4

Affected Environment

4.1 Introduction

This chapter discusses the existing conditions and environmental resources that may be affected by the Green Line Extension Project. Environmental resources evaluated include: land use; socioeconomic; environmental justice; traffic; air quality; noise and vibration; stormwater; wetlands; fish, wildlife and plants; parks and recreation; visual environment; historic and cultural; and hazardous materials. Figure 1-1 shows the entire Project area, and Figures 4.1-1 through 4.1-10 show the Project area and the surrounding neighborhoods at a larger scale, including local landmarks and specific resources. The potential impacts of the Project on the resources and conditions assessed in this chapter are discussed in Chapter 5, *Environmental Consequences*.

4.2 Land Use

This section provides an overview of the following: the existing land use conditions in the proposed Green Line corridor from Cambridge to Somerville and Medford; the existing zoning around each proposed station site; and a discussion of recent land use plans and studies in the corridor. Specific infrastructure projects that may affect the corridor are also described, as requested in the Secretary's Certificate for the Project.

4.2.1 Overview

Historically, the Massachusetts Bay Transportation Authority's (MBTA) Lowell Line (also known as the New Hampshire Mainline) was intended to serve Boston and points north and west with freight rail operations. The route proved popular, and by the 1840s, a second set of tracks and local passenger service were added. In the mid to late 20th century, the demand for passenger and freight rail services declined as automobiles and trucks became the preferred mode of transport. Active railroad tracks and railroad yards can be found in the eastern end of the Project corridor,

namely Yard 8 in Somerville, near the proposed Brickbottom Station site. Yard 8 is much smaller now than it once was.

Today, the Project Study Area contains a mix of commercial and industrial uses located adjacent to the railroad corridor. Residential uses are interspersed in various structural types but are largely wood frame, multi-family and single-family homes. The area is densely settled and well established with the greatest suburban growth occurring in the late industrial period (1870-1915). Very few houses in the corridor were built after the 1920s.

While the Project Study Area is virtually fully built out with little vacant land, there are major redevelopment proposals in the eastern portion that could change the development character in some locations. Some of the proposals have elements of transit-oriented development (TOD) that could generate transit ridership.

Based on the 2000 U.S. Census, the combined population of the three municipalities affected by the Study Area was 234,909 in 2000 and the combined land area is 18.7 square miles. This yields a relatively high population density of 12,562 persons per square mile. The population within a ½-mile radius of the proposed station sites was 81,663 in 2000. Similarly the combined at-place employment in the three municipalities was 151,945 and within a ½–mile radius of the station sites was 32,296. Together, this high concentration of population and employment makes for an excellent, transit-supportive corridor.

Major activity centers in the Study Area include:

- The Lechmere area in East Cambridge that includes Middlesex County courts and other governmental facilities as well as commercial uses, a large regional shopping mall, high density (mid-rise and high rise) housing, hotels, and one of the region's most popular tourist attractions, the Boston Museum of Science;
- The Somerville "city campus" which includes City Hall, the high school, and the main public library;
- Tufts University in Medford and Somerville, a major institution with 8,500 students; and
- Union Square in Somerville, a major neighborhood business district with historic roots.

In between these major activity centers are smaller centers such as Ball Square in Somerville and the shopping center and businesses at the northern terminus of the on the Somerville/Medford line, which is approximately 1.2 miles from Medford Square (i.e., Medford's downtown).

This section discusses the existing land uses surrounding the proposed station locations, future development planned for these areas, and proposed transportation projects for the local area.

4.2.2 Existing Land Use at Proposed Station Sites

This section describes the existing land uses within a ½-mile radius of the proposed station sites. This distance is considered the typical distance riders are willing to walk to a station. Figure 4.2-1 shows the land use areas assessed for each proposed station location.

4.2.2.1 Lechmere Station, East Cambridge

The proposed relocated Lechmere Station site is located along an abandoned former Boston & Maine (B&M) railroad spur (currently owned by MBTA), on the east side of the Monsignor O'Brien Highway/Route 28, near the Glassworks condominiums (Figure 4.2-2). The busy existing Lechmere Station (5,800 boardings daily) is located nearby on the west side of Monsignor O'Brien Highway/Route 28.

East of the station is the developing NorthPoint project, which when built out will include mixed-use and multi-family residential buildings and a five-acre central park with connections to the planned Somerville Community Path. As of July 2008, two residential buildings with a total of 329 units and the central park were nearly completed. Adjacent to NorthPoint is the recently completed Charles E. Smith/Archstone rental apartment building (Phase I of a two phase project) with 437 units and a pre-existing office building. West of the station is a Hampton Inn and, behind it at 22 Water Street, a development site with vacant buildings, that are slated for redevelopment as residential towers.

The ½-mile radius zone contains mostly railroad and industrial uses in the northeast half, including the MBTA's main commuter rail maintenance facility (the Boston Engine Terminal) in Somerville. The areas south and west of the station are fully developed, with older, dense residential neighborhoods of mostly two-family, wood-frame period revival homes to the west, a mix of older and newer commercial development to the south and west along Cambridge Street, and an area of parking lots and mostly one-story industrial buildings along the periphery of the zone to the south.

Several mid to high-rise brick structures built after 1980 are located along the Charles River embankment and the Lechmere Canal, including the 900,000-square foot Cambridgeside Galleria Mall, Thomas Graves Landing residential condominiums, Regatta Riverview Apartments, and the Royal Sonesta Hotel. The region's premier science museum, the Boston Museum of Science, is located east of the station on the Charles River Dam.

Despite the dense development activity along the waterfront and at NorthPoint, the overall housing density in this area is moderate, at less than 10 units per acre, but has been growing, as shown in Table 4.2-1. The employment density in this area is the highest in the corridor at close to 30 jobs per acre, but does not reach central business district densities of several hundred per acre.

Table 4.2-1 Population, Housing and Employment within ½-Mile Radius of the Relocated Lechmere Station Site

	Estimates		Projections	
	1990[1]	2000[2]	2010[2]	2030[2]
Population	5,909	7,274	8,624	12,317
Population density (persons/acre)	11.8	14.5	17.2	24.5
Households	2,899	3,719	4,572	7,068
Housing density[3] (units/acre)	5.8	7.4	9.1	14.1
Employment	12,857	14,380	15,937	19,850
Employment density (jobs/acre)	25.6	28.7	31.8	39.5

Source: Based on ½-mile radius overlays on Transportation Analysis Zones (TAZs) 1, 21, 22, 198, 203, 204, 579-583, and 625-637.

1 Derived from population, household and employment by TAZ 1990, Central Transportation Planning Staff, June 2008.

2 Derived from population, household, and employment by TAZ 2000-2030, Metropolitan Area Planning Council, December 2005.

3 Number of households is used as an estimate for the number of housing units in the study area.

4.2.2.2 Brickbottom Station, Somerville

The proposed Brickbottom Station is located in an industrial area south of Washington Street in the "Yard 8" railroad right-of-way off of Joy Street (Figure 4.2-3). The area between McGrath Highway/Route 28 and the proposed Green Line corridor, which is called the Brickbottom District, has a number of small businesses located in a mix of older multi-story brick warehouses and industrial buildings and various older and newer single-story structures. The immediate area includes an auto repair shop, Iron Mountain Storage, school bus parking, the Chambers Mercedes Benz dealer, and the Joy Street artist studios. Farther south on Fitchburg Street are the 150-unit Brickbottom Artists lofts buildings with two five-story masonry structures from the 1920s that were converted from the Atlantic & Pacific Tea Company Building in 1988. Northeast of the station on Washington Street is the 20-year old, suburban-style brick Cobble Hill apartment community for seniors and the Cobble Hill neighborhood convenience center with parking. A mix of older and newer developments along the north side of Washington Street include Cataldo Ambulance, a diner, a tattoo parlor, and other small commercial establishments mixed in with some older, wood frame housing.

Adjacent and east of the railroad corridor near the station are 200 Inner Belt Road (a partially vacant four-story brick office building built in 2001 for telecommunications uses), Yard 8, and a large vacant parcel.

The northern half of the ½-mile radius zone from the station consists of moderately dense (over 10 units per acre), older multi-family residential neighborhoods of mostly wood-frame, two-family colonial revival and Queen Anne homes with some triple-decker homes. Glen Street Park, with a playing field, basketball courts, and a playground is nearby and north of the station. The southeast quadrant of the zone between the McGrath Highway/Route 28 and I-93 is mostly industrial. This area includes the Inner Belt District, a 90-acre site that was cleared in the 1960s for the Inner Belt Highway (never constructed). It was redeveloped in the 1960s and 1970s with mostly single-story industrial, warehouse and distribution facilities, and is slated for potential redevelopment as a mixed-use district. West of the station along Somerville Avenue is Union Square, which includes a mix of commercial, industrial, and multi-family residential uses. Two major shopping centers with large parking lots are located nearby – Twin City Plaza on McGrath Highway/Route 28 southeast of the station, and the Target/Circuit City shopping center, on Somerville Avenue southwest of the station. Schools in the ½-mile radius include the Prospect Hill Academy Charter School (grades K-12) and the East Somerville Community School (grades K-8).

The housing density is moderate at fewer than 10 units per acre but has been growing, as shown in Table 4.2-2. The employment density is fairly low at 12 jobs per acre and has dropped slightly since 1990 but is projected to increase over the long-term.

Table 4.2-2 Population, Housing and Employment within ½-Mile Radius of the Brickbottom Station Site

	Estimates		Projections	
	1990[1]	2000[2]	2010[2]	2030[2]
Population	10,707	11,488	11,883	11,836
Population density (persons/acre)	21.3	22.9	23.7	23.6
Households	4,337	4,542	4,948	5,086
Housing density[3] (units/acre)	8.6	9.1	9.9	10.1
Employment	6,238	6,116	6,019	6,850
Employment density (jobs/acre)	12.4	12.2	12.0	13.7

Source: Based on ½-mile radius overlays on Transportation Analysis Zones (TAZs) 205, 579-585, 587-590, 600, 604-608, 629, and 646.

1 Derived from population, household and employment by TAZ 1990, Central Transportation Planning Staff, June 2008.

2 Derived from population, household, and employment by TAZ 2000-2030, Metropolitan Area Planning Council, December 2005.

3 Number of households is used as an estimate for the number of housing units in the study area.

4.2.2.3 Gilman Square Station, Somerville

The proposed Gilman Square Station site is located north of the Medford Street bridge behind the Somerville High School/City Hall complex, adjacent to an unused City-owned property on Medford Street (Figure 4.2-4). West of the station is a steep

embankment rising up to the Somerville High School, City Hall, and the Somerville Public Library. East of the station on Pearl Street and Medford Street are commercial buildings (a gas station; an older, four-story brick building that houses The Paddock Restaurant; a historic, four-story, semi-circular brick building at 343 Medford Street); a parking lot; a dense, multi-family residential neighborhood of wood frame three-deckers and two-family Colonial Revival homes; the six-story brick Pearl Street Park apartment community; and a small landscaped park.

The ½-mile radius zone around the station is comprised of mostly dense (over 15 housing units per acre), older multi-family residential neighborhoods of wood frame, two family colonial revival and Queen Anne homes and triple-deckers. Highland Avenue has some three-story to six-story brick apartment buildings, a number of three-story mansard-roof townhouses, and several architecturally distinctive Queen Anne, shingle, and Colonial Revival homes. A 10-story apartment building with 130 units of elderly housing is located adjacent to the City Hall complex on Highland Avenue and Walnut Street. Concentrations of one-story and two-story brick commercial buildings are located along Highland Avenue to the south and Broadway to the north, and auto-oriented strip development exists along the McGrath Highway/Route 28 north of Broadway.

Schools within the ½-mile radius include the adjacent Somerville High School, the Winter Hill Community School (grades K-8) and, near the periphery, the Full Circle High School and the Capuano Early Education Center. The former Cummings School south of the station was closed but is temporarily being used by the East Somerville Community School during repair work after a fire. The Central Street Health Center is located on the eastern periphery of the zone.

Table 4.2-3 Population, Housing and Employment within ½-Mile Radius of the Gilman Square Station Site

	Estimates		Projections	
	1990[1]	2000[2]	2010[2]	2030[2]
Population	18,787	19,373	19,245	18,769
Population density (persons/acre)	37.4	38.6	38.3	37.4
Households	7,528	7,806	7,806	7,806
Housing density[3] (units/acre)	15.0	15.6	15.6	15.6
Employment	4,008	3,216	3,247	3,826
Employment density (jobs/acre)	8.0	6.4	6.5	7.6

Source: Based on ½-mile radius overlays on Transportation Analysis Zones (TAZs) 587, 588, 590, 591, 598-602, 604-608, 610, and 611.

1 Derived from population, household and employment by TAZ 1990, Central Transportation Planning Staff, June 2008.

2 Derived from population, household, and employment by TAZ 2000-2030, Metropolitan Area Planning Council, December 2005.

3 Number of households is used as an estimate for the number of housing units in the study area.

The housing density is the highest in the corridor at over 15 units per acre, reflecting the number of low and mid-rise apartment buildings in walking distance to the station, as shown in Table 4.2-3. The employment density decreased since 1990 and is less than seven jobs per acre.

4.2.2.4 Lowell Street Station, Somerville

The proposed Lowell Street Station site is located in a residential neighborhood at the Lowell Street Bridge (Figure 4.2-5). The station site is adjacent to two vacant industrial buildings that will be removed and replaced with the proposed MaxPak Square residential development (199 units with below ground parking and open space) on the west. South of the station on Lowell Street is the large, three-story wood-frame Visiting Nurses Assisted Living Community (97 apartments) with associated parking and an auto body shop. Farther south on Central Street is the four-story brick industrial complex that houses Roger's Foam headquarters and the Vernon Street artist studios, a Verizon switching station, an apartment building, and a small park. North of the station, the Somerville Public Works Department has a maintenance facility comprised of one- and two-story brick and masonry buildings along the perimeter of a large triangular parcel located on Franey and Charles E. Ryan roads.

The area in the ½-mile radius zone around the station is mostly dense (14 housing units per acre), multi-family residential neighborhoods of older, two-family, Colonial Revival wood frame homes and three-deckers, some with small yards. North of the station is Magoun Square, which has a mix of retail, restaurant, and other business uses in one- and two-story brick buildings along Medford Street. Other commercial concentrations are located along Broadway to the west and Highland Avenue to the south. Ball Square is to the north, just beyond the ½-mile zone. North of the station beyond the public works facility are the Trum Playground and the baseball diamonds of Trum Fields. The Benjamin G. Brown School (grades K-6), Saint Catherine of Genoa (grades Pre-K–8), and the Winter Hill Community School (grades K-8) are near the periphery of the zone. Somerville Hospital is south of the station on Tower Street, off Highland Avenue.

The housing density is second highest in the corridor at approximately 15 units per acre, as shown in Table 4.2-4, because of the large multi-family structures and apartment buildings near the station site. The employment density has decreased since 1990 and is less than five jobs per acre, reflecting the residential character of this neighborhood.

Table 4.2-4 Population, Housing and Employment within ½-Mile Radius of the Lowell Street Station Site

	Estimates		Projections	
	1990[1]	2000[2]	2010[2]	2030[2]
Population	18,097	17,685	17,854	18,213
Population density (persons/acre)	36.1	35.2	35.6	36.3
Households	7,183	7,466	7,636	8,031
Housing density[3] (units/acre)	14.3	14.9	15.2	16.0
Employment	3,671	2,552	2,575	3,000
Employment density (jobs/acre)	7.3	5.1	5.1	6.0

Source: Based on ½-mile radius overlays on Transportation Analysis Zones (TAZs) 550, 553, 555, 598, 601-603, 607, 610-616, and 621.

1 Derived from population, household and employment by TAZ 1990, Central Transportation Planning Staff, June 2008.

2 Derived from population, household, and employment by TAZ 2000-2030, Metropolitan Area Planning Council, December 2005.

3 Number of households is used as an estimate for the number of housing units in the study area.

4.2.2.5 Ball Square Station, Somerville/Medford

The proposed Ball Square Station site is located on Boston Avenue at the Broadway Bridge, near the heart of Ball Square (Figure 4.2-6). The area is a developing neighborhood commercial center, with mostly older, one- and two-story brick and wood frame commercial buildings with decorative storefronts and awnings. The commercial strip along Broadway includes several popular restaurants (Kelly's Diner; Sound Bites; Ball Square Café), cafes (True Grounds), a bakery (Lyndell's), and a variety of older and newer retail establishments and services. The area around the station site on Boston Avenue is more industrial, with parking lots and newer one-story brick and wood-frame building including a bowling alley, auto repair shops, and the back side of a row of commercial buildings that front Broadway. Farther north Boston Avenue is residential, with a large, newer wood-frame, multi-family housing complex on the east side of the street and older wood-frame, two-family Colonial Revival homes on the west side. Beyond are the Saint Clement Parish schools (elementary, junior and senior high schools), a gas station, more homes, and several industrial buildings.

The ½-mile radius zone is primarily multi-family residential neighborhoods of older wood-frame, two-family Colonial Revival and Queen Anne homes with some three-deckers, but also includes a number of playing fields (Trum Fields to the south, Tufts Park to the east, Tufts Alumni Fields to the north, Powder House Square fields to the northwest) and the Tufts stadium. Several schools are located nearby (Somerville's Benjamin G. Brown School (grades K-6) to the southwest, and Medford's Curtis-Tufts Alternative School (grades 9-12) and Christopher Columbus School (grades K-12) to the east). Concentrations of commercial development are located at Magoun Square to the south, along Boston Avenue to the northwest, and on Medford Street to the northeast. Tufts University is located at the periphery of the

zone to the north, and Davis Square at College Avenue and Highland Avenue is just beyond the zone to the southwest.

The housing density is moderate at approximately 11 units per acre, and the employment density has decreased since 1990 to five jobs per acre, as shown in Table 4.2-5.

Table 4.2-5 Population, Housing and Employment within ½-Mile Radius of the Ball Square Station Site

	Estimates		Projections	
	1990[1]	2000[2]	2010[2]	2030[2]
Population	14,730	14,566	14,742	15,182
Population density (persons/acre)	29.3	29.0	29.4	30.2
Households	5,313	5,470	5,672	6,094
Housing density[3] (units/acre)	10.6	10.9	11.3	12.1
Employment	3,590	2,467	2,519	2,791
Employment density (jobs/acre)	7.2	4.9	5.0	5.6

Source: Based on ½-mile radius overlays on Transportation Analysis Zones (TAZs) 550-553, 555, 602, 603, 612, 613, 615, 616, and 619-621.

1 Derived from population, household and employment by TAZ 1990, Central Transportation Planning Staff, June 2008.

2 Derived from population, household, and employment by TAZ 2000-2030, Metropolitan Area Planning Council, December 2005.

3 Number of households is used as an estimate for the number of housing units in the study area.

4.2.2.6 College Avenue Station, Medford

The proposed College Avenue Station site is located in Medford Hillside on Boston Avenue immediately north of College Avenue (Figure 4.2-7). West of the station are several Tufts University properties including the five-story brick public parking garage/student services center, the edge of a campus green, and another five-story brick campus building and a parking lot located on a hill. Tufts' Alumni Fields and gymnasium are located east of the station. Moderately dense (eight housing units per acre) residential uses are located north and east of the station. Neighborhood commercial uses, many oriented to college students, are located along Boston Avenue on the south side of College Avenue and also north of the station site near Winthrop Street, including restaurants, a convenience store, a coffee shop, and several auto-services.

The ½-mile radius zone includes large tracts of Colonial Revival two-family and three-decker homes north, south and east of the station. West of the station is the Tufts University campus on College Hill, with its quadrangle of Early Victorian buildings and a diversity of older and more modern buildings arranged along a series of campus greens. The Tufts University stadium and several playing fields are located north, south, and east of the station. Older one- and two-story commercial buildings are located south of the station on Boston Avenue and east of the station on

Medford Street. The ½-mile radius includes the West Somerville Neighborhood School (grades K-8) and the Saint Clement Parish elementary school.

The housing density is moderate below eight units per acre, and the employment density dropped since 1990 to six jobs per acre, as shown in Table 4.2-6.

Table 4.2-6 Population, Housing and Employment within ½-Mile Radius of the College Avenue Station Site

	Estimates		Projections	
	1990[1]	2000[2]	2010[2]	2030[2]
Population	12,807	12,653	12,639	12,556
Population density (persons/acre)	25.5	25.2	25.2	25.0
Households	3,797	3,819	3,944	4,112
Housing density[3] (units/acre)	7.6	7.6	7.9	8.2
Employment	4,060	2,994	3,076	3,294
Employment density (jobs/acre)	8.1	6.0	6.1	6.6

Source: Based on ½-mile radius overlays on Transportation Analysis Zones (TAZs) 552-558, 615, 619-621, and 623.
1 Derived from population, household and employment by TAZ 1990, Central Transportation Planning Staff, June 2008.
2 Derived from population, household, and employment by TAZ 2000-2030, Metropolitan Area Planning Council, December 2005.
3 Number of households is used as an estimate for the number of housing units in the study area.

4.2.2.7 Mystic Valley Parkway/Route 16 Station, Somerville/Medford

The proposed Mystic Valley Parkway/Route 16 station is located near the intersection of Boston Avenue and Mystic Valley Parkway/Route 16 in a commercial/industrial site at the existing U-Haul storage building (Figure 4.2-8). While the station site is in Somerville, it abuts Medford on the north, south, and east sides.

The area around the station includes the following uses: a Sav-Mor liquor store, and a new Whole Foods supermarket (opened May 2008), and a large parking lot; at 200 Boston Avenue, the Cummings Park building, which is a three-story, masonry office and R&D building with a fitness center, a biotech firm, office uses, Tufts University laboratory space, and a parking lot. East of the station site is the two-story brick Walking Court senior housing complex with 144 apartment units located on a cul-de-sac off North Street. On the west side of Boston Avenue are dense residential neighborhoods of mostly older, two-family wood frame Colonial Revival and Queen Anne homes, and the two-story brick Capen Court senior housing complex located on a cul-de-sac off Stoughton Street.

The Mystic Valley Parkway and surrounding landscape are part of the Metropolitan Parks System, which is listed on the National Register of Historic Places and is owned and managed by the Massachusetts Department of Conservation and

Recreation (DCR). The Mystic River is located north of the parkway and the station site.

Most of the land in the ½-mile radius zone is multi-family residential, with some high-density single-family residential on the north side of the Mystic Valley Parkway and to the west in Arlington. The zone includes two schools - Saint Raphael Elementary School and the Brooks Elementary School - on the north side of the parkway, and West Medford Square, a major neighborhood commercial center with an MBTA commuter rail stop at West Medford Station on High Street/Route 60. Southwest of the proposed station is the recently renovated Dilboy Field Stadium on Alewife Brook Parkway.

The housing density is moderate at less than eight units per acre, and the employment density has decreased since 1990 to six jobs per acre, as shown in Table 4.2-7.

Table 4.2-7 Population, Housing and Employment within ½-Mile Radius of the Mystic Valley Parkway/Route 16 Station Site

	Estimates		Projections	
	1990[1]	2000[2]	2010[2]	2030[2]
Population	12,807	12,653	12,639	12,556
Population density (persons/acre)	25.5	25.2	25.2	25.0
Households	3,797	3,819	3,944	4,112
Housing density[3] (units/acre)	7.6	7.6	7.9	8.2
Employment	4,060	2,994	3,076	3,294
Employment density (jobs/acre)	8.1	6.0	6.1	6.6

Source: Based on ½-mile radius overlays on Transportation Analysis Zones (TAZs) 555-558, 573, 575-578, 623, 624, and 892.
1 Derived from population, household and employment by TAZ 1990, Central Transportation Planning Staff, June 2008.
2 Derived from population, household, and employment by TAZ 2000-2030, Metropolitan Area Planning Council, December 2005.
3 Number of households is used as an estimate for the number of housing units in the study area.

4.2.2.8 Union Square Station, Somerville

The proposed Union Square Station would be located either in the MBTA Fitchburg Line corridor with access from Prospect Street (Alternatives 1, 2, and 6) or directly on Prospect Street (Alternatives 3 and 4) (Figure 4.2-9). Due to the close proximity of these sites, the sites and their surrounding land uses were assessed together rather than separately. Both proposed station sites are within easy walking distance to areas with fairly high residential densities. The sites differ in that the proposed station site in the MBTA Fitchburg Line corridor is below street level and the area immediately surrounding the site is currently used for commercial/industrial purposes, whereas the proposed station site on Prospect Street is at street level and is closer to the commercial/retail center of the square. Both sites are at the intersection of several land uses, with the shops and restaurants of Union Square to the north, the

commercial/industrial Boynton Yards complex to the south, and a multi-family residential neighborhood to the east. The area of the proposed station in the MBTA Fitchburg Line corridor includes a masonry supplier and a scrap metal operation. The area of the proposed station on Prospect Street includes a used radiator store and two different two-family residences.

To the north of the station site is Union Square, with a municipal parking lot and several one- and two-story brick and wood frame structures containing restaurants, coffee shops, markets, convenience stores, and an outdoor flower market. Bow Street has a number of late 19th century three- and four story commercial blocks in revival styles. Somerville Community Access Television is located in a two story, historic brick firehouse with a bell tower in the center of Union Square, and the Somerville Public Safety building is located in a one story brick building to the northeast on Washington Street. The Prospect Hill Academy Charter School (grades K-12) and the newly reconstructed Dr. Albert F. Argenziano School (grades K-8) are located west of Union Square.

Table 4.2-8 Population, Housing and Employment within ½-Mile Radius of the Union Square Station Site

	Estimates		Projections	
	1990[1]	2000[2]	2010[2]	2030[2]
Population	15,669	15,887	15,885	15,754
Population density (persons/acre)	31.2	31.7	31.6	31.4
Households	6,353	6,663	6,746	6,833
Housing density[3] (units/acre)	12.7	13.3	13.4	13.6
Employment	6,523	6,747	6,653	7,426
Employment density (jobs/acre)	13.0	13.4	13.3	14.8

Source: Based on ½-mile radius overlays on Transportation Analysis Zones (TAZs) 579-585, 587, 588, 604-608, 629, 646-649, 651, 661, and 662.

1 Derived from population, household and employment by TAZ 1990, Central Transportation Planning Staff, June 2008.

2 Derived from population, household, and employment by TAZ 2000-2030, Metropolitan Area Planning Council, December 2005.

3 Number of households is used as an estimate for the number of housing units in the study area.

The ½-mile radius zone includes Inman Square in Cambridge with several restaurants, shops, banks, a signature bakery, and a well-known jazz club; a commercial district with one- and two-story shops and restaurants along Cambridge Street; a shopping center with three anchor stores and a large parking lot west of the station on Somerville Avenue; and industrial areas east of the McGrath Highway/Route 28 and on the western periphery of the zone. The remainder of the zone consists of multi-family residential neighborhoods of primarily Colonial Revival and Queen Anne two-family houses and triple-decker homes, with several architecturally distinctive single-family houses to the north on Prospect Hill. Prospect Hill is also the site of a park overlooking the square with the remnants of a military fortification from the American Revolution and a castellated monument constructed in 1903.

The housing density is relatively high at approximately 13 units per acre, and the employment density is second highest in the corridor with 13 jobs per acre but is still fairly low, as shown in Table 4.2-8.

4.2.3 Zoning

This section provides a description of existing zoning near each proposed station site. Figure 4.2-10 shows a generalized zoning plan for the communities of Cambridge, Somerville and Medford. The plan is derived from the Commonwealth of Massachusetts Massachusetts Geographical Information System (MassGIS) Primary Use mapping, which shows the highest density type of development permitted as of right.

At the east end of the corridor, the zoning is predominantly industrial. The zoning changes to business/commercial west of Brickbottom Station, then to residential west of Gilman Square Station to the proposed terminus at Mystic Valley Parkway/Route 16. The spur to Union Square is zoned for industrial uses in the Lechmere Station area and for residential and business uses at the terminus in Union Square.

Cambridge's zoning district map was prepared January 17, 2008 and its ordinance was amended June 18, 2007. Somerville's zoning district map is dated January 18, 2008 and the city's ordinance was amended June 6, 2007. Medford's zoning ordinance was adopted on November 20, 2001. A zoning district map dated 2001 from the Medford Open Space Plan was used as a source for this section.

A more detailed description of the zoning in the vicinity of each proposed station site is provided below.

4.2.3.1 Lechmere Station, Cambridge/Somerville/Boston

Zoning in the Cambridge portion of the Lechmere area has changed from industrial to Planned Unit Developments (PUD). The purpose of a PUD is to provide for a mix of uses at designated locations at greater variety, density and intensity than would normally be allowed. PUDs also are intended to maximize pedestrian transit-oriented development.

The proposed relocated Lechmere Station site is in the NorthPoint Residence District PUD (NP PUD-6). Zoning in the NorthPoint District is primarily residential, with retail, office uses and community services encourages. The 5.1 acres of NorthPoint land within the City of Somerville are zoned Industrial B (IB). The land in Boston that is adjacent to Somerville's NorthPoint land is zoned as a Local Industrial Subdistrict (LI).

The existing Lechmere Station site is in a multi-family residential district (C-2B) and a Cambridge PUD overlay district (PUD 4A). PUD-4 districts are intended to provide the opportunity for development of highly active, medium density commercial and residential areas with a mix of retail, office and residential uses.

Zoning south of the proposed station site is for a variety of land uses that include residential, business, open space and industrial. Areas closest to the station are zoned for business and multi-family dwellings (BA and BA PUD-4). Extending farther away is a mix of zones: multi-family dwellings (C 1), general business (BB), open space (OS), East Cambridge Riverfront (PUD-2), and industrial (IA and IA-1).

4.2.3.2 Brickbottom Station, Somerville

The proposed station site is located between an area zoned for general commercial and high density residential (BB – Commercial Residential District) and industrial (IA – Industrial District). Generally, land zoned for industrial use is southeast of the station. The remainder of land near the station site is zoned for various residential types that include one- and two- family homes (RA), medium density neighborhoods of one-, two- and three-family homes (RB), and multi-family residential (RC).

4.2.3.3 Gilman Square Station, Somerville

The Gilman Square Station site is situated in an area predominantly zoned for residential uses. Immediately north of the station is a large parcel of land zoned as a commercial district (BA). A large parcel of land zoned for multi-family residential use (RC) lies directly south of the station. Land zoned for one- and two- family homes (RA) and medium density neighborhoods of one-, two- and three-family homes (RB) is in the surrounding area of the station with some small parcels zoned as neighborhood business districts (NB).

4.2.3.4 Lowell Street Station, Somerville

The Lowell Street Station site is situated in an area primarily zoned for residential uses. The station site is zoned for medium density one-, two- and three-family homes (RB), and land near the station is zoned for one- and two- family homes (RA), and medium density one-, two- and three-family homes (RB), and some multi-family residential (RC). Immediately southwest of the station, a triangular parcel is zoned for a Planned Unit Development Overlay District (PUD-B1).

Northwest and southeast of the station are parcels zoned for industrial use (IA - Industrial District and IP - Industrial Park District). Parcels zoned for general commercial and high density residential (BB - Commercial Residential District) and neighborhood business districts (NB) are located in outlying areas of the station.

