FUNCTIONAL DESIGN REPORT

Mount Auburn Street (Route 16) Corridor
Watertown, MA

January 2016

Prepared for:

Town of Watertown
149 Main Street
Watertown, MA 02472

Prepared by:

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1.0 INTRODUCTION

WorldTech Engineering, LLC has been retained by the Town of Watertown Department of Public Works to provide professional engineering services necessary for investigation, analysis, design, and preparation of construction bid documents for improvements to existing safety conditions and traffic operations along the Mount Auburn Street (Route 16) corridor in the Town of Watertown, Massachusetts, including reducing the roadway from four to two basic travel lanes. The proposed study area includes the length of Mount Auburn Street beginning east of the intersection with Summer Street and continuing east, ending at the Cambridge city line. The study area also includes a section of Arlington Street beginning north of its intersection with Mount Auburn Street and continuing south through the intersection with Grove Street and terminating at Merrifield Avenue.

This Functional Design Report updates the findings of the March 2011 Feasibility Study, which examined existing traffic and safety conditions along roadways encompassing the project site and analyzed three conceptual build alternatives for reconstructing the corridor.

The scope of services currently envisioned for this project will be completed in the following phases:

Phase I – Traffic and Safety Study
Phase II – Engineering Design Services
Phase III – Construction Phase Services

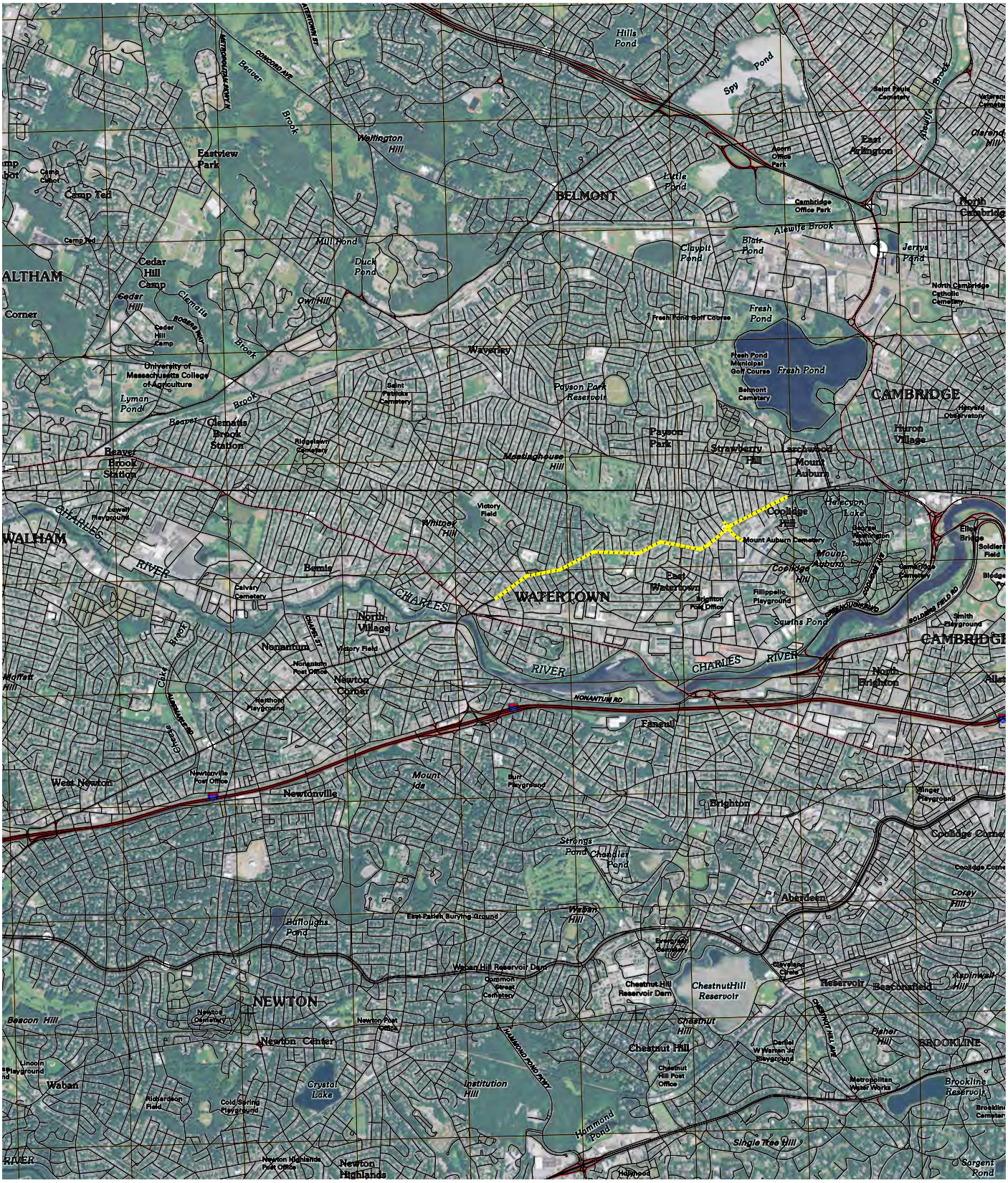
This document represents the completion of all tasks outlined in Phase II. Phase II presents the engineering design of the identified preferred alternative (geometric alignment and traffic controls), including several early action projects to provide operational and safety improvements in advance of the roadway reconstruction. The proposed improvements are presented on preliminary plans suitable to define the scope of work and to compile a budgetary cost estimate. The following sections detail the work and findings of the FDR. The proposed improvements are intended to enhance traffic operations, pedestrian and vehicular safety along the Mount Auburn Street corridor.

The study area for the traffic impact analysis includes the critical intersections and roadways within the area. Specifically, the study area includes the following roadway intersections:

- Mount Auburn Street at Marshall Street
- Mount Auburn Street at Phillips Street
- Mount Auburn Street at Parker Street
- Mount Auburn Street at Common Street
- Mount Auburn Street at Bates Road East and Walnut Street
- Mount Auburn Street at Boylston Street

- Mount Auburn Street at Winthrop Street
- Mount Auburn Street at Chauncey Street
- Mount Auburn Street at School Street
- Mount Auburn Street at Upland Road and Dexter Avenue
- Mount Auburn Street at Melendy Avenue
- Mount Auburn Street at Lloyd Road
- Mount Auburn Street at Elton Avenue
- Mount Auburn Street at Irma Avenue
- Mount Auburn Street at Kimball Road and Bigelow Avenue
- Mount Auburn Street at Templeton Parkway
- Mount Auburn Street at Arlington Street
- Arlington Street at Grove Street
- Grove Street at the Tufts Medical Center driveway
- Arlington Street at Wells Avenue
- Arlington Street at Merrifield Avenue

The project site location map with respect to the local roadway system is shown in Figure 1.



PREPARED FOR:	MOUNT AUBURN STREET (ROUTE 16) CORRIDOR SAFETY IMPROVEMENTS Project Location	NORTH	DATE: 1-08-2016 SCALE: 1"=4000'	Figure 1
			PREPARED BY: WORLDTECH ENGINEERING 300 TRADE CENTER, SUITE 5580 WOBURN, MASSACHUSETTS 01801 PHONE: 781.933.4800	

2.0 EXISTING CONDITIONS

In this section, existing conditions such as roadway and intersection geometrics, traffic volumes, crash history, and parking are examined in detail. The existing conditions analysis is based on field visits conducted by WorldTech Engineering, LLC, traffic counts conducted by Transdata Services and Accurate Counts, Inc., and traffic data provided by the Town of Watertown Department of Planning and Community Development and the Massachusetts Department of Transportation (MassDOT). Information was collected regarding roadway geometric conditions, traffic control, traffic volumes, and peak period traffic operations. The results of these investigations are described below.

2.1 Study Area Description

The study area consists of the Mount Auburn Street (Route 16) and Arlington Street corridors and the intersections along Mount Auburn Street from east of Summer Street to the Cambridge city line, and along Arlington Street between Mount Auburn Street and Merrifield Avenue. The classification and jurisdictional responsibility of the critical study area roadways is listed in Table 1.

TABLE 1
Road Classification and Jurisdiction

Roadway Section	Classification	JURISDICTION
Mount Auburn Street	Urban Principal Arterial	Town of Watertown
Arlington Street	Urban Collector	Town of Watertown

Roadways

The following section provides a description of the major study area roadways.

Mount Auburn Street
Mount Auburn Street (Route 16) traverses the study area in a general east-west direction providing access to Route 2 and Route 3 to the east; and to Interstate 90 (via Centre Street in Newton), Route 20, and Arsenal Street to the west. It is a four-lane, urban principal arterial roadway under the jurisdiction of the Town of Watertown. Mount Auburn Street, within the study area, provides two travel lanes per direction separated by a double-yellow centerline.

Additional turning lanes are provided at the intersection with Arlington Street. Within the study area, sidewalks are provided along both sides of Mount Auburn Street. Parking is permitted along the south side of Mount Auburn Street, except at bus stop locations, throughout the study area, and parking is permitted on both sides of Mount Auburn Street between Baptist Walk and Summer Street and between Lloyd Road and Arlington Street. The posted speed limit on Mount Auburn Street is 30 miles per hour (mph). Land use along Mount Auburn Street consists of residential and commercial uses and areas of open space.

Arlington Street

Arlington Street traverses the study area in a general north-south direction and is a two-lane roadway under the jurisdiction of the Town of Watertown. Within the study area, Arlington Street is classified as an urban collector and provides one travel lane per direction separated by a double-yellow centerline with no marked edge-lines. Additional turning lanes are provided at the intersection with Mount Auburn Street. Within the study area, sidewalks are provided along both sides of Arlington Street. The posted speed limit on Arlington Street is 30 miles per hour (mph). Land use along Arlington Street consists of residential and commercial uses and areas of open space.

Intersections

The following section provides a description of the study area intersections. Unless otherwise noted, Mount Auburn Street provides two general purpose travel lanes which are separated by a double-yellow centerline. In addition, sidewalks are provided along both sides of all roadways.

Mount Auburn Street at Phillips Street

Phillips Street intersects Mount Auburn Street from the south to form this three-legged, unsignalized intersection. The Phillips Street northbound approach consists of a general purpose travel lane which accommodates two-way traffic, although a centerline is not provided. Stop-signs and stop-lines are provided along the Phillips Street approach. A marked crosswalk is provided across Phillips Street. Land use in the vicinity of this intersection consists of retail and residential uses.

Mount Auburn Street at Marshall Street

Marshall Street intersects Mount Auburn Street from the north to form this three-legged, unsignalized intersection. The Marshall Street northbound approach consists of a general purpose travel lane which accommodates two-way traffic, although a centerline is not provided. Stop-signs and stop-lines are provided along the Marshall Street approach. A marked crosswalk is provided across Marshall Street. Land use in the vicinity of this intersection consists of retail and residential uses.

Mount Auburn Street at Parker Street and Common Street

Parker Street intersects Mount Auburn Street from the south and Common Street intersects Mount Auburn Street from the north to form two three-legged signalized intersections, offset by approximately 100 feet. The two intersections are controlled by a single signal controller. The Parker Street northbound approach consists of a general purpose travel lane which accommodates two-way traffic, although a centerline is not provided. The southbound Common Street approach consists of a southbound left turn lane and a southbound right turn lane, separated from a single northbound departure lane by a double yellow center line. Stop lines are provided along all three approaches at both intersections. Marked crosswalks and pedestrian signal heads are provided across Parker Street, Common Street, Mount Auburn Street west of Parker Street, and Mount Auburn Street east of Common Street. Parking is permitted along the south side of Mount Auburn Street and along both sides of Parker Street. Land use in the vicinity of this intersection consists of retail, residential, and cemetery uses, and the Phillips School is located approximately 300 feet north of the intersection on Common Street.

Mount Auburn Street at Bates Road East and Walnut Street

Walnut Street intersects Mount Auburn Street from the south and Bates Road East intersects Mount Auburn Street from the north to form a four-legged signalized intersection. The Walnut Street northbound approach consists of one northbound general purpose lane and one southbound departure lane separated by a double yellow center line. The Bates Road East southbound approach consists of a general purpose travel lane which accommodates two-way traffic, although a centerline is not provided. Mount Auburn Street consists of two eastbound and two westbound general purpose lanes separated by a double yellow center line; additionally, along the eastbound approach, the parking lane functions as an exclusive right turn lane during peak periods. Stop lines are provided along all approaches. Marked crosswalks and pedestrian signal heads are provided across all approaches. Parking is permitted along the south side of Mount Auburn Street and along the west side of Bates Road East. Land use in the vicinity of this intersection is residential.

Mount Auburn Street at Boylston Street

Boylston Street intersects Mount Auburn Street from the south to form a three-legged unsignalized intersection. The Boylston Street approach consists of a general purpose travel lane which accommodates two-way traffic, although a centerline is not provided. A stop sign and stop line are provided for the Boylston Street approach. A marked crosswalk is provided across Boylston Street, and a marked crosswalk and pedestrian signal are provided across Mount Auburn Street approximately 300 feet east of the intersection. Parking is permitted along the south side of Mount Auburn Street and along the west side of Boylston Street. Land use in the vicinity of this intersection is residential, and the Hosmer Elementary School is located southeast of the intersection.

Mount Auburn Street at Winthrop Street

Winthrop Street intersects Mount Auburn Street from the south to form a three-legged unsignalized intersection. The Winthrop Street approach consists of a general purpose travel lane which accommodates two-way traffic, although a centerline is not provided. A stop sign and stop line are provided for the Winthrop Street approach. Marked crosswalks are provided across Winthrop Street and across the eastern Mount Auburn Street leg of the intersection. Parking is permitted along the south side of Mount Auburn Street and along both sides of Winthrop Street. Land use in the vicinity of this intersection is residential, and the Hosmer Elementary School is located south of the intersection.

Mount Auburn Street at School Street

School Street intersects Mount Auburn Street to form a four-legged signalized intersection. The northbound School Street approach consists of one northbound general purpose lane and one southbound departure lane separated by a double yellow center line. The southbound School Street approach consists of one northbound general purpose lane and one southbound departure lane separated by a concrete island. Mount Auburn Street consists of two eastbound and two westbound general purpose lanes separated by a double yellow center line; additionally, the westbound right turn movement is channelized. Stop lines are provided along all approaches. Marked crosswalks and pedestrian signal heads are provided across all approaches. Parking is permitted along the south side of Mount Auburn Street and along the west side of Bates Road East. Land use in the vicinity of this intersection is residential.

Mount Auburn Street at Upland Road and Dexter Avenue

Upland Road and Dexter Avenue intersect Mount Auburn Street from the north and south to form a four-legged, unsignalized intersection. The Upland Road and Dexter Avenue southbound and northbound approaches consist of a general purpose travel lane and accommodate two directions of traffic although a centerline is not painted along either roadway. Stop signs and stop lines are provided along both the Upland Road and Dexter Avenue approaches. Marked crosswalks are provided across Upland Road and Dexter Avenue. Land use in the vicinity of this intersection consists of retail and residential uses.

Mount Auburn Street at Melendy Avenue

Melendy Avenue intersects Mount Auburn Street from the south to form a three-legged, unsignalized intersection. The Melendy Avenue northbound approach consists of a general purpose travel lane which accommodates two-way traffic, although a centerline is not provided. Stop-signs and stop-lines are provided along the Melendy Avenue approach. A marked crosswalk is provided across Melendy Avenue. Land use in the vicinity of this intersection consists of retail and residential uses.

Mount Auburn Street at Lloyd Road

Approximately 30 feet east of Melendy Avenue, Lloyd Road intersects Mount Auburn Street from the northwest to form a three-legged, unsignalized intersection. The Lloyd Road southeast bound approach consists of a general purpose travel lane which accommodates two-way traffic, although a centerline is not provided. Stop-signs and stop-lines are provided along the Lloyd Road approach. Marked crosswalks are provided across Lloyd Road and across the eastbound Mount Auburn Street approach. Land use in the vicinity of this intersection consists of retail and residential uses.

Mount Auburn Street at Elton Avenue

Approximately 30 feet east of Lloyd Road, Elton Avenue intersects Mount Auburn Street from the southeast to form a three-legged, unsignalized intersection. Elton Avenue is a one-way southeast bound (away from the intersection) roadway. A marked crosswalk is provided across Elton Avenue. Land use in the vicinity of this intersection consists of retail and residential uses.

Mount Auburn Street at Irma Avenue

Irma Avenue intersects Mount Auburn Street from the northwest to form this three-legged, unsignalized intersection. The Irma Avenue southeast bound approach consists of a general purpose travel lane which accommodates two-way traffic, although a centerline is not provided. Stop-signs and stop-lines are provided along the Irma Avenue approach. A marked crosswalk is provided across Irma Avenue. Land use in the vicinity of this intersection consists of retail uses.

