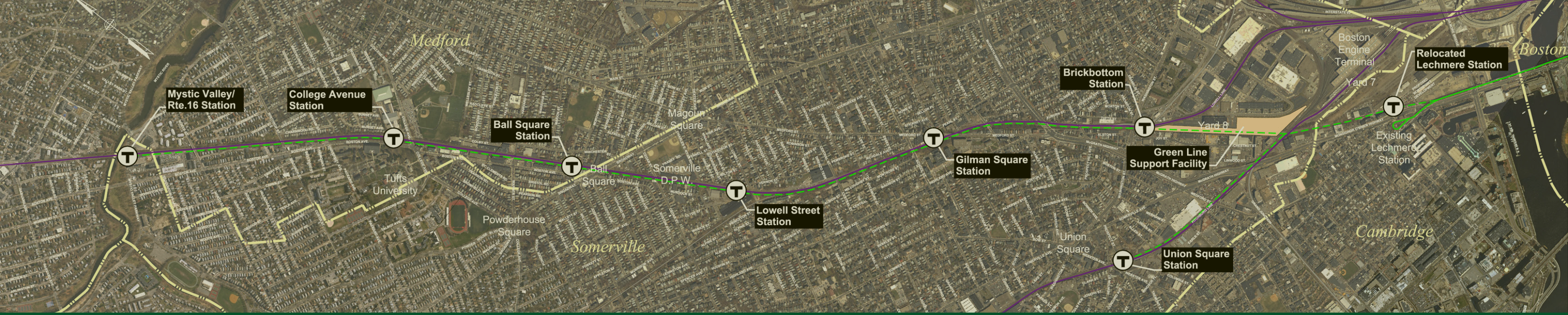

Draft Environmental Impact Report/
Environmental Assessment and
Section 4(f) Statement

Green Line Extension Project

EEA #13886

Volume 1 | Text

October 2009

Executive Office of Transportation and Public Works

U.S. Department of Transportation
Federal Transit Administration

DRAFT ENVIRONMENTAL IMPACT REPORT/ ENVIRONMENTAL ASSESSMENT (DEIR/EA) AND DRAFT SECTION 4(F) EVALUATION

FOR THE

GREEN LINE EXTENSION PROJECT

CAMBRIDGE, SOMERVILLE, MEDFORD, MASSACHUSETTS

STATE PROJECT NO. 13886

Prepared Pursuant to the Code of Federal Regulations, Title 23, Part 771, Section 119 (23 CFR 771.119); 49 U.S.C. Section 303 [formerly Department of Transportation Act of 1966, Section 4(f)] and the Massachusetts Environmental Policy Act M.G.L. CH 30 Sec. 61 through 62H

by the

FEDERAL TRANSIT ADMINISTRATION
U.S. DEPARTMENT OF TRANSPORTATION

and the

COMMONWEALTH OF MASSACHUSETTS
EXECUTIVE OFFICE OF TRANSPORTATION AND PUBLIC WORKS (EOT)

THE COMMONWEALTH OF MASSACHUSETTS
EXECUTIVE OFFICE OF TRANSPORTATION

EOT

DEVAL L. PATRICK
GOVERNOR

TIMOTHY P. MURRAY
LIEUTENANT GOVERNOR

JAMES A. ALOISI JR.
SECRETARY

October 15, 2009

Dear Reviewer:

On October 15, 2009, the Commonwealth of Massachusetts Executive Office of Transportation (EOT) is submitting a **Draft Environmental Impact Report/Environmental Assessment (DEIR/EA)** and **Draft Section 4(f) Statement** for the **Green Line Extension project** to the Secretary of Energy and Environmental Affairs. This document will be noticed in the October 26, 2009 *Environmental Monitor*; this will initiate review of the above Project pursuant to the Massachusetts Environmental Policy Act.

The Green Line Extension is a project of EOT and the MBTA to improve transit service, mobility, and regional access for residents of Cambridge, Somerville, and Medford. The Federal Transit Administration (FTA) is the lead federal agency for the Project. Bringing MBTA light rail service to these densely populated cities will address longstanding transportation inequities and meet strong demand for improved transit. The DEIR/EA is the product of a three-year long planning and environmental review process. This planning process entailed thorough technical analysis and comprehensive public involvement, with participation by corridor municipalities, neighborhood groups, business and advocacy organizations, members of the general public, and other stakeholders.

Enclosed is a copy of the DEIR/EA for your review. Complete reference copies are also available at public libraries and city clerk's offices in Cambridge, Somerville, and Medford. The DEIR/EA may also be viewed on the Project website www.mass.gov/greenlineextension.

EOT will hold a public hearing to provide members of the public and other stakeholders an opportunity to offer comments. The hearing will be held on:

November 18, 2009
6:00pm
Somerville High School - Auditorium
81 Highland Avenue, Somerville, MA 02143

Comments on the document must be submitted in writing (oral comments made at the public hearing will not be recognized by the MEPA office). A 45-day comment period has been established. If you wish to comment in writing on the Project, please write to the Secretary of Environmental Affairs, including the information listed below:

Secretary Ian Bowles
Executive Office of Energy and Environmental Affairs
MEPA Office, Attn: Holly Johnson, MEPA Analyst
EEA number #13886
100 Cambridge Street, Suite 900
Boston, MA 02114

Comment letters may be submitted by U.S. Mail to the above address, by fax to Holly Johnson at (617) 626-1181, and by email to holly.s.johnson@state.ma.us. Copies of comments may also be sent to Katherine Fichter, Executive Office of Transportation, 10 Park Plaza, Room 4150, Boston, MA 02116.

Comments must be received by the MEPA Office no later than December 9, 2009. The Secretary of Energy and Environmental Affairs will issue a MEPA Certificate by December 16, 2009.

If you have any questions, please do not hesitate to contact Katherine Fichter at katherine.fichter@state.ma.us or (617) 973-7342.

Sincerely,

James A. Aloisi, Jr.
Secretary of Transportation

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List of Tables

List of Figures

All figures are provided in Volume 2 except as indicated otherwise below.

Acronyms and Abbreviations

AAB	Architectural Access Board
AAI	All Appropriate Inquiries
ABA	Architectural Barriers Act
ACO	Administrative Consent Order
ADA	Americans with Disabilities Act
ADT	Annual Daily Traffic
A&P	The Great Atlantic & Pacific Tea Company
APC	Automated Passenger Counters
APE	Area of Potential Effect
APTA	American Public Transportation Association
ASI	Automatic Station Identification
ASME	American Society of Mechanical Engineers
ASTM	American Society for Testing Materials
ATR	Automated Traffic Recorder
AVI	Automated Vehicle Identification
AVL	Automated Vehicle Location
BCIL	Boston Center for Independent Living
BET	Boston Engine Terminal
B&L	Boston and Lowell Railroad
BLC	Boston Landmarks Commission
B&M	Boston and Maine Railroad
BRT	Bus Rapid Transit
CAAA	Clean Air Act Amendments
CAD	Computer-Assisted Dispatching

CA/T	Central Artery/Tunnel Project
CAT	Community Access Television
CCD	Commercial Corridor District
CCTV	Closed Circuit Television
CDBG	Community Development Block Grant
CEQ	Council on Environmental Quality
CERCLIS	Comprehensive Environmental Response, Compensation and Liability Information System
CFR	Code of Federal Regulations
CMR	Code of Massachusetts Regulations
CO	Carbon monoxide
CO_2	Carbon dioxide
CSO	Combined sewer overflows
CTPS	Central Transportation Planning Staff
DCR	Massachusetts Department of Conservation and Recreation
DEIR	Draft Environmental Impact Report
DEP	Department of Environmental Protection
DIF	District Improvement Financing
DNL	Day-Night Sound Level
DOCs	Diesel oxidation catalysts
DOT	U.S. Department of Transportation
DPFs	Diesel particulate filters
EA	Environmental Assessment
EENF	Expanded Environmental Notification Form
EIR	Environmental Impact Report
EEA	Executive Office of Energy and Environmental Affairs
EOT	Executive Office of Transportation and Public Works
EPA	Environmental Protection Agency
EPH	Extractable petroleum hydrocarbons
ERNS	Emergency Response Notification System

ESA	Environmental Site Assessment
FAQ	Frequently Asked Question
FAR	Floor Area Ratio
FEIR	Final Environmental Impact Report
FHWA	Federal Highway Administration
FONSI	Finding of No Significant Impact
FRA	Federal Railroad Administration
FSC	Forest Stewardship Council
FTA	Federal Transit Administration
GHG	Greenhouse Gas
GPS	Global Positioning System
GRS	Guilford Rail System
HDPE	High-density polyurethane
HUD	U.S. Department of Housing and Urban Development
HVAC	Heating, Ventilation and Air Conditioning
Hz	Hertz – noise cycles per second
I/M	Inspection and Maintenance
IRA	Immediate Response Action
IRIS	Integrated Risk Information System
ITE	Institute of Transportation Engineers
LI	Local Industrial Subdistrict
LNAPL	Light non-aqueous phase liquid
LOS	Level of service
LSP	Licensed Site Professional
MAAB	Massachusetts Architectural Access Board
MAPC	Metropolitan Area Planning Council
MassDEP	Massachusetts Department of Environmental Protection
MassGIS	Massachusetts Geographic Information System
MassHighway	Massachusetts Highway Department
MBTA	Massachusetts Bay Transportation Authority

MCP	Massachusetts Contingency Plan
MGL	Massachusetts General Law
MEPA	Massachusetts Environmental Policy Act
MHC	Massachusetts Historical Commission
MIS/AA	Major Investment Study/Alternatives Analysis
MOA	Memorandum of Agreement
MPO	Metropolitan Planning Organization
MPS	Multiple Property Submission
MSATs	Mobile Source Air Toxics
MSPG	Multi-Sector General Permit for Stormwater Discharges Associated with Industrial Activity
MS4	Small Municipal Separate Storm Sewer System
MUTCD	Manual on Uniform Traffic Control Devices
MWRA	Massachusetts Water Resource Authority
NAAQS	National Ambient Air Quality Standards
NATA	National Air Toxics Assessment
NCHRP	National Cooperative Highway Research Program
NEPA	National Environmental Policy Act
NFPA	National Fire Protection Association
NHPA	National Historic Preservation Act
NLEV	National low emission vehicle
NO	Nitric oxide
NOx	Oxide of nitrogen
NO_2	Nitrogen dioxide
NPDES	National Pollutant Discharge Elimination System
NPL	National Priorities List
NRSA	Neighborhood Revitalization Strategy Area
OCC	Operations Control Center
OCS	Overhead catenary system
OHM	Oil/Hazardous Materials

O&M	Operating and Maintenance
OSHA	Occupational Safety and Health Administration
PAH	Polycyclic aromatic hydrocarbons
PAR	Pan Am Railways
PCBs	Polycyclic chlorinated biphenyls
PDS	Priority Development Sites
PLOS	Pedestrian Level of Service
PM	Particulate matter
PMOC	Project Management Oversight Consultant
PPM	Parts per million
PUD	Planned Unit Developments
RAO	Response Action Outcome
RCRA	Resource Conservation and Recovery Act
R&D	Research and Development
REC	Recognizable Environmental Condition
RFG	Reformulated gasoline
RMS	Root-mean-square
ROW	Right-of-way
RTNs	Release Tracking Numbers
SCADA	Supervisory Control and Data Acquisition
SCAT	Somerville Community Access Television
SEL	Sound exposure level
SIP	State Implementation Plan
Somerville MRA	City of Somerville National Register Multiple Resource Area
SPCC	Spill Prevention, Control, and Countermeasures
ST	Springfield Terminal Railway
STIP	State Transportation Implementation Plan
SVOCs	Semi-volatile Organic Compounds
SWL	Solid Waste Landfills

SWPPP	Stormwater Pollution Prevention Plan
TAZ	Transportation analysis zone
TCLP	Toxicity characteristic leachate procedure
TCRB	Transportation Cooperative Research Program
TIP	Massachusetts Transportation Improvement Program
TOD	Transit-oriented development
TPH	Total petroleum hydrocarbons
TSD	Transportation, Sewage and Disposal
TSS	Total suspended solids
USC	United States Codes
UST	Underground Storage Tank
V/C	Volume to capacity ratio
VOCs	Volatile organic compounds
VMT	Vehicle miles travelled
VPH	Volatile petroleum hydrocarbons
WAN	Wide Area Network
YOE	Year-Of-Expenditure

The Commonwealth of Massachusetts
Executive Office of Environmental Affairs
100 Cambridge Street, Suite 900
Boston, MA 02114-2524

MITT ROMNEY
GOVERNOR
KERRY HEALEY
LIEUTENANT GOVERNOR
ROBERT W. GOLLEDGE, JR.
SECRETARY

Tel. (617) 626-1000
Fax. (617) 626-1181
http://www.mass.gov/envir

December 1, 2006

CERTIFICATE OF THE SECRETARY OF ENVIRONMENTAL AFFAIRS
ON THE
EXPANDED ENVIRONMENTAL NOTIFICATION FORM

PROJECT NAME	: Green Line Extension
PROJECT MUNICIPALITY	: Cambridge, Medford and Somerville
PROJECT WATERSHED	: Boston Harbor
EOEA NUMBER	: 13886
PROJECT PROPONENT	: Executive Office of Transportation (EOT)
DATE NOTICED IN MONITOR	: October 10, 2006

Pursuant to the Massachusetts Environmental Policy Act (G. L. c. 30, ss. 61-62H) and Section 11.03 of the MEPA regulations (301 CMR 11.00), I hereby determine that this project **requires** the preparation of an Environmental Impact Report (EIR).

This project is a hallmark of the Commonwealth's commitment to the principles and practice of smart growth. This significant investment in urban mass transit will provide important transportation, air quality and urban redevelopment benefits and will fulfill a longstanding commitment to incorporate transit projects as an integral element of the Central Artery/Tunnel Project (CA/T). It will significantly reduce regional emissions of nitrous oxides (NO_X) and volatile organic compounds (VOC), the chief precursors of smog, and of carbon dioxide, the principal greenhouse gas responsible for global warming. New public and private investments can revitalize the social and environmental fabric of the corridor. For this project to achieve its potential, however, the Executive Office of Transportation (EOT) and the Massachusetts Bay Transportation Authority (MBTA) must design the project carefully and coordinate proactively and effectively with state and city agencies, citizens, local businesses and other stakeholders during all aspects of the project – planning, design and construction.

The project should be designed to maximize benefits for local residents while preserving the integrity and character of existing neighborhoods. This project has received significant public input including approximately 100 comment letters representing a range of views. I have received comment letters from elected officials and municipal representatives including U.S. Representative Michael Capuano, Senator Barrios, Senator Jehlen, Representative Provost, Representative Sciortino, Medford Mayor McGlynn, Somerville Mayor Joseph Curtatone and Cambridge City Manager Robert Healy. I have received comments from multiple city, state and regional agencies, from environmental, bicycle and pedestrian advocacy groups, from neighborhood groups, from groups that represent the disabled and from businesses and residents.

These comments reflect significant interest in the future of this corridor and range from full and wholehearted support of the project to complete opposition. Commenters want to protect and enhance the character and vitality of this corridor, its neighborhoods and business centers, although their perception of this project's ability to achieve these goals varies. Many of the issues traditionally associated with expanded transit are minimized by using an existing ROW; however, this ROW will be altered significantly and service (and associated impacts) will increase and need to be mitigated. Even the most committed supporters of this project identify the need for additional analysis, information and commitment to mitigation measures to ensure the success of this long-term improvement. The uncertainty expressed in some of the comment letters is associated with the conceptual design of the project at this stage. Enhanced land use planning, re-analysis of station locations, identification of land takings, mitigation of environmental impacts (noise, vibration, and stormwater), and development of good access for pedestrians, cyclists and the disabled have been identified as important issues. Coordination of bridge design and re-construction with local officials will be critical. Traffic management and development and enforcement of parking will be particularly important around the terminus of the line.

I am confident that EOT and the MBTA can and will address these issues responsibly and thoroughly. The key to the project's overall success will be proactive coordination with municipalities, neighborhoods and abutters to ensure that it balances appropriately the adequacy of transit access with mitigation. EOT has made a commitment to plan and develop the project in coordination with a Citizen's Advisory Committee (CAC) representing a broad range of public and private interests.

Project Description

As described in the Expanded Environmental Notification Form (ENF), the project will extend Green Rail service using light-rail vehicles from the relocated Lechmere Station through Cambridge and Somerville to Medford. As currently proposed, the project will extend service 3.8 miles along the ROW for the Lowell commuter rail to the College Avenue/Medford Hillside area. It will include a .6 mile spur to Union Square along the Fitchburg commuter rail ROW. The project will not alter any wetlands although the ROW will be modified significantly and vegetated banks will be replaced with concrete retaining walls in some locations. The project cost is estimated at $500 million (assuming no purchase of new light rail vehicles). EOT indicates that construction could begin in 2011 with a completion date of 2014. The Executive Office of Transportation (EOT) is managing the planning and environmental review for the project. The Massachusetts Bay Transportation Authority (MBTA) will own and operate the system.

The project includes construction of new tracks and stations, re-location of existing commuter rail tracks, relocation, removal and/or elimination of freight tracks and elimination of track rights, reconstruction of bridges, construction of a maintenance storage facility, construction of a concrete intrusion barrier between the shared commuter rail/light rail ROW and construction of retaining walls. The project will alter approximately 23,400 linear feet of bank or terrain. The EENF indicates that the project will include stations in the following areas: College Avenue/Medford Hillside (Medford), Broadway/Ball Square (Somerville), Lowell Street (Somerville), Medford Street/Gilman Square (Somerville), Washington Street (Somerville), Union Square (Somerville). In addition, the EENF indicates that extension of service to the Winthrop Street area will be studied. The stations are proposed as center stations with a minimum width of 81 feet 6 inches and a desired width of 101 feet 6 inches. In other areas, a minimum width of 61 feet is required and 81 feet is preferred. To address significant changes in grade between surface streets and proposed stations, stations will include stairways and ramps and/or elevators to provide access.

The project will extend through densely populated urban areas that contain a large base of commuters and transit users. It includes many underutilized sites with significant redevelopment potential. Area roadways and the public transit system experience congestion and delay during peak hours. Bus service is provided by approximately 15 routes throughout the project area. The ROW is approximately 80 feet in most locations and is adjacent to residences, institutions and businesses.

Jurisdiction and Permits

The project is subject to review and mandatory preparation of an EIR pursuant to Section 11.03 (1)(a)(1) and (6)(a)(5) of the MEPA regulations because it may require a state permit and will alter more than 50 acres of land and consists of a new rail or rapid transit line along a new, unused or abandoned right-of-way for transportation of passengers or freight. The project will require Access Permits from the Massachusetts Highway Department and may require Access Permits from the Department of Conservation and Recreation (DCR). It will require review by the Massachusetts Historical Commission (MHC). Also, it will require a National Pollutant Discharge Elimination System (NPDES) permit from the US Environmental Protection Agency.

Because the proponent is a state agency and will use state funding, MEPA jurisdiction extends to all aspects of the project that may cause significant Damage to the Environment including those issues that relate to stormwater, air quality, traffic and transportation, noise, vibration, open space, historic resources, hazardous waste/contaminated soils and construction period impacts.

DEIR Request

In accordance with Section 11.05 (7) of the MEPA regulations, the proponent has submitted an EENF with a request that I allow the proponent to fulfill its EIR obligations under MEPA with a Single EIR, rather than the usual process of a Draft and Final EIR. The EENF received an extended comment period pursuant to Section 11.06 (8) of the MEPA regulations, and the MBTA voluntarily extended the comment period until November 24, 2006 to provide opportunities for further review and input. Section 11.06(8) of the MEPA regulations indicate that a Single EIR may be allowed provided that the EENF:

(a) describes and analyzes all aspects of the Project and all feasible alternatives, regardless of any jurisdictional or other limitation that may apply to the Scope;
(b) provides a detailed baseline in relation to which potential environmental impacts and mitigation measures can be assessed; and
(c) demonstrates that the planning and design for the Project use all feasible means to avoid potential environmental impacts.

I have reviewed the proponent's request for a Single EIR in accordance with the MEPA regulations. While the EENF provides a detailed description of the project and project elements and summarizes previous analyses of alternative alignments and technologies, it does not provide baseline data from which to measure potential environmental impacts, quantify potential impacts or demonstrate how such impacts will be mitigated. The EENF does not include a baseline analysis of noise, vibration, traffic, air quality impacts or stormwater. Although the EENF notes that the project area includes environmental justice areas, it does not identify them or analyze how the project will avoid disproportionate impacts and fair distribution of benefits (including access and economic development opportunities). The EENF identifies the potential for limited land takings but specific areas are not identified. The EENF identifies the general area of proposed station locations but does not identify the criteria used to select these locations or evaluate how proposed locations meet thses criteria.

While there is strong support from many commenters for the restoration of light rail within this corridor, comment letters also underscore the need to evaluate alternatives to the proposed alignment, particularly for the Union Square spur and the terminus of the line, and to develop adequate mitigation that will minimize impacts to abutters. I strongly support this project for its potential to provide affordable transit access and important air quality benefits, and I recognize that this project will fulfill a long-term commitment by the Commonwealth. Thorough planning and analysis, within the context of MEPA review, coupled with proactive coordination with communities, will ultimately facilitate permitting and local review and accelerate the completion of this project. Therefore, I am requiring the proponent to prepare a DEIR in fulfillment of the requirements of Section 11.08 of the MEPA regulations. I note that the MEPA regulations do provide sufficient flexibility to streamline the review in the future. If the DEIR provides a reasonably complete and stand-alone description and analysis of the project, project alternatives and environmental impacts, and adequately addresses mitigation, the regulations allow the DEIR to be reviewed as a FEIR.

Given the recent settlement associated with the Central Artery/Tunnel project's transit mitigation commitments, in combination with MassDEP's promulgation of regulations related to these transit commitments, which establish both a public review process and timetable for completion of this project, I am confident that EOT and the MBTA will comprehensively address the Scope contained in this Certificate. Therefore, if the DEIR is thorough, as I expect it will be, then it is very likely that the DEIR will be deemed adequate to serve as the FEIR, after public review and comment.

SCOPE

General

The EIR should follow Section 11.07 of the MEPA regulations for outline and content, as modified by this scope. The EIR should include a copy of this Certificate.

Project Description and Permitting

The EIR should provide a detailed project description including a project schedule, project costs and funding sources. If EOT will pursue federal funding, it should coordinate the and National Environmental Policy Act (NEPA) review process. The EIR should include an existing conditions plan illustrating resources and abutting land uses for the entire project area and a proposed conditions plan (or plans) illustrating proposed elevations, structures and stormwater management systems.

The EIR should describe designs for track locations, relocations and bridge replacements. It should provide detailed information on station locations, designs, lighting and access. The EIR should describe operating parameters for the service including the type and number of cars required to provide service and headways. The EIR should also include a circulation plan illustrating how motor vehicles, buses, pedestrians and cyclists will access each station. It should detail requirements for the maintenance facility including parking. It should describe electrical systems including the catenary and support structures, substations and signal and communication systems. The DEIR should identify temporary and permanent land takings. The DEIR should include plans, designs, renderings and, where appropriate, illustrations or photos.

The DEIR should include a list of required permits and approvals, demonstrate the project's consistency with regulatory standards and provide an update on the status of each permit and/or approval.

Smart Growth/Land Use

The overarching policy goal within MEPA review for the use and reuse of land as defined by the Office of Commonwealth Development's (OCD) Sustainable Design Principles and Executive Order 385 (Planning for Growth) is to direct public infrastructure investments to spur revitalization of previously developed urban sites over undeveloped Greenfield sites. MEPA and state agencies such as EOT must actively consider the consistency of their actions with local and regional growth management plans to avoid the distinction between state responsibility for transportation planning and local responsibility for land use planning. If this project is designed with the proactive participation of communities and based on solid land-use planning it will maximize economic development and long-term ridership potential.

As noted previously, EOT has committed to planning this project in conjunction with a CAC to facilitate effective and meaningful participation at the local level regarding all aspects of the project including land use, project alternatives, ridership and mitigation. The success of this project will be dependent not only on EOT's ability to plan effectively but the ability of Cambridge, Medford and Somerville to respond with appropriate zoning changes and complementary regulations. The CAC should include representatives of regional planning agencies, local government, business interests, community groups, representatives of environmental justice areas and the disabled community, abutters, and bicyclist and pedestrian groups.

EOT should use its work with municipalities on the Urban Ring Project (EOEA #12565) as a model for planning and coordination on this project. As the Conservation Law Foundation (CLF) and the Metropolitan Area Planning Council (MAPC) have indicated, EOT should build on the corridor planning work it has conducted to date and develop a more detailed corridor study to examine zoning, development opportunities (including the potential for air rights development to create open space and playing fields or affordable housing), the relationship of EJ communities to the project and potential and existing transit connections. The study should adequately account for near-term and long-term population projections and job growth in the entire corridor. Commenters have written and spoken eloquently about the potential impacts of new transit access and identified concerns that the project could change the character of their communities, reduce housing affordability and reduce transit access for certain populations. The corridor study should by used to inform these issues and the DEIR should describe how communities can plan to address these issues.

EOT should also assess opportunities to minimize environmental impacts from the project such as use of solar for station lighting, and use of recycled materials. Retaining wall alternatives should be considered that incorporate materials and landscape plantings that could minimize adverse visual impacts, noise and stormwater.

Consistency and Coordination with Planning and Projects

The corridor study should be employed to evaluate the consistency of this project with previous and ongoing planning efforts and relevant transportation plans. As noted in the EENF, a tremendous amount of land use, zoning and environmental planning has been conducted in areas throughout and adjacent to the corridor. Coordination with ongoing and planned projects can support the effectiveness of all projects by creating economies of scale and maximizing access opportunities (and therefore development opportunities). Specific projects that should be carefully evaluated for implications on the Green Line Extension and planned in conjunction with it include: the Urban Ring, reconstruction of Route 28/McGrath Highway, the North Point development and relocation of Lechmere Station, the Community Path and the Minuteman to Mystic Valley Parkway Path.

The Community Path, in particular, will benefit from a coordinated approach. Designing and building it in conjunction with the Green Line is critical to its overall viability and will certainly reduce its overall cost. The Community Path, in turn, can provide good access to the Green Line Extension and boost ridership levels for the Green Line Extension. Therefore, I am directing EOT to work proactively with the proponents of the Community Path and to include conceptual designs in the DEIR. The DEIR should identify where the Path can be accommodated within the ROW, identify potential pinch points and obstacles to including it within the ROW and, where the ROW cannot accommodate the Community Path, evaluate alternatives (i.e. cantilevering the trail or identifying on-street routes). The DEIR should evaluate whether bridges (new and rebuilt) are wide enough to accommodate the path. The DEIR should provide cost estimates of the project. Also, the DEIR should evaluate the viability of extending the Community Path to Route 16 to create a connection with the Mystic River Parkway.

Environmental Justice

Environmental justice principles lead EOEA and the proponent to ensure that no segment of the populations should be denied environmental benefits, or should bear a disproportionate burden of environmental impacts. This project is intended to provide transit service, along with better access to jobs, housing and public services. The DEIR should identify EJ areas and other sensitive populations, provide relevant socio-economic data, describe how the project is designed to provide fair access to stations and economic development opportunities and avoid any disproportionate share of impacts. In particular, the station locations and siting of the storage and maintenance facility should be carefully considered and community impacts carefully assessed and mitigated. In addition, the land use study and planning should consider strategies for allowing housing affordability.

EOT should take affirmative measures to ensure full public participation in the MEPA process by all affected communities, particularly those with a high percentage of minority, low-income, non-English-speakers and the disabled. I encourage EOT to work with EOEA staff in developing appropriate protocols.

Alternatives Analysis

As described in the EENF, the Beyond Lechmere Northwest Corridor Study Major Investment Study (MIS)/Alternatives Analysis process screened a broad range of project alternatives, technologies (e.g. Bus Rapid Transit (BRT), light rail, commuter rail) and operating plans for improving service to the study area. An Advisory Group was created to assist with the development and review of this document. The study area was identified as the area underserved by fixed guideway transit service in Cambridge, Somerville and Medford. It included the area between Interstate-93 and the Orange Line to the East and the Red Line and Fitchburg commuter rail line to the west and south. The study explored 9 options that were reduced to 5 upon further evaluation. The five included:

- 1A - Green Line to West Medford
- 1C - Green Line to West Medford/Union Square
- 2B - BRT to West Medford and Green Line to Union Square
- 3A - Commuter Rail Shuttle to West Medford
- 3B - Commuter Rail Shuttle to Anderson RTC

In addition, a Transportation System Management (TSM) alternative that explored how to improve existing infrastructure and service was evaluated. This Study indicated that the Alternatives 1A, 1C and 2B provided the most benefit in terms of air quality and reduction in vehicle miles of travel (vmt). The Preferred Alternative included in the EENF is a variant of Alternative 1C - Green Line to West Medford (with a terminus at College Avenue)/Union Square. EOT indicated that it was willing to consider extending the project to Winthrop Street.

As noted previously, the extension of the Green Line to Medford Hillside remains a part of the Commonwealth's transit commitments developed through the CNT Project permitting. This commitment was codified in the DEP Transit System Improvement Regulations (310 CMR 7.36) in 1991 and is included as an element of the Commonwealth7sState Implementation Plan (SIP) for ozone. Revised Transit Regulations are being issued today and include a legal commitment for EOT to extend Green Line Service using light-rail vehicles from Lechrnere Station to Medford Hillside and a spur to Union Square before December 31,2014. I note that the regulations do not specify the terminus of the line within Medford Hillside and final project designs will be dependent upon the attainment of specific emissions reductions. A broad approach to the alternatives analysis is important so that additional MEPA review will not be required should policy, regulations and/or funding opportunities change.

While many commenters object to any extension of the Green Line northward or its extension beyond certain locations, very few have requested additional analysis of previously explored alternatives (i.e. commuter rail or BRT). I have received numerous and thoughtful comments regarding the need for analyzing potential routing, station location and other variants on the Preferred Alternative. In addition, commenters have noted that EOT did not identify why the project has been limited to College Avenue rather than the original Alternative 1C and did not evaluate alternatives to the Fitchburg commuter rail alignment to Union Square.

Based on the alternatives analysis completed to date, the legal commitment requiring construction of this specific alignment and general support for the alignment and proposed technology, the DEIR should include analysis of the following alternatives:

- No Build
- Preferred Alternative – Green Line Extension to Medford Hillside and Spur to Union Square
- Route 16 Terminus Alternative
- Union Spur via McGrath/Somerville Avenue Alternative

The purpose of this analysis is to explore alternatives that will meet ridership goals and other project objectives while reducing potential impacts. I am cognizant of the fiscal constraints within which these projects are being planned and realize that all investment should be carefully analyzed to determine its benefits. The DEIR should describe benefits and drawbacks based on information on access, noise and air quality impacts and opportunities to minimize runoff. Information on baseline conditions – noise, vibration, air quality, traffic, access - will be critical for adequately comparing alternatives.

Some comment letters do not demonstrate public support for extending the Project across the Mystic River to the commuter rail station in West Medford Square although this terminus is the basis for ridership estimates of Alternative 1C. While I am not requiring EOT to evaluate this alternative further, the DEIR should identify the basis for selecting a variation of Alternative 1C and should consider other alternatives that could meet the goal of a connection between the Green Line Extension and the Lowell commuter rail including a rail stop at Tufts University or Gilman Square. I am directing EOT to evaluate the benefits and impacts of extending the project to Route 16.

The EENF propose only one possible alignment for the Union Square Spur. A large number of commenters, including elected officials, have requested that an alternative be evaluated that will bring the rail line closer to the center of Union Square to improve overall accessibility, to provide better connections with bus routes and to avoid disruption associated with the rebuilding of Prospect and Webster Street bridges. In addition, they note the opportunity to coordinate this alternative with reconstruction of McGrath Highway. The DEIR should consider alternatives that route the spur along the McGrath Highway and Somerville Avenue with a potential to loop back along the Fitchburg Line.

Maintenance and storage of Green Line vehicles are an integral part of this project. Many commenters have raised concern with the location of a maintenance facility at Yard 8 and suggested that expansion of the Boston Engine Terminal (BET) should be considered as an alternative. The DEIR should analyze feasible alternatives to the Yard 8 site, including but not limited to the BET, and evaluate how impacts related to the Yard 8 site can be avoided, minimized and mitigated.

Impacts to Land/Stormwater

For each alternative, the DEIR should quantify the amount of land altered, the amount of earth work involved in meeting final grades and the amount of impervious surfaces created. The EEIR should investigate all feasible methods of avoiding, reducing or minimizing impacts to land. The DEIR should consider alternatives to construction of concrete retaining walls that could retain trees and vegetation while minimizing noise, vibration and stormwater impacts.

Although this project is taking place within a developed corridor and will increase impervious surfaces only by a modest amount, it will change the nature of the ROW and affords opportunities for improvement of the existing stormwater infrastructure and management system. The DEIR should include an overall drainage plan and it should discuss the consistency of the post-development construction and drainage plan with the DEP Stormwater Management Policy. It should demonstrates that source controls, pollution prevention measures, erosion and sediment controls and the drainage system will comply with the DEP Stormwater Management Policy and standards for water quality and quantity both during construction and post-development. The EIR should include an operations and management plan to ensure the long-term effectiveness of the stormwater management system. The DEIR should identify any stormwater discharge points and describe any drainage impacts associated with required off-site roadway improvements. The DEIR should investigate all feasible measures of reducing impervious surfaces.

Station Design and Locations

Station design and location is an important factor in the design of the project and will impact ridership, travel times, access, parking availability and congestion. The EENF describes general areas/intersections where stations will be proposed but does not identify specific locations or identify the criteria (i.e. distance between stations; even distribution of station stops; proximity to elderly housing, independent living and assisted living and/or low-income housing; proximity to high ridership bus stops; limiting impacts to abutters; and locations near institutions) used to identify station locations. Corridor planning should inform the analysis of specific station locations and should consider near-term ridership opportunities as well as long-term growth potential. Because parking will not be provided, the ability to provide good pedestrian and bicycle access will be a critical factor in station locations and designs. Bus stops, drop-off areas and bike storage should be integrated into stations.

EOT should carefully consider comments provided on station locations and evaluate the feasibility and advisability of locating stations at Route 16, Winthrop Street, between Winthrop Street and College Avenue (as described by the Medford Green Line Neighborhood Alliance (MGNA) and supported by Tufts University) and to serve the Brickbottom/Twin Cities Plaza area.

The DEIR should propose specific station locations based on this analysis and describe how they support ridership goals and other objectives of the project. The DEIR should provide more detailed designs and renderings of the stations, describe amenities that will be provided (canopies, street furniture, lighting, vending machines, trash receptacles, etc.) and should consider measures to minimize impacts (combined lighting/electrical structures, use of solar for lighting, permeable pavement, etc.). It should identify how the station design will provide safe and efficient loading and unloading of passengers and its consistency with ADA and universal design principals. It should identify how access will be provided from street level to the stations, particularly where large grade changes are present. It should consider alternative to the proposed design such as integrating ramps into existing slopes.

Air Quality

According to the U.S. Environmental Protection Agency (EPA) Massachusetts is in moderate non-attainment for ozone, whose precursors are nitrogen oxides (NOx) and volatile organic compounds (VOCs). Ozone pollution causes a variety of health problems including aggravated asthma, reduced lung capacity and increased susceptibility to respiratory illnesses line pneumonia and bronchitis. A study by the Centers for Disease Control and Prevention revealed that Massachusetts has the highest rates of asthma for adults in the nation. Cars, trucks and buses, are the largest source of criteria air pollutants, air toxics and greenhouse gases in the state. Extension of the Green Line will reduce local air quality impacts by maximizing public transit service and replacing some diesel bus service with light rail service.

The DEIR should describe the air quality benefits associated with this project and describe its consistency with the State Implementation Plan (SIP) and MassDEP's Transit Regulations. The DEIR should include a mesoscale and a microscale air quality analysis. The analyses should analyze the following emissions: VOC, NOx, greenhouse gases, carbon monoxide, particulate matter (PM) and air toxics. The mesoscale analysis should examine the broad regional impacts of the project and predict total emission reductions. The microscale analysis should examine localized carbon monoxide (CO) conditions and identify hot spots related to traffic congestion near transit stations. EOT and the MBTA should consult with MassDEP regarding the development of the study protocols before initiating the study and submitting the DEIR.

The DEIR should respond to comments regarding the design of the electrification system to support long-term electrification of the commuter rail. In addition, it should evaluate benefits of reducing transit service provided by diesel buses.

Transit Ridership

The air quality benefits of light rail restoration will vary depending on the ridership levels that can be generated by the project design and operating plan. The DEIR should propose a design and operating plan that generates the highest level of ridership possible while balancing the use of MBTA resources and community impacts. The MIS Alternative IC Extension to West Medford was projected to support 10,060 system-wide trips. This was based on a terminus in West Medford and assumed 5 minute headways to West Medford and 7 minute headways to Union Square.

Ridership and associated reduction in vehicle miles of travel (VMT) should be re-evaluated for all alternatives explored in the DEIR. The DEIR should describe the assumptions used to generate the ridership numbers (including the margin of error associated with the model) and the operating parameters necessary to achieve them such as number and type of vehicles, consist size, vehicle capacity, travel time and peak and off peak headways. The DEIR should specify whether VMT reductions are based on new or diverted trips.

The DEIR should include a discussion of impacts and/or benefits associated with achieving various ridership levels and benefits to/impacts on the central subway and Green Line operations. Also, the DEIR should also discuss how and what bus routes are likely to change in response to the service and how existing and new bus and shuttle routes can be designed to maximize transit ridership. Finally, the DEIR should describe how construction will be managed with operation of the Lowell commuter rail service. It should discuss any impacts to the service including whether shutdowns or reduction in service will be required.

Traffic and Transportation

This service will operate in a dense urban area and will affect traffic patterns and circulation. It will draw thousands of people to the transit stations that will be constructed near intersections already experiencing significant congestion. Its completion will require the reconstruction of 6 to 11 roadway bridges and several railroad bridges. Comment letters express significant concern with temporary and long-term traffic impacts. Many citizens of Medford are particularly concerned with additional traffic and parking issues that could be generated at the terminus of the line. Although the project is intended to reduce vehicle traffic overall and will not incorporate parking at stations, there could be limited problems if it is not thoughtfully designed or constructed in conjunction with appropriate parking regulations and enforcement. Re-construction of bridges will need to be well-coordinated with the communities to minimize construction period impacts.

EOT should work with MHD, DCR, MAPC and local traffic department to develop the scope for the traffic study to address these concerns. The purpose of this analysis is not to hold EOT responsible for mitigating longstanding congestion problems but, rather, to identify the specific impacts and benefits of this project. This information will help state agencies and the Cities of Cambridge, Medford and Somerville to assess the consistency of this project with other planning efforts and projects in the area and facilitate exploration of design, infrastructure and operational changes to the corridor and regional traffic and transit network that could support this extension while improving traffic flow.

The DEIR should analyze traffic for existing, build and no build conditions to evaluate the implications of the project for intersection Level of Service (LOS) and pedestrian and bicycle circulation. It should address traffic circulation on all roadways adjacent to proposed locations. It should include mitigation for areas where the project will have a significant impact on traffic operations. At a minimum, the traffic analysis should include the following areas:

- Mystic Valley Parkway and its intersections with Alewife Brook Parkway, Auburn Street and Winthrop Street
- Boston Avenue and its intersections with High Street, Mystic Valley Parkway, North Street, Winthrop Street and College Avenue
- Harvard Street/Boston Avenue
- Broadway/College Avenue/Powderhouse Boulevard/Warner Street
- Main Street/Riverside Avenue/Forest Street/Salem Street
- Main Street and its intersections with South Street, Mystic Avenue, Harvard Street
- Medford Street and its intersections with Broadway, Lowell Street, Central Street, School Street, Walnut Street, Highland Avenue and Somerville Avenue
- Highland Avenue and its intersections with Lowell Street, Central Street, School Street, McGrath Highway
- Washington Street and its intersections with Innerbelt Road, McGrath Highway, Somerville Avenue/Webster Street and Beacon Street
- Prospect Street and its intersections with Somerville Avenue, Webster Avenue, Cambridge Street and Hampshire Street

The DEIR should include strategies for mitigating traffic and parking impacts associated with proposed operations and station locations. EOT will be limited in terms of its ability to implement some of the mitigation (e.g. parking enforcement is a municipal responsibility) but it will be useful to understand all approaches that are available to address issues in this corridor. The DEIR should identify proposed changes to bus routes that serve the corridor and incorporate these assumptions into the transit operation and traffic modeling. As noted previously, it should address the relationship between this project and the Urban Ring and other transit improvements planned for the area. It should identify bridges that must be re-constructed and include a commitment to coordinate design, scheduling and construction with city officials.

Freight Service

The project will remove and relocate freight rail tracks and may eliminate freight trackage rights. The DEIR should identify what services will be affected and whether changes will result in increased truck traffic on local and regional roadways. The air quality and traffic analysis should address whether changes will affect air quality and/or traffic patterns. The DEIR should consider alternatives that would minimize or avoid the elimination of freight service.

Noise/Vibration

The DEIR should include an analysis of noise and vibration for existing and proposed conditions. These analyses should identify sensitive receptors such as homes, hospitals, schools and elderly housing where nighttime noise is a particular concern. The DEIR shall include a detailed noise assessment and vibration analysis for the corridor that is consistent with Federal Transit Administration (FTA) guidelines, and an assessment of the impact of service on the surrounding community. The DEIR should indicate areas where mitigation for noise and vibration is needed based on the impact assessment and identify the specific mitigation that will be proposed (e.g. use of ballast along the tracks, sound insulation, sound barriers, maintenance plans).

Open Space and Historic Resources

The project corridor includes several historic resources and properties located in the Massachusetts Historical Commission (MHC) Inventory of Historic and Archaeological Assets and open space resources including athletic fields, school parks, and regional parkland. These include the Susan Russell House, Trum Field, the Hoyt Sullivan Playground and potentially the Mystic River.

EOT should consult with the Massachusetts Historical Commission (MHC) to evaluate impacts and develop appropriate mitigation. The DEIR should provide a Historic and Cultural Resource maps to identify historic resources and open spaces adjacent to the corridor and/or likely to be impacted by air quality, noise, vibration and stormwater impacts associated with the project. It should describe measures that will be employed to avoid, minimize and mitigate impacts to these resources.

Hazardous Waste/Contaminated Soils

The EENF identifies many locations of contaminated soil in the vicinity of the rail ROW and indicates that new reviews and potentially remediation of 21E sites will be needed as the project design progresses. Removal of contaminated soil, pumping contaminated groundwater or working in contaminated media must be done consistent with the provisions of MGL c.21E/21C and OSHA.

The DEIR should describe how contaminated soil will be evaluated, managed and disposed. The list of hazardous waste sites should be updated consistent with MassDEP comments and its database and Release Tracking Numbers (RTN) should be added to the list. EOT should consult with MassDEP regarding the planning and implementation of demolition and the management of contaminated soil to ensure consistency with applicable regulations.

Construction Period Impacts

The EIR should include a discussion of construction phasing, evaluate potential impacts associated with construction activities and propose feasible measures to avoid or eliminate these impacts. It should note whether any blasting will be required. The EIR should identify temporary and permanent construction easements. The proponent must comply with DEP's Solid Waste and Air Quality Control regulations during construction. The proponent should implement measures to alleviate dust, noise, and odor nuisance conditions (including rodent control), which may occur during construction.

The MBTA has developed a construction equipment retrofit program to reduce exposure to diesel exhaust fumes and particulate emissions for its construction projects. The MBTA must require contractors to retrofit construction equipment while working in this dense, urban corridor.

Mitigation

The DEIR should include a separate chapter on mitigation measures. This chapter should include proposed Section 61 Findings (in the form of a draft Letter of Commitment) for all state permits. It should provide a clear commitment to implement these measures, include a schedule for implementation and identify the responsible parties.

Response to Comments

The DEIR should include a copy of each comment received. The DEIR should respond to the substantive comments received. The EIR should present additional narrative and/or technical analysis as necessary to respond to the concerns raised.

Circulation

The proponent should circulate a hard copy of the DEIR to each state and city agency from which the proponent will seek permits or approvals and to each of the City agencies that submitted comments. The proponent should also circulate a copy of the DEIR to those submitting individual written comments. To save paper and other resources, the proponent may circulate the DEIR in CD-ROM format, although the proponent should make available a reasonable number of hard copies, to accommodate those without convenient access to a computer to be distributed upon request on a first come, first served basis. The proponent should send a notice of availability of the DEIR (including relevant comment deadlines and appropriate addresses) to those who signed the petition and for which addresses are available. In addition, a copy of the DEIR should be made available for public review at the Cambridge, Medford and Somerville public libraries.

December 1, 2006
Date

Robert W. Golledge, Jr.

RWG/CDB/cdb

Comments received:

11/13/06	Department of Conservation and Recreation (DCR)
11/9/06	Department of Environmental Protection (MassDEP)
11/24/06	Metropolitan Area Planning Council (MAPC)
10/26/06	U. S. Congressman Michael E. Capuano
11/13/06	Senator Jarrett T. Barrios
11/21/06	Senator Patricia Jehlen
11/22/06	Representative Denise Provost
11/24/06	Representative Carl Sciortino
11/22/06	City Manager Robert W. Healy, City of Cambridge
10/17/06	Mayor Michael J. McGlynn, City of Medford
11/25/06	Robert Maiocco, Medford City Council
11/21/06	Mayor Joseph A. Curtatone, City of Somerville
11/22/06	City of Somerville/Somerville Bicycle Committee
11/24/06	Arlington Transportation Advisory Committee
11/21/06	Conservation Law Foundation
11/30/06	Downtown North Association
11/22/06	East Somerville Main Streets Program
11/22/06	Green Line Community Forum
10/22/06	Groundworks Somerville
10/20/06	Mass Central Rail Trail Coalition
11/20/06	Medford Green Line Neighborhood Alliance (MGNA) Petition
10/17/06	MGNA Study
11/22/06	Tufts University
10/17/06	Union Square Main Streets
11/23/06	Walk Boston
11/22/06	Mary Anne Adducci
11/4/06	Ruth D. Alfasso
11/13/06	James A. and Christine M. Bennett
11/24/06	Melissa B. Bennett
11/3/06	Priscilla Chew
11/8/06	Cummings Foundation, Inc.
11/24/06	Susan Altman
11/19/06	Elisabeth Bayle
11/24/06	Sarah Bergstrom
11/24/06	Fred Berman and Lori Segall
11/18/06	Susan E. Brown
11/16/06	John J. Buckley
11/16/06	John F. Burckhardt
11/9/06	Natasha Burger and Jasper Vicenti
10/11/06	Roberta Cameron
11/24/06	Doug Carr
11/7/06	Theodora Clark
11/24/06	Sara Cohen
11/24/06	Stacy Colella
11/24/06	John F. Deacon

10/19/06	Darlene Domain
10/21/06	Rita Donnelly
11/24/06	Catherine D'Urso
11/20/06	John Roland Elliott
11/24/06	Robert Feigin
11/29/06	James Feldman
10/30/06	Stephanie Groll, Nelson/Nygaard Consulting Associates
10/20/06	Lois Grossman
10/28/06	John Haroutunian
11/24/06	Joseph Jaquinta
11/16/06	R Kangas
11/24/06	Ken Krause
11/14/06	Jerry Lauretano
11/1/06	Scott Lever
11/29/06	Jeffrey R. Levine
11/19/06	Thomas W. Lincoln
11/27/06	Suzanne Lipsky
10/16/06	Joseph P. Lynch, Jr.
11/24/06	Ken Martin
11/21/06	Jean McCarvill
11/24/06	James A. McGinnis
11/22/06	Lynn McWhood
11/22/06	Peter Micheli
11/16/06	Barbara A. Monagle
11/22/06	Alan Moore
11/18/06	Steve Mulder
11/18/06	Angela Murphy
11/19/06	John J. O'Donoghue
11/12/06	Crispin Olson
11/26/06	Alan Peterson
10/16/06	David Phillips
11/1/06	Nancy E. Phillips
11/20/06	Ruth Piscitelli
10/30/06	Jeffrey J. Reese
11/21/06	Ellin Reisner
11/16/06	Barry M. Steinberg
11/2/06	Maura Swan and Ben Lavery
11/22/06	Charles Tolson
11/16/06	Pete Varga
11/20/06	Donald E. Walker and Victoria A. Halal
10/14/06	Lynn Wiles
11/15/06	Dr. William Wood, Carolyn Rosen, James Morse and Gwen Blackburn
10/13/06	Paula Woolley

Executive Summary

About the Project

The Green Line Extension Project is an initiative of the Executive Office of Transportation and Public Works (EOT) and the Massachusetts Bay Transportation Authority (MBTA) to enhance transit services in order to improve mobility and regional access for residents in the communities of Cambridge, Somerville, and Medford. The Project is required by the State Implementation Plan (SIP) and fulfills a longstanding commitment of the Central Artery/Tunnel Project to increase public transit.

The Green Line Extension Project will finally provide light rail transit beyond Lechmere Station, serving the region's most densely populated communities of Cambridge, Somerville and Medford that today are surrounded by, but are not directly served by, fixed-guideway transit. With approximately 18,870 people per square mile in Somerville, 15,760 in Cambridge, and 6,850 in Medford, the study area neighborhoods are among the densest in the Boston region[1] and Somerville is recognized as one of the most densely populated municipalities in United States. In addition, approximately 60 percent of the residents of Cambridge, Somerville, and Medford live in state-defined environmental justice areas, which take up approximately 42.8 percent of the cities' combined area.[2]

The Project Area is currently under-served by transit, and U.S. Census data (2000) indicate that approximately 21 percent of study area households do not own a vehicle, which can create a need for reliable and efficient transit service. Although MBTA commuter rail lines pass through the study area corridor, there are no rail transit stops within these communities. In addition, roadway congestion in the study area affects the reliability of current on-street transit services and results in long travel times (approximately 30 minutes) from Lechmere Station to the Mystic Valley Parkway/Route 16 area despite the relatively short distance (approximately four miles).

1 U.S. Census Bureau, Census 2000.
2 Environmental justice areas are defined by thresholds for income, minority populations, foreign-born populations, and English proficiency. Therefore, most environmental justice areas contain a mix of environmental justice and non-environmental justice residents.

The purpose of the Green Line Extension Project is to improve corridor mobility, boost transit ridership, improve air quality, ensure equitable distribution of transit services, and support opportunities for smart growth initiatives and sustainable development in the Project area of Cambridge, Somerville, and Medford.

The proposed Green Line Extension Project evaluated in this Draft Environmental Impact Report/Environmental Assessment (DEIR/EA) includes:

- Extending Green Line service to Medford within the existing MBTA Lowell Line commuter railroad right-of-way (the Medford Branch), from a newly relocated Lechmere Station terminating at either Medford Hillside in the vicinity of College Avenue with intermediate stations at Brickbottom, Lowell Street, Gilman Square, and Ball Square; or at Mystic Valley Parkway/Route 16.
- Extending Green Line service to Union Square in Somerville (the Union Square Branch), either within the existing MBTA Fitchburg Line commuter railroad right-of-way, or using an in-street running option (a new at-grade alignment along Somerville Avenue), with a station near Union Square;

The Green Line Extension Project offers tremendous benefits to the area, in that the Proposed Project will:

- Be fully grade separated, constructed along existing MBTA railroad rights-of-way, which will enable light rail service to serve pedestrian-oriented centers with minimal disruption to the surrounding community and without significant property or neighborhood impacts.
- Focus regional transportation investment funds into established environmental justice communities, connecting residents to jobs and services in Boston and Cambridge and strengthening business and residential districts in the corridor.
- Maintain existing railroad operations while reducing net noise and vibration impacts and provide mitigation measures in areas that will substantially reduce existing noise levels.
- Offer a one-seat ride from the Project Area into downtown Boston, eliminating the forced bus/rail transfer that occurs at Lechmere Station or to the MBTA's other Orange and Red rapid transit lines.
- Improve transit travel times within the Project Area by 13 to 19 minutes compared to the No-Build Alternative to Union Square or Medford Hillside, respectively.
- Increase the MBTA's anticipated daily ridership at the Proposed Project's seven stations (boardings and alightings) by approximately 52,000 by 2030, with approximately 90% of these trips to take place in the Project's opening year of 2014. The Green Line will also see an increase of 30,700 boardings and the entire MBTA system will see an increase of 7,900 new daily linked transit trips as a result of the extension of Green Line service. Of these new transit trips,

approximately 70 percent of these riders are projected to switch from using their automobiles to using transit.

- Substantially improve mobility and service quality for transit-dependent riders, with improved access to jobs, schools and care facilities and provide universal access, meeting American with Disabilities Act (ADA) standards at all stations.
- Reduce daily Vehicle Miles Traveled (VMT) by 25,018, improving air quality and providing zero-emission transportation capacity for anticipated growth.

The Green Line Extension is urgently needed to improve corridor mobility and livability, particularly in transit-dependent and Environmental Justice communities. The No-Build Alternative provides insufficient mobility improvements for Project area residents and fails to improve environmental conditions and promote smart growth and economic development in the corridor.

The Proposed Project

Alternative 1, Green Line Extension to Medford Hillside and Union Square (using commuter rail rights-of-way), has been selected as the “Proposed Project” for the Green Line Extension Project, as it provides a balance of cost, ridership, and environmental impacts (Figure ES-1). EOT also believes that this alternative will help the Commonwealth achieve its goal of providing expanded transportation services and improve regional air quality. This alternative extends to Union Square via the MBTA Fitchburg Line right-of-way, which would require fewer acquisitions of private property, have more operational reliability, and have a lower capital cost than the Somerville Avenue option. Alternative 1 would meet all Project goals, would be operationally practical, and would generate a high number of new systemwide transit trips. This is the Project for which EOT is currently seeking approval by the FTA.

A total of seven stations are included in the Proposed Project: Lechmere, Brickbottom, Gilman Square, Lowell Street, Ball Square, College Avenue and Union Square. The route length would be about three miles to Medford Hillside with an approximately one-mile spur to Union Square. The primary infrastructure improvements of the Proposed Project would include relocating existing commuter rail lines, and constructing approximately four miles of new light rail track and systems, four multi-span viaducts, a maintenance facility, and reconstructing 11 bridge structures to support the extended service. The Proposed Project is expected to generate new systemwide transit ridership of 7,900 boardings per day and a reduction of 25,018 VMTs per day (projected to the year 2030).

Although the FTA action that is the subject of this EA is the Proposed Project described above, EOT has selected as its Preferred Alternative, Alternative 2, Green Line Extension to Mystic Valley Parkway/Route 16, with no parking at Mystic Valley Parkway/Route 16 Station, and Union Square (using commuter rail rights-of-way).

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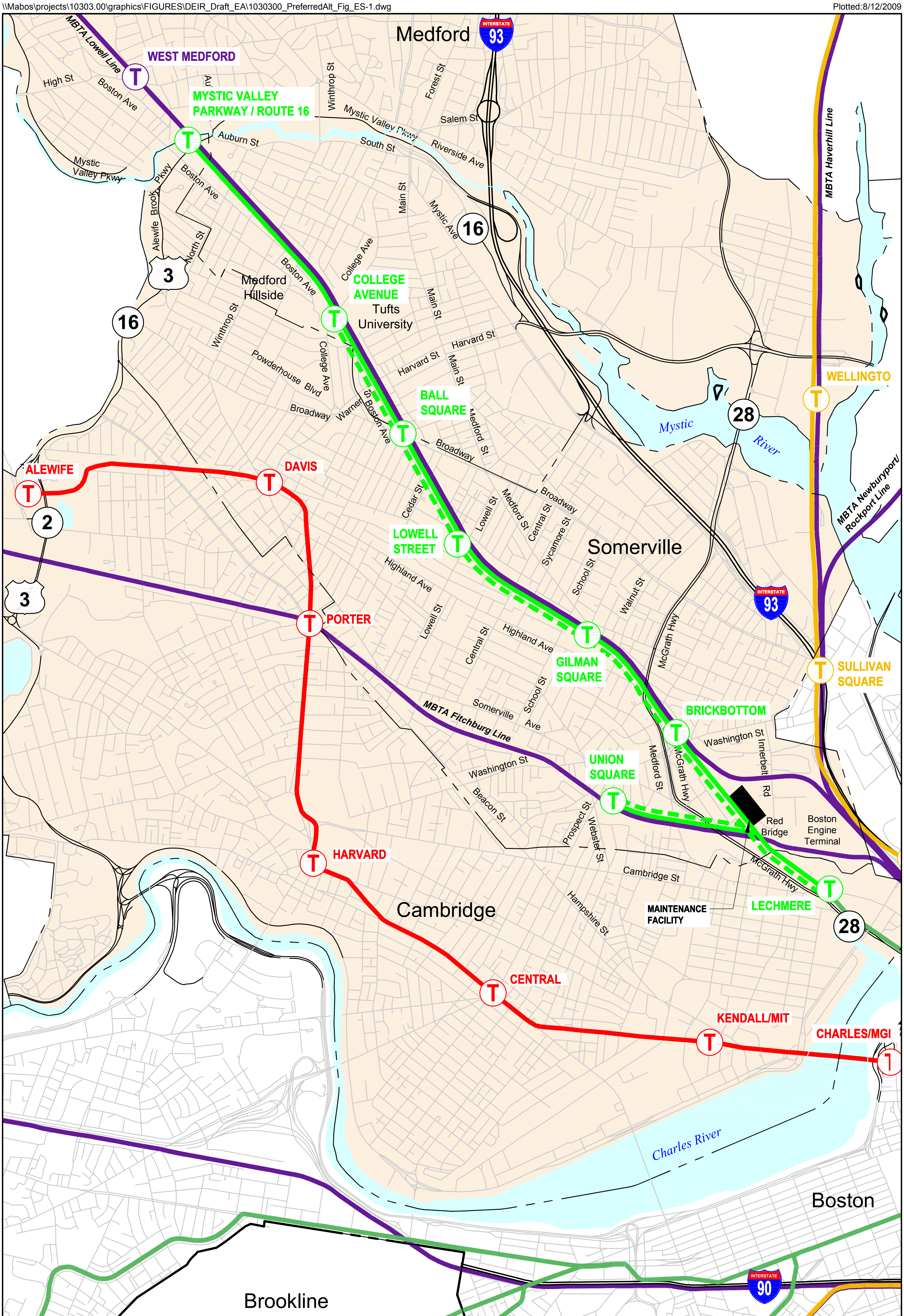

MBTA Blue Line
MBTA Green Line
MBTA Orange Line
MBTA Red Line
MBTA Silver Line
MBTA Commuter Rail Line
Green Line Proposed Project
Green Line Proposed Future Full-Build Alternative
Proposed Station

0 1200 2400 Feet

Green Line Extension Project

EOT

Figure ES-1

Proposed Project

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This alternative also meets all of the Project goals and provides additional regional benefits. However, because of the constraints placed on EOT by federal funding requirements and the economic crisis facing the Commonwealth, at this time EOT is not able to identify sufficient funding to support the construction of the Medford Hillside to Mystic Valley Parkway/Route 16 segment within the 2014 timeframe mandated by the State Implementation Plan.

As of the filing of this document, the Boston Region Metropolitan Planning Organization has voted to 'flex' funding dedicated to the construction of highways to fund the construction of the Medford Hillside to Mystic Valley Parkway/Route 16 segment. These funds will be available sometime between 2016 and 2020 and may allow this portion of the Green Line Extension to be constructed shortly after the 2014 schedule for the Proposed Project has been completed.

Therefore, EOT's Preferred Alternative is proposed to be built in two phases with an initial operating segment (or the "Proposed Project") being constructed to Medford Hillside in the vicinity of College Avenue on the Medford Branch and a spur to Union Square, which is described and evaluated in this DEIR/EA as Alternative 1. The second phase of this Project, the "Future Full-Build Alternative" will include extending the Project from College Avenue Station to Mystic Valley Parkway/ Route 16 Station in the future and has been described and evaluated in the DEIR/EA as Alternative 2.

The environmental impacts of both the Proposed Project, referred to as Alternative 1, and of the Future Full-Build Alternative, referred to as Alternative 2, have been fully evaluated and are described in detail in this DEIR/EA. For federal action, the Proposed Project to Medford Hillside is the subject of this DEIR/EA, as the extension to Mystic Valley Parkway/Route 16 is not envisioned to be constructed within the three-year MEPA or NEPA time frame and would, therefore, require re-assessment at a future date. However, constructing the initial operating segment of the Project will not preclude a future extension of the Preferred Alternative or Future Full-Build Alternative to Mystic Valley Parkway/Route 16, should funding become available in the future.

About the MEPA/NEPA Process

The Green Line Extension Project, as a major action of a state agency, requires public review under the Massachusetts Environmental Policy Act (MEPA). As required by MEPA, an Expanded Environmental Notification Form (EENF) was submitted to the Executive Office of Environmental Affairs (EEA) on October 10, 2006. The Secretary of EEA issued a Certificate on the EENF on December 1, 2006, requiring a Draft Environmental Impact Report (DEIR) for the proposed Project. This DEIR provides the information and analyses required by the Secretary's Certificate, and responds to the substantive comment letters on the EENF.

Because EOT is seeking funding through the FTA, the Project also requires review under the National Environmental Policy Act (NEPA). This document also serves as the Environmental Assessment (EA) for the proposed Project.

Public Involvement

The Green Line Extension Project has received significant public input throughout the planning process. As noted in the Secretary's Certificate, the approximately 90 comment letters on the EENF reflect a substantial interest in the future of the corridor from elected officials and municipal representatives; city, state, and regional agencies; environmental, bicycle, and pedestrian advocacy groups; neighborhood groups; groups that represent the disabled; businesses; residents; and the general public.

To plan and develop the Green Line Extension Project in coordination with this wide range of interests, EOT established a public involvement process that included an Advisory Group, open public meetings, and coordination with the staff and elected officials of Cambridge, Somerville, and Medford, as well as other stakeholders and neighborhood interest groups along the corridor. This process continued the public involvement that began in 2004, during the *Beyond Lechmere Major Investment Study/Alternatives Analysis* study.

Eleven Advisory Group meetings were held during preparation of this DEIR/EA, between September 2007 and March 2009. One round of public meetings, attended by 226 people, was held in January 2008, in two different locations. Station workshops were held to obtain neighborhood input on station locations, access, and potential impacts and mitigation measures. Five station workshops were held in January and February 2008. A second round of public meetings was held in March 2009, in two different locations, which over 600 people attended. In addition to these meetings, the Project Team also attended numerous community and neighborhood briefings.

During the course of the public involvement process for the Project, a number of key issues were raised involving technical analysis and Project outreach including, but not limited to:

- **Ridership Modeling** – Based on requests for additional information by Advisory Group members, EOT held technical tutorials on ridership modeling.
- **Maintenance Facility** – Based on requests for additional information by Advisory Group members, EOT held a site tour of the Green Line Riverside facility and conducted a technical tutorial. Due to concerns about the proposed location of the support facility, EOT and the Project team also produced a full study of the site selection process and evaluated numerous additional

alternatives based on feedback and suggestions by members of the public.

- **Station Siting** –Early in the Project, members of the Advisory Group and the public expressed interest in the siting of stations in the Project area neighborhoods. As a result, EOT held a series of five station workshops where members of the public could discuss their concerns in small groups with the Project team about station siting, including locations of drop-off and pick-up areas, platform locations, bicycle/pedestrian access, and ADA accessibility. Based on the feedback received at these meetings, some station locations received additional analysis and/or were reconfigured to address concerns raised by the public.

- **Tunnel Alignment Alternatives** – Several members of the public suggested constructing tunnels for segments of the Green Line Extension. Based upon this interest, EOT and the Project team performed an extensive analysis of tunneling as an alternative to at-grade construction. Ultimately, the report found tunneling to be cost-prohibitive for this Project.

- **Construction Impacts** –Members of the public expressed concerns with regard to impacts during construction. EOT developed a detailed construction staging plan to help minimize the impacts to neighborhoods, including vehicular traffic, pedestrian traffic, on-street parking, public access, and emergency access to local businesses and residences.

With regard to public outreach, EOT responded to requests for meeting materials in alternative formats, including audio tapes and large-print. These requests were in addition to the standard outreach approaches, including translating materials and meeting notices into multiple languages and other formats. Based on feedback from the public, EOT also expanded the Project database by sending notices of the March 2009 public meetings to all property owners in Medford, Somerville and East Cambridge.

EOT has maintained an informative and up-to-date interactive Project website, **www.mass.gov/greenlineextension**. Between November 2007 and March 2009, the site attracted more than 23,000 new visitors and had a total of more than 145,775 page views. Along with a brief overview of the Project's history and current phase, the website provides access to various reference materials, including documents from previous phases of the Project as well as the most up-to-date Project materials. Interested individuals are able to sign up to be part of the Project mailing list. Individuals are also able to post comments about the Project publicly, as well as use the website to ask questions of EOT and the Project team. The Project website contains all of the materials used at the Advisory Group and public meetings, including comments and responses to comments, fact sheets, Project updates, maps, and graphics. Materials from the Project website have been converted into audio tapes upon request from members of the public.

Regular coordination has occurred with the officials of Cambridge, Somerville, and Medford throughout the Project. In addition to the outreach at a local level, there was also a significant amount of coordination with the various state and Federal agencies to discuss potential Project impacts and other Project details. Agency coordination during the development of this DEIR/EA included, but was not limited to, the following: FTA, MBTA, Massachusetts Department of Environmental Protection (MassDEP), the Massachusetts Department of Conservation and Recreation (DCR), the Metropolitan Area Planning Council (MAPC), the Massachusetts Highway Department (MassHighway), the Massachusetts Historical Commission (MHC), and the Central Transportation Planning Staff (CTPS).

What Alternatives did EOT/FTA Evaluate?

Six "Build" Alternatives and a Baseline Alternative are evaluated in this DEIR/EA. The Baseline Alternative is evaluated, as required by FTA, to identify the best option for meeting the transportation needs of the study area with smaller capital investments than are proposed in the Build Alternatives. The Baseline Alternative evaluated in this document includes enhanced MBTA bus service within the study area, including enhancing the existing Route 80 between existing Lechmere Station and Mystic Valley Parkway/Route 16 parallel to the MBTA Lowell Line commuter rail right-of-way, and a new shuttle bus service between existing Lechmere Station and Union Square.

Table ES-1 Comparison of DEIR/EA Build Alternatives

Alternative	Medford Branch	Union Square Branch	Daily Boardings (2030)	Capital Cost ($M)[1]
1	Medford Hillside	Commuter Rail ROW	7,900	$804.8
2	Mystic Valley Parkway/ Route 16	Commuter Rail ROW	8,900[2]	$959.3[2]
3	Medford Hillside	In-street	7,700	$829.8
4	Mystic Valley Parkway/ Route 16	In-street	8,700	$984.3
5	Mystic Valley Parkway/ Route 16	None	10,500	$870.0
6	None	Commuter Rail ROW	3,900	$370.6

1 2008 dollars

2 These results include 300 parking spaces at Mystic Valley Parkway/Route 16 Station. With no parking at this station, the ridership would be 8,600 new systemwide boardings daily, and the capital cost would be $951.8 million.

The six Build Alternatives evaluated in this DEIR/EA are summarized in Table ES-1. All of these alternatives include relocating Lechmere Station and include a new layover/maintenance facility.

In addition to the Green Line Extension Alternatives, EOT was also scoped with the conceptual design of the Somerville Community Path. Design of the proposed Community Path was developed in order to determine its feasibility. However, construction of the Community Path is not included as part of the Green Line Extension Proposed Project. The design plans for the Somerville Community Path are shown in Appendix E.

Project Description

The Green Line Extension Proposed Project is envisioned to provide service to Medford Hillside and Union Square using a two-branch operation, both in existing commuter rail rights-of-way. One branch would operate from Relocated Lechmere Station to Medford Hillside along the MBTA Lowell Line. This branch would begin at Relocated Lechmere Station and head northwest, meeting the MBTA Lowell Line just south of Washington Street in Somerville. From Washington Street, the alignment would run parallel to the MBTA Lowell Line to Medford, terminating its route at Medford Hillside in the vicinity of College Avenue. The second branch would operate along the MBTA Fitchburg Line from new Lechmere Station into a terminus at Union Square in Somerville. The Union Square Branch would begin at Relocated Lechmere Station and head northwest to Red Bridge, then follow the MBTA Fitchburg Line to the Union Square area.

The Proposed Project is expected to increase the MBTA's anticipated daily ridership at the Project's seven stations (boardings and alightings) by approximately 52,000 by 2030 (and by 56,000 in the Future Full-Build Alternative by 2030), with approximately 90% of these trips to take place in the Project's opening year of 2014. The Proposed Project will generate new systemwide transit ridership of 7,900 boardings per day and a reduction of 25,018 VMTs per day (projected to the year 2030). In the Future Full-Build Alternative, new systemwide transit ridership will increase by 8,600 boardings per day and will result in a reduction of 26,647 VMTs per day (projected to the year 2030).

The Green Line Extension Project has been designed to minimize impacts to the communities by reducing the footprint of the Project and maximizing the use of existing transportation corridors. The Project would use existing railroad rights-of-way for most of its approximately four-mile length. This is possible because the MBTA Fitchburg Line and the MBTA Lowell Line had sufficient width to accommodate additional tracks for freight rail lines dating back to the late 19th century that have since been abandoned. The footprint of the abandoned tracks provides space for new tracks for this proposed Project. The existing right-of-way ranges from 55 to 110 feet in width. In places where space is limited by steep slopes, retaining walls have been proposed to maximize usable space in the railroad rights-of-way. The proposed retaining walls will include a "green" design component, which means that efforts will be made to use recycled and recyclable materials and to incorporate vegetation as part of the wall system, which will provide a more natural aesthetic for the retaining structure. Landscape treatments will also be proposed on the slopes above the walls and to the greatest extent possible at each of the stations.

The Green Line Branches

The Proposed Project includes extending the Green Line along two branches – the Medford Branch (from Lechmere Station to Medford Hillside in the vicinity of College Avenue, extending to Mystic Valley Parkway/Route 16 in the Future Full-Build) and the Union Square Branch (from Lechmere Station to Union Square).

Medford Branch

The 3.4-mile Medford Branch of the Green Line Extension Proposed Project would be constructed within the existing MBTA Lowell Line right-of-way, owned by the MBTA. The existing commuter rail tracks would be shifted approximately 13 feet toward the east side of the right-of-way, using retaining walls where necessary to avoid property impacts. The new light rail track and overhead catenary would be added within the western half of the right-of-way. For the Proposed Project, five stations would be constructed on this branch:

- south of Washington Street (Brickbottom Station);
- at Gilman Square;
- at Lowell Street;
- at Ball Square, north of Broadway; and
- at College Avenue.

In the Future Full-Build Alternative, there will be one additional station located just south of Mystic Valley Parkway/Route 16.

Although all of the Medford Branch alternatives would be constructed within the existing MBTA right-of-way, several existing roadway and rail bridges would need to be reconstructed to accommodate the new light rail tracks. These include:

- former Red Bridge (rail) (Somerville);
- Washington Street (rail) (Somerville);
- Walnut Street (roadway) (Somerville);
- Medford Street (roadway) (Somerville);
- School Street (roadway) (Somerville);
- Lowell Street (roadway) (Somerville);
- Cedar Street (roadway) (Somerville);
- Broadway (roadway) (Somerville);
- Harvard Street (rail) (Medford); and

- College Avenue (roadway) (Medford).

Two additional bridges would be reconstructed for the Future Full-Build Alternative:

- Winthrop Street (roadway) (Medford); and
- North Street (roadway) (Medford).

Union Square Branch

The 0.9-mile Union Square Branch of the Green Line Extension Project would be constructed within the existing MBTA Fitchburg Line right-of-way, owned by the MBTA. The existing commuter rail tracks would be shifted approximately 10 to 14 feet toward the south side of the right-of-way, using retaining walls where necessary to avoid property impacts. The new light rail track and overhead catenary would be added within the north half of the right-of-way. A station would be constructed along the rail corridor at Prospect Street near Union Square. The Union Square Branch would require reconstructing the Medford Street rail bridge in Somerville.

Other alternatives also evaluated the Union Square Branch of the Green Line Extension as a single-track loop alignment, starting its outbound service at Relocated Lechmere Station and travelling on a new alignment and connect into Somerville Avenue, where embedded tracks would allow in-street running in the roadway. From Union Square, the tracks would turn south towards the MBTA Fitchburg Line using private property along Prospect Street. This option was not selected as part of the Proposed Project because of its substantially higher environmental impacts.

Construction

Construction staging and sequencing strategies are critical to achieving the balance of an efficient construction project while minimizing the impacts to vehicular traffic, pedestrian traffic, on-street parking, public access, and emergency access to local businesses and residences. This corridor presents several construction challenges including narrow roadways, urban traffic volumes, and a variety of commercial, industrial, and residential land uses that require continuous access, limited space for construction zones and lay down areas within or near the rail corridor, and existing rail service that must be maintained throughout construction.

The Green Line Extension Proposed Project has been designed to minimize impacts to the communities by reducing the footprint of the Project and maximizing the use of existing transportation corridors. The Project would use existing railroad rights-of-way for most of its approximately four-mile length. The use of the existing MBTA commuter rail right-of-way for the proposed Green Line tracks greatly reduces the complexity of construction as well as construction impacts. Figures ES-2 and ES-3 show the existing right-of-way and the proposed right-of-way. The existing cut would be widened by installing retaining walls on either side and excavating the slopes. On the MBTA Lowell Line, the commuter rail tracks would be shifted to the east side of the widened cut, and the new Green Line tracks would be built along the west side. Most of the right-of-way is located below the surrounding land surface, reducing potential land acquisitions as well as environmental impacts such as noise and visual changes.

Bridge reconstruction will be staged whenever possible to maintain traffic over the respective bridges during construction. Construction staging will be required for roadway traffic as well as rail traffic beneath the bridge. In some cases, the existing bridge structure, the extent of reconstruction required on the bridge, and/or the proposed bridge structure are such that staged construction is not feasible and the bridge will have to be closed during construction. A detour will be required to provide alternative traffic routes during construction. Based on analysis of the existing bridges and a conceptual level design, two bridges will require traffic detours during construction.

The current level of construction staging and sequencing developed for the Project address the constraints of the corridor, impacts to abutters, and other construction issues. More detailed evaluation and staging recommendations will be developed as design progresses and through coordination with the City of Cambridge, City of Somerville, and City of Medford, and the respective Fire and Police Departments. This coordination will define restrictions that will be placed on the contractor, such as time of construction and construction zone set-up requirements, as well as maintenance of traffic and access to abutting properties. Blasting is not anticipated for construction of the Project. Rodent control policies will be included in construction management plans to prevent increased pest populations during the construction period. Likely measures would include good waste management (sealed trash containers, closed drains on dumpsters, etc.), fencing around long-term construction sites, and traps and/or baits as needed for any observed rodent problems. Construction procedures will comply with MassDEP’s solid waste and air quality control regulations to prevent the spread of contaminated material or air quality impacts during construction.

Close coordination with MBTA, City of Cambridge, City of Somerville, City of Medford, and the respective Fire and Police Departments will address specific construction issues. The preliminary analysis of construction staging and sequencing shows that it is feasible to construct the Project while maintaining railroad operations, access to abutters, and traffic and pedestrian paths. As the design progresses, the traffic management details will be refined to better identify specific measures in specific areas, including detours. A comprehensive construction staging and sequencing plan will be developed and included in the final construction contract documents and communicated to the public.

Figure ES-2 Existing Section Looking North

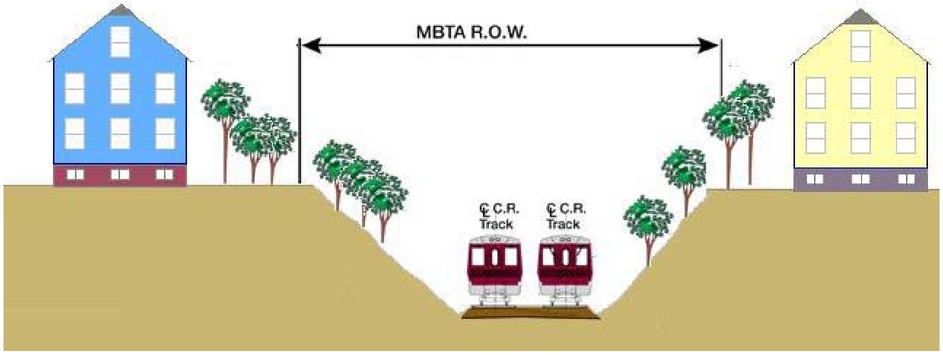
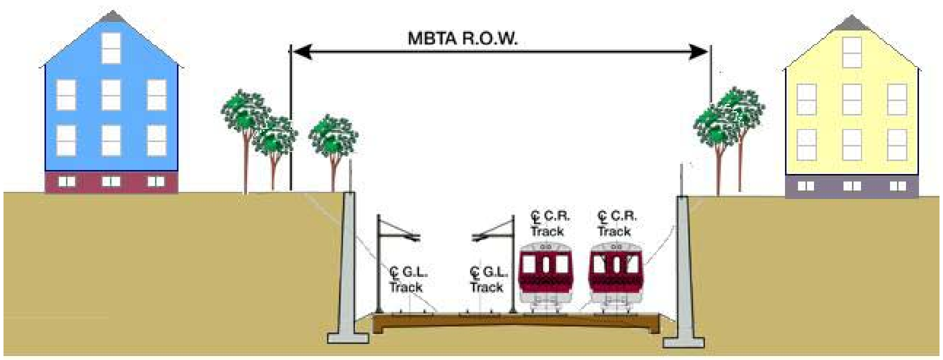


Figure ES-3 Proposed Section Looking North



Stations

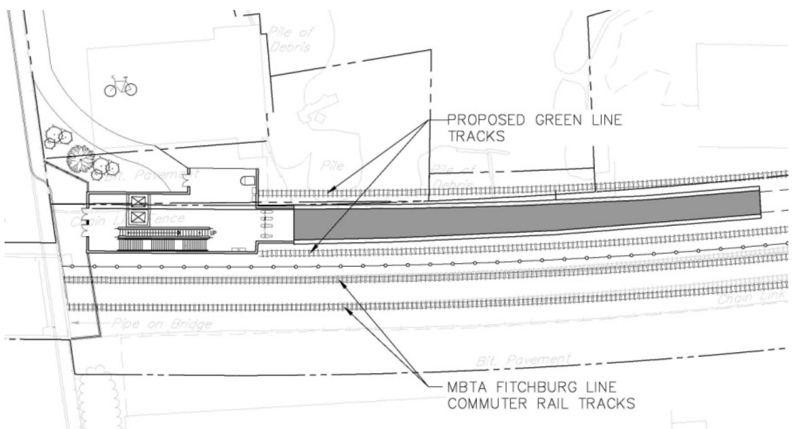
Station locations for the Green Line Extension were identified through an evaluation process and in working with the public and local officials. Important considerations in station siting and configuration included operations and access, as well as impacts to area properties. Stations are intended to function as neighborhood stations with no provisions for parking. The Future Full-Build Alternative could include parking at the terminal location at Mystic Valley Parkway/Route 16 Station although none is currently proposed.