4.2.3.5 Ball Square Station, Somerville/Medford

Ball Square Station is in an area predominantly zoned for residential uses. On the Somerville side, the proposed station is in a location zoned as a neighborhood business district (NB), with a small parcel of land zoned for a commercial district (BA) to the east. Parcels zoned for one- and two- family homes (RA) and medium density one-, two- and three- family homes (RB) are prevalent near the station site. On the Medford side, land in the station area is zoned for general residence (GR).

4.2.3.6 College Avenue Station, Medford

The College Avenue Station site is in an area zoned for residential use (APT-2) with land zoned for general residence (GR) to the east and single family homes (SF 2) to the north. A large parcel zoned as a University District (UN) lies south of the station in Somerville. Land is zoned for one- and two- family homes (RA) southeast of the station.

4.2.3.7 Mystic Valley Parkway/Route 16 Station, Somerville/Medford

The Mystic Valley Parkway/Route 16 Station site is on a parcel zoned for commercial (C-1) use. The immediate area has a large industrially zoned parcel in both Medford (I) and Somerville (IA). In Somerville, there is a parcel zoned for a commercial district (BA).

Surrounding land uses are mostly residential. In Somerville, the land is zoned for one-, two- and three- family homes (RB). In Medford, the land is zoned residential (APT-2). On the north side of the Mystic River, land is zoned for general residence (GR) and single family (SF-1). The Mystic River is zoned as an open space district (OS) in Somerville and a recreational open space district (ROS) in Medford.

4.2.3.8 Union Square Station, Somerville

The Union Square Station site area contains a wide range of zoning districts. The station itself would be in a parcel zoned for a commercial district (BA). To the north, land is zoned for one- and two- family homes (RA) and a commercial residential district (BB). An industrial district (IA) lies to the east and a large parcel zoned for a central business district (CBD) is to the west.

There are many zoning districts to the south that include one-, two- and three- family homes (RB), an industrial park district (IP), and a commercial district (BA) with a Planned Unit Overlay District (PUD B-1).

4.2.4 Land Use Plans

This section describes recent land use plans, studies, and design guidelines that affect development in the Project corridor in Cambridge, Somerville and Medford. Key points raised by planners from these cities are also summarized. The discussion is presented by each proposed station site.

4.2.4.1 Lechmere Station Area Plans

The *East Cambridge Neighborhood Study* (Fall 2006) prepared by Cambridge's Community Development Department reported that subsequent to the Eastern Cambridge Planning Study, Eastern Cambridge Rezoning was adopted in 2001. The rezoning allows for mixed-use development in commercial and former industrial districts, which includes NorthPoint. Specifically, a 'two-tiered' system of base zoning and overlay zoning regulations was established. Base zoning was lowered and PUD was adopted to allow for increased development opportunities.

The *Eastern Cambridge Design Guidelines: NorthPoint* (December 2003) prepared by Spaulding and Slye Colliers International are intended for use by architects designing buildings in NorthPoint. The guidelines envision a new mixed-use district with a variety of parks and public spaces. Creating a retail edge at the relocated Lechmere Station is a design goal. Additionally, the station area is envisioned to serve as an entrance gateway to NorthPoint.

The *NorthPoint Somerville Planning Study* (February 2003) prepared by ICON Architecture reviewed potential opportunities and impacts of Cambridge rezoning and the NorthPoint development on adjacent areas in Somerville. The study also includes a vision for the region beyond NorthPoint, including the Inner Belt District, the Green Line Extension and the Somerville Community Path. The study concludes that the proposed development in NorthPoint could provide a unique opportunity for the City to redevelop the Inner Belt into a productive district of mixed-use development to increase employment opportunities. In order to achieve this goal, the study provides three recommendations: changes in zoning such as increasing building height and density limits; improving vehicular access from all directions, and implementing the Green Line Extension Project.

The *Eastern Cambridge Planning Study* (October 2001) prepared for the Cambridge Community Development Department analyzed existing conditions, opportunities and constraints for Eastern Cambridge. NorthPoint is envisioned as a mixed-use neighborhood with housing as a dominant land use, and land in close proximity to Lechmere Station is viewed as prime area for development. TOD is encouraged.

4.2.4.2 Brickbottom Station Area Plans

The City of Somerville will be conducting a master planning process for the Inner Belt Area, from O'Brien Highway to I-93, starting in Fall 2008/Winter 2009. The City views this area as an opportunity for redevelopment, with potential for high-rise and mixed-use development.

Dimella and Schafer Consultants is conducting a master planning process for Cobble Hill, a ten-acre site on Washington Street. Cobble Hill is approximately ¼ mile east of the proposed station on the east side of the MBTA Lowell Line. Mixed-use development is envisioned for this site, which currently contains 400 senior housing units. The study is anticipated to be completed in Summer 2008.

The City of Somerville has had preliminary discussions with The Kraft Group, owners of the New England Patriots and the New England Revolution, about the possibility of constructing a 20,000-seat Major League Soccer Stadium in the Inner Belt Area. Proximity to a stop on the proposed Green Line Extension is a key factor in the discussion. The Kraft Group is contributing $150,000 toward a study of the development potential in the Brickbottom district and the Inner Belt Area.

4.2.4.3 Gilman Square Station Area Plans

Several studies have been conducted for the redevelopment of The Homans Building (350 Medford Street), a 53,600 square foot building on a 1.11-acre site owned by the City of Somerville. The building is on the east side of the MBTA Lowell Line, at the site of the proposed station. The City envisioned redevelopment for use as artist live/work/study space.

Planners in the City of Somerville noted that there is potential for existing auto mechanic/commercial uses along Walnut Street to be converted to residential use. Walnut Street crosses the MBTA Lowell Line approximately ¼-mile east of the proposed station.

4.2.4.4 Lowell Street Station Area Plans

The proposed MBTA Lowell Street Station site platform is located adjacent to the "MaxPak" site, a proposed 199-unit residential development on 5.49 acres on the west side of the MBTA Lowell Line. Two vacant industrial buildings, 56 and 61 Clyde Street, currently occupy the site. The "MaxPak" site is located between the MBTA Lowell Line and an inactive rail spur (the former freight cut-off through Davis Square). The City of Somerville has no firm demolition nor construction start dates for the project. Prior to demolition, the developer plans to remove the railroad tracks and ties between Cedar Street and Lowell Street to build a temporary construction road.

4.2.4.5 Ball Square Station Area Plans

Neither the City of Medford nor the City of Somerville has active development projects, ongoing or planned studies or rezoning plans at this location.

4.2.4.6 College Avenue Station Area Plans

The City of Medford does not have active development projects, ongoing or planned studies or rezoning plans at this location.

Tufts University is considering the addition of a new Integrated Lab Complex on Boston Avenue south of the proposed College Avenue Station and several other new structures along Boston Avenue for an estimated 913,000 square feet of new development or additions to existing facilities. The construction of these buildings would require razing two existing industrial buildings located at 550 and 574 Boston Avenue. These concepts were shown in a PowerPoint presentation entitled *Tufts University Master Plan: A Vision for the Future* by Tufts University and William Rawn Associates as part of the University's May 2006 Master Plan.

4.2.4.7 Mystic Valley Parkway/Route 16 Station Area Plans

The Cecil Group, Inc., planning consultants, prepared the *Medford Community Development Plan* (2004) for the City of Medford, Office of Community Development as part of the Commonwealth of Massachusetts' Executive Order 418. Although the Development Plan focuses primarily on Medford Square, the document identifies Medford Hillside (broadly defined as Boston Avenue from the Mystic Valley Parkway to Warner Street) as an economic development area. If the station site is approved, the City of Medford has expressed an interest in exploring the implementation of TOD adjacent to the station.

To date, Somerville does not have active development projects, planned studies or rezoning plans for this area.

Two ongoing regional studies include the area of the Mystic Valley Parkway/Route 16 Station. The *Mystic River Corridor Strategy Report* is part of a collaborative effort between the Metropolitan Area Planning Council, the Boston Redevelopment Authority and the Cities of Chelsea, Everett, Malden, Medford and Somerville. The Corridor Strategy is intended to create a collective vision for the river corridor and develop a targeted strategy to achieve that vision. When complete, the report's recommendations could either promote or restrict economic growth in the vicinity of this station.

The Massachusetts DCR is currently developing a *Mystic River Reservation Master Plan* focusing on open space, pathways, and riverfront access.

4.2.4.8 Union Square Station Area Plans

As of August 2008, the City of Somerville was in the midst of a Union Square re-zoning effort for approval by the Board of Aldermen and the Somerville Planning Board. The zoning amendment proposes increased height and density appropriate for TOD near the proposed Green Line station. The rezoning effort is intended to establish a more transit and pedestrian-oriented neighborhood. Key elements include: advancing economic development around under-used parcels with a mix of commercial and housing uses; fostering active, pedestrian-oriented first floor uses, with arts and culture; and preserving the district's historic architecture.

The proposal includes three new zoning districts for Union Square: TODs in the vicinity of the proposed Green Line Extension station; a Commercial Corridor District (CCD) along the heavily traveled streets in Union Square (Somerville Avenue, Washington Street, and parts of Bow, Prospect, and Webster Streets); and an Arts Overlay District (AOD) that covers the Commercial Corridor District and beyond.

The proposed zoning amendment would increase development densities in the TODs and CCD. In the TODs, the maximum building heights would increase from 50 feet to a range of 55-135 feet and the Floor Area Ratio (FAR)[1] would increase from two to a range of three to six. In the CCD, the maximum building height would increase from 50 feet to 55 feet and the FAR from two to three. The current maximum building height in the Union Square Central Business District is 50 feet.

The City of Somerville has designated two buildings as Priority Development Sites (PDS): The old Public Safety Building (228 Washington Street); and the Kiley Barrel site (266 Somerville Avenue). The City envisions redeveloping these buildings as primarily commercial with some residential use. Anticipated development in this area is projected to be over 300,000 square feet, at 100 feet in height with an FAR of four.

The City is preparing an in-house master plan and transportation plan for Boynton Yards. Abutting the south side of the MBTA Fitchburg Line, Boynton Yards is located south of the proposed station site on approximately 10 acres. The City envisions development in Boynton Yards to be high-end residential, commercial and laboratory with retail uses on the ground floor.

Somerville's Five-Year Consolidated Plan for 2008-2013 (February 2008) prepared by the Department of Community Planning and Development includes a Neighborhood Revitalization Strategy Area (NRSA) for Union Square. NRSAs are specially designated areas within a community that, based upon approval by the U.S. Department of Housing and Urban Development (HUD), allow for increased

1 Floor Area Ratio is a unitless number equal to the total building square footage divided by the site square footage.

flexibility to program HUD Community Development Block Grant (CDBG) Funds. The Union Square NRSA was initially adopted in 2002.

In 2007, the City began working on a *Development Implementation Strategy for Union Square*. This consultant-prepared study recommends specific action steps to advance development in Union Square. The study analyzed several public-private partnerships that could be used as models for the City's efforts in Union Square and recommended that a consultant selection process be initiated regarding reuse of City-owned parcels in the area. This report further ties into the District Improvement Financing (DIF) analysis by making recommendations of needed infrastructure improvements to facilitate development.

The *Somerville Community Development Plan* (June 2004) prepared for the Office of Housing and Community Development addressed extending the Green Line to Medford Hillside with the inclusion of a Union Square Alternative. The plan envisions multi-modal transit stations at Union Square, Gilman Square, and Ball Square. Development of access plans and new zoning are identified to encourage TOD.

BPG/Bluestone Planning Group prepared the *Union Square Master Plan* (April 2003) for the City of Somerville, Office of Housing and Community Development. The Master Plan designates three key redevelopment sites – the Citizens Bank Block (block on Bow Street between Stone and Warren); the South Side of Somerville Avenue (between Prospect Street and Webster Avenue); and the Prospect Street Corridor (TOD).

In anticipation of the Green Line Extension, the Master Plan recommends that new major development sites be within an easy walking distance (1,200 to 1,500 feet) from the intersection of Prospect Street and Webster Avenue. New office development and affordable housing are encouraged in Union Square. Where appropriate, infill is recommended along the approach corridors (Somerville Avenue and Washington Street) to the east and west of the district core.

Reuse of city properties for new office, retail and housing is addressed in the Master Plan. Potential locations include the old Bow Street Police Station, Old Union Square Fire Station/Somerville Community Access Television (SCAT) Building and the Recreation Commission Building. Opportunities to "green" the Square by converting small privately owned parcels to vest pocket parks are also addressed.

Edwards and Kelcey prepared the *Union Square Transportation Plan* (September 2002) for the City of Somerville, Office of Housing and Development. One of the plan's objectives is to create a more livable urban village by balancing traffic improvements with urban design initiatives, parking improvements and mass transit opportunities. The plan also supports and gives recommendations for implementing TOD.

The *Union Square Revitalization Study/Neighborhood Revitalization Strategy Area Plan* (2002) prepared by the City of Somerville serves as part of the City's Five Year Consolidated Plan and Phase One of a Master Plan for Union Square. The plan promotes creation of office space, research and development facilities; development of additional small scale retail uses; maintaining the Square's focus as a restaurant destination; encouraging uses related to arts and entertainment; and developing a reuse plan for the former Bow Street Police Station.

4.2.5 Proposed Transportation Projects

This section describes proposed transportation projects identified in the Secretary's Certificate on the Expanded Environmental Notification Form (EENF) as having potential effects on the Green Line Extension.

4.2.5.1 Somerville Community Path

The Somerville Community Path would connect the Minuteman Bikeway and Cambridge Linear Park that ends in Davis Square to the Charles River and Boston via a multi-use path. A conceptual design for a 2.5-mile segment of the path extending from the Lowell Street Station site in Somerville to the NorthPoint area in Cambridge is being developed as part of this Green Line Extension Project. This segment of the path would be mostly in or adjacent to the railroad right-of-way, on the western side of the MBTA Lowell Line.

A Somerville Community Path Feasibility Study for the School Street to Cambridge Line (July 2006) was prepared by Vollmer Associates, LLP for the City of Somerville's Strategic Planning and Community Development Department. The study determined that the Green Line Extension Project provides a number of advantages that would facilitate development of the Community Path. In addition, the study found that the path provides benefits to the Green Line Extension by providing a route for pedestrians and cyclists to reach the proposed stations. More detailed information on the Proposed Somerville Community Path is provided in Section 3.8.1.

4.2.5.2 The Urban Ring

The Urban Ring is a proposed 25-mile bus rapid transit (BRT) system that would operate in a circumferential alignment connecting population and employment centers in Boston, Brookline, Cambridge, Chelsea, Everett, Medford, and Somerville. Executive Office of Transportation and Public Works (EOT) recently developed a proposed alignment for the Project in consultation with the Citizens Advisory Committee and a variety of stakeholders and advocacy groups. Two proposed BRT station stops are located at or near proposed Green Line Extension stations: the

proposed Inner Belt stop, which would be less than ½-mile from the proposed Brickbottom station; and the Lechmere stop, which would be at the relocated Lechmere Station. EOT submitted the *Revised Draft Environmental Impact Report/Draft Environmental Impact Statement* in November 2008.

4.2.5.3 Reconstruction of McGrath Highway /Route 28

The State's Central Transportation Planning Staff (CTPS) is preparing a report, entitled *Toward a Route 28 Corridor Transportation Plan: An Emerging Vision*, that summarizes information on traffic studies and potential land use changes in the McGrath Highway/Route 28 corridor, and how redevelopment would impact traffic patterns. The McGrath Highway/Route 28, which is owned by DCR, is roughly parallel to the proposed Green Line Extension between the relocated Lechmere Station and Brickbottom Station and is elevated in this segment. The City of Somerville would like the State to consider removing the elevated segment and replacing it with an at-grade roadway as a way of reuniting the community absent this barrier. The CTPS report addresses this proposal but makes no recommendations. The report is expected to be finalized by the end of 2008.

DCR has been studying the viaduct's condition and is performing ongoing repairs/maintenance to the structure. Based on information provided by DCR, there are currently no immediate plans to reconstruct Route 28/McGrath Highway. The only planned improvements along Route 28/McGrath Highway would be in the form of in-kind repairs with no plans to increase capacity or significantly modify the corridor.

4.2.5.4 Minuteman to Mystic Valley Parkway Path

In 2003, the Metropolitan District Commission (now DCR) issued the *Alewife Reservation and Alewife Brook Master Plan* that recommended improvements to the Alewife Reservation and Alewife Brook corridor, including the construction of a continuous, 10-foot wide greenway path ("West Bank Greenway") that would connect the Minuteman Bike Trail with existing paths along the Mystic River Reservation. The West Bank Greenway is at 75 percent design as of August 2008 and is expected to be reviewed by the permitting agencies during Fall 2008. DCR will seek construction funds for this path upon approval by the permitting agencies.

4.3 Socioeconomic Conditions

The Secretary's Certificate on the EENF specifies that the Draft Environmental Impact Report (DEIR) should "adequately account for near-term and long-term population projections and job growth" and should describe how the affected

communities may address any undesirable changes to community character, housing affordability, and transit access. This section discusses the existing socioeconomic conditions in Cambridge, Somerville, and Medford, focusing on employment and income in each city, so that the issues raised in the Secretary's Certificate can be fully addressed in Chapter 5, *Environmental Consequences*.

Cambridge, Somerville, and Medford are among 20 cities and towns located in the Metro North Workforce Area, as defined by the Massachusetts Executive Office of Labor and Workforce Development. During 2007, unemployment decreased from 3.7 percent to 3.3 percent in the Metro North region, while unemployment for Massachusetts as a whole decreased from 4.3 percent to 3.9 percent. The Metro North workforce grew by 0.04 percent (164 workers) in 2007, while the total Massachusetts workforce decreased by 0.65 percent (21,933 workers). The total number of jobs in the Metro North region increased by 2.0 percent (7,573 jobs) in 2007, while jobs in Massachusetts overall increased by 1.0 percent (32,698 jobs).[2] These trends indicate that the Metro North region may have a more robust overall economy than Massachusetts as a whole. However, this information does not reflect the impacts of the recent economic downturn.

Growth projections indicate that the Massachusetts economy may generate 265,800 new jobs (a 7.8 percent increase) between 2004 and 2014, with an additional 799,200 existing jobs becoming available due to retirement and other career changes. Population growth from April 2000 to July 2006 was 1.3 percent for Massachusetts as a whole. During this same time, the Metro North population decreased by 1.5 percent, including a 4.0 percent decrease in Somerville and negligible (less than 0.1 percent) increases in Cambridge and Medford.

Table 4.3 1 summarizes social and economic statistics for Cambridge, Somerville, and Medford.

Table 4.3-1 Social and Economic Statistics for Cambridge, Somerville, and Medford

City	Population	Population per square mile	Rental Housing[1]	Units in multi-family buildings[1]	Median Household Income	Per Capita Income	Unemployment Rate[2]	Poverty Rate[2]
Cambridge	101,355	15,770	67.8%	85.3%	$47,979	$31,156	6.1%	11.1%
Somerville	77,478	18,874	69.4%	88.1%	$46,315	$23,628	3.5%	12.1%
Medford	55,765	6,888	41.3%	61.5%	$52,476	$24,707	3.6%	6.1%

Source: U.S. Census data (2000).

1 Rates expressed as percent of total occupied housing units.

2 Rates expressed as percent of population.

2 *Regional LMI Profile: Annual Profile for Metro North Workforce Area*. Commonwealth of Massachusetts Executive Office of Labor and Workforce Development, March 2008.

4.3.1 Cambridge

Cambridge is a very densely populated city with approximately 15,770 residents per square mile. The majority of Cambridge housing is in rental units (67.8 percent of all units) and in multi-unit buildings (85.3 percent of all units), which can include multi-family homes and apartment buildings. According to the 2000 U.S. Census, Cambridge has approximately 101,355 residents, with 59,965 of these (59.2 percent) listed as eligible workers. Of these, 3,668 workers are unemployed — a 6.1 percent overall unemployment rate. Median household income in Cambridge is $47,979, with a per capita income of $31,156. Approximately 11.1 percent of the population is below the poverty line, and 18.5 percent of the population is classified as low income by State environmental justice standards, defined as less than 65 percent of the statewide median household income. In 2000, median household income in Massachusetts was $46,753, making the environmental justice household income threshold approximately $30,389.

Approximately 25.1 percent of Cambridge workers commute to work on public transportation. The largest employers in Cambridge are its educational institutions - Harvard University and the Massachusetts Institute of Technology. Health care and biotechnology firms also make up an important segment of the Cambridge economy. Lechmere Station is located in the neighborhood of East Cambridge. The rest of the Project would take place outside of Cambridge, although parts of the proposed Green Line corridor would be within walking distance of North Cambridge and the Wellington/Harrington neighborhood.

4.3.2 Somerville

Somerville is the most densely populated city in New England with approximately 18,874 residents per square mile. The majority of Somerville housing is in rental units (69.4 percent of all units) and in multi-unit buildings (88.1 percent of all units).

Somerville has a larger population than Medford and a lower unemployment rate, but it has the lowest median and per capita income out of the three cities. According to the 2000 Census, Somerville has approximately 77,478 residents, with 47,656 of these (61.5 percent) listed as eligible workers. Of these, 1,661 workers are unemployed — a 3.5 percent overall unemployment rate. Median household income in Somerville is $46,315, with a per capita income of $23,628. Approximately 12.1 percent of the population is below the poverty line, and 8.6 percent of the population is classified as low income by state environmental justice standards.

Approximately 29.2 percent of Somerville workers commute to work on public transportation. The numerous educational institutions within Somerville and in nearby cities play a significant role in the City's economy. While both Harvard University and Tufts University are formally located outside of Somerville, many students and employees of these institutions live in Somerville or make use of its

amenities. The proposed Green Line Corridor would pass through neighborhoods such as Ball Square, Union Square, Gilman Square, and Winter Hill.

4.3.3 Medford

Medford has a much lower population density than Cambridge and Somerville with approximately 6,888 residents per square mile. Less than half of Medford housing consists of rental units (41.3 percent of all units), although the majority of Medford housing is in multi-unit buildings (61.5 percent of all units), as in Cambridge. Medford has a smaller population than Cambridge and a lower per capita income but also has higher household incomes and lower poverty and unemployment rates. According to the 2000 Census, Medford has approximately 55,765 residents, with 30,133 of these (54.0 percent) listed as eligible workers. Of these, 1,088 workers are unemployed — a 3.6 percent overall unemployment rate. Median household income in Medford is $52,476, with a per capita income of $24,707. Approximately 6.1 percent of the population is below the poverty line, and 5.8 percent of the population is classified as low income by state environmental justice standards.

Approximately 18.1 percent of Medford workers commute to work on public transportation. Medford is the formal location of Tufts University, although much of the campus is in Somerville as well. The University is a major factor in the local economy and employs many area residents. The proposed Green Line Extension would pass through the Medford Hillside neighborhood and South Medford.

4.4 Environmental Justice

This section introduces the concept of environmental justice in local and regional planning and discusses the existing environmental justice communities in Cambridge, Somerville and Medford. The Secretary's Certificate on the EENF specifies that the DEIR should "identify environmental justice areas and other sensitive populations, provide relevant socioeconomic data, describe how the Project is designed to provide fair access to stations and economic development opportunities and avoid any disproportionate share of impacts." The Project must also comply with Federal Department of Transportation (DOT) requirements for environmental justice.

4.4.1 Introduction

Executive Order 12898, Federal Actions to Address Environmental Justice in Minority Populations and Low-Income Populations, requires specific examination of environmental and human health effects on minority populations and low-income populations to ensure that these groups are not disproportionately affected.

Environmental justice is concerned with the impacts of services and Federal funding on defined minority and low-income populations. The U.S. DOT Order (5610.2) on environmental justice defines a disproportionately high effect on minority and low-income populations as "an adverse effect that is predominately borne by minority population and/or a low-income population; or will be suffered by the minority population and/or low-income population and is appreciably more severe or greater in magnitude than the adverse effect that will be suffered by the non-minority population and/or non low-income population."

Environmental justice compliance must be demonstrated for both Federal and state standards. Rather than using specific minority or income thresholds for environmental justice, the Federal DOT methodology requires examining the social makeup of any affected areas (usually based on *2000 U.S. Census* data) to ensure that low-income and minority populations do not bear a disproportionate share of the effects of a project. On the state level, environmental justice is usually analyzed by comparing 2000 U.S. Census data to thresholds for income, race, and ethnicity data established by the state, municipality, or Metropolitan Planning Organization to define minority populations, foreign-born populations, and low-income populations.

In Massachusetts, the Executive Office of Energy and Environmental Affairs (EEA) has established an environmental justice policy in an effort to protect the environment and public health. MassGIS mapping developed by the EEA is used to determine if the area meets the criteria of an environmental justice population for low-income, foreign born, and minority populations. The assessment of environmental justice populations for the Green Line Extension Project is based both on local demographics and on the Massachusetts definition of environmental justice populations, which is more conservative than the Federal methodology by including factors besides income and race.

4.4.2 Existing Conditions

Cambridge, Somerville, and Medford all have substantial state-defined environmental justice areas, as defined by areas with substantial foreign-born, minority, or low-income populations. Most of both Cambridge (52.7 percent) and Somerville (68.5 percent) consist of environmental justice areas, while less than a quarter of Medford (22.2 percent) is considered an environmental justice area. The majority of these areas are due to large foreign-born or minority populations. Table 4.4-1 summarizes these areas for each city.

Table 4.4-1 State-Listed Environmental Justice Areas in Cambridge, Somerville, and Medford

	Fraction of City Area Designated as Environmental Justice Area[1]			
	Defined by Any	Defined By Specific Criteria		
City	Criteria	Foreign-Born	Minority	Income
Cambridge	52.7%	41.9%	51.0%	12.1%
Somerville	68.5%	52.7%	45.8%	15.8%
Medford	22.2%	7.4%	14.9%	4.8%
COMBINED	42.8%	29.3%	34.3%	9.7%

Source: U.S. Census data (2000), MassGIS.

1 Environmental justice areas can be designated based on multiple independent criteria. The table presents the cumulative environmental justice areas for all criteria as well as the total area designated by the specific criteria indicated.

The state-defined environmental justice populations in the vicinity of the Project area are shown in Figure 4.4-1. Nearly all of the proposed Green Line corridor is adjacent to one or more environmental justice populations.

Due to variations in urban density, the breakdown of the actual environmental justice populations differs somewhat from the breakdown of areas alone. Approximately 71.1 percent of Cambridge residents live in environmental justice areas, as do 66.7 percent of Somerville residents and 30.7 percent of Medford residents. More than half of Cambridge and Somerville residents are foreign-born. In general, environmental justice populations tend to occur in areas of above-average population density. The exception is low-income populations in Somerville, which are found in 15.8 percent of the City area but only represent 8.6 percent of the population. Table 4.4-2 summarizes the environmental justice populations in each City.

Table 4.4-2 State-Listed Environmental Justice Populations in Cambridge, Somerville, and Medford

	Fraction of City Population Living in Environmental Justice Areas[1]			
	Defined by Any	Defined By Specific Criteria		
City	Criteria	Foreign-Born	Minority	Income
Cambridge	71.1%	50.3%	68.6%	18.5%
Somerville	66.7%	56.6%	48.8%	8.6%
Medford	30.7%	11.2%	20.8%	5.8%
COMBINED	60.0%	43.1%	50.7%	12.2%

Source: U.S. Census data (2000), MassGIS.

1 Environmental justice areas can be designated based on multiple independent criteria. The table presents the cumulative environmental justice areas for all criteria as well as the total area designated by the specific criteria indicated.

To further characterize the regional character, Table 4.4-3 lists the racial breakdown of each city as a whole. All three cities have predominantly white populations, with varying proportions of black, Asian, multiracial, and Hispanic residents. The most common minority in Cambridge are of Asian origin (12.0 percent), followed by black (11.9 percent) and Hispanic (7.3 percent) populations. Hispanics are the most common minority in Somerville (8.6 percent), followed by Asians (6.5 percent) and blacks (6.4 percent). Medford has the highest proportion of white residents (86.5 percent), with smaller black (5.9 percent), Asian (4.2 percent), and Hispanic (2.5 percent) percentages than the other two cities. By comparison, Middlesex County as a whole shares a similar racial breakdown with Medford, with a high proportion of white residents (85.8 percent) with smaller black (3.3 percent), Asian (6.3 percent), and Hispanic (4.5 percent) percentages than Cambridge or Somerville.

Table 4.4-3 Minority Populations in Cambridge, Somerville, Medford, and Middlesex County

		Percentage of Population by Race							
City	Total Population	White	Black	Native American	Asian	Pacific Islander	Other	Multiracial	Hispanic[1]
Cambridge	101,355	68.1%	11.9%	0.4%	12.0%	0.0%	3.0%	4.6%	7.3%
Somerville	77,478	77.0%	6.4%	0.4%	6.5%	0.1%	4.9%	4.8%	8.6%
Medford	55,765	86.5%	5.9%	0.2%	4.2%	0.0%	1.1%	2.1%	2.5%
Middlesex County	1,465,396	85.8%	3.3%	0.2%	6.3%	0.0%	2.1%	2.3%	4.5%

Source: U.S. Census data (2000), MassGIS.

1 Hispanic populations are generally included as subsets within the other racial categories but are listed separately as well for clarity. Therefore, the percentages for each city will add up to more than 100 percent.

All three cities are in Middlesex County and rank below the county averages for median household income ($60,821) and per capita income ($31,199), although Cambridge's per capita income ($31,153) is very close to the county average. Cambridge and Somerville, with 11.1 percent and 12.1 percent of the population below the poverty level, respectively, both have nearly double the county poverty rate of 6.5 percent, while Medford's poverty rate is just below the county average at 6.1 percent. Overall, these statistics indicate that these three cities combined comprise a somewhat disadvantaged segment of the Middlesex County economy. Many of these differences may be due to the relatively affluent suburban character of other Middlesex County cities and towns to the north that benefit from the region's high levels of employment and job growth but have lesser economic burdens from urban development and municipal infrastructure.

Overall, these data indicate that the cities affected by the Project have a fairly dense, low-income, minority residential population.

4.5 Existing Transportation Systems

The following sections describe the existing transportation systems within the study area including bus service, commuter rail, and freight.

4.5.1 Existing Bus Services

This section discusses existing bus services within the study area. The MBTA operates 15 bus routes in the study area. This section lists and describes the various bus routes provided by the MBTA, including ridership in 2007. Figure 4.5-1 highlights existing bus service within the study area.

No. 69: Harvard/Holyoke Gate – Lechmere Station via Cambridge Street

Route 69 is a local route that connects Harvard Square, Inman Square, and Lechmere. The route travels Cambridge Street between the two terminal stops of Massachusetts Avenue at Holyoke Street and Lechmere Station. This route is located on the southern periphery of the study area connecting to Lechmere Station. Average weekday daily ridership on this route is 2,985 boardings.

No. 80: Arlington Center – Lechmere Station via Powder House Square

Route 80 is a local route connecting Arlington Center, Medford Hillside, Powder House Square, Magoun Square, Gilman Square, and Lechmere Station. Most of this route is within the Project study area, traveling along Boston Avenue, College Avenue, Broadway, Medford Street, Pearl Street, and the McGrath/O'Brien Highway. Average weekday daily ridership on this route is 1,872 boardings.

No. 85: Spring Hill – Kendall/MIT Station

Route 85 is a local route connecting Spring Hill, Summer Street, Union Square and Kendall/MIT. The northern section of this route, serving Spring Hill and Summer Street is within the Project study area before traveling to Union Square where it runs along the same route as the CT2, described later in this section, to Kendall/MIT. Average weekday daily ridership on this route is 397 boardings.