Mount Auburn Street at Bigelow Avenue and Kimball Road

Bigelow Avenue and Kimball Road intersect Mount Auburn Street from the south and northwest to form this four-legged, signalized intersection. The Bigelow Avenue northbound approach consists of a general purpose travel lane and accommodates two directions of traffic divided by a double-yellow centerline. Entering traffic along Bigelow Avenue is divided by way of a raised delta island. The Kimball Road southwest bound approach consists of a general purpose travel lane which accommodates two-way traffic, although a centerline is not provided. Marked crosswalks are provided across each leg of the intersection. Land use in the vicinity of this intersection consists of retail and residential uses.

Mount Auburn Street at Templeton Parkway

Templeton Parkway intersects Mount Auburn Street from the northwest to form this three-legged, unsignalized intersection. The Templeton Parkway southeast bound approach consists of a general purpose travel lane which accommodates two-way traffic, although a centerline is not provided. Stop signs and stop lines are provided along the Templeton Parkway approach. A marked crosswalk is provided across Templeton Parkway. Land use in the vicinity of this intersection consists of retail uses.

Mount Auburn Street at Arlington Street

Arlington Street intersects Mount Auburn Street from the north and south to form this four-legged, signalized intersection. The Mount Auburn Street east and westbound approaches consist of an exclusive left-turn lane, an exclusive through lane, and a shared through/right-turn lane. The directions of travel along Mount Auburn Street are separated by a double yellow centerline. The Arlington Street north and southbound approaches consist of two general purpose travel lanes and accommodate two directions of traffic by way of a double-yellow centerline. Marked crosswalks are provided across each leg of the intersection. Land use in the vicinity of this intersection consists of retail, commercial and residential uses.

Arlington Street at Grove Street

Grove Street intersects Arlington Street from the south at a skewed angle to form this three-legged, unsignalized intersection. The Arlington Street southbound approach consists of a through lane and a right-turn slip-ramp. The Arlington Street northeast bound approach consists of a left-turn lane and a right-turn channel. The directions of travel along Arlington Street are separated by a double yellow centerline. The Grove Street northbound approach consists of a general purpose travel lane and accommodates two directions of traffic by way of a double yellow centerline. A marked crosswalk is provided across Grove Street. Land use in the vicinity of this intersection consists of commercial and residential uses.

Grove Street at the Tufts Medical Center Driveway

The Tufts Medical Center driveway intersects Grove Street from the east to form this three-legged, unsignalized intersection. The Grove Street north and southbound approaches consist of a general purpose travel lane and accommodates two-way traffic by way of a double yellow centerline. The Tufts Medical Center driveway westbound approach consists of an exclusive left-turn lane and an exclusive right-turn lane. Traffic along the Tufts Medical Center driveway is divided by way of a raised island. A stop line is provided along the Tufts Medical Center driveway approach; however a stop sign is not provided. There are no marked crosswalks provided at this intersection. Land use in the vicinity of this intersection consists of commercial uses.

Arlington Street at Wells Street

Wells Street intersects Arlington Street from the west to form this three-legged, unsignalized intersection. The Arlington Street north and southbound approaches consist of a general purpose travel lane and accommodates two-way traffic by way of a double yellow centerline. Wells Street is a one-way westbound (away from the intersection) roadway. No marked crosswalks are provided at this intersection. Land use in the vicinity of this intersection consists of commercial and residential uses.

Arlington Street at Merrifield Avenue

Merrifield Avenue intersects Arlington Street from the west to form this three-legged, unsignalized intersection. The Arlington Street north and southbound approaches consist of a

general purpose travel lane and accommodates two-way traffic by way of a double yellow centerline. The Merrifield Avenue eastbound approach consists of a general purpose travel lane which accommodates two-way traffic, although a centerline is not provided. Stop signs and stop lines are also not provided along the Merrifield Avenue approach. No marked crosswalks are provided at this intersection. Land use in the vicinity of this intersection consists of commercial and residential uses.

2.2 Applicable Design Standards

The 2006 MassDOT *Project Development and Design Guide* provides the applicable design standards for roadways based on their functional classification and the area type in which they are located. For projects involving MassDOT review, roadways that do not conform to these standards typically require design waivers. As noted above, Mount Auburn Street is functionally classified as an Urban Principal Arterial, and Arlington Street is functionally classified as an Urban Collector. The area type where the project corridor is located is a mixture of Urban Residential and Urban Central Business District (CBD), with CBD areas concentrated at the eastern .

According to the *Project Development and Design Guide*, the desirable cross section for an arterial in a Rural Village environment consists of 11 to 12 foot wide travel lanes and 4 to 12 foot wide shoulders, while a collector in a Rural Village environment with a design speed of less than 45 mph should consist of 10 to 12 foot wide travel lanes and 4 to 10 foot wide shoulders. A minimum shoulder width of 4 feet is recommended for bicycle use along arterials and collectors, not including an additional 1 foot shy distance from an adjacent curb or guardrail. In the event that sufficient shoulder width is not provided, a minimum travel lane width of 14 feet may be acceptable for shared use by both motor vehicles and bicyclists but would require a Design Exception Report for MassDOT projects. Along local roads, 9 to 12 foot wide travel lanes and 2 to 8 foot wide shoulders are recommended. Additional width for bicycle accommodations is not required for local roadways.

The existing cross section width of Mount Auburn Street is generally 54 feet consisting of four 11.5-foot-wide travel lanes (two eastbound, two westbound) and a seven foot wide parking labne along the south side of the street. Therefore, the existing cross section is insufficient to meet the above specified MassDOT desirable design criteria for arterials.

2.3 Traffic Volumes

In order to quantify existing traffic volume conditions in the project study area, automatic traffic recorder (ATR) counts and manual turning movement counts (TMC) were conducted along the corridor. Traffic volumes were initially collected in May 2007 and June 2010 for the 2011 Mount Auburn Street Corridor Feasibility Study. These counts were updated in June 2012

and May 2014, as well as supplemented with additional volumes collected for private development projects in 2013, 2014, and 2015 obtained from the Town of Watertown Department of Planning and Community Development. TMCs were conducted at the study area intersections during the normal weekday morning peak period (7:00 to 9:00 AM) and weekday evening peak period (4:00 to 6:00 PM).

Evaluation of the peak period traffic counts indicates that the weekday morning peak hour generally from 7:45 to 8:45 a.m. and the weekday evening peak hour generally occurs from 5:00 to 6:00 p.m.. Individual peak hour traffic volumes at each intersection were used to provide a conservative analysis scenario. The traffic count data is provided in the *Technical Appendix.*

Based on comparison of traffic counts collected since 2007, traffic volumes along the Mount Auburn Street corridor have remained stable or decreased during the past several years. Therefore, although the Existing conditions analysis discussed below refernces the year 2015, traffic volumes collected in prior years have not been adjusted upward to account for background growth. A growth rate of 0.5 percent per year has been applied to determine future traffic volumes, as discussd in *Section 3: Future Conditions.*

Seasonal Adjustment

Traffic on a given roadway typically fluctuates throughout the year depending on the area and the type of roadway. To determine if the data should be adjusted to account for this fluctuation, traffic volume data from MassDOT was researched. The most recent seasonal adjustment rates available from MassDOT show that for a roadway of this class, Group 6 - Urban Arterials, Collectors and Rural Arterials, the seasonal adjustment factors for March 2014 and May 2014 were 0.96 and 0.91, respectively. This signifies that the average traffic volumes during the months of data collection are approximately 4% to 9% higher than the average yearly volumes for similar roadways. Recognizing this, in order to provide a slightly conservative analysis traffic volumes were not decreased.

The existing weekday morning and evening peak hour traffic volumes are summarized in Table 2 and shown on Figure 2.

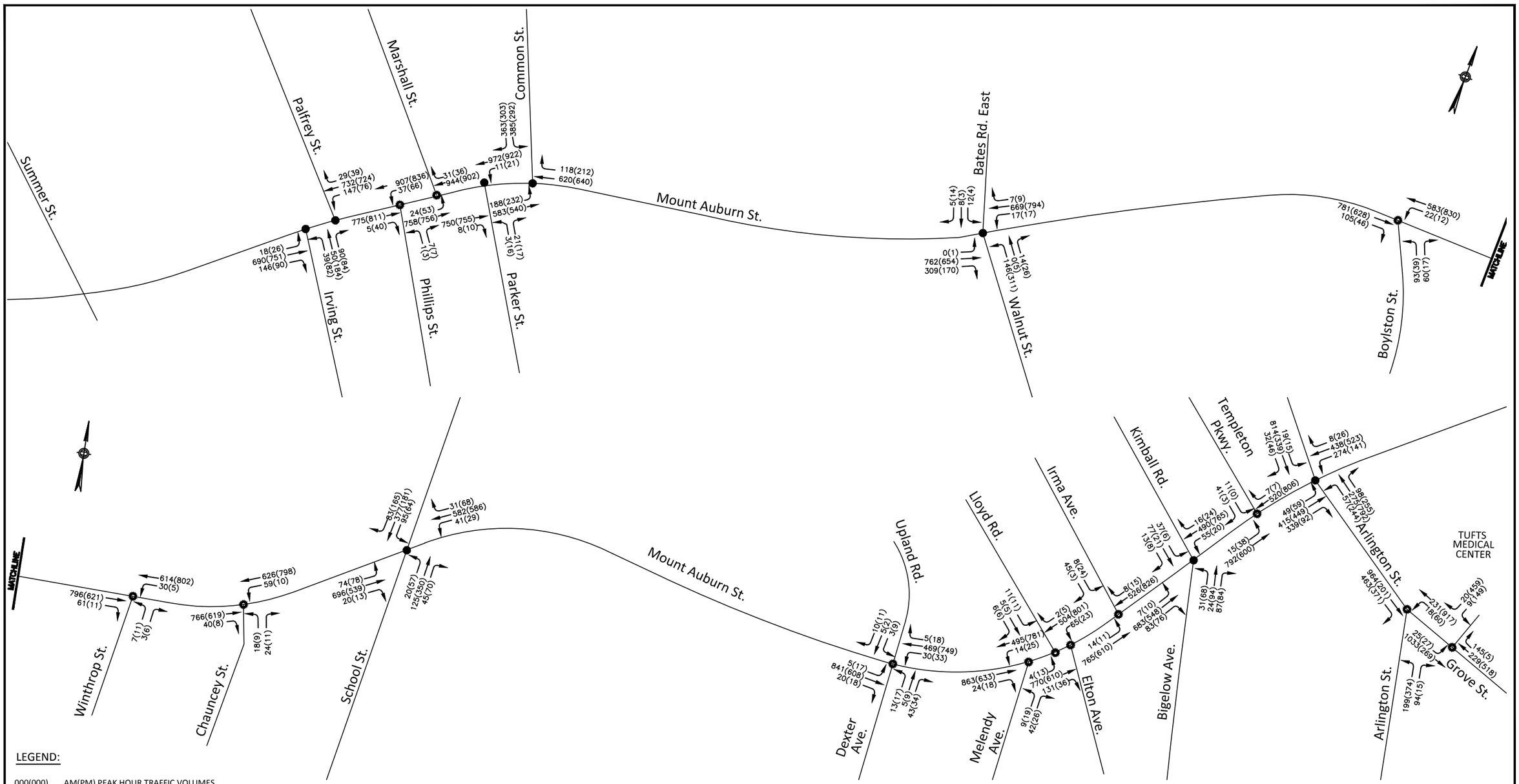
TABLE 2
Existing Average Daily Traffic

Location	**DAILY Volume**	**Peak Hour Volume**		**K Factor (%)**	**Directional Distribution**
Mount Auburn Street, east of Common Street					
Weekday (2014)	17,874	AM:	1,276	7.14%	69.0% EB
		PM:	1,260	7.05%	64.5% EB
Mount Auburn Street, east of Walnut Street					
Weekday (2010)	20,284	AM:	1,632	8.04%	50.9% WB
		PM:	1,552	7.65%	52.8% WB
Mount Auburn Street, east of Oakley Road					
Weekday (2010)	19,563	AM:	1,445	7.39%	53.7% EB
		PM:	1,543	7.89%	54.2% WB
Mount Auburn Street, east of School Street					
Weekday (2010)	18,995	AM:	1,426	7.51%	54.1% WB
		PM:	1,537	8.09%	53.5% EB
Mount Auburn Street, west of Irma Avenue					
Weekday (2012)	16,891	AM:	1,153	6.83%	60.0% EB
		PM:	1,284	7.60%	53.0% WB
Mount Auburn Street, east of Arlington Street					
Weekday (2014)	19,439	AM:	1,322	6.80%	55.3% WB
		PM:	1,408	7.24%	51.2% WB
Arlington Street, north of Mount Auburn Street					
Weekday (2014)	9,866	AM:	698	7.07%	73.2% SB
		PM:	766	7.76%	53.8% NB
Arlington Street, south of Wells Street					
Weekday (2014)	9,920	AM:	872	8.79%	56.1% SB
		PM:	668	6.73%	50.7% SB

K Factor: Proportion of daily traffic volume occurring during the specified peak hour.
Directional Distribution: Proportion of vehicles traveling in the peak direction.
NB = northbound; SB = southbound; EB = eastbound; WB = westbound

2.4 Crash History

Crash data was obtained from the MassDOT Crash Database for crashes occurring within the study area over the most recent three-year period available, 2011 through 2013. Crash data for a given location is ordinarily broken down into categories of information. Typical categories



LEGEND:

000(000) AM(PM) PEAK HOUR TRAFFIC VOLUMES

● SIGNALIZED INTERSECTION ANALYZED

◎ UNSIGNALIZED INTERSECTION ANALYZED

PREPARED FOR:	TITLE: MOUNT AUBURN STREET (ROUTE 16) CORRIDOR IMPROVEMENTS 2014 Existing Traffic Volumes		PREPARED BY: WORLDTECH ENGINEERING 300 TRADE CENTER, SUITE 5580 WOBURN, MASSACHUSETTS 01801 PHONE: 781.933.4800 FAX: 781.933.4801	DATE: 01-08-2016 SCALE: 1" = 250'	Figure 2

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include severity (property damage only, injury, or fatality) and collision type. A summary of this crash data is shown in Table 3. A total of 110 crashes occurred within the study area roadways. A review of the crash data indicates ten or more crashes each occurred at the intersections of Mount Auburn Street with Common Street, School Street, along the Mount Auburn Corridor, and at Arlington Street and Grove Street, which combined account for 49 crashes. Approximately 59 percent of the crashes at these four locations were either angle collisions or rear end crashes, indicating turning conflicts with through movements or failures to yield.

One crash, at the intersection of Mount Auburn Street with School Street, involved a pedestrian fatality (occurred back in 2008).

