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MEMORANDUM

DATE March 1, 2012
TO City of Newton
FROM Steven Andrews and Chen-Yuan Wang, MPO Staff
RE FFY 2011 Safety and Operations Analyses at Selected Boston
Region MPO Intersections: Crafts Street at Albemarle Road and at
North Street in Newton

INTRODUCTION

Staff selected the intersection of Crafts Street at Albemarle Road for study because of the large number of responses and comments received about this intersection through the Boston Region MPO's Intersections Survey. Meanwhile, Crafts Street at Albemarle Road's traffic conditions and pedestrian movements are highly correlated to those of the adjacent intersection of Crafts Street at North Street, which is why MPO staff studied the two intersections together.

This memorandum summarizes safety and operations analyses and proposes improvement strategies for the intersections of Crafts Street at Albemarle Road and Crafts Street at North Street. It contains the following sections:

- Intersection Layout and Traffic Control
- Issues and Concerns
- Crash Data Analysis
- Existing Conditions Analysis
- Preliminary Analysis of Traffic Signal Warrants for the Intersection of Crafts Street at Albemarle Road
- Analysis of Improvement Alternatives
- Improvement Recommendations and Discussion

The memorandum also includes a collection of technical appendices that contain methods and data applied in the study and detailed reports of the intersection capacity analyses.

INTERSECTION LAYOUT AND TRAFFIC CONTROL

These two intersections are located in the northern part of Newton near the Charles River. Crafts Street, running in the east-west direction, is a two-lane roadway classified as a minor urban arterial. It serves mainly the city's northern neighborhoods and carries a large portion of crosstown traffic. It connects with Waltham Street to the west and Washington Street to the east. Waltham Street leads to the downtown area of Waltham, and Washington Street connects to the Massachusetts Turnpike at Newton Corner.

North Street, running in the north-south direction, is also a two-lane minor urban arterial. It starts at the Crafts Street intersection as North Street, and it passes through Newton for about half a mile as North Street and then continues north with different street names, until it finally connects with Route 20 (Main Street) in Waltham. Albemarle Road, also running in the north-south direction, is a two-lane urban collector (which is considered a more minor roadway than an arterial) divided by Cheesecake Brook. It follows the brook north to the Charles River, where it connects to the Charles River Bike Path. To the south, it intersects with Watertown Street and terminates in a residential neighborhood. Figure 1 shows the locations of the intersections, the adjacent roadways, and the surrounding area.

Figure 2 shows the layout of the two intersections and recently collected peak-hour counts for vehicles, bicycles, and pedestrians. At the intersection of Crafts Street at Albemarle Road, the northbound approach has a shared through and left-turn lane and a short right-turn bay. The southbound approach is wide and an ad hoc right-turn queue forms, when necessary. Both the eastbound and westbound approaches (Crafts Street) have a lane shared by all movements. There is a short left-turn bay in the middle of the intersection (storing about two cars) for traffic heading to Albemarle Road southbound from Crafts Street westbound. Both of the Albemarle Road approaches are stop-controlled; Crafts Street operates freely through the intersection.

There are crosswalks across Albemarle Road and one across Crafts Street, allowing pedestrians to cross the busy roadway at the eastern side of the intersection. There is no crosswalk crossing Crafts Street on the western side of the intersection. There are sidewalks on both sides of Crafts Street, and sidewalks on the right side of all of the Albemarle Road approach legs, except Albemarle Road southbound south of the intersection. Left turns from Crafts Street eastbound to Albemarle Road northbound are prohibited. In addition, heavy vehicles are prohibited from traveling southbound on Albemarle Road.

The intersection of Crafts Street at North Street is a “T” intersection, with North Street intersecting with Crafts Street at about 60 degrees. The southbound approach is primarily a single lane shared by all movements, but occasionally vehicles form an additional queue on the approach for right turns. The eastbound approach of Crafts Street has two lanes: a left-turn exclusive lane (storing about five to six cars) and a through lane. The westbound approach has a short right-turn exclusive lane (storing about four cars) to North Street and a through lane. There are sidewalks and crosswalks on all of the approach legs at the intersection of Crafts Street at North Street.

The traffic signal at Crafts Street at North Street is semi-actuated and operates with three traffic phases and one exclusive pedestrian phase: southbound North Street, all movements (left turns protected) with an overlapping eastbound right turn; eastbound Crafts Street, all movements (left turns protected); eastbound/westbound Crafts Street, all movements (left turns permitted); and an actuated, exclusive pedestrian phase. The southbound phase is actuated. Field measurements indicate that the southbound phase receives a maximum of 30 seconds, including 25 seconds of green time, 3 seconds of yellow, and 2 seconds of all-red time. The leading eastbound phase is 11 seconds long, including 8 seconds of green time and 3 seconds of yellow time. The eastbound/westbound phase receives 37 seconds, including 31 seconds of green time, 4 seconds of yellow time, and 2 seconds of all-red time. The exclusive pedestrian phase receives 7 seconds of “walk” time, 23 seconds of “don’t walk” time, and 5 seconds of all-red time. Right turns on red are not permitted at any of the approaches. The signal heads, while pole-mounted, are clearly



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FIGURE 1
Intersection Locations and Surrounding Areas
Crafts Street at Albemarle Road and North Street, Newton

*Safety and Operations
 Analyses at
 Selected Intersections*

visible from all approaches. The signal lenses appear to be of sufficient size, and at least two signal heads face each approach.

MBTA bus Route 556 has two stops on the south side of Crafts Street eastbound (inbound), and two stops on the north side of Crafts Street (outbound.) The stop on the south side of Crafts Street at North Street is in the middle of the intersection. When a bus stops here, vehicles have to maneuver around the bus or queue behind it, as would be the case for any bus stop, but for a bus stop in an intersection, it is more likely that vehicles try to pass the bus. Buses operate with 30-minute headways during the peak and 60-minute headways during the off-peak. Due to the infrequent bus service, they are probably not interfering with operations at either intersection. The bus stop on the north side at North Street, on the other hand, is occupying the entire right turn lane before the intersection. It appears that it can be consolidated with the adjacent stop just about 300 feet downstream.

A draft of a bicycle plan presented to the City of Newton Transportation Advisory Committee's April 6, 2011, meeting shows some potential bicycle routes that could be planned for the area. The draft bicycle plan indicates that Crafts Street between California Street and Newton's boundary with Waltham could serve as a location for a dedicated bicycle lane (see Appendix A). Watertown Street could receive treatments encouraging bicyclists and motorists to share the road. Albemarle Road connects to the Charles River Bike Path, a popular recreational and commuter multiple-use path, on the eastern side of its northern end. Installing dedicated bicycle lanes on Albemarle Road is mentioned in the 2009 Cheesecake Brook Greenway Master Plan Report, but is not mentioned in the draft bicycle plan.

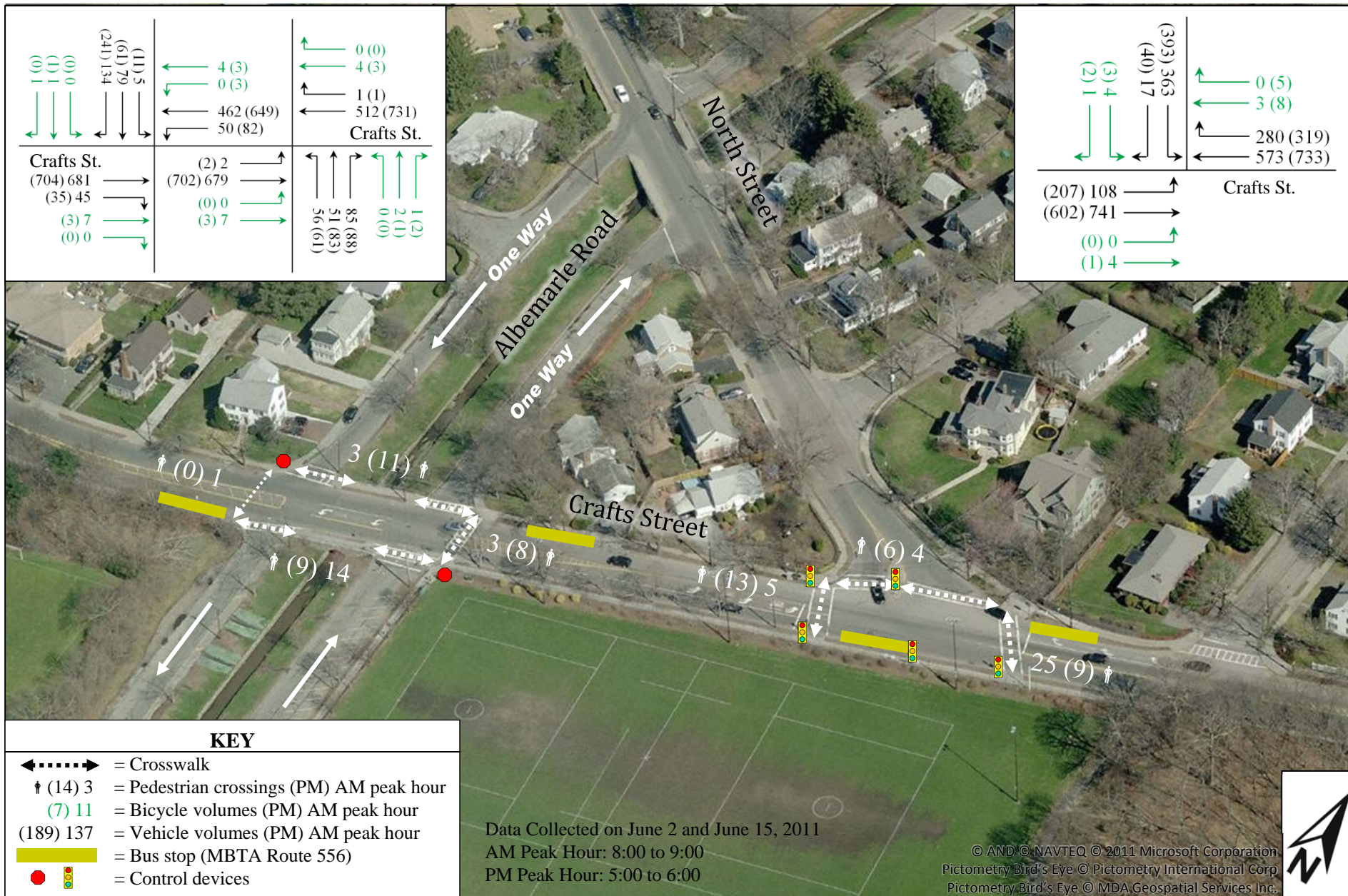
The land use in the vicinity of the intersection is mainly residential. There are also many athletic facilities and schools in the area. Albemarle Field is immediately adjacent to both intersections. One entrance to the park is just to the east of North Street, one is located near the bus stop in the middle of the intersection of Albemarle at North Street, and one is on Albemarle Road at the intersection with Crafts Street. Three schools are located south of Crafts Street in the area. Their start and release times and enrollments are as follows:

- F.A. Day Middle School, 8:05–2:35 (on Tuesday dismissal is at 1:50), 750 students
- Horace Mann Elem. School, 8:20–3:00 (on Tuesday dismissal is at 12:30), 370 students
- The Fessenden School: 7:55–2:30 (times are approximate), 480 students

According to the schedule, the peak pedestrian crossing hours at the two intersections are presumed to be 7:30 to 8:30 in the morning and 2:30 to 3:30 in the afternoon. During field visits in mid-June and mid-September, a crossing guard was present at each intersection during school opening and closing periods.

ISSUES AND CONCERNS

According to crash data and comments received from the MPO's Intersection Survey, of the two intersections, Crafts Street at Albemarle Road is more of a concern. A review of recent crash data from 2006 to 2008 indicates a high number of crashes occurring at the intersection, with a crash rate much higher than other unsignalized intersections in MassDOT Highway Division District 6.



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FIGURE 2
Intersections Layout and Transportation Data
Crafts Street at Albemarle Road and North Street, Newton

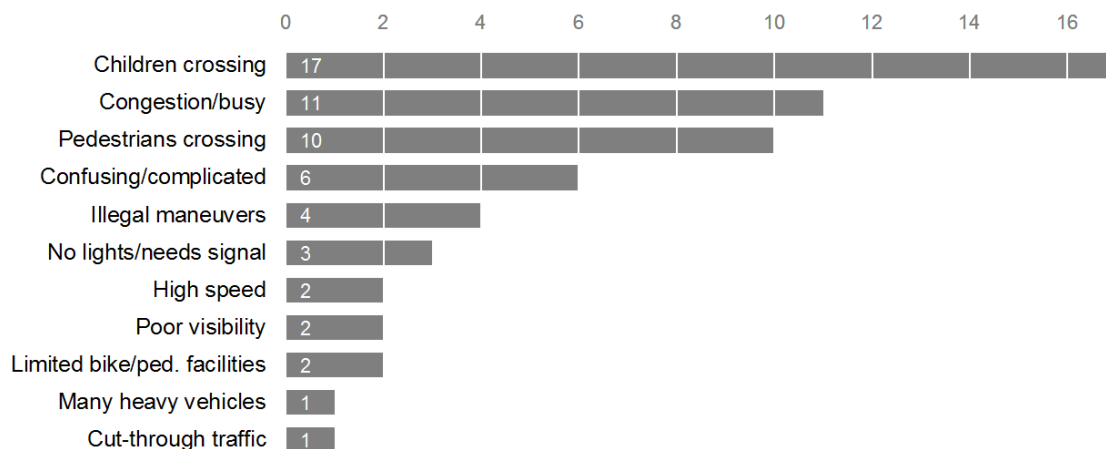
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Pedestrian crossings are also a major issue at the intersection. There are plenty of attractions for pedestrians in the area south of Crafts Street, including three schools, recreational fields, a swimming pool (Gath Pool), and a linear park used by walkers and joggers. Pedestrians from the north must cross Crafts Street to get to the park and recreational facilities. They can cross at the intersection with North Street or walk several hundred feet west to the signalized intersection at Albemarle Road and cross Crafts Street there. The only crosswalk crossing Crafts Street at Albemarle Road is just west of the left-turn lane of Craft Street westbound leading to the signalized intersection at North Street. Drivers often pay more attention to whether there is space to get into that left-turn lane than to whether there are pedestrians crossing the roadway. The length of the crosswalk – the distance pedestrians must walk to cross Crafts Street – is nearly 50 feet.

At the intersection of Crafts Street at North Street, the crosswalks across Crafts Street are about 45 feet long. The crosswalk across North Street is even longer – a distance of over 100 feet – but it has a pedestrian refuge in the middle. While not explicitly part of this study, the intersection of North Street at Albemarle Road does not have clearly marked crosswalks.

In the fall of 2010, the Boston Region Metropolitan Planning Organization (MPO) conducted a survey of the region’s intersections to identify priorities for safety and mobility improvements. The online survey offered the public the opportunity to comment on the intersections in their communities. The intersection of Crafts Street at Albemarle Road was one of the locations in the survey that received a high number of responses. In total, staff received comments from 23 Newton residents about this location (see Appendix B). Staff received only one comment about Crafts Street at North Street, which is not about that intersection itself but rather references its proximity to the intersection at Albemarle Road. Since one person could comment on multiple issues, the comments by the 24 residents were further divided into 59 comments and placed into 11 categories. Figure 3 shows the number of comments in the 11 categories.

FIGURE 3
Number of Comments in 11 Categories from the
Boston Region MPO Intersection Survey:
Crafts Street at Albemarle Road and Crafts Street at North Street



Staff separated the comments about children crossing from comments about pedestrians in general because many people specifically mentioned children or the nearby school. The other

two issues that residents have concerns about are the traffic congestion at the intersections and the confusing design of the intersections. Several people also mentioned that drivers make illegal maneuvers. Two respondents mentioned speed as an issue. Currently, the posted speed limit at the sections of Crafts Street adjacent to the two intersections is 30 miles per hour (mph). Field observations indicate that vehicles on Craft Street frequently travel at higher speeds than the speed limit, sometimes at 40 mph or more. This occurs most often in the section between Waltham Street and Albemarle Road.

The peak-hour traffic congestion on Crafts Street eastbound at Albemarle Road is mostly due to the spillbacks of traffic queuing from the intersection at North Street. Field observations indicate that at times queues even extend from North Street westward past Fessenden Lane and near Morrill Street (see Figure 4). During the morning and afternoon peak hours, eastbound traffic queues frequently block the intersection at Albemarle Road and affect its operation. It is especially difficult for the drivers on the northbound approach, as their sight line to Crafts Street is obstructed and traffic gaps are usually not available. There is a traffic regulatory sign – “Do Not Block Intersection” – located on Crafts Street eastbound before Albemarle Road (see Figure 5). However, it appears to have minimal effect; the intersection is frequently blocked.

FIGURE 4
Traffic Queue on Crafts Street Eastbound during AM Peak Period:
Crafts Street at North Street



This picture was taken on Crafts Street at North Street looking west toward Albemarle Road.

FIGURE 5
Multiple Signs at the Intersection:
Crafts Street Eastbound at Albemarle Road during the AM Peak Period



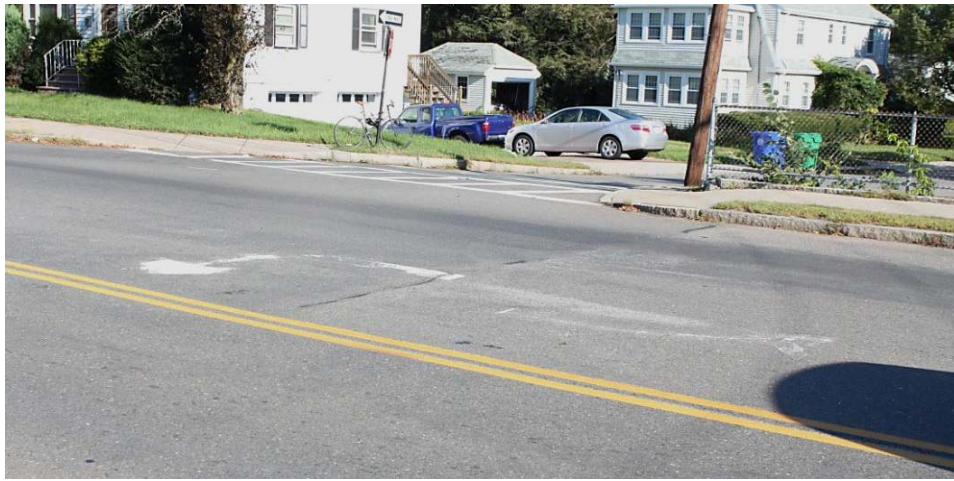
On Crafts Street eastbound, vehicles occasionally form a second lane in order to better utilize the exclusive left-turn lane to North Street. These vehicles frequently encroach on the opposite left-turn lane on Crafts Street and creates potential conflicts. Vehicles turning left from Albemarle Road northbound to Crafts Street westbound cannot, nor would they expect to, see the hidden additional vehicle queue on Crafts Street eastbound in the middle of the intersection.

Since Albemarle Road is split by a creek with one-way operation on each side of the creek, and is under stop control, having appropriate signage at the intersection can be challenging. There are “Stop” signs and “Do Not Enter” signs on Albemarle Road. Meanwhile, there are multiple signs on Crafts Street near the intersection, including a “School Advance Crossing” warning sign (MUTCD S1-1), a “Do Not Block Intersection” sign, “One-way Street” signs, a “No Left Turn” sign, street name signs, and an MBTA bus stop sign (see Figure 5).¹ These multiple signs create a confusing environment for drivers, cyclists, and pedestrians. On the other hand, all of the signs appear to be necessary for the existing operations at the intersection.

At the intersection of Crafts Street at Albemarle Road, the westbound left-turn lane on Crafts Street was converted recently from an eastbound left-turn lane. Old pavement markings are still somewhat visible, and the two sets of arrows are on top of each other. Although there is a “No left turn” sign on a light pole at the northeast corner of the intersection, some drivers may mistake the lane as a two-way left-turn lane. As Figure 6 shows, the westbound left-turn lane on Crafts Street in the middle of the intersection has two sets of left turn arrows.