No. 86: Sullivan Square Station – Cleveland Circle via Harvard Square

This route connects Sullivan Square to Union Square, Harvard Square, Allston, Brighton, and Cleveland Circle. The bus travels along Washington Street through the Project study area providing service between Sullivan Square and Union Square. Average weekday daily ridership on this route is 5,139 boardings.

No. 87: Arlington Center/ Clarendon Hill – Lechmere via Davis Square and Union Square

This route connects Arlington Center, Clarendon Hill, Davis Square, Union Square, and Lechmere Station along Broadway, Elm Street, and Somerville Avenue. Average weekday daily ridership on this route is 3,373 boardings.

No. 88: Clarendon Hill – Lechmere Station via Highland Avenue

This route connects Clarendon Hill, Davis Square, Somerville High School, and Lechmere Station along Broadway, Holland, and Highland. Average weekday daily ridership on this route is 3,785 boardings.

No. 89: Clarendon Hill or Davis Square – Sullivan Square Station via Broadway

This route operates from Clarendon Hill or Davis Square (Red Line) in Somerville to Sullivan Square (Orange Line) in Charlestown, serving Powder House Square, Magoun Square, and Winter Hill. The Davis Square branch was proposed in the 2004 Service Plan and was implemented in the Winter 2005 rating. Average weekday daily ridership on this route is 3,431 boardings.

No. 90: Davis Square – Wellington Station via Sullivan Square Station & Assembly Mall

This route provides service between Davis Square and Wellington Station via Union Square and Sullivan Square. Average weekday daily ridership on this route is 920 boardings.

No. 91: Sullivan Square Station – Central Square Cambridge via Washington Street

Route 91 connects Sullivan Square with Central Square (Cambridge) via Union Square and Inman Square. Average weekday daily ridership on this route is 1,482 boardings.

No. 94: Medford Square – Davis Square Station via West Medford & Medford Hillside

This route provides service from Medford Square to Davis Square. This route travels through the Project study area along Boston Street and College Avenue. Average weekday daily ridership on this route is 1,174 boardings.

No. 95: West Medford – Sullivan Square Station via Mystic Avenue

Route 95 bus operates between West Medford and Sullivan Square serving the West Medford Station and Medford Square. The route originates at the corner of Playstead Road and Winthrop Street and travels through the study area along Playstead Road, High Street, and Mystic Avenue in Medford before serving the Sullivan Square Orange Line Station. Average weekday daily ridership on this route is 1,253 boardings.

No. 96: Medford Square – Harvard Station via George Street & Davis Square Station

Route 96 operates between Medford Square and Harvard Square serving Tufts University, Powder House Square, Davis Square, and Porter Square. Average weekday daily ridership on this route is 1,500 boardings.

No. 101: Malden Station – Sullivan Square Station via Salem Street, Main Street, & Broadway

Route 101 connects Malden Center to Sullivan Square Station via Medford Square and Winter Hill. This route travels along Broadway and Main Street in the Project study area. Average weekday daily ridership on this route is 4,116 boardings.

No. 134: North Woburn - Wellington Station via Woburn, Winchester, Winthrop Street, Medford Square, Riverside Avenue, & Meadow Glen Mall

Route 134 provides service between the three towns of Woburn, Winchester, and Medford. In the study area the route travels through the community of West Medford along Winthrop Street, but does not serve the West Medford Station. Average weekday daily ridership on this route is 1,623 boardings.

No. CT2: Sullivan Square Station - Ruggles Station via Kendall/MIT Station

Route CT2 is a limited stop, cross-town route that operates between Sullivan Square and Ruggles Station. This route utilizes Cambridge Street and Washington Street to travel between Union Square and Sullivan Square in the Project study area. Average weekday daily ridership on this route is 1,636 boardings.

4.5.1.1 Bus Accessibility

The MBTA has a Service Delivery Policy that establishes the service objectives and standards for the MBTA system to "ensure that the MBTA provides quality transit services that meet the needs of the riding public." The MBTA's *Preliminary 2008 Service Plan: Bus, Rapid Transit, and Boat Service Changes and Service Delivery Plan Modification* includes an evaluation of route performance against the Service Delivery Policy standards.

A portion of the MBTA's *2006 Service Delivery Policy* identifies Service Objectives and Standards used to evaluate the MBTA's service performance. One of the evaluation criteria is accessibility. The Span of Service Standard for hours during which service is accessible is shown in Table 4.5-1. The Minimum Frequency of Service Standard is shown in Table 4.5-2. Bus service frequencies and daily ridership on the Project study area bus routes are shown in Table 4.5-3.

Table 4.5-1 Span of Service Standards

Mode	Time	Minimum Span of Service
Bus (local)	Weekday	7:00AM – 6:30PM
	Guideline for high density areas:	
	Saturday	8:00AM – 6:30PM
	Sunday	10:00AM – 6:30PM
Bus (community routes)	Weekday	10:00AM – 4:00PM
Bus (express/community routes)	Weekday	7:00 AM – 6:30 PM
		(no service required 9:00AM – 4:00PM)
Bus (key community routes)	Weekday	6:00AM – midnight
	Saturday	6:00AM – midnight
	Sunday	7:00AM – midnight

Source: Service Delivery Policy, MBTA, 2006

Table 4.5-2 Minimum Frequency of Service Standards

Mode	Time	Minimum Frequency
Bus (local/community)	AM & PM Peak	30-minute headway
	All Other Periods	60-minute headway
		(Mid-day policy objective of 30-minute headway in high density areas)
	Saturday & Sunday –all day	60-minute headway
Bus (express/commuter)	AM Peak	3 trips in the peak direction
	PM Peak	3 trips in the peak direction
Bus (key routes)	AM & PM Peak	10-minute headway
	Early AM & Midday Base/School	15-minute headway
	Evening & Late Eve	20-minute headway
	Saturday –all day	20-minute headway
	Sunday – all day	20-minute headway

Source: Service Delivery Policy, MBTA, 2006

Appendix A to the MBTA's *Preliminary 2008 Service Plan* contains a Summary Analysis of Routes and Proposed Changes that notes which routes meet or fail to meet each standard in the MBTA's *2006 Service Delivery Policy*. Of all the bus services that are included in the study area, only Route 85, 90 and 94 services do not meet the

Minimum Frequency of Service Standard, while all routes meet the Span of Service Standard.

Table 4.5-3 Bus Service Frequency and Ridership

		Number of Weekday Inbound Bus Trips				
Route	Daily Ridership	5-9:30am	9:30am-4pm	4-7pm	After 7pm	Total
No. 69	2,985	16	20	9	12	57
No. 80	1,872	13	13	8	6	40
No. 85	397	7	9	5	1	22
No. 86	5,139	19	20	10	7	56
No. 87	3,373	14	15	11	11	51
No. 88	3,785	24	16	9	12	53
No. 89	3,431	24	19	18	8	70
No. 90	920	6	9	5	3	23
No. 91	1,482	12	14	6	6	38
No. 94	1,174	11	9	8	7	35
No. 95	1,253	13	17	9	7	46
No. 96	1,500	12	9	9	8	38
No. 101	4,116	26	22	12	6	66
No. 134	1,623	12	17	7	7	43
No. CT2	1,636	9	14	8	0	31
TOTAL	34,686	211	223	137	98	669

Source: Ridership and Service Statistics, Eleventh Edition (2007), MBTA Bus Schedule (August 2008)

4.5.1.2 Bus Safety and Comfort

The MBTA's Service Standard for Safety and Comfort is identified in the MBTA's *2006 Service Delivery Policy* and is based on vehicle loading. The MBTA's Bus Loading Standard for bus service is shown in Table 4.5-4. These standards are calculated using an average maximum vehicle load per trip over any 30 to 60 minute period.

Table 4.5-4 MBTA Bus Loading Standards

Time Period	Passengers/Seat
Early AM, AM Peak, Midday School & PM Peak	140%
Midday Base, Evening, Late Evening, Night/Sunrise &Weekends	
Surface portions of routes	100%
Tunnel portions of routes	140%

Source: Service Delivery Policy, MBTA, 2006

Of all the bus services that are included in the study area, only Route 87 and Route 101 services do not meet the Bus Loading Standard, according to the MBTA's *Preliminary 2008 Service Plan*.

4.5.1.3 Bus Service Reliability

The portion of the MBTA's *2006 Service Delivery Policy* that deals with reliability includes Schedule Adherence Standards that are used to quantify the performance of each service and how well it adheres to the published schedules. The goal is to identify services that do not meet the standard, identify the problem and to take corrective action, where possible. The specific standards vary by the scheduled frequency of the route. Routes are divided into "walk-up service", where the service operates more frequently than every 10 minutes, and "scheduled departure service", where headways are greater than 10 minutes. Passengers with high-frequency service are generally more interested in regular headways, whereas, passengers on less frequent services expect departure as scheduled. Table 4.5-5 provides a summary of the MBTA's current Bus Schedule Adherence Standards.

According to the Summary Analysis of Routes and Recommended Changes in the MBTA's *Preliminary 2008 Service Plan*, all study area bus routes except the Route 85 failed to meet the Schedule Adherence Standards for their weekday service from the *2006 Service Delivery Policy*. Systemwide, only three percent of the MBTA's weekday bus routes met the Schedule Adherence Standard.

Table 4.5-5 Summary of Bus Schedule Adherence Standards

Standard in 2006 Service Plan (adopted September 2004)			
Trip Test	Beginning of Route	Mid-Route Time Point(s)*	End of Route
Scheduled Departure Trips (Headways ≥10 min.)	Start 0 min. early to 3 min. late	Depart 0 min. early to 5 min. late	Arrive 3 min. early to 5 min. late
Walk-up Trips (Headways <10 min.)	Start within 25% of scheduled headway	Leave within 50% of scheduled headway	Running time within 20% of scheduled running time
Route Test	For any given bus route to be in compliance with the Schedule Adherence standard, 75% of all trips on must adhere to the above measures over the entire service day.		

Source: Service Delivery Policy, MBTA, 2006

*For Schedule Adherence, mid-route time points will be used only for routes on which the on-time performance data has been collected using CAD/AVL equipment.

4.5.1.4 Bus Cost-Effectiveness

The MBTA's *2006 Service Delivery Policy* also contains the Cost-Effectiveness Service Standard to ensure that the operation of MBTA service is conducted within the resource levels budgeted for each mode. During the regular service planning process, all bus routes and their respective net cost per passenger is compared against the bus

system average. Routes that have a net cost per passenger more than three times the system average are considered deficient, as shown in Table 4.5-6.

According to the *Summary Analysis of Routes and Recommended Changes* in the MBTA's *Preliminary 2008 Service Plan*, all study area bus routes meet the Cost-Effective Service Standard.

Table 4.5-6 Bus Cost-Effectiveness Service Standard

Net Cost/Passenger	(Operating Costs – Service Revenue)/(Boarding Customers)
Deficient Routes	Greater than or equal to three times the system average

Source: Service Delivery Policy, MBTA, 2006

4.5.1.5 Bus System Improvements

New technologies and system improvements have been implemented in the MBTA bus system to provide high-quality and reliable transit service where it is most needed as demonstrated by various data collected as part of the MBTA's *Preliminary 2008 Service Plan* evaluations. Recent and ongoing improvement initiatives include:

- New buses with low floor have replaced many of the MBTA's old buses.
- 125 new buses are planned for delivery in 2008.
- From 2003 to 2008, the average bus fleet age has been reduced from 12 years to five years.
- New technologies are available aboard the bus allowing for enhanced service monitoring and bus intervention.
- Global Positioning System (GPS) system has been incorporated in the buses which allows for the improved run time measurements. These allow for more realistic schedules that reflect typical traffic conditions. Many schedules have been updated particularly on routes with heavy ridership or reliability issues.
- Computer-Assisted Dispatching/Automated Vehicle Location (CAD/AVL) technology has been incorporated in the MBTA operations, allowing for enhanced real-time operational control. Customized strategies are being refined for each route that account for ridership patterns and roadway geometry.
- Automated Passenger Counters (APCs) are available on some buses that allow for more frequent observations of ridership and crowding.
- Many of the MBTA's bus maintenance garages have reached their capacity. The MBTA has plans to expand existing facilities and/or construct garages to provide additional capacity. In the Green Line Extension Project area, all of the study area bus routes are operated out of the MBTA's Charlestown Garage, with the exception of Routes 94 and 96 which operate out of the Fellsway Garage in

Medford on weekdays and out of Charlestown on weekends (when the Fellsway facility is closed). The MBTA is planning for a new bus garage and maintenance facility to be constructed at Wellington Station within the next decade. This facility is intended to provide additional capacity and replace older garages such as the Fellsway facility.

4.5.2 Existing Commuter Rail

This section discusses existing commuter rail service within the study area including service headways and ridership. Figure 4.5-2 highlights existing commuter rail service through the study area.

4.5.2.1 MBTA Lowell Line

The MBTA's Lowell Line (also known as the New Hampshire Mainline) extends northwest from Boston's North Station through Somerville and Medford to Lowell, which is the present terminal for commuter rail service on the line. The MBTA identifies the route as the "Lowell Line" in its published schedules. The route continues northwards into New Hampshire. The Boston – Portland intercity passenger rail service operated by Amtrak as the "Downeaster" also uses this route. Freight service is operated by Pan Am Railways (formerly Guilford Rail System). The State of New Hampshire, in cooperation with the Massachusetts EOT, is proceeding with the initial design and operations planning to extend commuter rail service to Nashua, New Hampshire. From Boston through Lowell to the New Hampshire state line, the line is owned by the MBTA.

The route is also used by a few trains operating on the MBTA's Haverhill / Reading Line. Due to track capacity constraints, these trains are routed over the MBTA Lowell Line between North Station and Wilmington as non-stop trains.

Current MBTA Lowell Line service consists of 21 inbound and 21 outbound weekday trains. Weekend and holiday service consists of eight inbound and eight outbound trains. In 2001, the MBTA opened a large intermodal station on the line in Woburn, the Anderson Regional Transportation Center, which provides parking and Logan Express Bus connections for passengers in the vicinity of I-95/I-93. A passenger station at Tufts University was closed in the early 1980s due to low passenger volume and the desire to reduce travel time to Boston for passengers from outlying areas. At the northern end of the study area, the West Medford Station is served by all of the scheduled commuter rail trains. Travel time from Lowell to Boston is approximately 50 minutes. Travel time between West Medford Station and Boston is approximately 12 minutes. West Medford Station generates approximately 550 daily inbound boardings.

In keeping with MBTA operating standards for its "North Side" commuter rail lines, all trains consist of single level commuter rail coaches operated in push–pull configuration with the locomotive typically located at the outbound (or northern) end of the train. Maximum train lengths typically are six cars. Additional train capacity could be achieved in the near to mid-term by increasing train lengths to nine cars, subject to equipment availability. Long-term MBTA capital improvement plans call for the replacement of the single-level coaches with higher capacity bi-level coaches.

According to the MBTA's *Ridership and Service Statistics* (11th edition, 2007), daily weekday ridership on the MBTA Lowell Line service is approximately 11,000 passenger boardings. Table 4.5-7 shows typical weekday inbound boardings at each MBTA Lowell Line Station. Maximum train capacity, based on the use of six-car trains, is 804 passengers. The greatest ridership on a morning peak period train, 744 passengers, is 93 percent of train capacity, based on March 2008 ridership counts.

Table 4.5-7 MBTA Lowell Line Daily Weekday Boardings by Station

Station	Daily Weekday Inbound Boardings
Lowell	1,778
North Billerica	780
Wilmington	485
Anderson	875
Mishawum	18
Winchester	465
Wedgemere	410
West Medford	545

Source: Ridership and Service Statistics, Eleventh Edition (2007)

4.5.2.2 MBTA Fitchburg Division

The MBTA Fitchburg Line extends from North Station through Cambridge, Somerville and then westward to Fitchburg. Within the Project study area the route passes along the west side of the MBTA's Boston Engine Terminal (BET) maintenance facility in Somerville, continuing west through Union Square, paralleling Somerville Avenue. The MBTA Fitchburg Line then passes through Porter Square in Cambridge, Waltham, Concord, and South Acton with a terminus in Fitchburg. Commuter rail service on this route consists of 18 inbound and 18 outbound trains on a weekday. Of these 18 trains, five inbound and outbound trains originate / terminate at South Acton. Travel time between Boston and Fitchburg is approximately 1 hour and 20 minutes. Travel time between Boston North Station and Porter Square is 11 minutes.

The MBTA in February 2004 inaugurated express service on this route, with trains operating non-stop between South Acton and Porter Square, thereby reducing travel time by approximately 10 minutes. Sunday and holiday service consists of seven inbound and outbound trips, with reduced frequencies between South Acton and Fitchburg. Eight inbound and outbound trips are operated on Saturdays.

According to the MBTA's *Ridership and Service Statistics* (11th edition, 2007), daily weekday ridership is approximately 9,000 passenger boardings. Train capacity, based on a six-car train, is 825 passengers. Table 4.5-8 shows typical weekday inbound boardings at each MBTA Fitchburg Line Station. The greatest ridership on a morning peak period train is 605 passengers, representing 82 percent of the train's capacity.

Table 4.5-8 MBTA Fitchburg Line Daily Weekday Boardings by Station

Station	Daily Weekday Inbound Boardings
Fitchburg	363
North Leominster	321
Shirley	179
Ayer	336
Littleton/495	245
South Acton	705
West Concord	416
Concord	404
Lincoln	273
Silver Hill	6
Hastings	22
Kendal Green	140
Brandeis/Roberts	481
Waltham	513
Waverley	125
Belmont Center	140
Porter Square	269

Source: Ridership and Service Statistics, Eleventh Edition (2007)

4.5.3 Existing Freight Rail

The Green Line Extension Project is envisioned to be located adjacent to existing operating rail lines, including the MBTA Lowell Line, the MBTA Fitchburg Line and Pan Am Railway's Yard 8. Freight rail operations in the Project area are provided by two railroads: CSX and Pan Am Railway's (PAR) Springfield Terminal Railway.[3,4]

3 Pan Am Railway (PAR) is the new corporate name for the railway previously known as Guilford Rail System.
4 Springfield Terminal (ST) Railway, owned by PAR, is the designated operating railroad for PAR. All train crews are employed by ST.

4.5.3.1 CSX Freight Operations

CSX is a major national railway system operating in the eastern United States, with routes from Massachusetts to Florida and New York to Illinois and Missouri. In the Boston area, CSX operates a major yard in Allston known as Beacon Park. The yard is the hub for its operations in eastern Massachusetts and the end of its Boston & Albany mainline.

In the Project area, CSX operates a daily round trip between Beacon Park Yard and Chelsea via its Grand Junction Branch. CSX operations within the study area are highlighted in Figure 4.5-3. This movement originates in Beacon Park Yard and proceeds over the Grand Junction Branch to Somerville where this line crosses the MBTA Fitchburg Line near the O'Brien Highway overpass. From this point, the freight track parallels the MBTA Fitchburg Line a few hundred feet where it connects to the "Valley Tracks" just west of the MBTA BET maintenance facility. The Valley Tracks in turn connect to the Eastern Route Mainline (MBTA Newburyport/ Rockport Line). CSX trains use the Eastern Route through Sullivan Square, over the Mystic River on Draw 7 Bridge and into Everett where the CSX Grand Junction line has its own separate track through Everett and into Chelsea. The destination of the daily train is the product market in Chelsea.

As shown in Figure 4.5-3, the CSX freight operations proceed over the Grand Junction branch to the Valley Tracks and onto the Eastern Route (the MBTA's Newburyport/Rockport Line).

4.5.3.2 Pan Am Railways Freight Operations

Pan Am Railways (PAR), known as Guilford Rail System (GRS) before March 2006, is a Class 2 railroad with lines in northern New England, Massachusetts and New York. All freight operations are performed by PAR's subsidiary Springfield Terminal Railway (ST). Consolidated from the former B&M and Maine Central railroads, the current freight operations are generally oriented east-west, with most trains bypassing Boston.

PAR freight operations in the Boston area are limited to serving customers in the Boston Terminal Area (Boston Sand and Gravel and Yard 21), along the Eastern Route (MBTA's Newburyport/Rockport Line through Chelsea, Lynn, Salem and Peabody) and, occasionally, the Fresh Pond/West Cambridge area (e.g., Watertown Branch).[5]

All PAR freight trains reach the Boston Terminal area by the MBTA Lowell Line. Southbound freight trains typically take the southbound main track to the Walnut

5 The Watertown Branch is currently serviced by trains from Ayer using the MBTA Fitchburg Line.

Street crossover onto the "third iron" or lead track to Yard 8. While the third iron extends north to CP-3 north of Lowell Street, the portion between CP-3 and Walnut Street is not currently used.

After crossing over Washington Street, trains on the third iron enter Yard 8. Through movements pass through Yard 8 and use the Wiley Track to reach the "Valley," which is the curved track on the west side of the MBTA BET maintenance facility.

From the Valley, the trains will either cross over to the Eastern Route and proceed northbound to Chelsea, Salem, and Peabody, or pull onto the third or fourth "iron" (these are the freight leads adjacent to Sullivan Square Station platforms that connected to the old Yard 21). From the third or fourth iron, the train can either back into Boston Sand & Gravel or reverse direction to head west on the MBTA Fitchburg Line to Fresh Pond or the Watertown Branch.

4.5.3.3 Current Function of Yard 8

Once a major freight yard in the B&M Railroad operations, today the portion of Yard 8 owned by PAR includes one through track (connecting the MBTA Lowell Line to the Valley via the Wiley Track) and one side track. Ownership of the yard is divided with the MBTA owning the half of the yard adjacent to the Brickbottom district and PAR owning the half closer to Inner Belt.

All PAR movements arriving or departing via the MBTA Lowell Line pass through Yard 8. The side track is used for occasional storage of freight cars. It also serves as a run-around track, allowing the locomotives to be uncoupled from one end of the train and placed at the other end.

4.6 Traffic

Evaluation of the transportation impacts associated with the Green Line Extension Project requires a thorough understanding of the existing transportation system in the Project study area. An effective evaluation of existing conditions throughout the study area requires an understanding of current traffic volumes, operations, safety and geometric conditions. The existing conditions evaluation focused on morning and evening peak hour traffic volumes, recent crash history along study area corridors, traffic operations, and pedestrian operations. A comprehensive parking inventory was performed to support a future conditions assessment of potential parking impacts associated with the Green Line Extension Project. An inventory of roadway and intersection geometry used in support of the existing conditions analysis is provided in Appendix F. The following sections describe the data collected and analyses conducted for the existing conditions.

4.6.1 Study Area

The study area includes 45 intersections (Figure 4.6-1), seven of which were previously studied as part of the Lechmere Station Relocation Project:

- Mystic Valley Parkway/Route 16 at:
  - Alewife Brook Parkway (unsignalized rotary)
  - Auburn Street (signalized)
  - Winthrop Street (signalized)

- Boston Avenue at:
  - High Street and Sagamore Avenue (flashing signal)
  - Mystic Valley Parkway/Route 16 (signalized)
  - North Street (signalized)
  - Winthrop Street and Curtis Street (signalized)
  - College Avenue (signalized)
  - Harvard Street and Warner Street (signalized)

- Broadway at:
  - Boston Avenue (Ball Square) (signalized)
  - Winchester Street/Albion Street (unsignalized)

- College Avenue at:
  - Powder House Boulevard/Broadway/Warner Street (flashing signal/signalized mid-block pedestrian crossing; rotary)
  - George Street (unsignalized)

- Main Street at:
  - High Street/Salem Street/Forest Avenue/Riverside Avenue (signalized)
  - South Street and Mystic Valley Parkway/Route 16 EB Ramps (flashing signal)
  - Mystic Valley Parkway/Route 16 WB Ramps (flashing signal)
  - Mystic Avenue (flashing signal)
  - Harvard Street (signalized)
  - George Street (flashing signal)

- Medford Street at:
  - Broadway and Dexter Street (signalized)
  - Lowell Street (unsignalized)
  - Central Street (signalized)
  - School Street (signalized)
  - Pearl Street (unsignalized)
  - Walnut Street (signalized)
  - Highland Avenue and Hamlet Street (signalized)
  - Somerville Avenue and McGrath Highway/Route 28 (signalized)

- Highland Avenue at:
  - Lowell Street (signalized)
  - Central Street (signalized)
  - Highland Avenue/School Street (signalized)

- Washington Street at:
  - Innerbelt Road
  - McGrath Highway/Route 28 (signalized)
  - Somerville Avenue and Webster Street (signalized)
    Beacon Street and Kirkland Street (signalized)

- Prospect Street at:
  - Somerville Avenue and Washington Street (signalized)
  - Webster Avenue and Concord Avenue (signalized)
  - Cambridge Street (signalized)
  - Hampshire Street (signalized)

- O'Brien Highway
  - Third Street (signalized)
  - Water Street (unsignalized)
  - North First Street (Build Condition Only)
  - Mid-Block Pedestrian Crossing (Build Condition Only)
  - Land Boulevard/Gilmore Bridge (signalized)
  - Museum Way (signalized)

- Cambridge Street at:
  - First Street (signalized)

The intersections chosen for study were required by the Secretary's Certificate, with the exception of five locations. Intersections in the immediate vicinity of Ball Square, Gilman Square, and along George Street were included by EOT due to their proximity to proposed station locations or to address specific concerns raised by concerned residents as part of the public process.

4.6.2 Traffic Volumes

Daily and peak hour traffic volume data were collected to establish baseline traffic conditions within the study area. How traffic fluctuates over a typical day provides insight into when peak periods occur and the intensity of traffic occurring during the peak period. Daily traffic volumes were obtained by Automatic Traffic Recorders (ATR) throughout the study area for a typical weekday. These data are summarized in Table 4.6-1. Manual peak hour turning movement and vehicle classification counts were conducted at each of the study area intersections from 7:00 to 10:00 AM and 3:00 to 6:00 PM on November 7 and 8, 2007. Two intersections along George Street

were subsequently added to the study area in response to public input. Data at these locations were collected on May 15, 2008.

To gain a better understanding of traffic near the proposed Ball Square and Gilman Square Stations, three intersections (Boston Avenue at Broadway, Broadway at Winchester Street and Albion Street, and Medford Street at Pearl Street) were added to the study area and counted on September 10, 2008 and October 30, 2008.

A number of residents expressed concern that traffic data, which did not include the proposed grocery store (closed for renovation at the time) at the intersection of Mystic Valley Parkway/Route 16 and Auburn Street, would underestimate potential traffic impacts of the Green Line Extension Project. To account for traffic generated by the grocery store, trips were estimated using the suggested guidance and methodology of the Institute of Transportation Engineer's (ITE) *Trip Generation*.[6] Specifically, vehicle trips for the supermarket were estimated using Land Use Code 850 (supermarket). These trips were then distributed along study area roadways based on the current traffic patterns in the study area. These trips were then added to the existing peak hour traffic volumes to establish the existing conditions traffic volume with the proposed supermarket. Existing traffic network conditions are provided in Appendix F.

Table 4.6-1 Existing Daily Traffic Volumes on Study Area Roadways

			Weekday Morning Peak Hour			Weekday Evening Peak Hour		
Location	Direction	Weekday ADT[1]	Volume (vph)[2]	"k" factor[3]	Directional Flow	Volume (vph)	"k" factor	Directional Flow
High Street	Eastbound	8,995	570	6.3%	54%	775	8.6%	57%
East of Canal Street	Westbound	8,375	480	5.7%	46%	580	6.9%	43%
	Total	17,370	1,050	6.0%	100%	1,355	7.8%	100%
Canal Street	Northbound	1,670	185	11.1%	50%	180	10.8%	60%
South of Prescott Street	Southbound	1,455	185	12.7%	50%	120	8.2%	40%
	Total	3,125	370	11.8%	100%	300	9.6%	100%
Mystic Valley Parkway West of	Eastbound	13,435	955	7.1%	44%	965	7.2%	47%
Boston Avenue	Westbound	15,480	1,210	7.8%	56%	1,075	6.9%	53%
	Total	28,915	2,165	7.5%	100%	2,040	7.1%	100%
Boston Avenue	Northbound	3,010	230	7.6%	36%	280	9.3%	54%
North of Holton Street	Southbound	3,200	415	13.0%	64%	235	7.3%	46%
	Total	6,210	645	10.4%	100%	515	8.3%	100%
Boston Avenue	Northbound	5,580	295	5.3%	34%	540	9.7%	62%
South of University Avenue	Southbound	5,425	575	10.6%	66%	325	6.0%	38%
	Total	11,005	870	7.9%	100%	865	7.9%	100%
Boston Avenue	Northbound	3,105	225	7.2%	39%	290	9.3%	55%
South of Harvard Street	Southbound	3,210	350	10.9%	61%	240	7.5%	45%
	Total	6,315	575	9.1%	100%	530	8.4%	100%
College Avenue	Eastbound	3,795	230	6.1%	35%	355	9.4%	50%
East of Boston Avenue	Westbound	4,930	435	8.8%	65%	360	7.3%	50%
	Total	8,725	665	7.6%	100%	715	8.2%	100%
College Avenue	Eastbound	4,030	215	5.3%	28%	370	9.2%	50%
West of Boston Avenue	Westbound	5,400	550	10.2%	72%	375	6.9%	50%
	Total	9,430	765	8.1%	100%	745	7.9%	100%

6 Institute of Transportation Engineers, Trip Generation, Seventh Edition; Washington, D.C., 2004.

Table 4.6-1 Existing Daily Traffic Volumes on Study Area Roadways (continued)

Location	Direction	Weekday ADT[1]	Weekday Morning Peak Hour Volume (vph)[2]	Weekday Morning Peak Hour "k" factor[3]	Weekday Morning Peak Hour Directional Flow	Weekday Evening Peak Hour Volume (vph)	Weekday Evening Peak Hour "k" factor	Weekday Evening Peak Hour Directional Flow
Winthrop Street	Eastbound	7,200	595	8.3%	64%	720	10.0%	72%
East of Boston Avenue	Westbound	3,990	335	8.4%	36%	285	7.1%	28%
	Total	11,190	930	8.3%	100%	1,005	9.0%	100%
Curtis Street	Eastbound	4,465	350	7.8%	71%	345	7.7%	70%
West of Boston Avenue	Westbound	2,405	145	6.0%	29%	150	6.2%	30%
	Total	6,870	495	7.2%	100%	495	7.2%	100%
Harvard Street	Eastbound	7,585	525	6.9%	46%	550	7.3%	48%
East of Boston Avenue	Westbound	9,235	605	6.6%	54%	600	6.5%	52%
	Total	16,820	1,130	6.7%	100%	1,150	6.8%	100%
Broadway Between Boston	Eastbound	11,205	1,030	9.2%	57%	745	6.6%	45%
Avenue & Winchester Street	Westbound	10,450	785	7.5%	43%	920	8.8%	55%
	Total	21,655	1,815	8.4%	100%	1,665	7.7%	100%
Broadway South of Powder House	Northbound	8,150	585	7.2%	42%	645	7.9%	51%
Square	Southbound	8,590	805	9.4%	58%	610	7.1%	49%
	Total	16,740	1,390	8.3%	100%	1,255	7.5%	100%
Willow Avenue Between Broadway	Northbound	2,730	165	6.0%	54%	240	8.8%	70%
& Kidder Avenue	Southbound	1,710	195	11.4%	46%	105	6.1%	30%
	Total	4,440	360	8.1%	100%	345	7.8%	100%
Medford Street	Northbound	4,405	190	4.3%	27%	425	9.6%	63%
South of School Street	Southbound	4,525	520	11.5%	73%	245	5.4%	37%
	Total	8,930	710	8.0%	100%	670	7.5%	100%
Medford Street Between School	Eastbound	8,570	895	10.4%	77%	525	6.1%	55%
Street & Central Street	Westbound	4,910	260	5.3%	23%	435	8.9%	45%
	Total	13,480	1,155	8.6%	100%	960	7.1%	100%
Highland Avenue	Northbound	6,680	375	5.6%	35%	675	10.1%	56%
South of School Street	Southbound	9,435	700	7.4%	65%	530	5.6%	44%
	Total	16,115	1,075	6.7%	100%	1,205	7.5%	100%
School Street Between Medford Street & Highland Avenue	Southbound	5,540	490	8.8%	100%	440	7.9%	100%
Lowell Street Between Vernon	Northbound	1,785	115	6.4%	34%	140	7.8%	54%
Street & Princeton Street	Southbound	1,740	225	12.9%	66%	120	6.9%	46%
	Total	3,525	340	9.6%	100%	260	7.4%	100%
McGrath Highway/Route 28	Northbound	22,345	975	4.4%	24%	2,115	9.5%	56%
Between Greenville Street and	Southbound	29,105	3,045	10.5%	76%	1,650	5.7%	44%
Cross Street	Total	51,450	4,020	7.8%	100%	3,765	7.3%	100%
Washington Street	Eastbound	4.980	355	7.1%	52%	375	7.5%	54%
West of Hawkins Street	Westbound	5.205	330	6.3%	48%	325	6.2%	46%
	Total	10.185	685	6.7%	100%	700	6.9%	100%
Washington Street	Eastbound	10,050	540	5.4%	35%	765	7.6%	44%
East of Tufts Avenue	Westbound	14,460	995	6.9%	65%	960	6.6%	56%
	Total	24,510	1,535	6.3%	100%	1,725	7.0%	100%
Washington Street	Eastbound	12,865	730	5.7%	41%	975	7.6%	51%
East of Merriam Street	Westbound	13,940	1,040	7.5%	59%	940	6.7%	49%
	Total	26,805	1,770	6.6%	100%	1,915	7.1%	100%
Somerville Avenue	Eastbound	7,005	480	6.9%	72%	465	6.6%	61%
East of Prospect Street	Westbound	4,030	185	4.6%	28%	300	7.4%	39%
	Total	11,035	665	6.0%	100%	765	6.9%	100%
Prospect Street	Northbound	6,410	315	4.9%	53%	430	6.7%	64%
South of Webster Street	Southbound	3,920	285	7.3%	47%	240	6.1%	36%
	Total	10,330	600	5.8%	100%	670	6.5%	100%
Webster Street	Northbound	5,180	230	4.4%	37%	485	9.3%	76%
South of Prospect Street	Southbound	3,645	385	10.6%	63%	155	4.3%	24%
	Total	8,825	615	7.0%	100%	640	7.3%	100%

Source: 24-hour Automatic Traffic Recorder (ATR) counts conducted by Precision Data Industries, LLC in November 2007.