TABLE 3
Crash Data Summary

Location	Number of Crashes		Crash Rate	Severity			Type					
	Total	Avg per Year		PD[a]	PI[b]	F[c]	CM[d]	RE[e]	SS[f]	HO[g]	Ped[h]	Other
Mt Auburn St at Irving/Palfrey Sts	4	1.33	0.20	3	1	0	2	1	1	0	0	0
Mt Auburn St at Phillips St	2	0.67	0.10	2	0	0	1	1	0	0	0	0
Mt Auburn St at Marshall St	4	1.33	0.20	4	0	0	2	0	1	0	0	1
Mt Auburn St at Parker St	4	1.33	0.20	3	1	0	1	2	0	0	0	1
Mt Auburn St at Common St	11	3.67	0.56	4	7	0	3	3	1	2	0	2
Mt Auburn St at Chester St	3	1.00	0.14	1	2	0	3	0	0	0	0	0
Mt Auburn St at Russell Ave	4	1.33	0.18	2	2	0	3	0	0	0	0	1
Mt Auburn St at Bates Rd E/ Walnut St	7	2.33	0.36	4	3	0	1	5	0	0	0	1
Mt Auburn St at Garfield St	1	0.33	0.05	0	1	0	1	0	0	0	0	0
Mt Auburn St at Bailey Rd	2	0.67	0.09	2	0	0	2	0	0	0	0	0
Mt Auburn St at Spruce St	1	0.33	0.05	1	0	0	1	0	0	0	0	0
Mt Auburn St at Amherst Rd	0	--	--	0	0	0	0	0	0	0	0	0
Mt Auburn St at Boylston St	0	--	--	0	0	0	0	0	0	0	0	0
Mt Auburn St at Stearns Rd	0	--	--	0	0	0	0	0	0	0	0	0
Mt Auburn St at Oakley Rd	2	0.67	0.10	1	1	0	0	1	0	1	0	0
Mt Auburn St at Richards Rd	0	--	--	0	0	0	0	0	0	0	0	0
Mt Auburn St at Winthrop St	0	--	--	0	0	0	0	0	0	0	0	0
Mt Auburn St at Adams Ave	0	--	--	0	0	0	0	0	0	0	0	0
Mt Auburn St at School St	10	3.33	0.46	9	1	0	3	4	0	0	0	3

TABLE 3
Crash Data Summary (Continued)

Location	Number of Crashes		Crash Rate	Severity			Type					
	Total	Avg per Year		PD[a]	PI[b]	F[c]	CM[d]	RE[e]	SS[f]	HO[g]	Ped[h]	Other
Mt Auburn St at Winsor Ave	3	1.00	0.14	2	1	0	1	1	0	0	0	1
Mt Auburn St at Langdon Ave	2	0.67	0.10	1	1	0	1	1	0	0	0	0
Mt Auburn St at Hillside Rd/ Boylston St	0	--	--	0	0	0	0	0	0	0	0	0
Mt Auburn St at Adams St	1	0.33	0.05	1	0	0	0	0	1	0	0	0
Mt Auburn St at Upland Rd/ Dexter Ave	3	1.00	0.17	1	2	0	2	1	0	0	0	0
Mt Auburn St at Melendy Ave	0	--	--	0	0	0	0	0	0	0	0	0
Mt Auburn St at Lloyd Rd/Elton Ave	1	0.33	0.05	1	0	0	0	0	0	0	0	1
Mt Auburn St at Irma Ave	0	--	--	0	0	0	0	0	0	0	0	0
Mt Auburn St at Kimball Rd/ Bigelow Ave	7	2.33	0.37	5	2	0	2	2	0	0	0	3
Mt Auburn St at Templeton Pkwy	1	0.33	0.06	0	1	0	1	0	0	0	0	0
Mt Auburn St at Arlington St	9	3.00	0.39	5	4	0	5	2	0	0	0	2
Arlington St at Grove St	15	5.00	1.03	10	5	0	10	2	0	0	0	3
Mt Auburn St at Unknown Locations	13	4.33	--	10	3	0	0	4	3	0	0	6
TOTAL	**110**	**36.64**	**--**	**72**	**38**	**0**	**45**	**30**	**7**	**3**	**0**	**25**

[a]Property Damage Only; [b]Personal Injury; [c]Fatality; [d]Cross Movement (or angle); [e]Rear End; [f]Sideswipe; [g]Head-on; [h]Pedestrian/Bicycle

To evaluate the crashes at an intersection effectively, the number of crashes must relate or be compared to the traffic volumes entering the intersection. A procedure used for this purpose is the calculation of an intersection crash rate, which is a measure of the frequency of crashes compared to the intersection traffic volumes. The crash rate is based on crashes per million entering vehicles (C/MEV). MassDOT releases official Statewide and District rates that can be used as an effective tool to compare safety hazards at a specific intersection. The latest Statewide and District 6 rates for unsignalized intersections are 0.60 and 0.58 C/MEV, respectively. For signalized intersections, the Statewide and District 6 rates are 0.80 and 0.76 C/MEV, respectively. Crash rates higher than these averages could indicate a potential safety issue. The crash rate worksheets have been provided in the *Technical Appendix*. The results over the three year review period indicate the crash rates at one intersection within the study area, Arlington Street at Grove Street, experienced a crash rate greater than the Statewide and District 6 averages for signalized intersections. Additionally, the Coolidge Square area (Mount

Auburn Street from Dexter Avenue/Upland Road to Prentiss Street, Arlington Street from Maplewood Street to Merrifield Avenue) has been identified by MassDOT as a High Pedestrian Crash Cluster based on 2004 to 2013 data, with 17 pedestrian crashes, 13 involving personal injury, and an Equivalent Property Damage Only (EPDO) rating of 69.

2.5 Traffic Signal Warrants

A traffic signal warrants analysis was conducted at selected unsignalized intersections using traffic volume data collected for this study. A traffic signal warrants analysis is used to help determine if a traffic signal installation is justified at an intersection. Traffic signal warrants are defined in the Manual on Uniform Traffic Control Devices (MUTCD), 2009 Edition published by Federal Highway Administration. The MUTCD specifies minimum requirements for any of eight (8) different warrants under which a traffic signal may be installed at an intersection. Traffic control signals should not be installed unless one or more of the warrants in the MUTCD are satisfied. The satisfaction of a warrant or warrants is not in itself justification for a signal installation. It also needs to be determined that a traffic signal will improve the overall safety and/or operation of the intersection.

Warrants 1 (Minimum Vehicular Volume), 2 (Four Hour Vehicular Volume), 3 (Peak Hour Volume), and 7 (Crash Experience) were evaluated at the intersections of Mount Auburn Street with Boylston Street (west of School Street) and Arlington Street at Grove Street. The remaining unsignalized intersections along the corridor typically have low side street volumes and were not considered for signalization.

The intersection of Arlington Street at Grove Street was found to meet all four warrants evaluetd. The intersection of Mount Auburn Street with Boylston Street meets only Warrant 3 (Peak Hour), but did not meet Warrants 1, 2, or 7. However, since the existing signalized mid-block crosswalk is to be relocated from its current location between Stearns Road and Oakley Road to this intersection, a fully-actuated signal is proposed to ensure a safe route for Hosmer Elementary School students from the neighborhoods north of Mount Auburn Street. Detailed warrant analyses are included in the *Technical Appendix*.

2.6 Public Transportation

The Massachusetts Bay Transportation Authority (MBTA) operates a trackless trolley route (Route 71, Watertown Square – Harvard Station via Mount Auburn Street) along Mount Auburn Street between Watertown Square and the Harvard MBTA Rapid Transit station in Cambridge. As of Winter 2010, the most recent data available, this route has an average weekday daily ridership of 5,484 (2,678 inbound and 2,806 outbound), of which 3,258 riders (59.4 percent) board or alight within the study area (between Summer Street and Cottage Street). Average

weekday boardings at each stop within the study area are given in Table 4. Schedule, fare, and ridership information is provided in the *Technical Appendix*.

TABLE 4
Existing MBTA Route 71 Weekday Ridership (Winter 2010)

	Inbound			Outbound		
Trolley Stop	Boardings	Alightings	**Total**	Boardings	Alightings	**Total**
Summer Street/Patten Street	141	2	**143**	3	123	**126**
Marshall Street/Parker Street	154	15	**169**	20	164	**184**
Russell Avenue/Franklin Street	99	6	**105**	1	101	**102**
Bates Road East/Walnut Street	57	8	**65**	8	53	**61**
Bailey Road/Lincoln Street	24	3	**27**	5	20	**25**
Amherst Road/Boylston Street	69	11	**80**	7	59	**66**
Oakley Road	16	3	**19**	7	25	**32**
Adams Avenue/Chauncey Street	51	14	**65**	26	69	**95**
Winsor Avenue/School Street	90	40	**130**	17	73	**90**
Upland Road/Adams Street	110	45	**155**	16	86	**102**
Lloyd Road	--	--	**--**	46	71	**117**
Kimball Road/Bigelow Avenue	227	101	**328**	63	234	**297**
Keenan Street	210	39	**249**	34	232	**266**
St. Marys Street/Ralph Pietri Terrace	67	24	**91**	19	50	**69**
Total	*1,315*	*311*	***1,626***	*272*	*1,360*	***1,632***

It is important to note that the trackless trolley provides service via suspended wires located along Mount Auburn Street. These wires provide the electricity necessary to operate the trolley bus and, as such, play a critical role in any reconstruction alternatives. Bearing this in mind all geometric improvements suggested within this corridor have taken this very specific constraint into account.

Additionally, Route 71 is one of fifteen routes identified by the MBTA as a "Key Bus Route." These routes are characterized by high ridership and high service frequency seven days a week. Under its Key Bus Route Improvement Program, the MBTA has implemented improvements including stop consolidation, accessability enhancements, and improved shelters.

The proposed project will include additional enhancements along the route of the Route 71 Bus including marked off-street bus pull-outs, curb extensions, crosswalk improvements at key stops, and the capability for implementing transit signal priority. The Town has engaged the MBTA and will continue to coordinate with MBTA throughout the design process.

2.7 Pedestrian Accommodations

Crosswalks are marked across all stop-controlled street approaches throughout the study area, and at least one crosswalk is provided to cross Mount Auburn Street at each signalized intersection in the study area. Additionally, two signalized mid-block pedestrian crossings are provided between Stearns Road and Oakley Road and between Ralph Pietri Terrace and Cottage Street, and crosswalks are marked across Mount Auburn Street at the unsignalized intersections with Russell Avenue, Winthrop Street, Winsor Avenue, Adams Street, Lloyd Road/Elton Ave, and Keenan Street. The crosswalk at Lloyd Road/Elton Ave is a standard (MUTCD) crosswalk with solid red-toned paving material. This crosswalk has a "Yield Here to Pedestrians" sign (MUTCD R1-5) in the center of Mount Auburn Street to warn drivers of pedestrians crossing the roadway. All signalized pedestrian crossings are equipped with push buttons, pedestrian signal heads, and an exclusive pedestrian phase for all crossings.

2.8 Parking

Within the Coolidge Square area east of Hillside Road, most of the parking is posted for short term use, for visitors and patrons of local businesses. There is a smaller demand for long term parking for employees and citizens. The Town expressed great concern over the availability of parking in Coolidge Square and its impact on business. On-street metered parking in the Coolidge Square area currently provides fifty-six parking spaces. Currently, metered parking is provided along the south side of Mount Auburn Street from Boylston Street/Hillside Road to Arlington Street and along the north side from Lloyd Road to Kimball Road. One hour unmetered parking is permitted between the hours of 7:00 AM and 7:00 PM along both sides of Arlington Street from Wells Avenue to Merrifield Avenue.

Similarly, on-street metered parking is provided along both sides of Mount Auburn Street in the Watertown Square are between Baptist Walk/Taylor Street and Summer Street and along the south side of Mount Auburn Street between Summer Street and Patten Street for businesses in the Watertown Square area. Within the study area east of Summer Street, two metered parking spaces are provided along the south side of Mount Auburn Street with a time limit of two hours.

Between Patten Street and Hillside Road, parking is generally permitted along the south side of Mount Auburn Street. Based on observations of existing parking regulation signs, parking is unrestricted except at the flowing locations:

- Parker Street to Otis Street, one hour
- Otis Street to Walnut Street, two hours
- Lincoln Street to Spruce Street, two hours
- Adams Avenue to Chauncey Street, one hour

- School Street to Boylston Street/Hillside Road, one hour.

None of the conceptual alternatives developed as a part of this feasibility study would negatively impact parking in the study area. Therefore, a detailed parking inventory was not performed as a part of this study.

3.0 FUTURE CONDITIONS AND OPERATIONAL ANALYSIS

In this section, existing traffic volumes are projected to a future design year and then evaluated under alternative conditions to arrive at proposed optimal improvements. The development and analysis of these future traffic flows are described in the following sections.

3.1 Traffic Volume Projections

In order to assess the potential traffic impacts occurring within the future, existing traffic volumes were projected to a future design year. A twenty-year (2035) traffic projection was utilized on the study area roadways. Traffic increases along the study area roadways are associated with normal traffic growth patterns as well as other currently planned development projects.

Traffic growth on area roadways is a function of the expected land development in the immediate area, as well as the surrounding region. Several methods are used to estimate this growth. To develop the twenty-year forecast, two components of traffic growth were considered; traffic generated by both background growth and planned projects.

First, an annual-average traffic-growth percentage was determined. Based on a review of MassDOT historical traffic volume data at several locations within the Town of Watertown, traffic volumes over a ten year period were shown to decrease at a rate of 4.7 percent per year. To present a conservative analysis, a 0.5 percent per year compounded annual growth rate was used to account for general background traffic growth.

Second, any planned or approved specific developments were included that would generate a significant volume of traffic on study area roads within the next five years. Based on discussions with officials from the Town of Watertown, there are several projects planned that will add traffic to the study area in the near future:

- Proposed CVS Pharmacy, 631, 653, 655 Mount Auburn Street and 268 Arlington Street: This project will replace an existing gas station and 1,200± sf service station, 10,800± sf office building, and 8,960± sf Elks Lodge with a 14,000± sf CVS Pharmacy at the southwest corner of Mount Auburn Street at Arlington Street.

- 65 Grove Street Redevelopment: This potential project consists of redeveloping the existing vacant 148,000± sf GE Water and Process Technologies facility at 65 Grove Street as a 116,500± sf general office building.

- 202-204 Arsenal Street, 58 Irving Street, 70 Phillips Street: This potential project consists of razing the existing structures totaling 150,000± sf and constructing a new 40,000± sf supermarket, 34,000± sf of retail space, and 307 apartments.

- Elan on Arsenal Residential Community, Arsenal Street at Irving Street. This potential project consists of 288 apartments and 15,000± sf of retail space.

- Linx, 480 Arsenal Street: This project consists of the construction of a 185,595 sf office building on the existing Verizon site at 480 Arsenal Street.

Peak hour trip generation networks for each of these developments is included in the *Technical Appendix*. These volumes were added to traffic network with the above mentioned growth factor applied to determine the 2035 Future Year traffic network. The 2035 Future Year peak-hour traffic flow networks are represented on Figure 3 for the weekday morning and evening peak hours.

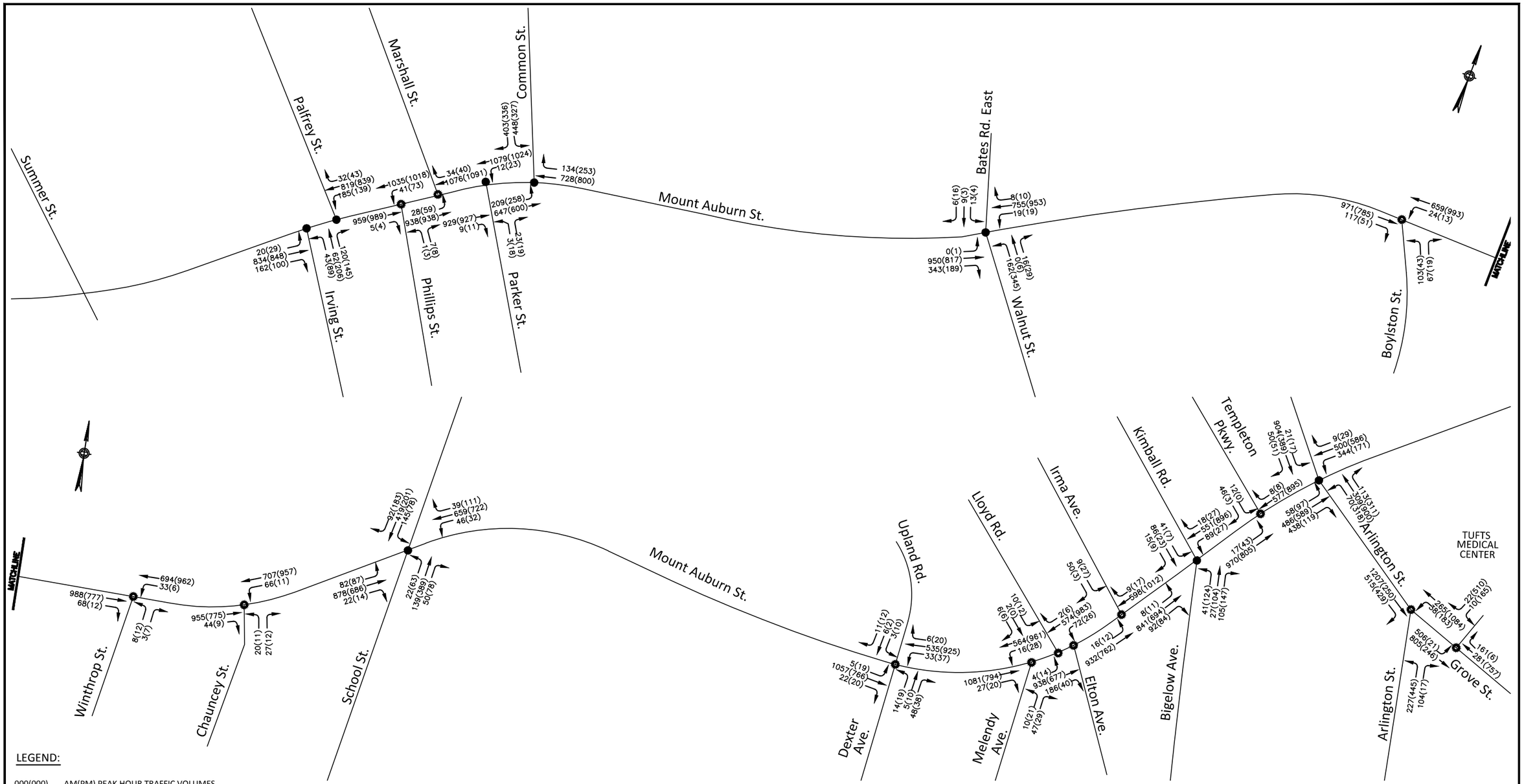
3.2 Traffic Operations and Queue Analysis

Existing peak hour traffic operations in the traffic study area were assessed from both a quantitative and qualitative perspective. The qualitative analysis is based on field observations made during peak traffic periods, while the quantitative analysis is based on calculated intersection operating levels of service as described in greater detail below.

