Veh/h)	16	1	346	3	3	6	287	555	6	5	578	27
Sign Control		Stop			Stop			Free			Free	
Grade		0%			0%			0%			0%	
Peak Hour Factor	0.67	0.25	0.84	0.75	0.38	0.50	0.84	0.90	0.75	0.31	0.91	0.68
Hourly flow rate (vph)	24	4	420	4	8	12	349	629	8	16	648	41
Pedestrians		1			1							
Lane Width (ft)		12.0			12.0							
Walking Speed (ft/s)		3.5			3.5							
Percent Blockage		0			0							
Right turn flare (veh)			2									
Median type								None			None	
Median storage (veh)												
Upstream signal (ft)								773				
pX, platoon unblocked	0.95	0.95		0.95	0.95	0.95				0.95		
vC, conflicting volume	2044	2038	670	2224	2054	634	690			638		
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	2076	2068	670	2266	2086	584	690			588		
tC, single (s)	7.2	6.5	6.2	7.1	6.5	6.2	4.1			4.3		
tC, 2 stage (s)												
tF (s)	3.6	4.0	3.3	3.5	4.0	3.3	2.2			2.4		
p0 queue free %	0	87	8	0	74	98	61			98		
cM capacity (veh/h)	19	31	457	1	30	487	899			854		
Direction, Lane #	EB 1	WB 1	NB 1	NB 2	SB 1	SB 2						
Volume Total	448	24	349	637	16	689						
Volume Left	24	4	349	0	16	0						
Volume Right	420	12	0	8	0	41						
cSH	238	8	899	1700	854	1700						
Volume to Capacity	1.88	3.17	0.39	0.37	0.02	0.41						
Queue Length 95th (ft)	789	Err	46	0	1	0						
Control Delay (s)	446.2	Err	11.5	0.0	9.3	0.0						
Lane LOS	F	F	B		A							
Approach Delay (s)	446.2	Err	4.1		0.2							
Approach LOS	F	F										
Intersection Summary												
Average Delay			205.3									
Intersection Capacity Utilization			67.9%			ICU Level of Service		C				
Analysis Period (min)			15									

HCM 2010 TWSC  
 1: Main St (1A) & Arbor St/Friend Ct

07/23/2018

Intersection												
Int Delay, s/veh	33.2											
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		↔	↔		↔		↔	↔		↔	↔	
Traffic Vol, veh/h	16	1	346	3	3	6	287	555	6	5	578	27
Future Vol, veh/h	16	1	346	3	3	6	287	555	6	5	578	27
Conflicting Peds, #/hr	0	0	0	0	0	0	1	0	1	1	0	1
Sign Control	Stop	Stop	Stop	Stop	Stop	Stop	Free	Free	Free	Free	Free	Free
RT Channelized	-	-	None	-	-	None	-	-	None	-	-	None
Storage Length	-	-	50	-	-	-	100	-	-	40	-	-
Veh in Median Storage, #	-	0	-	-	0	-	-	0	-	-	0	-
Grade, %	-	0	-	-	0	-	-	0	-	-	0	-
Peak Hour Factor	67	25	84	75	38	50	84	90	75	31	91	68
Heavy Vehicles, %	13	0	2	0	0	0	3	4	0	20	3	4
Mvmt Flow	24	4	420	4	8	12	349	629	8	16	648	41

Major/Minor	Minor2		Minor1		Major1		Major2					
Conflicting Flow All	2042	2037	669	2034	2053	634	689	0	0	638	0	0
Stage 1	702	702	-	1331	1331	-	-	-	-	-	-	-
Stage 2	1340	1335	-	703	722	-	-	-	-	-	-	-
Critical Hdwy	7.23	6.5	6.22	7.1	6.5	6.2	4.13	-	-	4.3	-	-
Critical Hdwy Stg 1	6.23	5.5	-	6.1	5.5	-	-	-	-	-	-	-
Critical Hdwy Stg 2	6.23	5.5	-	6.1	5.5	-	-	-	-	-	-	-
Follow-up Hdwy	3.617	4	3.318	3.5	4	3.3	2.227	-	-	2.38	-	-
Pot Cap-1 Maneuver	39	57	458	43	56	483	901	-	-	865	-	-
Stage 1	412	443	-	192	226	-	-	-	-	-	-	-
Stage 2	178	225	-	431	434	-	-	-	-	-	-	-
Platoon blocked, %								-	-	-	-	-
Mov Cap-1 Maneuver	~ 22	34	458	~ 2	34	483	901	-	-	865	-	-
Mov Cap-2 Maneuver	~ 22	34	-	~ 2	34	-	-	-	-	-	-	-
Stage 1	252	434	-	118	138	-	-	-	-	-	-	-
Stage 2	100	138	-	35	426	-	-	-	-	-	-	-

Approach	EB	WB	NB	SB
HCM Control Delay, s	83.4	\$ 1239.2	4.1	0.2
HCM LOS	F	F		

Minor Lane/Major Mvmt	NBL	NBT	NBR	EBLn1	EBLn2	WBLn1	SBL	SBT	SBR
Capacity (veh/h)	901	-	-	23	458	11	865	-	-
HCM Lane V/C Ratio	0.387	-	-	1.236	0.917	2.216	0.019	-	-
HCM Control Delay (s)	11.5	-	-	\$ 514.6	54.2	\$ 1239.2	9.2	-	-
HCM Lane LOS	B	-	-	F	F	F	A	-	-
HCM 95th %tile Q(veh)	1.8	-	-	3.6	10.4	4	0.1	-	-

Notes  
 -: Volume exceeds capacity    \$: Delay exceeds 300s    +: Computation Not Defined    \*: All major volume in platoon

Lanes, Volumes, Timings  
 2: Main St (1A) & Monument St/Wenham Town Hall

07/23/2018



Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		↕	↗				↖	↗			↕	
Traffic Volume (vph)	87	0	3	0	0	0	5	754	0	1	752	185
Future Volume (vph)	87	0	3	0	0	0	5	754	0	1	752	185
Ideal Flow (vphp)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Storage Length (ft)	0		15	0		0	25		0	0		0
Storage Lanes	0		1	0		0	1		0	0		0
Taper Length (ft)	0			0			25			0		
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Ped Bike Factor												
Frt			0.850								0.971	
Flt Protected		0.950					0.950					
Satd. Flow (prot)	0	1703	1615	0	0	0	1504	1827	0	0	1805	0
Flt Permitted		0.950					0.950					
Satd. Flow (perm)	0	1703	1615	0	0	0	1504	1827	0	0	1805	0
Link Speed (mph)		30			30			30			30	
Link Distance (ft)		2613			509			460			313	
Travel Time (s)		59.4			11.6			10.5			7.1	
Confl. Peds. (#/hr)							5					5
Peak Hour Factor	0.81	0.92	0.38	0.92	0.25	0.25	0.63	0.88	0.92	0.25	0.95	0.86
Growth Factor	102%	102%	102%	102%	102%	102%	102%	102%	102%	102%	102%	102%
Heavy Vehicles (%)	6%	2%	0%	2%	0%	0%	20%	4%	2%	0%	2%	3%
Adj. Flow (vph)	110	0	8	0	0	0	8	874	0	4	807	219
Shared Lane Traffic (%)												
Lane Group Flow (vph)	0	110	8	0	0	0	8	874	0	0	1030	0
Enter Blocked Intersection	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Lane Alignment	Left	Left	Right	Left	Left	Right	Left	Left	Right	Left	Left	Right
Median Width(ft)		0			0			12			12	
Link Offset(ft)		0			30			0			0	
Crosswalk Width(ft)		16			16			16			16	
Two way Left Turn Lane												
Headway Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Turning Speed (mph)	25		9	15		9	15		9	15		9
Sign Control		Stop			Stop			Free			Free	

Intersection Summary

Area Type:	Other
Control Type:	Unsignalized
Intersection Capacity Utilization	64.4%
ICU Level of Service	C
Analysis Period (min)	15



# HCM Unsignalized Intersection Capacity Analysis

## 2: Main St (1A) & Monument St/Wenham Town Hall

07/23/2018



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		↔	↔				↔	↔			↔	
Traffic Volume (veh/h)	87	0	3	0	0	0	5	754	0	1	752	185
Future Volume (Veh/h)	87	0	3	0	0	0	5	754	0	1	752	185
Sign Control		Stop			Stop			Free			Free	
Grade		0%			0%			0%			0%	
Peak Hour Factor	0.81	0.92	0.38	0.92	0.25	0.25	0.63	0.88	0.92	0.25	0.95	0.86
Hourly flow rate (vph)	110	0	8	0	0	0	8	874	0	4	807	219
Pedestrians		5										
Lane Width (ft)		12.0										
Walking Speed (ft/s)		3.5										
Percent Blockage		0										
Right turn flare (veh)			1									
Median type								None			None	
Median storage (veh)												
Upstream signal (ft)								460				
pX, platoon unblocked	0.67	0.67		0.67	0.67	0.67				0.67		
vC, conflicting volume	1820	1820	922	1818	1929	874	1031			874		
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	1978	1978	922	1976	2142	564	1031			564		
tC, single (s)	*6.0	6.5	*6.5	7.1	6.5	6.2	4.3			4.1		
tC, 2 stage (s)												
tF (s)	3.6	4.0	3.3	3.5	4.0	3.3	2.4			2.2		
p0 queue free %	0	100	97	100	100	100	99			99		
cM capacity (veh/h)	56	40	305	30	32	354	606			681		

Direction, Lane #	EB 1	NB 1	NB 2	SB 1
Volume Total	118	8	874	1030
Volume Left	110	8	0	4
Volume Right	8	0	0	219
cSH	59	606	1700	681
Volume to Capacity	2.00	0.01	0.51	0.01
Queue Length 95th (ft)	282	1	0	0
Control Delay (s)	614.7	11.0	0.0	0.2
Lane LOS	F	B		A
Approach Delay (s)	614.7	0.1		0.2
Approach LOS	F			

Intersection Summary			
Average Delay		35.9	
Intersection Capacity Utilization	64.4%		ICU Level of Service C
Analysis Period (min)	15		

\* User Entered Value

**Intersection**

Int Delay, s/veh 17.3

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		↕	↕				↕	↕			↕	
Traffic Vol, veh/h	87	0	3	0	0	0	5	754	0	1	752	185
Future Vol, veh/h	87	0	3	0	0	0	5	754	0	1	752	185
Conflicting Peds, #/hr	0	0	0	0	0	0	5	0	0	0	0	5
Sign Control	Stop	Stop	Stop	Stop	Stop	Stop	Free	Free	Free	Free	Free	Free
RT Channelized	-	-	None	-	-	None	-	-	None	-	-	None
Storage Length	-	-	15	-	-	-	25	-	-	-	-	-
Veh in Median Storage, #	-	0	-	-	-	-	-	0	-	-	0	-
Grade, %	-	0	-	-	0	-	-	0	-	-	0	-
Peak Hour Factor	81	92	38	92	25	25	63	88	92	25	95	86
Heavy Vehicles, %	6	2	0	2	0	0	20	4	2	0	2	3
Mvmt Flow	110	0	8	0	0	0	8	874	0	4	807	219

Major/Minor	Minor2			Major1			Major2					
Conflicting Flow All	1820	1820	922				1032	0	0	874	0	0
Stage 1	930	930	-				-	-	-	-	-	-
Stage 2	890	890	-				-	-	-	-	-	-
Critical Hdwy	6.46	6.52	6.2				4.3	-	-	4.1	-	-
Critical Hdwy Stg 1	5.46	5.52	-				-	-	-	-	-	-
Critical Hdwy Stg 2	5.46	5.52	-				-	-	-	-	-	-
Follow-up Hdwy	3.554	4.018	3.3				2.38	-	-	2.2	-	-
Pot Cap-1 Maneuver	~ 83	78	330				608	-	-	781	-	-
Stage 1	378	346	-				-	-	-	-	-	-
Stage 2	395	361	-				-	-	-	-	-	-
Platoon blocked, %								-	-		-	-
Mov Cap-1 Maneuver	~ 80	0	328				608	-	-	781	-	-
Mov Cap-2 Maneuver	~ 80	0	-				-	-	-	-	-	-
Stage 1	371	0	-				-	-	-	-	-	-
Stage 2	388	0	-				-	-	-	-	-	-

Approach	EB	NB	SB
HCM Control Delay, s	298.5	0.1	0
HCM LOS	F		

Minor Lane/Major Mvmt	NBL	NBT	NBR	EBLn1	EBLn2	SBL	SBT	SBR
Capacity (veh/h)	608	-	-	80	328	781	-	-
HCM Lane V/C Ratio	0.013	-	-	1.369	0.025	0.005	-	-
HCM Control Delay (s)	11	-	-	\$ 319.2	16.3	9.6	0	-
HCM Lane LOS	B	-	-	F	C	A	A	-
HCM 95th %tile Q(veh)	0	-	-	8.5	0.1	0	-	-

**Notes**

~: Volume exceeds capacity    \$: Delay exceeds 300s    +: Computation Not Defined    \*: All major volume in platoon

Lanes, Volumes, Timings  
 3: Main St (1A) & Cherry St/Old Country Rd

07/23/2018



Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	216	0	154	2	1	2	87	544	0	0	642	108
Future Volume (vph)	216	0	154	2	1	2	87	544	0	0	642	108
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Storage Length (ft)	0		50	0		0	75		0	0		0
Storage Lanes	1		1	0		0	1		0	0		0
Taper Length (ft)	0			0			25			0		
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Frt			0.850		0.955							0.977
Flt Protected	0.950				0.984		0.950					
Satd. Flow (prot)	1736	0	1538	0	1785	0	1752	1827	0	0	1805	0
Flt Permitted	0.750				0.984		0.104					
Satd. Flow (perm)	1370	0	1538	0	1785	0	192	1827	0	0	1805	0
Right Turn on Red			Yes			Yes			Yes			Yes
Satd. Flow (RTOR)			94		4							13
Link Speed (mph)		30			30			30				30
Link Distance (ft)		2702			575			3735				460
Travel Time (s)		61.4			13.1			84.9				10.5
Peak Hour Factor	0.98	0.25	0.88	0.50	0.25	0.50	0.84	0.83	0.50	0.50	0.93	0.75
Growth Factor	102%	102%	102%	102%	102%	102%	102%	102%	102%	102%	102%	102%
Heavy Vehicles (%)	4%	0%	5%	0%	0%	0%	3%	4%	0%	0%	3%	2%
Adj. Flow (vph)	225	0	179	4	4	4	106	669	0	0	704	147
Shared Lane Traffic (%)												
Lane Group Flow (vph)	225	0	179	0	12	0	106	669	0	0	851	0
Enter Blocked Intersection	No	No	No	No	No	No	No	No	No	No	No	No
Lane Alignment	Left	Left	Right	Left	Left	Right	Left	Left	Right	Left	Left	Right
Median Width(ft)		12			12			12				12
Link Offset(ft)		0			8			0				0
Crosswalk Width(ft)		16			16			16				16
Two way Left Turn Lane												
Headway Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Number of Detectors	1		1	1	2		1	2				2
Detector Template	Left		Right	Left	Thru		Left	Thru				Thru
Leading Detector (ft)	20		20	20	100		20	100				100
Trailing Detector (ft)	0		0	0	0		0	0				0
Detector 1 Position(ft)	0		0	0	0		0	0				0
Detector 1 Size(ft)	20		20	20	6		20	6				6
Detector 1 Type	Cl+Ex		Cl+Ex	Cl+Ex	Cl+Ex		Cl+Ex	Cl+Ex				Cl+Ex
Detector 1 Channel												
Detector 1 Extend (s)	0.0		0.0	0.0	0.0		0.0	0.0				0.0
Detector 1 Queue (s)	0.0		0.0	0.0	0.0		0.0	0.0				0.0
Detector 1 Delay (s)	0.0		0.0	0.0	0.0		0.0	0.0				0.0
Detector 2 Position(ft)					94			94				94
Detector 2 Size(ft)					6			6				6
Detector 2 Type					Cl+Ex			Cl+Ex				Cl+Ex
Detector 2 Channel												
Detector 2 Extend (s)					0.0			0.0				0.0
Turn Type	Perm		Prot	Perm	NA		pm+pt	NA				NA
Protected Phases			6		2		7	4				8

Lanes, Volumes, Timings  
 3: Main St (1A) & Cherry St/Old Country Rd

07/23/2018

Lane Group	Ø9
Lane Configurations	
Traffic Volume (vph)	
Future Volume (vph)	
Ideal Flow (vphpl)	
Storage Length (ft)	
Storage Lanes	
Taper Length (ft)	
Lane Util. Factor	
Frt	
Flt Protected	
Satd. Flow (prot)	
Flt Permitted	
Satd. Flow (perm)	
Right Turn on Red	
Satd. Flow (RTOR)	
Link Speed (mph)	
Link Distance (ft)	
Travel Time (s)	
Peak Hour Factor	
Growth Factor	
Heavy Vehicles (%)	
Adj. Flow (vph)	
Shared Lane Traffic (%)	
Lane Group Flow (vph)	
Enter Blocked Intersection	
Lane Alignment	
Median Width(ft)	
Link Offset(ft)	
Crosswalk Width(ft)	
Two way Left Turn Lane	
Headway Factor	
Number of Detectors	
Detector Template	
Leading Detector (ft)	
Trailing Detector (ft)	
Detector 1 Position(ft)	
Detector 1 Size(ft)	
Detector 1 Type	
Detector 1 Channel	
Detector 1 Extend (s)	
Detector 1 Queue (s)	
Detector 1 Delay (s)	
Detector 2 Position(ft)	
Detector 2 Size(ft)	
Detector 2 Type	
Detector 2 Channel	
Detector 2 Extend (s)	
Turn Type	
Protected Phases	9

# Lanes, Volumes, Timings

## 3: Main St (1A) & Cherry St/Old Country Rd

07/23/2018



Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Permitted Phases	6			2			4					
Detector Phase	6		6	2	2		7	4				8
Switch Phase												
Minimum Initial (s)	1.0		1.0	1.0	1.0		1.0	1.0				1.0
Minimum Split (s)	8.0		8.0	8.0	8.0		8.0	8.0				8.0
Total Split (s)	24.0		24.0	24.0	24.0		9.0	64.0				55.0
Total Split (%)	21.8%		21.8%	21.8%	21.8%		8.2%	58.2%				50.0%
Maximum Green (s)	19.0		19.0	19.0	19.0		4.0	59.0				50.0
Yellow Time (s)	3.0		3.0	3.0	3.0		3.0	3.0				3.0
All-Red Time (s)	2.0		2.0	2.0	2.0		2.0	2.0				2.0
Lost Time Adjust (s)	0.0		0.0		0.0		0.0	0.0				0.0
Total Lost Time (s)	5.0		5.0		5.0		5.0	5.0				5.0
Lead/Lag							Lead					Lag
Lead-Lag Optimize?							Yes					Yes
Vehicle Extension (s)	3.0		3.0	3.0	3.0		3.0	3.0				3.0
Recall Mode	None		None	None	None		None	None				None
Walk Time (s)												
Flash Dont Walk (s)												
Pedestrian Calls (#/hr)												
Act Effct Green (s)	18.9		18.9		18.9		59.5	59.5				50.4
Actuated g/C Ratio	0.20		0.20		0.20		0.65	0.65				0.55
v/c Ratio	0.80		0.46		0.03		0.55	0.57				0.86
Control Delay	58.6		21.2		28.0		21.7	13.2				29.6
Queue Delay	0.0		0.0		0.0		0.0	0.0				0.0
Total Delay	58.6		21.2		28.0		21.7	13.2				29.6
LOS	E		C		C		C	B				C
Approach Delay		42.1			28.0			14.3				29.6
Approach LOS		D			C			B				C
90th %ile Green (s)	19.0		19.0	19.0	19.0		4.0	59.0				50.0
90th %ile Term Code	Max		Max	Hold	Hold		Max	Hold				Max
70th %ile Green (s)	19.0		19.0	19.0	19.0		4.0	59.0				50.0
70th %ile Term Code	Max		Max	Hold	Hold		Max	Hold				Max
50th %ile Green (s)	19.0		19.0	19.0	19.0		4.0	59.0				50.0
50th %ile Term Code	Max		Max	Hold	Hold		Max	Hold				Max
30th %ile Green (s)	19.0		19.0	19.0	19.0		4.0	59.0				50.0
30th %ile Term Code	Max		Max	Hold	Hold		Max	Hold				Max
10th %ile Green (s)	17.8		17.8	17.8	17.8		4.0	59.0				50.0
10th %ile Term Code	Gap		Gap	Hold	Hold		Max	Hold				Max
Stops (vph)	183		68		4		31	305				552
Fuel Used(gal)	8		4		0		3	19				10
CO Emissions (g/hr)	578		307		5		221	1352				727
NOx Emissions (g/hr)	113		60		1		43	263				141
VOC Emissions (g/hr)	134		71		1		51	313				168
Dilemma Vehicles (#)	0		0		0		0	0				0
Queue Length 50th (ft)	118		39		4		18	169				351
Queue Length 95th (ft)	#310		120		4		#68	404				#882
Internal Link Dist (ft)		2622			495			3655				380
Turn Bay Length (ft)			50				75					
Base Capacity (vph)	284		394		374		192	1178				993



Lanes, Volumes, Timings  
 3: Main St (1A) & Cherry St/Old Country Rd

07/23/2018

Lane Group	Ø9
Permitted Phases	
Detector Phase	
Switch Phase	
Minimum Initial (s)	1.0
Minimum Split (s)	22.0
Total Split (s)	22.0
Total Split (%)	20%
Maximum Green (s)	20.0
Yellow Time (s)	2.0
All-Red Time (s)	0.0
Lost Time Adjust (s)	
Total Lost Time (s)	
Lead/Lag	
Lead-Lag Optimize?	
Vehicle Extension (s)	3.0
Recall Mode	None
Walk Time (s)	9.0
Flash Dont Walk (s)	11.0
Pedestrian Calls (#/hr)	5
Act Effct Green (s)	
Actuated g/C Ratio	
v/c Ratio	
Control Delay	
Queue Delay	
Total Delay	
LOS	
Approach Delay	
Approach LOS	
90th %ile Green (s)	20.0
90th %ile Term Code	Ped
70th %ile Green (s)	0.0
70th %ile Term Code	Skip
50th %ile Green (s)	0.0
50th %ile Term Code	Skip
30th %ile Green (s)	0.0
30th %ile Term Code	Skip
10th %ile Green (s)	0.0
10th %ile Term Code	Skip
Stops (vph)	
Fuel Used(gal)	
CO Emissions (g/hr)	
NOx Emissions (g/hr)	
VOC Emissions (g/hr)	
Dilemma Vehicles (#)	
Queue Length 50th (ft)	
Queue Length 95th (ft)	
Internal Link Dist (ft)	
Turn Bay Length (ft)	
Base Capacity (vph)	

# Lanes, Volumes, Timings

## 3: Main St (1A) & Cherry St/Old Country Rd

07/23/2018



Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Starvation Cap Reductn	0		0		0		0	0			0	
Spillback Cap Reductn	0		0		0		0	0			0	
Storage Cap Reductn	0		0		0		0	0			0	
Reduced v/c Ratio	0.79		0.45		0.03		0.55	0.57			0.86	

### Intersection Summary

Area Type:	Other
Cycle Length:	110
Actuated Cycle Length:	92.2
Natural Cycle:	110
Control Type:	Actuated-Uncoordinated
Maximum v/c Ratio:	0.86
Intersection Signal Delay:	26.2
Intersection LOS:	C
Intersection Capacity Utilization:	76.6%
ICU Level of Service:	D
Analysis Period (min):	15
90th %ile Actuated Cycle:	110
70th %ile Actuated Cycle:	88
50th %ile Actuated Cycle:	88
30th %ile Actuated Cycle:	88
10th %ile Actuated Cycle:	86.8
# 95th percentile volume exceeds capacity, queue may be longer. Queue shown is maximum after two cycles.	

### Splits and Phases: 3: Main St (1A) & Cherry St/Old Country Rd

Ø2	Ø4	Ø9
24 s	64 s	22 s
Ø6	Ø7	Ø8
24 s	9 s	55 s

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

















Lane Group	Ø9
Starvation Cap Reductn	
Spillback Cap Reductn	
Storage Cap Reductn	
Reduced v/c Ratio	
Intersection Summary	

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Lanes, Volumes, Timings  
 1: Main St (1A) & Arbor St/Friend Ct

07/23/2018

												
Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	18	0	267	7	0	13	297	652	11	5	596	25
Future Volume (vph)	18	0	267	7	0	13	297	652	11	5	596	25
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Storage Length (ft)	0		50	0		0	100		0	40		0
Storage Lanes	0		1	0		0	1		0	1		0
Taper Length (ft)	0			0			25			25		
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Ped Bike Factor												
Frt			0.850		0.905			0.997			0.993	
Flt Protected		0.950			0.986		0.950			0.950		
Satd. Flow (prot)	0	1805	1615	0	1695	0	1787	1858	0	1805	1869	0
Flt Permitted		0.950			0.986		0.950			0.950		
Satd. Flow (perm)	0	1805	1615	0	1695	0	1787	1858	0	1805	1869	0
Link Speed (mph)		30			30			30			30	
Link Distance (ft)		2388			2408			313			2230	
Travel Time (s)		54.3			54.7			7.1			50.7	
Confl. Peds. (#/hr)							1		2	2		1
Peak Hour Factor	0.56	0.92	0.88	0.58	0.92	0.46	0.88	0.89	0.69	0.63	0.93	0.78
Growth Factor	102%	102%	102%	102%	102%	102%	102%	102%	102%	102%	102%	102%
Heavy Vehicles (%)	0%	0%	0%	0%	0%	0%	1%	2%	0%	0%	1%	0%
Adj. Flow (vph)	33	0	309	12	0	29	344	747	16	8	654	33
Shared Lane Traffic (%)												
Lane Group Flow (vph)	0	33	309	0	41	0	344	763	0	8	687	0
Enter Blocked Intersection	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Lane Alignment	Left	Left	Right	Left	Left	Right	Left	Left	Right	Left	Left	Right
Median Width(ft)		0			0			12			12	
Link Offset(ft)		-10			0			0			0	
Crosswalk Width(ft)		16			16			16			16	
Two way Left Turn Lane												
Headway Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Sign Control		Stop			Stop			Free		1.00	1.00	Free

Intersection Summary




















Area Type:	Other
Control Type:	Unsignalized
Intersection Capacity Utilization	68.1%
Analysis Period (min)	15
	ICU Level of Service C



# HCM Unsignalized Intersection Capacity Analysis

## 1: Main St (1A) & Arbor St/Friend Ct

07/23/2018

												
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	18	0	267	7	0	13	297	652	11	5	596	25
Future Volume (Veh/h)	18	0	267	7	0	13	297	652	11	5	596	25
Sign Control		Stop			Stop			Free			Free	
Grade		0%			0%			0%			0%	
Peak Hour Factor	0.56	0.92	0.88	0.58	0.92	0.46	0.88	0.89	0.69	0.63	0.93	0.78
Hourly flow rate (vph)	33	0	309	12	0	29	344	747	16	8	654	33
Pedestrians		1			2							
Lane Width (ft)		12.0			12.0							
Walking Speed (ft/s)		3.5			3.5							
Percent Blockage		0			0							
Right turn flare (veh)			2									
Median type								None			None	
Median storage veh												
Upstream signal (ft)								773				
pX, platoon unblocked	0.86	0.86		0.86	0.86	0.86				0.86		
vC, conflicting volume	2152	2140	672	2270	2149	757	688			765		
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	2253	2241	672	2390	2250	641	688			650		
tC, single (s)	7.1	6.5	6.2	7.1	6.5	6.2	4.1			4.1		
tC, 2 stage (s)												
tF (s)	3.5	4.0	3.3	3.5	4.0	3.3	2.2			2.2		
p0 queue free %	0	100	33	0	100	93	62			99		
cM capacity (veh/h)	17	23	459	5	22	413	910			816		
Direction, Lane #	EB 1	WB 1	NB 1	NB 2	SB 1	SB 2						
Volume Total	342	41	344	763	8	687						
Volume Left	33	12	344	0	8	0						
Volume Right	309	29	0	16	0	33						
cSH	139	16	910	1700	816	1700						
Volume to Capacity	2.46	2.63	0.38	0.45	0.01	0.40						
Queue Length 95th (ft)	742	145	44	0	1	0						
Control Delay (s)	727.3	1238.4	11.3	0.0	9.5	0.0						
Lane LOS	F	F	B		A							
Approach Delay (s)	727.3	1238.4	3.5		0.1							
Approach LOS	F	F										
Intersection Summary												
Average Delay			138.9									
Intersection Capacity Utilization			68.1%	ICU Level of Service		C						
Analysis Period (min)			15									

HCM 2010 TWSC  
 1: Main St (1A) & Arbor St/Friend Ct

07/23/2018

Intersection												
Int Delay, s/veh	26.1											
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		↕	↕		↕		↕	↕		↕	↕	
Traffic Vol, veh/h	18	0	267	7	0	13	297	652	11	5	596	25
Future Vol, veh/h	18	0	267	7	0	13	297	652	11	5	596	25
Conflicting Peds, #/hr	0	0	0	0	0	0	1	0	2	2	0	1
Sign Control	Stop	Stop	Stop	Stop	Stop	Stop	Free	Free	Free	Free	Free	Free
RT Channelized	-	-	None	-	-	None	-	-	None	-	-	None
Storage Length	-	-	50	-	-	-	100	-	-	40	-	-
Veh in Median Storage, #	-	0	-	-	0	-	-	0	-	-	0	-
Grade, %	-	0	-	-	0	-	-	0	-	-	0	-
Peak Hour Factor	56	92	88	58	92	46	88	89	69	63	93	78
Heavy Vehicles, %	0	0	0	0	0	0	1	2	0	0	1	0
Mvmt Flow	33	0	309	12	0	29	344	747	16	8	654	33

Major/Minor	Minor2		Minor1		Major1		Major2					
Conflicting Flow All	2145	2141	671	2132	2150	757	687	0	0	765	0	0
Stage 1	687	687	-	1446	1446	-	-	-	-	-	-	-
Stage 2	1458	1454	-	686	704	-	-	-	-	-	-	-
Critical Hdwy	7.1	6.5	6.2	7.1	6.5	6.2	4.11	-	-	4.1	-	-
Critical Hdwy Stg 1	6.1	5.5	-	6.1	5.5	-	-	-	-	-	-	-
Critical Hdwy Stg 2	6.1	5.5	-	6.1	5.5	-	-	-	-	-	-	-
Follow-up Hdwy	3.5	4	3.3	3.5	4	3.3	2.209	-	-	2.2	-	-
Pot Cap-1 Maneuver	36	49	460	36	49	411	912	-	-	857	-	-
Stage 1	440	450	-	165	199	-	-	-	-	-	-	-
Stage 2	163	197	-	441	443	-	-	-	-	-	-	-
Platoon blocked, %								-	-	-	-	-
Mov Cap-1 Maneuver	~ 23	30	460	~ 8	30	410	912	-	-	857	-	-
Mov Cap-2 Maneuver	~ 23	30	-	~ 8	30	-	-	-	-	-	-	-
Stage 1	274	445	-	103	124	-	-	-	-	-	-	-
Stage 2	94	122	-	143	438	-	-	-	-	-	-	-

Approach	EB		WB		NB		SB	
HCM Control Delay, s	81.2		\$ 614.7		3.5		0.1	
HCM LOS	F		F					

Minor Lane/Major Mvmt	NBL	NBT	NBR	EBLn1	EBLn2	WBLn1	SBL	SBT	SBR
Capacity (veh/h)	912	-	-	23	460	26	857	-	-
HCM Lane V/C Ratio	0.377	-	-	1.425	0.673	1.582	0.009	-	-
HCM Control Delay (s)	11.3	-	-	\$ 588.3	27.5	\$ 614.7	9.2	-	-
HCM Lane LOS	B	-	-	F	D	F	A	-	-
HCM 95th %tile Q(veh)	1.8	-	-	4.2	4.9	5	0	-	-

Notes  
 -: Volume exceeds capacity    \$: Delay exceeds 300s    +: Computation Not Defined    \*: All major volume in platoon

# Lanes, Volumes, Timings

## 2: Main St (1A) & Monument St/Wenham Town Hall

07/23/2018



Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		↕	↗				↖	↗			↕	
Traffic Volume (vph)	76	0	6	0	0	0	6	882	2	1	659	210
Future Volume (vph)	76	0	6	0	0	0	6	882	2	1	659	210
Ideal Flow (vphp)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Storage Length (ft)	0		15	0		0	25		0	0		0
Storage Lanes	0		1	0		0	1		0	0		0
Taper Length (ft)	0			0			25			0		
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Ped Bike Factor												
Frt			0.850					0.999			0.964	
Flt Protected		0.950					0.950					
Satd. Flow (prot)	0	1787	1380	0	0	0	1805	1879	0	0	1814	0
Flt Permitted		0.950					0.950					
Satd. Flow (perm)	0	1787	1380	0	0	0	1805	1879	0	0	1814	0
Link Speed (mph)		30			30			30			30	
Link Distance (ft)		2613			509			460			313	
Travel Time (s)		59.4			11.6			10.5			7.1	
Confl. Peds. (#/hr)							1					1
Peak Hour Factor	0.86	0.92	0.38	0.92	0.25	0.25	0.75	0.93	0.50	0.25	0.94	0.83
Growth Factor	102%	102%	102%	102%	102%	102%	102%	102%	102%	102%	102%	102%
Heavy Vehicles (%)	1%	2%	17%	2%	0%	0%	0%	1%	0%	0%	1%	1%
Adj. Flow (vph)	90	0	16	0	0	0	8	967	4	4	715	258
Shared Lane Traffic (%)												
Lane Group Flow (vph)	0	90	16	0	0	0	8	971	0	0	977	0
Enter Blocked Intersection	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Lane Alignment	Left	Left	Right	Left	Left	Right	Left	Left	Right	Left	Left	Right
Median Width(ft)		0			0			12			12	
Link Offset(ft)		0			30			0			0	
Crosswalk Width(ft)		16			16			16			16	
Two way Left Turn Lane												
Headway Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Turning Speed (mph)	25		9	15		9	15		9	15		9
Sign Control		Stop			Stop			Free			Free	

### Intersection Summary

Area Type:	Other
Control Type:	Unsignalized
Intersection Capacity Utilization	60.2%
ICU Level of Service	B
Analysis Period (min)	15

# HCM Unsignalized Intersection Capacity Analysis

## 2: Main St (1A) & Monument St/Wenham Town Hall

07/23/2018



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		↔	↔				↔	↔			↔	
Traffic Volume (veh/h)	76	0	6	0	0	0	6	882	2	1	659	210
Future Volume (Veh/h)	76	0	6	0	0	0	6	882	2	1	659	210
Sign Control		Stop			Stop			Free			Free	
Grade		0%			0%			0%			0%	
Peak Hour Factor	0.86	0.92	0.38	0.92	0.25	0.25	0.75	0.93	0.50	0.25	0.94	0.83
Hourly flow rate (vph)	90	0	16	0	0	0	8	967	4	4	715	258
Pedestrians		1										
Lane Width (ft)		12.0										
Walking Speed (ft/s)		3.5										
Percent Blockage		0										
Right turn flare (veh)			1									
Median type								None			None	
Median storage (veh)												
Upstream signal (ft)								460				
pX, platoon unblocked	0.60	0.60		0.60	0.60	0.60				0.60		
vC, conflicting volume	1836	1840	845	1845	1967	969	974			971		
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	2058	2065	845	2073	2276	617	974			621		
tC, single (s)	*6.0	6.5	*6.5	7.1	6.5	6.2	4.1			4.1		
tC, 2 stage (s)												
tF (s)	3.5	4.0	3.5	3.5	4.0	3.3	2.2			2.2		
p0 queue free %	0	100	95	100	100	100	99			99		
cM capacity (veh/h)	46	32	331	22	24	297	715			583		

Direction, Lane #	EB 1	NB 1	NB 2	SB 1
Volume Total	106	8	971	977
Volume Left	90	8	0	4
Volume Right	16	0	4	258
cSH	52	715	1700	583
Volume to Capacity	2.02	0.01	0.57	0.01
Queue Length 95th (ft)	262	1	0	1
Control Delay (s)	641.9	10.1	0.0	0.2
Lane LOS	F	B		A
Approach Delay (s)	641.9	0.1		0.2
Approach LOS	F			

Intersection Summary			
Average Delay		33.1	
Intersection Capacity Utilization		60.2%	ICU Level of Service B
Analysis Period (min)		15	

\* User Entered Value

Intersection												
Int Delay, s/veh	10.1											
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		↕	↕				↕	↕			↕	
Traffic Vol, veh/h	76	0	6	0	0	0	6	882	2	1	659	210
Future Vol, veh/h	76	0	6	0	0	0	6	882	2	1	659	210
Conflicting Peds, #/hr	0	0	0	0	0	0	1	0	0	0	0	1
Sign Control	Stop	Stop	Stop	Stop	Stop	Stop	Free	Free	Free	Free	Free	Free
RT Channelized	-	-	None	-	-	None	-	-	None	-	-	None
Storage Length	-	-	15	-	-	-	25	-	-	-	-	-
Veh in Median Storage, #	-	0	-	-	-	-	-	0	-	-	0	-
Grade, %	-	0	-	-	0	-	-	0	-	-	0	-
Peak Hour Factor	86	92	38	92	25	25	75	93	50	25	94	83
Heavy Vehicles, %	1	2	17	2	0	0	0	1	0	0	1	1
Mvmt Flow	90	0	16	0	0	0	8	967	4	4	715	258

Major/Minor	Minor2			Major1			Major2					
Conflicting Flow All	1839	1841	845				974	0	0	971	0	0
Stage 1	853	853	-				-	-	-	-	-	-
Stage 2	986	988	-				-	-	-	-	-	-
Critical Hdwy	6.41	6.52	6.37				4.1	-	-	4.1	-	-
Critical Hdwy Stg 1	5.41	5.52	-				-	-	-	-	-	-
Critical Hdwy Stg 2	5.41	5.52	-				-	-	-	-	-	-
Follow-up Hdwy	3.509	4.018	3.453				2.2	-	-	2.2	-	-
Pot Cap-1 Maneuver	~ 83	75	341				716	-	-	718	-	-
Stage 1	419	376	-				-	-	-	-	-	-
Stage 2	363	325	-				-	-	-	-	-	-
Platoon blocked, %								-	-		-	-
Mov Cap-1 Maneuver	~ 81	0	341				716	-	-	718	-	-
Mov Cap-2 Maneuver	~ 81	0	-				-	-	-	-	-	-
Stage 1	413	0	-				-	-	-	-	-	-
Stage 2	359	0	-				-	-	-	-	-	-

Approach	EB	NB	SB
HCM Control Delay, s	194.4	0.1	0
HCM LOS	F		

Minor Lane/Major Mvmt	NBL	NBT	NBR	EBLn1	EBLn2	SBL	SBT	SBR
Capacity (veh/h)	716	-	-	81	341	718	-	-
HCM Lane V/C Ratio	0.011	-	-	1.113	0.047	0.006	-	-
HCM Control Delay (s)	10.1	-	-	226.2	16.1	10	0	-
HCM Lane LOS	B	-	-	F	C	B	A	-
HCM 95th %tile Q(veh)	0	-	-	6.4	0.1	0	-	-

Notes  
 -: Volume exceeds capacity    \$: Delay exceeds 300s    +: Computation Not Defined    \*: All major volume in platoon



### Lanes, Volumes, Timings

#### 3: Main St (1A) & Cherry St/Old Country Rd

07/23/2018



Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	198	0	107	5	1	5	158	692	0	0	552	110
Future Volume (vph)	198	0	107	5	1	5	158	692	0	0	552	110
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Storage Length (ft)	0		50	0		0	75		0	0		0
Storage Lanes	1		1	0		0	1		0	0		0
Taper Length (ft)	0			0			25			0		
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Ped Bike Factor					0.99							
Frt			0.850		0.932							0.976
Flt Protected	0.950				0.984		0.950					
Satd. Flow (prot)	1770	0	1599	0	1722	0	1770	1881	0	0	1836	0
Flt Permitted	0.742				0.984		0.106					
Satd. Flow (perm)	1382	0	1599	0	1720	0	197	1881	0	0	1836	0
Right Turn on Red			Yes			Yes			Yes			Yes
Satd. Flow (RTOR)			109		12							14
Link Speed (mph)		30			30			30				30
Link Distance (ft)		2702			575			3735				460
Travel Time (s)		61.4			13.1			84.9				10.5
Confl. Peds. (#/hr)				1		1						
Peak Hour Factor	0.91	0.25	0.86	0.63	0.25	0.42	0.96	0.94	0.50	0.50	0.91	0.83
Growth Factor	102%	102%	102%	102%	102%	102%	102%	102%	102%	102%	102%	102%
Heavy Vehicles (%)	2%	0%	1%	0%	0%	0%	2%	1%	0%	0%	1%	1%
Adj. Flow (vph)	222	0	127	8	4	12	168	751	0	0	619	135
Shared Lane Traffic (%)												
Lane Group Flow (vph)	222	0	127	0	24	0	168	751	0	0	754	0
Enter Blocked Intersection	No	No	No	No	No	No	No	No	No	No	No	No
Lane Alignment	Left	Left	Right	Left	Left	Right	Left	Left	Right	Left	Left	Right
Median Width(ft)		12			12			12				12
Link Offset(ft)		0			8			0				0
Crosswalk Width(ft)		16			16			16				16
Two way Left Turn Lane												
Headway Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Number of Detectors	1		1	1	2		1	2				2
Detector Template	Left		Right	Left	Thru		Left	Thru				Thru
Leading Detector (ft)	20		20	20	100		20	100				100
Trailing Detector (ft)	0		0	0	0		0	0				0
Detector 1 Position(ft)	0		0	0	0		0	0				0
Detector 1 Size(ft)	20		20	20	6		20	6				6
Detector 1 Type	Cl+Ex		Cl+Ex	Cl+Ex	Cl+Ex		Cl+Ex	Cl+Ex				Cl+Ex
Detector 1 Channel												
Detector 1 Extend (s)	0.0		0.0	0.0	0.0		0.0	0.0				0.0
Detector 1 Queue (s)	0.0		0.0	0.0	0.0		0.0	0.0				0.0
Detector 1 Delay (s)	0.0		0.0	0.0	0.0		0.0	0.0				0.0
Detector 2 Position(ft)					94			94				94
Detector 2 Size(ft)					6			6				6
Detector 2 Type					Cl+Ex			Cl+Ex				Cl+Ex
Detector 2 Channel												
Detector 2 Extend (s)					0.0			0.0				0.0

Lanes, Volumes, Timings  
3: Main St (1A) & Cherry St/Old Country Rd

07/23/2018

Lane Group	Ø9
Lane Configurations	
Traffic Volume (vph)	
Future Volume (vph)	
Ideal Flow (vphpl)	
Storage Length (ft)	
Storage Lanes	
Taper Length (ft)	
Lane Util. Factor	
Ped Bike Factor	
Frt	
Flt Protected	
Satd. Flow (prot)	
Flt Permitted	
Satd. Flow (perm)	
Right Turn on Red	
Satd. Flow (RTOR)	
Link Speed (mph)	
Link Distance (ft)	
Travel Time (s)	
Confl. Peds. (#/hr)	
Peak Hour Factor	
Growth Factor	
Heavy Vehicles (%)	
Adj. Flow (vph)	
Shared Lane Traffic (%)	
Lane Group Flow (vph)	
Enter Blocked Intersection	
Lane Alignment	
Median Width(ft)	
Link Offset(ft)	
Crosswalk Width(ft)	
Two way Left Turn Lane	
Headway Factor	
Number of Detectors	
Detector Template	
Leading Detector (ft)	
Trailing Detector (ft)	
Detector 1 Position(ft)	
Detector 1 Size(ft)	
Detector 1 Type	
Detector 1 Channel	
Detector 1 Extend (s)	
Detector 1 Queue (s)	
Detector 1 Delay (s)	
Detector 2 Position(ft)	
Detector 2 Size(ft)	
Detector 2 Type	
Detector 2 Channel	
Detector 2 Extend (s)	

# Lanes, Volumes, Timings

## 3: Main St (1A) & Cherry St/Old Country Rd

07/23/2018



Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Turn Type	Perm		Prot	Perm	NA		pm+pt	NA				NA
Protected Phases			6		2		7	4				8
Permitted Phases	6			2			4					
Detector Phase	6		6	2	2		7	4				8
Switch Phase												
Minimum Initial (s)	1.0		1.0	1.0	1.0		1.0	1.0				1.0
Minimum Split (s)	8.0		8.0	8.0	8.0		8.0	8.0				8.0
Total Split (s)	19.0		19.0	19.0	19.0		10.0	49.0				39.0
Total Split (%)	21.1%		21.1%	21.1%	21.1%		11.1%	54.4%				43.3%
Maximum Green (s)	14.0		14.0	14.0	14.0		5.0	44.0				34.0
Yellow Time (s)	3.0		3.0	3.0	3.0		3.0	3.0				3.0
All-Red Time (s)	2.0		2.0	2.0	2.0		2.0	2.0				2.0
Lost Time Adjust (s)	0.0		0.0		0.0		0.0	0.0				0.0
Total Lost Time (s)	5.0		5.0		5.0		5.0	5.0				5.0
Lead/Lag							Lead					Lag
Lead-Lag Optimize?							Yes					Yes
Vehicle Extension (s)	3.0		3.0	3.0	3.0		3.0	3.0				3.0
Recall Mode	None		None	None	None		None	None				None
Walk Time (s)												
Flash Dont Walk (s)												
Pedestrian Calls (#/hr)												
Act Effct Green (s)	14.2		14.2		14.2		44.6	44.6				34.4
Actuated g/C Ratio	0.20		0.20		0.20		0.62	0.62				0.48
v/c Ratio	0.82		0.32		0.07		0.73	0.65				0.86
Control Delay	55.8		11.0		19.9		31.5	14.5				30.2
Queue Delay	0.0		0.0		0.0		0.0	0.0				0.0
Total Delay	55.8		11.0		19.9		31.5	14.5				30.2
LOS	E		B		B		C	B				C
Approach Delay		39.5			19.9			17.6				30.2
Approach LOS		D			B			B				C
90th %ile Green (s)	14.0		14.0	14.0	14.0		5.0	44.0				34.0
90th %ile Term Code	Max		Max	Hold	Hold		Max	Max				Max
70th %ile Green (s)	14.0		14.0	14.0	14.0		5.0	44.0				34.0
70th %ile Term Code	Max		Max	Hold	Hold		Max	Hold				Max
50th %ile Green (s)	14.0		14.0	14.0	14.0		5.0	44.0				34.0
50th %ile Term Code	Max		Max	Hold	Hold		Max	Hold				Max
30th %ile Green (s)	14.0		14.0	14.0	14.0		5.0	44.0				34.0
30th %ile Term Code	Max		Max	Hold	Hold		Max	Hold				Max
10th %ile Green (s)	14.0		14.0	14.0	14.0		5.0	44.0				34.0
10th %ile Term Code	Max		Max	Hold	Hold		Max	Hold				Max
Stops (vph)	162		28		7		60	424				490
Fuel Used(gal)	7		3		0		6	25				9
CO Emissions (g/hr)	520		188		9		423	1746				648
NOx Emissions (g/hr)	101		37		2		82	340				126
VOC Emissions (g/hr)	121		44		2		98	405				150
Dilemma Vehicles (#)	0		0		0		0	0				0
Queue Length 50th (ft)	88		6		4		23	157				244
Queue Length 95th (ft)	#277		52		3		#166	#528				#700
Internal Link Dist (ft)		2622			495			3655				380

Lanes, Volumes, Timings  
 3: Main St (1A) & Cherry St/Old Country Rd

07/23/2018

Lane Group	Ø9
Turn Type	
Protected Phases	9
Permitted Phases	
Detector Phase	
Switch Phase	
Minimum Initial (s)	1.0
Minimum Split (s)	22.0
Total Split (s)	22.0
Total Split (%)	24%
Maximum Green (s)	20.0
Yellow Time (s)	2.0
All-Red Time (s)	0.0
Lost Time Adjust (s)	
Total Lost Time (s)	
Lead/Lag	
Lead-Lag Optimize?	
Vehicle Extension (s)	3.0
Recall Mode	None
Walk Time (s)	9.0
Flash Dont Walk (s)	11.0
Pedestrian Calls (#/hr)	5
Act Effct Green (s)	
Actuated g/C Ratio	
v/c Ratio	
Control Delay	
Queue Delay	
Total Delay	
LOS	
Approach Delay	
Approach LOS	
90th %ile Green (s)	20.0
90th %ile Term Code	Ped
70th %ile Green (s)	0.0
70th %ile Term Code	Skip
50th %ile Green (s)	0.0
50th %ile Term Code	Skip
30th %ile Green (s)	0.0
30th %ile Term Code	Skip
10th %ile Green (s)	0.0
10th %ile Term Code	Skip
Stops (vph)	
Fuel Used(gal)	
CO Emissions (g/hr)	
NOx Emissions (g/hr)	
VOC Emissions (g/hr)	
Dilemma Vehicles (#)	
Queue Length 50th (ft)	
Queue Length 95th (ft)	
Internal Link Dist (ft)	

Lanes, Volumes, Timings  
 3: Main St (1A) & Cherry St/Old Country Rd

07/23/2018

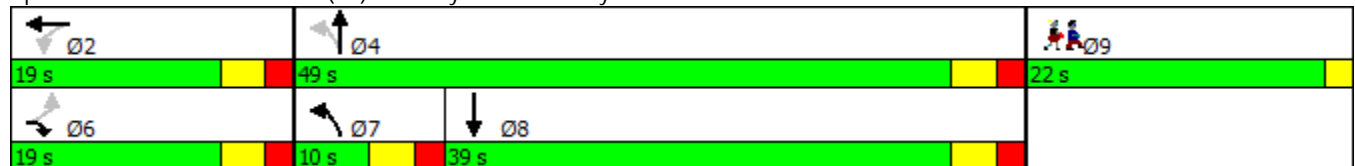


Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Turn Bay Length (ft)			50				75					
Base Capacity (vph)	270		400		346		231	1157				880
Starvation Cap Reductn	0		0		0		0	0				0
Spillback Cap Reductn	0		0		0		0	0				0
Storage Cap Reductn	0		0		0		0	0				0
Reduced v/c Ratio	0.82		0.32		0.07		0.73	0.65				0.86

Intersection Summary

Area Type:	Other
Cycle Length:	90
Actuated Cycle Length:	72.4
Natural Cycle:	90
Control Type:	Actuated-Uncoordinated
Maximum v/c Ratio:	0.86
Intersection Signal Delay:	26.0
Intersection LOS:	C
Intersection Capacity Utilization:	74.9%
ICU Level of Service:	D
Analysis Period (min):	15
90th %ile Actuated Cycle:	90
70th %ile Actuated Cycle:	68
50th %ile Actuated Cycle:	68
30th %ile Actuated Cycle:	68
10th %ile Actuated Cycle:	68
#	95th percentile volume exceeds capacity, queue may be longer. Queue shown is maximum after two cycles.