1 Daily traffic expressed in vehicles per day.

2 Peak hour volumes expressed in vehicles per hour.

3 Percent of daily traffic that occurs during the peak hour.

4.6.3 Intersection Geometrics and Traffic Control

Existing intersection geometries were collected at the study area intersections in January 2007. The majority (32 of 45) of the study area intersections are controlled by traffic signals. Traffic signal timing and phasing were obtained from the traffic signal controllers at each signalized intersection. Detailed geometrics and traffic signal information is provided in Appendix F.

4.6.4 Intersection Safety

A safety assessment was conducted for study area intersections using Massachusetts Highway Department (MassHighway) crash records for 2004 through 2006 (the most recent three years for which data are currently available). These data include all reported crashes at study area intersections with a property damage value greater than $1,000 or crashes that involved personal injuries or fatalities. A complete analysis can be found in Appendix F.

Twenty-one study area intersections experience, on average, five or fewer crashes per year. Three locations experience an average greater than 10 crashes per year:

- Mystic Valley Parkway/Route 16 at Winthrop Avenue
- Boston Avenue at Winthrop Avenue
- Washington Street at McGrath Highway/Route 28

This is likely a result of the heavy traffic volume these intersections process during the peak periods. Long vehicle delays and queuing combined with heavy turning movements may create a situation of red-light running or vehicles attempting to turn after the traffic signal has turned red.

As part of the safety assessment, crash rates were calculated for all study area intersections. A crash rate is the representative number of crashes that occur at a particular intersection for every 1,000,000 vehicles that enter that intersection. For example, a crash rate of 1.0 indicates that one crash occurs at an intersection for every 1,000,000 vehicles that enter it. The calculated crash rates were then measured against the current statewide average crash rates (0.87 for signalized intersections and 0.66 for unsignalized intersections) and MassHighway District 4 average crash rates (0.88 for signalized intersections and 0.63 for unsignalized intersections) to determine whether intersections in the study area experience greater than average crash occurrences. Five intersections exceed either the statewide or District 4 average rates:

- Boston Avenue at Winthrop Street/Curtis Street (Crash Rate: 1.02)
- Boston Avenue at Harvard Street/Warner Street (Crash Rate: 1.01)
- Medford Street at Somerville Avenue (Crash Rate: 0.95)
- Prospect Street at Cambridge Street (Crash Rate: 1.06)
- Prospect Street at Hampshire Street (Crash Rate: 1.19)

It should be noted that none of the intersections experiencing greater than 10 crashes per year exceed the statewide average crash rate. This indicates that there is not a disproportionately high number of incidents occurring at these locations given the traffic volume they process. The safety assessment also included a review of the statewide High Crash Location list[7]. This annually published list includes the top 1,000 crash locations within the Commonwealth. Nine of the 42 study area intersections appear on the list, with one intersection (Washington Street at McGrath Highway/Route 28) in the top 100, ranking at 41. While crash rates only consider the number of crashes and traffic volume at an intersection, the High Crash Location list also includes the severity of the accident and whether any fatalities or personal injuries occur. Therefore, it is possible to have a High Crash Location that does not exceed the statewide average crash rate. The nine intersections on the current High Crash Location list are:

- Washington Street at McGrath Highway/Route 28 (Ranked 41)
- Washington Street at Somerville Avenue (Ranked 323)
- O'Brien Highway at Land Boulevard and Charlestown Avenue (Ranked 389)
- Mystic Valley Parkway/Route 16 at Boston Avenue (Ranked 412)
- Mystic Valley Parkway/Route 16 at Winthrop Street (Ranked 501)
- Salem Street at High Street (Ranked 659)
- Medford Street at McGrath Highway/Route 28 (Ranked 906)
- Mystic Valley Parkway/Route 16 at Alewife Brook Parkway (Ranked 958)
- Prospect Street at Somerville Avenue (Ranked 958)

It should be noted that the 2005 High Crash Location list is based on crash statistics from 1999 to 2002. Any safety modifications to the intersections made since 2002 are not reflected in the rankings available.

4.6.5 Traffic Operations Analysis

Intersection capacity analyses were conducted for the study area intersections based on the existing traffic volumes and traffic control. Capacity analyses provide an indication of how well the intersections accommodate the traffic demands placed upon them. Intersections operating conditions are classified by calculated LOS as described below. Two computer software packages, *SYNCHRO Version 6.0* (intersection analysis) and *Sidra Intersection Version 3.2* (roundabout analysis), were used to model traffic conditions at the study area intersections. The evaluation criteria used to analyze the study area intersections are based on the *2000 Highway Capacity Manual (HCM).*[8]

7 *Top 1,000 High Crash Location Report* (1999-2001), MassHighway 2005.
8 *2000 Highway Capacity Manual*, Special Report 209, Transportation Research Board, Washington D.C., 2000.

Level of Service (LOS) is the term used to denote the different operating conditions that occur at a given intersection under various traffic conditions. It is a qualitative measure of the effect of a number of factors including roadway geometrics, speed, travel delay, freedom to maneuver, and safety. LOS provides an index to the operational qualities of an intersection. LOS designations range from A to F, with LOS A representing the optimal operating conditions with little or no delay and LOS F representing the worst operating conditions with high congestion and long delays. LOS D or better is generally considered an acceptable operating condition. In urban areas however, LOS E may also be considered an acceptable condition. Thresholds for vehicular LOS are shown in Table 4.6-2.

Table 4.6-2 Vehicular Level of Service Thresholds

	Average Delay (seconds)	
Level of Service	Signalized Intersection	Unsignalized Intersection
A	<10	<10
B	> 10 to 20	> 10 to 15
C	> 20 to 35	> 15 to 25
D	> 35 to 55	> 25 to 35
E	> 55 to 80	> 35 to 50
F	> 80	> 50

Source: 2000 Highway Capacity Manual

LOS designation is reported differently for signalized and unsignalized intersections. For signalized intersections, the analysis considers the operation of each lane group entering the intersection and the LOS designation represents overall conditions at the intersection. For unsignalized intersections, the analysis assumes that traffic on the mainline is not affected by traffic on the minor side streets. The LOS is determined separately for left-turns from the main street and all movements from the minor street. The unsignalized intersection LOS presented is for the most critical movement, often the left-turns out of the side street. The results of the existing conditions traffic operations analysis are presented in Tables 4.6-3 and 4.6-4.

As shown in Table 4.6-3, the following eleven signalized intersections currently operate at an unacceptable LOS E or LOS F during one or both peak hours:

- Mystic Valley Parkway/Route 16 at Boston Avenue
- Mystic Valley Parkway/Route 16 at Winthrop Street
- Main Street at High Street/Salem Street/Forest Avenue/Riverside Avenue
- Main Street at Harvard Street
- Broadway at Medford Street/Dexter Street
- Washington Street at McGrath Highway/Route 28 (east and west)
- Prospect Street at Somerville Avenue
- Prospect Street at Webster Street and Concord Avenue
- O'Brien Highway/Route 28 at Land Boulevard and Charlestown Avenue
- O'Brien Highway/Route 28 and Third Street

Table 4.6-3 Existing Condition Signalized Intersection Traffic Operations

Intersection	Morning Peak Hour			Evening Peak Hour		
	V/C[1]	Delay[2]	LOS[3]	V/C	Delay	LOS
Mystic Valley Pkwy at Boston Avenue	0.93	61	E	1.06	82	F
Mystic Valley Pkwy at Auburn Street (East)	0.81	33	C	0.79	35	D
Mystic Valley Pkwy at Auburn (West)	0.68	11	B	0.64	26	C
Mystic Valley Pkwy at Winthrop Street	> 1.20	>120	F	> 1.20	>120	F
Boston Avenue at North Street	0.52	17	B	0.39	16	B
Boston Avenue at Winthrop Street	1.00	46	D	0.99	55	D
Boston Avenue at College Avenue	0.92	55	D	0.86	47	D
Boston Avenue at Harvard Street/Warner Street	0.74	20	B	0.74	19	B
Broadway at Boston Avenue (Ball Square)	0.81	30	C	0.64	12	B
College Avenue at Powder House Blvd/Broadway/Warner Street (East Side)	0.52	2	A	0.60	2	A
College Avenue at Powder House Blvd/Broadway/Warner Street (West Side)	0.70	4	A	0.58	2	A
Main Street at High Street/Salem Street/Forest Avenue/Riverside Avenue	0.95	57	E	0.74	32	C
Main Street at Clipper Ship Drive	0.61	1	A	0.52	4	A
Main Street at Harvard Street	1.09	79	E	1.12	80	E
Broadway at Medford Street/Dexter Street	0.96	68	E	0.85	47	D
Medford Street at Central Street	0.71	20	C	0.64	20	C
Medford Street at School Street	0.87	26	C	0.83	29	C
Medford Street at Walnut Street	0.51	17	B	0.51	16	B
Medford Street at Highland Avenue	0.88	41	D	0.60	14	B
Medford Street at Somerville Avenue/McGrath Hwy	0.70	34	C	0.65	33	C
Highland Avenue at Lowell Street	0.64	17	B	0.50	12	B
Highland Avenue at Central Street	0.62	16	B	0.68	17	B
Highland Avenue at School Street	0.79	30	C	0.75	25	C
Washington Street at McGrath Hwy (East)	0.54	27	C	0.74	117	F
Washington Street at McGrath Hwy (West)	0.66	200	F	0.57	103	F
Washington Street at Innerbelt Road	0.63	9	A	0.72	14	B
Prospect Street at Somerville Avenue	0.89	67	E	0.94	65	E
Washington Street at Somerville Avenue/Webster Street	0.85	38	D	0.79	38	D

Table 4.6-3 Existing Condition Signalized Intersection Traffic Operations (continued)

Intersection	Morning Peak Hour			Evening Peak Hour		
	V/C[1]	Delay[2]	LOS[3]	V/C	Delay	LOS
Washington Street at Beacon Street/Kirkland Street	0.84	32	C	0.80	27	C
Prospect Street at Webster Street/Concord Avenue	0.71	30	C	1.19	136	F
Prospect Street at Cambridge Street	0.59	22	C	0.79	29	C
Prospect Street at Hampshire Street	0.64	27	C	0.56	25	C
O'Brien Highway at Land Boulevard/Gilmore Bridge	1.17	>120	F	1.16	>120	F
O'Brien Highway at Third Street	0.69	18	B	0.95	>120	F
O'Brien Highway at Museum Way	0.72	11	B	0.60	11	B
Cambridge Street at First Street	0.48	16	B	0.48	18	B

1 Volume-to-capacity ratio
2 Average delay expressed in seconds per vehicle
3 Level-of-Service

Table 4.6-4 Existing Condition Unsignalized Intersection Traffic Operations

Intersection	Critical Movement	Morning Peak Hour			Evening Peak Hour		
		v/c[1]	Delay[2]	LOS[3]	v/c	Delay	LOS
Boston Avenue at High Street/Sagamore Avenue	High Street Northbound	>1.2	>120	F	>1.2	>120	F
College Avenue at George Street	George Street Westbound	0.74	17	C	0.82	21	C
Main Street at George Street	George Street Eastbound	>1.2	>120	F	>1.2	>120	F
Main Street at Mystic Avenue/Fire Station	Main Street Eastbound	>1.2	>120	F	>1.2	>120	F
Main Street at South Street/Mystic Valley Pkwy EB Ramps	South Street Eastbound	>1.2	>120	F	>1.2	>120	F
Main Street at Mystic Valley Pkwy WB Ramps	Mystic Valley Pkwy Westbound Ramps	>1.2	>120	F	>1.2	>120	F
Medford Street at Lowell Street	Lowell Street Northbound	1.02	>120	F	0.32	18	C
Medford Street at Pearl Street	Pearl Street Westbound	0.96	74	F	0.70	26	D
Broadway at Winchester Street/Albion Street	Winchester/Albion SB	>1.2	>120	F	0.79	87	F
O'Brien Highway at Water Street	Water Street	0.03	9	A	0.02	11	B
ROUNDABOUT							
Mystic Valley Pkwy at Alewife Brook Pkwy	--	1.02	27	C	>1.2	63	E

1 Volume-to-capacity ratio
2 Average delay expressed in seconds per vehicle
3 Level-of-Service

As shown in Table 4.6-4, eight unsignalized intersections currently operate at an unacceptable LOS E or LOS F during one or both peak hours:

- Boston Avenue at High Street and Sagamore Avenue
- Main Street at George Street
- Main Street at Mystic Avenue and the Fire Station Driveway
- Main Street at South Street and Mystic Valley Parkway/Route 16 EB Ramps
- Main Street at Mystic Valley Parkway/Route 16 WB Ramps
- Medford Street at Lowell Street
- Medford Street at Pearl Street
- Broadway at Winchester Street/Albion Street

It should be noted that observed traffic volumes at the majority of existing unsignalized intersections far exceed the physical capacity of the intersections.

4.6.6 Pedestrian Operations

Crosswalk analyses were conducted at all study area intersections. Pedestrian Level of Service (PLOS) provides an index to quantify pedestrian delay similar to that of vehicles, with PLOS A representing excellent pedestrian operations and PLOS F representing an unacceptable delay for pedestrians waiting to cross the roadway. Thresholds for PLOS are noted in Table 4.6-5.

Table 4.6-5 Pedestrian Level of Service Thresholds

Pedestrian Level of Service	Average Delay per Pedestrian (seconds)	
	Signalized Intersection	Likelihood of Compliance
A	<10	Very High
B	> 10 to 20	High
C	> 20 to 30	High
D	> 30 to 40	Low
E	> 40 to 60	Moderate
F	> 60	High

Source: 2000 Highway Capacity Manual

Pedestrian delay was calculated using the *2000 Highway Capacity Manual* equation 18-5 for signalized intersections. At signalized intersections, the LOS measured for pedestrian crossings is not a function of the capacity of the crossing but a function of the green time allotted for pedestrians to cross. According to the *2000 Highway Capacity Manual*, pedestrians experiencing more than a 30-second delay become more impatient and more noncompliant with the signal indications. However, at intersections with high conflicting vehicle volumes, pedestrians have no choice but to wait for the walk signal so their disregard of the signal indication is reduced.

Table 4.6-6 Existing Condition Pedestrian Level-of-Service

Intersection	Crosswalk	Morning Peak Hour Average Delay (sec)	Morning Peak Hour PLOS	Evening Peak Hour Average Delay (sec)	Evening Peak Hour PLOS
Mystic Valley Pkwy at Auburn Street	North	60	E	60	E
	South	56	F	56	F
Mystic Valley Pkwy at Winthrop Street	North	68	F	68	F
	South	64	F	64	F
	East	60	E	60	E
	West	65	F	65	F
Mystic Valley Pkwy at Boston Avenue	North	54	E	54	E
	South	54	E	54	E
	East	54	E	54	E
	West	55	E	55	E
Boston Avenue at North Street	North	40	D	40	D
	South	39	D	39	D
	East	37	D	37	D
	West	36	D	36	D
Boston Avenue at Winthrop Street	North	37	D	37	D
	South	35	D	35	D
	East	35	D	35	D
	West	32	D	32	D
Boston Avenue at College Avenue	North	59	E	59	E
	South	59	E	59	E
	East	55	E	55	E
	West	56	E	56	E
Boston Avenue at Harvard Street/Warner Street	North	52	E	42	E
	South	52	E	42	E
	East	55	E	45	E
	West	55	E	45	E
College Avenue at Powder House Blvd/Broadway/Warner Street (East Side)	North	30	C	30	C
	South	27	C	27	C
	West	32	D	32	D
College Avenue at Powder House Blvd/Broadway/Warner Street (West Side)	North	34	D	34	D
	West	36	D	36	D
Main Street at High Street/Salem Street/Forest Avenue/Riverside Avenue	North	9	A	9	A
	South	43	E	43	E
	Northeast	34	D	34	D
	East	27	C	27	C
	West	37	D	31	D
Main Street at Harvard Street	North	38	D	38	D
	South	35	D	35	D
	East	35	D	35	D
	West	35	D	35	D
Broadway at Medford Street	North	58	E	58	E
	South	53	E	53	E
	North West	60	F	60	F
	Southeast	58	E	58	E
	East	49	E	49	E
	West	51	E	51	E
Medford Street at Central Street	North	35	D	35	D
	South	34	D	34	D
	East	33	D	33	D
	West	39	D	39	D

Table 4.6-6 Existing Condition Pedestrian Level-of-Service (continued)

Intersection	Crosswalk	Morning Peak Hour Average Delay (sec)	Morning Peak Hour PLOS	Evening Peak Hour Average Delay (sec)	Evening Peak Hour PLOS
Medford Street at School Street	North	28	C	28	C
	South	28	C	28	C
	East	28	C	28	C
	West	28	C	28	C
Medford Street at Walnut Street	North	32	D	32	D
	South	32	D	32	D
	East	31	D	31	D
	West	31	D	31	D
Medford Street at Highland Avenue	North	28	C	28	C
	South	25	C	25	C
	East	31	D	31	D
	West	29	C	29	C
Medford Street at Somerville Avenue/McGrath Hwy	North	48	E	48	E
	South	53	E	53	E
	West	33	D	33	D
Highland Avenue at Lowell Street	North	28	C	28	C
	South	28	C	28	C
	East	31	D	31	D
	West	31	D	31	D
Highland Avenue at Central Street	North	35	D	35	D
	South	35	D	35	D
	East	37	D	37	D
	West	37	D	37	D
Highland Avenue at School Street	North	39	D	39	D
	South	37	D	37	D
	East	40	E	40	E
	West	40	E	40	E
Washington Street at Innerbelt Road	South	34	D	34	D
	West	36	D	36	D
Washington Street at McGrath Highway/Route 28 (East)	North	20	B	20	B
Washington Street at McGrath Highway/Route 28 (West)	North	3	A	3	A
Washington Street at Somerville Avenue/Webster Street	North	51	E	50	E
	South	41	E	40	E
	East	54	E	53	E
	West	50	E	49	E
Washington Street at Beacon Street/Kirkland Street	North	41	E	41	E
	South	41	E	41	E
	East	40	D	40	D
	West	39	D	39	D
Prospect Street at Somerville Avenue	North	50	E	51	E
	South	43	E	44	E
	East	47	E	48	E
	West	51	E	52	E
Prospect Street at Webster Street	North	33	D	33	D
	South	42	E	42	E
	Southwest	32	D	32	D
	West	31	D	31	D

Table 4.6-6 Existing Condition Pedestrian Level-of-Service (continued)

Intersection	Crosswalk	Morning Peak Hour Average Delay (sec)	Morning Peak Hour PLOS	Evening Peak Hour Average Delay (sec)	Evening Peak Hour PLOS
Prospect Street at Cambridge Street	North	21	C	22	C
	South	21	C	22	C
	East	20	B	19	B
	West	20	B	19	B
Prospect Street at Hampshire Street	North	14	B	16	B
	South	15	B	17	B
	East	26	C	23	C
	West	25	C	22	C
O'Brien Highway at Third Street	South	58	E	58	E
	East	50	E	50	E
O'Brien Highway at Land Boulevard/Gilmore Bridge	South	44	E	53	E
	East	69	F	58	E
	West	26	C	43	E
O'Brien Highway at Museum Way	North	17	B	17	B
	East	54	E	54	E
	West	37	D	37	D
Cambridge Street at First Street	South	43	E	43	E
	East	41	E	41	E
	West	37	D	37	D

Based on the length of the individual crosswalks and a 3.5 foot per second walking speed, the crossing time at each crosswalk was calculated. In conformance with signal design guidelines, this crossing time represents the flashing "Don't Walk" phase of the traffic signal cycle. For locations with concurrent pedestrian phasing, the flashing "Don't Walk" time (minus four seconds per the HCM) was subtracted from the total red-time for the approach, deriving an effective walk (green time) for pedestrians. Where an exclusive pedestrian phase is provided, it forms the basis for the PLOS analysis.

Table 4.6-6 presents the Pedestrian Crossing LOS analysis. There are several pedestrian crossings that operate at PLOS E or PLOS F during the peak hours. This poor LOS is the result of the long traffic signal cycle lengths needed to process vehicular traffic and a relatively short pedestrian crossing phase. In addition to crossing delays, it should be noted that 18 signalized intersections were found to have substandard Walk/Flashing "Don't Walk" phases under the existing condition.

4.6.6.1 Pedestrian Safety

As part of the safety assessment discussed in Section 4.6.4, *Intersection Safety*, the MassHighway Crash database was reviewed for any crashes specific to pedestrians. In the three-year period between January 2004 and December 2006, 15 crashes involving pedestrians were reported at study area intersections; seven each in Medford and Somerville and one in Cambridge. No fatalities were reported, however

11 of the crashes involved personal injury. Five crashes occurred during the daytime in clear weather conditions. The remaining crashes occurred in poor weather conditions and/or at night. There is no apparent correlation between injury and road conditions and none of the intersections experience more than one pedestrian injury over the three-year period.

It is important to note that the MassHighway database has been created to provide information on vehicular crashes in cities and towns throughout Massachusetts. Therefore, the pedestrian incidents presented herein are all a result of vehicular conflict. Pedestrian incidents resulting from a conflict with a bicycle or other non-motorized source are not included. No database quantifying these types of incidents currently exists.

4.6.7 Bicycles

The study area defined as the Affected Environment for the Green Line Extension Project consists of relatively dense urban and suburban land uses. These communities typically have a larger than average number of bicyclists due to the proximity of Cambridge, Somerville, and Medford to each other and Boston. The current terminus of the Green Line is situated at the convergence of the planned Minuteman Commuter Bikeway/Somerville Community Path, planned NorthPoint bike system, the Dr. Paul Dudley White Bicycle Path, planned Urban Ring transit service, and the DCR Charles River Basin park system. The extension of the Green Line will reinforce this area as a hub for local and regional bicycle commuting and recreational bicycling.

As part of the data collection effort, bicycle turning movements were observed at each of the study area intersections during the morning and evening weekday peak hours. Bicycle volumes are moderate (less than 30 bicycles were noted on most roadways during the peak hour) throughout the study area; with the largest bicycle volumes observed along Somerville Avenue, McGrath and O'Brien Highways, and Washington Street. A higher concentration of bicycles was also seen in the vicinity of Powder House Square and Union Square. Minimal bicycle traffic was observed along Mystic Valley Parkway/Route 16 and Boston Avenue, where narrower roadway cross-sections may make cycling an unpleasant option for users. Bicycle volume observations can be found in Appendix F.

Bicycle parking is somewhat limited throughout the study area. There were a number of observations of bicycles locked to sign posts, parking meters, and fences. No bicycle parking areas were noted in the immediate vicinity of the proposed station locations.

4.6.7.1 Bicycle Safety

As part of the safety assessment discussed in Section 4.6.4, the MassHighway Crash database was reviewed for any crashes specific to bicycles. In the three-year period between January 2004 and December 2006, 16 crashes involving bicycles were reported at study area intersections; five each in Somerville and Cambridge and six in Medford. No fatalities were reported. However, 11 of the crashes involved personal injury. In all cases, roadway conditions were dry and only two incidents occurred during darkness. Two intersections (Boston Avenue at Harvard Avenue and Prospect Street at Cambridge Street) each experienced two incidents over the three-year period. The remainder of incidents occurred at various locations throughout the study area.

It is important to note that the MassHighway database has been created to provide information on vehicular crashes in cities and towns throughout Massachusetts. Therefore, the bicycle incidents presented herein are all a result of vehicular conflict. Bicycle incidents resulting from a conflict with another bicycle, pedestrian, or fixed object are not included. No database quantifying these types of incidents currently exists.

4.6.8 Parking

A limited parking inventory was conducted in the immediate vicinity of each of the proposed stations. This inventory includes on-street parking regulations, total parking supply, and the mid-day parking utilization (the number of parking spaces occupied) within 500 feet of the proposed centerline of the station platforms. Public off-street parking facilities were also included. An understanding of existing parking regulations and use in the station areas will help to determine the available parking supply that may be affected in the future as part of the Green Line Extension Project, either through a loss of parking spaces due to construction or use by Green Line riders.

Table 4.6-7 summarizes the findings of the parking inventory. A majority of parking spaces in the vicinity of Tufts University are regulated by parking permit for use by faculty, staff, and students. A number of additional spaces are restricted by length of stay. Time restrictions are enforced either by pay meter (all metered parking has a maximum time limit of two hours) or City parking enforcement. A detailed breakdown of the restricted parking spaces is provided in Table 4.6-8.

Table 4.6-7 Parking Inventory

Station	Total Parking Supply (number of spaces)				Percent Occupied[1]			
	Unrestricted	Restricted[2]	Permit Only	Metered	Unrestricted	Restricted	Permit Only	Metered
Mystic Valley Parkway	22	6	0	0	18%	0%	0%	0%
College Avenue	63	4	172	0	79%	0%	25%	0%
Ball Square	153	17	105	42	49%	12%	42%	48%
Lowell Street	97	5	75	0	44%	20%	33%	0%
Gilman Square	127	20	22	0	57%	53%	82%	0%
Brickbottom	62	18	25	0	68%	10%	72%	0%
Union Square	49	6	35	0	61%	0%	69%	0%
Lechmere	41	375	15	0	98%	95%	60%	0%

1 The percentage of parking spaces that were observed to be full during the middle of a typical weekday.
2 Restricted spaces include handicapped spaces, loading zones, areas with parking time limits, and MBTA dedicated spaces at Lechmere Station.

Table 4.6-8 Restricted Parking Allocation

Station	Number of Restricted Spaces By Type				
	Handicapped	Loading Zone	15-minute	2-hour	MBTA
Mystic Valley Parkway	0	0	0	6	0
College Avenue	3	1	0	0	0
Ball Square	5	6	6	0	0
Lowell Street	5	0	0	0	0
Gilman Square	0	0	0	20	0
Brickbottom	0	0	0	18	0
Union Square	0	1	0	5	0
Lechmere Square	0	0	0	0	375

4.6.9 Summary

The existing conditions assessment for the study area evaluated traffic and pedestrian operations, and safety statistics at 45 intersections throughout the communities of Cambridge, Somerville, and Medford. Parking and bicycle accommodations throughout the study area were observed in the vicinity of the proposed station locations and along key study area roadways.

The results of the existing conditions assessment reveal the following:

- Five study area intersections currently exceed the District 4 average crash rate.
- Nine study area intersections are currently ranked on the MassHighway Top 1,000 High Crash Location list.
- Ten signalized intersections and seven unsignalized intersections currently operate at unacceptable levels of service.
- Pedestrians currently experience a high pedestrian delay at 17 signalized intersections.
- While bicyclists were observed on almost all study area roadways, parking and/or storage areas for bicycles are minimal.
- A limited unrestricted parking supply is available to the public, with the majority of these spaces observed to be full during the midday period.

4.7 Air Quality

The Federal Transit Administration (FTA), in cooperation with the Federal Highway Administration (FHWA), has established procedures for Transportation Conformity requirements of the Clean Air Act as amended in 1990. The Transportation Conformity provisions of the Clean Air Act are intended to integrate transportation and air quality planning in areas that are designated by the Environmental Protection Agency (EPA) as not meeting the National Ambient Air Quality Standards. (NAAQS). Transit projects are an important part of improving air quality. The air quality study includes a local and regional air quality analysis that demonstrates compliance with State Implementation Plan (SIP) and Transportation Conformity. The local or hotspot analysis evaluated carbon monoxide (CO) and particulate matter (PM). The regional or mesoscale analysis evaluated ozone precursors (volatile organic compounds (VOCs), oxides of nitrogen (NO_x), the greenhouse gas carbon dioxide (CO_2), CO, and PM.

Guidance from both the EPA and MassDEP define the air quality modeling and review criteria for analyses prepared pursuant to the 1990 Clean Air Act Amendments (CAAA) and SIP. The CAAA and the SIP require that a proposed project not:

- Cause any new violation of the NAAQS;
- Increase the frequency or severity of any existing violations; or
- Delay attainment of any NAAQS.

These criteria are addressed in the microscale analysis.