Capacity Analysis Methodology

The capacity analysis methodology is based on the concepts and procedures described in the "Highway Capacity Manual" (HCM), 2010, Transportation Research Board, Washington, DC. A capacity analysis is used to assess the quality of traffic operations on a roadway or intersection as a result of traffic volume demands placed on the respective facility. The primary result of a capacity analysis is a level of service (LOS) assignment to the traffic operations of the respective facility. A LOS analysis results in assigning a letter index of A through F to describe the quality of traffic operations at a facility in terms of such factors as speed, traffic interruptions, freedom to maneuver, comfort, convenience and safety. The six letter designations of A through F define the operating conditions from best to worst, respectively. In general, a LOS C is used as the minimum design criteria although D is acceptable at urban, high volume locations.

LOS for either signalized or unsignalized intersections can be computed by the described methodology. LOS for signalized intersections is defined in terms of delay, which is a measure of driver discomfort, frustration, fuel consumption and lost travel time. The delay experienced by a motorist is made of factors that relate to intersection control, geometrics and traffic volumes. This delay is called "control delay" or "signal delay". Control delay includes initial



LEGEND:

000(000) AM(PM) PEAK HOUR TRAFFIC VOLUMES

● SIGNALIZED INTERSECTION ANALYZED

◎ UNSIGNALIZED INTERSECTION ANALYZED

PREPARED FOR:	TITLE: MOUNT AUBURN STREET (ROUTE 16) CORRIDOR IMPROVEMENTS 2035 Design Year Traffic Volumes - No Build		PREPARED BY: WORLDTECH ENGINEERING 300 TRADE CENTER, SUITE 5580 WOBURN, MASSACHUSETTS 01801 PHONE: 781.933.4800 FAX: 781.933.4801	DATE: 01-08-2016 SCALE: 1" = 250'	Figure 3

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deceleration delay, queue move-up time, stopped delay and final acceleration delay. Specifically, LOS criteria at an intersection with traffic signals are stated in terms of the average control delay per vehicle.

The LOS for an unsignalized intersection (two-way stop control) is defined for each minor movement, not for the intersection as a whole. The LOS criteria for the unsignalized intersections are somewhat different from the criteria for the signalized intersections. The primary reason for the difference is that motorists expect different levels of performance from the two facilities. Due to these expectations, the control delay threshold for any given LOS is less for an unsignalized intersection than it is for a signalized intersection. Table 5 summarizes the LOS criteria associated with the letter index and the relationship between signalized and unsignalized intersections. The LOS delay criteria may be applied to individual lane groups, to individual intersection approaches or to the entire signalized or unsignalized intersections.

TABLE 5
Intersection Level of Service Criteria [1]

Level of Service	Average Stopped Delay per Vehicle (seconds)	
	Signalized Intersection	Unsignalized Intersection
A	0 - 10	0 - 10
B	>10 - 20	>10 - 15
C	>20 - 35	>15 - 25
D	>35 - 55	>25 - 35
E	>55 – 80	>35 - 50
F	>80	>50

[1] 2010 *Highway Capacity Manual*, Transportation Research Board, Washington, DC.

Level of Service Analyses

Level of Service (LOS) analyses were performed for the study area intersections under various conditions to arrive at proposed optimal improvements. The unsignalized and signalized intersection methodology was used to evaluate the various alternatives. To reiterate, the unsignalized intersection methodology evaluates only the conflict movements, that is, the major street left turns and the minor street approaches. It does not assign a LOS to the intersection as a whole.

Existing Queues

In addition to level of service, a review of the 95th percentile queue lengths was performed during each of the peak hours under existing conditions. While an intersection may show acceptable levels of service, extensive queue lengths may exist that impede operations elsewhere by extending into adjacent intersections or other conflict areas. A description of the critical queues at each intersection location is presented below.

Volume-to-Capacity Ratio

In addition to LOS, another factor to take into consideration when discussing operation is the "volume-to-capacity" ratio. The volume-to-capacity (v/c) ratio is the ratio of the volume travelling in a lane group to the capacity of the same lane group, a percentage of the lane group's capacity being utilized. As with delay, this measure can be utilized for either the individual approach or the intersection as a whole. As opposed to delay there is no standard gauge to provide a specific point of reference for a certain volume-to-capacity ratio; however a lower volume-to-capacity ratio indicates that backups are less likely. As the v/c ratio approaches 1.0, the operation worsens since the facility is reaching capacity. A volume-to-capacity ratio of 1.0 or greater indicates traffic volumes are exceeding capacity. Generally speaking, a volume-to-capacity ratio under 1.0 is considered acceptable.

The various conditions and results are discussed below. The analysis work sheets are provided in the Appendix.

3.3 Capacity Analysis with Existing Geometry

Tables 6 and 7 summarize the results of the Existing 2014 and Future Year 2035 traffic operational analysis assuming existing roadway and intersection geometry. For future conditions, it was assumed that existing signal equipment and phasing would remain, but signal timing would be optimized and pedestrian intervals would be adjusted to comply with the latest MUTCD standards.

With the existing roadway and intersection geometry, all of the unsignalized study area intersections are operating at acceptable levels of service under both existing and future traffic volumes with the exceptions of the Mount Auburn Street intersections with Boylston Street and Upland Road/Dexter Avenue and the Grove Street intersections with Arlington Street and the Tufts Medical Center driveway. Under existing conditions, the signalized study area intersections are operating at acceptable levels of service under existing conditions with the exception of the Mount Auburn Street intersections with Common Street, School Street, and Arlington Street. Under future 2035 conditions, six of the eight study area signalized intersections – Mount Auburn at Summer Street, Irving Street/Palfrey Street, Parker Street, Kimball Road/Bigelow Avenue, and Arlington Street - would have at least one movement operating at an unacceptable level of service. Due to improvements in signal timing that were assumed in the future conditions analysis, the Mount Auburn Street intersections at Common Street and School Street would operate at acceptable levels of service in future year 2035. A detailed description of present and future operations at each study area intersection follows.

At the Mount Auburn Street intersection with Common Street, the eastbound approach experiences a v/c ratio of 1.12 under Existing 2014 traffic conditions, indicating that the volume exceeds capacity, and 95th percentile vehicle queue of 480 feet (24 vehicles), blocking adjacent

intersections along Route 16. During the evening peak hour, the eastbound direction v/c ratio is at 1.09 with 95th percentile queue of 430 feet (22 vehicles). Under future 2035 traffic volumes, both eastbound and westbound directions would worsen to LOS F, in the evening peak hour, with v/c ratios over 1.0 and 95th percentile queues of 598 feet (30 vehicles) and 547 feet (27 vehicles) respectively.

At the Mount Auburn Street intersection with Boylston Street, the northbound approach operates at LOS F during the morning peak hour under Existing 2014 traffic conditions, with the v/c ratio exceeding 1.0 and 95th percentile vehicle queues of 480 feet (24 vehicles). Under future 2035 traffic volumes, the northbound approach would continue to operate at LOS F during the morning peak hour, with 95th percentile queues extending 700 feet (35 vehicles). All approaches operate with acceptable levels of service during the evening peak hour under Existing 2014, whereas under future 2035 traffic conditions the northbound approach would operate at LOS E but with low v/c ratio (0.41).

At the Mount Auburn Street intersection with School Street, the southbound approach operates at LOS F during the morning peak hour under Existing 2014 traffic conditions, with the v/c ratio exceeding 1.0 and 95th percentile vehicle queues of 661 feet (33 vehicles). During the evening peak hour, all movements operate at acceptable LOS, but the northbound and southbound School Street approaches have 95th percentile vehicle queues of 531 feet and 473 feet (26 and 24 vehicles), respectively. Under future 2035 traffic volumes, the southbound approach would continue to operate at LOS F during the morning peak hour, with 95th percentile queues extending 828 feet (41 vehicles), and both the northbound and southbound approaches operate at LOS F during the evening peak hour, with v/c ratios of 1.05 and 1.13 and 95th percentile queues of 615 feet and 568 feet (31 and 28 vehicles), respectively. The eastbound and westbound Route 16 approaches operate at acceptable LOS during the peak hours under Existing 2014 and future 2035 traffic volumes.

At the Mount Auburn Street intersection with Upland Road and Dexter Avenue, all approaches are operating with acceptable levels of service under Existing 2014 traffic conditions. Under future 2035 traffic volumes, the northbound and southbound approaches operate at LOS F during the evening peak hour with v/c ratios of 0.56 and 0.26 indicating available capacity.

The Mount Auburn Street signalized intersection with Arlington Street operates at poor levels of service under Existing 2014 conditions. During the morning peak hour, the westbound left-turn movement and southbound approach each operate at LOS F with v/c ratios exceeding 1.0. During the evening peak hour, the northbound movements worsen to LOS F with v/c ratio exceeding 1.0 and the southbound movements operate at LOS E. Under future 2035 conditions, intersection operations are expected to worsen, with the eastbouth through-right lane, westbound left lane and southbound movement operating at LOS F during the morning peak hour, whereas in the evening peak hour, both northbound and southbound movements would operate at LOS F.

At the Arlington Street intersection with Grove Street, the Arlington northeast-bound approach is under stop-control. Under Existing 2014 and future 2035 traffic volume conditions, this approach operates with poor levels of service (LOS F) during the morning and evening peak hours. Operations are particularly poor during the evening peak hour where the v/c ratio far exceeds 1.0 and vehicle queues extend beyond available storage, backing past adjacent intersections. This is expected with high left-turn volumes (more than 300 during the evening peak hour) turning onto Arlington Street and few gaps available in the opposing Arlington Street/Grove Street through traffic.

At the Grove Street intersection with the Tufts Medical Center driveway, the Medical Center driveway westbound approach operates poorly (LOS F) during the evening peak hour in both existing and future analysis scenarios. Under both scenarios, the westbound right-turn queues exceed available capacity at the driveway and the v/c ratio exceeds 1.0, which is most likely due to employees leaving the facility at the same time, and the inability to find a sufficient gap in Arlington Street traffic to exit the driveway.

TABLE 6

Unsignalized Intersection Level of Service Summary

Intersection/Peak Period/Movement	2014 Existing Conditions				2035 Future Year Conditions			
	v/c[a]	Delay[b]	LOS[c]	Queue[d]	v/c	Delay	LOS	Queue
Mount Auburn Street at Phillips Street								
Weekday Morning Peak Hour:								
Mount Auburn Street EB TR	0.00	0.0	A	0	0.00	0.0	A	0
Mount Auburn Street WB LT	0.05	10.0	B	4	0.07	11.0	B	4
Phillips Street NB LR	0.02	14.5	B	2	0.03	17.9	C	2
Weekday Evening Peak Hour:								
Mount Auburn Street EB TR	0.00	0.0	A	0	0.00	0.0	A	0
Mount Auburn Street WB LT	0.09	10.3	B	6	0.12	11.2	B	8
Phillips Street NB LR	0.05	21.3	C	2	0.07	29.7	D	4
Mount Auburn Street at Marshall Street								
Weekday Morning Peak Hour:								
Mount Auburn Street EB LT	0.33	0.4	A	3	0.41	0.6	A	4
Mount Auburn Street WB TT	0.39	0.0	A	0	0.45	0.0	A	0
Weekday Evening Peak Hour:								
Mount Auburn Street EB LT	0.32	0.8	A	6	0.39	1.2	A	8
Mount Auburn Street WB TR	0.37	0.0	A	0	0.45	0.0	A	0
Mount Auburn Street at Boylston Street								
Weekday Morning Peak Hour:								
Mount Auburn Street EB TR	0.00	0.0	A	0	0.00	0.0	A	0
Mount Auburn Street WB LT	0.03	10.3	B	2	0.04	11.5	B	2
Boylston Street NB LR	***1.68***	***364.7***	***F***	472	***2.72***	*****	***F***	710
Weekday Evening Peak Hour:								
Mount Auburn Street EB TR	0.00	0.0	A	0	0.00	0.0	A	0
Mount Auburn Street WB LT	0.01	9.2	A	0	0.02	9.8	A	2
Boylston Street NB LR	0.25	25.6	D	20	0.41	41.8	E	36
Mount Auburn Street at Winthrop Street								
Weekday Morning Peak Hour:								
Mount Auburn Street EB TR	0.00	0.0	A	0	0.00	0.0	A	0
Mount Auburn Street WB LT	0.05	10.5	B	4	0.07	11.8	B	4
Winthrop Street NB LR	0.09	28.7	D	6	0.15	45.2	E	10
Weekday Evening Peak Hour:								
Mount Auburn Street EB TR	0.00	0.0	A	0	0.00	0.0	A	0
Mount Auburn Street WB LT	0.01	9.0	A	0	0.01	9.7	A	0
Winthrop Street NB LR	0.07	19.5	C	4	0.11	26.2	D	8

TABLE 6

Unsignalized Intersection Level of Service Summary (Continued)

Intersection/Peak Period/Movement	2014 Existing Conditions				2035 Future Year Conditions			
	v/c[a]	Delay[b]	LOS[c]	Queue[d]	v/c	Delay	LOS	Queue
Mount Auburn Street at Chauncey Street								
Weekday Morning Peak Hour:								
Mount Auburn Street EB TR	0.00	0.0	A	0	0.00	0.0	A	0
Mount Auburn Street WB LT	0.09	10.3	B	6	0.12	11.6	B	8
Chauncey Street NB LR	0.33	30.5	D	28	0.57	61.6	F	58
Weekday Evening Peak Hour:								
Mount Auburn Street EB TR	0.00	0.0	A	0	0.00	0.0	A	0
Mount Auburn Street WB LT	0.01	9.0	A	0	0.02	9.6	A	0
Chauncey Street NB LR	0.07	16.8	C	4	0.11	22.8	C	8
Mount Auburn Street at Upland Road/Dexter Avenue								
Weekday Morning Peak Hour:								
Mount Auburn Street EB LTR	0.01	8.4	A	0	0.01	8.6	A	0
Mount Auburn Street WB LTR	0.04	9.9	A	2	0.06	11.1	B	4
Dexter Avenue NB LTR	0.23	21.6	C	18	0.36	33.9	D	30
Upland Road SB LTR	0.08	20.6	C	4	0.12	29.4	D	8
Weekday Evening Peak Hour:								
Mount Auburn Street EB LT	0.02	9.5	A	2	0.03	10.3	B	2
Mount Auburn Street WB LT	0.04	9.0	A	2	0.05	9.7	A	4
Dexter Avenue NB LTR	0.30	29.5	D	24	***0.56***	***64.6***	***F***	***56***
Upland Road SB LTR	0.13	28.3	D	8	***0.26***	***53.6***	***F***	***18***
Mount Auburn Street at Melendy Avenue								
Weekday Morning Peak Hour:								
Mount Auburn Street EB TR	0.00	0.0	A	0	0.00	0.0	A	0
Mount Auburn Street WB LT	0.02	10.1	B	2	0.03	11.3	B	2
Melendy Avenue NB LR	0.22	16.9	C	16	0.33	23.3	C	28
Weekday Evening Peak Hour:								
Mount Auburn Street EB TR	0.00	0.0	A	0	0.00	0.0	A	0
Mount Auburn Street WB LT	0.03	9.1	A	2	0.04	9.8	A	2
Melendy Avenue NB LR	0.16	18.8	C	10	0.25	27.3	D	18

TABLE 6

Unsignalized Intersection Level of Service Summary (Continued)

Intersection/Peak Period/Movement	2014 Existing Conditions				2035 Future Year Conditions			
	v/c[a]	Delay[b]	LOS[c]	Queue[d]	v/c	Delay	LOS	Queue
Mount Auburn Street at Lloyd Road								
Weekday Morning Peak Hour:								
Mount Auburn Street EB LT	0.01	9.8	A	0	00.01	10.2	B	0
Mount Auburn Street WB TR	0.00	0.6	A	0	0.00	1.0	A	0
Lloyd Road SB LR	0.17	29.6	D	12	0.27	44.3	E	20
Weekday Evening Peak Hour:								
Mount Auburn Street EB LT	0.01	11.9	B	2	0.03	13.6	A	2
Mount Auburn Street WB TR	0.00	0.2	A	0	0.00	0.4	A	0
Lloyd Road SB LR	0.13	35.5	E	8	***0.24***	***62.7***	***F***	***16***
Mount Auburn Street at Elton Avenue								
Weekday Morning Peak Hour:								
Mount Auburn Street EB TR	0.00	0.1	A	0	0.00	0.1	A	0
Mount Auburn Street WB LT	0.10	10.6	B	6	0.14	12.2	B	10
Weekday Evening Peak Hour:								
Mount Auburn Street EB TR	0.00	0.2	A	0	0.00	0.4	A	0
Mount Auburn Street WB LT	0.03	9.1	A	2	0.04	9.8	A	2
Mount Auburn Street at Irma Avenue								
Weekday Morning Peak Hour:								
Mount Auburn Street EB LT	0.01	8.6	A	0	0.02	8.8	A	2
Mount Auburn Street WB TR	0.00	0.0	A	0	0.00	0.0	A	0
Irma Avenue SB LR	0.10	12.2	B	6	0.13	13.5	B	8
Weekday Evening Peak Hour:								
Mount Auburn Street EB LT	0.01	9.5	A	0	0.02	10.4	B	2
Mount Auburn Street WB TR	0.00	0.0	A	0	0.00	0.0	A	0
Irma Avenue SB LR	0.13	25.6	D	10	0.22	39.1	E	16
Mount Auburn Street at Templeton Parkway								
Weekday Morning Peak Hour:								
Mount Auburn Street EB LT	0.02	8.6	A	0	0.02	8.9	A	2
Mount Auburn Street WB TR	0.00	0.0	A	0	0.00	0.0	A	0
Templeton Parkway SB LR	0.11	13.0	B	8	0.14	14.9	B	10
Weekday Evening Peak Hour:								
Mount Auburn Street EB LT	0.01	10.0	B	4	0.07	10.9	B	4
Mount Auburn Street WB TR	0.00	0.0	A	0	0.00	0.0	A	0
Templeton Parkway SB LR	0.01	11.4	B	0	0.01	12.1	B	0