Splits and Phases: 3: Main St (1A) & Cherry St/Old Country Rd





Lanes, Volumes, Timings  
3: Main St (1A) & Cherry St/Old Country Rd

07/23/2018

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Lane Group	Ø9
Turn Bay Length (ft)	
Base Capacity (vph)	
Starvation Cap Reductn	
Spillback Cap Reductn	
Storage Cap Reductn	
Reduced v/c Ratio	
Intersection Summary	

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Lanes, Volumes, Timings  
 1: Main St (1A) & Arbor St/Friend Ct

07/23/2018



Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		↖	↗		↔		↖	↗		↖	↗	
Traffic Volume (vph)	16	1	346	3	3	6	287	555	6	5	578	27
Future Volume (vph)	16	1	346	3	3	6	287	555	6	5	578	27
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Storage Length (ft)	0		50	0		0	100		0	40		0
Storage Lanes	0		1	0		0	1		0	1		0
Taper Length (ft)	0			0			25			25		
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Ped Bike Factor							1.00	1.00		1.00	1.00	
Frt			0.850		0.932			0.998			0.991	
Flt Protected		0.959			0.992		0.950			0.950		
Satd. Flow (prot)	0	1639	1583	0	1757	0	1752	1824	0	1504	1825	0
Flt Permitted		0.929			0.935		0.249			0.423		
Satd. Flow (perm)	0	1588	1583	0	1656	0	459	1824	0	669	1825	0
Right Turn on Red			Yes			Yes			Yes			Yes
Satd. Flow (RTOR)			420		12			1			4	
Link Speed (mph)		30			30			30			30	
Link Distance (ft)		2388			2408			316			2230	
Travel Time (s)		54.3			54.7			7.2			50.7	
Confl. Peds. (#/hr)							1		1	1		1
Peak Hour Factor	0.67	0.25	0.84	0.75	0.38	0.50	0.84	0.90	0.75	0.31	0.91	0.68
Growth Factor	102%	102%	102%	102%	102%	102%	102%	102%	102%	102%	102%	102%
Heavy Vehicles (%)	13%	0%	2%	0%	0%	0%	3%	4%	0%	20%	3%	4%
Adj. Flow (vph)	24	4	420	4	8	12	349	629	8	16	648	41
Shared Lane Traffic (%)												
Lane Group Flow (vph)	0	28	420	0	24	0	349	637	0	16	689	0
Enter Blocked Intersection	No	No	No	No	No	No	No	No	No	No	No	No
Lane Alignment	Left	Left	Right	Left	Left	Right	Left	Left	Right	Left	Left	Right
Median Width(ft)		0			0			12			12	
Link Offset(ft)		0			-10			6			0	
Crosswalk Width(ft)		16			16			16			16	
Two way Left Turn Lane												
Headway Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Number of Detectors	1	1	2	1	2		1	2		1	2	
Detector Template	Left	Left	Thru	Left	Thru		Left	Thru		Left	Thru	
Leading Detector (ft)	20	20	100	20	100		20	100		20	100	
Trailing Detector (ft)	0	0	0	0	0		0	0		0	0	
Detector 1 Position(ft)	0	0	0	0	0		0	0		0	0	
Detector 1 Size(ft)	20	20	6	20	6		20	6		20	6	
Detector 1 Type	Cl+Ex	Cl+Ex	Cl+Ex	Cl+Ex	Cl+Ex		Cl+Ex	Cl+Ex		Cl+Ex	Cl+Ex	
Detector 1 Channel												
Detector 1 Extend (s)	0.0	0.0	0.0	0.0	0.0		0.0	0.0		0.0	0.0	
Detector 1 Queue (s)	0.0	0.0	0.0	0.0	0.0		0.0	0.0		0.0	0.0	
Detector 1 Delay (s)	0.0	0.0	0.0	0.0	0.0		0.0	0.0		0.0	0.0	
Detector 2 Position(ft)			94		94			94			94	
Detector 2 Size(ft)			6		6			6			6	
Detector 2 Type			Cl+Ex		Cl+Ex			Cl+Ex			Cl+Ex	
Detector 2 Channel												
Detector 2 Extend (s)			0.0		0.0			0.0			0.0	

Lanes, Volumes, Timings  
1: Main St (1A) & Arbor St/Friend Ct

07/23/2018

Lane Group	Ø9
Lane Configurations	
Traffic Volume (vph)	
Future Volume (vph)	
Ideal Flow (vphpl)	
Storage Length (ft)	
Storage Lanes	
Taper Length (ft)	
Lane Util. Factor	
Ped Bike Factor	
Frt	
Flt Protected	
Satd. Flow (prot)	
Flt Permitted	
Satd. Flow (perm)	
Right Turn on Red	
Satd. Flow (RTOR)	
Link Speed (mph)	
Link Distance (ft)	
Travel Time (s)	
Confl. Peds. (#/hr)	
Peak Hour Factor	
Growth Factor	
Heavy Vehicles (%)	
Adj. Flow (vph)	
Shared Lane Traffic (%)	
Lane Group Flow (vph)	
Enter Blocked Intersection	
Lane Alignment	
Median Width(ft)	
Link Offset(ft)	
Crosswalk Width(ft)	
Two way Left Turn Lane	
Headway Factor	
Number of Detectors	
Detector Template	
Leading Detector (ft)	
Trailing Detector (ft)	
Detector 1 Position(ft)	
Detector 1 Size(ft)	
Detector 1 Type	
Detector 1 Channel	
Detector 1 Extend (s)	
Detector 1 Queue (s)	
Detector 1 Delay (s)	
Detector 2 Position(ft)	
Detector 2 Size(ft)	
Detector 2 Type	
Detector 2 Channel	
Detector 2 Extend (s)	

Lanes, Volumes, Timings  
1: Main St (1A) & Arbor St/Friend Ct

07/23/2018



Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Turn Type	Perm	NA	pm+ov	Perm	NA		pm+pt	NA		pm+pt	NA	
Protected Phases		6	7		2		7	4		3	8	
Permitted Phases	6		6	2			4			8		
Detector Phase	6	6	7	2	2		7	4		3	8	
Switch Phase												
Minimum Initial (s)	1.0	1.0	1.0	1.0	1.0		1.0	1.0		1.0	1.0	
Minimum Split (s)	6.0	6.0	6.0	6.0	6.0		6.0	6.0		6.0	6.0	
Total Split (s)	9.0	9.0	27.0	9.0	9.0		27.0	71.0		8.0	52.0	
Total Split (%)	8.2%	8.2%	24.5%	8.2%	8.2%		24.5%	64.5%		7.3%	47.3%	
Maximum Green (s)	4.0	4.0	22.0	4.0	4.0		22.0	66.0		3.0	47.0	
Yellow Time (s)	3.0	3.0	3.0	3.0	3.0		3.0	3.0		3.0	3.0	
All-Red Time (s)	2.0	2.0	2.0	2.0	2.0		2.0	2.0		2.0	2.0	
Lost Time Adjust (s)		0.0	0.0		0.0		0.0	0.0		0.0	0.0	
Total Lost Time (s)		5.0	5.0		5.0		5.0	5.0		5.0	5.0	
Lead/Lag			Lead				Lead	Lag		Lead	Lag	
Lead-Lag Optimize?			Yes				Yes	Yes		Yes	Yes	
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0		3.0	3.0		3.0	3.0	
Recall Mode	None	None	None	None	None		None	C-Max		None	C-Max	
Walk Time (s)												
Flash Dont Walk (s)												
Pedestrian Calls (#/hr)												
Act Effct Green (s)		6.4	25.8		6.2		93.6	91.8		74.9	69.8	
Actuated g/C Ratio		0.06	0.23		0.06		0.85	0.83		0.68	0.63	
v/c Ratio		0.30	0.61		0.23		0.57	0.42		0.03	0.59	
Control Delay		59.2	7.0		38.2		24.1	4.6		6.4	19.2	
Queue Delay		0.0	0.8		0.0		0.6	0.7		0.0	0.2	
Total Delay		59.2	7.8		38.2		24.7	5.3		6.4	19.4	
LOS		E	A		D		C	A		A	B	
Approach Delay		11.0			38.3			12.2			19.1	
Approach LOS		B			D			B			B	
90th %ile Green (s)	4.0	4.0	22.0	4.0	4.0		22.0	66.0		3.0	47.0	
90th %ile Term Code	Max	Max	Max	Max	Max		Max	Coord		Max	Coord	
70th %ile Green (s)	8.6	8.6	25.9	8.6	8.6		25.9	80.6		5.8	60.5	
70th %ile Term Code	Gap	Gap	Gap	Hold	Hold		Gap	Coord		Gap	Coord	
50th %ile Green (s)	7.5	7.5	21.3	7.5	7.5		21.3	92.5		0.0	66.2	
50th %ile Term Code	Gap	Gap	Gap	Hold	Hold		Gap	Coord		Skip	Coord	
30th %ile Green (s)	0.0	0.0	15.4	0.0	0.0		15.4	105.0		0.0	84.6	
30th %ile Term Code	Skip	Skip	Gap	Skip	Skip		Gap	Coord		Skip	Coord	
10th %ile Green (s)	0.0	0.0	9.2	0.0	0.0		9.2	105.0		0.0	90.8	
10th %ile Term Code	Skip	Skip	Gap	Skip	Skip		Gap	Coord		Skip	Coord	
Stops (vph)		16	33		8		165	172		3	360	
Fuel Used(gal)		1	7		0		3	3		0	15	
CO Emissions (g/hr)		43	507		25		215	202		8	1059	
NOx Emissions (g/hr)		8	99		5		42	39		1	206	
VOC Emissions (g/hr)		10	118		6		50	47		2	245	
Dilemma Vehicles (#)		0	0		0		0	0		0	0	
Queue Length 50th (ft)		19	0		8		77	16		2	289	
Queue Length 95th (ft)		14	51		11		190	126		4	#664	
Internal Link Dist (ft)		2308			2328			236			2150	



Lanes, Volumes, Timings  
 1: Main St (1A) & Arbor St/Friend Ct

07/23/2018

Lane Group	Ø9
Turn Type	
Protected Phases	9
Permitted Phases	
Detector Phase	
Switch Phase	
Minimum Initial (s)	1.0
Minimum Split (s)	22.0
Total Split (s)	22.0
Total Split (%)	20%
Maximum Green (s)	20.0
Yellow Time (s)	2.0
All-Red Time (s)	0.0
Lost Time Adjust (s)	
Total Lost Time (s)	
Lead/Lag	
Lead-Lag Optimize?	
Vehicle Extension (s)	3.0
Recall Mode	None
Walk Time (s)	9.0
Flash Dont Walk (s)	11.0
Pedestrian Calls (#/hr)	10
Act Effct Green (s)	
Actuated g/C Ratio	
v/c Ratio	
Control Delay	
Queue Delay	
Total Delay	
LOS	
Approach Delay	
Approach LOS	
90th %ile Green (s)	20.0
90th %ile Term Code	Ped
70th %ile Green (s)	0.0
70th %ile Term Code	Skip
50th %ile Green (s)	0.0
50th %ile Term Code	Skip
30th %ile Green (s)	0.0
30th %ile Term Code	Skip
10th %ile Green (s)	0.0
10th %ile Term Code	Skip
Stops (vph)	
Fuel Used(gal)	
CO Emissions (g/hr)	
NOx Emissions (g/hr)	
VOC Emissions (g/hr)	
Dilemma Vehicles (#)	
Queue Length 50th (ft)	
Queue Length 95th (ft)	
Internal Link Dist (ft)	

Lanes, Volumes, Timings  
 1: Main St (1A) & Arbor St/Friend Ct

07/23/2018



Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Turn Bay Length (ft)			50				100			40		
Base Capacity (vph)		92	734		105		658	1522		494	1159	
Starvation Cap Reductn		0	0		0		91	523		0	0	
Spillback Cap Reductn		0	115		0		0	0		0	86	
Storage Cap Reductn		0	0		0		0	0		0	0	
Reduced v/c Ratio		0.30	0.68		0.23		0.62	0.64		0.03	0.64	

Intersection Summary

Area Type: Other  
 Cycle Length: 110  
 Actuated Cycle Length: 110  
 Offset: 0 (0%), Referenced to phase 4:NBTL and 8:SBTL, Start of Green, Master Intersection  
 Natural Cycle: 90  
 Control Type: Actuated-Coordinated  
 Maximum v/c Ratio: 0.61  
 Intersection Signal Delay: 14.5  
 Intersection LOS: B  
 Intersection Capacity Utilization 70.4%  
 ICU Level of Service C  
 Analysis Period (min) 15  
 # 95th percentile volume exceeds capacity, queue may be longer.  
 Queue shown is maximum after two cycles.

Splits and Phases: 1: Main St (1A) & Arbor St/Friend Ct



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Lane Group	Ø9
Turn Bay Length (ft)	
Base Capacity (vph)	
Starvation Cap Reductn	
Spillback Cap Reductn	
Storage Cap Reductn	
Reduced v/c Ratio	
Intersection Summary	

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Lanes, Volumes, Timings  
 2: Main St (1A) & Monument St/Wenham Town Hall

07/23/2018



Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	251	0	3	0	0	0	5	590	0	1	752	185
Future Volume (vph)	251	0	3	0	0	0	5	590	0	1	752	185
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Storage Length (ft)	0		15	0		0	25		0	0		0
Storage Lanes	0		1	0		0	1		0	0		0
Taper Length (ft)	0			0			25			0		
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Ped Bike Factor							1.00					0.99
Frt			0.850									0.971
Flt Protected		0.950					0.950					
Satd. Flow (prot)	0	1719	1615	0	0	0	1504	1845	0	0	1796	0
Flt Permitted		0.950					0.210				0.998	
Satd. Flow (perm)	0	1719	1615	0	0	0	332	1845	0	0	1792	0
Right Turn on Red			Yes			Yes			Yes			Yes
Satd. Flow (RTOR)			89									18
Link Speed (mph)		30			30			30				30
Link Distance (ft)		2613			509			460				316
Travel Time (s)		59.4			11.6			10.5				7.2
Confl. Peds. (#/hr)							5					5
Peak Hour Factor	0.89	0.92	0.38	0.92	0.25	0.25	0.63	0.86	0.92	0.25	0.95	0.86
Growth Factor	102%	102%	102%	102%	102%	102%	102%	102%	102%	102%	102%	102%
Heavy Vehicles (%)	5%	2%	0%	2%	0%	0%	20%	3%	0%	0%	2%	3%
Adj. Flow (vph)	288	0	8	0	0	0	8	700	0	4	807	219
Shared Lane Traffic (%)												
Lane Group Flow (vph)	0	288	8	0	0	0	8	700	0	0	1030	0
Enter Blocked Intersection	No	No	No	No	No	No	No	No	No	No	No	No
Lane Alignment	Left	Left	Right	Left	Left	Right	Left	Left	Right	Left	Left	Right
Median Width(ft)		0			0			12				12
Link Offset(ft)		0			30			0				0
Crosswalk Width(ft)		16			16			16				16
Two way Left Turn Lane												
Headway Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Turning Speed (mph)	25		9	15		9	15		9	15		9
Number of Detectors	1	2	1				1	2		1	2	
Detector Template	Left	Thru	Right				Left	Thru		Left	Thru	
Leading Detector (ft)	20	100	20				20	100		20	100	
Trailing Detector (ft)	0	0	0				0	0		0	0	
Detector 1 Position(ft)	0	0	0				0	0		0	0	
Detector 1 Size(ft)	20	6	20				20	6		20	6	
Detector 1 Type	Cl+Ex	Cl+Ex	Cl+Ex				Cl+Ex	Cl+Ex		Cl+Ex	Cl+Ex	
Detector 1 Channel												
Detector 1 Extend (s)	0.0	0.0	0.0				0.0	0.0		0.0	0.0	
Detector 1 Queue (s)	0.0	0.0	0.0				0.0	0.0		0.0	0.0	
Detector 1 Delay (s)	0.0	0.0	0.0				0.0	0.0		0.0	0.0	
Detector 2 Position(ft)		94						94			94	
Detector 2 Size(ft)		6						6			6	
Detector 2 Type		Cl+Ex						Cl+Ex			Cl+Ex	
Detector 2 Channel												

Lanes, Volumes, Timings  
2: Main St (1A) & Monument St/Wenham Town Hall

07/23/2018

Lane Group	Ø9
Lane Configurations	
Traffic Volume (vph)	
Future Volume (vph)	
Ideal Flow (vphpl)	
Storage Length (ft)	
Storage Lanes	
Taper Length (ft)	
Lane Util. Factor	
Ped Bike Factor	
Frt	
Flt Protected	
Satd. Flow (prot)	
Flt Permitted	
Satd. Flow (perm)	
Right Turn on Red	
Satd. Flow (RTOR)	
Link Speed (mph)	
Link Distance (ft)	
Travel Time (s)	
Confl. Peds. (#/hr)	
Peak Hour Factor	
Growth Factor	
Heavy Vehicles (%)	
Adj. Flow (vph)	
Shared Lane Traffic (%)	
Lane Group Flow (vph)	
Enter Blocked Intersection	
Lane Alignment	
Median Width(ft)	
Link Offset(ft)	
Crosswalk Width(ft)	
Two way Left Turn Lane	
Headway Factor	
Turning Speed (mph)	
Number of Detectors	
Detector Template	
Leading Detector (ft)	
Trailing Detector (ft)	
Detector 1 Position(ft)	
Detector 1 Size(ft)	
Detector 1 Type	
Detector 1 Channel	
Detector 1 Extend (s)	
Detector 1 Queue (s)	
Detector 1 Delay (s)	
Detector 2 Position(ft)	
Detector 2 Size(ft)	
Detector 2 Type	
Detector 2 Channel	



# Lanes, Volumes, Timings

## 2: Main St (1A) & Monument St/Wenham Town Hall

07/23/2018



Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Detector 2 Extend (s)		0.0						0.0				0.0
Turn Type	Split	NA	Perm				pm+pt	NA		Perm		NA
Protected Phases	6	6					7	4				8
Permitted Phases			6				4			8		
Detector Phase	6	6	6				7	4		8		8
Switch Phase												
Minimum Initial (s)	1.0	1.0	1.0				3.0	1.0		1.0		1.0
Minimum Split (s)	6.0	6.0	6.0				8.0	6.0		6.0		6.0
Total Split (s)	19.0	19.0	19.0				8.0	69.0		61.0		61.0
Total Split (%)	17.3%	17.3%	17.3%				7.3%	62.7%		55.5%		55.5%
Maximum Green (s)	14.0	14.0	14.0				3.0	64.0		56.0		56.0
Yellow Time (s)	3.0	3.0	3.0				3.0	3.0		3.0		3.0
All-Red Time (s)	2.0	2.0	2.0				2.0	2.0		2.0		2.0
Lost Time Adjust (s)		0.0	0.0				0.0	0.0				0.0
Total Lost Time (s)		5.0	5.0				5.0	5.0				5.0
Lead/Lag							Lag			Lead		Lead
Lead-Lag Optimize?							Yes			Yes		Yes
Vehicle Extension (s)	3.0	3.0	3.0				3.0	3.0		3.0		3.0
Recall Mode	None	None	None				None	C-Min		C-Max		C-Max
Walk Time (s)												
Flash Dont Walk (s)												
Pedestrian Calls (#/hr)												
Act Effct Green (s)		29.1	29.1				68.9	66.5				64.9
Actuated g/C Ratio		0.26	0.26				0.63	0.60				0.59
v/c Ratio		0.63	0.02				0.03	0.63				0.97
Control Delay		45.8	0.0				8.2	16.9				33.4
Queue Delay		0.1	0.0				0.0	0.0				0.0
Total Delay		45.8	0.0				8.2	16.9				33.4
LOS		D	A				A	B				C
Approach Delay		44.6						16.8				33.4
Approach LOS		D						B				C
90th %ile Green (s)	14.0	14.0	14.0				3.0	64.0		56.0		56.0
90th %ile Term Code	Max	Max	Max				Max	Coord		Coord		Coord
70th %ile Green (s)	28.7	28.7	28.7				0.0	71.3		71.3		71.3
70th %ile Term Code	Gap	Gap	Gap				Skip	Coord		Coord		Coord
50th %ile Green (s)	29.5	29.5	29.5				0.0	70.5		70.5		70.5
50th %ile Term Code	Gap	Gap	Gap				Skip	Coord		Coord		Coord
30th %ile Green (s)	32.1	32.1	32.1				0.0	67.9		67.9		67.9
30th %ile Term Code	Gap	Gap	Gap				Skip	Coord		Coord		Coord
10th %ile Green (s)	41.3	41.3	41.3				0.0	58.7		58.7		58.7
10th %ile Term Code	Gap	Gap	Gap				Skip	Coord		Coord		Coord
Stops (vph)		188	0				2	368				648
Fuel Used(gal)		9	0				0	6				12
CO Emissions (g/hr)		604	4				3	438				869
NOx Emissions (g/hr)		117	1				1	85				169
VOC Emissions (g/hr)		140	1				1	101				201
Dilemma Vehicles (#)		0	0				0	0				0
Queue Length 50th (ft)		179	0				1	263				555
Queue Length 95th (ft)		#433	0				6	407				#1066

Lanes, Volumes, Timings  
 2: Main St (1A) & Monument St/Wenham Town Hall

07/23/2018

Lane Group	Ø9
Detector 2 Extend (s)	
Turn Type	
Protected Phases	9
Permitted Phases	
Detector Phase	
Switch Phase	
Minimum Initial (s)	1.0
Minimum Split (s)	22.0
Total Split (s)	22.0
Total Split (%)	20%
Maximum Green (s)	20.0
Yellow Time (s)	2.0
All-Red Time (s)	0.0
Lost Time Adjust (s)	
Total Lost Time (s)	
Lead/Lag	
Lead-Lag Optimize?	
Vehicle Extension (s)	3.0
Recall Mode	None
Walk Time (s)	9.0
Flash Dont Walk (s)	11.0
Pedestrian Calls (#/hr)	5
Act Effct Green (s)	
Actuated g/C Ratio	
v/c Ratio	
Control Delay	
Queue Delay	
Total Delay	
LOS	
Approach Delay	
Approach LOS	
90th %ile Green (s)	20.0
90th %ile Term Code	Ped
70th %ile Green (s)	0.0
70th %ile Term Code	Skip
50th %ile Green (s)	0.0
50th %ile Term Code	Skip
30th %ile Green (s)	0.0
30th %ile Term Code	Skip
10th %ile Green (s)	0.0
10th %ile Term Code	Skip
Stops (vph)	
Fuel Used(gal)	
CO Emissions (g/hr)	
NOx Emissions (g/hr)	
VOC Emissions (g/hr)	
Dilemma Vehicles (#)	
Queue Length 50th (ft)	
Queue Length 95th (ft)	

Lanes, Volumes, Timings  
 2: Main St (1A) & Monument St/Wenham Town Hall

07/23/2018

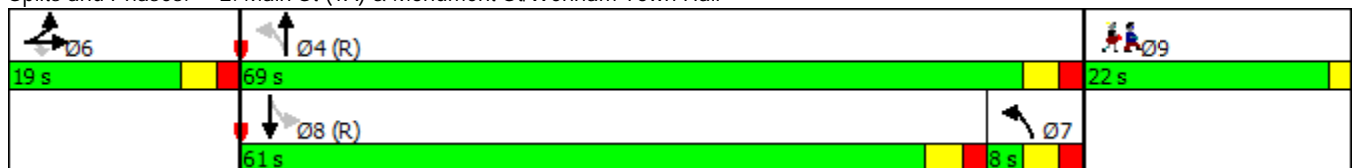


Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Internal Link Dist (ft)		2533			429			380				236
Turn Bay Length (ft)			15				25					
Base Capacity (vph)		455	493				239	1132				1064
Starvation Cap Reductn		0	0				0	0				0
Spillback Cap Reductn		4	0				0	2				0
Storage Cap Reductn		0	0				0	0				0
Reduced v/c Ratio		0.64	0.02				0.03	0.62				0.97

Intersection Summary

Area Type:	Other
Cycle Length:	110
Actuated Cycle Length:	110
Offset:	105 (95%), Referenced to phase 4:NBTL and 8:SBTL, Start of Green
Natural Cycle:	140
Control Type:	Actuated-Coordinated
Maximum v/c Ratio:	0.97
Intersection Signal Delay:	29.2
Intersection LOS:	C
Intersection Capacity Utilization	75.3%
ICU Level of Service	D
Analysis Period (min)	15
# 95th percentile volume exceeds capacity, queue may be longer.	
Queue shown is maximum after two cycles.	

Splits and Phases: 2: Main St (1A) & Monument St/Wenham Town Hall



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Lane Group	Ø9
Internal Link Dist (ft)	
Turn Bay Length (ft)	
Base Capacity (vph)	
Starvation Cap Reductn	
Spillback Cap Reductn	
Storage Cap Reductn	
Reduced v/c Ratio	
Intersection Summary	

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Lanes, Volumes, Timings  
 3: Main St (1A) & Cherry St/Old Country Rd

07/23/2018



Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		↕	↗				↖	↗			↕	
Traffic Volume (vph)	52	1	154	0	0	0	87	544	2	2	642	108
Future Volume (vph)	52	1	154	0	0	0	87	544	2	2	642	108
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Storage Length (ft)	0		50	0		0	75		0	0		0
Storage Lanes	0		1	0		0	1		0	0		0
Taper Length (ft)	0			0			25			0		
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Frt			0.850					0.999			0.977	
Flt Protected		0.955					0.950					
Satd. Flow (prot)	0	1781	1538	0	0	0	1752	1826	0	0	1805	0
Flt Permitted		0.955					0.950					
Satd. Flow (perm)	0	1781	1538	0	0	0	1752	1826	0	0	1805	0
Link Speed (mph)		30			30			30			30	
Link Distance (ft)		2702			575			3735			460	
Travel Time (s)		61.4			13.1			84.9			10.5	
Peak Hour Factor	0.95	0.25	0.88	0.92	0.92	0.92	0.84	0.83	0.50	0.50	0.93	0.75
Growth Factor	102%	102%	102%	102%	102%	102%	102%	102%	102%	102%	102%	102%
Heavy Vehicles (%)	2%	0%	5%	2%	0%	0%	3%	4%	0%	0%	3%	2%
Adj. Flow (vph)	56	4	179	0	0	0	106	669	4	4	704	147
Shared Lane Traffic (%)												
Lane Group Flow (vph)	0	60	179	0	0	0	106	673	0	0	855	0
Enter Blocked Intersection	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Lane Alignment	Left	Left	Right	Left	Left	Right	Left	Left	Right	Left	Left	Right
Median Width(ft)		0			0			12			12	
Link Offset(ft)		0			16			0			0	
Crosswalk Width(ft)		16			16			16			16	
Two way Left Turn Lane												
Headway Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Sign Control		Stop			Stop			Free		1.00	1.00	Free

Intersection Summary

Area Type:	Other
Control Type:	Unsignalized
Intersection Capacity Utilization	80.9%
ICU Level of Service	D
Analysis Period (min)	15



# HCM Unsignalized Intersection Capacity Analysis

## 3: Main St (1A) & Cherry St/Old Country Rd

07/23/2018



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		↔	↔				↔	↔			↔	↔
Traffic Volume (veh/h)	52	1	154	0	0	0	87	544	2	2	642	108
Future Volume (Veh/h)	52	1	154	0	0	0	87	544	2	2	642	108
Sign Control		Stop			Stop			Free			Free	
Grade		0%			0%			0%			0%	
Peak Hour Factor	0.95	0.25	0.88	0.92	0.92	0.92	0.84	0.83	0.50	0.50	0.93	0.75
Hourly flow rate (vph)	56	4	179	0	0	0	106	669	4	4	704	147
Pedestrians												
Lane Width (ft)												
Walking Speed (ft/s)												
Percent Blockage												
Right turn flare (veh)			2									
Median type								None			None	
Median storage (veh)												
Upstream signal (ft)											460	
pX, platoon unblocked	0.48	0.48	0.48	0.48	0.48		0.48					
vC, conflicting volume	1666	1670	778	1760	1742	671	851			673		
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	1845	1853	4	2038	2001	671	156			673		
tC, single (s)	*6.5	*6.2	*6.0	7.1	6.5	6.2	4.1			4.1		
tC, 2 stage (s)												
tF (s)	3.5	4.0	3.3	3.5	4.0	3.3	2.2			2.2		
p0 queue free %	0	89	65	100	100	100	85			100		
cM capacity (veh/h)	34	36	517	11	25	460	685			927		

Direction, Lane #	EB 1	NB 1	NB 2	SB 1
Volume Total	239	106	673	855
Volume Left	56	106	0	4
Volume Right	179	0	4	147
cSH	116	685	1700	927
Volume to Capacity	2.06	0.15	0.40	0.00
Queue Length 95th (ft)	497	14	0	0
Control Delay (s)	568.5	11.2	0.0	0.1
Lane LOS	F	B		A
Approach Delay (s)	568.5	1.5		0.1
Approach LOS	F			

Intersection Summary			
Average Delay		73.2	
Intersection Capacity Utilization	80.9%		ICU Level of Service D
Analysis Period (min)		15	

\* User Entered Value

**Intersection**

Int Delay, s/veh 5.9

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		↕	↕				↕	↕			↕	
Traffic Vol, veh/h	52	1	154	0	0	0	87	544	2	2	642	108
Future Vol, veh/h	52	1	154	0	0	0	87	544	2	2	642	108
Conflicting Peds, #/hr	0	0	0	0	0	0	0	0	0	0	0	0
Sign Control	Stop	Stop	Stop	Stop	Stop	Stop	Free	Free	Free	Free	Free	Free
RT Channelized	-	-	None	-	-	None	-	-	None	-	-	None
Storage Length	-	-	50	-	-	-	75	-	-	-	-	-
Veh in Median Storage, #	-	0	-	-	-	-	-	0	-	-	0	-
Grade, %	-	0	-	-	0	-	-	0	-	-	0	-
Peak Hour Factor	95	25	88	92	92	92	84	83	50	50	93	75
Heavy Vehicles, %	2	0	5	2	0	0	3	4	0	0	3	2
Mvmt Flow	56	4	179	0	0	0	106	669	4	4	704	147

Major/Minor	Minor2			Major1			Major2					
Conflicting Flow All	1668	1670	778				851	0	0	673	0	0
Stage 1	786	786	-				-	-	-	-	-	-
Stage 2	882	884	-				-	-	-	-	-	-
Critical Hdwy	6.42	6.5	6.25				4.13	-	-	4.1	-	-
Critical Hdwy Stg 1	5.42	5.5	-				-	-	-	-	-	-
Critical Hdwy Stg 2	5.42	5.5	-				-	-	-	-	-	-
Follow-up Hdwy	3.518	4	3.345				2.227	-	-	2.2	-	-
Pot Cap-1 Maneuver	106	97	392				783	-	-	927	-	-
Stage 1	449	406	-				-	-	-	-	-	-
Stage 2	405	366	-				-	-	-	-	-	-
Platoon blocked, %								-	-		-	-
Mov Cap-1 Maneuver	91	0	392				783	-	-	927	-	-
Mov Cap-2 Maneuver	91	0	-				-	-	-	-	-	-
Stage 1	445	0	-				-	-	-	-	-	-
Stage 2	350	0	-				-	-	-	-	-	-

Approach	EB	NB	SB
HCM Control Delay, s	41.4	1.4	0
HCM LOS	E		

Minor Lane/Major Mvmt	NBL	NBT	NBR	EBLn1	EBLn2	SBL	SBT	SBR
Capacity (veh/h)	783	-	-	91	392	927	-	-
HCM Lane V/C Ratio	0.135	-	-	0.658	0.455	0.004	-	-
HCM Control Delay (s)	10.3	-	-	100.5	21.6	8.9	0	-
HCM Lane LOS	B	-	-	F	C	A	A	-
HCM 95th %tile Q(veh)	0.5	-	-	3.2	2.3	0	-	-

Lanes, Volumes, Timings  
 1: Main St (1A) & Arbor St/Friend Ct

07/23/2018



Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		↖	↗		↔		↖	↗		↖	↗	
Traffic Volume (vph)	18	0	267	7	0	13	297	652	11	5	596	25
Future Volume (vph)	18	0	267	7	0	13	297	652	11	5	596	25
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Storage Length (ft)	0		50	0		0	100		0	40		0
Storage Lanes	0		1	0		0	1		0	1		0
Taper Length (ft)	0			0			25			25		
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Ped Bike Factor							1.00	1.00		1.00	1.00	
Frt			0.850		0.905			0.997				0.993
Flt Protected		0.950			0.986		0.950			0.950		
Satd. Flow (prot)	0	1805	1615	0	1695	0	1787	1857	0	1805	1867	0
Flt Permitted					0.889		0.249			0.373		
Satd. Flow (perm)	0	1900	1615	0	1529	0	468	1857	0	708	1867	0
Right Turn on Red			Yes			Yes			Yes			Yes
Satd. Flow (RTOR)			309		139			2				3
Link Speed (mph)		30			30			30				30
Link Distance (ft)		2388			2408			316				2230
Travel Time (s)		54.3			54.7			7.2				50.7
Confl. Peds. (#/hr)							1		2	2		1
Peak Hour Factor	0.56	0.92	0.88	0.58	0.92	0.46	0.88	0.89	0.69	0.63	0.93	0.78
Growth Factor	102%	102%	102%	102%	102%	102%	102%	102%	102%	102%	102%	102%
Heavy Vehicles (%)	0%	0%	0%	0%	0%	0%	1%	2%	0%	0%	1%	0%
Adj. Flow (vph)	33	0	309	12	0	29	344	747	16	8	654	33
Shared Lane Traffic (%)												
Lane Group Flow (vph)	0	33	309	0	41	0	344	763	0	8	687	0
Enter Blocked Intersection	No	No	No	No	No	No	No	No	No	No	No	No
Lane Alignment	Left	Left	Right	Left	Left	Right	Left	Left	Right	Left	Left	Right
Median Width(ft)		0			0			12				12
Link Offset(ft)		0			-10			6				0
Crosswalk Width(ft)		16			16			16				16
Two way Left Turn Lane												
Headway Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Number of Detectors	1	1	2	1	2		1	2		1	2	
Detector Template	Left	Left	Thru	Left	Thru		Left	Thru		Left	Thru	
Leading Detector (ft)	20	20	100	20	100		20	100		20	100	
Trailing Detector (ft)	0	0	0	0	0		0	0		0	0	
Detector 1 Position(ft)	0	0	0	0	0		0	0		0	0	
Detector 1 Size(ft)	20	20	6	20	6		20	6		20	6	
Detector 1 Type	Cl+Ex	Cl+Ex	Cl+Ex	Cl+Ex	Cl+Ex		Cl+Ex	Cl+Ex		Cl+Ex	Cl+Ex	
Detector 1 Channel												
Detector 1 Extend (s)	0.0	0.0	0.0	0.0	0.0		0.0	0.0		0.0	0.0	
Detector 1 Queue (s)	0.0	0.0	0.0	0.0	0.0		0.0	0.0		0.0	0.0	
Detector 1 Delay (s)	0.0	0.0	0.0	0.0	0.0		0.0	0.0		0.0	0.0	
Detector 2 Position(ft)			94		94			94			94	
Detector 2 Size(ft)			6		6			6			6	
Detector 2 Type			Cl+Ex		Cl+Ex			Cl+Ex			Cl+Ex	
Detector 2 Channel												
Detector 2 Extend (s)			0.0		0.0			0.0			0.0	

Lane Group	Ø9
Lane Configurations	
Traffic Volume (vph)	
Future Volume (vph)	
Ideal Flow (vphpl)	
Storage Length (ft)	
Storage Lanes	
Taper Length (ft)	
Lane Util. Factor	
Ped Bike Factor	
Frt	
Flt Protected	
Satd. Flow (prot)	
Flt Permitted	
Satd. Flow (perm)	
Right Turn on Red	
Satd. Flow (RTOR)	
Link Speed (mph)	
Link Distance (ft)	
Travel Time (s)	
Confl. Peds. (#/hr)	
Peak Hour Factor	
Growth Factor	
Heavy Vehicles (%)	
Adj. Flow (vph)	
Shared Lane Traffic (%)	
Lane Group Flow (vph)	
Enter Blocked Intersection	
Lane Alignment	
Median Width(ft)	
Link Offset(ft)	
Crosswalk Width(ft)	
Two way Left Turn Lane	
Headway Factor	
Number of Detectors	
Detector Template	
Leading Detector (ft)	
Trailing Detector (ft)	
Detector 1 Position(ft)	
Detector 1 Size(ft)	
Detector 1 Type	
Detector 1 Channel	
Detector 1 Extend (s)	
Detector 1 Queue (s)	
Detector 1 Delay (s)	
Detector 2 Position(ft)	
Detector 2 Size(ft)	
Detector 2 Type	
Detector 2 Channel	
Detector 2 Extend (s)	

Lanes, Volumes, Timings  
 1: Main St (1A) & Arbor St/Friend Ct

07/23/2018



Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Turn Type	Perm	NA	pm+ov	Perm	NA		pm+pt	NA		pm+pt	NA	
Protected Phases		6	7		2		7	4		3	8	
Permitted Phases	6		6	2			4			8		
Detector Phase	6	6	7	2	2		7	4		3	8	
Switch Phase												
Minimum Initial (s)	1.0	1.0	1.0	1.0	1.0		1.0	1.0		1.0	1.0	
Minimum Split (s)	6.0	6.0	6.0	6.0	6.0		6.0	6.0		6.0	6.0	
Total Split (s)	9.0	9.0	26.0	9.0	9.0		26.0	72.0		7.0	53.0	
Total Split (%)	8.2%	8.2%	23.6%	8.2%	8.2%		23.6%	65.5%		6.4%	48.2%	
Maximum Green (s)	4.0	4.0	21.0	4.0	4.0		21.0	67.0		2.0	48.0	
Yellow Time (s)	3.0	3.0	3.0	3.0	3.0		3.0	3.0		3.0	3.0	
All-Red Time (s)	2.0	2.0	2.0	2.0	2.0		2.0	2.0		2.0	2.0	
Lost Time Adjust (s)		0.0	0.0		0.0		0.0	0.0		0.0	0.0	
Total Lost Time (s)		5.0	5.0		5.0		5.0	5.0		5.0	5.0	
Lead/Lag			Lead				Lead	Lag		Lead	Lag	
Lead-Lag Optimize?			Yes				Yes	Yes		Yes	Yes	
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0		3.0	3.0		3.0	3.0	
Recall Mode	None	None	None	None	None		None	C-Max		None	C-Max	
Walk Time (s)												
Flash Dont Walk (s)												
Pedestrian Calls (#/hr)												
Act Effct Green (s)		5.5	22.0		5.3		90.1	90.7		73.3	69.2	
Actuated g/C Ratio		0.05	0.20		0.05		0.82	0.82		0.67	0.63	
v/c Ratio		0.35	0.54		0.20		0.60	0.50		0.02	0.58	
Control Delay		61.9	7.4		2.2		16.8	5.9		7.8	20.4	
Queue Delay		0.0	0.3		0.1		0.3	0.9		0.0	0.1	
Total Delay		61.9	7.7		2.2		17.1	6.8		7.8	20.5	
LOS		E	A		A		B	A		A	C	
Approach Delay		12.9			2.3			10.0			20.3	
Approach LOS		B			A			B			C	
90th %ile Green (s)	4.0	4.0	21.0	4.0	4.0		21.0	67.0		2.0	48.0	
90th %ile Term Code	Max	Max	Max	Max	Max		Max	Coord		Max	Coord	
70th %ile Green (s)	4.0	4.0	21.0	4.0	4.0		21.0	74.0		0.0	48.0	
70th %ile Term Code	Max	Max	Max	Max	Max		Max	Coord		Skip	Coord	
50th %ile Green (s)	7.4	7.4	19.2	7.4	7.4		19.2	92.6		0.0	68.4	
50th %ile Term Code	Gap	Gap	Gap	Hold	Hold		Gap	Coord		Skip	Coord	
30th %ile Green (s)	0.0	0.0	12.1	0.0	0.0		12.1	105.0		0.0	87.9	
30th %ile Term Code	Skip	Skip	Gap	Skip	Skip		Gap	Coord		Skip	Coord	
10th %ile Green (s)	0.0	0.0	6.1	0.0	0.0		6.1	105.0		0.0	93.9	
10th %ile Term Code	Skip	Skip	Gap	Skip	Skip		Gap	Coord		Skip	Coord	
Stops (vph)		17	27		0		127	230		3	386	
Fuel Used(gal)		1	6		0		2	4		0	16	
CO Emissions (g/hr)		46	393		27		174	262		8	1104	
NOx Emissions (g/hr)		9	76		5		34	51		2	215	
VOC Emissions (g/hr)		11	91		6		40	61		2	256	
Dilemma Vehicles (#)		0	0		0		0	0		0	0	
Queue Length 50th (ft)		23	0		0		42	36		1	268	
Queue Length 95th (ft)		#64	60		0		124	284		5	#637	
Internal Link Dist (ft)		2308			2328			236			2150	