¹ *The Manual on Uniform Traffic Control Devices (MUTCD)*, defines the standards used to install traffic control devices on roads open to the public. MUTCD includes guidance on how and where to install traffic signs, road markings, signalized intersections, and other types of traffic control devices.

FIGURE 6
Residue from Old Pavement Markings on Crafts Street Westbound:
Crafts Street at Albemarle Road



In summary, the issues and concerns related to the two intersections on Crafts Street are:

- There are a high number of crashes and a high crash rate at the intersection of Crafts Street at Albemarle Road.
- There are a high number of pedestrians, notably children walking to school, using the two intersections. Although there are school crossing guards to help children during school hours, there are no pedestrian signals for crossing Crafts Street at Albemarle Road during other time periods.
- Traffic congestion eastbound during the AM and PM peak periods causes backups from North Street past Albemarle Road. The backups frequently block the intersection at Albemarle Road and affect its operations.
- There are multiple signs at the intersection of Crafts Street at Albemarle Road, causing confusion for drivers.
- People occasionally make illegal maneuvers. Some of these are likely unintentional due to the complicated nature of the intersections.
- Vehicles travel at speeds higher than the posted speed limit on Crafts Street.
- Old left-turn pavement markings on Crafts Street at Albemarle Road are still somewhat visible.
- There are no clear connections from Albemarle Road to the bicycle trail near Charles River.

CRASH DATA ANALYSIS

Based on the 2006 to 2008 MassDOT Registry of Motor Vehicles Division crash data, Table 1 shows that, on average, about nine crashes occurred at Albemarle Road and Crafts Street each year. Almost 30% of the crashes resulted in personal injuries and about 70% of the total crashes involved property damage only. None of the crashes caused a fatality. The crash types consist of about 73% angle collisions, 12% sideswipe collisions, 8% rear-end collisions, and 4% single-vehicle collisions. There were no head-on crashes. One crash involved a pedestrian, but no crashes involved bicyclists. About 42% of the total crashes occurred during peak periods. About

27% of the total crashes happened when the roadway pavement was wet or icy. Only 8% of the crashes occurred in dark conditions (dawn, dusk, and nighttime).

Crash rates are another effective metric for examining the relative safety of a particular location.² Based on the 2006 to 2008 crash data and the recently collected traffic volume data, the crash rate for the intersection of Crafts Street at Albemarle Road is 1.06 crashes per million entering vehicles (see Appendix C for the calculation). This crash rate is nearly double the average rate for unsignalized intersections in MassDOT Highway Division District 6, reported by MassDOT to be 0.57 crashes per million entering vehicles.³

TABLE 1
Summary of MassDOT Crash Data (2006–08):
Crafts Street at Albemarle Road, Newton

Statistics Period		2006	2007	2008	3-Year	Annual
Total Number of Crashes		14	7	5	26	9
Severity	Property Damage Only	9	6	4	19	6
	Personal Injury	5	1	1	7	2
	Fatality	0	0	0	0	0
	Not Reported	0	0	0	0	0
Collision Type	Angle	7	7	5	19	6
	Rear-end	2	0	0	2	1
	Sideswipe	3	0	0	3	1
	Head-on	0	0	0	0	0
	Single Vehicle	1	0	0	1	0
	Not Reported/Unknown	1	0	0	1	0
Involved pedestrian(s)		1	0	0	1	0
Involved cyclist(s)		0	0	0	0	0
Occurred during weekday peak periods*		7	1	3	11	4
Wet or icy pavement conditions		4	3	0	7	2
Dark/lighted conditions		0	1	1	2	1

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

Staff also collected crash reports from the Newton Police Department (NPD) for the 14 reported crashes that occurred during the period 2008 to 2010: 4 in 2008, 6 in 2009, and 4 in 2010. From the reports, staff constructed a collision diagram for the intersection (see Appendix D). The prevailing type of collision in the three-year period (about 40% of the total crashes) is the angle collision caused by a vehicle traveling eastbound on Crafts Street and a vehicle traveling southbound on Albemarle Road. As was already mentioned, the speed limit on the section of Crafts Street west of the intersection, at Albemarle Road, is 30 mph, but vehicles frequently travel at 40 mph or more in this section. Coming from Waltham Street, the section is downhill and curved. Drivers do not see the intersection until they are near Fessenden Lane. In addition,

² Crash rates are estimated based on crash frequency (crashes per year) and vehicle exposure (traffic volumes or miles traveled). Crash rates are expressed as “crashes per million entering vehicles” for intersection locations and as “crashes per million miles traveled” for roadway segments.

³ The average crash rates estimated by the MassDOT Highway Division are based upon a database that contains intersection crash rates submitted to MassDOT as part of the review process for an Environmental Impact Report or Functional Design Report. The most recent average crash rates, which are updated on a nearly annual basis, are based on all entries in the database, not just those entries made within the past year. The average crash rate for District 6 was calculated on July 7, 2011.

the vegetation on both sides of Crafts Street in this section limits drivers' sight distance to each other from Crafts Street eastbound and the northbound and southbound Albemarle Road approaches.

The collision diagram also shows 10 angle collisions (about 75% of the total crashes), every one of which was caused by a vehicle from Albemarle Road and a vehicle traveling on Crafts Street. A high traffic volume and congestion on Crafts Street during peak periods compel drivers turning off Albemarle Road to choose smaller, and therefore riskier, gaps.

Based on the MassDOT crash data, Table 2 shows that the intersection of Crafts Street at North Street had an average of three crashes each year from 2006 to 2008, a third of the number of crashes that occurred at the Albemarle Road intersection. Most of the crashes (78%) involved property damage only. The crash types consist of 44% angle crashes, 33% rear-end collisions, 11% sideswipes, and 11% head-on collisions. There were no single-vehicle crashes. There was one crash, in 2008, where a bicyclist was involved. The crash rate at the intersection is 0.32 crashes per million entering vehicles, which is about half the average crash rate of District 6 signalized intersections (see Appendix C). The crash rate at Crafts Street at North Street is much lower than the crash rate at Crafts Street at Albemarle Road.

The crash reports from the NPD for 2008 to 2010 for the intersection of Crafts Street at North Street indicate that seven crashes were reported at the intersection (see Appendix D for the collision diagram). The total number of crashes is about the same as the data obtained from MassDOT's database, but the prevailing type of collision (nearly 50% of the total crashes) is the rear-end collision. Two of the three rear-end collisions occurred on the westbound approach of Crafts Street and one on the eastbound approach. The collision diagram also shows two crashes between the westbound through traffic and the eastbound left-turning traffic. These crashes are not unusual for a signalized intersection, especially for one that is frequently congested during peak periods.

TABLE 2
Summary of MassDOT Crash Data (2006–08):
Crafts Street at North Street, Newton

Statistics Period		2006	2007	2008	3-Year	Annual
Total Number of Crashes		2	3	4	9	3
Severity	Property Damage Only	1	3	3	7	2
	Personal Injury	1	0	1	2	1
	Fatality	0	0	0	0	0
	Not Reported	0	0	0	0	0
Collision Type	Angle	0	1	3	4	1
	Rear-end	2	1	0	3	1
	Sideswipe	0	1	0	1	0
	Head-on	0	0	1	1	0
	Single Vehicle	0	0	0	0	0
	Not Reported/Unknown	0	0	0	0	0
Involved pedestrian(s)		0	0	0	0	0
Involved cyclist(s)		0	0	1	1	0
Occurred during weekday peak periods*		0	1	3	4	1
Wet or icy pavement conditions		1	2	2	5	2
Dark/lighted conditions		0	1	1	2	1

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

EXISTING CONDITIONS ANALYSIS

Staff collected turning-movement counts at the intersections on June 2 and 15t, 2011. The data were recorded in 15-minute intervals for the peak traffic periods in the morning, from 7:00 to 9:00 AM, and in the evening, from 4:00 to 6:00 PM.

The collected data indicate that the area's traffic is very busy during both peak periods. The peak traffic hour in the morning was from 8:00 to 9:00, and in the evening, it was from 5:00 to 6:00. Table 3 shows that the intersection of Crafts Street at North Street carried about 2,100 vehicles and with about 35 pedestrian crossings in the morning peak hour, and about 2,300 vehicles with about 30 pedestrian crossings during the evening peak hour. Table 4 shows that the intersection of Crafts Street at Albemarle Road carried about 1,650 vehicles with about 20 pedestrian crossings in the morning peak hour, and about 2,000 vehicles with about 30 pedestrian crossings in the evening peak hour.

Due to the proximity to the intersections of three schools, the pedestrian activities peaked somewhat earlier in the morning than the vehicular activities – from 7:30 to 8:30. During this hour, the intersection of Crafts Street at North Street had over 50 pedestrian crossings and the intersection of Crafts Street at Albemarle Road had nearly 50 pedestrian crossings. Presumably, about the same number of pedestrian crossings and same patterns would occur during the schools' releasing hour, roughly from 2:30 to 3:30.

The two intersections each carried a total of about 10 to 15 bicyclists in each of the AM and PM peak traffic hours. There were more bicyclists (about 15 to 20 bicycles) going through each intersection in the morning hour from 7:00 to 8:00 than at any other hour during the peak periods. Figure 2 shows the vehicle and bicycle turning movements and the pedestrian crossings at the two intersections in the AM and PM peak traffic hours.

TABLE 3
AM and PM Peak-Hour Traffic Volumes and Pedestrian Crossings:
Crafts Street at North Street

Street name		North Street		Crafts Street				Total
Direction		Southbound		Eastbound		Westbound		
Turning movement		LT	RT	LT	TH	TH	RT	
AM peak hour	Turning volume	363	17	108	741	573	280	
	Mvmt. percentage	96%	4%	13%	87%	67%	23%	
	Approach volume	380		849		853		
	Ped. crossings	4		5		25		34
PM peak hour	Turning volume	393	40	207	602	733	319	2,294
	Mvmt. percentage	91%	9%	26%	74%	70%	30%	
	Approach volume	433		809		1,052		
	Ped. crossings	6		13		9		

TABLE 4
AM and PM Peak-Hour Traffic Volumes and Pedestrian Crossings:
Crafts Street at Albemarle Road

Street name		Albemarle Road						Crafts Street						Total
Direction		Northbound			Southbound			Eastbound			Westbound			
Turning movement		LT	TH	RT	LT	TH	RT	LT	TH	RT	LT	TH	RT	
AM peak hour	Turning volume	56	51	85	5	79	134	2	681	45	50	462	1	
	Mvmt. percentage	29%	27%	44%	2%	36%	61%	0%	94%	6%	10%	90%	0%	
	Approach volume	192			218			728			513			
	Ped. crossings	14			3			1			3			21
PM peak hour	Turning volume	61	83	88	11	61	241	2	704	35	82	649	1	2,018
	Mvmt. percentage	26%	36%	38%	4%	19%	77%	0%	95%	5%	11%	89%	0%	
	Approach volume	232			313			741			732			
	Ped. crossings	9			11			0			8			

Note: Eastbound left-turns are prohibited.
 There is not a marked crosswalk across the eastbound Crafts Street approach.

Based on the turning-movement counts and the signal timings measured at the site, staff analyzed the intersection capacity using an intersection capacity analysis program, Synchro.⁴ Crafts Street at North Street was modeled as a semi-actuated signalized intersection. Table 5 shows that all of the movements on Crafts Street encounter some delays during peak periods, especially the westbound through movement. Synchro analysis indicates that the intersection operates at an overall level of service (LOS) E in the AM peak hour with an average delay of just over a minute per vehicle, and at LOS F in the PM peak hour with an average delay of nearly one and a half minutes per vehicle. The volume on the westbound approach surpasses its capacity in both peak hours, and the volume on the eastbound approach is slightly over its capacity in the

⁴ Synchro Version 7 is developed and distributed by Trafficware Ltd. The software can perform capacity analysis and traffic simulation (when combined with SimTraffic) for an individual intersection or a series of intersections.

AM peak hour. The traffic queues observed on both approaches of Crafts Street support these analyses. See Appendix E for the Synchro reports of the analyses for the existing conditions.

Crafts Street at Albemarle Road was modeled as two closely spaced stop-control intersections. The existing right-turn bay was included in the Synchro simulation. While there is not a formal southbound right-turn bay, a small southbound right-turn bay was also added to model the flared area vehicles could use to form two queues. Table 6 summarizes the analysis results. It shows that the northbound and southbound movements endure significant delays due to the heavy traffic on Crafts Street. The Crafts Street approaches seem to be serving vehicles well, with no major delays. The estimation, however, does not include delays on the eastbound approach caused by the queues from the intersection at North Street.

TABLE 5
Intersection Capacity Analysis, Existing Conditions:
Crafts Street at North Street, Newton

Street name		North Street	Crafts Street				Overall
Direction		Southbound	Eastbound		Westbound		
Turning movement		LT/RT	LT	TH	TH	RT	
AM peak hour	LOS	E	C	E	F	A	E
	Delay (sec/veh)	55.5	30.6	67.8	94.8	9.3	63.1
PM peak hour	LOS	D	E	C	F	A	F
	Delay (sec/veh)	47.2	63.3	31.2	178.4	7.8	82.0

TABLE 6
Intersection Capacity Analysis, Existing Conditions:
Crafts Street at Albemarle Road, Newton

Street name		Western Intersection				Eastern Intersection		
Direction		SB	EB	WB		NB	EB	WB
Turning movement		LT/TH/RT	TH/RT	LT	TH	LT/TH/RT	LT/TH	TH/RT
AM peak hour	LOS	F	A	A	A	F	A	A
	Delay	135	0.0	9.5	0.0	>180	0.1	0.0
PM peak hour	LOS	F	A	A	A	F	A	A
	Delay	>180	0.0	10	0.0	>180	0.1	0.0

In addition, staff analyzed the regional traffic patterns in the area. Both Crafts Street and North Street are major crosstown arterials that carry high volumes of vehicles. The two intersections being analyzed – Crafts Street at North Street and Crafts Street at Albemarle Street – and the intersection of North Street at Albemarle Road form a triangle and are interconnected. To analyze the traffic patterns, MPO staff requested 24-hour traffic counts from MassDOT. Automatic Traffic Recorders (ATRs) were placed on the roadways adjacent to the three intersections for three consecutive weekdays in late May of 2011 (see Appendix F for the summary of daily and hourly traffic volumes from the ATR counts).

The data indicate that Crafts Street carries about 9,000 to 12,000 vehicles and North Street carries about 4,500 to 8,500 vehicles in each direction per weekday (see Figure F-1 in Appendix

F for the directional weekday traffic volumes on these streets). Except for the southbound section of Albemarle Road from North Street to Crafts Street, which carries about 3,500 vehicles per weekday, Albemarle Road carries fewer than 2,000 vehicles in each of the one-way directions on both sides of Crafts Street. About 7,500 vehicles per day arrive via North Street from the north. About 60% of these vehicles continue southward to the intersection at Crafts Street, where most of them make left-turns. About 40% of them turn right onto southbound Albemarle Road and reach the intersection at Crafts Street, where most of them make right turns.

Analysis of the peak-hour traffic volumes on these streets indicates a similar traffic pattern (see Figure F-2 in appendix F). Essentially, the southbound section of Albemarle Road serves as a connector for traffic from North Street southbound to Crafts Street westbound. This traffic pattern actually helps alleviate the pressure on the intersection of Crafts Street at North Street, which carries heavy traffic from all approaches. Except for this pattern, no traffic patterns are especially notable.

PRELIMINARY ANALYSIS OF TRAFFIC SIGNAL WARRANTS FOR THE INTERSECTION OF CRAFTS STREET AT ALBEMARLE ROAD

According to the MUTCD, an engineering study of traffic conditions, pedestrian characteristics, and physical characteristics of a location should be performed to determine whether installation of a traffic control signal is justified at that location.⁵ The investigation should include applicable factors contained in the following traffic signal warrants and other factors related to existing operations and safety at the study location:

- Warrant 1 Eight-Hour Vehicular Volume Warrant
- Warrant 2 Four-Hour Vehicular Volume Warrant
- Warrant 3 Peak-Hour Warrant
- Warrant 4 Pedestrian Volume Warrant
- Warrant 5 School Crossing Warrant
- Warrant 6 Coordinated Signal System Warrant
- Warrant 7 Crash Experience Warrant
- Warrant 8 Roadway Network Warrant
- Warrant 9 Intersection Near a Grade Crossing

A traffic control signal should not be installed unless one or more of the conditions represented in these warrants are present. Moreover, the satisfaction of a warrant or warrants in itself does not justify signal installation unless an engineering study indicates that the installation will improve the overall safety and/or operation of the intersection.

In this study, staff performed a preliminary analysis of the applicable traffic signal warrants at the intersection of Crafts Street at Albemarle Road. The applicable factors for this intersection are contained in Warrants 1, 2, 5, and 7. Warrant 3 is intended for unusual cases, such as office complexes, manufacturing plants, industrial complexes, or high-occupancy-vehicle facilities that attract or discharge large numbers of vehicles over a short time. Pedestrian volume is not high at this intersection, but the intersection is close to several schools. The intersection is not near a

⁵ Federal Highway Administration, U.S. Department of Transportation, *The Manual on Uniform Traffic Control Devices (MUTCD)*, Chapter 4C. *Traffic Control Signal Needs*, 2009 Edition, December 2009.

grade crossing, and installing a signal at this intersection is not crucial for maintaining proper vehicle grouping (platooning). Therefore, Warrants 3, 4, 6, 8, and 9 were not tested.

Because the school crossing guard directed most children to cross at Crafts Street's intersection with North Street, fewer than 20 schoolchildren crossed Crafts Street at Albemarle Road during the hour with the highest number of pedestrian crossings. Warrant 5, school crossings, is thus not satisfied.

The examination of Warrants 1, 2, and 7 was based on hourly volumes of an average day, which were derived from the recent MassDOT ATR counts (see Appendix F). Analysis indicates that the intersection meets the conditions required by Warrant 1 (Eight-Hour Vehicular Volume Warrant) and Warrant 2 (Four-Hour Vehicular Volume Warrant). Warrant 7 is not satisfied, as the traffic conditions meet the required criteria but the NPD data indicate that the number of crashes is less than five in 2010. Appendix G presents the analysis of the required hourly volumes for the three warrants.

MPO staff have determined that this intersection qualifies for the installation of a traffic signal, as its traffic conditions meet the requirements of Warrants 1 and 2. To justify the traffic signal installation, MassDOT usually prefers that Warrant 1, eight-hour vehicle volume, is met.

ANALYSIS OF IMPROVEMENT ALTERNATIVES

To improve operations and safety for all users at the two intersections on Crafts Street, staff examined improvement alternatives related mainly to signal operation strategies. Because of the adjacent residential land use and the limited availability of right-of-way, staff did not develop any alternatives that included major geometric modifications. Among the alternatives examined, three are considered feasible. They are (from the least to the most expensive improvement option):

- Alternative 1** Retime the signal at North Street; maintain the existing operations at Albemarle Road.
- Alternative 2** Upgrade the signal at North Street; maintain the existing operations at Albemarle Road.
- Alternative 3** Upgrade the signal at North Street; install a traffic signal at Albemarle Road; coordinate the two traffic signals.

All of the alternatives would maintain or install on-call exclusive pedestrian phases in the existing or new traffic signals (using a pedestrian actuation button). The North Street pedestrian signal phase would remain the same (35 seconds) and the new signal at the Albemarle Road intersection would include an exclusive pedestrian phase of 30 seconds. In addition, all the alternatives would include a minor geometric modification on the northbound approach of Albemarle Road. The approach has a high proportion of right turns. Lengthening the existing right-turn lane from 25 feet to about 75 feet would increase the capacity of the approach significantly. The extension would require removing two existing on-street angle parking spaces.

Alternative 1 would simply retime the traffic signal at the North Street intersection and maintain the existing two-way stop operations at the Albemarle Road intersection. Based on the recent turning-movement counts, Synchro optimization tests indicate that the intersection would improve from LOS E to LOS D in the AM peak hour, and in the PM peak hour from LOS F to

LOS E, with a reduction of overall delay about 10 to 15 seconds per vehicle (see Table 7). The tested model maintained the existing cycle length and pedestrian phase time but reallocated two seconds of green time in the AM peak hour and four in the PM peak hour from the southbound (North Street) phase to the eastbound/westbound phase. See Appendix H for the Synchro reports of the timing settings and analysis results.