TABLE 6

Unsignalized Intersection Level of Service Summary (Continued)

Intersection/Peak Period/Movement	2014 Existing Conditions				2035 Future Year Conditions			
	v/c[a]	Delay[b]	LOS[c]	Queue[d]	v/c	Delay	LOS	Queue
Arlington Street at Grove Street								
Weekday Morning Peak Hour:								
Arlington Street EB T	0.00	0.0	A	0	0.00	0.0	A	0
Arlington Street EB R	0.00	0.0	A	0	0.00	0.0	A	0
Grove Street WB L	0.03	12.2	B	2	0.08	12.7	B	6
Grove Street WB T	0.00	0.0	A	0	0.00	0.0	A	0
Arlington Street NB L	***1.44***	***283.6***	***F***	***284***	***2.87***	*****	***F***	***#***
Arlington Street NB R	0.39	26.9	D	36	***0.63***	***52.3***	***F***	***70***
Weekday Evening Peak Hour:								
Arlington Street EB T	0.00	0.0	A	0	0.00	0.0	A	0
Arlington Street EB R	0.00	0.0	A	0	0.00	0.0	A	0
Grove Street WB L	0.05	7.7	A	4	0.15	8.2	A	10
Grove Street WB T	0.00	0.0	A	0	0.00	0.0	A	0
Arlington Street NB L	***2.25***	*****	***F***	***#***	***5.87***	*****	***F***	***#***
Arlington Street NB R	0.02	9.4	A	1	0.02	9.7	A	2
Grove Street at Tufts Medical Center Driveway								
Weekday Morning Peak Hour:								
Grove Street EB LT	0.47	11.1	B	52	0.56	12.8	B	72
Grove Street WB TR	0.00	0.0	A	0	0.00	0.0	A	0
Tufts Medical Center driveway SB L	***0.87***	*****	***F***	***38***	***0.42***	***205.3***	***F***	***26***
Tufts Medical Center driveway SB R	0.04	11.4	B	2	0.05	12.1	B	4
Weekday Evening Peak Hour:								
Grove Street EB LT	0.02	8.9	A	2	0.03	10.1	A	2
Grove Street WB TR	0.00	0.0	A	0	0.00	0.0	A	0
Tufts Medical Center driveway SB L	0.57	31.8	D	66	***1.04***	***128.5***	***F***	***178***
Tufts Medical Center driveway SB R	***1.07***	***89.6***	***F***	***332***	***1.72***	*****	***F***	***#***

[a]Volume to Capacity Ratio

[b]Average Delay Time in Seconds

[c]Level-of-Service

[d]Queue Length in Feet.

NB = Northbound; SB = Southbound; EB = Eastbound; WB = Westbound;

L = Left Turn; T = Through; R = Right Turn; LT = Shared Left-turn/Thorough; TR Shared Through/Right-turn; LR = Shared Left/Right-turn; LTR = Shared Left/Through/Right-turn.

NC = No Capacity

***** - Delay over 300 seconds

- 95th percentile volume exceeds capacity; reported queues may not be accurate

Bold/Italic Type indicates v/c≥0.90, LOS E or F, 95th percentile volume exceeds capacity

TABLE 7

Signalized Intersection Level of Service Summary

Intersection/Peak Period/Movement	2014 Existing Conditions				2035 Future Year Conditions			
	v/c[a]	Delay[b]	LOS[c]	Queue[d] 50th/95th	v/c	Delay	LOS	Queue 50th/95th
Mount Auburn Street at Irving Street/Palfrey Street								
Weekday Morning Peak Hour:								
Mount Auburn Street EB LTR	0.38	6.4	A	60/187	0.46	7.7	A	89/244
Mount Auburn Street WB LTR	0.55	9.1	A	81/263	0.73	14.7	B	129/**#417**
Irving Street NB LTR	0.60	38.6	D	87/142	0.68	40.5	D	108/177
Overall	**0.60**	**10.6**	**B**	**--**	**0.73**	**14.1**	**B**	**--**
Weekday Evening Peak Hour:								
Mount Auburn Street EB LTR	0.42	10.7	B	112/275	0.51	14.5	B	158/364
Mount Auburn Street WB LTR	0.46	11.6	B	114/285	0.78	22.5	C	218/#555
Irving Street NB LTR	0.74	43.8	D	217/286	0.77	41.3	D	265/335
Overall	**0.74**	**16.8**	**B**	**--**	**0.78**	**22.7**	**C**	**--**
Mount Auburn Street at Parker Street								
Weekday Morning Peak Hour:								
Mount Auburn Street EB TR	0.55	21.0	C	216/217	0.68	24.3	C	291/282
Mount Auburn Street WB LT	0.47	2.2	A	6/25	0.55	3.2	A	7/m32
Parker Street NB LR	***0.24***	***208.6***	***F***	2/21	***0.26***	***194.1***	***F***	2/22
Overall	**1.12**	**14.3**	**F**	**--**	**1.37**	**16.3**	**F**	**--**
Weekday Evening Peak Hour:								
Mount Auburn Street EB TR	0.47	19.9	B	200/259	0.58	22.1	C	263/335
Mount Auburn Street WB LT	0.45	2.3	A	6/30	0.54	3.8	A	6/m32
Parker Street NB LR	0.28	267.5	F	11/42	0.31	267.5	F	12/45
Overall	**0.92**	**14.9**	**B**	**--**	**1.13**	**16.4**	**F**	**--**
Mount Auburn Street at Common Street								
Weekday Morning Peak Hour:								
Mount Auburn Street EB LT	***1.12***	***87.3***	***F***	***~402/#480***	***1.37***	***189.5***	***F***	***~590/#605***
Mount Auburn Street WB TR	0.74	35.7	D	235/306	0.87	42.7	D	290/**#398**
Common Street SB L	0.66	36.6	D	200/**#482**	0.77	41.5	D	245/**#578**
Common Street SB R	0.72	40.0	D	193/**#477**	0.80	44.5	D	223/**#537**
Overall	**1.12**	**55.9**	**E**	**--**	***1.37***	***100.5***	***F***	**--**
Weekday Evening Peak Hour:								
Mount Auburn Street EB LT	***1.09***	***35.2***	***F***	***~214/#430***	***1.22***	***88.0***	***F***	***~436/#598***
Mount Auburn Street 16 WB TR	0.84	39.7	D	280/**#364**	***1.05***	***73.5***	***F***	***~413/#547***
Common Street SB L	0.53	32.7	C	153/**#363**	0.59	34.4	C	176/**#421**
Common Street SB R	0.63	36.4	D	164/**#412**	0.70	39.0	D	189/**#466**
Overall	**0.92**	**36.8**	**D**	**--**	**1.13**	**73.1**	**F**	**--**

TABLE 7

Signalized Intersection Level of Service Summary (Continued)

Intersection/Peak Period/Movement	2014 Existing Conditions				2035 Future Year Conditions			
	v/c[a]	Delay[b]	LOS[c]	Queue[d] 50th/95th	v/c	Delay	LOS	Queue 50th/95th
Mount Auburn Street at Bates Road East/Walnut Street								
Weekday Morning Peak Hour:								
Mount Auburn Street 16 EB LT	0.47	12.0	B	58/197	0.60	15.2	B	80/**#308**
Mount Auburn Street EB R	0.48	12.5	B	31/**#185**	0.55	15.4	B	40/**#233**
Mount Auburn Street WB LTR	0.45	12.0	B	52/181	0.53	14.0	B	63/**#242**
Walnut Street NB LTR	0.50	21.3	C	32/101	0.54	21.6	C	36/112
Bates Road East SB LTR	0.07	14.6	B	4/23	0.08	14.4	B	5/25
Overall	**0.50**	**12.9**	**B**	**--**	**0.60**	**15.3**	**B**	**--**
Weekday Evening Peak Hour:								
Mount Auburn Street EB LT	0.42	15.7	B	75/229	0.55	18.8	B	108/320
Mount Auburn Street EB R	0.27	12.3	B	23/109	0.32	14.1	B	29/132
Mount Auburn Street WB LTR	0.54	17.3	B	101/302	0.68	21.5	C	141/**#464**
Walnut Street NB LTR	0.76	30.9	C	108/251	0.79	31.6	C	124/284
Bates Road East SB LTR	0.04	15.0	B	5/21	0.04	14.3	B	5/23
Overall	**0.76**	**18.7**	**B**	**--**	**0.79**	**21.5**	**C**	**--**
Mount Auburn Street at School Street								
Weekday Morning Peak Hour:								
Mount Auburn Street EB LTR	0.59	17.5	B	129/287	0.77	22.7	C	183/**#447**
Mount Auburn Street WB LTR	0.46	15.3	B	97/220	0.56	17.0	B	118/266
School Street NB LTR	0.41	25.5	C	70/172	0.47	26.7	C	79/192
School Street SB LTR	***1.08***	***91.0***	***F***	***~297/#661***	***1.38***	***208.3***	***F***	***~422/#828***
Overall	**1.08**	**36.2**	**D**	**--**	**1.38**	**68.4**	**E**	**--**
Weekday Evening Peak Hour:								
Mount Auburn Street EB LTR	0.46	15.5	B	91/208	0.64	19.0	B	129/294
Mount Auburn Street WB LTR	0.43	14.6	B	95/214	0.55	16.2	B	130/286
School Street NB LTR	0.91	50.9	D	209/**#531**	***1.05***	***82.2***	***F***	***~248/#615***
School Street SB LTR	0.91	53.5	D	179/**#473**	***1.13***	***112.6***	***F***	***~249/#568***
Overall	**0.91**	**30.0**	**C**	**--**	**1.13**	**47.1**	**D**	**--**

TABLE 7

Signalized Intersection Level of Service Summary (Continued)

Intersection/Peak Period/Movement	2014 Existing Conditions				2035 Future Year Conditions			
	v/c[a]	Delay[b]	LOS [c]	Queue[d] 50th/95th	v/c	Delay	LOS	Queue 50th/95th
Mount Auburn Street at Kimball Road/Bigelow Avenue								
Weekday Morning Peak Hour:								
Mount Auburn Street EB LTR	0.39	8.5	A	75/266	0.49	10.7	B	124/353
Mount Auburn Street WB LTR	0.31	8.5	A	52/188	0.44	11.3	B	84/251
Bigelow Avenue NB LTR	0.75	67.6	E	103/172	0.79	66.8	E	124/**#240**
Kimball Road SB LTR	0.67	58.6	E	87/151	0.63	53.1	D	95/168
Overall	**0.75**	**17.7**	**B**	**--**	**0.79**	**19.1**	**B**	**--**
Weekday Evening Peak Hour:								
Mount Auburn Street EB LTR	0.34	9.6	A	82/196	0.55	18.8	B	184/262
Mount Auburn Street WB LTR	0.41	11.4	B	115/264	0.64	31.1	C	240/334
Bigelow Avenue NB LTR	0.76	54.1	D	165/**#281**	0.72	39.7	D	220/**#514**
Kimball Road SB LTR	0.10	27.3	C	15/43	0.07	22.1	C	13/46
Overall	**0.76**	**17.1**	**B**	**--**	**0.72**	**27.9**	**C**	**--**
Mount Auburn Street at Arlington Street								
Weekday Morning Peak Hour:								
Mount Auburn Street EB L	0.24	36.6	D	27/61	0.31	38.6	D	33/72
Mount Auburn Street EB TR	0.85	39.5	D	196/**#293**	***1.03***	***70.4***	***F***	***~289/#417***
Mount Auburn Street WB L	***1.33***	***202.5***	***F***	***~177/#345***	***1.66***	***341.3***	***F***	***~278/#457***
Mount Auburn Street WB TR	0.38	27.4	C	117/161	0.43	28.2	C	137/185
Arlington Street NB L	0.31	28.0	C	26/55	0.38	29.7	C	32/65
Arlington Street NB TR	0.63	33.7	C	200/301	0.71	36.8	D	234/348
Arlington Street SB LTR	***1.07***	***91.1***	***F***	***~363/#486***	***1.26***	***160.3***	***F***	***~471/#600***
Overall	***1.33***	***68.3***	***F***	**--**	***1.66***	***113.4***	***F***	**--**
Weekday Evening Peak Hour:								
Mount Auburn Street EB L	0.18	26.7	C	24/75	0.33	30.6	C	44/118
Mount Auburn Street EB TR	0.39	25.1	C	122/234	0.54	29.5	C	181/**#351**
Mount Auburn Street WB L	0.34	17.3	B	41/116	0.49	21.6	C	51/**#163**
Mount Auburn Street WB TR	0.30	16.5	B	95/205	0.34	17.0	B	110/232
Arlington Street NB L	0.80	48.5	D	126/**#237**	***1.15***	***130.7***	***F***	***~206/#404***
Arlington Street NB TR	***1.73***	***363.4***	***F***	***~1072/#1324***	***2.01***	***484.2***	***F***	***~1312/#1571***
Arlington Street SB LTR	0.86	57.9	E	139/**#223**	***1.02***	***87.8***	***F***	***~170/#278***
Overall	***1.73***	***148.3***	***F***	**--**	***2.01***	**197.4**	**F**	**--**

[a]Volume to Capacity Ratio

[b]Average Delay Time in Seconds

[c]Level-of-Service

[d]Queue Length in Feet.

NB = Northbound; SB = Southbound; EB = Eastbound; WB = Westbound;

L = Left Turn; T = Through; R = Right Turn; LT = Shared Left-turn/Thorough; TR Shared Through/Right-turn; LR = Shared Left/Right-turn; LTR = Shared Left/Through/Right-turn

~/# = 50th/95th percentile volume exceeds capacity; reported queues may not be accurate

m = 95th percentile volume metered by upstream signal

Bold/Italic Type indicates v/c≥0.90, LOS E or F, 50th/95th percentile volume exceeds capacity

4.0 PROPOSED IMPROVEMENTS

Three alternatives were developed to potentially reconstruct the Mount Auburn Street corridor to provide a more contextual environment and complete accommodations for pedestrians, bicycles, vehicles, and transit riders, including enhanced pedestrian and bicycle facilities, improved access to businesses along the corridor, and reduced vehicular delays. Each alternative involved providing a single through lane in each direction along Mount Auburn Street between Common Street and the Cambridge incorporation limits. West of Common Street, Mount Auburn Street carries higher traffic volumes and would retain four travel lanes (two lanes in each direction) under each alternative.

In detail, Alternative 1 provides a single through lane and a bicycle lane in each direction, turn lanes at key intersections, and a new traffic signal at Arlington Street and Grove Street; Alternative 2 provides a two-way left-turn lane (TWLTL) on Mount Auburn Street (Rte 16) between Chester Street and Dexter Avenue/Upland Road; and, finally, Alternative 3 provides a raised median along Mount Auburn Street, with breaks at key intersections to facilitate left-turn movements and u-turns to access roadways where the left turn is restricted.

Alternatives 2 and 3 were dismissed without further analysis based on community feedback at public workshops in 2011. Reasons behind the dismissal were:

1. Alternative 2 – Numerous driveways and offset streets along Mount Auburn Street would mean tha drivers within the TWLTL would actually conflict with one another, and

2. Alternative 3 – This alternative creates diversions for a lot of the streets and driveways between the median breaks, and plowing around the median would be an issue.

Concept drawings for Alternatives 2 and 3 are included in Figures 6a through 6c and 7a through 7c respectively in the *Technical Appendix*.

Therefore, only Alternative 1 was carried forward for detailed operational analysis. In addition, a variety of treatments was explored for the treatment of bicycle accommodations along the corridor, including a two-wy cycle track, and a buffered bicycle lane located behind the parking lane. Convential on-street bike lanes were selected as part of the preferred alternative due to sight distance concerns at the numerous intersecting side streets.