The CAAA resulted in states being divided into attainment and non-attainment areas with classifications based upon the severity of their air quality problem. A non-attainment area is an area that has had measured pollutant levels that exceed the NAAQS and that has not been designated to attainment. The CAAA established emission reduction requirements that vary by an area's classification. The following is a discussion of the attainment status of each pollutant:

Carbon Monoxide (CO) Status. The proposed Project is located in the Cities of Cambridge, Somerville and Medford. The cities of Somerville and Medford are in attainment however the City of Cambridge is classified as a Maintenance attainment area for CO. Proposed projects that are located in CO non-attainment or Maintenance attainment areas are required to evaluate their impact on CO concentrations and the NAAQS.

Particulate Matter (PM) Status. The proposed Project is located in the Cities of Cambridge, Somerville, and Medford. All of these are in attainment. Under the Massachusetts Environmental Policy Act (MEPA) process, a PM analysis is typically not required unless the Project is in a non-attainment area or an analysis is specifically requested by MassDEP or EEA. However, because the Project is following the National Environmental Policy Act (NEPA) process as well as the MEPA process, a PM analysis was conducted.

Ozone Status. Massachusetts has been determined to be a non-attainment area, statewide, for ozone. The State has been divided into two non-attainment areas, Eastern and Western Massachusetts. On June 15, 2005, the EPA revoked the 1-hour ozone standard for most areas in the country. This action means that the 1-hour ozone non-attainment area classified as "Serious," is no longer applicable for Western Massachusetts. Only the 8-hour ozone NAAQS applies. The Project is located in the Eastern Massachusetts 8-hour ozone non-attainment area, which has been classified as "Moderate."

Greenhouse Gas Status. EEA has issued a policy and protocol for evaluating greenhouse gas (GHG) emissions from proposed projects with particular emphasis on CO_2 emissions. This policy requires that certain projects quantify greenhouse gas emissions generated by the Project and identify measures to reduce or minimize these impacts.

4.7.1 Air Quality Modeling Methodology

The air quality study for the Project evaluated the 2007 existing conditions for local and regional emissions for which future emissions could be compared. The existing 2007 conditions included the existing traffic conditions in the study area, and accounted for the existing roadway geometrics and observations of traffic flow.

The microscale analysis calculated CO and PM concentrations for congested intersections in the study area. The mesoscale analysis calculated VOCs, NO_x, CO_2, CO, and PM emissions for the existing conditions within the study area. The mesoscale analysis developed traffic (volumes and speeds) and emission factor data for the 2007 existing conditions. These data were incorporated into air quality models. The 2007 existing conditions represent current traffic conditions in the study area.

4.7.1.1 Microscale Analysis Methodology

The microscale analysis evaluated the CO and PM concentrations at congested intersections in the study area. The intersections selected for microscale air quality modeling were selected based upon the procedures outlined by the EPA and as referenced in the Department of Environmental Protection (DEP) guidelines.[9] These procedures require that the intersection be ranked by their LOS and their total traffic volumes and that the air quality analysis model the highest three intersection in each ranking. In addition, study intersections were added that would be impacted by station-related traffic and represent those that are in the vicinity of the proposed station sites. Intersections in the study area were ranked based on traffic volumes and LOS. As shown in Figure 4.7-1, the following intersections were selected for analysis because they were the most congested intersections in the study area:

- Mystic Valley Parkway/Route 16 at Boston Avenue
- Mystic Valley Parkway/Route 16 at Winthrop Street
- Mystic Valley Parkway/Route 16 Eastbound at Main Street and South Street
- Boston Avenue at College Avenue
- Harvard Street at Main Street
- Medford Street at Broadway and Dexter Street
- Highland Street at Central Street
- School Street at Medford Street
- Somerville Avenue at Webster Avenue
- Washington Street at McGrath Highway/Route 28 (East)
- Monsignor O'Brien Highway/Route 28 at Third Street
- Monsignor O'Brien Highway/Route 28 at East Street
- Monsignor O'Brien Highway/Route 28/Charles River Dam Bridge at Charlestown Avenue/Commercial Avenue

9 *Guidelines for Modeling Carbon Monoxide from Roadway Intersection*, U.S. Environmental Protection Agency, Office of Air Quality Planning and Standards, Technical Support Division; Research Triangle Park, NC; EPA-454/R-92-005; November 1992.

The microscale analysis calculated maximum 1-hour and 8-hour CO concentrations and the 24-hour PM concentrations in the Project area. The EPA's computer model CAL3QHC[10] was used to predict CO and PM concentrations at receptor locations for each intersection. These receptor locations were selected since they are located where the public has access and is expected to be for periods of time. Receptors were placed at the edge of the roadway, but not closer than 10 feet (3 meters) from the nearest travel lane, so that they were not within the roadway mixing cell. The results calculated at these receptor locations represent the highest concentrations at each intersection. Receptor locations farther away from the intersections will have lower concentrations because of the CO and PM dispersion characteristics. The receptor locations that are along the major roadways in the study area are also expected to have lower CO and PM concentrations than intersection receptors. The emission rates for vehicles traveling along these roadways are much lower than the emission rates for vehicles queuing at intersections.

The 1-hour CO concentrations were calculated directly using the EPA computer model, with evening peak hour traffic and emission data. The 8-hour CO concentrations were derived by applying a persistence factor of 0.73 to the 1-hour CO concentrations. This persistence factor was calculated from the DEP's most recent annual monitoring report.[11] It represents the average ratio of second highest 8-hour to second highest 1-hour CO readings at DEP's four Boston-area permanent monitoring stations.

4.7.1.2 Mesoscale Analysis Methodology

The predominant sources of regional pollution impacts anticipated from the proposed Green Line Extension Project are emissions reductions resulting from modal travel shifts from private automobiles to rail service. The mesoscale analysis uses traffic and emissions data for existing and future (No-Build and Build) conditions. The general modeling process to determine whether the Proposed Green Line Extension Project will have air quality impacts utilized link-by-link travel data from the CTPS statewide traffic model and emission factors derived using the EPA's *MOBILE 6.2* emission factor model. The link-by-link traffic data includes daily vehicle volumes as well as free flow and congested speeds over each link. The vehicle volumes are combined with the link lengths in order to determine the daily vehicle miles traveled (VMT) over the link. The VMT is then multiplied by the appropriate speed-specific emission factors in order to arrive at the total daily emissions for each link.

10 *User's Guide to CAL3QHC Version 2.0: A Modeling Methodology for Predicting Pollutant Concentrations Near Roadway Intersections*, U.S. Environmental Protection Agency, Office of Air Quality Planning and Standards, Technical Support Division; Research Triangle Park, NC; EPA-454/R-92-006; November 1992.

11 *2000 Annual Report on Air Quality in New England*, US Environmental Protection Agency, Region I, Lexington, Massachusetts; July 2001.

The roadways included in the mesoscale study area include the roadways coded in the CTPS statewide model and generally includes Eastern Massachusetts. The mesoscale analysis estimated the future regional VOCs, NO_x, CO_2, CO, and PM emissions due to the changes in average daily traffic volume, roadway characteristics, and vehicle emissions. The mesoscale analysis traffic (volumes, delays, and speeds) and emission factor data were developed for the above listed conditions.

The objective of the mesoscale analysis was to estimate the change in area-wide emissions of ozone precursor VOCs, NO_x, CO, and PM emissions during a typical day and CO_2 emissions during the entire year resulting from implementing the proposed Green Line Extension. The daily area-wide emissions are presented in kilograms per day to be consistent with the SIP emission inventories and in terms of tons per year to be consistent with Massachusetts GHG policy.

The vehicle emission factors used in the microscale and mesoscale analysis were obtained using the EPA's *MOBILE 6.2*[12] emissions model. *MOBILE 6.2* calculates emission factors from motor vehicles in grams per vehicle-mile for existing and future conditions. The emission rates calculated in this air quality study are adjusted to reflect Massachusetts-specific conditions such as the vehicle age distribution, the statewide Inspection and Maintenance (I/M) Program, and the Stage II Vapor Recovery System.[13] VOC and NOx emission factors for the mesoscale analysis were determined using the DEP-recommended temperatures for the summer (ozone) season and similarly for the microscale analysis, the CO emission factors were determined using winter (CO) seasons.

The air quality study used traffic data (volumes, delays, and speeds) developed for each analysis condition. The microscale analysis used the evening peak hour traffic conditions during the CO season (winter). The mesoscale analysis for VOC and NOx emissions used typical daily peak and off-peak traffic volumes for the ozone season (summer). Vehicle speeds are developed based upon traffic volumes, observed traffic flow characteristics, and roadway capacity. The detailed traffic analysis is presented in Section 4.6, *Traffic*.

4.7.2 Existing Conditions : Microscale Analysis

All the 1-hour and 8-hour CO concentrations are below the CO NAAQS of 35 and nine ppm, respectively. These values are consistent with the area's designation as a Maintenance CO attainment area. The microscale analysis determined that the 1-hour CO concentrations for 2007 ranged from 4.2 parts per million (ppm) to 8.4 ppm. The

12 MOBILE6.2 (Mobile Source Emission Factor Model), May 2004 release from US EPA, Office of Mobile Sources, Ann Arbor, MI.

13 The Stage II Vapor Recovery System is the process of collecting gasoline vapors from vehicles as they are refueled. This requires the use of a special gasoline nozzle at the fuel pump.

minimum 4.2 ppm value occurred at the intersections of Cambridge Street at First Street, Highland at Central Street and Boston Avenue at College Avenue and the maximum at the intersection of Monsignor O'Brien Highway at Charles River Dam Bridge at Charlestown Avenue and Commercial Avenue. The corresponding maximum 8-hour CO concentrations for 2007 ranged from a minimum of 2.8 ppm to a maximum of 5.5 ppm.

All the 24-hour PM concentrations are below the PM NAAQS of 150 ppm. These values are consistent with the area's designation as a PM attainment area. The microscale analysis determined that the 24-hour PM concentrations for 2007 ranged from 68 ppm to 91 ppm. The minimum 68 ppm value occurred at the intersections of Cambridge Street at First Street and Highland at Central Street and the maximum 91 ppm value occurred at the intersections of Monsignor O'Brien Highway at Charlestown Avenue/Land Boulevard and Mystic Valley Parkway/Route 16 at Winthrop Street. All of the microscale results are presented in Section 5.6, *Air Quality*.

4.7.3 Existing Conditions : Mesoscale Analysis

The 1990 CAAA divided states into attainment and non-attainment areas with classifications based upon the severity of the air quality problem. Massachusetts has been determined to be a non-attainment area, statewide, for ozone. As indicated earlier, only the 8-hour ozone NAAQS applies. The Project is located in the Eastern Massachusetts 8-hour ozone non-attainment area, which has been classified as "Moderate."

Under existing conditions, VOC emissions are estimated to be 65,473 kg/day, the NO_X emissions were estimated to be 162,965 kg/day and the PM10 emissions were estimated to be 5,819 kg/day. The corresponding vehicles miles traveled for the Eastern Massachusetts study area is 110, 409,645 vehicles per day.[14]

4.8 Noise

This section describes the existing noise conditions along the proposed Green Line Extension Project including:

- Background information on airborne noise and ground-borne noise;
- Description of FTA noise-sensitive land use categories;
- Identification of noise-sensitive locations along the corridor; and
- Measurement results of the existing noise conditions.

14 The Central Transportation Planning Staff (CTPS) Eastern Massachusetts study area contains 164 communities within the CTPS model area.

The noise impact analysis for the Green Line Extension Project is based on the methodology defined in the FTA guidance manual *Transit Noise and Vibration Impact Assessment* (Report FTA-VA-90-1003-06, May 2006).

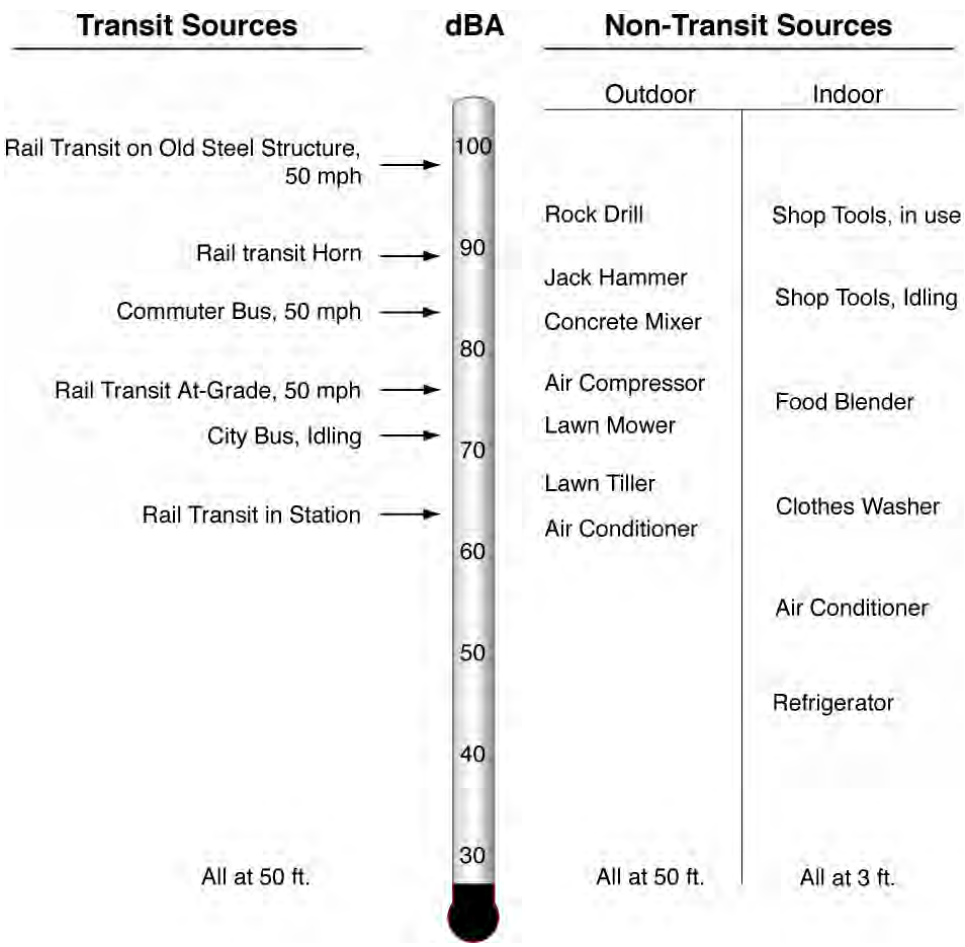
4.8.1 Introduction

Noise is typically defined as unwanted or undesirable sound, where sound is characterized by small air pressure fluctuations above and below the atmospheric pressure. The basic parameters of environmental noise that affect human subjective response are (1) intensity or level, (2) frequency content and (3) variation with time. The first parameter is determined by how greatly the sound pressure fluctuates above and below the atmospheric pressure, and is expressed on a compressed scale in units of decibels. By using this scale, the range of normally encountered sound can be expressed by values between zero and 120 decibels. On a relative basis, a three-decibel change in sound level generally represents a barely-noticeable change outside the laboratory, whereas a 10-decibel change in sound level would typically be perceived as a doubling (or halving) in the loudness of a sound.

The frequency content of noise is related to the tone or pitch of the sound, and is expressed based on the rate of the air pressure fluctuation in terms of cycles per second (called Hertz and abbreviated as Hz). The human ear can detect a wide range of frequencies from about 20 Hz to 17,000 Hz. However, because the sensitivity of human hearing varies with frequency, the A-weighting system is commonly used when measuring environmental noise to provide a single number descriptor that correlates with human subjective response. Sound levels measured using this weighting system are called "A-weighted" sound levels, and are expressed in decibel notation as "dBA." The A-weighted sound level is widely accepted by acousticians as a proper unit for describing environmental noise. To indicate what various noise levels represent, Figure 4.8-1 shows some typical A-weighted sound levels for both transit and non-transit sources. As indicated in this figure, most commonly encountered outdoor noise sources generate sound levels within the range of 60 dBA to 90 dBA at a distance of 50 feet.

Because environmental noise fluctuates from moment to moment, it is common practice to condense all of this information into a single number, called the "equivalent" sound level (Leq). Leq can be thought of as the steady sound level that represents the same sound energy as the varying sound levels over a specified time period (typically one hour or 24 hours). Often the Leq values over a 24-hour period are used to calculate cumulative noise exposure in terms of the Day-Night Sound Level (Ldn). Ldn is the A-weighted Leq for a 24-hour period with an added 10-decibel penalty imposed on noise that occurs during the nighttime hours (between 10 PM and 7 AM). Many surveys have shown that Ldn is well-correlated with human annoyance, and therefore this descriptor is widely used for environmental noise impact assessment.

Figure 4.8-1 Typical A-Weighted Sound Levels



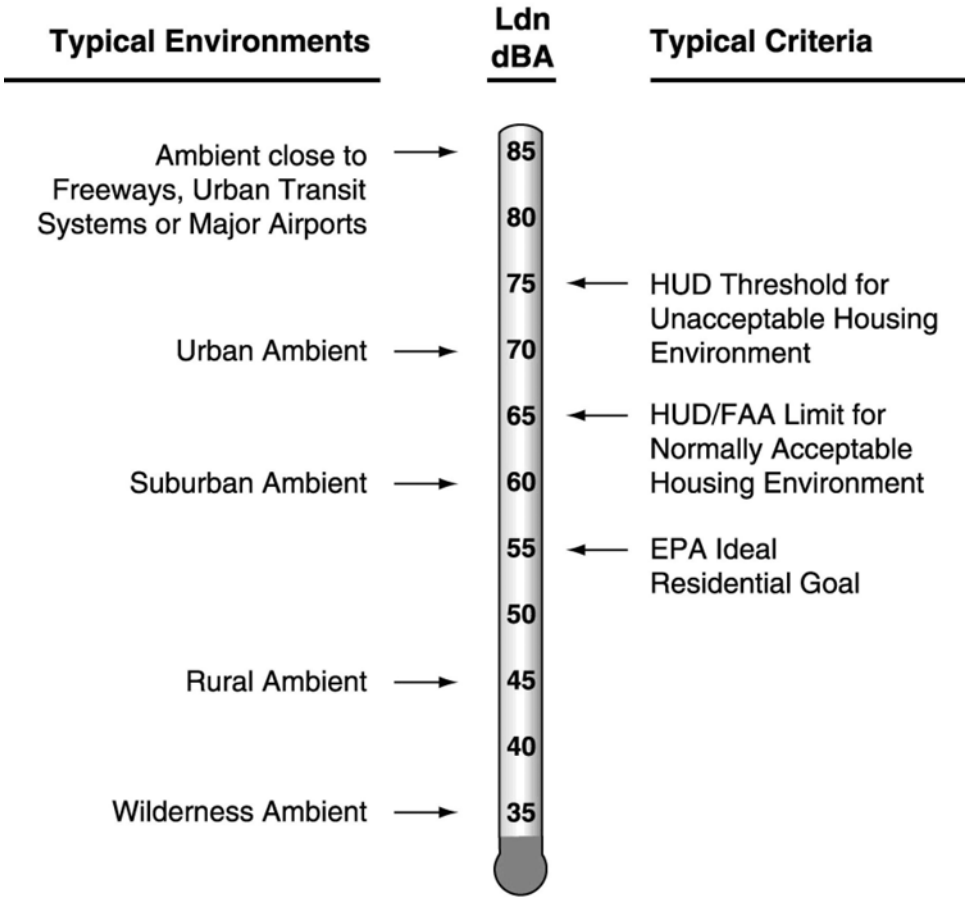
Source: Harris Miller Miller & Hanson, 2008

Figure 4.8-2 provides examples of typical noise environments and criteria in terms of Ldn. While the extremes of Ldn are shown to range from 35 dBA in a wilderness environment to 85 dBA in noisy urban environments, Ldn is generally found to range between 55 dBA and 75 dBA in most communities. As shown in Figure 4.8-2, this spans the range between an ideal residential environment and the threshold for an unacceptable residential environment according to U.S. Federal agencies such as the U.S. Department of Housing and Urban Development and the U.S. Environmental Protection Agency.

Ground-borne noise is produced when ground-borne vibrations propagate into a room and radiate noise from the motion of the surfaces. The room surfaces are essentially acting like a giant loudspeaker from the vibrations. Ground-borne noise is perceived as a low frequency rumble and is generally considered only when airborne paths are not present (e.g. train inside a tunnel or a large masonry building with no windows or other openings to the outdoors). As presented in the following section,

there are separate criteria for potential impact from airborne noise versus ground-borne noise.

Figure 4.8-2 Examples of Typical Outdoor Noise Exposure



Source: Harris Miller Miller & Hanson, 2008

4.8.2 Existing Noise Measurement Methodology

Existing noise measurements were conducted at representative noise-sensitive receptors. Noise impact is assessed at outdoor land uses with frequent use such as patios or pools, or at the nearest building façade. Both long-term (24-hour) and short-term (1-hour) noise measurements are conducted at these locations. Long-term measurements will provide a direct measurement of both Ldn and peak transit-hour Leq. Short-term measurements will provide a direct measurement of peak transit-hour Leq, and Ldn levels can be estimated based on methods described in the FTA guidance manual.

For measurements along the existing MBTA Fitchburg and MBTA Lowell Lines, one-second time histories of sound levels were measured along with audio recordings of events to allow the identification of train activity. These data were the basis for allowing us to determine noise levels generated from the existing commuter trains and also the contribution of noise from trains versus other ambient sources.

Existing noise measurement sites were selected based on the location of noise-sensitive land use along the proposed corridor, their proximity to the proposed alignment and the existing terrain conditions. The distance from the measurement location to significant noise sources (e.g. commuter train line or streets where there is no existing train activity) was chosen to be representative of typical noise-sensitive locations in each area. Measurements of the existing vibration levels of Green Line trains, existing vibration levels of commuter trains, and the vibration propagation characteristics of the soil were selected based on the ability to conduct measurements at-grade at distances up to 200 feet from the near tracks along sections of track without special trackwork. Vibration propagation characteristics measurement sites were also selected based on geological data available such as soil types and soil depths.

The FTA generally classifies noise-sensitive land uses into the following three categories.

- Category 1: Tracts of land where quiet is an essential element in their intended purpose. This category includes lands set aside for serenity and quiet, and such land uses as outdoor amphitheaters and concert pavilions, as well as National Historic Landmarks with significant outdoor use. Also included are recording studios and concert halls.
- Category 2: Residences and buildings where people normally sleep. This category includes homes, hospitals, and hotels where a nighttime sensitivity is assumed to be of utmost importance.
- Category 3: Institutional land uses with primarily daytime and evening use. This category includes schools, libraries, theaters and churches where it is important to avoid interference with such activities as speech, meditation and concentration on reading material. Places for meditation or study associated with cemeteries, monuments, museums, campgrounds and recreational facilities can also be considered to be in this category. Certain historical sites and parks are also included.

There are some buildings, such as concert halls, recording studios and theaters that can be very sensitive to noise and/or vibration but do not fit into any of the three categories. Due to the sensitivity of these buildings, they usually warrant special attention during the environmental assessment of a transit project.

4.8.3 Existing Conditions

This section discusses the existing noise levels and noise-sensitive land uses within the study area.

4.8.3.1 Existing Noise Conditions

To characterize the existing noise conditions in the study area, nine long-term (24-hour) and seven short-term (1-hour) measurements were conducted. Most locations adjacent to the MBTA Lowell Line and the MBTA Fitchburg Line were dominated by train activity. Figure 4.8-3 shows the noise measurement sites, and Table 4.8-1 shows the existing noise measurement results including Ldn, peak-transit hour Leq, the average noise levels from commuter trains (Lmax) and the distance to the nearest track. The table shows that existing Ldn levels at locations with existing commuter rail train activity range from 64 to 80 dBA. Maximum noise levels from the commuter trains range from 78 to 99 dBA at distances of 50 to 150 feet from the near-track centerline.

Table 4.8-1 Existing Noise Measurement Results

Measurement Site	Location	Existing Day-Night Average Sound Level (Ldn)	Existing Peak-Transit Hour Sound Level (Leq)	Commuter Train Noise Level (Lmax)[d]	Distance to Nearest Track (feet)
LT-1	39 Horace Street (Somerville)	64	65	79	60
LT-2	5 Alston Street (Somerville)	74	73	89	65
LT-3	283 Medford Street (Somerville)	66	64	80	120
LT-4	34 Richdale Street (Somerville)	74	73	90	50
LT-5	86 Vernon Street (Somerville)	68	67	85	110
LT-6	95 Boston Avenue (Somerville)	68	67	86	70
LT-7	7/9 Winchester Place (Somerville)	77	76	93	55
LT-8	131 Burget Avenue (Medford)	71	69	89	60
LT-9	76 Orchard Street (Medford)	71	69	88	60
ST-1	Water Street (Cambridge) – Hampton Inn Hotel	58[b]	60	n/a	n/a
ST-2	Fitchburg Street (Somerville) – Brickbottom Lofts	64[a]	61	78	65[c]
ST-3	248 Somerville Avenue (Somerville)	64[b]	66	n/a	n/a
ST-4	2 Charlestown Street (Somerville)	66[a]	64	82	150
ST-5	45 Aldrich Street (Somerville)	70[a]	62	87	50
ST-6	81 Hinckley Street (Somerville)	78[a]	72	96	50
ST-7	Colby Street (Medford) – Tufts University	80[a]	76	99	50

Source: HMMH, 2008.

a Ldn estimated by comparing SEL levels of train events to long-term sites whose noise environment is dominated by train noise.

b Ldn estimated according to FTA guidance for short-term measurements conducted between 7 am and 7 pm.

c There is a siding track at 40 feet from the measurement location.

d Commuter train noise level is average of all events at site.

4.8.3.2 Noise-Sensitive Land Use

Noise-sensitive land use near the Project study area includes residential properties, schools, libraries, a television studio and other institutional sites.

The existing noise environment for the study area is generally dominated by trains on the MBTA commuter rail lines. This includes MBTA commuter trains, Amtrak regional trains (on the MBTA Lowell Line) and occasional freight activity.

Lechmere Station to Fitchburg Street

Noise-sensitive land use between Lechmere Station and Fitchburg Street includes residential land use at the NorthPoint Properties, Glass Factory Condominiums, and the Hampton Inn Hotel on Monsignor O'Brien Highway. Lechmere Canal Park south of Monsignor O'Brien Highway and east of East Street is sensitive to noise. On Fitchburg Street, the south side of the Brickbottom Lofts is adjacent to the MBTA Fitchburg Line and the north side of the Brickbottom Lofts is adjacent to the proposed Green Line Extension. The existing noise environment for sensitive land use along the O'Brien Highway is dominated by vehicles. The existing noise environment for the Brickbottom Lofts is dominated by trains on the MBTA Fitchburg Line including MBTA commuter trains and freight train activity. Short-term (1-hour) noise measurements were conducted on the north side of the Hampton Inn on Water Street (ST-1) and the south side of the Brickbottom Lofts (ST-2). The estimated Ldn at ST-1 was 58 dBA and at ST-2 was 64 dBA (Table 4.8-1).

Fitchburg Street to Union Square

The proposed Green Line Extension branch line to Union Square would be adjacent to single-family residences on Horace Street, apartments on Charlestown Street, the Walnut Street Center (educational facility), single-family and multi-family residences on Somerville Avenue, Somerville Fire Department housing and the SCAT studio. Existing noise levels for sensitive land use on Horace Street and Charlestown Street is dominated by trains on the MBTA Fitchburg Line. Existing noise levels for residences and SCAT studio on Somerville Avenue are dominated by vehicles traveling on Somerville Avenue. A long-term (24-hour) noise measurement was conducted on Horace Street (LT-1) and two short-term noise measurements were conducted on Somerville Avenue (ST-3) and Charlestown Street (ST-4). The Ldn measured at LT-1 was 64 dBA and the estimated Ldn at sites ST-3 and ST-4 were 64 dBA and 66 dBA, respectively (Table 4.8-1).

Fitchburg Street to McGrath Highway/Route 28

Sensitive land use between Fitchburg Street and McGrath Highway/Route 28 along the MBTA Lowell Line includes single-family residences on Alston Street, Chester Avenue, Tufts Street and Auburn Place. A long-term noise measurement was

conducted at a single-family residence on Alston Street (LT-2). The measured Ldn at site LT-2 was 74 dBA (Table 4.8-1).

McGrath Highway/Route 28 to School Street

Sensitive land use between McGrath Highway/Route 28 and School Street includes multi-family residences on Medford Street, multi-family and single-family residences on Gilman Street and Aldrich Street, Somerville High School and the Somerville Public Library. Residences on Medford Street, the Somerville High School and Public Library are located on an embankment south of the MBTA Lowell Line approximately 50 feet above the tracks, residences on Gilman Street and Aldrich Street are on a slight embankment approximately 10 feet above the tracks. A long-term noise measurement was conducted on Medford Street (LT-3) and a short-term noise measurement was conducted on Aldrich Street (ST-5). The measured Ldn at site LT-3 was 66 dBA and the estimated Ldn at site ST-5 was 70 dBA (Table 4.8-1).

School Street to Central Street

Sensitive land use between School Street and Central Street includes residences on Montrose Street, Willoughby Street and Richdale Street. A long-term noise measurement was conducted on Richdale Street (LT-4). The measured Ldn at site LT-4 was 74 dBA (Table 4.8-1).

Central Street to Broadway

Sensitive land use between Central Street and Broadway includes residences on Vernon Street, Hinckley Street, Henderson Street, Nashua Street, Murdock Street and Boston Avenue and the Visiting Nurses Association assisted living facility on Lowell Street. The Park of Somerville Junction planned near Woodbine Street and Centre Street and Trum Playground are noise-sensitive. Long-term noise measurements were conducted on Vernon Street (LT-5) and Boston Avenue (LT-6) and a short-term noise measurement was conducted on Hinckley Street (ST-6). The measured Ldn at sites LT-5 and LT-6 were both 68 dBA and the estimated Ldn at site ST-6 was 78 dBA (Table 4.8-1).

Broadway to Harvard Street

Sensitive land use between Broadway and Harvard Street includes single-family residences on Winchester Court, Winchester Place, Granville Avenue, Morton Avenue, Newbern Avenue and a condominium complex on Boston Avenue. Grant Park south of Boston Avenue and East of Winthrop Street is sensitive to noise. A long-term noise measurement was conducted on Winchester Place (LT-7). The measured Ldn at site LT-7 was 77 dBA (Table 4.8-1).

Harvard Street to College Avenue

Noise-sensitive land use between Harvard Street and College Avenue include Tufts University buildings on Colby Street and Boston Avenue. These institutional buildings include the Science and Technology building, Bray Laboratories, the Outside the Lines artist studio and other classroom buildings. A short-term noise measurement near the artist studio was conducted (ST-7). In addition to existing noise measurements, vibration measurements were taken at this location to quantify the existing vibration levels of trains traveling on the MBTA Lowell Line. The estimated Ldn at site ST-7 was 80 dBA (Table 4.8-1).

College Avenue to Winthrop Street

Sensitive land use between College Avenue and Winthrop Street include single-family residences on Burget Avenue and Charnwood Road. A long-term noise measurement was conducted on Burget Avenue (LT-8). The measured Ldn at site LT-8 was 71 dBA (Table 4.8-1).