What a Typical Station Will Look Like

Stations were designed to meet the Project's goals of improved transit access and accessibility, and to minimize impacts to the community associated with land acquisition, traffic, and loss of parking. The design for each station is envisioned to provide a headhouse with automated fare lines, vending machines, an information booth, and restrooms. Figures ES-4 and ES-5 show a typical station layout and elevation. In addition to these design elements, the stations are also envisioned to provide:

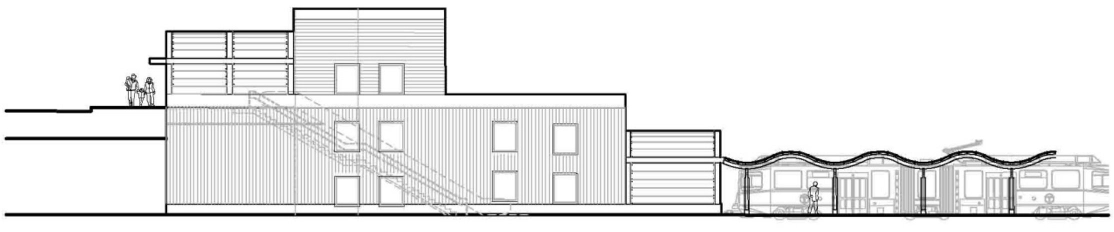
- Bike racks at all stations, which will encourage the use of bicycles to access the station and reduce vehicular access;
- MBTA Direction Maps showing inbound and outbound stations as well as the MBTA Spider Maps showing all rapid transit lines;
- Uniformly lit platforms at a level that enhances a feeling of safety;
- Tactile/Braille Station Identification signs; and
- Trash receptacles.

Figure ES-4 Typical Station Plan



Many station platforms would be located at a different elevation than the station access points. Entry to and exit from the platforms will be by elevators, escalators, and stairs. The design of the platform was based on projected peak hour passenger volume. Station access and platform design were based on requirements and guidance provided by the Americans with Disabilities Act (1990) and the Commonwealth of Massachusetts Architectural Access Board (AAB), as well as requirements of the MBTA.

Figure ES-5 Typical Station Elevation



In addition to station amenities and access requirements, station criteria also considered "green" or high performance design. Green design opportunities for the Green Line Extension Project include:

- **Access** - Stations will offer safe and convenient pedestrian access to encourage walking and transit-oriented development in the nearby vicinity. This includes providing secure bicycle racks and/or storage within 200 yards of each station entrance.
- **Lighting** - Station design will minimize unnecessary light pollution at each station site, while ensuring that adequate safety lighting measures are provided.
- **Stormwater** - Station design will minimize the amount of impervious cover, increase on-site infiltration, reduce or eliminate pollution from stormwater runoff, and eliminate contaminants.
- **Recycling** - Stations will provide easily accessible bins for recycling, including paper, corrugated cardboard, glass, plastics, and metals.
- **Site and Building Materials** - Where possible, station design and construction will use materials that incorporate recycled content materials; are extracted and manufactured locally; reduce the use and depletion of finite raw materials and long-cycle renewable materials by replacing them with rapidly renewable materials, such as bamboo, wool, cotton insulation, agrifiber, linoleum, wheat-board, strawboard, and cork; use Forest Stewardship Council (FSC) Certified Wood; and reduce the heat island effect at each station by utilizing high-reflectance (high-albedo) materials for hardscape.
- **Water Efficiency** - Where possible, station design will eliminate the use of potable water for landscape irrigation at each station site; and will reduce the generation of wastewater and potable water demand at each station by specifying high-efficiency fixtures and dry fixtures, such as waterless urinals and low-flow toilets.

- **Energy Performance** - Where possible, station design will include the building envelope, heating, ventilation, and air conditioning (HVAC), lighting, and other systems to maximize energy performance; utilize non-polluting and renewable energy sources, including solar, wind, geothermal, low-impact hydro, biomass, and bio-gas strategies; avoid or minimize the use of mechanical cooling and refrigeration equipment; and use ENERGY STAR compliant products throughout all buildings.
- **Indoor Air Quality** - Where possible, station design will include an indoor air quality management plan to address moisture and mold damage including the design of surface grades, drainage systems and heating, ventilating, and air conditioning systems, ductwork transport, storage, and installation and filtration media in air handlers. Effective air management systems will be employed to minimize the exposure of station occupants and ventilation air distribution systems to environmental tobacco smoke; provide additional outdoor ventilation to improve air quality within the station building; provide capacity for ventilation system monitoring to help sustain station occupant comfort; and reduce the quantity of indoor air contaminants that are odorous, irritating, or harmful to station occupants.
- **Demolition and Construction** - Where possible, construction management during demolition of existing buildings on the station sites will divert debris from disposal in landfills and incinerators. Station design will include Erosion and Sediment Control Plans and will consider additional methods to control dust and particulate matter during construction.

Station Selection Process

Beginning in late January 2008 and continuing throughout February, residents of Cambridge, Somerville, and Medford came in the hundreds to a series of five station workshops for the Green Line Extension Project. As the alternatives analysis phase began, EOT reached out to communities early in the process to help incorporate residents' everyday knowledge of the corridor into the analysis. The meetings began with a half-hour open house for participants to review maps of the corridor and talk with Project team members. After a brief overview of the Project and its current phase, the meetings broke into workshop style sessions with participants surrounding tables of maps and providing input regarding station locations; station access; traffic trends at nearby intersections; pedestrian, bus, and bike path connections; and desired station amenities. With attendance reaching 100 or more at some workshops, this series of meetings allowed residents to express both their excitement and their concerns about the Green Line Extension Project.

Station Locations

All of the Proposed Project stations have been designed to serve the local neighborhood, and allow residents to access the station by foot, bicycle, or vehicular pick-up/drop-off. Station boardings are estimated for the 2030 analysis year.

Lechmere Station

Relocated Lechmere Station and associated roadway and busway improvements have long been intended to be constructed as part of the NorthPoint development project. However, due to the uncertainty surrounding the NorthPoint project, the Commonwealth has included the planning for the relocation of Lechmere Station and area roadway improvements into the Green Line Extension Project. The new Lechmere Station will be relocated and elevated on a new and realigned viaduct on the east side of Monsignor O'Brien Highway/Route 28. Once the relocation is complete, the existing Lechmere Station would be demolished and cleared, and the existing station site would be made available for potential future redevelopment. There will be approximately 234 parking spaces provided in two separate parking lots within MBTA property at the station to replace the parking that currently exists on the same MBTA property for Lechmere Station patrons.

Vehicular access to the south parking lot would be provided from East Street. Vehicular access to the north lot will be provided primarily from Water Street. An access road will be provided to connect Water Street, North First Street, and East Street, allowing vehicular access between the two lots as well as providing busway connections to O'Brien Highway/Route 28 and Cambridge Street. Pedestrian access will be provided across O'Brien Highway/Route 28. A busway with one-way, southbound circulation will accommodate local bus service, including MBTA Bus Routes 69, 80, 87, and 88, with access from O'Brien Highway/Route 28 via Water Street and egress to O'Brien Highway/Route 28 via a new North First Street connection. Curbside drop-offs for taxis, corporate shuttles, and station patrons will be provided across New North First Street and the access road. Due to its location on the viaduct, the station proper would be accessed using elevators, escalators, and stairs. Bike racks will be provided to encourage use of this mode. Daily ridership at this station is anticipated to be 10,900 boardings.

Brickbottom Station

The proposed Brickbottom Station site is on two private parcels on the east side of Joy Street and approximately 220 feet south of the intersection with Washington Street. The area around the proposed station is categorized as light industrial with shops and automobile related businesses. There are residential homes located north of Washington Street and on the south end of Joy Street at the Brickbottom Artists Lofts. Access to the station will be provided for both pedestrian and vehicular traffic along Joy Street. At this location, the Green Line tracks will be at a higher elevation than Joy Street. Consequently, access to the platform will occur from below via elevators, escalators, and stairs. Bus Routes 86, 91, and CT2 provide service along Washington Street, with a bus stop 200 feet north of the proposed station. A pick-up/drop-off for automobiles will be provided. Bike racks will also be provided to encourage use of this mode. Connections to the proposed Somerville Community Path are possible. Daily ridership at this station is anticipated to be 2,730 boardings.

Gilman Square Station

Gilman Square Station is proposed to be located along Medford Street directly behind Somerville High School. The neighborhood is home to municipal facilities (Somerville City Hall, Somerville Public Library, Somerville High School), commercial enterprises along Highland Avenue and Medford Street, and residential areas. Access to the station will occur on the east side of the rail right-of-way from Medford Street through a City-owned parcel and at a second location directly from the Medford Street bridge structure. Access to the platform level will be via elevators, escalators, and stairs. These access points are being provided in order to provide access in accordance with ADA requirements, as the Medford Street Bridge has an approximately eight percent grade. Connections to the proposed Somerville Community Path are also possible in the future. The station's placement on the north side of Medford Street provides the opportunity for bicycle and pedestrian access with minimal property impacts. Connections to MBTA Bus Routes 80, 88, and 90 are located within ¼ mile of the station. Bike racks will also be provided. Daily ridership at this station is anticipated to be 4,410 boardings.

Lowell Street Station

Lowell Street Station is proposed to be located at Lowell Street, adjacent to an abandoned industrial building. Lowell Street Station is in a primarily residential area of two, three, and four-story structures. There is a nursing home nearby and an abandoned industrial building, which is scheduled for redevelopment for residential use. Accessibility at this station is a challenge due to the existing roadway grades. To better accommodate access, a vehicular pick-up/drop-off area will be provided on Lowell Street. At this location, the Green Line tracks and platform will be at a lower elevation than Lowell Street. Consequently, access to the platform will occur from street level via elevators, escalators, and stairs. The station will be constructed along with a new bridge to accept automobile pick-ups /drop-offs and bicycle traffic from the neighborhood. Bike racks will be provided. Pedestrian access will be provided using sidewalks along Lowell Street. Local MBTA Bus Routes 80, 88, and 90 are within ¼ mile of the station. Connections from the proposed Somerville Community Path to the station headhouse would be possible via Lowell Street. Daily ridership at this station is anticipated to be 1,260 boardings.

Ball Square Station

Ball Square Station is proposed to be located on the north side of the Broadway Bridge in the vicinity of the Somerville and Medford city line near the corner of Broadway and Boston Avenue. The area adjacent to the station is of mixed use with automobile shops along Boston Avenue, commercial uses on Broadway, and residential neighborhoods beyond. Residential structures are generally three to four stories. Due to Broadway's steep grade, the station provides two points of access. One access point will be provided at the intersection of Boston Avenue and Broadway. The other access point is envisioned directly from the Broadway Bridge. At this station, the Green Line tracks and platform will be at a lower elevation than Broadway, consequently, access to the platform from street level will be via elevators, escalators, and stairs. Local MBTA Bus Routes 80 and 89 have stops located adjacent to Ball Square Station. Bike racks will also be provided at the station. Daily ridership at this station is anticipated to be 1,890 boardings.

College Avenue Station

College Avenue Station is proposed to be located at the corner of College Avenue and Boston Avenue, which primarily serves the residential neighborhoods adjacent to the station and the Tufts University community. In order to meet accessibility requirements, the station provides two points of access due to the eight percent grade along the College Avenue Bridge. One access point will be provided from the College Avenue Bridge; the second access point will be provided from Boston Avenue. Vehicular pick-up/drop-off will be available along Boston Avenue. Bicycle parking will also be provided at this station. Local MBTA Bus Routes 80, 94, and 96 provide service adjacent to the station with a bus stop located on College Avenue, approximately 600 feet from the station. Daily ridership at this station is anticipated to be 2,420 boardings.

Mystic Valley Parkway/Route 16 Station (Future Full-Build Alternative Only)

The Mystic Valley Parkway/Route 16 Station, included in the Future Full-Build Alternative only, is proposed to be located south of the intersection of Boston Avenue and Mystic Valley Parkway/Route 16 in the vicinity of the Somerville and Medford city line. The neighborhood surrounding the proposed station is generally residential. There is a shopping center nearby as well as recreational facilities. This station has been considered both with and without 300 parking spaces in a multi-level parking garage. However, the Preferred Alternative does not include any parking at this station. Vehicular pick-up/drop-off is proposed with access primarily via Boston Avenue, with a possible curb cut onto Mystic Valley Parkway/Route 16. Pedestrian access will be provided from walkways along Boston Avenue and Mystic Valley Parkway/Route 16. Access to the platform will occur via elevators, escalators, and stairs. Local MBTA Bus Routes 80 and 94 provide service adjacent to the station with a bus stop at the corner of Boston Avenue and Mystic Valley Parkway/Route 16. Bike parking will be provided at this station. In the Full-Build Alternative, daily ridership at this station is anticipated to be 2,000 boardings (in year 2030).

Union Square Station

Union Square Station is the only station proposed on the Union Square Branch, proposed to be located at the intersection of the MBTA Fitchburg Line and Prospect Street. The area adjacent to the station is of mixed use with light industrial, residential, and commercial uses. Due to the eight percent grade along Prospect Street, the station is envisioned to provide access via two levels, including the lower grades along Prospect Street as well as directly from the bridge structure. Access to the platform will also occur via elevators, escalators, and stairs. Vehicular pick-up/drop-off will be accommodated along Prospect Street. Local MBTA Bus Routes 85, 86, and 87 provide service adjacent to the station. Bike parking will be provided at the station. Daily ridership at this station is anticipated to be 2,310 boardings.

The Layover and Maintenance Facility

The Build Alternatives also include a layover/maintenance facility. A separate alternatives analysis (described in Chapter 3) was developed to evaluate sites for this facility. The analysis determined that the most practicable location was the area known as “Yard 8,” a six-acre former railroad yard located adjacent to the proposed Green Line alignment and accessed from Inner Belt Road in Somerville. This site, combined with the adjacent grassy parcel along Inner Belt Road, could accommodate the necessary maintenance facility components. In general, the requirements include four storage tracks (providing storage capacity for approximately 80 cars), an approximate 100-vehicle employee parking lot, equipment for the various types of vehicle maintenance required, and a support facility building that includes maintenance bays, storage room, loading docks, administrative offices, and employee facilities and amenities. Figure ES-6 shows the proposed maintenance facility layout.

As described above, Yard 8 has been the preferred option for the construction of a Green Line vehicle storage and maintenance facility, given its combination of size, configuration, and adjacency to the Green Line Extension tracks. However, the Yard 8 site has elicited local opposition from some municipal officials, elected representatives, and abutting residents and businesses. To endeavor to address and resolve these concerns, EOT has initiated analysis of two additional possible sites for the facility: (1) the so-called “Mirror H” site, proposed by the City of Somerville; and (2) a site, newly conceived by EOT and termed “Option L.” The “Mirror H” site straddles the Inner Belt area of Somerville and the NorthPoint area of Cambridge.

The "Option L" site is located immediately adjacent to BET, outside the current BET fence line. Both locations are shown on Figure ES-6.

Preliminary analysis indicates that both alternative sites have impacts above and beyond that of the Yard 8 alternative (e.g., Mirror H – renegotiation of MBTA-NorthPoint agreement and Option L – relocation of active businesses). However, to sufficiently compare the sites to the preferred Yard 8 location, a complete analysis of both alternatives - including environmental impacts, schedule implications, community benefits, property acquisition needs, regulatory issues, and costs to the municipalities and the Commonwealth - will be performed over the next few weeks. Results will be made available to the public for input and discussion once underway. The outcome of the analyses will determine whether EOT chooses to pursue a Notice of Project Change for the Green Line Extension Project, to formally substitute one of the alternative options for Yard 8 as the preferred site for the storage and maintenance facility.

Why a Layover and Maintenance Facility is Needed

The existing Green Line fleet is currently stored at the Reservoir, Riverside, Lake Street, and Lechmere facilities, and within the central subway. It will be essential to store a number of cars on the north side of the proposed Green Line Extension to provide cars for start-up in the morning, provide a convenient location for overnight and off-peak storage as cars come out of service, and minimize the distance a disabled train has to travel to reach a maintenance facility. A north side facility would also eliminate much of the need to move cars to the west-side facilities each night and back to the north side in the early morning, a move that would interfere with critical overnight maintenance work for Green Line track, signal, and power systems. Car storage is not only required for the overnight storage of cars but also for the day-time lay-up of cars.

Maintenance support is only available at the Reservoir, Riverside, and Lake Street facilities; all are located on the west end of the Green Line system. The existing facilities are operating beyond their planned capacity and expansion of these facilities to accommodate the proposed Green Line Extension is impractical in terms of logistics, service reliability, and operating costs. There are currently no maintenance facilities located on the north side of the system, in the proximity of the proposed Green Line Extension. When a Green Line car becomes disabled, it is essential that the car be moved to the closest maintenance facility to get it out of the way of revenue service trains and to a location where it can be serviced. In order to provide a service that is reliable, cost-efficient, and does not adversely impact the remainder of the Green Line system, it is necessary that a maintenance facility be provided on the north side of the system. The Green Line Extension Project will therefore require a new maintenance facility on the north side of the Green Line system to store, inspect, maintain, and repair cars and to provide a base for the maintenance and repair of the track, power, and signal systems.

Layover Site Selection Process

Several sites were considered for the new Green Line maintenance facility including the Boston Engine Terminal (BET), Yard 8 and Option L. Additional sites or variations of these sites were suggested by representatives of the Cities of Medford and Somerville, by Project Advisory Group members, and by the public. Due to the density of development in the Project study area, there were limited potential sites to evaluate. However, in working with the Project stakeholders, 11 sites were identified for evaluation as potential maintenance facility locations.

These sites were put through a two-tier screening process to determine which site(s) best met the program requirements, which included size and configuration of the site(s) and proximity to the proposed extension. Those sites that were determined to be too small to accommodate the program and/or required a crossing of the MBTA Lowell Line in order to access the sites were eliminated from further consideration. Sites unable to meet the program because of inadequate size or configuration or because they were unable to make direct track connections to the proposed extension lines were also disqualified.

At the request of the Advisory Group and other Project stakeholders, the analysis considered 10 additional possible configurations for the maintenance facility, focusing on the MBTA BET Commuter Rail Maintenance Facility and on Yard 7 near the NorthPoint development. Additionally, the City of Somerville requested an evaluation of a modified scheme that would use the BET and NorthPoint development.

The results of the analysis showed that none of the areas within the MBTA BET Commuter Rail Maintenance Facility property are available or suitable for use as a Green Line support facility. The existing BET facility is barely adequate for current commuter rail needs. Most of the site is already in use for train operations. The parking lot is too far from the Green Line, and would require long bridges over the existing tracks for access. The configuration is not well suited for train storage. The existing open storage area is important for current and future commuter rail operations. Even if it were available for Green Line use, it is too long and narrow and not well-suited for a Green Line storage facility. Combining the BET site with Yard 7 does not offer a large enough site in the required configuration to accommodate a Green Line facility. Federal Railroad Administration (FRA) regulations also state that use of both commuter rail and light rail within the same facility is incompatible.[3]

[3] Federal Railroad Administration, 49 CFR Parts 209 and 211, *Shared Use of the Tracks of the General Railroad System by Conventional Railroad and Light Rail Transit Systems; Notice and Final Rule,* Federal Register, Vol. 65, No. 132, Monday, July 10, 2000, Notices.

Therefore, the MBTA BET Commuter Rail Maintenance Facility was determined to be unsuitable to support the program.

Of the numerous sites considered in the screening process, only Yard 8 with the Adjacent Parcel is of a sufficient size and configuration to effectively store the required cars and house a support facility while providing the operational flexibility that is needed for such a facility without additional environmental impacts. Yard 8 is a former railroad property located in an industrial area that is currently zoned for this type of a facility.

Estimated Cost

During the development of this DEIR/EA, 10-percent concept plans for the Proposed Project and Future Full-Build Alternative alignments were designed and detailed capital cost estimates were developed. The capital improvements described in previous sections include, but are not limited to, construction of track, stations, structures, systems, drainage, utilities, and the maintenance facility. Additional costs include property acquisitions and relocations as well as the cost for vehicle acquisitions. The cost of the Proposed Project (Alternative 1 - Extension to Medford Hillside with a spur to Union Square using the MBTA Fitchburg Line) includes the cost to reconstruct Lechmere Station and is estimated to be approximately $805 million in 2008 dollars, including $76.0 million for vehicles. Annual operating and maintenance costs would be approximately $21.3 million in 2008 dollars. The total costs for the Proposed Project were increased to include inflation for the time period in which the Project is to be implemented. Therefore, the "Year-of-Expenditure (YOE)" costs for the Proposed Project were calculated to be approximately $932.4 million in YOE dollars, with operating and maintenance costs of $25.9 million in YOE dollars.

In 2008, the FTA engaged a Project Management Oversight Consultant (PMOC) to undertake a review of the preliminary cost estimate for the Green Line Extension Project. The PMOC review identified a number of issues that introduce risk into this preliminary cost estimate. The most significant issues relate to construction methodology and schedule. As a result, FTA is not able to endorse these cost estimates at this time. EOT recognizes these issues, which are principally related to the current state of conceptual engineering for the Project, as appropriate to a draft environmental document. EOT will continue to work with FTA and the PMOC process to address these issues and ensure FTA endorsement of the Green Line Extension Project cost estimates as the Project develops through preliminary engineering and final design.

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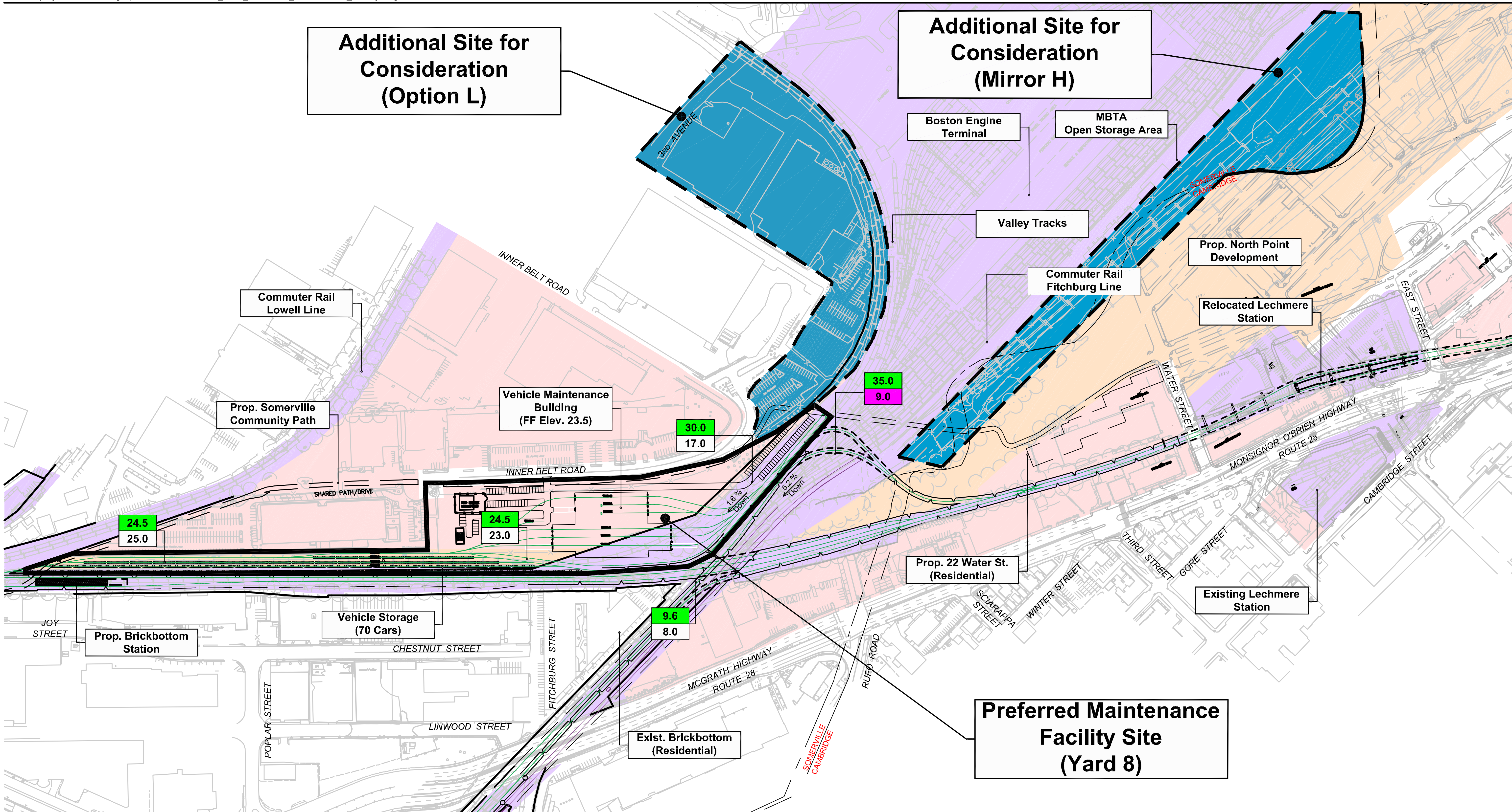

LEGEND

	M.B.T.A. Property	20.0	Proposed Elevation	10.0	Prop. Road Elevation
	B & M Property	19.0	Existing Elevation	1.5 % Down	Proposed Slope
	Private Property	8.0	MBCR Elevation		
	Additional Sites for Consideration		Preferred Maintenance Facility Site (Yard 8)		

0 150 300 Feet

Note: For Main Line Grades see Main Line Profile

Green Line Extension Project

EOT

Figure ES-6
Preferred Maintenance Facility Site

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What are the Project Benefits and Impacts?

The DEIR/EA evaluates the Project's impacts – both beneficial and adverse – on natural and human resources. These impacts were compared to the effects of the No-Build Alternative, in the year 2030. The Green Line Extension Project offers tremendous benefits with minimal impact to the Project area by virtue of the fact that it is being constructed along existing MBTA railroad rights-of-way, which will enable light rail service to serve pedestrian-oriented centers with minimal disruption to the surrounding community and without significant property or neighborhood impacts. Other benefits related to the Project's environmental impacts include:

- **Land Use, Social and Economic Resources** – The Proposed Project is expected to decrease low intensity commercial and light industrial uses in the Project corridor and increase mixed-use, high-density transit-oriented development, particularly at Union Square, Brickbottom Station, and Ball Square Station. Impacts to land, businesses and residences have been minimized as much as possible through the use of existing transportation corridors. The Proposed Project would provide socioeconomic benefits due to increased transit access, which increases both the potential for local commerce and the potential for area residents to commute to jobs elsewhere.
- **Environmental Justice** – According to the transit modeling performed on the Project, the Proposed Project would substantially increase transit access to environmental justice and disability populations. The Proposed Project will focus regional transportation investment funds into established environmental justice communities, connecting residents to jobs and services in Boston and Cambridge and strengthening business and residential districts in the corridor. There would be no disproportionate impacts to environmental justice areas from the Proposed Project.
- **Traffic** – The Proposed Project does not have an adverse impact on traffic operations throughout the study area and, in fact, makes improvements to many intersections for traffic and pedestrian movements. The Project would not physically alter designated bicycle facilities nor disrupt plans for future on-road or off-road facilities. When the opportunity is available, connections from bicycle facilities directly to proposed stations can be made. Ample bicycle parking would be provided at the Proposed Project station locations to accommodate and encourage commuting by bicycle. Minimal impacts to parking and recommendations for parking enforcement plans are expected for the Proposed Project.
- **Air Quality** – The Proposed Project is a significant investment in urban mass transit which will provide important transportation, air quality, and urban redevelopment benefits and will fulfill a longstanding commitment to incorporate transit projects as an integral element of the Central Artery/Tunnel project (CA/T). The air quality study demonstrates that the Proposed Project for

the Green Line Extension Project complies with the Clean Air Act Amendments (CAAA) and the State Implementation Plan (SIP). The Proposed Project will reduce daily Vehicle Miles Traveled (VMT) by 25,018, improving air quality and providing zero-emission transportation capacity for anticipated growth.

- **Noise** – Although the Proposed Project will introduce a new noise source into the Project study area, proposed noise barriers, potential sound insulation, and rail lubrication would be effective in mitigating all potential noise impacts from the Proposed Project and no residual impacts would be expected. In fact, for locations along the existing commuter rail lines, the future noise levels would be substantially lower than the existing noise levels due to the noise barriers. Therefore, with mitigation, there would be no severe noise impacts from the Project.

- **Vibration** – The proposed vibration mitigation for the Proposed Project including ballast mats or resilient fasteners on the proposed Green Line tracks and the relocated commuter rail tracks and the relocation or use of specially-engineered trackwork would be effective in keeping future vibration levels at or below existing levels for commuter trains and in reducing future vibration from Green Line trains below the impact criteria (72 VdB for commuter rail and 75 VdB for Green Line trains).

- **Visual** – The Proposed Project would not have a significant effect on the local visual environment. The changes proposed would occur in urbanized areas within and adjacent to the existing right-of-way and would have little overall visual impact on the public. The most significant change would be the loss of forested areas along the right-of-way, reducing the green space visible from local residential areas. The addition of landscaping at the stations and both on and above the retaining walls will reduce the overall visual effect of vegetation losses. The proposed noise barriers would block the view of the right-of-way for adjacent homes and prevent any further visual impacts by obscuring the trains and rails that would otherwise be visible from residential back yards.

- **Historic Resources** – The Proposed Project has impacts on a minimal number of historic or archeological resources, including existing Lechmere Station, which is recommended as potential National Register-eligible, several domestic properties and the industrial areas surrounding Yard 8. However, the Project has developed a Memorandum of Agreement that specifies the measure to be implemented to mitigate adverse effects resulting from the Project.

- **Hazardous Materials** – The Proposed Project would have an environmental benefit by remediating several sites that contain contaminated soils. Mitigation measures during construction include special handling, dust control, and management and disposal of contaminated soil and groundwater in order to prevent construction delays and to provide adequate protection to workers and any nearby sensitive receptors. All response actions must ensure that any nearby or adjacent receptors are adequately protected.

- **Indirect and Cumulative Impacts** – The Green Line Extension Project is proposed for an area that is already densely developed. The extension of rail service through this area provides opportunities for the cities to modify their zoning and create infill development. The Proposed Project would support a number of major redevelopment projects that are currently planned and underway near the proposed station sites. It is not expected that the Green Line Extension would lead to an increase in the overall level of growth in the region. Rather, it would focus the growth into patterns that would increase the number of viable travel options available to corridor residents and employees, including transit, walking, and bicycling. The Proposed Project is also not likely to generate additional regional growth in jobs or population. However, it may affect where that growth occurs, the form of the growth, and the pace of redevelopment.

The following sections provide additional detail on the Project's impacts and benefits.

"No Effect" Categories

The DEIR/EA evaluated impacts to a wide range of resources, and found that the proposed alternatives would have no adverse effect, or only a minor effect, on water quality, wetlands, threatened and endangered species, wildlife habitat, open space, and parks and recreation areas.

Land Use, Social, and Economic Resources

This group of categories evaluates the impacts on properties, types of land uses, jobs, neighborhoods, and property tax revenues. The increased transit access and ridership has the potential to increase commerce and encourage greater economic development along the Green Line Extension, which would increase property values and offset decreases in municipal property tax revenue.

Acquiring buildings and properties for the Project is unavoidable due to the dense urban character of the Project Area. Despite the relative abundance of commercial and industrial properties in the affected cities, the acquisition and demolition of existing businesses could result in temporary reductions in local commerce as the affected businesses relocate or permanent reductions if the businesses do not reopen locally or at all. The use of the existing right-of-way minimizes the property acquisitions, which would be much higher for an extension that involved establishing a new right-of-way through these cities.

The use of the existing right-of-way for most of the tracks also avoids dividing and segmenting any neighborhoods, which could otherwise cause significant changes to the local character. The proposed property acquisitions would not cut off access within any existing neighborhoods or block access from one neighborhood to another.

The Proposed Project is expected to decrease low intensity commercial and light industrial uses in the Project corridor and increase mixed-use, high-density transit-oriented development, particularly at Union Square, Brickbottom Station, and Ball Square Station. Impacts to land, businesses and residences have been minimized as much as possible through the use of existing transportation corridors.

Constructing the Proposed Project as currently designed would require 11.5 acres of land acquisition from approximately 38 properties, and would require relocating five businesses. The largest area acquisitions are for the Project's maintenance and storage facility at Yard 8 in Somerville (two parcels totaling 5.8 acres). In terms of impact, the most substantial acquisitions are those that require the displacement and relocation of residences and active businesses. These are located at Ball Square (three businesses), and in Union Square (two businesses). No residences would be displaced. The Future Full-Build Alternative (extending to Mystic Valley Parkway) would require additional properties to construct the Mystic Valley Parkway/ Route 16 Station (one business and two office/R&D buildings with multiple businesses).

The Proposed Project would have the lowest amount of property acquisition and displacement of the alternatives evaluated. Alternative 4, Green Line Extension to Mystic Valley Parkway/Route 16 (via commuter rail right-of-way) and Union Square (in-street running), would have the greatest impacts (52 acquisitions, 21.1 acres of land, seven business relocations and four residential relocations), largely associated with the Union Square extension.

The Proposed Project would provide socioeconomic benefits due to increased transit access, which increases both the potential for local commerce and the potential for area residents to commute to jobs elsewhere. As a result of the land acquisition, the Proposed Project would result in a total decrease of $228,239 in municipal property taxes (the least adverse impact of the four alternatives that include extending both to Medford and Union Square). The Future Full–Build Alternative would result in an additional $269,608 decrease in property taxes. Tax losses would be primarily in Medford ($205,935) with a small amount ($6,527) in Somerville for the Proposed Project.

The Proposed Project would displace an estimated 18 jobs in Somerville. The Future Full–Build Alternative could result in the displacement of an additional 13 jobs in Somerville and 224 jobs in Medford, largely as a result of constructing the Mystic Valley Parkway/Route 16 Station. These displacements do not represent a significant fraction of the jobs in these three cities. By comparison, the 2000 U.S. Census estimated the workforces of Cambridge, Medford, and Somerville at 59,965 workers, 30,133 workers, and 47,656 workers, respectively. Although it is uncertain how many of the jobs displaced are held by local residents rather than commuters, the small scale of the job losses relative to the workforce makes it clear that the jobs at stake represent at most a minor economic impact.

Many of the jobs displaced would likely be relocated or replaced within the affected cities. There is an inherent economic advantage to being located close to public transit and to educational and social centers such as Tufts University and Union Square. Therefore, many of the jobs affected — particularly the office positions displaced in Medford — would not actually be eliminated but only relocated locally.

Environmental Justice

According to the transit modeling performed on the Project, the Proposed Project would increase transit access to environmental justice and disability populations. The Project connects low-income and environmental justice communities to the region's fixed-guideway network, thus improving access to jobs and services. The Project is designed to provide fair access to stations and economic development opportunities and avoid any disproportionate share of impacts." The Project complies with federal DOT requirements for environmental justice as developed through Executive Order 12898 and DOT Order 5610.2 (DOT Order on Environmental Justice, April 15, 1997).

The primary benefit of the Project for local residents and workers is improved access to transit. Improved access was evaluated only for the Full Build Alternative, which provides similar benefits to the currently proposed Project. As this analysis demonstrates, the Green Line Extension would improve transit access to jobs, on average, by 6.1 percent; access to colleges by 7.6 percent, and access to hospital beds by 9.8 percent. While there are impacts of building acquisitions and noise on environmental justice populations, these impacts are unavoidable due to the proximity of the existing rail corridors to environmental justice areas. These impacts are neither severe nor disproportionate, and the impacts would be balanced by the transit benefits to environmental justice populations. While the exact economic benefits cannot be determined, providing increased transit access and economic opportunities to the same neighborhoods affected by the Project would offset any economic impacts to these neighborhoods.

The Proposed Project would result in the acquisition of five commercial buildings and displace approximately 18 jobs in environmental justice areas. The Future Full-Build Alternative would not increase these impacts. There would be no disproportionate noise impacts to environmental justice areas from the Proposed Project or the Future Full-Build Alternative. Noise mitigation would be required for the residences affected, resulting in no residual adverse impacts due to noise.

Traffic

This section discusses the direct, indirect, and cumulative effects of the Preferred Alternative with respect to intersection, pedestrian, bicycle, public bus transportation, and parking systems in the Study Area. For the year 2030, the DEIR/EA analyzes future traffic volumes throughout the Study Area (both with and without the Project), the impacts of the Project on the transportation system in the surrounding communities, and any measures that would mitigate Project impacts.

The DEIR/EA analyzes traffic for the No-Build and Build Alternatives in order to evaluate the effects of the Project on intersection levels of service and pedestrian and bicycle circulation. The DEIR/EA provides a detailed assessment of the impacts on the transportation system associated with the Build Alternatives. The following conclusions were reached:

- **Traffic Operations** – With mitigation at four intersections, the Proposed Project would improve operations at eight intersections. The Future Full-Build Alternative would improve operations at five intersections.
- **Pedestrians** – Pedestrian improvements would be implemented at 29 locations throughout the Study Area to accommodate the expected number of pedestrians accessing proposed stations. Pedestrian delays throughout the Study Area would be improved and signals would be timed to ensure pedestrians have adequate time to cross the street. The Future Full-Build Alternative would improve pedestrian operations at 33 intersections.
- **Bicycles** – The Project would not physically alter designated bicycle facilities nor disrupt plans for future on-road or off-road facilities. When the opportunity is available, connections from bicycle facilities directly to proposed stations can be made. Ample bicycle parking (270 spaces) would be provided at the Proposed Project station locations to accommodate and encourage commuting by bicycle. The Future Full-Build Alternative would provide an additional 50 bicycle parking spaces at Mystic Valley Parkway/Route 16 Station.
- **Parking** – Minimal impacts to parking are expected for the Proposed Project. A total of 12 parking spaces would be removed to accommodate the station entrances and enhance pedestrian access. The Future Full-Build Alternative extension to Mystic Valley Parkway/Route 16 would require removing and additional 16 parking spaces and demolishing an existing parking structure near Mystic Valley Parkway/Route 16. However, this alternative would also remove the commercial building associated with the parking structure thereby resulting in no parking impacts to the neighborhood. Enforcement would be necessary to ensure that on-street parking is being used appropriately.
- **Bus Transportation** – Slight operational changes to bus service would occur at Relocated Lechmere Station to facilitate the station relocation. No other bus routes or services would be impacted.

- **Construction Impacts** – Construction impacts would be related to construction and traffic detours and would be temporary. In the vicinity of the stations and bridges, available parking may be temporarily displaced. Construction staging would limit the number of temporary bridge closures and ensure that adjacent bridges are not closed at the same time.

Air Quality

The Proposed Project is a significant investment in urban mass transit which will provide important transportation, air quality, and urban redevelopment benefits and will fulfill a longstanding commitment to incorporate transit projects as an integral element of the Central Artery/Tunnel project (CA/T). The DEIR/EA describes the air quality benefits associated with the Green Line Extension Project and describes its consistency with the State Implementation Plan (SIP) and DEP's Transit Regulations. The DEIR/EA includes a mesoscale and microscale air quality analysis that evaluates emissions of volatile organic compounds (VOCs), oxides of nitrogen (NO_x), greenhouse gas carbon dioxide (CO_2), carbon monoxide (CO), and particulate matter (PM). The microscale (local or hotspot) analysis evaluated carbon monoxide (CO) and particulate matter (PM). The regional (mesoscale) analysis evaluated ozone precursors (VOCs, NO_x, CO_2, CO, and PM).

Microscale Analysis

The microscale analysis indicates that reductions in CO concentrations are expected to occur over time when compared to 2007 existing conditions. All of the calculated future CO concentrations are equal to or less than the 2007 existing conditions concentrations. These reductions can be attributed to more efficient vehicles with enhanced emissions control technologies and the benefits of the Massachusetts Vehicle Inspection and Maintenance program. The Proposed Project would not exceed the CO National Ambient Air Quality Standards (NAAQS).

The microscale analysis also calculated the 24-hour PM_{10} concentrations and the 24-hour and annual $PM_{2.5}$ concentrations for 2030. The 24-hour PM_{10} concentrations were calculated using EPA's CAL3QHC model. The 24-hour PM_{10} concentrations for the Proposed Project ranged from a minimumof 66 ug/m^3 to a maximum of 83 ug/m^3. All of the 24-hour PM_{10} concentrations are well below the PM NAAQS of 150 ug/m^3. The 24-hour $PM_{2.5}$ concentrations for the Proposed Project ranged from a minimum of 30.5 ug/m^3 to a maximum of 32.1 ug/m^3, and the annual $PM_{2.5}$ concentrations ranged from a minimum of 11.9 ug/m^3 to a maximum of 12.2 ug/m^3. All of the annual $PM_{2.5}$ concentrations are well below the $PM_{2.5}$ NAAQS of 15 ug/m^3, and all of the 24-hour $PM_{2.5}$ concentrations are below the $PM_{2.5}$ NAAQS of 35 ug/m^3.

Mesoscale Analysis

The air quality study included a mesoscale analysis that estimates the area-wide emissions of VOCs, NO_X, CO_2, CO, and PM emissions. The mesoscale analysis evaluated the changes in emissions based upon changes in the average daily traffic volumes, roadway lengths, and vehicle emission rates. The mesoscale analysis calculated the 2030 mobile source emissions from the major roadways in the study area. These emissions, estimated to be 22,687.5 kilograms per day (kg/day) of VOCs, 19,186.2 kilograms per day of NO_X, and 3,385.7 kg/day of PM_{10}, establish a baseline to which future emissions can be compared.

The results of the mesoscale analysis demonstrate that the Proposed Project would reduce emissions of VOC, NO_X, and PM_{10} as compared to the No-Build Alternative, as shown in Figure ES-7. The Future Full-Build Alternative (extension to Mystic Valley Parkway/Route 16) would provide a small additional decrease in air quality emissions.

The air quality study demonstrates that the Proposed Project for the Green Line Extension Project complies with the Clean Air Act Amendments (CAAA) and the State Implementation Plan (SIP). The ozone mesoscale analysis demonstrates that all Build Alternatives will result in a decrease of VOC, NO_X, and PM_{10} emissions, as compared to the No-Build Alternative.

Greenhouse Gas (CO_2) Analysis

The Executive Office of Energy and Environmental Affairs (EEA) has developed a policy that requires a proposed project to evaluate Greenhouse Gas (GHG) emissions. The air quality study calculated the GHG emissions from mobile sources related to the proposed Green Line Extension Project. While GHG emissions include several gases, CO_2 (carbon dioxide) was selected for evaluation because it is the most significant component of transportation-related GHG emissions. The year 2030 was selected as the future year of analysis to be consistent with the regional long-range transportation plan. The Proposed Project would reduce CO_2 by 17.115 kg/day in comparison to the No-Build Alternative. The Future Full-Build Alternative extension to Mystic Valley Parkway/Route 16 would provide an additional 928 kg/day reduction.

Figure ES-7 Mesoscale 2030 Mobile Source Analysis Results (kilograms per day)

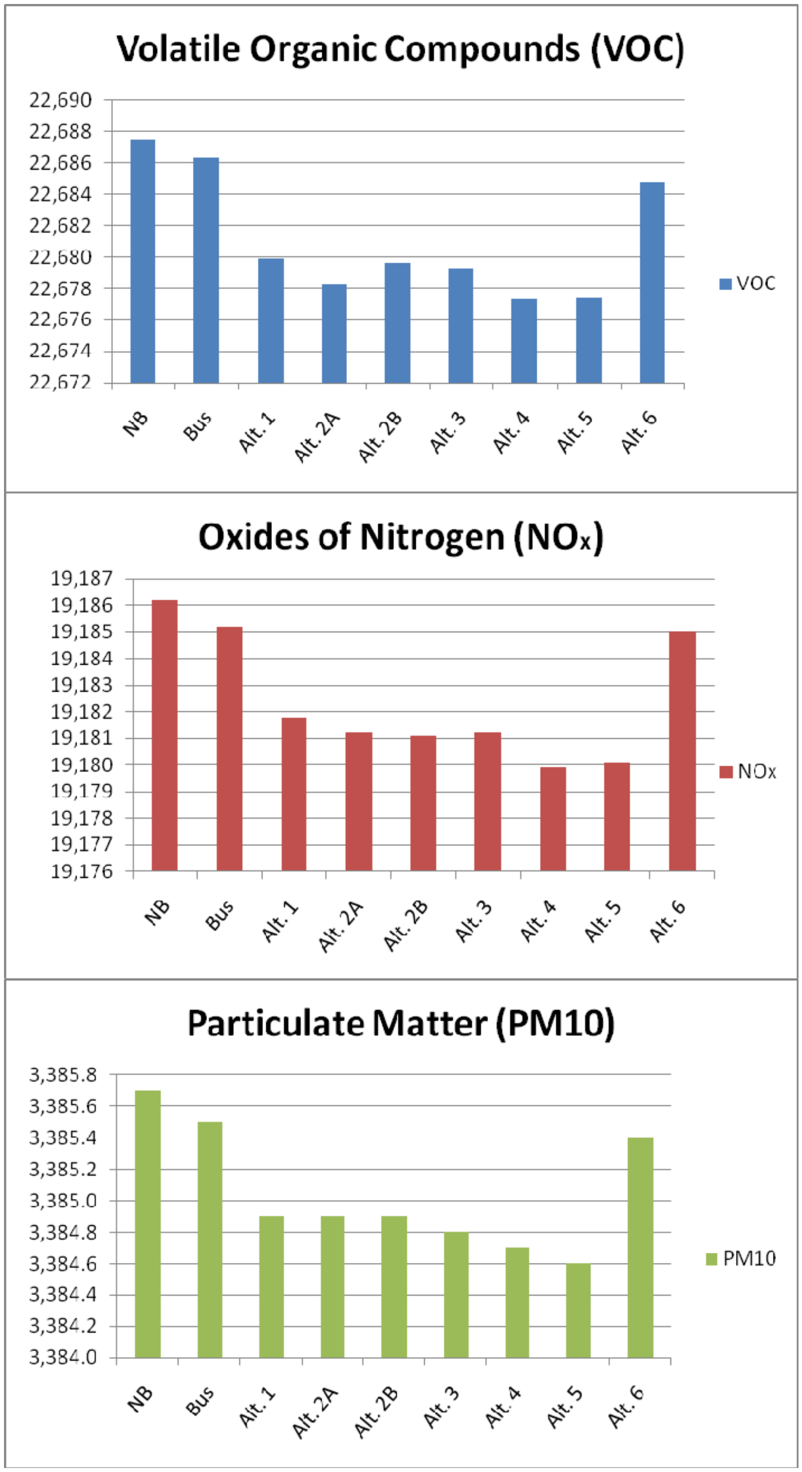

Table ES-2 – Comparison of Air Quality Benefits

	Carbon Monoxide (CO)	Nitrogen Oxides (NOx)	Volatile Organic Compounds (VOC)
2006 Approved Package of Projects (Arborway; Green Line Extension to Ball Square/Tufts; Blue Line/Red Line Connection)	292	8	11
2008 Federal Register SIP Approved Projects + 10%	321.2	8.8	12.1
2009 Package (Green Line Extension - College Avenue with Union Square Spur; Fairmount; Parking)	520	9.5	16
2009 Analysis – Green Line Extension Only Benefits	443	8.5	13
% of Green Line Extension Benefits as compared to Total Package	85%	89%	81%

Noise

The Green Line Extension would add a new noise source to the environment along the proposed corridor. While there is existing noise exposure from sources such as commuter trains and automobiles, introducing an additional noise source and relocating the commuter rail lines have the potential to increase future noise at some noise-sensitive receptors. The Proposed Project involves relocating the commuter rail lines up to 18 feet along some portions of the corridor and introducing the proposed Green Line tracks on the west side of the corridor along the Medford Branch and on the south side on the Union Square Branch.

Potential noise impact on the west side of the Lowell Line alignment is due primarily to the proximity of noise-sensitive receptors to the Green Line trains. At close distances (within approximately 50 feet) the contribution of noise from Green Line trains is more significant than from commuter trains. Future noise levels on the west side are projected to generally increase one to two decibels due to the close proximity of noise-sensitive receptors to the Green Line trains. At a few specific locations (Alston Street and Piggott Road) the increase in noise levels is higher (five to seven decibels) due to the close proximity (16 to 25 feet) to the near track centerline of the proposed Green Line trains.

Because existing noise levels are relatively high at locations along the existing commuter rail line, even small increases in future noise levels are considered to have the potential for moderate or severe noise impact. Moving the commuter rail closer to residences on the east side of the Lowell Line right-of-way would therefore have moderate to severe impacts in some locations.

Temporary noise impacts could result from construction activities associated with utility relocation, grading, excavation, track work, and installation of systems components. Such impacts may occur in residential areas and at other noise-sensitive land uses located within several hundred feet of the alignment. The potential for noise impact would be greatest at locations near pile driving operations for bridges and other structures, and at locations close to any nighttime construction activities.

The Proposed Project would expose 145 residential buildings to moderate (115) or severe (30) noise levels, and would expose three institutional buildings (Science and Technology Center, Outside the Line Artist's Studio, and Bacon Hall at Tufts University) to moderate noise levels and one severe institutional impact. (the Walnut Street Center, a non-profit support center for adults with developmental disabilities near Union Square). The Future Full–Build Alternative extension to Mystic Valley Parkway/Route 16 would add 55 moderate and 35 severe residential impacts.

With mitigation, there would be no severe noise impacts from the Project. Noise mitigation including noise barriers, potential sound insulation treatments, and rail lubrication would be feasible, reasonable, and effective in mitigating all potential noise impact due to the proposed Project for all alternatives. During the preliminary engineering phase of the Project, the existing outdoor-to-indoor noise reduction of the buildings will be measured. An analysis will be made as to whether the noise reduction of the building could be improved by five decibels or more with sound insulation treatments. The effectiveness of potential noise barriers to reduce interior noise levels at these locations will also be assessed.

The noise barriers (examples are shown in Figure ES-8) would be effective in reducing noise levels from transit sources generally 7 to 11 decibels and would result in substantial reduction in future noise levels in comparison to existing noise levels. The proposed noise barriers, potential sound insulation, and rail lubrication would be effective in mitigating all potential noise impacts from the Proposed Project and no residual impacts would be expected. In fact, for locations along the existing commuter rail lines, the future noise levels would be substantially lower than the existing noise levels due to the noise barriers. Therefore, with mitigation, there would be no severe noise impacts from the Project and noise improvements would be made along the corridor.

Figure ES-8 Examples of Noise Barrier Materials

Vibration

The Green Line Extension Project would add a new vibration source to the environment along the proposed corridor. While there is existing vibration exposure from sources such as commuter trains and automobiles, introducing an additional vibration source and relocating the commuter rail lines have the potential to increase future vibration at some sensitive receptors. The Project involves relocating the commuter rail lines up to 18 feet to the east along some portions of the corridor and adding the proposed Green Line tracks on the west side of the corridor.

Vibration impact from the commuter trains generally occurs within 60 feet of the future commuter rail near-track centerline and within 40 feet of the proposed Green Line near-track centerline. Most receptors projected to be exposed to vibration impact from commuter train activity are on the east side of the Lowell Line or the south side of the Fitchburg Line where the proposed commuter rail near track is planned to shift up to 18 feet closer than its current location. Shifting the existing commuter rail lines closer to sensitive receptors is generally expected to increase vibration levels 10 to 13 VdB. Most receptors projected to be exposed to vibration impact from Green Line train activity are located on the west side of the MBTA Lowell Line.

Temporary vibration impacts could result from construction activities associated with the Green Line Extension Project. The potential for vibration impact would be greatest at locations near pile driving and vibratory compactor operations.

The Proposed Project may potentially expose 93 vibration-sensitive buildings to impact without vibration mitigation. This includes 90 single-family and multi-family residential buildings and three institutional buildings (Science and Technology Center, Outside the Line Artist's Studio, and Bacon Hall at Tufts University). The Future Full–Build Alternative extension to Mystic Valley Parkway/Route 16 would expose an additional 9 residential buildings to vibration impacts.

The proposed vibration mitigation including 19,700 track-feet of vibration mitigation such as ballast mats or resilient fasteners on the proposed Green Line tracks and the relocated commuter rail tracks and the relocation or use of specially-engineered trackwork (flange-bearing or moveable-point frogs) for 12 crossovers and turnouts would be effective in keeping future vibration levels at or below existing levels for commuter trains and in reducing future vibration from Green Line trains below the impact criteria of 72 VdB (commuter rail) or 75 VdB (Green Line trains).

Visual

The Proposed Project would require acquiring property, demolishing buildings, constructing new Green Line track and stations, and relocating the commuter rail track within the existing right-of-way. Some existing vegetation would be removed, and new retaining walls and noise barriers would be built. Fences, trees, and steep slopes on each side of the right-of-way minimize the rail corridor's visibility. The right-of-way is only visible to the public from certain locations, such as from bridges or through fences. With the exception of the Lechmere Station area, which will be on an elevated structure, there will be minimal visual impact on the area. Because the changes would occur in urbanized areas within and adjacent to the existing right-of-way, they would have little overall visual impact on the public. New planting and screening efforts along the right-of-way and atop the retaining walls would be done in coordination with abutting residents and businesses to ensure that no undue visual impacts are imposed on local neighborhoods. The Project will incorporate vegetation in and above these walls and at the stations in order to maximize the amount of vegetation along the expanded right-of-way. These will reduce the net loss of vegetation and reduce the visual impact of any tree removal on the neighborhoods.

The stations themselves have generally small footprints and are located along and within the right-of-way to the greatest extent possible, minimizing the overall visual impact. The major materials used in the station buildings will be masonry, steel, and glass. Landscaping will be designed to provide protection from the elements without obscuring visibility. Landscaping will be inviting both to the users of the stations and to the passers-by, using small trees and low shrubs, which are easily maintained and of a design that encompasses lighting and defensible space for safety. The new stations would be visible from their street access points and from nearby bridges.

The Proposed Project would require noise mitigation, usually consisting of noise barriers, to protect sensitive receptors such as residences from increases in train noise. Noise barriers would range from six to 12 feet tall and would block the view of the right-of-way for adjacent homes. While this would reduce the visibility of the green space surrounding the right-of-way, it would also prevent any further visual impacts by obscuring the trains and rails that would otherwise be visible from residential back yards.

The Proposed Project would not have a significant effect on the local visual environment. The changes proposed would occur in urbanized areas within and adjacent to the existing right-of-way and would have little overall visual impact on the public. The most significant change would be the loss of forested areas along the right-of-way, reducing the green space visible from local residential areas. The addition of landscaping at the stations and both on and above the retaining walls will reduce the overall visual effect of vegetation losses. The proposed noise barriers would block the view of the right-of-way for adjacent homes and prevent any further visual impacts by obscuring the trains and rails that would otherwise be visible from residential back yards.

Historic Resources

The FTA is the lead federal agency for the Green Line Extension Project with responsibility for compliance with Section 106 of the National Historic Preservation Act (NHPA) of 1966 and other federal statutes. The Environmental Assessment filed under NEPA addresses compliance with Section 106 of the NHPA and Section 4(f) of the Department of Transportation Act of 1966.

The Proposed Project would impact historic resources by relocating the existing Lechmere Station, which is recommended as potentially eligible for the National Register-of Historic Places, to the north side of the O'Brien Highway in Somerville. This impact would occur for all of the alternatives considered in this DEIR/EA. This constitutes an "adverse effect" under Section 106 and a "use" under Section 4(f). The DEIR/EA documents that there are no feasible and prudent alternatives to the use of the Lechmere Station, and that adverse effects cannot be avoided.

Relocated Lechmere Station and associated roadway and busway improvements have long been intended to be constructed as part of the NorthPoint development project. However, due to the uncertainty surrounding the NorthPoint project, the Commonwealth has included the planning for the relocation of Lechmere Station and area roadway improvements into the Green Line Extension Project. The new Lechmere Station will be relocated and elevated, situated on a new and realigned viaduct on the east side of Monsignor O'Brien Highway/Route 28. Once the relocation is complete, the existing Lechmere Station would be demolished and cleared, and the area would be made available for potential future redevelopment.

A Memorandum of Agreement (MOA) has been developed that specifies the measures that will be implemented by FTA to mitigate the adverse effects. Mitigation measures include archival photographic documentation and historical interpretation.

Due to their location primarily within the existing right-of-way and their design, the proposed stations will have no effect or no adverse effect on historic properties in the surrounding Area of Potential Effect (APE).

The Proposed Project would potentially affect one archaeological sensitive area needed for the proposed Brickbottom Station (pickup/dropoff and access). This sensitive area is documented as having the potential to contain significant belowground remains associated with mid-late nineteenth-century worker housing that characterized the Joy Street section of Somerville during the late industrial period.

Yard 8, the proposed layover facility, may also contain deeply buried archaeologically sensitive strata that could be impacted by construction associated with the proposed new vehicle maintenance building. Mitigation measures for archaeological sites that will be adversely affected by construction activities will include an archaeological data recovery program designed in accordance with state and federal guidelines and standards for the excavation of National Register-eligible archaeological sites. Should any significant and National Register-eligible archaeological resources be identified during the intensive survey or subsequent site evaluation testing, then measures to avoid, minimize, or mitigate any adverse effects of the Project on the National Register-eligible resource(s) will need to be determined by the FTA and EOT, in consultation with the MHC and other consulting and interested parties.

Hazardous Materials

The Proposed Project would require construction in areas where contaminated soils or groundwater are likely to be present in the vicinity of the rail right-of-way or proposed stations and where soil and/or groundwater remediation may be required as the Project design progresses. The remediation includes removing contaminated soil and pumping contaminated groundwater in accordance with the provisions of the Massachusetts Contingency Plan (MCP), Massachusetts General Law (MGL) Chapter 21E and 21C, and the federal Resource Conservation and Recovery Act (RCRA).

The Proposed Project requires construction in seven areas which collectively contain 18 "Recognized Environmental Conditions" or RECs. These include off-site properties where releases have occurred but have been cleaned up or where there are underground storage tanks that are unlikely to have leaked; properties such as those with potential sources of oil and hazardous material with limited or inconclusive information; and sites such as those with confirmed soil, groundwater, and/or indoor air impacts that were reported to MassDEP and have undergone some type of cleanup or remain an active case. The Future Full-Build Alternative extension to Mystic Valley Parkway/Route 16 would require construction in an additional three sites with RECs.

The Proposed Project would have an environmental benefit by remediating sites that contain "high impact" RECs. One high-potential site would be cleaned as part of the proposed Green Line Extension Project.

Mitigation measures during construction on sites with RECs include special handling, dust control, and management and disposal of contaminated soil and groundwater in order to prevent construction delays and to provide adequate protection to workers and any nearby sensitive receptors. All response actions must ensure that any nearby or adjacent receptors are adequately protected.

Indirect and Cumulative Impacts

The DEIR/EA evaluates the consistency of the Project with ongoing and planned projects, evaluates the indirect and cumulative effects of the Project by topic and highlights how the effects would differ among alternatives.

Indirect impacts are defined as "effects which are caused by the [proposed] action and are later in time or farther removed in distance, but are still reasonably foreseeable. Indirect effects may include growth-inducing effects and other effects related to changes in the pattern of land use, population density, or growth rate…" For this analysis indirect effects are defined as potential land use impacts of the Proposed Project. In comparison, direct land use impacts are displacements of properties required for the Project.

Cumulative impacts are defined as "the impact on the environment which results from the incremental impact of the action when added to other past, present, and reasonably foreseeable future actions regardless of what agency (federal or non-federal) or person undertakes such actions. Cumulative impacts can result from individually minor, but collectively significant, actions taking place over a period of time." Cumulative impacts include the direct and indirect impacts of a project together with the reasonably foreseeable future actions of others.

The Proposed Project is not likely to generate additional regional growth in jobs or population. However, it may affect where that growth occurs, the form of the growth, and the pace of redevelopment.

The Green Line Extension Project is proposed for an area that is already densely developed. The extension of rail service through this area provides opportunities for the cities' to modify their zoning and create infill development, with opportunities for more housing and other changes that Somerville is already contemplating. The Proposed Project would support a number of major redevelopment projects that are currently planned and underway near the proposed station sites, particularly in the NorthPoint area of Cambridge. Improved mobility, access to a wider range of transportation options, and less traffic congestion would make these projects particularly appealing.

Within the Station areas, the Green Line Extension combined with supportive public policies could attract transit-supportive development that would otherwise locate outside Station areas in less transit-supportive forms. It is likely that Cambridge, Somerville, and Medford would adopt zoning rules that would allow for more dense development around transit stations relative to existing conditions and surrounding areas. Cambridge and Somerville have already taken steps in this direction. The NorthPoint, Union Square, and the developing Brickbottom and Inner Belt area plans in particular emphasize development in concert with the proposed transit Project.

Although the addition of transit does not directly cause development to occur, plans and policies that provide incentives for new development to be located near transit stations can significantly influence where development takes place and the form of the development. These policies and the presence of a transit system can also have an indirect positive effect on property values near station sites, as has been demonstrated in other cities with transit systems.

It is not expected that the Green Line Extension would lead to an increase in the overall level of growth in the region. Rather, it would focus the growth into patterns that would increase the number of viable travel options available to corridor residents and employees, including transit, walking, and bicycling. As an additional benefit, compact transit-oriented development (TOD) reduces the cost of providing utilities, facilities, and services to new residential and commercial developments.

The potential for TOD differs at each station site. Factors that could spur TOD development, beyond the addition of a transit station, include available and vacant land, adoption of TOD zoning and policies, other real estate investment in the area, and market demand for new and additional floor space.

Of the seven station sites being considered in the Proposed Project, only one, Lechmere, is in an area that can be characterized as already having TOD. Three stations with high potential for TOD are Lechmere, Brickbottom, and Union Square. In the Future Full-Build Alternative, Mystic Valley Parkway/Route 16 is also a station with TOD opportunities. Two station sites have moderate potential for TOD, and two have low potential due to a lack of available developable land. Those stations with moderate potential have strong public planning support for TOD and in some cases have redevelopment plans for the future. Table ES-3 summarizes the TOD potential for each station site.

Changes in property values that result from construction of a rail transit system are also considered indirect effects. Research based on rail transit systems in U.S. cities has shown that residential property values can increase close to a transit station. While most studies of rail transit's impact on real estate value show increases, they cannot explicitly isolate transit benefits from other market forces.

Housing affordability has been an ongoing concern in the Project corridor and throughout the Project region. The region has many characteristics that make it attractive and expensive - its dense, walkable cities and squares; a vibrant economy and proximity to jobs in downtown Boston and Kendall Square; a high concentration of universities and institutions; and its networks of parks and waterways.

Housing prices in the Project corridor have increased significantly over the last 20 years. The extension of the Red Line to Davis Square made an already desirable location even more desirable and increased real estate values in the neighborhood, including Ball Square. Student demand for housing near Tufts University has helped to keep rents and housing prices high near College Avenue. The NorthPoint development is geared toward high-end residential. The areas with the greatest potential for transit-related price increases are the areas with the greatest potential for high-end redevelopment – Union Square, with the potential redevelopment of Boynton Yards, and Brickbottom, with the potential redevelopment of the Brickbottom and Inner Belt industrial areas. To avoid potential displacement of current residents and middle-income individuals and families, the cities should make housing affordability a central theme in the planning for these areas.

Table ES-3 TOD Potentials at Proposed Station Sites

Station Site	TOD Potential: High	TOD Potential: Moderate	TOD Potential: Low	Comments
Lechmere, Cambridge (relocated)	X			Existing and planned future high density, mixed-use development is transit-oriented. Much vacant land exists in the NorthPoint Planned Unit Development zone. Surrounding area is already TOD.
Brickbottom, Somerville	X			City plans that are under development for Brickbottom and Inner Belt districts are transit-oriented. The area has much vacant and underused land.
Gilman Square, Somerville		X		The City could redevelop its adjacent parcel for high-density, mixed uses and include cross-track air rights development.
Lowell Street, Somerville			X	Planned housing development is transit supportive but not mixed-use TOD. No other space is available for TOD.
Ball Square, Medford		X		TOD would require redevelopment of occupied parcels and/or air rights development. New signs of increased activity and economic vitality may support redevelopment.
College Avenue, Medford			X	Tufts University controls most nearby land. TOD potential would require redevelopment of institutional properties to more public uses. Tufts could redevelop some of its properties to higher density.
Mystic Valley Parkway/Route 16, Medford (Future Full-Build Alternative Only)	X			Redevelopment of U-Haul site, 200 Boston Avenue, and 196 Boston Avenue for mixed uses in conjunction with the station presents an opportunity for TOD.
Union Square, Somerville	X			City plans for Union Square and Boynton Yards and related zoning initiatives promote TOD.
Total	4	2	2	

This section describes the potential indirect effects on land use within a ½-mile radius of each proposed station site. This represents the maximum distance riders are willing to walk. If TOD were to be approved, it would likely be sited within ¼-mile from a station.

Land Use – The Proposed Project is likely to result in higher density redevelopment, more TOD, and lower on-site parking requirements in areas that are within walking distance of the stations. The following station areas have the greatest potential for higher density redevelopment and TOD: Relocated Lechmere; Brickbottom; Mystic Valley Parkway/Route 16; and Union Square.

Transportation and Traffic – The Green Line Extension Project would provide a new transit option northwest of NorthPoint that would mitigate potential traffic increases from continued growth and redevelopment in the Project corridor. Combined with the Urban Ring, the Community Path, and the Alewife Brook Parkway to Mystic

Valley Path, the Green Line Extension would improve the regional transportation network and reduce regional traffic and congestion.

Property Values – Property values are likely to increase in areas within walking distance of the stations. However, the increases are likely to be modest, as the Project corridor is already highly desirable, and housing affordability is already a concern. The greatest increases are likely to occur in areas that are planned for significant redevelopment: Union Square, Boynton Yards, the Brickbottom District, and the Inner Belt District. Public policy to preserve affordability for moderate-income residents and small businesses should be implemented to mitigate transit-related increases in land values.

Economy – Continued transition away from the industrial and trade sectors toward the services, knowledge-based industries, life sciences, technology, and the arts is anticipated and is supported by public policy. Planned and proposed projects that would expand employment centers in the corridor (redevelopments in East Cambridge, Brickbottom and Inner Belt districts, Union Square, and Boynton Yards) would support this trend and are more likely to proceed under the Build Alternatives.

Neighborhoods – Redevelopment of underused land in the Project corridor would be enhanced by the addition of a new and improved transit alternative. The greatest changes would likely occur in the Brickbottom and Inner Belt districts and in Boynton Yards, where planning is underway for potential redevelopment of these lower rent, commercial/industrial neighborhoods as mixed-use employment centers. Public policy to preserve affordability for moderate-income residents and small businesses should be implemented to minimize impacts of redevelopment on existing neighborhoods.

Environmental Justice – Environmental justice populations would benefit from the addition of a reliable transit alternative that would provide more opportunities to live and work in places throughout the region. However, increases in land values near new stations, particularly around Brickbottom and Union Square, may impact small businesses and limit affordable housing opportunities. Public policy to help preserve small businesses and maintain housing affordability should be implemented to help maintain diverse communities in the corridor.

EOT's Mitigation Commitments

Potential permanent impacts resulting from constructing the Proposed Project would be mitigated to the extent practicable, as described in Chapter 5 of this DEIR/EA and summarized in Table ES-4.

Temporary, short-term impacts from construction activities would be mitigated to the extent practicable. Appropriate construction mitigation measures would be incorporated into the contract documents and specifications governing the activities of contractors and subcontractors constructing elements of the Proposed Project. On-site resident engineers and inspectors will monitor all construction activities to ensure that mitigation measures are properly implemented. The construction mitigation measures are summarized in Table ES-5.

What Permits and Approvals are Required?

In addition to review under MEPA and NEPA, the Green Line Extension Proposed Project will require the state and federal permits and approvals listed below.

- Determination of Adverse Effect to Historic or Archaeological Resources [Section 106 of the National Historic Preservation Act] (FTA);
- Section 4(f) Determination (FTA);
- National Pollutant Discharge Elimination System General Permit, Section 402, Federal Clean Water Act (U.S. Environmental Protection Agency); and
- Massachusetts Highway Department access permit(s).

Table ES-4 Project Mitigation Commitments

Environmental Categories	Mitigation Measure	Implementation Schedule	Implementation Responsibility
Traffic	Provide roadway and signal modifications at six specific intersections in order to prevent adverse traffic impacts from the Project.	Completion of construction	EOT/MBTA
	Provide pedestrian improvements at 29 specific locations to improve pedestrian flow and safety.	Completion of construction	EOT/MBTA
	Work with cities to develop station-area parking enforcement plans.	Completion of construction	EOT/MBTA
Noise	Provide noise mitigation in the form of noise barriers, home sound insulation, and rail lubrication to mitigate all moderate and severe noise impacts.	Completion of construction	EOT/MBTA
	Install continuously welded rail for light rail tracks.	Completion of construction	EOT/MBTA
Vibration	Provide vibration mitigation in the form of ballast mats and special trackwork to mitigate vibration impacts.	Completion of construction	EOT/MBTA
Water Quality/ Stormwater	Prepare a Stormwater Pollution Prevention Plan (SWPPP).	Prior to construction	EOT/MBTA
	Implement all aspects of the SWPPP including recommendations in annual updates based on new or improved procedures or changes to operations.	Ongoing	EOT/MBTA
	Update the Operation and Maintenance (O&M) plan in the SWPPP to include a detailed outline of inspection and cleaning schedules for stormwater management practices, including detention areas and deep sump catch basins.	Ongoing	EOT/MBTA
	Install detention and infiltration systems to prevent any increase in peak flows to municipal stormwater drainage systems and to remove TSS from stormwater runoff prior to discharge.	During construction	EOT/MBTA
Visual Environment	Provide vegetation on and/or above retaining walls to minimize visual changes.	Completion of construction	EOT/MBTA
	Work with affected communities on design of noise barriers and vegetated walls.	Prior to construction	EOT/MBTA
Historical and Cultural Resources	Perform archival documentation of historic structures to be removed or altered.	Prior to demolition	EOT/MBTA
	Construct noise barriers with materials and colors compatible with adjacent historic properties.	Completion of construction	EOT/MBTA
	Provide noise mitigation (sound insulation) for sensitive historic structures that cannot be protected using noise barriers.	Completion of construction	EOT/MBTA
	Perform intensive archaeological survey before disturbing any archaeologically-sensitive areas.	Prior to construction	EOT/MBTA

Table ES-5 Summary of Construction Mitigation Measures

Mitigation Measures

Traffic

- Temporary detours would be established to minimize traffic disruption due to construction.
- Bridge reconstruction would be timed so as to minimize temporary bridge closures and to ensure that adjacent bridges were not closed simultaneously.

Air Quality

- Use water trucks to disperse water on exposed soil to reduce dust.
- Use water for compaction in the fill areas and as a dust retardant in both the soil cut areas and haul roads.
- Follow existing MBTA retrofit procedures for construction equipment to reduce emissions.

Noise

- Use specially quieted equipment with enclosed engines and/or high-performance mufflers.
- Avoid nighttime construction in residential neighborhoods.
- Keep truck idling to a minimum.
- Route construction equipment and vehicles through areas that would cause the least disturbance to nearby receptors where possible.
- Fit any air-powered equipment with pneumatic exhaust silencers.
- Locate stationary construction equipment as far as possible from noise-sensitive sites.
- Construct noise barriers, such as temporary walls or piles of excavated material, between noisy activities and noise-sensitive receivers.

Vibration

- Avoid nighttime construction in residential neighborhoods.
- Use alternative construction methods to minimize the use of impact and vibratory equipment (e.g. pile drivers and compactors).

Water Quality/Stormwater

- Develop and implement a SWPPP in accordance with NPDES and MA DEP standards.
- Stabilize any highly erosive soils with erosion control blankets and other stabilization methods, as necessary.
- Reinforce slopes using a hydroseed mix with a resin base, native vegetation, or other approved methods.
- Use dewatering controls, if necessary.
- Install a gravel entrance to prevent sediment from being tracked onto roadways and potentially discharged to surface waters.
- Maintain construction equipment to prevent oil and fuel leaks.

Hazardous Materials and Solid Waste

- Implement special management procedures for any hazardous, contaminated or special wastes generated during construction, including special handling, dust control, and management and disposal of contaminated soil. Procedures should protect both workers and nearby receptors.
- Perform subsurface investigations for any planned excavation to test for possible contamination.
- Prepare a site-specific Health and Safety Plan.
- Conduct pre-demolition inspections to identify any hazardous materials such asbestos and lead-based paint.

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1

Introduction and Background

1.1 Introduction

The Green Line Extension Project is an initiative of the Executive Office of Transportation and Public Works (EOT) and the Massachusetts Bay Transportation Authority (MBTA) to enhance transit services in order to improve mobility and regional access for residents in the communities of Cambridge, Somerville and Medford. The Project is required by the State Implementation Plan (SIP) and fulfills a longstanding commitment of the Central Artery/Tunnel (CA/T) Project to increase public transit. The Massachusetts Air Pollution Control Regulations (310 CMR 7.36) require that EOT complete this Project by December 31, 2014.

Numerous studies over the last 40 years have explored extending transit from Lechmere Station (the current terminus of the Green Line) along the existing MBTA Lowell or MBTA Fitchburg Line commuter rail rights-of-way (Figure 1-1). Most recently, the *Beyond Lechmere Northwest Corridor Study* conducted a Major Investment Study/Alternatives Analysis that evaluated a wide range of technologies and operating plans for a future extension. The *Beyond Lechmere Northwest Corridor Study* did not identify a preferred alternative, but rather investigated a range of cost-effective transit solutions that would increase transit accessibility, improve corridor mobility, increase transit services, and support opportunities for smart growth initiatives and sustainable development.

An Expanded Environmental Notification Form (EENF) was submitted to the Executive Office of Environmental Affairs (EEA) on October 10, 2006. The Secretary of EEA issued a Certificate on the EENF on December 1, 2006, hereafter referred to as the Secretary's Certificate, requiring a Draft Environmental Impact Report (DEIR) for the Proposed Project. The Secretary's Certificate indicated that the Massachusetts Environmental Policy Act (MEPA) review of the Project could be streamlined if the DEIR provides a reasonably complete and stand-alone description and analysis of the Project, Project alternatives, and environmental impacts, and adequately addresses mitigation. This Draft Environmental Impact Report/Environmental Assessment (DEIR/EA) has been prepared to meet these goals and EOT anticipates that the Secretary will be able to determine that the DEIR, after public review and comment, will serve as the Final EIR.

Because EOT is seeking funding through the Federal Transit Administration (FTA), the Project also requires review under the National Environmental Policy Act (NEPA). Therefore, this document also serves as the EA for the Proposed Project. This document will serve as a joint DEIR/EA. EOT expects Project funding will come both from the FTA and from state bonds.

Since the submission of the EENF, the Project Area has been expanded to include the relocation of Lechmere Station. Relocating Lechmere Station was previously reviewed under MEPA as part of the NorthPoint development project (EEA 12651), but has not been reviewed under NEPA. This DEIR/EA includes an evaluation of relocating Lechmere Station to the location previously reviewed under MEPA. This evaluation includes the need to relocate the station, alternatives evaluated, and the environmental consequences of moving the station. EOT anticipates that the final determined NorthPoint developer will fund the station relocation.

The Green Line Extension Project documented in this DEIR/EA includes:

- Extending Green Line service to Medford within the existing MBTA Lowell Line commuter railroad right-of-way (the Medford Branch), from a newly relocated Lechmere Station terminating at either Medford Hillside in the vicinity of College Avenue with intermediate stations at Brickbottom, Lowell Street, Gilman Square, and Ball Square; or at Mystic Valley Parkway/Route 16.
- Extending Green Line service to Union Square in Somerville (the Union Square Branch), either within the existing MBTA Fitchburg Line commuter railroad right-of-way, or using an in-street running option (a new at-grade alignment along Somerville Avenue), with a station near Union Square.

1.2 Project Summary

The purpose of the Green Line Extension Project is to improve corridor mobility, boost transit ridership, improve air quality, ensure equitable distribution of transit services, and support opportunities for smart growth initiatives and sustainable development in the Project Area of Cambridge, Somerville, and Medford.

Six “Build” Alternatives and a Baseline Alternative are evaluated in this DEIR/EA. The Baseline Alternative is evaluated, as required by the FTA, to identify the best option for meeting the transportation needs of the study area with smaller capital investments than are proposed in the Build Alternatives. The Baseline Alternative evaluated in this document includes enhanced MBTA bus service within the study area, including enhancing the existing Route 80 between Lechmere Station and

Mystic Valley Parkway/Route 16 parallel to the MBTA Lowell Line commuter rail right-of-way, and a new shuttle bus service between Lechmere Station and Union Square, parallel to the MBTA Fitchburg Line.

The six Build Alternatives evaluated in this DEIR/EA are summarized in Table 1-1 and described in detail in Chapter 3, *Alternatives*. All of these alternatives include relocating Lechmere Station and include a new layover/maintenance facility. The Build Alternatives are:

- Alternative 1 – Green Line Extension to Medford Hillside and Union Square (via commuter rail rights-of-way);
- Alternative 2 – Green Line Extension to Mystic Valley Parkway/Route 16 and Union Square (via commuter rail rights-of-way);
- Alternative 3 – Green Line Extension to Medford Hillside (via commuter rail right-of-way) and Union Square (in-street running);
- Alternative 4 – Green Line Extension to Mystic Valley Parkway/Route 16 (via commuter rail right-of-way) and Union Square (in-street running);
- Alternative 5 – Green Line Extension to Mystic Valley Parkway/Route 16 (via commuter rail right-of-way); and
- Alternative 6 – Green Line Extension to Union Square (via commuter rail right-of-way).

Table 1-1 Comparison of DEIR/EA Build Alternatives

Alternative	Medford Branch	Union Square Branch	Daily Ridership (2030)	Capital Cost[1] ($M)
1	Medford Hillside	Commuter Rail ROW	7,500	$804.8
2*	Mystic Valley Parkway/ Route 16	Commuter Rail ROW	8,900	$959.3
3	Medford Hillside	In-street	7,700	$829.8
4*	Mystic Valley Parkway/ Route 16	In-street	8,700	$984.3
5*	Mystic Valley Parkway/ Route 16	None	10,500	$870.0
6	None	Commuter Rail ROW	3,900	$370.6

1 2008 dollars
2 These results include 300 parking spaces at Mystic Valley Parkway/Route 16 Station. With no parking at this station, the ridership would be 8,600 new systemwide boardings daily, and the capital cost would be $951.8 million.

The Medford Branch of the Green Line Extension would be constructed within the existing MBTA Lowell Line commuter rail right-of-way, owned by the MBTA. The existing commuter rail tracks would be shifted approximately 13 feet toward the east side of the right-of-way, using retaining walls where necessary to avoid property impacts. The new light rail track and overhead catenary systems would be added within the western half of the right-of-way.

For the Proposed Project, five stations would be constructed on this branch:

- south of Washington Street (Brickbottom Station);
- at Gilman Square;
- at Lowell Street;
- at Ball Square, north of Broadway; and
- at College Avenue.

Alternatives 2, 4, and 5 would include an additional station just south of the Mystic Valley Parkway/Route 16. Stations would generally consist of a single center-island platform with sidewalk access and would be designed as walk-up stations without parking. The Mystic Valley Parkway/Route 16 Station was evaluated both without parking and to potentially include a 300-car parking structure.

Although all of the Medford Branch alternatives would be constructed within the existing MBTA right-of-way, several existing roadway and rail bridges would need to be reconstructed to accommodate the new light rail tracks. These include:

- former Red Bridge (rail) (Somerville);
- Washington Street (rail) (Somerville);
- Walnut Street (roadway) (Somerville);
- Medford Street (roadway) (Somerville);
- School Street (roadway) (Somerville);
- Lowell Street (roadway) (Somerville);
- Cedar Street (roadway) (Somerville);
- Broadway (roadway) (Somerville);
- Harvard Street (rail) (Medford); and
- College Avenue (roadway) (Medford).

Two additional bridges would be reconstructed for the Future Full-Build Alternative:

- Winthrop Street (roadway) (Medford); and
- North Street (roadway) (Medford).

The Union Square Branch of the Green Line Extension, for Alternatives 1, 2, and 6, would be constructed within the existing MBTA Fitchburg Line commuter rail right-of-way, owned by the MBTA. The existing commuter rail tracks would be shifted approximately 10 to 14 feet toward the south side of the right-of-way, using retaining walls where necessary to avoid property impacts. The new light rail track and overhead catenary systems would be added within the northern half of the right-of-way. A station would be constructed along the rail corridor at Prospect Street near Union Square. The station would be designed as a walk-up station without parking. The Union Square Branch would require reconstructing the Medford Street rail bridge in Somerville.