Tables 8 and 9 below compare future operatons with Alternative 1 and future operations (2035) of Mount Auburn Street with existing geometric conditions.

TABLE 8

Unsignalized Intersection Level of Service Summary

Intersection/Peak Period/Movement	2035 No-Build				2035 Alternative 1			
	v/c[a]	Delay[b]	LOS[c]	Queue[d]	v/c	Delay	LOS	Queue 50th/95th
Route 16 at Phillips Street								
Weekday Morning Peak Hour:								
Route 16 EB TR	0.00	0.0	A	0	0.00	0.0	A	0
Route 16 WB LT	0.07	11.1	B	4	0.07	11.1	B	4
Phillips Street NB LR	0.02	17.9	C	1	0.05	19.3	C	2
Weekday Evening Peak Hour:								
Route 16 EB TR	0.00	0.0	A	0	0.00	0.0	A	0
Route 16 WB LT	0.12	11.2	B	8	0.12	11.1	B	8
Phillips Street NB LR	0.07	29.7	D	5	0.17	32.3	D	12
Route 16 at Marshall Street								
Weekday Morning Peak Hour:								
Route 16 EB LT	0.41	0.6	A	4	0.41	0.6	A	3
Route 16 WB TT	0.45	0.0	A	0	0.45	0.0	A	0
Weekday Evening Peak Hour:								
Route 16 EB LT	0.39	1.2	A	8	0.36	1.1	A	7
Route 16 WB TR	0.45	0.0	A	0	0.47	0.0	A	0
Route 16 at Boylston Street (unsignalized under existing, signalized under Alternative 1)								
Weekday Morning Peak Hour:								
Route 16 EB TR	0.00	0.0	A	0	***1.01***	***45.8***	***F***	***389/#1092***
Route 16 WB L	0.04	11.5	B	28	0.24	17.5	B	4/34
Route 16 WB T					0.61	14.0	B	146/466
Boylston Street NB LR	***2.73***	*****	***F***	***701***	0.86	46.5	D	143/121
Overall					***1.01***	***72.8***	***F***	--
Weekday Evening Peak Hour:								
Route 16 EB TR	0.00	0.0	A	0	0.54	8.5	A	97/**521**
Route 16 WB L	0.02	9.8	A	1	0.03	6.4	A	1/13
Route 16 WB T					0.69	11.9	B	155/**#876**
Boylston Street NB LR	0.41	41.8	E	36	0.38	31.4	C	26/62
Overall					**0.69**	**11.2**	**B**	**--**
Route 16 at Winthrop Street								
Weekday Morning Peak Hour:								
Route 16 EB TR	0.00	0.0	A	0	0.00	0.0	A	0
Route 16 WB LT	0.07	11.8	B	4	0.06	11.3	B	4
Winthrop Street NB LR	0.15	45.2	E	10	***0.21***	***57.3***	***F***	***16***
Weekday Evening Peak Hour:								
Route 16 EB TR	0.00	0.0	A	0	0.00	0.0	A	0
Route 16 WB LT	0.01	9.7	A	0	0.01	9.4	A	0
Winthrop Street NB LR	0.11	26.2	D	8	***0.23***	***51.2***	***F***	***16***

TABLE 8

Unsignalized Intersection Level of Service Summary (Continued)

Intersection/Peak Period/Movement	2035 No-Build v/c[a]	Delay[b]	LOS[c]	Queue[d]	2035 Alternative 1 v/c	Delay	LOS	Queue 50th/95th
Route 16 at Chauncey Street								
Weekday Morning Peak Hour:								
Route 16 EB TR	0.00	0.0	A	0	0.00	0.0	A	0
Route 16 WB LT	0.12	11.6	B	8	0.11	11.6	B	14
Chauncey Street NB LR	***0.57***	***61.6***	***F***	***59***	***0.74***	***99.9***	***F***	***80***
Weekday Evening Peak Hour:								
Route 16 EB TR	0.00	0.0	A	0	0.00	0.0	A	0
Route 16 WB LT	0.02	9.6	A	0	0.02	9.4	A	0
Chauncey Street NB LR	**0.11**	**22.8**	**C**	**8**	***0.27***	***56.6***	***F***	***20***
Route 16 at Upland Road/Dexter Avenue (unsignalized under existing, signalized under Alternative 1)								
Weekday Morning Peak Hour:								
Route 16 EB L	0.01	8.6	A	0	0.01	2.8	A	0/4
Route 16 EB TR					0.66	7.2	A	0/**#787**
Route 16 WB L	0.06	11.1	B	4	0.10	3.4	A	0/18
Route 16 WB TR					0.32	2.6	A	0/179
Dexter Avenue NB LTR	0.36	33.9	D	30	0.06	1.3	A	0/13
Upland Road SB LTR	0.12	29.4	D	8	0.02	1.9	A	0/7
Overall					**0.66**	**5.4**	**A**	**--**
Weekday Evening Peak Hour:								
Route 16 EB L	0.03	10.3	B	2	0.04	2.8	A	0/11
Route 16 EB TR					0.45	3.5	A	0/308
Route 16 WB L	0.05	9.7	A	3	0.06	2.6	A	0/17
Route 16 WB TR					0.55	4.8	A	0/479
Dexter Avenue NB LTR	***0.56***	***64.6***	***F***	***56***	0.05	1.5	A	0/18
Upland Road SB LTR	***0.26***	***53.6***	***F***	***20***	0.03	1.8	A	0/7
Overall					**0.55**	**4.0**	**A**	
Route 16 at Melendy Avenue								
Weekday Morning Peak Hour:								
Route 16 EB TR	0.00	0.0	A	0	0.00	0.0	A	0
Route 16 WB LT	0.03	11.3	B	2	0.03	11.3	B	2
Melendy Avenue NB LR	0.33	23.3	C	28	0.35	35.7	E	30
Weekday Evening Peak Hour:								
Route 16 EB TR	0.00	0.0	A	0	0.00	0.0	A	0
Route 16 WB LT	0.04	9.8	A	2	0.04	9.7	A	2
Melendy Avenue NB LR	0.25	27.3	D	20	***0.44***	***55.0***	***F***	***38***

TABLE 8

Unsignalized Intersection Level of Service Summary (Continued)

Intersection/Peak Period/Movement	2035 No-Build				2035 Alternative 1			
	v/c[a]	Delay[b]	LOS[c]	Queue[d]	v/c	Delay	LOS	Queue 50th/95th
Route 16 at Lloyd Road								
Weekday Morning Peak Hour:								
Route 16 EB LT	0.01	10.2	B	0	0.01	9.8	A	0
Route 16 WB TR	0.00	1.0	A	0	0.00	0.0	A	0
Lloyd Road SB LR	0.27	44.3	E	20	***0.35***	***63.7***	***F***	***28***
Weekday Evening Peak Hour:								
Route 16 EB LT	0.03	13.6	B	2	0.03	12.2	B	2
Route 16 WB TR	0.00	0.4	A	0	0.00	0.0	A	0
Lloyd Road SB LR	***0.24***	***62.7***	***F***	***16***	***0.44***	***81.0***	***F***	***36***
Route 16 at Elton Avenue								
Weekday Morning Peak Hour:								
Route 16 EB TR	0.00	0.1	A	0	0.00	0.0	A	0
Route 16 WB LT	0.14	12.2	B	10	0.16	10.6	B	26
Weekday Evening Peak Hour:								
Route 16 EB TR	0.00	0.4	A	0	0.00	0.0	A	0
Route 16 WB LT	0.04	9.8	A	2	0.04	1.0	A	3
Route 16 at Irma Avenue								
Weekday Morning Peak Hour:								
Route 16 EB LT	0.02	8.8	A	1	0.02	9.0	A	2
Route 16 WB TR	0.00	0.0	A	0	0.00	0.0	A	0
Irma Avenue SB LR	0.13	13.5	B	8	0.30	23.0	C	24
Weekday Evening Peak Hour:								
Route 16 EB LT	0.02	10.4	B	1	0.02	10.9	B	2
Route 16 WB TR	0.00	0.0	A	0	0.00	0.0	A	0
Irma Avenue SB LR	0.22	39.1	E	16	***0.56***	***101.3***	***F***	***48***
Route 16 at Templeton Parkway								
Weekday Morning Peak Hour:								
Route 16 EB LT	0.02	8.9	A	1	0.02	8.9	A	2
Route 16 WB TR	0.00	0.0	A	0	0.00	0.0	A	0
Templeton Parkway SB LR	0.14	14.9	B	10	0.24	20.5	C	18
Weekday Evening Peak Hour:								
Route 16 EB LT	0.07	10.9	B	4	0.07	10.7	B	4
Route 16 WB TR	0.00	0.0	A	0	0.00	0.0	A	0
Templeton Parkway SB LR	0.01	12.1	B	0	0.01	17.6	C	0

TABLE 8

Unsignalized Intersection Level of Service Summary (Continued)

Intersection/Peak Period/Movement	2035 No-Build				2035 Alternative 1			
	v/c[a]	Delay[b]	LOS[c]	Queue [d]	v/c	Delay	LOS	Queue 50th/95th
Arlington Street at Grove Street (in 2035 Alternative 1 this intersection is combined with the Tufts Center Driveway)								
Weekday Morning Peak Hour:								
Arlington Street EB L	0.00	0.0	A	0	***1.09***	***100.6***	***F***	***~420/#793***
Arlington Street EB T					0.63	44.2	D	347/693
Arlington Street EB R	0.00	0.0	A	0	0.37	4.0	A	21/83
Grove Street WB L	0.08	12.7	B	5	0.20	35.6	D	25/66
Grove Street WB TR	0.00	0.0	A	0	0.76	46.7	D	337**/#597**
Arlington Street NB L	***2.87***	*****	***F***	***#***	***1.14***	***156.2***	***F***	***~236/#353***
Arlington Street NB R	***0.63***	***52.3***	***F***	***70***	0.75	50.3	D	112/166
Tufts Medical Center driveway SB L	--	--	--	--	0.12	67.0	E	10/33
Tufts Medical Center driveway SB R	--	--	--	--	***1.21***	***206.8***	***F***	***~114/#261***
Overall					**1.21**	**64.5**	**F**	**--**
Weekday Evening Peak Hour:								
Arlington Street EB L	0.00	0.0	A	0	0.22	22.7	C	6/30
Arlington Street EB T					0.39	18.0	B	73/179
Arlington Street EB R	0.00	0.0	A	0	0.40	2.4	A	0/48
Grove Street WB L	0.15	8.2	A	10	0.00	16.0	B	0/4
Grove Street WB TR	0.00	0.0	A	0	0.97	50.3	D	252**/#666**
Arlington Street NB L	***5.87***	*****	***F***	***#***	***1.08***	***116.6***	***F***	***~97/#306***
Arlington Street NB TR	0.02	9.7	A	2	0.75	33.6	C	47**/#196**
Tufts Medical Center driveway SB L	--	--	--	--	0.55	28.0	C	79/132
Tufts Medical Center driveway SB R	--	--	--	--	***1.19***	***114.5***	***F***	***~276/#617***
Overall					**1.19**	**59.7**	**F**	**--**
Grove Street at Tufts Medical Center Driveway								
Weekday Morning Peak Hour:								
Grove Street EB LT	0.56	12.8	B	72	See above for results			
Grove Street WB TR	0.00	0.00	A	0				
Tufts Medical Center driveway SB L	***0.42***	***205.3***	***F***	***26***				
Tufts Medical Center driveway SB R	0.05	12.1	B	3				
Weekday Evening Peak Hour:								
Grove Street EB LT	0.03	10.1	B	2	See above for results			
Grove Street WB TR	0.00	0.0	A	0				
Tufts Medical Center driveway SB L	***1.04***	***128.5***	***F***	***178***				
Tufts Medical Center driveway SB R	***1.72***	*****	***F***	***#***				

[a]Volume to Capacity Ratio, [b]Average Delay Time in Seconds, [c]Level-of-Service, [d]Queue Length in Feet.

NB = Northbound; SB = Southbound; EB = Eastbound; WB = Westbound;

L = Left Turn; T = Through; R = Right Turn; LT = Shared Left-turn/Thorough; TR Shared Through/Right-turn; LR = Shared Left/Right-turn; LTR = Shared Left/Through/Right-turn.

NC = No Capacity

***** - Delay not calculated

- 95th percentile volume exceeds capacity; reported queues may not be accurate

Bold/Italic Type indicates v/c≥0.90, LOS E or F, 95th percentile volume exceeds capacity

TABLE 9

Signalized Intersection Level of Service Summary

Intersection/Peak Period/Movement	2035 No-Build v/c[a]	Delay[b]	LOS[c]	Queue[d] 50th/95th	2035 Alternative 1 v/c	Delay	LOS	Queue 50th/95th
Mount Auburn Street at Irving Street/Palfrey Street								
Weekday Morning Peak Hour:								
Route 16 EB LTR	0.46	7.7	A	89/244	0.49	8.0	A	85/m253
Route 16 WB LTR	0.73	14.7	B	129/**#417**	0.79	24.0	C	227/**#559**
Irving Street NB LTR	0.68	40.5	D	108/177	0.81	59.5	E	207/**#345**
Overall	**0.73**	**14.1**	**B**	**--**	**0.81**	**21.2**	**C**	**--**
Weekday Evening Peak Hour:								
Route 16 EB LTR	0.51	14.5	B	158/364	0.78	16.0	B	92/**#165**
Route 16 WB LTR	0.78	22.5	C	218/**#555**	***1.33***	***175.8***	***F***	***~185/#284***
Irving Street NB LTR	0.77	41.3	D	265/335	0.65	13.7	B	70/**#14**4
Overall	**0.78**	**22.7**	**C**	**--**	**1.33**	**83.8**	**F**	**--**
Mount Auburn Street at Parker Street (Under Alternative 1 Parker St is one-way SB and there is no signal)								
Weekday Morning Peak Hour:								
Route 16 EB TR	0.68	24.3	C	291/282	0.45	0.0	A	0
Route 16 WB LT	0.55	3.2	A	7/m32	0.47	0.6	A	3
Parker Street NB LR	0.26	194.1	F	2/22	--	--	--	--
Overall	**1.37**	**16.2**	**B**	**--**				
Weekday Evening Peak Hour:								
Route 16 EB TR	0.58	22.1	C	263/335	0.35	0.0	A	0
Route 16 WB LT	0.54	3.8	A	6/m32	0.49	0.3	A	2
Parker Street NB LR	0.31	267.5	F	12/45	--	--	--	--
Overall	**1.13**	**16.4**	**B**	**--**				
***Mount Auburn Street* at Common Street**								
Weekday Morning Peak Hour:								
Route 16 EB L	1.37	189.5	F	***~590/#605***	0.46	25.2	C	97/144
Route 16 EB T					0.86	21.0	C	369/245
Route 16 WB TR	0.87	42.7	D	290/**#398**	0.79	38.3	D	298/401
Common Street SB L	0.77	41.5	D	245/**#578**	0.87	54.7	D	301/**#428**
Common Street SB R	0.80	44.5	D	223/**#537**	0.45	14.1	B	157/206
Overall	**1.37**	**100.5**	**F**	**--**	**0.87**	**31.1**	**C**	**--**
Weekday Evening Peak Hour:								
Route 16 EB L	***1.22***	***88.0***	***F***	***~436/#598***	0.63	35.8	D	145**/#290**
Route 16 EB T					0.68	36.4	D	394/**#791**
Route 16 WB TR	***1.05***	***82.7***	***F***	***~413/#547***	0.74	38.9	D	476/**#783**
Common Street SB L	0.59	34.4	C	176/**#421**	0.84	72.7	E	323/441
Common Street SB R	0.70	39.0	D	189/**#466**	0.56	29.3	C	236/235
Overall	**1.13**	**73.1**	**F**	**--**	**0.84**	**41.0**	**D**	**--**

TABLE 9

Signalized Intersection Level of Service Summary (Continued)