Winthrop Street to Mystic Valley Parkway/Route 16

Sensitive land uses between Winthrop Street and Mystic Valley Parkway/Route 16 include single-family residences on Orchard Street and Piggot Road and a Tufts University building on Boston Avenue including the Nanoscale Integrated Sensors and Systems laboratory. The Mystic River Reservation north of the MBTA Lowell Line and west of Fortunado Drive is sensitive to noise. A long-term noise measurement was conducted on Orchard Street (LT-9). The measured Ldn at site LT-9 was 71 dBA (Table 4.8-1).

4.9 Vibration

This section describes the methodology used to characterize the existing noise and vibration conditions, including:

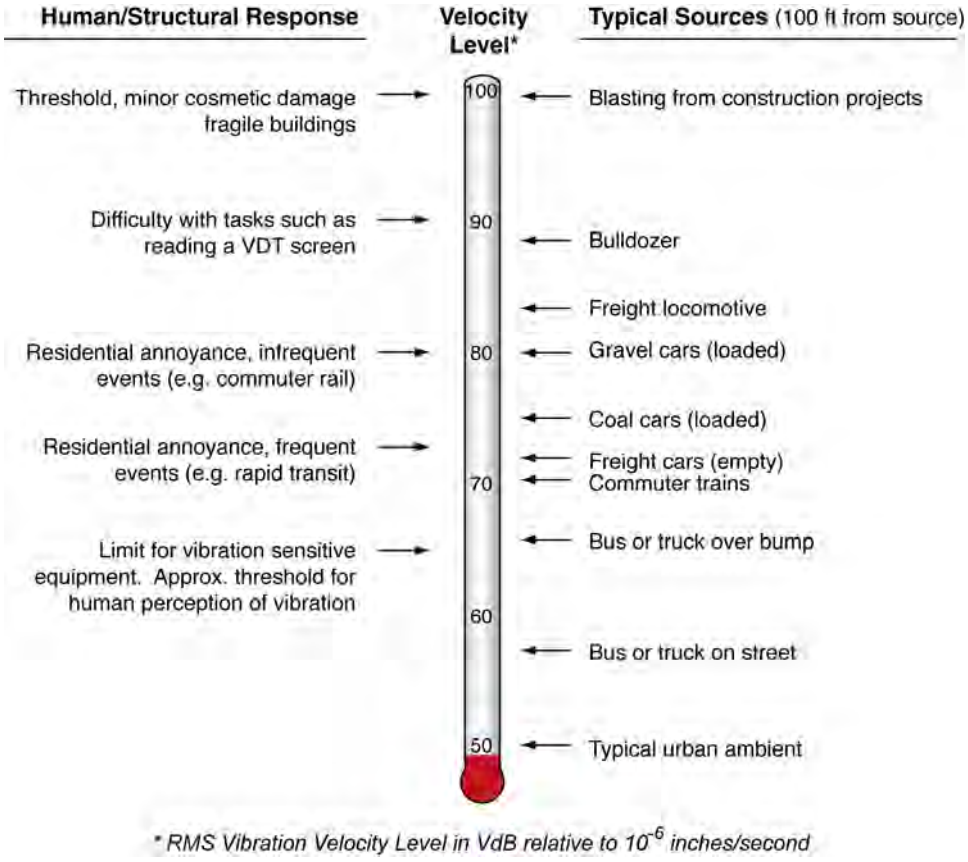
- Background information on vibration;
- Description of FTA vibration-sensitive land use categories;
- Identification of vibration sensitive locations along the corridor; and
- Measurement results of the existing vibration conditions.

The noise impact analysis for the Green Line Extension Project is based on the methodology defined in the FTA guidance manual *Transit Noise and Vibration Impact Assessment* (Report FTA-VA-90-1003-06, May 2006).

4.9.1 Introduction

Ground-borne vibration is the oscillatory motion of the ground about some equilibrium position that can be described in terms of displacement, velocity or acceleration. Because sensitivity to vibration typically corresponds to the vibration velocity amplitude in the low-frequency range of most concern for environmental vibration (roughly eight to 80 Hz), velocity is the preferred measure for evaluating ground-borne vibration from transit projects.

Figure 4.9-1 Typical Ground-Borne Vibration Levels and Criteria



Source: Harris Miller Miller & Hanson, 2008

Ground-borne vibration is typically characterized in terms of the "smoothed" root-mean-square (RMS) vibration velocity level, in decibels (VdB), with a reference quantity of one micro-inch per second. VdB is used in place of dB to avoid confusing vibration decibels with sound decibels. Vibration levels in terms of RMS velocity have been found to correlate most suitably to human response to vibration in buildings and is the metric commonly used in American and International standards.

Figure 4.9-1 illustrates typical ground-borne vibration levels for common sources as well as criteria for human and structural response to vibration. As shown, the range of interest is from approximately 50 to 100 VdB, from imperceptible background vibration to the threshold of damage. Although the approximate threshold of human vibration perception is 65 VdB, annoyance is usually not significant unless the vibration exceeds 70 VdB.

Ground-borne noise is produced when ground-borne vibrations propagate into a room and radiate noise from the motion of the surfaces. The room surfaces are essentially acting like a giant loudspeaker from the vibrations. Ground-borne noise is perceived as a low frequency rumble and is generally considered only when airborne paths are not present (e.g. train inside a tunnel or a large masonry building with no windows or other openings to the outdoors).

4.9.2 Methodology

Existing vibration levels of the commuter trains were measured at Tufts University Alumni Field. In addition to reference vibration levels of the commuter trains, measurements of the vibration propagation characteristics of the soil were conducted at three locations along the proposed corridor. These locations include 200 Innerbelt Road, 20 Vernon Street and Tufts University Alumni Field. These measurements allow us to project future vibration levels from new transit sources such as the proposed Green Line trains and project future vibration levels from the commuter trains including any modifications to the alignment. Vibration-measurement locations are shown on Figure 4.8-3.

4.9.3 Vibration-Sensitive Land Use Categories

The FTA generally classifies vibration-sensitive land uses into the same three categories as noise:

- Category 1: Tracts of land where quiet is an essential element in their intended purpose. This category includes lands set aside for serenity and quiet, and such land uses as outdoor amphitheaters and concert pavilions, as well as National Historic Landmarks with significant outdoor use. Also included are recording studios and concert halls.
- Category 2: Residences and buildings where people normally sleep. This category includes homes, hospitals, and hotels where a nighttime sensitivity is assumed to be of utmost importance.
- Category 3: Institutional land uses with primarily daytime and evening use. This category includes schools, libraries, theaters and churches where it is important to avoid interference with such activities as speech, meditation and concentration on reading material. Places for meditation or study associated with cemeteries,

monuments, museums, campgrounds and recreational facilities can also be considered to be in this category. Certain historical sites and parks are also included.

There are some buildings, such as concert halls, recording studios and theaters that can be very sensitive to vibration but do not fit into any of the three categories. Due to the sensitivity of these buildings, they usually warrant special attention during the environmental assessment of a transit project. Some buildings such as medical facilities or research institutions may contain vibration-sensitive equipment. Potential vibration impact of sensitive equipment such as electron microscopes and magnetic resonance imaging scanners is also considered.

4.9.4 Existing Vibration Conditions

To characterize the existing vibration conditions in the study area, reference vibration measurements of MBTA commuter trains and Amtrak trains (the primary consistent sources of vibration) were conducted at Tufts University Alumni Field. Measurements were conducted of train passbys at several distances away from the track centerline (50 to 250 feet).

Figure 4.9-2 Existing Vibration Measurement Results

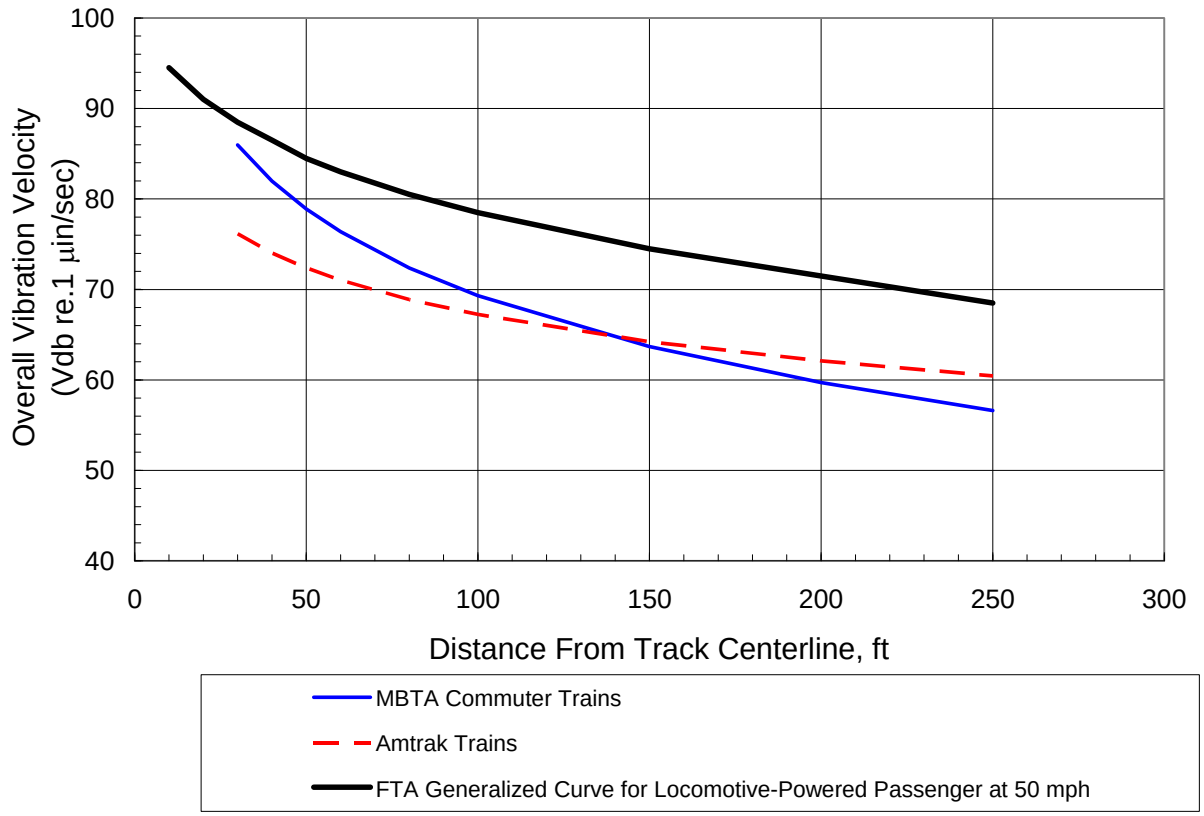


Figure 4.9-2 shows the maximum overall vibration level for each train type at a range of distances and the typical FTA generalized curve for locomotive-powered passenger trains at 50 mph. This figure shows that the vibration levels from the MBTA commuter and Amtrak trains are about five to 10 VdB lower than the generalized curve.

4.9.5 Vibration-Sensitive Land Use

Vibration-sensitive land uses near the Project study area include residential properties, schools, libraries, a television studio, and other institutional sites.

The existing vibration environment for the study area is generally dominated by trains on the MBTA commuter rail lines. This includes MBTA commuter trains, Amtrak regional trains (on the MBTA Lowell Line) and occasional freight activity.

Lechmere Station to Fitchburg Street

Sensitive land use between Lechmere Station and Fitchburg Street includes residential land use at the Glass Factory condos and the Hampton Inn Hotel on Monsignor O'Brien Highway. On Fitchburg Street, the south side of the Brickbottom Lofts is adjacent to the MBTA Fitchburg Line and the north side of the Brickbottom Lofts is adjacent to the proposed Green Line Extension. The existing noise environment for sensitive land use adjacent to O'Brien Highway is dominated by vehicles. The existing environment for the Brickbottom Lofts is dominated by trains on the MBTA Fitchburg Line including MBTA commuter trains and freight train activity.

Fitchburg Street to Union Square

The area along the Green Line Extension branch line to Union Square includes single-family residences on Horace Street, apartments on Charlestown Street, the Walnut Street Center (educational facility), single-family and multi-family residences on Somerville Avenue, Somerville Fire Department housing and the Somerville Community Access Television Studio (CATS). Existing conditions for sensitive land use on Horace Street and Charlestown Street is dominated by trains on the MBTA Fitchburg Line. Existing conditions for residences and CATS on Somerville Avenue are dominated by vehicles traveling on Somerville Avenue.

Fitchburg Street to McGrath Highway/Route 28

Sensitive land use between Fitchburg Street and McGrath Highway/Route 28 along the MBTA Lowell Line includes single-family residences on Alston Street, Chester Avenue, Tufts Street and Auburn Place.

McGrath Highway/Route 28 to School Street

Sensitive land use between McGrath Highway/Route 28 and School Street includes multi-family residences on Medford Street, multi-family and single-family residences on Gilman Street and Aldrich Street, Somerville High School and the Somerville Public Library. Residences on Medford Street, the Somerville High School and Public Library are located on an embankment south of the MBTA Lowell Line approximately 50 feet above the tracks, residences on Gilman Street and Aldrich Street are on a slight embankment approximately 10 feet above the tracks.

School Street to Central Street

Sensitive land use between School Street and Central Street includes residences on Montrose Street, Willoughby Street and Richdale Street.

Central Street to Broadway

Sensitive land use between Central Street and Broadway includes residences on Vernon Street, Hinckley Street, Henderson Street, Nashua Street, Murdock Street and Boston Avenue and the Visiting Nurses Association assisted living facility on Lowell Street.

Broadway to Harvard Street

Sensitive land use between Broadway and Harvard Street includes single-family residences on Winchester Court, Winchester Place, Granville Avenue, Morton Avenue, Newbern Avenue and a condominium complex on Boston Avenue.

Harvard Street to College Avenue

Noise and vibration-sensitive land use between Harvard Street and College Avenue include Tufts University buildings on Colby Street and Boston Avenue. These institutional buildings include the Science and Technology building, Bray Laboratories, the Outside the Lines artist studio and other classroom buildings. Vibration measurements were taken at this location to quantify the existing vibration levels of trains traveling on the MBTA Lowell Line. Existing vibration levels from MBTA commuter trains were found to be approximately 83 VdB at 50 feet from the track centerline and 76 VdB at 100 feet from the track centerline.

College Avenue to Winthrop Street

Sensitive land use between College Avenue and Winthrop Street include single-family residences on Burget Avenue and Charnwood Road.

Winthrop Street to Mystic Valley Parkway/Route 16

Sensitive land use between Winthrop Street and Mystic Valley Parkway/Route 16 includes single-family residences on Orchard Street and Piggot Road, a Tufts University building on Boston Avenue including the Nanoscale Integrated Sensors and Systems laboratory and multi-family housing on Fortunato Drive. This laboratory houses vibration-sensitive equipment including photolithography and metrology instruments.

4.10 Stormwater

The Secretary's Certificate specifies that the DEIR should quantify new impervious surfaces, identify new discharge points, include an overall drainage plan, describe any stormwater impacts, and demonstrate compliance with the DEP Stormwater Management Policy (now the Stormwater Management Standards). This section introduces the major concepts relevant to stormwater management, summarizes the existing stormwater drainage system in Somerville and Medford, and discusses the relationship between stormwater drainage and local water resources.

4.10.1 Introduction

When precipitation touches the ground during a storm, some fraction of the water is absorbed while the rest becomes surface runoff (overland flow of water). The permeability of the ground cover determines how much runoff occurs. Vegetated areas such as fields and forests can absorb a large fraction of most storms, while impervious surfaces such as concrete and asphalt prevent infiltration and generate large quantities of runoff.

Development has two common effects on stormwater:

- Increased flows and flooding; and
- Increased loading of contaminants.

Impervious cover for buildings, parking, roads, and sidewalks decreases the amount of water infiltrating into the ground and increases the volume of runoff generated. Water also flows faster across impervious surfaces than across natural, pervious ones, which results in increased flow rates. The combination of increased runoff volumes and increased flow rates can cause flooding and erosion. Stormwater drainage systems are designed to collect runoff from developed areas and discharge it to a safe location, usually a local water body. These systems are usually designed to detain the water, controlling the rate of discharge to prevent flooding in the receiving water or downstream. Some systems also incorporate infiltration areas (both on the

surface and underground) to reduce the total volume of runoff and maintain groundwater recharge.

Urbanized stormwater typically contains contaminants that are washed off of paved surfaces during storms. Roads and parking lots can contribute metals, hydrocarbons, salts, sediments, and other substances to runoff. The accumulation of pollutants from vehicles on road surfaces is primarily dependent upon vehicle traffic volumes.[15] Urbanized areas — particularly residential neighborhoods — are also common sources of bacteria from due to uncontrolled waste from wildlife and pets. Overall, the pollutants carried in roadway runoff may have adverse effects on the aquatic ecosystem if they occur within surface waters in sufficient concentrations. To reduce these problems, most stormwater systems include measures to prevent or reduce water contamination, including simple gratings to screen out trash, settling basins to collect suspended particles, and specialized structures to separate oil and floating debris. Additional measures may be used to protect especially sensitive water bodies from contamination and impairment.

Based on these concepts, the primary areas of interest for stormwater management include:

- The amount and type of development that has taken place in a watershed, which affects both the quantity of impervious surface and the types of potential contaminant sources;
- The design of the stormwater system, which includes any measures to reduce flow rates, prevent flooding, and control contaminants; and
- The quality of the receiving water body that may be impacted by stormwater discharges.

4.10.2 Regional Context

Somerville and Medford are both urban Cities located within the Mystic River watershed, one of the most densely populated urban areas in Massachusetts. The Mystic River is the largest waterway in both cities and is impaired by a number of environmental hazards. The Mystic River is controlled by the Amelia Earhart Dam, which was installed in 1966 and is located at the confluence of the Mystic River and the Malden River near McGrath Highway/Route 28. The dam cuts off the lower Mystic River from the majority of its watershed upstream, causing a buildup of contaminated sediments behind the dam and preventing the migration of anadromous fish. The watershed as a whole (76 square miles) also includes a number of contaminant sources, including waste disposal sites, contaminated sediments, and bacteria discharges. Between Lower Mystic Lake and the Amelia Earhart Dam, the

15 Buckler & Granato. *Assessing Biological Effects from Highway-Runoff Constituents*. (1999). Page 16.

Mystic River is a Class B warm-water fishery, which designates waterways that are not used for drinking water but should have adequate quality for aquatic life, recreational uses, and fish consumption. This section of the Mystic River is listed on the Massachusetts 303(d) list as impaired (and therefore not supporting its intended uses) due to metals, excess nutrients, and pathogens. Downstream of the dam, the Mystic River is listed as a Class SB water, which applies to saltwaters intended to support aquatic life, recreational uses, and fish/shellfish consumption. This section of the Mystic River is impaired due to priority organics, metals, unionized ammonia, low dissolved oxygen, pathogens, oil and grease, aesthetic issues such as taste, odor, and color, and unspecified inorganics.[16] The numerous urban stormwater discharges into the Mystic River have been cited as the main source of its existing impairments.[17]

Communities upstream of Somerville and Medford affect the Mystic River's health as well. For example, Cambridge has multiple combined sewer overflows (CSOs) on Alewife Brook upstream of Somerville's discharges. CSOs allow combined sewers to discharge to surface waters when storm events overwhelm the system's capacity. This can lead to discharges of untreated sewage during large storms and impairment of the receiving waters. Alewife Brook is tributary to the Mystic River and is listed on the Massachusetts 303(d) list as impaired due to metals, excess nutrients, low DO, pathogens, oil and grease, and aesthetic issues such as taste, odor, and color.[18]

Many of the local communities, including Cambridge, Somerville, and Medford are part of the National Pollutant Discharge Elimination System (NPDES) Small Municipal Separate Storm Sewer System (MS4) General Permit, which includes numerous requirements to improve stormwater management through public education, upgraded infrastructure, and municipal bylaws. The permit also requires the cities to locate and correct any unauthorized sewage discharges into the stormwater system.

4.10.3 Rail Corridors

Most of the Green Line Extension Project would be constructed in existing rail corridors. The existing drainage systems consist of a network of ditches and underdrains that intercept the runoff within the railroad corridor. Due to the corridor's narrow width, the use of drainage ditches is limited to the north end of the corridor between College Avenue and North Street. The ditches and underdrains convey the runoff to a trunkline that discharges to any one of several outfalls on the Mystic River and the Miller's River (a tributary to the Charles River).

16 Division of Watershed Management, Watershed Planning Program. *Massachusetts Year 2006 Integrated List of Waters*. (August 2007), Page 85.
17 City of Somerville, Massachusetts. *Developing an Innovative Model for Cost Effective Asset Management and Pollution Prevention in a Municipal Storm Water System*. (2005), Page 6.
18 Division of Watershed Management, Watershed Planning Program. *Massachusetts Year 2006 Integrated List of Waters*. (August 2007), Page 84.

4.10.4 Somerville

Approximately two-thirds of Somerville's streets use a combined sewer system in which both stormwater and domestic sewage are conveyed in the same pipe and treated at the Massachusetts Water Resource Authority's (MWRA's) Deer Island wastewater facility. The remainder of the city has a separate stormwater system that discharges to the Mystic River.[19] Somerville also has four CSOs, all discharging to the Mystic River or its tributaries. The discharge of untreated sewage (combined with stormwater runoff) to the Mystic River during large storms increases the risk to human health and makes the river temporarily unusable for recreational purposes.

Physical controls to manage stormwater and improve its quality in Somerville include street sweeping and annual catch basin maintenance. Additional structural improvements such as hooded outlets in catch basins have not been implemented at this time. However, state grants have been used to install treatment structures on the Alewife Brook, including a Stormtreat system that uses vegetation and gravel filters to improve water quality and promote infiltration.

4.10.5 Medford

In Medford, all stormwater discharges directly to the Mystic River and its tributaries such as the Malden River via nearly 100 separate stormwater outfalls. The Mystic River flows from the west to the southeast through Medford. The City has a separate stormwater system and no CSOs. However, there are utility systems in Medford (such as the MWRA sewer line and stormwater cross-connections with Somerville) that are not under Medford's control and may contain relief outlets or illicit discharges contributing sewage or other contamination to the Mystic River.

Physical controls to manage stormwater and improve its quality in Medford include street sweeping and annual catch basin maintenance. Additional structural improvements such as hooded outlets in catch basins have not been implemented at this time. Medford has developed training programs, city ordinances, and fines to encourage both municipal employees and the general public to prevent common sources of water pollution such as littering, pet waste, and illicit discharges.

4.11 Wetlands

There are no state- or Federally-regulated wetlands within the study area and therefore no potential for wetland impacts. Site investigations identified one potential wetland area, an isolated ditch within the MBTA Lowell Line right-of-way

19 City of Somerville, Massachusetts. *Developing an Innovative Model for Cost Effective Asset Management and Pollution Prevention in a Municipal Storm Water System.* (2005). Page 9.

at Cedar Street in Somerville. The ditch was determined to be non-jurisdictional by the Somerville Conservation Commission.

4.12 Fish, Wildlife and Plants

Portions of the Project area along the MBTA Lowell Line provide habitat for urban wildlife species. Throughout much of the Project area there is a narrow fringe of vegetation (generally 30 to 40 feet wide) between the commuter rail tracks and the limits of the right-of-way. This fringe of vegetation is absent where the tracks are directly bordered by retaining walls, buildings or parking lots. Vegetated areas primarily occur between Fitchburg Street and Washington Street; between McGrath Highway/Route 28 and Medford Street; between School Street and Central Street; between Central Street and Lowell Street; and between College Avenue and Winthrop Street in Medford.

The vegetation in most of these areas is dominated by non-native and invasive species, including Norway maple (*Acer platanoides*), tree of heaven (*Ailanthus altissima*), catalpa (*Catalpa speciosa*), rock (sycamore) maple (*Acer pseudoplatanus*), and oriental bittersweet (*Celastrus orbiculatus*). Other dominant species include goldenrods (*Solidago* spp.), poison ivy (*Toxicodendron radicans*), and grasses (primarily *Agrostis* sp.). This plant community provides limited wildlife habitat due to the narrow width, lack of shrub stratum, sparse herbaceous layer, and few food resources for wildlife. Some common suburban wildlife species could use the habitat for feeding or nesting, such as gray squirrel, American robin, gray catbird, or downy woodpecker. During field investigations, a groundhog (*Marmota monax*) was observed in the segment north of School Street.

The vegetation in the segment between College Avenue and just north of Winthrop Street has a more diverse plant community which includes, in addition to the species listed above, native tree species (red oak, *Quercus rubra*; pin oak, *Quercus palustris*; silver maple, *Acer saccharinum;* black cherry*, Prunus serotina;* and gray birch*, Betula populifolia*) and native herbaceous species (hay-scented fern, *Dennstaedtia punctilobula*; tree clubmoss, *Lycopodium obscurum*). This plant community contains good wildlife food resources (acorns, birch seeds, cherry), a denser sapling layer, and a denser herbaceous layer that provides cover for small animals. In addition to the species listed above, this habitat could also provide feeding or nesting habitat for blue jay, common grackle, mourning dove, chipping sparrow, white-footed deer mouse, and chipmunk. A comment letter on the EENF noted that red-tailed hawks have been observed feeding, roosting and potentially nesting in this area. Red-tailed hawks are common urban/suburban raptors.

4.13 Parks and Recreation

Public parks, recreation areas, and conservation lands are subject to Section 4(f) provisions of the U.S. Department of Transportation Act of 1966, recodified at 49 U.S.C., Section 303(c)[20] and the Commonwealths' Article 97 Land Disposition Policy.[21]

The Green Line Extension Project area of potential effects (APE) for parks and recreational areas is defined as an area extending approximately 100 feet on either side of the proposed Medford and Union Square corridors, associated station locations, and maintenance and/or interim train storage facilities. This area encompasses the construction limits of the Project and the associated area of impacts (physical disturbance, noise, changes in access, etc.). Playgrounds on public school properties are considered Section 4(f) resources if they meet the four conditions of a park or recreation area (publicly owned, open to the public, must be used for recreation, and must be considered significant). No public school playgrounds were identified within 100 feet of the proposed transit corridor and stations

This section identifies and describes public parks, recreation areas, and conservation lands within the APE. These resources were identified within the study area (Cambridge, Somerville, and Medford) using available GIS data, information from DCR, and information provided by the municipalities of Somerville and Medford.

Five existing public parks, recreation areas, and conservation lands were identified within 100 feet of the proposed transit corridor and stations and are described below (Table 4.13-1).

- Lechmere Canal Park (Figure 4.1-1) is southeast of the Cambridgeside Galleria Mall off of Edwin H. Land Boulevard in Cambridge. This 4.39-acre area offers a scenic area for passive recreational opportunities such as picnic areas, walking, running, and bicycling. Lechmere Canal Park is owned and operated by the City of Cambridge.
- Hoyt-Sullivan Playground (Figure 4.1-6) is on Central Street between Pembroke Street and the railroad bridge in Somerville. This 0.38-acre recreational area contains children's playground equipment and a basketball court. Hoyt-Sullivan Playground is owned and operated by the City of Somerville.
- Trum Playground Figure 4.1-7) is at the corner of Cedar Street and Franey Road, across from Trum Field in Somerville. This 0.39-acre area contains playground equipment and benches. Trum Playground is owned and operated by the City of Somerville.

20 *Section 4(f) of 1966, (Recodified at 49 U.S.C., Subtitle I, Section 303(c)*. United States Department of Transportation Act.
21 Executive Office of Environmental Affairs. *Article 97 Land Disposition Policy*. February 19, 1998.

- Grant Park (Figure 4.1-9), off of Boston Avenue in Medford, is a 0.20-acre public park used for passive recreation. Grant Park is owned and operated by the City of Medford.
- The Mystic River Reservation (Figure 4.1-10), along the Mystic Valley Parkway/Route 16 in Medford and Somerville, offers picnic areas, and trails for bicycling, running, and hiking. Three parcels of the reservation, containing 4.87 acres between the intersection of Boston Avenue and Mystic Valley Parkway/Route 16 in Medford to the intersection of Auburn Street and Mystic Valley Parkway/Route 16 in Somerville, are located within 100 feet of the proposed transit corridor and stations. The reservation is operated by the DCR.

Table 4.13-1 Existing Park and Recreation Areas within the Study Area

Property	Size *(acres)*	Ownership	Type of Property	Primary (Designated) Use of Property	City
Mystic River Reservation (3 parcels)	4.87 total (2.40, 1.80, 0.67)	DCR	Conservation Land	Passive Recreation, Picnic Areas, Running, Walking, Bicycling	Medford/Somerville
Grant Park	0.20	City of Medford	Public Park	Passive Recreation	Medford
Trum Playground	0.39	City of Somerville	Public Recreation Area	Passive Recreation, Playground	Somerville
Hoyt Sullivan Playground	0.38	City of Somerville	Public Recreation Area	Active Recreation, Playground, Basketball	Somerville
Lechmere Canal Park	4.39	City of Cambridge	Public Park	Passive Recreation, Picnic Areas, Running, Bicycling, Walking	Cambridge

DCR = Massachusetts Department of Conservation and Recreation, Division of Urban Parks and Recreation

An additional park area under development has also been identified. According to Somerville's Office of Strategic Planning and Community Development Office, an approximate 0.5-acre passive park area is in Phase 1 of construction at the former location of Somerville Junction.[22] This park is intended to connect the future Community Path at the intersection of Centre Street and Woodbine Street. Funding to construct the "Park at Somerville Junction" has been provided by the Massachusetts Urban Self Help Program, which places a conservation deed restriction on the property in perpetuity.

22 Phone conversation June 23, 2008 with Stephen Winslow, Somerville Office of Strategic Planning and Community Development.

4.14 Visual Environment

The Secretary's Certificate specifies that the DEIR should specify the station locations and provide details on station design. Since the station selection and design process has the potential to alter the local visual environment, Section 5.12 discusses the station designs and potential visual impacts. Information on the existing conditions can be found in Section 3.7, which discusses the major features of the railroad corridor and of each proposed station location, Section 4.2, which discusses existing land uses, and Section 4.12, which discusses the natural resources found within the Project area.

The majority of the Project area is existing rail corridor bordered by urban neighborhoods. These areas consist mostly of multi-family residences with some commercial and industrial uses and mixed-use buildings. Natural visual resources around the Project area consist mostly of the isolated, low-diversity habitat discussed in Section 4.12.

One exception is the Mystic River Reservation, a connected area of publicly-owned open space and parks along the banks of Mystic River that includes land in Somerville, Medford, and Everett. The Mystic River is surrounded by a forested corridor that is almost entirely publicly owned and protects the river from some of the effects of its urbanized watershed. Part of this forested corridor is visible from the proposed Mystic Valley Parkway/Route 16 Station, which would make the station itself visible from the reservation as well. The existing station site includes large commercial/industrial buildings, including the U-Haul facility discussed in Section 4.2.2.7.

Due to the urbanized character of the portions of Cambridge, Somerville, and Medford, and involved, there are no other significant visual resources associated with the Project.

4.15 Historic and Archaeological Resources

A historic and archaeological resources reconnaissance survey for the Green Line Extension Project was undertaken as the first step in fulfilling compliance responsibilities regarding cultural resources under Section 106 of the National Historic Preservation Act (NHPA) as amended, the regulations of the Advisory Council on Historic Preservation (Council) at 36 CFR 800, NEPA, and Section 4(f) of the Department of Transportation Act. The FTA is the lead Federal agency for the Green Line Extension Project. EOT serves as the lead state agency and is responsible for identifying and evaluating properties through archaeological and historic architectural surveys in accordance with MGL Ch. 9 Sections 26-27C, as amended; 950 CMR 71.00, 950 CMR 70.00, and MEPA.