The Union Square Branch of the Green Line Extension, for Alternatives 3 and 4, would function as a single-track loop with portions operating as an in-street running alignment. The alignment will start its outbound service at Lechmere Station and head north to the Red Bridge and then west along the MBTA Fitchburg Line. In the vicinity of the Monsignor O'Brien Highway overpass, the Union Square Branch would split off from the MBTA Fitchburg Line and travel on a new alignment and along a portion of McGrath Highway and connect into Somerville Avenue where embedded tracks would accommodate in-street running in the roadway. At the intersection of Somerville Avenue and Prospect Street, the tracks would turn south along Prospect Street and then be routed inbound along the MBTA Fitchburg Line, where it would join with the outbound tracks near the McGrath Highway overpass.

All of the Build Alternatives would include a layover/maintenance facility. A separate alternatives analysis (described in Chapter 3) was developed to evaluate sites for this facility. The analysis determined that the most practicable location was the area known as "Yard 8," a six-acre former railroad yard located adjacent to the proposed Green Line alignment and accessed from Innerbelt Road in Somerville. The layover facility would include four tracks (providing storage capacity for 80 cars), an approximate 100-vehicle employee parking lot, and a vehicle maintenance building.

The Build Alternatives include relocating Lechmere Station to the east side of the Monsignor O'Brien Highway, on a new viaduct. The relocated station would include reconstructing the 234 existing parking spaces and providing a new bus turnaround.

Based on the analyses presented in this DEIR/EA, Alternative 1, Green Line Extension to Medford Hillside and Union Square (using commuter rail rights-of-way), has been selected as the "Proposed Project" for the Green Line Extension Project, as it provides a balance of cost, ridership, and environmental impacts. EOT also believes that this alternative will help the Commonwealth achieve its goal of providing expanded transportation services and improve regional air quality. This alternative extends to Union Square via the MBTA Fitchburg Line right-of-way, which would require fewer acquisitions of private property, have more operational reliability, and have a lower capital cost than the Somerville Avenue option. Alternative 1 would meet all Project goals, would be operationally practical, and would generate a high number of new systemwide transit trips. This is the Project for which EOT is currently seeking approval by the FTA.

A total of seven stations are included in the Proposed Project, at Lechmere, Brickbottom, Gilman Square, Lowell Street, Ball Square, College Avenue and at Union Square. The route length would be about three miles to Medford Hillside with an approximately one-mile spur to Union Square. The primary infrastructure improvements of the Proposed Project would include relocating existing commuter rail lines, and constructing approximately four miles of new light rail track and systems, four multi-span viaducts, a maintenance facility and reconstructing 11 bridge structures to support the extension service. Parking will not be provided at any of the stations. The Proposed Project is expected to generate new systemwide transit ridership of 7,900 boardings per day (projected to the year 2030). The Project complies with the SIP and with the regulations of the Massachusetts Department of Environmental Protection (MassDEP). EOT anticipates starting construction of the Proposed Project by 2011 and completing construction prior to the required December 31, 2014 opening date.

Although the FTA action evaluated in this document is the Proposed Project described above, EOT has selected as its Preferred Alternative, Alternative 2, Green Line Extension to Mystic Valley Parkway/Route 16, with no parking at Mystic Valley Parkway/Route 16 Station, and Union Square (using commuter rail rights-of-way). This alternative also meets all of the Project goals and provides additional regional benefits. However, because of the constraints placed on EOT by federal funding requirements and the economic crisis facing the Commonwealth, at this time EOT is not able to identify sufficient funding to support the construction of the Medford Hillside to Mystic Valley Parkway/Route 16 segment within the 2014 timeframe mandated by the State Implementation Plan.

As of the filing of this document, the Boston Region Metropolitan Planning Organization has voted to 'flex' funding dedicated to the construction of highways to fund the construction of the Medford Hillside to Mystic Valley Parkway/ Route 16 segment. These funds will be available sometime between 2016 and 2020 and may allow this portion of the Green Line Extension to be constructed shortly after the 2014 schedule for the Proposed Project has been completed.

Therefore, EOT's Preferred Alternative is proposed to be built in two phases with an initial operating segment (or the "Proposed Project") being constructed to Medford Hillside in the vicinity of College Avenue on the Medford Branch and a spur to Union Square, which is described and evaluated in this DEIR/EA as Alternative 1. The second phase of this Project, the "Future Full-Build Alternative" will include extending the Project from College Avenue Station to Mystic Valley Parkway/ Route 16 Station in the future and has been described and evaluated in the DEIR/EA as Alternative 2.

The environmental impacts of both the Proposed Project, referred to as Alternative 1, and of the Future Full-Build Alternative, referred to as Alternative 2, have been fully evaluated and are described in detail in this DEIR/EA. For federal action, the Proposed Project to Medford Hillside is the subject of this DEIR/EA, as the extension to Mystic Valley Parkway/Route 16 is not envisioned to be constructed within the three-year MEPA or NEPA time frame and would, therefore, require re-assessment at a future date. However, construction of the initial operating segment of the Project will not preclude a future extension of the Preferred Alternative or Future Full-Build Alternative to Mystic Valley Parkway/Route 16, should funding become available in the future.

1.3 Permits and Approvals

The Green Line Extension Project is subject to mandatory preparation of an EIR under MEPA because it will require a state permit and will alter more than 50 acres of land and consists of a new rapid transit line along a new right-of-way (the in-street portion of the Union Square Branch in Alternatives 3 and 4) for transportation of passengers. Because the proponent is a state agency and will use state funding, MEPA jurisdiction extends to all aspects of the Project that may cause significant damage to the environment.

The Green Line Extension Project also requires review under NEPA because EOT is requesting Federal funding for the Project. The regulations of the Council on Environmental Quality (CEQ) implementing NEPA ensure that information on the social and environmental impacts of any Federally funded action is available to public officials and citizens before decisions are made and before actions are taken.

NEPA regulations direct Federal agencies to integrate into their planning and decision-making the natural and social sciences, environmental amenities and values, and the design arts along with the necessary engineering and economic considerations. The objective is to balance infrastructure development, economic prosperity, health and environmental protection, community and neighborhood preservation, and quality of life. The FTA uses the NEPA process as the overarching umbrella under which the mandates and considerations of all laws affecting transit project development are considered. The FTA's NEPA process provides a forum for interested agencies and the public to learn about proposed transportation actions and to react to those proposals. The formal review process requires the transit agency to develop and evaluate a range of reasonable alternatives, in addition to the Proposed Project, in order to determine the best option for addressing transportation problems, respecting the community, and protecting the environment. Because the proposed Green Line Extension Project would be primarily within existing active commuter rail rights-of-way and would be beneficial to the communities, EOT has prepared this EA in coordination with the FTA, and anticipates that the FTA will issue a Finding of No Significant Impact (FONSI) at the conclusion of the NEPA review.

In addition, the Green Line Extension Project will require the state and Federal permits and approvals listed below:

- Determination of Effect to Historic or Archaeological Resources [Section 106 of the National Historic Preservation Act] (FTA);
- Section 4(f) Determination (FTA);
- National Pollutant Discharge Elimination System General Permit, Section 402, Federal Clean Water Act (U.S. Environmental Protection Agency); and
- Massachusetts Highway Department access permit(s).

EOT will initiate these permit applications when the appropriate designs are available and the MEPA process has been satisfied.

1.4 Consistency With Federal, State, and Local Planning

The proposed Green Line Extension Project is consistent with all applicable Federal, state, and local planning. It is fully consistent with the SIP and highly supportive of local, regional, state, and Federal policies related to transportation facilities including transit, pedestrian, and bicycle facilities and services. The Proposed Project's consistency with local planning is described in more detail in Section 3.9, *Coordination with Regional Projects*, and Section 5.15, *Indirect and Cumulative Effects*. In addition to the SIP, the Project is consistent with the Urban Ring and the Somerville Community Path projects described below.

1.4.1 State Implementation Plan

The SIP and Air Pollution Control Regulations (310 CMR 7.36) require EOT to construct a Green Line Extension to Medford Hillside with a Green Line Union Square spur. The currently proposed Green Line Extension Project includes alternatives that would extend service to the area north of Medford Hillside in response to the requirements of the Secretary's Certificate, public comments, and support for providing light rail service to a larger population.

1.4.2 Urban Ring Project

The Urban Ring project, in the planning stages during the development of this DEIR/EA, is a three-phased, circumferential transit improvement project within a corridor approximately two miles outside the downtown Boston core. The project includes segments within the municipalities of Boston, Cambridge, Somerville, Brookline, Everett, Medford, and Chelsea; these areas include some of the fastest growing areas around Boston. The Urban Ring would provide new transit services that would connect to existing radial transit lines (subway, commuter rail, and bus) to create shorter transit trips and fewer transfers in the corridor. The Urban Ring would connect with the Green Line Extension at Lechmere Station.

1.4.3 Somerville Community Path

The City of Somerville is pursuing the construction of a bicycle/pedestrian facility linking the existing linear park at Davis Square to Lechmere Station. The project envisions the use of the abandoned segment of the Lexington & Arlington Railroad between Cedar and Lowell Streets. The City of Somerville completed a Feasibility

Study in July 2006. Concept design for the Community Path is being developed as part of the Green Line Extension Project. In addition to coordinating the physical arrangements of the proposed Community Path project, there is also an opportunity to integrate the Community Path's neighborhood connections into the transit stations, particularly where the Community Path will cross local streets at-grade. As directed by the Secretary's Certificate on the EENF, the alignments under consideration for the Green Line Extension Project are being coordinated with the Community Path project, and this DEIR/EA includes conceptual designs for the Community Path (see Chapter 3 for more details on the Community Path design).

1.5 Public Involvement and Agency Coordination

The Green Line Extension Project has received significant public input throughout the planning process. As noted in the Secretary's Certificate, the approximately 90 comment letters on the EENF reflect a substantial interest in the future of the corridor from elected officials and municipal representatives; city, state, and regional agencies; environmental, bicycle, and pedestrian advocacy groups; neighborhood groups; groups that represent the disabled; businesses; residents; and the general public.

To plan and develop the Green Line Extension Project in coordination with this wide range of interests, EOT established a public involvement process that included an Advisory Group, open public meetings, and coordination with the staff and elected officials of Cambridge, Somerville and Medford as well as other stakeholders along the corridor. This process continued the public involvement that began in 2004, during the *Beyond Lechmere Northwest Corridor* study. The Project website (www.mass.gov/greenlineextension) contains all of the materials used at the Advisory Group and public meetings, including comments and responses to comments, fact sheets, Project updates, maps, and graphics.

Eleven Advisory Group meetings were held during preparation of this DEIR/EA, between September 2007 and August 2009. One round of public meetings, attended by 226 people, was held in January 2008, in two different locations. Station workshops were held to obtain neighborhood input on station locations, access, and potential impacts and mitigation measures. Five station workshops were held in January and February 2008. A second round of public meetings was held in March 2009, in two different locations, in which over 600 people attended. In addition to these meetings, the Project Team also attended numerous community and neighborhood briefings.

During the course of the public involvement process for the Project, a number of key issues were raised involving technical analysis and Project outreach including, but not limited to:

- **Ridership Modeling** – Based on requests for additional information by Advisory Group members, EOT held technical tutorials on ridership modeling.

- **Maintenance Facility** – Based on requests for additional information by Advisory Group members, EOT held a site tour of the Green Line Riverside facility and conducted a technical tutorial. Due to concerns about the proposed location of the support facility, EOT and the Project team also produced a full study of the site selection process and evaluated numerous additional alternatives based on feedback and suggestions by members of the public.

- **Station Siting** – Early in the Project, members of the Advisory Group members and of the public expressed interest in the siting of stations in the Project area neighborhoods. As a result, EOT held a series of five station workshops where members of the public could discuss their concerns in small groups with the Project team about station siting, including locations of drop-off and pick-up areas, platform locations, bicycle/pedestrian access, and Americans with Disabilities Act (ADA) accessibility. Based on the feedback received at these meetings, some station locations received additional analysis and/or were reconfigured to address concerns raised by the public.

- **Tunnel Alignment Alternatives** – Several members of the public suggested constructing tunnels for segments of the Green Line Extension. Based upon this interest, EOT and the Project team performed an extensive analysis of tunneling as an alternative to at-grade construction, as documented in Appendix B as "Consideration of Tunnel Alignment Alternatives." Ultimately, the report found tunneling to be cost-prohibitive for this Project.

- **Construction Impacts** – Members of the public expressed concerns with regard to impacts during construction. EOT developed a detailed construction staging plan to help minimize the impacts to neighborhoods, including vehicular traffic, pedestrian traffic, on-street parking, public access, and emergency access to local businesses and residences.

With regard to public outreach, EOT responded to requests for meeting materials in alternative formats, including audio tapes and large-print. These requests were in addition to the standard outreach approaches, including translating materials and meeting notices into multiple languages and other formats. Based on feedback from the public, EOT also expanded the Project database by sending notices of the March 2009 public meetings to all property owners in Medford, Somerville and East Cambridge.

1.5.1 Project Advisory Group

EOT established a Project Advisory Group of municipal officials, community representatives, and other interested individuals to help guide the public process, build consensus, and advise EOT on issues of concern. The members were recommended by the respective municipalities and appointed by the Secretary of Transportation.[1] The Advisory Group provides important guidance and input to EOT and the consultant team on a range of issues relating to the Project.

The Advisory Group has met approximately monthly throughout this process and serves as the Project's liaison to the community. Members review information and advise on the preferred alternatives, station stops, and recommendations. Several members have made independent recommendations as well. Advisory Group meeting presentations, materials, and summary meeting minutes are posted on the Project website to keep the public apprised of issues that arise during meetings. All Advisory Group meetings are open to the public. Several meetings were filmed for local cable access broadcast. Eleven Advisory Group meetings have taken place between September 2007 and August 2009.

1.5.2 Agency Coordination

EOT facilitated 35 interagency meetings with federal and state regulatory agencies, and 48 public agency and local official briefings to guide the environmental review process. Meetings included representatives of:

- Federal Transit Administration (FTA);
- Massachusetts Bay Transportation Authority (MBTA);
- Massachusetts Department of Conservation and Recreation (DCR);
- Massachusetts Department of Environmental Protection (MassDEP);
- Massachusetts Executive Office of Energy and Environmental Affairs (EEA);
- Massachusetts Environmental Policy Act Office (MEPA);
- Massachusetts Highway Department (MassHighway);
- Massachusetts Historical Commission (MHC);
- Central Transportation Planning Staff (CTPS);
- City of Cambridge;
- City of Somerville; and
- City of Medford.

1 The Advisory Group consists of: Lee Auspitz, Davis Square Task Force; Paul Cote, Appointed by City of Cambridge; William Deignan, City of Cambridge; Councilor Frederick DelloRusso, City of Medford; Rita Donnelly, Appointed by City of Medford; Mimi Graney, Union Square Main Streets; Joe Guelpa, Appointed by City of Somerville; David Jordan, Appointed by City of Somerville; Kenneth Krause, Appointed by City of Medford; Monica Lamboy, City of Somerville; Barbara Lucas, MAPC; Steve Mackey, Somerville Chamber of Commerce; Jim McGinnis, Appointed by City of Somerville; Ellin Reisner, STEP/Green Line Forum; Barbara Rubel, Tufts University; Carrie Russell, Conservation Law Foundation; William Wood, Appointed by City of Medford.

1.5.3 Meetings

Advisory Group Tutorials

EOT has facilitated tutorial sessions for Advisory Group members to help them gain a deeper understanding of aspects of the Project. Three tutorial sessions were offered during the Summer of 2008: a ridership modeling presentation and discussion led by the CTPS; a presentation and discussion of the proposed Community Path design; and a tour of the existing Riverside Green Line support facility with a presentation about the proposed layover/support facility for the Project.

General Public Meetings

Two public meetings were held in Medford in January and February 2008 to provide Project background and context. Meetings included a half-hour open house for participants to talk with Project Team members, followed by a presentation and a question and answer session. Attendance was over 100 at each meeting.

In March 2009, EOT held two public meetings in Somerville and Medford, where it presented an overview of the Project, an environmental analysis, recommendations for station sites, and the preferred Project alignment. At both meetings, there was a one-hour Open House, where members of the Project Team were available to answer questions about the Project. The meeting presentation, followed by a public question and comment period, lasted two hours. These meetings were advertised in local newspapers, noticed to the Project database, and all residents of Somerville, Medford, and portions of East Cambridge received notices of the meetings. The distribution list for these meetings totaled approximately 37,000 individuals. Meeting notices were also translated into multiple languages including Spanish, Portuguese and Haitian Creole. Approximately 265 individuals attended the Medford meeting, and 346 attended the Somerville meeting.

Station Workshops

Beginning in late January 2008 and continuing throughout February, residents of Cambridge, Somerville, and Medford came in the hundreds to a series of five station workshops for the Green Line Extension Project. As the alternatives analysis phase began, EOT reached out to communities early in the process to help incorporate residents' everyday knowledge of the corridor into the analysis. The meetings began with a half-hour open house for participants to review maps of the corridor and talk with Project Team members. After a brief overview of the Project and its current phase, the meetings broke into workshop style sessions with participants surrounding tables of maps and providing input regarding station locations, station access, traffic intersections, pedestrian, bus, and bike path connections, and desired station amenities. With attendance reaching 100 or more at some workshops, this robust series of meetings allowed residents to express both their excitement and their concerns about the Green Line Extension. The Project Team wrote down participants' comments on flipcharts near the station tables, while participants themselves filled out worksheets for the Project Team to collect and review.

Members of the Project distribution list were mailed notices of these meetings, and abutters to the proposed station locations received flyers about the meetings. Flyers in multiple languages were also distributed at nearby commuter rail and Orange Line stations. Flyers in multiple languages were sent to area libraries and city clerks' offices for posting.

Briefings for Public Agencies and Elected Officials

EOT has had over 70 meetings with public agencies, municipal officials, elected officials, and municipal disability commissions in Cambridge, Somerville and Medford.

Briefings for Neighborhood Groups and Institutions

EOT has attended over 17 meetings with neighborhood groups. The team provided brief presentations at these neighborhood meetings (targeted by EOT and upon request by a group) and for the disability communities (municipal disability commissions and the MBTA Access Advisory Committee) in Cambridge, Somerville and Medford.

1.5.3.1 Website

EOT has maintained an informative and up-to-date interactive Project website, www.mass.gov/greenlineextension. Between November 2007 and March 2009, the site attracted more than 23,000 new visitors and had a total of more than 145,775 page views. Along with a brief overview of the Project's history and current phase, the website provides access to various reference materials, including documents from previous phases of the Project as well as the most up-to-date Project materials. Interested individuals are also able to sign up to be part of the Project mailing list. Individuals are also able to post comments about the Project publicly as well as use the website to ask questions of EOT and the Project Team. Materials from the Project website have been converted into audio tapes upon request from members of the public.

1.5.3.2 Written Materials

The Project Team has also provided documents summarizing Project meetings, activities, and information on a regular basis. These materials have been provided to the 1,967 names in the Green Line Extension database.

Summary Meeting Minutes

The Project Team provided summary minutes of every EOT-hosted meeting, including Public meetings, Advisory Group meetings and tutorials, and agency briefings (Table 1-2). These notes highlight the presentation, key issues raised, and participants' concerns. They are posted on the website and printed versions are available in different formats upon request.

Fact Sheets

The Project Team prepared one fact sheet in advance of the January/February 2008 public meetings to outline the issues and options under review and indicate how and when comments can be shared or submitted. The Project Team also prepared an additional fact sheet and frequently asked questions (FAQs) sheet in advance of the March 2009 public meetings. The fact and FAQ sheets are available in print and are formatted for downloading from the Project website. Fact and FAQ sheets are available in multiple languages as well as in a large-print, text-only version.

Table 1-2 Meeting Summary (as of August 5, 2009)

Meeting Type	Number of Meetings to Date
Advisory Group Meetings	11
Station Taskforce Meetings	5[1]
Interagency Meetings	35
Neighborhood Briefings	17
Public Agency and Local Official Briefings	48
Institutions/Business Groups Briefings	4
Public Meetings	4[2]
EOT Tutorials	3

1 Attendance at these five meetings was 83, 114, 98, 89, and 74, respectively.
2 Attendance at these four meetings was 138, 88, 264, and 350, respectively.

1.5.4 Environmental Justice

EOT and the Project Team are committed to reaching out to environmental justice populations. The Green Line Extension will bring major benefits of improved accessibility and mobility to numerous environmental justice neighborhoods located throughout the study corridor. The team reached out to these communities to ensure their participation in the DEIR/EA process and to achieve compliance with state and Federal guidelines.

The majority of the Advisory Group meetings were covered by local cable to ensure that individuals could view the proceedings even if they were not able to attend the meetings in person. Meeting presentations and minutes were transcribed onto audio tape on behalf of the visually impaired at the request of participants.

The series of station workshops was held in local environmental justice neighborhoods, and flyers advertising these workshops and other meetings were distributed at Orange Line and local bus stops in Spanish, English and Portuguese. These flyers were also distributed door-to-door to potential abutters to the stations (both residential and business in these environmental justice neighborhoods) in advance of the meeting. EOT used local media for press announcements and paid advertisements of these meetings. At the public meetings and station workshops, interpreters were also available upon request for participants. All English-language meeting announcements included a statement in Spanish, Portuguese and Haitian Creole offering to translate the announcement.

The Project fact sheet was translated into Spanish and English. A large-print fact sheet was developed for the visually impaired. These materials were distributed at public meetings, on the Project website and upon request. Audio equipment was employed at all meetings to accommodate hearing impaired participants in the community.

Environmental justice issues were discussed in numerous meetings with community planning and elected officials. The Project Team also met with many neighborhood and community organizations to provide Project briefings to community members and listen to their concerns. These organizations included the Disability Commissions in Cambridge, Somerville and Medford.

The Project database includes multiple community, neighborhood, and environmental justice organizations in the three affected communities. Meeting announcements for the final set of public meetings were mailed to all residents of East Cambridge, Somerville and Medford to assure the widest possible outreach to environmental justice residents.

1.6 Requirements of Secretary's Certificate

The Secretary's Certificate on the EENF (December 1, 2006) identified the critical general issues to be addressed in the DEIR, as well as specific requirements for the scope of the DEIR. The general issues included:

- The Project should be designed to maximize benefits for local residents while preserving the integrity and character of existing neighborhoods.
- Additional analysis, information and commitment to mitigation measures is necessary to ensure the success of the Project, specifically with regard to:
  - Enhanced land use planning;
  - Station locations;
  - Land takings;
  - Mitigation of noise and vibration impacts;
  - Stormwater;

- Good access for pedestrians, bicyclists, and disabled persons;
- Coordination of bridge design and reconstruction; and
- Traffic management and parking.

The Secretary's Certificate indicated that the MEPA review of the Project could be streamlined if the DEIR provides a reasonably complete and stand-alone description and analysis of the Project, Project alternatives, and environmental impacts, and adequately addresses mitigation. This DEIR/EA has been prepared to meet these goals and EOT anticipates that the Secretary will be able to determine that the DEIR, after public review and comment, will serve as the Final EIR (FEIR).

The general requirements of the Secretary's Certificate, and the sections of this DEIR/EA that address these requirements, are provided in Table 1-3. Detailed, point-by-point responses to the Secretary's Certificate are provided with the other responses to comments in Appendix A.

Table 1-3 Requirements of the Secretary's Certificate

Category	Requirement	Addressed In
Project Description	Include a detailed Project description, schedule, and funding plan	Section 3.7
	Existing conditions plan	Chapter 4
	Proposed conditions plan with plans, designs, renderings, and illustrations/photos	Section 3.7 Chapter 5
	Detailed information on station locations, designs, lighting and access, including circulation plans	Sections 3.6, 3.7
	Descriptions of track locations/relocations and bridge replacements	Sections 3.6, 3.7
	Requirements for maintenance facility, including parking	Section 3.3
	Describe electrical systems, including catenary/support structures, substations, and signal/communication systems; respond to comments on capacity for future electrification of commuter rail	Sections 3.3.1, 3.6
	Operating plans for future service	Sections 3.6, 3.7.4
	Identify temporary and permanent land takings	Sections 3.7.1, 5.2
	List of required permits and approvals, with status of each	Sections 1.3, 6.5
Smart Growth/Land Use	Develop a detailed corridor study that examines zoning, development opportunities, and the relationship of environmental justice communities to the Project	Sections 5.2, 5.4, 5.15
	Describe how communities can plan to address potential for the Project to change the character of their communities	Section 5.15
	Assess opportunities to minimize environmental impacts (solar lighting, use recycled materials, retaining wall alternatives)	Sections 3.7.3, 5.12

Table 1-3 Requirements of the Secretary's Certificate (continued)

Category	Requirement	Addressed In
Environmental Justice	Identify environmental justice areas and other sensitive populations, provide relevant socio-economic data, and describe how the Project is designed to avoid any disproportionate impacts	Sections 4.4, 5.4
	Consider strategies for allowing housing affordability	Section 5.15
	Locations for the stations and the storage and maintenance facility should be carefully assessed for community impacts and/or mitigated	Section 3.3 Chapter 5
	Take affirmative measures to ensure full public participation in the MEPA process	Section 1.5
Alternatives Analysis	Evaluate the No-Build Alternative: The Green Line Extension to Medford Hillside and Spur to Union Square Route 16 Terminus Alternative Union Spur via McGrath/Somerville Avenue Alternative	Sections 3.2, 3.5, 3.6 Chapter 5
	Describe the benefits and drawbacks of each alternative	Chapter 5
	Consider other alternatives that could meet the goal of a connection between the Green Line Extension and the MBTA Lowell Line	Chapter 3
	Evaluate feasible alternatives to the Yard 8 site	Section 3.3.2
Land/Stormwater	Quantify the amount of land altered, the amount of earthwork required, and the amount of impervious surfaces created, and investigate all feasible methods of avoiding, reducing, and minimizing impervious surfaces and impacts to land	Sections 3.7, 5.9
	Consider alternatives to concrete retaining walls to retain trees and vegetation while reducing noise, vibration, and stormwater impacts	Sections 5.7, 5.8, 5.12
	Provide an overall drainage plan and discuss consistency with the DEP Stormwater Management Standards.	Section 5.9
	Include a stormwater operations and management plan	Section 5.9
	Identify any stormwater discharge points and any drainage improvements associated with off-site roadway improvements	Section 5.9
Stations	Identify specific station locations and identify the criteria used to identify station locations	Sections 3.3.1, 3.6, 3.7
Air Quality	Describe air quality benefits of the Project and its consistency with the SIP and DEP's Transit Regulations	Section 5.6
	Assess emissions of VOCs, NOx, greenhouse gases, carbon monoxide, particulate matter (PM), and air toxics. Mesoscale analysis should look at regional impacts and predict total reductions. Microscale analysis should examine localized carbon monoxide (CO) conditions and identify traffic-related hot spots near stations.	Section 5.6
Transit Ridership	Propose a design and operating plan that generates the highest level of ridership possible while balancing the use of MBTA resources and community impacts	Sections 3.6, 3.7
	Describe the assumptions used to generate the ridership numbers and the operating parameters necessary to achieve them	Section 3.4
	Specify whether the vehicle miles traveled (VMT) reductions are based on new or diverted trips	Sections 3.4, 3.6, 3.7
	Discuss the impacts and benefits associated with various ridership levels and impacts on the central subway, Green Line, bus, and commuter rail services during and after construction	Section 5.5

Table 1-3 Requirements of the Secretary's Certificate (continued)

Category	Requirement	Addressed In
Traffic and Transportation	Analyze traffic for existing, build and no-build conditions with respect to intersection level of service (LOS), pedestrian and bicycle circulation	Sections 4.6, 5.5
	Address traffic circulation on all roadways adjacent to proposed stations, and include mitigation for areas where the Project will have a significant impact on traffic operations	Section 5.5
	The traffic analysis should include 10 specific intersections	Sections 4.6, 5.5
	Include strategies for mitigating traffic and parking impacts associated with proposed operations and stations	Section 5.5
	Identify changes in bus routes and incorporate these into the transit operation and traffic modeling	Section 5.5
	Identify bridges that must be reconstructed and include a commitment to coordinate design, scheduling and construction with city officials	Sections 3.7.2, 3.7.6, 5.5
	Evaluate the consistency of this Project with previous and on-going planning efforts and relevant transportation plans (Urban Ring, Reconstruction of Route 28, NorthPoint development, Lechmere Station, the Community Path, etc.)	Sections 3.8, 3.9
Freight Service	Identify what services will be affected and whether changes will result in increased truck traffic on local and regional roadways. Consider alternatives that would minimize or avoid the elimination of freight service.	Sections 4.5, 5.5
Noise/Vibration	Include an analysis of noise and vibration for existing and proposed conditions, identify sensitive receptors	Sections 4.8, 4.9 Sections 5.7, 5.8
	Include a detailed analysis consistent with the FTA guidelines	Sections 5.7, 5.8
	Identify specific mitigation measures for areas where mitigation is needed	Sections 5.7, 5.8
Open Space and Historic Resources	Consult with Massachusetts Historical Commission (MHC) to evaluate impacts and develop appropriate mitigation	Sections 4.15, 5.13
	Provide historic and cultural resource maps to identify historic resources and open spaces adjacent to the corridor and likely to be impacted by the Project	Sections 4.13, 4.15
	Describe measures that will be employed to avoid, minimize and mitigate impacts	Sections 5.11, 5.13
Hazardous Waste	Describe how contaminated soils will be evaluated, managed and disposed of	Section 5.14
	Include an updated list of hazardous waste sites	Sections 4.16, 5.14
	Consult with MassDEP to ensure that demolition and management of contaminated soils are consistent with applicable regulations	Section 5.14
Construction Period	Include a discussion of construction phasing, potential impacts associated with construction activities, and feasible measures to avoid or eliminate these impacts.	Section 3.7.6
	Identify temporary and permanent construction easements	Section 3.7.1
	Require contractors to retrofit construction equipment to reduce diesel exhaust	Section 5.6
Mitigation	Include a separate chapter on mitigation measures, including a proposed Section 61 findings for all state permits, and a schedule for implementation	Chapter 6
Responses to Comments	Include a copy of each comment received and respond to the substantive comments received	Appendix A

2

Purpose and Need

2.1 Overview

The Commonwealth of Massachusetts, in obtaining environmental permits for the Central Artery/Tunnel (CA/T) project in the early 1990s, committed to implement a number of transit improvement projects in the Boston region as mitigation measures. The transit project commitments included a Green Line Extension to Medford Hillside. The Green Line Extension Project is also a requirement of the Massachusetts Air Pollution Control Regulations (310 CMR 7.36).

The study area is generally bounded by I-93 and the Massachusetts Bay Transportation Authority (MBTA) Orange Line to the east, the MBTA Red Line and MBTA Fitchburg Line commuter rail right-of-way to the west and south, and the MBTA West Medford commuter rail station to the north. This area includes East Cambridge and portions of Somerville and Medford. The area consists of densely settled urban corridors with a large base of commuters and transit users, but is currently underserved by fixed-guideway transit. Figure 1-1 shows the study area for the Green Line Extension Project.

With approximately 18,870 people per square mile in Somerville, 15,760 in Cambridge, and 6,850 in Medford, the study area neighborhoods are among the densest in the Boston region.[1] In addition, approximately 60 percent of the residents of Cambridge, Somerville, and Medford live in state-defined environmental justice areas, which take up approximately 42.8 percent of the cities' combined area.[2] The region is currently underserved by transit, and U.S. Census data (2000) indicate that approximately 21 percent of study area households do not own a vehicle, which can create a need for reliable and efficient transit service. Although MBTA commuter rail lines passes through the study area corridor, there are no rail transit stops within these communities. In addition, roadway congestion in the study area impacts the

1 U.S. Census Bureau, *Census 2000*.

2 Environmental justice areas are defined by thresholds for income, minority populations, foreign-born populations, and English proficiency. Therefore, most environmental justice areas contain a mix of environmental justice and non-environmental justice residents.

reliability of current on-street transit services and results in lengthy travel times (approximately 30 minutes) from Lechmere Station to Mystic Valley Parkway/Route 16 Station despite the relatively short distance (approximately four miles).

This chapter defines the purpose of, and need for, the Green Line Extension Project and identifies a number of related Project goals. The Purpose and Need statement is a simple method for outlining both the reasons for proposing a project and the underlying need for the Project.

2.2 Project Purpose

Traffic congestion, mode transfer, and service delays hamper access from the study area to downtown Boston, as well as to employment and services within the study area. The Purpose of this Project is to improve corridor mobility, boost transit ridership, improve regional air quality, ensure equitable distribution of transit services, and support opportunities for smart growth initiatives and sustainable development.

2.3 Need for Transit Improvements

Transit improvements are needed along the Green Line Extension corridor as a result of:

- Poor transit access and mobility;
- Limited transit capacity;
- Poor regional air quality; and
- Traffic congestion on local roads.

Existing transit service within the study area in Cambridge, Somerville, and Medford is currently offered by 15 MBTA bus routes with access to points within those communities as well as to Boston, Arlington, Woburn, and Winchester. However, existing bus routes operate within existing traffic, which hinders bus service and causes inefficient and unreliable transit service in the study area. Although MBTA commuter rail lines travel through the study area, with impacts to the environment within the study area, there are no rail transit stops within the area communities to provide the benefit of transit access. These deficiencies and needs are more fully defined in the following sections.

2.3.1 Transit Access and Mobility

The study area neighborhoods are among the densest in the Boston region. Somerville is ranked among the densest cities in the United States and is the densest city in Massachusetts, with approximately 18,870 people per square mile; Cambridge ranks number three at roughly 15,760 people per square mile; and Medford number 18 at roughly 6,850 people per square mile.[3] By way of comparison, the City of Boston ranks number four in Massachusetts with a population density of approximately 12,170 people per square mile. Cambridge is well-served by transit, with one MBTA Green Line station (Lechmere), five MBTA Red Line stations, and one MBTA commuter rail station (Porter Square). Somerville is served by one MBTA Red Line station (Davis Square) and one MBTA Orange Line station (Sullivan Square), but these are located at the periphery of the City and do not serve the dense population within the study corridor. Medford has one commuter rail station (West Medford).

Transit services that currently operate in the study area provide inadequate links between centers of activity including private and public colleges and universities, medical facilities and specialties, cultural facilities, and sporting events within the corridor communities. Access constraints affect employment opportunities for the residents within the study area, as well. Although the City of Boston provides employment opportunities at all income levels, access to jobs in Boston is constrained by the congested roadways and lengthy travel times to the downtown core. The lack of easy connections to alternative transit modes in parts of the study area makes it necessary for transit patrons to make multiple transfers to reach jobs in Boston. Improvements to transit services would make public transportation a more compelling travel choice by reducing transit travel times throughout the study area and to downtown Boston.

The growth of area institutions is also constrained by the limitations of the transportation system. Improved transit services would make economic, educational, medical, and recreational opportunities within the study area and the region more accessible to corridor households.

2.3.2 Transit Capacity and Service Quality

The existing bus network experiences poor service quality. Congestion in the corridor contributes to the inability of existing transit service to meet the standards for service delivery, which could be attributed to or exacerbated by the fact that 13 study area intersections experience a failing level of service (LOS), which delays

3 U.S. Census Bureau, *Census 2000*.

existing bus operations. For instance, currently only one of the 15 bus service routes in the study area meets the MBTA's Schedule Adherence Standard on weekdays.[4]

According to the Summary Analysis of Routes and Recommended Changes in the *2008 MBTA Service Plan*, all study area bus routes except the Route 85 failed to meet the Schedule Adherence Standards from the *2008 MBTA Service Plan*. Bus service is affected by the corridor's narrow streets, on-street parking, and numerous intersections, all of which create significant delay for motorists. MBTA buses that travel within the flow of traffic along these corridors are subject to the same delays, averaging speeds of nine mph through the corridor based on the current bus schedule and current bus stops. The potential to improve the reliability and capacity of the bus network in the study area is severely limited.

Existing bus service in the study area accommodates approximately 34,690 weekday daily riders.[5] The system cannot be expanded to provide more service due to the physical constraints of the area roads.

2.3.3 Air Quality

The study area is located within an area designated non-attainment for ozone by the EPA, with a classification of "moderate." Motor vehicles are the predominant sources of ozone precursor emissions within the study area. These emissions are exacerbated by truck traffic through the area. Reducing vehicle miles traveled (VMT) and cutting consequent emissions of volatile organic compounds (VOCs) and carbon monoxide (CO) requires the need to improve transit options and promote a shift in travel mode from automobiles. The Project is also a requirement of the Massachusetts Air Pollution Control Regulations (310 CMR 7.36).

2.3.4 Sustainable Development/Smart Growth

The study area presents opportunities for economic development around transit centers. Introducing enhanced transit, undertaken in coordination with smart-growth based local land use planning, may support Commonwealth goals in promoting concentrated mixed-use development and revitalizing urban centers.

There are a number of local development plans or master plans that are being undertaken by the communities in the study area, including transit-oriented development (TODs) such as NorthPoint and the Charles E. Smith residential development adjacent to Lechmere Station. The focus of smart growth efforts is to develop or revitalize neighborhoods. Any transportation investment undertaken by

4 MBTA's *Schedule* Adherence Rating – *Final 2006 Service Plan* Appendix A (Summary Analysis of Routes and Recommended Changes).
5 *Ridership and Service Statistics*, Eleventh Edition (2007), MBTA Bus Schedule, March 2008.

the Commonwealth must be coordinated with local land use policies and regulatory structures that support smart growth aims of expanding the region's housing supply and employment base, concentrating development, and protecting environmental resources.

2.3.5 Environmental Justice

The study area for the Green Line Extension Project contains a significant representation of environmental justice populations. More specifically, approximately 42.8 percent of Cambridge, Somerville, and Medford consist of environmental justice areas, which contain approximately 60 percent of the residents of the three cities.[6] 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 by infrastructure projects. The U.S. Department of Transportation (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."

Alleviating the burden on environmental justice communities, outlined below, and providing benefits to these populations in terms of air quality, mobility, and access to services and jobs are important goals of this Project. According to the Boston Region Metropolitan Planning Organization (MPO), the following transportation-related burdens impact environmental justice populations in the study corridor:[7]

- Commuter rail lines pass through the community without providing access to their service;
- The lack of reliable transit services constrains access to job opportunities outside of the immediate neighborhoods;
- The area lacks services such as radial bus connections that access employment centers; and
- Study area residents lack access to jobs outside of peak-period commuter hours (i.e., peak-periods that demonstrate commuting patterns of "9 to 5" jobs) because there is limited off-peak bus service.

6 Environmental justice areas are defined by thresholds for income, minority populations, foreign-born populations, and English proficiency. Therefore, most environmental justice areas contain a mix of environmental justice and non-environmental justice residents.
7 *Regional Transportation Plan 2004-2025* of the Boston Region MPO.

2.4 Goals and Objectives

In addition to the Commonwealth's commitments to provide transit service to this area as part of the CA/T Project and the State Implementation Plan (SIP), the Green Line Extension Project is also part of EOT's efforts to achieve a series of broad transportation goals to improve the quality and equity of transportation services. The goals, associated objectives, and potential evaluation measures are described below.

2.4.1 Improve Regional Mobility and Capacity and Expand Transit Access and Intermodal Connections

Mobility improvements in the study area are expected to result in significant regional improvements by increasing accessibility for all users, including residents, employees, students, visitors, and shoppers. Residents of the study area would benefit from improved employment access and reduced commuting times, as well as reduced travel times and costs. Measures that will be used to evaluate the improved transit access and regional mobility include:

- The addition of seat-miles and vehicle-hours of system capacity service;
- Reliability of the service in the study area;
- User benefits, including travel time savings; and
- Congestion relief.

Increasing mode choice options will improve efficiency and effectiveness of the region's transportation system. Multimodal connections in the study area between commuter rail, bus services, and rapid transit or light rail would also benefit commuters by improving mobility and flexibility in route choice. Factors to be used in evaluating the effectiveness of increased mode choice options include:

- Mode shift;
- Transit ridership;
- Transit system capacity impacts; and
- Reductions in the number of transfers required.

2.4.2 Maximize Transportation Capacity Efficiently

Given the need for increased transit capacity in the study area and the limited funding resources at all levels, transit improvements should be cost effective as well as provide a service to the customers that is reliable, comfortable, and attractive, thereby increasing ridership.

In order to identify an optimal service, factors to be used in evaluating this goal include:

- Total capital cost;
- Annual operating and maintenance costs; and
- The Federal Transit Administration (FTA) cost effectiveness index.[8]

2.4.3 Improve Air Quality

Transit improvements should contribute to the attainment and long-term maintenance of conformity with National Ambient Air Quality Standards (NAAQS). Factors to be considered in evaluating the air quality benefits of alternatives include:

- Regional/mesoscale air quality;
- Energy consumption; and
- Vehicular travel/congestion.

2.4.4 Advance Sustainable Development

Proposed transit improvements must advance the Commonwealth of Massachusetts' goals for sustainable development. While transportation improvements alone will not necessarily stimulate economic growth, congestion and the lack of access can be major impediments to implementing a smart growth vision of balanced housing, economic development, and open space recreation. Factors to be considered in evaluating sustainable design benefits of alternatives include:

- Mode shift;
- Transit ridership; and
- Congestion relief.

2.4.5 Provide Services to Environmental Justice Populations

Improvements to transit services will need to be in conformance with environmental justice objectives to provide benefits to these populations in terms of air quality, mobility, and access to services and jobs. Mobility improvements should conform to the Federal, state, and local requirements that are intended to promote nondiscrimination in programs affecting human health and the environment.[9]

8 FY 2009 New Starts and Small Starts Evaluation and Rating Process, July 2007 (Prepared by Federal Transit Administration, Office of Planning and Environment, US Department of Transportation).
9 Executive Order 12898, *Federal Actions to Address Environmental Justice in Minority Populations and Low-Income Populations.*

Factors to be used in evaluating the effectiveness of providing services to environmental justice populations include:

- Service to environmental justice target areas;
- Access to opportunities for residents of environmental justice target areas;
- Improvement in mobility and connectivity and/or removal of barriers faced by environmental justice areas; and
- User benefits, including travel time savings.

3

Alternatives

3.1 Introduction

Based on the requirements of the December 1, 2006 Secretary's Certificate on the Expanded Environmental Notification Form (EENF), the Green Line Extension Project Draft Environmental Impact Report/Environmental Assessment (DEIR/EA) includes a No-Build Alternative and six "Build" Alternatives. Additionally, a "Baseline" Alternative has been included in accordance with the FTA's requirements. Four of the Build Alternatives would provide service to both Medford and to Union Square in Somerville; one Build Alternative would provide service to Medford only (terminating at a new Mystic Valley Parkway/Route 16 Station); and one Build Alternative would provide service to Union Square only.

Section 3.2 discusses the No-Build Alternative, which demonstrates future (2030) conditions with all other committed transportation improvement projects identified in the Massachusetts Transportation Improvement Program (TIP) in place (including both highway and transit projects) but without the Green Line Extension. Section 3.3 provides a description of the Project elements including station and maintenance facility locations, and the inclusion of the Somerville Community Path into the planning and design of the Project. Section 3.4 discusses the ridership modeling methodology used to assess each Build Alternative. Section 3.5 describes the Baseline Alternative in accordance with the Federal Transit Administration's (FTA's) requirements to identify the best option for meeting the transportation needs of the study area with smaller capital investments than are proposed in the Build Alternatives. Section 3.6 offers a detailed analysis of the Build Alternatives to identify the best scenario for meeting the transportation needs of the study area. Section 3.7 provides a detailed description of the Preferred Alternative and a rationale for its selection. Section 3.8 discusses the planned Somerville Community Path and its relation to the Project. Section 3.9 identifies planned projects that are envisioned to provide regional transportation improvements to the area and have been considered in the Green Line Extension planning process, as they are anticipated to affect regional transportation patterns.

3.2 No-Build Alternative

The No-Build Alternative consists of the existing transportation facilities and services and all future committed transportation improvement projects without the extension of the Green Line. The No-Build Alternative includes anticipated changes to the transportation infrastructure including highway and transit projects currently shown on the TIP long-range regional plans, and proposed improvements along O'Brien Highway/Route 28 associated with the NorthPoint development. It represents the base condition against which the transportation benefits and environmental impacts of the Baseline and Build Alternatives are measured. The committed improvements that are included as part of the No-Build Alternative are summarized in Section 5.5.2.1. The No-Build Alternative does not meet the Project Purpose because it would not improve corridor mobility, boost transit ridership, improve regional air quality, ensure equitable distribution of transit services, or support opportunities for smart growth initiatives and sustainable development.

3.3 Project Elements

In order to determine the most appropriate alternatives for the Green Line Extension Project, it was first necessary to evaluate the study area in terms of feasible locations for stations and a maintenance facility, as well as the viability of a Union Square spur.

During the development of the 2005 *Beyond Lechmere* Major Investment Study/Alternatives Analysis (MIS/AA), the alternative that evaluated light rail service (Alternative 1C) included evaluating the extension of service beyond the Mystic River to West Medford. The MIS/AA's proposed light rail alignment traveled via the Massachusetts Bay Transportation Authority's (MBTA) Lowell Commuter Rail Line beyond the Mystic Valley Parkway/Route 16 and Mystic River to terminate at a location south of the existing West Medford Commuter Rail Station near High Street/ Route 60. This termination point was determined to have a number of operational and environmental challenges, including the crossing of an existing highway-railroad at-grade crossings and impacts on the existing historic Mystic Valley Parkway/Route 16 and the Mystic River structures.

By extending the Green Line service across the Canal Street grade crossing, this existing two-track crossing would become a four-track crossing (two Green Line tracks; two commuter rail tracks). The differing operational characteristics of the Green Line, commuter rail, and roadway would significantly raise safety concerns. In a similar situation in Los Angeles, the accident rates are significantly higher than the national average; ninety people have died on the Los Angeles County Metropolitan Transportation Authority's 22-mile Blue Line (consisting of 100 at-grade crossings). This line has had more than 821 recorded incidents between its inception in July 1990 and July 2008. All of the at-grade crossings in Los Angeles have grade crossings gates and lights. With the potential of having Green Line vehicles cross the roadway in each direction, safety concerns were raised at the Canal Street crossing.

Additionally, extending the Green Line to West Medford would require the widening of the historic structures over the Mystic Valley Parkway/Route 16 and the Mystic River and could impact the parklands beneath the structures. If these structures were impacted, there would be an increased amount of environmental documentation and coordination that would be required, which could significantly impact the ability to meet the Project schedule of December 31, 2014 and could incur additional expenses to the Project. For these reasons, it was determined during the EENF process that a variation of the Alternative 1C from the MIS/AA was proposed with a Project terminus south of the Mystic Valley Parkway/Route 16, in the vicinity of College Avenue. The Secretary's Certificate specifically cited that a potential terminus be evaluated in the vicinity of the Mystic Valley Parkway/Route 16.

The following sections describe the evaluations related to the siting of the stations, the alignment of the Union Square Branch, and the maintenance facility.

3.3.1 Stations

This section discusses the proposed station site alternatives and the process by which the preferred station sites were selected for the proposed Green Line Extension Project. Various design criteria have been developed to evaluate the benefits and disadvantages of different possible station locations. Such evaluated criteria included, but were not limited to, station access, transit operations, land use compatibility, and costs. Each Station Alternative was rated numerically in the range of -2 for being the most unfavorable and +2 for being the most favorable based on (each) design criteria. All ratings were summed at the end for each Alternative Option, and the final station site was selected based on the Option that received the highest score for each Alternative. Station ranking and rating summaries are provided in Appendix B.

Station locations and design were also based on feedback received from the public at Station Workshops and from public officials on accessibility, level of service (LOS), passenger circulation, and safety requirements. Keeping uniform architectural elements was also an important station design goal. The following codes and standards were used for consistency with local and state requirements, as well as MBTA and other transit standards and guidelines:

- Massachusetts State Building Code 780 CMR, Sixth Edition;
- Massachusetts State Elevator Code 524 CMR, 2003;
- National Fire Protection Association (NFPA) 101 Life Safety Code, 1994 (Per 6th edition of CMR 780);

- NFPA 130 Standard for Fixed Guideway Transit Systems, 1995(Per 6th edition of CMR 780);
- Massachusetts Architectural Access Board 521 CMR, 2002;
- American Society of Mechanical Engineers (ASME) A17.1 Safety Code for Elevators and Escalators, 2000;
- MBTA Guidelines & Standards, 1977;
- MBTA Guide to Access, 1990;
- APTA Guidelines (American Public Transportation Association), 1981;
- ADA Architectural Guidelines (in connection with Uniform Federal Accessibility Standards), 2002;
- Transit Capacity and Quality of Service Manual, TCRB Report, 1999;
- Pedestrian Planning and Design, Dr. John Fruin, Second Edition 1987; and
- Boston Center for Independent Living (BCIL) agreement.

As required by the Secretary's Certificate, the station selection and design process identified the following stations for the proposed Green Line Extension Project along the Medford Branch:

- Brickbottom Station;
- Gilman Square Station;
- Lowell Street Station;
- Ball Square Station;
- College Avenue Station; and
- Mystic Valley Parkway/Route 16 Station.

Figures 3.3-1 and 3.3-2 identify the station locations along the Green Line Extension corridor. Conceptual layouts showing the station locations are included and discussed in Section 3.7.3, *Stations*. The terminus of the Medford Branch, more specifically whether the branch ends at the College Avenue Station or at the Mystic Valley Parkway/Route 16 Station, is discussed in detail in Section 3.6, *Build Alternatives*.

In addition to these stations, Executive Office of Transportation and Public Works (EOT) was directed to evaluate the feasibility and advisability of locating stations at Winthrop Street and at a location between Winthrop Street and College Avenue. As detailed in Appendix B, a thorough station siting evaluation was performed. In addition to the physical characteristics of the stations and their impacts on the surrounding areas, the ridership market was evaluated to determine if additional stations were warranted in particular areas.

Because none of the stations have park-and-ride facilities, the ridership market for these stations are almost wholly defined as persons capable of accessing the stations by walking or bicycle. Based on the FTA's requirements for walk-access distances, a one-mile walk-access transit catchment area was evaluated. Based on this distance, nearly every portion of the area around Winthrop Street is covered by the one-mile walk-access catchment areas around the proposed College Avenue and Mystic Valley Parkway/Route 16 Stations. Therefore, the Winthrop Street area will be easily served by both College Avenue Station and Mystic Valley Parkway/Route 16 Station, and is not warranted at this time.

In addition to the Winthrop Street Station, a combined Winthrop Street/College Avenue area station was evaluated. The proposed combined station, based on feedback from the community, would only provide access from the Boston Avenue side of the tracks, resulting in longer walk times to the station for individuals from the neighborhoods. Based on concerns raised by the community and with a thorough understanding of the ridership market, it was determined that the locations of the College Avenue and Mystic Valley Parkway/Route 16 Stations can sufficiently address the demand in this area while minimizing the impacts on area residents.

In addition to specific light rail station locations, the Secretary's Certificate also specified evaluating alternatives that "could meet the goal of a connection between the Green Line Extension and the Lowell commuter rail including a rail stop at Tufts University or Gilman Square." Toward this goal, the development of joint Commuter Rail/Green Line stations were evaluated at College Avenue and at Gilman Square in order to take advantage of possible transfer opportunities for commuters prior to entering Boston. These options are shown in detail and discussed in Appendix B.

In order to provide a potential for providing a commuter rail station along the MBTA's Lowell Line, it would be necessary to fully comply with the accessibility requirements for commuter rail stations, as well as to accommodate the requirements for freight service along the corridor. The MBTA's Lowell Line currently accommodates freight rail service in addition to passenger rail service and is designated as a "high-and-wide route," meaning that additional clearances are required for freight traffic along the corridor.

All new stations must be constructed in a manner that meets the Americans with Disabilities Act (ADA) for providing fully accessible stations. In order to meet these standards, a new commuter rail station would need to include a fully accessible high-level platform. The MBTA Railroad Operations' *Commuter Rail Design Standards Manual* specifies that a wider side clearance (7'-3'') must be provided for all high level platform stations. This wider side clearance does not comply with the Americans with Disabilities Act Statute and Regulations found at 42 USC Section 12162(e) and the U.S. Department of Transportation's regulations found at 49 CFR Parts 37 and 38, which requires a gap of no more than 3'' horizontal and 5/8'' vertical between platform edge and entrance to the rail car. Bridge plates can be used for smaller or "mini-high" platforms to address this gap. However, bridge plates are not a practical solution for use at full-length high-level platforms.

In order to accommodate these requirements, it would be necessary to construct an additional track for freight service in the vicinity of the commuter rail station areas. These "gauntlet" or "bypass" tracks would provide the freight trains with the additional clearances that would be necessary to circumvent the stations. An example of this type of design can be found at the MBTA's Anderson/Woburn Station. Constructing an additional commuter rail track along the already constrained College Avenue and Gilman Square area corridor would significantly impact additional properties in these areas. As it is the goal of this Project to minimize property impacts to the greatest extent possible, the impact on the neighboring areas would outweigh the potential benefits of providing a commuter rail and light rail connection. Although the Project does not provide a new connection between the Green Line and the commuter rail, a connection already exists at North Station and would continue to be available.

The Secretary's Certificate also raised the issue of how the Project could affect the electrification of the MBTA commuter rail. The Project does not preclude the implementation of future electrification of the MBTA commuter rail line. However, the Green Line electrical system and the electrical system needed for a commuter rail line are quite different and do not share much compatible infrastructure. The Green Line uses a 600-volt direct current (DC) overhead catenary, while typical railroad electrification (such as the Amtrak line from New Haven to Boston) uses a 25,000-volt alternating current (AC) supply. Substation and overhead wiring requirements also vary significantly between DC and AC systems. Since the required upgrades to the Green Line system do not overlap with the upgrades necessary for electrification of the commuter rail lines, the Project does not include infrastructure for commuter rail electrification.

For the Green Line Union Square Branch, there is one station proposed in the vicinity of Union Square, connecting Union Square Station and Lechmere Station. Three options were considered for Union Square, each with a different operational plan and station location. More details on the various alignments for the Union Square Branch that were considered, including two in-street running options, are provided in Appendix B.

Section 3.7, *Project Description - Preferred Alternative*, provides the following additional station detail, as required by the Secretary's Certificate:

- Specific station locations and describes how they support ridership goals;
- Detailed designs and renderings of the stations and a discussion of station amenities and measures to minimize impact;
- Station design that provides safe and efficient loading and unloading of passengers that is consistent with ADA and universal design principles; and
- A description of how access will be provided from street level to the stations.

3.3.2 Maintenance Facility

The capacity of the MBTA's Green Line system is constrained by the need for layover and maintenance facilities. Understanding existing capacity constraints as well as the impact that a new service would have on the overall Green Line system is critical. The existing Green Line fleet is currently stored at the Reservoir, Riverside, Lake Street, and Lechmere facilities, and within the central subway. Maintenance support is only available at the Reservoir, Riverside, and Lake Street facilities; all are located on the west end of the Green Line system. There are currently no maintenance facilities located on the north side of the system in proximity to the proposed Green Line Extension. The existing facilities are operating beyond their planned capacity and expansion of these facilities to accommodate the proposed Green Line Extension is impractical in terms of logistics, service reliability, and operating costs. The Green Line Extension Project will, therefore, require a new maintenance facility on the north side of the Green Line system to store, inspect, maintain, and repair cars and to provide a base for the maintenance and repair of the track, power, and signal systems.

It is essential to store a number of cars on the north side of the Green Line system in order to provide cars for start-up in the morning, provide a convenient location for overnight and off-peak storage as cars come out of service, and minimize the distance a disabled train would have to travel to reach a maintenance facility. A north-side facility would also eliminate much of the need to move cars to the west-side facilities each night and back to the north side in the early morning, a move which would interfere with critical overnight maintenance work for Green Line track, signal, and power systems. Car storage is not only required for the overnight storage of cars but also for the day-time lay-up of cars. When a Green Line car becomes disabled, it is essential that the car be moved to the closest maintenance facility to get it out of the way of revenue service trains and to a location where it can be serviced. For all of these reasons, in order to provide a service that is reliable, cost-efficient, and does not adversely impact the remainder of the Green Line system, it is necessary that a maintenance facility be provided on the north side of the system.

The new Green Line Extension Project maintenance facility would consist of an area for vehicle storage and a support structure for vehicular inspection, servicing, maintenance, and repairs. The storage yard needs to accommodate 80 Green Line cars, which includes the estimated 72 cars needed for the service and allows additional capacity. The facility would also require approximately 100 parking spaces for employees. Specific requirements for the facility are described in more detail in Appendix C. In general, the requirements include: track layouts that provide operational flexibility (i.e., parallel "ladder" tracks with access from both ends of the facility); sufficient track lengths; an adequate number of tracks and equipment for the various types of vehicle maintenance required; and a support facility building that includes maintenance bays, storage room, loading docks, administrative offices, and employee facilities and amenities. In order to meet these program objectives, the site must be approximately 10 to 12 acres.

Based on the requirements of the Secretary's Certificate, several sites were considered for the new Green Line maintenance facility in addition to those specified in the Secretary's Certificate, including the Boston Engine Terminal (BET) and Yard 8. Figure 3.3-3 shows the BET and Yard 8 locations as well as the first tier of sites evaluated for the proposed maintenance facility. Additional sites or variations of these sites were suggested by representatives of the Cities of Somerville and Medford, by Advisory Group members, and by the public. The detailed maintenance facility report in Appendix C describes the many variations of potential sites that were evaluated. Due to the density of development in the Project study area, there were limited potential sites to evaluate. However, in working with the Project stakeholders, 11 initial sites were identified for evaluation as potential maintenance facility locations. The 11 initial sites include:

- Gilman Square at Medford Street;
- City of Somerville Department of Public Works (DPW) Yard;
- Wild Oats site at Route 16;
- U-Haul site at Boston Avenue/Route 16;
- 200 Boston Avenue Site (Cummings Park);
- Medford Hillside Boston and College Avenue at Tufts;
- Pat's Tow Lot-Somerville Avenue at Medford Street;
- MBTA BET Commuter Rail Facility;
- Yard 8;
- Yard 8 with adjacent parcel-the neighboring undeveloped lot for the support facility; and
- Yard 7/8 (a split operation using a combination of sites to reduce activity on Yard 8).

These sites were put through a two-tier screening process to determine which site(s) best met the program requirements, which includes size and configuration of the site(s) and proximity to the proposed extension. Those sites that were determined to be too small to accommodate the program and/or required a crossing of the MBTA Lowell Line in order to access the sites were eliminated from further consideration. Sites unable to meet the program because of inadequate size or configuration or because they were unable to make direct track connections to the propose extension lines were also disqualified.

At the request of the Advisory Group and other Project stakeholders, the analysis considered 10 additional possible configurations for the maintenance facility, focusing on the MBTA BET Commuter Rail Maintenance Facility and on Yard 7 near the NorthPoint development. Additionally, the City of Somerville requested an evaluation of a modified scheme that would use the BET and NorthPoint development. The analysis of all sites considered for the maintenance facility is presented in greater detail in Appendix C.

The MBTA BET Commuter Rail Maintenance Facility was determined to be unsuitable to support the program. None of the areas within the BET property are available or suitable for use as a Green Line support facility. The existing BET facility is barely adequate for current commuter rail needs. Most of the site is already in use for train operations. The parking lot is too far from the Green Line, and would require long bridges over the existing tracks for access. The configuration is not well suited for train storage. The existing open storage area is important for current and future commuter rail operations. Even if it were available for Green Line use, it is too long and narrow and not well-suited for a Green Line storage facility. Combining the BET site with Yard 7 does not offer a large enough site in the required configuration to accommodate a Green Line facility. Federal Railroad Administration (FRA) regulations also state that use of both commuter rail and light rail within the same facility is incompatible.[1]

Of the numerous sites considered in the screening process, only Yard 8 with the Adjacent Parcel is of a sufficient size and configuration to effectively store the required cars and house a support facility while providing the operational flexibility that is needed for such a facility without additional environmental impacts. Yard 8 is a former railroad property located in an industrial area that is currently zoned for this type of a facility. Figure 3.3-4 shows the Preferred Maintenance Facility Site.

The Yard 8 parcel that would be acquired for the maintenance facility has an existing building permit for a 190,000-square-foot building approximately 64 feet high. The approved building and the maintenance facility cannot share the site due to space constraints. Therefore, the maintenance facility would require voiding the existing building permit.

The construction of the Green Line Extension Project would result in the removal of some existing freight trackage within Yard 8 and would require some relatively minor revisions to freight operations by Pan Am Railways (PAR). However, none of this would preclude any existing freight rail operations, based on discussions with PAR.

PAR freight trains reach Boston via the MBTA Lowell Line. Typically, there are about three to four round trips per week for the local switching operation, which serves Somerville as well as Chelsea, Salem, and Peabody via the Eastern Route mainline. In addition, the "gravel train" to Boston Sand and Gravel in Charlestown

1 Federal Railroad Administration, 49 CFR Parts 209 and 211, *Shared Use of the Tracks of the General Railroad System by Conventional Railroad and Light Rail Transit Systems*; Notice and Final Rule, Federal Register, Vol. 65, No. 132, Monday, July 10, 2000, Notices.

makes another three to four round trips a week. Most freight trains operate in the evening or night, when commuter rail operations are less frequent.

The main impact to freight operations would be the use of Yard 8 for Green Line storage and maintenance. Currently, PAR has two tracks in the yard: one through track and one storage track. PAR freight trains coming down the MBTA Lowell Line pass through Yard 8, occasionally temporarily storing freight cars in the Yard. If Yard 8 were dedicated to the Green Line, it would still be possible for PAR to access the Boston area and to store freight cars in other nearby locations. As discussed with Sid Culliford, Senior Vice President for Operations of PAR, freight trains could simply be diverted from Yard 8 via a reconstructed Yard 10 lead (a little-used track that runs adjacent to New Washington Street). This track connects to the “3rd and 4th Irons,” which are the two freight tracks on the west side of the Orange Line Sullivan Square Station. These tracks also provide an alternative location where PAR could temporarily store freight cars.

The Green Line Extension Project would include the reconstruction of the Yard 10 lead track, allowing PAR freight operations to continue in a manner acceptable to PAR and with only a minor deviation from the route utilized today.

As described above, Yard 8 has been the preferred option for the construction of a Green Line vehicle storage and maintenance facility, given its combination of size, configuration, and adjacency to the Green Line Extension tracks. However, the Yard 8 site has elicited local opposition from some municipal officials, elected representatives, and abutting residents and businesses. To endeavor to address and resolve these concerns, EOT has initiated analysis of two additional possible sites for the facility: (1) the so-called “Mirror H” site, proposed by the City of Somerville; and (2) a site, newly conceived by EOT and termed “Option L.” The “Mirror H” site straddles the Inner Belt area of Somerville and the NorthPoint area of Cambridge. The “Option L” site is located immediately adjacent to BET, outside the current BET fence line. Both locations are shown on Figure 3.3-4.

Preliminary analysis indicates that both alternative sites have impacts above and beyond that of the Yard 8 alternative (e.g., Mirror H – renegotiation of MBTA-NorthPoint agreement and Option L – relocation of active businesses). However, to sufficiently compare the sites to the preferred Yard 8 location, a complete analysis of both alternatives - including environmental impacts, schedule implications, community benefits, property acquisition needs, regulatory issues, and costs to the municipalities and the Commonwealth - will be performed over the next few weeks. Results will be made available to the public for input and discussion once underway. The outcome of the analyses will determine whether EOT chooses to pursue a Notice of Project Change for the Green Line Extension Project, to formally substitute one of the alternative options for Yard 8 as the preferred site for the storage and maintenance facility.

3.4 Ridership Methodology

Ridership for the Baseline and Build Alternatives was forecast by the Central Transportation Planning Staff (CTPS) using the regional model and land use assumptions in compliance with the FTA's requirements and consistent with the study area Metropolitan Planning Organization (MPO). A detailed summary of the travel demand modeling methodology and assumptions utilized by CTPS is included in Appendix D.

The model developed to calculate ridership provides projections for a forecast year of 2030 and assumes that a number of proposed transportation projects, including segments of the Urban Ring project Phase II and Silver Line Phase III projects and other area highway transportation projects consistent with the Regional Transportation Plan, will be implemented by this time.

Detailed operating plans for each alternative were developed, including identifying the number and types of vehicles, size, vehicle capacity, travel times, peak and off-peak headways, used for each alternative. The operating plans were developed as an extension of existing Green Line D and E Branch services, so as to minimize any impact to the Central Subway system operations. Existing service frequencies and headways were maintained for the branch lines within the Central Subway and these lines were extended beyond Lechmere Station with the same service plans. Detailed descriptions of the operating plans for each Build Alternative are included in Section 3.6, *Build Alternatives*.

For each alternative, future ridership projections were calculated on a system-wide level and for each proposed station location by identifying new transit trips generated and boardings at each station. Additionally, a reduction in the vehicle miles traveled (VMT) generated by each for each Build Alternative was calculated. VMT reduction estimates were calculated based on both new and diverted trips. Ridership projections for each Build Alternative are described in later sections of this chapter.

The additional ridership projected by the Green Line Extension was evaluated by CTPS for its impact on existing Green Line capacity on the various segments of the system, including the Central Subway. The summary of this analysis, included in Appendix D, indicate that all of the various segments of the different Green Line branches are capable of accommodating the peak transit loads in both the AM and PM peak hours. Based on CTPS' analysis, none of the peak load segments exceed the MBTA's maximum load service policy.

3.5 Baseline Alternative

A Baseline Alternative was developed in accordance with the FTA's requirements to identify the best option for meeting the transportation needs of the study area with smaller capital investments than are proposed in the Build Alternatives. The Baseline Alternative builds upon the No-Build conditions by adding low-cost transit services that provide a level of service comparable to the Build Alternatives. The Baseline Alternative to be evaluated as part of this DEIR/EA is enhanced MBTA bus service in the Project Area. This section focuses on the proposed operating plan for the Baseline Alternative.

The Baseline Alternative would enhance the existing MBTA Route 80 bus service. This service would operate parallel to the MBTA Lowell Line corridor. The Baseline Alternative would also include a new shuttle service that would be similar to the proposed Union Square Branch.

Under the Baseline Alternative, Enhanced Route 80 would operate from Lechmere Station to Mystic Valley Parkway/Route 16. The existing Route 80 bus parallels the MBTA Lowell Line commuter rail right-of-way. Under the Baseline Alternative, the Enhanced Route 80 would make limited stops that closely match the proposed Green Line stations, and the headways would be adjusted to provide the same frequency of service as the Green Line Extension Medford Branch utilized in the Build Alternatives.

The Baseline Alternative would also include a shuttle bus service between Lechmere Station and Union Square using Monsignor O'Brien Highway/Route 28, McGrath Highway, and Somerville Avenue, traveling along a similar route as the current Route 87 bus with headways similar to the Green Line Extension Union Square Branch, as described in Section 3.6, *Build Alternatives*.

Under the Baseline Alternative conditions, the existing Green Line E branch would operate to Lechmere Station. It is also assumed that the existing Green Line D branch would be extended from Government Center Station to Lechmere Station, as the service has operated in the past. Commuters in the morning, who arrive at Lechmere Station using either the Enhanced Route 80 or the Union Square shuttle, would have the ability to transfer to one of the two Green Line branches to continue their trip to Boston. The Baseline Alternative, which includes the Union Square shuttle, is expected to generate new systemwide transit ridership of 2,700 boardings per day and a reduction of 8,834 VMT per day (projected to the year 2030).

Figure 3.5-1 shows the conceptual alignment of the Baseline Alternative including both the Enhanced Route 80 service from Mystic Valley Parkway/Route 16 to Lechmere Station and the shuttle service from Union Square to Lechmere Station.

3.5.1 Enhanced Bus Route 80 Service

The current MBTA Route 80 is a local route serving from Arlington Center to Lechmere Station through Medford Hillside, Powder House Square, Magoun Square, and Gilman Square. The Route 80 inbound bus begins its route in Arlington Center, and travels along Medford Street, High Street, Boston Avenue, College Avenue, Broadway, Medford Street, and McGrath Highway. The Enhanced Route 80 inbound service, intended to serve the Medford area initially, would begin its route from the area of Mystic Valley Parkway/Route 16 and Boston Avenue, and travel south along Boston Avenue, College Avenue, Broadway, Medford Street, and McGrath Highway. The Enhanced Route 80 inbound service would terminate its route at Lechmere Station. The Enhanced Route 80 outbound service would begin its route at Lechmere Station, travel northbound on roadways parallel to the MBTA Lowell Line and terminate in the vicinity of Mystic Valley Parkway/Route 16 and Boston Avenue. The Enhanced Route 80 would serve the following stops only:

- Boston Avenue at Mystic Valley Parkway/Route 16;
- Boston Avenue at College Avenue;
- Boston Avenue at Broadway;
- Medford Street at Broadway;
- Medford Street at School Street;
- Medford Street at Washington Street; and
- Lechmere Station.

Under the Baseline Alternative, the current Route 80 would continue to operate, serving the same local stops as it does under existing conditions.

Travel Time

According to current MBTA scheduling, it takes approximately 30 minutes for the Route 80 bus to travel the route from Mystic Valley Parkway/Route 16 to Lechmere Station, serving all scheduled stops between. In the Spring of 2008, a field study was conducted riding the Route 80 bus on several weekday commute peak hours and identifying travel times between stations. The actual travel times were occasionally shorter than the scheduled travel times, due to skipped stops at which there were no passengers. However, for the purposes of this study, the MBTA's published schedule was used as the basis for estimating the travel times for the Enhanced Route 80 Bus Service.

As shown in Table 3.5-1, the Enhanced Route 80 service traveling between Mystic Valley Parkway/Route 16 and Lechmere Station is estimated to have a travel time of approximately 18 minutes.

Table 3.5-1 Estimated Enhanced Route 80 Travel Time

Location	Distance (miles)	Speed (miles per hour)	Travel Time (minutes)	Dwell Time (minutes)	Cumulative Travel Time (minutes)
Boston Avenue at Mystic Valley Pkwy					
Boston Avenue at University Avenue	0.17	15	0.7	0.5	1.2
Boston Avenue at Broadway	0.62	15	2.5	0.5	3.0
Medford Street at Broadway	0.51	15	2.0	0.5	2.5
Medford Street at School Street	0.86	15	3.4	0.5	3.9
Medford Street at Washington Street	0.64	15	2.6	0.5	3.1
Lechmere Station	0.99	15	3.9	0.0	3.9
				Total	17.6

Note: An average bus speed of 15 mph and a dwell time of 30 seconds at each stop were assumed based on the MBTA's published schedule.

Headways

The headways of the Enhanced Route 80 would be adjusted to provide the same frequency of service as the Green Line Medford Branch proposed in the Build Alternatives, while the headways on the existing Route 80 local bus would remain unchanged. The proposed headways for the Enhanced Route 80 service would be five minutes in the morning and evening peak periods and ten minutes during off-peak periods, closely matching the projected headway of the proposed Green Line Medford Branch. The headways of the existing Route 80 local bus service would remain at 20 minutes for the peak periods, 30 minutes for the midday period, and 60 minutes for the evening period.

Fares

Fares for the Route 80 local service are based on the MBTA's local bus fare structure of $1.25 per one-way adult trip. Fares for the Enhanced Route 80 service are based on the MBTA's subway fare structure, which is $1.70 for each one-way adult trip and includes a free transfer to the subway.

3.5.2 Union Square Shuttle

Under the Baseline Alternative, a shuttle bus service would also be introduced, making a direct connection between Union Square and Lechmere Station along a route similar to the existing Route 87 bus, but without serving local stops. The current MBTA Route 87 is a local route operating from Arlington Center to Lechmere Station through Davis Square and Union Square. The Route 87 inbound begins its route in Arlington Center, and travels along Broadway, Elm Street, Somerville Avenue, and McGrath Highway, connecting Arlington Center, Clarendon Hills, Davis Square, Union Square, and Lechmere Station. The proposed shuttle inbound service would begin its route at Union Square and travel using Somerville Avenue and McGrath Highway to Lechmere Station, traveling along the same routes in the outbound direction.

The shuttle service would only serve the following stops:

- Union Square; and
- Lechmere Station.

Travel Time

Similar to the Route 80, the travel time for the existing Route 87 was obtained from the MBTA's schedule and validated by collecting field data. According to the MBTA's schedule and confirmed by the field data, travel time for the Route 87 bus between Union Square and Lechmere Station can take approximately seven to 17 minutes, depending on the time of the day. There are five existing stops on Route 87 between Union Square and Lechmere Station. It is estimated that travel time for the enhanced shuttle service between Union Square and Lechmere Station with no intervening stops would take approximately seven minutes based on average bus speeds.

Headways

The headways for the proposed shuttle would provide the same frequency of service as the Green Line Union Square Branch proposed in the Build Alternatives, while the existing Route 87 bus would continue to operate with the same headways as the existing operations, with service every 15 to 20 minutes during the peak periods and every 20 to 30 minutes during off-peak periods. During the peak periods, the shuttle would make its trip every five to six minutes, closely matching the projected headway of the proposed Green Line Union Square Branch. During off-peak periods, the shuttle service would run every nine to 10 minutes.

Fares

Fares for the shuttle service connecting Union Square and Lechmere Station would include a free transfer to the Green Line at Lechmere Station and would be $1.70 for one-way adult trips, based on current MBTA subway fares.

3.5.3 Capital Improvements

The Baseline Alternative would require the purchase of 15 standard, 40-foot transit buses and five new Green Line vehicles. Ten buses would be required for the Enhanced Route 80 bus service, and three would be required for the Union Square shuttle. It is anticipated that two spare buses would also be purchased to support the service. It is assumed that these buses would be Emissions Control Diesel buses, consistent with the MBTA's plans for future bus procurements. The new Green Line cars would be needed to service the extension of the existing Green Line D branch to Lechmere.

A new or an expanded existing bus facility would also be required. Based on the MBTA's bus program, the bus facility should accommodate approximately 60 buses, be located in Somerville, and require roughly the same amount of space as the maintenance facility proposed for the Build Alternatives. Improvements to existing Lechmere Station would also be required in order to accommodate the additional buses needed to serve the Baseline Alternative.

3.5.4 Conceptual Capital Costs

The estimate of conceptual capital costs was developed by conducting detailed quantity calculations of the various construction elements included in the conceptual design plans and applying current 2008 unit prices to each item. A 30 percent contingency was applied to the total construction cost to provide a level of confidence that the estimate presented at this stage reflects the true cost of the Project. As the Project moves forward into preliminary engineering and final design, the contingency will be reduced and replaced with costs that can be more accurately quantified through a more detailed design. Based on this evaluation, it is estimated that the conceptual capital cost of the Baseline Alternative for the facility, the new buses, and improvements to existing Lechmere Station would be approximately $146.2 million in 2008 dollars.

3.5.5 Conceptual Operating & Maintenance Costs

Based on the MBTA's FY2008 Fully-Allocated Operating and Maintenance Cost Model, the conceptual operating and maintenance cost of the enhanced Baseline Alternative is estimated to be approximately $13.7 million per year in 2008 dollars.

3.6 Build Alternatives

To identify the best scenario for meeting the transportation needs of the study area, six Build Alternatives have been developed for the proposed Green Line Extension Project. The Alternatives are:

- Alternative 1 – Green Line Extension to Medford Hillside and Union Square (using commuter rail rights-of-way);
- Alternative 2 – Green Line Extension to Mystic Valley Parkway/Route 16 and Union Square (using commuter rail rights-of-way);
- Alternative 3 – Green Line Extension to Medford Hillside (using commuter rail right-of-way) and Union Square (using McGrath Highway/Somerville Avenue);

- Alternative 4 – Green Line Extension to Mystic Valley Parkway/Route 16 (using commuter rail right-of-way) and Union Square (using McGrath Highway/Somerville Avenue);

- Alternative 5 – Green Line Extension to Mystic Valley Parkway/Route 16 (using commuter rail right-of-way); and

- Alternative 6 – Green Line Extension to Union Square (using commuter rail right-of-way).

The following sections describe each alternative, including its physical characteristics, costs, ridership, and operating plans.

3.6.1 Alternative 1 – Extension to Medford Hillside and Union Square (using commuter rail rights-of-way)

This alternative would provide Green Line service to Union Square and to Medford Hillside using a two-branch operation, both within existing commuter rail rights-of-way. One branch would operate from Lechmere Station to Medford Hillside along the MBTA Lowell Line. This branch would begin at Lechmere Station and head northwest, meeting the MBTA Lowell Line just south of Washington Street in Somerville. From Washington Street, the alignment would run parallel to the MBTA Lowell Line to College Avenue Station. The second branch, the Union Square Branch, would start at Lechmere Station and head north to Red Bridge and then west along the MBTA Fitchburg Line to the Union Square area in Somerville. Alternative 1 is expected to generate new systemwide transit ridership of 7,900 boardings per day and a reduction of 25,018 VMT per day (projected to the year 2030).

Figure 3.6-1 shows the conceptual alignment of Alternative 1 including both the Medford Branch and the Union Square Branch.

Stations

The proposed Green Line stations for the Medford Branch under Alternative 1 are:

- Relocated Lechmere Station, Cambridge (relocated to east side of O'Brien Highway/Route 28);
- Brickbottom Station, Somerville;
- Gilman Square Station, Somerville;
- Lowell Street Station, Somerville;
- Ball Square Station, Medford; and
- College Avenue Station, Medford.

The proposed Green Line stations for the Union Square Branch under Alternative 1 are:

- Relocated Lechmere Station, Cambridge (relocated to east side of O'Brien Highway/Route 28); and
- Union Square Station, Somerville.

Travel Times

Travel times between proposed stations were estimated based on travel distances and estimated speeds. The travel speeds between proposed stations were based on the railroad's physical and operational characteristics. Estimated travel time between each station for the proposed Green Line Medford Branch is shown in Table 3.6-1.

Table 3.6-1 Alternative 1: Medford Branch Travel Times

Station	Distance (miles)	Travel Time (minutes)	Dwell Time (minutes)	Cumulative Travel Time (minutes)
Lechmere				
Brickbottom	0.78	2.25	0.75	3
Gilman Square	0.71	1.25	0.75	2
Lowell Street	0.70	1.25	0.75	2
Ball Square	0.49	0.75	0.75	1.5
College Avenue	0.57	1.0	0	1.0
			Total	9.5

Estimated travel time between Union Square and Lechmere Station for the proposed Green Line Union Square Branch is 4.5 minutes.

Headways

The operating plan for this alternative would extend the existing Green Line D branch service from Lechmere Station to the northwest to College Avenue. The Green Line service beyond Lechmere Station for the Medford Branch would operate on headways equal to that of the existing Green Line D branch service: five minutes in the morning and evening peak periods and ten minutes during off-peak periods.

The Green Line service beyond Lechmere Station for the Union Square Branch would operate on headways equal to that of the existing Green Line E branch service: six minutes in the morning peak period, five minutes in the evening peak period, and between nine and ten minutes during off-peak periods.

Fares

Fares for the Green Line Medford Branch and Union Square Branch under Alternative 1 would be $1.70 for one-way adult trips, based on current MBTA subway fares.

Vehicle Requirements

The Green Line Extension Project vehicle fleet will include a mix of three vehicle types: the two current vehicles (Type 7 high-floor cars and Type 8 low-floor cars) and a new "Type 9" low-floor car, which is currently under development. The Type 9 cars will be used for the Extension, which will replace older cars and expand service on the existing Green Line.

The specifications for the proposed Type 9 Green Line Cars are currently being developed. However, the new cars will have similar dimensions, accessibility, and performance to the existing Type 8 low-floor cars. The Type 9 cars will be able to work with the existing fleet, allowing for two and three-car trains, which will consist of any combination of Type 7, 8, and 9 cars.

In general, the current Green Line trainsets (or "consists") include two or three cars. It is anticipated that consist sizes will continue to remain the same under this Alternative. For the purpose of calculating the number of required cars, two-car Green Line trains were conservatively assumed. Based on the 2006 MBTA's Service Delivery Policy, the seating capacity of each Green Line car is 44 to 46 seats, depending on the car type, and the maximum peak load standard is 225 percent of the seated capacity for the peak periods. This translates into a peak period train capacity of 198 to 207 passengers per trainset. Utilizing the projected ridership and proposed operating plan for this Alternative, it was determined that 23 additional cars would be needed to accommodate the proposed headways and projected ridership for Alternative 1.