Lanes, Volumes, Timings  
 1: Main St (1A) & Arbor St/Friend Ct

07/23/2018

Lane Group	Ø9
Turn Type	
Protected Phases	9
Permitted Phases	
Detector Phase	
Switch Phase	
Minimum Initial (s)	1.0
Minimum Split (s)	22.0
Total Split (s)	22.0
Total Split (%)	20%
Maximum Green (s)	20.0
Yellow Time (s)	2.0
All-Red Time (s)	0.0
Lost Time Adjust (s)	
Total Lost Time (s)	
Lead/Lag	
Lead-Lag Optimize?	
Vehicle Extension (s)	3.0
Recall Mode	None
Walk Time (s)	9.0
Flash Dont Walk (s)	11.0
Pedestrian Calls (#/hr)	15
Act Effct Green (s)	
Actuated g/C Ratio	
v/c Ratio	
Control Delay	
Queue Delay	
Total Delay	
LOS	
Approach Delay	
Approach LOS	
90th %ile Green (s)	20.0
90th %ile Term Code	Ped
70th %ile Green (s)	20.0
70th %ile Term Code	Ped
50th %ile Green (s)	0.0
50th %ile Term Code	Skip
30th %ile Green (s)	0.0
30th %ile Term Code	Skip
10th %ile Green (s)	0.0
10th %ile Term Code	Skip
Stops (vph)	
Fuel Used(gal)	
CO Emissions (g/hr)	
NOx Emissions (g/hr)	
VOC Emissions (g/hr)	
Dilemma Vehicles (#)	
Queue Length 50th (ft)	
Queue Length 95th (ft)	
Internal Link Dist (ft)	



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Lane Group	Ø9
Turn Bay Length (ft)	
Base Capacity (vph)	
Starvation Cap Reductn	
Spillback Cap Reductn	
Storage Cap Reductn	
Reduced v/c Ratio	
Intersection Summary	

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# Lanes, Volumes, Timings

## 2: Main St (1A) & Monument St/Wenham Town Hall

07/23/2018



Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		↖	↗				↖	↗			↕	
Traffic Volume (vph)	225	0	6	0	0	0	6	733	2	1	659	210
Future Volume (vph)	225	0	6	0	0	0	6	733	2	1	659	210
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Storage Length (ft)	0		15	0		0	25		0	0		0
Storage Lanes	0		1	0		0	1		0	0		0
Taper Length (ft)	0			0			25			0		
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Ped Bike Factor							1.00					0.99
Frt			0.850					0.999				0.964
Flt Protected		0.950					0.950					
Satd. Flow (prot)	0	1770	1380	0	0	0	1805	1879	0	0	1804	0
Flt Permitted		0.950					0.224				0.998	
Satd. Flow (perm)	0	1770	1380	0	0	0	426	1879	0	0	1800	0
Right Turn on Red			Yes			Yes			Yes			Yes
Satd. Flow (RTOR)			89									24
Link Speed (mph)		30			30			30				30
Link Distance (ft)		2613			509			460				316
Travel Time (s)		59.4			11.6			10.5				7.2
Confl. Peds. (#/hr)							1					1
Peak Hour Factor	0.93	0.92	0.38	0.92	0.25	0.25	0.75	0.93	0.50	0.25	0.94	0.83
Growth Factor	102%	102%	102%	102%	102%	102%	102%	102%	102%	102%	102%	102%
Heavy Vehicles (%)	2%	2%	17%	2%	0%	0%	0%	1%	0%	0%	1%	1%
Adj. Flow (vph)	247	0	16	0	0	0	8	804	4	4	715	258
Shared Lane Traffic (%)												
Lane Group Flow (vph)	0	247	16	0	0	0	8	808	0	0	977	0
Enter Blocked Intersection	No	No	No	No	No	No	No	No	No	No	No	No
Lane Alignment	Left	Left	Right	Left	Left	Right	Left	Left	Right	Left	Left	Right
Median Width(ft)		0			0			12				12
Link Offset(ft)		0			30			0				0
Crosswalk Width(ft)		16			16			16				16
Two way Left Turn Lane												
Headway Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Turning Speed (mph)	25		9	15		9	15		9	15		9
Number of Detectors	1	2	1				1	2		1	2	
Detector Template	Left	Thru	Right				Left	Thru		Left	Thru	
Leading Detector (ft)	20	100	20				20	100		20	100	
Trailing Detector (ft)	0	0	0				0	0		0	0	
Detector 1 Position(ft)	0	0	0				0	0		0	0	
Detector 1 Size(ft)	20	6	20				20	6		20	6	
Detector 1 Type	Cl+Ex	Cl+Ex	Cl+Ex				Cl+Ex	Cl+Ex		Cl+Ex	Cl+Ex	
Detector 1 Channel												
Detector 1 Extend (s)	0.0	0.0	0.0				0.0	0.0		0.0	0.0	
Detector 1 Queue (s)	0.0	0.0	0.0				0.0	0.0		0.0	0.0	
Detector 1 Delay (s)	0.0	0.0	0.0				0.0	0.0		0.0	0.0	
Detector 2 Position(ft)		94						94				94
Detector 2 Size(ft)		6						6				6
Detector 2 Type		Cl+Ex						Cl+Ex				Cl+Ex
Detector 2 Channel												

Lanes, Volumes, Timings  
2: Main St (1A) & Monument St/Wenham Town Hall

07/23/2018

Lane Group	Ø9
Lane Configurations	
Traffic Volume (vph)	
Future Volume (vph)	
Ideal Flow (vphpl)	
Storage Length (ft)	
Storage Lanes	
Taper Length (ft)	
Lane Util. Factor	
Ped Bike Factor	
Frt	
Flt Protected	
Satd. Flow (prot)	
Flt Permitted	
Satd. Flow (perm)	
Right Turn on Red	
Satd. Flow (RTOR)	
Link Speed (mph)	
Link Distance (ft)	
Travel Time (s)	
Confl. Peds. (#/hr)	
Peak Hour Factor	
Growth Factor	
Heavy Vehicles (%)	
Adj. Flow (vph)	
Shared Lane Traffic (%)	
Lane Group Flow (vph)	
Enter Blocked Intersection	
Lane Alignment	
Median Width(ft)	
Link Offset(ft)	
Crosswalk Width(ft)	
Two way Left Turn Lane	
Headway Factor	
Turning Speed (mph)	
Number of Detectors	
Detector Template	
Leading Detector (ft)	
Trailing Detector (ft)	
Detector 1 Position(ft)	
Detector 1 Size(ft)	
Detector 1 Type	
Detector 1 Channel	
Detector 1 Extend (s)	
Detector 1 Queue (s)	
Detector 1 Delay (s)	
Detector 2 Position(ft)	
Detector 2 Size(ft)	
Detector 2 Type	
Detector 2 Channel	

# Lanes, Volumes, Timings

## 2: Main St (1A) & Monument St/Wenham Town Hall

07/23/2018



Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Detector 2 Extend (s)		0.0						0.0				0.0
Turn Type	Split	NA	Perm				pm+pt	NA		Perm	NA	
Protected Phases	6	6					7	4				8
Permitted Phases			6				4			8		
Detector Phase	6	6	6				7	4		8		8
Switch Phase												
Minimum Initial (s)	1.0	1.0	1.0				3.0	1.0		1.0		1.0
Minimum Split (s)	6.0	6.0	6.0				8.0	6.0		6.0		6.0
Total Split (s)	18.0	18.0	18.0				8.0	70.0		62.0		62.0
Total Split (%)	16.4%	16.4%	16.4%				7.3%	63.6%		56.4%		56.4%
Maximum Green (s)	13.0	13.0	13.0				3.0	65.0		57.0		57.0
Yellow Time (s)	3.0	3.0	3.0				3.0	3.0		3.0		3.0
All-Red Time (s)	2.0	2.0	2.0				2.0	2.0		2.0		2.0
Lost Time Adjust (s)		0.0	0.0				0.0	0.0				0.0
Total Lost Time (s)		5.0	5.0				5.0	5.0				5.0
Lead/Lag							Lead			Lag		Lag
Lead-Lag Optimize?							Yes			Yes		Yes
Vehicle Extension (s)	3.0	3.0	3.0				3.0	3.0		3.0		3.0
Recall Mode	None	None	None				None	C-Min		C-Max		C-Max
Walk Time (s)												
Flash Dont Walk (s)												
Pedestrian Calls (#/hr)												
Act Effct Green (s)		23.8	23.8				71.8	71.8				70.2
Actuated g/C Ratio		0.22	0.22				0.65	0.65				0.64
v/c Ratio		0.65	0.04				0.02	0.66				0.84
Control Delay		50.0	0.2				7.8	15.4				17.9
Queue Delay		0.5	0.0				0.0	0.1				0.0
Total Delay		50.5	0.2				7.8	15.5				17.9
LOS		D	A				A	B				B
Approach Delay		47.5						15.4				17.9
Approach LOS		D						B				B
90th %ile Green (s)	13.0	13.0	13.0				3.0	65.0		57.0		57.0
90th %ile Term Code	Max	Max	Max				Max	Coord		Coord		Coord
70th %ile Green (s)	25.1	25.1	25.1				0.0	74.9		74.9		74.9
70th %ile Term Code	Gap	Gap	Gap				Skip	Coord		Coord		Coord
50th %ile Green (s)	25.0	25.0	25.0				0.0	75.0		75.0		75.0
50th %ile Term Code	Gap	Gap	Gap				Skip	Coord		Coord		Coord
30th %ile Green (s)	25.9	25.9	25.9				0.0	74.1		74.1		74.1
30th %ile Term Code	Gap	Gap	Gap				Skip	Coord		Coord		Coord
10th %ile Green (s)	29.9	29.9	29.9				0.0	70.1		70.1		70.1
10th %ile Term Code	Gap	Gap	Gap				Skip	Coord		Coord		Coord
Stops (vph)		178	0				2	447				379
Fuel Used(gal)		8	0				0	8				8
CO Emissions (g/hr)		560	9				3	525				526
NOx Emissions (g/hr)		109	2				1	102				102
VOC Emissions (g/hr)		130	2				1	122				122
Dilemma Vehicles (#)		0	0				0	0				0
Queue Length 50th (ft)		157	0				2	286				96
Queue Length 95th (ft)		#370	0				7	542				#963



Lanes, Volumes, Timings  
 2: Main St (1A) & Monument St/Wenham Town Hall

07/23/2018

Lane Group	Ø9
Detector 2 Extend (s)	
Turn Type	
Protected Phases	9
Permitted Phases	
Detector Phase	
Switch Phase	
Minimum Initial (s)	1.0
Minimum Split (s)	22.0
Total Split (s)	22.0
Total Split (%)	20%
Maximum Green (s)	20.0
Yellow Time (s)	2.0
All-Red Time (s)	0.0
Lost Time Adjust (s)	
Total Lost Time (s)	
Lead/Lag	
Lead-Lag Optimize?	
Vehicle Extension (s)	3.0
Recall Mode	None
Walk Time (s)	9.0
Flash Dont Walk (s)	11.0
Pedestrian Calls (#/hr)	5
Act Effct Green (s)	
Actuated g/C Ratio	
v/c Ratio	
Control Delay	
Queue Delay	
Total Delay	
LOS	
Approach Delay	
Approach LOS	
90th %ile Green (s)	20.0
90th %ile Term Code	Ped
70th %ile Green (s)	0.0
70th %ile Term Code	Skip
50th %ile Green (s)	0.0
50th %ile Term Code	Skip
30th %ile Green (s)	0.0
30th %ile Term Code	Skip
10th %ile Green (s)	0.0
10th %ile Term Code	Skip
Stops (vph)	
Fuel Used(gal)	
CO Emissions (g/hr)	
NOx Emissions (g/hr)	
VOC Emissions (g/hr)	
Dilemma Vehicles (#)	
Queue Length 50th (ft)	
Queue Length 95th (ft)	

Lanes, Volumes, Timings

2: Main St (1A) & Monument St/Wenham Town Hall

07/23/2018



Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Internal Link Dist (ft)		2533			429			380				236
Turn Bay Length (ft)			15				25					
Base Capacity (vph)		382	367				341	1226				1157
Starvation Cap Reductn		0	0				0	0				0
Spillback Cap Reductn		17	0				0	29				0
Storage Cap Reductn		0	0				0	0				0
Reduced v/c Ratio		0.68	0.04				0.02	0.68				0.84

Intersection Summary

Area Type:	Other
Cycle Length:	110
Actuated Cycle Length:	110
Offset:	104 (95%), Referenced to phase 4:NBTL and 8:SBTL, Start of Green
Natural Cycle:	110
Control Type:	Actuated-Coordinated
Maximum v/c Ratio:	0.84
Intersection Signal Delay:	20.7
Intersection LOS:	C
Intersection Capacity Utilization	70.3%
ICU Level of Service	C
Analysis Period (min)	15
# 95th percentile volume exceeds capacity, queue may be longer.	
Queue shown is maximum after two cycles.	

Splits and Phases: 2: Main St (1A) & Monument St/Wenham Town Hall

Ø6	Ø4 (R)	Ø9
18 s	70 s	22 s
	Ø7 (R)	
	Ø8 (R)	
	8 s	62 s

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Lane Group	Ø9
Internal Link Dist (ft)	
Turn Bay Length (ft)	
Base Capacity (vph)	
Starvation Cap Reductn	
Spillback Cap Reductn	
Storage Cap Reductn	
Reduced v/c Ratio	
Intersection Summary	

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Lanes, Volumes, Timings  
 3: Main St (1A) & Cherry St/Old Country Rd

07/23/2018



Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		↖	↗				↖	↗			↕	
Traffic Volume (vph)	49	1	107	0	0	0	158	692	5	5	552	110
Future Volume (vph)	49	1	107	0	0	0	158	692	5	5	552	110
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Storage Length (ft)	0		50	0		0	75		0	0		0
Storage Lanes	0		1	0		0	1		0	0		0
Taper Length (ft)	0			0			25			0		
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Ped Bike Factor												
Frt			0.850					0.998			0.976	
Flt Protected		0.955					0.950				0.999	
Satd. Flow (prot)	0	1781	1599	0	0	0	1770	1878	0	0	1834	0
Flt Permitted		0.955					0.950				0.999	
Satd. Flow (perm)	0	1781	1599	0	0	0	1770	1878	0	0	1834	0
Link Speed (mph)		30			30			30			30	
Link Distance (ft)		2702			575			3735			460	
Travel Time (s)		61.4			13.1			84.9			10.5	
Confl. Peds. (#/hr)									1	1		
Peak Hour Factor	0.87	0.25	0.86	0.92	0.92	0.92	0.96	0.94	0.42	0.63	0.91	0.83
Growth Factor	102%	102%	102%	102%	102%	102%	102%	102%	102%	102%	102%	102%
Heavy Vehicles (%)	2%	0%	1%	2%	0%	0%	2%	1%	0%	0%	1%	1%
Adj. Flow (vph)	57	4	127	0	0	0	168	751	12	8	619	135
Shared Lane Traffic (%)												
Lane Group Flow (vph)	0	61	127	0	0	0	168	763	0	0	762	0
Enter Blocked Intersection	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Lane Alignment	Left	Left	Right	Left	Left	Right	Left	Left	Right	Left	Left	Right
Median Width(ft)		0			0			12			12	
Link Offset(ft)		0			16			0			0	
Crosswalk Width(ft)		16			16			16			16	
Two way Left Turn Lane												
Headway Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Sign Control		Stop			Stop			Free			Free	

Intersection Summary

Area Type:	Other
Control Type:	Unsignalized
Intersection Capacity Utilization	87.5%
ICU Level of Service	E
Analysis Period (min)	15

# HCM Unsignalized Intersection Capacity Analysis

## 3: Main St (1A) & Cherry St/Old Country Rd

07/23/2018



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		↖	↗				↖	↗			↕	
Traffic Volume (veh/h)	49	1	107	0	0	0	158	692	5	5	552	110
Future Volume (Veh/h)	49	1	107	0	0	0	158	692	5	5	552	110
Sign Control		Stop			Stop			Free			Free	
Grade		0%			0%			0%			0%	
Peak Hour Factor	0.87	0.25	0.86	0.92	0.92	0.92	0.96	0.94	0.42	0.63	0.91	0.83
Hourly flow rate (vph)	57	4	127	0	0	0	168	751	12	8	619	135
Pedestrians												1
Lane Width (ft)												0.0
Walking Speed (ft/s)												3.5
Percent Blockage												0
Right turn flare (veh)			2									
Median type								None				None
Median storage (veh)												
Upstream signal (ft)												460
pX, platoon unblocked	0.53	0.53	0.53	0.53	0.53		0.53					
vC, conflicting volume	1790	1802	686	1862	1864	758	754			764		
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	2043	2067	0	2179	2182	758	101			764		
tC, single (s)	*6.5	*6.2	*6.0	7.1	6.5	6.2	4.1			4.1		
tC, 2 stage (s)												
tF (s)	3.5	4.0	3.3	3.5	4.0	3.3	2.2			2.2		
p0 queue free %	0	85	78	100	100	100	79			99		
cM capacity (veh/h)	26	27	580	10	19	410	795			858		

Direction, Lane #	EB 1	NB 1	NB 2	SB 1
Volume Total	188	168	763	762
Volume Left	57	168	0	8
Volume Right	127	0	12	135
cSH	75	795	1700	858
Volume to Capacity	2.51	0.21	0.45	0.01
Queue Length 95th (ft)	451	20	0	1
Control Delay (s)	805.3	10.7	0.0	0.3
Lane LOS	F	B		A
Approach Delay (s)	805.3	1.9		0.3
Approach LOS	F			

Intersection Summary			
Average Delay		81.5	
Intersection Capacity Utilization		87.5%	ICU Level of Service E
Analysis Period (min)		15	

\* User Entered Value

**Intersection**

Int Delay, s/veh 7.7

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		↕	↕				↕	↕			↕	
Traffic Vol, veh/h	49	1	107	0	0	0	158	692	5	5	552	110
Future Vol, veh/h	49	1	107	0	0	0	158	692	5	5	552	110
Conflicting Peds, #/hr	0	0	0	0	0	0	0	0	1	1	0	0
Sign Control	Stop	Stop	Stop	Stop	Stop	Stop	Free	Free	Free	Free	Free	Free
RT Channelized	-	-	None	-	-	None	-	-	None	-	-	None
Storage Length	-	-	50	-	-	-	75	-	-	-	-	-
Veh in Median Storage, #	-	0	-	-	-	-	-	0	-	-	0	-
Grade, %	-	0	-	-	0	-	-	0	-	-	0	-
Peak Hour Factor	87	25	86	92	92	92	96	94	42	63	91	83
Heavy Vehicles, %	2	0	1	2	0	0	2	1	0	0	1	1
Mvmt Flow	57	4	127	0	0	0	168	751	12	8	619	135

Major/Minor	Minor2			Major1			Major2		
Conflicting Flow All	1796	1803	686	754	0	0	764	0	0
Stage 1	703	703	-	-	-	-	-	-	-
Stage 2	1093	1100	-	-	-	-	-	-	-
Critical Hdwy	6.42	6.5	6.21	4.12	-	-	4.1	-	-
Critical Hdwy Stg 1	5.42	5.5	-	-	-	-	-	-	-
Critical Hdwy Stg 2	5.42	5.5	-	-	-	-	-	-	-
Follow-up Hdwy	3.518	4	3.309	2.218	-	-	2.2	-	-
Pot Cap-1 Maneuver	88	80	449	856	-	-	858	-	-
Stage 1	491	443	-	-	-	-	-	-	-
Stage 2	321	290	-	-	-	-	-	-	-
Platoon blocked, %									
Mov Cap-1 Maneuver	70	0	449	856	-	-	858	-	-
Mov Cap-2 Maneuver	70	0	-	-	-	-	-	-	-
Stage 1	483	0	-	-	-	-	-	-	-
Stage 2	258	0	-	-	-	-	-	-	-

Approach	EB	NB	SB
HCM Control Delay, s	67.8	1.8	0.1
HCM LOS	F		

Minor Lane/Major Mvmt	NBL	NBT	NBR	EBLn1	EBLn2	SBL	SBT	SBR
Capacity (veh/h)	856	-	-	70	449	858	-	-
HCM Lane V/C Ratio	0.196	-	-	0.879	0.283	0.009	-	-
HCM Control Delay (s)	10.2	-	-	174.4	16.1	9.2	0	-
HCM Lane LOS	B	-	-	F	C	A	A	-
HCM 95th %tile Q(veh)	0.7	-	-	4.3	1.1	0	-	-



Lanes, Volumes, Timings  
 1: Main St (1A) & Arbor St/Friend Ct

07/23/2018



Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		↖	↗		↔		↖	↗		↖	↗	
Traffic Volume (vph)	16	1	346	3	3	6	287	555	6	5	578	27
Future Volume (vph)	16	1	346	3	3	6	287	555	6	5	578	27
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Storage Length (ft)	0		50	0		0	100		0	40		0
Storage Lanes	0		1	0		0	1		0	1		0
Taper Length (ft)	0			0			25			25		
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Ped Bike Factor							1.00	1.00		1.00	1.00	
Frt			0.850		0.932			0.998				0.991
Flt Protected		0.959			0.992		0.950			0.950		
Satd. Flow (prot)	0	1639	1583	0	1757	0	1752	1824	0	1504	1825	0
Flt Permitted		0.825			0.935		0.266			0.313		
Satd. Flow (perm)	0	1410	1583	0	1656	0	491	1824	0	495	1825	0
Right Turn on Red			Yes			Yes			Yes			Yes
Satd. Flow (RTOR)			420		12			1				4
Link Speed (mph)		30			30			30				30
Link Distance (ft)		2388			2408			316				2230
Travel Time (s)		54.3			54.7			7.2				50.7
Confl. Peds. (#/hr)							1		1	1		1
Peak Hour Factor	0.67	0.25	0.84	0.75	0.38	0.50	0.84	0.90	0.75	0.31	0.91	0.68
Growth Factor	102%	102%	102%	102%	102%	102%	102%	102%	102%	102%	102%	102%
Heavy Vehicles (%)	13%	0%	2%	0%	0%	0%	3%	4%	0%	20%	3%	4%
Adj. Flow (vph)	24	4	420	4	8	12	349	629	8	16	648	41
Shared Lane Traffic (%)												
Lane Group Flow (vph)	0	28	420	0	24	0	349	637	0	16	689	0
Enter Blocked Intersection	No	No	No	No	No	No	No	No	No	No	No	No
Lane Alignment	Left	Left	Right	Left	Left	Right	Left	Left	Right	Left	Left	Right
Median Width(ft)		0			0			12				12
Link Offset(ft)		0			-10			6				0
Crosswalk Width(ft)		16			16			16				16
Two way Left Turn Lane												
Headway Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Number of Detectors	1	1	2	1	2		1	2		1	2	
Detector Template	Left	Left	Thru	Left	Thru		Left	Thru		Left	Thru	
Leading Detector (ft)	20	20	100	20	100		20	100		20	100	
Trailing Detector (ft)	0	0	0	0	0		0	0		0	0	
Detector 1 Position(ft)	0	0	0	0	0		0	0		0	0	
Detector 1 Size(ft)	20	20	6	20	6		20	6		20	6	
Detector 1 Type	Cl+Ex	Cl+Ex	Cl+Ex	Cl+Ex	Cl+Ex		Cl+Ex	Cl+Ex		Cl+Ex	Cl+Ex	
Detector 1 Channel												
Detector 1 Extend (s)	0.0	0.0	0.0	0.0	0.0		0.0	0.0		0.0	0.0	
Detector 1 Queue (s)	0.0	0.0	0.0	0.0	0.0		0.0	0.0		0.0	0.0	
Detector 1 Delay (s)	0.0	0.0	0.0	0.0	0.0		0.0	0.0		0.0	0.0	
Detector 2 Position(ft)			94		94			94			94	
Detector 2 Size(ft)			6		6			6			6	
Detector 2 Type			Cl+Ex		Cl+Ex			Cl+Ex			Cl+Ex	
Detector 2 Channel												
Detector 2 Extend (s)			0.0		0.0			0.0			0.0	

Lanes, Volumes, Timings  
1: Main St (1A) & Arbor St/Friend Ct

07/23/2018

Lane Group	Ø9
Lane Configurations	
Traffic Volume (vph)	
Future Volume (vph)	
Ideal Flow (vphpl)	
Storage Length (ft)	
Storage Lanes	
Taper Length (ft)	
Lane Util. Factor	
Ped Bike Factor	
Frt	
Flt Protected	
Satd. Flow (prot)	
Flt Permitted	
Satd. Flow (perm)	
Right Turn on Red	
Satd. Flow (RTOR)	
Link Speed (mph)	
Link Distance (ft)	
Travel Time (s)	
Confl. Peds. (#/hr)	
Peak Hour Factor	
Growth Factor	
Heavy Vehicles (%)	
Adj. Flow (vph)	
Shared Lane Traffic (%)	
Lane Group Flow (vph)	
Enter Blocked Intersection	
Lane Alignment	
Median Width(ft)	
Link Offset(ft)	
Crosswalk Width(ft)	
Two way Left Turn Lane	
Headway Factor	
Number of Detectors	
Detector Template	
Leading Detector (ft)	
Trailing Detector (ft)	
Detector 1 Position(ft)	
Detector 1 Size(ft)	
Detector 1 Type	
Detector 1 Channel	
Detector 1 Extend (s)	
Detector 1 Queue (s)	
Detector 1 Delay (s)	
Detector 2 Position(ft)	
Detector 2 Size(ft)	
Detector 2 Type	
Detector 2 Channel	
Detector 2 Extend (s)	

Lanes, Volumes, Timings  
 1: Main St (1A) & Arbor St/Friend Ct

07/23/2018



Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Turn Type	Perm	NA	pm+ov	Perm	NA		pm+pt	NA		pm+pt	NA	
Protected Phases		6	7		2		7	4		3	8	
Permitted Phases	6		6	2			4			8		
Detector Phase	6	6	7	2	2		7	4		3	8	
Switch Phase												
Minimum Initial (s)	1.0	1.0	1.0	1.0	1.0		1.0	1.0		1.0	1.0	
Minimum Split (s)	6.0	6.0	6.0	6.0	6.0		6.0	6.0		6.0	6.0	
Total Split (s)	10.0	10.0	27.0	10.0	10.0		27.0	70.0		8.0	51.0	
Total Split (%)	9.1%	9.1%	24.5%	9.1%	9.1%		24.5%	63.6%		7.3%	46.4%	
Maximum Green (s)	5.0	5.0	22.0	5.0	5.0		22.0	65.0		3.0	46.0	
Yellow Time (s)	3.0	3.0	3.0	3.0	3.0		3.0	3.0		3.0	3.0	
All-Red Time (s)	2.0	2.0	2.0	2.0	2.0		2.0	2.0		2.0	2.0	
Lost Time Adjust (s)		0.0	0.0		0.0		0.0	0.0		0.0	0.0	
Total Lost Time (s)		5.0	5.0		5.0		5.0	5.0		5.0	5.0	
Lead/Lag			Lag				Lag	Lag		Lead	Lead	
Lead-Lag Optimize?			Yes				Yes	Yes		Yes	Yes	
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0		3.0	3.0		3.0	3.0	
Recall Mode	None	None	None	None	None		None	C-Max		None	C-Max	
Walk Time (s)												
Flash Dont Walk (s)												
Pedestrian Calls (#/hr)												
Act Effct Green (s)		7.0	28.5		6.7		89.3	91.3		66.1	66.1	
Actuated g/C Ratio		0.06	0.26		0.06		0.81	0.83		0.60	0.60	
v/c Ratio		0.31	0.58		0.22		0.54	0.42		0.05	0.63	
Control Delay		59.2	5.6		37.0		11.8	3.8		14.4	20.6	
Queue Delay		0.0	0.0		0.0		0.0	0.0		0.0	0.0	
Total Delay		59.2	5.6		37.0		11.8	3.8		14.4	20.6	
LOS		E	A		D		B	A		B	C	
Approach Delay		9.0			37.0			6.6			20.5	
Approach LOS		A			D			A			C	
90th %ile Green (s)	5.0	5.0	22.0	5.0	5.0		22.0	65.0		3.0	46.0	
90th %ile Term Code	Max	Max	Max	Max	Max		Max	Coord		Max	Coord	
70th %ile Green (s)	9.4	9.4	22.0	9.4	9.4		22.0	79.3		6.3	63.6	
70th %ile Term Code	Gap	Gap	Max	Hold	Hold		Max	Coord		Gap	Coord	
50th %ile Green (s)	8.0	8.0	22.0	8.0	8.0		22.0	92.0		0.0	65.0	
50th %ile Term Code	Gap	Gap	Hold	Hold	Hold		Hold	Coord		Skip	Coord	
30th %ile Green (s)	0.0	0.0	22.0	0.0	0.0		22.0	105.0		0.0	78.0	
30th %ile Term Code	Skip	Skip	Hold	Skip	Skip		Hold	Coord		Skip	Coord	
10th %ile Green (s)	0.0	0.0	22.0	0.0	0.0		22.0	105.0		0.0	78.0	
10th %ile Term Code	Skip	Skip	Hold	Skip	Skip		Hold	Coord		Skip	Coord	
Stops (vph)		16	32		8		112	114		3	376	
Fuel Used(gal)		1	7		0		2	2		0	15	
CO Emissions (g/hr)		43	500		25		143	173		8	1078	
NOx Emissions (g/hr)		8	97		5		28	34		2	210	
VOC Emissions (g/hr)		10	116		6		33	40		2	250	
Dilemma Vehicles (#)		0	0		0		0	0		0	0	
Queue Length 50th (ft)		19	0		8		31	40		4	298	
Queue Length 95th (ft)		14	35		10		91	194		7	#677	
Internal Link Dist (ft)		2308			2328			236			2150	

Lanes, Volumes, Timings  
 1: Main St (1A) & Arbor St/Friend Ct

07/23/2018

Lane Group	Ø9
Turn Type	
Protected Phases	9
Permitted Phases	
Detector Phase	
Switch Phase	
Minimum Initial (s)	1.0
Minimum Split (s)	22.0
Total Split (s)	22.0
Total Split (%)	20%
Maximum Green (s)	20.0
Yellow Time (s)	2.0
All-Red Time (s)	0.0
Lost Time Adjust (s)	
Total Lost Time (s)	
Lead/Lag	
Lead-Lag Optimize?	
Vehicle Extension (s)	3.0
Recall Mode	None
Walk Time (s)	9.0
Flash Dont Walk (s)	11.0
Pedestrian Calls (#/hr)	10
Act Effct Green (s)	
Actuated g/C Ratio	
v/c Ratio	
Control Delay	
Queue Delay	
Total Delay	
LOS	
Approach Delay	
Approach LOS	
90th %ile Green (s)	20.0
90th %ile Term Code	Ped
70th %ile Green (s)	0.0
70th %ile Term Code	Skip
50th %ile Green (s)	0.0
50th %ile Term Code	Skip
30th %ile Green (s)	0.0
30th %ile Term Code	Skip
10th %ile Green (s)	0.0
10th %ile Term Code	Skip
Stops (vph)	
Fuel Used(gal)	
CO Emissions (g/hr)	
NOx Emissions (g/hr)	
VOC Emissions (g/hr)	
Dilemma Vehicles (#)	
Queue Length 50th (ft)	
Queue Length 95th (ft)	
Internal Link Dist (ft)	

Lanes, Volumes, Timings  
 1: Main St (1A) & Arbor St/Friend Ct

07/23/2018

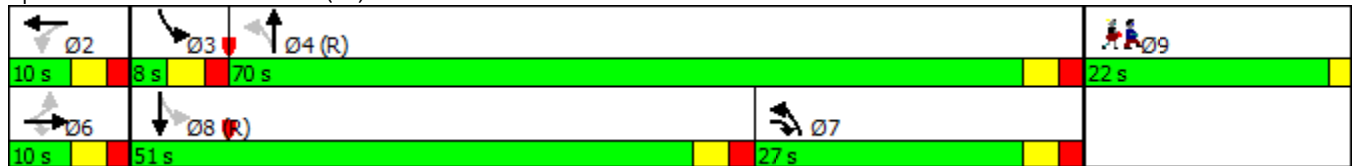


Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Turn Bay Length (ft)			50				100			40		
Base Capacity (vph)		89	721		111		650	1513		345	1098	
Starvation Cap Reductn		0	0		0		0	0		0	0	
Spillback Cap Reductn		0	0		0		0	0		0	0	
Storage Cap Reductn		0	0		0		0	0		0	0	
Reduced v/c Ratio		0.31	0.58		0.22		0.54	0.42		0.05	0.63	

Intersection Summary

Area Type: Other  
 Cycle Length: 110  
 Actuated Cycle Length: 110  
 Offset: 0 (0%), Referenced to phase 4:NBTL and 8:SBTL, Start of Green, Master Intersection  
 Natural Cycle: 90  
 Control Type: Actuated-Coordinated  
 Maximum v/c Ratio: 0.63  
 Intersection Signal Delay: 12.0 Intersection LOS: B  
 Intersection Capacity Utilization 70.4% ICU Level of Service C  
 Analysis Period (min) 15  
 # 95th percentile volume exceeds capacity, queue may be longer.  
 Queue shown is maximum after two cycles.

Splits and Phases: 1: Main St (1A) & Arbor St/Friend Ct



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Lane Group	Ø9
Turn Bay Length (ft)	
Base Capacity (vph)	
Starvation Cap Reductn	
Spillback Cap Reductn	
Storage Cap Reductn	
Reduced v/c Ratio	
Intersection Summary	

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# Lanes, Volumes, Timings

## 2: Main St (1A) & Monument St/Wenham Town Hall

07/23/2018



Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		↕	↗				↖	↗			↕	
Traffic Volume (vph)	52	0	3	0	0	0	5	789	0	1	752	185
Future Volume (vph)	52	0	3	0	0	0	5	789	0	1	752	185
Ideal Flow (vphp)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Storage Length (ft)	0		15	0		0	25		0	0		0
Storage Lanes	0		1	0		0	1		0	0		0
Taper Length (ft)	0			0			25			0		
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Ped Bike Factor												
Frt			0.850								0.971	
Flt Protected		0.950					0.950					
Satd. Flow (prot)	0	1703	1615	0	0	0	1504	1827	0	0	1805	0
Flt Permitted		0.950					0.950					
Satd. Flow (perm)	0	1703	1615	0	0	0	1504	1827	0	0	1805	0
Link Speed (mph)		30			30			30			30	
Link Distance (ft)		2613			509			460			316	
Travel Time (s)		59.4			11.6			10.5			7.2	
Confl. Peds. (#/hr)							5					5
Peak Hour Factor	0.81	0.92	0.38	0.92	0.25	0.25	0.63	0.89	0.92	0.25	0.95	0.86
Growth Factor	102%	102%	102%	102%	102%	102%	102%	102%	102%	102%	102%	102%
Heavy Vehicles (%)	6%	2%	0%	2%	0%	0%	20%	4%	0%	0%	2%	3%
Adj. Flow (vph)	65	0	8	0	0	0	8	904	0	4	807	219
Shared Lane Traffic (%)												
Lane Group Flow (vph)	0	65	8	0	0	0	8	904	0	0	1030	0
Enter Blocked Intersection	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	2 veh	Yes
Lane Alignment	Left	Left	Right	Left	Left	Right	Left	Left	Right	Left	Left	Right
Median Width(ft)		0			0			12			12	
Link Offset(ft)		0			30			0			0	
Crosswalk Width(ft)		16			16			16			16	
Two way Left Turn Lane												
Headway Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Turning Speed (mph)	25		9	15		9	15		9	15		9
Sign Control		Stop			Stop			Free			Free	

### Intersection Summary

Area Type:	Other
Control Type:	Unsignalized
Intersection Capacity Utilization	62.8%
ICU Level of Service	B
Analysis Period (min)	15

# HCM Unsignalized Intersection Capacity Analysis

## 2: Main St (1A) & Monument St/Wenham Town Hall

07/23/2018



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR	
Lane Configurations		↕	↗				↖	↖			↕		
Traffic Volume (veh/h)	52	0	3	0	0	0	5	789	0	1	752	185	
Future Volume (Veh/h)	52	0	3	0	0	0	5	789	0	1	752	185	
Sign Control		Stop			Stop			Free			Free		
Grade		0%			0%			0%			0%		
Peak Hour Factor	0.81	0.92	0.38	0.92	0.25	0.25	0.63	0.89	0.92	0.25	0.95	0.86	
Hourly flow rate (vph)	65	0	8	0	0	0	8	904	0	4	807	219	
Pedestrians		5											
Lane Width (ft)		12.0											
Walking Speed (ft/s)		3.5											
Percent Blockage		0											
Right turn flare (veh)			1										
Median type								None			None		
Median storage (veh)													
Upstream signal (ft)								460			316		
pX, platoon unblocked	0.77	0.77	0.72	0.77	0.77	0.63	0.72			0.63			
vC, conflicting volume	1850	1850	922	1848	1959	904	1031			904			
vC1, stage 1 conf vol													
vC2, stage 2 conf vol													
vCu, unblocked vol	1134	1134	696	1133	1276	554	848			554			
tC, single (s)	*6.0	6.5	*6.5	7.1	6.5	6.2	4.3			4.1			
tC, 2 stage (s)													
tF (s)	3.6	4.0	3.3	3.5	4.0	3.3	2.4			2.2			
p0 queue free %	66	100	97	100	100	100	98			99			
cM capacity (veh/h)	191	152	301	132	126	338	514			647			

Direction, Lane #	EB 1	NB 1	NB 2	SB 1
Volume Total	73	8	904	1030
Volume Left	65	8	0	4
Volume Right	8	0	0	219
cSH	207	514	1700	647
Volume to Capacity	0.35	0.02	0.53	0.01
Queue Length 95th (ft)	38	1	0	0
Control Delay (s)	31.6	12.1	0.0	0.2
Lane LOS	D	B		A
Approach Delay (s)	31.6	0.1		0.2
Approach LOS	D			

Intersection Summary			
Average Delay		1.3	
Intersection Capacity Utilization	62.8%		ICU Level of Service
Analysis Period (min)	15		B

\* User Entered Value

Intersection												
Int Delay, s/veh	5.2											
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		↕	↕				↕	↕			↕	
Traffic Vol, veh/h	52	0	3	0	0	0	5	789	0	1	752	185
Future Vol, veh/h	52	0	3	0	0	0	5	789	0	1	752	185
Conflicting Peds, #/hr	0	0	0	0	0	0	5	0	0	0	0	5
Sign Control	Stop	Stop	Stop	Stop	Stop	Stop	Free	Free	Free	Free	Free	Free
RT Channelized	-	-	None	-	-	None	-	-	None	-	-	None
Storage Length	-	-	15	-	-	-	25	-	-	-	-	-
Veh in Median Storage, #	-	0	-	-	-	-	-	0	-	-	0	-
Grade, %	-	0	-	-	0	-	-	0	-	-	0	-
Peak Hour Factor	81	92	38	92	25	25	63	89	92	25	95	86
Heavy Vehicles, %	6	2	0	2	0	0	20	4	0	0	2	3
Mvmt Flow	65	0	8	0	0	0	8	904	0	4	807	219

Major/Minor	Minor2			Major1			Major2					
Conflicting Flow All	1850	1850	922				1032	0	0	904	0	0
Stage 1	930	930	-				-	-	-	-	-	-
Stage 2	920	920	-				-	-	-	-	-	-
Critical Hdwy	6.46	6.52	6.2				4.3	-	-	4.1	-	-
Critical Hdwy Stg 1	5.46	5.52	-				-	-	-	-	-	-
Critical Hdwy Stg 2	5.46	5.52	-				-	-	-	-	-	-
Follow-up Hdwy	3.554	4.018	3.3				2.38	-	-	2.2	-	-
Pot Cap-1 Maneuver	80	74	330				608	-	-	761	-	-
Stage 1	378	346	-				-	-	-	-	-	-
Stage 2	382	350	-				-	-	-	-	-	-
Platoon blocked, %								-	-		-	-
Mov Cap-1 Maneuver	77	0	328				608	-	-	761	-	-
Mov Cap-2 Maneuver	77	0	-				-	-	-	-	-	-
Stage 1	371	0	-				-	-	-	-	-	-
Stage 2	375	0	-				-	-	-	-	-	-

Approach	EB	NB	SB
HCM Control Delay, s	140.7	0.1	0
HCM LOS	F		

Minor Lane/Major Mvmt	NBL	NBT	NBR	EBLn1	EBLn2	SBL	SBT	SBR
Capacity (veh/h)	608	-	-	77	328	761	-	-
HCM Lane V/C Ratio	0.013	-	-	0.85	0.025	0.005	-	-
HCM Control Delay (s)	11	-	-	156	16.3	9.8	0	-
HCM Lane LOS	B	-	-	F	C	A	A	-
HCM 95th %tile Q(veh)	0	-	-	4.3	0.1	0	-	-

Lanes, Volumes, Timings  
 3: Main St (1A) & Cherry St/Old Country Rd

07/23/2018



Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	251	0	154	2	1	2	87	544	0	0	642	108
Future Volume (vph)	251	0	154	2	1	2	87	544	0	0	642	108
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Storage Length (ft)	0		50	0		0	75		0	0		0
Storage Lanes	1		1	0		0	1		0	0		0
Taper Length (ft)	0			0			25			0		
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Frt			0.850		0.955							0.977
Flt Protected	0.950				0.984		0.950					
Satd. Flow (prot)	1736	0	1538	0	1785	0	1752	1827	0	0	1805	0
Flt Permitted	0.750				0.984		0.069					
Satd. Flow (perm)	1370	0	1538	0	1785	0	127	1827	0	0	1805	0
Right Turn on Red			Yes			Yes			Yes			Yes
Satd. Flow (RTOR)			89		4							12
Link Speed (mph)		30			30			30				30
Link Distance (ft)		2702			575			3735				460
Travel Time (s)		61.4			13.1			84.9				10.5
Peak Hour Factor	0.95	0.25	0.88	0.50	0.25	0.50	0.84	0.83	0.42	0.25	0.93	0.75
Growth Factor	102%	102%	102%	102%	102%	102%	102%	102%	102%	102%	102%	102%
Heavy Vehicles (%)	4%	0%	5%	0%	0%	0%	3%	4%	0%	0%	3%	2%
Adj. Flow (vph)	269	0	179	4	4	4	106	669	0	0	704	147
Shared Lane Traffic (%)												
Lane Group Flow (vph)	269	0	179	0	12	0	106	669	0	0	851	0
Enter Blocked Intersection	No	No	No	No	No	No	No	No	No	No	No	No
Lane Alignment	Left	Left	Right	Left	Left	Right	Left	Left	Right	Left	Left	Right
Median Width(ft)		12			12			12				12
Link Offset(ft)		0			8			0				0
Crosswalk Width(ft)		16			16			16				16
Two way Left Turn Lane												
Headway Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Number of Detectors	1		1	1	2		1	2				2
Detector Template	Left		Right	Left	Thru		Left	Thru				Thru
Leading Detector (ft)	20		20	20	100		20	100				100
Trailing Detector (ft)	0		0	0	0		0	0				0
Detector 1 Position(ft)	0		0	0	0		0	0				0
Detector 1 Size(ft)	20		20	20	6		20	6				6
Detector 1 Type	Cl+Ex		Cl+Ex	Cl+Ex	Cl+Ex		Cl+Ex	Cl+Ex				Cl+Ex
Detector 1 Channel												
Detector 1 Extend (s)	0.0		0.0	0.0	0.0		0.0	0.0				0.0
Detector 1 Queue (s)	0.0		0.0	0.0	0.0		0.0	0.0				0.0
Detector 1 Delay (s)	0.0		0.0	0.0	0.0		0.0	0.0				0.0
Detector 2 Position(ft)					94			94				94
Detector 2 Size(ft)					6			6				6
Detector 2 Type					Cl+Ex			Cl+Ex				Cl+Ex
Detector 2 Channel												
Detector 2 Extend (s)					0.0			0.0				0.0
Turn Type	Perm		Prot	Perm	NA		pm+pt	NA				NA
Protected Phases			6		2		7	4				8