Alternative 2 would upgrade the traffic signal at the North Street intersection to a fully actuated signal. It would require installing vehicle and bicycle detectors on both approaches of Crafts Street and upgrading the existing signal controllers. As Table 7 shows, the alternative would further improve the intersection operations by reducing overall delay by about 3 to 6 seconds per vehicle over Alternative 1. Since the signal system would be actuated, both approaches of Crafts Street would operate more efficiently, and the eastbound left-turn signal could gap out at its minimum green time or be skipped.⁶ The tested model contained a cycle length of 115 seconds, including one pedestrian and three traffic phases, in the AM peak period, and a cycle length of 120 seconds in the PM peak period. See Appendix I for the Synchro reports of the timing settings and analysis results.

Under Alternatives 1 and 2, the Albemarle Road approaches would maintain the existing stop-control traffic operation. Although there would be no major operational improvements expected, the intersection's operations and safety would be improved to a certain degree by the installation and modification of traffic control devices. These measures include installing additional crosswalk walk signage at the crosswalk, enlarging and doubling the number of "Stop" signs, and relocating traffic signs on the eastbound approaches. These are low-cost improvements and can be implemented in the short term. See the next section for further discussions of the recommended measures.

Alternative 3 is the most costly, and the most effective, improvement option. It would significantly improve the safety and operations at the Albemarle Road intersection. The alternative would upgrade the North Street intersection to a fully actuated traffic signal, install a fully actuated traffic signal at the Albemarle Road intersection, and coordinate the two traffic signals as a closed-loop system. The traffic signal would prevent blockage of the intersection during peak hours and provide intervals of sufficient time for vehicles from Albemarle Road to pass through the intersection in a more orderly and safe manner and endure less delay during peak hours.⁷ Moreover, it would provide exclusive pedestrian signal phases to stop traffic at all approaches for pedestrians to cross Crafts Street.

Tables 8 and 9 show that Alternative 3 would improve the Albemarle Road approaches from the undesirable LOS F to the acceptable LOS C, D, and E in both the AM and PM peak hours, with a significant reduction of delays, from several minutes to about a half a minute or a minute per vehicle. Meanwhile, it would maintain traffic operations at the desirable LOS A, B, and C on all the Crafts Street approaches.

Unlike existing operations, the signal installation at Albemarle Road would create interruptions of traffic flow on Crafts Street. Coordination would synchronize the two intersections' traffic

⁶ A traffic signal is said to have "gapped out" when an actuated phase terminates before its maximum allotted green time is reached because there is a gap in traffic.

⁷ Installing a traffic signal would potentially reduce delays on the Albemarle Road approaches during other, non-peak hours, as the traffic is usually heavy during most of the daylight hours.

signals and would smooth traffic flow on Crafts Street. As Table 8 shows, all of the alternatives would maintain intersection operations at the acceptable LOS D and E in the AM and PM peak hours. The model designated the North Street intersection as the master intersection in coordinating the eastbound/westbound approaches of the two intersections. The North Street intersection would operate with phasing and timing settings similar to those in Alternative 2.

TABLE 7
Intersection Capacity Analyses of Improvement Alternatives:
Crafts Street at North Street, Newton

Street name		Crafts Street				North Street		Overall	
Direction		Eastbound		Westbound		Southbound			
Measurement		LOS	Delay	LOS	Delay	LOS	Delay	LOS	Delay
AM peak hour	Existing	E	63.1	E	66.7	E	55.5	E	63.1
	Alternative 1	E	53.2	D	48.5	E	66.6	D	53.8
	Alternative 2	D	49.8	C	34.5	E	71.3	D	47.6
	Alternative 3	C	34.6	C	30.0	F	92.6	D	43.6
PM peak hour	Existing	D	39.4	F	126.7	D	47.2	F	82.0
	Alternative 1	D	35.4	F	83.2	E	72.6	E	64.8
	Alternative 2	D	36.3	E	73.1	E	79.0	E	61.5
	Alternative 3	E	66.2	E	64.8	F	92.2	E	70.4

TABLE 8
Intersection Capacity Analyses of Improvement Alternatives:
Eastern Intersection, Crafts Street at Albemarle Road, Newton

Street name		Crafts Street				Albemarle Road		Overall	
Direction		Eastbound		Westbound		Northbound			
Measurement		LOS	Delay	LOS	Delay	LOS	Delay	LOS	Delay
AM peak hour	Existing	A	0.1	A	0.0	F	>180	NA	NA
	Alt. 1/2	A	4.8	A	5.1	E	72.4	B	15.7
	Alternative 3	A	4.8	A	5.1	E	72.4	B	15.7
PM peak hour	Existing	A	0.1	A	0.0	F	>180	NA	NA
	Alt. 1/2	A	2.7	B	12.2	E	65.4	B	15.8
	Alternative 3	A	2.7	B	12.2	E	65.4	B	15.8

TABLE 9
Intersection Capacity Analyses of Improvement Alternatives:
Western Intersection, Crafts Street at Albemarle Road, Newton

Street name		Crafts Street				Albemarle Road		Overall	
Direction		Eastbound		Westbound		Southbound			
Measurement		LOS	Delay	LOS	Delay	LOS	Delay	LOS	Delay
AM peak hour	Existing	A	0.0	A	0.9	F	135	NA	NA
	Alt. 1/2								
	Alternative 3	C	26.1	A	1.5	D	47.4	C	21.0
PM peak hour	Existing	A	0.0	A	1.1	F	>180	NA	NA
	Alt. 1/2								
	Alternative 3	C	29.0	A	4.0	C	33.4	B	18.6

The Albemarle Road intersection would operate with a split phase on Albemarle Road approaches so that traffic would not get stuck in the middle of the intersection. See Appendix J for the Synchro reports of the timing settings and analysis results.

IMPROVEMENT RECCOMENDATIONS AND DISCUSSION

The two intersections on Crafts Street carried heavy traffic and the intersection of Crafts Street at Albemarle Road had a high number of crashes in recent years. To improve the operations and safety for all users at the two intersections, staff collected traffic and crash data, performed intersection capacity and safety analyses, and developed improvement alternatives. Three alternatives selected for consideration are:

- Alternative 1** Retime the signal at North Street; maintain the existing operations at Albemarle Road.
- Alternative 2** Upgrade the signal at North Street; maintain the existing operations at Albemarle Road.
- Alternative 3** Upgrade the signal at North Street; install a traffic signal at Albemarle Road; coordinate the two traffic signals.

Alternatives 1 and 2 basically aim at improving the signal operations at the North Street intersection and maintain the operations at the Albemarle Road intersection with signage and pavement marking improvements. These measures would improve the operations at the Albemarle Road intersection to a certain degree but not significantly. Alternative 3 proposes to install a traffic signal at the Albemarle Road intersection with exclusive pedestrian signal phases and coordinate the two traffic signals on Crafts Street. It would significantly improve the safety and operations at the intersection.

In the short term, staff recommends Alternative 1 with the following improvements at the Albemarle Road intersection:

- Double the number of (left and right) and enlarge the “Stop” signs on the both approaches of Albemarle Road.⁸
- Double the number of and enlarge the “Do Not Enter” signs on the both approaches of Albemarle Road.
- Install “Pedestrian Crossing” warning sign (MUTCD W11-2) on both approaches of Crafts Street about 100 feet ahead of the intersection.^{9,10}
- Install a pedestrian crossing warning sign (W11-2) with downward sloping arrow plaque (W16-7P) at both ends of the existing crosswalk on Crafts Street to indicate the crossing location and to supplement to the advance placement of the pedestrian crossing warning sign.
- Clear the vegetation on the northwest corner of Crafts Street at Albemarle Road; this vegetation limits the distance at which drivers on the eastbound and southbound can see each other.
- Install a series of “Slow” pavement markings, as discussed in Section 3B.20 of the MUTCD, on the Crafts Street eastbound approach to slow down traffic on the approach.¹¹
- Increase the length of the northbound right-turn lane on Albemarle Road.
- Increase the size of “Do Not Block Intersection” on the eastbound approach of Crafts Street.¹²
- Increase the size of “No Left Turn” (MUTCD R3-2) sign on the eastbound approach.
- Set back the “One Way” street arrow signs to at least 50 feet from the intersection so that they will not crowd with the multiple traffic signs at the intersection.¹³
- Obliterate the old left-turn arrows in turning lane on Crafts Street.
- Maintain clear pavement markings in the intersection vicinity, especially the crosswalks at the intersection.

At the North Street intersection, staff recommends that the city maintain clearly marked crosswalks. Lastly, staff recommends keeping the existing school guards at the two intersections during the school opening and releasing hours. At this preliminary planning stage, the total cost of these short-term improvements is roughly estimated as about \$15,000 to \$20,000.

In the long term, staff recommends Alternative 3 with the following features and improvements:

⁸ Currently there is a 24-by-24-inch stop sign on each of the two approaches of Albemarle Road. Since the approaches are wide and traffic usually forms two lanes during peak hours, doubling the number of stop signs would increase drivers’ awareness of the stop operation. In addition, the size of the stop sign should be increased to 36-inch-by-36-inch.

⁹ *The Manual on Uniform Traffic Control Devices (MUTCD)* defines the standards used by road managers nationwide to install and maintain traffic control devices on all public streets, highways, bikeways, and private roads open to public traffic. The manual is published by the Federal Highway Administration (FHWA).

¹⁰ Currently there is a pedestrian crossing warning sign on the eastbound approach. However, it is not noticeable as it is attached to a light pole away from the edge of the road and is obstructed by nearby trees (see the hidden yellow sign on the far right in Figure 5 on page 7). It should be relocated closer to the edge of the road and about 50 feet west of its current location.

¹¹ At least three “Slow” pavement markings should be placed sequentially on the approach within about 250 to 500 feet from the intersection.

¹² The existing sign’s size is too small and is obstructed by foliage. It should be doubled in size and located away from the nearby trees.

¹³ The one-way street signs are confusing to drivers, as the multiple signs at the intersection crowd them. Especially important is that drivers from the eastbound approach are likely to be confused by the multiple “arrow” signs facing the approach pointing in different directions (see Figure 5 on page 7). Enlarging and doubling the number of “Do Not Enter” signs should be sufficient to deter drivers entering the wrong way.

- Install countdown and audible pedestrian signals at the two intersections.
- Install ADA (Americans with Disabilities Act)-compliant curb ramps with tactile paving at the two intersections.
- Install overhead signal heads that are clearly visible from all approaches at the two intersections.
- Add emergency vehicle preemption to the coordinated signal system.
- Consider removing or relocating the MBTA bus stop at the North Street intersection.¹⁴
- Integrate the design of bicycle lanes (dedicated or shared) in the functional design of the two intersections.
- Consider designating the entire section of Albemarle Road between Watertown Street and Charles River as a bicycle route.

As Crafts Street is designated as a bicycle route in the City's draft bicycle transportation plan, dedicated or shared bicycle lanes should be considered at the function design stage of improving the two intersections. At moment, it appears that the section between Fessenden Street and Albemarle Road has limited space for the shared lane option, as it has to accommodate turning lanes to North Street. However, bicycle lanes or five-foot wide shoulders could potentially be added to both sides of the section of Crafts Street west of Albemarle Road.¹⁵ The addition will also narrow the existing wide traffic lanes and could help reduce vehicle speeds.

In addition, staff recommends designating Albemarle Road as a bicycle route in the City's bicycle transportation plan. Albemarle Road is a major connection for the City to the popular Charles River Bike Path. Albemarle Road also connects the proposed Crafts Street and Watertown Street bike routes. A previous study, Cheesecake Brook Greenway Master Plan (December 2009), proposed the installation of bicycle lanes adjacent to the creek on both approaches of Albemarle Road between Watertown Street and Crafts Street. The bicycle lanes could probably continue north of Crafts Street until the Charles River Bike Path, but they would probably have to change to share-the-road lanes north of Crafts Street. A transition between the bicycle lane at the intersection of North Street and sharrows can be attained by installing bicycle boxes on Albemarle Road at the intersection. Bicycle facility improvements should be considered at the functional design stage of the two intersections.

At this preliminary planning stage, the total cost of these long-term improvements is roughly estimated as about \$1,000,000 to \$1,250,000. Both streets and the intersections are under the jurisdiction of the City of Newton. The city can seek funding support from the state by working closely with MassDOT Highway District 6 through the project implementation process. See Appendix K for more information on the project implementation process.

SPA/CW/spa/cw

¹⁴ This bus stop is located on the westbound right-turn lane at of the intersection. It sometimes causes traffic to back up during the peak periods. There is another bus stop about 300 feet father west, on westbound Crafts Street, before Albemarle Road. If the city decides to remove the stop in the right-turn lane, the other bus stop on westbound Crafts Street could remain in its current location or it could be moved closer to North Street. Another option is to relocate the bus stop from the right-turn lane to about 50 feet east of Fessenden Street.

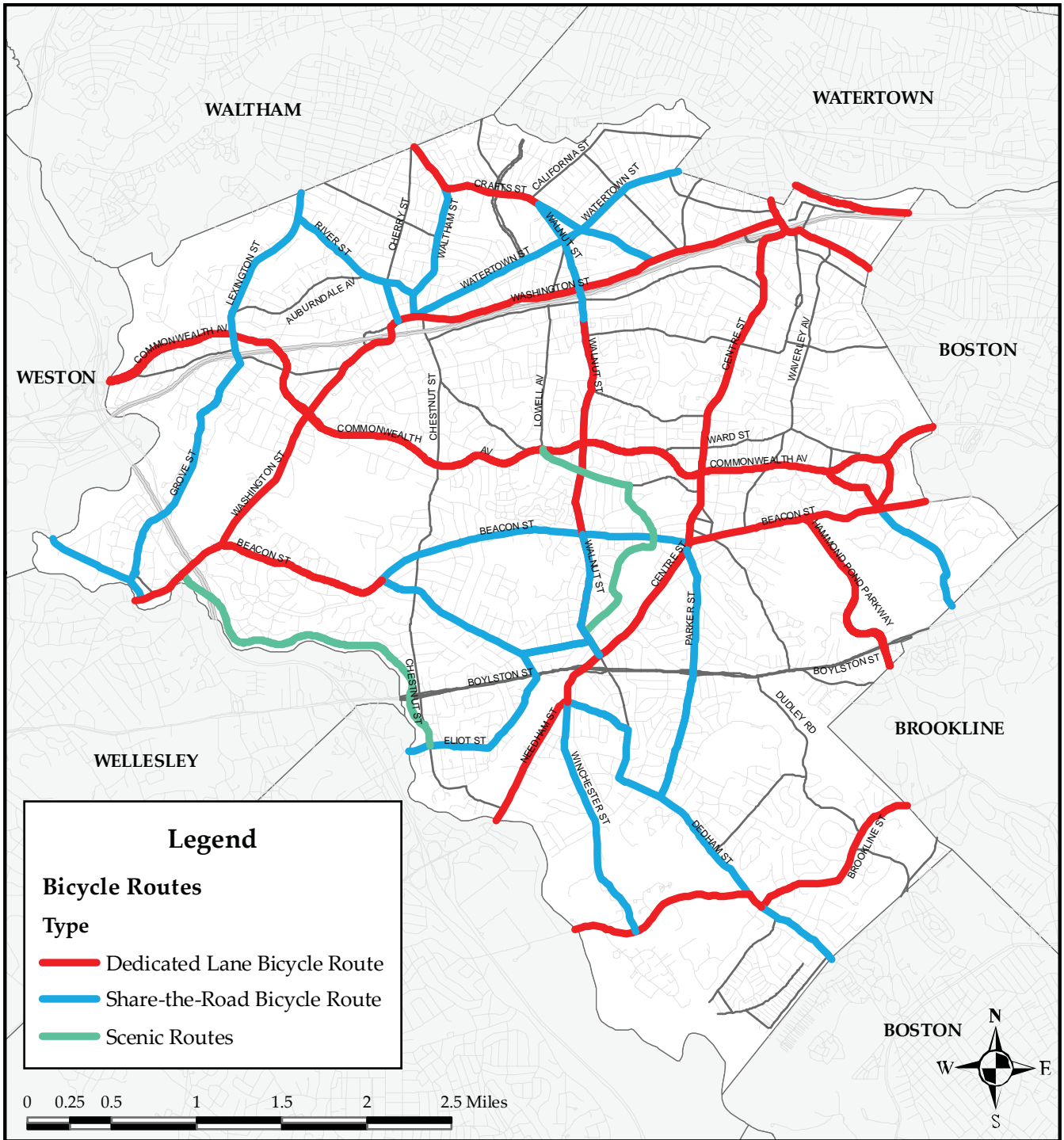
¹⁵ The MassDOT Roadway Inventory File indicates that the section of Crafts Street between Fessenden Street and Waltham Street has a right-of-way of 60 feet and a surface width of 40 feet.

APPENDIX A

**City of Newton Transportation Advisory Committee's
Bicycle Routes Map**

(from Their Draft Bicycle Transportation Plan, February 2, 2011)

DRAFT



Bicycle Routes (Transportation Advisory Committee) City of Newton, Massachusetts



CITY OF NEWTON, MASSACHUSETTS
Mayor - Setti D. Warren
GIS Administrator - Douglas Greenfield

SOURCE: City of Newton GIS

MAP DATE: January 13, 2011

APPENDIX B

**Responses to the Boston Region MPO's Survey
on the Intersection of Crafts Street at Albemarle Road, Newton**

Fall 2010

Newton Intersection Survey

Albemarle Road/Crafts Street

Responses: 25

Note: 23 out of 25 respondents wrote a comment.

Comments:

“Crafts and Linwood and Crafts and Albemarle are both extremely dangerous because drivers fly down the roads. The light needs attention---never seem to work and there are lots of kids on one side of Crafts that need to get to school/pool/fields on the other side--thank you for your attention!”

“It is awful and needs to be addressed. There are so many near misses, illegal turns, added to the fact that the children are crossing to get to schools and fields. The crossing guard looks scared to step into the road!”

“It is a very difficult and dangerous intersection to get through, especially in times of high traffic.”

“Of the group listed above, this one has much confusion for drivers and pedestrians. There is a high traffic volume and public resources that pedestrians must cross Crafts Street to access.”

“It can be quite dangerous to cross here unless you are at the light, which is not the most convenient place to cross. Commuters, school kids for both Day and Horace Mann, and families walking to the Gath Pool all use this intersection. Having a safe crossing at California and Crafts would make a lot of sense.”

“I live 1/10 mile from it. Crafts St is very busy and crossing it on Albemarle or turning onto Crafts St. from Albemarle can be risky and take several minutes. In addition, there is a lot of foot traffic from FA Day, Horace Mann School, Fessenden School, and the recreation facilities on Albemarle.”

“This street is very heavily traveled and people often turn onto Crafts only to turn around to the other side of Albemarle. It is very dangerous.”

“This is a very busy interaction during morning and afternoon rush hours. Many children who go to Horace Man Elementary school and Day Middle school need to go through this intersection on foot or in cars. There are no traffic lights.”

“A lot of kids cross it to get to Day Middle School, Horace Mann Elementary School, the Gath Pool, sports activities at Albemarle playing fields, and the summer camps at those locations. In addition, cars from school and camp pick-ups and sports events pull out from Albemarle onto Crafts and are blinded by the line of cars backed up on Crafts from the North St. light. Many cars

speed down the hill past the Scandinavian home and Fessenden School (east on Crafts). Often they try to make a left lane as they go through the intersection with Albemarle in anticipation of a left turn at the light at North St. Cars pulling out of Albemarle Rd. onto Crafts can't see them coming. It's a recipe for disaster.”

“This intersection is very dangerous as there is a confluence of factors:

- 1) Three school zones (two public one private)
- 2) A heavily used recreation area and pool with many children and adults
- 3) Heavy cut-through traffic from Waltham to the Pike
- 4) Heavy repair vehicle traffic from the NSTAR facility on Calvary Street in Waltham
- 5) Heavy pedestrian and bike traffic heading to the Charles River Pathway at the end of Albemarle Road

Newton has funded planning for a pedestrian/bike path following Cheesecake Brook to the Charles River Pathway at the end of Albemarle. However, there are no funds to implement the plan. If as a state we are going to encourage more biking and walking, safe pedestrian ways to bike trails like the Charles River Pathway are essential. With the poor crossing at Albemarle and Crafts, a major bikeway is cut off by a dangerous intersection from a heavily populated section of Newton.”