3.6.1.1 Capital Improvements – Alternative 1

Capital improvements for the Medford Branch include construction of light rail tracks and overhead catenary system (OCS) along the existing railroad right-of-way between the Relocated Lechmere Station and College Avenue in Medford. This includes use of the "Yard 8" right-of-way between Relocated Lechmere Station and Washington Street and along the MBTA Lowell Line between Washington Street and College Avenue. The service would end immediately north of the College Street overpass. A support facility for storage and servicing of the Green Line fleet would be constructed to accommodate the existing north-side Green Line service fleet and an additional fleet of 23 vehicles needed to meet the intended headways when providing service to the new stations along the extended Green Line. In addition to the track construction, some of the existing bridges along the right-of-way would need to be reconstructed to accommodate the additional tracks. The structures that would need to be reconstructed include the former Red Bridge, Washington Street, Walnut Street, Medford Street, School Street, Lowell Street, Cedar Street, Broadway, Harvard Street, and College Avenue. Existing track and signal equipment would also need to be relocated in order to accommodate the planned light rail tracks. Since College Avenue would be the terminus for the line, additional track lengths would be required north of the station for short-term storage and operational flexibility.

The Union Square Branch would also require light rail tracks and OCS to be constructed along the MBTA Fitchburg Line between the former Red Bridge and the proposed Union Square Station near Prospect Street. The alignment to Union Square would require reconfiguration of the existing signal equipment as well as the commuter rail and freight rail tracks between the MBTA's BET and Webster Avenue. In addition, the existing rail bridge over Medford Street along the right-of-way would need to be reconstructed to accommodate the additional tracks.

New signal, communications, and electrical systems will be required for the Green Line Extension Project. Alternative 1 would require Automatic Wayside Block Signals to govern Green Line train operations for both the Medford Branch and the Union Square Branch.

Multiple communication systems are proposed for MBTA operations, MBTA staff communications, mechanical system monitoring, passenger communications, and emergency reporting. These include the following systems:

- Automatic Vehicle Identification (AVI) to provide real time train locations and destinations;
- Wayside Telephone System for MBTA staff communications with the Operations Control Center (OCC);
- Automatic Station Identification (ASI) to passengers with up-to-date information on train status;
- Wide Area Network (WAN) to interconnect computers at MBTA stations and facilities with OCC;
- Public Address System that transmits audible messages that correspond with LED messages;
- LED Signage System provides LED visual text messages synchronized with the Public Address System per ADA requirements;
- Closed Circuit Television (CCTV) provides real time analog and IP video from cameras at each station and facility;
- Supervisory Control and Data Acquisition (SCADA) Systems to monitor fire alarm, escalators and elevators at each station;
- Customer Information Call Boxes at each station to provide a direct line to the MBTA Police and the Maintenance Terminal; and
- Fire Alarm Systems at each station and at the maintenance facility.

Traction power for the Green Line is provided by 600 volts direct current (600 VDC) through an OCS. Direct current traction power is produced at traction power substations. Each Green Line car is equipped with a pantograph, which collects the current from contact with the trolley wire. The proposed Green Line Extension Project will require traction power substations to supply DC power to both the Medford Branch and the Union Square Branch. Substations would be required at Yard 8 and at Ball Square Station. Traction power will be fed from the substations to the OCS via 2,000 kcmil DC feeders in conduit along the trackway. The traction power feeders and returns will be installed in underground electrical conduits. The OCS will consist of an overhead auto-tension catenary system registered and supported on cantilever-type assemblies, span wire assemblies, and portal bents.

3.6.1.2 Conceptual Capital Costs – Alternative 1

The estimate of conceptual capital costs was developed by conducting detailed quantity calculations of the various construction elements included in the conceptual design plans and applying current 2008 unit prices to each item. A 30 percent contingency was applied to the total construction cost to provide a level of confidence that the estimate presented at this stage reflects the true cost of the Project. As the Project moves forward into preliminary engineering and final design, the contingency will be reduced and replaced with costs that can be more accurately quantified through a more detailed design. Based on this evaluation, it is estimated that the conceptual capital cost of Alternative 1 is approximately $804.8 million in 2008 dollars, including the purchase of new train cars.

3.6.1.3 Conceptual Operating & Maintenance Costs – Alternative 1

Based on the MBTA's FY2008 Fully-Allocated Operating and Maintenance Cost Model, the conceptual operating and maintenance costs of Alternative 1 are estimated to be approximately $21.3 million per year in 2008 dollars.

3.6.2 Alternative 2 – Extension to Mystic Valley Parkway/Route 16 and Union Square (using commuter rail rights-of-way)

This alternative would provide Green Line service to Union Square and to Mystic Valley Parkway/Route 16 using a two-branch operation, both in existing commuter rail rights-of-way. One branch would operate from Relocated Lechmere Station to Mystic Valley Parkway/Route 16 Station along the MBTA Lowell Line. This branch would begin at Lechmere Station and head northwest, meeting the MBTA Lowell Line just south of Washington Street in Somerville. From Washington Street, the alignment would run parallel to the MBTA Lowell Line to Medford, terminating its route at the Mystic Valley Parkway/Route 16 Station. Mystic Valley Parkway/Route 16 Station has been considered both with and without a 300-space parking structure. The second branch, the Union Square Branch, would begin at Relocated Lechmere Station and head north to Red Bridge, then west, following the MBTA Fitchburg Line to the Union Square area. Alternative 2 is expected to generate new systemwide transit ridership of 8,900 boardings per day and a reduction of 26,556 VMT per day (projected to the year 2030) in the scenario that provides a 300-space parking garage at Mystic Valley Parkway/Route 16 Station. The option for Alternative 2 that does not provide a parking garage at the terminal station generates new systemwide transit ridership of 8,600 boardings per day and a reduction of 26,647 VMT per day (projected to the year 2030).

Figure 3.6-2 shows the conceptual alignment of Alternative 2 including both the Medford Branch and the Union Square Branch.

Stations

The proposed Green Line stations for the Medford Branch under Alternative 2 are:

- Relocated Lechmere Station, Cambridge (relocated to east side of O'Brien Highway/Route 28);
- Brickbottom Station, Somerville;
- Gilman Square Station, Somerville;
- Lowell Street Station, Somerville;
- Ball Square Station, Medford;
- College Avenue Station, Medford; and
- Mystic Valley Parkway/Route 16 Station, Somerville/Medford.

The proposed Green Line stations for the Union Square Branch under Alternative 2 are:

- Existing Lechmere Station, Cambridge (relocated to east side of O'Brien Highway/Route 28); and
- Union Square Station, Somerville (at Fitchburg Line).

Travel Times

Travel times between proposed stations were estimated based on travel distances and estimated speeds. The travel speeds between proposed stations were based on the railroad's physical and operational characteristics. Estimated travel time between each station for the proposed Green Line Medford Branch is shown in Table 3.6-2.

Estimated travel time between Lechmere Station and Union Square Station for the proposed Green Line Union Square Branch is 4.5 minutes.

Table 3.6-2 Alternative 2: Medford Branch Travel Times

Station	Distance (miles)	Travel Time (minutes)	Dwell Time (minutes)	Cumulative Travel Time (minutes)
Lechmere				
Brickbottom	0.78	2.25	0.75	3
Gilman Square	0.71	1.25	0.75	2
Lowell Street	0.70	1.25	0.75	2
Ball Square	0.49	0.75	0.75	1.5
College Avenue	0.57	1.0	0.75	1.75
Mystic Valley Parkway/Route 16	0.9	1.75	0	1.75
			Total	12.0

Headways

The operating plan for this alternative would extend the existing Green Line D branch service from Lechmere to the northwest to Mystic Valley Parkway/Route 16 Station. The Green Line service beyond Lechmere Station for the Mystic Valley Parkway/Route 16 branch would operate on headways equal to that of the existing Green Line D branch service: five minutes in the morning and evening peak periods and ten minutes during off-peak periods. The Green Line service beyond Lechmere Station for the Union Square Branch would operate on headways equal to that of the existing Green Line E branch service: six minutes in the morning peak period, five minutes in the evening peak period, and between nine and 10 minutes during off-peak periods.

Fares

Fares for the Green Line Medford Branch and Union Square Branch under Alternative 2 would be $1.70 for one-way adult trips, based on current MBTA subway fares.

Vehicle Requirements

The Green Line Extension Project vehicle fleet will include a mix of three vehicle types: the two current vehicles (Type 7 high-floor cars and Type 8 low-floor cars) and a new "Type 9" low-floor car, which is currently under development. The Type 9 cars will be used for the Extension, which will replace older cars and expand service on the existing Green Line. Based on the passenger capacities described for Alternative 1 in Section 3.6.1, *Alternative 1 – Extension to Medford Hillside and Union Square (using commuter rail rights-of-way)*, and the projected ridership and proposed operating plan for Alternative 2, it was determined that 27 additional cars would be needed to accommodate the proposed headways and projected ridership for Alternative 2.

3.6.2.1 Capital Improvements – Alternative 2

Capital improvements for the Medford Branch include construction of light rail tracks and OCS along the existing railroad right-of-way between the Relocated Lechmere Station and Mystic Valley Parkway/Route 16 Station. This includes use of the "Yard 8" right-of-way between Relocated Lechmere Station and Washington Street and along the MBTA Lowell Line between Washington Street and Mystic Valley Parkway/Route 16. The service would end prior to the Mystic River. A 300-space MBTA parking garage was considered at the Mystic Valley Parkway/Route 16 Station. Alternative 2 was analyzed for its impacts both with and without the construction of the parking garage. A support facility for storage and servicing of the Green Line fleet would be constructed to accommodate the existing north-side Green Line service fleet and an additional 27 vehicles needed to meet the intended headways when providing service to the new stations along the extended Green Line. Alternative 2 requires more new vehicles than Alternative 1 due to the addition of track miles to service Mystic Valley Parkway/Route 16 Station. In addition to the track construction, some of the existing bridges along the right-of-way would need to be reconstructed to accommodate the additional tracks. The structures that would need to be reconstructed include the former Red Bridge, Washington Street, Walnut Street, Medford Street, School Street, Lowell Street, Cedar Street, Broadway, Harvard Street, College Avenue, Winthrop Street, and North Street. Existing track and signal equipment would also need to be relocated in order to accommodate the planned light rail tracks. Since Mystic Valley Parkway/Route 16 Station would be the terminus on this branch line, a longer station platform would be required for short-term storage and operational flexibility.

The Union Square Branch would also require light rail tracks and OCS to be constructed along the MBTA Fitchburg Line between the former Red Bridge and the proposed Union Square Station near Prospect Street. The alignment and necessary improvements along this route are conceptual and have been developed in order to assess the concept of service to Union Square. The alignment to Union Square would require reconfiguration of the existing signal equipment and the commuter rail and freight rail tracks between the MBTA's BET and Webster Avenue. In addition, the existing rail bridge over Medford Street along the right-of-way would need to be reconstructed to accommodate the additional tracks.

Alternative 2 would require the same signals, communication, and electrical systems discussed for Alternative 1. Alternative 2 would also require a third electrical substation located at Mystic Valley Parkway/Route 16 Station.

3.6.2.2 Conceptual Capital Costs – Alternative 2

The estimate of conceptual capital costs was developed by conducting detailed quantity calculations of the various construction elements included in the conceptual design plans and applying current 2008 unit prices to each item. A 30 percent contingency was applied to the total construction cost to provide a level of confidence that the estimate presented at this stage reflects the true cost of the Project. As the Project moves forward into preliminary engineering and final design, the contingency will be reduced and replaced with costs that can be more accurately quantified through a more detailed design. Based on this evaluation, it is estimated that the conceptual capital cost of Alternative 2A (with parking) is approximately $959.3 million in 2008 dollars, including the purchase of new train cars. The conceptual capital cost of Alternative 2B (without parking) is approximately $951.8 million in 2008 dollars, including the purchase of new train cars.

3.6.2.3 Conceptual Operating & Maintenance Costs – Alternative 2

Based on the MBTA's FY2008 Fully-Allocated Operating and Maintenance Cost Model, the conceptual operating and maintenance costs of both Alternative 2A (with parking) and Alternative 2B (without parking) are estimated to be approximately $23.7 million per year in 2008 dollars.

3.6.3 Alternative 3 – Extension to Medford Hillside (using commuter rail rights of way) and Union Square (using McGrath Highway and Somerville Avenue)

In Alternative 3, the Green Line service would be provided to Medford Hillside and Union Square using a two-branch operation, with one branch in commuter rail rights-of-way and the other operating in-street. One branch would operate from Relocated Lechmere Station to Medford Hillside along the MBTA Lowell Line. This branch would begin at Relocated Lechmere Station and head northwest, meeting the MBTA Lowell Line just south of Washington Street in Somerville. From Washington Street, the alignment would run parallel to the MBTA Lowell Line within the existing commuter rail right-of-way to College Avenue Station.

The second branch would operate using Somerville Avenue into a terminus near Union Square. Under this operation, the Union Square Branch would function as a single loop alignment starting its outbound service at Relocated Lechmere Station and heading north to Red Bridge, then west along the MBTA Fitchburg Line. In the vicinity of the Monsignor O'Brien Highway/Route 28 overpass, the Union Square Branch would split off from the MBTA Fitchburg Line and travel through private property and along a portion of McGrath Highway and connect into Somerville

Avenue where tracks embedded in the pavement would allow in-street running in the low-volume portion of the roadway. From Union Square, the tracks would turn south towards the MBTA Fitchburg Line, using Prospect Street, and be routed inbound along the MBTA Fitchburg Line, where it would join the outbound leg near the McGrath Highway overpass. Alternative 3 is expected to generate additional systemwide ridership of 7,700 boardings per day and a reduction of 27,895 VMTs per day (projected to the year 2030).

Figure 3.6-3 shows the conceptual alignment of Alternative 3, including both the Medford Branch and the Union Square Branch using Somerville Avenue.

Stations

The proposed Green Line stations for the Medford Branch under Alternative 3 are:

- Relocated Lechmere Station, Cambridge (relocated to east side of O'Brien Highway/Route 28);
- Brickbottom Station, Somerville;
- Gilman Square Station, Somerville;
- Lowell Street Station, Somerville;
- Ball Square Station, Medford; and
- College Avenue Station, Medford.

The proposed Green Line stations for the Union Square Branch under Alternative 3 are:

- Relocated Lechmere Station, Cambridge (relocated to east side of O'Brien Highway/Route 28); and
- Union Square Station, Somerville.

Travel Times

Travel times between proposed stations were estimated based on travel distances and estimated speeds. The travel speeds between proposed stations were based on the railroad's physical and operational characteristics. Estimated travel time between each station for the proposed Green Line Medford Branch under Alternative 3 is shown in Table 3.6-3.

Estimated travel time between Union Square and Relocated Lechmere Station for the proposed Green Line Union Square Branch under Alternative 3 is six minutes.

Table 3.6-3 Alternative 3: Medford Branch Travel Times

Station	Distance (miles)	Travel Time (minutes)	Dwell Time (minutes)	Cumulative Travel Time (minutes)
Lechmere				
Brickbottom	0.78	2.25	0.75	3.00
Gilman Square	0.71	1.25	0.75	2.00
Lowell Street	0.70	1.25	0.75	2.00
Ball Square	0.49	0.75	0.75	1.50
College Avenue	0.57	1.00	0.00	1.00
			Total	9.50

Headways

The operating plan for this alternative would extend the existing Green Line D branch service from Relocated Lechmere Station to the northwest to College Avenue Station. The Green Line service beyond Lechmere Station for the Medford Branch would operate on headways equal to that of the current Green Line D Line service: five minutes in the morning and evening peak periods and ten minutes during off-peak periods. The Green Line service beyond relocated Lechmere Station for the Union Square Branch would operate on headways equal to that of the current Green Line E branch service: six minutes in the morning peak period, five minutes in the evening peak period, and between nine and ten minutes during off-peak periods.

Fares

Fares for the Green Line Medford Branch and the Union Square Branch under Alternative 3 would be $1.70 for one-way adult trips, based on current MBTA subway fares.

Vehicle Requirements

The Green Line Extension Project vehicle fleet will include a mix of three vehicle types: the two current vehicles (Type 7 high-floor cars and Type 8 low-floor cars) and a new “Type 9” low-floor car, which is currently under development. The Type 9 cars will be used for the Extension, which will replace older cars and expand service on the existing Green Line. Based on the passenger capacities described for Alternative 1 in Section 3.6.1, *Alternative 1 – Extension to Medford Hillside and Union Square (using commuter rail rights-of-way)*, and the projected ridership and proposed operating plan for Alternative 3, it was determined that 23 additional cars would be needed to accommodate the proposed headways and projected ridership for Alternative 3.

3.6.3.1 Capital Improvements – Alternative 3

Capital improvements for the Medford Branch include constructing light rail tracks and OCS along the existing railroad right-of-way between the Relocated Lechmere Station and College Avenue Station. This includes use of the "Yard 8" right-of-way between Lechmere Station and Washington Street and along the MBTA Lowell Line between Washington Street and College Avenue. The service would end immediately north of the College Street overpass. A support facility for storage and servicing of the Green Line fleet would be constructed to accommodate the existing north-side Green Line service fleet and an additional 23 vehicles needed to meet the intended headways when providing service to the new stations along the extended Green Line. In addition to the track construction, some of the existing bridges along the right-of-way would need to be reconstructed to accommodate the additional tracks. The structures that would need to be reconstructed include the former Red Bridge, Washington Street, Walnut Street, Medford Street, School Street, Lowell Street, Cedar Street, Broadway, Harvard Street and College Avenue. Existing track and signal equipment would also need to be relocated in order to accommodate the planned light rail tracks. Since College Avenue would be the terminus for the line, additional track lengths would be required north of the station for short-term storage and operational flexibility.

The Union Square Branch would also require light rail tracks and OCS to be constructed. This alignment would branch off the Medford Branch near Red Bridge. From that junction, the alignment would continue northwest towards the McGrath Highway overpass of the MBTA Fitchburg Line. At this point, the alignment would travel through private property along McGrath Highway/Route 28 and tie into Somerville Avenue at the intersection of Medford Street and McGrath Highway/Route 28. The remainder of the distance to Union Square would utilize an in-street running style operation on Somerville Avenue with embedded track and OCS. In this alternative, the Green Line would travel in a dedicated reservation along Somerville Avenue to the intersection of Prospect Street. At Prospect Street, the alignment would travel through the parking lot at the southeast corner of Somerville Avenue, then head south along several private properties on the east side of Prospect Street. Any area that the tracks would cross would need to be acquired. The alignment would then tie back into the MBTA Fitchburg Line and travel inbound within the commuter rail right-of-way back to the vicinity of the McGrath Highway/Route 28 overpass. This alternative would require relocating existing commuter rail tracks and signal equipment in the vicinity of the McGrath Highway/Route 28 overpass. The Union Square Branch would require reconstructing the Medford Street Bridge in Somerville.

Alternative 3 would require the same signals, communication, and electrical systems discussed for Alternative 1. Alternative 3 would also require Line of Sight Signals and Traffic Signals where the Green Line shares the public right-of-way on Somerville Avenue and at the intersection of McGrath Highway/Route 28 and Somerville Avenue.

3.6.3.2 Conceptual Capital Costs – Alternative 3

The estimate of conceptual capital costs was developed by conducting detailed quantity calculations of the various construction elements included in the conceptual design plans and applying current 2008 unit prices to each item. A 30 percent contingency was applied to the total construction cost to provide a level of confidence that the estimate presented at this stage reflects the true cost of the Project. As the Project moves forward into preliminary engineering and final design, the contingency will be reduced and replaced with costs that can be more accurately quantified through a more detailed design. Based on this evaluation, it is estimated that the conceptual capital cost of Alternative 3 is approximately $829.8 million in 2008 dollars, including the purchase of new train cars.

3.6.3.3 Conceptual Operating & Maintenance Costs – Alternative 3

Based on the MBTA's FY2008 Fully-Allocated Operating and Maintenance Cost Model, the conceptual operating and maintenance costs of Alternative 3 are estimated to be approximately $22.1 million per year in 2008 dollars.

3.6.4 Alternative 4 – Extension to Mystic Valley Parkway/Route 16 (using commuter rail right of way) and Union Square (using McGrath Highway and Somerville Avenue)

This alternative would provide Green Line service to Mystic Valley Parkway/Route 16 and Union Square using a two-branch operation, with one branch in commuter rail rights-of-way and the other operating in-street. One branch would operate from Relocated Lechmere Station to Mystic Valley Parkway/Route 16 Station along the MBTA Lowell Line. This branch would begin at Relocated Lechmere Station and head northwest, meeting the MBTA Lowell Line just south of Washington Street in Somerville. From Washington Street, the alignment would run parallel to the MBTA Lowell Line to Mystic Valley Parkway/Route 16 Station. Alternative 4 includes consideration of a 300-space parking structure at Mystic Valley Parkway/Route 16 Station.

The second branch would operate to Union Square using a portion of Somerville Avenue for in-street running. Under this operation, the Union Square Branch would function as a single loop alignment starting its outbound service at Relocated Lechmere Station and heading north to Red Bridge, then west along the MBTA Fitchburg Line. In the vicinity of the Monsignor O'Brien Highway/Route 28 overpass, the Union Square Branch would split off from the MBTA Fitchburg Line and travel through private property and along a portion of McGrath Highway/Route 28 and connect into Somerville Avenue where tracks embedded in the street surface would allow in-street running in the low-volume portion of the roadway. From Union Square, the tracks would turn south towards the MBTA Fitchburg Line using private properties along Prospect Street and be routed inbound along the MBTA Fitchburg Line where it would join the outbound leg somewhere near the McGrath Highway/Route 28 overpass. Alternative 4 is expected to generate additional systemwide ridership of 8,700 boardings per day and a reduction of 32,005 VMT per day (projected to the year 2030).

Figure 3.6-4 shows the conceptual alignment of Alternative 4 including both the Medford Branch and the Union Square Branch using Somerville Avenue.

Stations

The proposed Green Line stations for the Medford Branch under Alternative 4 are:

- Relocated Lechmere Station, Cambridge (relocated to east side of O'Brien Highway/Route 28);
- Brickbottom Station, Somerville;
- Gilman Square Station, Somerville;
- Lowell Street Station, Somerville;
- Ball Square Station, Medford;
- College Avenue Station, Medford; and
- Mystic Valley Parkway/Route 16 Station, Somerville/Medford.

The proposed Green Line stations for the Union Square Branch under Alternative 4 are:

- Relocated Lechmere Station, Cambridge (relocated to east side of O'Brien Highway/Route 28); and
- Union Square Station, Somerville.

Travel Times

Travel times between proposed stations were estimated based on travel distances and estimated speeds. The travel speeds between proposed stations were based on the railroad's physical and operational characteristics. Estimated travel time between each station for the proposed Green Line Medford Branch under Alternative 4 is shown in Table 3.6-4.

Table 3.6-4 Alternative 4: Medford Branch Travel Times

Station	Distance (miles)	Travel Time (minutes)	Dwell Time (minutes)	Cumulative Travel Time (minutes)
Lechmere				
Brickbottom	0.78	2.25	0.75	3.00
Gilman Square	0.71	1.25	0.75	2.00
Lowell Street	0.70	1.25	0.75	2.00
Ball Square	0.49	0.75	0.75	1.50
College Avenue	0.57	1.00	0.75	1.75
Mystic Valley Parkway/Route 16	0.90	1.75	0.00	1.75
			Total	12.00

Estimated travel time between Union Square and the Lechmere Station for the proposed Green Line Union Square Branch under Alternative 4 is six minutes.

Headways

The operating plan for this alternative would extend the existing Green Line D branch service from Lechmere to the northwest to Mystic Valley Parkway/Route 16 Station. The Green Line service beyond Relocated Lechmere Station for the Medford Branch would operate on headways equal to that of the existing Green Line D branch service: five minutes in the morning and evening peak periods and ten minutes during off-peak periods. The Green Line service beyond Relocated Lechmere Station for the Union Square Branch would operate on headways equal to that of the existing Green Line E branch service: six minutes in the morning peak period, five minutes in the evening peak period, and between nine and 10 minutes during off-peak periods.

Fares

Fares for the Green Line Medford Branch and Union Square Branch under Alternative 4 would be $1.70 for one-way adult trips, based on current MBTA subway fares.

Vehicle Requirements

The Green Line Extension Project vehicle fleet will include a mix of three vehicle types: the two current vehicles (Type 7 high-floor cars and Type 8 low-floor cars) and a new "Type 9" low-floor car, which is currently under development. The Type 9 cars will be used for the Extension, which will replace older cars and expand service on the existing Green Line. Based on the passenger capacities described for Alternative 1 in Section 3.6.1, *Alternative 1 – Extension to Medford Hillside and Union Square (using commuter rail rights-of-way)*, and the projected ridership and proposed operating plan for Alternative 4, it was determined that 27 additional cars would be needed to accommodate the proposed headways and projected ridership for Alternative 4.

3.6.4.1 Capital Improvements – Alternative 4

Capital improvements for the Medford Branch include constructing light rail tracks and OCS along the existing railroad right-of-way between the Relocated Lechmere Station and Mystic Valley Parkway/Route 16 Station. This includes use of the "Yard 8" right-of-way between Lechmere Station and Washington Street and along the MBTA Lowell Line between Washington Street and Mystic Valley Parkway/Route 16 Station. The service would end prior to the Mystic River. A support facility for storage and servicing of the Green Line fleet would be constructed to accommodate the existing north-side Green Line service fleet and an additional 27 vehicles needed to meet the intended headways when providing service to the new stations along the extended Green Line. In addition to the track construction, some of the existing bridges along the right-of-way would need to be reconstructed to accommodate the additional tracks. The structures that would need to be reconstructed include the former Red Bridge, Washington Street, Walnut Street, Medford Street, School Street, Lowell Street, Cedar Street, Broadway, Harvard Street, College Avenue, Winthrop Street, and North Street. Existing signal equipment would also need to be relocated in order to accommodate the planned light rail tracks. Since Mystic Valley Parkway/Route 16 Station would be the terminus on this branch line, a longer station platform would be required for short-term storage and operational flexibility.

The Union Square Branch would also require light rail tracks and OCS to be constructed. This alignment would branch off the Medford Branch near Red Bridge. From that junction, the alignment would continue northwest towards the McGrath Highway/Route 28 overpass of the MBTA Fitchburg Line. At this point, the alignment would travel through private property along McGrath Highway/Route 28 and tie into Somerville Avenue at the intersection of Medford Street and McGrath Highway/Route 28. The remainder of the distance to Union Square would utilize an in-street running style operation on Somerville Avenue with embedded track and OCS. In this alternative, the Green Line would travel in a dedicated reservation along Somerville Avenue to the intersection of Prospect Street. At Prospect Street, the alignment would travel through the parking lot at the southeast corner of Somerville Avenue, then head south along several private properties on the east side of Prospect Street. Any area that the tracks would cross would need to be acquired. The alignment would then tie back into the MBTA Fitchburg Line and travel inbound within the commuter rail right-of-way back to the vicinity of the McGrath Highway/Route 28 overpass. This alternative would require relocating existing tracks and signal equipment in the vicinity of the McGrath Highway/Route 28 overpass, and reconstruction of Medford Street Bridge in Somerville.

Alternative 4 would require the same signals, communication, and electrical systems discussed for Alternative 3. Alternative 4 would also require a third electrical substation located at Mystic Valley Parkway/Route 16 Station.

3.6.4.2 Conceptual Capital Costs – Alternative 4

The estimate of conceptual capital costs was developed by conducting detailed quantity calculations of the various construction elements included in the conceptual design plans and applying current 2008 unit prices to each item. A 30 percent contingency was applied to the total construction cost to provide a level of confidence that the estimate presented at this stage reflects the true cost of the Project. As the Project moves forward into preliminary engineering and final design, the contingency will be reduced and replaced with costs that can be more accurately quantified through a more detailed design. Based on this evaluation, it is estimated that the conceptual capital cost of Alternative 4 is approximately $984.3 million in 2008 dollars, including the purchase of new train cars.

3.6.4.3 Conceptual Operating & Maintenance Costs – Alternative 4

Based on the MBTA's FY2008 Fully-Allocated Operating and Maintenance Cost Model, the conceptual operating and maintenance costs of Alternative 4 are estimated to be approximately $24.5 million per year in 2008 dollars.

3.6.5 Alternative 5 – Extension to Mystic Valley Parkway/Route 16 (using commuter rail rights of way)

This alternative would provide Green Line service to Mystic Valley Parkway/ Route 16 Station using a one-branch operation in commuter rail rights-of-way. One branch would operate from Relocated Lechmere Station to Mystic Valley Parkway/Route 16 Station along the MBTA Lowell Line. This branch would begin at Lechmere Station and head northwest, meeting the MBTA Lowell Line just south of Washington Street in Somerville. From Washington Street, the alignment would run parallel to the MBTA Lowell Line to Mystic Valley Parkway/Route 16 Station. Alternative 5 also includes consideration of a 300-space parking structure at Mystic Valley Parkway/Route 16 Station. This alternative does not include a branch to Union Square. Alternative 5 is expected to generate new systemwide transit ridership of 10,500 boardings per day and a reduction of 33,206 VMTs per day (projected to the year 2030).

Figure 3.6-5 shows the conceptual alignment of Alternative 5.

Stations

Stations for the Medford Branch would be located at:

- Relocated Lechmere Station, Cambridge (relocated to east side of O'Brien Highway/Route 28);
- Brickbottom Station, Somerville;
- Gilman Square Station, Somerville;
- Lowell Street Station, Somerville;
- Ball Square Station, Medford;
- College Avenue Station, Medford; and
- Mystic Valley Parkway/Route 16 Station, Medford/Somerville.

Travel Times

Travel time between proposed stations was estimated based on travel distances and estimated speeds based on the railroad's physical and operational characteristics. Estimated travel time between each station for the proposed Green Line Medford Branch under Alternative 5 is shown in Table 3.6-5.

Table 3.6-5 Alternative 5: Medford Branch Travel Times

Station	Distance (miles)	Travel Time (minutes)	Dwell Time (minutes)	Cumulative Travel Time (minutes)
Lechmere				
Brickbottom	0.78	2.25	0.75	3.00
Gilman Square	0.71	1.25	0.75	2.00
Lowell Street	0.70	1.25	0.75	2.00
Ball Square	0.49	0.75	0.75	1.50
College Avenue	0.57	1.00	0.75	1.75
Mystic Valley Parkway/Route 16	0.90	1.75	0.00	1.75
			Total	12.00

Headways

The operating plan for this alternative would extend the existing Green Line D and E branch services from Relocated Lechmere Station to the northwest to Mystic Valley Parkway/Route 16 Station. The Green Line service beyond Relocated Lechmere Station for the Medford Branch would operate on headways equal to that of the existing Green Line D and E branch services: three minutes in the morning and evening peak periods and five minutes during off-peak periods.

Fares

Fares for the Green Line Medford Branch under Alternative 5 would be $1.70 for one-way adult trips, based on current MBTA subway fares.

Vehicle Requirements

The Green Line Extension Project vehicle fleet will include a mix of three vehicle types: the two current vehicles (Type 7 high-floor cars and Type 8 low-floor cars) and a new "Type 9" low-floor car, which is currently under development. The Type 9 cars will be used for the Extension, which will replace older cars and expand service on the existing Green Line. Based on the passenger capacities described for Alternative 1 in Section 3.6.1, *Alternative 1 – Extension to Medford Hillside and Union Square (using commuter rail rights-of-way)*, and the projected ridership and proposed operating plan for Alternative 5, it was determined that 33 additional cars would be needed to accommodate the proposed headways and projected ridership for Alternative 5.

3.6.5.1 Capital Improvements – Alternative 5

Capital improvements for the Medford Branch include constructing light rail tracks and OCS along the existing railroad right-of-way between the Relocated Lechmere Station and Mystic Valley Parkway/Route 16 Station. This includes use of the "Yard 8" right-of-way between Relocated Lechmere Station and Washington Street and along the MBTA Lowell Line between Washington Street and Mystic Valley Parkway/Route 16 Station. The service would end prior to the Mystic River. A support facility for storage and servicing of the Green Line fleet would be constructed to accommodate the existing north-side Green Line service fleet and an additional fleet of 33 vehicles needed to meet the intended headways when providing service to the new stations along the extended Green Line. In addition to the track construction, some of the existing bridges along the right-of-way would need to be reconstructed to accommodate the additional tracks. The structures that would need to be reconstructed include the former Red Bridge, Washington Street, Walnut Street, Medford Street, School Street, Lowell Street, Cedar Street, Broadway, Harvard Street, College Avenue, Winthrop Street, and North Street. Existing track and signal equipment would also need to be relocated in order to accommodate the planned light rail tracks. Since Mystic Valley Parkway/Route 16 Station would be the terminus on this branch line, a longer station platform would be required for short-term storage and operational flexibility.

Alternative 5 would require the same signals, communication, and electrical systems along the Lowell Line discussed for Alternative 1. Alternative 5 would also require a third electrical substation located at Mystic Valley Parkway/Route 16 Station.

3.6.5.2 Conceptual Capital Costs – Alternative 5

The estimate of conceptual capital costs was developed by conducting detailed quantity calculations of the various construction elements included in the conceptual design plans and applying current 2008 unit prices to each item. A 30 percent contingency was applied to the total construction cost to provide a level of confidence that the estimate presented at this stage reflects the true cost of the Project. As the Project moves forward into preliminary engineering and final design, the contingency will be reduced and replaced with costs that can be more accurately quantified through a more detailed design. Based on this evaluation, it is estimated that the conceptual capital cost of Alternative 5 is approximately $870.0 million in 2008 dollars, including the purchase of new train cars.

3.6.5.3 Conceptual Operating & Maintenance Costs – Alternative 5

Based on the MBTA's FY2008 Fully-Allocated Operating and Maintenance Cost Model, the conceptual operating and maintenance costs of Alternative 5 are estimated to be approximately $28.2 million per year in 2008 dollars.

3.6.6 Alternative 6 – Extension to Union Square (using commuter rail rights of way)

This alternative would provide Green Line service to Union Square using a one-branch operation in commuter rail rights-of-way. The branch would operate along the MBTA Fitchburg Line from Relocated Lechmere Station into a terminus near Union Square in Somerville. The Union Square Branch would begin at Relocated Lechmere Station and head north to Red Bridge, then west following the MBTA Fitchburg Line to Union Square Station at Prospect Street. This alternative does not include a branch to Medford. Alternative 6 is expected to generate new systemwide transit ridership of 3,900 boardings per day and a reduction of 9,604 VMTs per day (projected to the year 2030).

Figure 3.6-6 shows the conceptual alignment of Alternative 6.

Stations

Stations for the Union Square Branch would be located in the vicinity of:

- Relocated Lechmere Station, Cambridge (relocated to east side of O'Brien Highway/Route 28); and
- Union Square Station (at Fitchburg Line).

Travel Times

Travel time between proposed stations was estimated based on travel distances and estimated speeds based on the railroad's physical and operational characteristics. Estimated travel time between Union Square Station and Relocated Lechmere Station for the proposed Green Line Union Square Branch under Alternative 6 is six minutes.

Headways

The operating plan for this alternative would extend the existing Green Line D and E branch service from Relocated Lechmere Station to the northwest to Union Square Station. The Green Line service beyond Relocated Lechmere Station for the Union Square Branch would operate on headways equal to that of the existing Green Line D and E branch services: three minutes in the morning and evening peak periods and five minutes during off-peak periods.

Fares

Fares for the Green Line Union Square Branch under Alternative 6 would be $1.70 for one-way adult trips, based on current MBTA subway fares.

Vehicle Requirements

The Green Line Extension Project vehicle fleet will include a mix of three vehicle types: the two current vehicles (Type 7 high-floor cars and Type 8 low-floor cars) and a new "Type 9" low-floor car, which is currently under development. The Type 9 cars will be used for the Extension, which will replace older cars and expand service on the existing Green Line. Based on the passenger capacities described for Alternative 1 in Section 3.6.1, *Alternative 1 – Extension to Medford Hillside and Union Square (using commuter rail rights-of-way)*, and the projected ridership and proposed operating plan for Alternative 6, it was determined that no new cars would be needed to accommodate the proposed headways and projected ridership for Alternative 6.

3.6.6.1 Capital Improvements – Alternative 6

The Union Square Branch would also require light rail track and OCS to be constructed along the MBTA Fitchburg Line between the former Red Bridge and the proposed Union Square Station near Prospect Street. The alignment to Union Square would require extensive reconfiguration of the existing signal equipment as well as the commuter rail and freight rail tracks between the MBTA's BET and Prospect Street. In addition, the existing Medford Street Bridge along the MBTA Fitchburg Line right-of-way would need to be reconstructed to accommodate the additional tracks. Alternative 6 would not require any additional Green Line cars.

Alternative 6 would require similar signals, communication, and electrical systems along the Fitchburg Line to those discussed for Alternative 1. Alternative 6 would only require one new electrical substation, which would likely be located on MBTA property near Union Square Station or Lechmere Station.

3.6.6.2 Conceptual Capital Costs – Alternative 6

The estimate of conceptual capital costs was developed by conducting detailed quantity calculations of the various construction elements included in the conceptual design plans and applying current 2008 unit prices to each item. A 30 percent contingency was applied to the total construction cost to provide a level of confidence that the estimate presented at this stage reflects the true cost of the Project. As the Project moves forward into preliminary engineering and final design, the contingency will be reduced and replaced with costs that can be more accurately quantified through a more detailed design. Based on this evaluation, it is estimated that the conceptual capital cost of Alternative 6 is approximately $370.6 million in 2008 dollars.

3.6.6.3 Conceptual Operating & Maintenance Costs – Alternative 6

Based on the MBTA's FY2008 Fully-Allocated Operating and Maintenance Cost Model, the conceptual operating and maintenance costs of Alternative 6 are estimated to be approximately $8.1 million per year in 2008 dollars.

3.6.7 Build Alternatives Cost Summary and Ridership Comparison

In order to determine the preferred Build Alternative, it is necessary to evaluate the six alternatives by comparing the service each alternative offers to the cost of each service and the additional ridership each is envisioned to generate. Table 3.6-6 provides this comparison of new systemwide ridership and cost to determine the practicability of each alternative.

Table 3.6-6 Build Alternative Evaluation

Alternative	Capital Cost[1] ($million)	Operation and Maintenance Cost[1] ($million/year)	New Systemwide Boardings[2] (boardings/day)
Baseline Alternative	$146.2	$13.7	2,800
Alternative 1 – Medford Hillside and Union Square (via commuter rail right-of-way)	$804.8	$21.3	7,900
Alternative 2A – Mystic Valley Parkway/Route 16 (with parking) and Union Square (via commuter rail right-of-way)	$959.3	$23.7	8,900
Alternative 2B – Mystic Valley Parkway/Route 16 (without parking) and Union Square (via commuter rail right-of-way)	$951.8	$23.7	8,600
Alternative 3 – Medford Hillside and Union Square (via Somerville Avenue)	$829.8	$22.1	7,700
Alternative 4 – Mystic Valley Parkway/Route 16 (with parking) and Union Square (via Somerville Avenue)	$984.3	$24.5	8,700
Alternative 5 – Mystic Valley Parkway/Route 16 (with parking)	$870.0	$28.2	10,500
Alternative 6 –Union Square (via commuter rail right-of-way)	$370.6	$8.1	3,900

1 Cost estimates based on 2008 dollars.
2 New ridership is based on projections to year 2030 and the difference between future No-Build Conditions for the Green Line and the future Build Conditions with the Green Line Extension Project in place.

3.7 Project Description – Preferred Alternative

Alternative 1, Green Line Extension to Medford Hillside and Union Square (using commuter rail rights-of-way), has been selected as the "Proposed Project" for the Green Line Extension Project, as it provides a balance of cost, ridership, and environmental impacts. EOT also believes that this alternative will help the Commonwealth achieve its goal of providing expanded transportation services and improve regional air quality. This alternative extends to Union Square via the MBTA Fitchburg Line right-of-way, which would require fewer acquisitions of private property, have more operational reliability, and have a lower capital cost than the Somerville Avenue option. Alternative 1 would meet all Project goals, would be operationally practical, and would generate a high number of new systemwide transit trips. This is the Project for which EOT is currently seeking approval by the FTA. Figure 3.7-1 shows the Proposed Project.

A total of seven stations are included in the Proposed Project, at Lechmere, Brickbottom, Gilman Square, Lowell Street, Ball Square, College Avenue and at Union Square. The route length would be about three miles to Medford Hillside with an approximately one-mile spur to Union Square. The primary infrastructure improvements of the Proposed Project would include relocating existing commuter rail lines, and constructing approximately four miles of new light rail track and systems, four multi-span viaducts, a maintenance facility, and reconstructing 11 bridge structures to support the extension service. The Proposed Project is expected to generate new systemwide transit ridership of 7,900 boardings per day and a reduction of 25,018 VMTs per day (projected to the year 2030).

Although the FTA action of this document is based on the Proposed Project described above, EOT has selected as its Preferred Alternative, Alternative 2, Green Line Extension to Mystic Valley Parkway/Route 16, with no parking at Mystic Valley Parkway/Route 16 Station, and Union Square (using commuter rail rights-of-way). This alternative also meets all of the Project goals and provides additional regional benefits. However, because of the constraints placed on EOT by Federal funding requirements and the economic crisis facing the Commonwealth, at this time EOT is not able to identify sufficient funding to support the construction of the Medford Hillside to Mystic Valley Parkway/Route 16 segment within the 2014 timeframe mandated by the State Implementation Plan.

As of the filing of this document, the Boston Region Metropolitan Planning Organization has voted to 'flex' funding dedicated to the construction of highways to fund the construction of the Medford Hillside to Mystic Valley Parkway/ Route 16 segment. These funds will be available sometime between 2016 and 2020 and may allow this portion of the Green Line Extension to be constructed shortly after the 2014 schedule for the Proposed Project has been completed.

Therefore, EOT's Preferred Alternative is proposed to be built in two phases with an initial operating segment (or the "Proposed Project") being constructed to Medford Hillside in the vicinity of College Avenue on the Medford Branch and a spur to Union Square, which is described and evaluated in this DEIR/EA as Alternative 1. The second phase of this Project, the "Future Full-Build Alternative" will include extending the Project from College Avenue Station to Mystic Valley Parkway/Route 16 Station in the future and has been described and evaluated in the DEIR/EA as Alternative 2.

The environmental impacts of both the Proposed Project, referred to as Alternative 1, and of the Future Full-Build Alternative, referred to as Alternative 2, have been fully evaluated and are described in detail in this DEIR/EA. For Federal action, the Proposed Project to Medford Hillside is the subject of this DEIR/EA, as the extension to Mystic Valley Parkway/Route 16 is not envisioned to be constructed within the three-year Massachusetts Environmental Policy Act (MEPA) or National Environmental Policy Act (NEPA) time frame and would, therefore, require re-assessment at a future date. However, construction of the initial operating segment of the Project will not preclude a future extension of the Preferred Alternative or Future Full-Build Alternative to Mystic Valley Parkway/Route 16, should funding become available in the future. Figure 3.7-1 shows both the Proposed Project and Future Full-Build Alternative Segments of the Preferred Alternative.

Figures 3.7-2 through 3.7-34 show the proposed stations, including a neighborhood map, detailed layout plan of the station, circulation plan, and architectural concept for each station. The Proposed Project Green Line stations for the Medford Branch are:

- Relocated Lechmere Station, Cambridge (relocated to east side of O'Brien Highway/Route 28);
- Brickbottom Station, Somerville;
- Gilman Square Station, Somerville;
- Lowell Street Station, Somerville;
- Ball Square Station, Medford; and
- College Avenue Station, Medford.

The Proposed Project also includes one station on the Union Square Branch in the vicinity of Prospect Street near Union Square in Somerville. In the future Full-Build Alternative, an additional station would be constructed along the Medford Branch at Mystic Valley Parkway/Route 16 Station in Somerville/Medford. Section 3.7.3 describes these stations in more detail.

As described in Section 3.3.2, Yard 8 has been the preferred option for the construction of a Green Line vehicle storage and maintenance facility, given its combination of size, configuration, and adjacency to the Green Line Extension tracks. However, the Yard 8 site has elicited local opposition from some municipal officials, elected representatives, and abutting residents and businesses. To endeavor to address and resolve these concerns, EOT has initiated analysis of two additional possible sites for the facility: (1) the so-called "Mirror H" site, proposed by the City of Somerville; and (2) a site, newly conceived by EOT and termed "Option L." The "Mirror H" site straddles the Inner Belt area of Somerville and the NorthPoint area of Cambridge. The "Option L" site is located immediately adjacent to BET, outside the current BET fence line. Both locations are shown on Figure 3.3-4.

Preliminary analysis indicates that both alternative sites have impacts above and beyond that of the Yard 8 alternative (e.g., Mirror H – renegotiation of MBTA-NorthPoint agreement and Option L – relocation of active businesses). However, to sufficiently compare the sites to the preferred Yard 8 location, a complete analysis of both alternatives - including environmental impacts, schedule implications, community benefits, property acquisition needs, regulatory issues, and costs to the municipalities and the Commonwealth - will be performed over the next few weeks. Results will be made available to the public for input and discussion once underway. The outcome of the analyses will determine whether EOT chooses to pursue a Notice of Project Change for the Green Line Extension Project, to formally substitute one of the alternative options for Yard 8 as the preferred site for the storage and maintenance facility.

3.7.1 Land Acquisitions and Easements

The Green Line Extension Project makes use of existing railroad rights-of-way for most of its approximately five mile length. This is possible because the MBTA Fitchburg Line and the MBTA Lowell Line had sufficient width to accommodate additional tracks for freight rail lines dating back to the late 19th century that have since been abandoned. The footprint of the abandoned tracks provides space for new tracks for this proposed Project. The existing right-of-way ranges from 55 to 110 feet in width. In places where space is limited by steep slopes, retaining walls have been proposed to maximize usable space in the railroad rights-of-way. The proposed retaining walls will include a "green" design component, which means that efforts will be made to use recycled and recyclable materials and to incorporate vegetation as part of the wall system, which will provide a more natural aesthetic for the retaining structure. Landscape treatments will also be proposed on the slopes above the walls and to the greatest extent possible at each of the stations.

For the purposes of planning, the maximum property impacts of the Project have been identified and evaluated in the DEIR/EA. As this Project progresses through preliminary engineering and final design, EOT will strive to refine the designs in an effort to further minimize property acquisitions and have the least possible impact on local neighborhood and property owners.

Constructing the Proposed Project as currently designed would require 11.5 acres of land acquisition from approximately 38 properties, and would require relocating five businesses. The largest area acquisitions are for the Project's maintenance and storage facility at Yard 8 in Somerville (two parcels totaling 5.8 acres) and for the Union Square Station using the MBTA Fitchburg Line (four parcels totaling 1.1 acres). In terms of impact, the most substantial acquisitions are those that require the displacement and relocation of residences and active businesses. These are located at Ball Square (one occupied building with multiple businesses), and in Union Square (two businesses). No residences would be displaced. The Future Full-Build Alternative (extending to Mystic Valley Parkway) would require additional properties (four parcels totaling 6.6 acres) to construct the Mystic Valley Parkway/Route 16 Station and relocation of one business and two occupied office/R&D buildings with multiple businesses). The whole property land acquisitions are further summarized in Table 3.7-1.

In addition to whole property acquisitions, the Project will require strip takings (partial lots) that would not require building demolition or the acquisition of full properties. Additional temporary easements for construction access may also be necessary. A more comprehensive review of easement requirements will occur once more detailed, final design plans are prepared. The final design will minimize these land acquisitions and any construction easements as much as possible.

Table 3.7-1 Land Acquisition Summary

Address	Owner/Tenant	Parcel Area (SF)	Purpose
Somerville			
200 Inner Belt Road	Light Industrial	368,392	Yard 8
0 Inner Belt Road	Rail yard	82,983	Yard 8
30 Joy Street	Vacant	6,000	Brickbottom Station
350 Medford Street	Municipal Building	48,296	Gilman Square Station
675 Broadway	Lot 2 - Veterinary Building (vacant);	B2: 6,725	Ball Square Station
	Lot 3 - Karate Studio	B3: 830	Ball Square Station
662 & 664 Boston Avenue	Ball Square Auto Repair & Ball Square Bowling Alley	682	Ball Square Station
600 Mystic Valley Parkway*	U-Haul - Self Storage	95,348	Mystic Valley Parkway Station
200R Boston Avenue*	Vacant	10,996	Mystic Valley Parkway Station
40 Bennett Street	Industrial, Warehouse	24,563	Union Square Station
Outbuilding - 50 Prospect Street	Storage lot for commercial outbuilding	8,095	Union Square Station
50 Prospect Street	Empire Marble & Granite	8,517	Union Square Station
42 Prospect Street	Vacant	3,150	Union Square Station
32 Prospect Street	Vacant commercial/industrial building	4,068	Union Square Station
Medford			
675 Broadway	Former Veterinary Office (vacant)	4,448	Ball Square Station
662 & 664 Boston Avenue	Ball Square Bowling Alley & Ball Square Auto Repair	11,854	Ball Square Station
222 Boston Avenue*	Office Building	28,443	Mystic Valley Parkway Station
200 Boston Avenue*	Office and Research & Development	15,2460	Mystic Valley Parkway Station

*Indicates whole property takings associated only with the Future Full-Build Alternative Only

3.7.2 Affected Bridges

For the Proposed Project, there are nine highway bridges over the railroad right-of-way and three railroad bridges over city streets. The following highway bridges will have to be replaced as part of the Proposed Project:

- Walnut Street (Somerville);
- Medford Street over the MBTA Lowell Line (Somerville);
- School Street (Somerville);
- Lowell Street (Somerville);
- Cedar Street (Somerville);
- Broadway (Somerville); and
- College Avenue near College Avenue Station (Medford).

In the Future Full-Build Alternative, two additional highway bridges will need to be rebuilt:

- Winthrop Street (Medford); and
- North Street (Medford).

The following bridges appear to have adequate clearance and should not need replacement:

- Central Street (Somerville);
- Sycamore Street (Somerville);
- Prospect Street (Somerville);
- McGrath Highway over MBTA Lowell Line (Somerville);
- Cross Street (Somerville); and
- McGrath Highway over MBTA Fitchburg Line (Somerville).

Of the railroad bridges, the bridge over Washington Street can accommodate six tracks but must be replaced due to its poor condition. The bridge that carries the MBTA Lowell Line over Harvard Street will have to be reconstructed to add two spans to accommodate four tracks. The bridge that carries the MBTA Fitchburg Line over Medford Street will have to be reconstructed to add two spans to accommodate four tracks. The rail bridge over the MBTA Fitchburg Line at Red Bridge Junction would have to be reconstructed, and two new viaducts would be needed at Red Bridge Junction to serve the Union Square Branch. The Lechmere Viaduct would also need to be reconstructed. The design and construction of these bridges will be coordinated with appropriate municipal personnel in Cambridge, Somerville, and Medford.

3.7.3 Stations

The Proposed Green Line Extension Project includes six mainline stations on the Medford Branch: Relocated Lechmere Station, Brickbottom Station, Gilman Square Station, Lowell Street Station, Ball Square Station, and College Avenue Station; and one station at Union Square. In the Future Full-Build Alternative, one additional station would be constructed at the Mystic Valley Parkway/Route 16 Station. Station locations were determined based on a thorough station siting analysis process, which included input from public workshops and city officials. Details are provided in Appendix B.

As required by the Secretary's Certificate, this section:

- Highlights station locations with a summary of 2030 ridership projections;
- Provides a description of station amenities;
- Summarizes the program for safe and efficient loading;
- Demonstrates how each station will meet ADA accessibility standards;
- Identifies Green Design opportunities; and
- Describes access from street level to the station.

Detailed designs and renderings of each station are provided in Figures 3.7-2 through 3.7-34.

Project stations will generally be located along the new Green Line alignment adjacent to the relocated MBTA Lowell Line, and along the MBTA Fitchburg Line alignment for Union Square Station. The design for each station is envisioned to provide: a headhouse as a shelter for the paid and unpaid lobbies with automated fare lines; vending machines; an information booth; and restrooms. In addition to these design elements, the stations are also envisioned to provide:

- Landscaping;
- Bike racks at all stations, which will encourage the use of bicycles to access the station and reduce vehicular access;
- MBTA Direction Maps showing inbound and outbound stations as well as the MBTA Spider Maps showing all rapid transit lines;
- Street-facing fascia displaying the station name;
- Uniformly lit platforms at a level that enhances a feeling of safety;
- Tactile/Braille Station Identification signs; and
- Trash receptacles.

Many station platforms are envisioned to be located at a different elevation than the station access points. Entry to and exit from the platforms will be provided by elevators, escalators, and stairs. The design of the platform was based on peak hour passenger volume. Station access and platform design were based on requirements and guidance provided by:

- Americans with Disabilities Act, 1990;
- Commonwealth of Massachusetts Architectural Access Board (MAAB); and
- The MBTA.

In addition to station amenities and access requirements, station criteria also considered “green” or high performance design. Green design opportunities for the Green Line Extension Project include:

- **Access** - Stations will offer safe and convenient pedestrian access to encourage walking and transit-oriented development in the nearby vicinity. This includes providing secure bicycle racks and/or storage within 200 yards of each station entrance.

- **Lighting** - Station design will minimize unnecessary light pollution on each station site, while ensuring that adequate safety lighting measures are adhered to.

- **Stormwater** - Station design will minimize the amount of impervious cover, increase on-site infiltration, reduce or eliminate pollution from stormwater runoff, and eliminate contaminants.

- **Recycling** - Stations will provide easily accessible bins for recycling, including paper, corrugated cardboard, glass, plastics, and metals.

- **Site and Building Materials** - Where possible, station design and construction will use materials that incorporate recycled content materials; are extracted and manufactured locally; reduce the use and depletion of finite raw materials and long-cycle renewable materials by replacing them with rapidly renewable materials, such as bamboo, wool, cotton insulation, agrifiber, linoleum, wheat-board, strawboard, and cork; use Forest Stewardship Council (FSC) Certified Wood; and reduce the heat island effect at each station by utilizing high-reflectance (high-albedo) materials for hardscape.
- **Water Efficiency** - Where possible, station design will eliminate the use of potable water for landscape irrigation at each station site; and will reduce the generation of wastewater and potable water demand at each station by specifying high-efficiency fixtures and dry fixtures, such as waterless urinals and low-flow toilets.
- **Energy Performance** - Where possible, station design will include the building envelope, heating, ventilation, and air conditioning (HVAC), lighting, and other systems to maximize energy performance; utilize non-polluting and renewable energy sources, including solar, wind, geothermal, low-impact hydro, biomass, and bio-gas strategies; avoid or minimize the use of mechanical cooling and refrigeration equipment; and use ENERGY STAR compliant products throughout all buildings.
- **Indoor Air Quality**- Where possible, station design will include an indoor air quality management plan to address moisture and mold damage including the design of surface grades, drainage systems and heating, ventilating, and air conditioning systems, ductwork transport, storage, and installation and filtration media in air handlers. Effective air management systems will be employed to minimize the exposure of station occupants and ventilation air distribution systems to environmental tobacco smoke; provide additional outdoor ventilation to improve air quality within the station building; provide capacity for ventilation system monitoring to help sustain station occupant comfort; and reduce the quantity of indoor air contaminants that are odorous, irritating, or harmful to station occupants.
- **Demolition and Construction** - Where possible, construction management during demolition of existing buildings on the station sites will divert debris from disposal in landfills and incinerators. Station design will include Erosion and Sediment Control Plans and will consider additional methods to control polluting the air with dust and particulate matter during construction.

3.7.3.1 Relocated Lechmere Station

Relocated Lechmere Station and associated roadway and busway improvements have long been intended to be constructed as part of the NorthPoint development project. However, due to the uncertainty surrounding the NorthPoint project, the

Commonwealth has included the planning for the relocation of Lechmere Station and area roadway improvements into the Green Line Extension Project.

The first station along the Green Line Extension as it moves northward is the new Lechmere Station, currently the existing northern terminus of the Green Line. Figure 3.7-2 shows the station and the surrounding neighborhood, Figure 3.7-3 shows the station itself in detail, Figure 3.7-4 shows routes of access for the station, and Figure 3.7-5 shows an architectural concept for the station's exterior. Daily ridership at this station is anticipated to be 10,900 boardings (projected to the year 2030). The new Lechmere Station will be relocated and elevated, on a new and realigned viaduct on the east side of Monsignor O'Brien Highway/Route 28. The area around the relocated station is primarily industrial with some residential uses. There will be approximately 234 parking spaces provided in two separate parking lots at the station to replace the existing parking for commuter park-and-ride patrons. Vehicular access to the south parking lot will be provided via East Street. Vehicular access to the north lot will be provided primarily via Water Street. An access road will be provided to connect Water Street, North First Street, and East Street, allowing vehicular access between the two lots as well as providing busway connections to O'Brien Highway/Route 28 and Cambridge Street. Pedestrian access will be provided across O'Brien Highway/Route 28. A busway with one-way, southbound circulation will accommodate local bus service, including MBTA Bus Routes 69, 80, 87, and 88, with access from O'Brien Highway/Route 28 via Water Street and egress to O'Brien Highway/Route 28 via a new North First Street connection. Curbside drop-offs for taxis, corporate shuttles, and station patrons will be provided along New North First Street and the access road. Due to its location on the viaduct, the station proper will be accessed using elevators, escalators, and stairs. Bike racks will be provided to encourage use of this mode. Once the relocation is complete, the existing Lechmere Station area will be demolished and the existing station site would be made available for potential future redevelopment.

3.7.3.2 Brickbottom Station

Brickbottom Station is on two private parcels on the east side of Joy Street and approximately 220 feet south of the intersection with Washington Street. Figure 3.7-6 shows the station and the surrounding neighborhood, Figure 3.7-7 shows the station itself in detail, Figure 3.7-8 shows routes of access for the station, and Figure 3.7-9 shows an architectural concept for the station's exterior. Daily ridership at this station is anticipated to be 2,730 boardings (projected to the year 2030). The area around the proposed station is categorized as light industrial with shops and automobile-related businesses. There are residential homes located north of Washington Street and on the south end of Joy Street at the Brickbottom Artists Lofts. Access to the station will be provided for both pedestrian and vehicular traffic along Joy Street. At this location, the Green Line tracks will be at a higher elevation than Joy Street. Consequently, access to the platform will occur from below via elevators, escalators, and stairs. Bus Routes 86, 91, and CT2 provide service along Washington Street, with a bus stop 200 feet north of the proposed station. A pick-up/drop-off for automobiles will be provided. Bike racks will also be provided to encourage use of this mode. Connections to the proposed Somerville Community Path are possible.

3.7.3.3 Gilman Square Station

Gilman Square Station is proposed to be located along Medford Street directly behind Somerville High School. Figure 3.7-10 shows the station and the surrounding neighborhood, Figure 3.7-11 shows the station itself in detail, Figure 3.7-12 shows routes of access for the station, and Figure 3.7-13 shows an architectural concept for the station's exterior. Daily ridership at this station is anticipated to be 4,410 boardings (projected to the year 2030). The neighborhood is home to municipal facilities (Somerville City Hall, Somerville Public Library, Somerville High School), commercial enterprises along Highland Avenue and Medford Street, and residential areas. Access to the station will occur on the east side of the railroad right of way from Medford Street through a City-owned parcel and at a second location directly from the Medford Street bridge structure. Access to the platform level will be via elevators, escalators, and stairs. These access points are proposed in order to provide access in accordance with ADA requirements, as the Medford Street Bridge has an approximately eight-percent grade. Connections to the proposed Somerville Community Path are also possible in the future. The station's placement on the north side of Medford Street provides the opportunity for bicycle and pedestrian access with minimal property impacts. Connections to MBTA for Bus Routes 80, 88, and 90 are located within ¼ mile of the station. Bike racks will also be provided.

3.7.3.4 Lowell Street Station

Lowell Street Station is proposed to be located at Lowell Street, adjacent to an abandoned industrial building. Figure 3.7-14 shows the station and the surrounding neighborhood, Figure 3.7-15 shows the station itself in detail, Figure 3.7-16 shows routes of access for the station, and Figure 3.7-17 shows an architectural concept for the station's exterior. Daily ridership at this station is anticipated to be 1,260 boardings (projected to the year 2030). Lowell Street Station is in a primarily residential area of two, three, and four-story structures. There is a nursing home nearby and an abandoned industrial building, which is scheduled for redevelopment for residential use. Accessibility at this station is a challenge due to the existing roadway grades. To better accommodate access, a vehicular pick-up/drop-off area will be provided on Lowell Street. At this location, the Green Line tracks and platform will be at a lower elevation than Lowell Street. Consequently, access to the platform will occur from street level via elevators, escalators, and stairs. The station will be constructed along with a new bridge to accept automobile pick-ups/drop-offs and bicycle traffic from the neighborhood. Bike racks will be provided. Pedestrian access will be provided using sidewalks along Lowell Street. Local MBTA Bus Routes

80, 88, and 90 are within ¼ mile of the station. Connections from the proposed Somerville Community Path to the station headhouse would be possible via Lowell Street.

3.7.3.5 Ball Square Station

Ball Square Station is proposed to be located on the north side of the Broadway Bridge in the vicinity of the Somerville and Medford city line near the corner of Broadway and Boston Avenue. Figure 3.7-18 shows the station and the surrounding neighborhood, Figure 3.7-19 shows the station itself in detail, Figure 3.7-20 shows routes of access for the station, and Figure 3.7-21 shows an architectural concept for the station's exterior. Daily ridership at this station is anticipated to be 1,890 boardings (projected to the year 2030). The area adjacent to the station is of mixed use with automobile shops along Boston Avenue, commercial uses on Broadway, and residential neighborhoods beyond. Residential structures are generally three to four stories. Due to Broadway's steep grade, the station provides two points of access. One access point will be provided at the intersection of Boston Avenue and Broadway. The other access point is envisioned directly from the Broadway Bridge. At this station, the Green Line tracks and platform will be at a lower elevation than Broadway; consequently, access to the platform from street level will be via elevators, escalators, and stairs. Local MBTA Bus Routes 80 and 89 have stops located adjacent to Ball Square Station. Bike racks will also be provided at the station.

3.7.3.6 College Avenue Station

College Avenue Station is proposed to be located at the corner of College Avenue and Boston Avenue, which primarily serves the residential neighborhoods adjacent to the station and the Tufts University community. Figures 3.7-22 and 3.7-23 show the station and the surrounding neighborhood for both the Proposed Project and Future Full-Build Alternative. In the Proposed Project, College Avenue Station will serve as the Project terminus and tail tracks will be provided beyond the end of the platform for operational flexibility at the end of the line. Figure 3.7-24 shows the station itself in detail, Figure 3.7-25 shows routes of access for the station, and Figure 3.7-26 shows an architectural concept for the station's exterior. Daily ridership at this station is anticipated to be 2,420 boardings (projected to the year 2030) for the Proposed Project. In order to meet accessibility requirements, the station provides two points of access due to the eight-percent grade along the College Avenue Bridge. One access point will be provided from the College Avenue Bridge; the second access point will be provided from Boston Avenue. Vehicular pick-up/drop-off will be available along Boston Avenue. Bicycle parking will also be provided at this station. Local MBTA Bus Routes 80, 94, and 96 provide service adjacent to the station with a bus stop located on College Avenue, approximately 600 feet from the station.

3.7.3.7 Mystic Valley Parkway/ Route 16 Station (Future Full-Build Alternative Only)

The Mystic Valley Parkway/Route 16 Station, to be included in the Future Full-Build Alternative only, is proposed to be located south of the intersection of Boston Avenue and Mystic Valley Parkway/Route 16 in the vicinity of the Somerville and Medford city line. Figure 3.7-27 shows the station and the surrounding neighborhood, Figure 3.7-28 shows the station itself in detail, Figure 3.7-29 shows routes of access for the station, and Figure 3.7-30 shows an architectural concept for the station's exterior. Daily ridership at this station is anticipated to be 2,000 boardings (projected to the year 2030) in the Future Full-Build condition. The neighborhood surrounding the proposed station is generally residential. There is a shopping center nearby as well as recreational facilities. This station has been considered both with and without 300 parking spaces in a multi-level parking garage. However, the Preferred Alternative does not include any parking at this station. Vehicular pick-up/drop-off is proposed with access primarily via Boston Avenue, with a possible curb cut onto Mystic Valley Parkway/ Route 16. Pedestrian access will be provided from walkways along Boston Avenue and Mystic Valley Parkway/Route 16. Access to the platform will occur via elevators, escalators, and stairs. Local MBTA Bus Routes 80 and 94 provide service adjacent to the station with a bus stop at the corner of Boston Avenue and Mystic Valley Parkway/Route 16. Bike parking will be provided at this station.

3.7.3.8 Union Square Station

Union Square Station is the only station proposed on the Union Square Branch, proposed to be located at the intersection of the MBTA Fitchburg Line and Prospect Street. Figure 3.7-31 shows the station and the surrounding neighborhood, Figure 3.7-32 shows the station itself in detail, Figure 3.7-33 shows routes of access for the station, and Figure 3.7-34 shows an architectural concept for the station's exterior. Daily ridership at this station is anticipated to be 2,310 boardings (projected to the year 2030). The area adjacent to the station is of mixed use with light industrial, residential, and commercial uses. Due to the eight-percent grade along Prospect Street, the station is envisioned to provide access via two levels, including the lower grades along Prospect Street as well as directly from the bridge structure. Access to the platform will also occur via elevators, escalators, and stairs. Vehicular pick-up/drop-off will be accommodated along Prospect Street. Local MBTA Bus Routes 85, 86, and 87 provide service adjacent to the station. Bike parking will be provided at the station.

3.7.4 Operating Plan

The operating plan is envisioned to extend the existing Green Line D and E branch services from Lechmere Station to Medford Hillside in the vicinity of College Avenue and Union Square for the Proposed Project. For the Future Full-Build Alternative, the Project will extend northwest to Mystic Valley Parkway/Route 16. The Green Line service would operate on headways equal to that of the existing Green Line D and E branch services and is not envisioned to impact the Central Subway System.

Travel times between proposed stations were estimated based on the travel distances and the estimated speeds. The travel speeds between proposed stations were based on the railroad's physical and operational characteristics. Estimated travel time between each station for the proposed Green Line Medford Branch is shown in Table 3.7-2.

Table 3.7-2 Travel Times for the Preferred Alternative

Station	Distance (miles)	Travel Time (minutes)	Dwell Time (minutes)	Cumulative Travel Time (minutes)
Lechmere				
Brickbottom	0.78	2.25	0.75	3
Gilman Square	0.71	1.25	0.75	2
Lowell Street	0.70	1.25	0.75	2
Ball Square	0.49	0.75	0.75	1.5
College Avenue	0.57	1.0	0.0	1.0
			Total	9.5

As shown in Table 3.7-2, the estimated travel time between Medford Hillside in the vicinity of College Avenue and Lechmere Station is approximately 9.5 minutes. In the Future Full-Build Alternative, the travels times between Lechmere Station and Mystic Valley Parkway/Route 16 Station will be 12.0 minutes. The estimated travel time between Relocated Lechmere Station and Union Square Station is 4.5 minutes.

The proposed headways for the Medford Branch would be five minutes in the morning and evening peak periods and 10 minutes during off-peak periods. The proposed headways for the Union Square Branch would be six minutes in the morning peak period, five minutes in the evening peak period, and between nine and 10 minutes during off-peak periods.

Fares would be based on current MBTA subway fares of $1.70 for one-way adult trips.

3.7.5 Cost Estimate

During the development of this DEIR/EA, 10-percent concept plans for the Proposed Project and Future Full-Build Alternative alignments were designed and detailed capital cost estimates were developed. The capital improvements described in previous sections include, but are not limited to, construction of track, stations, structures, systems, drainage, utilities, and the maintenance facility. Additional costs include property acquisitions and relocations as well as the cost for vehicle acquisitions. The cost of the Proposed Project (Alternative 1 - Extension to Medford Hillside with a spur to Union Square using the MBTA Fitchburg Line) includes the cost to reconstruct Lechmere Station and is estimated to be approximately $805 million in 2008 dollars, including $76.0 million for vehicles. Annual operating and maintenance costs would be approximately $21.3 million in 2008 dollars. The total costs for the Proposed Project were increased to include inflation for the time period in which the Project is to be implemented. Therefore, the "Year-of-Expenditure (YOE)" costs for the Proposed Project were calculated to be approximately $932.4 million in YOE dollars, with operating and maintenance costs of $25.9 million in YOE dollars.

In 2008, the FTA engaged a Project Management Oversight Consultant (PMOC) to undertake a review of the preliminary cost estimate for the Green Line Extension Project. The PMOC review identified a number of issues that introduce risk into this preliminary cost estimate. The most significant issues relate to construction methodology and schedule. As a result, the FTA is not able to endorse these cost estimates at this time. EOT recognizes these issues, which are principally related to the current state of conceptual engineering for the Project, as appropriate to a draft environmental document. EOT will continue to work with the FTA and the PMOC process to address these issues and ensure the FTA's endorsement of the Green Line Extension Project cost estimates as the Project develops through preliminary engineering and final design.

3.7.6 Construction Sequencing and Staging

Construction staging and sequencing strategies are critical to achieving the balance of an efficient construction project while minimizing the impacts to vehicular traffic, pedestrian traffic, on-street parking, public access, and emergency access to local businesses and residences. This corridor presents several construction challenges including narrow roadways, urban traffic volumes, and a variety of commercial, industrial, and residential land uses that require continuous access, limited space for construction zones and lay down areas within or near the rail corridor, and existing rail service that must be maintained throughout construction.

The use of the existing MBTA commuter rail right-of-way for the proposed Green Line tracks greatly reduces the complexity of construction as well as construction impacts. Figures 3.7-35 and 3.7-36 show the existing right-of-way and the proposed right-of-way. The existing cut would be widened by installing retaining walls on either side and excavating the slopes. On the MBTA Lowell Line, the commuter rail tracks would be shifted to the east side of the widened cut, and the new Green Line tracks would be built along the west side. Most of the right-of-way is located below the surrounding land surface, reducing potential land acquisitions as well as environmental impacts such as noise and visual changes.

Figure 3.7-35 Existing Section Looking North

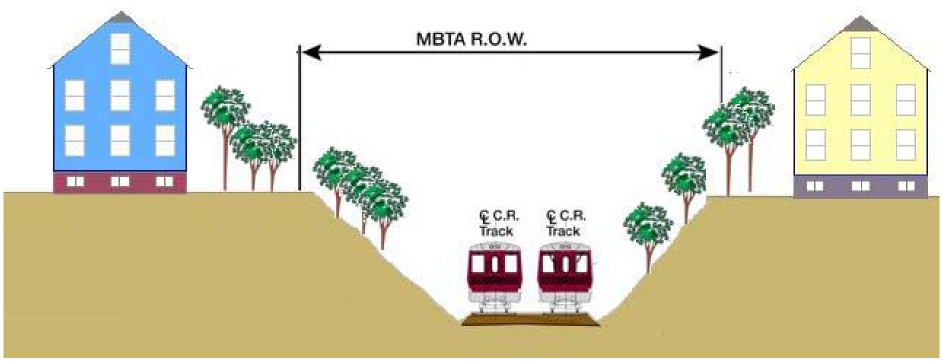
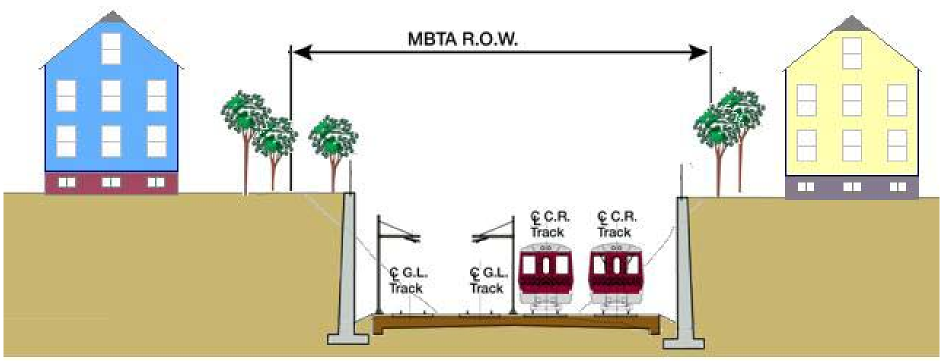


Figure 3.7-36 Proposed Section Looking North



Bridge reconstruction will be staged whenever possible to maintain traffic over the respective bridges during construction. Construction staging will be required for roadway traffic as well as rail traffic beneath the bridge. In some cases, the existing bridge structure, the extent of reconstruction required on the bridge, and/or the proposed bridge structure are such that staged construction is not feasible and the bridge will have to be closed during construction. A detour will be required to provide alternative traffic routes during construction.

Based on analysis of the existing bridges and a conceptual level design, the following bridges will require traffic detours during construction:

- Medford Street (Somerville, over the MBTA Lowell Line);
- Broadway (Somerville);

The construction staging and sequencing presented in this section address the constraints of the corridor, impacts to abutters, and other construction issues. More detailed evaluation and staging recommendations will be developed as design progresses and through coordination with the City of Cambridge, City of Somerville, and City of Medford, and the respective Fire and Police Departments. This coordination will define restrictions that will be placed on the contractor, such as time of construction and construction zone set-up requirements, as well as maintenance of traffic and access to abutting properties. Blasting is not anticipated for construction of the Project. Rodent control policies will be included in construction management plans to prevent increased pest populations during the construction period. Likely measures would include good waste management (sealed trash containers, closed drains on dumpsters, etc.), fencing around long-term construction sites, and traps and/or baits as needed for any observed rodent problems. Construction procedures will comply with Massachusetts Department of Environmental Protection's (MassDEP's) solid waste and air quality control regulations to prevent the spread of contaminated material or air quality impacts during construction.

For this initial stage of the Project, it is assumed that the following criteria will be required for traffic management and construction staging:

Roadway

- Perform construction activities during day time hours whenever possible. Avoid night time construction, particularly in residential areas;
- Restrict temporary lane closures to mid-week, off-peak traffic hours;
- Maintain one 11-foot travel lane in each direction except for short term, temporary closures;
- Detours are allowed subject to approval of the respective municipality;
- Maintain pedestrian accessibility;
- Maintain access to all abutting properties;
- Maintain access for emergency vehicles through construction zones;
- Limit the length and duration of construction zones that will temporarily eliminate on-street parking;
- Limit the number of abutting construction zones where work is taking place simultaneously;
- Construction zones will be set-up in accordance with industry standards [*Manual on Uniform Traffic Control Devices* (MUTCD)] and municipal

requirements, including police details, signage, variable message boards, temporary precast concrete barriers, drums, cones, etc;
- Coordinate with public safety departments, and city officials;
- Maintain communication with the community concerning construction activities, lane restrictions, closures, locations of construction zones, etc;
- Limit bridge closures such that no two consecutive bridges will be closed at the same time and provide reasonable detour routes subject to municipal approval; and
- Isolate construction work zones from vehicular and pedestrian traffic with a temporary precast concrete barrier, drums, and cones.

Rail

- Maintain commuter rail and freight traffic at all times;
- Provide flagmen for all work within the rail corridor;
- Minimize track closures;
- Track outages are subject to approval of the MBTA;
- Track relocation work will be limited to off-peak hours; and
- Maintain minimum horizontal and vertical offsets from live track centerlines to work zones and structures.

General Construction Sequence

The construction activities for this Project will be performed in the following sequence to allow an efficient construction process while maintaining roadway and rail traffic in the area. Construction staging and sequencing will be coordinated to minimize the duration of detours and lane closures.

- Clear and grub, demolish buildings, and conduct any required remediation of contaminated soils;
- Clear and grub corridor;
- Construct retaining walls and initial bridges/abutments;
- Cut/rough grade corridor;
- Install corridor drainage system, utilities, signal conduit, etc. and construct remaining bridges;
- Construct station/platform foundations and footings;
- Install/rough grade track bed;
- Install new outbound commuter rail track along east side of corridor;
- Relocate existing commuter rail track 1 to proposed commuter rail track 2 alignment;
- Construct off-site traffic improvements;
- Construct stations and platforms, catenary, etc;
- Install proposed Green Line tracks and landscaping;
- Construct bridges and walls south of Red Bridge;
- Construct new Lechmere Station; and
- Demolish existing Lechmere Station.

Typical construction staging plans have been developed and are depicted in Figures 3.7-37 and 3.7-38.

Close coordination with MBTA, City of Cambridge, City of Somerville, City of Medford, and the respective Fire and Police Departments will address specific construction issues. The preliminary analysis of construction staging and sequencing shows that it is feasible to construct the Project while maintaining railroad operations, access to abutters, and traffic and pedestrian paths. As the design progresses, the traffic management details will be refined to better identify specific measures in specific areas, including detours. A comprehensive construction staging and sequencing plan will be developed and included in the final construction contract documents and communicated to the public.

3.8 Community Paths

The Secretary's Certificate requires the DEIR/EA to include conceptual designs that connect the Green Extension Project to the Somerville Community Path and evaluate the viability of extending the Community Path to Route 16 in order to create a connection with the Mystic River Parkway. EOT is committed to working with the City of Somerville and the local community to progress the final design of the Somerville Community Path in conjunction with the design of the Green Line Extension Project. Regionally, the Somerville Community Path would also form part of a system of multi-use pathways connecting Somerville to the communities of Cambridge, Boston, Belmont, Arlington, Lexington, Bedford, Watertown, and Newton. This section discusses the coordination considered and decided upon for local community path projects.

3.8.1 Somerville Community Path

The proposed Somerville Community Path was developed by a number of advocates for bicycle and pedestrian facilities. The purpose of the Somerville Community Path is to be a multi-use pathway connecting neighborhoods to each other. As ultimately envisioned, the path would provide connectivity from Davis Square at one end to the Relocated Lechmere Station in Cambridge at the other.

The intent of the Somerville Community Path is to extend the Minuteman Bikeway/Linear Park multi-use path from its current terminus at Cedar Street in Somerville to the Charles River Path network in Cambridge and Boston, a distance of approximately 2.5 miles. The proposed route follows the edge of the MBTA Lowell Line, generally located at street level while the existing commuter rail trains and the proposed Green Line trains would run below, in a cut section. As required by the Secretary's Certificate, 10 -percent design plans for the path have been developed as part of the Green Line Extension Project.

The path design will comply with all applicable accessibility regulations including Regulations of the ADA and Regulations of the MAAB. In addition to these regulations, there are other documents relevant to path design that will be used:

- 36 CFR Part 1195 - Architectural Barriers Act (ABA) - Accessibility Guidelines for Outdoor Developed Areas;
- Federal Highway Administration, Designing Sidewalks and Trails for Access Part II of II: Best Practices Design Guide; and
- Federal Register – Architectural Barriers Act, Accessibility Guidelines for Outdoor Developed Areas.

The path design will also be reviewed by representatives of the disability community who can provide first-hand input and comments on the design and its details.

The Somerville Community Path will begin at Cedar Street from the end of the existing pathway that leads to Davis Square and the Linear Path. The terminus of the proposed Path will be located at the Cambridge City limits where it will connect with the multi-use path within the Central Park of the NorthPoint development. This section of path within NorthPoint will connect to the Department of Conservation and Recreation (DCR) pathways along the Charles River. In addition to coordinating the physical arrangements of the proposed Community Path project, there is also an opportunity to integrate the Community Path's neighborhood connections into the transit stations, particularly where the path would cross local streets at grade. The Green Line Extension Project has been coordinated with the Community Path project for compatibility. EOT has worked continuously with the City of Somerville and other interest groups in the development of these plans.

Design on the Somerville Community Path has been ongoing with the City of Somerville as the Project proponent. Major milestones in the design process to date include:

- 2001: Initial Feasibility Study;
- 2003 - Present: Design of Phase One path (Cedar Street to Central Street);
- 2006: Feasibility Study: School Street to City Line; and
- 2008: Construction of 150-foot section of path east of the Visiting Nurses Association facility between Lowell and Central Streets.