Lanes, Volumes, Timings  
 3: Main St (1A) & Cherry St/Old Country Rd

07/23/2018

Lane Group	Ø9
Lane Configurations	
Traffic Volume (vph)	
Future Volume (vph)	
Ideal Flow (vphpl)	
Storage Length (ft)	
Storage Lanes	
Taper Length (ft)	
Lane Util. Factor	
Frt	
Flt Protected	
Satd. Flow (prot)	
Flt Permitted	
Satd. Flow (perm)	
Right Turn on Red	
Satd. Flow (RTOR)	
Link Speed (mph)	
Link Distance (ft)	
Travel Time (s)	
Peak Hour Factor	
Growth Factor	
Heavy Vehicles (%)	
Adj. Flow (vph)	
Shared Lane Traffic (%)	
Lane Group Flow (vph)	
Enter Blocked Intersection	
Lane Alignment	
Median Width(ft)	
Link Offset(ft)	
Crosswalk Width(ft)	
Two way Left Turn Lane	
Headway Factor	
Number of Detectors	
Detector Template	
Leading Detector (ft)	
Trailing Detector (ft)	
Detector 1 Position(ft)	
Detector 1 Size(ft)	
Detector 1 Type	
Detector 1 Channel	
Detector 1 Extend (s)	
Detector 1 Queue (s)	
Detector 1 Delay (s)	
Detector 2 Position(ft)	
Detector 2 Size(ft)	
Detector 2 Type	
Detector 2 Channel	
Detector 2 Extend (s)	
Turn Type	
Protected Phases	9

### Lanes, Volumes, Timings

#### 3: Main St (1A) & Cherry St/Old Country Rd

07/23/2018



Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Permitted Phases	6			2			4					
Detector Phase	6		6	2	2		7	4				8
Switch Phase												
Minimum Initial (s)	1.0		1.0	1.0	1.0		3.0	1.0				1.0
Minimum Split (s)	6.0		6.0	6.0	6.0		8.0	6.0				6.0
Total Split (s)	26.0		26.0	26.0	26.0		9.0	62.0				53.0
Total Split (%)	23.6%		23.6%	23.6%	23.6%		8.2%	56.4%				48.2%
Maximum Green (s)	21.0		21.0	21.0	21.0		4.0	57.0				48.0
Yellow Time (s)	3.0		3.0	3.0	3.0		3.0	3.0				3.0
All-Red Time (s)	2.0		2.0	2.0	2.0		2.0	2.0				2.0
Lost Time Adjust (s)	0.0		0.0		0.0		0.0	0.0				0.0
Total Lost Time (s)	5.0		5.0		5.0		5.0	5.0				5.0
Lead/Lag							Lead					Lag
Lead-Lag Optimize?							Yes					Yes
Vehicle Extension (s)	3.0		3.0	3.0	3.0		3.0	3.0				3.0
Recall Mode	None		None	Min	Min		None	C-Min				C-Min
Walk Time (s)												
Flash Dont Walk (s)												
Pedestrian Calls (#/hr)												
Act Effct Green (s)	28.6		28.6		28.6		67.0	67.0				54.2
Actuated g/C Ratio	0.26		0.26		0.26		0.61	0.61				0.49
v/c Ratio	0.76		0.38		0.03		0.55	0.60				0.95
Control Delay	53.4		20.3		26.8		26.7	17.2				38.6
Queue Delay	0.0		0.0		0.0		0.0	0.0				0.0
Total Delay	53.4		20.3		26.8		26.7	17.2				38.6
LOS	D		C		C		C	B				D
Approach Delay		40.1			26.8			18.5				38.6
Approach LOS		D			C			B				D
90th %ile Green (s)	21.0		21.0	21.0	21.0		4.0	57.0				48.0
90th %ile Term Code	Max		Max	Hold	Hold		Max	Coord				Coord
70th %ile Green (s)	31.8		31.8	31.8	31.8		9.9	68.2				53.3
70th %ile Term Code	Gap		Gap	Hold	Hold		Gap	Coord				Coord
50th %ile Green (s)	30.8		30.8	30.8	30.8		9.4	69.2				54.8
50th %ile Term Code	Gap		Gap	Hold	Hold		Gap	Coord				Coord
30th %ile Green (s)	30.0		30.0	30.0	30.0		8.5	70.0				56.5
30th %ile Term Code	Gap		Gap	Hold	Hold		Gap	Coord				Coord
10th %ile Green (s)	29.2		29.2	29.2	29.2		7.4	70.8				58.4
10th %ile Term Code	Gap		Gap	Hold	Hold		Gap	Coord				Coord
Stops (vph)	207		67		3		33	343				596
Fuel Used(gal)	9		4		0		3	20				12
CO Emissions (g/hr)	651		304		5		228	1398				842
NOx Emissions (g/hr)	127		59		1		44	272				164
VOC Emissions (g/hr)	151		70		1		53	324				195
Dilemma Vehicles (#)	0		0		0		0	0				0
Queue Length 50th (ft)	170		49		4		27	255				544
Queue Length 95th (ft)	#369		121		4		#97	422				#892
Internal Link Dist (ft)		2622			495			3655				380
Turn Bay Length (ft)			50				75					
Base Capacity (vph)	355		465		466		193	1113				895



Lanes, Volumes, Timings  
 3: Main St (1A) & Cherry St/Old Country Rd

07/23/2018

Lane Group	Ø9
Permitted Phases	
Detector Phase	
Switch Phase	
Minimum Initial (s)	1.0
Minimum Split (s)	22.0
Total Split (s)	22.0
Total Split (%)	20%
Maximum Green (s)	20.0
Yellow Time (s)	2.0
All-Red Time (s)	0.0
Lost Time Adjust (s)	
Total Lost Time (s)	
Lead/Lag	
Lead-Lag Optimize?	
Vehicle Extension (s)	3.0
Recall Mode	None
Walk Time (s)	9.0
Flash Dont Walk (s)	11.0
Pedestrian Calls (#/hr)	5
Act Effct Green (s)	
Actuated g/C Ratio	
v/c Ratio	
Control Delay	
Queue Delay	
Total Delay	
LOS	
Approach Delay	
Approach LOS	
90th %ile Green (s)	20.0
90th %ile Term Code	Ped
70th %ile Green (s)	0.0
70th %ile Term Code	Skip
50th %ile Green (s)	0.0
50th %ile Term Code	Skip
30th %ile Green (s)	0.0
30th %ile Term Code	Skip
10th %ile Green (s)	0.0
10th %ile Term Code	Skip
Stops (vph)	
Fuel Used(gal)	
CO Emissions (g/hr)	
NOx Emissions (g/hr)	
VOC Emissions (g/hr)	
Dilemma Vehicles (#)	
Queue Length 50th (ft)	
Queue Length 95th (ft)	
Internal Link Dist (ft)	
Turn Bay Length (ft)	
Base Capacity (vph)	

Lanes, Volumes, Timings  
 3: Main St (1A) & Cherry St/Old Country Rd

07/23/2018

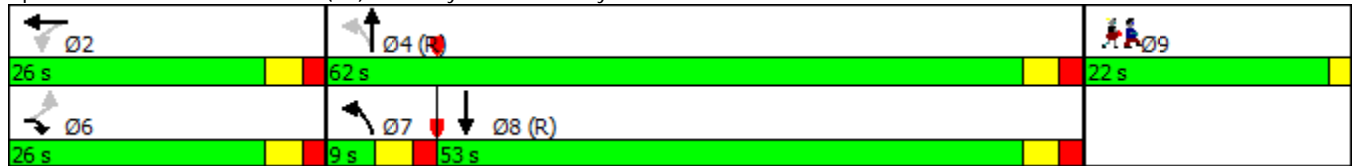


Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Starvation Cap Reductn	0		0		0		0	0			0	
Spillback Cap Reductn	0		0		0		0	0			0	
Storage Cap Reductn	0		0		0		0	0			0	
Reduced v/c Ratio	0.76		0.38		0.03		0.55	0.60			0.95	

Intersection Summary

Area Type: Other  
 Cycle Length: 110  
 Actuated Cycle Length: 110  
 Offset: 8 (7%), Referenced to phase 4:NBTL and 8:SBT, Start of Green  
 Natural Cycle: 120  
 Control Type: Actuated-Coordinated  
 Maximum v/c Ratio: 0.95  
 Intersection Signal Delay: 31.4  
 Intersection LOS: C  
 Intersection Capacity Utilization 78.6%  
 ICU Level of Service D  
 Analysis Period (min) 15  
 # 95th percentile volume exceeds capacity, queue may be longer.  
 Queue shown is maximum after two cycles.

Splits and Phases: 3: Main St (1A) & Cherry St/Old Country Rd



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Lane Group	Ø9
Starvation Cap Reductn	
Spillback Cap Reductn	
Storage Cap Reductn	
Reduced v/c Ratio	
Intersection Summary	

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Lanes, Volumes, Timings  
 1: Main St (1A) & Arbor St/Friend Ct

07/23/2018



Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		↖	↗		↔		↖	↗		↖	↗	
Traffic Volume (vph)	18	0	267	7	0	13	297	652	11	5	596	25
Future Volume (vph)	18	0	267	7	0	13	297	652	11	5	596	25
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Storage Length (ft)	0		50	0		0	100		0	40		0
Storage Lanes	0		1	0		0	1		0	1		0
Taper Length (ft)	0			0			25			25		
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Ped Bike Factor							1.00	1.00		1.00	1.00	
Frt			0.850		0.905			0.997				0.993
Flt Protected		0.950			0.986		0.950			0.950		
Satd. Flow (prot)	0	1805	1615	0	1695	0	1787	1857	0	1805	1867	0
Flt Permitted					0.889		0.251			0.239		
Satd. Flow (perm)	0	1900	1615	0	1529	0	472	1857	0	454	1867	0
Right Turn on Red			Yes			Yes			Yes			Yes
Satd. Flow (RTOR)			309		139			2				3
Link Speed (mph)		30			30			30				30
Link Distance (ft)		2388			2408			316				2230
Travel Time (s)		54.3			54.7			7.2				50.7
Confl. Peds. (#/hr)							1		2	2		1
Peak Hour Factor	0.56	0.92	0.88	0.58	0.92	0.46	0.88	0.89	0.69	0.63	0.93	0.78
Growth Factor	102%	102%	102%	102%	102%	102%	102%	102%	102%	102%	102%	102%
Heavy Vehicles (%)	0%	0%	0%	0%	0%	0%	1%	2%	0%	0%	1%	0%
Adj. Flow (vph)	33	0	309	12	0	29	344	747	16	8	654	33
Shared Lane Traffic (%)												
Lane Group Flow (vph)	0	33	309	0	41	0	344	763	0	8	687	0
Enter Blocked Intersection	No	No	No	No	No	No	No	No	No	No	No	No
Lane Alignment	Left	Left	Right	Left	Left	Right	Left	Left	Right	Left	Left	Right
Median Width(ft)		0			0			12				12
Link Offset(ft)		0			-10			6				0
Crosswalk Width(ft)		16			16			16				16
Two way Left Turn Lane												
Headway Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Number of Detectors	1	1	2	1	2		1	2		1	2	
Detector Template	Left	Left	Thru	Left	Thru		Left	Thru		Left	Thru	
Leading Detector (ft)	20	20	100	20	100		20	100		20	100	
Trailing Detector (ft)	0	0	0	0	0		0	0		0	0	
Detector 1 Position(ft)	0	0	0	0	0		0	0		0	0	
Detector 1 Size(ft)	20	20	6	20	6		20	6		20	6	
Detector 1 Type	Cl+Ex	Cl+Ex	Cl+Ex	Cl+Ex	Cl+Ex		Cl+Ex	Cl+Ex		Cl+Ex	Cl+Ex	
Detector 1 Channel												
Detector 1 Extend (s)	0.0	0.0	0.0	0.0	0.0		0.0	0.0		0.0	0.0	
Detector 1 Queue (s)	0.0	0.0	0.0	0.0	0.0		0.0	0.0		0.0	0.0	
Detector 1 Delay (s)	0.0	0.0	0.0	0.0	0.0		0.0	0.0		0.0	0.0	
Detector 2 Position(ft)			94		94			94			94	
Detector 2 Size(ft)			6		6			6			6	
Detector 2 Type			Cl+Ex		Cl+Ex			Cl+Ex			Cl+Ex	
Detector 2 Channel												
Detector 2 Extend (s)			0.0		0.0			0.0			0.0	

Lanes, Volumes, Timings  
1: Main St (1A) & Arbor St/Friend Ct

07/23/2018

Lane Group	Ø9
Lane Configurations	
Traffic Volume (vph)	
Future Volume (vph)	
Ideal Flow (vphpl)	
Storage Length (ft)	
Storage Lanes	
Taper Length (ft)	
Lane Util. Factor	
Ped Bike Factor	
Frt	
Flt Protected	
Satd. Flow (prot)	
Flt Permitted	
Satd. Flow (perm)	
Right Turn on Red	
Satd. Flow (RTOR)	
Link Speed (mph)	
Link Distance (ft)	
Travel Time (s)	
Confl. Peds. (#/hr)	
Peak Hour Factor	
Growth Factor	
Heavy Vehicles (%)	
Adj. Flow (vph)	
Shared Lane Traffic (%)	
Lane Group Flow (vph)	
Enter Blocked Intersection	
Lane Alignment	
Median Width(ft)	
Link Offset(ft)	
Crosswalk Width(ft)	
Two way Left Turn Lane	
Headway Factor	
Number of Detectors	
Detector Template	
Leading Detector (ft)	
Trailing Detector (ft)	
Detector 1 Position(ft)	
Detector 1 Size(ft)	
Detector 1 Type	
Detector 1 Channel	
Detector 1 Extend (s)	
Detector 1 Queue (s)	
Detector 1 Delay (s)	
Detector 2 Position(ft)	
Detector 2 Size(ft)	
Detector 2 Type	
Detector 2 Channel	
Detector 2 Extend (s)	



Lanes, Volumes, Timings  
 1: Main St (1A) & Arbor St/Friend Ct

07/23/2018



Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Turn Type	Perm	NA	pm+ov	Perm	NA		pm+pt	NA		pm+pt	NA	
Protected Phases		6	7		2		7	4		3	8	
Permitted Phases	6		6	2			4			8		
Detector Phase	6	6	7	2	2		7	4		3	8	
Switch Phase												
Minimum Initial (s)	1.0	1.0	1.0	1.0	1.0		1.0	1.0		1.0	1.0	
Minimum Split (s)	6.0	6.0	6.0	6.0	6.0		6.0	6.0		6.0	6.0	
Total Split (s)	9.0	9.0	25.0	9.0	9.0		25.0	72.0		7.0	54.0	
Total Split (%)	8.2%	8.2%	22.7%	8.2%	8.2%		22.7%	65.5%		6.4%	49.1%	
Maximum Green (s)	4.0	4.0	20.0	4.0	4.0		20.0	67.0		2.0	49.0	
Yellow Time (s)	3.0	3.0	3.0	3.0	3.0		3.0	3.0		3.0	3.0	
All-Red Time (s)	2.0	2.0	2.0	2.0	2.0		2.0	2.0		2.0	2.0	
Lost Time Adjust (s)		0.0	0.0		0.0		0.0	0.0		0.0	0.0	
Total Lost Time (s)		5.0	5.0		5.0		5.0	5.0		5.0	5.0	
Lead/Lag			Lag				Lag	Lag		Lead	Lead	
Lead-Lag Optimize?			Yes				Yes	Yes		Yes	Yes	
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0		3.0	3.0		3.0	3.0	
Recall Mode	None	None	None	None	None		None	C-Max		None	C-Max	
Walk Time (s)												
Flash Dont Walk (s)												
Pedestrian Calls (#/hr)												
Act Effct Green (s)		5.5	24.1		5.3		88.7	90.7		65.1	65.1	
Actuated g/C Ratio		0.05	0.22		0.05		0.81	0.82		0.59	0.59	
v/c Ratio		0.35	0.52		0.20		0.56	0.50		0.03	0.62	
Control Delay		61.9	5.7		2.2		13.4	4.9		16.0	21.6	
Queue Delay		0.0	0.0		0.0		0.0	0.1		0.0	0.0	
Total Delay		61.9	5.7		2.2		13.4	5.0		16.0	21.6	
LOS		E	A		A		B	A		B	C	
Approach Delay		11.1			2.2			7.6			21.5	
Approach LOS		B			A			A			C	
90th %ile Green (s)	4.0	4.0	20.0	4.0	4.0		20.0	67.0		2.0	49.0	
90th %ile Term Code	Max	Max	Max	Max	Max		Max	Coord		Max	Coord	
70th %ile Green (s)	4.0	4.0	20.0	4.0	4.0		20.0	74.0		0.0	49.0	
70th %ile Term Code	Max	Max	Max	Max	Max		Max	Coord		Skip	Coord	
50th %ile Green (s)	7.4	7.4	20.0	7.4	7.4		20.0	92.6		0.0	67.6	
50th %ile Term Code	Gap	Gap	Hold	Hold	Hold		Hold	Coord		Skip	Coord	
30th %ile Green (s)	0.0	0.0	20.0	0.0	0.0		20.0	105.0		0.0	80.0	
30th %ile Term Code	Skip	Skip	Hold	Skip	Skip		Hold	Coord		Skip	Coord	
10th %ile Green (s)	0.0	0.0	20.0	0.0	0.0		20.0	105.0		0.0	80.0	
10th %ile Term Code	Skip	Skip	Hold	Skip	Skip		Hold	Coord		Skip	Coord	
Stops (vph)		17	27		0		112	136		4	416	
Fuel Used(gal)		1	6		0		2	3		0	16	
CO Emissions (g/hr)		46	386		27		153	216		9	1126	
NOx Emissions (g/hr)		9	75		5		30	42		2	219	
VOC Emissions (g/hr)		11	90		6		35	50		2	261	
Dilemma Vehicles (#)		0	0		0		0	0		0	0	
Queue Length 50th (ft)		23	0		0		18	42		2	274	
Queue Length 95th (ft)		#64	43		0		m81	215		9	#594	
Internal Link Dist (ft)		2308			2328			236			2150	

Lanes, Volumes, Timings  
 1: Main St (1A) & Arbor St/Friend Ct

07/23/2018

Lane Group	Ø9
Turn Type	
Protected Phases	9
Permitted Phases	
Detector Phase	
Switch Phase	
Minimum Initial (s)	1.0
Minimum Split (s)	22.0
Total Split (s)	22.0
Total Split (%)	20%
Maximum Green (s)	20.0
Yellow Time (s)	2.0
All-Red Time (s)	0.0
Lost Time Adjust (s)	
Total Lost Time (s)	
Lead/Lag	
Lead-Lag Optimize?	
Vehicle Extension (s)	3.0
Recall Mode	None
Walk Time (s)	9.0
Flash Dont Walk (s)	11.0
Pedestrian Calls (#/hr)	15
Act Effct Green (s)	
Actuated g/C Ratio	
v/c Ratio	
Control Delay	
Queue Delay	
Total Delay	
LOS	
Approach Delay	
Approach LOS	
90th %ile Green (s)	20.0
90th %ile Term Code	Ped
70th %ile Green (s)	20.0
70th %ile Term Code	Ped
50th %ile Green (s)	0.0
50th %ile Term Code	Skip
30th %ile Green (s)	0.0
30th %ile Term Code	Skip
10th %ile Green (s)	0.0
10th %ile Term Code	Skip
Stops (vph)	
Fuel Used(gal)	
CO Emissions (g/hr)	
NOx Emissions (g/hr)	
VOC Emissions (g/hr)	
Dilemma Vehicles (#)	
Queue Length 50th (ft)	
Queue Length 95th (ft)	
Internal Link Dist (ft)	

Lanes, Volumes, Timings  
 1: Main St (1A) & Arbor St/Friend Ct

07/23/2018

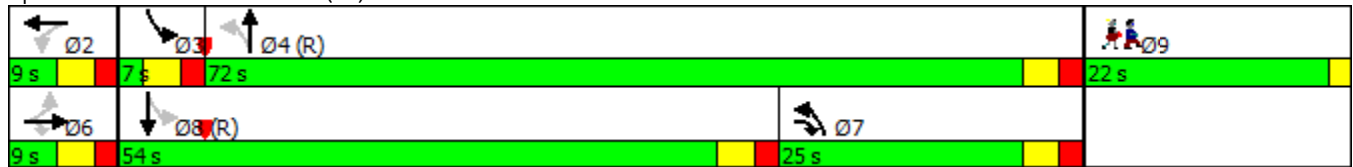


Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Turn Bay Length (ft)			50				100			40		
Base Capacity (vph)		94	594		205		619	1531		319	1106	
Starvation Cap Reductn		0	0		0		0	164		0	0	
Spillback Cap Reductn		0	0		0		0	0		0	0	
Storage Cap Reductn		0	0		0		0	0		0	0	
Reduced v/c Ratio		0.35	0.52		0.20		0.56	0.56		0.03	0.62	

Intersection Summary

Area Type: Other  
 Cycle Length: 110  
 Actuated Cycle Length: 110  
 Offset: 0 (0%), Referenced to phase 4:NBTL and 8:SBTL, Start of Green, Master Intersection  
 Natural Cycle: 90  
 Control Type: Actuated-Coordinated  
 Maximum v/c Ratio: 0.62  
 Intersection Signal Delay: 12.5 Intersection LOS: B  
 Intersection Capacity Utilization 70.6% ICU Level of Service C  
 Analysis Period (min) 15  
 # 95th percentile volume exceeds capacity, queue may be longer.  
 Queue shown is maximum after two cycles.  
 m Volume for 95th percentile queue is metered by upstream signal.

Splits and Phases: 1: Main St (1A) & Arbor St/Friend Ct



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Lane Group	Ø9
Turn Bay Length (ft)	
Base Capacity (vph)	
Starvation Cap Reductn	
Spillback Cap Reductn	
Storage Cap Reductn	
Reduced v/c Ratio	
Intersection Summary	

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Lanes, Volumes, Timings  
 2: Main St (1A) & Monument St/Wenham Town Hall

07/23/2018



Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		↕	↗				↖	↗			↕	
Traffic Volume (vph)	46	0	6	0	0	0	6	912	2	1	659	210
Future Volume (vph)	46	0	6	0	0	0	6	912	2	1	659	210
Ideal Flow (vphp)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Storage Length (ft)	0		15	0		0	25		0	0		0
Storage Lanes	0		1	0		0	1		0	0		0
Taper Length (ft)	0			0			25			0		
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Ped Bike Factor												
Frt			0.850					0.999			0.964	
Flt Protected		0.950					0.950					
Satd. Flow (prot)	0	1787	1380	0	0	0	1805	1879	0	0	1814	0
Flt Permitted		0.950					0.950					
Satd. Flow (perm)	0	1787	1380	0	0	0	1805	1879	0	0	1814	0
Link Speed (mph)		30			30			30			30	
Link Distance (ft)		2613			509			460			316	
Travel Time (s)		59.4			11.6			10.5			7.2	
Confl. Peds. (#/hr)							1					1
Peak Hour Factor	0.86	0.92	0.38	0.92	0.25	0.25	0.75	0.93	0.50	0.25	0.94	0.83
Growth Factor	102%	102%	102%	102%	102%	102%	102%	102%	102%	102%	102%	102%
Heavy Vehicles (%)	1%	2%	17%	2%	0%	0%	0%	1%	0%	0%	1%	1%
Adj. Flow (vph)	55	0	16	0	0	0	8	1000	4	4	715	258
Shared Lane Traffic (%)												
Lane Group Flow (vph)	0	55	16	0	0	0	8	1004	0	0	977	0
Enter Blocked Intersection	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	2 veh	Yes
Lane Alignment	Left	Left	Right	Left	Left	Right	Left	Left	Right	Left	Left	Right
Median Width(ft)		0			0			12			12	
Link Offset(ft)		0			30			0			0	
Crosswalk Width(ft)		16			16			16			16	
Two way Left Turn Lane												
Headway Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Turning Speed (mph)	25		9	15		9	15		9	15		9
Sign Control		Stop			Stop			Free			Free	

Intersection Summary

Area Type:	Other
Control Type:	Unsignalized
Intersection Capacity Utilization	59.3%
ICU Level of Service	B
Analysis Period (min)	15

# HCM Unsignalized Intersection Capacity Analysis

## 2: Main St (1A) & Monument St/Wenham Town Hall

07/23/2018



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		↕	↗				↖	↖			↕	
Traffic Volume (veh/h)	46	0	6	0	0	0	6	912	2	1	659	210
Future Volume (Veh/h)	46	0	6	0	0	0	6	912	2	1	659	210
Sign Control		Stop			Stop			Free			Free	
Grade		0%			0%			0%			0%	
Peak Hour Factor	0.86	0.92	0.38	0.92	0.25	0.25	0.75	0.93	0.50	0.25	0.94	0.83
Hourly flow rate (vph)	55	0	16	0	0	0	8	1000	4	4	715	258
Pedestrians		1										
Lane Width (ft)		12.0										
Walking Speed (ft/s)		3.5										
Percent Blockage		0										
Right turn flare (veh)			1									
Median type								None			None	
Median storage (veh)												
Upstream signal (ft)								460			316	
pX, platoon unblocked	0.75	0.75	0.72	0.75	0.75	0.60	0.72			0.60		
vC, conflicting volume	1869	1873	845	1878	2000	1002	974			1004		
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	1139	1144	585	1151	1314	676	766			679		
tC, single (s)	*6.0	6.5	*6.5	7.1	6.5	6.2	4.1			4.1		
tC, 2 stage (s)												
tF (s)	3.5	4.0	3.5	3.5	4.0	3.3	2.2			2.2		
p0 queue free %	71	100	95	100	100	100	99			99		
cM capacity (veh/h)	187	146	339	122	117	276	613			557		

Direction, Lane #	EB 1	NB 1	NB 2	SB 1
Volume Total	71	8	1004	977
Volume Left	55	8	0	4
Volume Right	16	0	4	258
cSH	241	613	1700	557
Volume to Capacity	0.29	0.01	0.59	0.01
Queue Length 95th (ft)	30	1	0	1
Control Delay (s)	28.5	11.0	0.0	0.2
Lane LOS	D	B		A
Approach Delay (s)	28.5	0.1		0.2
Approach LOS	D			

### Intersection Summary

Average Delay		1.1	
Intersection Capacity Utilization		59.3%	ICU Level of Service
Analysis Period (min)		15	B

\* User Entered Value



Intersection												
Int Delay, s/veh	3.4											
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		↔	↔				↔	↔			↔	
Traffic Vol, veh/h	46	0	6	0	0	0	6	912	2	1	659	210
Future Vol, veh/h	46	0	6	0	0	0	6	912	2	1	659	210
Conflicting Peds, #/hr	0	0	0	0	0	0	1	0	0	0	0	1
Sign Control	Stop	Stop	Stop	Stop	Stop	Stop	Free	Free	Free	Free	Free	Free
RT Channelized	-	-	None	-	-	None	-	-	None	-	-	None
Storage Length	-	-	15	-	-	-	25	-	-	-	-	-
Veh in Median Storage, #	-	0	-	-	-	-	-	0	-	-	0	-
Grade, %	-	0	-	-	0	-	-	0	-	-	0	-
Peak Hour Factor	86	92	38	92	25	25	75	93	50	25	94	83
Heavy Vehicles, %	1	2	17	2	0	0	0	1	0	0	1	1
Mvmt Flow	55	0	16	0	0	0	8	1000	4	4	715	258

Major/Minor	Minor2			Major1			Major2					
Conflicting Flow All	1872	1874	845				974	0	0	1004	0	0
Stage 1	853	853	-				-	-	-	-	-	-
Stage 2	1019	1021	-				-	-	-	-	-	-
Critical Hdwy	6.41	6.52	6.37				4.1	-	-	4.1	-	-
Critical Hdwy Stg 1	5.41	5.52	-				-	-	-	-	-	-
Critical Hdwy Stg 2	5.41	5.52	-				-	-	-	-	-	-
Follow-up Hdwy	3.509	4.018	3.453				2.2	-	-	2.2	-	-
Pot Cap-1 Maneuver	80	72	341				716	-	-	698	-	-
Stage 1	419	376	-				-	-	-	-	-	-
Stage 2	350	314	-				-	-	-	-	-	-
Platoon blocked, %								-	-		-	-
Mov Cap-1 Maneuver	78	0	341				716	-	-	698	-	-
Mov Cap-2 Maneuver	78	0	-				-	-	-	-	-	-
Stage 1	413	0	-				-	-	-	-	-	-
Stage 2	346	0	-				-	-	-	-	-	-

Approach	EB	NB	SB
HCM Control Delay, s	97.6	0.1	0
HCM LOS	F		

Minor Lane/Major Mvmt	NBL	NBT	NBR	EBLn1	EBLn2	SBL	SBT	SBR
Capacity (veh/h)	716	-	-	78	341	698	-	-
HCM Lane V/C Ratio	0.011	-	-	0.699	0.047	0.006	-	-
HCM Control Delay (s)	10.1	-	-	121.7	16.1	10.2	0	-
HCM Lane LOS	B	-	-	F	C	B	A	-
HCM 95th %tile Q(veh)	0	-	-	3.3	0.1	0	-	-

Lanes, Volumes, Timings  
 3: Main St (1A) & Cherry St/Old Country Rd

07/23/2018



Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	228	0	107	5	1	5	158	692	0	0	552	110
Future Volume (vph)	228	0	107	5	1	5	158	692	0	0	552	110
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Storage Length (ft)	0		50	0		0	75		0	0		0
Storage Lanes	1		1	0		0	1		0	0		0
Taper Length (ft)	0			0			25			0		
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Ped Bike Factor					0.99							
Frt			0.850		0.932							0.976
Flt Protected	0.950				0.984		0.950					
Satd. Flow (prot)	1770	0	1599	0	1723	0	1770	1881	0	0	1836	0
Flt Permitted	0.742				0.984		0.104					
Satd. Flow (perm)	1382	0	1599	0	1721	0	194	1881	0	0	1836	0
Right Turn on Red			Yes			Yes			Yes			Yes
Satd. Flow (RTOR)			89		12							12
Link Speed (mph)		30			30			30				30
Link Distance (ft)		2702			575			3735				460
Travel Time (s)		61.4			13.1			84.9				10.5
Confl. Peds. (#/hr)				1		1						
Peak Hour Factor	0.92	0.25	0.86	0.63	0.25	0.42	0.96	0.94	0.42	0.25	0.91	0.83
Growth Factor	102%	102%	102%	102%	102%	102%	102%	102%	102%	102%	102%	102%
Heavy Vehicles (%)	2%	0%	1%	0%	0%	0%	2%	1%	0%	0%	1%	1%
Adj. Flow (vph)	253	0	127	8	4	12	168	751	0	0	619	135
Shared Lane Traffic (%)												
Lane Group Flow (vph)	253	0	127	0	24	0	168	751	0	0	754	0
Enter Blocked Intersection	No	No	No	No	No	No	No	No	No	No	No	No
Lane Alignment	Left	Left	Right	Left	Left	Right	Left	Left	Right	Left	Left	Right
Median Width(ft)		12			12			12				12
Link Offset(ft)		0			8			0				0
Crosswalk Width(ft)		16			16			16				16
Two way Left Turn Lane												
Headway Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Number of Detectors	1		1	1	2		1	2				2
Detector Template	Left		Right	Left	Thru		Left	Thru				Thru
Leading Detector (ft)	20		20	20	100		20	100				100
Trailing Detector (ft)	0		0	0	0		0	0				0
Detector 1 Position(ft)	0		0	0	0		0	0				0
Detector 1 Size(ft)	20		20	20	6		20	6				6
Detector 1 Type	Cl+Ex		Cl+Ex	Cl+Ex	Cl+Ex		Cl+Ex	Cl+Ex				Cl+Ex
Detector 1 Channel												
Detector 1 Extend (s)	0.0		0.0	0.0	0.0		0.0	0.0				0.0
Detector 1 Queue (s)	0.0		0.0	0.0	0.0		0.0	0.0				0.0
Detector 1 Delay (s)	0.0		0.0	0.0	0.0		0.0	0.0				0.0
Detector 2 Position(ft)					94			94				94
Detector 2 Size(ft)					6			6				6
Detector 2 Type					Cl+Ex			Cl+Ex				Cl+Ex
Detector 2 Channel												
Detector 2 Extend (s)					0.0			0.0				0.0

Lanes, Volumes, Timings  
 3: Main St (1A) & Cherry St/Old Country Rd

07/23/2018

Lane Group	Ø9
Lane Configurations	
Traffic Volume (vph)	
Future Volume (vph)	
Ideal Flow (vphpl)	
Storage Length (ft)	
Storage Lanes	
Taper Length (ft)	
Lane Util. Factor	
Ped Bike Factor	
Frt	
Flt Protected	
Satd. Flow (prot)	
Flt Permitted	
Satd. Flow (perm)	
Right Turn on Red	
Satd. Flow (RTOR)	
Link Speed (mph)	
Link Distance (ft)	
Travel Time (s)	
Confl. Peds. (#/hr)	
Peak Hour Factor	
Growth Factor	
Heavy Vehicles (%)	
Adj. Flow (vph)	
Shared Lane Traffic (%)	
Lane Group Flow (vph)	
Enter Blocked Intersection	
Lane Alignment	
Median Width(ft)	
Link Offset(ft)	
Crosswalk Width(ft)	
Two way Left Turn Lane	
Headway Factor	
Number of Detectors	
Detector Template	
Leading Detector (ft)	
Trailing Detector (ft)	
Detector 1 Position(ft)	
Detector 1 Size(ft)	
Detector 1 Type	
Detector 1 Channel	
Detector 1 Extend (s)	
Detector 1 Queue (s)	
Detector 1 Delay (s)	
Detector 2 Position(ft)	
Detector 2 Size(ft)	
Detector 2 Type	
Detector 2 Channel	
Detector 2 Extend (s)	

Lanes, Volumes, Timings  
 3: Main St (1A) & Cherry St/Old Country Rd

07/23/2018



Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Turn Type	Perm		Prot	Perm	NA		pm+pt	NA				NA
Protected Phases			6		2		7	4				8
Permitted Phases	6			2			4					
Detector Phase	6		6	2	2		7	4				8
Switch Phase												
Minimum Initial (s)	1.0		1.0	1.0	1.0		3.0	1.0				1.0
Minimum Split (s)	6.0		6.0	6.0	6.0		8.0	6.0				6.0
Total Split (s)	26.0		26.0	26.0	26.0		12.0	62.0				50.0
Total Split (%)	23.6%		23.6%	23.6%	23.6%		10.9%	56.4%				45.5%
Maximum Green (s)	21.0		21.0	21.0	21.0		7.0	57.0				45.0
Yellow Time (s)	3.0		3.0	3.0	3.0		3.0	3.0				3.0
All-Red Time (s)	2.0		2.0	2.0	2.0		2.0	2.0				2.0
Lost Time Adjust (s)	0.0		0.0		0.0		0.0	0.0				0.0
Total Lost Time (s)	5.0		5.0		5.0		5.0	5.0				5.0
Lead/Lag							Lead					Lag
Lead-Lag Optimize?							Yes					Yes
Vehicle Extension (s)	3.0		3.0	3.0	3.0		3.0	3.0				3.0
Recall Mode	None		None	Min	Min		None	C-Min				C-Min
Walk Time (s)												
Flash Dont Walk (s)												
Pedestrian Calls (#/hr)												
Act Effct Green (s)	25.6		25.6		25.6		70.0	70.0				53.8
Actuated g/C Ratio	0.23		0.23		0.23		0.64	0.64				0.49
v/c Ratio	0.79		0.29		0.06		0.60	0.63				0.83
Control Delay	58.2		14.6		22.5		22.7	16.8				24.2
Queue Delay	0.0		0.0		0.0		0.0	0.0				0.0
Total Delay	58.2		14.6		22.5		22.7	16.8				24.2
LOS	E		B		C		C	B				C
Approach Delay		43.6			22.5			17.9				24.2
Approach LOS		D			C			B				C
90th %ile Green (s)	21.0		21.0	21.0	21.0		7.0	57.0				45.0
90th %ile Term Code	Max		Max	Hold	Hold		Max	Coord				Coord
70th %ile Green (s)	30.1		30.1	30.1	30.1		14.3	69.9				50.6
70th %ile Term Code	Gap		Gap	Hold	Hold		Gap	Coord				Coord
50th %ile Green (s)	28.5		28.5	28.5	28.5		12.7	71.5				53.8
50th %ile Term Code	Gap		Gap	Hold	Hold		Gap	Coord				Coord
30th %ile Green (s)	26.5		26.5	26.5	26.5		11.6	73.5				56.9
30th %ile Term Code	Gap		Gap	Hold	Hold		Gap	Coord				Coord
10th %ile Green (s)	22.1		22.1	22.1	22.1		10.0	77.9				62.9
10th %ile Term Code	Gap		Gap	Hold	Hold		Gap	Coord				Coord
Stops (vph)	192		33		6		60	435				491
Fuel Used(gal)	9		3		0		6	25				8
CO Emissions (g/hr)	610		196		9		403	1774				591
NOx Emissions (g/hr)	119		38		2		78	345				115
VOC Emissions (g/hr)	141		45		2		93	411				137
Dilemma Vehicles (#)	0		0		0		0	0				0
Queue Length 50th (ft)	162		20		6		42	282				438
Queue Length 95th (ft)	#340		69		4		#171	574				#767
Internal Link Dist (ft)		2622			495			3655				380

Lanes, Volumes, Timings  
 3: Main St (1A) & Cherry St/Old Country Rd

07/23/2018

Lane Group	Ø9
Turn Type	
Protected Phases	9
Permitted Phases	
Detector Phase	
Switch Phase	
Minimum Initial (s)	1.0
Minimum Split (s)	22.0
Total Split (s)	22.0
Total Split (%)	20%
Maximum Green (s)	20.0
Yellow Time (s)	2.0
All-Red Time (s)	0.0
Lost Time Adjust (s)	
Total Lost Time (s)	
Lead/Lag	
Lead-Lag Optimize?	
Vehicle Extension (s)	3.0
Recall Mode	None
Walk Time (s)	9.0
Flash Dont Walk (s)	11.0
Pedestrian Calls (#/hr)	5
Act Effct Green (s)	
Actuated g/C Ratio	
v/c Ratio	
Control Delay	
Queue Delay	
Total Delay	
LOS	
Approach Delay	
Approach LOS	
90th %ile Green (s)	20.0
90th %ile Term Code	Ped
70th %ile Green (s)	0.0
70th %ile Term Code	Skip
50th %ile Green (s)	0.0
50th %ile Term Code	Skip
30th %ile Green (s)	0.0
30th %ile Term Code	Skip
10th %ile Green (s)	0.0
10th %ile Term Code	Skip
Stops (vph)	
Fuel Used(gal)	
CO Emissions (g/hr)	
NOx Emissions (g/hr)	
VOC Emissions (g/hr)	
Dilemma Vehicles (#)	
Queue Length 50th (ft)	
Queue Length 95th (ft)	
Internal Link Dist (ft)	

### Lanes, Volumes, Timings 3: Main St (1A) & Cherry St/Old Country Rd

07/23/2018



Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Turn Bay Length (ft)			50				75					
Base Capacity (vph)	322		441		410		282	1196				904
Starvation Cap Reductn	0		0		0		0	0				0
Spillback Cap Reductn	0		0		0		0	0				0
Storage Cap Reductn	0		0		0		0	0				0
Reduced v/c Ratio	0.79		0.29		0.06		0.60	0.63				0.83

#### Intersection Summary

Area Type:	Other
Cycle Length:	110
Actuated Cycle Length:	110
Offset:	14 (13%), Referenced to phase 4:NBTL and 8:SBT, Start of Green
Natural Cycle:	100
Control Type:	Actuated-Coordinated
Maximum v/c Ratio:	0.83
Intersection Signal Delay:	25.0
Intersection LOS:	C
Intersection Capacity Utilization	76.6%
ICU Level of Service	D
Analysis Period (min)	15
# 95th percentile volume exceeds capacity, queue may be longer. Queue shown is maximum after two cycles.	