“The traffic is heavy on Crafts and the light at the corner with North St causes traffic to back up. The visibility is bad with the fence there due to Cheesecake Brook and you must pull further onto Crafts than is safe to see.”

“Complicated intersection. Difficult when school is in session -- kids crossing the road, traffic backs up from light.”

“It is a major intersection around 3 schools. Every weekday, cars block the intersection so that cars that are on Albemarle looking to cross over Crafts to go to/from the schools & fields have to cross 1/2 of the road to await a "kind" driver who will let them in to cross the other 1/2. I have waited 5 minutes before to cross the street in one action! There are never police there to monitor the gridlock & most of the time, drivers are on cell phones & don't think twice about blocking the intersection. A light that works at school hours & rush hours might be useful.”

“I see accidents there all the time. It's also hard for me to cross the street to get to the Charles River pathway where I go to ride my bike.”

“I use it every day. Lots of kids use it to go to Horace Mann or Day or the fields and the pool.”

“From the intersection of Albemarle/Crafts, California/Crafts, Walnut/Crafts and Linwood/Crafts and Linwood/Walnut are all problematic. The light at Albemarle causes the traffic to back up all the way to Linwood making it hard to turn onto Crafts from any side street. People take risks as a result. I will not try and make a left from California onto Crafts because it is too hazardous. I avoid it by using Linwood. Because of the Day Middle School and the size of both Walnut and Crafts feeding into Crafts and Albemarle, the traffic is very heavy. Whatever is done, all of these intersections need to be dealt with together.”

“Lived on/around Albemarle Road for 37 years (went to grade school at Horace Mann, Day Jr. High, NNHS while living on Albemarle Road and later bought a house two streets away). I take my two kids to Horace Mann in the morning and pick them up every day having to negotiate a way to cross through Washington Street to get out of the jam. Cars are always racing through trying to hit the lights (which makes this a very scary place for kids to cross to get to school or even the park during the day. There was a minor improvement with not allowing someone to take a left down Albemarle Road, but what makes it so complicated is that you have cars coming and going in multiple directions, which makes this headache for everyone involved. A new and safe system needs to be implemented that keep in mind that these dangerous intersections have two big schools in its perimeter.”

“Extremely poor visibility on either side of Albemarle turning on to Crafts. Need to edge out into traffic in order for you to see cars coming. Moreover, since it's metro Boston, no one -- I mean NO ONE -- will ever stop and let you go unless you edge out. The solution? A traffic light.”

“At peak times and despite the recent changes made to the traffic flow, it is a hazard to pedestrians (children walking to school especially) and difficult to figure out the wrong way intersections if you are not familiar with the area. Many times cars are in the wrong turning lanes making illegal turns.”

“Vehicular accidents are routine here. Vehicle/pedestrian incidents have been infrequent, but the high concentration of schoolchildren and recreational users mean such accidents will necessarily be very serious. The city has taken small steps to improve safety over the years, but the head of DPW has been adamant in his refusal to implement a plan for improved pedestrian and recreational access. This plan was paid for with CPA funding, developed by DPW, and promptly forgotten. In a meeting with the head of DPW earlier this year, it was clear that he was completely unfamiliar with his department's plan, and had no interest in hearing community concerns, and was unwilling to use ANY resources to improve safety in the area.”

“There are three schools off Albemarle, which causes serious safety and traffic issues at the intersection.”

“I live nearby and the backups here in the morning are horrible. Then there is the fact that it's near multiple schools, PLUS it's a main route to the MDC biking trail. This should be a safe place for kids to cross, but it's not.”

“Despite all the effort to make improvements by limiting options and reducing lanes this is one of the worst intersection around, mostly because of rude driver behavior. When drivers are courteous, things go okay but this is a rarity. I use this intersection every day, throw in a soccer game at Albemarle or school release time and you have mayhem. It would mean more driving for me but I see forced turns and prohibition of crossing traffic as only way short of a traffic light.”

APPENDIX C

Calculation of Crash Rate for Both Intersections:

**Crafts Street at Albemarle Road, Newton
and
Crafts Street at North Street, Newton**

June 2, 2011

APPENDIX D

Collision Diagrams for Both Intersections:

**Crafts Street at Albemarle Road, Newton
and
Crafts Street at North Street, Newton**

November 30, 2011

COLLISION DIAGRAM

CITY/TOWN: NEWTON

DATE PREPARED: 11/30/11

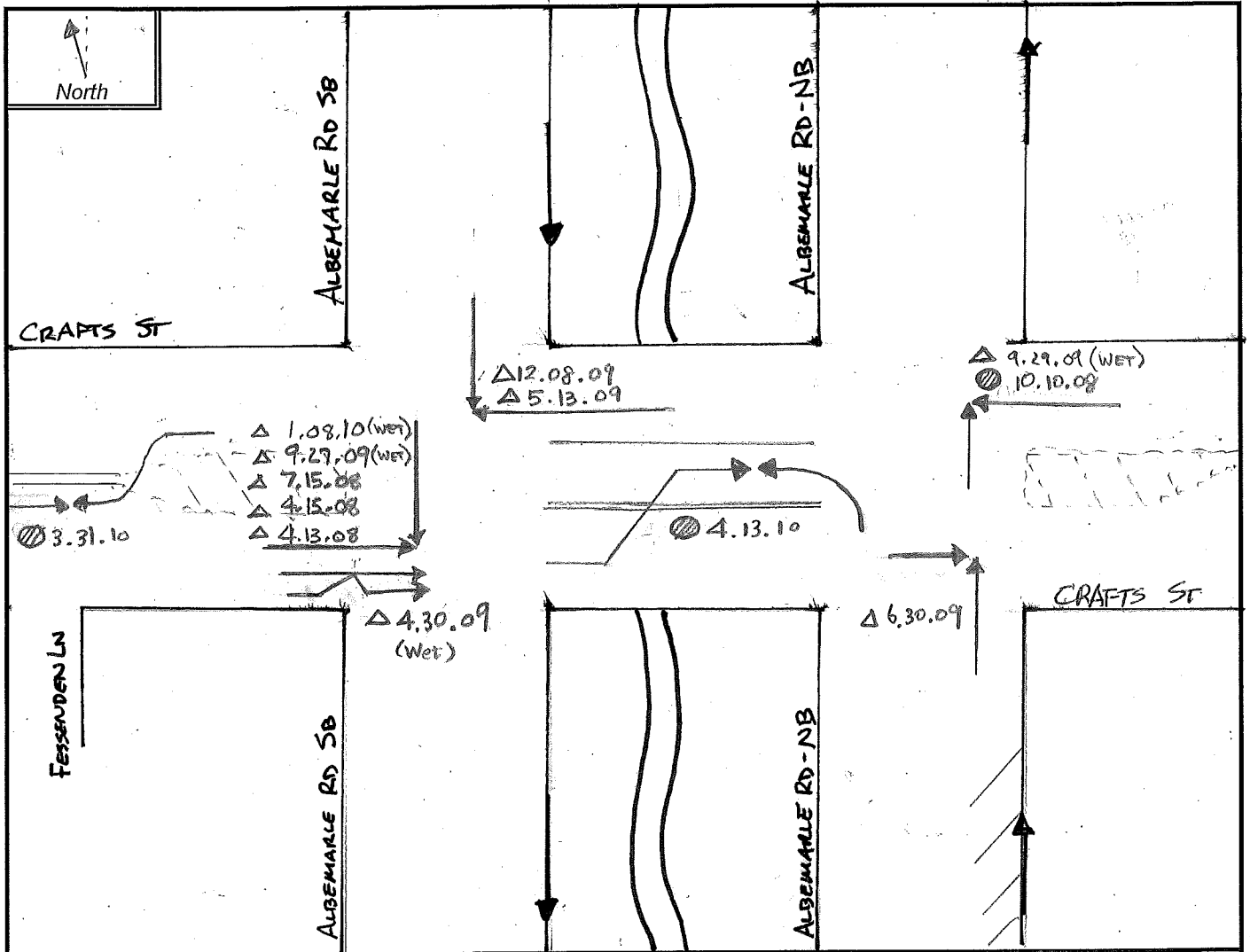
REGION: 6

PREPARED BY: STEVEN ANDREWS (CTPS)

ROADWAY NAMES: CRAFTS ST (MAJOR) AT ALBEMARLE RD (MINOR)

TIME PERIOD ANALYZED: 2008-2010

SOURCE OF CRASH REPORTS: NEWTON POLICE DEPT.



SYMBOLS	TYPES OF CRASH	SEVERITY
Moving Vehicle	Head On	Property Damage Only
Backing Vehicle	Angle	Injury Accident
Non-Involved Vehicle	Turning Move	
Pedestrian	Rear End	
Parked Vehicle	Sideswipe	Fatal Accident
Fixed Object	Out of Control	DATE
Bicycle		Month . Day . Year
Animal		

COLLISION DIAGRAM

CITY/TOWN: NEWTON

DATE PREPARED: 12/1/11

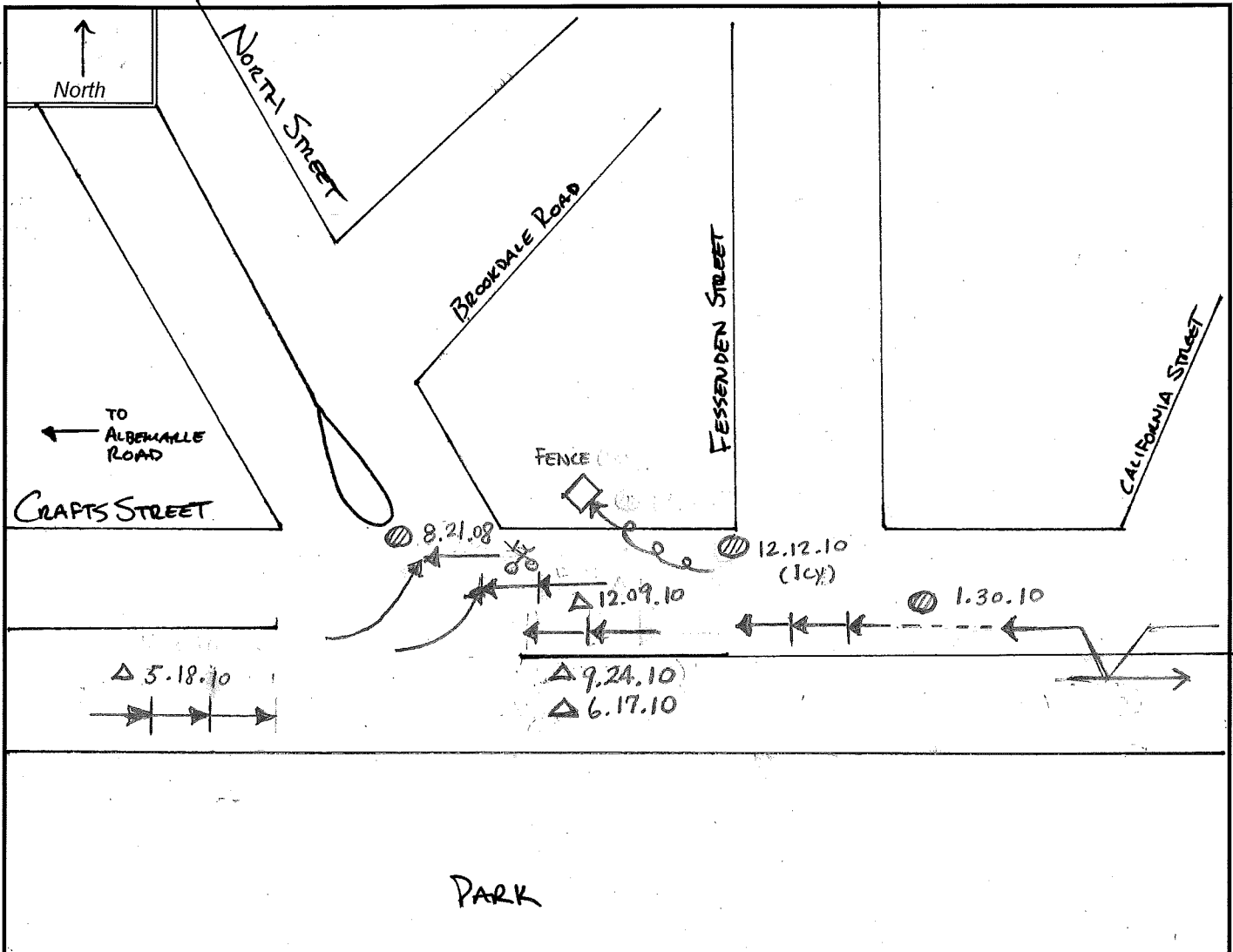
REGION: 6

PREPARED BY: STEVEN ANDREWS CTPS

ROADWAY NAMES: CRAFTS STREET AT NORTH STREET

TIME PERIOD ANALYZED: 2008-10

SOURCE OF CRASH REPORTS: NEWTON POLICE DEPT



SYMBOLS		TYPES OF CRASH		SEVERITY
	Moving Vehicle		Head On	 Property Damage Only
	Backing Vehicle		Angle	
	Non-Involved Vehicle		Turning Move	 Injury Accident
	Pedestrian		Rear End	 Fatal Accident
	Parked Vehicle Fixed Object		Sideswipe	
	Bicycle		Out of Control	<u>DATE</u>
	Animal			<u>Month, Day, Year</u>

APPENDIX E

Existing Conditions

AM/PM Peak-Hour Intersection Capacity Analysis for Both Intersections:

**Crafts Street at North Street, Newton (Signalized)
and
Crafts Street at Albemarle Road, Newton (Stop-Controlled)**

Intersection Capacity Analysis

Crafts St at North St

12/9/2011



Lane Group	EBL	EBT	WBT	WBR	SBL	ø9
Lane Configurations						
Volume (vph)	108	741	573	280	363	
Lane Group Flow (vph)	115	788	610	298	418	
Turn Type	pm+pt			pt+ov		
Protected Phases	7	4	8	6 8	6	9
Permitted Phases	4					
Detector Phase	7	4	8	6 8	6	
Switch Phase						
Minimum Initial (s)	4.0	8.0	8.0		8.0	4.0
Minimum Split (s)	11.0	14.0	14.0		14.0	35.0
Total Split (s)	11.0	48.0	37.0	67.0	30.0	35.0
Total Split (%)	9.7%	42.5%	32.7%	59.3%	26.5%	31%
Yellow Time (s)	3.0	4.0	4.0		3.0	3.0
All-Red Time (s)	0.0	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)	3.0	6.0	6.0	5.0	5.0	
Lead/Lag	Lead		Lag			
Lead-Lag Optimize?						
Recall Mode	Max	Max	Max		None	None
Act Effct Green (s)	46.5	43.4	32.1	61.3	25.7	
Actuated g/C Ratio	0.47	0.44	0.32	0.62	0.26	
v/c Ratio	0.54	1.01	1.07	0.32	0.85	
Control Delay	30.6	67.8	94.8	9.3	55.5	
Queue Delay	0.0	0.0	0.0	0.0	0.0	
Total Delay	30.6	67.8	94.8	9.3	55.5	
LOS	C	E	F	A	E	
Approach Delay		63.1	66.7		55.5	
Approach LOS		E	E		E	
Queue Length 50th (ft)	53	~696	~560	88	305	
Queue Length 95th (ft)	#108	#932	#780	134	#510	
Internal Link Dist (ft)		282	1100		528	
Turn Bay Length (ft)	110					
Base Capacity (vph)	212	777	568	948	496	
Starvation Cap Reductn	0	0	0	0	0	
Spillback Cap Reductn	0	0	0	0	0	
Storage Cap Reductn	0	0	0	0	0	
Reduced v/c Ratio	0.54	1.01	1.07	0.31	0.84	

Intersection Summary

Cycle Length: 113

Actuated Cycle Length: 98.9

Natural Cycle: 130

Control Type: Semi Act-Uncoord

Maximum v/c Ratio: 1.07

Intersection Signal Delay: 63.1

Intersection LOS: E

Intersection Capacity Utilization 69.8%

ICU Level of Service C

Analysis Period (min) 15

~ Volume exceeds capacity, queue is theoretically infinite.

Queue shown is maximum after two cycles.






Intersection Capacity Analysis

Crafts St at North St

12/9/2011

95th percentile volume exceeds capacity, queue may be longer.
 Queue shown is maximum after two cycles.

Splits and Phases: 4: Crafts & North

 ø6	 ø4	 ø9
30 s	48 s	35 s
	 ø7	 ø8
	11 s	37 s

Intersection Capacity Analysis
 Crafts St at Albemarle Rd (Eastern Intersection)

12/9/2011















Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		↑			↑			↑	↑			
Volume (veh/h)	2	679	0	0	512	1	56	51	85	0	0	0
Sign Control		Free			Free			Stop			Stop	
Grade		0%			0%			0%			0%	
Peak Hour Factor	0.94	0.94	0.94	0.94	0.94	0.94	0.80	0.80	0.80	0.92	0.92	0.92
Hourly flow rate (vph)	2	722	0	0	545	1	70	64	106	0	0	0
Pedestrians		1			1			14			3	
Lane Width (ft)		16.0			16.0			12.0			0.0	
Walking Speed (ft/s)		4.0			4.0			4.0			4.0	
Percent Blockage		0			0			1			0	
Right turn flare (veh)									1			
Median type		None			None							
Median storage (veh)												
Upstream signal (ft)					362							
pX, platoon unblocked	0.70						0.70	0.70		0.70	0.70	0.70
vC, conflicting volume	549			736			1287	1289	737	1361	1289	549
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	132			736			1194	1197	737	1300	1196	133
tC, single (s)	4.1			4.1			7.1	6.5	6.3	7.1	6.5	6.2
tC, 2 stage (s)												
tF (s)	2.2			2.2			3.5	4.0	3.4	3.5	4.0	3.3
p0 queue free %	100			100			36	50	74	100	100	100
cM capacity (veh/h)	1019			868			110	127	405	43	129	640

Direction, Lane #	EB 1	WB 1	NB 1
Volume Total	724	546	240
Volume Left	2	0	70
Volume Right	0	1	106
cSH	1019	1700	177
Volume to Capacity	0.00	0.32	1.36
Queue Length 95th (ft)	0	0	356
Control Delay (s)	0.1	0.0	243.5
Lane LOS	A		F
Approach Delay (s)	0.1	0.0	243.5
Approach LOS			F

Intersection Summary		
Average Delay		38.7
Intersection Capacity Utilization	56.5%	ICU Level of Service
Analysis Period (min)	15	B

Intersection Capacity Analysis
 Crafts St at Albemarle Rd (Western Intersection)

12/9/2011

												
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		↑		↔	↑						↑	↔
Volume (veh/h)	0	681	45	50	462	0	0	0	0	5	79	134
Sign Control		Free			Free			Stop			Stop	
Grade		0%			0%			0%			0%	
Peak Hour Factor	0.94	0.94	0.94	0.94	0.94	0.94	0.92	0.92	0.92	0.86	0.86	0.86
Hourly flow rate (vph)	0	724	48	53	491	0	0	0	0	6	92	156
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)					451							
pX, platoon unblocked	0.73						0.73	0.73		0.73	0.73	0.73
vC, conflicting volume	491			772			1470	1346	748	1346	1370	491
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	113			772			1459	1289	748	1289	1322	113
tC, single (s)	4.1			4.1			7.1	6.5	6.2	7.1	6.5	6.3
tC, 2 stage (s)												
tF (s)	2.2			2.2			3.5	4.0	3.3	3.5	4.0	3.4
p0 queue free %	100			94			100	100	100	94	14	77
cM capacity (veh/h)	1083			852			15	113	415	98	106	664
Direction, Lane #	EB 1	WB 1	WB 2	SB 1								
Volume Total	772	53	491	253								
Volume Left	0	53	0	6								
Volume Right	48	0	0	156								
cSH	1700	852	1700	230								
Volume to Capacity	0.45	0.06	0.29	1.10								
Queue Length 95th (ft)	0	5	0	283								
Control Delay (s)	0.0	9.5	0.0	134.9								
Lane LOS		A		F								
Approach Delay (s)	0.0	0.9		134.9								
Approach LOS				F								
Intersection Summary												
Average Delay			22.1									
Intersection Capacity Utilization			52.7%		ICU Level of Service				A			
Analysis Period (min)			15									

Intersection Capacity Analysis

Crafts St at North St

12/9/2011



Lane Group	EBL	EBT	WBT	WBR	SBL	ø9
Lane Configurations						
Volume (vph)	207	602	733	319	393	
Lane Group Flow (vph)	218	634	814	354	456	
Turn Type	pm+pt			pt+ov		
Protected Phases	7	4	8	6 8	6	9
Permitted Phases	4					
Detector Phase	7	4	8	6 8	6	
Switch Phase						
Minimum Initial (s)	4.0	8.0	8.0		8.0	4.0
Minimum Split (s)	11.0	14.0	14.0		14.0	35.0
Total Split (s)	11.0	48.0	37.0	67.0	30.0	35.0
Total Split (%)	9.7%	42.5%	32.7%	59.3%	26.5%	31%
Yellow Time (s)	3.0	4.0	4.0		3.0	3.0
All-Red Time (s)	0.0	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)	3.0	6.0	6.0	5.0	5.0	
Lead/Lag	Lead		Lag			
Lead-Lag Optimize?						
Recall Mode	Max	Max	Max		None	None
Act Effct Green (s)	46.5	43.4	32.0	62.4	25.8	
Actuated g/C Ratio	0.51	0.47	0.35	0.68	0.28	
v/c Ratio	0.91	0.75	1.31	0.33	0.81	
Control Delay	63.3	31.2	178.4	7.8	47.2	
Queue Delay	0.0	0.0	0.0	0.0	0.0	
Total Delay	63.3	31.2	178.4	7.8	47.2	
LOS	E	C	F	A	D	
Approach Delay		39.4	126.7		47.2	
Approach LOS		D	F		D	
Queue Length 50th (ft)	51	205	~472	32	193	
Queue Length 95th (ft)	#293	#680	#1100	162	#557	
Internal Link Dist (ft)		282	1100		528	
Turn Bay Length (ft)	110					
Base Capacity (vph)	239	843	622	1064	561	
Starvation Cap Reductn	0	0	0	0	0	
Spillback Cap Reductn	0	0	0	0	0	
Storage Cap Reductn	0	0	0	0	0	
Reduced v/c Ratio	0.91	0.75	1.31	0.33	0.81	

Intersection Summary

Cycle Length: 113

Actuated Cycle Length: 92

Natural Cycle: 150

Control Type: Semi Act-Uncoord

Maximum v/c Ratio: 1.31

Intersection Signal Delay: 82.0

Intersection LOS: F

Intersection Capacity Utilization 86.9%

ICU Level of Service E

Analysis Period (min) 15

~ Volume exceeds capacity, queue is theoretically infinite.