The current status of design can be summarized by sections of the path:

- Cedar Street to Central Street:
  - In 75 percent design; and
  - Short, disconnected section built in 2008.
- Central Street to School Street: Concept identified; and
- School Street to Cambridge Line: Feasibility Study – 2006.

Due to the proximity of the proposed path to the Green Line Extension Project, a number of comments were made in response to the EENF that the Path design should be explored in the context of the Green Line Extension Project. The Secretary's Certificate required the inclusion of conceptual design work for the Path to be included in the DEIR/EA.

As part of the Green Line Extension Project, a design concept has been developed to demonstrate the feasibility to construct the Path alongside the proposed Green Line Extension Project. Construction of the Path is not intended to be part of the Green Line Extension Project.

The typical section of the Path will be bituminous pavement 12 feet wide with 2-foot unpaved shoulders on either side. At "pinch points," or areas where the right-of-way narrows, the Path width and/or shoulder width will be reduced. Figure 3.8-1 shows a typical section of the Somerville Community Path. Additional figures showing the current conceptual layout of the Community Path are included in Appendix E. The estimated cost for construction of the path is approximately $16 million, excluding costs for land acquisition, removal of any contaminated soils, and major utility work.

Figure 3.8-1 Typical Section of Somerville Community Path

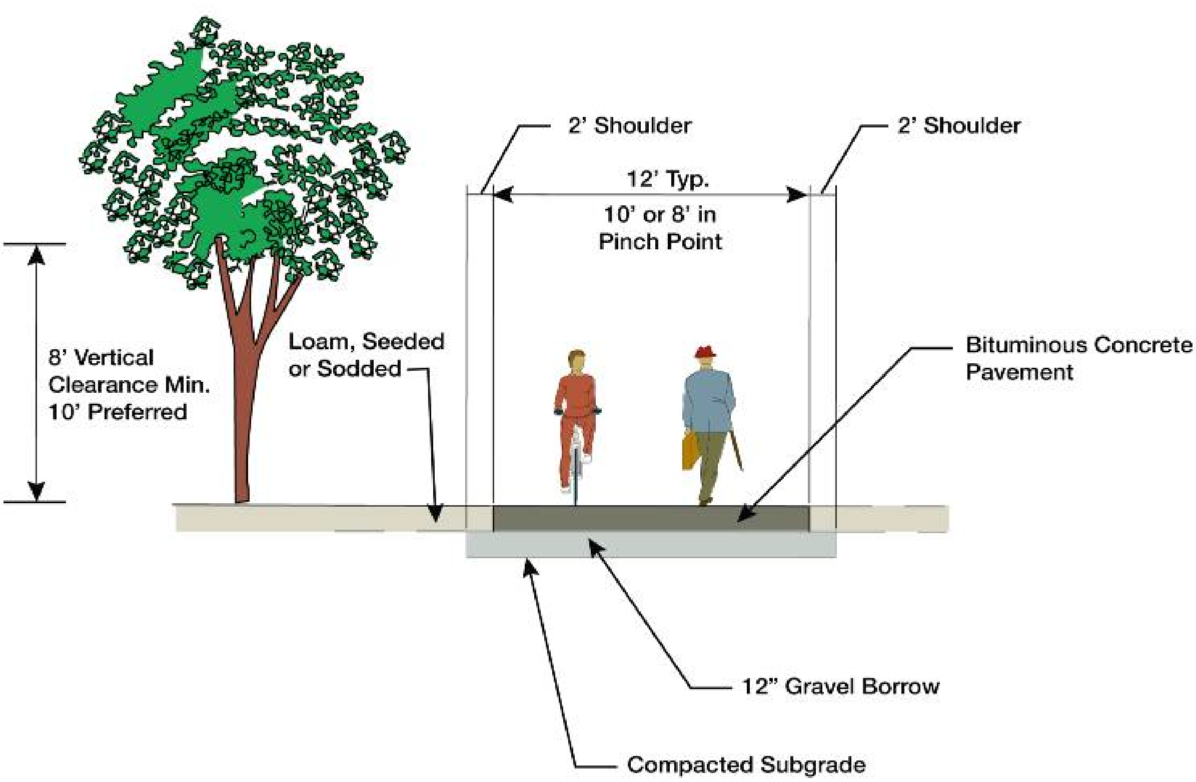


Table 3.8-1 summarizes the pinch points along the proposed Community Path alignment and how the Path design will be adjusted to accommodate the limitations at those locations.

Table 3.8-1 Pinch Points for Somerville Community Path

Location	Length (ft.)	Recommended Solution	Comments
Behind VNA[1]	300	Use cantilevered path	Solution proposed by City's path designer
Approaching School Street	100	Narrow path to 10 ft. wide	Alternative would be to acquire a sliver from adjacent parcels
Cross Street to Washington Street	800	Narrow path to 10 ft. wide	Path constrained by existing buildings
TOTAL	1200		

1 VNA = Visiting Nurse Association assisted living facility at Lowell Street

3.8.2 Medford Community Path Feasibility

The Community Path planning effort completed as part of the Green Line Extension Project conceptual design also evaluated the feasibility of extending the Community Path to Route 16 to make a connection to the Mystic Valley Parkway. Following along the Medford Branch, a new path was evaluated to connect to the Somerville Community Path at Lowell Street and then follow the proposed Green Line Extension to Ball Square and into Medford. At Mystic Valley Parkway, the extension might then connect to the existing pathway system through the DCR reservation along the Mystic River.

The feasibility study considered two primary screening factors – sufficient physical width/right-of-way for the 12-foot paved path with two 2-foot shoulders along the entire length of the corridor and/or alternative on-street routes to maintain a continuous connection where adequate width is not available.

The study evaluated the corridor in three segments – Lowell Street to Ball Square, Ball Square to College Avenue and College Avenue to Mystic Valley Parkway. A detailed analysis is provided in Appendix E. However, the results of the study by segment are summarized as follows.

- Lowell Street to Ball Square: The extension is not viable due to insufficient right-of-way width within this mostly residential segment.
- Ball Square to College Avenue: The extension is not viable due to insufficient right-of-way width within this mixed residential, commercial, institutional and industrial segment. Even with land acquisitions there is not enough physical width for the path.
- College Avenue to Mystic Valley Parkway: The extension is not viable due to insufficient right-of-way width within this mixed residential, commercial,

institutional and industrial segment. Boston Avenue does not have adequate pavement width for an on-street facility and therefore would have to be reconstructed to accommodate an on-street bike route or a parallel bike path. Decking over the railroad right-of-way was considered, however this option is limited since the track bed north of Winthrop Street is raised above the abutting properties.

3.9 Coordination with Regional Projects

The communities in the study area are pursuing a number of transportation and development projects that are of importance to the Project study area. Descriptions of the key features of these undertakings are provided in the following sections, which also discuss their relationship to the Green Line Extension Project.

3.9.1 Urban Ring

The Urban Ring project, in the planning stages during the development of this DEIR/EA, is a three-phased transit improvement project within a corridor approximately two miles outside of the downtown Boston core. The project includes segments within the municipalities of Boston, Cambridge, Somerville, Brookline, Everett, Medford, and Chelsea; these areas include some of the fastest growing areas around Boston. The neighborhoods in the corridor are facing significant challenges, including:

- Inadequate existing transit accessibility and mobility;
- Transit congestion in the Boston core;
- Degraded environment and quality of life caused by auto congestion and air pollution in the neighborhoods of the corridor;
- Constrained economic development by traffic congestion and poor transit access; and
- Growing public demand for more transit choices due to rising fuel costs and greater awareness of the effects of auto emissions on climate change.

The Urban Ring project is designed to address these issues by providing new transit services that would connect to existing radial transit lines (subway, commuter rail, and bus) to create shorter transit trips and few transfers in the corridor.[2]

The initial phase has consisted of implementing three "Crosstown" bus routes by the MBTA, designated CT-1, CT-2, and CT-3. In late 2004, the MBTA completed the DEIR for Phase 2 of the project, followed by a July 2007 Notice of Project Change (approval

2 http://www.theurbanring.com/urbanfacts.asp

of revised project schedule). The DEIR envisions implementing various Bus Rapid Transit (BRT) routes, expanded Crosstown bus services, and improved intermodal transit connections. These services would provide connections from the existing Silver Line/Dudley Street terminal in Boston extending north and then east through the Longwood Medical Area, Kenmore Square, Massachusetts Institute of Technology (MIT), Kendall Square, Lechmere, Union Square, Assembly Square, Orange Line stations between Community College and Wellington, and east to Chelsea and Logan Airport. In addition to the proposed BRT routes, Phase 2 of the Urban Ring project provides new commuter rail stations at Union Square, Gilman Square, and Sullivan Square. Phase 3 of the Urban Ring project envisions converting some Phase 2 BRT routes and services to light rail and heavy rail rapid transit operations. Phase 3 has been developed as part of a Major Investment Study by the MBTA. Submittal of the Phase 3 DEIR is anticipated in June 2011.

The Urban Ring and Green Line Extension Projects are envisioned to provide services that complement each other and provide a greater benefit for the communities. Together, the Urban Ring in conjunction with the Green Line Extension Project would provide environmental and economic benefit to the neighborhoods surrounding the greater Boston area.

3.9.2 Reconstruction of Route 28/McGrath Highway

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.

3.9.3 NorthPoint Development and Relocation of Lechmere Station

NorthPoint is the 45-acre area in Cambridge south of the MBTA Fitchburg Line and north of the boundary line that separates Somerville and Cambridge. NorthPoint has been part of a planning initiative undertaken by the City of Cambridge to promote a new, dense urban neighborhood. The area is within the Charles River Basin area between the Charles River Esplanade and Boston's Harbor Park. The proposed mixed-use development may eventually include up to 21 buildings with 2,700 residential units, 2.1 million square feet of office/lab space, and 75,000 square feet of retail space. This project has been reviewed by MEPA. The Final Environmental Impact Report (FEIR) Certificate was issued in December 2002 (EEA # 12650).

The NorthPoint development promises to transform a formerly underutilized area of land straddling Boston, Cambridge, and Somerville into a vital mixed-used, transit oriented neighborhood. The groundbreaking for the NorthPoint development occurred in March 2005, and marked the start of Phase 1 construction on two residential buildings totaling 329 condominiums, and half of the 10-acre Central Park green space. The NorthPoint project would require continuing coordination among the private developer, the communities, and the MBTA, particularly as the Lechmere Station relocation is undertaken.

Planning and design of the Lechmere Station Relocation project is currently a part of the Green Line Extension Project. Although design and construction funding for the relocation of Lechmere Station was previously being financed primarily by private (NorthPoint development) and Federal (FTA) funds, recent changes in the NorthPoint development have left uncertain the future opening year of the Relocated Lechmere Station. The alignment of the Green Line Extension Project would not be possible without the relocation of the station. Therefore, the Green Line Extension Project has extended its original limits to include planning for the relocation of Lechmere Station.

The Charles E. Smith residential development, adjacent to NorthPoint, is a planned residential community. The project is proposed to redevelop an existing warehouse and retail operation into an apartment complex consisting of approximately 750 housing units in two buildings. A parking structure for approximately 900 spaces is also proposed.

Together, NorthPoint and the Charles E. Smith development would be important contributors to the Green Line Extension Project. In order to properly design station platforms, service headways, and the required number of Green Line vehicles, it is crucial to account for their transit ridership contribution to the expanded Green Line ridership increases. It is also important to note that NorthPoint and the Charles E. Smith residential project are transit-oriented developments that can contribute to Green Line Extension Project's objectives to promote a decrease in automobile dependence within the study area.

3.9.4 Minuteman to Mystic Valley Parkway Path

The DCR is currently developing a Mystic River Reservation Master Plan. The key element of the plan is to provide a guide to implementing a continuous river corridor trail system from the Harvard Avenue Bridge in Medford to the Alford Street Bridge between Somerville and Everett. This trail system would provide access to an almost continuous stretch of DCR property along both banks of the Mystic River, and would link recreation areas, overlooks, and canoe/kayak launches and pull-outs. The trail system would connect to existing trail networks along the Malden River and Alewife Brook, and would provide future access to the Mystic Lakes and Lower Mystic waterfront. The trail system is also envisioned to:

- Provide safe access to the Mystic River from MBTA subway and bus stops as well as surrounding neighborhoods;

- Connect to local pedestrian pathways and bicycle trails;
- Provide recreational loop trails where possible; and
- Connect destinations such as parks, conservation space, and commercial areas.

This project is of particular interest to the design of the Mystic Valley Parkway/ Route 16 Station of the Green Line Extension. Coordinating the physical integration of the pathway with the proposed station can help encourage safe and multi-modal access between these two uses.

3.9.5 Assembly Square Orange Line Station

Several alternative configurations have been developed for the proposed Assembly Square Orange Line Station, a project currently under study by the City of Somerville. All of the alternatives minimize any encroachment on the development parcels at the western side of the proposed station while also minimizing the need for realignment of the Orange Line tracks and the Haverhill/Reading Line commuter rail tracks east of the Orange Line. The station configuration is ultimately intended to consist of three tracks serving two center platforms, taking full advantage of the three-track Orange Line configuration at this location. Operational issues are also being addressed, notably the impact on existing Orange Line operations due to the implementation of a new station. Other issues include impacts on travel times, headways, passenger capacity, and the possible need for additional cars.

The proposed Assembly Square Orange Line Station is an important element in the planning of the Green Line Extension Project because, in order to properly estimate the increase in Green Line ridership totals, it is crucial to understand the relationship between the service the new Orange Line station would provide to the surrounding neighborhoods and how that service will affect the future ridership draw onto the proposed Green Line Expansion.

3.10 Summary

Based on the requirements of the December 1, 2006 Secretary of Environmental Affairs Certificate on the Green Line Extension EENF (EEA Number 13866), the Green Line Extension Project includes a No-Build Alternative, a “Baseline” Alternative, in accordance with the FTA’s requirements, and six “Build” Alternatives. Four of the Build Alternatives would provide service to both Medford and to Union Square in Somerville; one Build Alternative would provide service to Medford only (terminating at a new Mystic Valley Parkway/Route 16 Station); and one Build Alternative would provide service to Union Square only.

Alternative 1 is the "Proposed Project" and the subject of this DEIR/EA, for which EOT is currently seeking approval by the FTA. Alternative 2 is EOT's "Preferred Alternative" which extends the Project to the Mystic Valley Parkway/Route 16. EOT has programmed 'flex' funds to construct the extension from College Avenue to Mystic Valley Parkway/Route 16 as a second phase. The second phase will be constructed after 2014 and will require a separate MEPA/NEPA assessment at a future date.

The following chapters discuss the impact the Green Line Extension Project would have on the surrounding environment as well as the proposed mitigation measures to alleviate these impacts.

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

City	Total Population	Percentage of Population by Race							
		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

Route	Daily Ridership	Number of Weekday Inbound Bus Trips: 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 East of Canal Street	Eastbound	8,995	570	6.3%	54%	775	8.6%	57%
	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 South of Prescott Street	Northbound	1,670	185	11.1%	50%	180	10.8%	60%
	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 Boston Avenue	Eastbound	13,435	955	7.1%	44%	965	7.2%	47%
	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 North of Holton Street	Northbound	3,010	230	7.6%	36%	280	9.3%	54%
	Southbound	3,200	415	13.0%	64%	235	7.3%	46%
	Total	6,210	645	10.4%	100%	515	8.3%	100%
Boston Avenue South of University Avenue	Northbound	5,580	295	5.3%	34%	540	9.7%	62%
	Southbound	5,425	575	10.6%	66%	325	6.0%	38%
	Total	11,005	870	7.9%	100%	865	7.9%	100%
Boston Avenue South of Harvard Street	Northbound	3,105	225	7.2%	39%	290	9.3%	55%
	Southbound	3,210	350	10.9%	61%	240	7.5%	45%
	Total	6,315	575	9.1%	100%	530	8.4%	100%
College Avenue East of Boston Avenue	Eastbound	3,795	230	6.1%	35%	355	9.4%	50%
	Westbound	4,930	435	8.8%	65%	360	7.3%	50%
	Total	8,725	665	7.6%	100%	715	8.2%	100%
College Avenue West of Boston Avenue	Eastbound	4,030	215	5.3%	28%	370	9.2%	50%
	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)

			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
Winthrop Street East of Boston Avenue	Eastbound	7,200	595	8.3%	64%	720	10.0%	72%
	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 West of Boston Avenue	Eastbound	4,465	350	7.8%	71%	345	7.7%	70%
	Westbound	2,405	145	6.0%	29%	150	6.2%	30%
	Total	6,870	495	7.2%	100%	495	7.2%	100%
Harvard Street East of Boston Avenue	Eastbound	7,585	525	6.9%	46%	550	7.3%	48%
	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 Avenue & Winchester Street	Eastbound	11,205	1,030	9.2%	57%	745	6.6%	45%
	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 Square	Northbound	8,150	585	7.2%	42%	645	7.9%	51%
	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 & Kidder Avenue	Northbound	2,730	165	6.0%	54%	240	8.8%	70%
	Southbound	1,710	195	11.4%	46%	105	6.1%	30%
	Total	4,440	360	8.1%	100%	345	7.8%	100%
Medford Street South of School Street	Northbound	4,405	190	4.3%	27%	425	9.6%	63%
	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 Street & Central Street	Eastbound	8,570	895	10.4%	77%	525	6.1%	55%
	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 South of School Street	Northbound	6,680	375	5.6%	35%	675	10.1%	56%
	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 Street & Princeton Street	Northbound	1,785	115	6.4%	34%	140	7.8%	54%
	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 Between Greenville Street and Cross Street	Northbound	22,345	975	4.4%	24%	2,115	9.5%	56%
	Southbound	29,105	3,045	10.5%	76%	1,650	5.7%	44%
	Total	51,450	4,020	7.8%	100%	3,765	7.3%	100%
Washington Street West of Hawkins Street	Eastbound	4.980	355	7.1%	52%	375	7.5%	54%
	Westbound	5.205	330	6.3%	48%	325	6.2%	46%
	Total	10.185	685	6.7%	100%	700	6.9%	100%
Washington Street East of Tufts Avenue	Eastbound	10,050	540	5.4%	35%	765	7.6%	44%
	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 East of Merriam Street	Eastbound	12,865	730	5.7%	41%	975	7.6%	51%
	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 East of Prospect Street	Eastbound	7,005	480	6.9%	72%	465	6.6%	61%
	Westbound	4,030	185	4.6%	28%	300	7.4%	39%
	Total	11,035	665	6.0%	100%	765	6.9%	100%
Prospect Street South of Webster Street	Northbound	6,410	315	4.9%	53%	430	6.7%	64%
	Southbound	3,920	285	7.3%	47%	240	6.1%	36%
	Total	10,330	600	5.8%	100%	670	6.5%	100%
Webster Street South of Prospect Street	Northbound	5,180	230	4.4%	37%	485	9.3%	76%
	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		Evening Peak Hour	
		Average Delay (sec)	PLOS	Average Delay (sec)	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).

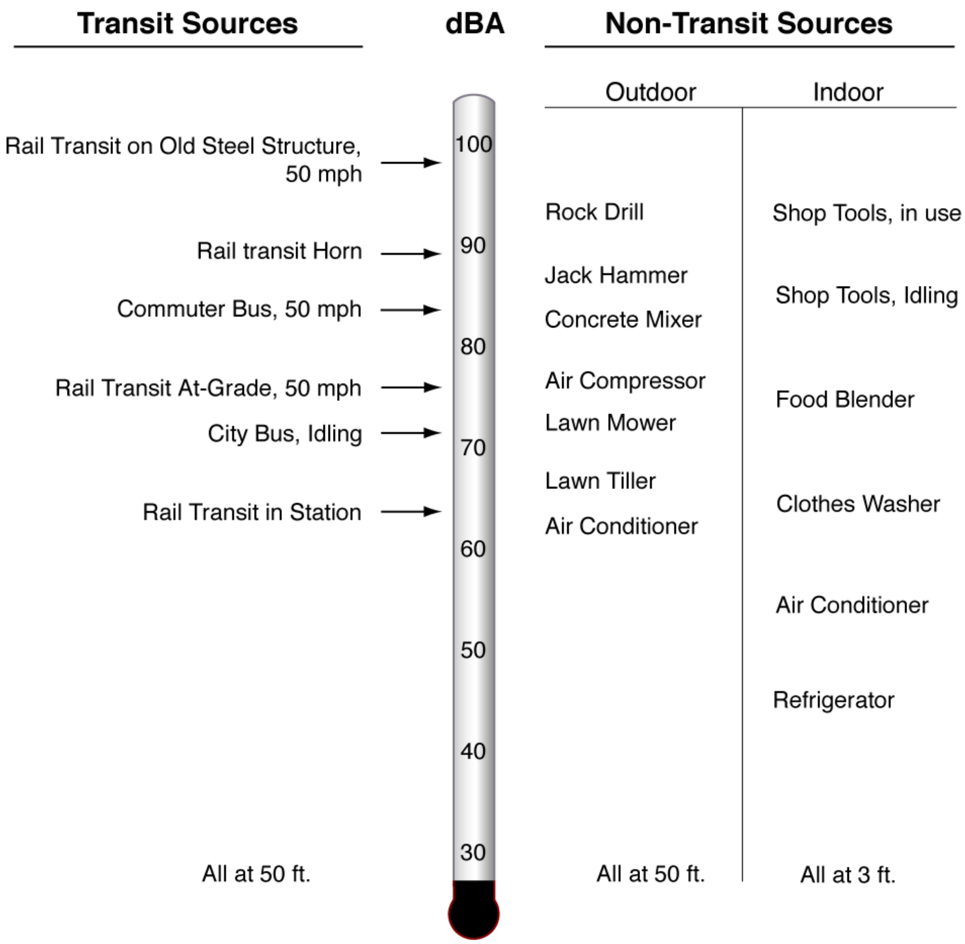
4.8.1 Introduction

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

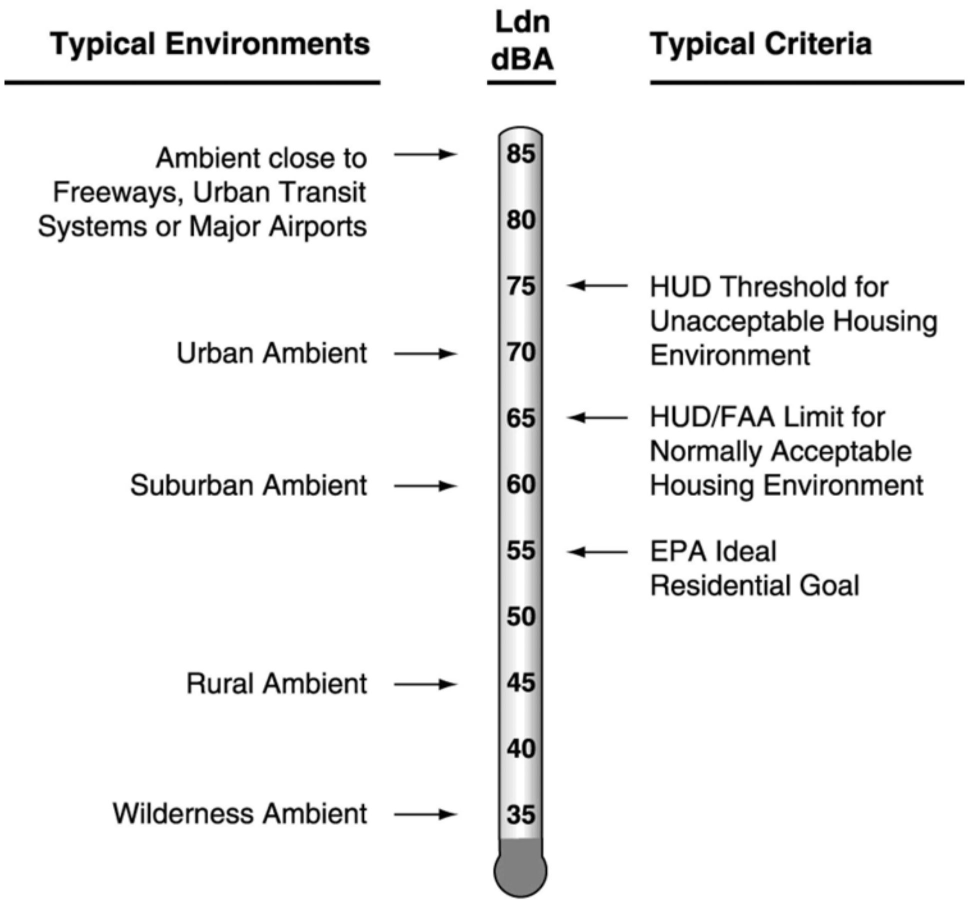


Source: Harris Miller Miller & Hanson, 2008

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:

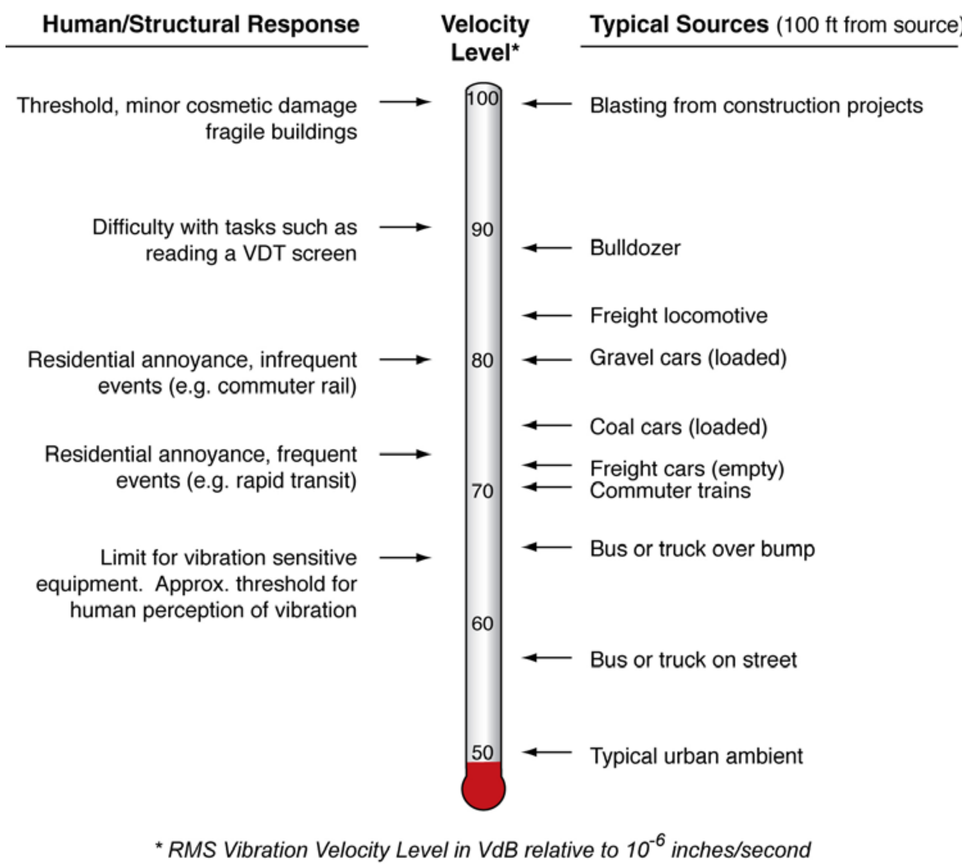
- Background information on vibration;
- Description of FTA vibration-sensitive land use categories;
- Identification of vibration sensitive locations along the corridor; and
- Measurement results of the existing vibration conditions.

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

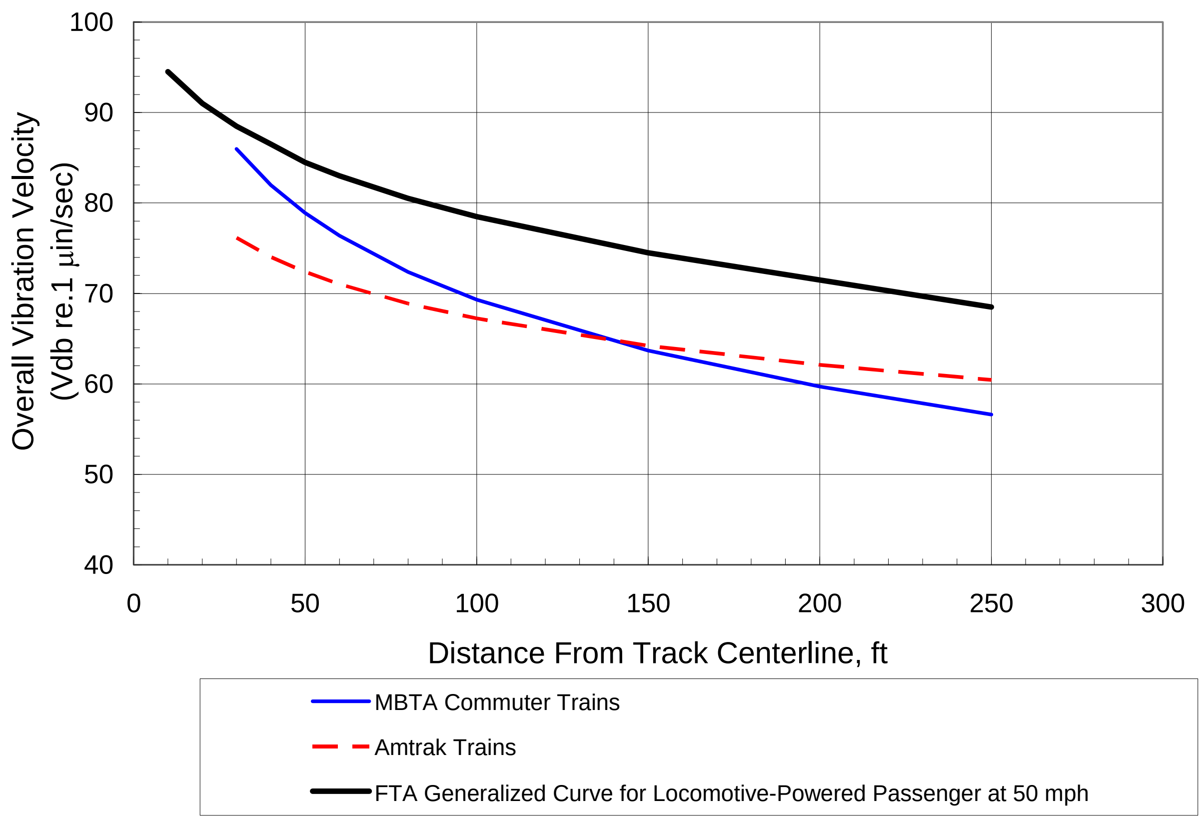


Figure 4.9-2 shows the maximum overall vibration level for each train type at a range of distances and the typical FTA generalized curve for locomotive-powered passenger trains at 50 mph. This figure shows that the vibration levels from the MBTA commuter and Amtrak trains are about five to 10 VdB lower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

5

Environmental Consequences

5.1 Introduction

This chapter discusses the impacts that each alternative may have on the environmental resources described in Chapter 4, *Affected Environment*. Figure 3.5-1 and Figures 3.6-1 through 3.6-6 show the alternatives under consideration. The sections in this chapter respond to the requirements of the Secretary's Certificate on the Expanded Environmental Notification Form (EENF) and consider the comment letters received on the EENF. The analyses for each section were developed in compliance with the National Environmental Policy Act (NEPA) and Massachusetts Environmental Policy Act (MEPA) regulations and guidance developed by the Council on Environmental Quality (CEQ) and the Federal Transit Administration (FTA).

5.2 Land Use

The CEQ regulations at 40 CFR 1500 et seq. require an assessment of direct effects and their significance for Federally-assisted projects. MEPA regulations require an assessment of short-term and long-term impacts for all phases of the Project, including acquisition (301 CMR 11.07), and the Secretary's Certificate requires that this Draft Environmental Impact Report (DEIR) identify temporary and permanent land acquisitions. This section summarizes the direct effects on land use for each alternative (see Section 4.2, *Land Use*, for information on the affected environment; Section 5.3, *Socioeconomic Impacts*, for socioeconomic impacts; and Section 5.15, *Indirect and Cumulative Effects*, for indirect effects not addressed in this section).

5.2.1 Overview

Direct effects are defined by the CEQ as effects "which are caused by the [proposed] action and occur at the same time and place…Effects includes ecological (such as the effects on natural resources and on the components, structures, and functioning of affected ecosystems), aesthetic, historic, cultural, economic, social, or health…Effects may also include those resulting from actions which may have both beneficial and detrimental effects, even if on balance the agency believes that the effect will be beneficial." For this section, direct effects or direct impacts on land use are defined as displacements of properties or property acquisitions required for the Project.

The following sections summarize the direct land use impacts of the Baseline Alternative and each of the six Build Alternatives. Proposed property acquisitions surrounding each proposed station are shown on Figures 5.2-1 through 5.2-9. The acquisitions presented in this section were identified as full or partial takings. It is assumed at this level of conceptual planning and design that if a commercial property is impacted by a potential station that the entire property would be acquired. However, as the Project advances, the final design will strive to reduce the necessary acquisitions in order to have the least possible impact on local neighborhoods and property owners.

5.2.2 Baseline Alternative

There are no land use impacts under the Baseline Alternative.

5.2.3 Alternative 1: Extension to Medford Hillside and Union Square (via commuter rail right-of-way)

The land acquisitions for the extension of the Green Line to Medford Hillside are summarized in Table 5.2-1, and the land acquisitions for the extension to Union Square are summarized in Table 5.2-2. The Medford Branch would affect 28 parcels for a total of 10.1 acres, and the Union Square Branch would affect 10 parcels for a total of 1.4 acres. Acquisitions are concentrated in the following areas: Yard 8; Brickbottom Station; Gilman Square Station; Ball Square Station; and Union Square Station.

The electrical substation on Medford Street near Gilman Square (Table 5.2-1) would need to be relocated. Discussions with NSTAR have indicated that the substation could likely be relocated on the same property, allowing the Massachusetts Bay Transportation Authority (MBTA) to acquire only a portion of this property.

The acquisition of part of 200 Inner Belt Road for the maintenance facility would require voiding an existing building permit for a 64-foot-high, 190,000-square-foot building on this site and would therefore reduce opportunities for future commercial development. The acquisitions in Union Square and at Brickbottom Station would likely decrease low-intensity commercial and light industrial uses in the area of these stations in favor of future mixed-use, high-density transit-oriented development. The acquisitions in Ball Square may change the character of development near the station, as the existing uses (a bowling alley and an auto repair shop) are not high-density uses typically associated with transit-oriented development. The introduction of new high capacity transit into a community will increase the mobility and accessibility, which tends in turn to increase land values and development density. Additional indirect effects on land use are discussed in Section 5.15, *Indirect and Cumulative Effects*.

Table 5.2-1 Land Acquisitions for Extension to Medford Hillside

Address	Description	Cause of Impact	Area (square feet)	Full or Partial Lot Acquisition
Cambridge:				
South of East Street	NorthPoint parcel	Viaduct	6,963	Partial
East Street	City-owned parcel	Viaduct	1,549	Partial
Water Street	City-owned parcel	Viaduct	1,366	Partial
Monsignor O'Brien Highway	NorthPoint parcel	Track junction	240	Partial
Lechmere Station	MBTA station	Station relocation	--	n/a
Somerville:				
1 McGrath Highway	Commercial (undeveloped portion)	Tracks	104	Partial
35 McGrath Highway	Commercial (undeveloped portion)	Tracks	295	Partial
Monsignor O'Brien Highway	Undeveloped area	Viaduct	35,703	Partial
200 Inner Belt Road	Commercial (undeveloped portion)	Yard 8	169,585	Partial
0 Inner Belt Road	Guildford rail yard	Yard 8	83,844	Full
24 Joy Street	Vacant	Brickbottom Station	12,000	Full
30 Joy Street	Vacant	Brickbottom Station	6,000	Full
Medford Street	Electrical substation	Tracks	37,947	Full
350 Medford Street	The Homan's Building (vacant, city-owned)	Gilman Square Station	48,296	Full
20 Vernon Street	Factory/artist studios (parking lot)	Tracks	2,779	Partial
61 Clyde Street	Undeveloped portion	Tracks	4,348	Partial
42 Murdock Street #1, 2, 3	3-family residence/condo (yard)	Tracks	260	Partial
46 Murdock Street	2-family residence (yard)	Tracks	260	Partial
50 Murdock Street	Vacant lot (yard)	Tracks	260	Partial
Rear of 54/56 Murdock Street	NA	Tracks	260	Partial
675 Broadway (Somerville part)	Lot 2: Veterinary office; Lot 3: Karate studio	Ball Square Station	7,555	Full
662 Boston Avenue (Somerville part)	Auto Repair	Ball Square Station	340	Full
664 Boston Avenue (Somerville part)	Bowling Alley	Ball Square Station	340	Full
Medford				
675 Broadway (Medford part)	Lot 2: Veterinary office	Ball Square Station	4,448	Full
662 Boston Avenue (Medford part)	Auto repair	Ball Square Station	5,927	Full
664 Boston Avenue (Medford part)	Bowling alley	Ball Square Station	5,927	Full
Boston Avenue	Street right-of-way (Commonwealth of MA)	Tracks	1,739	Partial
675 Broadway (Medford part)	Lot 2: Veterinary office	Ball Square Station	4,448	Full
662 Boston Avenue (Medford part)	Auto repair	Ball Square Station	5,927	Full
664 Boston Avenue (Medford part)	Bowling alley	Ball Square Station	5,927	Full
Boston Avenue	Street right-of-way (Commonwealth of MA)	Tracks	1,739	Partial
590 Boston Avenue	Gas station/car wash (lot)	Tracks	285	Partial
474 Boston Avenue	Student offices and café (lot)	Tracks	580	Partial
179 College Avenue	Street right-of-way (Commonwealth of MA)	Tracks	180	Partial
Boston Avenue	Street right-of-way (Commonwealth of MA)	Tracks	1,205	Partial
Total number of parcels: 28		**Total Area:**	**440,590 square feet (10.1 acres)**	

Table 5.2-2 Land Acquisitions for Extension to Union Square (via commuter rail right-of-way)

Address	Description	Cause of Impact	Area (square feet)	Full or Partial Lot Acquisition
Somerville:				
1 Fitchburg Street	Retail condominium (lot)	Tracks	954	Partial
McGrath Highway (under)	City-owned parcel	Tracks	954	Partial
120 McGrath Highway	Garage (lot)	Tracks	954	Partial
35 Charlestown Street	NA (lot)	Tracks	1,132	Partial
174 Somerville Avenue	Shopping mall (lot)	Tracks	1,132	Partial
51 Allen Street	Auto repair	Tracks	31,761	Full
40 Bennett Street	Warehouse (lot)	Tracks	1,004	Partial
Rear of 50 Prospect Street	Storage lot for commercial building	Union Square Station	8,039	Full
50 Prospect Street	Commercial building	Union Square Station	13,037	Full
42 Prospect Street	Vacant	Union Square Station	3,021	Full
Total number of parcels: 10		**Total Area:**	**61,988 square feet (1.4 acres)**	

NA = Not available.

5.2.4 Alternative 2: Extension to Mystic Valley Parkway/Route 16 and Union Square (via commuter rail right-of-way)

The land acquisitions for the extension to Mystic Valley Parkway/Route 16 are summarized in Table 5.2-3, and the land acquisitions for the extension to Union Square via commuter rail right-of-way are summarized in Table 5.2-2. The Medford Branch would affect 33 parcels for a total of 16.7 acres, and the Union Square Branch would affect 10 parcels for a total of 1.4 acres. The acquisitions for the Medford Branch would be the same as the acquisitions for the Medford Branch in Alternative 1 (listed in Table 5.2-1) with the addition of two new parcels in Somerville and four new parcels in Medford. Acquisitions are concentrated in the following areas: Yard 8; Brickbottom Station; Gilman Square Station; Ball Square Station; Mystic Valley Parkway/Route 16 Station; and Union Square Station. The electrical substation discussed for Alternative 1 in Section 5.2.3 would also need to be relocated under this alternative.

Table 5.2-3 Land Acquisitions for Extension to Mystic Valley Parkway/Route 16

Address	Description	Cause of Impact	Area (sq. ft)	Full or Partial Lot Acquisition
Cambridge				
South of East Street	NorthPoint parcel	Viaduct	6,963	Partial
East Street	City-owned parcel	Viaduct	1,549	Partial
Water Street	City-owned parcel	Viaduct	1,366	Partial
Monsignor O'Brien Highway	NorthPoint parcel	Track junction	240	Partial
Lechmere Station	MBTA station	Station relocation	--	n/a
Somerville				
1 McGrath Highway	Commercial (undeveloped portion)	Tracks	104	Partial
35 McGrath Highway	Commercial (undeveloped portion)	Tracks	295	Partial
Monsignor O'Brien Highway	Undeveloped area	Viaduct	35,703	Partial
200 Inner Belt Road	Commercial (undeveloped portion)	Yard 8	169,585	Partial
0 Inner Belt Road	Guildford rail yard	Yard 8	83,844	Full
24 Joy Street	Vacant	Brickbottom Station	12,000	Full
30 Joy Street	Vacant	Brickbottom Station	6,000	Full
Medford Street	Electrical substation	Tracks	37,947	Full
350 Medford Street	The Homan's building (vacant, city-owned)	Gilman Square Station	48,296	Full
20 Vernon Street	Factory/artist studios (parking lot)	Tracks	2,779	Partial
61 Clyde Street	Undeveloped portion	Tracks	4,348	Partial
42 Murdock Street #1, 2, 3	3-family residence/condo (yard)	Tracks	260	Partial
46 Murdock Street	2-family residence (yard)	Tracks	260	Partial
50 Murdock Street	Vacant lot (yard)	Tracks	260	Partial
Rear of 54/56 Murdock Street	NA	Tracks	260	Partial
675 Broadway (Somerville part)	Lot 2: Veterinary office; Lot 3: Karate studio	Ball Square Station	7,555	Full
662 Boston Avenue (Somerville part)	Auto repair	Ball Square Station	341	Full
664 Boston Avenue (Somerville part)	Bowling alley	Ball Square Station	341	Full
600 Mystic Valley Parkway	Commercial storage business	Mystic Valley Parkway Station	95,348	Full
200R Boston Avenue (Somerville part)	Vacant	Mystic Valley Parkway Station	10,996	Full
Medford				
675 Broadway (Medford part)	Lot 2: Veterinary office	Ball Square Station	4,448	Full
662 Boston Avenue (Medford part)	Auto repair	Ball Square Station	5,927	Full
664 Boston Avenue (Medford part)	Bowling alley	Ball Square Station	5,927	Full
Boston Avenue	Street right-of-way (Commonwealth of MA)	Tracks	1,739	Partial
590 Boston Avenue	Gas station/car wash (lot)	Tracks	285	Partial
474 Boston Avenue	Student offices and café (lot)	Tracks	580	Partial
179 College Avenue	Street right-of-way (Commonwealth of MA)	Tracks	180	Partial
Boston Avenue	Street right-of-way (Commonwealth of MA)	Tracks	1,205	Partial
222 Boston Avenue	Multi-office building	Mystic Valley Parkway Station	28,443	Full
200 Boston Avenue	Multi-office and Research & Development building	Mystic Valley Parkway Station	152,460	Full
Piggott Road	Residence (lot)	Mystic Valley Parkway Station	50	Partial
200R Boston Avenue (Medford part)	Vacant lot	Mystic Valley Parkway Station	1,083	Partial
Total number of parcels: 33		**Total Area:**	**728,970 square feet (16.7 acres)**	

NA = Not available.

The acquisition of part of 200 Inner Belt Road for the maintenance facility would require voiding an existing building permit for a 64-foot-high, 190,000-square-foot building on this site and would therefore reduce opportunities for future commercial development. The acquisitions in Union Square and at Brickbottom Station would likely decrease low-intensity commercial and light industrial uses in the area of these stations in favor of future mixed-use, high-density transit-oriented development. The acquisitions in Ball Square may change the character of development near the station, as the existing uses (a bowling alley and an auto repair shop) are not high-density uses typically associated with transit-oriented development. The commercial and office/research-and-development building acquisitions at Mystic Valley Parkway/Route 16 Station would not likely change the character of development in this area, as high-density, mixed-use transit-oriented development is similar to the development that would be displaced.

5.2.5 Alternative 3: Extension to Medford Hillside and Union Square (via McGrath Highway/Route 28 and Somerville Avenue)

The land acquisitions for the extension to Medford Hillside are summarized in Table 5.2-1, and the land acquisitions for the extension to Union Square are summarized in Table 5.2-4. The Medford Branch would affect 28 parcels for a total of 10.1 acres, and the Union Square Branch would affect 19 parcels for a total of 4.4 acres. Acquisitions are concentrated in the following areas: Yard 8; Brickbottom Station; Gilman Square Station; Ball Square Station; and along the Union Square Prospect Street alignment and at the station. The electrical substation discussed for Alternative 1 in Section 5.2.3 would also need to be relocated under this alternative.

The acquisition of part of 200 Inner Belt Road for the maintenance facility would require voiding an existing building permit for a 64-foot-high, 190,000-square-foot building on this site and would therefore reduce opportunities for future commercial development. The building acquisitions in Union Square and at Brickbottom Station would likely decrease low intensity commercial and light industrial uses in the area of these stations in favor of future mixed-use, high-density transit-oriented development. The acquisitions in Ball Square may change the character of development near the station, as the existing uses (a bowling alley and an auto repair shop) are not high-density uses typically associated with transit-oriented development.

Table 5.2-4 Land Acquisitions for Extension to Union Square (via McGrath Highway/Route 28 and Somerville Avenue)

Address	Description	Cause of Impact	Area (sq. feet)	Full or Partial Lot Acquisition
Somerville:				
1 Fitchburg Street	Retail condominium (lot)	Tracks	1,356	Partial
McGrath Highway (under)	City-owned parcel	Tracks	1,356	Partial
120 McGrath Highway	Garage (lot)	Tracks	1,584	Partial
McGrath Highway	NA (lot)	Loop track	31,665	Full
160 McGrath Highway	NA (lot)	Loop track	31,665	Full
200 McGrath Highway	Commercial/industrial lot	Loop track	31,665	Full
216 McGrath Highway	Commercial building	Loop track	31,665	Full
40 Bennett Street	Warehouse (lot)	Tracks	135	Partial
Rear of 50 Prospect Street	Storage lot for commercial building	Union Square Station	8,039	Full
50 Prospect Street	Commercial building	Union Square Station	13,037	Full
42 Prospect Street	Vacant	Union Square Station	3,021	Full
32 Prospect Street	Vacant commercial/industrial building	Union Square Station	4,379	Full
Beside 32 Prospect Street	Industrial storage lot	Union Square Station	5,748	Full
Beside 30 Prospect Street	Industrial storage lot	Union Square Station	2,326	Full
30 Prospect Street	Residence (2-family home) with small business	Union Square Station	2,342	Full
26 Prospect Street	Residence (2-family home)	Union Square Station	5,676	Full
266 Somerville Avenue	City-owned building	Union Square Station	5,422	Full
Somerville Avenue	Vacant	Tracks	2,827	Full
Prospect Street	Parking lot (city-owned)	Tracks	7,706	Full
Total number of parcels: 19		**Total Area:**	**191,615 square feet (4.4 acres)**	

5.2.6 Alternative 4: Extension to Mystic Valley Parkway/Route 16 and Union Square (via McGrath Highway/Route 28 and Somerville Avenue)

The land acquisitions for the extension to Mystic Valley Parkway/Route 16 are summarized in Table 5.2-3, and the land acquisitions for the extension to Union Square via McGrath Highway/Route 28 and Somerville Avenue are summarized in Table 5.2-4. The Medford Branch would affect 33 parcels for a total of 16.7 acres, and the Union Square Branch would affect 19 parcels for a total of 4.4 acres. Acquisitions are concentrated in the following areas: Yard 8; Brickbottom Station; Gilman Square Station; Ball Square Station; Mystic Valley Parkway/Route 16 Station; and along the Union Square alignment and station. The electrical substation discussed for Alternative 1 in Section 5.2.3 would also need to be relocated under this alternative.

The acquisition of part of 200 Inner Belt Road for the maintenance facility would require voiding an existing building permit for a 64-foot-high, 190,000-square-foot building on this site and would therefore reduce opportunities for future commercial development. The acquisitions in Union Square and at Brickbottom Station would likely decrease low-intensity commercial and light industrial uses in the area of these stations in favor of future mixed-use, high-density transit-oriented development. The acquisitions would also eliminate two different two-family homes. The acquisitions in Ball Square may change the character of development near the station, as the existing uses (a bowling alley and an auto repair shop) are not high-density uses typically associated with transit-oriented development. The commercial and office/research-and-development building acquisitions at Mystic Valley Parkway/Route 16 Station would not likely change the character of development in this area, as high-density, mixed-use transit-oriented development is similar to the development that would be displaced.

5.2.7 Alternative 5: Extension to Mystic Valley Parkway/Route 16

The land acquisitions for the extension to Mystic Valley Parkway/Route 16 are summarized in Table 5.2-3. The Medford Branch would affect 33 parcels for a total of 16.7 acres. Acquisitions are concentrated in the following areas: Yard 8; Brickbottom Station; Gilman Square Station; Ball Square Station; and Mystic Valley Parkway/Route 16 Station. The electrical substation discussed for Alternative 1 in Section 5.2.3 would also need to be relocated under this alternative.

The acquisition of part of 200 Inner Belt Road for the maintenance facility would require voiding an existing building permit for a 64-foot-high, 190,000-square-foot building on this site and would therefore reduce opportunities for future commercial development. The acquisitions in the Brickbottom district would likely decrease the low-intensity commercial and light industrial uses in the area of the Brickbottom station in favor of future mixed-use, high-density transit-oriented development. The acquisitions in Ball Square may change the character of development near the station, as the existing uses (a bowling alley and an auto repair shop) are not high-density uses typically associated with transit-oriented development. The commercial and office/research-and-development building acquisitions at Mystic Valley Parkway/Route 16 Station would not likely change the character of development in this area, as high-density, mixed-use transit-oriented development is similar to the development that would be displaced.

5.2.8 Alternative 6: Extension to Union Square (via commuter rail right-of-way)

The land acquisitions for the extension to Union Square via commuter rail right-of-way are summarized in Table 5.2-2. The maintenance facility would also require the acquisition of the 0 Inner Belt Road and 200 Inner Belt Road parcels noted in Table 5.2-1. The Union Square Branch would affect 12 parcels for a total of 7.2 acres. Acquisitions are concentrated in the area of Union Square Station and the maintenance facility.

The acquisitions in Union Square would likely decrease low intensity commercial and light industrial uses in the area of this station in favor of future mixed-use, high-density transit-oriented development.

5.2.9 Summary of Land Acquisitions

In general, the six Build Alternatives are likely to decrease low-intensity commercial and light industrial uses in the Project corridor and increase mixed-use, high-density transit-oriented development, particularly at Union Square, Brickbottom Station, and Ball Square Station. Two different two-family residences would be displaced in the extension to Union Square (via McGrath Highway and Somerville Avenue).

The largest area acquisitions are for the Project's maintenance and storage facility at Yard 8 in Somerville (two parcels totaling 5.8 acres), the Mystic Valley Parkway/Route 16 Station (five parcels totaling 6.6 acres), and the extension to Union Square via McGrath Highway and Somerville Avenue (19 parcels totaling 4.4 acres). In terms of impact, the most substantial acquisitions are those that require the displacement and relocation of residences and active businesses. These are located at the Mystic Valley Parkway/Route 16 Station (one business and two office/Research and Development (R&D) buildings with multiple businesses), Ball Square (three businesses), and in Union Square (two businesses under the commuter rail right-of-way alternative; three businesses and two different two-family residences under the McGrath Highway and Somerville Avenue alternative). No residences would be displaced for the extension to Mystic Valley Parkway/Route 16 or the extension to Union Square via commuter rail right-of-way.

The designs for the Build Alternatives have been developed with the specific intent of minimizing land acquisitions. Although all of the Build Alternatives require land acquisitions, the use of the existing right-of-way minimizes the property acquisitions, which would be much higher for an extension that involved establishing a new right-of-way through developed properties. Station locations and track curvature have been optimized in order to avoid unnecessary property acquisitions. The acquisitions presented in this section are also conservative planning projections based on the current level of design for the Build Alternatives. The final design for the Preferred Alternative will strive to reduce the necessary acquisitions in order to have the least possible impact on local neighborhoods and property owners. A summary of land acquisitions by alternative is provided in Table 5.2-5.

Table 5.2-5 Summary of Land Acquisitions by Alternative

Alternative	Number of Acquisitions	Acres	Number of Businesses Displaced	Number of Households Displaced
Baseline Alternative	0	0	0	0
Alternative 1	38	11.5	5	0
Alternative 2	43	18.2	6 plus 2 multiple office/ Research & Development buildings	0
Alternative 3	47	14.5	6	4 (two different two-family residences)
Alternative 4	52	21.1	7 plus 2 multiple office/ Research & Development buildings	4 (two different two-family residences)
Alternative 5	33	16.7	4 plus 2 multiple office/Research & Development buildings	0
Alternative 6	12	7.2	2	0

5.3 Socioeconomic Impacts

The Secretary's Certificate specifies that the DEIR should "adequately account for near-term and long-term population projections and job growth" and should describe the potential to change the character of communities, reduce housing affordability, and reduce transit access, most notably for disabled and environmental justice populations. This section addresses the economic effects of property acquisition for the Project and the possible effects on local communities.

In examining the proposed property acquisitions for each Build Alternative, this section examines the acquisitions that would require building demolition rather than those that involve vacant lots or strips of land that would not affect existing buildings. The type of property to be acquired and its estimated value are also taken into account. The acquisition and demolition of existing homes and businesses would have an effect on local economics, whereas land-only acquisitions would not have a direct effect on housing or employment. Direct and indirect effects of land acquisitions are discussed in greater detail in Section 5.2, *Land Use*, and Section 5.15, *Indirect and Cumulative Effects*. Specific analyses of environmental justice populations, including land acquisition and changes in transit access, can be found in Section 5.4, *Environmental Justice*.

5.3.1 No-Build Alternative

No properties would be acquired under the No-Build Alternative, and there would be no change in transit service, resulting in no disruption of existing businesses and no direct socioeconomic impacts or benefits.

5.3.2 Baseline Alternative

The expansion of bus service would increase regional transit access, which could stimulate economic development by an undeterminable amount. Effects on land use and transit access are discussed in greater detail in Section 5.2, *Land Use*, and Section 5.15, *Indirect and Cumulative Effects*.

No properties would be acquired under the Baseline Alternative, resulting in no disruption of existing businesses and no direct socioeconomic impacts.

5.3.3 Common Factors of the Build Alternatives

The Build Alternatives would all involve different amounts of property acquisition, property tax changes, and job displacement. However, many of the relevant socioeconomic factors are similar or identical for all six Build Alternatives.

The acquisition of buildings and properties for the Project is unavoidable due to the dense urban character of the Project Area. Despite the relative abundance of commercial and industrial properties in the affected cities, the acquisition and demolition of existing businesses could result in temporary reductions in local commerce as the affected businesses relocate or permanent reductions if the businesses do not reopen locally or at all. The use of the existing right-of-way minimizes the property acquisitions, which would be much higher for an extension that involved establishing a new right-of-way through developed properties.

The use of the existing right-of-way for most of the tracks also avoids dividing and segmenting any neighborhoods, which could otherwise cause significant changes to the local character. The proposed property acquisitions would not cut off access within any existing neighborhoods or block access from one neighborhood to another.

The increased transit access and ridership has the potential to increase commerce and encourage greater economic development along the Project corridor, which would increase property values and offset decreases in municipal property tax revenue. However, the precise economic benefit of increased transit access cannot be quantified based on existing data. Effects on land use and transit access are discussed in greater detail in Section 5.2, *Land Use*, and Section 5.15, *Indirect and Cumulative Effects*.

The electrical substation on Medford Street near Gilman Square would need to be relocated under Alternatives 1, 2, 3, 4, and 5. Discussions with NSTAR have indicated that the substation could likely be relocated on the same property, allowing MBTA to acquire only a portion of this property. However, as a conservative measure, the costs for acquiring the property and relocating the substation entirely are included in the Green Line Extension Project.

5.3.4 Alternative 1: Green Line Extension to Medford Hillside and Union Square (using commuter rail right-of-way)

Six buildings would be purchased and demolished under this alternative, including three for the extension to Medford Hillside and three for the extension to Union Square. All other acquisitions would involve strips of land or vacant lots and would not require building demolition. Table 5.3-1 lists the annual property taxes for the areas to be acquired.

Table 5.3-1 Property Tax Effects for Alternative 1

Property	Type	Property Taxes on Acquired Area[1]	Estimated Jobs Displaced or Relocated[2]	Purpose of Acquisition
350 Medford Street	Municipal building[3]	$0	0	Gilman Square Station
675 Broadway	Commercial building	$11,928	0	Ball Square Station
662/664 Boston Avenue	Commercial/industrial building	$10,261	5	Ball Square Station
51 Allen Street	Commercial/industrial building	$4,712	2	Union Square Station
50 Prospect Street	Commercial/industrial building	$12,281	11	Union Square Station
Outbuilding at 50 Prospect Street	Commercial/industrial building	$4,892	0	Union Square Station
Non-building acquisitions	Vacant lots, strip acquisition, etc.	$184,165	0	Varies
Subtotals:	**Cambridge**	**$6,527**	**0**	
	Somerville	**$205,935**	**18**	
	Medford	**$15,777**	**0**	
TOTAL		**$228,239**	**18**	

1 Property taxes estimated based on local property tax rates and the most recent assessed value (as of 2008) of any buildings and land involved. Property taxes for partial acquisitions are prorated based on the square footage taken from each parcel.
2 Jobs estimated based on data from InfoUSA and publicly-available data. Municipal buildings are assumed to relocate within the same city and cause no net change. Vacant buildings are assumed to have no jobs under existing conditions.
3 Municipal properties are exempt from property taxes.

The total estimated property tax value of the land and buildings acquired for this alternative is $228,239. These acquisitions would reduce property tax revenue by $6,527 in Cambridge, $15,777 in Medford, and $205,935 in Somerville. The property tax impact is largest in Somerville because most of the proposed alignment and proposed acquisitions would be located in Somerville. A total of 18 jobs would be displaced or relocated, all located in Somerville.

5.3.5 Alternative 2: Green Line Extension to Mystic Valley Parkway/Route 16 and Union Square (using commuter rail right-of-way)

Nine buildings would be purchased and demolished under this alternative, including six buildings for the extension to Mystic Valley Parkway/Route 16 and three buildings for the extension to Union Square. All other acquisitions would involve strips of land or vacant lots and would not require building demolition. Table 5.3-2 lists the annual property taxes for the areas to be acquired.

The total estimated property tax value of the land and buildings acquired for this alternative is $497,847. These acquisitions would reduce property tax revenue by $6,527 in Cambridge, $182,886 in Medford, and $308,434 in Somerville. The property tax impact is largest in Somerville because most of the proposed alignment and proposed acquisitions would be located in Somerville. This alternative has more than double the property tax impact of Alternative 1, primarily due to impacts in Medford.

Table 5.3-2 Property Tax Effects for Alternative 2

Property	Type	Property Taxes on Acquired Area[1]	Estimated Jobs Displaced or Relocated[2]	Purpose of Acquisition
350 Medford Street	Municipal building[3]	$0	0	Gilman Square Station
675 Broadway	Commercial building	$11,928	0	Ball Square Station
662/664 Boston Avenue	Commercial/industrial building	$10,261	5	Ball Square Station
600 Mystic Valley Parkway	Commercial/industrial building	$101,741	13	Mystic Valley Parkway/ Route 16 Station
222 Boston Avenue	Office building	$42,608	30	Mystic Valley Parkway/ Route 16 Station
200 Boston Avenue	Office and Research & Development building	$121,879	194	Mystic Valley Parkway/ Route 16 Station
51 Allen Street	Commercial/industrial building	$4,712	2	Union Square Station
50 Prospect Street	Commercial/industrial building	$12,281	11	Union Square Station
Outbuilding at 50 Prospect Street	Commercial/industrial building	$4,892	0	Union Square Station
Non-building acquisitions	Vacant lots, strip acquisition, etc.	$187,545	0	Varies
Subtotals:	**Cambridge**	**$6,527**	**0**	
	Somerville	**$308,434**	**31**	
	Medford	**$182,886**	**224**	
TOTAL		**$497,847**	**255**	

1 Property taxes estimated based on local property tax rates and the most recent assessed value (as of 2008) of any buildings and land involved. Property taxes for partial acquisitions are prorated based on the square footage taken from each parcel.
2 Jobs estimated based on data from InfoUSA and publicly-available data. Municipal buildings are assumed to relocate within the same city and cause no net change. Vacant buildings are assumed to have no jobs under existing conditions.
3 Municipal properties are exempt from property taxes.

A total of 255 jobs would be displaced or relocated, including 224 jobs in Medford and 31 jobs in Somerville. More jobs would be displaced in Medford than Somerville due to the acquisition of 200 Boston Avenue, which represents approximately 194 jobs.

5.3.6 Alternative 3: Green Line Extension to Medford Hillside (using commuter rail right-of-way) and Union Square (using McGrath Highway/Somerville Avenue)

Under this alternative, 10 buildings would be purchased and demolished, including three buildings for the extension to Medford Hillside and seven buildings for the extension to Union Square. All other acquisitions would involve strips of land or vacant lots and would not require building demolition. Table 5.3-3 lists the annual property taxes for the areas to be acquired.

The total estimated property tax value of the land and buildings acquired for this alternative is $305,086. These acquisitions would reduce property tax revenue by $6,527 in Cambridge, $15,777 in Medford, and $282,781 in Somerville. The property tax impact is largest in Somerville because most of the proposed alignment and proposed acquisitions would be located in Somerville. A total of 38 jobs would be displaced or relocated, all in Somerville.

The use of Somerville Avenue under this alternative increases the property acquisitions relative to Alternatives 1 and 2, although the use of the existing right-of-way for the extension to Medford Hillside minimizes the property impacts for that segment. The segment on Somerville Avenue would use in-street rails and would not prevent pedestrian passage across Somerville Avenue. The proposed property acquisitions would not cut off access within any existing neighborhoods or block access from one neighborhood to another. While this alternative does require acquiring two multi-family residential buildings, these buildings are surrounded by commercial uses, and their acquisition would not divide or segment any neighborhoods.

Table 5.3-3 Property Tax Effects for Alternative 3

Property	Type	Property Taxes on Acquired Area[1]	Estimated Jobs Displaced or Relocated[2]	Purpose of Acquisition
350 Medford Street	Municipal building[3]	$0	0	Gilman Square Station
675 Broadway	Commercial building	$11,928	0	Ball Square Station
662/664 Boston Avenue	Commercial/industrial building	$10,261	5	Ball Square Station
26 Prospect Street	Two-family residential building	$3,777	0	Union Square Station
30 Prospect Street	Two-family residential building with small business	$4,058	2	Union Square Station
32 Prospect Street	Commercial/industrial building	$3,979	0	Union Square Station
50 Prospect Street	Commercial/industrial building	$12,281	11	Union Square Station
Outbuilding at 50 Prospect Street	Commercial/industrial building	$4,892	0	Union Square Station
266 Somerville Avenue	Municipal building[3]	$0	0	Union Square Station
216 McGrath Highway	Commercial/industrial building	$7,387	20	Union Square Station
Non-building acquisitions	Vacant lots, strip acquisition, etc.	$246,523	0	Varies
Subtotals:	**Cambridge**	**$6,527**	**0**	
	Somerville	**$282,781**	**38**	
	Medford	**$15,777**	**0**	
TOTAL		**$305,086**	**38**	

1 Property taxes estimated based on local property tax rates and the most recent assessed value (as of 2008) of any buildings and land involved. Property taxes for partial acquisitions are prorated based on the square footage taken from each parcel.
2 Jobs estimated based on data from InfoUSA and publicly-available data. Municipal buildings are assumed to relocate within the same city and cause no net change. Vacant buildings are assumed to have no jobs under existing conditions.
3 Municipal properties are exempt from property taxes.

5.3.7 Alternative 4: Green Line Extension to Mystic Valley Parkway/Route 16 using commuter rail right-of-way) and Union Square (using McGrath Highway/Somerville Avenue)

Under this alternative, 13 buildings would be purchased and demolished, including six buildings for the extension to Mystic Valley Parkway/Route 16 and seven buildings for the extension to Union Square. All other acquisitions would involve strips of land or vacant lots and would not require building demolition. Table 5.3-4 lists the annual property taxes for the areas to be acquired.

This alternative has the largest effect on property taxes out of all of the Build Alternatives, with more than double the property tax impact of Alternative 1, primarily due to impacts in Medford. The total estimated property tax value of the land and buildings acquired for this alternative is $574,694. These acquisitions would reduce property tax revenue by $6,527 in Cambridge, $182,886 in Medford, and $385,281 in Somerville. The property tax impact is largest in Somerville because most of the proposed alignment and proposed acquisitions would be located in Somerville.

A total of 275 jobs would be displaced or relocated, including 224 jobs in Medford and 51 jobs in Somerville. Medford would lose more jobs than Somerville due to the acquisition of 200 Boston Avenue, which represents approximately 194 jobs.

The use of Somerville Avenue under this alternative increases the property acquisitions relative to Alternatives 1 and 2, although the use of the existing right-of-way for the extension to Mystic Valley Parkway/Route 16 minimizes the property impacts for that segment. The segment on Somerville Avenue would use in-street rails and would not prevent pedestrian passage across Somerville Avenue. The proposed property acquisitions would not cut off access within any existing neighborhoods or block access from one neighborhood to another. While this alternative does require acquiring two multi-family residential buildings, these buildings are surrounded by commercial uses, and their acquisition would not divide or segment any neighborhoods.

Table 5.3-4 Property Tax Effects for Alternative 4

Property	Type	Property Taxes on Acquired Area[1]	Estimated Jobs Displaced or Relocated[2]	Purpose of Acquisition
350 Medford Street	Municipal building[3]	$0	0	Gilman Square Station
675 Broadway	Commercial building	$11,928	0	Ball Square Station
662/664 Boston Avenue	Commercial/industrial building	$10,261	5	Ball Square Station
600 Mystic Valley Parkway	Commercial/industrial building	$101,741	13	Mystic Valley Parkway/Route 16 Station
222 Boston Avenue	Office building	$42,608	30	Mystic Valley Parkway/Route 16 Station
200 Boston Avenue	Office and Research & Development building	$121,879	194	Mystic Valley Parkway/Route 16 Station
26 Prospect Street	Two-family residential building	$3,777	0	Union Square Station
30 Prospect Street	Two-family residential building with small business	$4,058	2	Union Square Station
32 Prospect Street	Commercial/industrial building	$3,979	0	Union Square Station
50 Prospect Street	Commercial/industrial building	$12,281	11	Union Square Station
Outbuilding at 50 Prospect Street	Commercial/industrial building	$4,892	0	Union Square Station
266 Somerville Avenue	Municipal building[3]	$0	0	Union Square Station
216 McGrath Highway	Commercial/industrial building	$7,387	20	Union Square Station
Non-building acquisitions	Vacant lots, strip acquisition, etc.	$249,903	0	Varies
Subtotals:	**Cambridge**	**$6,527**	**0**	
	Somerville	**$385,281**	**51**	
	Medford	**$182,886**	**224**	
TOTAL		**$574,694**	**275**	

1 Property taxes estimated based on local property tax rates and the most recent assessed value (as of 2008) of any buildings and land involved. Property taxes for partial acquisitions are prorated based on the square footage taken from each parcel.
2 Jobs estimated based on data from InfoUSA and publicly-available data. Municipal buildings are assumed to relocate within the same city and cause no net change. Vacant buildings are assumed to have no jobs under existing conditions.
3 Municipal properties are exempt from property taxes.

5.3.8 Alternative 5: Extension to Mystic Valley Parkway/ Route 16 (via commuter rail right-of-way)

Six buildings would be purchased and demolished for the extension to Mystic Valley Parkway/Route 16 under this alternative. All other acquisitions would involve strips of land or vacant lots and would not require building demolition. Table 5.3-5 lists the annual property taxes for the areas to be acquired.

The total estimated property tax value of the land and buildings acquired for this alternative is $467,062. These acquisitions would reduce property tax revenue by $6,527 in Cambridge, $182,886 in Medford, and $277,649 in Somerville. The property tax impact is largest in Somerville because most of the proposed alignment and proposed acquisitions would be located in Somerville. This alternative has more than double the property tax impact of Alternative 1, primarily due to impacts in Medford. A total of 242 jobs would be displaced or relocated, including 224 jobs in Medford and 18 jobs in Somerville. Medford would lose more jobs than Somerville due to the acquisition of 200 Boston Avenue, which represents approximately 194 jobs.

Table 5.3-5 Property Tax Effects for Alternative 5

Property	Type	Property Taxes on Acquired Area[1]	Estimated Jobs Displaced or Relocated[2]	Purpose of Acquisition
350 Medford Street	Municipal building[3]	$0	0	Gilman Square Station
675 Broadway	Commercial building	$11,928	0	Ball Square Station
662/664 Boston Avenue	Commercial/industrial building	$10,261	5	Ball Square Station
600 Mystic Valley Parkway	Commercial/industrial building	$101,741	13	MVP/Rt. 16 Station
222 Boston Avenue	Office building	$42,608	30	MVP/Rt. 16 Station
200 Boston Avenue	Office and Research & Development building	$121,879	194	MVP/Rt. 16 Station
Non-building acquisitions	Vacant lots, strip acquisition, etc.	$178,645	0	Varies
Subtotals:	**Cambridge**	**$6,527**	**0**	
	Somerville	**$277,649**	**18**	
	Medford	**$182,886**	**224**	
TOTAL		**$467,062**	**242**	

1 Property taxes estimated based on local property tax rates and the most recent assessed value (as of 2008) of any buildings and land involved. Property taxes for partial acquisitions are prorated based on the square footage taken from each parcel.
2 Jobs estimated based on data from InfoUSA and publicly-available data. Municipal buildings are assumed to relocate within the same city and cause no net change. Vacant buildings are assumed to have no jobs under existing conditions.
3 Municipal properties are exempt from property taxes.

5.3.9 Alternative 6: Extension to Union Square (via commuter rail right-of-way)

This alternative would provide Green Line service to Union Square along the existing MBTA Fitchburg Line from relocated Lechmere Station into a terminus at Union Square. There would be no service to Medford.

Three buildings would be purchased and demolished for the extension to Union Square under this alternative. All other acquisitions would involve strips of land or vacant lots and would not require building demolition. Table 5.3-6 lists the annual property taxes for the areas to be acquired.

The total estimated property tax value of the land and buildings acquired for this alternative is $142,746. These acquisitions would reduce property tax revenue by $6,527 in Cambridge and $136,219 in Somerville. The property tax impact is largest in Somerville because most of the proposed alignment and proposed acquisitions would be located in Somerville. A total of 13 jobs would be displaced or relocated, all in Somerville. This alternative has the fewest building acquisitions, the smallest property tax effects, and the fewest displaced or relocated jobs out of all the Build Alternatives.

Table 5.3-6 Property Tax Effects for Alternative 6

Property	Type	Property Taxes on Acquired Area[1]	Estimated Jobs Displaced or Relocated[2]	Purpose of Acquisition
51 Allen Street	Commercial/industrial building	$4,712	2	Union Square Station
50 Prospect Street	Commercial/industrial building	$12,281	11	Union Square Station
Outbuilding at 50 Prospect Street	Commercial/industrial building	$4,892	0	Union Square Station
Non-building acquisitions	Vacant lots, strip acquisition, etc.	$120,861	0	Varies
Subtotals:	**Cambridge**	**$6,527**	**0**	
	Somerville	**$136,219**	**13**	
	Medford	**$0**	**0**	
TOTAL		**$142,746**	**13**	

1 Property taxes estimated based on local property tax rates and the most recent assessed value (as of 2008) of any buildings and land involved. Property taxes for partial acquisitions are prorated based on the square footage taken from each parcel.
2 Jobs estimated based on data from InfoUSA and publicly-available data.

5.3.10 Summary

All of the Build Alternatives would provide socioeconomic benefits due to increased transit access, which increases both the potential for local commerce and the potential for area residents to commute to jobs elsewhere. However, all six Build Alternatives would require acquiring and demolishing multiple buildings to accommodate the proposed stations. Table 5.3-7 summarizes the property tax value of the value of the buildings and vacant land to be acquired for each alternative. Alternative 6 would cause the smallest decrease in property tax revenue ($142,746), while Alternative 4 would cause the largest decrease ($574,694).

Table 5.3-7 Property Taxes of Real Estate Acquired For Each Alternative

	Residences		All Other Buildings			
Alternative	#	Tax Value	#	Tax Value	Tax Value of Other Land	Total
Alternative 1	0	$0	6	$44,074	$184,165	**$228,239**
Alternative 2	0	$0	9	$310,302	$187,545	**$497,847**
Alternative 3	2	$7,835	8	$58,563	$246,523	**$305,086**
Alternative 4	2	$7,835	11	$324,791	$249,903	**$574,694**
Alternative 5	0	$0	6	$288,417	$178,645	**$467,062**
Alternative 6	0	$0	3	$21,885	$120,861	**$142,746**

Table 5.3-8 summarizes the tax value decreases by city. Cambridge would have a negligible tax loss of $6,527 (0.003 percent of Cambridge property tax revenue) under all Build Alternatives. Medford would have a fairly small tax loss of $15,777 (0.021 percent of Medford property tax revenue) under Alternatives 1 and 3, $182,886 (0.243 percent) under Alternatives 2, 4, and 5, and no loss under Alternative 6. Somerville would have the greatest tax revenue decreases under all alternatives, ranging from $136,219 (0.155 percent) under Alternative 6 to $385,281 (0.437 percent) under Alternative 4.

Table 5.3-8 Property Tax Decreases by City

	Cambridge		Somerville		Medford	
Alternative	Tax revenue decrease	% of City total	Tax revenue decrease	% of City total	Tax revenue decrease	% of City total
Alternative 1	$6,527	0.003%	$205,935	0.233%	$15,777	0.021%
Alternative 2	$6,527	0.003%	$308,434	0.350%	$182,886	0.243%
Alternative 3	$6,527	0.003%	$282,781	0.321%	$15,777	0.021%
Alternative 4	$6,527	0.003%	$385,281	0.437%	$182,886	0.243%
Alternative 5	$6,527	0.003%	$277,649	0.315%	$182,886	0.243%
Alternative 6	$6,527	0.003%	$136,219	0.155%	$0	0%

All of the Build Alternatives would result in some degree of job displacement or relocation, ranging from 13 jobs in Alternative 6 to 275 jobs in Alternative 4. Table 5.3-9 summarizes the job displacements or relocations for each city. Medford would lose between zero jobs (Alternatives 1, 3, and 6) and 224 jobs (Alternatives 2, 4, and 5). Somerville would lose between 13 jobs (Alternative 6) and 51 jobs (Alternative 4). Although Alternative 4 would have the greatest job displacements, this change does not represent a significant fraction of the jobs in these three cities. By comparison, the 2000 U.S. Census estimated the workforces of Cambridge, Somerville, and Medford at 59,965 workers, 47,656 workers, and 30,133 workers, respectively. Although it is uncertain how many of the jobs displaced under any given Build Alternative are held by local residents rather than commuters, the small scale of the job displacements relative to the workforce makes it clear that the jobs at stake represent at most a minor economic impact.

Many of the jobs displaced would likely be relocated or replaced within the affected cities. There is an inherent economic advantage to being located close to public transit and to educational and social centers such as Tufts University and Union Square. Therefore, many of the jobs affected — particularly the office positions displaced in Medford under Alternatives 2, 4, and 5 — would likely be relocated locally.

Table 5.3-9 Estimated Job Decreases or Relocations

Alternative	Cambridge	Medford	Somerville	TOTAL
Alternative 1	0	0	18	**18**
Alternative 2	0	224	31	**255**
Alternative 3	0	0	38	**38**
Alternative 4	0	224	51	**275**
Alternative 5	0	224	18	**242**
Alternative 6	0	0	13	**13**
Work Force in City[1]	*59,965*	*30,133*	*47,656*	*137,754*

1 Total work force from 2000 U.S. Census included to demonstrate scale of impacts.

5.4 Environmental Justice

The Secretary's Certificate 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 as developed through Executive Order 12898 and DOT Order 5610.2 (*DOT Order on Environmental Justice*, April 15, 1997).

This section discusses the possible benefits and impacts to environmental justice populations for each of the Build Alternatives in comparison to the No-Build Alternative. The primary benefit of the Project for local residents and workers is improved access to transit. Environmental justice populations may be disproportionately affected if Project impacts such as land acquisition or noise are concentrated in environmental justice communities. The proposed maintenance facility would also be located in an environmental justice area and may contribute to various impacts on environmental justice populations. Land acquisitions are discussed in greater detail in Section 5.2, *Land Use*. Noise impacts are discussed in Section 5.7, *Noise*.

Public outreach efforts have included targeted efforts to reach environmental justice populations. Meetings on the Green Line Extension Project have attempted to reach as many residents as possible by ensuring that meetings and Project materials were widely available and in a variety of formats.

- The majority of the Project Advisory Group meetings were covered by local cable to ensure that individuals could view the proceedings even if they were not able to attend the meetings in person. Meeting presentations and minutes were transcribed onto audio tape on behalf of the visually impaired at the request of participants.
- The series of station workshops was held in local environmental justice neighborhoods, and flyers advertising these workshops and other meetings were distributed at Orange Line and local bus stops in Spanish, English and Portuguese. These flyers were also distributed door-to-door to potential abutters to the stations (both residential and business in these environmental justice neighborhoods) in advance of the meeting.
- At the public meetings and station workshops, interpreters were also available upon request for participants. All English-language meeting announcements included a statement in Spanish, Portuguese and Haitian Creole offering to translate the announcement.
- The Project fact sheet was translated into Spanish. A large-print fact sheet was developed for the visually impaired. These materials were distributed at public meetings, on the Project website and upon request. Audio equipment was employed at all meetings to accommodate hearing impaired participants in the community.
- The Project database includes multiple community, neighborhood and environmental justice organizations in the three affected communities. Meeting announcements for the final set of public meetings were mailed to all residents of East Cambridge, Somerville, and Medford to assure the widest possible outreach to environmental justice residents.

Environmental justice issues were frequent topics in meetings with the community, with planning organizations, and with local officials. The Green Line Extension Project Team also met with many neighborhood and community organizations to provide Project briefings to community members and listen to their concerns. These organizations included the Disability Commissions in Cambridge, Somerville, and Medford.

5.4.1 No-Build Alternative

No properties would be acquired under the No-Build Alternative, which eliminates the possibility of disproportionate environmental justice property impacts. No changes in noise are anticipated under the No-Build Alternative, which eliminates the possibility of disproportionate noise impacts. Therefore, there are no environmental justice impacts under the Baseline Alternative. However, this alternative would not improve transit services or access in environmental justice communities.

5.4.2 Baseline Alternative

Expanding bus service under the Baseline Alternative would increase transit access to disabled and environmental justice populations. Central Transportation Planning Staff (CTPS) conducted transit access modeling for disability and environmental justice populations to assess the benefits of the Baseline Alternative in comparison to the No-Build Alternative. This analysis examined the number of destinations within a 40-minute transit trip and included the following types of destinations:

- the number of industrial, retail, and service jobs, to assess access to services and employment opportunities;
- the average number of students at two- and four-year institutions of higher education, to assess educational opportunities; and
- The average number of hospital beds, to assess the availability of medical care.

Table 5.4-1 presents the transit access changes for disability and environmental justice populations for the Baseline Alternative compared to existing conditions. Transit access for disability and environmental justice populations would be improved under every category assessed by 0.4 percent to 6.8 percent. These increases would be higher than the increases for non-disability and non-environmental justice populations under this alternative. Non-disability and non-environmental justice populations would have reduced college enrollment access under this alternative due to changes in travel times under expanded bus service. The full results for the transit access analysis are provided in Appendix G.