#### Splits and Phases: 3: Main St (1A) & Cherry St/Old Country Rd

Ø2	Ø4 (R)	Ø9
26 s	62 s	22 s
Ø6	Ø7	Ø8 (R)
26 s	12 s	50 s



Lanes, Volumes, Timings  
3: Main St (1A) & Cherry St/Old Country Rd

07/23/2018

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Lane Group	Ø9
Turn Bay Length (ft)	
Base Capacity (vph)	
Starvation Cap Reductn	
Spillback Cap Reductn	
Storage Cap Reductn	
Reduced v/c Ratio	
Intersection Summary	

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Lanes, Volumes, Timings  
 1: Main St (1A) & Arbor St/Friend Ct

07/23/2018



Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		↖	↗		↔		↖	↗		↖	↗	
Traffic Volume (vph)	16	1	346	3	3	6	287	555	6	5	578	27
Future Volume (vph)	16	1	346	3	3	6	287	555	6	5	578	27
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Storage Length (ft)	0		50	0		0	100		0	40		0
Storage Lanes	0		1	0		0	1		0	1		0
Taper Length (ft)	0			0			25			25		
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Ped Bike Factor							1.00	1.00		1.00	1.00	
Frt			0.850		0.932			0.998			0.991	
Flt Protected		0.959			0.992		0.950			0.950		
Satd. Flow (prot)	0	1639	1583	0	1757	0	1752	1824	0	1504	1825	0
Flt Permitted		0.825			0.935		0.266			0.313		
Satd. Flow (perm)	0	1410	1583	0	1656	0	491	1824	0	495	1825	0
Right Turn on Red			Yes			Yes			Yes			Yes
Satd. Flow (RTOR)			420		12			1			4	
Link Speed (mph)		30			30			30			30	
Link Distance (ft)		2388			2408			316			2230	
Travel Time (s)		54.3			54.7			7.2			50.7	
Confl. Peds. (#/hr)							1		1	1		1
Peak Hour Factor	0.67	0.25	0.84	0.75	0.38	0.50	0.84	0.90	0.75	0.31	0.91	0.68
Growth Factor	102%	102%	102%	102%	102%	102%	102%	102%	102%	102%	102%	102%
Heavy Vehicles (%)	13%	0%	2%	0%	0%	0%	3%	4%	0%	20%	3%	4%
Adj. Flow (vph)	24	4	420	4	8	12	349	629	8	16	648	41
Shared Lane Traffic (%)												
Lane Group Flow (vph)	0	28	420	0	24	0	349	637	0	16	689	0
Enter Blocked Intersection	No	No	No	No	No	No	No	No	No	No	No	No
Lane Alignment	Left	Left	Right	Left	Left	Right	Left	Left	Right	Left	Left	Right
Median Width(ft)		0			0			12			12	
Link Offset(ft)		0			-10			6			0	
Crosswalk Width(ft)		16			16			16			16	
Two way Left Turn Lane												
Headway Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Number of Detectors	1	1	2	1	2		1	2		1	2	
Detector Template	Left	Left	Thru	Left	Thru		Left	Thru		Left	Thru	
Leading Detector (ft)	20	20	100	20	100		20	100		20	100	
Trailing Detector (ft)	0	0	0	0	0		0	0		0	0	
Detector 1 Position(ft)	0	0	0	0	0		0	0		0	0	
Detector 1 Size(ft)	20	20	6	20	6		20	6		20	6	
Detector 1 Type	Cl+Ex	Cl+Ex	Cl+Ex	Cl+Ex	Cl+Ex		Cl+Ex	Cl+Ex		Cl+Ex	Cl+Ex	
Detector 1 Channel												
Detector 1 Extend (s)	0.0	0.0	0.0	0.0	0.0		0.0	0.0		0.0	0.0	
Detector 1 Queue (s)	0.0	0.0	0.0	0.0	0.0		0.0	0.0		0.0	0.0	
Detector 1 Delay (s)	0.0	0.0	0.0	0.0	0.0		0.0	0.0		0.0	0.0	
Detector 2 Position(ft)			94		94			94			94	
Detector 2 Size(ft)			6		6			6			6	
Detector 2 Type			Cl+Ex		Cl+Ex			Cl+Ex			Cl+Ex	
Detector 2 Channel												
Detector 2 Extend (s)			0.0		0.0			0.0			0.0	

Lanes, Volumes, Timings  
1: Main St (1A) & Arbor St/Friend Ct

07/23/2018

Lane Group	Ø9
Lane Configurations	
Traffic Volume (vph)	
Future Volume (vph)	
Ideal Flow (vphpl)	
Storage Length (ft)	
Storage Lanes	
Taper Length (ft)	
Lane Util. Factor	
Ped Bike Factor	
Frt	
Flt Protected	
Satd. Flow (prot)	
Flt Permitted	
Satd. Flow (perm)	
Right Turn on Red	
Satd. Flow (RTOR)	
Link Speed (mph)	
Link Distance (ft)	
Travel Time (s)	
Confl. Peds. (#/hr)	
Peak Hour Factor	
Growth Factor	
Heavy Vehicles (%)	
Adj. Flow (vph)	
Shared Lane Traffic (%)	
Lane Group Flow (vph)	
Enter Blocked Intersection	
Lane Alignment	
Median Width(ft)	
Link Offset(ft)	
Crosswalk Width(ft)	
Two way Left Turn Lane	
Headway Factor	
Number of Detectors	
Detector Template	
Leading Detector (ft)	
Trailing Detector (ft)	
Detector 1 Position(ft)	
Detector 1 Size(ft)	
Detector 1 Type	
Detector 1 Channel	
Detector 1 Extend (s)	
Detector 1 Queue (s)	
Detector 1 Delay (s)	
Detector 2 Position(ft)	
Detector 2 Size(ft)	
Detector 2 Type	
Detector 2 Channel	
Detector 2 Extend (s)	

Lanes, Volumes, Timings  
 1: Main St (1A) & Arbor St/Friend Ct

07/23/2018



Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Turn Type	Perm	NA	pm+ov	Perm	NA		pm+pt	NA		pm+pt	NA	
Protected Phases		6	7		2		7	4		3	8	
Permitted Phases	6		6	2			4			8		
Detector Phase	6	6	7	2	2		7	4		3	8	
Switch Phase												
Minimum Initial (s)	1.0	1.0	1.0	1.0	1.0		1.0	1.0		1.0	1.0	
Minimum Split (s)	6.0	6.0	6.0	6.0	6.0		6.0	6.0		6.0	6.0	
Total Split (s)	10.0	10.0	27.0	10.0	10.0		27.0	70.0		8.0	51.0	
Total Split (%)	9.1%	9.1%	24.5%	9.1%	9.1%		24.5%	63.6%		7.3%	46.4%	
Maximum Green (s)	5.0	5.0	22.0	5.0	5.0		22.0	65.0		3.0	46.0	
Yellow Time (s)	3.0	3.0	3.0	3.0	3.0		3.0	3.0		3.0	3.0	
All-Red Time (s)	2.0	2.0	2.0	2.0	2.0		2.0	2.0		2.0	2.0	
Lost Time Adjust (s)		0.0	0.0		0.0		0.0	0.0		0.0	0.0	
Total Lost Time (s)		5.0	5.0		5.0		5.0	5.0		5.0	5.0	
Lead/Lag			Lag				Lag	Lag		Lead	Lead	
Lead-Lag Optimize?			Yes				Yes	Yes		Yes	Yes	
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0		3.0	3.0		3.0	3.0	
Recall Mode	None	None	None	None	None		None	C-Max		None	C-Max	
Walk Time (s)												
Flash Dont Walk (s)												
Pedestrian Calls (#/hr)												
Act Effct Green (s)		7.0	28.5		6.7		89.3	91.3		66.1	66.1	
Actuated g/C Ratio		0.06	0.26		0.06		0.81	0.83		0.60	0.60	
v/c Ratio		0.31	0.58		0.22		0.54	0.42		0.05	0.63	
Control Delay		59.2	5.6		37.0		11.6	3.5		14.4	20.6	
Queue Delay		0.0	0.0		0.0		0.0	0.0		0.0	0.0	
Total Delay		59.2	5.6		37.0		11.6	3.5		14.4	20.6	
LOS		E	A		D		B	A		B	C	
Approach Delay		9.0			37.0			6.4			20.5	
Approach LOS		A			D			A			C	
90th %ile Green (s)	5.0	5.0	22.0	5.0	5.0		22.0	65.0		3.0	46.0	
90th %ile Term Code	Max	Max	Max	Max	Max		Max	Coord		Max	Coord	
70th %ile Green (s)	9.4	9.4	22.0	9.4	9.4		22.0	79.3		6.3	63.6	
70th %ile Term Code	Gap	Gap	Max	Hold	Hold		Max	Coord		Gap	Coord	
50th %ile Green (s)	8.0	8.0	22.0	8.0	8.0		22.0	92.0		0.0	65.0	
50th %ile Term Code	Gap	Gap	Hold	Hold	Hold		Hold	Coord		Skip	Coord	
30th %ile Green (s)	0.0	0.0	22.0	0.0	0.0		22.0	105.0		0.0	78.0	
30th %ile Term Code	Skip	Skip	Hold	Skip	Skip		Hold	Coord		Skip	Coord	
10th %ile Green (s)	0.0	0.0	22.0	0.0	0.0		22.0	105.0		0.0	78.0	
10th %ile Term Code	Skip	Skip	Hold	Skip	Skip		Hold	Coord		Skip	Coord	
Stops (vph)		16	32		8		119	122		3	376	
Fuel Used(gal)		1	7		0		2	2		0	15	
CO Emissions (g/hr)		43	500		25		145	174		8	1078	
NOx Emissions (g/hr)		8	97		5		28	34		2	210	
VOC Emissions (g/hr)		10	116		6		34	40		2	250	
Dilemma Vehicles (#)		0	0		0		0	0		0	0	
Queue Length 50th (ft)		19	0		8		23	32		4	298	
Queue Length 95th (ft)		14	35		10		113	236		7	#677	
Internal Link Dist (ft)		2308			2328			236			2150	

Lanes, Volumes, Timings  
 1: Main St (1A) & Arbor St/Friend Ct

07/23/2018

Lane Group	Ø9
Turn Type	
Protected Phases	9
Permitted Phases	
Detector Phase	
Switch Phase	
Minimum Initial (s)	1.0
Minimum Split (s)	22.0
Total Split (s)	22.0
Total Split (%)	20%
Maximum Green (s)	20.0
Yellow Time (s)	2.0
All-Red Time (s)	0.0
Lost Time Adjust (s)	
Total Lost Time (s)	
Lead/Lag	
Lead-Lag Optimize?	
Vehicle Extension (s)	3.0
Recall Mode	None
Walk Time (s)	9.0
Flash Dont Walk (s)	11.0
Pedestrian Calls (#/hr)	10
Act Effct Green (s)	
Actuated g/C Ratio	
v/c Ratio	
Control Delay	
Queue Delay	
Total Delay	
LOS	
Approach Delay	
Approach LOS	
90th %ile Green (s)	20.0
90th %ile Term Code	Ped
70th %ile Green (s)	0.0
70th %ile Term Code	Skip
50th %ile Green (s)	0.0
50th %ile Term Code	Skip
30th %ile Green (s)	0.0
30th %ile Term Code	Skip
10th %ile Green (s)	0.0
10th %ile Term Code	Skip
Stops (vph)	
Fuel Used(gal)	
CO Emissions (g/hr)	
NOx Emissions (g/hr)	
VOC Emissions (g/hr)	
Dilemma Vehicles (#)	
Queue Length 50th (ft)	
Queue Length 95th (ft)	
Internal Link Dist (ft)	



Lanes, Volumes, Timings  
 1: Main St (1A) & Arbor St/Friend Ct

07/23/2018

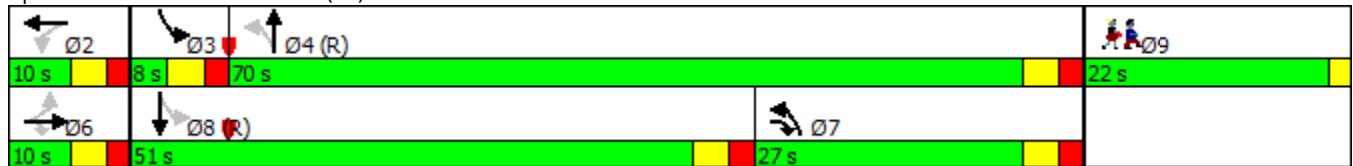


Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Turn Bay Length (ft)			50				100			40		
Base Capacity (vph)		89	721		111		650	1513		345	1098	
Starvation Cap Reductn		0	0		0		0	0		0	0	
Spillback Cap Reductn		0	0		0		0	0		0	0	
Storage Cap Reductn		0	0		0		0	0		0	0	
Reduced v/c Ratio		0.31	0.58		0.22		0.54	0.42		0.05	0.63	

Intersection Summary

Area Type: Other  
 Cycle Length: 110  
 Actuated Cycle Length: 110  
 Offset: 0 (0%), Referenced to phase 4:NBTL and 8:SBTL, Start of Green, Master Intersection  
 Natural Cycle: 90  
 Control Type: Actuated-Coordinated  
 Maximum v/c Ratio: 0.63  
 Intersection Signal Delay: 11.9 Intersection LOS: B  
 Intersection Capacity Utilization 70.4% ICU Level of Service C  
 Analysis Period (min) 15  
 # 95th percentile volume exceeds capacity, queue may be longer.  
 Queue shown is maximum after two cycles.

Splits and Phases: 1: Main St (1A) & Arbor St/Friend Ct



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Lane Group	Ø9
Turn Bay Length (ft)	
Base Capacity (vph)	
Starvation Cap Reductn	
Spillback Cap Reductn	
Storage Cap Reductn	
Reduced v/c Ratio	
Intersection Summary	

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Lanes, Volumes, Timings  
 2: Main St (1A) & Monument St/Wenham Town Hall

07/23/2018



Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		↕	↗				↖	↗			↕	
Traffic Volume (vph)	0	0	3	0	0	0	5	841	0	1	752	185
Future Volume (vph)	0	0	3	0	0	0	5	841	0	1	752	185
Ideal Flow (vphp)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Storage Length (ft)	0		15	0		0	25		0	0		0
Storage Lanes	0		1	0		0	1		0	0		0
Taper Length (ft)	0			0			25			0		
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Ped Bike Factor												
Frt			0.850								0.971	
Flt Protected							0.950					
Satd. Flow (prot)	0	1863	1615	0	0	0	1504	1827	0	0	1805	0
Flt Permitted							0.950					
Satd. Flow (perm)	0	1863	1615	0	0	0	1504	1827	0	0	1805	0
Link Speed (mph)		30			30			30			30	
Link Distance (ft)		2613			509			460			316	
Travel Time (s)		59.4			11.6			10.5			7.2	
Confl. Peds. (#/hr)							5					5
Peak Hour Factor	0.92	0.92	0.38	0.92	0.25	0.25	0.63	0.90	0.92	0.25	0.95	0.86
Growth Factor	102%	102%	102%	102%	102%	102%	102%	102%	102%	102%	102%	102%
Heavy Vehicles (%)	6%	2%	0%	2%	0%	0%	20%	4%	0%	0%	2%	3%
Adj. Flow (vph)	0	0	8	0	0	0	8	953	0	4	807	219
Shared Lane Traffic (%)												
Lane Group Flow (vph)	0	0	8	0	0	0	8	953	0	0	1030	0
Enter Blocked Intersection	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	2 veh	Yes
Lane Alignment	Left	Left	Right	Left	Left	Right	Left	Left	Right	Left	Left	Right
Median Width(ft)		0			0			12			12	
Link Offset(ft)		0			30			0			0	
Crosswalk Width(ft)		16			16			16			16	
Two way Left Turn Lane												
Headway Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Turning Speed (mph)	25		9	15		9	15		9	15		9
Sign Control		Stop			Stop			Free			Free	

Intersection Summary	
Area Type:	Other
Control Type:	Unsignalized
Intersection Capacity Utilization	62.0%
ICU Level of Service	B
Analysis Period (min)	15

# HCM Unsignalized Intersection Capacity Analysis

## 2: Main St (1A) & Monument St/Wenham Town Hall

07/23/2018



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		↕	↗				↖	↗			↕	
Traffic Volume (veh/h)	0	0	3	0	0	0	5	841	0	1	752	185
Future Volume (Veh/h)	0	0	3	0	0	0	5	841	0	1	752	185
Sign Control		Stop			Stop			Free			Free	
Grade		0%			0%			0%			0%	
Peak Hour Factor	0.92	0.92	0.38	0.92	0.25	0.25	0.63	0.90	0.92	0.25	0.95	0.86
Hourly flow rate (vph)	0	0	8	0	0	0	8	953	0	4	807	219
Pedestrians		5										
Lane Width (ft)		12.0										
Walking Speed (ft/s)		3.5										
Percent Blockage		0										
Right turn flare (veh)			1									
Median type								None			None	
Median storage (veh)												
Upstream signal (ft)								460			316	
pX, platoon unblocked	0.70	0.70	0.72	0.70	0.70	0.56	0.72			0.56		
vC, conflicting volume	1898	1898	922	1898	2008	953	1031			953		
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	1169	1169	696	1168	1325	530	848			530		
tC, single (s)	*6.0	6.5	*6.5	7.1	6.5	6.2	4.3			4.1		
tC, 2 stage (s)												
tF (s)	3.6	4.0	3.3	3.5	4.0	3.3	2.4			2.2		
p0 queue free %	100	100	97	100	100	100	98			99		
cM capacity (veh/h)	167	132	301	114	108	312	514			591		

Direction, Lane #	EB 1	NB 1	NB 2	SB 1
Volume Total	8	8	953	1030
Volume Left	0	8	0	4
Volume Right	8	0	0	219
cSH	226	514	1700	591
Volume to Capacity	0.04	0.02	0.56	0.01
Queue Length 95th (ft)	3	1	0	1
Control Delay (s)	21.5	12.1	0.0	0.2
Lane LOS	C	B		A
Approach Delay (s)	21.5	0.1		0.2
Approach LOS	C			

Intersection Summary			
Average Delay		0.3	
Intersection Capacity Utilization	62.0%	ICU Level of Service	B
Analysis Period (min)	15		

\* User Entered Value

Intersection												
Int Delay, s/veh	0.1											
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		↔	↔				↔	↔			↔	
Traffic Vol, veh/h	0	0	3	0	0	0	5	841	0	1	752	185
Future Vol, veh/h	0	0	3	0	0	0	5	841	0	1	752	185
Conflicting Peds, #/hr	0	0	0	0	0	0	5	0	0	0	0	5
Sign Control	Stop	Stop	Stop	Stop	Stop	Stop	Free	Free	Free	Free	Free	Free
RT Channelized	-	-	None	-	-	None	-	-	None	-	-	None
Storage Length	-	-	15	-	-	-	25	-	-	-	-	-
Veh in Median Storage, #	-	0	-	-	-	-	-	0	-	-	0	-
Grade, %	-	0	-	-	0	-	-	0	-	-	0	-
Peak Hour Factor	92	92	38	92	25	25	63	90	92	25	95	86
Heavy Vehicles, %	6	2	0	2	0	0	20	4	0	0	2	3
Mvmt Flow	0	0	8	0	0	0	8	953	0	4	807	219

Major/Minor	Minor2			Major1			Major2					
Conflicting Flow All	1899	1899	922				1032	0	0	953	0	0
Stage 1	930	930	-				-	-	-	-	-	-
Stage 2	969	969	-				-	-	-	-	-	-
Critical Hdwy	6.46	6.52	6.2				4.3	-	-	4.1	-	-
Critical Hdwy Stg 1	5.46	5.52	-				-	-	-	-	-	-
Critical Hdwy Stg 2	5.46	5.52	-				-	-	-	-	-	-
Follow-up Hdwy	3.554	4.018	3.3				2.38	-	-	2.2	-	-
Pot Cap-1 Maneuver	74	69	330				608	-	-	729	-	-
Stage 1	378	346	-				-	-	-	-	-	-
Stage 2	362	332	-				-	-	-	-	-	-
Platoon blocked, %								-	-		-	-
Mov Cap-1 Maneuver	71	0	328				608	-	-	729	-	-
Mov Cap-2 Maneuver	71	0	-				-	-	-	-	-	-
Stage 1	371	0	-				-	-	-	-	-	-
Stage 2	356	0	-				-	-	-	-	-	-

Approach	EB	NB	SB
HCM Control Delay, s	16.3	0.1	0
HCM LOS	C		

Minor Lane/Major Mvmt	NBL	NBT	NBR	EBLn1	EBLn2	SBL	SBT	SBR
Capacity (veh/h)	608	-	-	-	328	729	-	-
HCM Lane V/C Ratio	0.013	-	-	-	0.025	0.006	-	-
HCM Control Delay (s)	11	-	-	0	16.3	10	0	-
HCM Lane LOS	B	-	-	A	C	A	A	-
HCM 95th %tile Q(veh)	0	-	-	-	0.1	0	-	-

### Lanes, Volumes, Timings

#### 3: Main St (1A) & Cherry St/Old Country Rd

07/23/2018



Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	303	0	154	2	1	2	87	544	0	0	642	108
Future Volume (vph)	303	0	154	2	1	2	87	544	0	0	642	108
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Storage Length (ft)	0		50	0		0	75		0	0		0
Storage Lanes	1		1	0		0	1		0	0		0
Taper Length (ft)	0			0			25			0		
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Frt			0.850		0.955							0.977
Flt Protected	0.950				0.984		0.950					
Satd. Flow (prot)	1736	0	1538	0	1785	0	1752	1827	0	0	1805	0
Flt Permitted	0.750				0.984		0.076					
Satd. Flow (perm)	1370	0	1538	0	1785	0	140	1827	0	0	1805	0
Right Turn on Red			Yes			Yes			Yes			Yes
Satd. Flow (RTOR)			89		4							12
Link Speed (mph)		30			30			30				30
Link Distance (ft)		2702			575			3735				460
Travel Time (s)		61.4			13.1			84.9				10.5
Peak Hour Factor	0.92	0.25	0.88	0.50	0.25	0.50	0.84	0.83	0.42	0.25	0.93	0.75
Growth Factor	102%	102%	102%	102%	102%	102%	102%	102%	102%	102%	102%	102%
Heavy Vehicles (%)	4%	0%	5%	0%	0%	0%	3%	4%	0%	0%	3%	2%
Adj. Flow (vph)	336	0	179	4	4	4	106	669	0	0	704	147
Shared Lane Traffic (%)												
Lane Group Flow (vph)	336	0	179	0	12	0	106	669	0	0	851	0
Enter Blocked Intersection	No	No	No	No	No	No	No	No	No	No	No	No
Lane Alignment	Left	Left	Right	Left	Left	Right	Left	Left	Right	Left	Left	Right
Median Width(ft)		12			12			12				12
Link Offset(ft)		0			8			0				0
Crosswalk Width(ft)		16			16			16				16
Two way Left Turn Lane												
Headway Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Number of Detectors	1		1	1	2		1	2				2
Detector Template	Left		Right	Left	Thru		Left	Thru				Thru
Leading Detector (ft)	20		20	20	100		20	100				100
Trailing Detector (ft)	0		0	0	0		0	0				0
Detector 1 Position(ft)	0		0	0	0		0	0				0
Detector 1 Size(ft)	20		20	20	6		20	6				6
Detector 1 Type	Cl+Ex		Cl+Ex	Cl+Ex	Cl+Ex		Cl+Ex	Cl+Ex				Cl+Ex
Detector 1 Channel												
Detector 1 Extend (s)	0.0		0.0	0.0	0.0		0.0	0.0				0.0
Detector 1 Queue (s)	0.0		0.0	0.0	0.0		0.0	0.0				0.0
Detector 1 Delay (s)	0.0		0.0	0.0	0.0		0.0	0.0				0.0
Detector 2 Position(ft)					94			94				94
Detector 2 Size(ft)					6			6				6
Detector 2 Type					Cl+Ex			Cl+Ex				Cl+Ex
Detector 2 Channel												
Detector 2 Extend (s)					0.0			0.0				0.0
Turn Type	Perm		Prot	Perm	NA		pm+pt	NA				NA
Protected Phases			6		2		7	4				8



Lanes, Volumes, Timings  
 3: Main St (1A) & Cherry St/Old Country Rd

07/23/2018

Lane Group	Ø9
Lane Configurations	
Traffic Volume (vph)	
Future Volume (vph)	
Ideal Flow (vphpl)	
Storage Length (ft)	
Storage Lanes	
Taper Length (ft)	
Lane Util. Factor	
Frt	
Flt Protected	
Satd. Flow (prot)	
Flt Permitted	
Satd. Flow (perm)	
Right Turn on Red	
Satd. Flow (RTOR)	
Link Speed (mph)	
Link Distance (ft)	
Travel Time (s)	
Peak Hour Factor	
Growth Factor	
Heavy Vehicles (%)	
Adj. Flow (vph)	
Shared Lane Traffic (%)	
Lane Group Flow (vph)	
Enter Blocked Intersection	
Lane Alignment	
Median Width(ft)	
Link Offset(ft)	
Crosswalk Width(ft)	
Two way Left Turn Lane	
Headway Factor	
Number of Detectors	
Detector Template	
Leading Detector (ft)	
Trailing Detector (ft)	
Detector 1 Position(ft)	
Detector 1 Size(ft)	
Detector 1 Type	
Detector 1 Channel	
Detector 1 Extend (s)	
Detector 1 Queue (s)	
Detector 1 Delay (s)	
Detector 2 Position(ft)	
Detector 2 Size(ft)	
Detector 2 Type	
Detector 2 Channel	
Detector 2 Extend (s)	
Turn Type	
Protected Phases	9

Lanes, Volumes, Timings  
 3: Main St (1A) & Cherry St/Old Country Rd

07/23/2018



Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Permitted Phases	6			2			4					
Detector Phase	6		6	2	2		7	4				8
Switch Phase												
Minimum Initial (s)	1.0		1.0	1.0	1.0		3.0	1.0				1.0
Minimum Split (s)	6.0		6.0	6.0	6.0		8.0	6.0				6.0
Total Split (s)	26.0		26.0	26.0	26.0		8.0	62.0				54.0
Total Split (%)	23.6%		23.6%	23.6%	23.6%		7.3%	56.4%				49.1%
Maximum Green (s)	21.0		21.0	21.0	21.0		3.0	57.0				49.0
Yellow Time (s)	3.0		3.0	3.0	3.0		3.0	3.0				3.0
All-Red Time (s)	2.0		2.0	2.0	2.0		2.0	2.0				2.0
Lost Time Adjust (s)	0.0		0.0		0.0		0.0	0.0				0.0
Total Lost Time (s)	5.0		5.0		5.0		5.0	5.0				5.0
Lead/Lag							Lead					Lag
Lead-Lag Optimize?							Yes					Yes
Vehicle Extension (s)	3.0		3.0	3.0	3.0		3.0	3.0				3.0
Recall Mode	None		None	Min	Min		None	C-Min				C-Min
Walk Time (s)												
Flash Dont Walk (s)												
Pedestrian Calls (#/hr)												
Act Effct Green (s)	37.2		37.2		37.2		58.4	58.4				49.0
Actuated g/C Ratio	0.34		0.34		0.34		0.53	0.53				0.45
v/c Ratio	0.73		0.31		0.02		0.77	0.69				1.05
Control Delay	44.4		17.3		24.8		52.3	23.8				66.8
Queue Delay	0.0		0.0		0.0		0.0	0.0				0.0
Total Delay	44.4		17.3		24.8		52.3	23.8				66.8
LOS	D		B		C		D	C				E
Approach Delay		35.0			24.8			27.7				66.8
Approach LOS		C			C			C				E
90th %ile Green (s)	21.0		21.0	21.0	21.0		3.0	57.0				49.0
90th %ile Term Code	Max		Max	Hold	Hold		Max	Coord				Coord
70th %ile Green (s)	39.1		39.1	39.1	39.1		6.9	60.9				49.0
70th %ile Term Code	Gap		Gap	Hold	Hold		Max	Coord				Coord
50th %ile Green (s)	40.1		40.1	40.1	40.1		5.9	59.9				49.0
50th %ile Term Code	Gap		Gap	Hold	Hold		Max	Coord				Coord
30th %ile Green (s)	43.0		43.0	43.0	43.0		3.0	57.0				49.0
30th %ile Term Code	Max		Max	Hold	Hold		Max	Coord				Coord
10th %ile Green (s)	43.0		43.0	43.0	43.0		3.0	57.0				49.0
10th %ile Term Code	Max		Max	Hold	Hold		Max	Coord				Coord
Stops (vph)	223		63		3		37	402				625
Fuel Used(gal)	11		4		0		4	21				17
CO Emissions (g/hr)	736		296		4		262	1473				1160
NOx Emissions (g/hr)	143		58		1		51	287				226
VOC Emissions (g/hr)	171		69		1		61	341				269
Dilemma Vehicles (#)	0		0		0		0	0				0
Queue Length 50th (ft)	198		43		4		35	324				~654
Queue Length 95th (ft)	#482		121		4		#103	422				#879
Internal Link Dist (ft)		2622			495			3655				380
Turn Bay Length (ft)			50				75					
Base Capacity (vph)	463		579		607		138	969				810

Lanes, Volumes, Timings  
 3: Main St (1A) & Cherry St/Old Country Rd

07/23/2018

Lane Group	Ø9
Permitted Phases	
Detector Phase	
Switch Phase	
Minimum Initial (s)	1.0
Minimum Split (s)	22.0
Total Split (s)	22.0
Total Split (%)	20%
Maximum Green (s)	20.0
Yellow Time (s)	2.0
All-Red Time (s)	0.0
Lost Time Adjust (s)	
Total Lost Time (s)	
Lead/Lag	
Lead-Lag Optimize?	
Vehicle Extension (s)	3.0
Recall Mode	None
Walk Time (s)	9.0
Flash Dont Walk (s)	11.0
Pedestrian Calls (#/hr)	5
Act Effct Green (s)	
Actuated g/C Ratio	
v/c Ratio	
Control Delay	
Queue Delay	
Total Delay	
LOS	
Approach Delay	
Approach LOS	
90th %ile Green (s)	20.0
90th %ile Term Code	Ped
70th %ile Green (s)	0.0
70th %ile Term Code	Skip
50th %ile Green (s)	0.0
50th %ile Term Code	Skip
30th %ile Green (s)	0.0
30th %ile Term Code	Skip
10th %ile Green (s)	0.0
10th %ile Term Code	Skip
Stops (vph)	
Fuel Used(gal)	
CO Emissions (g/hr)	
NOx Emissions (g/hr)	
VOC Emissions (g/hr)	
Dilemma Vehicles (#)	
Queue Length 50th (ft)	
Queue Length 95th (ft)	
Internal Link Dist (ft)	
Turn Bay Length (ft)	
Base Capacity (vph)	

Lanes, Volumes, Timings  
 3: Main St (1A) & Cherry St/Old Country Rd

07/23/2018



Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Starvation Cap Reductn	0		0		0		0	0			0	
Spillback Cap Reductn	0		0		0		0	0			0	
Storage Cap Reductn	0		0		0		0	0			0	
Reduced v/c Ratio	0.73		0.31		0.02		0.77	0.69			1.05	

Intersection Summary

Area Type:	Other
Cycle Length:	110
Actuated Cycle Length:	110
Offset:	7 (6%), Referenced to phase 4:NBTL and 8:SBT, Start of Green
Natural Cycle:	140
Control Type:	Actuated-Coordinated
Maximum v/c Ratio:	1.05
Intersection Signal Delay:	44.9
Intersection LOS:	D
Intersection Capacity Utilization	81.5%
ICU Level of Service	D
Analysis Period (min)	15
~ Volume exceeds capacity, queue is theoretically infinite. Queue shown is maximum after two cycles.	
# 95th percentile volume exceeds capacity, queue may be longer. Queue shown is maximum after two cycles.	

Splits and Phases: 3: Main St (1A) & Cherry St/Old Country Rd

Ø2 26 s	Ø4 (R) 62 s	Ø9 22 s
Ø6 26 s	Ø7 8 s	Ø8 (R) 54 s

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Lane Group	Ø9
Starvation Cap Reductn	
Spillback Cap Reductn	
Storage Cap Reductn	
Reduced v/c Ratio	
Intersection Summary	

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Lanes, Volumes, Timings  
 1: Main St (1A) & Arbor St/Friend Ct

07/23/2018



Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		↖	↗		↔		↖	↗		↖	↗	
Traffic Volume (vph)	18	0	267	7	0	13	297	652	11	5	596	25
Future Volume (vph)	18	0	267	7	0	13	297	652	11	5	596	25
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Storage Length (ft)	0		50	0		0	100		0	40		0
Storage Lanes	0		1	0		0	1		0	1		0
Taper Length (ft)	0			0			25			25		
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Ped Bike Factor							1.00	1.00		1.00	1.00	
Frt			0.850		0.905			0.997				0.993
Flt Protected		0.950			0.986		0.950			0.950		
Satd. Flow (prot)	0	1805	1615	0	1695	0	1787	1857	0	1805	1867	0
Flt Permitted					0.889		0.251			0.239		
Satd. Flow (perm)	0	1900	1615	0	1529	0	472	1857	0	454	1867	0
Right Turn on Red			Yes			Yes			Yes			Yes
Satd. Flow (RTOR)			309		139			2				3
Link Speed (mph)		30			30			30				30
Link Distance (ft)		2388			2408			316				2230
Travel Time (s)		54.3			54.7			7.2				50.7
Confl. Peds. (#/hr)							1		2	2		1
Peak Hour Factor	0.56	0.92	0.88	0.58	0.92	0.46	0.88	0.89	0.69	0.63	0.93	0.78
Growth Factor	102%	102%	102%	102%	102%	102%	102%	102%	102%	102%	102%	102%
Heavy Vehicles (%)	0%	0%	0%	0%	0%	0%	1%	2%	0%	0%	1%	0%
Adj. Flow (vph)	33	0	309	12	0	29	344	747	16	8	654	33
Shared Lane Traffic (%)												
Lane Group Flow (vph)	0	33	309	0	41	0	344	763	0	8	687	0
Enter Blocked Intersection	No	No	No	No	No	No	No	No	No	No	No	No
Lane Alignment	Left	Left	Right	Left	Left	Right	Left	Left	Right	Left	Left	Right
Median Width(ft)		0			0			12				12
Link Offset(ft)		0			-10			6				0
Crosswalk Width(ft)		16			16			16				16
Two way Left Turn Lane												
Headway Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Number of Detectors	1	1	2	1	2		1	2		1	2	
Detector Template	Left	Left	Thru	Left	Thru		Left	Thru		Left	Thru	
Leading Detector (ft)	20	20	100	20	100		20	100		20	100	
Trailing Detector (ft)	0	0	0	0	0		0	0		0	0	
Detector 1 Position(ft)	0	0	0	0	0		0	0		0	0	
Detector 1 Size(ft)	20	20	6	20	6		20	6		20	6	
Detector 1 Type	Cl+Ex	Cl+Ex	Cl+Ex	Cl+Ex	Cl+Ex		Cl+Ex	Cl+Ex		Cl+Ex	Cl+Ex	
Detector 1 Channel												
Detector 1 Extend (s)	0.0	0.0	0.0	0.0	0.0		0.0	0.0		0.0	0.0	
Detector 1 Queue (s)	0.0	0.0	0.0	0.0	0.0		0.0	0.0		0.0	0.0	
Detector 1 Delay (s)	0.0	0.0	0.0	0.0	0.0		0.0	0.0		0.0	0.0	
Detector 2 Position(ft)			94		94			94			94	
Detector 2 Size(ft)			6		6			6			6	
Detector 2 Type			Cl+Ex		Cl+Ex			Cl+Ex			Cl+Ex	
Detector 2 Channel												
Detector 2 Extend (s)			0.0		0.0			0.0			0.0	

Lanes, Volumes, Timings  
1: Main St (1A) & Arbor St/Friend Ct

07/23/2018

Lane Group	Ø9
Lane Configurations	
Traffic Volume (vph)	
Future Volume (vph)	
Ideal Flow (vphpl)	
Storage Length (ft)	
Storage Lanes	
Taper Length (ft)	
Lane Util. Factor	
Ped Bike Factor	
Frt	
Flt Protected	
Satd. Flow (prot)	
Flt Permitted	
Satd. Flow (perm)	
Right Turn on Red	
Satd. Flow (RTOR)	
Link Speed (mph)	
Link Distance (ft)	
Travel Time (s)	
Confl. Peds. (#/hr)	
Peak Hour Factor	
Growth Factor	
Heavy Vehicles (%)	
Adj. Flow (vph)	
Shared Lane Traffic (%)	
Lane Group Flow (vph)	
Enter Blocked Intersection	
Lane Alignment	
Median Width(ft)	
Link Offset(ft)	
Crosswalk Width(ft)	
Two way Left Turn Lane	
Headway Factor	
Number of Detectors	
Detector Template	
Leading Detector (ft)	
Trailing Detector (ft)	
Detector 1 Position(ft)	
Detector 1 Size(ft)	
Detector 1 Type	
Detector 1 Channel	
Detector 1 Extend (s)	
Detector 1 Queue (s)	
Detector 1 Delay (s)	
Detector 2 Position(ft)	
Detector 2 Size(ft)	
Detector 2 Type	
Detector 2 Channel	
Detector 2 Extend (s)	

Lanes, Volumes, Timings  
 1: Main St (1A) & Arbor St/Friend Ct

07/23/2018



Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Turn Type	Perm	NA	pm+ov	Perm	NA		pm+pt	NA		pm+pt	NA	
Protected Phases		6	7		2		7	4		3	8	
Permitted Phases	6		6	2			4			8		
Detector Phase	6	6	7	2	2		7	4		3	8	
Switch Phase												
Minimum Initial (s)	1.0	1.0	1.0	1.0	1.0		1.0	1.0		1.0	1.0	
Minimum Split (s)	6.0	6.0	6.0	6.0	6.0		6.0	6.0		6.0	6.0	
Total Split (s)	9.0	9.0	25.0	9.0	9.0		25.0	72.0		7.0	54.0	
Total Split (%)	8.2%	8.2%	22.7%	8.2%	8.2%		22.7%	65.5%		6.4%	49.1%	
Maximum Green (s)	4.0	4.0	20.0	4.0	4.0		20.0	67.0		2.0	49.0	
Yellow Time (s)	3.0	3.0	3.0	3.0	3.0		3.0	3.0		3.0	3.0	
All-Red Time (s)	2.0	2.0	2.0	2.0	2.0		2.0	2.0		2.0	2.0	
Lost Time Adjust (s)		0.0	0.0		0.0		0.0	0.0		0.0	0.0	
Total Lost Time (s)		5.0	5.0		5.0		5.0	5.0		5.0	5.0	
Lead/Lag			Lag				Lag	Lag		Lead	Lead	
Lead-Lag Optimize?			Yes				Yes	Yes		Yes	Yes	
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0		3.0	3.0		3.0	3.0	
Recall Mode	None	None	None	None	None		None	C-Max		None	C-Max	
Walk Time (s)												
Flash Dont Walk (s)												
Pedestrian Calls (#/hr)												
Act Effct Green (s)		5.5	24.1		5.3		88.7	90.7		65.1	65.1	
Actuated g/C Ratio		0.05	0.22		0.05		0.81	0.82		0.59	0.59	
v/c Ratio		0.35	0.52		0.20		0.56	0.50		0.03	0.62	
Control Delay		61.9	5.7		2.2		13.9	5.0		16.0	21.6	
Queue Delay		0.0	0.0		0.0		0.0	0.1		0.0	0.0	
Total Delay		61.9	5.7		2.2		13.9	5.1		16.0	21.6	
LOS		E	A		A		B	A		B	C	
Approach Delay		11.1			2.2			7.8			21.5	
Approach LOS		B			A			A			C	
90th %ile Green (s)	4.0	4.0	20.0	4.0	4.0		20.0	67.0		2.0	49.0	
90th %ile Term Code	Max	Max	Max	Max	Max		Max	Coord		Max	Coord	
70th %ile Green (s)	4.0	4.0	20.0	4.0	4.0		20.0	74.0		0.0	49.0	
70th %ile Term Code	Max	Max	Max	Max	Max		Max	Coord		Skip	Coord	
50th %ile Green (s)	7.4	7.4	20.0	7.4	7.4		20.0	92.6		0.0	67.6	
50th %ile Term Code	Gap	Gap	Hold	Hold	Hold		Hold	Coord		Skip	Coord	
30th %ile Green (s)	0.0	0.0	20.0	0.0	0.0		20.0	105.0		0.0	80.0	
30th %ile Term Code	Skip	Skip	Hold	Skip	Skip		Hold	Coord		Skip	Coord	
10th %ile Green (s)	0.0	0.0	20.0	0.0	0.0		20.0	105.0		0.0	80.0	
10th %ile Term Code	Skip	Skip	Hold	Skip	Skip		Hold	Coord		Skip	Coord	
Stops (vph)		17	27		0		128	152		4	416	
Fuel Used(gal)		1	6		0		2	3		0	16	
CO Emissions (g/hr)		46	386		27		161	223		9	1126	
NOx Emissions (g/hr)		9	75		5		31	43		2	219	
VOC Emissions (g/hr)		11	90		6		37	52		2	261	
Dilemma Vehicles (#)		0	0		0		0	0		0	0	
Queue Length 50th (ft)		23	0		0		21	39		2	274	
Queue Length 95th (ft)		#64	43		0		m123	295		9	#594	
Internal Link Dist (ft)		2308			2328			236			2150	

Lanes, Volumes, Timings  
 1: Main St (1A) & Arbor St/Friend Ct

07/23/2018

Lane Group	Ø9
Turn Type	
Protected Phases	9
Permitted Phases	
Detector Phase	
Switch Phase	
Minimum Initial (s)	1.0
Minimum Split (s)	22.0
Total Split (s)	22.0
Total Split (%)	20%
Maximum Green (s)	20.0
Yellow Time (s)	2.0
All-Red Time (s)	0.0
Lost Time Adjust (s)	
Total Lost Time (s)	
Lead/Lag	
Lead-Lag Optimize?	
Vehicle Extension (s)	3.0
Recall Mode	None
Walk Time (s)	9.0
Flash Dont Walk (s)	11.0
Pedestrian Calls (#/hr)	15
Act Effct Green (s)	
Actuated g/C Ratio	
v/c Ratio	
Control Delay	
Queue Delay	
Total Delay	
LOS	
Approach Delay	
Approach LOS	
90th %ile Green (s)	20.0
90th %ile Term Code	Ped
70th %ile Green (s)	20.0
70th %ile Term Code	Ped
50th %ile Green (s)	0.0
50th %ile Term Code	Skip
30th %ile Green (s)	0.0
30th %ile Term Code	Skip
10th %ile Green (s)	0.0
10th %ile Term Code	Skip
Stops (vph)	
Fuel Used(gal)	
CO Emissions (g/hr)	
NOx Emissions (g/hr)	
VOC Emissions (g/hr)	
Dilemma Vehicles (#)	
Queue Length 50th (ft)	
Queue Length 95th (ft)	
Internal Link Dist (ft)	

Lanes, Volumes, Timings  
 1: Main St (1A) & Arbor St/Friend Ct

07/23/2018

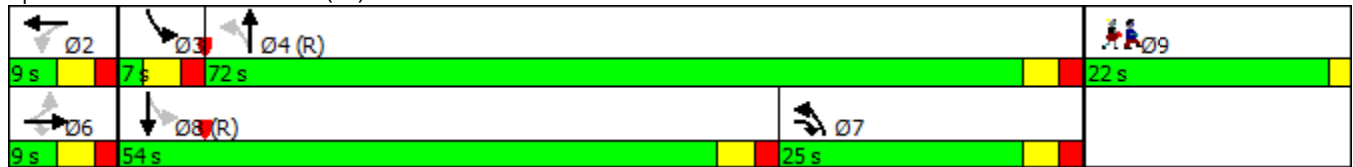


Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Turn Bay Length (ft)			50				100			40		
Base Capacity (vph)		94	594		205		619	1531		319	1106	
Starvation Cap Reductn		0	0		0		0	154		0	0	
Spillback Cap Reductn		0	0		0		0	0		0	0	
Storage Cap Reductn		0	0		0		0	0		0	0	
Reduced v/c Ratio		0.35	0.52		0.20		0.56	0.55		0.03	0.62	

Intersection Summary

Area Type: Other  
 Cycle Length: 110  
 Actuated Cycle Length: 110  
 Offset: 0 (0%), Referenced to phase 4:NBTL and 8:SBTL, Start of Green, Master Intersection  
 Natural Cycle: 90  
 Control Type: Actuated-Coordinated  
 Maximum v/c Ratio: 0.62  
 Intersection Signal Delay: 12.6 Intersection LOS: B  
 Intersection Capacity Utilization 70.6% ICU Level of Service C  
 Analysis Period (min) 15  
 # 95th percentile volume exceeds capacity, queue may be longer.  
 Queue shown is maximum after two cycles.  
 m Volume for 95th percentile queue is metered by upstream signal.