Queue shown is maximum after two cycles.






Intersection Capacity Analysis

Crafts St at North St

12/9/2011

95th percentile volume exceeds capacity, queue may be longer.
 Queue shown is maximum after two cycles.

Splits and Phases: 4: Crafts & North

 ø6	 ø4	 ø9
30 s	48 s	35 s
	 ø7 11 s	 ø8 37 s

Intersection Capacity Analysis
 Crafts St at Albemarle Rd (Eastern Intersection)

12/9/2011



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		↑			↑			↑	↑			
Volume (veh/h)	2	702	0	0	731	1	61	83	88	0	0	0
Sign Control		Free			Free			Stop			Stop	
Grade		0%			0%			0%			0%	
Peak Hour Factor	0.94	0.94	0.94	0.92	0.92	0.92	0.87	0.87	0.87	0.92	0.92	0.92
Hourly flow rate (vph)	2	747	0	0	795	1	70	95	101	0	0	0
Pedestrians		1			8			9			11	
Lane Width (ft)		16.0			16.0			12.0			0.0	
Walking Speed (ft/s)		4.0			4.0			4.0			4.0	
Percent Blockage		0			1			1			0	
Right turn flare (veh)									1			
Median type		None			None							
Median storage (veh)												
Upstream signal (ft)					362							
pX, platoon unblocked	0.67						0.67	0.67		0.67	0.67	0.67
vC, conflicting volume	807			756			1556	1567	764	1663	1566	807
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	466			756			1584	1599	764	1744	1599	467
tC, single (s)	4.1			4.1			7.1	6.5	6.2	7.1	6.5	6.2
tC, 2 stage (s)												
tF (s)	2.2			2.2			3.5	4.0	3.3	3.5	4.0	3.3
p0 queue free %	100			100			0	0	75	0	100	100
cM capacity (veh/h)	742			857			58	71	400	0	71	402

Direction, Lane #	EB 1	WB 1	NB 1
Volume Total	749	796	267
Volume Left	2	0	70
Volume Right	0	1	101
cSH	742	1700	95
Volume to Capacity	0.00	0.47	2.80
Queue Length 95th (ft)	0	0	635
Control Delay (s)	0.1	0.0	909.4
Lane LOS	A		F
Approach Delay (s)	0.1	0.0	909.4
Approach LOS			F

Intersection Summary		
Average Delay		133.9
Intersection Capacity Utilization	59.6%	ICU Level of Service
Analysis Period (min)	15	B

Intersection Capacity Analysis
 Crafts St at Albemarle Rd (Western Intersection)

12/9/2011



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		↑		↖	↑						↑	↗
Volume (veh/h)	0	704	35	82	649	0	0	0	0	11	61	241
Sign Control		Free			Free			Stop			Stop	
Grade		0%			0%			0%			0%	
Peak Hour Factor	0.94	0.94	0.94	0.92	0.92	0.92	0.92	0.92	0.92	0.90	0.90	0.90
Hourly flow rate (vph)	0	749	37	89	705	0	0	0	0	12	68	268
Pedestrians		1			8			9			11	
Lane Width (ft)		14.0			14.0			0.0			12.0	
Walking Speed (ft/s)		4.0			4.0			4.0			4.0	
Percent Blockage		0			1			0			1	
Right turn flare (veh)												1
Median type		None			None							
Median storage (veh)												
Upstream signal (ft)					451							
pX, platoon unblocked	0.67						0.67	0.67		0.67	0.67	0.67
vC, conflicting volume	716			795			1829	1671	785	1670	1690	717
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	335			795			1989	1755	785	1753	1782	336
tC, single (s)	4.1			4.1			7.1	6.5	6.2	7.1	6.5	6.2
tC, 2 stage (s)												
tF (s)	2.2			2.2			3.5	4.0	3.3	3.5	4.0	3.3
p0 queue free %	100			89			0	100	100	70	0	43
cM capacity (veh/h)	823			831			0	51	393	41	49	471

Direction, Lane #	EB 1	WB 1	WB 2	SB 1
Volume Total	786	89	705	348
Volume Left	0	89	0	12
Volume Right	37	0	0	268
cSH	1700	831	1700	159
Volume to Capacity	0.46	0.11	0.41	2.18
Queue Length 95th (ft)	0	9	0	704
Control Delay (s)	0.0	9.9	0.0	598.5
Lane LOS		A		F
Approach Delay (s)	0.0	1.1		598.5
Approach LOS				F

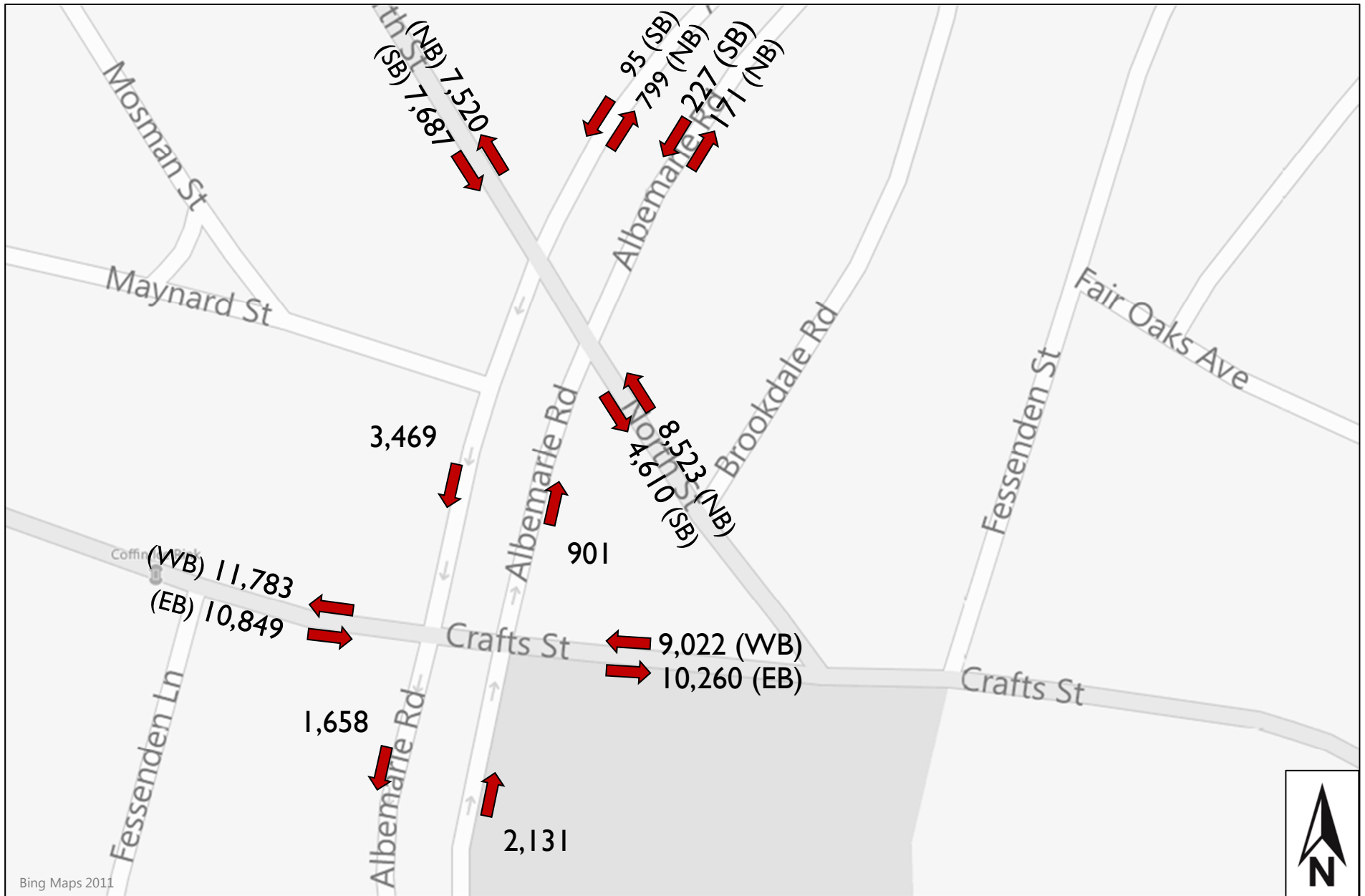
Intersection Summary

Average Delay		108.4		
Intersection Capacity Utilization		57.9%	ICU Level of Service	B
Analysis Period (min)		15		

APPENDIX F

**Average Daily Traffic (ADT) and Average AM/PM Peak-Hour Traffic
of the Study Area Roadways**

May 23–26, 2011

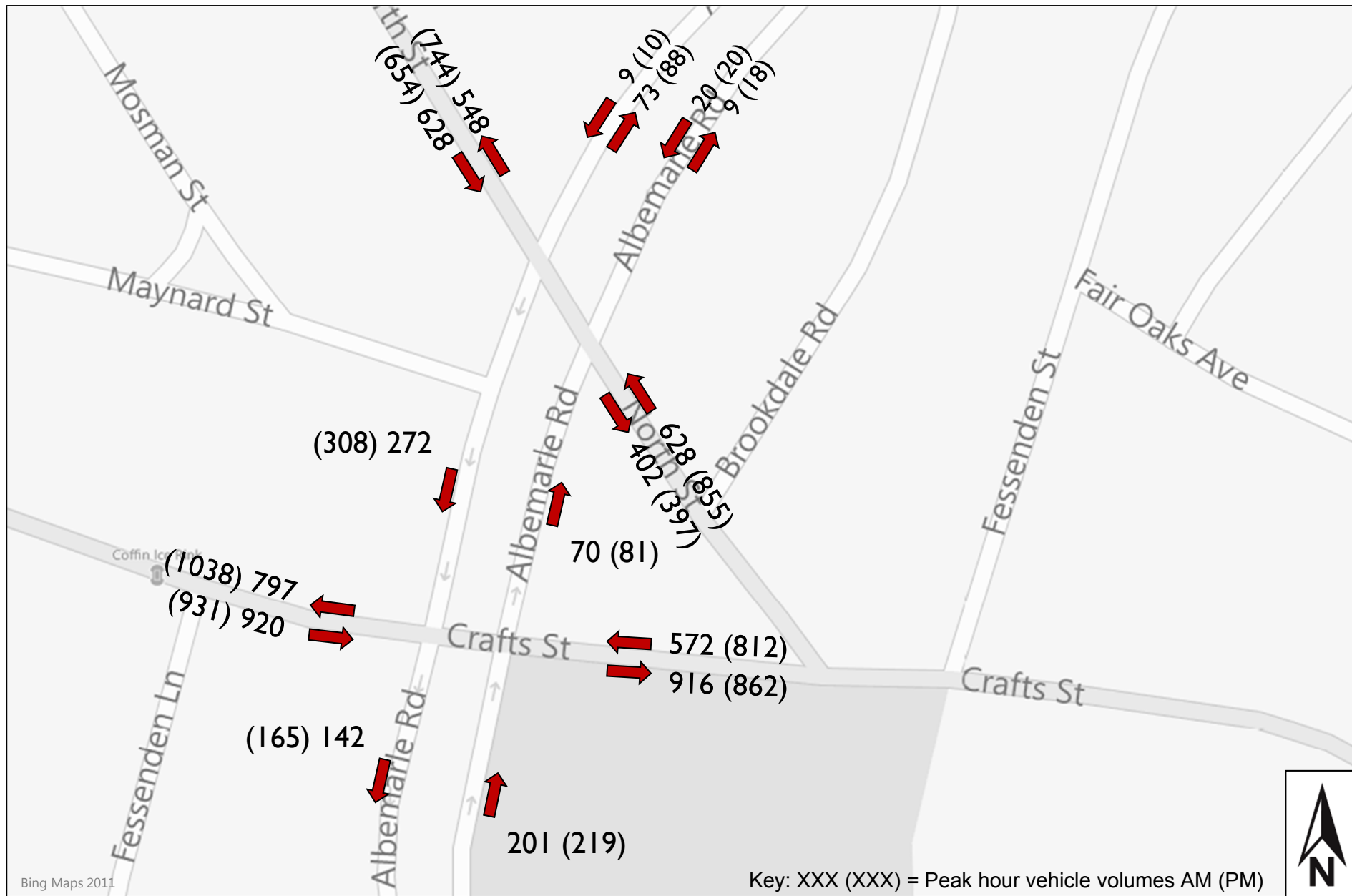


Bing Maps 2011

BOSTON
REGION
MPO

FIGURE F-1
Average Daily Traffic (ADT) of the Study Area Roadways
May 23–26, 2011

*Safety and Operations
Analyses at
Selected Intersections*



BOSTON
REGION
MPO

FIGURE F-2
Average AM/PM Peak-Hour Traffic of the Study Area Roadways
May 23–26, 2011

*Safety and Operations
Analyses at
Selected Intersections*

Mass Highway Department
 WEEKLY SUMMARY FOR LANE 1
 Starting: 5/23/2011

STA. 1NB

Site Reference: 110280000605
 Site ID: 000000000101
 Location: ALBEMARLE RD. SOUTH OF CRAFTS ST.
 Direction: NORTH

File: 101.prn
 City: NEWTON
 County: VOL N.B.

TIME	MON 23	TUE 24	WED 25	THU 26	FRI	WKDAY AVG	SAT	SUN	WEEK AVG	TOTAL
01:00		8	6	4		6			6	18
02:00		3	5	1		3			3	9
03:00		0	3	4		2			2	7
04:00		0	0	0		0			0	0
05:00		4	4	5		4			4	13
06:00		9	14	13		12			12	36
07:00		29	26	35		30			30	90
08:00		125	123	122		123			123	370
09:00		185	204	216		201			201	605
10:00		94	105	108		102			102	307
11:00	82	89	85	86		85			85	342
12:00	81	100	127			102			102	308
13:00	97	163	110			123			123	370
14:00	95	120	119			111			111	334
15:00	123	152	128			134			134	403
16:00	216	154	230			200			200	600
17:00	169	166	213			182			182	548
18:00	227	201	230			219			219	658
19:00	189	170	196			185			185	555
20:00	107	148	131			128			128	386
21:00	65	103	87			85			85	255
22:00	44	51	84			59			59	179
23:00	20	20	20			20			20	60
24:00	14	13	18			15			15	45
TOTALS	1529	2107	2268	594	0	2131	0	0	2131	6498
% AVG WKDY	71.7	98.8	106.4	27.8						
% AVG WEEK	71.7	98.8	106.4	27.8						
AM Times	11:00	09:00	09:00	09:00		09:00			09:00	
AM Peaks	82	185	204	216		201			201	
PM Times	18:00	18:00	16:00			18:00			18:00	
PM Peaks	227	201	230			219			219	

u6

NB 2131
 SB 1658
 COMB AWD 3789
 FAC .91(.99)
 COMB ADT 3,400

Mass Highway Department
 WEEKLY SUMMARY FOR LANE 1
 Starting: 5/23/2011

Page: 1

STA. 1 SB

Site Reference: 110280000400
 Site ID: 000000000102
 Location: ALBEMARLE RD. SOUTH OF CRAFTS ST.
 Direction: SOUTH

File: 102.prn
 City: NEWTON
 County: VOL S.B.

TIME	MON 23	TUE 24	WED 25	THU 26	FRI	WKDAY AVG	SAT	SUN	WEEK AVG	TOTAL
01:00		5	7	3		5			5	15
02:00		2	1	4		2			2	7
03:00		2	3	3		2			2	8
04:00		1	0	1		0			0	2
05:00		1	2	1		1			1	4
06:00		6	11	10		9			9	27
07:00		37	41	44		40			40	122
08:00		107	130	120		119			119	357
09:00		137	149	142		142			142	428
10:00		86	70	61		72			72	217
11:00		67	81	82		76			76	230
12:00	71	74	85			76			76	230
13:00	74	132	88			98			98	294
14:00	105	123	76			101			101	304
15:00	144	109	133			128			128	386
16:00	120	111	174			135			135	405
17:00	112	123	145			126			126	380
18:00	176	170	151			165			165	497
19:00	126	138	128			130			130	392
20:00	69	72	124			88			88	265
21:00	64	78	62			68			68	204
22:00	27	44	49			40			40	120
23:00	20	28	24			24			24	72
24:00	14	10	11			11			11	35
TOTALS	1122	1663	1745	471	0	1658	0	0	1658	5001
% AVG WKDY	67.6	100.3	105.2	28.4						
% AVG WEEK	67.6	100.3	105.2	28.4						
AM Times	12:00	09:00	09:00	09:00		09:00			09:00	
AM Peaks	71	137	149	142		142			142	
PM Times	18:00	18:00	16:00			18:00			18:00	
PM Peaks	176	170	174			165			165	

Mass Highway Department
 WEEKLY SUMMARY FOR LANE 1
 Starting: 5/23/2011

STA. 2 NB

Site Reference: 110280000613
 Site ID: 000000000201
 Location: ALBEMARLE RD. NORTH OF CRAFTS ST.
 Direction: NORTH

File: 201.prn
 City: NEWTON
 County: VOL N.B.