No properties would be acquired under the Baseline Alternative, which eliminates the possibility of disproportionate environmental justice property impacts. No changes in noise are anticipated under the Baseline Alternative, which eliminates the possibility of disproportionate noise impacts. Therefore, there are no environmental justice impacts under the Baseline Alternative.

Table 5.4-1 Changes in Transit Access for Disability and Environmental Justice Populations under the Baseline Alternative

Population	Basic Employment	Retail Employment	Service Employment	College Enrollment	Hospital Beds
Disability	+1.8%	+2.5%	+2.1%	+0.8%	+6.8%
Non-Disability	+1.0%	+0.8%	+0.6%	-2.0%	+0.8%
Environmental Justice	+1.5%	+1.7%	+1.3%	+0.4%	+2.7%
Non-Environmental Justice	+0.8%	+1.0%	+0.9%	-4.1%	+3.7%

Source: U.S. Census data (2000), CTPS analysis. Analysis is based on number of jobs, average number of enrolled students, and average number of hospital beds within a 40-minute transit trip of the populations listed.

5.4.3 Maintenance Facility (All Build Alternatives)

The maintenance facility proposed at Yard 8 under all Build Alternatives would require acquiring two pieces of land on Inner Belt Road: the existing Yard 8, and an open grassy area at 150/200 Inner Belt Road. Like the other maintenance facility sites considered, this site is within a designated environmental justice area. However, no buildings would be acquired or demolished, and no residential land would be acquired, resulting in no direct effect on local environmental justice populations.

The proposed maintenance facility site is located in an existing industrial area next to the MBTA Fitchburg and Lowell Lines. The noise from the maintenance facility is included in the overall noise analysis in Section 5.7, *Noise*. The Brickbottom Artist Lofts are the only nearby residential receptors that could be affected by the maintenance facility. Noise mitigation measures such as sound insulation would be provided to reduce these impacts, and the Executive Office of Transportation will work closely with the City of Somerville and the Brickbottom Artist community to develop a noise mitigation program that addresses residents' concerns about noise impacts associated with the Project. The lack of other residences eliminates further potential for impacts on environmental justice populations. There would be no moderate or severe impacts from noise after mitigation was implemented. Therefore, there would be no disproportionate environmental justice impacts from the proposed maintenance facility.

The building for the maintenance facility would change the local visual environment slightly by introducing an additional industrial building to this largely commercial/industrial neighborhood. In the absence of the proposed maintenance facility, the site selected may be redeveloped for other uses that would have similar or greater impacts on the local neighborhood. The proposed maintenance facility building site is zoned for industrial use and other related uses. Somerville zoning would allow a 50-foot-high commercial or industrial building without invoking any special permits, and an existing building permit already issued for this site would allow a second 64-foot-high building. By contrast, the proposed maintenance facility building would be only 30 feet high on its west side and 40 feet high on its east side.

Based on the City of Somerville's stated plans for redevelopment and the local zoning regulations, future development on this site appears likely and could have a greater overall aesthetic impact than the proposed maintenance facility.

Overall, the placement of the maintenance facility in an existing industrial district would not result in any substantial changes to the local environment. With mitigation for the one residential property affected by noise and no other residential populations nearby, there would be no disproportionate impact to environmental justice populations due to the proposed maintenance facility.

5.4.4 Alternative 1: Extension to Medford Hillside and Union Square (via commuter rail right-of-way)

The proximity to environmental justice populations provides these populations with a greater share of the transit benefits of the Project. CTPS conducted transit access modeling for disability and environmental justice populations (using the same methodology discussed in Section 5.4.2) to assess the benefits of extending the Green Line to Mystic Valley Parkway/Route 16 and Union Square as compared to the No-Build Alternative. Although this scenario does not match Alternative 1 directly, it provides a measure of the transit benefits provided by a rail extension in comparison to expanded bus service.

Table 5.4-2 Changes in Transit Access for Disability and Environmental Justice Populations under a Light Rail Extension to Mystic Valley Parkway/Route 16 and Union Square

Population	Basic Employment	Retail Employment	Service Employment	College Enrollment	Hospital Beds
Disability	+10.7%	+11.8%	+11.0%	+14.3%	+19.8%
Non-Disability	+2.9%	+3.8%	+3.0%	+3.0%	+3.6%
Environmental Justice	+6.1%	+6.7%	+5.9%	+7.6%	+9.8%
Non-Environmental Justice	+5.5%	+7.3%	+6.4%	+6.2%	+9.3%

Source: U.S. Census data (2000), CTPS analysis. Analysis is based on number of jobs, average number of enrolled students, and average number of hospital beds within a 40-minute transit trip of the populations listed.

Table 5.4-2 presents the analysis results for the extension of Green Line service to Mystic Valley Parkway/Route 16 and Union Square. This rail service expansion would increase transit access for all affected populations in all categories assessed by 2.9 percent to 19.8 percent. Disability populations would benefit more than non-disability populations in all categories, while environmental justice and non-environmental justice populations would generally have similar increases. While CTPS's analysis involves an extension to Mystic Valley Parkway/Route 16 rather than Medford Hillside, these results indicate a substantial increase in transit access for disability and environmental justice populations with a light rail extension to

Somerville and Medford. The full results for the transit access analysis are provided in Appendix G.

Six buildings would be purchased and demolished under this alternative, including three buildings for the extension to Medford Hillside and three buildings for the extension to Union Square. All other acquisitions would involve strips of land or vacant lots and would not require building demolition. Tables 5.4-3 and 5.4-4 list the buildings involved and identify the environmental justice and racial breakdown of the affected census block groups.

Table 5.4-3 Building Acquisitions and Local Demographics for Extension to Medford Hillside

				Percentage of Local Population by Race							
Building	Type	Jobs Displaced	State EJ Status	White	Black	Native American	Asian	Pacific Islander	Other	Multi.	Hisp.[1]
350 Medford Street	Municipal	0	None	90.2%	3.3%	0.0%	0.0%	0.0%	5.0%	1.5%	2.8%
675 Broadway	Commercial	0	FM	85.2%	3.3%	0.0%	6.5%	0.0%	0.9%	4.1%	3.7%
662/664 Boston Avenue	Commercial/ industrial	5	FM	82.2%	3.2%	0.0%	9.2%	0.0%	0.6%	4.8%	4.1%
Medford				86.5%	5.9%	0.2%	4.2%	0.0%	1.1%	2.1%	2.5%
Somerville				77.0%	6.4%	0.4%	6.5%	0.1%	4.9%	4.8%	8.6%

F = Foreign-born M = Minority I = Income (poverty)
Source: U.S. Census data (2000), MassGIS.
1 Hispanic populations are already included 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.

Table 5.4-4 Building Acquisitions and Local Demographics for Extension to Union Square (via commuter rail right-of-way)

				Percentage of Local Population by Race							
Building	Type	Jobs Displaced	State EJ Status	White	Black	Native American	Asian	Pacific Islander	Other	Multi.	Hisp.[1]
51 Allen Street	Commercial/ industrial	2	FM	60.0%	10.3%	0.0%	6.8%	0.0%	16.8%	6.1%	11.1%
50 Prospect Street	Commercial/ industrial	11	FM	60.0%	10.3%	0.0%	6.8%	0.0%	16.8%	6.1%	11.1%
Outbuilding at 50 Prospect Street	Commercial/ industrial	0	FM	60.0%	10.3%	0.0%	6.8%	0.0%	16.8%	6.1%	11.1%
Somerville				77.0%	6.4%	0.4%	6.5%	0.1%	4.9%	4.8%	8.6%
Union Square region				69.7%	9.5%	0.7%	7.4%	0.0%	6.5%	6.1%	9.6%

F = Foreign-born M = Minority I = Income (poverty)
Source: U.S. Census data (2000), MassGIS.
1 Hispanic populations are already included 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.

None of the buildings are residences and therefore would not affect environmental justice populations directly. Although five of the buildings are located within environmental justice areas, these areas have similar racial populations to the rest of the region. The three acquisitions in Union Square (51 Allen Street, 50 Prospect Street, and the outbuilding for 50 Prospect Street) are surrounded by different racial demographics than the rest of Somerville, but they match the demographics of the Union Square area specifically. Most of Union Square is an environmental justice area, which makes any construction there likely to affect environmental justice populations. The property acquisition areas have a similar racial population to the Union Square area as a whole, which indicates a proportionate overall racial impact for this area.

Under this alternative, 18 jobs would be displaced, all located in environmental justice areas. While the analysis cannot assume that the employees of these businesses are local residents, the local racial makeup and economic status provides the best available indicator for the affected populations. As discussed in Section 5.3, *Socioeconomic Impacts*, the displacement of these jobs does not represent a substantial economic change for the local area.

Under Alternative 1 with no mitigation, 146 sensitive receptors would have moderate to severe noise impacts, including 84 buildings in environmental justice areas. Therefore, approximately 57.5 percent of the noise impacts to sensitive receptors would be in environmental justice areas. As noted in Section 4.4, *Environmental Justice*, approximately 60.0 percent of the combined populations of Cambridge, Somerville, and Medford live in environmental justice areas, which indicates that the impacts on environmental justice populations would be roughly proportionate. With mitigation measures such as noise barriers and sound insulation in place, there would be no residual impacts to these areas and therefore no disproportionate impacts. Noise impacts, specific buildings impacted, and proposed mitigation measures are discussed in greater detail in Section 5.7, *Noise*.

5.4.5 Alternative 2: Extension to Mystic Valley Parkway/Route 16 and Union Square (via commuter rail right-of-way)

The discussion of transit access and environmental justice in Section 5.4.4 applies to this alternative as well. The CTPS transit access modeling results in Table 5.4-2 apply to this alternative specifically. Disability populations would benefit more than non-disability populations in all categories, while environmental justice and non-environmental justice populations would generally have similar increases. These results indicate a substantial increase in transit access for disability and environmental justice populations. The full results for the transit access analysis are provided in Appendix G.

Nine buildings would be purchased and demolished under this alternative, including six buildings for the extension to Mystic Valley Parkway/Route 16 and three buildings for the extension to Union Square. All other acquisitions would involve strips of land or vacant lots and would not require building demolition. Tables 5.4-4 and 5.4-5 list the buildings involved and identify the environmental justice and racial breakdown of the affected census block groups.

Table 5.4-5 Building Acquisitions and Local Demographics for Extension to Mystic Valley Parkway/Route 16

				Percentage of Local Population by Race							
Building	Type	Jobs Displaced	State EJ Status	White	Black	Native American	Asian	Pacific Islander	Other	Multi.	Hisp.[1]
350 Medford Street	Municipal	0	None	90.2%	3.3%	0.0%	0.0%	0.0%	5.0%	1.5%	2.8%
675 Broadway	Commercial	0	FM	85.2%	3.3%	0.0%	6.5%	0.0%	0.9%	4.1%	3.7%
662/664 Boston Avenue	Commercial/ industrial	5	FM	82.2%	3.2%	0.0%	9.2%	0.0%	0.6%	4.8%	4.1%
222 Boston Avenue	Office	30	None	91.9%	1.1%	0.0%	0.7%	0.0%	1.5%	4.8%	0.8%
200 Boston Avenue	Office & Research & Development	194	None	90.7%	2.1%	0.0%	0.3%	0.0%	4.2%	2.6%	6.3%
600 Mystic Valley Parkway	Commercial/ industrial	13	None	89.8%	3.0%	0.0%	0.0%	0.0%	6.6%	0.7%	11.0%
Medford				86.5%	5.9%	0.2%	4.2%	0.0%	1.1%	2.1%	2.5%
Somerville				77.0%	6.4%	0.4%	6.5%	0.1%	4.9%	4.8%	8.6%

F = Foreign-born M = Minority I = Income (poverty)
Source: U.S. Census data (2000), MassGIS.
1 Hispanic populations are already included 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.

None of the buildings are residences and therefore would not affect environmental justice populations directly. Although five of the buildings are located within environmental justice areas, these areas have similar racial populations to the rest of the region. The three acquisitions in Union Square (51 Allen Street, 50 Prospect Street, and the outbuilding for 50 Prospect Street) are surrounded by different racial demographics than the rest of Somerville, but they match the demographics of the Union Square area specifically. Most of Union Square is an environmental justice area, which makes any construction there likely to affect environmental justice populations. The property acquisition areas have a similar racial population to the Union Square area as a whole, which indicates a proportionate overall racial impact for this area.

Under this alternative, 255 jobs would be displaced, including 18 jobs located in environmental justice areas. While the analysis cannot assume that the employees of these businesses are local residents, the local racial makeup and economic status provides the best available indicator for the affected populations. As discussed in

Section 5.3, *Socioeconomic Impacts*, the displacement of these jobs does not represent a substantial economic change for the local area.

Under Alternative 2 with no mitigation, 236 sensitive receptors would have moderate to severe noise impacts, including 93 buildings in environmental justice areas. Therefore, approximately 39.4 percent of the noise impacts to sensitive receptors would be in environmental justice areas. As noted in Section 4.4, *Environmental Justice*, approximately 60.0 percent of the combined populations of Cambridge, Somerville, and Medford live in environmental justice areas, which indicates that there would be no disproportionate impact to environmental justice populations. With mitigation measures such as noise barriers and sound insulation in place, there would be no residual impacts to these areas, ensuring that there would be no disproportionate impacts. Noise impacts, specific buildings impacted, and proposed mitigation measures are discussed in greater detail in Section 5.7, *Noise*.

5.4.6 Alternative 3: Extension to Medford Hillside and Union Square (via McGrath Highway and Somerville Avenue)

This alternative would provide Green Line service along two branches – one to Medford Hillside along the MBTA Lowell Line, and the second to Union Square via McGrath Highway/Route 28 and Somerville Avenue.

This alternative provides transit service to the same areas (Medford Hillside and Union Square) as Alternative 1. Therefore, the discussion of improved transit service for disability and environmental justice populations in Section 5.4.4 and the CTPS modeling results in Table 5.4-2 apply to this alternative as well. While CTPS's analysis involves an extension to Mystic Valley Parkway/Route 16 rather than Medford Hillside, these results indicate a substantial increase in transit access for disability and environmental justice populations under a light rail extension. The full results for the transit access analysis are provided in Appendix G.

A total of 10 buildings would be purchased and demolished under this alternative, including three buildings for the extension to Medford Hillside and seven buildings for the extension to Union Square. All other acquisitions would involve strips of land or vacant lots and would not require building demolition. Tables 5.4-3 and 5.4-6 list the buildings involved and identify the environmental justice and racial breakdown of the affected census block groups.

Table 5.4-6 Building Acquisitions and Local Demographics for Extension to Union Square via McGrath Highway and Somerville Avenue

Building	Type	Jobs Displaced	State EJ Status	Percentage of Local Population by Race: White	Black	Native American	Asian	Pacific Islander	Other	Multi.	Hisp.[1]
26 Prospect Street	Residential	0	FM	60.0%	10.3%	0.0%	6.8%	0.0%	16.8%	6.1%	11.1%
30 Prospect Street	Residential and business	2	FM	60.0%	10.3%	0.0%	6.8%	0.0%	16.8%	6.1%	11.1%
32 Prospect Street	Commercial/ industrial	0	FM	60.0%	10.3%	0.0%	6.8%	0.0%	16.8%	6.1%	11.1%
50 Prospect Street	Commercial/ industrial	11	FM	60.0%	10.3%	0.0%	6.8%	0.0%	16.8%	6.1%	11.1%
Outbuilding at 50 Prospect Street	Commercial/ industrial	0	FM	60.0%	10.3%	0.0%	6.8%	0.0%	16.8%	6.1%	11.1%
266 Somerville Avenue	Municipal	0	FM	60.0%	10.3%	0.0%	6.8%	0.0%	16.8%	6.1%	11.1%
216 McGrath Highway	Commercial/ industrial	20	I	98.5%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	2.9%
Somerville				77.0%	6.4%	0.4%	6.5%	0.1%	4.9%	4.8%	8.6%
Union Square region				69.7%	9.5%	0.7%	7.4%	0.0%	6.5%	6.1%	9.6%

F = Foreign-born M = Minority I = Income (poverty)

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

1 Hispanic populations are already included 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.

Nine of the 10 buildings are located within environmental justice areas. Two of the buildings are residences and therefore could affect environmental justice populations directly. The acquisitions in Union Square (26 Prospect Street, 30 Prospect Street, 32 Prospect Street, 50 Prospect Street, the outbuilding for 50 Prospect Street, 266 Somerville Avenue, and 216 McGrath Highway) are surrounded by different racial demographics than the rest of Somerville, but they match the demographics of the Union Square area specifically. Most of Union Square is an environmental justice area, which makes any construction there likely to affect environmental justice populations. The property acquisition areas have a similar racial population to the Union Square area as a whole, which indicates a proportionate overall racial impact for this area.

Under this alternative, 38 jobs would be displaced, all located in environmental justice areas. While the analysis cannot assume that the employees of these businesses are local residents, the local racial makeup and economic status provides the best available indicator for the affected populations. As discussed in Section 5.3, *Socioeconomic Impacts*, the displacement of these jobs does not represent a substantial economic change for the local area.

Under Alternative 3 with no mitigation, 155 sensitive receptors would have moderate to severe noise impacts, including 93 buildings in environmental justice areas. Therefore, approximately 60.0 percent of the noise impacts to sensitive receptors would be in environmental justice areas. As noted in Section 4.4, *Environmental Justice*, approximately 60.0 percent of the combined populations of Cambridge, Somerville, and Medford live in environmental justice areas, which indicates that these impacts are roughly proportionate. With mitigation measures such as noise barriers and sound insulation in place, there would be no residual impacts to these areas and therefore no disproportionate impacts. Noise impacts, specific buildings impacted, and proposed mitigation measures are discussed in greater detail in Section 5.7, *Noise*.

5.4.7 Alternative 4: Extension to Mystic Valley Parkway/Route 16 (via commuter rail right-of-way) and Union Square (via McGrath Highway and Somerville Avenue)

This alternative would provide Green Line Service along two branches – to Mystic Valley Parkway/Route 16 along the MBTA Lowell Line and to Union Square via McGrath Highway and Somerville Avenue.

The discussion of transit access and environmental justice in Section 5.4.4 applies to this alternative as well. The CTPS transit access modeling results in Table 5.4-2 apply to this alternative specifically. Disability populations would benefit more than non-disability populations in all categories, while environmental justice and non-environmental justice populations would generally have similar increases. These results indicate a substantial increase in transit access for disability and environmental justice populations. The full results for the transit access analysis are provided in Appendix G.

A total of 13 buildings would be purchased and demolished under this alternative, including six buildings for the extension to Mystic Valley Parkway/Route 16 and seven buildings for the extension to Union Square. All other acquisitions would involve strips of land or vacant lots and would not require building demolition. Tables 5.4-5 and 5.4-6 list the buildings involved and identify the environmental justice and racial breakdown of the affected census block groups.

Nine of the 13 buildings are located within environmental justice areas. Two of the buildings are residences and therefore could affect environmental justice populations directly. The acquisitions in Union Square (26 Prospect Street, 30 Prospect Street, 32 Prospect Street, 50 Prospect Street, the outbuilding for 50 Prospect Street, 266 Somerville Avenue, and 216 McGrath Highway) are surrounded by different racial demographics than the rest of Somerville, but they match the demographics of the Union Square area specifically. Most of Union Square is an environmental justice area, which makes any construction there likely to affect environmental justice populations. The property acquisition areas have a similar racial population to the Union Square area as a whole, which indicates a proportionate overall racial impact for this area.

Under this alternative, 275 jobs would be displaced, including 38 located in environmental justice areas. While the analysis cannot assume that the employees of these businesses are local residents, the local racial makeup and economic status provides the best available indicator for the affected populations. As discussed in Section 5.3, *Socioeconomic Impacts*, the displacement of these jobs does not represent a substantial economic change for the local area.

Under Alternative 4 with no mitigation, 245 sensitive receptors would have moderate to severe noise impacts, including 102 buildings in environmental justice areas. Therefore, approximately 41.6 percent of the noise impacts to sensitive receptors would be in environmental justice areas. As noted in Section 4.4, *Environmental Justice*, approximately 60.0 percent of the combined populations of Cambridge, Somerville, and Medford live in environmental justice areas, which indicates that the impacts to environmental justice populations would not be disproportionate. In addition, with mitigation measures such as noise barriers and sound insulation in place, there would be no residual impacts to these areas and therefore no possibility of disproportionate impacts. Noise impacts, specific buildings impacted, and proposed mitigation measures are discussed in greater detail in Section 5.7, *Noise*.

5.4.8 Alternative 5: Extension to Mystic Valley Parkway/ Route 16 (via commuter rail right-of-way)

This alternative would provide Green Line Service to Mystic Valley Parkway/ Route 16 along the MBTA Lowell Line. There would be no service to Union Square, Somerville.

The discussion of transit access for environmental justice and disability populations in Section 5.4.4 applies to this alternative as well. While CTPS's analysis includes the Union Square Branch, which is not a part of Alternative 5, these results indicate a substantial increase in transit access for disability and environmental justice populations under a light rail extension. The full results for the transit access analysis are provided in Appendix G.

Six buildings would be purchased and demolished for the extension to Mystic Valley Parkway/Route 16 under this alternative. All other acquisitions would involve strips of land or vacant lots and would not require building demolition. Table 5.4-5 lists the buildings involved and identifies the environmental justice and racial breakdown of the affected census block groups.

Two of the six buildings are located within environmental justice areas. None of the buildings are residences and therefore would not affect environmental justice populations directly. The areas affected have similar racial populations to the rest of the region and do not represent a disproportionate environmental justice impact.

Under this alternative, 242 jobs would be displaced, including five located in environmental justice areas. While the analysis cannot assume that the employees of these businesses are local residents, the local racial makeup and economic status provides the best available indicator for the affected populations. As discussed in Section 5.3, *Socioeconomic Impacts*, the displacement of these jobs does not represent a substantial economic change for the local area.

Under Alternative 5 with no mitigation, 282 sensitive receptors would have moderate to severe noise impacts, including 105 buildings in environmental justice areas. Therefore, approximately 37.2 percent of the noise impacts to sensitive receptors would be in environmental justice areas. As noted in Section 4.4, *Environmental Justice*, approximately 60.0 percent of the combined populations of Cambridge, Somerville, and Medford live in environmental justice areas, which indicates that the impacts to environmental justice populations would not be disproportionate. In addition, with mitigation measures such as noise barriers and sound insulation in place, there would be no residual impacts to these areas and therefore no possibility of disproportionate impacts. Noise impacts, specific buildings impacted, and proposed mitigation measures are discussed in greater detail in Section 5.7, *Noise*.

5.4.9 Alternative 6: Extension to Union Square (via commuter rail right-of-way)

The discussion of transit access and environmental justice in Section 5.4.4 applies to this alternative as well. This alternative can be assumed to increase transit access to environmental justice populations due to the high concentration of environmental justice populations in the Project Area. Exact transit access improvements for specific populations are difficult to assess as CTPS's transit access modeling scenarios did not apply to this alternative.

Three buildings would be purchased and demolished for the extension to Union Square under this alternative. All other acquisitions would involve strips of land or vacant lots and would not require building demolition. Table 5.4-4 lists the buildings involved and identifies the environmental justice and racial breakdown of the affected census block groups.

None of the buildings are residences and therefore would not affect environmental justice populations directly. Although all three buildings are located within environmental justice areas, these areas have similar racial populations to the rest of the region. Most of Union Square is an environmental justice area, which makes any construction there likely to affect environmental justice populations. The property acquisition areas have a similar racial population to the Union Square area as a whole, which indicates a proportionate overall racial impact for this area.

Under this alternative, 13 jobs would be displaced, all located in environmental justice areas. While the analysis cannot assume that the employees of these businesses are local residents, the local racial makeup and economic status provides the best available indicator for the affected populations. As discussed in Section 5.3, *Socioeconomic Impacts*, the displacement of these jobs does not represent a substantial economic change for the local area.

Under Alternative 6 with no mitigation, 13 sensitive receptors would have severe noise impacts, all in environmental justice areas. This could represent a disproportionate impact, as all noise impacts would be in environmental justice areas; however, this alternative would provide service to Union Square only, which is itself an environmental justice area, making impacts to environmental justice populations unavoidable. With mitigation measures such as noise barriers and sound insulation in place, there would be no residual impacts to these areas and therefore no disproportionate impacts. Noise impacts, specific buildings impacted, and proposed mitigation measures are discussed in greater detail in Section 5.7, *Noise*.

5.4.10 Summary

Table 5.4-7 summarizes the impacts of building acquisitions and noise from the Build Alternatives on environmental justice populations. These impacts are neither severe nor disproportionate, and the impacts would be balanced by the transit benefits to environmental justice populations. Environmental justice populations would also receive a larger-than-average share of the new transit benefits. According to the transit modeling performed for the Project, the Build Alternatives would substantially increase transit access to environmental justice and disability populations. While the exact economic benefits cannot be determined, providing increased transit access and economic opportunities to the same neighborhoods affected by the Project would offset any economic impacts to these neighborhoods. With mitigation in place, the Project would have no residual impacts from noise and would have no disproportionate impacts on environmental justice populations.

Alternatives 3 and 4 would have the greatest direct impact to environmental justice populations by each acquiring two residences in environmental justice areas. All other building acquisitions, including all buildings acquired for Alternatives 1, 2, 5, and 6, would be of businesses or municipal properties instead of residences. There would be no disproportionate noise impacts to environmental justice areas under Alternatives 1, 2, 3, 4, or 5. Alternative 6 would have noise impacts in environmental justice areas only, although this may not be disproportionate given the constrained spaces and high concentrations of environmental justice populations found in Union Square. Noise mitigation would be required for the residences affected under all alternatives, resulting in no residual adverse impacts due to noise. Noise impacts and mitigation are discussed in detail in Section 5.7, *Noise*.

Table 5.4-7 Summary of Project Impacts in Environmental Justice Areas

ernative	Buildings Acquired	Jobs Displaced	Sensitive Receptors Affected by Noise	
			Without Mitigation	With Mitigation
Alternative 1	5	18	84	0
Alternative 2	5	18	93	0
Alternative 3	9	38	93	0
Alternative 4	9	38	102	0
Alternative 5	2	5	105	0
Alternative 6	3	13	13	0

5.5 Traffic

This section discusses the direct, indirect, and cumulative effects of the Build Alternatives with respect to intersection, pedestrian, bicycle, public bus transportation, and parking systems in the study area. This evaluation is based on an assumed design year of 2030.

As required in the Secretary's Certificate, this section analyzes traffic for the No-Build and Build Alternatives in order to evaluate the implications of the Project for intersection levels of service and pedestrian and bicycle circulation. The evaluation addresses traffic circulation on roadways adjacent to proposed station locations and includes mitigation at locations where the Project is determined to have a significant impact on traffic operations. In addition to the intersections identified by the Secretary's Certificate, five additional intersections were included due to their proximity to proposed station locations. In preparing the scope of transportation work completed, Executive Office of Transportation and Public Works (EOT) coordinated with Massachusetts Highway Department (MassHighway), Massachusetts Department of Conservation and Recreation (DCR), the Metropolitan Area Planning Council (MAPC), and the communities of Cambridge, Somerville, and Medford.

The following sections provide discussions related to forecasting future traffic volumes throughout the study area (both with and without the Project), the impacts of the Project on the transportation system in the surrounding communities, and any measures that would mitigate Project impacts.

5.5.1 Methodology

This section provides a summary of the methods used to identify the Environmental Consequences related to vehicular transportation, pedestrians, bicycles, public transportation, and parking.

5.5.1.1 Vehicular Transportation

Methods used for this study followed standard transportation planning industry practice for the evaluation of transportation systems and infrastructure. Much of the evaluation was based on a 2030 traffic forecast with and without the Project. The CTPS used its regional travel demand model to provide the traffic forecasts for this study. CTPS is the staff for the metropolitan planning organization for the Boston region and works with the communities within the region to address issues such as transportation, land use, and economic development.

CTPS's method of travel demand forecasting follows the traditional four steps of trip generation, trip distribution, modal split, and travel assignment. CTPS's TranPlan model uses changes in population, households, employed residents, total automobiles, and total employment to forecast changes in traffic over time. Section 3.4, *Ridership Methodology*, summarizes the methods used to forecast travel demand. Key points of the forecasting method are summarized below:

- As a starting point, CTPS's regional travel demand model was calibrated to 2008 conditions using the existing condition assessment presented in Section 4.6, *Traffic*. This produced an existing baseline condition in the model that approximates empirical traffic counts and traffic operations.
- Future No-Build (2030) model runs were prepared based on the forecasted changes in population, households, employed residents, and total automobiles. The model was also updated to reflect anticipated changes to the transportation infrastructure including highway and transit projects on the Transportation Improvement Program (TIP), long-range regional plans, and proposed improvements along O'Brien Highway associated with the NorthPoint development. A list of specific projects included is provided in Section 5.5.2.1.
- Using the future No-Build model runs, weekday morning and evening peak hour turning movement volume networks were created. The resulting peak hour volumes were used as inputs into a traffic operations model to evaluate how well the future infrastructure would accommodate the demands placed on it during the morning and evening peak periods. The model assigns a level of service (LOS) rating to each facility analyzed that is similar to a report card – LOS A (under capacity, little delay) to LOS F (over capacity, excessive delays). This traffic operations analysis, or level of service evaluation, is consistent with the Highway Capacity Manual (HCM) which is the industry-wide guideline for transportation assessments. The level of service assessment was prepared for all Study Area intersections.
- Future Build model runs for Alternatives 1 through 6 were prepared by including the extended Green Line as a mode choice and quantifying the number of vehicle trips expected to change mode from passenger car to transit service. Using the Build model runs, peak hour turning movement volumes were developed for each alternative.

- A secondary analysis was performed to determine the number of pick-up/drop-off and park-and-ride trips that can be expected. The net increase in trips associated with these components was then manually added to the Build Alternative model runs.
- The peak hour volumes were then used to conduct level of service assessments for the Build conditions. When compared to the No-Build Alternative, the level of service assessment for the Build Alternatives will show the effect of the proposed action, both positive and detrimental.
- Measures to improve conditions and avoid or minimize impacts on the transportation network were identified and evaluated for effectiveness.
- Where impacts could not be avoided or minimized, mitigation was proposed and evaluated for effectiveness. Mitigation was proposed for intersections where LOS E/F conditions resulted because of the Build Alternatives and where LOS E/F conditions under the No-Build Alternative were notably worsened (generally an increase in control delay of more than 10 seconds).

As described in Section 4.6.5, *Traffic Operations Analysis*, level of service is based on delay at signalized and unsignalized intersections. The criteria established to define levels of service can be found in Table 4.6-2 of that section.

5.5.1.2 Pedestrians

The travel demand model was also used to establish pedestrian patterns throughout the study area as they relate to the Project. For each transportation analysis zone (TAZ) within the regional model, CTPS was able to provide the number of pedestrians using transit and the specific station they would access. Each pathway of travel was mapped and pedestrians were accordingly assigned to routes. A pedestrian level of service analysis was completed to determine the expected delay to pedestrians at study area intersections (i.e. how long a pedestrian has to wait at a traffic signal before getting a “Walk” indication to cross the street). For signalized intersections, pedestrian level of service is based on traffic signal timings. At unsignalized intersections, where motorists are required to yield the right-of-way to pedestrians in a crosswalk, pedestrian delays are expected to be minor and are not quantified.

In addition to the pedestrian level of service analysis, a secondary analysis was completed to determine whether sufficient crossing times were provided at traffic signals (i.e. whether or not there is enough time provided for the pedestrian to physically cross the street before the flashing “Don’t Walk” signal ends), whether existing crosswalks were sufficient to accommodate projected pedestrian volumes and travel patterns, and whether any alternative would be likely to result in an adverse impact to pedestrians. Pedestrian volume networks for all Project Alternatives can be found in Appendix F.

5.5.1.3 Bicycles

The methodology used for evaluating the impacts on bicycle transportation by each alternative involved documenting the existing and potential future bicycle facilities in the vicinity of the proposed station locations. Bicycle demand at the proposed station locations was estimated based on the ridership for the stations and 2000 U.S. Census data on bicycle commuting for Cambridge, Somerville, and Medford. These estimates assume that the proposed Somerville Community Path would not change the overall proportion of bicycle commuters. Bicycle accommodations were evaluated qualitatively with respect to their ability to serve demand and their sensitivity to Project-related traffic volumes and roadway improvements.

5.5.1.4 Parking

The methodology for the parking assessment includes two components. The first identifies the number of parking spaces (by alternative) that would be removed from the study area in support of the proposed alternative. The reason for the parking reduction, whether to support construction (temporary) or needed traffic mitigation (permanent), is also identified. The second component quantifies the number of unrestricted parking spaces within the vicinity of each proposed station location. The likelihood of available parking spaces to be used by Green Line patrons legally is assessed and, as necessary, mitigation measures to discourage this practice are identified.

5.5.1.5 Public Bus Transportation

None of the Build Alternatives would alter or eliminate existing bus service through the study area. CTPS conducted a study to evaluate the demand on existing bus routes that could be affected by the Green Line Extension Project. This evaluation determined that no routes had an overwhelming majority of their ridership lost due to the Project that would warrant elimination. Additionally, although some routes saw a reduction in ridership due to the Project, these same routes also experienced an increase in ridership due to their function as feeder buses to new Green Line stations. Finally, an examination of truncating Bus Routes 80, 87, and 88 at Green Line stations was also evaluated and found to be unfavorable. Existing bus services are proposed to remain within the study area. However, the relocation of Lechmere Station will require minor modifications to some routes.

5.5.1.6 Prospect Street Roadway Changes

The City of Somerville is currently studying whether to convert Prospect Street from a one-way to a two-way street between Webster Avenue and Somerville Avenue in Union Square. This change would affect vehicle, pedestrian, and bicycle operations related to Union Square Station only.

A review of how traffic volumes might shift based on this new roadway pattern indicates that levels of service at three intersections could be improved:

- Washington Street at Somerville Avenue/Webster Street
- Prospect Street at Somerville Avenue
- Prospect Street at Webster Street/Concord Avenue

The Green Line Extension Project would not present an adverse impact on these three locations regardless of whether the roadway change is made by the City. However, traffic circulation to and from the proposed Union Square Station (which would be located on Prospect Street) would be improved if Prospect Street were bi-directional. For example, traffic destined to the south would be able access Prospect Street directly and then continue south. Under the existing condition, this traffic would travel south on Webster Street, north on Prospect Street for passenger pick-up/drop-off, and then south on Webster Street again to continue to their destination. The basis of this traffic analysis assumes that Prospect Street remains one way. However, there would be no substantial traffic differences between the one-way and two-way scenario.

5.5.2 Environmental Consequences

The Environmental Consequences for each Build Alternative can be considered as both direct and indirect impacts. Direct impacts are a direct consequence of the alternative, such as altered traffic demands from changes in the roadway system or increased traffic demands that result from the volume of pick-up/drop-off traffic and the amount of parking available for each alternative. Reasonably foreseeable impacts are caused by the action but occur later in time or farther removed in distance. Indirect impacts include induced traffic shifts from other roadways to access stations because of the modified roadway network.

Once individual impacts are identified, cumulative impacts can also be discussed. Cumulative impacts account for the incremental impact of the action when added to other past, present, and reasonably foreseeable future actions. Cumulative impacts can result from individual, minor actions that collectively constitute a significant action. Since the CTPS model was used to forecast traffic for the No-Build and Build Alternatives, direct, indirect, and cumulative effects are inherently incorporated in the analyses.

Each Build Alternative is expected to have temporary impacts resulting from construction. Construction impacts are expected to terminate when construction is complete, and usually consist of temporary road and sidewalk closures and detours.

5.5.2.1 No-Build Alternative

This section describes the transportation impacts of the No-Build Alternative on the roadway, pedestrian, bicycle, and public bus systems in the study area. The impacts of the Build Alternatives are compared to the No-Build Alternative.

Description

The No-Build Alternative assumes planned or on-going physical and operational changes would occur to the transportation system between 2008 and 2030. These changes include:

Physical Changes

- Reconstructing O'Brien Highway in Cambridge from the Boston City Line north to Third Street. (Phased to support interim Lechmere Station relocated and the full build of the NorthPoint development project).
- Converting Prospect Street from one-way northbound to accommodate two-way traffic (Note: The City of Somerville has not finalized plans to complete this conversion; the potential effects of the two-way traffic were discussed previously in Section 5.5.1, *Methodology*. However, the analysis assumes that Prospect Street is one-way.).

Operational Changes

- Implementing the planned Urban Ring transit service.
- Changes in traffic demands attributed to forecast changes in population, households, and employment.
- Changes in traffic demands attributed to the following specific planned/permitted projects:
  - **Cambridge - NorthPoint Mixed Use Development**, approximately 5 million square feet of mixed use development located on O'Brien Highway, including 2.14 million square feet of office/research development, 0.165 million square feet of retail/hotel and 2,790 residential units.
  - **Cambridge - Charles E. Smith Residential Development**, 767 apartment units located at O'Brien Highway and East Street.
  - **Cambridge - One First Street**, 10,000 square feet of retail and office space and 209 residential units located on First Street and Otis Street.

- **Cambridge - 22 Water Street**, 392 residential units located on Water Street.
- **Somerville - MaxPak,** 199 residential units on Clyde Street and Lowell Street.
- **Somerville – Brickbottom Redevelopment**, Rezoning to a mix-used area. These plans are still in the preliminary stage with no estimate of square footage, building height, or land use available.
- **Somerville – Union Square Redevelopment**, Rezoning Washington Street to a mix-used area. These plans are still in the preliminary stage with no estimate of building usage available.
- **Medford – Tufts University Master Plan**, Tufts University has indicated that current Master Planning efforts do not involve an increase in students, faculty, or staff. Therefore, while the Master Plan is included, no additional traffic demand is considered as part of the project.

The operational changes identified above were provided by the communities of Cambridge, Somerville, and Medford in discussions with their respective Planning Departments. Communities surrounding the study area were also contacted. However, none of the changes planned in surrounding communities are expected to affect traffic operations within the study area.

The specific information provided by each community was reviewed against the population, household, and employment data considered in the CTPS travel demand model for 2030. All noted projects are included in the 2030 model. The No-Build Alternative traffic volume networks are presented in Appendix F.

Traffic Operations

A traffic operations analysis was preformed for the No-Build conditions based on the methodology described in Section 4.6, *Traffic*. The results of this analysis are presented in Table 5.5-1 for signalized intersections and Table 5.5-2 for unsignalized intersections. Complete level of service results for all intersections are provided in Appendix F.

As discussed in Section 4.6, 11 signalized intersections and eight unsignalized intersections operate at an unacceptable level of service during at least one peak hour in 2008. By 2030, 17 signalized intersections and nine unsignalized intersections are expected to operate at unacceptable LOS E or LOS F.

Table 5.5-1 No-Build Alternative Signalized Intersection Traffic Operations Results

Signalized Intersection	Existing Morning Peak Hour			Existing Evening Peak Hour			No-Build Morning Peak Hour			No-Build Evening Peak Hour		
	V/C [1]	Delay [2]	LOS [3]	V/C	Delay	LOS	V/C	Delay	LOS	V/C	Delay	LOS
Mystic Valley Pkwy at Boston Avenue	0.93	61	E	1.06	82	F	**1.03**	**81**	**F**	>1.2	111	F
Mystic Valley Pkwy at Winthrop Street	>1.2	>120	F	>1.2	>120	F	>1.2	>120	F	>1.2	>120	F
Boston Avenue at Winthrop Street	1.00	46	D	0.99	55	D	**1.1**	**65**	**E**	**1.09**	**75**	**E**
Boston Avenue at College Avenue	0.92	55	D	0.86	47	D	**0.98**	**71**	**E**	**0.94**	**60**	**E**
Main Street at High Street/ Salem Street/Forest Avenue/ Riverside Avenue	0.95	57	E	0.74	32	C	**1.14**	**104**	**F**	**0.82**	**37**	**D**
Main Street at Harvard Street	1.09	79	E	1.12	80	E	**>1.2**	**>120**	**F**	**>1.2**	**>120**	**F**
Broadway at Medford Street/ Dexter Street	0.96	68	E	0.85	47	D	**1.14**	**104**	**F**	**1.01**	**104**	**F**
Medford Street at School Street	0.87	26	C	0.83	29	C	**1.05**	**55**	**E**	**1.00**	**73**	**E**
Medford Street at Highland Avenue	0.88	41	D	0.60	14	B	**0.99**	**66**	**E**	**0.73**	**20**	**C**
Washington Street at McGrath Hwy (East)	0.54	27	C	0.74	117	F	**0.7**	**39**	**D**	0.89	>120	F
Washington Street at McGrath Hwy (West)	0.66	200	F	0.57	103	F	0.84	>120	F	0.68	>120	F
Washington Street at Innerbelt Road	0.63	9	A	0.72	14	B	**1.07**	**61**	**E**	0.80	17	B
Prospect Street at Somerville Avenue	0.89	67	E	0.94	65	E	**1.11**	**>120**	**F**	1.04	75	E
Washington Street at Somerville Avenue/Webster Street	0.85	38	D	0.79	38	D	**1.06**	**67**	**E**	0.91	54	D
Prospect Street at Webster Street/Concord Avenue	0.71	30	C	1.19	136	F	**1.08**	**117**	**F**	>1.2	>120	F
O'Brien Highway at Land Boulevard/Gilmore Bridge	1.17	>120	F	1.16	>120	F	>1.2	>120	F	>1.2	>120	F
O'Brien Highway at Third Street	0.69	18	B	0.95	>120	F	**1.15**	**>120**	**F**	>1.2	>120	F

Note: Intersections degrading by at least one level of service are denoted in **bold** and shaded.
1 Volume-to-capacity ratio
2 Average delay expressed in seconds per vehicle
3 Level-of-Service

Table 5.5-2 No-Build Alternative Unsignalized Intersection Traffic Operations Results

		Existing Morning Peak Hour			Existing Evening Peak Hour			No-Build Morning Peak Hour			No-Build Evening Peak Hour		
Unsignalized Intersection	Critical Movement	V/C [1]	Delay [2]	LOS [3]	V/C	Delay	LOS	V/C	Delay	LOS	V/C	Delay	LOS
Boston Avenue at High Street/ Sagamore Avenue	Sagamore Avenue Southbound	>1.2	>120	F	>1.2	>120	F	>1.2	>120	F	>1.2	>120	F
College Avenue at George Street	George Street Westbound	0.74	17	C	0.82	21	C	0.90	38	E	0.92	41	E
Main Street at George Street	George Street Eastbound	>1.2	>120	F	>1.2	>120	F	>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	>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	>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	>1.2	>120	F	>1.2	>120	F
Medford Street at Lowell Street	Lowell Street Northbound	1.02	>120	F	0.32	18	C	>1.2	>120	F	0.41	22	C
Medford Street at Pearl Street	Pearl Street Westbound	0.96	74	F	0.70	26	D	>1.2	>120	F	0.93	56	F
Broadway at Winchester Street/Albion Street	Winchester/Albion SB	>1.2	>120	F	0.79	82	F	>1.2	>120	F	>1.2	>120	F

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

Pedestrians

Pedestrian level of service at signalized intersections is a function of the traffic signal timing and phasing. Because traffic signal timing and phasing is assumed unchanged from existing conditions in the No-Build Alternative, pedestrian level of service would remain the same as presented in Table 4.6-6. No-Build Alternative pedestrian volumes are provided in Appendix F.

Eighteen signalized intersections do not currently provide sufficient crossing times for pedestrians. This will continue in 2030 if no changes are made to the traffic signals.

Bicycles

The No-Build Alternative would not physically alter existing designated bicycle facilities nor preclude the construction of on-road or off-road facilities that may be proposed for the study area in the future. The proposed Somerville Community Path is assumed to be complete by 2030. Bicycle accommodations will likely expand by 2030, with travel along routes that offer exclusive bicycle lanes seeing an increase in bicycle traffic. Along routes where no exclusive bicycle accommodation is provided, bicycle travel would become more difficult as traffic volumes increase.

Parking

The No-Build Alternative would not physically alter existing parking supply or a community's ability to expand parking or change enforcement. As traffic volumes increase, it is expected that the availability of unrestricted parking spaces would decrease, particularly in the vicinity of College Avenue and Lechmere Station where occupancy is currently high throughout the day.

Bus Transportation

There would be no change to public transportation systems assumed with the No-Build Alternative.

5.5.2.2 Baseline Alternative

The Baseline Alternative consists of an express bus, with limited stops, similar to the current (and remaining) Route 80 local bus service. This service would operate parallel to the MBTA Lowell Line corridor and would serve the following stops:

- Boston Avenue at Mystic Valley Parkway/Route 16;
- Boston Avenue at College Avenue;
- Boston Avenue at Broadway;
- Medford Street at Broadway;
- Medford Street at School Street;
- Medford Street at Washington Street; and
- Lechmere Station.

A complete description of this alternative is provided in Section 3.5, *Baseline Alternative.*

With the exception of the new service, the Baseline Alternative contains the same physical and operational changes in the transportation system as the 2030 No-Build Alternative described above. CTPS used the travel demand model to test the effects of this service on the transportation network and provided expected traffic volumes, which are presented in Appendix F.

Traffic Operations

Because the changes in vehicular traffic volumes expected under this alternative are negligible, none of the study area intersections would see a degradation in level of service. However, this alternative assumes that all traffic signal timing and phasing would be upgraded to maximize efficiency and provide adequate pedestrian crossing times. This results in improved traffic operations (reduced delay when compared to the No-Build condition) at 13 locations. Intersections where level of service would improve due to the optimized signal timing and phasing assumed under this alternative are denoted in *italics.*

Four locations would see traffic operations improved by at least one level of service. Level of service results are provided in Table 5.5-3. The table highlights only intersections operating at LOS E or LOS F during at least one of the peak hours under the No-Build Alternative. Operational results for the remainder of intersections can be found in Appendix F.

Table 5.5-3 Baseline Alternative Signalized Intersection Traffic Operations Results

	No-Build Morning Peak Hour			No-Build Evening Peak Hour			Baseline Morning Peak Hour			Baseline Evening Peak Hour		
Signalized Intersection	V/C[1]	Delay[2]	LOS[3]	V/C	Delay	LOS	V/C	Delay	LOS	V/C	Delay	LOS
Mystic Valley Pkwy at Boston Avenue	1.03	81	F	>1.2	111	F	*0.99*	*58*	*E*	>1.2	101	F
Mystic Valley Pkwy at Winthrop Street	>1.2	>120	F	>1.2	>120	F	>1.2	>120	F	>1.2	>120	F
Boston Avenue at Winthrop Street	1.1	65	E	1.09	75	E	1.08	62	E	1.11	73	E
Boston Avenue at College Avenue	0.98	71	E	0.94	60	E	0.97	63	E	0.92	58	E
Main Street at High Street/Salem Street/Forest Avenue/Riverside Avenue	1.14	104	F	0.82	37	D	1.12	83	F	*0.79*	*30*	*C*
Main Street at Harvard Street	>1.2	>120	F	>1.2	>120	F	>1.2	>120	F	>1.2	>120	F
Broadway at Medford Street/Dexter Street	1.14	104	F	1.01	104	F	1.11	87	F	*0.97*	*57*	*E*
Medford Street at School Street	1.05	55	E	1.00	73	E	*0.96*	*37*	*D*	*0.91*	*27*	*C*
Medford Street at Highland Avenue	0.99	66	E	0.73	20	C	0.94	62	E	*0.68*	*15*	*B*
Washington Street at McGrath Hwy (East)	0.70	39	D	0.89	>120	F	0.73	49	D	*0.89*	*63*	*E*
Washington Street at McGrath Hwy (West)	0.84	>120	F	0.68	>120	F	*0.85*	*52*	*D*	*0.67*	*63*	*E*
Washington Street at Innerbelt Road	1.07	61	E	0.80	17	B	*1.00*	*40*	*D*	0.79	16	B
Prospect Street at Somerville Avenue	1.11	>120	F	1.04	75	E	*1.02*	*72*	*E*	1.02	63	E
Washington Street at Somerville Avenue/Webster Street	1.06	67	E	0.91	55	E	1.03	62	E	0.92	57	E
Prospect Street at Webster Street/Concord Avenue	1.08	117	F	>1.2	>120	F	*0.86*	*22*	*C*	1.18	97	F
O'Brien Highway at Land Boulevard/Gilmore Bridge	>1.2	>120	F	>1.2	>120	F	>1.2	>120	F	>1.2	>120	F
O'Brien Highway at Third Street	1.15	>120	F	>1.2	>120	F	>1.2	>120	F	>1.2	>120	F

Note: Intersections improving by at least one level of service are denoted in *italics.* Intersections degrading by at least one level of service are denoted in **bold**.

1 Volume-to-capacity ratio

2 Average delay expressed in seconds per vehicle

3 Level-of-Service

When compared to the No-Build, nine unsignalized intersections would continue to operate at LOS E or LOS F. Only one intersection, College Avenue at George Street, is expected to see a change in delay when compared to the No-Build Alternative, as shown in Table 5.5-4.

Table 5.5-4 Baseline Alternative Unsignalized Intersection Traffic Operations Results

Unsignalized Intersection	Critical Movement	No-Build Morning Peak Hour			No-Build Evening Peak Hour			Baseline Morning Peak Hour			Baseline Evening Peak Hour		
		V/C [1]	Delay [2]	LOS [3]	V/C	Delay	LOS	V/C	Delay	LOS	V/C	Delay	LOS
Boston Avenue at High Street/ Sagamore Avenue	Sagamore Avenue Southbound	>1.2	>120	F	>1.2	>120	F	>1.2	>120	F	>1.2	>120	F
College Avenue at George Street	George Street Westbound	0.90	38	E	0.92	41	E	0.90	38	E	0.93	43	E
Main Street at George Street	George Street Eastbound	>1.2	>120	F	>1.2	>120	F	>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	>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	>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	>1.2	>120	F	>1.2	>120	F
Medford Street at Lowell Street	Lowell Street Northbound	>1.2	>120	F	>1.2	22	C	>1.2	>120	F	0.41	22	C
Medford Street at Pearl Street	Pearl Street Westbound	>1.2	>120	F	0.93	56	F	>1.2	>120	F	0.93	56	F
Broadway at Winchester Street/Albion Street	Winchester/Albion SB	>1.2	>120	F	>1.2	>120	F	>1.2	>120	F	>1.2	>120	F

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

Pedestrians

This alternative assumes optimized traffic signal timing and phasing at a number of study area intersections. Pedestrian level of service is expected to improve slightly. While pedestrians will notice some reduction in delay waiting to cross the street, pedestrian levels of service are not expected to change.

Eighteen signalized intersections do not provide enough time provided for the pedestrian to physically cross the street before the flashing "Don't Walk" signal ends. Signal timing and phasing would be adjusted under this alternative to improve this condition. These locations are discussed in Section 5.5.4, *Mitigation Measures*. Baseline Alternative pedestrian volumes are provided in Appendix F.

Bicycles

No impacts to bicycles are expected because the Baseline Alternative would not physically alter designated bicycle facilities nor disrupt future plans for either on-road or off-road facilities in the study area.

Parking

The Baseline Alternative would not physically alter the existing parking supply or a community's ability to expand parking or change enforcement. Bus stops for the service would be accommodated at existing Route 80 bus stops and would not result in the loss of parking. Parking demand may increase slightly if patrons try to drive rather than walk to bus stop areas. This would result in minimal parking disruption as a result of this alternative.

Bus Transportation

Except for the addition of the enhanced bus service, there would be no other changes to public transportation services associated with the Baseline Alternative.

Construction Impacts

There are no construction impacts associated with this alternative.

5.5.2.3 Alternative 1: Extension to Medford Hillside and Union Square (via commuter rail right-of-way)

Table 5.5-5 presents the expected peak hour Green Line ridership under Alternative 1 and how riders are likely to access each station. The remaining riders are assumed to access the station by walking. Alternative 1 traffic volume networks are presented in Appendix F.

Table 5.5-5 Alternative 1 Peak Hour Trip Summary by Station

Green Line Station	Boardings	Park and Ride[2]	Pick-Up/Drop-Off	Walk	Bike[1]
Lechmere	3,200	150	190	2,750	110
Brickbottom	700	0	45	620	35
Gilman Square	1,500	0	75	1,355	70
Lowell Street	500	0	20	455	25
Ball Square	700	0	30	635	35
College Avenue	800	0	40	720	40
Union Square	700	0	45	620	35

1 Based on 2000 Census data and bicycle mode split in each community.
2 Lechmere parking supply exists currently. No proposed new spaces are associated with this alternative at Lechmere.

Traffic Operations

As seen in Table 5.5-6, 15 signalized intersections would continue to operate at unacceptable levels of service under Alternative 1 during at least one peak hour. Intersections where level of service would improve due to the optimized signal timing and phasing assumed under this alternative are denoted in *italics.* Four intersections would improve to acceptable traffic operations during at least one peak hour under this alternative:

- Main Street at High Street/Salem Street/Forest Avenue/Riverside Avenue
- Medford Street at School Street
- Washington Street at Innerbelt Road
- Prospect Street at Webster Street/Concord Avenue

An additional four intersections would improve from LOS F to LOS E during at least one peak hour:

- Mystic Valley Parkway/Route 16 at Boston Avenue
- Broadway at Medford Street/Dexter Street
- Medford Street at Highland Avenue
- Washington Street at McGrath Avenue West

Intersections where level of service would degraded by at least one letter are denoted in **bold**. Level of Service would decrease at five locations:

- Boston Avenue at Winthrop Street (evening peak hour only)
- Boston Avenue at College Avenue (morning peak hour only)
- Washington Street at McGrath Highway/Route 28 East (morning peak hour only)
- Prospect Street at Somerville Avenue (evening peak hour only)
- Washington Street at Somerville Avenue/Webster Street (both peak hours)

For the majority of these intersections, vehicular LOS would degrade because signal timings would be adjusted to provide enough time for pedestrians to cross the street before the flashing "Don't Walk" signal ends. Changes in vehicular LOS would be negligible if mitigation for pedestrians was not provided. Mitigation to offset adverse impacts is presented in Section 5.5.4, *Mitigation Measures*.

Table 5.5-6 Alternative 1 Signalized LOS Summary Comparison

Signalized Intersection	No-Build Morning Peak Hour			No-Build Evening Peak Hour			Alternative 1 Morning Peak Hour			Alternative 1 Evening Peak Hour		
	V/C [1]	Delay [2]	LOS [3]	V/C	Delay	LOS	V/C	Delay	LOS	V/C	Delay	LOS
Mystic Valley Pkwy at Boston Avenue	1.03	81	F	>1.2	111	F	*1.05*	*69*	*E*	>1.2	117	F
Mystic Valley Pkwy at Winthrop Street	>1.20	>120	F	>1.2	>120	F	>1.2	>120	F	>1.2	>120	F
Boston Avenue at Winthrop Street	1.1	65	E	1.09	75	E	1.09	69	E	**1.19**	**91**	**F**
Boston Avenue at College Avenue	0.98	71	E	0.94	60	E	**1.04**	**81**	**F**	0.94	62	E
Main Street at High Street/Salem Street/Forest Avenue/Riverside Avenue	1.14	104	F	0.82	37	D	*1.10*	*79*	*E*	*0.80*	*31*	*C*
Main Street at Harvard Street	>1.20	>120	F	>1.2	>120	F	>1.2	>120	F	>1.2	>120	F
Broadway at Medford Street/Dexter Street	1.14	104	F	1.01	104	F	1.14	94	F	*0.98*	*59*	*E*
Medford Street at School Street	1.05	55	E	1.00	73	E	*1.01*	*53*	*D*	*0.97*	*37*	*D*
Medford Street at Highland Avenue	0.99	66	E	0.73	20	C	0.96	76	E	*0.67*	*16*	*B*
Washington Street at McGrath Hwy (East)	0.7	39	D	0.89	>120	F	**0.74**	**55**	**E**	*0.94*	*65*	*E*
Washington Street at McGrath Hwy (West)	0.84	>120	F	0.68	>120	F	*0.85*	*51*	*E*	*0.70*	*61*	*E*
Washington Street at Innerbelt Road	1.07	61	E	0.80	17	B	*1.01*	*42*	*D*	0.78	16	B
Prospect Street at Somerville Avenue	1.11	>120	F	1.04	75	E	1.07	113	F	**1.11**	**110**	**F**
Washington Street at Somerville Avenue/Webster Street	1.06	67	E	0.91	54	D	**1.10**	**85**	**F**	**0.91**	**66**	**E**
Prospect Street at Webster Street/Concord Avenue	1.08	117	F	>1.2	>120	F	*0.86*	*35*	*D*	1.25	119	F
O'Brien Highway at Land Boulevard/Gilmore Bridge	>1.2	>120	F	>1.2	>120	F	>1.2	>120	F	>1.2	>120	F
O'Brien Highway at Third Street	1.15	>120	F	>1.2	>120	F	1.13	>120	F	>1.2	>120	F

Note: Intersections improving by at least one level of service are denoted in *italics.* Intersections degrading by at least one level of service are denoted in **bold**.
1 Volume to capacity ratio
2 Delay in seconds per vehicle
3 Level of Service

As shown in Table 5.5-7, three unsignalized intersections are expected to see a change in delay under Alternative 1, but no change in level of service. The remaining intersections would continue to operate as in the No-Build Alternative. Traffic operations at the unsignalized intersection of Medford Street and Pearl Street are expected to degrade under Alternative 1. This is due to its proximity to the Gilman Square station and the number of pedestrians that are expected to access the station through this busy intersection. Mitigation to offset adverse impacts is presented in Section 5.5.4.

Table 5.5-7 Alternative 1 Unsignalized LOS Summary Comparison

		No-Build Morning Peak Hour			No-Build Evening Peak Hour			Alternative 1 Morning Peak Hour			Alternative 1 Evening Peak Hour		
Unsignalized Intersection	Critical Movement	V/C [1]	Delay [2]	LOS [3]	V/C	Delay	LOS	V/C	Delay	LOS	V/C	Delay	LOS
Boston Avenue at High Street/ Sagamore Avenue	Sagamore Avenue Southbound	>1.2	>120	F	>1.2	>120	F	>1.2	>120	F	>1.2	>120	F
College Avenue at George Street	George Street Westbound	0.90	38	E	0.92	41	E	0.92	40	E	0.91	39	E
Main Street at George Street	George Street Eastbound	>1.2	>120	F	>1.2	>120	F	>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	>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	>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	>1.2	>120	F	>1.2	>120	F
Medford Street at Lowell Street	Lowell Street Northbound	>1.2	>120	F	>1.2	22	C	>1.2	>120	F	0.43	23	C
Medford Street at Pearl Street	Pearl Street Westbound	>1.2	>120	F	0.93	56	F	>1.2	>120	F	**>1.2**	**>120**	**F**
Broadway at Winchester Street/Albion Street	Winchester/Albion SB	>1.2	>120	F	>1.2	>120	F	>1.2	>120	F	>1.2	>120	F

1 Volume to capacity ratio
2 Delay in seconds per vehicle
3 Level of Service

Pedestrians

Alternative 1 would increase pedestrian activity in the vicinity of the stations. In many cases, traffic signal timing and phasing changes at study area intersections would improve pedestrian level of service slightly. However, levels of service are not expected to change.

Eighteen signalized intersections would not provide enough time provided for the pedestrian to physically cross the street before the flashing "Don't Walk" signal ends. Signal timing and phasing would be adjusted under this alternative to improve this condition. An additional 19 locations would need other pedestrian improvements (such as restriping crosswalks, installing crosswalks, or installing pedestrian signals) to accommodate the expected increase in pedestrian volumes. These locations are discussed in Section 5.5.4, *Mitigation Measures*. Alternative 1 pedestrian volumes are provided in Appendix F.

Bicycles

Alternative 1 would not physically alter designated bicycle facilities nor disrupt future plans for either on-road or off-road facilities in the study area. However, the Project would attract bicyclists to station locations in both the inbound and outbound direction. This alternative assumes that the proposed Somerville Community Path is completed with connections to Green Line Extension stations. It is also assumed that other on-road bicycle accommodations that are not yet programmed would be available to commuters.

To accommodate demand, bicycle parking and storage locations would be maximized using available space. Based on the bicycle demand estimates provided in Table 5.5-5, at a minimum the following bicycle parking would be provided (numbers are rounded to the nearest 10):

- Brickbottom Station- 40 spaces
- Gilman Square Station - 80 spaces
- Lowell Street Station - 30 spaces
- Ball Square Station - 40 spaces
- College Avenue Station - 40 spaces
- Union Square Station - 40 spaces

Sufficient bicycle parking (at least 110 spaces) would be provided and available at Lechmere Station.

Parking

Alternative 1 would not physically alter existing public parking supply or a community's ability to expand parking or change enforcement. Many of the parking areas near station locations already see parking violations throughout the day and the available parking supply is limited. Increased enforcement would be necessary to ensure that parking areas would be used appropriately.

Approximately 100 spaces for private, employee-only parking would be available at the proposed maintenance facility at Yard 8. The facility is expected to have three working shifts, with all shift changes occurring outside of the commuter peak hours. Therefore, these spaces would not impact local traffic operations or the LOS for any road.

Bus Transportation

Prior to the full construction of the NorthPoint Development roadway networks, several roadway improvements are being made along McGrath Highway/Route 28 and within MBTA property to accommodate the buses and parking areas as well as improved pedestrian access. These station/busway-supportive roadway improvements include improvements to O'Brien Highway/Route 28 and construction of First Street, as shown in the station plans in Figure 3.7-2. The bus operations associated with Lechmere Station would be slightly altered once the station is relocated across O'Brien Highway. This is expected to have a direct impact on four existing bus routes in the immediate vicinity of the station: MBTA Routes 69, 80, 87 and 88. Three of these routes (Routes 80, 87, and 88) currently enter the station via a right-turn off of O'Brien Highway and exit the station via a left-turn onto

O'Brien Highway. These buses would continue along their current path down O'Brien Highway, but would turn left into Water Street and right out of New First Street. The Route 69 bus (which connects Lechmere Station with Harvard Square) would continue to travel Cambridge Street to O'Brien Highway, entering the station from Water Street via either a left onto Third Street and O'Brien Highway/Route 28 or via Cambridge Street to First Street and then a left onto O'Brien Highway/Route 28 and a right onto Water Street.

In addition to existing local bus routes, it is assumed that by 2030, in the Full-Build scenario for the NorthPoint Development, Lechmere Station would serve six routes as part of the planned Urban Ring Circumferential Transit System. Five of these routes would use the First Street entrance to access Lechmere Station, while the sixth would access the station at Water Street. Upon exiting, one route would exit the station via Water Street (heading north and west into Somerville) and four through First Street. The remaining route would move through the NorthPoint Development. These changes are also not expected to alter the service provided or disrupt traffic along these roadways. No other modifications to existing bus routes within the study area are proposed.

Construction Impacts

Construction impacts for Alternative 1 include traffic related to construction equipment, bridge closures, and traffic detours. These impacts are expected to be temporary and to terminate when construction is complete. Mobilization of construction equipment is not expected to impact traffic operations at study area intersections. Road closures related to bridge reconstruction would require traffic detours and result in some disruption to typical travel patterns in the study area. Temporary displacement of parking spaces may also be required, particularly in the immediate vicinity of station and bridge construction.

Although 7 roadway bridges would need to be reconstructed under Alternative 1, most of the bridges would still allow one- or two-way traffic during construction. It is expected that only two bridges would be temporarily closed to traffic under Alternative 1, and a temporary replacement bridge may be feasible for one of these locations. In any event, care will be taken to ensure that bridges are only closed when absolutely necessary and that no two adjacent bridges are closed at the same time to minimize disruption. This is discussed in further detail in Section 3.7.6, *Construction Sequencing and Staging*.

5.5.2.4 Alternative 2: Extension to Mystic Valley Parkway/Route 16 and Union Square (via commuter rail right-of-way)

Alternative 2 would extend a branch of the Green Line to Union Square via the MBTA Fitchburg Line right-of-way and extend a branch to a terminal station along the MBTA Lowell Line right-of-way near the intersection of Mystic Valley Parkway/Route 16 and Boston Avenue. Alternative 2A was evaluated with approximately 300 parking spaces at Mystic Valley Parkway/Route 16 Station. Alternative 2B was evaluated with no parking at this station. A complete description of this alternative is provided in Section 3.6, *Build Alternatives*.

Table 5.5-8 presents the expected peak hour Green Line ridership under Alternative 2 and how riders are likely to access the stations. Ridership, parking, and pick-up/drop-off totals are incorporated into the travel demand model and reported by CTPS. The remaining riders are assumed to access the station by walking or bicycle. Alternative 2 traffic volume networks are presented in Appendix F.

Table 5.5-8 Alternative 2 Peak Hour Trip Summary by Station

Green Line Station	Boardings	Park and Ride[2]	Pick-Up/Drop-Off	Walk	Bike[1]
Lechmere Square:					
2A	3,200	150	195	2,745	110
2B	3,300	150	200	2,830	120
Brickbottom	800	0	50	710	40
Gilman Square	1,600	0	75	1,450	75
Lowell Street	500	0	20	455	25
Ball Square	700	0	30	635	35
College Avenue	700	0	35	630	35
Mystic Valley Parkway:					
2A	900	80	40	740	40
2B	800	0	40	720	40
Union Square	700	0	40	625	35

1 Based on 2000 Census data and bicycle mode split in each community
2 Lechmere parking supply exists currently. No proposed new spaces are associated with this alternative at Lechmere

Traffic Operations

Traffic operations differ slightly between Alternatives 2A and 2B, and are presented separately below.

Alternative 2A (with parking)

As seen in Table 5.5-9, 15 signalized intersections would continue to operate unacceptably under Alternative 2A during at least one peak hour. Intersections where level of service would improve due to the optimized signal timing and phasing assumed under this alternative are denoted in *italics*. Four intersections would be improved to acceptable traffic operations during at least one peak hour under this alternative:

- Medford Street at School Street
- Washington Street at McGrath Highway West
- Washington Street at Innerbelt Road
- Prospect Street at Webster Street/Concord Avenue

One additional intersection would improve from LOS F to LOS E:

- Broadway at Medford/Dexter Street

Intersections where level of service would degrade by at least one letter are denoted in **bold**. Four locations are expected to degrade in level of service during at least one peak hour:

- Boston Avenue at Winthrop Street (evening peak hour)
- Washington Street at McGrath Highway East (morning peak hour)
- Prospect Street at Somerville Avenue (evening peak hour)
- Washington Street at Somerville Avenue/Webster Street (both peak hours)

This alternative would result in additional congestion along Mystic Valley Parkway/Route 16 during each of the peak hour conditions. Increased traffic volumes along Mystic Valley Parkway/Route 16 can be attributed to the parking accommodations at proposed Mystic Valley Parkway/Route 16 Station. This volume increase is greatest at two signalized intersections where LOS F conditions are projected by 2030:

- Mystic Valley Parkway/Route 16 at Boston Avenue; and
- Mystic Valley Parkway/Route 16 at Winthrop Street.

As seen in Table 5.5 -10, 10 unsignalized intersections would operate unacceptably under Alternative 2A. In addition to the nine intersections previously noted, the intersection of Mystic Valley Parkway/Route 16 at Alewife Brook Parkway would degrade from LOS D to LOS E during both peak hours under Alternative 2A. This is due to the increase in traffic at this intersection associated with parking and the pick-up/drop-off of riders at the Mystic Valley Parkway/Route 16 Station. Potential mitigation measures to address impacts to this location are provided in Section 5.5.4, *Mitigation Measures*.

In addition to the intersections noted in Table 5.5-10, Alternative 2A would create a new unsignalized intersection on Boston Avenue across from Stoughton Street. This intersection would serve as the main entrance to the proposed Mystic Valley Parkway Station and provide an exclusive left-turn lane southbound on Boston Avenue.

Table 5.5-9 Alternative 2A (with parking) Signalized LOS Summary Comparison

	No-Build Morning Peak Hour			No-Build Evening Peak Hour			Alternative 2A Morning Peak Hour			Alternative 2A Evening Peak Hour		
Signalized Intersection	**V/C [1]**	**Delay [2]**	**LOS [3]**	**V/C**	**Delay**	**LOS**	**V/C**	**Delay**	**LOS**	**V/C**	**Delay**	**LOS**
Mystic Valley Pkwy at Boston Avenue	1.03	81	F	>1.2	111	F	1.16	113	F	>1.2	>120	F
Mystic Valley Pkwy at Winthrop Street	>1.2	>120	F	>1.2	>120	F	>1.2	>120	F	>1.2	>120	F
Boston Avenue at Winthrop Street	1.1	65	E	1.09	75	E	1.13	68	E	**>1.2**	**90**	**F**
Boston Avenue at College Avenue	0.98	71	E	0.94	60	E	1.03	79	E	0.98	71	E
Main Street at High Street/Salem Street/Forest Avenue/Riverside Avenue	1.14	104	F	0.82	37	D	1.11	83	F	*0.79*	*33*	*C*
Main Street at Harvard Street	>1.2	>120	F	>1.2	>120	F	>1.2	>120	F	>1.2	118	F
Broadway at Medford Street/Dexter Street	1.14	104	F	1.01	104	F	1.13	93	F	*0.99*	*59*	*E*
Medford Street at School Street	1.05	55	E	1.00	73	E	*1.01*	*49*	*D*	*0.97*	*34*	*C*
Medford Street at Highland Avenue	0.99	66	E	0.73	20	C	1.01	61	E	*0.67*	*16*	*B*
Washington Street at McGrath Hwy (East)	0.70	39	D	0.89	>120	F	**0.74**	**62**	**E**	*0.94*	*72*	*E*
Washington Street at McGrath Hwy (West)	0.84	>120	F	0.68	>120	F	*0.86*	*50*	*D*	*0.70*	*60*	*E*
Washington Street at Innerbelt Road	1.07	61	E	0.80	17	B	*1.02*	*42*	*D*	0.78	16	B
Prospect Street at Somerville Avenue	1.11	>120	F	1.04	75	E	1.10	>120	F	**1.10**	**94**	**F**
Washington Street at Somerville Avenue/Webster Street	1.06	67	E	0.91	54	D	**1.12**	**87**	**F**	**0.91**	**71**	**E**
Prospect Street at Webster Street/Concord Avenue	1.08	117	F	>1.2	>120	F	*0.85*	*30*	*C*	>1.2	>120	F
O'Brien Highway at Land Boulevard/Gilmore Bridge	>1.2[1]	>120	F	>1.2	>120	F	>1.2	>120	F	>1.2	>120	F
O'Brien Highway at Third Street	1.15	>120	F	>1.2	>120	F	1.14	>120	F	>1.2	>120	F

Note: Intersections improving by at least one level of service are denoted in *italics.* Intersections degrading by at least one level of service are denoted in **bold**.

1 Volume to capacity ratio

2 Delay in seconds per vehicle

3 Level of Service

Table 5.5-10 Alternative 2A (with parking) Unsignalized Intersection Traffic Operations Results

Unsignalized Intersection	Critical Movement	No-Build Morning Peak Hour			No-Build Evening Peak Hour			Alternative 2A Morning Peak Hour			Alternative 2A Evening Peak Hour		
		V/C[1]	Delay[2]	LOS[3]	V/C	Delay	LOS	V/C	Delay	LOS	V/C	Delay	LOS
Boston Avenue at High Street/ Sagamore Avenue	Sagamore Avenue Southbound	>1.2	>120	F	>1.2	>120	F	>1.2	>120	F	>1.2	>120	F
College Avenue at George Street	George Street Westbound	0.90	38	E	0.92	41	E	0.91	39	E	0.95	49	E
Main Street at George Street	George Street Eastbound	>1.2	>120	F	>1.2	>120	F	>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	>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	>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	>1.2	>120	F	>1.2	>120	F
Medford Street at Lowell Street	Lowell Street Northbound	>1.2	>120	F	>1.2	22.2	C	>1.2	>120	F	0.47	25	D
Medford Street at Pearl Street	Pearl Street Westbound/Gilman Square Station	>1.2	>120	F	0.93	56.4	F	>1.2	>120	F	>1.2	>120	F
Broadway at Winchester Street/Albion Street	Winchester/Albion SB	>1.2	>120	F	>1.2	>120	F	>1.2	>120	F	1.00	>120	F
Mystic Valley Pkwy at Alewife Brook Pkwy	Roundabout	1.19	47	D	1.19	41	D	>1.2	59	E	>1.2	53	E

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

Alternative 2B (without parking)

Since no parking would be provided at the Mystic Valley Parkway/Route 16 Station under this alternative, three signalized intersections are expected to see a slight improvement in delay when compared to Alternative 2A:

- Mystic Valley Parkway/Route 16 at Boston Avenue
- Boston Avenue at Winthrop Street
- Boston Avenue at College Avenue

However, these intersections would still experience higher delay than under No-Build conditions and would still operate at an unacceptable LOS E/F. The increase in traffic delay is a direct result of pick-up/drop-off traffic at the Mystic Valley Parkway/Route 16 Station.

Traffic operations at unsignalized intersections would be largely the same under Alternative 2B as under Alternative 2A. The exception is operations at the Mystic Valley Parkway/Alewife Brook Parkway roundabout. When compared to Alternative 2A, this intersection would see a decrease in delay and operations would improve from LOS F to an acceptable LOS D during the evening peak hour; roughly the same as the No-Build condition.

Pedestrians

Pedestrian impacts would be the same as discussed under Alternative 1 above. However, the volume of pedestrians would be higher in and around the proposed Mystic Valley Parkway/Route 16 Station, particularly at the intersection of Mystic Valley Parkway/Route 16 and Boston Avenue. Alternative 2 pedestrian volumes are provided in Appendix F.

Bicycles

Alternative 2 would not physically alter designated bicycle facilities nor disrupt future plans for either on-road or off-road facilities in the study area. However, the Project would attract bicyclists to station locations in both the inbound and outbound direction. This alternative assumes that the proposed Somerville Community Path is completed with connections to Green Line Extension stations. It is also assumed that other on-road bicycle accommodations that are not yet programmed would be available to commuters.

To accommodate demand, bicycle parking and storage locations would be maximized using available space. Based on the bicycle demand estimates provided in Table 5.5-8, the following bicycle parking would be provided:

- Brickbottom - 40 spaces
- Gilman Square - 80 spaces
- Lowell Street Station - 30 spaces
- Ball Square Station - 40 spaces
- College Avenue Station - 40 spaces
- Mystic Valley Parkway - 50 spaces
- Union Square Station - 40 spaces

Sufficient bicycle parking (at least 110 spaces) would be provided and available at Relocated Lechmere Station.

Parking

There would be no permanent loss of parking as a result of constructing Green Line Extension stations. Both options for Alternative 2 would result in the loss of approximately 350 spaces in an existing parking garage, but would also acquire and demolish the building served by this parking.

Alternative 2A would add approximately 300 structured parking spaces at the Mystic Valley Parkway/Route 16 Station for use by MBTA patrons. No other changes to the parking supply are envisioned. The alternative would not alter a community's ability to expand parking or change enforcement. The availability of parking for use explicitly by MBTA patrons would likely reduce the number of vehicles who could potentially park on neighborhood streets. Increased enforcement would be necessary to ensure that parking areas are being used appropriately.

Approximately 100 spaces for private, employee-only parking would be available at the proposed maintenance facility at Yard 8. The facility is expected to have three working shifts, with all shift changes occurring outside of the commuter peak hours. Therefore, these spaces would not impact local traffic operations or the LOS for any road.

Bus Transportation

Impacts to bus transportation would remain the same as discussed under Alternative 1.

Construction Impacts

Construction impacts for Alternative 2 include traffic related to construction equipment, bridge closures, and traffic detours. These impacts are expected to be temporary and to terminate when construction is complete. Mobilization of construction equipment is not expected to impact traffic operations at study area intersections. Road closures related to bridge reconstruction would require traffic detours and would disrupt typical travel patterns in the study area. Temporary displacement of parking spaces may also be required, particularly in the immediate vicinity of station and bridge construction. Alternative 2 would require 9 roadway bridge reconstructions but, like Alternative 1, would require only two temporary bridge closings.

5.5.2.5 Alternative 3: Extension to Medford Hillside and Union Square (via McGrath Highway and Somerville Avenue)

Table 5.5-11 presents the expected peak hour Green Line ridership under Alternative 3 and how riders are likely to access the stations. Ridership and pick-up/drop-off totals are incorporated into the travel demand model and reported by CTPS. The remaining riders are assumed to access the station by walking or by bicycle. Alternative 3 traffic volume networks are presented in Appendix F.

Table 5.5-11 Alternative 3 Peak Hour Trip Summary by Station

Green Line Station	Boardings	Park and Ride[2]	Pick-Up/Drop-Off	Walk	Bike[1]
Lechmere Square	3,200	150	195	2,745	110
Brickbottom	700	0	45	620	35
Gilman Square	1,500	0	75	1,355	70
Lowell Street	500	0	20	455	25
Ball Square	700	0	30	635	35
College Avenue	800	0	40	720	40
Union Square	800	0	50	710	40

1 Based on 2000 Census data and bicycle mode split in each community.
2 Lechmere parking supply exists currently. No proposed new spaces are associated with this alternative at Lechmere.

Traffic Operations

As seen in Table 5.5-12, 15 signalized intersections would continue to operate unacceptably under Alternative 3 during at least one peak hour. Intersections where level of service would improve due to the optimized signal timing and phasing assumed under this alternative are denoted in *italics*. Three intersections would be improved to acceptable traffic operations during at least one peak hour under Alternative 3:

- Medford Street at School Street
- Washington Street at Innerbelt Road
- Prospect Street at Webster Street/Concord Avenue

An additional four intersections would improve from LOS F to LOS E during at least one peak hour:

- Mystic Valley Parkway/Route 16 at Boston Avenue
- Main Street at High Street/Salem Street/Forest Avenue/Riverside Avenue
- Broadway at Medford Street/Dexter Street
- Washington Street at McGrath Avenue West

Intersections where level of service would degrade by at least one letter are denoted in **bold**. Level of service would decrease at four locations:

- Boston Avenue at Winthrop Street (evening peak hour only)
- Washington Street at McGrath Highway East (morning peak hour only)
- Prospect Street at Somerville Avenue (evening peak hour only)
- Washington Street at Somerville Avenue/Webster Street (both peak hours)

Table 5.5-12 Alternative 3 Signalized Intersection Traffic Operations Results

Signalized Intersection	No-Build Morning Peak Hour			No-Build Evening Peak Hour			Alternative 3 Morning Peak Hour			Alternative 3 Evening Peak Hour		
	V/C [1]	Delay [2]	LOS [3]	V/C	Delay	LOS	V/C	Delay	LOS	V/C	Delay	LOS
Mystic Valley Pkwy at Boston Avenue	1.03	81	F	>1.2	111	F	*1.05*	*72*	*E*	>1.2	>120	F
Mystic Valley Pkwy at Winthrop Street	>1.2	>120	F	>1.2	>120	F	>1.2	>120	F	>1.2	>120	F
Boston Avenue at Winthrop Street	1.1	65	E	1.09	75	E	1.11	69	E	**1.18**	**87**	**F**
Boston Avenue at College Avenue	0.98	71	E	0.94	60	E	1.03	78	E	0.96	65	E
Main Street at High Street/Salem Street/Forest Avenue/Riverside Avenue	1.14	104	F	0.82	37	D	*1.10*	*79*	*E*	*0.81*	*31*	*C*
Main Street at Harvard Street	>1.2	>120	F	>1.2	>120	F	>1.2	>120	F	>1.2	>120	F
Broadway at Medford Street/Dexter Street	1.14	104	F	1.01	104	F	1.13	92	F	*1.01*	*64*	*E*
Medford Street at School Street	1.05	55	E	1.00	73	E	*1.02*	*48*	*D*	*0.98*	*37*	*D*
Medford Street at Highland Avenue	0.99	66	E	0.73	20	C	0.95	75	E	*0.70*	*16*	*B*
Washington Street at McGrath Hwy (East)	0.70	39	D	0.89	>120	F	**0.75**	**59**	**E**	*0.94*	*63*	*E*
Washington Street at McGrath Hwy (West)	0.84	>120	F	0.68	>120	F	*0.88*	*63*	*E*	*0.69*	*62*	*E*
Washington Street at Innerbelt Road	1.07	61	E	0.80	17	B	*1.00*	*41*	*D*	0.79	16	B
Prospect Street at Somerville Avenue	1.11	>120	F	1.04	75	E	1.10	>120	F	**1.09**	**98**	**F**
Washington Street at Somerville Avenue/Webster Street	1.06	67	E	0.91	54	D	**1.12**	**92**	**F**	**0.89**	**67**	**E**
Prospect Street at Webster Street/Concord Avenue	1.08	117	F	>1.2	>120	F	*0.87*	*43*	*D*	>1.2	112	F
O'Brien Highway at Land Boulevard/Gilmore Bridge	>1.2	>120	F	>1.2	>120	F	>1.2	>120	F	>1.2	>120	F
O'Brien Highway at Third Street	1.15	>120	F	>1.2	>120	F	1.14	>120	F	>1.2	>120	F

Note: Intersections improving by at least one level of service are denoted in *italics*. Intersections degrading by at least one level of service are denoted in **bold**.