Splits and Phases: 1: Main St (1A) & Arbor St/Friend Ct



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Lane Group	Ø9
Turn Bay Length (ft)	
Base Capacity (vph)	
Starvation Cap Reductn	
Spillback Cap Reductn	
Storage Cap Reductn	
Reduced v/c Ratio	
Intersection Summary	

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Lanes, Volumes, Timings  
 2: Main St (1A) & Monument St/Wenham Town Hall

07/23/2018



Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		↕	↗				↖	↖			↕	
Traffic Volume (vph)	0	0	6	0	0	0	6	958	2	1	659	210
Future Volume (vph)	0	0	6	0	0	0	6	958	2	1	659	210
Ideal Flow (vphp)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Storage Length (ft)	0		15	0		0	25		0	0		0
Storage Lanes	0		1	0		0	1		0	0		0
Taper Length (ft)	0			0			25			0		
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Ped Bike Factor												
Frt			0.850					0.999			0.964	
Flt Protected							0.950					
Satd. Flow (prot)	0	1863	1380	0	0	0	1805	1879	0	0	1814	0
Flt Permitted							0.950					
Satd. Flow (perm)	0	1863	1380	0	0	0	1805	1879	0	0	1814	0
Link Speed (mph)		30			30			30			30	
Link Distance (ft)		2613			509			460			316	
Travel Time (s)		59.4			11.6			10.5			7.2	
Confl. Peds. (#/hr)							1					1
Peak Hour Factor	0.92	0.92	0.38	0.92	0.25	0.25	0.75	0.93	0.50	0.25	0.94	0.83
Growth Factor	102%	102%	102%	102%	102%	102%	102%	102%	102%	102%	102%	102%
Heavy Vehicles (%)	6%	2%	17%	2%	0%	0%	0%	1%	0%	0%	1%	1%
Adj. Flow (vph)	0	0	16	0	0	0	8	1051	4	4	715	258
Shared Lane Traffic (%)												
Lane Group Flow (vph)	0	0	16	0	0	0	8	1055	0	0	977	0
Enter Blocked Intersection	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	2 veh	Yes
Lane Alignment	Left	Left	Right	Left	Left	Right	Left	Left	Right	Left	Left	Right
Median Width(ft)		0			0			12			12	
Link Offset(ft)		0			30			0			0	
Crosswalk Width(ft)		16			16			16			16	
Two way Left Turn Lane												
Headway Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Turning Speed (mph)	25		9	15		9	15		9	15		9
Sign Control		Stop			Stop			Free			Free	

Intersection Summary

Area Type:	Other
Control Type:	Unsignalized
Intersection Capacity Utilization	58.5%
	ICU Level of Service B
Analysis Period (min)	15

# HCM Unsignalized Intersection Capacity Analysis

## 2: Main St (1A) & Monument St/Wenham Town Hall

07/23/2018



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		↕	↗				↖	↖			↕	
Traffic Volume (veh/h)	0	0	6	0	0	0	6	958	2	1	659	210
Future Volume (Veh/h)	0	0	6	0	0	0	6	958	2	1	659	210
Sign Control		Stop			Stop			Free			Free	
Grade		0%			0%			0%			0%	
Peak Hour Factor	0.92	0.92	0.38	0.92	0.25	0.25	0.75	0.93	0.50	0.25	0.94	0.83
Hourly flow rate (vph)	0	0	16	0	0	0	8	1051	4	4	715	258
Pedestrians		1										
Lane Width (ft)		12.0										
Walking Speed (ft/s)		3.5										
Percent Blockage		0										
Right turn flare (veh)			1									
Median type								None			None	
Median storage (veh)												
Upstream signal (ft)								460			316	
pX, platoon unblocked	0.69	0.69	0.72	0.69	0.69	0.55	0.72			0.55		
vC, conflicting volume	1920	1924	845	1929	2051	1053	974			1055		
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	1184	1190	585	1197	1373	686	766			690		
tC, single (s)	*6.0	6.5	*6.5	7.1	6.5	6.2	4.1			4.1		
tC, 2 stage (s)												
tF (s)	3.6	4.0	3.5	3.5	4.0	3.3	2.2			2.2		
p0 queue free %	100	100	95	100	100	100	99			99		
cM capacity (veh/h)	162	127	339	105	99	248	613			502		

Direction, Lane #	EB 1	NB 1	NB 2	SB 1
Volume Total	16	8	1055	977
Volume Left	0	8	0	4
Volume Right	16	0	4	258
cSH	254	613	1700	502
Volume to Capacity	0.06	0.01	0.62	0.01
Queue Length 95th (ft)	5	1	0	1
Control Delay (s)	20.1	11.0	0.0	0.3
Lane LOS	C	B		A
Approach Delay (s)	20.1	0.1		0.3
Approach LOS	C			

Intersection Summary			
Average Delay		0.3	
Intersection Capacity Utilization		58.5%	ICU Level of Service B
Analysis Period (min)		15	

\* User Entered Value

Intersection												
Int Delay, s/veh	0.2											
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		↔	↔				↔	↔			↔	
Traffic Vol, veh/h	0	0	6	0	0	0	6	958	2	1	659	210
Future Vol, veh/h	0	0	6	0	0	0	6	958	2	1	659	210
Conflicting Peds, #/hr	0	0	0	0	0	0	1	0	0	0	0	1
Sign Control	Stop	Stop	Stop	Stop	Stop	Stop	Free	Free	Free	Free	Free	Free
RT Channelized	-	-	None	-	-	None	-	-	None	-	-	None
Storage Length	-	-	15	-	-	-	25	-	-	-	-	-
Veh in Median Storage, #	-	0	-	-	-	-	-	0	-	-	0	-
Grade, %	-	0	-	-	0	-	-	0	-	-	0	-
Peak Hour Factor	92	92	38	92	25	25	75	93	50	25	94	83
Heavy Vehicles, %	6	2	17	2	0	0	0	1	0	0	1	1
Mvmt Flow	0	0	16	0	0	0	8	1051	4	4	715	258

Major/Minor	Minor2			Major1			Major2					
Conflicting Flow All	1922	1924	845				974	0	0	1055	0	0
Stage 1	853	853	-				-	-	-	-	-	-
Stage 2	1069	1071	-				-	-	-	-	-	-
Critical Hdwy	6.46	6.52	6.37				4.1	-	-	4.1	-	-
Critical Hdwy Stg 1	5.46	5.52	-				-	-	-	-	-	-
Critical Hdwy Stg 2	5.46	5.52	-				-	-	-	-	-	-
Follow-up Hdwy	3.554	4.018	3.453				2.2	-	-	2.2	-	-
Pot Cap-1 Maneuver	72	67	341				716	-	-	668	-	-
Stage 1	411	376	-				-	-	-	-	-	-
Stage 2	324	297	-				-	-	-	-	-	-
Platoon blocked, %												
Mov Cap-1 Maneuver	70	0	341				716	-	-	668	-	-
Mov Cap-2 Maneuver	70	0	-				-	-	-	-	-	-
Stage 1	405	0	-				-	-	-	-	-	-
Stage 2	320	0	-				-	-	-	-	-	-

Approach	EB	NB	SB
HCM Control Delay, s	16.1	0.1	0
HCM LOS	C		

Minor Lane/Major Mvmt	NBL	NBT	NBR	EBLn1	EBLn2	SBL	SBT	SBR
Capacity (veh/h)	716	-	-	-	341	668	-	-
HCM Lane V/C Ratio	0.011	-	-	-	0.047	0.006	-	-
HCM Control Delay (s)	10.1	-	-	0	16.1	10.4	0	-
HCM Lane LOS	B	-	-	A	C	B	A	-
HCM 95th %tile Q(veh)	0	-	-	-	0.1	0	-	-

Lanes, Volumes, Timings  
 3: Main St (1A) & Cherry St/Old Country Rd

07/23/2018



Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	274	0	107	5	1	5	158	692	0	0	552	110
Future Volume (vph)	274	0	107	5	1	5	158	692	0	0	552	110
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Storage Length (ft)	0		50	0		0	75		0	0		0
Storage Lanes	1		1	0		0	1		0	0		0
Taper Length (ft)	0			0			25			0		
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Ped Bike Factor					0.99							
Frt			0.850		0.932							0.976
Flt Protected	0.950				0.984		0.950					
Satd. Flow (prot)	1770	0	1599	0	1723	0	1770	1881	0	0	1836	0
Flt Permitted	0.742				0.984		0.078					
Satd. Flow (perm)	1382	0	1599	0	1722	0	145	1881	0	0	1836	0
Right Turn on Red			Yes			Yes			Yes			Yes
Satd. Flow (RTOR)			89		12							12
Link Speed (mph)		30			30			30				30
Link Distance (ft)		2702			575			3735				460
Travel Time (s)		61.4			13.1			84.9				10.5
Confl. Peds. (#/hr)				1		1						
Peak Hour Factor	0.93	0.25	0.86	0.63	0.25	0.42	0.96	0.94	0.42	0.25	0.91	0.83
Growth Factor	102%	102%	102%	102%	102%	102%	102%	102%	102%	102%	102%	102%
Heavy Vehicles (%)	2%	0%	1%	0%	0%	0%	2%	1%	0%	0%	1%	1%
Adj. Flow (vph)	301	0	127	8	4	12	168	751	0	0	619	135
Shared Lane Traffic (%)												
Lane Group Flow (vph)	301	0	127	0	24	0	168	751	0	0	754	0
Enter Blocked Intersection	No	No	No	No	No	No	No	No	No	No	No	No
Lane Alignment	Left	Left	Right	Left	Left	Right	Left	Left	Right	Left	Left	Right
Median Width(ft)		12			12			12				12
Link Offset(ft)		0			8			0				0
Crosswalk Width(ft)		16			16			16				16
Two way Left Turn Lane												
Headway Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Number of Detectors	1		1	1	2		1	2				2
Detector Template	Left		Right	Left	Thru		Left	Thru				Thru
Leading Detector (ft)	20		20	20	100		20	100				100
Trailing Detector (ft)	0		0	0	0		0	0				0
Detector 1 Position(ft)	0		0	0	0		0	0				0
Detector 1 Size(ft)	20		20	20	6		20	6				6
Detector 1 Type	Cl+Ex		Cl+Ex	Cl+Ex	Cl+Ex		Cl+Ex	Cl+Ex				Cl+Ex
Detector 1 Channel												
Detector 1 Extend (s)	0.0		0.0	0.0	0.0		0.0	0.0				0.0
Detector 1 Queue (s)	0.0		0.0	0.0	0.0		0.0	0.0				0.0
Detector 1 Delay (s)	0.0		0.0	0.0	0.0		0.0	0.0				0.0
Detector 2 Position(ft)					94			94				94
Detector 2 Size(ft)					6			6				6
Detector 2 Type					Cl+Ex			Cl+Ex				Cl+Ex
Detector 2 Channel												
Detector 2 Extend (s)					0.0			0.0				0.0

Lanes, Volumes, Timings  
 3: Main St (1A) & Cherry St/Old Country Rd

07/23/2018

Lane Group	Ø9
Lane Configurations	
Traffic Volume (vph)	
Future Volume (vph)	
Ideal Flow (vphpl)	
Storage Length (ft)	
Storage Lanes	
Taper Length (ft)	
Lane Util. Factor	
Ped Bike Factor	
Frt	
Flt Protected	
Satd. Flow (prot)	
Flt Permitted	
Satd. Flow (perm)	
Right Turn on Red	
Satd. Flow (RTOR)	
Link Speed (mph)	
Link Distance (ft)	
Travel Time (s)	
Confl. Peds. (#/hr)	
Peak Hour Factor	
Growth Factor	
Heavy Vehicles (%)	
Adj. Flow (vph)	
Shared Lane Traffic (%)	
Lane Group Flow (vph)	
Enter Blocked Intersection	
Lane Alignment	
Median Width(ft)	
Link Offset(ft)	
Crosswalk Width(ft)	
Two way Left Turn Lane	
Headway Factor	
Number of Detectors	
Detector Template	
Leading Detector (ft)	
Trailing Detector (ft)	
Detector 1 Position(ft)	
Detector 1 Size(ft)	
Detector 1 Type	
Detector 1 Channel	
Detector 1 Extend (s)	
Detector 1 Queue (s)	
Detector 1 Delay (s)	
Detector 2 Position(ft)	
Detector 2 Size(ft)	
Detector 2 Type	
Detector 2 Channel	
Detector 2 Extend (s)	

Lanes, Volumes, Timings  
 3: Main St (1A) & Cherry St/Old Country Rd

07/23/2018



Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Turn Type	Perm		Prot	Perm	NA		pm+pt	NA				NA
Protected Phases			6		2		7	4				8
Permitted Phases	6			2			4					
Detector Phase	6		6	2	2		7	4				8
Switch Phase												
Minimum Initial (s)	1.0		1.0	1.0	1.0		3.0	1.0				1.0
Minimum Split (s)	6.0		6.0	6.0	6.0		8.0	6.0				6.0
Total Split (s)	28.0		28.0	28.0	28.0		12.0	60.0				48.0
Total Split (%)	25.5%		25.5%	25.5%	25.5%		10.9%	54.5%				43.6%
Maximum Green (s)	23.0		23.0	23.0	23.0		7.0	55.0				43.0
Yellow Time (s)	3.0		3.0	3.0	3.0		3.0	3.0				3.0
All-Red Time (s)	2.0		2.0	2.0	2.0		2.0	2.0				2.0
Lost Time Adjust (s)	0.0		0.0		0.0		0.0	0.0				0.0
Total Lost Time (s)	5.0		5.0		5.0		5.0	5.0				5.0
Lead/Lag							Lead					Lag
Lead-Lag Optimize?							Yes					Yes
Vehicle Extension (s)	3.0		3.0	3.0	3.0		3.0	3.0				3.0
Recall Mode	None		None	Min	Min		None	C-Min				C-Min
Walk Time (s)												
Flash Dont Walk (s)												
Pedestrian Calls (#/hr)												
Act Effect Green (s)	31.3		31.3		31.3		64.3	64.3				47.9
Actuated g/C Ratio	0.28		0.28		0.28		0.58	0.58				0.44
v/c Ratio	0.77		0.25		0.05		0.66	0.68				0.94
Control Delay	51.4		13.2		20.9		33.8	20.9				38.5
Queue Delay	0.0		0.0		0.0		0.0	0.0				0.0
Total Delay	51.4		13.2		20.9		33.8	20.9				38.5
LOS	D		B		C		C	C				D
Approach Delay		40.1			20.9			23.3				38.5
Approach LOS		D			C			C				D
90th %ile Green (s)	23.0		23.0	23.0	23.0		7.0	55.0				43.0
90th %ile Term Code	Max		Max	Hold	Hold		Max	Coord				Coord
70th %ile Green (s)	34.1		34.1	34.1	34.1		14.6	65.9				46.3
70th %ile Term Code	Gap		Gap	Hold	Hold		Gap	Coord				Coord
50th %ile Green (s)	33.3		33.3	33.3	33.3		13.0	66.7				48.7
50th %ile Term Code	Gap		Gap	Hold	Hold		Gap	Coord				Coord
30th %ile Green (s)	32.9		32.9	32.9	32.9		12.1	67.1				50.0
30th %ile Term Code	Gap		Gap	Hold	Hold		Gap	Coord				Coord
10th %ile Green (s)	33.0		33.0	33.0	33.0		10.5	67.0				51.5
10th %ile Term Code	Gap		Gap	Hold	Hold		Gap	Coord				Coord
Stops (vph)	224		32		6		75	484				527
Fuel Used(gal)	10		3		0		6	26				11
CO Emissions (g/hr)	704		193		9		434	1834				743
NOx Emissions (g/hr)	137		38		2		84	357				145
VOC Emissions (g/hr)	163		45		2		101	425				172
Dilemma Vehicles (#)	0		0		0		0	0				0
Queue Length 50th (ft)	189		19		6		58	324				483
Queue Length 95th (ft)	#403		67		3		#209	598				#792
Internal Link Dist (ft)		2622			495			3655				380



Lanes, Volumes, Timings  
 3: Main St (1A) & Cherry St/Old Country Rd

07/23/2018

Lane Group	Ø9
Turn Type	
Protected Phases	9
Permitted Phases	
Detector Phase	
Switch Phase	
Minimum Initial (s)	1.0
Minimum Split (s)	22.0
Total Split (s)	22.0
Total Split (%)	20%
Maximum Green (s)	20.0
Yellow Time (s)	2.0
All-Red Time (s)	0.0
Lost Time Adjust (s)	
Total Lost Time (s)	
Lead/Lag	
Lead-Lag Optimize?	
Vehicle Extension (s)	3.0
Recall Mode	None
Walk Time (s)	9.0
Flash Dont Walk (s)	11.0
Pedestrian Calls (#/hr)	5
Act Effct Green (s)	
Actuated g/C Ratio	
v/c Ratio	
Control Delay	
Queue Delay	
Total Delay	
LOS	
Approach Delay	
Approach LOS	
90th %ile Green (s)	20.0
90th %ile Term Code	Ped
70th %ile Green (s)	0.0
70th %ile Term Code	Skip
50th %ile Green (s)	0.0
50th %ile Term Code	Skip
30th %ile Green (s)	0.0
30th %ile Term Code	Skip
10th %ile Green (s)	0.0
10th %ile Term Code	Skip
Stops (vph)	
Fuel Used(gal)	
CO Emissions (g/hr)	
NOx Emissions (g/hr)	
VOC Emissions (g/hr)	
Dilemma Vehicles (#)	
Queue Length 50th (ft)	
Queue Length 95th (ft)	
Internal Link Dist (ft)	

Lanes, Volumes, Timings  
 3: Main St (1A) & Cherry St/Old Country Rd

07/23/2018



Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Turn Bay Length (ft)			50				75					
Base Capacity (vph)	392		518		498		253	1100				806
Starvation Cap Reductn	0		0		0		0	0				0
Spillback Cap Reductn	0		0		0		0	0				0
Storage Cap Reductn	0		0		0		0	0				0
Reduced v/c Ratio	0.77		0.25		0.05		0.66	0.68				0.94

Intersection Summary

Area Type: Other  
 Cycle Length: 110  
 Actuated Cycle Length: 110  
 Offset: 16 (15%), Referenced to phase 4:NBTL and 8:SBT, Start of Green  
 Natural Cycle: 110  
 Control Type: Actuated-Coordinated  
 Maximum v/c Ratio: 0.94  
 Intersection Signal Delay: 32.0  
 Intersection LOS: C  
 Intersection Capacity Utilization 79.2%  
 ICU Level of Service D  
 Analysis Period (min) 15  
 # 95th percentile volume exceeds capacity, queue may be longer.  
 Queue shown is maximum after two cycles.

Splits and Phases: 3: Main St (1A) & Cherry St/Old Country Rd

← Ø2 28 s	↑ Ø4 (R) 60 s	↘ Ø9 22 s
↘ Ø6 28 s	↘ Ø7 12 s	↓ Ø8 (R) 48 s

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Lane Group	Ø9
Turn Bay Length (ft)	
Base Capacity (vph)	
Starvation Cap Reductn	
Spillback Cap Reductn	
Storage Cap Reductn	
Reduced v/c Ratio	
Intersection Summary	

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Lanes, Volumes, Timings  
 1: Main St (1A) & Arbor St/Friend Ct

07/23/2018



Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		↖	↗		↔		↖	↗		↖	↗	
Traffic Volume (vph)	16	1	346	3	3	6	287	555	6	5	578	27
Future Volume (vph)	16	1	346	3	3	6	287	555	6	5	578	27
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Storage Length (ft)	0		50	0		0	100		0	40		0
Storage Lanes	0		1	0		0	1		0	1		0
Taper Length (ft)	0			0			25			25		
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Ped Bike Factor							1.00	1.00		1.00	1.00	
Frt			0.850		0.932			0.998			0.991	
Flt Protected		0.959			0.992		0.950			0.950		
Satd. Flow (prot)	0	1639	1583	0	1757	0	1752	1824	0	1504	1825	0
Flt Permitted		0.929			0.935		0.249			0.423		
Satd. Flow (perm)	0	1588	1583	0	1656	0	459	1824	0	669	1825	0
Right Turn on Red			Yes			Yes			Yes			Yes
Satd. Flow (RTOR)			420		12			1			4	
Link Speed (mph)		30			30			30			30	
Link Distance (ft)		2388			2408			316			2230	
Travel Time (s)		54.3			54.7			7.2			50.7	
Confl. Peds. (#/hr)							1		1	1		1
Peak Hour Factor	0.67	0.25	0.84	0.75	0.38	0.50	0.84	0.90	0.75	0.31	0.91	0.68
Growth Factor	102%	102%	102%	102%	102%	102%	102%	102%	102%	102%	102%	102%
Heavy Vehicles (%)	13%	0%	2%	0%	0%	0%	3%	4%	0%	20%	3%	4%
Adj. Flow (vph)	24	4	420	4	8	12	349	629	8	16	648	41
Shared Lane Traffic (%)												
Lane Group Flow (vph)	0	28	420	0	24	0	349	637	0	16	689	0
Enter Blocked Intersection	No	No	No	No	No	No	No	No	No	No	No	No
Lane Alignment	Left	Left	Right	Left	Left	Right	Left	Left	Right	Left	Left	Right
Median Width(ft)		0			0			12			12	
Link Offset(ft)		0			-10			6			0	
Crosswalk Width(ft)		16			16			16			16	
Two way Left Turn Lane												
Headway Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Number of Detectors	1	1	2	1	2		1	2		1	2	
Detector Template	Left	Left	Thru	Left	Thru		Left	Thru		Left	Thru	
Leading Detector (ft)	20	20	100	20	100		20	100		20	100	
Trailing Detector (ft)	0	0	0	0	0		0	0		0	0	
Detector 1 Position(ft)	0	0	0	0	0		0	0		0	0	
Detector 1 Size(ft)	20	20	6	20	6		20	6		20	6	
Detector 1 Type	Cl+Ex	Cl+Ex	Cl+Ex	Cl+Ex	Cl+Ex		Cl+Ex	Cl+Ex		Cl+Ex	Cl+Ex	
Detector 1 Channel												
Detector 1 Extend (s)	0.0	0.0	0.0	0.0	0.0		0.0	0.0		0.0	0.0	
Detector 1 Queue (s)	0.0	0.0	0.0	0.0	0.0		0.0	0.0		0.0	0.0	
Detector 1 Delay (s)	0.0	0.0	0.0	0.0	0.0		0.0	0.0		0.0	0.0	
Detector 2 Position(ft)			94		94			94			94	
Detector 2 Size(ft)			6		6			6			6	
Detector 2 Type			Cl+Ex		Cl+Ex			Cl+Ex			Cl+Ex	
Detector 2 Channel												
Detector 2 Extend (s)			0.0		0.0			0.0			0.0	

Lanes, Volumes, Timings  
1: Main St (1A) & Arbor St/Friend Ct

07/23/2018

Lane Group	Ø9
Lane Configurations	
Traffic Volume (vph)	
Future Volume (vph)	
Ideal Flow (vphpl)	
Storage Length (ft)	
Storage Lanes	
Taper Length (ft)	
Lane Util. Factor	
Ped Bike Factor	
Frt	
Flt Protected	
Satd. Flow (prot)	
Flt Permitted	
Satd. Flow (perm)	
Right Turn on Red	
Satd. Flow (RTOR)	
Link Speed (mph)	
Link Distance (ft)	
Travel Time (s)	
Confl. Peds. (#/hr)	
Peak Hour Factor	
Growth Factor	
Heavy Vehicles (%)	
Adj. Flow (vph)	
Shared Lane Traffic (%)	
Lane Group Flow (vph)	
Enter Blocked Intersection	
Lane Alignment	
Median Width(ft)	
Link Offset(ft)	
Crosswalk Width(ft)	
Two way Left Turn Lane	
Headway Factor	
Number of Detectors	
Detector Template	
Leading Detector (ft)	
Trailing Detector (ft)	
Detector 1 Position(ft)	
Detector 1 Size(ft)	
Detector 1 Type	
Detector 1 Channel	
Detector 1 Extend (s)	
Detector 1 Queue (s)	
Detector 1 Delay (s)	
Detector 2 Position(ft)	
Detector 2 Size(ft)	
Detector 2 Type	
Detector 2 Channel	
Detector 2 Extend (s)	

Lanes, Volumes, Timings  
 1: Main St (1A) & Arbor St/Friend Ct

07/23/2018



Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Turn Type	Perm	NA	pm+ov	Perm	NA		pm+pt	NA		pm+pt	NA	
Protected Phases		6	7		2		7	4		3	8	
Permitted Phases	6		6	2			4			8		
Detector Phase	6	6	7	2	2		7	4		3	8	
Switch Phase												
Minimum Initial (s)	3.0	3.0	3.0	3.0	3.0		3.0	3.0		3.0	3.0	
Minimum Split (s)	8.0	8.0	8.0	8.0	8.0		8.0	8.0		8.0	8.0	
Total Split (s)	9.0	9.0	27.0	9.0	9.0		27.0	71.0		8.0	52.0	
Total Split (%)	8.2%	8.2%	24.5%	8.2%	8.2%		24.5%	64.5%		7.3%	47.3%	
Maximum Green (s)	4.0	4.0	22.0	4.0	4.0		22.0	66.0		3.0	47.0	
Yellow Time (s)	3.0	3.0	3.0	3.0	3.0		3.0	3.0		3.0	3.0	
All-Red Time (s)	2.0	2.0	2.0	2.0	2.0		2.0	2.0		2.0	2.0	
Lost Time Adjust (s)		0.0	0.0		0.0		0.0	0.0		0.0	0.0	
Total Lost Time (s)		5.0	5.0		5.0		5.0	5.0		5.0	5.0	
Lead/Lag			Lead				Lead	Lag		Lead	Lag	
Lead-Lag Optimize?			Yes				Yes	Yes		Yes	Yes	
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0		3.0	3.0		3.0	3.0	
Recall Mode	None	None	None	None	None		None	C-Max		None	C-Max	
Walk Time (s)												
Flash Dont Walk (s)												
Pedestrian Calls (#/hr)												
Act Effect Green (s)		6.4	25.8		6.2		93.6	91.8		74.9	69.8	
Actuated g/C Ratio		0.06	0.23		0.06		0.85	0.83		0.68	0.63	
v/c Ratio		0.30	0.61		0.23		0.57	0.42		0.03	0.59	
Control Delay		59.2	7.0		38.2		22.6	4.4		6.4	19.2	
Queue Delay		0.0	0.5		0.0		0.5	0.6		0.0	0.1	
Total Delay		59.2	7.5		38.2		23.1	5.0		6.4	19.3	
LOS		E	A		D		C	A		A	B	
Approach Delay		10.7			38.3			11.4			19.0	
Approach LOS		B			D			B			B	
90th %ile Green (s)	4.0	4.0	22.0	4.0	4.0		22.0	66.0		3.0	47.0	
90th %ile Term Code	Max	Max	Max	Max	Max		Max	Coord		Max	Coord	
70th %ile Green (s)	8.6	8.6	25.9	8.6	8.6		25.9	80.6		5.8	60.5	
70th %ile Term Code	Gap	Gap	Gap	Hold	Hold		Gap	Coord		Gap	Coord	
50th %ile Green (s)	7.5	7.5	21.3	7.5	7.5		21.3	92.5		0.0	66.2	
50th %ile Term Code	Gap	Gap	Gap	Hold	Hold		Gap	Coord		Skip	Coord	
30th %ile Green (s)	0.0	0.0	15.4	0.0	0.0		15.4	105.0		0.0	84.6	
30th %ile Term Code	Skip	Skip	Gap	Skip	Skip		Gap	Coord		Skip	Coord	
10th %ile Green (s)	0.0	0.0	9.2	0.0	0.0		9.2	105.0		0.0	90.8	
10th %ile Term Code	Skip	Skip	Gap	Skip	Skip		Gap	Coord		Skip	Coord	
Stops (vph)		16	33		8		154	139		3	360	
Fuel Used(gal)		1	7		0		3	3		0	15	
CO Emissions (g/hr)		43	507		25		204	188		8	1059	
NOx Emissions (g/hr)		8	99		5		40	37		1	206	
VOC Emissions (g/hr)		10	118		6		47	44		2	245	
Dilemma Vehicles (#)		0	0		0		0	0		0	0	
Queue Length 50th (ft)		19	0		8		78	19		2	289	
Queue Length 95th (ft)		14	51		11		191	98		4	#664	
Internal Link Dist (ft)		2308			2328			236			2150	



Lanes, Volumes, Timings  
 1: Main St (1A) & Arbor St/Friend Ct

07/23/2018

Lane Group	Ø9
Turn Type	
Protected Phases	9
Permitted Phases	
Detector Phase	
Switch Phase	
Minimum Initial (s)	3.0
Minimum Split (s)	22.0
Total Split (s)	22.0
Total Split (%)	20%
Maximum Green (s)	20.0
Yellow Time (s)	2.0
All-Red Time (s)	0.0
Lost Time Adjust (s)	
Total Lost Time (s)	
Lead/Lag	
Lead-Lag Optimize?	
Vehicle Extension (s)	3.0
Recall Mode	None
Walk Time (s)	9.0
Flash Dont Walk (s)	11.0
Pedestrian Calls (#/hr)	10
Act Effct Green (s)	
Actuated g/C Ratio	
v/c Ratio	
Control Delay	
Queue Delay	
Total Delay	
LOS	
Approach Delay	
Approach LOS	
90th %ile Green (s)	20.0
90th %ile Term Code	Ped
70th %ile Green (s)	0.0
70th %ile Term Code	Skip
50th %ile Green (s)	0.0
50th %ile Term Code	Skip
30th %ile Green (s)	0.0
30th %ile Term Code	Skip
10th %ile Green (s)	0.0
10th %ile Term Code	Skip
Stops (vph)	
Fuel Used(gal)	
CO Emissions (g/hr)	
NOx Emissions (g/hr)	
VOC Emissions (g/hr)	
Dilemma Vehicles (#)	
Queue Length 50th (ft)	
Queue Length 95th (ft)	
Internal Link Dist (ft)	

Lanes, Volumes, Timings  
 1: Main St (1A) & Arbor St/Friend Ct

07/23/2018



Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Turn Bay Length (ft)			50				100			40		
Base Capacity (vph)		92	734		105		658	1522		494	1159	
Starvation Cap Reductn		0	0		0		76	504		0	0	
Spillback Cap Reductn		0	81		0		0	0		0	27	
Storage Cap Reductn		0	0		0		0	0		0	0	
Reduced v/c Ratio		0.30	0.64		0.23		0.60	0.63		0.03	0.61	

Intersection Summary

Area Type: Other  
 Cycle Length: 110  
 Actuated Cycle Length: 110  
 Offset: 0 (0%), Referenced to phase 4:NBTL and 8:SBTL, Start of Green, Master Intersection  
 Natural Cycle: 90  
 Control Type: Actuated-Coordinated  
 Maximum v/c Ratio: 0.61  
 Intersection Signal Delay: 14.0  
 Intersection LOS: B  
 Intersection Capacity Utilization 70.4%  
 ICU Level of Service C  
 Analysis Period (min) 15  
 # 95th percentile volume exceeds capacity, queue may be longer.  
 Queue shown is maximum after two cycles.

Splits and Phases: 1: Main St (1A) & Arbor St/Friend Ct



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Lane Group	Ø9
Turn Bay Length (ft)	
Base Capacity (vph)	
Starvation Cap Reductn	
Spillback Cap Reductn	
Storage Cap Reductn	
Reduced v/c Ratio	
Intersection Summary	

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# Lanes, Volumes, Timings

## 2: Main St (1A) & Monument St/Wenham Town Hall

07/23/2018



Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	174	0	3	0	0	0	5	667	0	1	752	185
Future Volume (vph)	174	0	3	0	0	0	5	667	0	1	752	185
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Storage Length (ft)	0		15	0		0	25		0	0		0
Storage Lanes	0		1	0		0	1		0	0		0
Taper Length (ft)	0			0			25			0		
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Ped Bike Factor							1.00					0.99
Frt			0.850									0.971
Flt Protected		0.950					0.950					
Satd. Flow (prot)	0	1703	1615	0	0	0	1504	1845	0	0	1796	0
Flt Permitted		0.950					0.235				0.998	
Satd. Flow (perm)	0	1703	1615	0	0	0	372	1845	0	0	1792	0
Right Turn on Red			Yes			Yes			Yes			Yes
Satd. Flow (RTOR)			89									19
Link Speed (mph)		30			30			30				30
Link Distance (ft)		2613			509			460				316
Travel Time (s)		59.4			11.6			10.5				7.2
Confl. Peds. (#/hr)							5					5
Peak Hour Factor	0.81	0.92	0.38	0.92	0.25	0.25	0.63	0.87	0.92	0.25	0.95	0.86
Growth Factor	102%	102%	102%	102%	102%	102%	102%	102%	102%	102%	102%	102%
Heavy Vehicles (%)	6%	2%	0%	2%	0%	0%	20%	3%	0%	0%	2%	3%
Adj. Flow (vph)	219	0	8	0	0	0	8	782	0	4	807	219
Shared Lane Traffic (%)												
Lane Group Flow (vph)	0	219	8	0	0	0	8	782	0	0	1030	0
Enter Blocked Intersection	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	2 veh	Yes
Lane Alignment	Left	Left	Right	Left	Left	Right	Left	Left	Right	Left	Left	Right
Median Width(ft)		0			0			12				12
Link Offset(ft)		0			30			0				0
Crosswalk Width(ft)		16			16			16				16
Two way Left Turn Lane												
Headway Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Turning Speed (mph)	25		9	15		9	15		9	15		9
Number of Detectors	1	2	1				1	2		1	2	
Detector Template	Left	Thru	Right				Left	Thru		Left	Thru	
Leading Detector (ft)	20	100	20				20	100		20	100	
Trailing Detector (ft)	0	0	0				0	0		0	0	
Detector 1 Position(ft)	0	0	0				0	0		0	0	
Detector 1 Size(ft)	20	6	20				20	6		20	6	
Detector 1 Type	Cl+Ex	Cl+Ex	Cl+Ex				Cl+Ex	Cl+Ex		Cl+Ex	Cl+Ex	
Detector 1 Channel												
Detector 1 Extend (s)	0.0	0.0	0.0				0.0	0.0		0.0	0.0	
Detector 1 Queue (s)	0.0	0.0	0.0				0.0	0.0		0.0	0.0	
Detector 1 Delay (s)	0.0	0.0	0.0				0.0	0.0		0.0	0.0	
Detector 2 Position(ft)		94						94			94	
Detector 2 Size(ft)		6						6			6	
Detector 2 Type		Cl+Ex						Cl+Ex			Cl+Ex	
Detector 2 Channel												

Lanes, Volumes, Timings  
 2: Main St (1A) & Monument St/Wenham Town Hall

07/23/2018

Lane Group	Ø9
Lane Configurations	
Traffic Volume (vph)	
Future Volume (vph)	
Ideal Flow (vphpl)	
Storage Length (ft)	
Storage Lanes	
Taper Length (ft)	
Lane Util. Factor	
Ped Bike Factor	
Frt	
Flt Protected	
Satd. Flow (prot)	
Flt Permitted	
Satd. Flow (perm)	
Right Turn on Red	
Satd. Flow (RTOR)	
Link Speed (mph)	
Link Distance (ft)	
Travel Time (s)	
Confl. Peds. (#/hr)	
Peak Hour Factor	
Growth Factor	
Heavy Vehicles (%)	
Adj. Flow (vph)	
Shared Lane Traffic (%)	
Lane Group Flow (vph)	
Enter Blocked Intersection	
Lane Alignment	
Median Width(ft)	
Link Offset(ft)	
Crosswalk Width(ft)	
Two way Left Turn Lane	
Headway Factor	
Turning Speed (mph)	
Number of Detectors	
Detector Template	
Leading Detector (ft)	
Trailing Detector (ft)	
Detector 1 Position(ft)	
Detector 1 Size(ft)	
Detector 1 Type	
Detector 1 Channel	
Detector 1 Extend (s)	
Detector 1 Queue (s)	
Detector 1 Delay (s)	
Detector 2 Position(ft)	
Detector 2 Size(ft)	
Detector 2 Type	
Detector 2 Channel	

# Lanes, Volumes, Timings

## 2: Main St (1A) & Monument St/Wenham Town Hall

07/23/2018



Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Detector 2 Extend (s)		0.0						0.0			0.0	
Turn Type	Split	NA	Perm				pm+pt	NA		Perm	NA	
Protected Phases	6	6					7	4				8
Permitted Phases			6				4			8		
Detector Phase	6	6	6				7	4		8		8
Switch Phase												
Minimum Initial (s)	3.0	3.0	3.0				3.0	3.0		3.0	3.0	
Minimum Split (s)	8.0	8.0	8.0				8.0	8.0		8.0	8.0	
Total Split (s)	17.0	17.0	17.0				8.0	71.0		63.0	63.0	
Total Split (%)	15.5%	15.5%	15.5%				7.3%	64.5%		57.3%	57.3%	
Maximum Green (s)	12.0	12.0	12.0				3.0	66.0		58.0	58.0	
Yellow Time (s)	3.0	3.0	3.0				3.0	3.0		3.0	3.0	
All-Red Time (s)	2.0	2.0	2.0				2.0	2.0		2.0	2.0	
Lost Time Adjust (s)		0.0	0.0				0.0	0.0			0.0	
Total Lost Time (s)		5.0	5.0				5.0	5.0			5.0	
Lead/Lag							Lag			Lead	Lead	
Lead-Lag Optimize?							Yes			Yes	Yes	
Vehicle Extension (s)	3.0	3.0	3.0				3.0	3.0		3.0	3.0	
Recall Mode	None	None	None				None	C-Min		C-Max	C-Max	
Walk Time (s)												
Flash Dont Walk (s)												
Pedestrian Calls (#/hr)												
Act Effct Green (s)		22.4	22.4				75.6	73.2			71.6	
Actuated g/C Ratio		0.20	0.20				0.69	0.67			0.65	
v/c Ratio		0.63	0.02				0.03	0.64			0.88	
Control Delay		51.1	0.0				3.4	10.8			18.6	
Queue Delay		0.0	0.0				0.0	0.1			0.9	
Total Delay		51.1	0.0				3.4	10.9			19.5	
LOS		D	A				A	B			B	
Approach Delay		49.3						10.8			19.5	
Approach LOS		D						B			B	
90th %ile Green (s)	12.0	12.0	12.0				3.0	66.0		58.0	58.0	
90th %ile Term Code	Max	Max	Max				Max	Coord		Coord	Coord	
70th %ile Green (s)	23.9	23.9	23.9				0.0	76.1		76.1	76.1	
70th %ile Term Code	Gap	Gap	Gap				Skip	Coord		Coord	Coord	
50th %ile Green (s)	23.7	23.7	23.7				0.0	76.3		76.3	76.3	
50th %ile Term Code	Gap	Gap	Gap				Skip	Coord		Coord	Coord	
30th %ile Green (s)	24.5	24.5	24.5				0.0	75.5		75.5	75.5	
30th %ile Term Code	Gap	Gap	Gap				Skip	Coord		Coord	Coord	
10th %ile Green (s)	28.1	28.1	28.1				0.0	71.9		71.9	71.9	
10th %ile Term Code	Gap	Gap	Gap				Skip	Coord		Coord	Coord	
Stops (vph)		136	0				1	320			399	
Fuel Used(gal)		6	0				0	6			8	
CO Emissions (g/hr)		433	4				2	398			572	
NOx Emissions (g/hr)		84	1				0	78			111	
VOC Emissions (g/hr)		100	1				0	92			133	
Dilemma Vehicles (#)		0	0				0	0			0	
Queue Length 50th (ft)		140	0				1	183			109	
Queue Length 95th (ft)		#338	0				m1	186			#1041	

Lanes, Volumes, Timings  
 2: Main St (1A) & Monument St/Wenham Town Hall

07/23/2018

Lane Group	Ø9
Detector 2 Extend (s)	
Turn Type	
Protected Phases	9
Permitted Phases	
Detector Phase	
Switch Phase	
Minimum Initial (s)	3.0
Minimum Split (s)	22.0
Total Split (s)	22.0
Total Split (%)	20%
Maximum Green (s)	20.0
Yellow Time (s)	2.0
All-Red Time (s)	0.0
Lost Time Adjust (s)	
Total Lost Time (s)	
Lead/Lag	
Lead-Lag Optimize?	
Vehicle Extension (s)	3.0
Recall Mode	None
Walk Time (s)	9.0
Flash Dont Walk (s)	11.0
Pedestrian Calls (#/hr)	5
Act Effct Green (s)	
Actuated g/C Ratio	
v/c Ratio	
Control Delay	
Queue Delay	
Total Delay	
LOS	
Approach Delay	
Approach LOS	
90th %ile Green (s)	20.0
90th %ile Term Code	Ped
70th %ile Green (s)	0.0
70th %ile Term Code	Skip
50th %ile Green (s)	0.0
50th %ile Term Code	Skip
30th %ile Green (s)	0.0
30th %ile Term Code	Skip
10th %ile Green (s)	0.0
10th %ile Term Code	Skip
Stops (vph)	
Fuel Used(gal)	
CO Emissions (g/hr)	
NOx Emissions (g/hr)	
VOC Emissions (g/hr)	
Dilemma Vehicles (#)	
Queue Length 50th (ft)	
Queue Length 95th (ft)	



Lanes, Volumes, Timings  
 2: Main St (1A) & Monument St/Wenham Town Hall

07/23/2018



Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Internal Link Dist (ft)		2533			429			380				236
Turn Bay Length (ft)			15				25					
Base Capacity (vph)		347	400				286	1227				1172
Starvation Cap Reductn		0	0				0	45				0
Spillback Cap Reductn		0	0				0	1				32
Storage Cap Reductn		0	0				0	0				0
Reduced v/c Ratio		0.63	0.02				0.03	0.66				0.90

Intersection Summary

Area Type: Other  
 Cycle Length: 110  
 Actuated Cycle Length: 110  
 Offset: 104 (95%), Referenced to phase 4:NBTL and 8:SBTL, Start of Green  
 Natural Cycle: 120  
 Control Type: Actuated-Coordinated  
 Maximum v/c Ratio: 0.88  
 Intersection Signal Delay: 19.4  
 Intersection LOS: B  
 Intersection Capacity Utilization 70.9%  
 ICU Level of Service C  
 Analysis Period (min) 15  
 # 95th percentile volume exceeds capacity, queue may be longer.  
 Queue shown is maximum after two cycles.  
 m Volume for 95th percentile queue is metered by upstream signal.

Splits and Phases: 2: Main St (1A) & Monument St/Wenham Town Hall



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Lane Group	Ø9
Internal Link Dist (ft)	
Turn Bay Length (ft)	
Base Capacity (vph)	
Starvation Cap Reductn	
Spillback Cap Reductn	
Storage Cap Reductn	
Reduced v/c Ratio	
Intersection Summary	

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Lanes, Volumes, Timings  
 3: Main St (1A) & Cherry St/Old Country Rd

07/23/2018



Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	129	0	154	2	1	2	87	544	0	0	642	108
Future Volume (vph)	129	0	154	2	1	2	87	544	0	0	642	108
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Storage Length (ft)	0		50	0		0	75		0	0		0
Storage Lanes	1		1	0		0	1		0	0		0
Taper Length (ft)	0			0			25			0		
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Frt			0.850		0.955							0.977
Flt Protected	0.950				0.984		0.950					
Satd. Flow (prot)	1770	0	1538	0	1785	0	1752	1827	0	0	1805	0
Flt Permitted	0.750				0.984		0.157					
Satd. Flow (perm)	1397	0	1538	0	1785	0	290	1827	0	0	1805	0
Right Turn on Red			Yes			Yes			Yes			Yes
Satd. Flow (RTOR)			143		4							14
Link Speed (mph)		30			30			30				30
Link Distance (ft)		2702			575			3735				460
Travel Time (s)		61.4			13.1			84.9				10.5
Peak Hour Factor	0.95	0.25	0.88	0.50	0.25	0.50	0.84	0.83	0.50	0.25	0.93	0.75
Growth Factor	102%	102%	102%	102%	102%	102%	102%	102%	102%	102%	102%	102%
Heavy Vehicles (%)	2%	0%	5%	0%	0%	0%	3%	4%	0%	0%	3%	2%
Adj. Flow (vph)	139	0	179	4	4	4	106	669	0	0	704	147
Shared Lane Traffic (%)												
Lane Group Flow (vph)	139	0	179	0	12	0	106	669	0	0	851	0
Enter Blocked Intersection	No	No	No	No	No	No	No	No	No	No	No	No
Lane Alignment	Left	Left	Right	Left	Left	Right	Left	Left	Right	Left	Left	Right
Median Width(ft)		12			12			0				12
Link Offset(ft)		0			8			0				0
Crosswalk Width(ft)		16			16			16				16
Two way Left Turn Lane												
Headway Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Number of Detectors	1		1	1	2		1	2				2
Detector Template	Left		Right	Left	Thru		Left	Thru				Thru
Leading Detector (ft)	20		20	20	100		20	100				100
Trailing Detector (ft)	0		0	0	0		0	0				0
Detector 1 Position(ft)	0		0	0	0		0	0				0
Detector 1 Size(ft)	20		20	20	6		20	6				6
Detector 1 Type	Cl+Ex		Cl+Ex	Cl+Ex	Cl+Ex		Cl+Ex	Cl+Ex				Cl+Ex
Detector 1 Channel												
Detector 1 Extend (s)	0.0		0.0	0.0	0.0		0.0	0.0				0.0
Detector 1 Queue (s)	0.0		0.0	0.0	0.0		0.0	0.0				0.0
Detector 1 Delay (s)	0.0		0.0	0.0	0.0		0.0	0.0				0.0
Detector 2 Position(ft)					94			94				94
Detector 2 Size(ft)					6			6				6
Detector 2 Type					Cl+Ex			Cl+Ex				Cl+Ex
Detector 2 Channel												
Detector 2 Extend (s)					0.0			0.0				0.0
Turn Type	Perm		Prot	Perm	NA		pm+pt	NA				NA
Protected Phases			6		2		7	4				8

Lanes, Volumes, Timings  
 3: Main St (1A) & Cherry St/Old Country Rd

07/23/2018

Lane Group	Ø9
Lane Configurations	
Traffic Volume (vph)	
Future Volume (vph)	
Ideal Flow (vphpl)	
Storage Length (ft)	
Storage Lanes	
Taper Length (ft)	
Lane Util. Factor	
Frt	
Flt Protected	
Satd. Flow (prot)	
Flt Permitted	
Satd. Flow (perm)	
Right Turn on Red	
Satd. Flow (RTOR)	
Link Speed (mph)	
Link Distance (ft)	
Travel Time (s)	
Peak Hour Factor	
Growth Factor	
Heavy Vehicles (%)	
Adj. Flow (vph)	
Shared Lane Traffic (%)	
Lane Group Flow (vph)	
Enter Blocked Intersection	
Lane Alignment	
Median Width(ft)	
Link Offset(ft)	
Crosswalk Width(ft)	
Two way Left Turn Lane	
Headway Factor	
Number of Detectors	
Detector Template	
Leading Detector (ft)	
Trailing Detector (ft)	
Detector 1 Position(ft)	
Detector 1 Size(ft)	
Detector 1 Type	
Detector 1 Channel	
Detector 1 Extend (s)	
Detector 1 Queue (s)	
Detector 1 Delay (s)	
Detector 2 Position(ft)	
Detector 2 Size(ft)	
Detector 2 Type	
Detector 2 Channel	
Detector 2 Extend (s)	
Turn Type	
Protected Phases	9

Lanes, Volumes, Timings  
 3: Main St (1A) & Cherry St/Old Country Rd

07/23/2018



Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Permitted Phases	6			2			4					
Detector Phase	6		6	2	2		7	4				8
Switch Phase												
Minimum Initial (s)	3.0		3.0	3.0	3.0		3.0	3.0				3.0
Minimum Split (s)	8.0		8.0	8.0	8.0		8.0	8.0				8.0
Total Split (s)	18.0		18.0	18.0	18.0		9.0	70.0				61.0
Total Split (%)	16.4%		16.4%	16.4%	16.4%		8.2%	63.6%				55.5%
Maximum Green (s)	13.0		13.0	13.0	13.0		4.0	65.0				56.0
Yellow Time (s)	3.0		3.0	3.0	3.0		3.0	3.0				3.0
All-Red Time (s)	2.0		2.0	2.0	2.0		2.0	2.0				2.0
Lost Time Adjust (s)	0.0		0.0		0.0		0.0	0.0				0.0
Total Lost Time (s)	5.0		5.0		5.0		5.0	5.0				5.0
Lead/Lag							Lead					Lag
Lead-Lag Optimize?							Yes					Yes
Vehicle Extension (s)	3.0		3.0	3.0	3.0		3.0	3.0				3.0
Recall Mode	None		None	None	None		None	C-Min				C-Min
Walk Time (s)												
Flash Dont Walk (s)												
Pedestrian Calls (#/hr)												
Act Effct Green (s)	15.4		15.4		15.4		80.2	80.2				68.0
Actuated g/C Ratio	0.14		0.14		0.14		0.73	0.73				0.62
v/c Ratio	0.71		0.53		0.05		0.35	0.50				0.76
Control Delay	65.6		17.8		33.6		9.3	9.6				8.2
Queue Delay	0.0		0.0		0.0		0.0	0.0				1.2
Total Delay	65.6		17.8		33.6		9.3	9.6				9.4
LOS	E		B		C		A	A				A
Approach Delay		38.7			33.6			9.6				9.4
Approach LOS		D			C			A				A
90th %ile Green (s)	13.0		13.0	13.0	13.0		4.0	65.0				56.0
90th %ile Term Code	Max		Max	Hold	Hold		Max	Coord				Coord
70th %ile Green (s)	19.8		19.8	19.8	19.8		9.0	80.2				66.2
70th %ile Term Code	Gap		Gap	Hold	Hold		Gap	Coord				Coord
50th %ile Green (s)	17.8		17.8	17.8	17.8		8.3	82.2				68.9
50th %ile Term Code	Gap		Gap	Hold	Hold		Gap	Coord				Coord
30th %ile Green (s)	15.2		15.2	15.2	15.2		7.6	84.8				72.2
30th %ile Term Code	Gap		Gap	Hold	Hold		Gap	Coord				Coord
10th %ile Green (s)	11.3		11.3	11.3	11.3		6.8	88.7				76.9
10th %ile Term Code	Gap		Gap	Hold	Hold		Gap	Coord				Coord
Stops (vph)	113		41		4		27	241				220
Fuel Used(gal)	5		4		0		3	19				5
CO Emissions (g/hr)	361		289		6		203	1299				366
NOx Emissions (g/hr)	70		56		1		40	253				71
VOC Emissions (g/hr)	84		67		1		47	301				85
Dilemma Vehicles (#)	0		0		0		0	0				0
Queue Length 50th (ft)	92		22		5		17	160				56
Queue Length 95th (ft)	#210		89		4		51	350				m#722
Internal Link Dist (ft)		2622			495			3655				380
Turn Bay Length (ft)			50				75					
Base Capacity (vph)	200		342		259		306	1331				1121

Lanes, Volumes, Timings  
 3: Main St (1A) & Cherry St/Old Country Rd

07/23/2018

Lane Group	Ø9
Permitted Phases	
Detector Phase	
Switch Phase	
Minimum Initial (s)	3.0
Minimum Split (s)	22.0
Total Split (s)	22.0
Total Split (%)	20%
Maximum Green (s)	20.0
Yellow Time (s)	2.0
All-Red Time (s)	0.0
Lost Time Adjust (s)	
Total Lost Time (s)	
Lead/Lag	
Lead-Lag Optimize?	
Vehicle Extension (s)	3.0
Recall Mode	None
Walk Time (s)	9.0
Flash Dont Walk (s)	11.0
Pedestrian Calls (#/hr)	5
Act Effct Green (s)	
Actuated g/C Ratio	
v/c Ratio	
Control Delay	
Queue Delay	
Total Delay	
LOS	
Approach Delay	
Approach LOS	
90th %ile Green (s)	20.0
90th %ile Term Code	Ped
70th %ile Green (s)	0.0
70th %ile Term Code	Skip
50th %ile Green (s)	0.0
50th %ile Term Code	Skip
30th %ile Green (s)	0.0
30th %ile Term Code	Skip
10th %ile Green (s)	0.0
10th %ile Term Code	Skip
Stops (vph)	
Fuel Used(gal)	
CO Emissions (g/hr)	
NOx Emissions (g/hr)	
VOC Emissions (g/hr)	
Dilemma Vehicles (#)	
Queue Length 50th (ft)	
Queue Length 95th (ft)	
Internal Link Dist (ft)	
Turn Bay Length (ft)	
Base Capacity (vph)	

Lanes, Volumes, Timings  
 3: Main St (1A) & Cherry St/Old Country Rd

07/23/2018



Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Starvation Cap Reductn	0		0		0		0	0			110	
Spillback Cap Reductn	0		0		0		0	26			0	
Storage Cap Reductn	0		0		0		0	0			0	
Reduced v/c Ratio	0.69		0.52		0.05		0.35	0.51			0.84	

Intersection Summary

Area Type:	Other
Cycle Length:	110
Actuated Cycle Length:	110
Offset:	6 (5%), Referenced to phase 4:NBTL and 8:SBT, Start of Green
Natural Cycle:	90
Control Type:	Actuated-Coordinated
Maximum v/c Ratio:	0.76
Intersection Signal Delay:	14.4
Intersection LOS:	B
Intersection Capacity Utilization	71.7%
ICU Level of Service	C
Analysis Period (min)	15
#	95th percentile volume exceeds capacity, queue may be longer. Queue shown is maximum after two cycles.
m	Volume for 95th percentile queue is metered by upstream signal.