4.15.1 Methodology

The purpose of the cultural resources reconnaissance survey was to identify known historic and archaeological resources within the MBTA's Green Line Extension Project Area of potential effects (APE). The survey was also designed to provide recommendations regarding the locations of potential sensitivity for archaeological resources and identified historic resources requiring additional intensive survey and/or significance evaluation. To achieve these goals, archival research, field survey of the APE, and analysis were completed.

The APE, in accordance with 36 CFR 800.16(d) is the area or areas within which an undertaking may directly, indirectly, or cumulatively cause changes in the character or use of historic properties (defined as resources listed or eligible for listing in the National Register), if any such properties exist there. In addition to the actual site of the undertaking, the APE also includes other areas where the undertaking could cause changes in land use, traffic patterns, or other aspects that could affect historic properties. Different project factors may produce more than one APE for a given undertaking. Factors with potential to cause changes are noise, vibration, visual (setting), traffic, atmospheric, construction, indirect, and cumulative.

The Green Line Extension APE for historic resources is defined as an area extending approximately 125 feet or one assessor's lot on either side of the proposed Medford and Union Square Branch routes, associated proposed station locations, and maintenance and/or interim train storage facilities. This area encompasses the direct APE, defined as the construction limits of the Project, as well as the indirect APE. The Green Line Extension APE for archaeological resources is the direct APE where ground disturbances are planned for the construction of Project elements. These elements include the active and inactive railroad right-of-way segments, new station locations, the new layover/maintenance facility, and any other ancillary work areas and land takings identified as part of the alternatives refinement.

Archival research included review of existing cultural resource inventories, reports, and collected information on previously documented archaeological and historic resources in the Green Line Extension Project Area. These include the Inventory of the Historic and Archaeological Assets of the Commonwealth, and State and National Register of Historic Places (National Register) files maintained by the Massachusetts Historical Commission (MHC) as well as the files of the Boston Landmarks Commission (BLC). Other archival materials, including local histories, historic maps and photographs, and census data were collected to establish a historical context for the towns encompassing the Project Area. Environmental, geotechnical, and utilities information was reviewed to establish environmental contexts and understand prior ground disturbance.

A walkover/driveover reconnaissance field survey was conducted for the Green Line Extension Project to identify historic resources and areas potentially sensitive for archaeological resources. The historic resources survey included an initial driveover along the Project corridor to become familiar with the general character and number of historic resources within it, and a walkover of the entire length of both of the existing rail rights-of-way, including proposed station locations. Field survey for archaeological sensitivity was conducted for work areas outside the rights-of-way, including stations and land-takings to obtain existing conditions information on ground surface integrity, modern disturbances, and current environmental settings. Because of safety and permit requirements, the existing conditions information for right-of-way work areas was obtained from digital photographs and field notes. The archaeological survey was conducted under Massachusetts State Archaeological Permit No. 3014.

Analysis for historic architectural resources included the application of the National Register Criteria for Evaluation in order to provide preliminary National Register eligibility recommendations and recommendations for further identification survey and for evaluation of the significance of cultural resources within the APE.

The National Register criteria established by the National Park Service state that, "the quality of significance in American history, architecture, archaeology, engineering, and culture is present in districts, sites, buildings, structures, and objects that possess integrity of location, design, setting, materials, workmanship, feeling, and association and:

- that are associated with events that have made a significant contribution to the broad patterns of our history; or
- that are associated with the lives of persons significant in our past; or
- that embody the distinctive characteristics of a type, period or method of construction, or that represent the work of a master, or that possess high artistic values, or that represent a significant and distinguishable entity whose component may lack individual distinction; or
- that have yielded, or may be likely to yield information important in prehistory or history."

The analysis for the archaeological sensitivity assessment utilized information collected during the archival research and the walkover survey/existing conditions review to develop a predictive model of potential site types and their cultural and temporal affiliation. The development of predictive models for locating archaeological resources has become an increasingly important aspect of cultural resource management planning. The predictive model considers various criteria to rank the potential for the Project study area to contain archaeological sites. The criteria are proximity of recorded and documented sites, local land use history, environmental data, and existing conditions. The Project study area was stratified

into zones of expected archaeological sensitivity to determine which areas would be tested.

4.15.2 Historic Resources

The Green Line Extension APE is a linear corridor that spans dense, urban development over hilly terrain, along the railroad corridor from Cambridge, through Somerville to Medford. The south/east end of the APE, which extends parallel to Monsignor O'Brien/McGrath Highway, consists primarily of boxy, multi-story commercial and industrial structures constructed from the early to late twentieth century. The highway separates the rail corridor from residential neighborhoods to the south and limits pedestrian traffic. The majority of the APE is comprised of late-nineteenth to early-twentieth-century residential neighborhoods with modest wood-frame, two- to three-story single and multi-family houses. The neighborhoods within the APE are adjacent to pockets of commercial development and small civic or institutional centers. The Tufts University Medford campus is near the north end of the APE on either side of Boston Avenue.

A total of 423 individual properties, two railroad corridor landscapes, and 15 areas/districts were identified during the architectural survey. Of these properties, four are individually listed in the National Register, 16 are recommended eligible for listing, and 52 were previously recorded in the MHC Inventory. The locations of all individual properties identified within the APE are shown on Figures 4.15-1 thru 4.15-10. Of the areas/districts, two are districts, two are multiple property submissions listed in the National Register, one is a local historic district listed in the State Register, and five are recommended eligible as historic districts.

Two properties previously recommended as National Register-eligible have lost integrity and are no longer eligible. These are the B&M Railroad Building (now the Glass Factory Condominiums) at 167-169 Monsignor O'Brien Highway, Cambridge (Map No. 10) and the Kiley Wagon Shop Complex at 5-9 Linwood Street, Somerville (MHC No. SMV.1020) (Map No. 21). Several previously inventoried resources were observed in the field to be no longer extant.

The following section presents a summary of the two railroad landscape corridors followed by information about resources that have been listed, determined eligible for listing, or are recommended eligible for listing in the National Register. Resources are organized by the geographical order from south to north along the Project alignment. Individual resources have map number references for figures and tables.

4.15.2.1 Railroad Corridor Landscapes

The two railroad corridors are the MBTA Lowell Line and the MBTA Fitchburg Line.

MBTA Lowell Line

The proposed Green Line Extension includes approximately 3.7 miles of the MBTA Lowell Line (Map No. A). This active railroad right-of-way was initially constructed by the Boston & Lowell (B&L) Railroad, which was subsequently taken over by the B&M and by the MBTA, who are the current owners. Maintenance and improvement programs have left few historic B&L or B&M elements of the rail corridor intact. Three historic railroad bridges over streets survive in the APE: the B&M Bridge over Washington Street (MHC No. SMV.907), the B&M Bridge over Harvard Avenue, and the Mystic Valley Parkway Bridge (MHC No. SMV.906). Spans for the Red Bridge at the crossing of the MBTA Lowell and MBTA Fitchburg Lines were removed within the last 15 years, although the granite and concrete abutments remain. Most road bridges over the MBTA Lowell Line have recently been replaced, leaving only the Cross Street Bridge (MHC No. SMV.923) and the McGrath Highway/Route 28 Bridge (MHC No. SMV.911). The MBTA Lowell Line corridor is not recommended as eligible for the National Register as an historic district.

MBTA Fitchburg Line

The proposed Union Square Branch of the Project includes approximately 0.6 miles of MBTA Fitchburg Line (Map No. B), which was initially constructed by the Fitchburg Railroad. The route alternative also intersects with the former Grand Junction Railroad. Like the MBTA Lowell Line corridor, the MBTA Fitchburg Line has been extensively upgraded by the MBTA and there are few historic railroad structures still in existence. The MBTA Fitchburg Line corridor is not recommended as eligible for the National Register as an historic district.

4.15.2.2 National Register Listed Properties

A number of properties located along the APE that may be affected by the Project are listed on the National Register of Historic Places.

Charles River Basin Historic District, Cambridge (MHC No. CAM.AJ)

The Charles River Basin Historic District (Map No. 3) encompasses the parkways, park reservations, canals, dams, bridges, and other infrastructure constructed along the Charles River in Boston and Cambridge during the late-nineteenth and early-twentieth-centuries. The Charles River Basin was improved and incorporated into Boston's metropolitan park system in an effort to maximize land use along the shoreline. The east end of the Charles River Basin Historic District is immediately south of the origin of the Green Line Extension APE at Monsignor O'Brien Highway

and Lechmere Station. One contributing resource within the Charles River Basin—the Lechmere Viaduct (Map No. 1) is located within the Green Line Extension APE, has been determined eligible for individual National Register listing, and is described in Section 4.15.2.3.

Somerville Multiple Resource Area (MHC No. SMV.AY)

The City of Somerville National Register Multiple Resource Area (Somerville MRA) (Map No. F) includes four historic districts and 79 individually listed properties located throughout the City of Somerville. The Somerville MRA is identified in the MHC Inventory as Area SMV.AY. It consists of a collection of primarily residential, modest examples of architectural styles prevalent in Somerville during major periods of development from the early eighteenth to the early twentieth century. Three properties individually listed in the National Register as part of the Somerville MRA are located within the Green Line Extension APE.

Samuel Ireland House, 117 Washington Street, Somerville (MHC No. SMV.12; SMV.AY)

The Samuel Ireland House (Map No. 68) is located approximately 100 feet northwest of an open, paved area that is part of the MBTA Lowell Line right-of-way. The house was initially inventoried by MHC in 1986 and dated to circa 1792, based on deed research. The MHC evaluated the building as eligible for National Register listing at the local level under Criterion C, for its significance as the only known eighteenth century residence in the Cobble Hill neighborhood of Somerville. The Samuel Ireland House was designated as a Somerville Local Historic District in 1985 and was individually listed in the National Register as part of the Somerville MRA (MHC No. SMV.AY) in 1989.

City Hall, 93 Highland Avenue, Somerville (MHC No. SMV.37; SMV.AY, SMV.C)

The Somerville City Hall (Map No. 162; F; H) is at the east corner of Highland Avenue and School Street. The building is within a civic complex on Central Hill above the MBTA Lowell Line right-of-way, but only the northeast (side) elevation of the building is visible from the railroad. The main block was constructed in 1852 as the first Somerville High School. The southwest wing was added in 1896 after the building was converted to the City Hall in 1872 and was expanded again in 1924. City Hall is a local example of a prominent civic building designed in the Classical Revival style. The building is individually listed in the National Register in the Somerville MRA (MHC No. SMV.AY) and is within the Central Hill Area (MHC No. SMV.C).

Susan Russell House, 58 Sycamore Street, Somerville (MHC No. SMV.40; SMV.AY)

The Susan Russell House (Map No. 195; F) is adjacent to the MBTA Lowell Line right-of-way and faces southeast toward Sycamore Street. The building is individually listed in the National Register in the Somerville MRA (MHC No. SMV.AY) as a well preserved, intact, local example of a Greek Revival-style, single-family house.

Mystic Valley Parkway Historic District (MHC No. SMV.BJ)

Mystic Valley Parkway/Route 16 (Map No. N) is an approximately five-mile-long roadway paralleling the Mystic River through Arlington, Medford, Somerville, and Winchester, Massachusetts. The parkway is part of the Metropolitan Park System of Greater Boston (MHC No. SMV.BB). Trees are planted between the roadway and the sidewalk to form a Tree Canopy (MHC No. SMV.935). The roadway passes below the MBTA Lowell Line (formerly the B&L), which is carried by the B&M Railroad Bridge over Mystic Valley Parkway/Route 16, a reinforced concrete arch structure (No. S-17-014, MBTA No. 2.11, Br.5.08) (MHC No. SMV.906) (see description below). The Parkway was constructed by Metropolitan Parks Commission contractors between 1895 and 1936, with that portion of the road within the Project APE completed in 1908. The Parkway is significant as one of the earliest river parkways designed for the Metropolitan Park Commission by Olmsted, Olmsted, and Eliot and its successor firm, the Olmsted Brothers. The Mystic Valley Parkway District was listed in the National Register in 2006 as part of the Metropolitan Parks System of Greater Boston Multiple Property Submission (MPS) (Map No. M), which was listed in the National Register in 2003. Contributing elements to the district that are within the Project APE bounds include the roadway itself, the B&M Railroad Bridge, and the Tree Canopy. The B&M Railroad Bridge has also been individually surveyed, as described below.

Metropolitan Parks System of Greater Boston Multiple Property Submission

See Mystic Valley Parkway Historic District discussion above. (Map No. M).

B&M Railroad Bridge (No. S-17-014, MBTA No. 2.11, Br.5.08) over Mystic Valley Parkway/Route 16 (MHC No. SMV.906)

The B&M Bridge (Map No. 420) over the Mystic River is a concrete arch bridge with a 56-foot span carrying the two-track MBTA Lowell Line. The B&M Bridge was designed by the Metropolitan Park Commission (now the DCR) as one of four crossings in the Mystic River Reservation, which was absorbed into the Mystic Valley Parkway/Route 16. The bridge was surveyed in 1987 and 1990 and was recommended as individually eligible for the National Register on both occasions for its significance as an excellent example of the reinforced concrete arch bridge type, for its neoclassical design, and for the innovative use of precast concrete decorative

element. It was listed in the National Register in 2006 as a contributing element in the Mystic Valley Parkway National Register Historic District, as part of the Metropolitan Parks System of Greater Boston MPS, which was listed in the National Register in 2003.

4.15.2.3 National Register Determined Eligible Properties

A number of properties were not on the National Register but were determined to be eligible for listing on it as part of this study.

Lechmere Viaduct (a/k/a East Cambridge Viaduct), Cambridge and Boston (MHC No. CAM.913)

The Lechmere Viaduct (a/k/a East Cambridge Viaduct) (Map No. 1) is a contributing resource within the Charles River Basin. The Lechmere Viaduct was erected from 1910 to 1911 to carry MBTA street rail tracks over the river. The Viaduct consists of three elements: a ten-span concrete arch bridge incorporating a steel trunnion bascule, a steel elevated section in Boston, and a steel elevated section in Cambridge. The concrete portion of the Viaduct with its attendant bascule span was listed as a contributing resource in the Charles River Basin National Register Historic District. This portion of the viaduct was also surveyed in 1984 and determined individually eligible for National Register listing in 1985. The steel elevated section of the viaduct in Cambridge was recommended as eligible for listing in the National Register by PAL in 2004. This portion of the viaduct extends within the construction limits of the Green Line Extension Project. The steel elevated section in Boston under the MBTA's Science Park Station was recommended as eligible for listing in the National Register in 2007.

McGrath Highway/Route 28 Bridge over B&M Railroad, Somerville (MHC No. SMV.911)

The McGrath Highway/Route 28 Bridge (Map No. 19) over the MBTA Lowell Line (formerly the B&M Railroad) (No. S-17-22, MBTA No. 2.11) is a double-barreled (three truss panels creating two roadways), riveted, Parker/Camelback through truss bridge. The skewed, 162-foot span structure carries the McGrath Highway/Route 28 (formerly the Northern Traffic Artery) on a north-south course over the southeast-northwest trending, multi-track earthen cut of the former B&M Railroad, (originally the B&L). The bridge was erected as part of McGrath Highway/Route 28 construction in 1926 by the Boston Bridge Works, which followed designs provided by the Metropolitan District Commission. The bridge was rehabilitated in 1983. The MHC determined that the bridge was eligible for the National Register in 1987 as the only known example of the camelback truss type in Massachusetts.

Somerville High School, 81 Highland Avenue, Somerville (MHC No. SMV.69)

The Somerville High School (Map No. 161) faces Highland Avenue within the Central Hill Area (SMV.C), but its northeast (rear) elevation overlooks a steep slope toward the MBTA Lowell Line and proposed Gilman Square Station. The first building on the site is incorporated into the current central block of the complex. In 1895, the Somerville English High School was completed. Two more three-story wings on either side of the central building (called the east and west wings), and a connected two-story auditorium wing were added to the school in 1928 constructed of the same materials and in the same style as the central building. The Somerville High School was surveyed in 1978 and determined National Register eligible by MHC in 1982 as the "center of a significant institutional complex," including the adjacent Somerville City Hall (MHC No. SMV.37) and Somerville Library (MHC No. SMV.66).

4.15.2.4 Local Historic Districts (State Register Listed Only)

Various properties are identified on the State Register as Local Historic Districts.

Buddy's Truck Stop/Sawin's Diner, 113 Washington Street, Somerville (MHC No. SMV.303; SMV.BA)

Buddy's Truck Stop (Map No. 69; G) is approximately 100 feet northwest of an open, paved area that is part of the MBTA Lowell Line right-of-way. The structure is a one-story diner constructed in 1929 by the Worcester Lunch Car Company. The diner was moved to its current location from Leominster, Massachusetts in 1951, where it was known as Sawin's Diner. Buddy's Truck Stop was designated as a Local Historic District in 1989. It was considered but not included in the Diners of Massachusetts National Register Multiple Property Submission completed in 1999. In 2005, Buddy's Truck Stop was evaluated as individually eligible for National Register listing under Criterion C as a rare local example of an early twentieth-century diner.

The Montrose, 156 School Street, Somerville (MHC No. SMV.321; SMV.BA)

The Montrose (Map No. 163; G) is approximately 100 feet from the MBTA Lowell Line right-of-way, near the proposed location of the Gilman Square Station to the east. The Montrose is a three-story, six-bay-wide apartment hotel constructed in the Queen Anne style in 1894 and subsequently updated with Colonial Revival features. The Montrose was surveyed in 1988 and designated as a single building local historic district in 1989.

Michael Cotter House, 282 Lowell Street, Somerville (MHC No. SMV.1272; SMV.BA)

The Michael Cotter House (Map No. 223; G) is approximately 50 feet from the MBTA Lowell Line right-of-way. The house is separated from the railroad by another

residence, but the rear section of the lot abuts the railroad. The property was surveyed in 2006, but was not recommended as eligible for the National Register. The Cotter House was designated as a single building Somerville Local Historic District in 2007 as part of an expansion of local historic districts because it is a local example of a late nineteenth-century worker's cottage associated with the railroad industry.

4.15.2.5 Properties Recommended Eligible for National Register Listing

A number of additional properties are not on the National Register but are recommended to be eligible for listing on it.

Lechmere Station, Lechmere Square at Cambridge and Gore Street, Cambridge (MHC No. CAM.914)

Existing Lechmere Station (Map No. 2) is an MBTA Green Line light rail complex in Cambridge between O'Brien Highway (Bridge Street/SR 28) and Cambridge Street. The station is at the north end of the Lechmere Viaduct, which carries the Green Line across the Charles River. The station was opened July 10, 1922 as a transfer point between street cars from Cambridge and Somerville and the Tremont Street Subway. Prior to the opening of the new station, cars from the Tremont Street Subway passed over the Lechmere Viaduct (completed 1910) and continued in streetcar service through Cambridge and Somerville. The station continues to serve in its intended capacity today. The station complex appears to be eligible under Criteria A and C at the local level. The station's construction and design as a transfer point was an important step in the rationalization of Tremont Street Subway operations and has continued to serve as a critical operations point to the present day. The station platforms are rare surviving early twentieth century street rail shelters. The bus shelter is eligible as part of the complex and, in conjunction with the original platforms, is illustrative of changing approaches to mass transit shelter construction.

John Morrell and Company, 221 Monsignor O'Brien Highway, Cambridge (Not in MHC Inventory)

The John Morrell & Company Building (Map No. 12) is a reinforced concrete, Georgian Revival-style intermodal warehouse with brick curtain walls built in 1929 fronting Monsignor O'Brien Highway (SR 28). The Morrell and Company Building was constructed in 1929 as a wholesale meat distributor. According to the Cambridge Architectural Inventory form, the building was designed by the architectural firm of Henschein and McLaren of Chicago. The property is currently vacant and condemned. John Morrell & Co., now part of processed meat producer Smithfield Foods, Inc., is considered to be the oldest continually operating meat manufacturer in the United States. Founded in 1827, company was historically based in Ottumwa, Iowa and specialized in pork packaging and shipping. Branch distribution warehouses were in Boston and New York. Between 1982 and 1991, the company was one of the top-ranking meat and poultry companies as measured by net sales.

The Cambridge Historical Commission has included the property in its Cambridge Architectural Inventory and considers the building significant and potentially eligible for the National Register. The building appears eligible for the National Register under Criterion A because of its relationship to the meat packing trade of greater Boston, an important regional late nineteenth and early twentieth century industry, and under Criterion C because of its unique Classical Revival treatment as applied to a local distribution warehouse.

Whitehead Metal Products Company, 225 Monsignor O'Brien Highway, Cambridge (Not in MHC Inventory)

The Whitehead Metal Products Company building (Map No. 13) is an Art Deco-style loft and warehouse, four stories tall and five-by-seven bays in plan. The Whitehead Metal Products building was constructed in 1929 with design services by M.A. Reidy and John H. Spiers. Whitehead Metal Products was a New York-based firm that manufactured and distributed sheet metal, road and wire, pipes, valves, and fittings. Around 1950, the building was taken over by the Jordan Marsh Company as a warehouse. Superior Nut Company currently occupies the building. The Whitehead Building was surveyed by the Cambridge Historical Commission in 1969 and 1993, is included in the Cambridge Architectural Inventory, and is considered by the Commission as significant and potentially eligible for the National Register. The Whitehead Metal Products Company warehouse appears eligible for the National Register under Criterion C because of its distinguished Art Deco decorative treatment as applied to a warehouse structure. Although the building's fenestration has been covered and/or altered, the structure retains all of its character-defining massing and Art Deco trim elements.

Jackson and Newton Company, 51 McGrath Highway/Route 28, Somerville (MHC No. SMV.1019)

The Jackson & Newton Company building (Map No. 18) is a three story, twelve-bay-by twenty four-bay mill loft. The Jackson & Newton Factory was built between 1900 and 1908 for the manufacture of doors, sash, and blinds. The company was owned by Frederick H. Newton of West Roxbury, who operated a second architectural trim company in West Somerville. The firm operated until ca. 1927, when it merged with Brockaway-Smith and a third company to form the Brockaway-Smith-Haigh-Lovell Company (now Brosco), which continues to operate as a wholesale distributor of building products. The building was vacant from that year until 1933, which it was occupied by a furniture manufacturer and radiator company. The building appears to be partially unoccupied.

Jackson & Newton was surveyed in 1990 as part of the *Somerville Industrial and Commercial Survey* and recommended eligible for the National Register under Criterion C as "a very well-preserved representative or early twentieth century brick and granite industrial architecture". Although the building has been partially rehabilitated since this recommendation, it still appears eligible for the National

Register under Criterion C because is retains the majority of its character-defining elements. The building is further recommended as eligible for the National Register under Criterion A because of its association with the building trades industry of Somerville in the late industrial period.

Atlantic and Pacific (A&P) Grocery Warehouse, 3-25 Fitchburg Street, Somerville (MHC No. SMV.664)

The Great Atlantic & Pacific Tea Company (A&P) complex (Map No. 20) occupies a triangular lot flanked to the south by the MBTA Fitchburg Line and to the northeast by the former B&L line (inactive). The original warehouse is to the northwest of and connected to a bakery, added later. A&P, a grocery retail and distribution company, constructed the intermodal (train to truck) warehouse in 1920 and added the bakery in 1923. The warehouse was converted to artist's live/work space in 1987. A&P occupies a prominent place in the history of commercial food sales in America. The company was founded as the Great American Tea Company in Manhattan in 1859 by George Huntington Hartford and George Gilman. The success of the store led to expansion and to the renaming of the company as the Great Atlantic & Pacific Tea Company in 1870. George Hartford's sons John and George L. took over the company in 1878 and between that year and the 1950s grew the retail chain into the largest grocery store chain in the United States.

The complex was surveyed in 1980 and was recommended as eligible for the National Register in 1990 under Criteria A and C for its association with the modern food distribution industry, as the most intact and earliest example of a food distribution facility, and its embodiment of early twentieth century reinforced concrete construction. Although modified in 1987, the complex still appears eligible for the National Register under Criteria A and C for the reasons outlined above because the 1987 modifications have not substantially altered essential characteristics of construction that identify the property as a distribution warehouse or that diminish its association with the A&P corporation.

Hill-Michie Company Auto Garage, 295-97 Medford Street, Somerville (MHC No. SMV.669)

The Hill-Michie Auto Garage (Map No. 130) is at the east corner of Walnut and Medford Streets on a sloping lot bounded by the MBTA Lowell Line on the northeast (rear) side. The garage is a one-story, brick commercial building constructed in 1906 and designed by Frank H. Dillaby of Boston. The garage was surveyed in 1980 and 1990 and recommended as eligible for the National Register in 1990 for associations with the development of automobile commercial services in the city and as a well-preserved example of early twentieth century brick garage construction. The building is likely the oldest auto garage and car dealership in Somerville.

Gilman Square Area, Somerville (MHC No. SMV.M)

The Gilman Square Area (Map No. I) is at the nexus of Medford, Marshall, and Pearl Streets. This area contains four multi-story brick commercial and industrial buildings constructed between approximately 1887 and 1930. Gilman Square developed in the late nineteenth century as one of two competing commercial centers in Somerville, along the former B&L (later B&M) Railroad. The MBTA Lowell Line abuts the southwest edge of the area and the Green Line Extension Project may extend into Gilman Square.

Gilman Square was surveyed in 1990 and no eligibility opinion was assessed. Although a few of the original buildings in Gilman Square are not extant, the area is recommended as potentially eligible for listing in the National Register at the local level under Criteria A and C for its historical associations with the commercial development of Somerville and as a collection of intact building types that are not common in the Central Hill neighborhood. Three contributing resources in the area, Malta Temple/Signet Commandery No. 188 (Map No. 137) (MHC No. SMV.742) at 339-343 Medford Street, Reid & Murdock Company Warehouse (Map No. 138) (MHC No. SMV.753) at 350 Medford Street, and Litchfield Block (Map No. 136) (MHC No. SMV.747) at 247-251 Pearl Street are included within the Project APE.

Stickney Subdivision Area, Somerville (MHC No. SMV.Y)

The Stickney Subdivision Area (Map No. J) is an approximately six-block neighborhood that encompasses both sides of School, Dartmouth, and Thurston Streets between Broadway and Medford Street. The east corner of the Stickney area meets the edge of the Green Line Extension APE at Gilman Square. The Stickney subdivision was platted in 1883 and developed with 2.5-story, wood-frame, Queen Anne and Colonial Revival houses constructed between approximately 1885 and 1910. The majority of the houses were constructed and inhabited by Boston businessmen. Two properties (Map No. 142 and 144) within the area are within the Green Line Extension APE. The Stickney Subdivision area was surveyed in 1981, but no eligibility evaluation was included on the form. The area is recommended as a potentially eligible National Register District at the local level under Criteria A and C for its associations with the development of Somerville as a commuter suburb and as an intact neighborhood of late nineteenth and early twentieth-century residential architecture.

Powderhouse/Winter Hill Industrial Area, Somerville (MHC No. SMV.F)

The Powderhouse/Winter Hill Industrial Area (Map No. K) is north and south of the MBTA Lowell Line (former Boston &Lowell Railroad) at the now abandoned junction with the Fitchburg Freight Cut-Off in Somerville. This linear district contains a concentration of late-nineteenth and early twentieth century industrial complexes associated with some of Somerville's historic manufacturing specialties, including baked goods, paper products, and wood furniture and architectural trim.

Three contributing resources in the area, the Derby Desk Company (Map No. 206) (MHC No. SMV.750) at 20 Vernon Street, Agar Manufacturing Co. (Map No. 226) (MHC No. SMV.720) at 55 Clyde Street, and Carlisle-Ayer Company (Map No. 227) (MHC No. SMV.721) at 50 Clyde Street are included within the Project APE. The district was surveyed and recommended as eligible for the National Register in 1990. The Derby Desk Company was also recommended as individually eligible at this time.

Kelly's Diner, 674 Broadway, Somerville (Not in MHC Inventory)

Kelly's Diner (Map No. 274) is about 100 feet southwest of the proposed Ball Square station. The structure is a one-story, approximately 10-bay by six-bay, streamlined, polished Stainless Steel Diner, with a flat roof and concrete slab foundation, that has attributes congruent with the typology described in *The Diners of Massachusetts* National Register of Historic Places Multiple Property Submission completed in 1999. Kelly's Diner occupies a portion of the lot shared by the adjacent Ball Square Block (SMV.715). The diner retains a high degree of architectural and material integrity. Kelly's Diner was constructed by Jerry O'Mahony, Inc. of Elizabeth, New Jersey in 1953, and moved to its current location from Wilmington, Delaware in 1995.

Kelly's Diner was not included in the Diners of Massachusetts National Register Multiple Property Submission area because it was not in Massachusetts during its period of significance. Despite the loss of its original setting, Kelly's Diner is recommended as potentially eligible for National Register listing at the local level under Criterion C for its high level of material and architectural integrity as a rare local example of a stainless steel, Modern diner. The property meets National Register Criteria Consideration B regarding moved buildings as it is primarily significant for its architecture and use an example of the diner property type, which was intended to be mobile and moved.

Hillson Building, 693-701 Broadway, 651 Boston Avenue, Somerville (MHC No. SMV.717, SMV.K)

The Hillson Building (Map No. 280) is approximately 50 feet west of the proposed Ball Square Station. The building is a two-story, Classical Revival style commercial block completed in 1925. The building was inventoried in 1990 and recommended eligible for National Register listing at the local level under Criterion C, as a rare example of a Beaux Arts style commercial block in Somerville.

Middlesex Canal, Somerville (MHC No. SMV-HA-5)

The historic Middlesex Canal (Map No. O) is an archaeological site (SMV-HA-5) where it intersects the Green Line Extension APE at a skewed angle approximately 400 ft south of Mystic Valley Parkway/Route 16 in Somerville (see discussion in Section 4.15.3 below). An amendment to the existing National Register nomination that was listed on the National Register in 1972, which consists of a 15.25-mile

segment of the Middlesex Canal in Woburn, Wilmington, Billerica, and Lowell, is being prepared by others. The nomination amendment for the Middlesex Canal will likely be an historic district extending from Lowell, through Winchester, Medford, and Somerville to Charlestown (Boston); however the boundaries and eligibility criteria have not been finalized or released.

Warner & Childs Division Factory, 574 Boston Avenue, Medford (Not in MHC Inventory)

The Warner & Childs Division Factory complex (Map No. 302) in Medford abuts the MBTA Lowell Line at the corner of Boston Avenue and Harvard Street. The complex consists of two reinforced concrete pier-and-spandrel buildings with flat roofs: a four-story, fourteen-bay-by-six-bay manufacturing loft with an attached Boiler Room and brick stack and a one-story garage (Map No. 303). The mill complex was constructed in 1919 by the Robert Gair Company, an umbrella organization that included the Warner & Childs Division. The mill complex is one of three early-twentieth century corrugated paper box factories within the Project APE on the MBTA Lowell Line (see also Agar Manufacturing [Map No. 226], listed in the Powderhouse/Winter Hill Industrial Area above, and Russell Box Company [Map No. 411]). Box manufacturers were a supporting industry for the intermodal distribution facilities that were established in Cambridge and Somerville during the same time period.