1 Volume to capacity ratio
2 Delay in seconds per vehicle
3 Level of service

For the majority of these intersections, vehicular LOS would degrade because signal timings would be adjusted to provide enough time for pedestrians to cross the street before the flashing "Don't Walk" signal ends. Changes in vehicular LOS would be negligible if mitigation for pedestrians was not provided. Mitigation to offset adverse impacts is presented in Section 5.5.4, *Mitigation Measures*.

Traffic operations at unsignalized intersections are the same as discussed under Alternative 1, as the change in ridership due to in-street running has a negligible effect on unsignalized traffic operations.

Pedestrians

Pedestrian impacts would generally remain the same as discussed under Alternative 1. In the vicinity of Union Square, along McGrath Highway and Somerville Avenue, there would be increased pedestrian conflicts due to the in-street transit operations. Alternative 3 pedestrian volumes are provided in Appendix F.

Bicycles

Bicycle impacts would remain the same as discussed under Alternative 1.

Bus Transportation

Impacts to bus transportation would remain the same as discussed under Alternative 1.

Parking

Parking impacts would remain the same as discussed under Alternative 1.

Construction Impacts

Construction impacts would remain the same as discussed under Alternative 1 through the majority of the study area. Under Alternative 3, additional construction impacts would occur as a result of constructing in-street service along Somerville Avenue, between McGrath Highway/Route 28 and Prospect Street. No full-time roadway closures are expected as part of construction. However, periodic detours for vehicles, bicycles, and pedestrians would be likely. Temporary relocation of four bus stops along the Route 87 bus route could also be necessary, based on the ultimate construction management plan selected. Alternative 3 would require 7 roadway bridge reconstructions but would have only two temporary bridge closings, identical to Alternative 1.

5.5.2.6 Alternative 4: Extension to Mystic Valley Parkway/Route 16 and Union Square (via McGrath Highway and Somerville Avenue)

Table 5.5-13 presents the expected peak hour Green Line ridership under Alternative 4 and how riders are likely to access the stations. Ridership, parking, and pick-up/drop-off totals are incorporated into the travel demand model and reported by CTPS. The remaining riders are assumed to access the station by walking or by bicycle. Alternative 4 traffic volume networks are presented in Appendix F.

Table 5.5-13 Alternative 4 Peak Hour Trip Summary by Station

Green Line Station	Boardings	Park and Ride[2]	Pick-Up/Drop-Off	Walk	Bike[1]
Lechmere Square	3,200	150	195	2,745	110
Brickbottom	800	0	45	715	40
Gilman Square	1,600	0	75	1,450	75
Lowell Street	500	0	20	455	25
Ball Square	700	0	30	635	35
College Avenue	700	0	35	630	35
Mystic Valley Parkway[3]	900	80	40	740	40
Union Square	800	0	40	720	40

1 Based on 2000 Census data and bicycle mode split in each community.
2 Lechmere parking supply exists currently. No proposed new spaces are associated with this alternative at Lechmere.
3 Assumes 300-car parking garage at Mystic Valley Parkway Station.

Traffic Operations

As seen in Table 5.5-14, 15 signalized intersections would continue to operate unacceptably under Alternative 4 during at least one peak hour. Overall traffic operations are the same as described for Alternative 2A. Intersections where level of service would improve due to the optimized signal timing and phasing assumed under this alternative are denoted in *italics*. Four intersections would be improved to acceptable traffic operations during at least one peak hour under Alternative 4:

- Medford Street at School Street
- Washington Street at McGrath Highway West
- Washington Street at Innerbelt Road
- Prospect Street at Webster Street/Concord Avenue

An additional two intersections would improve from LOS F to LOS E during at least one peak hour:

- Broadway at Medford Street/Dexter Street
- Washington Street at McGrath Avenue West

Intersections where level of service degrades by at least one letter are denoted in **bold**. Level of Service would decrease at four locations:

- Boston Avenue at Winthrop Street (evening peak hour only)
- Washington Street at McGrath Highway East (morning peak hour only)
- Prospect Street at Somerville Avenue (evening peak hour only)
- Washington Street at Somerville Avenue/Webster Street (both peak hours)

For the majority of these intersections, vehicular LOS would degrade because signal timings would be adjusted to provide enough time for pedestrians to cross the street before the flashing “Don’t Walk” signal ends. Changes in vehicular LOS would be negligible if mitigation for pedestrians was not provided.

Traffic operations at the proposed Mystic Valley Parkway/Route 16 Station driveway would be the same as discussed under Alternative 2A. Mitigation to offset adverse impacts is presented in Section 5.5.4, *Mitigation Measures*.

Traffic operations at unsignalized intersections would be the same as discussed for Alternative 2A, as the change in ridership due to in-street running has a negligible effect on unsignalized traffic operations.

Table 5.5-14 Alternative 4 Signalized Intersection Traffic Operations Results

	No-Build Morning Peak Hour			No-Build Evening Peak Hour			Alternative 4 Morning Peak Hour			Alternative 4 Evening Peak Hour		
Signalized Intersection	**V/C [1]**	**Delay [2]**	**LOS [3]**	**V/C**	**Delay**	**LOS**	**V/C**	**Delay**	**LOS**	**V/C**	**Delay**	**LOS**
Mystic Valley Pkwy at Boston Avenue	1.03	81	F	>1.2	111	F	1.19	>120	F	>1.2	>120	F
Mystic Valley Pkwy at Winthrop Street	>1.2	>120	F	>1.2	>120	F	>1.2	>120	F	>1.2	>120	F
Boston Avenue at Winthrop Street	1.1	65	E	1.09	75	E	1.12	73	E	**1.18**	**>120**	**F**
Boston Avenue at College Avenue	0.98	71	E	0.94	60	E	1.04	79	E	0.97	67	E
Main Street at High Street/Salem Street/Forest Avenue/Riverside Avenue	1.14	104	F	0.82	37	D	1.10	83	F	*0.84*	*32*	*C*
Main Street at Harvard Street	>1.2	>120	F	>1.2	>120	F	>1.2	>120	F	>1.2	>120	F
Broadway at Medford Street/Dexter Street	1.14	104	F	1.01	104	F	1.15	98	F	*0.98*	*59*	*E*
Medford Street at School Street	1.05	55	E	1.00	73	E	*1.05*	*54*	*D*	*0.98*	*37*	*D*
Medford Street at Highland Avenue	0.99	66	E	0.73	20	C	1.00	58	E	*0.71*	*17*	*B*
Washington Street at McGrath Hwy (East)	0.70	39	D	0.89	>120	F	**0.73**	**57**	**E**	*0.89*	*66*	*E*
Washington Street at McGrath Hwy (West)	0.84	>120	F	0.68	>120	F	*0.86*	*52*	*D*	*0.69*	*58*	*E*
Washington Street at Innerbelt Road	1.07	61	E	0.80	17	B	*1.01*	*42*	*D*	0.78	16	B
Prospect Street at Somerville Avenue	1.11	>120	F	1.04	75	E	1.10	>120	F	**1.09**	**93**	**F**
Washington Street at Somerville Avenue/Webster Street	1.06	67	E	0.91	54	D	**1.11**	**99**	**F**	**0.89**	**65**	**E**
Prospect Street at Webster Street/Concord Avenue	1.08	117	F	>1.2	>120	F	*0.84*	*28*	*C*	>1.2	119	F
O’Brien Highway at Land Boulevard/Gilmore Bridge	>1.2	>120	F	>1.2	>120	F	>1.2	>120	F	>1.2	>120	F
O’Brien Highway at Third Street	1.15	>120	F	>1.2	>120	F	1.14	>120	F	>1.2	>120	F

Note: Intersections improving by at least one level of service are denoted in *italics.* Intersections degrading by at least one level of service are denoted in **bold**.

1 Volume to capacity ratio

2 Delay in seconds per vehicle

3 Level of Service

Pedestrians

Pedestrian impacts would generally remain the same as discussed under Alternative 2A. In the vicinity of Union Square, along McGrath Highway and Somerville Avenue, there would be increased pedestrian conflicts due to the in-street transit operations. Alternative 4 pedestrian volumes are provided in Appendix F.

Bicycles

Bicycle impacts would remain the same as discussed under Alternative 2.

Bus Transportation

Impacts to bus transportation would remain the same as discussed under Alternative 1.

Parking

Parking impacts would remain the same as discussed under Alternative 2.

Construction Impacts

Construction impacts would remain the same as discussed under Alternative 2 through the majority of the study area. Under Alternative 4, additional construction impacts would occur because of constructing in-street service along Somerville Avenue, between McGrath Highway and Prospect Street. No full-time roadway closures are expected as part of construction. However, periodic detours for vehicles, bicycles, and pedestrians would be likely. Temporary relocation of four bus stops along the Route 87 bus route could also be necessary, based on the ultimate construction management plan selected. Alternative 4 would require 9 roadway bridge reconstructions but would have only two temporary bridge closings, identical to Alternative 2.

5.5.2.7 Alternative 5: Extension to Mystic Valley Parkway/Route 16

Alternative 5 would extend both the D branch and the E branch of the Green Line to a terminal station along the MBTA Lowell Line right-of-way at the intersection of Mystic Valley Parkway/Route 16 and Boston Avenue. Alternative 5 would provide approximately 300 parking spaces at the Mystic Valley Parkway/Route 16 Station. Because both the D and E branches would provide service along the MBTA Lowell Line, train service would be more frequent than alternatives where service is provided to Union Square and College Avenue or Mystic Valley Parkway/ Route 16. This results in an increase of almost 1,000 peak hour boardings when compared to Alternative 2A. A complete description of this alternative is provided in Chapter 3, *Alternatives*.

Tables 5.5-15 present the expected peak hour Green Line ridership under Alternatives 5 and how riders are likely to access the stations. Ridership, parking, and pick-up/drop-off totals are incorporated into the travel demand model and reported by CTPS. The remaining riders are assumed to access the station by walking or by bicycle. Alternative 5 traffic volume networks are presented in Appendix F.

Table 5.5-15 Alternative 5 Peak Hour Trip Summary by Station

Green Line Station	Boardings	Park and Ride[2]	Pick-Up/ Drop-Off	Walk	Bike[1]
Lechmere Square	3,300	150	200	2,830	120
Brickbottom	1,300	0	85	1,155	60
Gilman Square	1,900	0	90	1,720	90
Lowell Street	600	0	25	545	30
Ball Square	900	0	40	815	45
College Avenue	800	0	40	720	40
Mystic Valley Parkway	1,200	80	55	1,025	40

1 Based on 2000 Census data and bicycle mode split in each community.
2 Lechmere parking supply exists currently. No proposed new spaces are associated with this alternative at Lechmere.

Traffic Operations

As seen in Table 5.5-16, 15 signalized intersections would continue to operate unacceptably under Alternative 5 during at least one peak hour. Intersections where level of service would improve due to the optimized signal timing and phasing assumed under this alternative are denoted in *italics*. Three intersections would be improved to acceptable traffic operations during at least one peak hour under Alternative 5:

- Medford Street at School Street
- Washington Street at Innerbelt Road
- Prospect Street at Webster Street/Concord Avenue

An additional two intersections would improve from LOS F to LOS E during at least one peak hour:

- Broadway at Medford Street/Dexter Street
- Washington Street at McGrath Avenue West

Intersections where level of service degrades by at least one letter are denoted in **bold**. Level of service would decrease at four locations:

- Boston Avenue at Winthrop Street (evening peak hour only)
- Washington Street at McGrath Highway East (morning peak hour only)
- Prospect Street at Somerville Avenue (evening peak hour only)
- Washington Street at Somerville Avenue/Webster Street (evening peak hour only)

Table 5.5-16 Alternative 5 Signalized Intersection Traffic Operations Results

Signalized Intersection	No-Build Morning Peak Hour			No-Build Evening Peak Hour			Alternative 5 Morning Peak Hour			Alternative 5 Evening Peak Hour		
	V/C [1]	Delay [2]	LOS [3]	V/C	Delay	LOS	V/C	Delay	LOS	V/C	Delay	LOS
Mystic Valley Pkwy at Boston Avenue	1.03	81	F	>1.2	111	F	1.2	115	F	>1.2	>120	F
Mystic Valley Pkwy at Winthrop Street	>1.2	>120	F	>1.2	>120	F	>1.2	>120	F	>1.2	>120	F
Boston Avenue at Winthrop Street	1.1	65	E	1.09	75	E	1.12	72	E	**>1.2**	**90**	**F**
Boston Avenue at College Avenue	0.98	71	E	0.94	60	E	1.02	78	E	0.98	68	E
Main Street at High Street/Salem Street/Forest Avenue/Riverside Avenue	1.14	104	F	0.82	37	D	1.11	81	F	*0.83*	*32*	*C*
Main Street at Harvard Street	>1.2	>120	F	>1.2	>120	F	>1.2	>120	F	>1.2	>120	F
Broadway at Medford Street/Dexter Street	1.14	104	F	1.01	104	F	1.15	95	F	*1.02*	*65*	*E*
Medford Street at School Street	1.05	55	E	1.00	73	E	*1.05*	*52*	*D*	*0.96*	*34*	*C*
Medford Street at Highland Avenue	0.99	66	E	0.73	20	C	1.00	64	E	*0.72*	*18*	*B*
Washington Street at McGrath Hwy (East)	0.70	39	D	0.89	>120	F	**0.74**	**63**	**E**	*0.92*	*67*	*E*
Washington Street at McGrath Hwy (West)	0.84	>120	F	0.68	>120	F	*0.89*	*57*	*E*	*0.69*	*56*	*E*
Washington Street at Innerbelt Road	1.07	61	E	0.80	17	B	*1.00*	*39*	*D*	0.81	17	B
Prospect Street at Somerville Avenue	1.11	>120	F	1.04	75	E	1.07	89	F	**1.06**	**88**	**F**
Washington Street at Somerville Avenue/Webster Street	1.06	67	E	0.91	54	D	1.05	60	E	**0.88**	**60**	**E**
Prospect Street at Webster Street/Concord Avenue	1.08	117	F	>1.2	>120	F	*0.83*	*33*	*C*	>1.2	118	F
O'Brien Highway at Land Boulevard/Gilmore Bridge	>1.2	>120	F	>1.2	>120	F	>1.2	>120	F	>1.2	>120	F
O'Brien Highway at Third Street	1.15	>120	F	>1.2	>120	F	1.15	>120	F	>1.2	>120	F

Note: Intersections improving by at least one level of service are denoted in *italics.* Intersections degrading by at least one level of service are denoted in **bold**.
1 Volume to capacity ratio
2 Delay in seconds per vehicle
3 Level of Service

Of note, Alternative 5 shows impacts to intersections in Union Square although no station would be proposed at this location under this alternative. Level of service would degrade due to an increase in pick-up/drop-off traffic associated with the Gilman Square and Lowell Street Stations as well as adjusting signal timings to provide enough time for pedestrians to cross the street before the flashing "Don't Walk" signal ends.

Traffic operations at the proposed Mystic Valley Parkway/Route 16 Station driveway would be the same as discussed under Alternative 2A. Mitigation to offset adverse impacts is presented in Section 5.5.4, *Mitigation Measures*.

Pedestrians

With the exception of Union Square, pedestrian impacts would remain the same as discussed for Alternative 2A. There are no anticipated impacts to pedestrians within Union Square since no station would be provided under this alternative. Alternative 5 pedestrian volumes are provided in Appendix F.

Bicycles

Impacts to bicycles would remain largely the same as discussed under Alternative 2. Because the Union Square Station would not be an option for bicyclists under this alternative, Lowell Street Station and Gilman Square Station could see an increase in the expected number of bicycles. To accommodate potential demand, 100 bicycle parking spaces would be made available in the vicinity of Gilman Square Station and 35 spaces in the vicinity of Lowell Street Station. The proximity of these stations to each other allows the user the opportunity to remain on a bicycle and change their station choice, rather than require them to switch from a bicyclist to a pedestrian.

Bus Transportation

Impacts to bus transportation would remain the same as discussed under Alternative 1.

Parking

Parking impacts related to this alternative are the same as discussed under Alternative 2. There would be no parking impact in the vicinity of Union Square.

Construction Impacts

Construction impacts remain the same as discussed under Alternative 2. There would be no construction impact in the vicinity of Union Square. Alternative 5 would require 9 roadway bridge reconstructions but, like Alternatives 1, 2, 3, and 4, would have only two temporary bridge closings.

5.5.2.8 Alternative 6: Extension to Union Square (via commuter rail right-of-way)

Table 5.5-17 presents the expected peak hour Green Line ridership under Alternative 6 and how riders are likely to access the station. Ridership and pick-up/drop-off totals are incorporated into the travel demand model and reported by CTPS. The remaining riders are assumed to access the station by walking or by bicycle. Alternative 6 traffic volume networks are presented in Appendix F.

Table 5.5-17 Alternative 6 Peak Hour Trip Summary by Station

Green Line Station	Boardings	Park and Ride[2]	Pick-Up/Drop-Off	Walk	Bike[1]
Lechmere Square	3,100	150	180	2,680	90
Union Square	1,200	0	70	1,070	60

1 Based on 2000 Census data and bicycle mode split in each community.
2 Lechmere parking supply exists currently. No proposed new spaces are associated with this alternative at Lechmere.

Traffic Operations

As seen in Table 5.5-18, 14 signalized intersections would continue to operate unacceptably under Alternative 6 during at least one peak hour. Intersections where level of service would improve due to the optimized signal timing and phasing assumed under this alternative are denoted in *italics.* Four intersections would improve to acceptable traffic operations during at least one peak hour under Alternative 6:

- Medford Street at School Street
- Medford Street at Highland Street
- Washington Street at Innerbelt Road
- Prospect Street at Webster Street/Concord Avenue

An additional four intersections would improve from LOS F to LOS E during at least one peak hour:

- Mystic Valley Parkway/Route 16 at Boston Avenue
- Broadway at Medford Street/Dexter Street
- Washington Street at McGrath Avenue East
- Washington Street at McGrath Avenue West

Intersections where level of service would degrade by at least one letter are denoted in **bold**. Level of service would decrease at three locations:

- Boston Avenue at Winthrop Street (evening peak hour only)
- Prospect Street at Somerville Avenue (evening peak hour only)
- Washington Street at Somerville Avenue/Webster Street (both peak hours)

Under Alternative 6, impacts to level of service would be attributed to the increase in pick-up/drop-off traffic associated with the proposed station. Because Union Square is the only transit option made available under this alternative, pick-up/drop-off traffic would be attracted from further away. Along Somerville Avenue, impacts would also occur because signal timings would be adjusted to provide enough time for pedestrians to cross the street before the flashing "Don't Walk" signal ends.

Traffic operations at unsignalized intersections would remain the same as under the No-Build Alternative. Because Alternative 6 would not provide any service outside of Union Square, none of these unsignalized Study Area intersections would see a decrease in level of service when compared to the No-Build Alternative.

Table 5.5-18 Alternative 6 Signalized Intersection Traffic Operations Results

	No-Build Morning Peak Hour			No-Build Evening Peak Hour			Alternative 6 Morning Peak Hour			Alternative 6 Evening Peak Hour		
Signalized Intersection	V/C [1]	Delay [2]	LOS [3]	V/C	Delay	LOS	V/C	Delay	LOS	V/C	Delay	LOS
Mystic Valley Pkwy at Boston Avenue	1.03	81	F	>1.2	111	F	*1.04*	*61*	*E*	>1.2	>120	F
Mystic Valley Pkwy at Winthrop Street	>1.2	>120	F	>1.2	>120	F	>1.2	>120	F	>1.2	>120	F
Boston Avenue at Winthrop Street	1.1	65	E	1.09	75	E	1.05	57	E	**1.19**	**85**	**F**
Boston Avenue at College Avenue	0.98	71	E	0.94	60	E	0.96	62	E	0.95	63	E
Main Street at High Street/Salem Street/Forest Avenue/Riverside Avenue	1.14	104	F	0.82	37	D	1.11	85	F	*0.80*	*32*	*C*
Main Street at Harvard Street	>1.2	>120	F	>1.2	>120	F	>1.2	>120	F	>1.2	>120	F
Broadway at Medford Street/Dexter Street	1.14	104	F	1.01	104	F	1.13	92	F	*0.97*	*58*	*E*
Medford Street at School Street	1.05	55	E	1.00	73	E	*1.02*	*50*	*D*	*0.93*	*31*	*C*
Medford Street at Highland Avenue	0.99	66	E	0.73	20	C	*0.93*	*52*	*D*	*0.67*	*16*	*B*
Washington Street at McGrath Hwy (East)	0.70	39	D	0.89	>120	F	0.73	55	D	*0.90*	*67*	*E*
Washington Street at McGrath Hwy (West)	0.84	>120	F	0.68	>120	F	*0.86*	*49*	*D*	*0.69*	*58*	*E*
Washington Street at Innerbelt Road	1.07	61	E	0.80	17	B	*0.99*	*39*	*D*	0.77	16	B
Prospect Street at Somerville Avenue	1.11	>120	F	1.04	75	E	1.10	>120	F	**1.11**	**99**	**F**
Washington Street at Somerville Avenue/Webster Street	1.06	67	E	0.91	54	D	**1.11**	**86**	**F**	**0.91**	**69**	**E**
Prospect Street at Webster Street/Concord Avenue	1.08	117	F	>1.2	>120	F	*0.84*	*29*	*C*	>1.2	>120	F
O'Brien Highway at Land Boulevard/Gilmore Bridge	>1.2	>120	F	>1.2	>120	F	>1.2	>120	F	>1.2	>120	F
O'Brien Highway at Third Street	1.15	>120	F	>1.2	>120	F	1.16	>120	F	>1.2	>120	F

Note: Intersections improving by at least one level of service are denoted in *italics.* Intersections degrading by at least one level of service are denoted in **bold**.
1 Volume to capacity ratio
2 Delay in seconds per vehicle
3 Level of Service

Pedestrians

Pedestrian activity would increase in the vicinity of Union Square under Alternative 6. At signalized Study Area locations within a one-third mile walking distance of Union Square, traffic signal timing and phasing changes would improve pedestrian level of service slightly and intersections that do not provide enough time for pedestrians to cross the street before the flashing "Don't Walk" signal ends would be improved. These locations are discussed in section 5.5.4, *Mitigation Measures*. Beyond Union Square, no pedestrian impacts are anticipated, as no new services would be provided. Alternative 6 pedestrian volumes are provided in Appendix F.

Bicycles

Alternative 6 would not physically alter designated bicycle facilities nor disrupt future plans for either on-road or off-road facilities in the study area. However, the Project would attract bicyclists to the proposed Union Square Station. It is also assumed that other on-road bicycle accommodations that are not yet programmed would be available to commuters, making travel to Union Square easier. To accommodate demand, bicycle parking and storage locations would be maximized using available space. Based on the bicycle demand estimates provided in Table 5.5-17, approximately 70 bicycle spaces would be provided at Union Square.

Parking

Alternative 6 would not physically alter existing public parking supply or the community's ability to expand parking or change enforcement. There are less than 50 public parking spaces within 500 feet of the proposed station location, the majority of which were observed to be occupied throughout the day. Increased enforcement would be necessary to ensure that parking areas would be used appropriately.

Bus Transportation

Impacts to bus transportation would remain the same as under Alternative 1.

Construction Impacts

Construction impacts for Alternative 6 would include traffic related to construction equipment and traffic detours. These impacts are expected to be temporary and would terminate when construction is complete. Mobilization of construction equipment is not expected to impact traffic operations at study area intersections. Sporadic road closures related to station and rail bridge construction may be necessary, could require traffic detours, and would result in some disruption to typical travel patterns in the vicinity of Union Square. This is discussed in further detail in Section 3.7.6, *Construction Sequencing and Staging*.

5.5.3 Safety

As discussed in Section 4.6, *Traffic*, the available safety data do not show a definitive pattern of safety deficiencies but do show a number of concerns throughout the study area. Traffic volume added to these intersections as a direct result of the Project would be minimal.

Traffic signal timing and phasing adjustments proposed as part of the Project could help to reduce incidents within the study area by providing adequate clearance intervals and pedestrian timings. Additionally, designated pick-up/drop-off areas would be designed to ensure proper spacing between signalized intersections and provide adequate sight distance.

Comparatively, alternatives that provide service to Union Square along the MBTA Fitchburg Line right-of-way (Alternatives 1, 2, and 6) would provide increased safety to motorists, pedestrians, and bicyclists when compared to Alternatives that consider in-street running (Alternatives 3 and 4). Two intersections that are listed on MassHighway's Top 1,000 High Crash Location list are along the proposed in-street service route. Allowing the Green Line to run in-street would introduce a number of potential conflict points that could increase the possibility of incidents along Somerville Avenue.

5.5.4 Mitigation Measures

By 2030, regardless of the Green Line Extension Project, traffic signal timing and phasing would be inadequate to accommodate the projected traffic demands at a number of locations. As part of any Build Alternative, the Project will include optimizing traffic signal timing and phasing to maximize the efficiency of signalized intersections.

5.5.4.1 Pedestrian Mitigation

Mitigation measures are necessary to accommodate safe and efficient pedestrian access to the proposed Green Line Extension stations. Mitigation measures include:

- Install crosswalks and appropriate warning signage;
- Increase pedestrian walk time;
- Improve existing crosswalk markings and repairing existing pedestrian signal equipment;
- Signalize side street crossings and increase walk time on main streets; and
- Conduct signal warrant analyses and, if warranted, install signals.

Under existing conditions, 18 signalized intersections do not currently provide enough time for pedestrians to cross the street before the flashing "Don't Walk" signal ends. In total, pedestrian mitigation is proposed at 33 locations. In some cases, pedestrian mitigation is proposed at locations that were not otherwise studied as part of this analysis. These locations were identified for mitigation as part of the regional pedestrian analysis. These measures are presented in Table 5.5-19.

Table 5.5-19 Proposed Pedestrian Mitigation Measures

Intersection	Proposed Mitigation	Alternative							
		1	2A	2B	3	4	5A	5B	6
Mystic Valley Parkway at Alewife Brook Parkway	Install crosswalk and appropriate warning signage across Capen Street		x	x		x	x		
Mystic Valley Parkway at Boston Avenue	Increase pedestrian walk/flashing don't walk time		x	x		x	x		
Mystic Valley Parkway at Auburn Street	Signalize side street crossings and increase pedestrian walk/flashing don't walk time		x	x		x	x		
Mystic Valley Parkway at Winthrop Street	Increase pedestrian walk/flashing don't walk time		x	x		x	x		
Boston Avenue at North Street	Upgrade pedestrian signal heads and increase pedestrian walk/flashing don't walk time	x	x	x	x	x	x	x	
Boston Avenue at Winthrop Street	Restripe crosswalk markings	x	x	x	x	x	x	x	
Boston Avenue between Winthrop Street and College Avenue (mid-block)	Install warning signage for mid-block crossing	x	x	x	x	x	x	x	
Boston Avenue at Harvard Street	Restripe crosswalk markings	x	x	x	x	x	x	x	
Powder House Rotary	Increase pedestrian walk/flashing don't walk time	x	x	x	x	x	x	x	
Boston Avenue at Broadway	Install crosswalk across Broadway	x	x	x	x	x	x	x	
College Avenue between Boston Street and Frederick Avenue (mid-block)	Conduct signal warrant analysis and install pedestrian signal for crossing	x	x	x	x	x	x	x	
College Avenue at George Street	Restripe crosswalk markings and install wheelchair ramps	x	x	x	x	x	x	x	
Main Street at George Street	Install crosswalk across George and install wheelchair ramps	x	x	x	x	x	x	x	
Main Street at Mystic Valley Parkway Ramps	Restripe crosswalk markings	x	x	x	x	x	x	x	
Main Street at Harvard Street	Restripe crosswalk markings	x	x	x	x	x	x	x	
Main Street at Mystic Avenue	Restripe crosswalk markings	x	x	x	x	x	x	x	
Medford Street at Broadway	Increase pedestrian walk/flashing don't walk time	x	x	x	x	x	x	x	
Medford Street at Lowell Street	Install crosswalk across Medford Street (south)	x	x	x	x	x	x	x	
Medford Street at Central Street	Repair pedestrian signal head and increase pedestrian walk/flashing don't walk time	x	x	x	x	x	x	x	
Medford Street at School Street	Increase pedestrian walk/flashing don't walk time	x	x	x	x	x	x	x	
Medford Street at Pearl Street	Conduct signal warrant analysis and if warranted install pedestrian signal for crossing	x	x	x	x	x	x	x	
Medford Street at Walnut Street	Increase pedestrian walk/flashing don't walk time	x	x	x	x	x	x	x	
Medford Street at Highland Avenue	Signalize side street crossings. Increase pedestrian walk/flashing don't walk time	x	x	x	x	x	x	x	
Highland Avenue at Lowell Street	Increase pedestrian walk/flashing don't walk time	x	x	x	x	x	x	x	
Highland Avenue at Central Street	Increase pedestrian walk/flashing don't walk time	x	x	x	x	x	x	x	
Washington Street at McGrath Highway	Incorporate pedestrian crossings into traffic signal phasing and install appropriate equipment	x	x	x	x	x	x	x	
Washington Street at Tufts Street	Conduct signal warrant analysis and if warranted install pedestrian signal for crossing	x	x	x	x	x	x	x	
Washington Street at Innerbelt Road	Increase pedestrian walk/flashing don't walk time	x	x	x	x	x	x	x	
Medford Street at Somerville Avenue /McGrath Highway	Incorporate pedestrian crossings into traffic signal phasing and install appropriate equipment	x	x	x	x	x			x

Table 5.5-19 Proposed Pedestrian Mitigation Measures (continued)

		Alternative							
Intersection	**Proposed Mitigation**	**1**	**2A**	**2B**	**3**	**4**	**5A**	**5B**	**6**
Washington Street at Somerville Avenue/Prospect Street	Increase pedestrian walk/flashing don't walk time	x	x	x	x	x			x
Washington Street at Somerville Avenue/Webster Street	Increase pedestrian walk/flashing don't walk time	x	x	x	x	x			x
Washington Street at Kirkland Street	Increase pedestrian walk/flashing don't walk time	x	x	x	x	x			x
Prospect Street at Webster Street	Install a crosswalk across Prospect north. Increase pedestrian walk/flashing don't walk time. Incorporate unsignalized crossings into traffic signal and install appropriate equipment.	x	x	x	x	x			x

As shown in Table 5.5-19, the majority of the measures recommended above are necessary under all alternatives except for Alternative 6, which would provide service to Union Square only. Improvements in the vicinity of Mystic Valley Parkway/Route 16 Station are recommended only for Alternatives that extend the line to Mystic Valley Parkway/Route 16 (Alternatives 2, 4, and 5). Improvements in the Union Square area are only recommended in alternatives that are proposed to extend service to Union Square (Alternatives 1, 2, 3, 4, and 6).

5.5.4.2 Traffic Mitigation

Several intersections would require additional physical mitigation to mitigate adverse impacts, caused by the Project's increased vehicular traffic.

Boston Avenue at Mystic Valley Parkway/Route 16 Station

To facilitate pick-up/drop-off or parking–related traffic (depending on the alternative) to the Mystic Valley Parkway/Route 16 Station, an existing driveway on Boston Avenue (across from Stoughton Street) would become the main point of access. An exclusive left-turn lane would be provided in the southbound direction on Boston Avenue to accommodate turning vehicles. Construction of the station entrance would require the removal of approximately 15 parking spaces.

Boston Avenue at Winthrop Street

To mitigate impacts caused by the Project, Boston Avenue northbound (which currently provides all movements from a single lane) would be striped to provide an exclusive left-turn lane and a shared through/right-turn lane. Signal timing and phasing changes would also be required. This improvement would require removing approximately 12 parking spaces along Boston Avenue. It is anticipated that level of service would improve at this intersection from LOS F to LOS D during the evening peak hour as a result of this mitigation. This mitigation would not be required under Alternative 6 but would be incorporated into all other alternatives.

While evening peak hour level of service improves, morning peak hour level of service degrades from LOS E to LOS F under Alternative 4 and Alternative 5 (Operations remain at LOS E during the morning peak hour for all other alternatives). This is a result of slightly higher traffic volumes in the morning peak hour at this location under Alternatives 4 and 5.

Boston Avenue at College Avenue

To mitigate impacts caused by the Project, College Avenue westbound could be widened to provide an exclusive right-turn lane to Boston Avenue. Signal timing and phasing changes would also be required. To accommodate this improvement, the College Avenue Bridge over the railroad tracks must be widened more than is already proposed to accommodate the Green Line tracks. Changes can be made without additional construction impacts. It is anticipated that level of service would improve at this intersection from LOS F to LOS D during the critical evening peak hour with this mitigation. This mitigation would not be required under Alternative 6.

Washington Avenue at McGrath Highway

A new signal phasing sequence is proposed at this intersection to incorporate pedestrian accommodations into the traffic signal (although this is a signalized intersection, pedestrian crossings at this location are not part of the traffic signal). This change would likely require new equipment and new wiring between traffic signal heads and the control cabinet. With these improvements in place, it is anticipated this intersection would remain at LOS E rather than degrade to LOS F during the morning and evening peak hours. This mitigation is proposed for all alternatives.

Prospect Street at Somerville Avenue

To accommodate Project-related pedestrian traffic at this location, pedestrian crossing times would increase, which would cause an adverse impact to overall vehicular traffic operations (i.e. delay) under every alternative during at least one peak hour. There is no opportunity at this location to increase capacity by adding lanes or changing lane allocation. However, traffic and pedestrian signal timings could be further adjusted to balance the needs of pedestrians and motorists.

Washington Street at Somerville Avenue/ Webster Street

To accommodate Project-related pedestrian traffic at this location, pedestrian crossing times would increase, which would cause an adverse impact to overall vehicular traffic operations (i.e. delay) under every alternative during at least one peak hour. There is no opportunity at this location to increase capacity by adding lanes or changing lane allocation. However, traffic and pedestrian signal timings could be further adjusted to balance the needs of pedestrians and motorists.

Mystic Valley Parkway/Route 16 at Alewife Brook Parkway

In all scenarios evaluated with a parking structure provided at Mystic Valley Parkway/Route 16 Station (Alternatives 2A, 4, and 5), LOS E conditions are projected for this location. Upgrading this roundabout to meet current design standards would ease congestion and help facilitate better traffic flow. Improvements would include improved signage, striping, and minor geometric modifications to the approach and departure angles of the roundabout; any improvements would require coordination with the DCR.

Medford Street at Pearl Street

This unsignalized intersection processes a high amount of traffic, currently operates at LOS F during the morning peak hour, and would degrade to LOS F during the evening peak hour by 2030, with or without the Project in place. The number of pedestrians crossing Medford Street would increase and would require a crosswalk to accommodate pedestrian demands.

A traffic signal would be installed to accommodate changes to this intersection as a result of the Project. Pearl Street would be controlled by the traffic signal and crosswalks would be striped on the south (Medford Street) and east (Pearl Street) approaches to the intersection. Due to the intersection's proximity with School Street, the two traffic signals would operate as a coordinated system. With the proposed improvement, the intersection of Medford Street and Pearl Street would operate at LOS B during both the morning and evening peak hour.

5.5.4.3 O'Brien Highway Reconstruction

As discussed in Section 5.5.2.1, the Full-Build NorthPoint development is assumed to be in place by 2030, the design year for the Green Line Extension transportation analysis. By 2030, it is also assumed that all mitigation associated with the NorthPoint development would be in place. This includes reconstructing O'Brien Highway from Third Street to Museum Way (including the midblock pedestrian crossing west of Land Boulevard) and constructing internal NorthPoint streets as delineated in the NorthPoint special permit.

A number of the mitigation measures associated with NorthPoint are necessary to support the relocation of Lechmere Station across O'Brien Highway. With the delay of the NorthPoint project, these mitigation measures would be accomplished as mitigation for the Green Line Extension. Specifically, the following measures are proposed:

- Reconstruct O'Brien Highway at its intersection with Third Street to restrict westbound left-turns from O'Brien Highway to Third Street, provide an upgraded pedestrian crossing, and new signal timing and phasing.
- Reconstruct O'Brien Highway at its intersection with Water Street to remove the median and allow eastbound left-turns from O'Brien Highway to Water Street. Left-turns from Water Street would be restricted. A new crosswalk would be provided on the east side of the intersection and the intersection would be signalized.
- Reconstruct O'Brien Highway at North First Street and East Street:
  - First Street would be extended through existing Lechmere Station to connect to O'Brien Highway creating a new signalized intersection.
  - Eastbound left-turns onto North First Street (into the new Station) would be prohibited. This movement would be accommodated at Water Street.
  - Westbound left-turns from O'Brien Highway to First Street and Cambridge Street would occur at this intersection under the proposed mitigation.
  - East Street would be reconstructed to be a right-turn in/right-turn out driveway and the median extended along O'Brien Highway to prohibit other movements. The existing traffic signal would be removed.
- Reconstruct the intersection of Cambridge Street and First Street, including new signal timing and phasing.
- Reconstruct First Street between Cambridge Street and O'Brien Highway to make the roadway one-way eastbound to O'Brien Highway.

The proposed improvements are necessary to support vehicular traffic and pedestrian crossings associated with the relocation of Lechmere Station.

Improvements at the intersection of O'Brien Highway at Land Boulevard/Charlestown Avenue and at the intersection of O'Brien Highway at Museum Way are not proposed as part of the Green Line Extension, as the Project does not impact traffic or pedestrian operations at these locations. It is assumed that the changes proposed at these two intersections as part of NorthPoint would be completed by the ultimate proponent of the developments completion.

Midblock O'Brien Highway Crossing

The mitigation as part of the NorthPoint project includes a midblock pedestrian crossing of O'Brien Highway between East Street and Land Boulevard\Charlestown Avenue. The installation of this crossing is dependent upon the location's ability to demonstrate need by meeting pedestrian signal traffic warrants as established by the Manual on Uniform Traffic Control Devices (MUTCD). Pedestrian projections for the area indicate that both the relocation of Lechmere Station and the Full-Build development of NorthPoint must occur before a pedestrian traffic signal would be warranted. Since the completion of NorthPoint is unknown at this time, pedestrian traffic related to the development could not be included in the warrant analysis and the warrant would not be met. As such, no pedestrian traffic signal is proposed as part of the Green Line Extension Project. Traffic signal conduit would extend to the end of the Project limits for the reconstruction of O'Brien Highway, to be tied into by the NorthPoint proponent once that project is complete.

Internal NorthPoint Streets

The NorthPoint project assumed development of a certain number of NorthPoint buildings prior to relocation of Lechmere Station. As such, the project was able to assume that the station's circulation roadways could be built on property that is not owned by EOT or the MBTA. Since NorthPoint has not been constructed, the circulation roadways around the relocated Lechmere Station must remain within the property limits owned by the MBTA. The proposed north-south circulation roadways would be in the same general location, but connectivity and alignment with the proposed NorthPoint infrastructure would be skewed. Once NorthPoint is constructed, these circulation roadways would be reconstructed to match the roadway layout delineated as part of the special permit for NorthPoint. Early action relocation of Lechmere Station would not preclude NorthPoint buildings or roadways from being constructed as permitted.

5.5.4.4 Parking Enforcement Mitigation

The parking demand analysis completed for Alternatives that would provide parking indicated a need to accommodate approximately 200 park-and-ride patrons who would drive to the station. The travel demand model estimates that these are regional travelers who are diverting from another station (such as Wellington or Alewife) or who pass the proposed station location today while driving into Boston. The majority of these riders would not switch to Green Line service under the Preferred Alternative, which would not include parking at Mystic Valley Parkway/Route 16 Station. However, no available long-term parking may encourage some motorists to park on local streets. Increasing parking enforcement or changing local parking restrictions to restrict commuter parking would be effective in reducing neighborhood impacts. EOT will work with the affected communities to develop acceptable parking enforcement plans for the areas within one-half mile of the stations in order to limit potential impacts.

5.5.5 Summary of Findings

This section provided a detailed assessment of the impacts on the transportation system associated with the Build Alternatives. Key points include:

Traffic Operations

- With mitigation, none of the proposed alternatives would have an adverse impact on traffic operations throughout the study area.
- The Baseline Alternative would have the least impact to the transportation system.
- Alternative 6 would have the least impact of all the Build Alternatives.

Pedestrians

- Pedestrian improvements would be implemented throughout the study area to accommodate the expected number of pedestrians accessing proposed stations.
- Pedestrian delays throughout the study area would be improved and signals would be timed to ensure pedestrians have adequate time to cross the street.

Bicycles

- None of the alternatives would physically alter designated bicycle facilities nor disrupt plans for future on-road or off-road facilities.
- When the opportunity is available, connections would be made from bicycle facilities to proposed stations.
- Adequate bicycle parking would be provided at station locations to accommodate and encourage commuting by bicycle.

Parking

- Minimal impacts to parking are expected (fewer than 12 places displaced on Boston Avenue near Winthrop Street and about 15 spaces displaced on Boston Avenue near Stoughton Street).
- Enforcement would be necessary to ensure that on-street parking is being used appropriately.

Bus Transportation

- Slight operational changes to bus service would be required at Relocated Lechmere Station as a result of the station relocation.
- No other bus routes or services would be modified.

An alternative-by-alternative comparison of the findings is presented in Table 5.5-20.

Table 5.5-20 Summary of Traffic Impacts and Mitigation

	Alternative							
	Bus	1	2A	2B	3	4	5	6
Total Peak Hour Boardings	N/A	8,100	9,100	9,100	8,200	9,200	10,000	4,300
• Total Peak Park and Ride (trips)	N/A	150	230	150	150	230	230	150
• Total Peak Pick-up/Drop-off (trips)	N/A	445	485	485	455	480	535	250
• Total Peak Walk (trips)	N/A	7,155	7,990	8,070	7,240	8,090	8,810	3,750
• Total Peak Bike (trips)	N/A	350	395	395	355	400	425	150
# Signalized Intersections Improved by Build Condition[1]	4	8	5	5	8	6	5	8
# Signalized Intersections Impacted[1]	0	5	4	4	4	4	4	3
# Signalized Intersections Improved with Mitigation[2]	0	3	3	3	3	3	3	1
# Unsignalized Intersections Improved by Build Condition[1]	0	0	0	0	0	0	0	0
# Unsignalized Intersections Impacted[1]	0	0	1	0	0	1	1	0
# Unsignalized Intersections Improved with mitigation[2]	0	1	2	1	1	2	2	0
Improved Pedestrian Mitigation (# locations)	None	29	33	33	29	33	28	5
Improved Bicycle Parking	None	270 new	320 new	320 new	270 new	320 new	345 new	70 new
Vehicular Parking Impacts	None	12 spaces	28 spaces	28 spaces	12 spaces	28 spaces	28 spaces	None
New Public MBTA Parking Spaces[3]	None	None	300	None	None	300	300	None
Bus Operations Impacts	New Service	Lechmere	Lechmere	Lechmere	Lechmere	Lechmere	Lechmere	Lechmere
Construction Impacts	None	Minor	Minor	Minor	Minor	Minor	Minor	Minor
Safety	No Change	Improved signal timings	Improved signal timings	Improved signal timings	Impacts to Somerville Avenue	Impacts to Somerville Avenue	Improved signal timings	Improved signal timings

1 Assumes a one letter change in Level of Service as a result of the Build condition and signal timing changes associated with the Build condition.
2 Assumes level of service Improved or maintained (when compared to No-Build) by mitigation measures identified in Section 5.5.4.
3 Lechmere Station parking is provided under the existing condition.

Construction Impacts

- Construction impacts could result in temporary lane closures and temporary traffic detours.
- In the vicinity of the stations, construction could temporarily displace on-street parking.
- Construction staging would limit the number of temporary bridge closures and ensure that adjacent bridges are not closed at the same time.

5.6 Air Quality

The Secretary's Certificate indicated that the Project is a significant investment in urban mass transit that will provide important transportation, air quality and urban redevelopment benefits and will fulfill a longstanding commitment to incorporate transit projects as an integral element of the Central Artery/Tunnel project (CA/T). The Secretary's Certificate requires that the DEIR describe the air quality benefits associated with the Green Line Extension Project and describe its consistency with the State Implementation Plan (SIP) and the Transit Regulations of the Massachusetts Department of Environmental Protection's (MassDEP). As required by the Secretary's Certificate, the DEIR/EA includes a mesoscale and microscale air quality analysis and includes the following emissions: volatile organic compounds (VOCs), oxides of nitrogen (NO_x), greenhouse gas carbon dioxide (CO_2), carbon monoxide (CO), and particulate matter (PM). In addition, an evaluation of air toxics was conducted. The Secretary's Certificate also indicated that MassDEP should be consulted regarding the study protocols, which has occurred during the development of this DEIR/EA.

The FTA, in cooperation with the FHWA and EPA, has established procedures for Transportation Conformity requirements of the Clean Air Act Amendments. The Transportation Conformity requirements are intended to integrate transportation and air quality planning in areas that are designated by the EPA as not meeting the National Ambient Air Quality Standards (NAAQS). The full results of the air quality analysis are provided in Appendix H.

5.6.1 Pollutants of Concern

Air pollution is of concern because of its demonstrated effects on human health. Of special concern are the respiratory effects of the pollutants and their potential toxic effects. The transportation air pollutants of concern include:

- **Carbon monoxide.** CO is a colorless and odorless gas that is a product of incomplete combustion. Carbon monoxide is absorbed by the lungs and reacts with hemoglobin to reduce the oxygen carrying capacity of the blood. At low concentrations, CO has been shown to aggravate the symptoms of cardiovascular disease. It can cause headaches and nausea and, at sustained high concentration levels, can lead to coma and death.
- **Particulate Matter.** PM is made up of small solid particles and liquid droplets. PM_{10} refers to particulate matter with a nominal aerodynamic diameter of 10 micrometers or less, and $PM_{2.5}$ refers to particulate matter with an aerodynamic diameter of 2.5 micrometers or less. Particulates can enter the body through the respiratory system. Particulates over 10 micrometers in size are generally captured in the nose and throat and are readily expelled from the body. Particles smaller than 10 micrometers, and especially particles smaller than

2.5 micrometers, can reach the air ducts (bronchi) and the air sacs (alveoli) in the lungs. Particulates are associated with increased incidence of respiratory diseases, cardiopulmonary disease, and cancer.

- **Ozone.** Ozone is a strong oxidizer and an irritant that affects the lung tissues and respiratory functions. Exposure to ozone can impair the ability to perform physical exercise, can result in symptoms such as tightness in the chest, coughing, and wheezing, and can ultimately result in asthma, bronchitis, and emphysema.
- **Volatile organic compounds.** VOCs are a general class of compounds containing hydrogen and carbon and are a precursor to the formation of the pollutant ozone. While concentrations of VOCs in the atmosphere are not generally measured, ground-level ozone is measured and used to assess potential health effects. Emissions of VOCs and NO_X react in the presence of heat and sunlight to form ozone in the atmosphere. Accordingly, ozone is regulated as a regional pollutant and is not assessed on a project-specific basis.
- **Nitrogen Oxides.** When combustion temperatures are extremely high, as in automobile engines, atmospheric nitrogen gas may combine with oxygen gas to form various oxides of nitrogen. Of these, nitric oxide (NO) and nitrogen dioxide (NO_2) are the most significant air pollutants. This group of pollutants is generally referred to as NO_X. Nitric oxide is relatively harmless to humans but quickly converts to NO_2. Nitrogen dioxide has been found to be a lung irritant and can lead to respiratory illnesses. Nitrogen oxides, along with VOCs, are also precursors to ozone formation.
- **Carbon Dioxide.** Greenhouse gases (GHG) are essential to maintaining the temperature of the Earth, without them the planet would be so cold as to be uninhabitable. While there are other GHGs, CO_2 is the predominant contributor to global warming, and emissions can be calculated for CO_2 with readily accessible data.

5.6.2 Air Quality Methodology

The EPA and MassDEP have established guidelines that define the modeling and review criteria for local and regional air quality analyses prepared pursuant to the MEPA process. These guidelines require that the project determine the change in project-related vehicle emissions. If the VOC and emissions from the Build Alternatives are greater than the No-Build Alternative, then the Project should include all reasonable and feasible emission reduction mitigation measures. Massachusetts has incorporated this criterion into the SIP.

The EPA and MassDEP guidelines require that the air quality study utilize traffic and emissions data for existing and future (No-Build and Build) conditions. The traffic and emissions data are incorporated into the EPA air quality models and modeling procedures to generate emissions estimates that demonstrate whether or not the Project will have air quality impacts.

The air quality study for the Green Line Extension Project evaluated several conditions, including the 2007 existing conditions (see Section 4.7, *Air Quality*), the No-Build Alternative, the Baseline Alternative, and six Build Alternatives. The six Build Alternatives are described in more detail in Chapter 3, *Alternatives*.

The No-Build Alternative (2030) included regional background traffic growth and planned roadway improvements. The Build Alternatives include the anticipated future changes in travel demand due to each alternative. The year 2030 was selected as the future year of analysis to be consistent with the statewide model as well as to be consistent with the regional long-range transportation plan. Future Project-related emission calculations are based upon changes in traffic and emission factor data. The traffic data include traffic volumes, vehicle-miles traveled (VMT), roadway operations, and physical roadway improvements. The emission factor data included emission reduction programs, years of analysis, and roadway speeds.

The microscale and mesoscale analyses developed traffic (volumes and speeds) and emission factor data for the 2030 No-Build and Build Alternatives. These data were incorporated into air quality models to demonstrate that the proposed Green Line Extension Project will meet the Clean Air Acts Amendments (CAAA) and SIP criteria. The mesoscale analysis evaluated the regional air quality impacts from the Project by determining the change in total ozone precursor emissions (volatile organic compounds and nitrogen oxides) for the existing and future conditions within the study area. The microscale analysis calculated the CO and PM concentrations for the same conditions at congested intersections near the Project corridor.

Further information about the air quality modeling methodology can be found in Section 4.7, *Air Quality*.

5.6.2.1 Air Quality Standards

The EPA has set the NAAQS for CO to protect the public health. Table 5.6-1 outlines the NAAQS for all of the pollutants. The predominant source of pollution anticipated from the proposed development is emissions from Project-related motor vehicle traffic. CO is directly emitted by motor vehicles. CO concentrations can be estimated by computer modeling, which can then be compared to the NAAQS.

Table 5.6-1 National Ambient Air Quality Standards

	Primary Standards		Secondary Standards	
Pollutant	**Level**	**Averaging Time**	**Level**	**Averaging**
Carbon Monoxide	9 ppm (10 mg/m^3)	8-hour[1]	None	
	35 ppm (40 mg/m^3)	1-hour[1]	None	
Lead	1.5 ug/m^3	Quarterly Average	Same as Primary	
Nitrogen Dioxide	0.053 ug/m^3 (100 ug/m^3)	Annual (Arithmetic Mean)	Same as Primary	
Particulate Matter (PM_{10})	150 ug/m^3	24-hour[2]	Same as Primary	
Particulate Matter ($PM_{2.5}$)	15 ug/m^3	Annual (Arithmetic Mean) [3]	Same as Primary	
	35 ug/m^3	24-hour[4]	Same as Primary	
Ozone	0.075 ppm (2008 std)	8-hour[5]	Same as Primary	
	0.08 ppm (1997 std)	8-hour[6]	Same as Primary	
	0.12 ppm	1-hour (applied to limited areas) [7]		
Sulfur Dioxide	0.03 ppm	Annual	0.5 ppm	3-hour
	0.14 ppm	24-hour[1]		

1 Not to be exceeded more than once per year.
2 Not to be exceeded more than once per year on average over 3 years.
3 To attain this standard, the 3-year average of the weighted annual mean PM2.5 concentrations from single or multiple community-oriented monitors must not exceed 15.0µg/m3.
4 To attain this standard, the 3-year average of the 98th percentile of 24-hour concentrations at each population-oriented monitor within an area must not exceed 35 µg/m3 (effective December 17, 2006).
5 To attain this standard, the 3-year average of the fourth-highest daily maximum 8-hour average ozone concentrations measured at each monitor within an area over each year must not exceed 0.075 ppm. (Effective 60 days after publication in the Federal Register)
6 (a) To attain this standard, the 3-year average of the fourth-highest daily maximum 8-hour average ozone concentrations measured at each monitor within an area over each year must not exceed 0.08 ppm.
(b) The 1997 standard—and the implementation rules for that standard—will remain in place for implementation purposes as EPA undertakes rulemaking to address the transition from the 1997 ozone standard to the 2008 ozone standard.
7 (a) The standard is attained when the expected number of days per calendar year with maximum hourly average concentrations above 0.12 ppm is < 1.
(b) As of June 15, 2005 EPA revoked the 1-hour ozone standard in all areas except the 8-hour ozone nonattainment Early Action Compact (EAC) Areas.

5.6.3 Microscale Analysis

Future estimates of Project-related emissions of CO and PM are based upon changes in traffic and emission factor data. The traffic data include traffic volumes, VMT, signal cycle timing, and physical roadway improvements. The emission factor data include years of analysis and roadway speeds. The microscale analysis for the six Build Alternatives for the proposed Green Line Extension Project is based upon changes in these parameters.

5.6.3.1 Microscale CO Emissions Results

The microscale analysis calculated CO concentrations for the No-Build Alternative, the Baseline Alternative, and the six Build Alternatives. The concentrations are expressed in parts per million (ppm) and include a 1-hour background concentration of 3.0 ppm which was based on background values determined by the MassDEP from air quality monitoring documented in the *New England Annual Air Quality Report*.[1]

The 1-hour CO concentrations were calculated using EPA's *CAL3QHC model*, with evening peak hour traffic and emission data. The 8-hour CO concentrations were derived by applying a persistence factor of 0.66 to the 1-hour CO concentrations. This persistence factor was obtained from the MassDEP nearest CO monitoring station at 590 Commonwealth Avenue, Kenmore Square, Boston. It represents the average ratio of second highest 8-hour to second highest 1-hour CO reading.

As presented earlier, the EPA has set the NAAQS for CO to protect the public health. The NAAQS for CO sets maximum concentrations of 35 ppm for a 1-hour period and 9 ppm for an 8-hour period, each not to be exceeded more than once per year.

The microscale results for all the intersections are presented in Table 5.6-2 and 5.6-3. All the 1-hour and 8-hour concentrations are below the CO NAAQS of 35 and 9 ppm, respectively. These values are consistent with the area's designation as a Maintenance CO attainment area. As documented in Section 4.7, the 2007 existing conditions results of the microscale analysis for the 1-hour CO concentrations ranged from 4.2 ppm to 8.4 ppm. The corresponding maximum 8-hour CO concentrations for 2007 ranged from a minimum of 2.8 ppm to a maximum of 5.5 ppm, which approaches the CO NAAQS of 9.0 ppm.

The microscale analysis indicates that reductions in CO concentrations are expected to occur over time when compared to the 2007 existing condition. All of the calculated future CO concentrations (both 1- and 8-hour) are equal to or less than the 2007 existing conditions concentrations. These reductions can be attributed to more efficient vehicles with enhanced emissions control technologies and the benefits of the Massachusetts' vehicle inspection and maintenance program. None of the future No-Build, Baseline, and Build Alternatives concentrations approach the CO NAAQS for 1-hour or 8-hour.

The No-Build Alternative 1-hour CO emissions range from a minimum of 3.8 ppm to a maximum of 7.9 ppm. Similarly, the No-Build 8-hour CO emissions range from a minimum of 2.5 ppm to a maximum of 5.2 ppm. The highest 1-hour 2030 Build CO emissions under all of the Project's 2030 Build Alternatives occurred at the intersection of Monsignor O'Brien Highway at Charles River Dam Bridge at Charlestown Avenue and Commercial Avenue (6.1 ppm is the highest under Alternative 6: Union Square). The lowest CO emissions of 3.8 ppm would be experienced at the intersection of Highland Street at Central Street and at the intersection of School Street at Medford Street under Alternatives 2, 4, and 6.

1 *2006 New England Annual Report on Air Quality*, United States Environmental Protection Agency, Region 1, Office of Environmental Measurement and Evaluation North Chelmsford, MA 01863, Ecosystems Assessment Unit, July 2007. (http://www.epa.gov/region01/lab/reportsdocuments.html).

Table 5.6-2 Predicted Maximum 1-Hour CO Concentrations (Parts Per Million)[1, 2]

				Alt. 1	Alt. 2[3]	Alt. 3	Alt. 4	Alt. 5	Alt. 6
Intersection Number and Intersection	2007 Existing	2030 No-Build	2030 Baseline	Medford Hillside/ Union Square	Mystic Valley Pkwy/ Union Square	Medford Hillside/ Union Square Loop	Mystic Valley Pkwy/ Union Square	Mystic Valley Pkwy	Union Square
1 Mystic Valley Parkway at Boston Avenue	5.5	4.6	4.6	4.6	4.6	4.6	4.6	4.6	4.6
2. Mystic Valley Parkway at Winthrop Street	6.8	5.2	5.4	5.4	5.4	5.3	5.3	5.2	5.4
3. Mystic Valley Parkway EB off-ramp at Main Street and South Street	5.0	4.2	4.3	4.2	4.3	4.2	4.3	4.3	4.2
4. Boston Avenue at College Avenue	5.4	4.5	4.3	4.3	4.4	4.4	4.4	4.5	4.4
5. Harvard Street at Main Street	4.9	4.3	4.3	4.3	4.2	4.3	4.3	4.3	4.2
6. Medford Street at Broadway and Dexter Street	5.7	4.7	4.3	4.4	4.4	4.4	4.4	4.6	4.3
7. Highland Street at Central Street	4.5	3.9	4.0	4.0	4.0	4.0	4.0	4.0	4.0
8. School Street at Medford Street	4.7	4.0	3.9	4.0	3.9	4.0	4.0	4.1	3.9
9. Somerville Avenue at Washington and Prospect Street	6.6	5.2	5.3	5.3	5.2	5.3	5.3	5.3	5.2
10. Washington Street at McGrath Highway	5.8	4.7	5.2	5.2	5.3	5.2	5.3	4.8	5.3
11. Monsignor O'Brien Highway at Third Street	5.5	5.5	6.1	5.9	5.9	5.9	5.9	5.8	6.0
12. Monsignor O'Brien Highway at East Street/ Cambridge Street	4.9	4.8	4.6	4.6	4.6	4.6	4.6	4.6	4.6
13. Cambridge Street at First Street	4.5	4.9	4.8	4.8	4.8	4.8	4.8	4.8	4.8
14. Monsignor O'Brien Highway at Charlestown Avenue/ Lands Boulevard	8.4	7.9	6.1	6.0	6.0	6.0	6.0	6.0	6.0

Source: Vanasse Hangen Brustlin, Inc.

1 The remaining intersections are included in Appendix H. The concentrations are expressed in parts per million (ppm) and include a 1-hour background concentration of 3.0ppm. The 1-hour NAAQS for CO is 35 ppm. The emissions presented represent the highest emissions experienced at each intersection for each alternative. The air quality study assumes that if these intersections meet the NAAQS, then all other intersections, regardless of alternative, which will have lower volumes and better levels of service, can be assumed to also meet the NAAQS.

2 The Build Alternatives used for the air quality analysis include the physical and operational mitigation proposed to improve traffic operations (as outlined in the traffic section).

3 The results are the same for Alternatives 2A and 2B.

Table 5.6-3 Predicted Maximum 8-Hour CO Concentrations (Parts Per Million)[1, 2]

Intersection No. and Intersection		2007 Existing	2030 No-Build	2030 Baseline	Alt. 1 Medford Hillside/ Union Square	Alt. 2[3] Mystic Valley Pkwy/ Union Square	Alt. 3 Medford Hillside/ Union Square Loop	Alt. 4 Mystic Valley Parkway/ Union Square	Alt. 5 Mystic Valley Parkway	Alt. 6 Union Square
1	Mystic Valley Parkway at Boston Avenue	3.6	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0
2.	Mystic Valley Parkway at Winthrop Street	4.5	3.4	3.6	3.6	3.6	3.5	3.5	3.4	3.6
3.	Mystic Valley Parkway EB off-ramp at Main Street and South Street	3.3	2.8	2.8	2.8	2.8	2.8	2.8	2.8	2.8
4.	Boston Avenue at College Avenue	3.6	3.0	2.8	2.8	2.9	2.9	2.9	3.0	2.9
5.	Harvard Street at Main Street	3.2	2.8	2.8	2.8	2.8	2.8	2.8	2.8	2.8
6.	Medford Street at Broadway and Dexter Street	3.8	3.1	2.8	2.9	2.9	2.9	2.9	3.0	2.8
7.	Highland Street at Central Street	3.0	2.6	2.6	2.6	2.6	2.6	2.6	2.6	2.6
8.	School Street at Medford Street	3.1	2.6	2.6	2.6	2.6	2.6	2.6	2.7	2.6
9.	Somerville Avenue at Washington and Prospect Street	4.4	3.4	3.4	3.5	3.4	3.5	3.5	3.4	3.4
10.	Washington Street at McGrath Highway	3.8	3.1	3.4	3.4	3.5	3.4	3.5	3.2	3.5
11.	Monsignor O'Brien Highway at Third Street	4.0	3.6	4.0	3.9	3.9	3.9	3.9	3.8	4.0
12.	Monsignor O'Brien Highway at East Street/ Cambridge Street	3.8	3.2	3.0	3.0	3.0	3.0	3.0	3.0	3.0
13.	Cambridge Street at First Street	3.0	3.4	3.2	3.2	3.2	3.2	3.2	3.2	3.2
14.	Monsignor O'Brien Highway at Charlestown Avenue/ Lands Boulevard	5.5	5.2	4.0	4.0	4.0	4.0	4.0	4.0	4.0

Source: Vanasse Hangen Brustlin, Inc.

1 The remaining intersections are included in Appendix H. The concentrations are expressed in parts per million (ppm) and a persistence factor of 0.66 was used. The 8-hour NAAQS for CO is 9 ppm. The emissions presented represent the highest emissions experienced at each intersection for each alternative. The air quality study assumes that if this intersection meets the NAAQS, then all other intersections, regardless of alternative, which will have lower volumes and better levels of service, can be assumed to also meet the NAAQS.

2 The Build Alternatives used for the air quality analysis include the physical and operational mitigation proposed to improve traffic operations (as outlined in the traffic section).

3 The results are the same for Alternatives 2A and 2B.

5.6.3.2 Microscale PM_{10} Emissions Results

The microscale analysis calculated the 24-hour PM_{10} concentrations for the No-Build Alternative, the Baseline Alternative, and the six Build Alternatives. The 24-hour PM_{10} concentrations were calculated using EPA's CAL3QHC model. The concentrations are expressed in micrograms per cubic meter (ug/m^3) and include a

24-hour background concentration of 23 ug/m^3, which was based on MassDEP air quality monitoring data.

Table 5.6-4 presents the 24-hour PM_{10} concentrations for the Project. The 2030 24-hour PM_{10} concentrations for the Build Alternatives ranged from a minimum of 66 ug/m^3 to a maximum of 83 ug/m^3. All of the 24-hour PM_{10} concentrations are well below the PM NAAQS of 150 ug/m^3.

Table 5.6-4 Predicted Maximum 24-Hour PM_{10} Concentrations (Parts Per Million)[1, 2]

					Alt. 1	Alt. 2[3]	Alt. 3	Alt. 4	Alt. 5	Alt. 6
Intersection No. and Intersection		2007 Existing	2030 No-Build	2030 Baseline	Medford Hillside/ Union Square	Mystic Valley Parkway/ Union Square	Medford Hillside/ Union Square Loop	Mystic Valley Parkway/ Union Square	Mystic Valley Parkway	Union Square
1	Mystic Valley Parkway at Boston Avenue	81	71	73	73	73	73	73	73	73
2.	Mystic Valley Parkway at Winthrop Street	91	78	78	78	78	78	78	76	78
3.	Mystic Valley Parkway EB off-ramp at Main Street and South Street	78	71	71	71	71	71	71	71	71
4.	Boston Avenue at College Avenue	73	68	66	66	68	68	68	68	66
5.	Harvard Street at Main Street	76	68	68	68	68	68	68	71	68
6.	Medford Street at Broadway and Dexter Street	76	71	68	68	68	68	68	71	68
7.	Highland Street at Central Street	71	66	66	66	66	66	66	66	66
8.	School Street at Medford Street	71	68	68	68	68	68	68	68	68
9.	Somerville Avenue at Washington and Prospect Street	86	73	76	76	76	76	76	76	76
10.	Washington Street at McGrath Highway	81	71	71	73	73	73	73	73	73
11.	Monsignor O'Brien Highway at Third Street	81	76	81	81	81	81	81	81	81
12.	Monsignor O'Brien Highway at East Street/ Cambridge Street	76	71	68	68	68	68	68	68	68
13.	Cambridge Street at First Street	68	71	71	71	71	71	71	71	71
14.	Monsignor O'Brien Hwy at Charlestown Avenue/ Lands Boulevard	91	86	83	83	83	83	83	83	83

Source: Vanasse Hangen Brustlin, Inc.

1 The concentrations are expressed in micrograms per cubic meter (ug/m^3). The NAAQS for PM_{10} is 150 ug/m3. The emissions presented represent the highest emissions experienced at each intersection for each alternative. The air quality study assumes that if this intersection meets the NAAQS, then all other intersections, regardless of alternative, which will have lower volumes and better levels of service, can be assumed to also meet the NAAQS.

2 The Build Alternatives used for the air quality analysis include the physical and operational mitigation proposed to improve traffic operations (as outlined in the traffic section).

3 The results are the same for Alternatives 2A and 2B.

Table 5.6-5 Predicted Maximum 24-Hour $PM_{2.5}$ Concentrations (Parts Per Million)[1, 2]

					Alt. 1	Alt. 2[3]	Alt. 3	Alt. 4	Alt. 5	Alt. 6
Intersection No. and Intersection		2007 Existing	2030 No-Build	2030 Baseline	Medford Hillside/ Union Square	Mystic Valley Parkway/ Union Square	Medford Hillside/ Union Square Loop	Mystic Valley Parkway/ Union Square	Mystic Valley Parkway	Union Square
1	Mystic Valley Parkway at Boston Avenue	31.7	30.9	30.9	30.9	32.1	30.9	31.3	30.9	30.9
2.	Mystic Valley Parkway at Winthrop Street	32.9	31.7	31.7	31.7	32.9	31.7	31.7	31.3	31.7
3.	Mystic Valley Parkway EB off-ramp at Main Street and South Street	31.7	30.9	30.9	30.9	31.7	30.9	30.9	30.9	30.9
4.	Boston Avenue at College Avenue	31.3	30.5	30.5	30.5	30.5	30.5	30.5	30.5	30.5
5.	Harvard Street at Main Street	31.3	30.9	30.5	30.5	30.5	30.9	30.5	30.9	30.5
6.	Medford Street at Broadway and Dexter Street	31.3	30.9	30.5	30.9	30.9	30.9	30.9	30.9	30.5
7.	Highland Street at Central Street	30.9	30.5	30.5	30.5	30.5	30.5	30.5	30.5	30.5
8.	School Street at Medford Street	30.9	30.5	30.5	30.5	30.5	30.5	30.5	30.5	30.5
9.	Somerville Avenue at Washington and Prospect Street	32.5	31.3	31.3	31.3	31.3	31.3	31.3	31.3	31.3
10.	Washington Street at McGrath Highway	32.1	31.3	31.3	31.3	31.3	31.3	31.3	31.3	31.3
11.	Monsignor O'Brien Highway at Third Street	32.1	31.7	31.7	31.7	31.7	31.7	31.7	31.7	31.7
12.	Monsignor O'Brien Highway at East Street/ Cambridge Street	31.3	30.9	30.9	30.5	30.5	30.5	30.5	30.5	30.9
13.	Cambridge Street at First Street	30.5	30.9	30.9	30.9	30.9	30.9	30.9	30.9	30.9
14.	Monsignor O'Brien Highway at Charlestown Avenue/ Lands Boulevard	33.3	32.5	32.1	32.1	32.1	32.1	31.7	31.7	32.1

Source: Vanasse Hangen Brustlin, Inc.

1 The concentrations are expressed in micrograms per cubic meter (ug/m3). The background concentrations assumed for the 24-Hour $PM_{2.5}$ was 29.7 ug/m^{3}The NAAQS for $PM_{2.5}$ is 35 ug/m3. The emissions presented represent the highest emissions experienced at each intersection for each alternative. The air quality study assumes that if this intersection meets the NAAQS, then all other intersections, regardless of alternative, which will have lower volumes and better levels of service, can be assumed to also meet the NAAQS.

2 The Build Alternatives used for the air quality analysis include the physical and operational mitigation proposed to improve traffic operations (as outlined in the traffic section).

3 The results are the same for Alternatives 2A and 2B.

Table 5.6-6 Predicted Maximum Annual $PM_{2.5}$ Concentrations (Parts Per Million)[1, 2]

					Alt. 1	Alt. 2[3]	Alt. 3	Alt. 4	Alt. 5A	Alt. 5B	Alt. 6
Intersection No. and Intersection		2007 Existing	2030 No-Build	2030 Baseline	Medford Hillside/ Union Square	Mystic Valley Parkway/ Union Square	Medford Hillside/ Union Square Loop	Mystic Valley Parkway/ Union Square	Mystic Valley Parkway w/ Parking	Mystic Valley Parkway w/o Parking	Union Square
1	Mystic Valley Parkway at Boston Avenue	12.1	11.9	11.9	11.9	12.1	11.9	12.0	11.9	11.9	11.9
2.	Mystic Valley Parkway at Winthrop Street	12.3	12.1	12.1	12.1	12.3	12.1	12.1	12.0	12.1	12.1
3.	Mystic Valley Parkway EB Off-Ramp at Main Street and South Street	12.1	11.9	11.9	11.9	12.1	11.9	11.9	11.9	11.9	11.9
4.	Boston Avenue at College Avenue	12.0	11.9	11.9	11.9	11.9	11.9	11.9	11.9	11.9	11.9
5.	Harvard Street at Main Street	12.0	11.9	11.9	11.9	11.9	11.9	11.9	11.9	11.9	11.9
6.	Medford Street at Broadway and Dexter Street	12.0	11.9	11.9	11.9	11.9	11.9	11.9	11.9	11.9	11.9
7.	Highland Street at Central Street	11.9	11.9	11.9	11.9	11.9	11.9	11.9	11.9	11.9	11.9
8.	School Street at Medford Street	12.0	11.9	11.9	11.9	11.9	11.9	11.9	11.9	11.9	11.9
9.	Somerville Avenue at Washington and Prospect Street	12.3	12.0	12.0	12.0	12.0	12.0	12.0	12.0	12.0	12.0
10.	Washington Street at McGrath Highway	12.2	12.0	12.0	12.0	12.0	12.0	12.0	12.0	12.0	12.0
11.	Monsignor O'Brien Highway at Third Street	12.2	12.1	12.1	12.1	12.1	12.1	12.1	12.1	12.1	12.1
12.	Monsignor O'Brien Highway at East Street/ Cambridge Street	12.0	11.9	11.9	11.9	11.9	11.9	11.9	11.9	11.9	11.9
13.	Cambridge Street at First Street	11.9	11.9	11.9	11.9	11.9	11.9	11.9	11.9	11.9	11.9
14.	Monsignor O'Brien Highway at Charlestown Avenue/ Lands Boulevard	12.4	12.3	12.2	12.2	12.2	12.2	12.2	12.2	12.2	12.2

Source: Vanasse Hangen Brustlin, Inc.

1 The concentrations are expressed in micrograms per cubic meter (ug/m3). The background concentrations assumed for the annual $PM_{2.5}$ was 11.7 ug/m^3. The NAAQS for $PM_{2.5}$ is 15 ug/m^3. The emissions presented represent the highest emissions experienced at each intersection for each alternative. The air quality study assumes that if this intersection meets the NAAQS, then all other intersections, regardless of alternative, which will have lower volumes and better levels of service, can be assumed to also meet the NAAQS.

2 The Build Alternatives used for the air quality analysis include the physical and operational mitigation proposed to improve traffic operations (as outlined in the traffic section).

3 The results are the same for Alternatives 2A and 2B

5.6.3.3 Microscale $PM_{2.5}$ Emissions Results

The microscale analysis calculated the 24-hour and annual $PM_{2.5}$ concentrations for the No-Build Alternative, the Baseline Alternative, and the six Build Alternatives. The 1-hour $PM_{2.5}$ concentrations were calculated using EPA's CAL3QHC model and were then adjusted using MassDEP standards to develop the 24-hour and annual $PM_{2.5}$ concentrations. The concentrations are expressed in micrograms per cubic meter (ug/m^3) and include a 24-hour background concentration of 29.7 ug/m^3 and an annual background concentration of 11.7 ug/m^3 which was based on DEP air quality monitoring data. Tables 5.6-5 and 5.6-6 present the results of the microscale analysis for the 24-hour and annual $PM_{2.5}$, respectively.

The 2030 Build 24-hour $PM_{2.5}$ concentrations for the Build Alternatives ranged from a minimum of 30.5 ug/m^3 to a maximum of 33.3 ug/m^3. All of the 24-hour $PM_{2.5}$ concentrations are below the $PM_{2.5}$ NAAQS of 35 ug/m^3.

The 2030 Build annual $PM_{2.5}$ concentrations for the Build Alternatives ranged from a minimum of 11.9 ug/m^3 to a maximum of 12.4 ug/m^3. All of the annual $PM_{2.5}$ concentrations are well below the $PM_{2.5}$ NAAQS of 15 ug/m^3.

5.6.3.4 Microscale Commuter Rail Evaluation

The trains that will be used on the Green Line Extension Project will be electric and will not generate air pollution in the study area. However, a segment of the commuter rail track will be relocated closer to a residential area. The nearest residential property to the proposed commuter rail alignment is located at the end of Morton Street near Ball Square Station. The commuter rail track is currently 25 feet from the property line and 33 feet to the residential building. The relocation will result in track being moved to approximately 10 feet from the property line and 18 feet from the residential building. The air quality analysis calculated an analysis of $PM_{2.5}$ emissions because it represents the most sensitive pollutant to changes in distance.

Table 5.6-7 lists the results of the air quality analysis. The results demonstrate that the relocation of the commuter track closer to the residential area will not result in an adverse air quality impact. The 24-hour $PM_{2.5}$ concentration from train emissions for the existing track location (at both the nearest property line and nearest residential property) is 29.7 micrograms per cubic meter (ug/m^3). The annual $PM_{2.5}$ concentration from train emissions at both the nearest property line and nearest residential building for the existing track location is 11.7 ug/m^3

Table 5.6-7 Projected $PM_{2.5}$ Emissions for Proposed Commuter Rail Track Relocation (ug/m^3)

	Track Distance From Nearest Residential Property Line			Track Distance from Nearest Residential Building		
	Existing (25 feet)	Proposed (10 feet)	Difference	Existing (33 feet)	Proposed (18 feet)	Difference
24-Hour $PM_{2.5}$ Concentration[1]	29.7	30.1	+0.4	29.7	30.1	+0.4
Annual $PM_{2.5}$ Concentration[2]	11.7	11.8	+0.1	11.7	11.8	+0.1

1 The background concentration for the 24-hour concentration assumed was 29.7 ug/m^3. The NAAQS standard for 24-Hour $PM_{2.5}$ is 35 ug/m^3.
2 The background concentration assumed for the annual concentration was 11.7 ug/m^3. The NAAQS standard for Annual $PM_{2.5}$ is 15 ug/m^3.

By relocating the tracks approximately 15 feet closer to the nearest property line and residential building, the 24-hour $PM_{2.5}$ concentrations are expected to increase to 30.1 ug/m^3 at both the nearest property line and residential building (an increase of 0.4 ug/m^3). The annual $PM_{2.5}$ concentrations are expected to increase to 11.8 ug/m^3 (an increase of 0.1 ug/m^3). The new $PM_{2.5}$ concentrations at both the nearest property line and residential building for the 24-hour (30.1 ug/m^3) and annual (11.8 ug/m^3) emissions are still below NAAQS standard of 35 ug/m^3 and 15 ug/m^3 for the 24-hour and annual periods, respectively. All receptor locations, which would be located further away, would experience even lower concentrations.

5.6.4 Mesoscale Analysis

The air quality study included a mesoscale analysis that estimates the area wide emissions of VOCs, NO_X, CO_2, CO, and PM emissions. The mesoscale analysis evaluated the changes in emissions based upon changes in the average daily traffic volumes, roadway lengths, and vehicle emission rates. To demonstrate compliance with the SIP criteria, the air quality study must show the proposed Green Line Extension Project's change in daily (24-hour period) VOC and NO_X emissions. Using EPA-recommended air quality modeling techniques, total pollutant emissions were calculated for the No-Build Alternative, the Baseline Alternative, and the Build Alternatives. The mesoscale analysis calculated the 2030 mobile source emissions from the major roadways in the study area. These emissions, estimated to be 22,687.5 kilograms per day (kg/day) of VOCs, 19,186.2 kilograms per day of NO_X, 3,385.7 kg/day of PM_{10} establish a baseline to which future emissions can be compared. Table 5.6-8 presents the mesoscale analysis results.

Under the No-Build Alternative, VOC emissions are estimated to be 22,687.5 kg/day, the NO_X emissions were estimated to be 19,186.2 kg/day, and the PM_{10} emissions were estimated to be 3,385.7 kg/day. The No Build Alternative VOC and NO_X emissions are typically lower than the existing conditions emissions due to the implementation of state and Federal emission control programs, such as the Federal Motor Vehicle Emission Control Program, the Stage II Vapor Recovery System, and the Massachusetts Inspection and Maintenance program. Table 5.6-8 presents the mesoscale analysis results for all the alternatives.