Splits and Phases: 3: Main St (1A) & Cherry St/Old Country Rd





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Lane Group	Ø9
Starvation Cap Reductn	
Spillback Cap Reductn	
Storage Cap Reductn	
Reduced v/c Ratio	
Intersection Summary	

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Lanes, Volumes, Timings  
 1: Main St (1A) & Arbor St/Friend Ct

07/23/2018



Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		↕	↗		↕		↗	↖		↗	↖	
Traffic Volume (vph)	18	0	267	7	0	13	297	652	11	5	596	25
Future Volume (vph)	18	0	267	7	0	13	297	652	11	5	596	25
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Storage Length (ft)	0		50	0		0	100		0	40		0
Storage Lanes	0		1	0		0	1		0	1		0
Taper Length (ft)	0			0			25			25		
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Ped Bike Factor							1.00	1.00		1.00	1.00	
Frt			0.850		0.905			0.997			0.993	
Flt Protected		0.950			0.986		0.950			0.950		
Satd. Flow (prot)	0	1805	1615	0	1695	0	1787	1857	0	1805	1867	0
Flt Permitted					0.889		0.249			0.372		
Satd. Flow (perm)	0	1900	1615	0	1529	0	468	1857	0	706	1867	0
Right Turn on Red			Yes			Yes			Yes			Yes
Satd. Flow (RTOR)			309		139			2			3	
Link Speed (mph)		30			30			30			30	
Link Distance (ft)		2388			2408			316			2230	
Travel Time (s)		54.3			54.7			7.2			50.7	
Confl. Peds. (#/hr)							1		2	2		1
Peak Hour Factor	0.56	0.92	0.88	0.58	0.92	0.46	0.88	0.89	0.69	0.63	0.93	0.78
Growth Factor	102%	102%	102%	102%	102%	102%	102%	102%	102%	102%	102%	102%
Heavy Vehicles (%)	0%	0%	0%	0%	0%	0%	1%	2%	0%	0%	1%	0%
Adj. Flow (vph)	33	0	309	12	0	29	344	747	16	8	654	33
Shared Lane Traffic (%)												
Lane Group Flow (vph)	0	33	309	0	41	0	344	763	0	8	687	0
Enter Blocked Intersection	No	No	No	No	No	No	No	No	No	No	No	No
Lane Alignment	Left	Left	Right	Left	Left	Right	Left	Left	Right	Left	Left	Right
Median Width(ft)		0			0			12			12	
Link Offset(ft)		0			-10			6			0	
Crosswalk Width(ft)		16			16			16			16	
Two way Left Turn Lane												
Headway Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Number of Detectors	1	1	2	1	2		1	2		1	2	
Detector Template	Left	Left	Thru	Left	Thru		Left	Thru		Left	Thru	
Leading Detector (ft)	20	20	100	20	100		20	100		20	100	
Trailing Detector (ft)	0	0	0	0	0		0	0		0	0	
Detector 1 Position(ft)	0	0	0	0	0		0	0		0	0	
Detector 1 Size(ft)	20	20	6	20	6		20	6		20	6	
Detector 1 Type	Cl+Ex	Cl+Ex	Cl+Ex	Cl+Ex	Cl+Ex		Cl+Ex	Cl+Ex		Cl+Ex	Cl+Ex	
Detector 1 Channel												
Detector 1 Extend (s)	0.0	0.0	0.0	0.0	0.0		0.0	0.0		0.0	0.0	
Detector 1 Queue (s)	0.0	0.0	0.0	0.0	0.0		0.0	0.0		0.0	0.0	
Detector 1 Delay (s)	0.0	0.0	0.0	0.0	0.0		0.0	0.0		0.0	0.0	
Detector 2 Position(ft)			94		94			94			94	
Detector 2 Size(ft)			6		6			6			6	
Detector 2 Type			Cl+Ex		Cl+Ex			Cl+Ex			Cl+Ex	
Detector 2 Channel												
Detector 2 Extend (s)			0.0		0.0			0.0			0.0	

Lanes, Volumes, Timings  
1: Main St (1A) & Arbor St/Friend Ct

07/23/2018

Lane Group	Ø9
Lane Configurations	
Traffic Volume (vph)	
Future Volume (vph)	
Ideal Flow (vphpl)	
Storage Length (ft)	
Storage Lanes	
Taper Length (ft)	
Lane Util. Factor	
Ped Bike Factor	
Frt	
Flt Protected	
Satd. Flow (prot)	
Flt Permitted	
Satd. Flow (perm)	
Right Turn on Red	
Satd. Flow (RTOR)	
Link Speed (mph)	
Link Distance (ft)	
Travel Time (s)	
Confl. Peds. (#/hr)	
Peak Hour Factor	
Growth Factor	
Heavy Vehicles (%)	
Adj. Flow (vph)	
Shared Lane Traffic (%)	
Lane Group Flow (vph)	
Enter Blocked Intersection	
Lane Alignment	
Median Width(ft)	
Link Offset(ft)	
Crosswalk Width(ft)	
Two way Left Turn Lane	
Headway Factor	
Number of Detectors	
Detector Template	
Leading Detector (ft)	
Trailing Detector (ft)	
Detector 1 Position(ft)	
Detector 1 Size(ft)	
Detector 1 Type	
Detector 1 Channel	
Detector 1 Extend (s)	
Detector 1 Queue (s)	
Detector 1 Delay (s)	
Detector 2 Position(ft)	
Detector 2 Size(ft)	
Detector 2 Type	
Detector 2 Channel	
Detector 2 Extend (s)	

Lanes, Volumes, Timings  
 1: Main St (1A) & Arbor St/Friend Ct

07/23/2018



Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Turn Type	Perm	NA	pm+ov	Perm	NA		pm+pt	NA		pm+pt	NA	
Protected Phases		6	7		2		7	4		3	8	
Permitted Phases	6		6	2			4			8		
Detector Phase	6	6	7	2	2		7	4		3	8	
Switch Phase												
Minimum Initial (s)	3.0	3.0	3.0	3.0	3.0		3.0	3.0		3.0	3.0	
Minimum Split (s)	8.0	8.0	8.0	8.0	8.0		8.0	8.0		8.0	8.0	
Total Split (s)	9.0	9.0	26.0	9.0	9.0		26.0	71.0		8.0	53.0	
Total Split (%)	8.2%	8.2%	23.6%	8.2%	8.2%		23.6%	64.5%		7.3%	48.2%	
Maximum Green (s)	4.0	4.0	21.0	4.0	4.0		21.0	66.0		3.0	48.0	
Yellow Time (s)	3.0	3.0	3.0	3.0	3.0		3.0	3.0		3.0	3.0	
All-Red Time (s)	2.0	2.0	2.0	2.0	2.0		2.0	2.0		2.0	2.0	
Lost Time Adjust (s)		0.0	0.0		0.0		0.0	0.0		0.0	0.0	
Total Lost Time (s)		5.0	5.0		5.0		5.0	5.0		5.0	5.0	
Lead/Lag			Lead				Lead	Lag		Lead	Lag	
Lead-Lag Optimize?			Yes				Yes	Yes		Yes	Yes	
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0		3.0	3.0		3.0	3.0	
Recall Mode	None	None	None	None	None		None	C-Max		None	C-Max	
Walk Time (s)												
Flash Dont Walk (s)												
Pedestrian Calls (#/hr)												
Act Effect Green (s)		5.5	22.0		5.3		90.1	90.5		73.7	69.2	
Actuated g/C Ratio		0.05	0.20		0.05		0.82	0.82		0.67	0.63	
v/c Ratio		0.35	0.54		0.20		0.60	0.50		0.02	0.58	
Control Delay		61.9	7.4		2.2		16.3	6.1		7.6	20.4	
Queue Delay		0.0	0.0		0.0		0.3	0.8		0.0	0.0	
Total Delay		61.9	7.4		2.2		16.5	6.8		7.6	20.5	
LOS		E	A		A		B	A		A	C	
Approach Delay		12.7			2.2			9.8			20.3	
Approach LOS		B			A			A			C	
90th %ile Green (s)	4.0	4.0	21.0	4.0	4.0		21.0	66.0		3.0	48.0	
90th %ile Term Code	Max	Max	Max	Max	Max		Max	Coord		Max	Coord	
70th %ile Green (s)	4.0	4.0	21.0	4.0	4.0		21.0	74.0		0.0	48.0	
70th %ile Term Code	Max	Max	Max	Max	Max		Max	Coord		Skip	Coord	
50th %ile Green (s)	7.4	7.4	19.2	7.4	7.4		19.2	92.6		0.0	68.4	
50th %ile Term Code	Gap	Gap	Gap	Hold	Hold		Gap	Coord		Skip	Coord	
30th %ile Green (s)	0.0	0.0	12.1	0.0	0.0		12.1	105.0		0.0	87.9	
30th %ile Term Code	Skip	Skip	Gap	Skip	Skip		Gap	Coord		Skip	Coord	
10th %ile Green (s)	0.0	0.0	6.1	0.0	0.0		6.1	105.0		0.0	93.9	
10th %ile Term Code	Skip	Skip	Gap	Skip	Skip		Gap	Coord		Skip	Coord	
Stops (vph)		17	27		0		109	202		3	386	
Fuel Used(gal)		1	6		0		2	4		0	16	
CO Emissions (g/hr)		46	393		27		164	253		8	1104	
NOx Emissions (g/hr)		9	76		5		32	49		2	215	
VOC Emissions (g/hr)		11	91		6		38	59		2	256	
Dilemma Vehicles (#)		0	0		0		0	0		0	0	
Queue Length 50th (ft)		23	0		0		46	47		1	268	
Queue Length 95th (ft)		#64	60		0		145	318		5	#637	
Internal Link Dist (ft)		2308			2328			236			2150	

Lanes, Volumes, Timings  
 1: Main St (1A) & Arbor St/Friend Ct

07/23/2018

Lane Group	Ø9
Turn Type	
Protected Phases	9
Permitted Phases	
Detector Phase	
Switch Phase	
Minimum Initial (s)	3.0
Minimum Split (s)	22.0
Total Split (s)	22.0
Total Split (%)	20%
Maximum Green (s)	20.0
Yellow Time (s)	2.0
All-Red Time (s)	0.0
Lost Time Adjust (s)	
Total Lost Time (s)	
Lead/Lag	
Lead-Lag Optimize?	
Vehicle Extension (s)	3.0
Recall Mode	None
Walk Time (s)	9.0
Flash Dont Walk (s)	11.0
Pedestrian Calls (#/hr)	15
Act Effct Green (s)	
Actuated g/C Ratio	
v/c Ratio	
Control Delay	
Queue Delay	
Total Delay	
LOS	
Approach Delay	
Approach LOS	
90th %ile Green (s)	20.0
90th %ile Term Code	Ped
70th %ile Green (s)	20.0
70th %ile Term Code	Ped
50th %ile Green (s)	0.0
50th %ile Term Code	Skip
30th %ile Green (s)	0.0
30th %ile Term Code	Skip
10th %ile Green (s)	0.0
10th %ile Term Code	Skip
Stops (vph)	
Fuel Used(gal)	
CO Emissions (g/hr)	
NOx Emissions (g/hr)	
VOC Emissions (g/hr)	
Dilemma Vehicles (#)	
Queue Length 50th (ft)	
Queue Length 95th (ft)	
Internal Link Dist (ft)	

Lanes, Volumes, Timings  
 1: Main St (1A) & Arbor St/Friend Ct

07/23/2018



Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Turn Bay Length (ft)			50				100			40		
Base Capacity (vph)		94	630		205		635	1528		518	1176	
Starvation Cap Reductn		0	0		0		45	432		0	0	
Spillback Cap Reductn		0	4		1		0	0		0	24	
Storage Cap Reductn		0	0		0		0	0		0	0	
Reduced v/c Ratio		0.35	0.49		0.20		0.58	0.70		0.02	0.60	

Intersection Summary

Area Type: Other  
 Cycle Length: 110  
 Actuated Cycle Length: 110  
 Offset: 0 (0%), Referenced to phase 4:NBTL and 8:SBTL, Start of Green, Master Intersection  
 Natural Cycle: 90  
 Control Type: Actuated-Coordinated  
 Maximum v/c Ratio: 0.60  
 Intersection Signal Delay: 13.5 Intersection LOS: B  
 Intersection Capacity Utilization 70.6% ICU Level of Service C  
 Analysis Period (min) 15  
 # 95th percentile volume exceeds capacity, queue may be longer.  
 Queue shown is maximum after two cycles.

Splits and Phases: 1: Main St (1A) & Arbor St/Friend Ct





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Lane Group	Ø9
Turn Bay Length (ft)	
Base Capacity (vph)	
Starvation Cap Reductn	
Spillback Cap Reductn	
Storage Cap Reductn	
Reduced v/c Ratio	
Intersection Summary	

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# Lanes, Volumes, Timings

## 2: Main St (1A) & Monument St/Wenham Town Hall

07/23/2018



Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		↖	↗				↖	↗			↕	
Traffic Volume (vph)	152	0	6	0	0	0	6	806	2	1	659	210
Future Volume (vph)	152	0	6	0	0	0	6	806	2	1	659	210
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Storage Length (ft)	0		15	0		0	25		0	0		0
Storage Lanes	0		1	0		0	1		0	0		0
Taper Length (ft)	0			0			25			0		
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Ped Bike Factor							1.00					0.99
Frt			0.850					0.999				0.964
Flt Protected		0.950					0.950					
Satd. Flow (prot)	0	1787	1380	0	0	0	1805	1879	0	0	1804	0
Flt Permitted		0.950					0.244				0.997	
Satd. Flow (perm)	0	1787	1380	0	0	0	464	1879	0	0	1798	0
Right Turn on Red			Yes			Yes			Yes			Yes
Satd. Flow (RTOR)			89									26
Link Speed (mph)		30			30			30				30
Link Distance (ft)		2613			509			460				316
Travel Time (s)		59.4			11.6			10.5				7.2
Confl. Peds. (#/hr)							1					1
Peak Hour Factor	0.86	0.92	0.38	0.92	0.25	0.25	0.75	0.92	0.50	0.25	0.94	0.83
Growth Factor	102%	102%	102%	102%	102%	102%	102%	102%	102%	102%	102%	102%
Heavy Vehicles (%)	1%	2%	17%	2%	0%	0%	0%	1%	0%	0%	1%	1%
Adj. Flow (vph)	180	0	16	0	0	0	8	894	4	4	715	258
Shared Lane Traffic (%)												
Lane Group Flow (vph)	0	180	16	0	0	0	8	898	0	0	977	0
Enter Blocked Intersection	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	2 veh	Yes
Lane Alignment	Left	Left	Right	Left	Left	Right	Left	Left	Right	Left	Left	Right
Median Width(ft)		0			0			12				12
Link Offset(ft)		0			30			0				0
Crosswalk Width(ft)		16			16			16				16
Two way Left Turn Lane												
Headway Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Turning Speed (mph)	25		9	15		9	15		9	15		9
Number of Detectors	1	2	1				1	2		1	2	
Detector Template	Left	Thru	Right				Left	Thru		Left	Thru	
Leading Detector (ft)	20	100	20				20	100		20	100	
Trailing Detector (ft)	0	0	0				0	0		0	0	
Detector 1 Position(ft)	0	0	0				0	0		0	0	
Detector 1 Size(ft)	20	6	20				20	6		20	6	
Detector 1 Type	Cl+Ex	Cl+Ex	Cl+Ex				Cl+Ex	Cl+Ex		Cl+Ex	Cl+Ex	
Detector 1 Channel												
Detector 1 Extend (s)	0.0	0.0	0.0				0.0	0.0		0.0	0.0	
Detector 1 Queue (s)	0.0	0.0	0.0				0.0	0.0		0.0	0.0	
Detector 1 Delay (s)	0.0	0.0	0.0				0.0	0.0		0.0	0.0	
Detector 2 Position(ft)		94						94				94
Detector 2 Size(ft)		6						6				6
Detector 2 Type		Cl+Ex						Cl+Ex				Cl+Ex
Detector 2 Channel												

Lanes, Volumes, Timings  
 2: Main St (1A) & Monument St/Wenham Town Hall

07/23/2018

Lane Group	Ø9
Lane Configurations	
Traffic Volume (vph)	
Future Volume (vph)	
Ideal Flow (vphpl)	
Storage Length (ft)	
Storage Lanes	
Taper Length (ft)	
Lane Util. Factor	
Ped Bike Factor	
Frt	
Flt Protected	
Satd. Flow (prot)	
Flt Permitted	
Satd. Flow (perm)	
Right Turn on Red	
Satd. Flow (RTOR)	
Link Speed (mph)	
Link Distance (ft)	
Travel Time (s)	
Confl. Peds. (#/hr)	
Peak Hour Factor	
Growth Factor	
Heavy Vehicles (%)	
Adj. Flow (vph)	
Shared Lane Traffic (%)	
Lane Group Flow (vph)	
Enter Blocked Intersection	
Lane Alignment	
Median Width(ft)	
Link Offset(ft)	
Crosswalk Width(ft)	
Two way Left Turn Lane	
Headway Factor	
Turning Speed (mph)	
Number of Detectors	
Detector Template	
Leading Detector (ft)	
Trailing Detector (ft)	
Detector 1 Position(ft)	
Detector 1 Size(ft)	
Detector 1 Type	
Detector 1 Channel	
Detector 1 Extend (s)	
Detector 1 Queue (s)	
Detector 1 Delay (s)	
Detector 2 Position(ft)	
Detector 2 Size(ft)	
Detector 2 Type	
Detector 2 Channel	

Lanes, Volumes, Timings  
 2: Main St (1A) & Monument St/Wenham Town Hall

07/23/2018



Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Detector 2 Extend (s)		0.0						0.0			0.0	
Turn Type	Split	NA	Perm				pm+pt	NA		Perm	NA	
Protected Phases	6	6					7	4				8
Permitted Phases			6				4			8		
Detector Phase	6	6	6				7	4		8		8
Switch Phase												
Minimum Initial (s)	3.0	3.0	3.0				3.0	3.0		3.0	3.0	
Minimum Split (s)	8.0	8.0	8.0				8.0	8.0		8.0	8.0	
Total Split (s)	15.0	15.0	15.0				8.0	73.0		65.0	65.0	
Total Split (%)	13.6%	13.6%	13.6%				7.3%	66.4%		59.1%	59.1%	
Maximum Green (s)	10.0	10.0	10.0				3.0	68.0		60.0	60.0	
Yellow Time (s)	3.0	3.0	3.0				3.0	3.0		3.0	3.0	
All-Red Time (s)	2.0	2.0	2.0				2.0	2.0		2.0	2.0	
Lost Time Adjust (s)		0.0	0.0				0.0	0.0			0.0	
Total Lost Time (s)		5.0	5.0				5.0	5.0			5.0	
Lead/Lag							Lead			Lag	Lag	
Lead-Lag Optimize?							Yes			Yes	Yes	
Vehicle Extension (s)	3.0	3.0	3.0				3.0	3.0		3.0	3.0	
Recall Mode	None	None	None				None	C-Min		C-Max	C-Max	
Walk Time (s)												
Flash Dont Walk (s)												
Pedestrian Calls (#/hr)												
Act Effct Green (s)		18.1	18.1				77.5	77.5			75.9	
Actuated g/C Ratio		0.16	0.16				0.70	0.70			0.69	
v/c Ratio		0.61	0.05				0.02	0.68			0.78	
Control Delay		54.1	0.3				5.0	9.9			11.8	
Queue Delay		0.9	0.0				0.0	0.1			0.4	
Total Delay		55.0	0.3				5.0	10.0			12.2	
LOS		E	A				A	A			B	
Approach Delay		50.6						10.0			12.2	
Approach LOS		D						A			B	
90th %ile Green (s)	10.0	10.0	10.0				3.0	68.0		60.0	60.0	
90th %ile Term Code	Max	Max	Max				Max	Coord		Coord	Coord	
70th %ile Green (s)	20.2	20.2	20.2				0.0	79.8		79.8	79.8	
70th %ile Term Code	Gap	Gap	Gap				Skip	Coord		Coord	Coord	
50th %ile Green (s)	19.7	19.7	19.7				0.0	80.3		80.3	80.3	
50th %ile Term Code	Gap	Gap	Gap				Skip	Coord		Coord	Coord	
30th %ile Green (s)	19.7	19.7	19.7				0.0	80.3		80.3	80.3	
30th %ile Term Code	Gap	Gap	Gap				Skip	Coord		Coord	Coord	
10th %ile Green (s)	20.8	20.8	20.8				0.0	79.2		79.2	79.2	
10th %ile Term Code	Gap	Gap	Gap				Skip	Coord		Coord	Coord	
Stops (vph)		122	0				2	363			287	
Fuel Used(gal)		6	0				0	7			6	
CO Emissions (g/hr)		387	9				3	463			413	
NOx Emissions (g/hr)		75	2				1	90			80	
VOC Emissions (g/hr)		90	2				1	107			96	
Dilemma Vehicles (#)		0	0				0	0			0	
Queue Length 50th (ft)		117	0				1	174			60	
Queue Length 95th (ft)		#285	0				m2	148			#926	

Lanes, Volumes, Timings  
 2: Main St (1A) & Monument St/Wenham Town Hall

07/23/2018

Lane Group	Ø9
Detector 2 Extend (s)	
Turn Type	
Protected Phases	9
Permitted Phases	
Detector Phase	
Switch Phase	
Minimum Initial (s)	3.0
Minimum Split (s)	22.0
Total Split (s)	22.0
Total Split (%)	20%
Maximum Green (s)	20.0
Yellow Time (s)	2.0
All-Red Time (s)	0.0
Lost Time Adjust (s)	
Total Lost Time (s)	
Lead/Lag	
Lead-Lag Optimize?	
Vehicle Extension (s)	3.0
Recall Mode	None
Walk Time (s)	9.0
Flash Dont Walk (s)	11.0
Pedestrian Calls (#/hr)	5
Act Effct Green (s)	
Actuated g/C Ratio	
v/c Ratio	
Control Delay	
Queue Delay	
Total Delay	
LOS	
Approach Delay	
Approach LOS	
90th %ile Green (s)	20.0
90th %ile Term Code	Ped
70th %ile Green (s)	0.0
70th %ile Term Code	Skip
50th %ile Green (s)	0.0
50th %ile Term Code	Skip
30th %ile Green (s)	0.0
30th %ile Term Code	Skip
10th %ile Green (s)	0.0
10th %ile Term Code	Skip
Stops (vph)	
Fuel Used(gal)	
CO Emissions (g/hr)	
NOx Emissions (g/hr)	
VOC Emissions (g/hr)	
Dilemma Vehicles (#)	
Queue Length 50th (ft)	
Queue Length 95th (ft)	

Lanes, Volumes, Timings  
 2: Main St (1A) & Monument St/Wenham Town Hall

07/23/2018



Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Internal Link Dist (ft)		2533			429			380			236	
Turn Bay Length (ft)			15				25					
Base Capacity (vph)		293	301				388	1324			1248	
Starvation Cap Reductn		0	0				0	10			0	
Spillback Cap Reductn		21	2				0	29			44	
Storage Cap Reductn		0	0				0	0			0	
Reduced v/c Ratio		0.66	0.05				0.02	0.69			0.81	

Intersection Summary

Area Type: Other  
 Cycle Length: 110  
 Actuated Cycle Length: 110  
 Offset: 105 (95%), Referenced to phase 4:NBTL and 8:SBTL, Start of Green  
 Natural Cycle: 110  
 Control Type: Actuated-Coordinated  
 Maximum v/c Ratio: 0.78  
 Intersection Signal Delay: 14.8  
 Intersection LOS: B  
 Intersection Capacity Utilization 66.2%  
 ICU Level of Service C  
 Analysis Period (min) 15  
 # 95th percentile volume exceeds capacity, queue may be longer.  
 Queue shown is maximum after two cycles.  
 m Volume for 95th percentile queue is metered by upstream signal.

Splits and Phases: 2: Main St (1A) & Monument St/Wenham Town Hall



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Lane Group	Ø9
Internal Link Dist (ft)	
Turn Bay Length (ft)	
Base Capacity (vph)	
Starvation Cap Reductn	
Spillback Cap Reductn	
Storage Cap Reductn	
Reduced v/c Ratio	
Intersection Summary	

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Lanes, Volumes, Timings  
 3: Main St (1A) & Cherry St/Old Country Rd

07/23/2018



Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	122	0	107	5	1	5	158	692	0	0	552	110
Future Volume (vph)	122	0	107	5	1	5	158	692	0	0	552	110
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Storage Length (ft)	0		50	0		0	75		0	0		0
Storage Lanes	1		1	0		0	1		0	0		0
Taper Length (ft)	0			0			25			0		
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Ped Bike Factor					0.99							
Frt			0.850		0.932							0.976
Flt Protected	0.950				0.984		0.950					
Satd. Flow (prot)	1770	0	1599	0	1722	0	1770	1881	0	0	1836	0
Flt Permitted	0.742				0.984		0.199					
Satd. Flow (perm)	1382	0	1599	0	1719	0	371	1881	0	0	1836	0
Right Turn on Red			Yes			Yes			Yes			Yes
Satd. Flow (RTOR)			100		12							13
Link Speed (mph)		30			30			30				30
Link Distance (ft)		2702			575			3735				460
Travel Time (s)		61.4			13.1			84.9				10.5
Confl. Peds. (#/hr)				1		1						
Peak Hour Factor	0.87	0.25	0.86	0.63	0.25	0.42	0.96	0.94	0.50	0.25	0.91	0.83
Growth Factor	102%	102%	102%	102%	102%	102%	102%	102%	102%	102%	102%	102%
Heavy Vehicles (%)	2%	0%	1%	0%	0%	0%	2%	1%	0%	0%	1%	1%
Adj. Flow (vph)	143	0	127	8	4	12	168	751	0	0	619	135
Shared Lane Traffic (%)												
Lane Group Flow (vph)	143	0	127	0	24	0	168	751	0	0	754	0
Enter Blocked Intersection	No	No	No	No	No	No	No	No	No	No	No	No
Lane Alignment	Left	Left	Right	Left	Left	Right	Left	Left	Right	Left	Left	Right
Median Width(ft)		12			12			0				12
Link Offset(ft)		0			8			0				0
Crosswalk Width(ft)		16			16			16				16
Two way Left Turn Lane												
Headway Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Number of Detectors	1		1	1	2		1	2				2
Detector Template	Left		Right	Left	Thru		Left	Thru				Thru
Leading Detector (ft)	20		20	20	100		20	100				100
Trailing Detector (ft)	0		0	0	0		0	0				0
Detector 1 Position(ft)	0		0	0	0		0	0				0
Detector 1 Size(ft)	20		20	20	6		20	6				6
Detector 1 Type	Cl+Ex		Cl+Ex	Cl+Ex	Cl+Ex		Cl+Ex	Cl+Ex				Cl+Ex
Detector 1 Channel												
Detector 1 Extend (s)	0.0		0.0	0.0	0.0		0.0	0.0				0.0
Detector 1 Queue (s)	0.0		0.0	0.0	0.0		0.0	0.0				0.0
Detector 1 Delay (s)	0.0		0.0	0.0	0.0		0.0	0.0				0.0
Detector 2 Position(ft)					94			94				94
Detector 2 Size(ft)					6			6				6
Detector 2 Type					Cl+Ex			Cl+Ex				Cl+Ex
Detector 2 Channel												
Detector 2 Extend (s)					0.0			0.0				0.0

Lanes, Volumes, Timings  
 3: Main St (1A) & Cherry St/Old Country Rd

07/23/2018

Lane Group	Ø9
Lane Configurations	
Traffic Volume (vph)	
Future Volume (vph)	
Ideal Flow (vphpl)	
Storage Length (ft)	
Storage Lanes	
Taper Length (ft)	
Lane Util. Factor	
Ped Bike Factor	
Frt	
Flt Protected	
Satd. Flow (prot)	
Flt Permitted	
Satd. Flow (perm)	
Right Turn on Red	
Satd. Flow (RTOR)	
Link Speed (mph)	
Link Distance (ft)	
Travel Time (s)	
Confl. Peds. (#/hr)	
Peak Hour Factor	
Growth Factor	
Heavy Vehicles (%)	
Adj. Flow (vph)	
Shared Lane Traffic (%)	
Lane Group Flow (vph)	
Enter Blocked Intersection	
Lane Alignment	
Median Width(ft)	
Link Offset(ft)	
Crosswalk Width(ft)	
Two way Left Turn Lane	
Headway Factor	
Number of Detectors	
Detector Template	
Leading Detector (ft)	
Trailing Detector (ft)	
Detector 1 Position(ft)	
Detector 1 Size(ft)	
Detector 1 Type	
Detector 1 Channel	
Detector 1 Extend (s)	
Detector 1 Queue (s)	
Detector 1 Delay (s)	
Detector 2 Position(ft)	
Detector 2 Size(ft)	
Detector 2 Type	
Detector 2 Channel	
Detector 2 Extend (s)	

# Lanes, Volumes, Timings

## 3: Main St (1A) & Cherry St/Old Country Rd

07/23/2018



Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Turn Type	Perm		Prot	Perm	NA		pm+pt	NA				NA
Protected Phases			6		2		7	4				8
Permitted Phases	6			2			4					
Detector Phase	6		6	2	2		7	4				8
Switch Phase												
Minimum Initial (s)	3.0		3.0	3.0	3.0		3.0	3.0				3.0
Minimum Split (s)	8.0		8.0	8.0	8.0		8.0	8.0				8.0
Total Split (s)	19.0		19.0	19.0	19.0		13.0	69.0				56.0
Total Split (%)	17.3%		17.3%	17.3%	17.3%		11.8%	62.7%				50.9%
Maximum Green (s)	14.0		14.0	14.0	14.0		8.0	64.0				51.0
Yellow Time (s)	3.0		3.0	3.0	3.0		3.0	3.0				3.0
All-Red Time (s)	2.0		2.0	2.0	2.0		2.0	2.0				2.0
Lost Time Adjust (s)	0.0		0.0		0.0		0.0	0.0				0.0
Total Lost Time (s)	5.0		5.0		5.0		5.0	5.0				5.0
Lead/Lag							Lead					Lag
Lead-Lag Optimize?							Yes					Yes
Vehicle Extension (s)	3.0		3.0	3.0	3.0		3.0	3.0				3.0
Recall Mode	None		None	None	None		None	C-Min				C-Min
Walk Time (s)												
Flash Dont Walk (s)												
Pedestrian Calls (#/hr)												
Act Effect Green (s)	15.8		15.8		15.8		79.8	79.8				65.9
Actuated g/C Ratio	0.14		0.14		0.14		0.73	0.73				0.60
v/c Ratio	0.72		0.40		0.09		0.44	0.55				0.68
Control Delay	66.0		17.0		27.5		9.8	10.6				9.0
Queue Delay	0.0		0.0		0.0		0.0	0.0				0.9
Total Delay	66.0		17.0		27.5		9.8	10.7				10.0
LOS	E		B		C		A	B				A
Approach Delay		42.9			27.5			10.5				10.0
Approach LOS		D			C			B				A
90th %ile Green (s)	14.0		14.0	14.0	14.0		8.0	64.0				51.0
90th %ile Term Code	Max		Max	Hold	Hold		Max	Coord				Coord
70th %ile Green (s)	20.3		20.3	20.3	20.3		11.9	79.7				62.8
70th %ile Term Code	Gap		Gap	Hold	Hold		Gap	Coord				Coord
50th %ile Green (s)	18.1		18.1	18.1	18.1		9.3	81.9				67.6
50th %ile Term Code	Gap		Gap	Hold	Hold		Gap	Coord				Coord
30th %ile Green (s)	15.3		15.3	15.3	15.3		8.3	84.7				71.4
30th %ile Term Code	Gap		Gap	Hold	Hold		Gap	Coord				Coord
10th %ile Green (s)	11.3		11.3	11.3	11.3		7.2	88.7				76.5
10th %ile Term Code	Gap		Gap	Hold	Hold		Gap	Coord				Coord
Stops (vph)	106		30		6		51	329				229
Fuel Used(gal)	5		3		0		5	24				5
CO Emissions (g/hr)	340		198		10		370	1671				344
NOx Emissions (g/hr)	66		39		2		72	325				67
VOC Emissions (g/hr)	79		46		2		86	387				80
Dilemma Vehicles (#)	0		0		0		0	0				0
Queue Length 50th (ft)	95		16		7		29	192				116
Queue Length 95th (ft)	#199		67		4		85	488				#688
Internal Link Dist (ft)		2622			495			3655				380

Lanes, Volumes, Timings  
 3: Main St (1A) & Cherry St/Old Country Rd

07/23/2018

Lane Group	Ø9
Turn Type	
Protected Phases	9
Permitted Phases	
Detector Phase	
Switch Phase	
Minimum Initial (s)	3.0
Minimum Split (s)	22.0
Total Split (s)	22.0
Total Split (%)	20%
Maximum Green (s)	20.0
Yellow Time (s)	2.0
All-Red Time (s)	0.0
Lost Time Adjust (s)	
Total Lost Time (s)	
Lead/Lag	
Lead-Lag Optimize?	
Vehicle Extension (s)	3.0
Recall Mode	None
Walk Time (s)	9.0
Flash Dont Walk (s)	11.0
Pedestrian Calls (#/hr)	5
Act Effct Green (s)	
Actuated g/C Ratio	
v/c Ratio	
Control Delay	
Queue Delay	
Total Delay	
LOS	
Approach Delay	
Approach LOS	
90th %ile Green (s)	20.0
90th %ile Term Code	Ped
70th %ile Green (s)	0.0
70th %ile Term Code	Skip
50th %ile Green (s)	0.0
50th %ile Term Code	Skip
30th %ile Green (s)	0.0
30th %ile Term Code	Skip
10th %ile Green (s)	0.0
10th %ile Term Code	Skip
Stops (vph)	
Fuel Used(gal)	
CO Emissions (g/hr)	
NOx Emissions (g/hr)	
VOC Emissions (g/hr)	
Dilemma Vehicles (#)	
Queue Length 50th (ft)	
Queue Length 95th (ft)	
Internal Link Dist (ft)	

Lanes, Volumes, Timings  
 3: Main St (1A) & Cherry St/Old Country Rd

07/23/2018



Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Turn Bay Length (ft)			50				75					
Base Capacity (vph)	205		322		265		384	1364				1104
Starvation Cap Reductn	0		0		0		0	0				142
Spillback Cap Reductn	0		0		0		0	38				0
Storage Cap Reductn	0		0		0		0	0				0
Reduced v/c Ratio	0.70		0.39		0.09		0.44	0.57				0.78

Intersection Summary

Area Type:	Other
Cycle Length:	110
Actuated Cycle Length:	110
Offset:	14 (13%), Referenced to phase 4:NBTL and 8:SBT, Start of Green
Natural Cycle:	90
Control Type:	Actuated-Coordinated
Maximum v/c Ratio:	0.72
Intersection Signal Delay:	15.0
Intersection LOS:	B
Intersection Capacity Utilization	70.3%
ICU Level of Service	C
Analysis Period (min)	15
# 95th percentile volume exceeds capacity, queue may be longer. Queue shown is maximum after two cycles.	

Splits and Phases: 3: Main St (1A) & Cherry St/Old Country Rd



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Lane Group	Ø9
Turn Bay Length (ft)	
Base Capacity (vph)	
Starvation Cap Reductn	
Spillback Cap Reductn	
Storage Cap Reductn	
Reduced v/c Ratio	
Intersection Summary	

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Lanes, Volumes, Timings  
 1: Main St (1A) & Arbor St/Friend Ct

07/23/2018



Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		↕			↕			↕			↕	
Traffic Volume (vph)	16	1	346	3	3	6	287	555	6	5	578	27
Future Volume (vph)	16	1	346	3	3	6	287	555	6	5	578	27
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Storage Length (ft)	0		50	0		0	150		0	40		0
Storage Lanes	0		0	0		0	0		0	0		0
Taper Length (ft)	0			0			25			25		
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Ped Bike Factor												
Frt		0.873			0.932			0.999			0.992	
Flt Protected		0.997			0.992			0.983			0.999	
Satd. Flow (prot)	0	1612	0	0	1757	0	0	1801	0	0	1820	0
Flt Permitted		0.997			0.992			0.983			0.999	
Satd. Flow (perm)	0	1612	0	0	1757	0	0	1801	0	0	1820	0
Link Speed (mph)		30			30			30			30	
Link Distance (ft)		2388			2408			316			2230	
Travel Time (s)		54.3			54.7			7.2			50.7	
Confl. Peds. (#/hr)							1		1	1		1
Peak Hour Factor	0.67	0.25	0.84	0.75	0.38	0.50	0.84	0.90	0.75	0.31	0.91	0.68
Growth Factor	102%	102%	102%	102%	102%	102%	102%	102%	102%	102%	102%	102%
Heavy Vehicles (%)	13%	0%	2%	0%	0%	0%	3%	4%	0%	20%	3%	4%
Adj. Flow (vph)	24	4	420	4	8	12	349	629	8	16	648	41
Shared Lane Traffic (%)												
Lane Group Flow (vph)	0	448	0	0	24	0	0	986	0	0	705	0
Enter Blocked Intersection	No	No	No	No	No	No	No	No	No	No	No	No
Lane Alignment	Left	Left	Right	Left	Left	Right	Left	Left	Right	Left	Left	Right
Median Width(ft)		0			0			0			0	
Link Offset(ft)		0			-10			6			0	
Crosswalk Width(ft)		16			16			16			16	
Two way Left Turn Lane												
Headway Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Sign Control		Yield			Yield			Yield			Yield	

Intersection Summary

Area Type:	Other
Control Type:	Roundabout
Intersection Capacity Utilization	113.0%
ICU Level of Service	H
Analysis Period (min)	15

HCM Unsignalized Intersection Capacity Analysis  
 1: Main St (1A) & Arbor St/Friend Ct

07/23/2018



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Right Turn Channelized												
Traffic Volume (veh/h)	16	1	346	3	3	6	287	555	6	5	578	27
Future Volume (veh/h)	16	1	346	3	3	6	287	555	6	5	578	27
Peak Hour Factor	0.67	0.25	0.84	0.75	0.38	0.50	0.84	0.90	0.75	0.31	0.91	0.68
Hourly flow rate (vph)	24	4	420	4	8	12	349	629	8	16	648	41
Approach Volume (veh/h)	448						986		705			
Crossing Volume (veh/h)	668				1002			44		361		
High Capacity (veh/h)	816				621			1338		1043		
High v/c (veh/h)	0.55				0.04			0.74		0.68		
Low Capacity (veh/h)	650				482			1119		852		
Low v/c (veh/h)	0.69				0.05			0.88		0.83		
<b>Intersection Summary</b>												
Maximum v/c High			0.74									
Maximum v/c Low			0.88									
Intersection Capacity Utilization			113.0%		ICU Level of Service				H			

HCM 2010 Roundabout  
 1: Main St (1A) & Arbor St/Friend Ct

07/23/2018

Intersection				
Intersection Delay, s/veh	37.4			
Intersection LOS	E			
Approach	EB	WB	NB	SB
Entry Lanes	1	1	1	1
Conflicting Circle Lanes	1	1	1	1
Adj Approach Flow, veh/h	448	24	986	705
Demand Flow Rate, veh/h	459	24	1021	729
Vehicles Circulating, veh/h	690	1040	50	371
Vehicles Exiting, veh/h	410	31	1099	693
Follow-Up Headway, s	3.186	3.186	3.186	3.186
Ped Vol Crossing Leg, #/h	1	1	0	0
Ped Cap Adj	1.000	1.000	1.000	1.000
Approach Delay, s/veh	32.6	9.9	37.1	42.0
Approach LOS	D	A	E	E
Lane	Left	Left	Left	Left
Designated Moves	LTR	LTR	LTR	LTR
Assumed Moves	LTR	LTR	LTR	LTR
RT Channelized				
Lane Util	1.000	1.000	1.000	1.000
Critical Headway, s	5.193	5.193	5.193	5.193
Entry Flow, veh/h	459	24	1021	729
Cap Entry Lane, veh/h	567	399	1075	780
Entry HV Adj Factor	0.976	1.000	0.966	0.966
Flow Entry, veh/h	448	24	986	705
Cap Entry, veh/h	553	399	1038	754
V/C Ratio	0.810	0.060	0.950	0.935
Control Delay, s/veh	32.6	9.9	37.1	42.0
LOS	D	A	E	E
95th %tile Queue, veh	8	0	16	13

Lanes, Volumes, Timings  
 2: Main St (1A) & Monument St/Wenham Town Hall

07/23/2018



Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	0	0	3	0	0	0	5	841	0	1	752	185
Future Volume (vph)	0	0	3	0	0	0	5	841	0	1	752	185
Ideal Flow (vphp)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Storage Length (ft)	0		15	0		0	25		0	0		0
Storage Lanes	0		0	0		0	1		0	0		0
Taper Length (ft)	0			0			25			0		
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Ped Bike Factor												
Frt		0.865									0.971	
Flt Protected							0.950					
Satd. Flow (prot)	0	1644	0	0	0	0	1504	1827	0	0	1805	0
Flt Permitted							0.950					
Satd. Flow (perm)	0	1644	0	0	0	0	1504	1827	0	0	1805	0
Link Speed (mph)		30			30			30			30	
Link Distance (ft)		2613			509			460			316	
Travel Time (s)		59.4			11.6			10.5			7.2	
Confl. Peds. (#/hr)							5					5
Peak Hour Factor	0.92	0.92	0.38	0.92	0.25	0.25	0.63	0.90	0.92	0.25	0.95	0.86
Growth Factor	102%	102%	102%	102%	102%	102%	102%	102%	102%	102%	102%	102%
Heavy Vehicles (%)	6%	2%	0%	2%	0%	0%	20%	4%	0%	0%	2%	3%
Adj. Flow (vph)	0	0	8	0	0	0	8	953	0	4	807	219
Shared Lane Traffic (%)												
Lane Group Flow (vph)	0	8	0	0	0	0	8	953	0	0	1030	0
Enter Blocked Intersection	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	2 veh	Yes
Lane Alignment	Left	Left	Right	Left	Left	Right	Left	Left	Right	Left	Left	Right
Median Width(ft)		0			0			12			12	
Link Offset(ft)		0			30			0			0	
Crosswalk Width(ft)		16			16			16			16	
Two way Left Turn Lane												
Headway Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Turning Speed (mph)	25		9	15		9	15		9	15		9
Sign Control		Stop			Stop			Free			Free	

Intersection Summary	
Area Type:	Other
Control Type:	Unsignalized
Intersection Capacity Utilization	62.8%
	ICU Level of Service B
Analysis Period (min)	15

# HCM Unsignalized Intersection Capacity Analysis

## 2: Main St (1A) & Monument St/Wenham Town Hall

07/23/2018



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		↕					↕	↕			↕	
Traffic Volume (veh/h)	0	0	3	0	0	0	5	841	0	1	752	185
Future Volume (Veh/h)	0	0	3	0	0	0	5	841	0	1	752	185
Sign Control		Stop			Stop			Free			Free	
Grade		0%			0%			0%			0%	
Peak Hour Factor	0.92	0.92	0.38	0.92	0.25	0.25	0.63	0.90	0.92	0.25	0.95	0.86
Hourly flow rate (vph)	0	0	8	0	0	0	8	953	0	4	807	219
Pedestrians		5										
Lane Width (ft)		12.0										
Walking Speed (ft/s)		3.5										
Percent Blockage		0										
Right turn flare (veh)												
Median type								None			None	
Median storage (veh)												
Upstream signal (ft)												
pX, platoon unblocked												
vC, conflicting volume	1898	1898	922	1902	2008	953	1031			953		
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	1898	1898	922	1902	2008	953	1031			953		
tC, single (s)	*6.0	6.5	*6.5	7.1	6.5	6.2	4.3			4.1		
tC, 2 stage (s)												
tF (s)	3.6	4.0	3.3	3.5	4.0	3.3	2.4			2.2		
p0 queue free %	100	100	97	100	100	100	99			99		
cM capacity (veh/h)	93	68	305	50	59	317	606			729		