Intersection/Peak Period/Movement	2035 No-Build v/c[a]	Delay[b]	LOS[c]	Queue[d] 50th/95th	2035 Alternative 1 v/c	Delay	LOS	Queue 50th/95th
Mount Auburn Street at Bates Road East/Walnut Street								
Weekday Morning Peak Hour:								
Route 16 EB L	0.60	15.2	B	80/**#308**	0.00	10.0	B	0/3
Route 16 EB T					0.90	28.8	C	**370/#950**
Route 16 EB R	0.55	15.4	B	40/**#233**	0.44	8.8	A	51/177
Route 16 WB L	0.53	14.0	B	63/**#242**	0.19	17.1	B	4/26
Route 16 WB TR					0.68	17.1	B	**218/#565**
Walnut Street NB LTR	0.54	21.6	C	36/112	0.77	48.9	D	105/**#203**
Bates Road East SB LTR	0.08	14.4	B	5/25	0.09	27.5	C	12/40
Overall	**0.60**	**15.3**	**B**	--	**0.90**	**23.9**	**C**	--
Weekday Evening Peak Hour:								
Route 16 EB L	0.55	18.8	B	108/320	0.01	11.0	B	0/3
Route 16 EB T					0.70	21.8	C	407/555
Route 16 EB R	0.32	14.1	B	29/132	0.18	4.2	A	31/58
Route 16 WB L	0.68	21.5	C	141/**#464**	0.11	13.0	B	7/21
Route 16 WB TR					0.94	39.3	D	705**/#1039**
Walnut Street NB LTR	0.79	31.6	C	124/284	0.83	51.5	D	284**/#478**
Bates Road East SB LTR	0.04	14.3	B	5/23	0.12	18.3	B	6/22
Overall	**0.79**	**21.5**	**C**	--	**0.94**	**32.7**	**C**	--
Mount Auburn Street at School Street								
Weekday Morning Peak Hour:								
Route 16 EB L	0.77	22.7	C	183/**#447**	0.61	34.8	C	32/**#92**
Route 16 EB TR					***1.05***	***70.7***	***F***	***~798/#1213***
Route 16 WB L	0.56	17.0	B	118/266	***0.74***	***88.3***	***F***	***29/#124***
Route 16 WB T					0.85	40.2	D	443/**#842**
Route 16 WB R					0.05	0.2	A	0/1
School Street NB L	0.47	26.7	C	79/192	0.30	49.7	D	16/45
School Street NB TR					0.67	51.5	D	153/241
School Street SB L	***1.38***	***208.3***	***F***	***~422/#828***	0.45	29.0	C	72/146
School Street SB TR					0.89	52.2	D	350/**#651**
Overall	**1.38**	**68.4**	**F**	--	**1.05**	**53.8**	**D**	--
Weekday Evening Peak Hour:								
Route 16 EB L	0.64	19.0	B	129/294	***1.49***	***324.6***	***F***	***~99/#192***
Route 16 EB TR					0.68	29.9	C	395/679
Route 16 WB L	0.55	16.2	B	130/286	0.19	22.8	C	15/47
Route 16 WB T					0.95	49.9	D	693/#**1173**
Route 16 WB R					0.00	0.0	A	0/0
School Street NB L	***1.05***	***82.2***	***F***	***~248/#615***	0.28	33.8	C	39/96
School Street NB TR					0.71	42.1	D	356/589
School Street SB L	***1.13***	***112.6***	***F***	***~249/#568***	0.57	52.3	D	52/**#147**
School Street SB TR					0.63	39.5	D	267/458
Overall	**1.13**	**47.1**	**F**	--	**1.49**	**50.1**	**D**	--

TABLE 9

Signalized Intersection Level of Service Summary (Continued)

Intersection/Peak Period/Movement	2035 No-Build				2035 Alternative 1			
	v/c[a]	Delay[b]	LOS[c]	Queue[d] 50th/95th	v/c	Delay	LOS	Queue 50th/95th
Mount Auburn Street at Kimball Road/Bigelow Avenue								
Weekday Morning Peak Hour:								
Route 16 EB L	0.49	10.7	B	124/353	0.03	11.2	B	2/12
Route 16 EB TR					0.57	14.8	B	193/372
Route 16 WB L	0.44	11.3	B	84/251	0.43	11.5	B	15/m31
Route 16 WB TR					0.57	8.2	A	98/m145
Bigelow Avenue NB LTR	0.79	66.8	E	124/#240	0.81	62.7	E	179/196
Kimball Road SB LTR	0.63	53.1	D	95/168	0.58	46.5	D	118/161
Overall	**0.79**	**19.1**	**B**	**--**	**0.81**	**20.7**	**C**	**--**
Weekday Evening Peak Hour:								
Route 16 EB L	0.55	18.8	B	184/262	0.08	9.7	A	4/13
Route 16 EB TR					0.36	10.6	B	147/184
Route 16 WB L	0.64	31.1	C	240/334	0.07	5.8	A	5/m6
Route 16 WB TR					0.80	20.5	C	584/m173
Bigelow Avenue NB LTR	0.72	39.7	D	220/**#514**	***1.03***	***93.3***	***F***	***~416/#492***
Kimball Road SB LTR	0.07	22.1	C	13/46	0.11	27.9	C	21/38
Overall	**0.72**	**27.9**	**C**	**--**	**1.03**	**31.9**	**F**	**--**
Mount Auburn Street at Arlington Street								
Weekday Morning Peak Hour:								
Route 16 EB L	0.31	38.6	D	33/72	0.26	31.2	C	37/m42
Route 16 EB TR	***1.03***	***70.4***	***F***	***~289/#417***	0.95	66.7	E	316/**#431**
Route 16 WB L	***1.66***	***341.3***	***F***	***~278/#457***	0.69	32.4	C	165/**#495**
Route 16 WB TR	0.43	28.2	C	137/185	0.53	22.1	C	228/471
Arlington Street NB L	0.38	29.7	C	32/65	0.63	48.8	D	36/**#84**
Arlington Street NB T	0.71	36.8	D	234/348	0.52	34.6	C	205/298
Arlington Street NB R					0.11	1.7	A	0/18
Arlington Street SB LTR	***1.26***	***160.3***	***F***	***~471/#600***	***1.01***	***69.4***	***E***	***~472/#606***
Overall	***1.66***	***113.4***	***F***	**--**	***1.01***	***51.0***	***F***	**--**
Weekday Evening Peak Hour:								
Route 16 EB L	0.33	30.6	C	44/118	0.67	51.9	D	76/**m#153**
Route 16 EB TR	0.54	29.5	C	181/**#351**	0.57	30.7	C	220/m320
Route 16 WB L	0.49	21.6	C	51/**#163**	0.54	30.2	C	83/**#273**
Route 16 WB TR	0.34	17.0	B	110/232	0.73	35.7	C	418/**#809**
Arlington Street NB L	***1.15***	***130.7***	***F***	***~206/#404***	0.95	66.4	E	214/**#360**
Arlington Street NB T	***2.01***	***484.2***	***F***	***~1312/#1571***	***1.35***	***198.0***	***F***	***~1207/#1468***
Arlington Street NB R					0.35	7.6	A	54/109
Arlington Street SB LTR	***1.02***	***87.8***	***F***	***~170/#278***	0.87	62.9	E	221/**#318**
Overall	**2.01**	**197.4**	**F**	**--**	***1.35***	**83.2**	**F**	**--**

[a]Volume to Capacity Ratio, [b]Average Delay Time in Seconds, [c]Level-of-Service, [d]Queue Length in Feet.

NB = Northbound; SB = Southbound; EB = Eastbound; WB = Westbound; L = Left Turn; T = Through; R = Right Turn; LT = Shared Left-turn/Thorough; TR Shared Through/Right-turn; LR = Shared Left/Right-turn; LTR = Shared Left/Through/Right-turn

~/# = 50th/95th percentile volume exceeds capacity; reported queues may not be accurate

m = 95th percentile volume metered by upstream signal

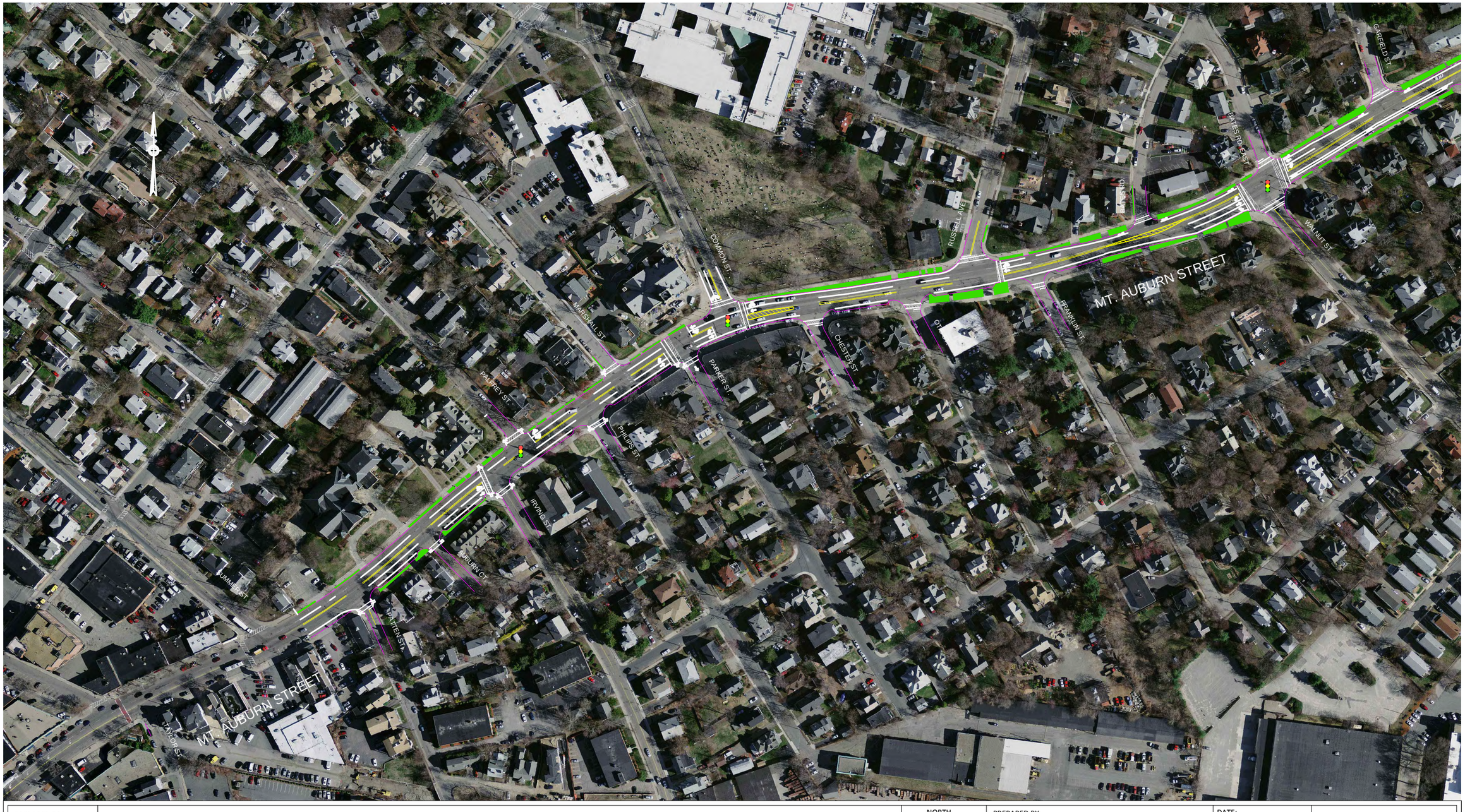
Alternative 1 investigates providing a safer environment for motorists, pedestrians, and bicycles, as well as improving traffic operations for turning movements and minor-street approaches, by restriping Mount Auburn Street east of Common Street to consist of one vehicular travel lane and one bicycle lane in each direction with additional turn lanes at key intersections. Also under this alternative, a new traffic signal would be provided at the intersection of Arlington Street with Grove Street, new pedestrian signals would be provided at the intersections of Mount Auburn Street with Boylston Street and with Dexter Avenue/Upland Road, and each existing traffic signal would be upgraded or optimized. Curb extensions would be provided at crosswalks wherever possible, and all exclusive pedestrian signal phases would be retimed to comply with the latest MUTCD guidelines for walk, pedestrian clearance, and buffer intervals. West of Common Street, four lanes of travel are required to accommodate Future Year traffic volumes; therefore this segment would remain in its current configuration.

Eliminating one travel lane in each direction improves safety for pedestrians by shortening the crossing distance across Mount Auburn Street and improves vehicle safety by allowing left-turning vehicles traveling along Mount Auburn Street to be removed from the mainline traffic stream. The specific geometric improvements at each of the study area intersections are described below and depicted on Figures 4a through 4c. The future 2035 peak hour traffic volumes resulting from changes to the roadway network are shown on Figure 5.

Although the analysis indicates that some movements would operate at unacceptable levels of service, these are primarily low-volume movements that would cause minor inconveniences but would not affect system operations and/or are movements that would operate less efficiently with existing geometry. Additionally, SimTraffic microsimulation was used to enure that Future Year 2035 traffic operations would be adequate. A detailed discussion of operations at each study intersection follows.

Mount Auburn Street at Parker Street - This intersection currently operates under signal control. Under Alternative 1, Parker Street would change from a two-way street to one-way southbound, away from Mount Auburn Street, eliminating the need for a signal. The existing crosswalk across Mount Auburn Street would be eliminated, and pedestrians would cross at the Common Street signal. Mount Auburn Street would continue to carry two general purpose lanes in each direction with parking along the south side of the roadway. All movements at this intersection would operate at LOS A during the peak hours under Alternative 1.

Mount Auburn Street at Common Street - This intersection currently operates under signal control. Under Alternative 1, Mount Auburn Street eastbound would remain in its current four-lane configuration, with the eastbound left lane designated exclusively for left turns. East of Common Street, Mount Auburn Street would carry one basic travel lane in each direction; however, to maintain efficient operations at Common Street the westbound approach would widen to two general purpose lanes at the intersection of Mount Auburn Street with Russell Avenue. The existing signal heads at Parker Street would be removed. At Common Street, a



PREPARED FOR:

TITLE:

MOUNT AUBURN STREET CORRIDOR IMPROVEMENTS

ALTERNATIVE 1 - TWO WAY CROSS SECTION (SHEET 1 OF 3)

NORTH

PREPARED BY:

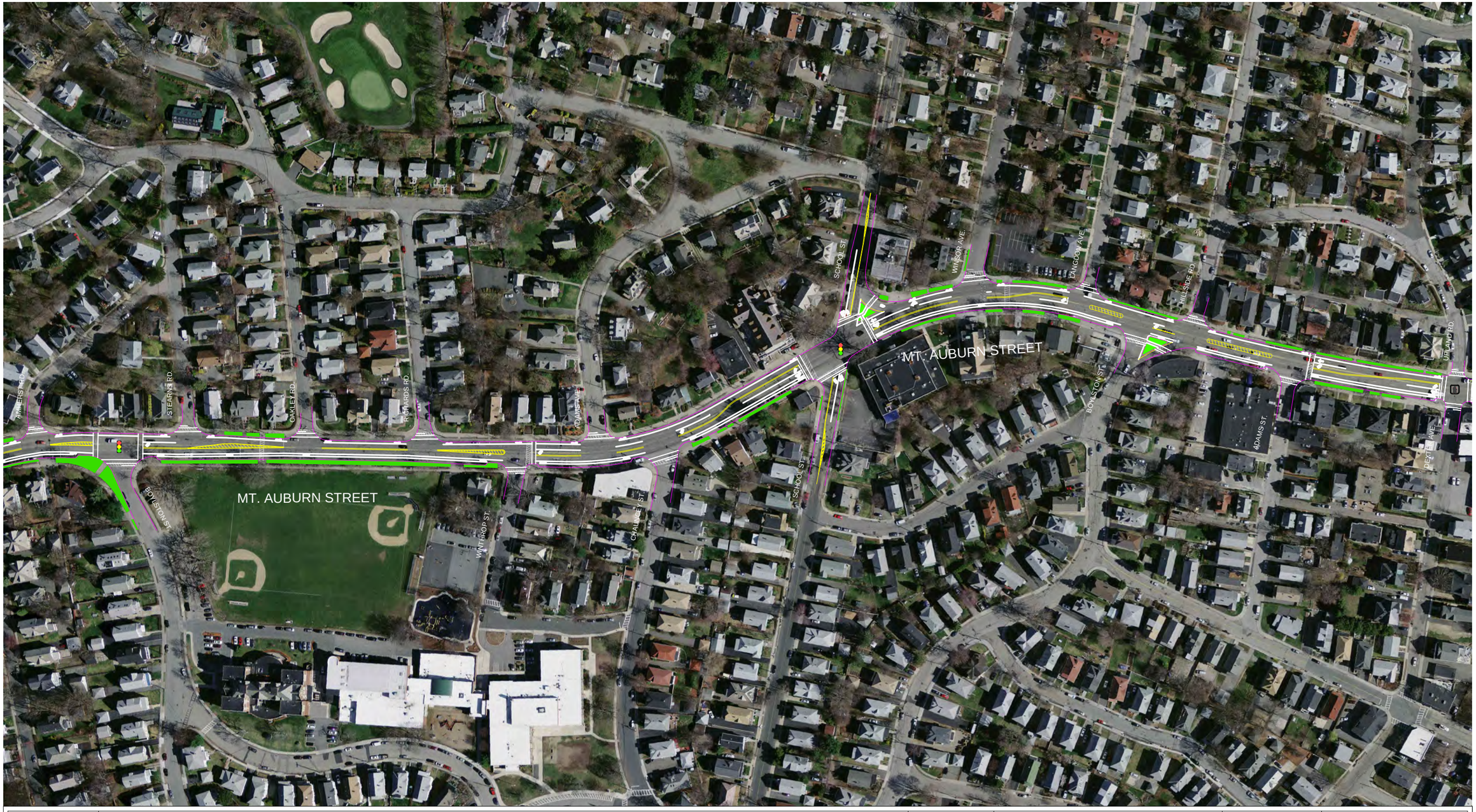
WORLDTECH ENGINEERING
300 TRADE CENTER, SUITE 5580
WOBURN, MASSACHUSETTS 01801
PHONE: 781.933.4800
FAX: 781.933.4801