TIME	MON 23	TUE 24	WED 25	THU 26	FRI	WKDAY AVG	SAT	SUN	WEEK AVG	TOTAL
01:00		3	3	3		3			3	9
02:00		1	4	2		2			2	7
03:00		0	2	5		2			2	7
04:00		1	1	1		1			1	3
05:00		5	4	4		4			4	13
06:00		12	17	18		15			15	47
07:00		25	26	17		22			22	68
08:00		35	32	37		34			34	104
09:00		67	65	79		70			70	211
10:00		57	58	61		58			58	176
11:00	58	45	42			48			48	145
12:00	59	50	70			59			59	179
13:00	53	64	57			58			58	174
14:00	61	45	68			58			58	174
15:00	55	61	52			56			56	168
16:00	65	60	67			64			64	192
17:00	75	70	79			74			74	224
18:00	79	78	86			81			81	243
19:00	67	69	71			69			69	207
20:00	50	44	40			44			44	134
21:00	27	36	36			33			33	99
22:00	17	27	31			25			25	75
23:00	14	12	11			12			12	37
24:00	10	9	10			9			9	29

TOTALS	690	876	932	227	0	901	0	0	901	2725

% AVG WKDY	76.5	97.2	103.4	25.1						
% AVG WEEK	76.5	97.2	103.4	25.1						

AM Times	12:00	09:00	12:00	09:00		09:00			09:00	
AM Peaks	59	67	70	79		70			70	

PM Times	18:00	18:00	18:00			18:00			18:00	
PM Peaks	79	78	86			81			81	

u6
 NB 901
 SB 3469

 COMB AWD 4370
 FAC .91(.99)
 COMB ADT 3,900

Mass Highway Department
 WEEKLY SUMMARY FOR LANE 1
 Starting: 5/23/2011

STA. 2 SB

Site Reference: 110280000402
 Site ID: 000000000202
 Location: ALBEMARLE RD. NORTH OF CRAFTS ST.
 Direction: SOUTH

File: 202.prn
 City: NEWTON
 County: VOL S.B.

TIME	MON 23	TUE 24	WED 25	THU 26	FRI	WKDAY AVG	SAT	SUN	WEEK AVG	TOTAL
01:00		9	6	11		8			8	26
02:00		13	3	12		9			9	28
03:00		7	5	7		6			6	19
04:00		4	2	7		4			4	13
05:00		9	9	7		8			8	25
06:00		35	47	41		41			41	123
07:00		106	144	150		133			133	400
08:00		275	265	266		268			268	806
09:00		277	278	262		272			272	817
10:00		191	187	152		176			176	530
11:00		160	189			174			174	349
12:00	156	163	220			179			179	539
13:00	181	231	190			200			200	602
14:00	216	197	195			202			202	608
15:00	267	229	234			243			243	730
16:00	251	266	253			256			256	770
17:00	265	289	320			291			291	874
18:00	272	319	333			308			308	924
19:00	227	229	228			228			228	684
20:00	179	156	193			176			176	528
21:00	97	119	145			120			120	361
22:00	68	108	94			90			90	270
23:00	45	53	54			50			50	152
24:00	25	19	39			27			27	83

TOTALS	2249	3464	3633	915	0	3469	0	0	3469	10261

% AVG WKDY	64.8	99.8	104.7	26.3						
% AVG WEEK	64.8	99.8	104.7	26.3						

AM Times	12:00	09:00	09:00	08:00		09:00			09:00	
AM Peaks	156	277	278	266		272			272	

PM Times	18:00	18:00	18:00			18:00			18:00	
PM Peaks	272	319	333			308			308	

Mass Highway Department
 WEEKLY SUMMARY FOR LANE 1
 Starting: 5/23/2011

Site Reference: 110280000856
 Site ID: 010000030102
 Location: ALBEMARLE RD. NORTH OF NORTH ST.
 Direction: NORTH

STA. 3 NB - NORTH
 SIDE

File: 30102-NB.prn
 City: NEWTON
 County: DIR VOL N&S NO. SIDE

TIME	MON 23	TUE 24	WED 25	THU 26	FRI	WKDAY AVG	SAT	SUN	WEEK AVG	TOTAL
01:00		1	2	1		1			1	4
02:00		3	0	2		1			1	5
03:00		1	1	1		1			1	3
04:00		0	0	0		0			0	0
05:00		2	2	0		1			1	4
06:00		4	4	11		6			6	19
07:00		16	16	16		16			16	48
08:00		44	48	50		47			47	142
09:00		71	76	73		73			73	220
10:00		38	43	29		36			36	110
11:00		29	33			31			31	62
12:00	37	45	54			45			45	136
13:00	31	43	43			39			39	117
14:00	41	44	34			39			39	119
15:00	58	59	47			54			54	164
16:00	58	62	48			56			56	168
17:00	53	59	72			61			61	184
18:00	92	87	87			88			88	266
19:00	73	85	85			81			81	243
20:00	40	55	63			52			52	158
21:00	34	44	25			34			34	103
22:00	15	24	22			20			20	61
23:00	10	13	18			13			13	41
24:00	3	3	8			4			4	14

TOTALS	545	832	831	183	0	799	0	0	799	2391

% AVG WKDY	68.2	104.1	104	22.9						
% AVG WEEK	68.2	104.1	104	22.9						

AM Times	12:00	09:00	09:00	09:00		09:00			09:00	
AM Peaks	37	71	76	73		73			73	

PM Times	18:00	18:00	18:00			18:00			18:00	
PM Peaks	92	87	87			88			88	

u6

NB 799
 SB 95

 COMB AWD 894
 FAC .91(.99)
 COMB ADT 800

Mass Highway Department
 WEEKLY SUMMARY FOR LANE 2
 Starting: 5/23/2011

STA. 3 SB - NORTH
 SIDE

Site Reference: 110280000856
 Site ID: 010000030102
 Location: ALBEMARLE RD. NORTH OF NORTH ST.
 Direction: SOUTH

File: 30102-NB.prn
 City: NEWTON
 County: DIR VOL N&S NO. SIDE

TIME	MON 23	TUE 24	WED 25	THU 26	FRI	WKDAY AVG	SAT	SUN	WEEK AVG	TOTAL
01:00		0	0	1		0			0	1
02:00		0	0	1		0			0	1
03:00		0	1	0		0			0	1
04:00		0	0	1		0			0	1
05:00		0	0	2		0			0	2
06:00		1	0	0		0			0	1
07:00		3	2	3		2			2	8
08:00		5	2	6		4			4	13
09:00		11	8	9		9			9	28
10:00		9	1	7		5			5	17
11:00		6	6			6			6	12
12:00	1	10	3			4			4	14
13:00	7	8	4			6			6	19
14:00	4	6	8			6			6	18
15:00	7	3	4			4			4	14
16:00	3	3	3			3			3	9
17:00	10	11	9			10			10	30
18:00	7	11	14			10			10	32
19:00	6	13	13			10			10	32
20:00	3	9	10			7			7	22
21:00	6	3	3			4			4	12
22:00	1	2	6			3			3	9
23:00	2	3	3			2			2	8
24:00	0	0	2			0			0	2
TOTALS	57	117	102	30	0	95	0	0	95	306
% AVG WKDY	60	123.1	107.3	31.5						
% AVG WEEK	60	123.1	107.3	31.5						
AM Times	12:00	09:00	09:00	09:00		09:00			09:00	
AM Peaks	1	11	8	9		9			9	
PM Times	17:00	19:00	18:00			17:00			17:00	
PM Peaks	10	13	14			10			10	

Mass Highway Department
 WEEKLY SUMMARY FOR LANE 1
 Starting: 5/23/2011

STA. 3 NB - SOUTH SIDE

Site Reference: 110280000750
 Site ID: 020000030102
 Location: ALBEMARLE RD. NORTH OF NORTH ST.
 Direction: NORTH

File: 30102-SB.prn
 City: NEWTON
 County: DIR VOL N&S SO. SIDE

TIME	MON 23	TUE 24	WED 25	THU 26	FRI	WKDAY AVG	SAT	SUN	WEEK AVG	TOTAL
01:00		2	0	1		1			1	3
02:00		1	0	0		0			0	1
03:00		0	1	0		0			0	1
04:00		0	0	0		0			0	0
05:00		1	1	0		0			0	2
06:00		1	1	3		1			1	5
07:00		6	4	4		4			4	14
08:00		5	10	7		7			7	22
09:00		6	9	12		9			9	27
10:00		11	10	7		9			9	28
11:00		8	5			6			6	13
12:00	6	7	8			7			7	21
13:00	10	15	11			12			12	36
14:00	13	17	14			14			14	44
15:00	10	15	13			12			12	38
16:00	12	15	23			16			16	50
17:00	17	17	20			18			18	54
18:00	15	6	14			11			11	35
19:00	7	8	20			11			11	35
20:00	14	9	12			11			11	35
21:00	9	11	8			9			9	28
22:00	5	11	4			6			6	20
23:00	4	4	5			4			4	13
24:00	0	5	5			3			3	10

TOTALS	122	181	198	34	0	171	0	0	171	535

% AVG WKDY	71.3	105.8	115.7	19.8						
% AVG WEEK	71.3	105.8	115.7	19.8						

AM Times	12:00	10:00	08:00	09:00		09:00			09:00	
AM Peaks	6	11	10	12		9			9	

PM Times	17:00	14:00	16:00			17:00			17:00	
PM Peaks	17	17	23			18			18	

NB 171
 SB 227
 COMB AWD 398
 FAD .91(.99)
 COMB ADT 360

Mass Highway Department
 WEEKLY SUMMARY FOR LANE 2
 Starting: 5/23/2011

Page: 2

Site Reference: 110280000750

Site ID: 020000030102

Location: ALBEMARLE RD. NORTH OF NORTH ST.

Direction: SOUTH

STA. 3 SB - SOUTH
 SIDE

File: 30102-SB.prn

City: NEWTON

County: DIR VOL N&S SO. SIDE

TIME	MON 23	TUE 24	WED 25	THU 26	FRI	WKDAY AVG	SAT	SUN	WEEK AVG	TOTAL
01:00		0	1	4		1			1	5
02:00		0	0	0		0			0	0
03:00		0	1	1		0			0	2
04:00		0	0	0		0			0	0
05:00		0	0	1		0			0	1
06:00		6	6	4		5			5	16
07:00		7	12	13		10			10	32
08:00		16	16	15		15			15	47
09:00		18	18	25		20			20	61
10:00		11	17	8		12			12	36
11:00		18	13			15			15	31
12:00	13	16	14			14			14	43
13:00	11	16	14			13			13	41
14:00	16	27	17			20			20	60
15:00	13	16	17			15			15	46
16:00	10	15	17			14			14	42
17:00	9	10	12			10			10	31
18:00	20	15	23			19			19	58
19:00	12	14	16			14			14	42
20:00	9	15	22			15			15	46
21:00	2	6	13			7			7	21
22:00	1	3	5			3			3	9
23:00	2	6	3			3			3	11
24:00	2	1	3			2			2	6

TOTALS	120	236	260	71	0	227	0	0	227	687

% AVG WKDY	52.8	103.9	114.5	31.2						
% AVG WEEK	52.8	103.9	114.5	31.2						

AM Times	12:00	09:00	09:00	09:00		09:00			09:00	
AM Peaks	13	18	18	25		20			20	

PM Times	18:00	14:00	18:00			14:00			14:00	
PM Peaks	20	27	23			20			20	

Mass Highway Department
 WEEKLY SUMMARY FOR LANE 1
 Starting: 5/23/2011

STA. 4 EB

Site Reference: 110280000596
 Site ID: 000000040304
 Location: CRAFTS ST. EAST OF ALBEMARLE RD.
 Direction: EAST

File: 40304.prn
 City: NEWTON
 County: DIR VOL E&W

TIME	MON 23	TUE 24	WED 25	THU 26	FRI	WKDAY AVG	SAT	SUN	WEEK AVG	TOTAL
01:00		44	33	46		41			41	123
02:00		20	26	22		22			22	68
03:00		13	11	22		15			15	46
04:00		13	17	14		14			14	44
05:00		48	50	35		44			44	133
06:00		119	128	134		127			127	381
07:00		440	431	407		426			426	1278
08:00		903	773	820		832			832	2496
09:00		906	933	909		916			916	2748
10:00		637	654	626		639			639	1917
11:00	510	511	500			507			507	1521
12:00	455	515	529			499			499	1499
13:00	554	626	551			577			577	1731
14:00	522	611	565			566			566	1698
15:00	574	607	561			580			580	1742
16:00	740	665	796			733			733	2201
17:00	744	705	745			731			731	2194
18:00	827	840	921			862			862	2588
19:00	683	690	778			717			717	2151
20:00	498	542	555			531			531	1595
21:00	295	407	357			353			353	1059
22:00	225	277	327			276			276	829
23:00	135	168	183			162			162	486
24:00	81	75	114			90			90	270

TOTALS	6843	10382	10538	3035	0	10260	0	0	10260	30798

% AVG WKDY	66.6	101.1	102.7	29.5						
% AVG WEEK	66.6	101.1	102.7	29.5						

AM Times	11:00	09:00	09:00	09:00		09:00			09:00	
AM Peaks	510	906	933	909		916			916	

PM Times	18:00	18:00	18:00			18:00			18:00	
PM Peaks	827	840	921			862			862	

u5
 EB 10260
 WB 9022

 COMB AWD 19282
 FAC .91(.98)
 COMB ADT 17,200

Mass Highway Department
 WEEKLY SUMMARY FOR LANE 2
 Starting: 5/23/2011

Page: 2

STA. 4 WB

Site Reference: 110280000596
 Site ID: 000000040304
 Location: CRAFTS ST. EAST OF ALBEMARLE RD.
 Direction: WEST

File: 40304.prn
 City: NEWTON
 County: DIR VOL E&W

TIME	MON 23	TUE 24	WED 25	THU 26	FRI	WKDAY AVG	SAT	SUN	WEEK AVG	TOTAL
01:00		78	66	80		74			74	224
02:00		33	27	28		29			29	88
03:00		20	12	25		19			19	57
04:00		19	19	18		18			18	56
05:00		37	33	31		33			33	101
06:00		95	109	91		98			98	295
07:00		272	290	282		281			281	844
08:00		524	579	549		550			550	1652
09:00		586	568	564		572			572	1718
10:00		449	448	472		456			456	1369
11:00	388	407	414			403			403	1209
12:00	417	511	450			459			459	1378
13:00	471	526	486			494			494	1483
14:00	458	476	533			489			489	1467
15:00	510	581	529			540			540	1620
16:00	629	655	671			651			651	1955
17:00	748	735	728			737			737	2211
18:00	795	848	794			812			812	2437
19:00	667	733	735			711			711	2135
20:00	469	535	605			536			536	1609
21:00	376	378	396			383			383	1150
22:00	283	331	343			319			319	957
23:00	196	212	216			208			208	624
24:00	137	147	166			150			150	450
TOTALS	6544	9188	9217	2140	0	9022	0	0	9022	27089
% AVG WKDY	72.5	101.8	102.1	23.7						
% AVG WEEK	72.5	101.8	102.1	23.7						
AM Times	12:00	09:00	08:00	09:00		09:00			09:00	
AM Peaks	417	586	579	564		572			572	
PM Times	18:00	18:00	18:00			18:00			18:00	
PM Peaks	795	848	794			812			812	

Mass Highway Department
 WEEKLY SUMMARY FOR LANE 1
 Starting: 5/23/2011

STA. 5 EB

Site Reference: 110280000614
 Site ID: 000000050304
 Location: CRAFTS ST. WEST OF ALBEMARLE RD.
 Direction: EAST

File: 50304.prn
 City: NEWTON
 County: DIR VOL E&W

TIME	MON 23	TUE 24	WED 25	THU 26	FRI	WKDAY AVG	SAT	SUN	WEEK AVG	TOTAL
01:00		46	63	67		58			58	176
02:00		17	40	34		30			30	91
03:00		14	17	30		20			20	61
04:00		13	21	18		17			17	52
05:00		45	57	35		45			45	137
06:00		112	147	146		135			135	405
07:00		394	461	424		426			426	1279
08:00		774	886	888		849			849	2548
09:00		766	1016	979		920			920	2761
10:00		562	718	684		654			654	1964
11:00		461	565			513			513	1026
12:00	419	468	591			492			492	1478
13:00	479	541	636			552			552	1656
14:00	468	593	681			580			580	1742
15:00	533	612	679			608			608	1824
16:00	628	730	915			757			757	2273
17:00	644	822	1045			837			837	2511
18:00	715	980	1099			931			931	2794
19:00	589	835	916			780			780	2340
20:00	435	653	689			592			592	1777
21:00	260	467	459			395			395	1186
22:00	209	386	410			335			335	1005
23:00	144	236	240			206			206	620
24:00	80	112	161			117			117	353
TOTALS	5603	10639	12512	3305	0	10849	0	0	10849	32059
% AVG WKDY	51.6	98	115.3	30.4						
% AVG WEEK	51.6	98	115.3	30.4						
AM Times	12:00	08:00	09:00	09:00		09:00			09:00	
AM Peaks	419	774	1016	979		920			920	
PM Times	18:00	18:00	18:00			18:00			18:00	
PM Peaks	715	980	1099			931			931	

45
 EB 10849
 WB 11783

 COMB AWD 22632
 FAC .91 (.98)
 COMB APT 20,200

Mass Highway Department
WEEKLY SUMMARY FOR LANE 2
Starting: 5/23/2011

Page: 2

STA. 5 WB

Site Reference: 110280000614
Site ID: 000000050304
Location: CRAFTS ST. WEST OF ALBEMARLE RD.
Direction: WEST

File: 50304.prn
City: NEWTON
County: DIR VOL E&W

TIME	MON 23	TUE 24	WED 25	THU 26	FRI	WKDAY AVG	SAT	SUN	WEEK AVG	TOTAL
01:00		93	79	100		90			90	272
02:00		51	30	41		40			40	122
03:00		27	17	37		27			27	81
04:00		22	24	28		24			24	74
05:00		51	50	45		48			48	146
06:00		119	154	118		130			130	391
07:00		333	412	460		401			401	1205
08:00		723	805	848		792			792	2376
09:00		768	796	829		797			797	2393
10:00		573	560	628		587			587	1761
11:00		521	522			521			521	1043
12:00	522	612	586			573			573	1720
13:00	594	655	586			611			611	1835
14:00	604	601	638			614			614	1843
15:00	685	749	658			697			697	2092
16:00	834	862	809			835			835	2505
17:00	943	986	1006			978			978	2935
18:00	973	1069	1073			1038			1038	3115
19:00	876	898	1006			926			926	2780
20:00	605	655	821			693			693	2081
21:00	422	470	571			487			487	1463
22:00	348	416	465			409			409	1229
23:00	256	260	297			271			271	813
24:00	166	185	232			194			194	583
TOTALS	7828	11699	12197	3134	0	11783	0	0	11783	34858
% AVG WKDY	66.4	99.2	103.5	26.5						
% AVG WEEK	66.4	99.2	103.5	26.5						
AM Times	12:00	09:00	08:00	08:00		09:00			09:00	
AM Peaks	522	768	805	848		797			797	
PM Times	18:00	18:00	18:00			18:00			18:00	
PM Peaks	973	1069	1073			1038			1038	

Mass Highway Department
 WEEKLY SUMMARY FOR LANE 1
 Starting: 5/23/2011

STA. 6 EB

Site Reference: 110280000754
 Site ID: 000000060304
 Location: NORTH ST. WEST OF ALBEMARLE RD.
 Direction: EAST

File: 60304.prn
 City: NEWTON
 County: DIR VOL E&W

TIME	MON 23	TUE 24	WED 25	THU 26	FRI	WKDAY AVG	SAT	SUN	WEEK AVG	TOTAL
01:00		25	19	24		22			22	68
02:00		17	18	31		22			22	66
03:00		15	9	8		10			10	32
04:00		11	6	14		10			10	31
05:00		32	25	27		28			28	84
06:00		80	90	86		85			85	256
07:00		270	325	293		296			296	888
08:00		589	583	594		588			588	1766
09:00		620	652	613		628			628	1885
10:00		468	414	419		433			433	1301
11:00		366	382			374			374	748
12:00	406	394	421			407			407	1221
13:00	454	466	423			447			447	1343
14:00	470	429	423			440			440	1322
15:00	563	504	476			514			514	1543
16:00	523	579	512			538			538	1614
17:00	620	617	606			614			614	1843
18:00	622	648	694			654			654	1964
19:00	527	538	533			532			532	1598
20:00	366	373	416			385			385	1155
21:00	245	293	291			276			276	829
22:00	185	222	208			205			205	615
23:00	106	109	133			116			116	348
24:00	59	45	85			63			63	189