Direction, Lane #	EB 1	NB 1	NB 2	SB 1
Volume Total	8	8	953	1030
Volume Left	0	8	0	4
Volume Right	8	0	0	219
cSH	305	606	1700	729
Volume to Capacity	0.03	0.01	0.56	0.01
Queue Length 95th (ft)	2	1	0	0
Control Delay (s)	17.1	11.0	0.0	0.2
Lane LOS	C	B		A
Approach Delay (s)	17.1	0.1		0.2
Approach LOS	C			

Intersection Summary			
Average Delay		0.2	
Intersection Capacity Utilization	62.8%		ICU Level of Service
Analysis Period (min)	15		B

\* User Entered Value

Intersection												
Int Delay, s/veh	0.1											
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		↕					↕	↕			↕	
Traffic Vol, veh/h	0	0	3	0	0	0	5	841	0	1	752	185
Future Vol, veh/h	0	0	3	0	0	0	5	841	0	1	752	185
Conflicting Peds, #/hr	0	0	0	0	0	0	5	0	0	0	0	5
Sign Control	Stop	Stop	Stop	Stop	Stop	Stop	Free	Free	Free	Free	Free	Free
RT Channelized	-	-	None	-	-	None	-	-	None	-	-	None
Storage Length	-	-	-	-	-	-	25	-	-	-	-	-
Veh in Median Storage, #	-	0	-	-	-	-	-	0	-	-	0	-
Grade, %	-	0	-	-	0	-	-	0	-	-	0	-
Peak Hour Factor	92	92	38	92	25	25	63	90	92	25	95	86
Heavy Vehicles, %	6	2	0	2	0	0	20	4	0	0	2	3
Mvmt Flow	0	0	8	0	0	0	8	953	0	4	807	219

Major/Minor	Minor2			Major1			Major2					
Conflicting Flow All	1899	1899	922				1032	0	0	953	0	0
Stage 1	930	930	-				-	-	-	-	-	-
Stage 2	969	969	-				-	-	-	-	-	-
Critical Hdwy	6.46	6.52	6.2				4.3	-	-	4.1	-	-
Critical Hdwy Stg 1	5.46	5.52	-				-	-	-	-	-	-
Critical Hdwy Stg 2	5.46	5.52	-				-	-	-	-	-	-
Follow-up Hdwy	3.554	4.018	3.3				2.38	-	-	2.2	-	-
Pot Cap-1 Maneuver	74	69	330				608	-	-	729	-	-
Stage 1	378	346	-				-	-	-	-	-	-
Stage 2	362	332	-				-	-	-	-	-	-
Platoon blocked, %								-	-		-	-
Mov Cap-1 Maneuver	71	0	328				608	-	-	729	-	-
Mov Cap-2 Maneuver	71	0	-				-	-	-	-	-	-
Stage 1	371	0	-				-	-	-	-	-	-
Stage 2	356	0	-				-	-	-	-	-	-

Approach	EB	NB	SB
HCM Control Delay, s	16.3	0.1	0
HCM LOS	C		

Minor Lane/Major Mvmt	NBL	NBT	NBR	EBLn1	SBL	SBT	SBR
Capacity (veh/h)	608	-	-	328	729	-	-
HCM Lane V/C Ratio	0.013	-	-	0.025	0.006	-	-
HCM Control Delay (s)	11	-	-	16.3	10	0	-
HCM Lane LOS	B	-	-	C	A	A	-
HCM 95th %tile Q(veh)	0	-	-	0.1	0	-	-

Lanes, Volumes, Timings  
 3: Main St (1A) & Cherry St/Old Country Rd

07/23/2018



Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		↕			↕			↕			↕	
Traffic Volume (vph)	303	0	154	2	1	2	87	544	0	0	642	108
Future Volume (vph)	303	0	154	2	1	2	87	544	0	0	642	108
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Storage Length (ft)	0		15	0		0	15		0	0		0
Storage Lanes	0		0	0		0	0		0	0		0
Taper Length (ft)	0			0			25			0		
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Frt		0.953			0.955						0.977	
Flt Protected		0.968			0.984			0.993				
Satd. Flow (prot)	0	1680	0	0	1785	0	0	1817	0	0	1805	0
Flt Permitted		0.968			0.984			0.993				
Satd. Flow (perm)	0	1680	0	0	1785	0	0	1817	0	0	1805	0
Link Speed (mph)		30			30			30			30	
Link Distance (ft)		2702			575			3735			460	
Travel Time (s)		61.4			13.1			84.9			10.5	
Peak Hour Factor	0.92	0.25	0.88	0.50	0.25	0.50	0.84	0.83	0.50	0.50	0.93	0.75
Growth Factor	102%	102%	102%	102%	102%	102%	102%	102%	102%	102%	102%	102%
Heavy Vehicles (%)	4%	0%	5%	0%	0%	0%	3%	4%	0%	0%	3%	2%
Adj. Flow (vph)	336	0	179	4	4	4	106	669	0	0	704	147
Shared Lane Traffic (%)												
Lane Group Flow (vph)	0	515	0	0	12	0	0	775	0	0	851	0
Enter Blocked Intersection	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Lane Alignment	Left	Left	Right	Left	Left	Right	Left	Left	Right	Left	Left	Right
Median Width(ft)		0			0			12			12	
Link Offset(ft)		0			16			0			0	
Crosswalk Width(ft)		16			16			16			16	
Two way Left Turn Lane												
Headway Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Sign Control		Yield			Yield			Yield			Yield	

Intersection Summary

Area Type:	Other
Control Type:	Roundabout
Intersection Capacity Utilization	118.7%
ICU Level of Service	H
Analysis Period (min)	15



HCM Unsignalized Intersection Capacity Analysis  
 3: Main St (1A) & Cherry St/Old Country Rd

07/23/2018



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Right Turn Channelized												
Traffic Volume (veh/h)	303	0	154	2	1	2	87	544	0	0	642	108
Future Volume (veh/h)	303	0	154	2	1	2	87	544	0	0	642	108
Peak Hour Factor	0.92	0.25	0.88	0.50	0.25	0.50	0.84	0.83	0.50	0.50	0.93	0.75
Hourly flow rate (vph)	336	0	179	4	4	4	106	669	0	0	704	147
Approach Volume (veh/h)	515		12				775			851		
Crossing Volume (veh/h)	708				1111			336			114	
High Capacity (veh/h)	790				568			1064			1267	
High v/c (veh/h)	0.65				0.02			0.73			0.67	
Low Capacity (veh/h)	628				436			871			1054	
Low v/c (veh/h)	0.82				0.03			0.89			0.81	
<b>Intersection Summary</b>												
Maximum v/c High	0.73											
Maximum v/c Low	0.89											
Intersection Capacity Utilization	118.7%				ICU Level of Service				H			

HCM 2010 Roundabout  
 3: Main St (1A) & Cherry St/Old Country Rd

07/23/2018

Intersection				
Intersection Delay, s/veh	46.8			
Intersection LOS	E			
Approach	EB	WB	NB	SB
Entry Lanes	1	1	1	1
Conflicting Circle Lanes	1	1	1	1
Adj Approach Flow, veh/h	515	12	775	851
Demand Flow Rate, veh/h	537	12	805	875
Vehicles Circulating, veh/h	729	1154	349	117
Vehicles Exiting, veh/h	263	0	917	1049
Follow-Up Headway, s	3.186	3.186	3.186	3.186
Ped Vol Crossing Leg, #/h	0	0	0	0
Ped Cap Adj	1.000	1.000	1.000	1.000
Approach Delay, s/veh	63.8	10.6	58.2	26.8
Approach LOS	F	B	F	D
Lane	Left	Left	Left	Left
Designated Moves	LR	LTR	LT	TR
Assumed Moves	LR	LTR	LT	TR
RT Channelized				
Lane Util	1.000	1.000	1.000	1.000
Critical Headway, s	5.193	5.193	5.193	5.193
Entry Flow, veh/h	537	12	805	875
Cap Entry Lane, veh/h	545	356	797	1005
Entry HV Adj Factor	0.959	1.000	0.963	0.972
Flow Entry, veh/h	515	12	775	851
Cap Entry, veh/h	523	356	768	977
V/C Ratio	0.985	0.034	1.010	0.870
Control Delay, s/veh	63.8	10.6	58.2	26.8
LOS	F	B	F	D
95th %tile Queue, veh	13	0	18	12



Lanes, Volumes, Timings  
 1: Main St (1A) & Arbor St/Friend Ct

07/23/2018



Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		↕			↕			↕			↕	
Traffic Volume (vph)	18	0	267	7	0	13	297	652	11	5	596	25
Future Volume (vph)	18	0	267	7	0	13	297	652	11	5	596	25
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Storage Length (ft)	0		50	0		0	150		0	40		0
Storage Lanes	0		0	0		0	0		0	0		0
Taper Length (ft)	0			0			25			25		
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Ped Bike Factor												
Frt		0.878			0.905			0.998			0.994	
Flt Protected		0.995			0.986			0.985			0.999	
Satd. Flow (prot)	0	1660	0	0	1695	0	0	1837	0	0	1869	0
Flt Permitted		0.995			0.986			0.985			0.999	
Satd. Flow (perm)	0	1660	0	0	1695	0	0	1837	0	0	1869	0
Link Speed (mph)		30			30			30			30	
Link Distance (ft)		2388			2408			316			2230	
Travel Time (s)		54.3			54.7			7.2			50.7	
Confl. Peds. (#/hr)							1		2	2		1
Peak Hour Factor	0.56	0.92	0.88	0.58	0.92	0.46	0.88	0.89	0.69	0.63	0.93	0.78
Growth Factor	102%	102%	102%	102%	102%	102%	102%	102%	102%	102%	102%	102%
Heavy Vehicles (%)	0%	0%	0%	0%	0%	0%	1%	2%	0%	0%	1%	0%
Adj. Flow (vph)	33	0	309	12	0	29	344	747	16	8	654	33
Shared Lane Traffic (%)												
Lane Group Flow (vph)	0	342	0	0	41	0	0	1107	0	0	695	0
Enter Blocked Intersection	No	No	No	No	No	No	No	No	No	No	No	No
Lane Alignment	Left	Left	Right	Left	Left	Right	Left	Left	Right	Left	Left	Right
Median Width(ft)		0			0			0			0	
Link Offset(ft)		0			-10			6			0	
Crosswalk Width(ft)		16			16			16			16	
Two way Left Turn Lane												
Headway Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Sign Control		Yield			Yield			Yield			Yield	

Intersection Summary

Area Type:	Other
Control Type:	Roundabout
Intersection Capacity Utilization	114.6%
Analysis Period (min)	15
	ICU Level of Service H

# HCM Unsignalized Intersection Capacity Analysis

## 1: Main St (1A) & Arbor St/Friend Ct

07/23/2018



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Right Turn Channelized												
Traffic Volume (veh/h)	18	0	267	7	0	13	297	652	11	5	596	25
Future Volume (veh/h)	18	0	267	7	0	13	297	652	11	5	596	25
Peak Hour Factor	0.56	0.92	0.88	0.58	0.92	0.46	0.88	0.89	0.69	0.63	0.93	0.78
Hourly flow rate (vph)	33	0	309	12	0	29	344	747	16	8	654	33
Approach Volume (veh/h)		342			41			1107				695
Crossing Volume (veh/h)		674			1124			41				356
High Capacity (veh/h)		812			562			1341				1047
High v/c (veh/h)		0.42			0.07			0.83				0.66
Low Capacity (veh/h)		647			431			1122				856
Low v/c (veh/h)		0.53			0.10			0.99				0.81
<b>Intersection Summary</b>												
Maximum v/c High												0.83
Maximum v/c Low												0.99
Intersection Capacity Utilization			114.6%				ICU Level of Service					H

HCM 2010 Roundabout  
 1: Main St (1A) & Arbor St/Friend Ct

07/23/2018

Intersection				
Intersection Delay, s/veh	42.9			
Intersection LOS	E			
Approach	EB	WB	NB	SB
Entry Lanes	1	1	1	1
Conflicting Circle Lanes	1	1	1	1
Adj Approach Flow, veh/h	342	41	1107	695
Demand Flow Rate, veh/h	342	41	1125	702
Vehicles Circulating, veh/h	681	1142	41	359
Vehicles Exiting, veh/h	380	24	982	824
Follow-Up Headway, s	3.186	3.186	3.186	3.186
Ped Vol Crossing Leg, #/h	1	2	0	0
Ped Cap Adj	1.000	1.000	1.000	1.000
Approach Delay, s/veh	18.2	11.8	57.3	33.8
Approach LOS	C	B	F	D
Lane	Left	Left	Left	Left
Designated Moves	LTR	LTR	LTR	LTR
Assumed Moves	LTR	LTR	LTR	LTR
RT Channelized				
Lane Util	1.000	1.000	1.000	1.000
Critical Headway, s	5.193	5.193	5.193	5.193
Entry Flow, veh/h	342	41	1125	702
Cap Entry Lane, veh/h	572	361	1085	789
Entry HV Adj Factor	1.000	1.000	0.984	0.991
Flow Entry, veh/h	342	41	1107	695
Cap Entry, veh/h	572	361	1067	782
V/C Ratio	0.598	0.114	1.037	0.890
Control Delay, s/veh	18.2	11.8	57.3	33.8
LOS	C	B	F	D
95th %tile Queue, veh	4	0	23	12

# Lanes, Volumes, Timings

## 2: Main St (1A) & Monument St/Wenham Town Hall

07/23/2018



Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		↕					↕	↕			↕	
Traffic Volume (vph)	0	0	6	0	0	0	6	958	2	1	659	210
Future Volume (vph)	0	0	6	0	0	0	6	958	2	1	659	210
Ideal Flow (vphp)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Storage Length (ft)	0		15	0		0	25		0	0		0
Storage Lanes	0		0	0		0	1		0	0		0
Taper Length (ft)	0			0			25			0		
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Ped Bike Factor												
Frt		0.865						0.999			0.964	
Flt Protected							0.950					
Satd. Flow (prot)	0	1405	0	0	0	0	1805	1879	0	0	1814	0
Flt Permitted							0.950					
Satd. Flow (perm)	0	1405	0	0	0	0	1805	1879	0	0	1814	0
Link Speed (mph)		30			30			30			30	
Link Distance (ft)		2613			509			460			316	
Travel Time (s)		59.4			11.6			10.5			7.2	
Confl. Peds. (#/hr)							1					1
Peak Hour Factor	0.92	0.92	0.38	0.92	0.25	0.25	0.75	0.93	0.50	0.25	0.94	0.83
Growth Factor	102%	102%	102%	102%	102%	102%	102%	102%	102%	102%	102%	102%
Heavy Vehicles (%)	6%	2%	17%	2%	0%	0%	0%	1%	0%	0%	1%	1%
Adj. Flow (vph)	0	0	16	0	0	0	8	1051	4	4	715	258
Shared Lane Traffic (%)												
Lane Group Flow (vph)	0	16	0	0	0	0	8	1055	0	0	977	0
Enter Blocked Intersection	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	2 veh	Yes
Lane Alignment	Left	Left	Right	Left	Left	Right	Left	Left	Right	Left	Left	Right
Median Width(ft)		0			0			12			12	
Link Offset(ft)		0			30			0			0	
Crosswalk Width(ft)		16			16			16			16	
Two way Left Turn Lane												
Headway Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Turning Speed (mph)	25		9	15		9	15		9	15		9
Sign Control		Stop			Stop			Free			Free	

### Intersection Summary

Area Type: Other

Control Type: Unsignalized

Intersection Capacity Utilization 61.6% ICU Level of Service B

Analysis Period (min) 15



# HCM Unsignalized Intersection Capacity Analysis

## 2: Main St (1A) & Monument St/Wenham Town Hall

07/23/2018



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		↕					↕	↕			↕	
Traffic Volume (veh/h)	0	0	6	0	0	0	6	958	2	1	659	210
Future Volume (Veh/h)	0	0	6	0	0	0	6	958	2	1	659	210
Sign Control		Stop			Stop			Free			Free	
Grade		0%			0%			0%			0%	
Peak Hour Factor	0.92	0.92	0.38	0.92	0.25	0.25	0.75	0.93	0.50	0.25	0.94	0.83
Hourly flow rate (vph)	0	0	16	0	0	0	8	1051	4	4	715	258
Pedestrians		1										
Lane Width (ft)		12.0										
Walking Speed (ft/s)		3.5										
Percent Blockage		0										
Right turn flare (veh)												
Median type								None			None	
Median storage (veh)												
Upstream signal (ft)												
pX, platoon unblocked												
vC, conflicting volume	1920	1924	845	1937	2051	1053	974			1055		
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	1920	1924	845	1937	2051	1053	974			1055		
tC, single (s)	*6.0	6.5	*6.5	7.1	6.5	6.2	4.1			4.1		
tC, 2 stage (s)												
tF (s)	3.6	4.0	3.5	3.5	4.0	3.3	2.2			2.2		
p0 queue free %	100	100	95	100	100	100	99			99		
cM capacity (veh/h)	91	66	331	46	55	277	715			668		

Direction, Lane #	EB 1	NB 1	NB 2	SB 1
Volume Total	16	8	1055	977
Volume Left	0	8	0	4
Volume Right	16	0	4	258
cSH	331	715	1700	668
Volume to Capacity	0.05	0.01	0.62	0.01
Queue Length 95th (ft)	4	1	0	0
Control Delay (s)	16.4	10.1	0.0	0.2
Lane LOS	C	B		A
Approach Delay (s)	16.4	0.1		0.2
Approach LOS	C			

Intersection Summary			
Average Delay		0.3	
Intersection Capacity Utilization	61.6%		ICU Level of Service
Analysis Period (min)	15		B

\* User Entered Value

Intersection												
Int Delay, s/veh	0.2											
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		↕					↕	↕			↕	
Traffic Vol, veh/h	0	0	6	0	0	0	6	958	2	1	659	210
Future Vol, veh/h	0	0	6	0	0	0	6	958	2	1	659	210
Conflicting Peds, #/hr	0	0	0	0	0	0	1	0	0	0	0	1
Sign Control	Stop	Stop	Stop	Stop	Stop	Stop	Free	Free	Free	Free	Free	Free
RT Channelized	-	-	None	-	-	None	-	-	None	-	-	None
Storage Length	-	-	-	-	-	-	25	-	-	-	-	-
Veh in Median Storage, #	-	0	-	-	-	-	-	0	-	-	0	-
Grade, %	-	0	-	-	0	-	-	0	-	-	0	-
Peak Hour Factor	92	92	38	92	25	25	75	93	50	25	94	83
Heavy Vehicles, %	6	2	17	2	0	0	0	1	0	0	1	1
Mvmt Flow	0	0	16	0	0	0	8	1051	4	4	715	258

Major/Minor	Minor2			Major1			Major2					
Conflicting Flow All	1922	1924	845				974	0	0	1055	0	0
Stage 1	853	853	-				-	-	-	-	-	-
Stage 2	1069	1071	-				-	-	-	-	-	-
Critical Hdwy	6.46	6.52	6.37				4.1	-	-	4.1	-	-
Critical Hdwy Stg 1	5.46	5.52	-				-	-	-	-	-	-
Critical Hdwy Stg 2	5.46	5.52	-				-	-	-	-	-	-
Follow-up Hdwy	3.554	4.018	3.453				2.2	-	-	2.2	-	-
Pot Cap-1 Maneuver	72	67	341				716	-	-	668	-	-
Stage 1	411	376	-				-	-	-	-	-	-
Stage 2	324	297	-				-	-	-	-	-	-
Platoon blocked, %								-	-		-	-
Mov Cap-1 Maneuver	70	0	341				716	-	-	668	-	-
Mov Cap-2 Maneuver	70	0	-				-	-	-	-	-	-
Stage 1	405	0	-				-	-	-	-	-	-
Stage 2	320	0	-				-	-	-	-	-	-

Approach	EB	NB	SB
HCM Control Delay, s	16.1	0.1	0
HCM LOS	C		

Minor Lane/Major Mvmt	NBL	NBT	NBR	EBLn1	SBL	SBT	SBR
Capacity (veh/h)	716	-	-	341	668	-	-
HCM Lane V/C Ratio	0.011	-	-	0.047	0.006	-	-
HCM Control Delay (s)	10.1	-	-	16.1	10.4	0	-
HCM Lane LOS	B	-	-	C	B	A	-
HCM 95th %tile Q(veh)	0	-	-	0.1	0	-	-

Lanes, Volumes, Timings  
 3: Main St (1A) & Cherry St/Old Country Rd

07/23/2018



Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		↕			↕			↕			↕	
Traffic Volume (vph)	274	0	107	5	1	5	158	692	0	0	552	110
Future Volume (vph)	274	0	107	5	1	5	158	692	0	0	552	110
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Storage Length (ft)	0		15	0		0	15		0	0		0
Storage Lanes	0		0	0		0	0		0	0		0
Taper Length (ft)	0			0			25			0		
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Ped Bike Factor												
Frt		0.960			0.932							0.976
Flt Protected		0.966			0.984			0.991				
Satd. Flow (prot)	0	1732	0	0	1742	0	0	1861	0	0	1836	0
Flt Permitted		0.966			0.984			0.991				
Satd. Flow (perm)	0	1732	0	0	1742	0	0	1861	0	0	1836	0
Link Speed (mph)		30			30			30			30	
Link Distance (ft)		2702			575			3735			460	
Travel Time (s)		61.4			13.1			84.9			10.5	
Confl. Peds. (#/hr)				1		1						
Peak Hour Factor	0.93	0.25	0.86	0.63	0.25	0.42	0.96	0.94	0.50	0.50	0.91	0.83
Growth Factor	102%	102%	102%	102%	102%	102%	102%	102%	102%	102%	102%	102%
Heavy Vehicles (%)	2%	0%	1%	0%	0%	0%	2%	1%	0%	0%	1%	1%
Adj. Flow (vph)	301	0	127	8	4	12	168	751	0	0	619	135
Shared Lane Traffic (%)												
Lane Group Flow (vph)	0	428	0	0	24	0	0	919	0	0	754	0
Enter Blocked Intersection	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Lane Alignment	Left	Left	Right	Left	Left	Right	Left	Left	Right	Left	Left	Right
Median Width(ft)		0			0			12			12	
Link Offset(ft)		0			16			0			0	
Crosswalk Width(ft)		16			16			16			16	
Two way Left Turn Lane												
Headway Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Sign Control		Yield			Yield			Yield			Yield	

Intersection Summary

Area Type:	Other
Control Type:	Roundabout
Intersection Capacity Utilization	121.3%
ICU Level of Service	H
Analysis Period (min)	15

HCM Unsignalized Intersection Capacity Analysis  
 3: Main St (1A) & Cherry St/Old Country Rd

07/23/2018



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR	
Right Turn Channelized													
Traffic Volume (veh/h)	274	0	107	5	1	5	158	692	0	0	552	110	
Future Volume (veh/h)	274	0	107	5	1	5	158	692	0	0	552	110	
Peak Hour Factor	0.93	0.25	0.86	0.63	0.25	0.42	0.96	0.94	0.50	0.50	0.91	0.83	
Hourly flow rate (vph)	301	0	127	8	4	12	168	751	0	0	619	135	
Approach Volume (veh/h)	428		24				919			754			
Crossing Volume (veh/h)	627				1220#			301		180			
High Capacity (veh/h)	843				519			1093			1203		
High v/c (veh/h)	0.51				0.05			0.84			0.63		
Low Capacity (veh/h)	674				395			897			996		
Low v/c (veh/h)	0.63				0.06			1.02			0.76		
<b>Intersection Summary</b>													
Maximum v/c High	0.84												
Maximum v/c Low	1.02												
Intersection Capacity Utilization	121.3%				ICU Level of Service				H				
# Crossing flow exceeds 1200, method is not applicable													

HCM 2010 Roundabout  
 3: Main St (1A) & Cherry St/Old Country Rd

07/23/2018

Intersection				
Intersection Delay, s/veh	51.8			
Intersection LOS	F			
Approach	EB	WB	NB	SB
Entry Lanes	1	1	1	1
Conflicting Circle Lanes	1	1	1	1
Adj Approach Flow, veh/h	428	24	919	754
Demand Flow Rate, veh/h	435	24	930	761
Vehicles Circulating, veh/h	633	1237	307	183
Vehicles Exiting, veh/h	311	0	761	1078
Follow-Up Headway, s	3.186	3.186	3.186	3.186
Ped Vol Crossing Leg, #/h	1	0	1	1
Ped Cap Adj	1.000	1.000	1.000	1.000
Approach Delay, s/veh	24.1	12.2	90.2	22.0
Approach LOS	C	B	F	C
Lane	Left	Left	Left	Left
Designated Moves	LR	LTR	LT	TR
Assumed Moves	LR	LTR	LT	TR
RT Channelized				
Lane Util	1.000	1.000	1.000	1.000
Critical Headway, s	5.193	5.193	5.193	5.193
Entry Flow, veh/h	435	24	930	761
Cap Entry Lane, veh/h	600	328	831	941
Entry HV Adj Factor	0.984	1.000	0.989	0.991
Flow Entry, veh/h	428	24	919	754
Cap Entry, veh/h	590	328	822	932
V/C Ratio	0.725	0.073	1.119	0.809
Control Delay, s/veh	24.1	12.2	90.2	22.0
LOS	C	B	F	C
95th %tile Queue, veh	6	0	26	9



**APPENDIX E:  
SIGNAL WARRANT ANALYSIS**



**Table E-1**  
**Summary of Hourly Volumes and Warrant Analyses**  
**Route 1A (Main Street) at Arbor Street and Friend Court, Wenham**

Hourly period starting	Route 1A (major street)		Arbor St. (minor street)	Friend Ct. (minor street)	Sum of major street	Maximum of minor street	Volumes above the required minimum on main/minor street			
	SW	NE	SB	NB			Warrant 1	Warrant 2	Warrant 3	Warrant 7
6:00	248	323	174	4	571	174	√			3 crashes
7:00	536	742	354	12	1278	354	√	√	√	
8:00	614	797	324	17	1411	324	√	√	√	
9:00	530	645	241	25	1175	241	√	√	√	
10:00	492	603	187	19	1095	187	√	√	√	
11:00	478	672	196	30	1149	196	√	√	√	
12:00	550	726	201	34	1277	201	√	√	√	
13:00	533	717	193	40	1251	193	√	√	√	
14:00	572	846	209	33	1418	209	√	√	√	
15:00	627	977	281	29	1604	281	√	√	√	
16:00	611	1001	266	29	1612	266	√	√	√	
17:00	510	950	231	17	1460	231	√	√	√	
18:00	356	752	170	8	1109	170	√	√	√	
19:00	243	514	95	11	757	95	√			
							<b>MET</b>	<b>MET</b>	<b>MET</b>	<b>NOT MET</b>

EB = eastbound. NB = northbound. NE = northeastbound. SB = southbound. SW = southwestbound

Note: ATR counts were conducted over a three-day period between 10 AM 11/27/17 and 10 AM 11/30/17

**Warrants 1, 2, 3, and 7 in Manual on Uniform Traffic Control Devices (MUTCD) Chapter 4C were applied to this intersection.**

**Warrant 1 (Eight-hour Volume) is fulfilled.** It requires that the traffic conditions (observed vehicular volumes higher than the specified minimum volumes) exist for each of any eight hours of an average day. Both Condition A (minimum vehicular volume) and Condition B (interruption of continuous traffic) were met in this case.

**Warrant 2 (Four-hour Volume) is fulfilled.** It requires that the traffic conditions (main street combined/minor street maximum volume falling above an applicable curve) exist for each of any four hours of an average day. The lower threshold volume for a minor street of one lane is 80 vehicles per hour (vph).

**Warrant 3 (Peak-hour Volume) is fulfilled.** It requires either that delay for a minor approach exceeds a threshold value, or that the existing traffic volumes are plotted above the applicable curve for any single hour of an average day. Only the volume condition was used, and this intersection exceeds the required volumes for all but two of the studied hours.

**Warrant 7 (Crash Experience) is NOT fulfilled.** Only three crashes likely to be corrected by signalization were observed during 2017, the most recent 12 months for which data are available.

**Table E-2  
Summary of Hourly Volumes and Warrant Analyses  
Route 1A (Main Street) at Monument Street, Wenham**

Hourly period starting	Route 1A (major street)		Monument St. (minor street)	Sum of main street	Maximum of minor street	Volumes above the required minimum on main/minor street			
	SB	NB	EB			Warrant 1	Warrant 2	Warrant 3	Warrant 7
6:00	414	263	52	677	52				2 crashes
7:00	859	567	142	1426	142	√	√	√	
8:00	886	607	165	1493	165	√	√	√	
9:00	733	528	127	1262	127	√	√		
10:00	654	509	113	1163	113	√	√		
11:00	660	568	115	1228	115	√	√		
12:00	724	608	121	1331	121	√	√		
13:00	701	598	137	1298	137	√	√	√	
14:00	763	678	163	1441	163	√	√	√	
15:00	893	768	161	1661	161	√	√	√	
16:00	849	789	147	1638	147	√	√	√	
17:00	727	763	146	1491	146	√	√	√	
18:00	494	625	119	1120	119	√	√		
19:00	314	417	87	731	87				
						<b>MET</b>	<b>MET</b>	<b>MET</b>	<b>NOT MET</b>

EB = eastbound. NB = northbound. NE = northeastbound. SB = southbound. SW = southwestbound

Note: ATR counts were conducted over a three-day period between 10 AM 11/27/17 and 10 AM 11/30/17

**Warrants 1, 2, 3, and 7 in MUTCD Chapter 4C were applied to this intersection.**

**Warrant 1 (Eight-hour Volume) is fulfilled.** It requires that the traffic conditions (observed vehicular volumes higher than the specified minimum volumes) exist for each of any eight hours of an average day. Condition B (interruption of continuous traffic) was met in this case due to high volumes along Route 1A.

**Warrant 2 (Four-hour Volume) is fulfilled.** It requires that the traffic conditions (main street combined/minor street maximum volume falling above an applicable curve) exist for each of any four hours of an average day. The lower threshold volume for a minor street of one lane is 80 vph.

**Warrant 3 (Peak-hour Volume) is fulfilled.** It requires either that delay for a minor approach exceeds a threshold value, or that the existing traffic volumes are plotted above the applicable curve for any single hour of an average day. Only the volume condition was used, and this intersection exceeds the required volumes for seven different hours.

**Warrant 7 (Crash Experience) is NOT fulfilled.** Only two crashes likely to be corrected by signalization were observed during 2017, the most recent 12 months for which data are available.

**Table E-3  
Summary of Hourly Volumes and Warrant Analyses  
Route 1A (Main Street) at Cherry Street, Wenham**

Hourly period starting	Route 1A (major street)		Cherry Street (minor street)	Sum of major street	Maximum of minor street	Volumes above the required minimum on main/minor street			
	SB	NB	EB			Warrant 1	Warrant 2	Warrant 3	Warrant 7
6:00	356	255	95	611	95				8 crashes
7:00	682	534	248	1,217	248	√	√	√	
8:00	718	553	256	1,271	256	√	√	√	
9:00	616	519	160	1,136	160	√	√		
10:00	536	502	131	1,038	131	√	√		
11:00	560	546	139	1,105	139	√	√		
12:00	597	603	151	1,201	151	√	√	√	
13:00	564	603	155	1,167	155	√	√	√	
14:00	587	678	172	1,266	172	√	√	√	
15:00	670	764	219	1,434	219	√	√	√	
16:00	642	810	220	1,452	220	√	√	√	
17:00	545	790	212	1,334	212	√	√	√	
18:00	386	643	130	1,028	130	√	√		
19:00	243	429	67	672	67				
EB = eastbound. NB = northbound. NE = northeastbound. SB = southbound. SW = southwestbound Note: ATR counts were conducted over a three-day period between 10 AM 11/27/17 and 10 AM 11/30/17						<b>MET</b>	<b>MET</b>	<b>MET</b>	<b>MET</b>

**Warrants 1, 2, 3, and 7 in MUTCD Chapter 4C were applied to this intersection.**

**Warrant 1 (Eight-hour Volume) is fulfilled.** It requires that the traffic conditions (observed vehicular volumes higher than the specified minimum volumes) exist for each of any eight hours of an average day. Both Condition A (minimum vehicular volume) and Condition B (interruption of continuous traffic) were met in this case.

**Warrant 2 (Four-hour Volume) is fulfilled.** It requires that the traffic conditions (main street combined/minor street maximum volume falling above an applicable curve) exist for each of any four hours of an average day. The lower threshold volume for a minor street of one lane is 80 vph.

**Warrant 3 (Peak-hour Volume) is fulfilled.** It requires either that delay for a minor approach exceeds a threshold value, or that the existing traffic volumes are plotted above the applicable curve for any single hour of an average day. Only the volume condition was used, and this intersection exceeds the required volumes for eight different hours.

**Warrant 7 (Crash Experience) is fulfilled.** Eight crashes likely to be corrected by signalization were observed during 2017, the most recent 12 months for which data are available.

**APPENDIX F:  
COMMENTS ON PROPOSED IMPROVEMENTS FROM  
STUDY ADVISORY MEMBERS**

## Comments from the Town of Wenham

---

**From:** Peter Lombardi <PLombardi@wenhamma.gov>  
**Sent:** Monday, May 07, 2018 2:55 PM  
**To:** 'Chen-Yuan Wang'  
**Cc:** 'Benjamin Erban'; 'Mark Abbott'  
**Subject:** RE: Wenham Study Comments

**Flag Status:** Flagged

Hello Chen-Yuan,

After reviewing this with the Board of Selectmen at their meeting last Tuesday and circling back with my Dept Heads, our consensus is in line with MassDOT's and your recommendation: Alternative 4A (coordinated lights at Cherry and Arbor) is preferred. We also agree that Alternative 1 (Arbor) is the preferred location if only 1 light is installed after we go through the public process and get feedback from more residents.

Thank you again and look forward to your final report. Please let us know if you need anything else from us in the meantime.

Peter

Peter Lombardi  
Town Administrator

138 Main Street  
Wenham, MA 01984  
978-468-5520 x.2  
<http://wenhamma.gov>

## Comments from MassDOT District 4

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**From:** Timoner, Sara (DOT) <Sara.Timoner@dot.state.ma.us>  
**Sent:** Wednesday, May 02, 2018 4:22 PM  
**To:** Chen-Yuan Wang; Bill Tyack; Peter Lombardi; Perkins, Thomas C.; Kevin Dinapoli; David Marsh; Jeff Baxter; Stephen B. Kavanagh; Gregg, John E. (DOT); Clark, Michael (DOT); Gascon, Cassandra (DOT)  
**Cc:** Nicole Roebuck; Mark Abbott; Benjamin Erban; Seth Asante  
**Subject:** RE: Wenham Study Scoping Meeting 2/15/2018 Draft Summary  
**Flag Status:** Flagged

Hi Chen-Yuan,

Below are the comments from MassDOT District 4 on the Wenham Scoping meeting last Thursday.

- Alternative 4A is our preferred alternative. Alternative 4B can be installed after the intersections are signalized, if it is determined that a left-turn lane is needed for safety or operations.
- If the town decides on only one signal, the MassDOT District 4 preferred alternative is Alternative 1 (signal at Arbor Street/Friend Court)
- Short term accommodations which MassDOT can currently accommodate:
  - Signal timing changes at the pedestrian signal at Main street in front of the post office
  - Adding Pedestrian Warning Sign to both sides of crosswalks at Cherry Street and Monument Street.
- We will not be able to accommodate resurfacing on Rt 1A in Wenham this year.
  - MassDOT will develop a pavement marking plan based on the 'short-term' plan for implementation when Route 1A is resurfaced.

Please let me know if you have any questions.

Thanks!  
Sara

**Sara L. Timoner | Traffic Engineer | MassDOT | Highway Division | District 4**  
519 Appleton Street | Arlington, MA 02476 | p.(781)641-8435 | f.(781)646-5115 | [www.mass.gov/massdot](http://www.mass.gov/massdot)

**APPENDIX G:  
MASSDOT HIGHWAY DIVISION'S PROJECT  
DEVELOPMENT PROCESS**



## Overview of the Project Development Process

Transportation decision-making is complex and can be influenced by legislative mandates, environmental regulations, financial limitations, agency programmatic commitments, and partnering opportunities. Decision-makers and reviewing agencies, when consulted early and often throughout the project development process, can ensure that all participants understand the potential impact these factors can have on project implementation. Project development is the process that takes a transportation improvement from concept through construction.

The MassDOT Highway Division has developed a comprehensive project development process which is contained in Chapter 2 of the *MassDOT Highway Division's Project Development and Design Guide*. The eight-step process covers a range of activities extending from identification of a project need, through completion of a set of finished contract plans, to construction of the project. The sequence of decisions made through the project development process progressively narrows the project focus and, ultimately, leads to a project that addresses the identified needs. The descriptions provided below are focused on the process for a highway project, but the same basic process will need to be followed for non-highway projects as well.

### **1. Needs Identification**

For each of the locations at which an improvement is to be implemented, MassDOT leads an effort to define the problem, establishes project goals and objectives, and defines the scope of the planning needed for implementation. To that end, it has to complete a Project Need Form (PNF), which states in general terms the deficiencies or needs related to the transportation facility or location. The PNF documents the problems and explains why corrective action is needed. For this study, the information defining the need for the project will be drawn primarily, perhaps exclusively, from the present report. Also, at this point in the process, MassDOT meets with potential participants, such as the Metropolitan Planning Organization (MPO) and community members, to allow for an informal review of the project.

The PNF is reviewed by the MassDOT Highway Division district office whose jurisdiction includes the location of the proposed project. MassDOT also sends the PNF to the MPO, for informational purposes. The outcome of this step determines whether the project requires further planning, whether it is already well supported by prior planning studies, and, therefore, whether it is ready to move forward into the design phase, or whether it should be dismissed from further consideration.

### **2. Planning**

This phase will likely not be required for the implementation of the improvements proposed in this planning study, as this planning report should constitute the outcome of this step. However, in general, the purpose of this implementation step is for the project proponent to identify issues, impacts, and approvals that may need to be obtained, so that the subsequent design and permitting processes are understood.

The level of planning needed will vary widely, based on the complexity of the project. Typical tasks include: define the existing context, confirm project need, establish goals and objectives, initiate public outreach, define the project, collect data, develop and analyze alternatives, make recommendations, and provide documentation. Likely outcomes include consensus on the project definition to enable it to move forward into environmental documentation (if needed) and design, or a recommendation to delay the project or dismiss it from further consideration.

### **3. Project Initiation**

At this point in the process, the proponent, MassDOT Highway Division, fills out a Project Initiation Form (PIF) for each improvement, which is reviewed by its Project Review Committee (PRC) and the MPO. The PRC is composed of the Chief Engineer, each District Highway Director, and representatives of the Project Management, Environmental, Planning, Right-of-Way, Traffic, and Bridge departments, and the MassDOT Federal Aid Program Office (FAPO). The PIF documents the project type and description, summarizes the project planning process, identifies likely funding and project management responsibility, and defines a plan for interagency and public participation. First the PRC reviews and evaluates the proposed project based on the MassDOT's statewide priorities and criteria. If the result is positive, MassDOT Highway Division moves the project forward to the design phase, and to programming review by the MPO. The PRC may provide a Project Management Plan to define roles and responsibilities for subsequent steps. The MPO review includes project evaluation based on the MPO's regional priorities and criteria. The MPO may assign project evaluation criteria score, a Transportation Improvement Program (TIP) year, a tentative project category, and a tentative funding category.

### **4. Environmental Permitting, Design, and Right-of-Way Process**

This step has four distinct but closely integrated elements: public outreach, environmental documentation and permitting (if required), design, and right-of-way acquisition (if required). The outcome of this step is a fully designed and permitted project ready for construction. However, a project does not have to be fully designed in order for the MPO to program it in the TIP. The sections below provide more detailed information on the four elements of this step of the project development process.

#### Public Outreach

Continued public outreach in the design and environmental process is essential to maintain public support for the project and to seek meaningful input on the design elements. The public outreach is often in the form of required public hearings, but can also include less formal dialogues with those interested in and affected by a proposed project.

#### Environmental Documentation and Permitting

The project proponent, in coordination with the Environmental Services section of the MassDOT Highway Division, will be responsible for identifying and complying with all applicable federal, state, and local environmental laws and requirements. This includes determining the appropriate project category for both the Massachusetts Environmental Protection Act (MEPA) and the National Environmental Protection Act (NEPA). Environmental documentation and permitting is often completed in conjunction with the **Preliminary Design** phase described below.

#### Design

There are three major phases of design. The first is **Preliminary Design**, which is also referred to as the 25-percent submission. The major components of this phase include full survey of the project area, preparation of base plans, development of basic geometric layout, development of preliminary cost estimates, and submission of a functional design report. Preliminary Design, although not required to, is often completed in conjunction with the Environmental Documentation and Permitting. The next phase is **Final Design**, which is also referred to as the 75-percent and 100-percent submission. The major components of this phase include preparation of a subsurface exploratory plan (if required), coordination of utility relocations, development of traffic management plans through construction zones, development of final cost estimates, and refinement and finalization of the construction plans. Once Final Design is complete, a full set of **Plans, Specifications, and Estimates (PS&E)** is developed for the project.

## Right-of-Way Acquisition

A separate set of Right-of-Way plans are required for any project that requires land acquisition or easements. The plans must identify the existing and proposed layout lines, easements, property lines, names of property owners, and the dimensions and areas of estimated takings and easements.

### **5. Programming (Identification of Funding)**

Programming, which typically begins during the design phase, can actually occur at any time during the process, from planning to design. In this step, which is distinct from project initiation, the proponent requests that the MPO place the project in the region's Transportation Improvement Program (TIP). The proponent requesting the project's listing on the TIP can be the community or it can be one of the MPO member agencies (the Regional Planning Agency, MassDOT, and the Regional Transit Authority). The MPO then considers the project in terms of state and regional needs, evaluation criteria, and compliance with the regional Transportation Plan and decides whether to place it in the draft TIP for public review and then in the final TIP.

### **6. Procurement**

Following project design and programming of a highway project, the MassDOT Highway Division publishes a request for proposals. It then reviews the bids and awards the contract to the qualified bidder with the lowest bid.

### **7. Construction**

After a construction contract is awarded, MassDOT Highway Division and the contractor develop a public participation plan and a management plan for the construction process.

### **8. Project Assessment**

The purpose of this step is to receive constituents' comments on the project development process and the project's design elements. MassDOT Highway Division can apply what is learned in this process to future projects.

## Project Development Schematic Timetable

Description	Schedule Influence	Typical Duration
<p><b>Step I: Problem/Need/Opportunity Identification</b> The proponent completes a Project Need Form (PNF). This form is then reviewed by the MassDOT District office which provides guidance to the proponent on the subsequent steps of the process.</p>	<p>The Project Need Form has been developed so that it can be prepared quickly by the proponent, including any supporting data that is readily available. The District office shall return comments to the proponent within one month of PNF submission.</p>	<p>1 to 3 months</p>
<p><b>Step II: Planning</b> Project planning can range from agreement that the problem should be addressed through a clear solution to a detailed analysis of alternatives and their impacts.</p>	<p>For some projects, no planning beyond preparation of the Project Need Form is required. Some projects require a planning study centered on specific project issues associated with the proposed solution or a narrow family of alternatives. More complex projects will likely require a detailed alternatives analysis.</p>	<p>Project Planning Report: 3 to 24+ months</p>
<p><b>Step III: Project Initiation</b> The proponent prepares and submits a Project Initiation Form (PIF) and a Transportation Evaluation Criteria (TEC) form in this step. The PIF and TEC are informally reviewed by the Metropolitan Planning Organization (MPO) and MassDOT District office, and formally reviewed by the PRC.</p>	<p>The PIF includes refinement of the preliminary information contained in the PNF. Additional information summarizing the results of the planning process, such as the Project Planning Report, are included with the PIF and TEC. The schedule is determined by PRC staff review (dependent on project complexity) and meeting schedule.</p>	<p>1 to 4 months</p>
<p><b>Step IV: Design, Environmental, and Right of Way</b> The proponent completes the project design. Concurrently, the proponent completes necessary environmental permitting analyses and files applications for permits. Any right of way needed for the project is identified and the acquisition process begins.</p>	<p>The schedule for this step is dependent upon the size of the project and the complexity of the design, permitting, and right-of-way issues. Design review by the MassDOT district and appropriate sections is completed in this step.</p>	<p>3 to 48+ months</p>
<p><b>Step V: Programming</b> The MPO considers the project in terms of its regional priorities and determines whether or not to include the project in the draft Regional Transportation Improvement Program (TIP) which is then made available for public comment. The TIP includes a project description and funding source.</p>	<p>The schedule for this step is subject to each MPO's programming cycle and meeting schedule. It is also possible that the MPO will not include a project in its Draft TIP based on its review and approval procedures.</p>	<p>3 to 12+ months</p>
<p><b>Step VI: Procurement</b> The project is advertised for construction and a contract awarded.</p>	<p>Administration of competing projects can influence the advertising schedule.</p>	<p>1 to 12 months</p>
<p><b>Step VII: Construction</b> The construction process is initiated including public notification and any anticipated public involvement. Construction continues to project completion.</p>	<p>The duration for this step is entirely dependent upon project complexity and phasing.</p>	<p>3 to 60+ months</p>
<p><b>Step VIII: Project Assessment</b> The construction period is complete and project elements and processes are evaluated on a voluntary basis.</p>	<p>The duration for this step is dependent upon the proponent's approach to this step and any follow-up required.</p>	<p>1 month</p>

Source: MassDOT Highway Division Project Development and Design Guide