DATE: 01-08-2016

SCALE: 1" = 250'

Figure 4a

Filename: J:\Watertown\13-033.01 Watertown - Rehab of Mt. Auburn Street\Documents\Report\Figures\13-033.01 Alt 1.dwg



PREPARED FOR:

TITLE:

MOUNT AUBURN STREET CORRIDOR IMPROVEMENTS

ALTERNATIVE 1 - TWO WAY CROSS SECTION (SHEET 2 OF 3)

NORTH

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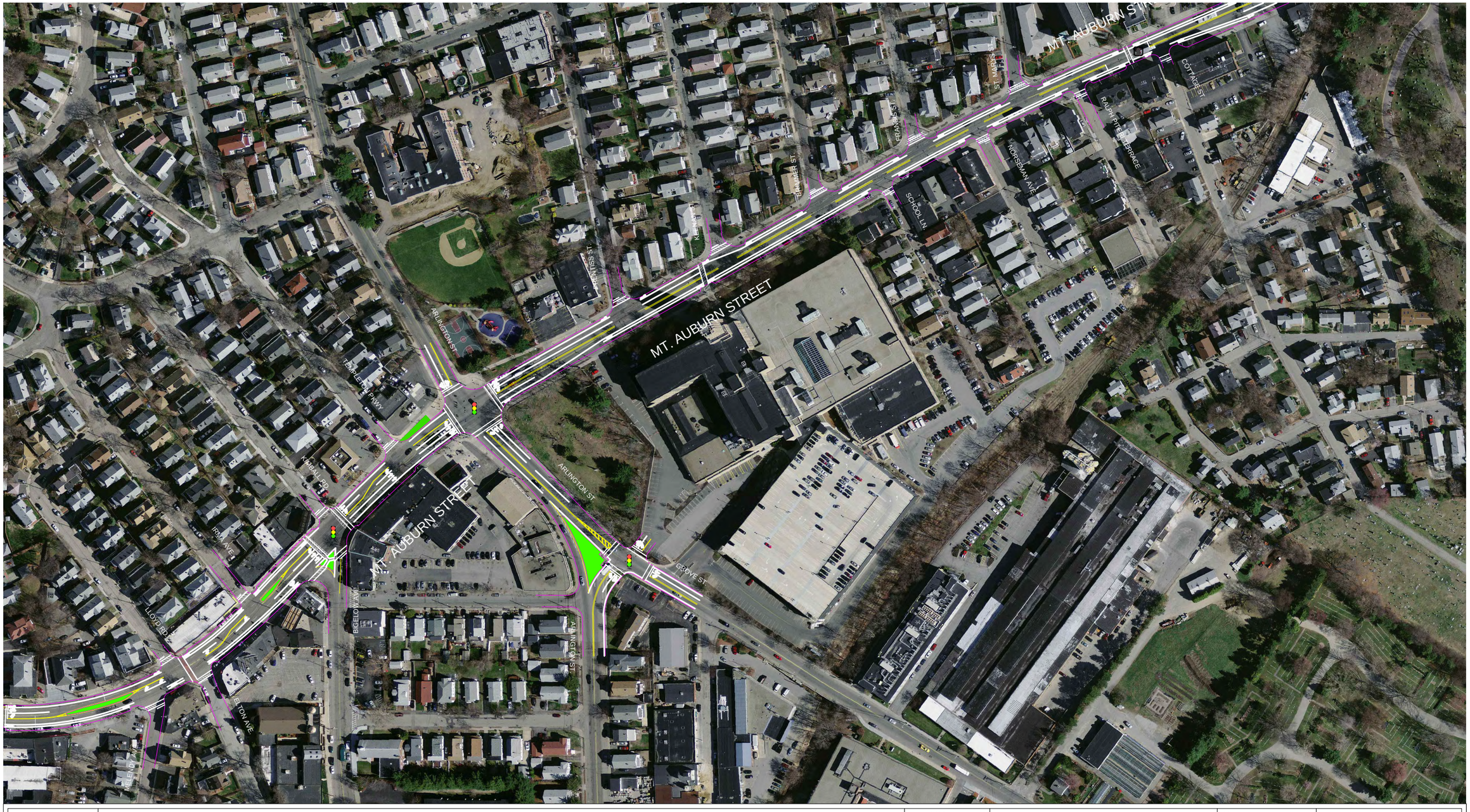
DATE: 01-08-2016

SCALE: 1" = 250'

Figure 4b

Filename: J:\Watertown\13-033.01 Watertown - Rehab of Mt. Auburn Street\Documents\Report\Figures\13-033.01 Alt 1.dwg



PREPARED FOR:	TITLE: MOUNT AUBURN STREET CORRIDOR IMPROVEMENTS ALTERNATIVE 1 - TWO WAY CROSS SECTION (SHEET 3 OF 3)	NORTH	PREPARED BY: WORLDTECH ENGINEERING 300 TRADE CENTER, SUITE 5580 WOBURN, MASSACHUSETTS 01801 PHONE: 781.933.4800 FAX: 781.933.4801	DATE: 01-08-2016 SCALE: 1" = 250'	Figure 4c

Filename: J:\Watertown\13-033.01 Watertown - Rehab of Mt. Auburn Street\Documents\Report\Figures\13-033.01 Alt 1.dwg

southbound right-turn overlap would be added to the eastbound protected left-turn phase, and the signal would be interconnected with the nearby signals at Irving Street/Palfrey Street and Common Street to provide coordinated operation. During the morning peak hour, all movements would operate at LOS D or better under Alternative 1. During the evening peak hour, the southbound left-turn movement from Common Street would operate at LOS E.

Mount Auburn Street at Bates Road East and Walnut Street - This intersection currently operates under signal control. Under this alternative, the eastbound Mount Auburn Street approach would consist of one left-turn lane with 75 feet of storage, one through lane, one right-turn lane with 100 feet of storage, and one bicycle lane. The westbound Mount Auburn Street approach would consist of one left-turn lane with 75 feet of storage, one shared through/right-turn lane, and one bicycle lane. Parking would continue to be provided along the south side of Mount Auburn Street, although approximately eight parking spaces would be eliminated to create the eastbound right-turn lane. The northbound Walnut Street approach and southbound Bates Road East approach would remain in their existing configuration, and no changes would be made to the existing signal phasing. Each movement at this intersection would operate at LOS D or better during both morning and evening peak hours with the implementation of this alternative.

Mount Auburn Street at Boylston Street – This intersection currently operates under stop control. Under Alternative 1, the existing signalized pedestrian crossing across Route 16 between Stearns Road and Oakley Road is proposed to be removed and replaced with a new fully actuated traffic signal at the intersection with Boylston Street. Mount Auburn Street would be restriped through the intersection to provide a single shared through/right-turn lane, a bicycle lane, and a parking lane in the eastbound direction, and an exclusive left-turn lane with 75 feet of storage, a single through lane, and a bicycle lane in the westbound direction. The northbound Boylston Street approach would provide one general purpose lane. Under Alternative 1, the eastbound approach would operate at LOS F (v/c=1.01) but with 45.8 seconds of delay in the morning peak, whereas every other approach would operate at LOS D or better. In the evening peak, all approaches would operate at LOS C or better.

Mount Auburn Street at Winthrop Street – This intersection currently operates under stop control. Under Alternative 1, Mount Auburn Street would be restriped through the intersection to provide a single general purpose lane and a bicycle lane in each direction and a parking lane in the eastbound direction. The northbound Winthrop Street approach would provide one general purpose lane. Under Alternative 1, the northbound Winthrop Street approach would operate at LOS F during both morning and evening peak hours, but with very low volume to capacity ratio (v/c = 0.23).

Mount Auburn Street at Chauncey Street – This intersection currently operates under stop control. Under Alternative 1, Mount Auburn Street would be restriped through the intersection to provide a single shared through/right-turn lane, a bicycle lane, and a parking lane in the

eastbound direction, and an exclusive left-turn lane with 75 feet of storage, a single through lane, and a bicycle lane in the westbound direction. The northbound Chauncey Street approach would provide one general purpose lane. Under Alternative 1, the northbound Chauncey Street approach would operate at LOS F with v/c ratio of 0.74 in the morning peak and 0.27 in the evening peak – meaning that there is excess capacity – and the Mount Auburn Street westbound left turn would operate at LOS B or better during both peak hours.

Mount Auburn Street at School Street – This intersection currently operates under signal control. Under Alternative 1, Mount Auburn Street would be restriped through the intersection to provide an exclusive left-turn lane with 100 feet of storage, a shared through/right-turn lane, and a bicycle lane in each direction. The westbound right-turn channel would remain, and parking would continue to be provided along the south side of Mount Auburn Street. The existing concrete median on School Street would be removed, and the northbound and southbound School Street approaches would each provide an exclusive left-turn lane with 75 feet of storage and a shared through/right-turn lane. A permitted-plus-protected phase would be provided for the eastbound and southbound left-turn movements.

Under Alternative 1, in the morning peak, the eastbound through/right lane and westbound left turn lane will operate at LOS F; the eastbound through/right lane will go over capacity with a queue of 1213 feet (60 vehicles) but the westbound left turn will experience delays but will not reach its capacity (v/c ratio = 0.74, 95th queue = 124 feet or 6 vehicles). All other movements will operate at LOS D or better. In the evening peak, the eastbound left turn will operate at LOS F with heavy delays (over 300 seconds) but with only 192 feet of queue (95th queue, 10 vehicles). All other movements would operate at LOS D or better.

Mount Auburn Street at Dexter Avenue and Upland Road – This intersection currently operates under stop control. Under Alternative 1, a new pedestrian signal is proposed to be installed at this intersection. When the pedestrian phase is not actuated, the signal heads facing Mount Auburn Street would display flashing yellow indications and the signal heads facing Dexter Avenue and Upland Road would display flashing red indications. The eastbound and westbound Mount Auburn Street approaches would each consist of one exclusive left-turn lane with 75 feet of storage, one shared through/right-turn lane, and one bicycle lane, and parking would continue to be permitted along the south side of Mount Auburn Street. The northbound Dexter Avenue and southbound Upland Road approaches would each consist of a single general purpose lane.

Under Alternative 1 and in both morning and evening peaks, all approaches will operate at LOS A, with the eastbound through movement 95th queue reaching about 39 vehicles (780 feet) in the morning. This is likely due to the heavy through movement in the morning peak the pedestrian phase been actuated.

Mount Auburn Street at Melendy Avenue, Lloyd Road, Irma Avenue, and Templeton Parkway – Under this alternative, Mount Auburn Street is proposed as providing a single travel lane in each direction between Upland Road and Arlington Street. The Mount Auburn Street eastbound and westbound approaches at each of the four unsignalized intersections would provide one general purpose travel lane, one bicycle lane, and a parking lane. East of Irma Avenue, Mount Auburn Street eastbound would widen to two general purpose travel lanes to provide adequate capacity at the signalized intersections at Kimball Road/Bigelow Avenue and Arlington Street. Each minor street approach would provide one general purpose lane with the exception of Elton Avenue, which will continue to provide one-way southbound travel.

Under this alternative, the side street movements will operate at LOS F during either peak hour, but with excess capacity (v/c < 1.0). Those side streets are: Melendy Avenue (evening peak only), Lloyd Road, (both peaks), and Irma Avenue (evening peak only). All other times and movements would operate at LOS C or better.

Mount Auburn Street at Kimball Road and Bigelow Avenue - This intersection currently operates under signal control. Under Alternative 1, the Mount Auburn Street eastbound approach would consist of an exclusive left-turn lane with 75 feet of storage, one through lane, one shared through/right-turn lane beginning immediately east of Irma Avenue, a bicycle lane, and a parking lane. The Mount Auburn Street westbound approach would consist of an exclusive left-turn lane with 75 feet of storage, one shared through/right-turn lane, a bicycle lane, and a parking lane. The northbound Bigelow Avenue and southbound Kimball Road approaches would retain their existing configuration of one general purpose travel lane. The existing channelization island for the eastbound right-turn would be reconstructed to increase the curb radius and shorten the length of the crosswalk across the channel, improving pedestrian safety. The traffic control signal would be interconnected with the nearby signal at Arlington Street to provide coordinated operation.

Each movement would operate at LOS E or better during the morning peak hour under Alternative 1. During the evening peak hour, the northbound Bigelow Avenue approach would operate at LOS F. 95th percentile queues would be approximately 25 vehicles, and SimTraffic simulation indicates that all vehicles on the approach would pass through the intersection during one cycle. Overall, the intersection would operate at LOS C during the morning peak hour.

Mount Auburn Street at Arlington Street - This intersection currently operates under signal control. Under Alternative 1, the northbound Arlington Street approach will be widened to provide an exclusive left-turn lane, a though lane, and an exclusive right-turn lane. The eastbound Mount Auburn Street approach would retain its current configuration of one exclusive left-turn lane, one through lane, and one shared through/right-turn lane. The westbound Mount Auburn Street approach would widen from a single lane to an exclusive left-turn lane and a shared through/left-turn lane immediately west of the Keenan Street

intersection. The northbound and westbound left-turn movements would retain their existing permitted/protected phase, and an overlapping northbound right-turn phase would be added. The signal is proposed to be interconnected with the signal at Kimball Road/Bigelow Avenue to provide coordinated operation.

During the morning peak hour, the southbound Arlington Street approach would operate at LOS E with a v/c ratio of 1.01, indicating oversaturated conditions. The 95th percentile volume would exceed capacity and queues are at 600 feet long (30 vehicles). The eastbound through movement would also operate at LOS E but with v/c ratio of 0.95 (approaching capacity) and a 95th percentile queue of 431 feet (22 vehicles). All other movements would operate at LOS D or better.

During the evening peak hour, the Arlington Street northbound through movement would operate at LOS F with v/c ratio of 1.35, indicating oversaturated conditions. The northbound left and southbound approaches would operate at LOS E with v/c ratio below 1.0 and 95th percentile queue of about 300 feet (15 vehicles). All other movements would operate at LOS D or better.

Arlington Street at Grove Street - This intersection is proposed to operate under signal control. The northbound Arlington Street approach would be realigned to intersect with Grove Street at approximately a 90-degree angle and widened to provide a northbound left-turn lane, shared left/through/right-turn lane, and southbound departure lane. The Tufts Medical Center driveway would be relocated to oppose the Arlington Street northbound approach. The existing southbound right-turn channel would remain and would operate under yield control.

During the morning peak hour, three movements would operate at LOS F; the Arlington Street eastbound left turn, the Arlington Street northbound left turn, and the Tufts Medical Center Driveway southbound right turn. All three movements will be just over capacity and the Tufts Medical Driveway southbound right turn would see a delay of 206.8 seconds. All other movements would operate at LOS E or better.

During the evening peak hour, only the Arlington Street northbound left turn and the Tufts Medical Center southbound left turn would operate at LOS F; in the evening peak, the Driveway's delay would be 114.5 seconds. All other movements would operate at LOS D or better.

5.0 CONCLUSION

Out of the three alternatives mentioned above, Alternative 1 was chosen as the preferred alternative because of its flexibility; there are many streets along the Mount Auburn Street (Route 16) corridor that are offset, thus making it harder to service with either a two-way left-turn lane or a raised median, and there are numerous driveways as well that would not be serviced by either Alternative 2 or 3 efficiently.

Alternative 1 provides left turn and right turn pockets where needed, reduces the width of roadway pedestrians would have to cross and be able to do so safely, provides bicycle lanes on either direction, retains as much, if not all, of the parking as is available today, and provides some operational improvement along the Mount Auburn Street Corridor.

With the implementation of a Road Diet along Mount Auburn Street, the corridor will be transformed from a four-lane, commuter-oriented arterial last reconstructed as an Urban Systems project in the early 1980s to a Complete Street providing one travel lane and one on-street bike lane in each direction, parking, improved pedestrian amenities, and green infrastructure. In its proposed configuration, the Mount Auburn Street corridor will better serve the community in which it sits, providing better connectivity for pedestrian and bicycle access between neighborhoods, commercial districts, Hosmer Elementary School and Watertown High School, and recreational uses including the Watertown Community Path and the proposed DCR Watertown-Cambridge Greenway.

6.0 Technical Appendix

To reduce paper use, the Appendix is included on the CD provided inside the back cover. For hard copies of the Appendix, please call WorldTech Engineering at (781) 933-4800.