TOTALS	5146	7710	7744	2109	0	7687	0	0	7687	22709

% AVG WKDY	66.9	100.2	100.7	27.4						
% AVG WEEK	66.9	100.2	100.7	27.4						

AM Times	12:00	09:00	09:00	09:00		09:00			09:00	
AM Peaks	406	620	652	613		628			628	

PM Times	18:00	18:00	18:00			18:00			18:00	
PM Peaks	622	648	694			654			654	

u5
 EB 7687
 WB 7520
 COMB AWD 15207
 FTR .91(.99)
 COMB ADT 13,700

Mass Highway Department
WEEKLY SUMMARY FOR LANE 2
Starting: 5/23/2011

STA. 6WB

Site Reference: 110280000754
Site ID: 000000060304
Location: NORTH ST. WEST OF ALBEMARLE RD.
Direction: WEST

File: 60304.prn
City: NEWTON
County: DIR VOL E&W

TIME	MON 23	TUE 24	WED 25	THU 26	FRI	WKDAY AVG	SAT	SUN	WEEK AVG	TOTAL
01:00		31	34	40		35			35	105
02:00		11	13	21		15			15	45
03:00		8	9	16		11			11	33
04:00		7	11	20		12			12	38
05:00		30	17	27		24			24	74
06:00		76	91	83		83			83	250
07:00		210	196	172		192			192	578
08:00		374	334	316		341			341	1024
09:00		529	598	517		548			548	1644
10:00		414	453	431		432			432	1298
11:00		371	396			383			383	767
12:00	334	432	493			419			419	1259
13:00	405	434	470			436			436	1309
14:00	420	475	492			462			462	1387
15:00	461	538	477			492			492	1476
16:00	536	612	632			593			593	1780
17:00	582	651	668			633			633	1901
18:00	717	837	680			744			744	2234
19:00	533	684	640			619			619	1857
20:00	365	428	458			417			417	1251
21:00	217	296	287			266			266	800
22:00	154	223	220			199			199	597
23:00	86	102	124			104			104	312
24:00	72	45	65			60			60	182
TOTALS	4882	7818	7858	1643	0	7520	0	0	7520	22201
% AVG WKDY	64.9	103.9	104.4	21.8						
% AVG WEEK	64.9	103.9	104.4	21.8						
AM Times	12:00	09:00	09:00	09:00		09:00			09:00	
AM Peaks	334	529	598	517		548			548	
PM Times	18:00	18:00	18:00			18:00			18:00	
PM Peaks	717	837	680			744			744	

Mass Highway Department
 WEEKLY SUMMARY FOR LANE 1
 Starting: 5/23/2011

STA. 7EB

Site Reference: 110280000859
 Site ID: 000000070304
 Location: NORTH ST. EAST OF ALBEMARLE RD.
 Direction: EAST

File: 70304.prn
 City: NEWTON
 County: DIR VOL E&W

TIME	MON 23	TUE 24	WED 25	THU 26	FRI	WKDAY AVG	SAT	SUN	WEEK AVG	TOTAL
01:00		14	15	12		13			13	41
02:00		6	14	18		12			12	38
03:00		9	4	3		5			5	16
04:00		7	5	8		6			6	20
05:00		23	16	18		19			19	57
06:00		51	52	43		48			48	146
07:00		180	201	168		183			183	549
08:00		367	365	357		363			363	1089
09:00		401	421	385		402			402	1207
10:00		283	276	288		282			282	847
11:00	239	233	227			233			233	699
12:00	233	261	227			240			240	721
13:00	278	264	259			267			267	801
14:00	281	267	253			267			267	801
15:00	293	312	284			296			296	889
16:00	270	346	283			299			299	899
17:00	359	361	330			350			350	1050
18:00	369	409	415			397			397	1193
19:00	299	334	330			321			321	963
20:00	209	222	256			229			229	687
21:00	144	172	153			156			156	469
22:00	112	119	119			116			116	350
23:00	64	60	78			67			67	202
24:00	42	30	46			39			39	118
TOTALS	3192	4731	4629	1300	0	4610	0	0	4610	13852
% AVG WKDY	69.2	102.6	100.4	28.1						
% AVG WEEK	69.2	102.6	100.4	28.1						
AM Times	11:00	09:00	09:00	09:00		09:00			09:00	
AM Peaks	239	401	421	385		402			402	
PM Times	18:00	18:00	18:00			18:00			18:00	
PM Peaks	369	409	415			397			397	

u5

EB 4610
 WB 8557

 COMB AWD 13167
 FAE 191(.98)
 COMB ADT 11,700

Mass Highway Department
WEEKLY SUMMARY FOR LANE 2
Starting: 5/23/2011

STA. 7 WB

Site Reference: 110280000859
Site ID: 000000070304
Location: NORTH ST. EAST OF ALBEMARLE RD.
Direction: WEST

File: 70304.prn
City: NEWTON
County: DIR VOL E&W

TIME	MON 23	TUE 24	WED 25	THU 26	FRI	WKDAY AVG	SAT	SUN	WEEK AVG	TOTAL
01:00		36	39	42		39			39	117
02:00		15	10	25		16			16	50
03:00		14	8	14		12			12	36
04:00		4	12	20		12			12	36
05:00		33	18	27		26			26	78
06:00		89	92	94		91			91	275
07:00		230	200	216		215			215	646
08:00		469	390	423		427			427	1282
09:00		596	654	636		628			628	1886
10:00		479	500	474		484			484	1453
11:00	455	436	438			443			443	1329
12:00	393	450	495			446			446	1338
13:00	524	502	483			503			503	1509
14:00	487	532	532			517			517	1551
15:00	468	579	517			521			521	1564
16:00	609	674	736			673			673	2019
17:00	713	719	760			730			730	2192
18:00	866	927	773			855			855	2566
19:00	607	743	699			683			683	2049
20:00	440	485	515			480			480	1440
21:00	279	336	343			319			319	958
22:00	190	283	262			245			245	735
23:00	103	103	152			119			119	358
24:00	82	56	81			73			73	219
TOTALS	6216	8790	8709	1971	0	8557	0	0	8557	25686
% AVG WKDY	72.6	102.7	101.7	23						
% AVG WEEK	72.6	102.7	101.7	23						
AM Times	11:00	09:00	09:00	09:00		09:00			09:00	
AM Peaks	455	596	654	636		628			628	
PM Times	18:00	18:00	18:00			18:00			18:00	
PM Peaks	866	927	773			855			855	

APPENDIX G

Preliminary Traffic Signal Warrants Analysis: Crafts Street at Albemarle Road, Newton

Summary of Hourly Volumes and Warrant Fulfillment Crafts Street at Albemarle Road, Newton

Hourly Period Starting	Crafts Street (main street)		Albemarle Road (minor street)		Sum of main street	Higher of minor street	Volumes above the minimum requirement		
	EB	WB	SB	NB			Warrant 1	Warrant 2	Warrant 7
6:00	127	130	12	41	257	41			
7:00	426	401	30	133	827	133			X
8:00	832	792	123	268	1,624	268	X	X	X
9:00	916	797	201	272	1,713	272	X	X	X
10:00	639	587	102	176	1,226	176	X	X	X
11:00	507	521	85	174	1,028	174	X	X	X
12:00	499	573	102	179	1,072	179	X	X	X
13:00	577	611	123	200	1,188	200	X	X	X
14:00	566	614	111	202	1,180	202	X	X	X
15:00	580	697	134	243	1,277	243	X	X	X
16:00	733	835	200	256	1,568	256	X	X	X
17:00	731	978	182	291	1,709	291	X	X	X
18:00	862	1,038	219	308	1,900	308	X	X	X
19:00	717	926	185	228	1,643	228	X	X	X

Note: **Warrant 1 is fulfilled.** It requires that the traffic conditions (observed vehicular volumes higher than the specified minimum volumes) exist for each of any 8 hours of an average day. Condition A was applied in this case.

Warrant 2 is fulfilled. It requires that the traffic conditions (minimum volumes specified differently from Warrant 1) exist for each of any 4 hours of an average day.

Warrant 7 (crash experience) requires that the traffic conditions (vehicular volumes higher than 80 percent of the volumes specified in Warrant 1 Condition A), in addition to the requirement of five or more correctable crashes in a recent 12-month period.

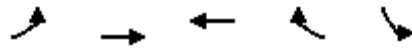
APPENDIX H

Alternative 1: Retime the Signal at North Street

AM/PM Peak-Hour Intersection Capacity Analysis: Crafts Street at North Street, Newton

Intersection Capacity Analysis
 Crafts St at North St

12/9/2011



Lane Group	EBL	EBT	WBT	WBR	SBL	ø9
Lane Configurations						
Volume (vph)	108	741	573	280	363	
Lane Group Flow (vph)	115	788	610	298	418	
Turn Type	pm+pt			pt+ov		
Protected Phases	7	4	8	6 8	6	9
Permitted Phases	4					
Detector Phase	7	4	8	6 8	6	
Switch Phase						
Minimum Initial (s)	4.0	8.0	8.0		8.0	4.0
Minimum Split (s)	10.0	14.0	14.0		14.0	35.0
Total Split (s)	10.0	50.0	40.0	68.0	28.0	35.0
Total Split (%)	8.8%	44.2%	35.4%	60.2%	24.8%	31%
Yellow Time (s)	3.0	4.0	4.0		3.0	3.0
All-Red Time (s)	0.0	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)	3.0	6.0	6.0	5.0	5.0	
Lead/Lag	Lead		Lag			
Lead-Lag Optimize?						
Recall Mode	Max	Max	Max		None	None
Act Effct Green (s)	48.6	45.5	35.1	62.5	23.8	
Actuated g/C Ratio	0.49	0.46	0.35	0.63	0.24	
v/c Ratio	0.59	0.97	0.98	0.31	0.92	
Control Delay	33.4	56.0	67.7	9.1	66.6	
Queue Delay	0.0	0.0	0.0	0.0	0.0	
Total Delay	33.4	56.0	67.7	9.1	66.6	
LOS	C	E	E	A	E	
Approach Delay		53.2	48.5		66.6	
Approach LOS		D	D		E	
Queue Length 50th (ft)	52	~672	~525	88	~340	
Queue Length 95th (ft)	#121	#908	#744	134	#536	
Internal Link Dist (ft)		282	1100		528	
Turn Bay Length (ft)	110					
Base Capacity (vph)	194	813	622	962	456	
Starvation Cap Reductn	0	0	0	0	0	
Spillback Cap Reductn	0	0	0	0	0	
Storage Cap Reductn	0	0	0	0	0	
Reduced v/c Ratio	0.59	0.97	0.98	0.31	0.92	

Intersection Summary

Cycle Length: 113
 Actuated Cycle Length: 99
 Natural Cycle: 130
 Control Type: Semi Act-Uncoord
 Maximum v/c Ratio: 0.98
 Intersection Signal Delay: 53.8
 Intersection LOS: D
 Intersection Capacity Utilization 69.8%
 ICU Level of Service C
 Analysis Period (min) 15
 ~ Volume exceeds capacity, queue is theoretically infinite.
 Queue shown is maximum after two cycles.

Intersection Capacity Analysis

Crafts St at North St

12/9/2011

95th percentile volume exceeds capacity, queue may be longer.
 Queue shown is maximum after two cycles.

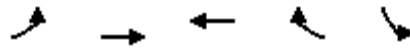
Splits and Phases: 4: Crafts & North

 ø6	 ø4	 ø9
28 s	50 s	35 s
	 ø7  ø8	
	10 s	40 s

Intersection Capacity Analysis

Crafts St at North St

12/9/2011



Lane Group	EBL	EBT	WBT	WBR	SBL	ø9
Lane Configurations						
Volume (vph)	207	602	733	319	393	
Lane Group Flow (vph)	218	634	814	354	456	
Turn Type	pm+pt			pt+ov		
Protected Phases	7	4	8	6 8	6	9
Permitted Phases	4					
Detector Phase	7	4	8	6 8	6	
Switch Phase						
Minimum Initial (s)	4.0	8.0	8.0		8.0	4.0
Minimum Split (s)	11.0	14.0	14.0		14.0	35.0
Total Split (s)	11.0	52.0	41.0	67.0	26.0	35.0
Total Split (%)	9.7%	46.0%	36.3%	59.3%	23.0%	31%
Yellow Time (s)	3.0	4.0	4.0		3.0	3.0
All-Red Time (s)	0.0	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)	3.0	6.0	6.0	5.0	5.0	
Lead/Lag	Lead		Lag			
Lead-Lag Optimize?						
Recall Mode	Max	Max	Max		None	None
Act Effct Green (s)	50.6	47.5	36.2	62.4	21.7	
Actuated g/C Ratio	0.55	0.52	0.39	0.68	0.24	
v/c Ratio	0.92	0.69	1.16	0.33	0.97	
Control Delay	62.8	26.0	116.0	7.8	72.6	
Queue Delay	0.0	0.0	0.0	0.0	0.0	
Total Delay	62.8	26.0	116.0	7.8	72.6	
LOS	E	C	F	A	E	
Approach Delay		35.4	83.2		72.6	
Approach LOS		D	F		E	
Queue Length 50th (ft)	51	178	~396	32	210	
Queue Length 95th (ft)	#294	#632	#1052	162	#611	
Internal Link Dist (ft)		282	1100		528	
Turn Bay Length (ft)	110					
Base Capacity (vph)	238	923	702	1064	471	
Starvation Cap Reductn	0	0	0	0	0	
Spillback Cap Reductn	0	0	0	0	0	
Storage Cap Reductn	0	0	0	0	0	
Reduced v/c Ratio	0.92	0.69	1.16	0.33	0.97	

Intersection Summary

Cycle Length: 113
 Actuated Cycle Length: 92
 Natural Cycle: 150
 Control Type: Semi Act-Uncoord
 Maximum v/c Ratio: 1.16
 Intersection Signal Delay: 64.8
 Intersection Capacity Utilization 86.9%
 Analysis Period (min) 15
 ~ Volume exceeds capacity, queue is theoretically infinite.
 Queue shown is maximum after two cycles.

Intersection Capacity Analysis Crafts St at North St

12/9/2011

95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

Splits and Phases: 4: Crafts & North

 ø6 26 s	 ø4 52 s	 ø9 35 s
	 ø7 11 s	 ø8 41 s

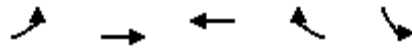
APPENDIX I

Alternative 2: Upgrade the Signal at North Street

**AM/PM Peak-Hour Intersection Capacity Analysis:
Crafts Street at North Street, Newton**

Intersection Capacity Analysis
 Crafts St at North St

12/9/2011



Lane Group	EBL	EBT	WBT	WBR	SBL	ø9
Lane Configurations	↖	↗	↗	↖	↖	
Volume (vph)	108	741	573	280	363	
Lane Group Flow (vph)	115	788	610	298	418	
Turn Type	pm+pt			pm+ov		
Protected Phases	7	4	8	6	6	9
Permitted Phases	4			8		
Detector Phase	7	4	8	6	6	
Switch Phase						
Minimum Initial (s)	2.0	8.0	8.0	8.0	8.0	4.0
Minimum Split (s)	6.0	14.0	14.0	14.0	14.0	35.0
Total Split (s)	7.0	52.0	45.0	28.0	28.0	35.0
Total Split (%)	6.1%	45.2%	39.1%	24.3%	24.3%	30%
Yellow Time (s)	3.0	4.0	4.0	3.0	3.0	3.0
All-Red Time (s)	0.0	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)	3.0	6.0	6.0	5.0	5.0	
Lead/Lag	Lead		Lag			
Lead-Lag Optimize?	Yes		Yes			
Recall Mode	Max	Max	Max	None	None	None
Act Effct Green (s)	50.6	47.5	40.2	65.0	23.7	
Actuated g/C Ratio	0.50	0.47	0.40	0.64	0.23	
v/c Ratio	0.64	0.95	0.87	0.31	0.94	
Control Delay	39.7	51.3	47.2	8.5	71.2	
Queue Delay	0.0	0.0	0.0	0.0	0.0	
Total Delay	39.7	51.3	47.2	8.5	71.2	
LOS	D	D	D	A	E	
Approach Delay		49.8	34.5		71.3	
Approach LOS		D	C		E	
Queue Length 50th (ft)	52	~670	~483	88	~352	
Queue Length 95th (ft)	#124	#906	#703	133	#548	
Internal Link Dist (ft)		282	1100		528	
Turn Bay Length (ft)	110					
Base Capacity (vph)	179	832	698	966	446	
Starvation Cap Reductn	0	0	0	0	0	
Spillback Cap Reductn	0	0	0	0	0	
Storage Cap Reductn	0	0	0	0	0	
Reduced v/c Ratio	0.64	0.95	0.87	0.31	0.94	

Intersection Summary

Cycle Length: 115
 Actuated Cycle Length: 101
 Natural Cycle: 130
 Control Type: Actuated-Uncoordinated
 Maximum v/c Ratio: 0.95
 Intersection Signal Delay: 47.6
 Intersection LOS: D
 Intersection Capacity Utilization 69.8%
 ICU Level of Service C
 Analysis Period (min) 15
 ~ Volume exceeds capacity, queue is theoretically infinite.
 Queue shown is maximum after two cycles.

Intersection Capacity Analysis Crafts St at North St

12/9/2011

95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

Splits and Phases: 8: Crafts & North



Intersection Capacity Analysis

Crafts St at North St

12/9/2011



Lane Group	EBL	EBT	WBT	WBR	SBL	ø9
Lane Configurations						
Volume (vph)	207	602	733	319	393	
Lane Group Flow (vph)	218	634	814	354	456	
Turn Type	pm+pt			pm+ov		
Protected Phases	7	4	8	6	6	9
Permitted Phases	4			8		
Detector Phase	7	4	8	6	6	
Switch Phase						
Minimum Initial (s)	2.0	8.0	8.0	8.0	8.0	4.0
Minimum Split (s)	6.0	14.0	14.0	14.0	14.0	35.0
Total Split (s)	11.0	54.0	43.0	26.0	26.0	35.0
Total Split (%)	9.6%	47.0%	37.4%	22.6%	22.6%	30%
Yellow Time (s)	3.0	4.0	4.0	3.0	3.0	3.0
All-Red Time (s)	0.0	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)	3.0	6.0	6.0	5.0	5.0	
Lead/Lag	Lead		Lag			
Lead-Lag Optimize?	Yes		Yes			
Recall Mode	Max	Max	Max	None	None	None
Act Effct Green (s)	52.6	49.5	38.2	60.9	21.7	
Actuated g/C Ratio	0.56	0.53	0.41	0.65	0.23	
v/c Ratio	0.94	0.67	1.12	0.35	0.99	
Control Delay	68.4	25.3	101.4	7.9	79.0	
Queue Delay	0.0	0.0	0.0	0.0	0.0	
Total Delay	68.4	25.3	101.4	7.9	79.0	
LOS	E	C	F	A	E	
Approach Delay		36.3	73.1		79.0	
Approach LOS		D	E		E	
Queue Length 50th (ft)	55	178	385	32	218	
Queue Length 95th (ft)	#302	#627	#1051	160	#626	
Internal Link Dist (ft)		282	1100		528	
Turn Bay Length (ft)	110					
Base Capacity (vph)	233	941	726	999	460	
Starvation Cap Reductn	0	0	0	0	0	
Spillback Cap Reductn	0	0	0	0	0	
Storage Cap Reductn	0	0	0	0	0	
Reduced v/c Ratio	0.94	0.67	1.12	0.35	0.99	

Intersection Summary

Cycle Length: 115

Actuated Cycle Length: 94

Natural Cycle: 150

Control Type: Actuated-Uncoordinated

Maximum v/c Ratio: 1.12

Intersection Signal Delay: 61.5

Intersection LOS: E

Intersection Capacity Utilization 86.9%

ICU Level of Service E

Analysis Period (min) 15

95th percentile volume exceeds capacity, queue may be longer.