The Warner & Childs Mill complex is recommended as eligible for the National Register under Criterion A because of its association with the rail freight distribution and paper industries in the Cambridge-Somerville-Medford area, its associations with the Robert Gair Company, and under Criterion C as an excellent representative example of early-twentieth-century reinforced concrete loft construction.

Tufts University, Bray Memorial Laboratory of Mechanical Engineering, 504 Boston Avenue, Medford (Not in MHC Inventory)

The Tufts University Bray Memorial Laboratory of Mechanical Engineering (Map No. 306) is between Boston Avenue and the MBTA Lowell Line, which is parallel to the northeast (rear) side of the building. Bray Lab is a two-story, 13-bay by three-bay, rectangular, Modern style building constructed in 1947 as part of Tufts University's Medford campus. The Bray Lab building has not previously surveyed. The building is recommended as potentially eligible for National Register listing at the local level, under Criteria A and C as an intact example Modern institutional building and for its historic use as a Navy test laboratory.

Tufts University, Commons Building/Curtis Hall, 474 Boston Avenue, Medford (Not in MHC Inventory)

The Tufts University Commons Building/Curtis Hall (Map No. 307) faces west toward the intersection of Boston Avenue and College Avenue and is adjacent to the MBTA Lowell Line, which is to the east (rear) of the building. Curtis Hall is a Renaissance Revival-style mess hall and student center constructed in 1893 with a three-story central block flanked by side wings. Curtis Hall was designed by George A. Clough, who served as the architect for several other buildings on the Tufts campus. The building has been continually used for mixed-use student purposed since its construction. Such uses included a dining hall, post office, store, dormitory above the first story, and a conference room. The dining hall was used by the Student Army Training Corps during World War I and the Navy during World War II. Curtis Hall is potentially eligible for a National Register listing at the local level under Criteria A and C as an example of the Renaissance Revival style as designed by George A. Clough and for its continual use as a primary Tufts University community building.

4.15.3 Archaeological Resources

There are no previously recorded pre-contact period archaeological sites within the Green Line Project APE for archaeological resources. The pre-contact/contact period estuarine environment of the Mystic and Charles Rivers and Boston Harbor would have been highly conducive for Native American subsistence activities and settlement. It is generally expected that portions of the Project APE could possibly contain intact pre-contact/contact period archaeological deposits such as shell resource processing/middens, fish weirs, and seasonal encampments. According to MHC site files, one such resource area, a pre-contact period shell midden (19-MD-171), was identified in 1968 near the tip of Lechmere's Point, about half a mile to the north and east of Lechmere Station.

The Green Line Extension Project area and the surrounding land have experienced large-scale and widespread post-contact period earthmoving activities. The most prominent disturbance factors include extensive filling and/or cutting of the existing rail line. It is therefore expected that the degree of post-contact period disturbances have substantially decreased the likelihood of encountering intact pre-contact/contact period archaeological deposits in the majority of the APE.

There is one recorded historic archaeological site that crosses the MBTA Lowell Line right-of-way in Medford. It consists of a portion of the Middlesex Canal (SMV-HA-5) over which the rail corridor was built (via a stone arch bridge). The built-over sections of the Middlesex Canal in Cambridge, Somerville, and Medford and have recently been included in this National Register eligible resource area. In addition, there is one recorded historic site immediately adjacent (south side) to the MBTA

Fitchburg Line right-of-way in Somerville. It consists of the Union Glass Works (SMV-HA-1), a mid-nineteenth- thru early-twentieth-century industrial complex.

It can be generally expected that evidence of recorded sites as well as additional documented resources based on historical maps and underdocumented resources from the seventeenth-century through the late nineteenth-century and early twentieth-century could be present in belowground strata within sensitive sections of the APE. Resource types could range from residential (early farmsteads to urban dwellings), commercial, industrial, and transportation-related resources both in terrestrial and riverine environments. As with the pre-contact/contact period site potential, it is expected that the degree of modern period (twentieth-century and ongoing) disturbances would substantially decrease the likelihood of encountering intact historic period archaeological deposits in the majority of the APE.

The reconnaissance archaeological survey resulted in the identification of five sensitive areas where potentially significant archaeological resources may be located within proposed Project impact areas. These sensitive areas include:

- Historic Middlesex Canal (SMV-HA-1) stone bridge crossing, canal prism, and tow path within and adjacent to the MBTA Lowell Line in Medford;
- Mid- to late-nineteenth-century worker housing on Joy Street in Somerville;
- Late-nineteenth/early-twentieth-century North meat-packing plant factory complex off Somerville Avenue in Somerville;
- Early/mid-nineteenth-century Clark Bennett residence, outbuildings, and yard areas on Prospect Street in Somerville and potential for pre-contact/contact period Native American resources in yard areas; and
- Late-nineteenth-century dwelling (possible worker housing) on the subdivided Clark Bennett estate property on Prospect Street in Somerville.

There is also the potential for archaeologically-sensitive strata below railroad and upper fill deposits in the Yard 8 area where the new maintenance facility is proposed. No other areas of archaeological sensitivity were identified for the Green Line Project APE because of the presence of extensive fill and/or previously disturbed belowground soil contexts.

4.16 Hazardous Materials

This section discusses the potential presence of oil or hazardous materials (OHM) on or adjacent to the proposed station locations for the proposed Green Line Extension Project.

To assess the potential for encountering OHM, Phase I Environmental Site Assessments (ESAs) were performed as per the American Society for Testing Materials (ASTM) 1527-05 Standard and All Appropriate Inquiries (AAI) pursuant to 40 CFR Part 312. The purpose of the Phase I ESAs is to identify Recognized Environmental Conditions (RECs) in connection with the properties, to the extent feasible pursuant to the process described in the Standard. The Phase I ESAs were completed utilizing the Standard as guidance. The scope of services provided for the Phase I ESAs included the following:

- Performed a computer database search of Federal and state files. The Federal databases included the current Comprehensive Environmental Response, Compensation and Liability Information System (CERCLIS), National Priorities List (NPL), Resource Conservation and Recovery Act (RCRA) Transportation, Storage and Disposal (TSD), RCRA Generators, and Emergency Response Notification System (ERNS) list. The state databases included the state equivalent CERCLIS list, spills, Underground Storage Tanks (USTs), Solid Waste Landfills (SWL), and public water supply lists.
- If necessary, reviewed available Massachusetts Department of Environmental Protection (MassDEP) files to provide more information about reported releases of OHM identified through the database search on or adjacent to the Site. The MassDEP files provided additional information regarding past ownership; historic Site usage; past usage, storage and disposal of OHM on and adjacent to the subject Site; and other evidence of potential environmental impacts.
- Reviewed available municipal and historic files to help confirm ownership history and past usage. Resources included tax records, aerial photographs, Board of Health Department records, Building Department records, Fire Department records, Conservation Commission records, and Sanborn fire insurance maps. The Site history review also identified reports of historic spills, disposal areas, or other past releases of OHM on or adjacent to the property.
- Reviewed previous Site documents including an ESA, if applicable and/or available for review.
- Performed a site reconnaissance to observe the Site for overt evidence of a release or threat of release of oil and/or hazardous materials within interior and exterior portions of the entire property. The uses of abutting properties were also documented.

Areas of property acquisition were assessed as discussed above. Properties already owned by the MBTA or the Commonwealth of Massachusetts were not assessed. Potential environmental concerns or de minimis conditions have been identified at the majority of the station sites since asbestos-containing materials, including roof flashing, tiles, and other materials, as well as lead-based paint, may be present.

4.16.1 Lechmere Station, Cambridge

For this station, the MBTA Water Street Garage property located at 21 Water Street in Cambridge (Release Tracking Numbers (RTNs) 3-18502 and 3-26115) was assessed due to known contamination issues near the proposed relocated Lechmere Station. Documents reviewed included:

- The *March 2004 Phase II Comprehensive Site Assessment Report and Phase III Remedial Action Plan* prepared by Weston and Sampson,
- The December 28, 2007 *Immediate Response Action (IRA) Completion Statement* prepared by ATC Associates, and
- The August 8, 2008 *Phase IV Status Report No. 7* prepared by ATC Associates.

This property, which comprises 2.5 acres, has been developed with a two-story concrete block garage used by the MBTA that includes a tool shop and storage area. The garage is located on the northern portion of the property. Abandoned railroad tracks are located on the southern portion of the property. A pad-mounted electrical transformer is located on the western end of the property and a storage shed is located on the eastern portion. The remaining property consists of an asphalt paved parking area.

A historic release of gasoline and fuel oil from USTs into soil and groundwater resulted in a release notification form being submitted to the DEP on July 2, 1999. RTN 3-18502 was assigned to the release. Remedial actions have consisted of the removal of approximately six tons of petroleum-contaminated soil. RTN 3-26155 was assigned to the site in August 17, 2007 when a 4,000-gallon gasoline UST failed a tightness test, resulting in a 72-hour reporting condition to the DEP. The UST was subsequently removed; no contaminated soil was encountered. The failed tightness test was deemed to be attributed to the associated piping. The two RTNs were subsequently linked to one RTN (3-18502).

Groundwater monitoring wells installed throughout the site showed the existence of gasoline-related compounds above the applicable regulatory standards as per the Massachusetts Contingency Plan (MCP). The remedial technology chosen in the Phase III Remedial Action Plan is monitored natural attenuation. During the last sampling round, which occurred in May 2008, only xylene was detected in four monitoring wells above the regulatory standards. The groundwater flow direction is shown to be to the south, southwest, parallel to the proposed Lechmere Station which is located southeast of the site.

4.16.2 Maintenance Facility, Somerville

Based upon the tasks conducted in advance of a Phase I ESA, two RECs associated with the Site were identified.

4.16.2.1 REC #1 – Releases of Polychlorinated Biphenyls (PCBs) and Other Contaminants at Nearby Properties

Releases of PCBs, petroleum products, and metals in soil and groundwater have occurred at neighboring properties. Since the contamination is pervasive in this area, there is a possibility that the contaminants from these properties have migrated to the Site, impacting soil and/or groundwater; therefore, these nearby releases are deemed a REC to the Site.

4.16.2.2 REC #2 – Historic Use of Site as Railroad Yard

Historic aerial photograph and Sanborn fire insurance maps show the Site as previously encompassing a network of railroad tracks from the early to mid 1990s. Historic rail yards are typically sources of OHM, including metals and semi-volatile organic compounds (SVOCs). Therefore, environmental media may be impacted by these contaminants, constituting a REC.

4.16.3 Brickbottom Station, Somerville

Based upon the tasks conducted in advance of a Phase I ESA, one REC associated with the Site was identified.

4.16.3.1 REC #1 – Releases of PCBs and Other Contaminants at Nearby Properties

Releases of PCBs, petroleum products, and metals in soil and groundwater have occurred at neighboring properties. Since the contamination is pervasive in this area, there is a possibility that the contaminants from these properties have migrated to the Site, impacting soil and/or groundwater; therefore, these nearby releases are deemed a REC to the Site.

4.16.4 Union Square Station (Fitchburg Corridor Alternative), Somerville

Based upon the tasks conducted for the Phase I ESA, four RECs associated with the Site were identified.

4.16.4.1 REC #1 – Historic Use of 51 Allen Street as Oil Supply Company, Junk Yard and Auto Repair Garage, Previous Existence of Underground Storage Tanks, and Release Site - Release Tracking Numbers 3-24339 and 3-24921

According to historic Sanborn fire insurance maps, the property located at 51 Allen Street was historically used as an oil supply company, a junk yard, and auto repair shop. Photographs dated August 15, 2002 for this property reviewed at the Somerville Fire Department showed hundreds of automobile gas tanks, several large fuel storage tanks, and several 55-gallon drums being stored on the property. It is possible that releases from these OHM sources to environmental media may have occurred. A letter from an attorney representing the owner of the property dated August 10, 1995 stated "you are using the premises for the storage of abandoned vehicles, tires, heavy metals, auto parts, and fluids which have penetrated the top surface of the owner's parking area. These conditions appear to disclose the existence of hazardous materials and petroleum products which you are allowing to remain on the premises…"

Fire Department records also showed that several USTs were removed from the property in 1967 and 1989. However, it was not indicated on the removal records if contamination was encountered during the removal of the tanks and detailed closure reports were not identified. Therefore, OHM may be present in the locations of the former USTs.

In 2004, several contaminants were detected in soil and groundwater at the property, including extractable petroleum hydrocarbons (EPH), polycyclic aromatic hydrocarbons (PAHs), and PCBs in soil and EPH, PAHs, and volatile petroleum hydrocarbons (VPH) in groundwater. In November 2005, an MCP regulatory endpoint consisting of a Class A-2 Response Action Outcome (RAO) was submitted to the DEP, indicating that a Permanent Solution was achieved, but contamination was not reduced to background. A release of OHM was identified at this site. The DEP database does not indicate that this RAO was audited which may indicate that it was generally conducted in accordance with regulations in effect at the time. Changing Site use or regulations, construction activities, a DEP audit of the RAO report, or identification of new environmental conditions (such as indoor air impacts in nearby structures) could trigger the need to conduct additional assessment and/or remediation activities.

Therefore, the presence of multiple OHM sources and detection of OHM in site media is deemed a REC.

4.16.4.2 REC #2 – Releases of PCBs and Other Contaminants at Nearby Properties

Releases of PCBs, petroleum products, and metals in soil and groundwater have occurred at neighboring properties located north, west, and south of Areas 32, 33, 34,

and 35. Since the contamination is pervasive in this area, there is a possibility that the contaminants from these properties have migrated to Areas 32, 33, 34 and 35, impacting soil and/or groundwater at these properties and is deemed a REC.

4.16.4.3 REC #3 – Existence of USTs at 120 McGrath Highway/Route 28 (part of Area 30)

According to records reviewed at the Somerville Fire Department, a permit to install one 5,000 diesel and one 5,000-gallon gasoline UST was granted for the property at 120 McGrath Highway/Route 28 (part of Area 30) on June 8, 1978. A UST Removal Permit was filed for two 5,000-gallon diesel and one 5,000-gallon gasoline UST. However, it was not indicated on the removal records if contamination was encountered during the removal of the tanks and detailed closure reports were not identified. Therefore, OHM may be present in the locations of the former USTs which constitutes a REC.

4.16.4.4 REC #4 – Existence of USTs at One Fitchburg Street (part of Area 30)

According to records reviewed at the Somerville Fire Department, a permit to install one 15,000-gallon No. 6 fuel oil UST, one 2,000-gallon gasoline UST and one 20,000-gallon fuel oil UST was granted to the One Fitchburg Street property (part of Area 30) on May 1, 1942. In 1987, a memo stated that none of the USTs at the property were in use. The 20,000-gallon UST was removed in 1987 and another UST had been filled in place. There was no mention of the third tank. It was not indicated in the removal records if contamination was encountered during the removal of the tanks and detailed closure reports were not identified. Therefore, OHM may be present in the locations of the former USTs. There are no records to indicate that all of the USTs that were reportedly installed at that property were, in fact, removed. Therefore, it is possible that a UST, the integrity of which is unknown, is still present at this location and OHM associated with USTs on this property may be present which would constitute a REC.

4.16.5 Union Square Station (In-Street Running Alternative), Somerville

Based upon the tasks conducted for the Phase I ESA, six RECs associated with the Site were identified.

4.16.5.1 REC #1 – Documented Presence of OHM at Areas 63, 64, and 65, Release Tracking Number 3-2849

This property, currently owned by the City of Somerville, consists of properties comprising the subject Site (Areas 63, 64, and 65), as well as property located east of

Bennett Street. The addresses include 0-22 Prospect Street, 264-266 Somerville Avenue, 9 and 10 Milk Place, and 8, 14, and 16-20 Bennett Street. A *Phase II Comprehensive Site Assessment* for this site prepared by ECS and dated April 2006 was reviewed. EPH, VPH, PAHs, volatile organic compounds (VOCs), arsenic and lead were detected in soil above the Method 1 standards. The extent of PCBs was not delineated to date. It was concluded that further remedial response actions are needed at this site to achieve a Condition of No Significant Risk.

Vinyl chloride and 1,2-dichloriethane were detected in groundwater above the Method 1 standards. The groundwater flow direction is toward the northeast, with a mounding observed on the southeastern portion of the site.

According to a letter prepared to the DEP by TRC dated June 30, 2008, TRC was retained by the City to conduct assessment activities at the site under a Brownfields assessment grant. The proposed Project schedule shows that removal of 310 cubic yards of the PCB soil stockpile to occur in July 2008. According to a Somerville Fire Department employee, soil excavation did in fact occur at this site in July 2008. Off-site groundwater and on-site soil investigation was scheduled to occur in September 2008. A Supplemental Phase II and Phase III Remedial Action Plan were due in June 2009.

4.16.5.2 REC #2 – Releases of PCBs and Other Contaminants at Nearby Properties

A release of PCBs, petroleum products, and metals in soil and groundwater have occurred at neighboring properties located north, west, and south of Areas 53 through 62. Since the contamination is pervasive in this area, there is a possibility that the contaminants from these properties have migrated to Areas 53 through 62, impacting soil and/or groundwater at these properties.

4.16.5.3 REC #3 – Existence of USTs at 216 McGrath Highway/Route 28 (part of Area 52)

According to records reviewed at the Somerville Fire Department, a permit to install the following USTs was granted on September 20, 1962: one 6,000-gallon gasoline, one 500-gallon waste oil, one 1,000-gallon heating oil, two 2,000-gallon gasoline, and one 3,000 gallon gasoline. A removal permit for the previously mentioned USTs was granted on March 31, 1999. In addition, an undated permit for the above ground storage of 700 gallons of motor oil, 1,000 gallons of gasoline, 1,000 gallons of fuel oil, 550 gallons of waste oil, 1,000 gallons of motor oil, 960 gallons of antifreeze, and 100 gallons of kerosene was granted. It was not indicated on the removal records if contamination was encountered during the removal of the tanks and detailed closure reports were not identified. Therefore, OHM may be present in the locations of the former USTs.

4.16.5.4 REC #4 – Existence of UST and Stained Soil at 200 McGrath Highway/Route 28 (part of Area 52)

According to records reviewed at the Somerville Fire Department, a permit to install a 5,000-gallon No. 6 fuel oil UST was granted on December 6, 1952. There are no records to indicate that the UST that was reportedly installed at that property was, in fact, removed. Therefore, it is possible that a UST, the integrity of which is unknown, is still present at this location.

In addition, photographs available for review at the Somerville Building Department dated January 3, 1991 showed large areas of oil stained soil on the ground surface along a fence at the property. Photographs dated September 14, 1996 showed several 55-gallon drums on the property. Therefore, the presence of OHM with indications of a release suggests that soils or groundwater have been impacted.

4.16.5.5 REC #5 – Existence of USTs at 120 McGrath Highway/Route 28 (Area 51)

According to records reviewed at the Somerville Fire Department, a permit to install one 5,000 diesel and one 5,000-gallon gasoline UST was granted to this property (Area 51) on June 8, 1978. A UST Removal Permit was filed for two 5,000-gallon diesel and one 5,000-gallon gasoline UST. It was not indicated on the removal records if contamination was encountered during the removal of the tanks and detailed closure reports were not identified. Therefore, OHM may be present in the locations of the former USTs.

4.16.5.6 REC #6 – Existence of USTs at One Fitchburg Street (Area 50)

According to records reviewed at the Somerville Fire Department, a permit to install one 15,000-gallon No. 6 fuel oil UST, one 2,000-gallon gasoline UST and one 20,000-gallon fuel oil UST was granted to this property (Area 50) on May 1, 1942. In 1987, a memo stated that none of the USTs at the property were in use. The 20,000-gallon UST was removed in 1987 and another UST had been filled in place. There was no mention of the third tank. It was not indicated on the removal records if contamination was encountered during the removal of the tanks and detailed closure reports were not identified. Therefore, OHM may be present in the locations of the former USTs. There are no records to indicate that all of the USTs that were reportedly installed at that property were, in fact, removed. Therefore, it is possible that a UST, the integrity of which is unknown, is still present at this location.

4.16.6 Gilman Square, Somerville

Based upon the tasks conducted for the Phase I ESA, three RECs associated with the Site were identified.

4.16.6.1 REC #1 – Release at Somerville High School, 81 Highland Avenue, Release Tracking Number 3-26487

Approximately 1,000 gallons of fuel oil were released from a rupture of a boiler transfer supply pump pipe at the high school boiler room on December 26, 2006. The high school boiler room is located immediately south of and hydraulically upgradient of the electrical sub-station and railroad tracks which are part of the Site (Area 18A). In January 2007, three groundwater monitoring wells were installed outside of the boiler room. The results were to be reported in the next DEP submittal which was not available for review at the DEP file review. Soil borings were advanced within the basement area and indicated that the floor area was impacted with petroleum.

According to Somerville Fire Department, fuel oil was released outside of the building toward the railroad tracks. Based on the local topography, it appears that groundwater from the area of the release flows toward the subject Site. Because the groundwater results were not available for review, it is possible that the release could potentially environmentally impact the Site.

4.16.6.2 REC #2 – Potential Presence of an Underground Storage Tank at the Homan's Building (Area 9A)

During the site reconnaissance of the Homan's Building (Area 9A), a suspected fuel oil tank fill pipe and vent pipe were observed on the outside of the rear wall of the building. The tank or the source of the suspected fill and vent pipe could not be located in the interior of the building. According to documents reviewed at the Somerville Fire Department, a permit to install a 2,000-gallon tank in the basement was dated 1988. It is not known if that tank was located aboveground or underground. In addition, during the site reconnaissance of the Homan's Building, a basement was not observed or located inside the building. Therefore, it is possible that an underground storage tank (UST) is located below and underneath the building's concrete slab, the integrity of which is unknown.

4.16.6.3 REC #3 – Release at 350 Medford Street (Area 9A), Release Tracking Number 3-17076

On July 23, 1998, a release of 60 gallons of diesel fuel occurred when the saddle tank on a delivery truck was damaged as the truck was backing into the parking lot of the

Homan's Building. As a result of the incident, diesel fuel flowed from the fuel tank to the paved surface of Medford Street, the paved parking lot of 350 Medford Street, a Bell Atlantic manhole on Medford Street and soils adjacent to the parking lot on a railroad right of way west of Medford Street. Impacted soil was removed from the railroad right of way and several rounds of confirmatory soil samples were collected. A Class A-2 RAO was submitted for this release on September 24, 1998 by Clean Harbors.

A release of OHM was identified at this site. The DEP database does not indicate that this RAO was audited which may indicate that it was generally conducted in accordance with regulations in effect at the time. Changing Site use or regulations, construction activities, a DEP audit of the RAO report, or identification of new environmental conditions could trigger the need to conduct additional assessment and/or remediation activities.

4.16.7 Lowell Street Station, Somerville

Based upon the tasks conducted for the Phase I ESA, two RECs associated with the Site were identified.

4.16.7.1 REC #1 – Underground Storage Tank located at 20 Vernon Street (Area 10)

According to records reviewed at the Somerville Fire Department, the 20 Vernon Street building (Area 10) currently has one 10,000-gallon heating oil UST which was installed in 1946. It is not known if the tank has been tightness tested. Therefore, the integrity of the tank is unknown.

4.16.7.2 REC #2 – Historic and Current Use of 20 Vernon Street (Area 10)

According to historic Sanborn fire insurance maps, the location of 20 Vernon Street (Area 10) has been used prior to 1900 as a furniture, paint-spraying machine, and box manufacturer, as well as a printer, shoe warehouse, and pipe shop. It has been used by Rogers Foam Corporation since sometime between 1950 and 1991 as a foam and rubber products manufacturer. This property has stored, used, generated and/or sold OHM. The OHM historically stored would typically include not only gasoline but also diesel fuel, waste oil, fuel oil, alcohol, paints, a variety of printing chemicals and degreasing chemicals which can contain chlorinated solvents. Therefore, historic uses of OHM at the property may have impacted soils or groundwater at the Site.

4.16.8 Ball Square Station, Somerville and Medford

Based upon the tasks conducted for the Phase I ESA, four RECs associated with the Site were identified.

4.16.8.1 REC #1 – Historic Use of 662-664 Boston Avenue Property (Area 13A) as Auto Repair Garage

According to historic Sanborn fire insurance maps, the property located at 662-664 Boston Avenue (Area 13A) was historically used as an automobile repair garage since sometime prior to 1910. The Ball Square Auto Repair business currently operates at this property; therefore, this property has stored, used, and/or generated petroleum and other OHM. The OHM would typically include waste oil, fuel oil, alcohol, anti-freeze, and degreasing chemicals which can contain chlorinated solvents. Historic and current activities may have resulted in a release of OHM and is considered a REC.

4.16.8.2 REC #2 – Release at 294 Harvard Street, Medford, Release Tracking Number 3-833

The property located at 294 Harvard Street is situated across the railroad tracks from the gas station located at 590 Boston Avenue (Area 15). According to files reviewed at the DEP, the 294 Harvard Street property was used as a fuel oil transfer station from the 1950s until 1985. Two USTs and 2,000 cubic yards of impacted soil were removed from this property in 1986. At the same time, three groundwater monitoring wells installed at that property contained light non-aqueous phase liquid (LNAPL) in each of the wells at an unknown thickness. In January 2008, a Phase I Report stated that LNAPL was "recently" encountered in a monitoring well at a thickness of 1.39 feet. Based on local topography, groundwater is assumed to flow in a westerly direction toward the railroad tracks and the 590 Boston Avenue property. Based on this information, conditions present at this property could impact soils or groundwater at the 590 Boston Avenue property and is considered a REC.

4.16.8.3 REC #3 – Release at Shell Service Station, 620 Broadway, Somerville, Release Tracking Number 3-1322

This property is located adjacent to and southeast of the former veterinarian office building located at 675 Broadway, Somerville property (Areas 13 and 13A). It was first listed with DEP in 1990 due to the discovery of petroleum impacted soil which was encountered during a UST removal. In 2007, LNAPL was detected in several monitoring wells on this property; however, no LNAPL was detected in any of the wells bordering the railroad tracks opposite the 675 Broadway property. Several monitoring wells located along the railroad tracks were sampled for gasoline and

fuel oil parameters. The results showed that several of these parameters were detected above the applicable regulatory standards. Therefore, conditions present at this property may be impacting groundwater at the 675 Broadway property.

4.16.8.4 REC #4 – Release at Analetto Brothers, Inc., 590 Boston Avenue, Medford (Area 15), Release Tracking Number 3-18017

This property consists of the gas station located at 590 Boston Avenue (Area 15). A two hour reporting condition for a release from drums of oil was reported to DEP on February 20, 1999. A Class A-1 RAO was filed with the DEP on April 20, 2001, indicating that a Permanent Solution was achieved and contamination was reduced to background. A release of OHM was identified at this site. The DEP database does not indicate that this RAO was audited which may indicate that it was generally conducted in accordance with regulations in effect at the time. Changing site use or regulations, construction activities, a DEP audit of the RAO report, or identification of new environmental conditions (such as indoor air impacts in nearby structures) could trigger the need to conduct additional assessment and/or remediation activities.

4.16.9 College Avenue Station, Somerville and Medford

Based upon the tasks conducted for this Phase I ESA, two RECs associated with the Site were identified.

4.16.9.1 REC #1 – Historic and Current Use of 175-179 College Avenue as a Printing Facility, Vehicle Repair Garage, and Presence of Underground Storage Tanks, and Documented Release

According to historic Sanborn fire insurance maps, a printing facility was located on this property which is located adjacent to Area 16B between the early 1900s to the present. In addition, a vehicle repair garage and fuel USTs have also been located on this property from sometime between 1910 and 1936 to the present. These facilities store, use, and generate petroleum and other OHM which would typically consist of motor oil, waste oil, fuel oil, alcohol, anti-freeze, degreasing chemicals that may contain chlorinated solvents, a variety of printing chemicals, and metals. The storage, use, and/or generation of these products may have or could result in a release of OHM and is considered a REC.

In addition, a gasoline release from an UST was reported to the DEP in 1998. A Class A-1 RAO was submitted to the DEP for this release, indicating that a Permanent Solution was achieved and that contamination was reduced to background. The DEP database does not indicate that this RAO was audited which may indicate that it was generally conducted in accordance with regulations in effect at the time. Changing

Site use or regulations, construction activities, a DEP audit of the RAO report, or identification of new environmental conditions could trigger the need to conduct additional assessment and/or remediation activities. A release of OHM was identified at this site; therefore, this condition represents a REC.

4.16.9.2 REC #2 – Historic Use of Building Adjacent to 474 Boston Avenue as a Chemical Laboratory

According to historic Sanborn fire insurance maps, the building located immediately southeast of Curtis Hall (474 Boston Avenue), adjacent to Area 16 was used as a chemical laboratory from sometime prior to 1897 until sometime between 1910 and 1936. It is likely that this laboratory stored and used OHM. The storage and/or use of these products may have resulted in a release of OHM, particularly given the age and OHM management practices utilized at that time, and is therefore considered a REC.

4.16.10 Mystic Valley Parkway Station/ Route 16, Somerville and Medford

Based upon the tasks conducted for the Phase I ESA, three RECs associated with the Site were identified.

4.16.10.1 REC #1 – Historic Use of Properties as Wool and Leather Manufacturers (Areas 17A, 17B, 18A, and 18B)

According to historic Sanborn fire insurance maps, the buildings located at 600 Mystic Valley Parkway, 200R, 200, and 222 Boston Avenue (Areas 17A, 17B, 18A, and 18B) were historically used for wool and leather manufacturing. These processes typically treat animal hides with a variety of OHM. In addition, the machinery used to process and treat wool and leather also utilized various OHM. No assessment information was identified to address the presence of historical sources of OHM on these properties. Given the processes involved and the age of the buildings, the historic use and presence of OHM is considered a REC.

4.16.10.2 REC #2 – Potential for Underground Storage Tanks (Areas 17B, 18A, and 18B)

According to information obtained from the Medford and Somerville Fire Departments, several USTs were installed at the properties located at 600 Mystic Valley Parkway, 200R and 200 Boston Avenue (Areas 17B, 18A, and 18B). Many of these tanks were removed; however, it was not indicated on the removal records if contamination was encountered during the removal of the tanks and detailed closure reports were not identified. Therefore, OHM may be present in the locations of the

former USTs. For the 200R Boston Avenue building which was destroyed by fire in 1991, there are no records to indicate that all of the USTs that were reportedly installed at that property were, in fact, removed. Therefore, it is possible that USTs, the integrities of which are unknown, are still present at this location.

4.16.10.3 REC #3 – Current Use of 600 Mystic Valley Parkway (Area 18A) as a Vehicle Maintenance and Repair Facility

The U-Haul facility located at this address (Area 18A) currently performs vehicle repair maintenance for the U-Haul rental vehicles, and therefore stores, uses, and generates petroleum and other OHM which would typically consist of motor oil, waste oil, fuel oil, alcohol, anti-freeze, and degreasing chemicals that may contain chlorinated solvents. The storage, use, and/or generation of these products may have or could result in a release of OHM.

4.16.11 Summary

The Phase 1 Environmental Site Assessment indicates that the entire length of the Project Area borders on numerous sites of known and suspected OHM contamination, along with building materials that can include asbestos and lead. As discussed in Chapter 5, *Environmental Consequences*, this presents the possibility of OHM releases when demolishing buildings or constructing new stations and tracks.