Queue shown is maximum after two cycles.

Intersection Capacity Analysis Crafts St at North St

12/9/2011

Splits and Phases: 4: Crafts & North



APPENDIX J

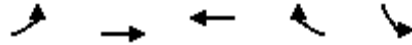
Alternative 3: Install a Traffic Signal at Albemarle Road and Coordinate It with the Upgraded Signal at North Street

AM/PM Peak-Hour Intersection Capacity Analysis:

**Crafts Street at North Street, Newton
and
Crafts Street at Albemarle Road, Newton**

Intersection Capacity Analysis
 Crafts St at North St

12/9/2011



Lane Group	EBL	EBT	WBT	WBR	SBL	ø9
Lane Configurations	↖	↑	↑	↗	↘	
Volume (vph)	108	741	573	280	363	
Lane Group Flow (vph)	115	788	610	298	418	
Turn Type	pm+pt			pt+ov		
Protected Phases	7	4	8	6 8	6	9
Permitted Phases	4					
Detector Phase	7	4	8	6 8	6	
Switch Phase						
Minimum Initial (s)	5.0	4.0	4.0		4.0	4.0
Minimum Split (s)	8.0	20.0	20.0		20.0	35.0
Total Split (s)	8.0	50.0	42.0	72.0	30.0	35.0
Total Split (%)	7.0%	43.5%	36.5%	62.6%	26.1%	30%
Yellow Time (s)	3.0	3.0	3.0		3.0	3.0
All-Red Time (s)	0.0	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)	3.0	5.0	5.0	5.0	5.0	
Lead/Lag	Lead		Lag			
Lead-Lag Optimize?			Yes			
Recall Mode	None	C-Max	C-Max		None	None
Act Effct Green (s)	61.0	59.0	51.0	78.0	25.0	
Actuated g/C Ratio	0.53	0.51	0.44	0.68	0.22	
v/c Ratio	0.55	0.87	0.79	0.29	1.01	
Control Delay	26.9	35.2	40.6	8.2	92.6	
Queue Delay	0.0	0.6	0.0	0.0	0.0	
Total Delay	26.9	35.8	40.6	8.2	92.6	
LOS	C	D	D	A	F	
Approach Delay		34.6	30.0		92.6	
Approach LOS		C	C		F	
Queue Length 50th (ft)	46	~685	~506	88	~318	
Queue Length 95th (ft)	m#76	#900	#727	133	#522	
Internal Link Dist (ft)		282	1100		528	
Turn Bay Length (ft)	110					
Base Capacity (vph)	211	908	777	1034	413	
Starvation Cap Reductn	0	17	0	0	0	
Spillback Cap Reductn	0	0	0	0	0	
Storage Cap Reductn	0	0	0	0	0	
Reduced v/c Ratio	0.55	0.88	0.79	0.29	1.01	

Intersection Summary

Cycle Length: 115
 Actuated Cycle Length: 115
 Offset: 0 (0%), Referenced to phase 4:EBTL and 8:WBT, Start of Green, Master Intersection
 Natural Cycle: 125
 Control Type: Actuated-Coordinated
 Maximum v/c Ratio: 1.01
 Intersection Signal Delay: 43.6
 Intersection LOS: D
 Intersection Capacity Utilization 69.0%
 ICU Level of Service C
 Analysis Period (min) 15
 ~ Volume exceeds capacity, queue is theoretically infinite.

Intersection Capacity Analysis

Crafts St at North St

12/9/2011

Queue shown is maximum after two cycles.

95th percentile volume exceeds capacity, queue may be longer.

Queue shown is maximum after two cycles.

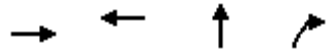
m Volume for 95th percentile queue is metered by upstream signal.

Splits and Phases: 4: Crafts & North



Intersection Capacity Analysis
 Crafts St at Albemarle Rd (Eastern Intersection)

12/9/2011



Lane Group	EBT	WBT	NBT	NBR	ø4	ø11
Lane Configurations	↑	↑	↑	↗		
Volume (vph)	679	512	51	85		
Lane Group Flow (vph)	722	546	134	106		
Turn Type				Prot		
Protected Phases	4 10	10	2	2	4	11
Permitted Phases						
Detector Phase	4 10	10	2	2		
Switch Phase						
Minimum Initial (s)		4.0	4.0	4.0	4.0	4.0
Minimum Split (s)		20.0	10.0	10.0	10.0	30.0
Total Split (s)	67.0	52.0	18.0	18.0	15.0	30.0
Total Split (%)	58.3%	45.2%	15.7%	15.7%	13%	26%
Yellow Time (s)		3.0	3.0	3.0	3.0	3.0
All-Red Time (s)		2.0	2.0	2.0	2.0	2.0
Lost Time Adjust (s)	0.0	0.0	0.0	0.0		
Total Lost Time (s)	5.0	5.0	5.0	5.0		
Lead/Lag						
Lead-Lag Optimize?						
Recall Mode		C-Max	None	None	None	None
Act Effct Green (s)	80.8	65.8	12.2	12.2		
Actuated g/C Ratio	0.70	0.57	0.11	0.11		
v/c Ratio	0.50	0.47	0.71	0.66		
Control Delay	3.7	3.8	69.7	69.5		
Queue Delay	1.1	1.3	0.0	6.3		
Total Delay	4.8	5.1	69.7	75.8		
LOS	A	A	E	E		
Approach Delay	4.8	5.1	72.4			
Approach LOS	A	A	E			
Queue Length 50th (ft)	11	14	97	76		
Queue Length 95th (ft)	54	m36	144	120		
Internal Link Dist (ft)	9	282	317			
Turn Bay Length (ft)				50		
Base Capacity (vph)	1442	1164	203	171		
Starvation Cap Reductn	0	397	0	0		
Spillback Cap Reductn	451	0	0	32		
Storage Cap Reductn	0	0	0	0		
Reduced v/c Ratio	0.73	0.71	0.66	0.76		

Intersection Summary

Cycle Length: 115
 Actuated Cycle Length: 115
 Offset: 112 (97%), Referenced to phase 10:EBWB, Start of Green
 Natural Cycle: 90
 Control Type: Actuated-Coordinated
 Maximum v/c Ratio: 0.71
 Intersection Signal Delay: 15.7
 Intersection LOS: B
 Intersection Capacity Utilization 94.1%
 ICU Level of Service F
 Analysis Period (min) 15
 m Volume for 95th percentile queue is metered by upstream signal.

Intersection Capacity Analysis Crafts St at Albemarle Rd (Eastern Intersection)

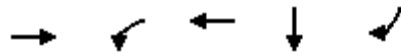
12/9/2011

Splits and Phases: 8: Crafts & Albemarle



Intersection Capacity Analysis
 Crafts St at Albemarle Rd (Western Intersection)

12/9/2011



Lane Group	EBT	WBL	WBT	SBT	SBR	ø11
Lane Configurations	↑	↖	↑	↑	↗	
Volume (vph)	681	50	462	79	134	
Lane Group Flow (vph)	772	53	491	98	156	
Turn Type		D.P+P			Prot	
Protected Phases	10	2	2 10	4	4	11
Permitted Phases		10				
Detector Phase	10	2	2 10	4	4	
Switch Phase						
Minimum Initial (s)	4.0	4.0		4.0	4.0	4.0
Minimum Split (s)	20.0	10.0		10.0	10.0	30.0
Total Split (s)	52.0	18.0	70.0	15.0	15.0	30.0
Total Split (%)	45.2%	15.7%	60.9%	13.0%	13.0%	26%
Yellow Time (s)	3.0	3.0		3.0	3.0	3.0
All-Red Time (s)	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 Optimize?						
Recall Mode	C-Max	None		None	None	None
Act Effct Green (s)	65.8	78.0	81.0	10.0	10.0	
Actuated g/C Ratio	0.57	0.68	0.70	0.09	0.09	
v/c Ratio	0.69	0.14	0.34	0.61	0.69	
Control Delay	26.0	1.9	1.5	67.6	34.7	
Queue Delay	0.1	0.0	0.0	0.0	0.0	
Total Delay	26.1	1.9	1.5	67.6	34.7	
LOS	C	A	A	E	C	
Approach Delay	26.1		1.5	47.4		
Approach LOS	C		A	D		
Queue Length 50th (ft)	284	0	1	71	33	
Queue Length 95th (ft)	#811	m4	22	#125	#107	
Internal Link Dist (ft)	637		9	245		
Turn Bay Length (ft)					25	
Base Capacity (vph)	1118	389	1459	160	225	
Starvation Cap Reductn	0	0	0	0	0	
Spillback Cap Reductn	22	0	0	0	0	
Storage Cap Reductn	0	0	0	0	0	
Reduced v/c Ratio	0.70	0.14	0.34	0.61	0.69	

Intersection Summary

Cycle Length: 115
 Actuated Cycle Length: 115
 Offset: 112 (97%), Referenced to phase 10:EBWB, Start of Green
 Natural Cycle: 90
 Control Type: Actuated-Coordinated
 Maximum v/c Ratio: 0.71
 Intersection Signal Delay: 21.0
 Intersection Capacity Utilization 94.1%
 Analysis Period (min) 15
 Intersection LOS: C
 ICU Level of Service F
 # 95th percentile volume exceeds capacity, queue may be longer.

Intersection Capacity Analysis Crafts St at Albemarle Rd (Western Intersection)

12/9/2011

Queue shown is maximum after two cycles.

m Volume for 95th percentile queue is metered by upstream signal.

Splits and Phases: 5: Crafts & Albemarle



Intersection Capacity Analysis

Crafts St at North St

12/9/2011



Lane Group	EBL	EBT	WBT	WBR	SBL	ø9
Lane Configurations						
Volume (vph)	207	602	733	319	393	
Lane Group Flow (vph)	218	634	797	347	456	
Turn Type	pm+pt			pt+ov		
Protected Phases	7	4	8	6 8	6	9
Permitted Phases	4					
Detector Phase	7	4	8	6 8	6	
Switch Phase						
Minimum Initial (s)	5.0	8.0	8.0		8.0	4.0
Minimum Split (s)	10.0	14.0	14.0		14.0	35.0
Total Split (s)	11.0	53.0	42.0	74.0	32.0	35.0
Total Split (%)	9.2%	44.2%	35.0%	61.7%	26.7%	29%
Yellow Time (s)	3.0	4.0	4.0		3.0	3.0
All-Red Time (s)	0.0	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)	3.0	6.0	6.0	5.0	5.0	
Lead/Lag	Lead		Lag			
Lead-Lag Optimize?						
Recall Mode	Min	C-Max	C-Max		None	None
Act Effct Green (s)	64.0	61.0	50.0	80.0	27.0	
Actuated g/C Ratio	0.53	0.51	0.42	0.67	0.22	
v/c Ratio	1.22	0.70	1.07	0.33	1.01	
Control Delay	170.2	30.1	89.2	8.7	92.2	
Queue Delay	0.0	0.3	0.0	0.0	0.0	
Total Delay	170.2	30.4	89.2	8.7	92.2	
LOS	F	C	F	A	F	
Approach Delay		66.2	64.8		92.2	
Approach LOS		E	E		F	
Queue Length 50th (ft)	~185	284	~853	105	~363	
Queue Length 95th (ft)	#346	#670	#1093	156	#577	
Internal Link Dist (ft)		282	1100		528	
Turn Bay Length (ft)	110					
Base Capacity (vph)	179	908	744	1045	450	
Starvation Cap Reductn	0	43	0	0	0	
Spillback Cap Reductn	0	0	0	0	0	
Storage Cap Reductn	0	0	0	0	0	
Reduced v/c Ratio	1.22	0.73	1.07	0.33	1.01	

Intersection Summary

Cycle Length: 120
 Actuated Cycle Length: 120
 Offset: 0 (0%), Referenced to phase 4:EBTL and 8:WBT, Start of Green, Master Intersection
 Natural Cycle: 150
 Control Type: Actuated-Coordinated
 Maximum v/c Ratio: 1.22
 Intersection Signal Delay: 70.4
 Intersection Capacity Utilization 86.9%
 Analysis Period (min) 15
 Intersection LOS: E
 ICU Level of Service E

~ Volume exceeds capacity, queue is theoretically infinite.

Intersection Capacity Analysis Crafts St at North St






12/9/2011

Queue shown is maximum after two cycles.

95th percentile volume exceeds capacity, queue may be longer.

Queue shown is maximum after two cycles.

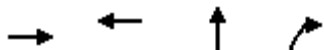
Splits and Phases: 4: Crafts & North

 ø6 32 s	 ø4 53 s	 ø9 35 s
	 ø7 11 s	 ø8 42 s

Intersection Capacity Analysis

Crafts St at Albemarle Rd (Eastern Intersection)

12/9/2011



Lane Group	EBT	WBT	NBT	NBR	ø4	ø11
Lane Configurations	↑	↑	↙	↘		
Volume (vph)	702	731	83	88		
Lane Group Flow (vph)	747	796	165	91		
Turn Type				Prot		
Protected Phases	4 10	10	2	2	4	11
Permitted Phases						
Detector Phase	4 10	10	2	2		
Switch Phase						
Minimum Initial (s)		4.0	4.0	4.0	4.0	4.0
Minimum Split (s)		20.0	20.0	20.0	10.0	30.0
Total Split (s)	70.0	58.0	20.0	20.0	12.0	30.0
Total Split (%)	58.3%	48.3%	16.7%	16.7%	10%	25%
Yellow Time (s)		3.5	3.5	3.5	3.5	3.0
All-Red Time (s)		0.5	0.5	0.5	0.5	2.0
Lost Time Adjust (s)	0.0	0.0	0.0	0.0		
Total Lost Time (s)	4.0	4.0	4.0	4.0		
Lead/Lag						
Lead-Lag Optimize?						
Recall Mode		C-Max	None	None	None	None
Act Effct Green (s)	79.0	67.0	15.0	15.0		
Actuated g/C Ratio	0.66	0.56	0.12	0.12		
v/c Ratio	0.54	0.70	0.72	0.45		
Control Delay	2.2	9.0	68.2	55.9		
Queue Delay	0.5	3.1	0.0	4.4		
Total Delay	2.7	12.2	68.2	60.3		
LOS	A	B	E	E		
Approach Delay	2.7	12.2	65.4			
Approach LOS	A	B	E			
Queue Length 50th (ft)	10	121	123	66		
Queue Length 95th (ft)	27	m80	192	120		
Internal Link Dist (ft)	9	282	317			
Turn Bay Length (ft)				50		
Base Capacity (vph)	1377	1136	245	215		
Starvation Cap Reductn	0	236	0	0		
Spillback Cap Reductn	260	0	0	71		
Storage Cap Reductn	0	0	0	0		
Reduced v/c Ratio	0.67	0.88	0.67	0.63		

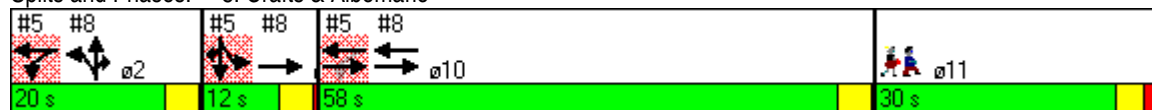
Intersection Summary

Cycle Length: 120
 Actuated Cycle Length: 120
 Offset: 0 (0%), Referenced to phase 10:EBWB, Start of Green
 Natural Cycle: 100
 Control Type: Actuated-Coordinated
 Maximum v/c Ratio: 0.75
 Intersection Signal Delay: 15.8
 Intersection LOS: B
 Intersection Capacity Utilization 111.7%
 ICU Level of Service H
 Analysis Period (min) 15
 m Volume for 95th percentile queue is metered by upstream signal.

Intersection Capacity Analysis Crafts St at Albemarle Rd (Eastern Intersection)

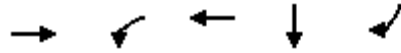
12/9/2011

Splits and Phases: 8: Crafts & Albemarle



Intersection Capacity Analysis
 Crafts St at Albemarle Rd (Western Intersection)

12/9/2011



Lane Group	EBT	WBL	WBT	SBT	SBR	ø11
Lane Configurations	↑	↖	↑	↖	↗	
Volume (vph)	704	82	649	61	241	
Lane Group Flow (vph)	786	89	705	80	268	
Turn Type		D.P+P			Prot	
Protected Phases	10	2	2 10	4	4	11
Permitted Phases		10				
Detector Phase	10	2	2 10	4	4	
Switch Phase						
Minimum Initial (s)	4.0	4.0		4.0	4.0	4.0
Minimum Split (s)	20.0	20.0		10.0	10.0	30.0
Total Split (s)	58.0	20.0	78.0	12.0	12.0	30.0
Total Split (%)	48.3%	16.7%	65.0%	10.0%	10.0%	25%
Yellow Time (s)	3.5	3.5		3.5	3.5	3.0
All-Red Time (s)	0.5	0.5		0.5	0.5	2.0
Lost Time Adjust (s)	0.0	0.0	0.0	0.0	0.0	
Total Lost Time (s)	4.0	4.0	4.0	4.0	4.0	
Lead/Lag						
Lead-Lag Optimize?						
Recall Mode	C-Max	None		None	None	None
Act Effct Green (s)	67.0	82.0	83.6	8.0	8.0	
Actuated g/C Ratio	0.56	0.68	0.70	0.07	0.07	
v/c Ratio	0.73	0.23	0.48	0.63	0.75	
Control Delay	29.0	4.0	1.5	77.2	20.3	
Queue Delay	0.0	0.0	0.0	0.0	0.0	
Total Delay	29.0	4.0	1.5	77.2	20.3	
LOS	C	A	A	E	C	
Approach Delay	29.0		1.8	33.4		
Approach LOS	C		A	C		
Queue Length 50th (ft)	551	1	8	61	0	
Queue Length 95th (ft)	#804	m4	24	#132	#107	
Internal Link Dist (ft)	637		9	245		
Turn Bay Length (ft)					100	
Base Capacity (vph)	1083	394	1474	126	357	
Starvation Cap Reductn	0	0	0	0	0	
Spillback Cap Reductn	1	0	0	0	0	
Storage Cap Reductn	0	0	0	0	0	
Reduced v/c Ratio	0.73	0.23	0.48	0.63	0.75	

Intersection Summary

Cycle Length: 120
 Actuated Cycle Length: 120
 Offset: 0 (0%), Referenced to phase 10:EBWB, Start of Green
 Natural Cycle: 100
 Control Type: Actuated-Coordinated
 Maximum v/c Ratio: 0.75
 Intersection Signal Delay: 18.6
 Intersection LOS: B
 Intersection Capacity Utilization 111.7%
 ICU Level of Service H
 Analysis Period (min) 15
 # 95th percentile volume exceeds capacity, queue may be longer.

Intersection Capacity Analysis

Crafts St at Albemarle Rd (Western Intersection)

12/9/2011

Queue shown is maximum after two cycles.

m Volume for 95th percentile queue is metered by upstream signal.

Splits and Phases: 5: Crafts & Albemarle



APPENDIX K

MassDOT Project Implementation Process

MassDOT Project Implementation Process

The following description of the implementation process is based on Chapter 2 of the MassDOT Highway Division's *Project Development and Design Guide (2005)*. The text below borrows heavily from that document.

1 NEEDS IDENTIFICATION

For each of the locations at which an improvement is to be implemented, the MassDOT Highway Division 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, the MassDOT Highway Division meets with potential participants, such as the Boston Region 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. The MassDOT Highway Division 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, the MassDOT Highway Division, fills out, for each improvement, a Project Initiation Form (PIF), 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 Capital Expenditure Program Office (CEPO). 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 MassDOT's statewide priorities and criteria. If the result is positive, the 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 a project evaluation criteria score, a Transportation Improvement Program (TIP) year, a tentative project category, and a tentative funding category.

4 ENVIRONMENTAL, 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.

5 PROGRAMMING

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, where the MPO receives preliminary information on the proposed project, the proponent requests that the MPO place the project in the region's TIP. The MPO considers the project in terms of regional needs, evaluation criteria, and compliance with the Long-Range 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, 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, the 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. The MassDOT Highway Division can apply what is learned in this process to future projects.