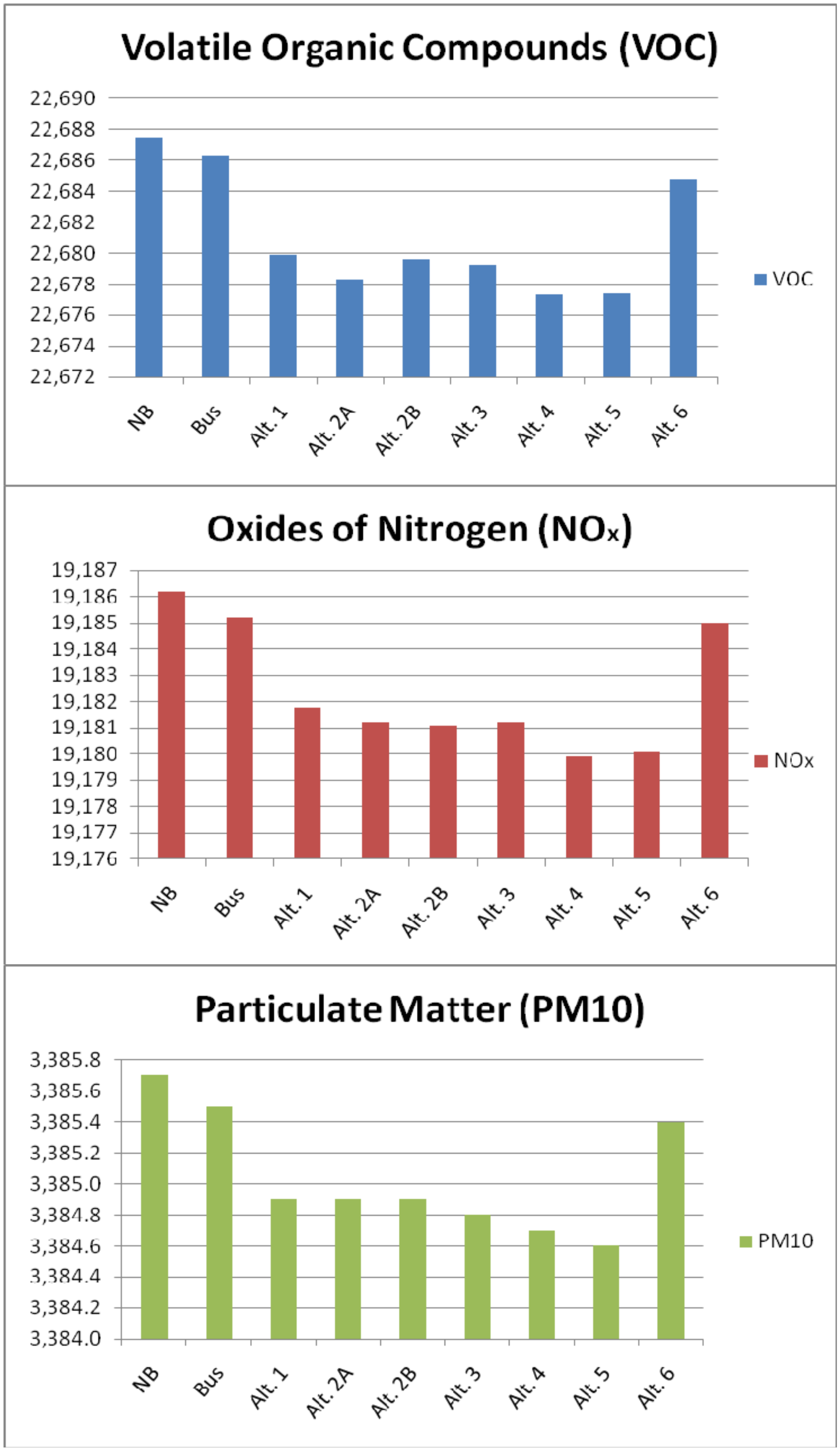
The results of the mesoscale analysis demonstrate that all of the Build Alternatives would reduce emissions of VOC, NO_X, and PM_{10} as compared to the No-Build Alternative. These reductions range from 2.7 to 10.1 kg/day for VOC emissions, 1.2 to 6.1 kg/day in NO_X, emissions, and 0.3 to 1.1 kg/day of PM_{10} emissions. A comparison of VOC, NO_X and PM_{10} emissions for the No-Build Alternative, the Baseline Alternative, and the Build Alternatives is presented in Figure 5.6-1.

Table 5.6-8 Mesoscale 2030 Mobile Source Analysis Results (kilograms per day)

Alternative[2]	Vehicle Miles Traveled (VMT)[1]	Volatile Organic Compounds (VOCs)	Build / No-Build Difference	Nitrogen Oxides (NO_x)	Build / No-Build Difference	Particulate Matter 10 (PM_{10})	Build / No-Build Difference
Existing	110,409,645	65,473	--	162,965.0	--	5,818.6	--
No-Build Alternative	123,166,996	22,687.5	--	19,186.2	--	3,385.7	--
Baseline Alternative	123,158,162	22,686.3	-1.2	19,185.2	-1.0	3,385.5	-0.2
Alternative 1: Medford Hillside and Union Square (via commuter rail ROW)	123,141,978	22,679.9	-7.6	19,181.8	-4.4	3,384.9	-0.8
Alternative 2A: Mystic Valley Parkway/Route 16 and Union Square (via commuter rail ROW) with parking at Mystic Valley Parkway/Route 16	123,140,440	22,678.3	-8.2	19,181.2	-5.0	3,384.9	-0.7
Alternative 2B: Mystic Valley Parkway/Route 16 and Union Square (via commuter rail ROW) without parking	123,140,349	22,679.6	-7.9	19,181.1	-5.1	3,384.9	-0.8
Alternative 3: Medford Hillside and Union Square (via McGrath Highway and Somerville Avenue)	123,139,101	22,679.3	-7.1	19,181.2	-5.0	3,384.8	-0.7
Alternative 4: Mystic Valley Parkway/Route 16 and Union Square (via McGrath Highway and Somerville Avenue) with parking at Mystic Valley Parkway/Route 16	123,134,991	22,677.3	-9.1	19,179.9	-6.3	3,384.7	-0.9
Alternative 5: Mystic Valley Parkway/Route 16 with parking at Mystic Valley Parkway/Route 16	123,133,790	22,677.4	-10.1	19,180.1	-6.1	3,384.6	-1.1
Alternative 6: Union Square (via commuter rail ROW)	123,157,392	22,684.8	-2.7	19,185.0	-1.2	3,385.4	-0.3

1 VMT represents the vehicle miles traveled on an average weekday in 2030.
2 The Build Alternatives used for the air quality analysis include the physical and operational mitigation proposed to improve traffic operations (as outlined in the traffic section).

Figure 5.6-1 Mesoscale 2030 Mobile Source Analysis Results (kilograms per day)



As Table 5.6-8 and Figure 5.6-1 show, Alternatives 1 through 5 are relatively similar with regard to reductions in emissions of VOCs, NO_x, and PM_{10}. Within this group, Alternative 5 consistently would result in the greatest air quality benefits, and Alternative 3 would yield the least air quality benefit. Alternative 6 (Union Square only) would provide the fewest air quality benefits of any of the Build Alternatives, and is generally close to the negligible reductions associated with the Baseline Alternative.

The air quality study demonstrates that all alternatives for the proposed Green Line Extension Project comply with the CAAA and the SIP. The ozone mesoscale analysis demonstrates that all Build Alternatives will result in a decrease of VOC, NO_X and PM_{10} emissions, as compared to the No-Build Alternative.

5.6.5 Greenhouse Gas (CO_2) Analysis

The Executive Office of Energy and Environmental Affairs (EEA) has developed a policy that requires a project to evaluate GHG emissions. The air quality study calculated the GHG emissions from mobile sources related to the proposed Green Line Extension Project. While GHG emissions include several gases, CO_2 was selected for evaluation because it is the most significant component of transportation-related GHG emissions. The year 2030 was selected as the future year of analysis to be consistent with the regional long-range transportation plan. The GHG mobile source analysis traffic (volumes, delays, and speeds) and emission factor data were developed for the following conditions:

- No-Build Alternative;
- Baseline Alternative; and
- Build Alternatives (Alternatives 1, 2A, 2B, 3, 4, 5, and 6).

The GHG mobile source analysis was conducted following procedures similar to the ozone mesoscale analysis. The changes in CO_2 emissions from traffic were based on the average daily traffic volumes, roadway lengths and vehicle emissions factors for existing and new trips for weekday and weekend conditions.

The mesoscale analysis estimated the future study area CO_2 emissions due to the changes in traffic and emission data. Table 5.6-9 presents a summary of the CO_2 emissions projected under each proposed alternative. Under the No-Build Alternative, CO_2 emissions were estimated to be 70,131,287 kg/day.

The Baseline Alternative provides a reduction in CO_2 emissions of approximately 5,000 kg/day over the No-Build Alternative. Alternatives 1 through 5 would provide much larger CO_2 emission reductions from just over 15,000 kg/day (Alternative 2A) to over 22,000 kg/day (Alternative 5). Alternative 6, with a reduction of approximately 6,000 kg/day, is the only alternative that is closer to the Baseline Alternative emission reductions. This can be attributed to the limited service and, therefore, limited reduction in vehicle miles traveled for this alternative.

Table 5.6-9 Greenhouse Gas (CO_2) Analysis Results (kilograms per day)

Alternative	Carbon Dioxide (CO_2)	Change from No-Build
No-Build Alternative	70,131,288	-
Baseline Alternative	70,126,257	-5,031
Alternative 1: Medford Hillside and Union Square (via commuter rail ROW)	70,114,173	-17,115
Alternative 2A : Mystic Valley Parkway/Route 16 and Union Square (via commuter rail ROW) with parking at Mystic Valley Parkway/Route 16	70,113,297	-17,991
Alternative 2B : Mystic Valley Parkway/Route 16 and Union Square (via commuter rail ROW) without parking	70,113,245	-18,043
Alternative 3 : Medford Hillside and Union Square (via McGrath Highway and Somerville Avenue)	70,112,415	-18,873
Alternative 4: Mystic Valley Parkway/Route 16 and Union Square (via McGrath Highway and Somerville Avenue) with parking at Mystic Valley Parkway/Route 16	70,110,075	-21,213
Alternative 5: Mystic Valley Parkway/Route 16 with parking at Mystic Valley Parkway/ Route 16	70,109,112	-22,176
Alternative 6: Union Square (via commuter rail ROW)	70,125,022	-6,266

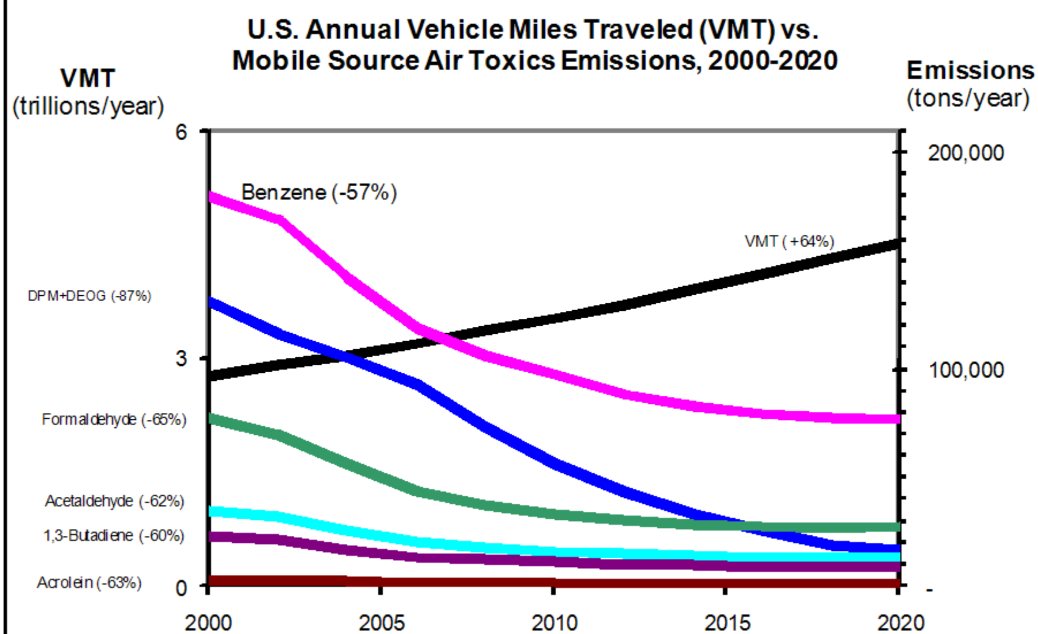
5.6.6 Air Toxics

The air quality study evaluated the potential for impact due to air toxics, as required in The Secretary's Certificate. Most air toxics originate from human-made sources, including on-road mobile sources, non-road mobile sources (e.g., airplanes), area sources (e.g., dry cleaners) and stationary sources (e.g., factories or refineries).

Mobile Source Air Toxics (MSATs) are a subset of the 188 air toxics defined by the Clean Air Act. The MSATs are compounds emitted from highway vehicles and non-road equipment. Some toxic compounds are present in fuel and are emitted to the air when the fuel evaporates or passes through the engine unburned. Other toxics are emitted from the incomplete combustion of fuels or as secondary combustion products. Metal air toxics also result from engine wear or from impurities in oil or gasoline.

The EPA is the lead Federal agency for administering the Clean Air Act and has certain responsibilities regarding the health effects of MSATs. Under the authority in Section 202 of the Clean Air Act, the EPA issued a Final Rule on Controlling Emissions of Hazardous Air Pollutants from Mobile Sources: 66 FR 17229 (March 29, 2001). In its rule, EPA examined the impacts of existing and newly promulgated mobile source control programs, including its reformulated gasoline (RFG) program, its national low emission vehicle (NLEV) standards, its Tier 2 motor vehicle emissions standards and gasoline sulfur control requirements, and its proposed heavy duty engine and vehicle standards and on-highway diesel fuel sulfur control requirements. Between 2000 and 2020, these programs, even with a 64 percent increase in VMT, are expected to reduce on-highway emissions of benzene, formaldehyde, 1,3-butadiene, and acetaldehyde by 57 to 65 percent, and to reduce on-highway diesel PM emissions by 87 percent, as shown in Figure 5.6-2.

Figure 5.6-2 Mobile Source Air Toxics Emissions



Notes: For on-road mobile sources. Emissions factors were generated using MOBILE6.2. MTBE proportion of market for oxygenates is held constant, at 50%. Gasoline RVP and oxygenate content are held constant. VMT: *Highway Statistics 2000*, Table VM-2 for 2000, analysis assumes annual growth rate of 2.5%. "DPM + DEOG" is based on MOBILE6.2-generated factors for elemental carbon, organic carbon and SO4 from diesel-powered vehicles, with the particle size cutoffset at 10.0 microns.

As a result, EPA concluded that no further motor vehicle emissions standards or fuel standards were necessary to further control MSATs. The agency is preparing another rule under authority of CAA Section 202(l) that will address these issues further and could make adjustments to MSATs.

The available technical tools do not allow the Project-specific health impacts of the emission changes associated with the alternatives for the Green Line Extension Project to be predicted. Due to these limitations, the following discussion is included in accordance with the CEQ regulations (40 CFR 1502.22(b)) regarding incomplete or unavailable information.

Evaluating the environmental and health impacts from MSATs on a proposed transit would involve several key elements, including emissions modeling, dispersion modeling in order to estimate ambient concentrations resulting from the estimated emissions, exposure modeling in order to estimate human exposure to the estimated concentrations, and then final determination of health impacts based on the estimated exposure. Each of these steps is encumbered by technical shortcomings or uncertain science that prevents a more complete determination of the MSAT health impacts of the Project.

- **Emissions**: The EPA tools to estimate MSAT emissions from motor vehicles are not sensitive to key variables determining emissions of MSATs in the context of highway projects. While MOBILE 6.2 is used to predict emissions at a regional level, it has limited applicability at the project level. MOBILE 6.2 is a trip-based model. The emission factors are projected based on a typical trip of 7.5 miles, and on average speeds for this typical trip. This means that MOBILE 6.2 does not have the ability to predict emission factors for a specific vehicle operating condition at a specific location at a specific time. Because of this limitation, MOBILE 6.2 can only approximate the operating speeds and levels of congestion likely to be present on the largest-scale projects, and cannot adequately capture emissions effects of smaller projects. For particulate matter, the model results are not sensitive to average trip speed, although the other MSAT emission rates do change with changes in trip speed. Also, the emissions rates used in MOBILE 6.2 for both particulate matter and MSATs are based on a limited number of tests of mostly older-technology vehicles. Lastly, in its discussions of PM under the conformity rule, EPA has identified problems with MOBILE 6.2 as an obstacle to quantitative analysis. These deficiencies compromise the capability of MOBILE 6.2 to estimate MSAT emissions. MOBILE 6.2 is an adequate tool for projecting emissions trends, and performing relative analyses between alternatives for very large projects, but it is not sensitive enough to capture the effects of travel changes tied to smaller projects or to predict emissions near specific roadside locations.
- **Dispersion**: The tools to predict how MSATs disperse are also limited. The EPA's current regulatory models, CALINE3 and CAL3QHC, were developed and validated more than a decade ago for the purpose of predicting episodic concentrations of carbon monoxide to determine compliance with the NAAQS. The performance of dispersion models is more accurate for predicting maximum concentrations that can occur at some time at some location within a geographic area. This limitation makes it difficult to predict accurate exposure patterns at specific times at specific highway project locations across an urban area to assess potential health risk. The National Cooperative Highway Research Program (NCHRP) is conducting research on best practices in applying models and other technical methods in the analysis of MSATs. This work also will focus on identifying appropriate methods of documenting and communicating MSAT impacts in the NEPA process and to the general public. Along with these general limitations of dispersion models, the FTA is also faced with a lack of monitoring data in most areas for use in establishing Project-specific MSAT background concentrations.

- **Exposure Levels and Health Effects**: Even if emission levels and concentrations of MSATs could be accurately predicted, shortcomings in current techniques for exposure assessment and risk analysis preclude meaningful conclusions about Project-specific health impacts. Exposure assessments are difficult because it is difficult to accurately calculate annual concentrations of MSATs near roadways, and to determine the portion of a year that people are actually exposed to those concentrations at a specific location. These difficulties are magnified for 70-year cancer assessments, particularly because unsupportable assumptions would have to be made regarding changes in travel patterns and vehicle technology (which affects emissions rates) over a 70-year period. There are also considerable uncertainties associated with the existing estimates of toxicity of the various MSATs, because of factors such as low-dose extrapolation and translation of occupational exposure data to the general population. Because of these shortcomings, any calculated difference in health impacts between alternatives is likely to be much smaller than the uncertainties associated with calculating the impacts. Consequently, the results of such assessments would not be useful to decision makers, who would need to weigh this information against other Project impacts that are better suited for quantitative analysis.

Research into the health impacts of MSATs is ongoing. For different emission types, there are a variety of studies that show that some either are statistically associated with adverse health outcomes through epidemiological studies (frequently based on emissions levels found in occupational settings) or that animals demonstrate adverse health outcomes when exposed to large doses.

Exposure to toxics has been a focus of a number of EPA efforts. Most notably, the agency conducted the National Air Toxics Assessment (NATA) in 1996 to evaluate modeled estimates of human exposure applicable to the county level. While not intended for use as a measure of or benchmark for local exposure, the modeled estimates in the NATA database best illustrate the levels of various toxics when aggregated to a national or state level.

The EPA is in the process of assessing the risks of various kinds of exposures to these pollutants. The EPA Integrated Risk Information System (IRIS) is a database of human health effects that may result from exposure to various substances found in the environment. The IRIS database is located at http://www.epa.gov/iris. The following toxicity information for the six prioritized MSATs was taken from the IRIS database Weight of Evidence Characterization summaries. This information is taken verbatim from EPA's IRIS database and represents EPA's most current evaluations of the potential hazards and toxicology of these chemicals or mixtures. These chemicals include:

- Benzene;
- Acrolein;
- Formaldehyde;

- 1,3-butadiene;
- Acetaldehyde; and
- Diesel exhaust.

As discussed above, technical shortcomings of emissions and dispersion models and uncertain science with respect to health effects prevent meaningful or reliable estimates of MSAT emissions and effects of the Project. However, even though reliable methods do not exist to accurately estimate the health impacts of MSATs at the project level, it is possible to qualitatively assess the levels of future MSAT emissions under the Project. Although a qualitative analysis cannot identify and measure health impacts from MSATs, it can give a basis for identifying and comparing the potential differences among MSAT emissions—if any—from the various alternatives. The qualitative assessment presented below is derived in part from a study conducted by the FHWA.[2]

For each alternative, the amount of MSATs emitted would be proportional to the VMT, assuming that other variables such as fleet mix are the same for each alternative. The VMT for each alternative are presented earlier in Table 5.6-8. The VMT estimated for each of the Build Alternatives are lower than that for the No-Build Alternative, because the extension of the Green Line will remove vehicles (and therefore reduce VMT) from the study area roadways by shifting mode choice to public transportation (i.e. the Green Line). This reduction in VMT would lead to lower MSAT emissions for the Build Alternatives.

Because the estimated VMT under each of the Alternatives are nearly the same, it is expected there would be no appreciable difference in overall MSAT emissions among the various alternatives. Also, regardless of the alternative chosen, emissions will likely be lower than present levels in the design year as a result of EPA's national control programs that are projected to reduce MSAT emissions by 57 to 87 percent between 2000 and 2020. Local conditions may differ from these national projections in terms of fleet mix and turnover, VMT growth rates, and local control measures. However, the magnitude of the EPA-projected reductions is so great (even after accounting for VMT growth) that MSAT emissions in the study area are likely to be lower in the future in all cases.

5.6.7 Construction/Demolition Mitigation

In an effort to reduce GHG emissions from temporary construction activities, the Proponent will contractually require the construction contractors to adhere to all applicable regulations regarding control of construction vehicles emissions. This will include, but not be limited to, maintenance of all motor vehicles, machinery, and equipment associated with construction activities and proper fitting of equipment

2 *A Methodology for Evaluating Mobile Source Air Toxic Emissions Among Transportation Project Alternatives,* FHWA, www.fhwa.dot.gov/environment/airtoxic/msatcompare/msatemissions.html.

with mufflers or other regulatory-required emissions control devices. Also, the prohibition of excessive idling of construction equipment engines will be implemented, as required by MassDEP regulations in 310 CMR 7.11.

Additionally, construction specifications will require that all diesel construction equipment used on-site will be fitted with after-engine emission controls such as diesel oxidation catalysts (DOCs) or diesel particulate filters (DPFs)[3]. Additionally, the Proponent will contractually require the construction contractors to utilize ultra-low sulfur diesel fuel for all off-road construction vehicles as an additional measure to reduce air emissions from construction activities. The Proponent will put idling restriction signs on the premises to remind drivers and construction personnel of the state's idling regulation.

The contractor will also be responsible for protective measures around the construction and demolition work to protect pedestrians and prevent dust and debris from leaving the site or entering the surrounding community. Dust generated from earthwork and other construction activities like stockpiled soils will be controlled by spraying with water to mitigate wind erosion on open soil areas. Other dust suppression methods will be implemented to ensure minimization of the off-site transport of dust. There will be regular sweeping of the pavement of adjacent roadway surfaces during the construction period to minimize the potential for vehicular traffic to create airborne dust and particulate matter.

5.6.8 Metropolitan Planning and Air Quality Conformity

The proposed Green Line Extension Project is included in the current approved State Transportation Improvement Program (STIP). The Project is required by the SIP and fulfills a longstanding commitment of the Central Artery/Tunnel Project to increase public transit. The Massachusetts Air Pollution Control Regulations (310 CMR 7.36) require that EOT complete the Project by December 31, 2014.

The Transportation Improvement Program (TIP) is managed by the Boston Region Metropolitan Planning Organization (MPO). The TIP lists all transportation projects programmed to receive Federal funds over a four-year horizon and all projects programmed with Federal and state highway funds that are expected to be available. Eligible project categories are: bridges, roads, bicycle facilities, and pedestrian and streetscape improvements. The TIP is financially constrained; the MPO can only include projects for which funds are expected to be available.

3 This is consistent with the Certificate of Construction Equipment Standard Compliance Form required for all bids to the MBTA.

The MPO has defined the overall framework for TIP programming and created project selection criteria. Criteria are used on existing conditions, safety, mobility, cost effectiveness, economic development, land use, and community impact. The most current Transportation Improvement Program and Air Quality Conformity Determination available is for the fiscal years 2007-2010. The Green Line Extension Project is included in the 2007-2010 TIP under the Air Conformity section of the report (Chapter 4). The Green Line Extension Project was submitted as a transportation control measures as a SIP commitment as part of the Central Artery/Tunnel mitigation as "Green Line Extension to Medford Hillside." The Enhanced Green Line extended beyond Lechmere to West Medford and Union Square Project was included in the 2007-2010 TIP. The current version of the Green Line Extension Project is expected to be included in the 2010-2013 TIP, which may involve an amendment to the TIP depending on Project timing.

An MPO-endorsed TIP is incorporated into the STIP, which is distributed to the FHWA, FTA, and EPA for certification before the end of each Federal fiscal year (September 30).

The SIP is a list of statewide intermodal program of transportation projects funded by the FHWA or FTA, which are consistent with the Statewide Long Range Transportation Plan and the Massachusetts Transportation Improvement Program. For the Regional Transportation Plan and TIP, conformity is determined in relation to the SIP mobile source emission budgets.

The Massachusetts Transit System Improvements regulation (310 CMR 7.36) became effective in December of 1991 and was incorporated into the Massachusetts SIP in October of 1994.[4] This regulation specified transit system improvement projects deemed necessary to mitigate the air quality impacts of the Central Artery and Third Harbor Tunnel Project. While a number of projects included in 310 CMR 7.36 were completed, several transit system improvement projects (Green Line Arborway Restoration, the Blue Line Connection from Bowdoin Station to the Red Line at Charles Station, and the Green Line Extension to Ball Square/Tufts University) were delayed and it was determined would not be completed within the required SIP timeframes. The EOT and the Department of Environmental protection (DEP) established an Administrative Consent Order (ACO) in 2000, which addressed revised schedules for implementation. The ACO was revised in 2002 and 2005 to address additional compliance issues.

310 CMR 7.36, as adopted in 1991, included a substitution process for changing projects that are included in the regulation and the approved SIP. In 2005, EOT initiated the process for the substitution of the original SIP projects with a new package of projects which included an extension of the Green Line to Medford Hillside with a spur to Union Square, improvements to the Fairmount Line, and the

4 Federal Register (59 FR 50495--50498), dated October 4, 1994.

construction of an additional 1,000 Park and Ride spaces. Following a public process on the proposed substitute projects, EOT submitted a request to DEP to revise the 310 CMR 7.36 and the SIP.[5] Air quality modeling was done for these projects in 2006 with results shown here in Table 5.6-10, demonstrating that the package of substitution projects would – as required – achieve a minimum of 110 percent of the emissions reductions that would have been achieved if the original SIP projects had been built relative to a common no-build scenario for the year 2025. The No-Build scenario for the 2006 SIP analysis included highway and transit projects that were included in the 2030 Regional Transportation Plan for the Boston MPO No-Build scenario in the JOURNEY TO 2030 Plan.

Table 5.6-10 EOT Air Quality Analysis Comparison of Project Packages Benefits in the Year 2025

	Daily Emissions Benefits in Kilograms (kg)		
	Carbon Monoxide (CO)	Nitrogen Oxides (NOx)	Volatile Organic Compounds (VOC)
SIP Approved Projects (Package): Arborway; Green Line Extension to Ball Square/Tufts; Blue Line/Red Line Connection (Bowdoin Station to Charles Station)	292	8	11
SIP Approved Projects (Package) Plus Ten Percent	321.2	8.8	12.1
Replacement/Substitution Projects (Package): Green Line Extension to Union Square and Medford Hillside, Fairmont Line Improvements, and Additional Parking	435	11	17

On July 31, 2008, the EPA approved the SIP revision that had been submitted by the Commonwealth of Massachusetts.[6] This revision revises the list of required transit projects, changes the completion dates for the delayed transit projects, provides interim deadlines for projects, maintains requirements for interim emission reduction offsets in the event a project becomes delayed, modifies the project substitution process, and expands public participation in and oversight of the required projects.

During the analysis prepared for the Green Line Extension Draft Environmental Impact Report, a number of different alternatives for the Green Line Extensions were examined. However, the air quality results could not be compared to the Table 5.6-10 values because the analyses prepared for the DEIR were relative to a different No-Build scenario than that used in the 2006 SIP analysis. The 2006 SIP Analysis No-Build scenario included projects such as the Urban Ring, Silver Line Phase III, the

5 DEP adopted revisions to 310 CMR 7.36 on December 1, 2006 and submitted SIP revisions to EPA.
6 Federal Register / Vol. 73, No. 148 / Thursday, July 31, 2008 / Rules and Regulations, Environmental Protection Agency, 40 CFR Part 52 [EPA–R01–OAR–2006–1018; A–1–FRL–8691–5].

Blue Line Extension to Lynn, and South Coast Rail, which was not incorporated into the 2009 No-Build Scenario. As EOT plans to seek Federal funding for the project, the Green Line Extension No-Build scenario was chosen based on requirements of the FTA to reflect the most reasonable project commitments given the state's current financial condition; therefore, the air quality analysis is not comparable to the one done in 2006, based on the differences in the No-Build scenarios. Other differences between the 2006 SIP analysis and this Green Line analysis include:

- The 2009 CTPS travel demand model used to conduct the air quality analysis has been modified since 2006. The 2009 version of the travel demand model was updated to include a roadway network and land use data that was more recent than was used in the 2006 version of the travel demand model. Furthermore, enhancements have been made to the model since 2006 to improve its predictive ability.
- The Green Line Extension analysis uses the most current land use from the last adopted Regional Transportation Plan. This input produces fewer home-based trips than the 2006 study showed for the 2030 forecast year, resulting in slightly less demand for the proposed extension of the Green Line to areas further away from Boston.
- Emission factors for pollutants have changed over time as EPA has refined its MOBILE air quality model. Each SIP analysis was performed using the most current set of emission factors available at the time.

Therefore, in order to conduct a fair comparison of air quality benefits associated with the package of approved SIP projects, CTPS created a No-Build scenario in accordance with the latest 2009 assumptions but used a comparative process to ascertain air quality benefits that is equivalent to the one used in the 2006 SIP analysis. This No-Build scenario was compared to a Build scenario that includes the following transit improvements:

1. The most current preferred Green Line Extension option (Green Line D to College Avenue/Medford Hillside and Green Line E to Union Square)
2. Fairmont Commuter Rail Improvements (four new stations and off-peak headway improvements)
3. Parking expansions – totaling at least 1,000 parking spaces in the Boston Region

The findings of this analysis, using a consistent methodology to the 2006 SIP analysis, show that the proposed package of transit improvements exceeds the 110 percent threshold that was required for carbon monoxide, nitrogen oxides, and volatile organic compounds. The Green Line Extension represents the majority of the air quality benefits that are being forecasted for the package of improvements included in the 2009 SIP analysis, as shown in Table 5.6-11.

Based upon this evaluation, the emission reductions from the Green Line Extension project equal or exceed the emission reductions projected in the air quality modeling done in 2006.

Table 5.6-11 Comparison of Air Quality Benefits

	Daily Emissions Benefits in Kilograms (kg)		
	Carbon Monoxide (CO)	Nitrogen Oxides (NOx)	Volatile Organic Compounds (VOC)
2006 Approved Package of Projects: Arborway; Green Line Extension to Ball Square/Tufts; Blue Line/Red Line Connection	292	8	11
2008 Federal Register SIP Approved Projects + 10%	321.2	8.8	12.1
2009 Package: Green Line Extension to College Avenue with Union Square Spur; Fairmount; Parking	520	9.5	16
2009 Analysis – Green Line Extension Only Benefits	443	8.5	13
Percent of Green Line Extension Benefits as compared to Total Package	85%	89%	81%

5.6.9 Transportation Improvement Program and Air Quality Conformity Determination Summary

The Project meets the Transportation Conformity planning-level conformity requirements because the Green Line Extension Project is part of an approved SIP. The Project meets the Transportation Conformity project-level conformity requirements because it includes an air quality analysis using MOBILE6.2 and CAL3QHC demonstrating that it meets the NAAQS. The air quality analyses conducted and presented in this DEIR/EA indicate that all Build Alternatives are well below the NAAQS. The emissions for all alternatives reviewed for both the mesoscale (VOC, NO_x and PM_{10}) and the microscale (CO and PM_{10}) analyses are below the NAAQS requirements. Overall, the Build Alternatives show a reduction in emissions for each of the assessed pollutants of concern.

5.7 Noise

The Secretary's Certificate requires that the DEIR analyze noise for existing and proposed conditions consistent with the FTA's guidelines. The Secretary's Certificate requires that this analysis identify the location of noise-sensitive receptors, assess the potential for noise impact, and specify both where mitigation is required and what mitigation measures will be used.

The noise impact analysis for the Green Line Extension Project is based on the methodology defined in the FTA's guidance manual "*Transit Noise and Vibration Impact Assessment*" (Report FTA-VA-90-1003-06, May 2006). The analysis includes background on the noise impact assessment methodology, environmental consequences of the Project including noise impact results for the proposed Build Alternatives, the type and location of specific measures required to mitigate potential significant noise impacts, and a summary of results.

5.7.1 Noise Impact Assessment Methodology

The noise impact assessment methodology involves identifying noise-sensitive land uses, conducting measurements of existing noise levels in the community, projecting future noise levels from the Project, assessing potential impact and determining the need, feasibility, reasonableness and effectiveness of mitigation measures. This section describes the categories of noise-sensitive land use specified by the FTA, the noise impact criteria used to assess impact and a summary of the principal assumptions in projecting future noise levels from transit sources.

5.7.1.1 Noise-Sensitive Land Use Categories

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.

5.7.1.2 Noise Impact Criteria

The FTA noise impact criteria are founded on well-documented research on community reaction to noise and are based on change in noise exposure using a sliding scale. Although higher levels of transit noise are allowed in neighborhoods with high levels of existing noise, smaller increases in total noise exposure are allowed with increasing levels of existing noise.

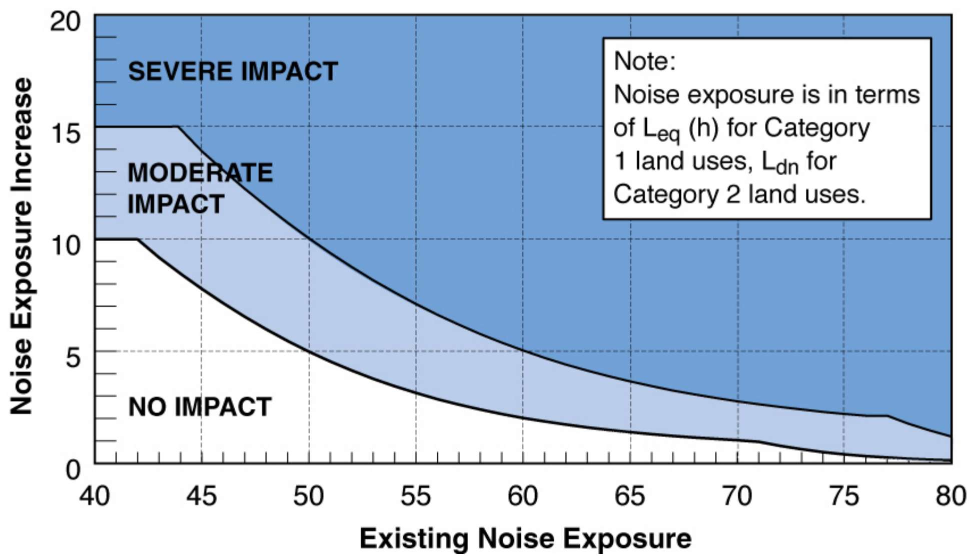
The Day-Night Sound Level (Ldn) is used to characterize noise exposure for residential areas (Category 2). For other noise sensitive land uses, such as parks and school buildings (Categories 1 and 3), the maximum 1-hour "equivalent" sound level (Leq) during the facility's operating period is used. Ldn and Leq are explained in Section 4.8, *Noise*.

There are two levels of impact included in the FTA criteria, as summarized below:

- Severe Impact: Project-generated noise in the severe impact range can be expected to cause a significant percentage of people to be highly annoyed by the new noise and represents the most compelling need for mitigation. Noise mitigation will normally be specified for severe impact areas unless there are truly extenuating circumstances that prevent it.
- Moderate Impact: In this range of noise impact, the change in the cumulative noise level is noticeable to most people but may not be sufficient to cause strong, adverse reactions from the community. In this transitional area, other Project-specific factors must be considered to determine the magnitude of the impact and the need for mitigation. These factors include the existing noise level, the predicted level of increase over existing noise levels, the types and numbers of noise-sensitive land uses affected, the noise sensitivity of the properties, the effectiveness of the mitigation measures, community views and the cost of mitigating noise to more acceptable levels.

The FTA noise impact criteria are shown in graphical form in Figure 5.7-1. Along the horizontal axis of the graph is the existing noise exposure and the vertical axis shows the increase in future noise exposure due to the combination of the existing noise exposure and the additional noise exposure caused by the transit project. Figure 5.7-1 shows the noise impact criteria for Category 1 and 2 land uses. Because the Green Line Extension Project includes modifications to existing noise sources, such as moving the existing commuter rail lines, it is not possible to define project noise separately from existing noise and, therefore, noise impact is assessed according to the increase in future noise exposure (Figure 5.7-1).

Figure 5.7-1 Increase in Cumulative Noise Levels Allowed by FTA Criteria



5.7.1.3 Noise Projections

Noise level projections are based on planned operations of existing commuter trains and proposed Green Line trains, measured reference levels of existing commuter trains and Green Line trains, and prediction modeling from the FTA guidance manual. The principal assumptions used in the analysis are summarized below.

Planned Operations

- The operating periods and schedule of the commuter trains are not expected to change as part of the Project.
- MBTA commuter trains typically have one locomotive and four to six passenger cars.
- The locations of the commuter rail lines are expected to be modified along some portions of the Project to accommodate the proposed Green Line tracks.
- The existing speeds of the commuter rail trains are not expected to change.
- The operating periods and schedule of the proposed Green Line trains assumes:
  - Start of service is 5:00 am (inbound) and 5:30 am (outbound)
  - End of service is 12:00 am (inbound) and 12:30 am (outbound)
  - Peak periods are 6:30 am to 9:00 am and 3:30 pm to 6:30 pm
  - Off-peak period headways are ten minutes (Alternatives 1,2,3, and 4)
  - Off-peak period headways are five minutes (Alternatives 5 and 6)
  - Peak period headways are five minutes (Alternatives 1,2,3, and 4)
  - Peak period headways are three minutes (Alternative 5 and 6)
- Green Line trains will consist of three light rail vehicles.

- The speeds of the proposed Green Line trains are expected to be up to 50 mph along the Mystic Valley Parkway/Medford Hillside branch except approaching and leaving station locations. Speeds along the Union Square extension are expected to be up to 30 mph along Somerville Avenue and Prospect Street and up to 50 mph along the MBTA Fitchburg Line.
- Transit warning horns will only be used in emergencies as there are no public grade-crossings proposed for either commuter trains or proposed Green Line trains on the Mystic Valley Parkway/Medford Hillside segments. No train horns or crossing bells are expected for any grade-crossings associated with the Union Square (via McGrath Highway and Somerville Avenue) segment.

Noise Reference Levels

- Based on measurements conducted of Green Line trains on the existing D Branch near Woodland Station and Beaconsfield Station, a single Green Line light rail vehicle operating at 50 mph on ballast and tie track with jointed rail generates a maximum noise level (Lmax) of 81 dBA and a sound exposure level (SEL) of 85 dBA at a distance of 50 feet from the track centerline. The proposed Green Line track is expected to be continuous-welded rail which typically generates lower noise levels than jointed rail.
- Based on measurements along the existing MBTA Fitchburg and Lowell Lines, MBTA commuter trains generate an Lmax of 90 dBA and an SEL of 96 dBA at 50 mph and a distance of 50 feet.
- Measurements of Amtrak commuter trains show that noise levels are relatively quieter than those for MBTA commuter trains. At a distance of 50 feet from the track centerline at a speed of 50 mph, an Amtrak train generates an Lmax of 81 dBA and an SEL of 86 dBA.
- Wheel impacts at turnouts are assumed to cause localized noise increases of 3 to 6 dBA.
- Wheel squeal for Green Line trains operating on tight curves (radius less than 400 feet) is assumed to contribute an Lmax of 86 dBA and an SEL of 92 dBA at 50 feet from the nearest curved segment of the track.

Noise Prediction Model

Existing noise levels at all sensitive receptors have been estimated based on the existing noise measurements and relative distances to the existing commuter rail lines. Whichever is closer between outdoor areas with frequent human use and indoor areas is modeled as the noise-sensitive location. The effects of terrain and intervening objects such as buildings have been included in the estimation of existing noise levels.

Future noise levels from the commuter trains are projected based on the existing measured noise levels at sensitive locations and changes to the alignment. Since future noise levels are based on existing noise levels, the projections include all operations from MBTA commuter trains, Amtrak trains, and freight rail activity.

With this modeling approach, the projections include the contributions from several factors such as train speed, presence of special trackwork or other site-specific conditions.

The existing and future commuter train noise levels depend on different sound propagation conditions due to changes to the commuter rail alignment and modification to any special trackwork. The relative contributions of noise from trains on both tracks and from locomotives versus rail cars are included in this modeling. Portions of the existing MBTA Fitchburg and Lowell Lines are in a cut (lower than) relative to nearby sensitive locations. Cross sections of the existing and proposed alignments at sensitive receptors were used as input to the modeling process.

Future noise levels from the proposed Green Line trains are based on reference noise levels, site-specific conditions such as the terrain, intervening objects such as building rows and operational plans including train consist (the number of cars), speed, and headways.

5.7.2 Noise Impacts

Extending the Green Line would add a new noise source to the environment along the proposed corridor. While there is existing noise exposure from sources such as commuter trains and automobiles, introducing an additional noise source and relocating the commuter rail lines have the potential to increase future noise at some noise-sensitive receptors. The Project involves relocating the commuter rail lines up to 18 feet to the east along some portions of the corridor and introducing the proposed Green Line tracks on the west side of the corridor.

Potential noise impact has been assessed for the Build Alternatives. Noise level projections for sensitive receptors that may be exposed to noise impact without any mitigation measures are shown in Table 5.7-1 (Alternatives 1, 2, 3 and 4) and in Table 5.7-2 (Alternatives 5 and 6). These tables show the noise sensitive receptor location, side of tracks, distances to the future commuter line and Green Line near track centerlines, the existing noise levels estimated at each location, moderate and severe noise impact criteria, the future projected noise level, increase in future noise level over the existing and the number of moderate and severe impacted buildings. Potential noise impacts to sensitive receptors are shown in Figures 5.7-2 through 5.7-6.

All of the noise sensitive receptors listed in this table are single-family and/or multi-family residential properties unless specified. Institutional land uses that may be exposed to noise impact without mitigation include the Science and Technology Center, Outside the Line Artist Studio and Bacon Hall at Tufts University and the Walnut Street Center (a non-profit support center for adults with developmental disabilities) in Union Square. Trum Playground would also potentially be exposed to noise impact, without mitigation.

Table 5.7-1 Potential Noise Impacts without Mitigation for Alternatives 1, 2, 3, and 4

		Distance to Near Track (feet)		Existing Noise Level	Impact Criteria		Future Noise Level		Total Number of Impacts (buildings)	
Noise Sensitive Receptor Location	**Side of Tracks**	**Comm. Line**	**Green Line**	**(Ldn)**	**Mod.**	**Sev.**	**(Ldn)**	**Increase**	**Mod.**	**Sev.**
Segment between Lechmere Station and Fitchburg Mainline- Alternatives 1, 2, 3, 4										
NorthPoint Properties	East	n/a	109	61.0	62.8	65.6	63.8	2.8	1	
Glass Factory Condos	West	n/a	43	57.6	60.0	63.5	70.2	12.6		1
Hampton Inn Hotel	West	n/a	41	57.6	60.0	63.5	67.3	9.7		1
Brickbottom Lofts (Northeast façade)	West	n/a	18	57.6	60.0	63.5	76.4[2]	18.8		1
Totals between Lechmere Station and Fitchburg Mainline - Alternatives 1, 2, 3, 4									1	3
Segment between Fitchburg Mainline and Medford Hillside - Alternatives 1, 2, 3, 4										
Alston St near Cross Street	West	59	25	74.4	74.8	76.6	79.1	4.7		4
Avon Place and Auburn Ave near McGrath Highway	East	33	61	77.2	77.4	79.2	77.6	0.4	11	
Gilman St and Aldrich Street	East	32	60	71.9	72.6	74.3	73.0	1.1	14	
Pearl St near Medford Street	East	29	57	71.8	72.5	74.2	73.1	1.3	1	
Richdale Street	East	39	67	75.5	75.8	77.6	77.4	1.9	19	
Willoughby St near Sycamore Street	West	74	46	74.0	74.5	76.3	76.5	2.5		1
Sycamore St near Richdale Street	East	65	93	71.2	72.1	73.8	72.9	1.7	1	
Visiting Nurses Assisted Living	West	78	41	70.9	71.9	73.5	72.4	1.5	4	
Vernon Street, Nashua Street, Henderson Street, Hinckley Street	East	37	65	78.0	78.2	79.8	80.4	2.4		9
Vernon Street and Berwick Street	East	92	120	68.4	69.4	71.3	69.9	1.5	17	
Murdock Street	West	57	29	80.1	80.1	81.2	80.4	0.3	4	
Cedar Street	East	22	50	73.0	73.6	75.4	76.5	3.5		1
Wilson Avenue and Cedar Street	East	71	99	67.9	69.1	71.0	69.8	1.9	3	
Trum Playground[1]	East	n/a	67	68.6[1]	71.4[1]	74.7[1]	72.0[1]	3.4	0	
Boston Avenue between Cedar Street and Broadway	West	59	28	73.0	73.6	75.4	73.8	0.8	19	
Newbern Avenue, Morton Avenue, Granville Avenue, Winchester Place, Winchester Court (1st row)	East	33	61	76.7	76.9	78.7	79.4	2.7		9
Newbern Avenue, Morton Avenue, Granville Avenue, Winchester Place, Winchester Court (2nd row)	East	58	86	69.0	70.0	71.8	70.9	1.9	16	
Tufts - Science and Technology Center and Outside the Lines Art Studio[1]	East	27	55	77.0[1]	77.7[1]	81.5[1]	80.3[1]	3.3	2	
Tufts – Bacon Hall[1]	West	47	17	79.4[1]	79.9[1]	82.7[1]	81.0[1]	1.6	1	
Burget Avenue[4]	East	29	57	72.2	74.2	77.5	76.8	4.6	3	
Burget Avenue[4]	East	37	65	71.2	72.1	73.8	75.8	4.6		11
Burget Avenue[5]	East	29	57	72.2	74.2	77.5	75.3	3.1	3	
Burget Avenue[5]	East	37	65	71.2	72.1	73.8	74.1	2.9		11
Brookings Street[4]	East	48	n/a	70.3	71.3	73.0	72.0	1.7	2	0
Totals between Fitchburg Mainline and Medford Hillside - Alternatives 1, 2, 3, 4									117	35

Table 5.7-1 Potential Noise Impact Without Mitigation for Alternatives 1, 2, 3, and 4 (continued)

Noise Sensitive Receptor Location	Side of Tracks	Distance to Near Track (feet) Comm. Line	Green Line	Existing Noise Level (Ldn)	Impact Criteria Mod.	Sev.	Future Noise Level (Ldn)	Increase	Total Number of Impacts (buildings) Mod.	Sev.
Segment between Medford Hillside and Mystic Valley Parkway - Alternatives 2, 4										
Charnwood Road	East	48	76	70.3	71.3	73.0	72.1	1.8	20	
Winthrop Street near Charnwood Road and Orchard Street	East	58	86	69.1	70.1	71.9	71.3	2.2	12	
Orchard Street	East	46	74	71.0	72.0	73.6	74.4	3.4		17
Orchard Street near North Street	East	96	124	66.2	67.4	69.5	68.5	2.3	1	
Orchard Street near North Street (2nd row)	East	133	161	59.0	61.1	64.3	61.3	2.3	8	
Piggot Road near Boston Avenue	West	111	83	67.2	68.3	70.3	68.6	1.4	7	
Piggot Road near North Street	West	59	16	71.4	72.2	73.9	78.9	7.5		7
Fortunato Drive	East	59	87	70.5	71.4	73.1	72.1	1.6	2	
Totals between Medford Hillside and Mystic Valley Parkway - Alternatives 2, 4									50	24
Segment on Fitchburg Mainline between McGrath Highway and Prospect Street (Union Square)- Alternatives 1, 2, 3, 4										
Horace Street (1st and 2nd row)	South	21	35	65.2	66.6	68.8	72.5	7.3		3
Horace Street (3rd row)	South	69	83	61.0	62.8	65.6	65.4	4.4	3	
Walnut Street Center[1]	North	58	30	63.3[1]	67.1[1]	71.0[1]	71.5[1]	8.2		1
Charlestown Street	North	113	85	61.0	62.8	65.6	65.2	4.2	2	
Totals on Fitchburg Mainline between McGrath Hwy and Prospect St (Union Square) - Alternatives 1, 2, 3, 4									5	4
Segment on Prospect Street and Somerville Avenue, (Union Square)- Alternatives 3, 4										
Somerville Avenue near Allen Street	North	n/a	35	66.0	67.2	69.4	74.9[3]	8.9		1
Somerville Avenue near Allen Street	South	n/a	45	66.0	67.2	69.4	72.9[3]	6.9		1
Somerville Avenue near Linden Street	North	n/a	45	66.0	67.2	69.4	67.8	1.8	3	
Somerville Avenue (Merriam Street to Rossmore Street)	North	n/a	35	66.0	67.2	69.4	68.2	2.2	4	
Totals on Prospect Street and Somerville Avenue, (Union Square) - Alternatives 3, 4									7	2

Source: Harris Miller Miller & Hanson Inc., August 2008.
1 Peak-transit hour Leq used for institutional land use.
2 Projected noise levels include contribution from noise generated at the proposed maintenance facility (Yard 8).
3 Projected noise levels include contribution from wheel squeal.
4 Impact is due to relocation of commuter tracks beyond College Avenue Station for Alternatives 1 and 3.
5 Impact is due to relocation of commuter tracks beyond College Avenue Station for Alternatives 2 and 4.

Table 5.7-2 Potential Noise Impacts Without Mitigation for Alternatives 5 and 6

		Distance to Near Track (feet)		Existing Noise Level	Impact Criteria		Future Noise Level		Total Number of Impacts (buildings)	
Noise Sensitive Receptor Location	**Side of Tracks**	**Comm. Line**	**Green Line**	**(Ldn)**	**Mod.**	**Sev.**	**(Ldn)**	**Increase**	**Mod.**	**Sev.**
Segment between Lechmere Station and Fitchburg Mainline- Alternatives 5,6										
NorthPoint Properties	East	n/a	109	61.0	62.8	65.6	66.6	5.6		1
Glass Factory Condos	West	n/a	43	57.6	60.0	63.5	73.0	15.4		1
Hampton Inn Hotel	West	n/a	41	57.6	60.0	63.5	70.1	12.5		1
Brickbottom Lofts (Northeast façade)	West	n/a	18	57.6	60.0	63.5	79.2[2]	21.6		1
Totals between Lechmere Station and Fitchburg Mainline- Alternatives 5,6									0	4
Segment between Fitchburg Mainline and Mystic Valley Parkway – Alternative 5										
Tufts Street near Knowlton Street (2nd row)	East	159	191	62.6	64.2	66.8	64.5	1.9	6	
Alston Street near Cross Street (2nd row)	West	172	133	61.9	63.7	66.3	63.9	2.0	7	
Avon Place	West	59	25	74.4	74.8	76.6	81.2	6.8		4
Avon Place and Auburn Ave near McGrath Highway	East	33	61	77.2	77.4	79.2	77.9	0.7	11	
Gilman Street and Aldrich Street	East	32	60	71.9	72.6	74.3	73.8	1.9	14	
Pearl Street near Medford Street	East	29	57	71.8	72.5	74.2	73.8	2.0	1	
Montrose Street	West	70	42	74.1	74.6	76.4	75.2	1.1	17	
Richdale Street near School Street	East	39	67	75.5	75.8	77.6	77.7	2.2		12
Richdale Street near Sycamore Street	East	45	73	74.2	74.6	76.4	76.1	1.9	7	
Willoughby Street near Sycamore Street (1st row)	West	74	46	74.0	74.5	76.3	78.3	4.3		1
Willoughby Street near Sycamore Street (2nd row)	West	103	75	70.0	71.0	72.7	71.6	1.6	5	
Sycamore Street near Richdale Street (1st row)	East	65	93	71.2	72.1	73.8	74.3	3.1		1
Albion Street near Central Street	West	149	121	67.0	68.1	70.2	68.2	1.2	3	
Woodbine Street near Centre Street	West	116	82	68.2	69.4	71.2	70.7	2.5	3	
Visiting Nurses Assisted Living	West	78	41	70.9	71.9	73.5	73.8	2.9		1
Vernon Street and Berwick Street	East	92	120	68.4	69.4	71.3	70.5	2.1	15	
Vernon Street, Nashua Street, Henderson Street, Hinckley Street	East	37	65	78.0	78.2	79.8	80.5	2.5		11
Murdock Street near Cedar Street (1st row)	West	57	29	80.1	80.1	81.2	81.9	1.8		2
Murdock Street near Cedar Street (2nd row)	West	126	98	73.4	74.0	75.8	75.1	1.7	2	
Trum Playground[1]	East	n/a	67	68.6[1]	71.4[1]	74.7[1]	72.0[1]	3.4	0	
Cedar Street	East	22	50	73.0	73.6	75.4	77.0	4.0		1
Wilson Avenue and Cedar Street (2nd and 3rd rows)	East	71	99	67.9	69.1	71.0	70.7	2.8	6	

Table 5.7-2 Potential Noise Impact Without Mitigation for Alternatives 5 and 6 (continued)

Noise Sensitive Receptor Location	Side of Tracks	Distance to Near Track (feet) Comm. Line	Distance to Near Track (feet) Green Line	Existing Noise Level (Ldn)	Impact Criteria Mod.	Impact Criteria Sev.	Future Noise Level (Ldn)	Increase	Total Number of Impacts (buildings) Mod.	Total Number of Impacts (buildings) Sev.
Segment between Fitchburg Mainline and Mystic Valley Parkway – Alternative 5 (continued)										
Boston Avenue between Cedar Street and Broadway	West	65	37	71.8	72.6	74.3	74.3	2.5	16	
Boston Avenue near Broadway	West	59	28	73.0	73.6	75.4	75.5	2.5		3
Newbern Avenue, Morton Avenue, Granville Avenue, Winchester Place, Winchester Court (1st row)	East	33	61	76.7	76.9	78.7	79.6	2.9		9
Newbern Avenue, Morton Avenue, Granville Avenue, Winchester Place, Winchester Court (2nd row)	East	58	86	69.0	70.0	71.8	71.0	2.0	18	
Tufts - Science and Technology Center and Outside the Lines Art Studio[1]	East	27	55	77.0	77.7[1]	81.5[1]	80.7[1]	3.7	2	
Tufts - Bacon Hall[1]	West	47	17	79.4	79.9[1]	82.7[1]	82.9[1]	3.5		1
Burget Avenue	East	29	57	72.2	74.2	77.5	75.8	3.6	3	
Burget Avenue	East	37	65	71.2	72.1	73.8	74.7	3.5		11
Charnwood Road near Brookings Street	East	48	76	70.3	71.3	73.0	72.9	2.6	12	
Charnwood Road near Winthrop Street	East	42	70	71.2	72.1	73.7	74.0	2.8		10
Boston Avenue near Winthrop Street	West	107	79	65.9	67.2	69.4	67.4	1.5	2	
Orchard Street	East	63	91	67.4	68.5	70.5	69.5	2.1	11	
Orchard Street near North Street, Winthrop Street near Charnwood Road	East	46	74	71.0	72.0	73.6	76.0	5.0		19
Orchard Street (2nd row)	East	133	161	59.0	61.1	64.3	62.6	3.6	17	
New Life Baptist Church	West	70	42	67.6	70.6	74.0	72.5	4.9	1	
Piggot Road near Boston Avenue	West	111	83	67.2	68.3	70.3	70.0	2.8	7	
Piggot Road near North Street	West	59	16	71.4	72.2	73.9	81.4	10.0		7
Fortunato Drive	East	59	87	70.5	71.4	73.1	73.2	2.7	2	
Totals between Fitchburg Mainline and Mystic Valley Parkway – Alternative 5									188	93
Segment on Fitchburg Mainline between McGrath Highway and Prospect Street (Union Square)- Alternative 6										
Horace Street	South	21	35	65.2	66.6	68.8	74.3	9.1		6
Walnut Street Center[1]	North	58	30	63.3	67.1	71.0[1]	74.0[1]	10.7		1
Charlestown Street near Allen Street	North	113	85	61.0	62.8	65.6	67.4	6.4		2
Totals on Fitchburg Mainline between McGrath Highway and Prospect Street (Union Square) - Alternative 6									0	9

Source: Harris Miller Miller & Hanson Inc., August 2008.

1 Peak-transit hour Leq used for institutional land use.

2 Projected noise levels include contribution from noise generated at the proposed maintenance facility (Yard 8).

3 Projected noise levels include contribution from wheel squeal.

Potential noise impacts on the west side of the alignment are due primarily to the proximity of noise-sensitive receptors to the Green Line trains. At close distances (within approximately 50 feet) the contribution of noise from Green Line trains is more significant than from commuter trains. Future noise levels on the west side are projected to generally increase one to two decibels due to the close proximity of noise-sensitive receptors to the Green Line trains. Typically, this increase is not perceptible to humans. At a few specific locations (Alston Street and Piggott Road) the increase in noise levels is higher (five to seven decibels) due to the close proximity (16 to 25 feet) to the near track centerline of the proposed Green Line trains.

Since existing noise levels are relatively high at locations along the existing commuter rail line, even small increases in future noise levels are considered to have the potential for moderate or severe noise impact.

Shorter headways are expected for Alternatives 5 and 6 than for Alternatives 1, 2, 3, and 4. This increased number of Green Line train operations would generate higher future noise levels and increases the potential for noise impact.

At locations where there is no existing train activity beyond Lechmere Station and near Union Square, the future increase in noise levels due to the Project would be higher because existing noise levels are lower. In particular, future noise levels for the Hampton Inn Hotel, Glass Factory Condominiums, and Brickbottom Lofts are projected to be nine to 18 decibels higher due to the relatively quiet existing conditions. These locations are not close to existing train activity and these buildings have limited exposure to noise from automobile traffic on O'Brien Highway/Route 28.

The noise model includes noise contributions from the proposed maintenance facility. While these contribute to the noise impacts, the majority of the increase in noise levels near the maintenance facility would be due to Green Line operations, due in part to the greater proximity of the proposed Green Line tracks to residential receptors and to the frequency of Green Line operations. For example, rail operations alone would increase noise levels at the Brickbottom Lofts from 57.6 dBA to 75.3 dBA, which would constitute a severe impact. The addition of the maintenance facility noise to this scenario would increase overall noise levels to 76.4 dBA, an increase of only 1.1 dBA.

Table 5.7-3 shows the summary of noise sensitive receptors that are projected to be exposed to moderate and severe noise impact for each alternative with and without noise mitigation.

Table 5.7-3 Summary of Potential Noise Impacts

	Residential Buildings Impacted				Institutional Buildings Impacted[1]			
	Without Mitigation		With Mitigation		Without Mitigation		With Mitigation	
Alternative	Moderate	Severe	Moderate	Severe	Moderate	Severe	Moderate	Severe
1	120	41	0	0	3[2]	1	0	0
2	170	65	0	0	3[2]	1	0	0
3	127	43	0	0	3[2]	1	0	0
4	177	67	0	0	3[2]	1	0	0
5	185	96	0	0	3[2]	1	0	0
6	0	12	0	0	0	1	0	0

Source: Harris Miller Miller & Hanson Inc., August 2008.
1 Institutional buildings include the Tufts University Science and Technology Center, Outside the Line Artist's Studio and Bacon Hall.
2 Moderate impacts include Trum Playground.

For Alternative 1, moderate noise impact is projected at 120 single-family and multi-family residential buildings and severe noise impact is projected at 41 residential buildings. Moderate impact is projected at three institutional buildings (Science and Technology Center, Outside the Line Artist's Studio and Bacon Hall at Tufts University) and Trum Playground. Severe noise impact is projected at the Walnut Street Center near Union Square.

For Alternative 2, moderate noise impact is projected at 170 single-family and multi-family residential buildings and severe noise impact is projected at 65 residential buildings. Moderate and severe impacts to non-residential buildings would be the same as for Alternative 1.

For Alternative 3, moderate impact is projected at 127 single-family and multi-family residential buildings and severe noise impact is projected at 43 residential buildings. Moderate and severe impacts to non-residential buildings would be the same as for Alternative 1.

For Alternative 4, moderate impact is projected at 177 single-family and multi-family residential buildings and severe noise impact is projected at 67 residential buildings. Moderate and severe impacts to non-residential buildings would be the same as for Alternative 1.

For Alternative 5, moderate impact is projected at 185 single-family and multi-family residential buildings and severe noise impact is projected at 96 residential buildings. Moderate impact is projected at three buildings at Tufts University and Trum Playground.

For Alternative 6, severe impact is projected at 12 single-family and multi-family residential buildings and the Walnut Street Center near Union Square.

5.7.2.1 Temporary Construction Noise Impacts

Temporary noise impacts could result from construction activities associated with utility relocation, grading, excavation, track work and installation of systems components. Such impacts may occur in residential areas and at other noise-sensitive land use located within several hundred feet of the alignment. The potential for noise impact would be greatest at locations near pile driving operations for bridges and other structures, and at locations close to any nighttime construction activities.

5.7.3 Noise Mitigation

Noise mitigation is considered depending on the need, feasibility, reasonableness and effectiveness of potential options. The FTA states that in considering potential noise impact, severe impacts should be mitigated if at all practical. At the moderate impact level, more discretion should be used, and other project-specific factors should be included in considering mitigation. These factors include the predicted increase over existing noise levels, the types and number of noise-sensitive land uses affected, existing outdoor-to-indoor sound reduction, and the effectiveness of mitigation options and the cost-effectiveness of mitigating the noise. However, the FTA also states that there is a stronger need for mitigation if a project is proposed in an area currently experiencing high noise levels (Ldn above 65 dBA) from surface transportation sources. This is clearly the case at sensitive receptors along the existing MBTA Fitchburg and Lowell Lines where existing Ldn levels range between 65 to 80 dBA. In view of this guidance by the FTA, the Project would mitigate both moderate and severe noise impacts wherever practical and wherever existing noise levels are above 65 dBA.

To mitigate noise impact from train operations, noise control can be considered at the source, along the sound path, or at the receiver. Source noise control options, for example, may include special hardware at turnout locations (e.g. by using spring-rail or moveable-point frogs in place of standard rigid frogs), relocating special trackwork away from sensitive areas and using continuous welded rail. Noise barrier construction is the most common sound path noise control treatment and can be very effective at reducing noise levels in the community. Noise control at the receiver can also be achieved by using sound insulation treatments at residences and institutional buildings. The mitigation recommendations in this section would be refined further during the design process of the Project.

Noise barriers have been used to mitigate potential noise impact for numerous transit lines across the United States and internationally. Noise barriers are generally effective means of reducing noise from most transit sources when they break the line-of-sight between the source and the receiver. The height necessary for providing sufficient noise reduction depends on the source height and the distance from the source to the barrier. Effective noise barriers can easily reduce noise levels 10 decibels or more depending on the specific implementation. There are many different materials and designs available for noise barriers including some made of recycled or other environmentally-conscious materials. Figure 5.7-7 shows several possible materials for noise barriers. During final design, illustrations of proposed barriers may be available to the community and the public will have an opportunity to provide input into the specific noise barrier design.

Figure 5.7-7 Examples of Noise Barrier Materials

For many locations along the MBTA Fitchburg and Lowell Lines, noise barriers are a feasible and effective means of noise mitigation because the existing right-of-way is lower than sensitive receptors for substantial portions of the Project. Noise barriers would be constructed with an absorptive surface to minimize the potential of sound reflecting off barriers to sensitive locations on the opposite side of the tracks. Table 5.7-4 shows a summary of proposed noise barrier mitigation. This table includes the barrier length, side of tracks, barrier height, and range of noise reduction and the general location of the barrier. Proposed noise barrier locations are shown in Figures 5.7-2 through 5.7-6.

Noise barriers ranging between six and 12 feet in height would be effective in reducing noise levels from the Project by generally seven to 11 decibels. The 26 noise barriers (15,550 feet in length and approximately 124,000 square feet in area) would cost approximately $3.7 million dollars based on $30 per square foot of installed noise barriers not counting design and inspection costs.

Table 5.7-4 Summary of Proposed Noise Barrier Mitigation

Barrier Number	Length (feet)	Side of Tracks	Barrier Height (feet)	Noise Reduction (dBA)	Location
1[b]	300	West	7	7 to 17	On existing retaining wall
2[c]	400	East	6	7 to 10	Right-of-way limit
3[b]	500	East	7	7 to 14	Right-of-way limit
4[b]	750	East	6 to 10	9 to 16	Right-of-way/Trackside
5[b]	850	East	9	10 to 14	Right-of-way limit
6[c]	850	West	9	10 to 14	Right-of-way limit
7[b]	300	West	7	7 to 14	Right-of-way limit
8[b]	300	East	7	9 to 11	Right-of-way limit
9[c]	450	West	8	7 to 9	Right-of-way limit
10[b]	250	West	6 to 12	7 to 9	On proposed retaining wall
11[b]	1,050	East	7 to 10	10 to 15	Right-of-way limit
12[b]	1,000	East	8	9 to 15	Right-of-way limit
13[b]	400	West	8	8 to 12	On proposed retaining wall
14[a]	100	East	8	10 to 14	Right-of-way limit
15[b]	400	East	8	10 to 14	Right-of-way limit
16[b]	800	West	8	10 to 14	Right-of-way limit
17[b]	1,200	East	10	6 to 15	On trackbed retaining wall
18[b]	1,000	East	6	9 to 11	Right-of-way/retaining wall
19[d]	750	East	6	9 to 11	Right-of-way/retaining wall
20[d]	200	West	8	8	Right-of-way limit
21[c]	200	West	8	8	Right-of-way limit
22[d]	1,450	East	6 to 10	7 to 11	Right-of-way and trackside
23[d]	850	West	10	5 to 16	Right-of-way limit
24[d]	550	East	6	14	On existing retaining wall
25[e]	250	South	8	10 to 14	Trackside
26[e]	400	North	8	10 to 14	Trackside

Source: Harris Miller Miller & Hanson Inc., August 2008.
a There is an existing 6-foot barrier at this location.
b Mitigation needed only for Alternatives 1, 2, 3, 4 and 5.
c Mitigation needed only for Alternative 5.
d Mitigation needed only for Alternatives 2, 4 and 5.
e Mitigation needed only for Alternatives 1, 2, 3, 4 and 5.

At some locations projected to be exposed to noise impact, noise barriers may not be a feasible or effective means of mitigation. These locations include the NorthPoint Properties (Alternative 5 and 6 only), Glass Factory Condominiums, Hampton Inn Hotel, Brickbottom Lofts, an apartment complex on Pearl Street near Medford Street, the Visiting Nurses Association, Tufts Science and Technology Center, Tufts Outside the Lines Art Studio, Tufts Bacon Hall, the Walnut Street Center in Union Square (Alternatives 1, 2, 3, 4 and 6 only) and seven residential buildings on Somerville Avenue near Linden Street, Merriam Street and Rossmore Street (Alternatives 3 and 4 only). Some of these buildings have upper-floor residences that would not benefit from a potential noise barrier. The proposed alignment is street-running on Somerville Avenue and, therefore, noise barriers are not feasible. Since there is no significant outdoor land use at these locations, sound insulation mitigation will be considered during the preliminary engineering phase of the project.

Sound insulation of residences and institutional buildings to improve the outdoor-to-indoor noise reduction has been widely applied around airports but has seen limited application for rail projects. Although this approach has no effect on noise in exterior areas, it may be the best choice for sites where noise barriers are not feasible or desirable, and for buildings where indoor sensitivity is of most concern. Substantial improvements in building sound insulation (on the order of 5 to 10 dBA) can often be achieved by adding an extra layer of glazing to windows, by sealing any holes in exterior surfaces that act as sound leaks, and by providing forced ventilation and air conditioning so that windows do not need to be opened.

Some of these large buildings, however, may have a greater outdoor-to-indoor sound reduction than for typical buildings (about 25 dB with windows closed). If it can be established that there is indoor activity only and that the performance of these windows is sufficiently better than normal, sound insulation mitigation may not be necessary. Sound insulation would be considered an effective mitigation measure if it is possible to improve the noise reduction of the existing building by five decibels or more and provide interior noise levels of 65 dBA or less (Lmax) from transit sources.

During the preliminary engineering phase of the project, the existing outdoor-to-indoor noise reduction of the buildings will be measured. An analysis will be made as to whether the noise reduction of the building could be improved by five decibels or more with sound insulation treatments. The effectiveness of potential noise barriers to reduce interior noise levels at these locations will also be assessed.

At multi-family residences on Somerville Avenue near Allen Street, noise impact would primarily be due to potential wheel squeal from trains turning between Somerville Avenue and Prospect Street. To minimize the potential impact from wheel squeal, noise source mitigation options would be implemented such as using rail lubrication (top-of-rail friction modifiers).

Estimated costs for sound insulation depend on specific factors such as the existing noise reduction, existing Heating, Ventilation and Air Conditioning (HVAC) systems and the number and size of windows and doors that need to be replaced. Approximately 165 units may require sound insulation in the Glass Factory Condominiums (50), Hampton Inn Hotel (30), Brickbottom Lofts (40), multi-family building on Pearl Street (15) and the Visiting Nurses Assisted Living (30). Seven residential buildings on Somerville Avenue may also require sound insulation. Based on an estimated cost of $50,000 per typical residential building or per unit within a large residential building, the estimated costs for these residential buildings is $8.6 million. Sound insulation costs for the Tufts Science and Technology Center, Tufts Bacon Hall, Outside the Lines Studio, and the Walnut Street Center are estimated to be between $500,000 and $2 million per building. The total estimated cost for sound insulation is $12.1 million. These recommendations and estimated costs will be refined during final design of the Project.

The proposed noise barriers, potential sound insulation, and rail lubrication would be effective in mitigating all potential noise impact from the Project, and no residual impacts would be expected. In fact, for locations along the existing commuter rail lines, the future noise levels would be substantially lower than the existing noise levels due to the noise barriers. Therefore, with mitigation, there would be no moderate or severe noise impacts from the Project.

5.7.3.1 Construction Noise Mitigation

The following mitigation measures will be applied where feasible to minimize temporary construction noise impacts:

- Avoiding nighttime construction in residential neighborhoods;
- Using specially quieted equipment with enclosed engines and/or high-performance mufflers;
- Locating stationary construction equipment as far as possible from noise-sensitive sites; and
- Constructing noise barriers, such as temporary walls or piles of excavated material, between noisy activities and noise-sensitive receivers.

5.7.4 Summary

Depending on the alternative, up to 285 noise-sensitive receptors may be exposed to noise impact in the absence of mitigation. These include 185 moderate impacts and 96 severe impacts at single-family and multi-family residential buildings, moderate impact at three institutional buildings (Science and Technology Center, Outside the Line Artist's Studio and Bacon Hall at Tufts University), moderate impact at Trum

Playground, and severe noise impact at the Walnut Street Center (a non-profit support center for adults with developmental disabilities) near Union Square.

Noise mitigation including noise barriers, sound insulation treatments, and rail lubrication would be feasible, reasonable, and effective in mitigating all potential noise impact due to the Project for all alternatives. The noise barriers would be effective in reducing noise levels from transit sources generally seven to 11 decibels and would result in substantial reduction in future noise levels in comparison to existing noise levels. With mitigation, there would be no moderate or severe noise impacts from the Project.

5.8 Vibration

The Secretary's Certificate required that the DEIR analyze vibration for existing and proposed conditions consistent with the FTA's guidelines. The Secretary's Certificate requires that this analysis identify the location of vibration-sensitive receptors, assess the potential for vibration impact, and specify both where mitigation is required and what mitigation measures will be used.

The vibration impact analysis for the Green Line Extension Project is based on the methodology defined in the FTA's guidance manual "*Transit Noise and Vibration Impact Assessment*" (Report FTA-VA-90-1003-06, May 2006). The analysis includes background on the vibration impact assessment methodology, environmental consequences of the Project (including impact results for the proposed Build Alternatives), the type and location of specific measures required to mitigate potential vibration impacts, and a summary of results.

5.8.1 Vibration Impact Methodology

The vibration impact assessment methodology includes conducting reference vibration measurements of commuter trains and Green Line trains, conducting measurements of the vibration propagation characteristics of the soil along the proposed corridor, projecting future vibration levels from the Project, assessing potential impacts, and determining the need, feasibility and reasonableness of mitigation recommendations. Future vibration levels from the Project would be generated from the proposed Green Line trains and existing commuter trains and includes modifications to the commuter rail lines.

5.8.1.1 Vibration-Sensitive Land Use Categories

The FTA generally classifies vibration-sensitive land uses into the same three categories as noise. Although, since vibration is only assessed inside buildings, outdoor land uses are not considered to be sensitive. In addition to the potential for human annoyance from vibration, vibration impact is also assessed for certain equipment that is sensitive to vibration.

- **Vibration Category 1 – High Sensitivity**: Included in this category are buildings where vibration would interfere with operations. Vibration levels may be well below those associated with human annoyance. These buildings include vibration-sensitive research and manufacturing facilities, hospitals with sensitive equipment and university research operations. The sensitivity to vibration is dependent on the specific equipment present. Some examples of sensitive equipment include scanning electron microscopes, magnetic resonance imaging scanners and lithographic equipment.

- **Vibration Category 2 - Residential**: Residences and buildings where people normally sleep. This category includes homes, hospitals, and hotels.

- **Vibration Category 3 - Institutional**: This category includes buildings with primarily daytime and evening use. This category includes schools, libraries and churches.

- **Special Buildings**: Special-use buildings such as concert halls, recording studios, auditoriums and theatres warrant special consideration. Potential ground-borne vibration and ground-borne noise impact is assessed at these buildings.

5.8.1.2 Vibration Impact Criteria

The FTA vibration impact criteria are based on land use and train frequency, as shown in Table 5.8-1. 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 listed in Table 5.8-1. Due to the sensitivity of these buildings, they usually warrant special attention during the environmental assessment of a transit project. Table 5.8-2 gives criteria for acceptable levels of ground-borne vibration for various types of special buildings.

It should also be noted that there are separate FTA criteria for ground-borne noise, the “rumble” that can be radiated from the motion of room surfaces in buildings due to ground-borne vibration. Such criteria are particularly important for underground transit operations. However, because airborne noise tends to mask ground-borne noise from above ground (i.e. at-grade or elevated) rail systems, ground-borne noise criteria are not applied to the Green Line Extension Project except for one location at the Somerville Community Access Television studio.

Table 5.8-1 FTA Ground-Borne Noise and Vibration Impact Criteria

Land Use Category	Ground-Borne Vibration Impact Levels (VdB re 1 micro-inch/sec) Frequent Events[1]	Occasional Events[2]	Infrequent Events[3]	Ground-Borne Noise Impact Levels (dBA re 20 micro-pascals) Frequent Events[1]	Occasional Events[2]	Infrequent Events[3]
Category 1: Buildings where low ambient vibration is essential for interior operations.	65 VdB[4]	65 VdB[4]	65 VdB[4]	n/a[5]	n/a[5]	n/a[5]
Category 2: Residences and buildings where people normally sleep.	72 VdB	75 VdB	80 VdB	35 dBA	38 dBA	43 dBA
Category 3: Institutional land uses with primarily daytime use.	75 VdB	78 VdB	83 VdB	40 dBA	43 dBA	48 dBA

Source: FTA, 2006.
1 "Frequent Events" is defined as more than 70 vibration events per day. Most rapid transit projects fall into this category.
2 "Occasional Events" is defined as between 30 and 70 vibration events of the same kind per day. Most commuter rail trunk lines have this many operations.
3 "Infrequent Events" is defined as fewer than 30 vibration events of the same kind per day. This category includes most commuter rail branch lines.
4 This criterion limit is based on levels that are acceptable for most moderately sensitive equipment such as optical microscopes. Vibration sensitive manufacturing or research will require detailed evaluation to define the acceptable vibration levels. Ensuring lower vibration levels in a building often requires special design of the HVAC systems and stiffened floors.
5 Vibration-sensitive equipment is generally not sensitive to ground-borne noise.

Table 5.8-2 FTA Ground-Borne Noise and Vibration Impact Criteria for Special Buildings

Type of Building or Room[3]	Ground-Borne Vibration Impact Levels (VdB re 1 micro-inch/sec) Frequent Events[1]	Occasional or Infrequent Events[2]	Ground-Borne Noise Impact Levels (dBA re 20 micro-pascals) Frequent Events[1]	Occasional or Infrequent Events[2]
Concert Halls	65 VdB	65 VdB	25 dBA	25 dBA
TV Studios	65 VdB	65 VdB	25 dBA	25 dBA
Recording Studios	65 VdB	65 VdB	25 dBA	25 dBA
Auditoriums	72 VdB	80 VdB	30 dBA	38 dBA
Theatres	72 VdB	80 VdB	35 dBA	43 dBA

Source: FTA, 2006.
1 "Frequent Events" is defined as more than 70 vibration events per day. Most rapid transit projects fall into this category.
2 "Occasional or Infrequent Events" is defined as fewer than 70 vibration events per day. This category includes most commuter rail lines.
3 If the building will rarely be occupied when the trains are operating, there is no need to consider impact. As an example consider locating a commuter rail line next to a concert hall. If no commuter trains will operate after 7 pm, it should be rare that the trains interfere with the use of the hall.

In addition to the criteria provided in Tables 5.8-1 and 5.8-2 for general assessment purposes, the FTA has established criteria in terms of one-third octave band frequency spectra for use in detailed analyses. Table 5.8-3 and Figure 5.8-1 show the more detailed vibration criteria and the description of their use.

Table 5.8-3 Vibration Criteria for Detailed Analysis

Criterion Curve	Maximum Vibration Level (VdB re 1 micro-inch/sec)	Description of Use
Workshop	90	Distinctly feelable vibration. Appropriate to workshops and non-sensitive areas
Office	84	Feelable vibration. Appropriate to offices and non-sensitive areas
Residential Day	78	Barely feelable vibration. Adequate for computer equipment and low-power optical microscopes (up to 20X)
Residential Night, Operating Rooms	72	Vibration not feelable, but ground-borne noise may be audible inside quiet rooms. Suitable for medium-power optical microscopes (100X) and other equipment of low sensitivity
VC-A	66	Adequate for medium- to high-power optical microscopes (400X), microbalances, optical balances, and similar specialized equipment
VC-B	60	Adequate for high-power optical microscopes (1000X), inspection and lithography equipment to 3 micron line widths
VC-C	54	Appropriate for most lithography and inspection equipment to 1 micron detail size
VC-D	48	Suitable in most instances for the most demanding equipment, including electron microscopes operating to the limits of their capability
VC-E	42	The most demanding criterion for extremely vibration-sensitive equipment

Source: FTA, 2006.

For residential buildings with nighttime occupancy, the applicable criterion for vibrations generated by commuter trains (occasional events) is a maximum velocity level of 75 VdB, measured in any one-third octave band over the frequency range from 4 Hz to 80 Hz. For residential buildings, the applicable criterion for vibrations generated from Green Line trains (frequent events) is 72 VdB. For institutional buildings such as schools, libraries and churches, the applicable criterion for a vibrations generated from commuter trains is 78 VdB and the criterion for vibrations generated from Green Line trains is 75 VdB. Potential vibration impact of sensitive equipment such as electron microscopes and magnetic resonance imaging scanners is considered using detailed analyses.

Vibration Projections

Similar to noise, vibration level projections are based on planned operations of existing commuter trains and proposed Green Line trains, measured reference levels of existing commuter trains and Green Line trains, measurements of the vibration propagation characteristics of the soil and prediction modeling from the FTA guidance manual. The principal assumptions used in this analysis are similar to the noise projections with the following additional details:

Planned Operations

- The future commuter train and Green Line tracks are expected to be on ballast and tie including a "boat section" trackform. A "boat section" is a concrete slab approximately 2 to 3 feet thick which supports all of the commuter train and Green Line train tracks.
- Green Line trains are assumed to operate on jointed rail.
- Commuter trains are assumed to operate on continuous welded rail.

Vibration Reference Levels

Measurements of Green Line trains on the existing D Branch near Beaconsfeld Station and vibration propagation characteristics of the soil show that Green Line trains operating at 50 mph on ballast and tie track with jointed rail generate maximum vibration levels of 63 to 69 VdB at a distance of 50 feet from the track centerline. Maximum vibration levels of Green Line trains typically occur in the 50-Hz one-third octave band.

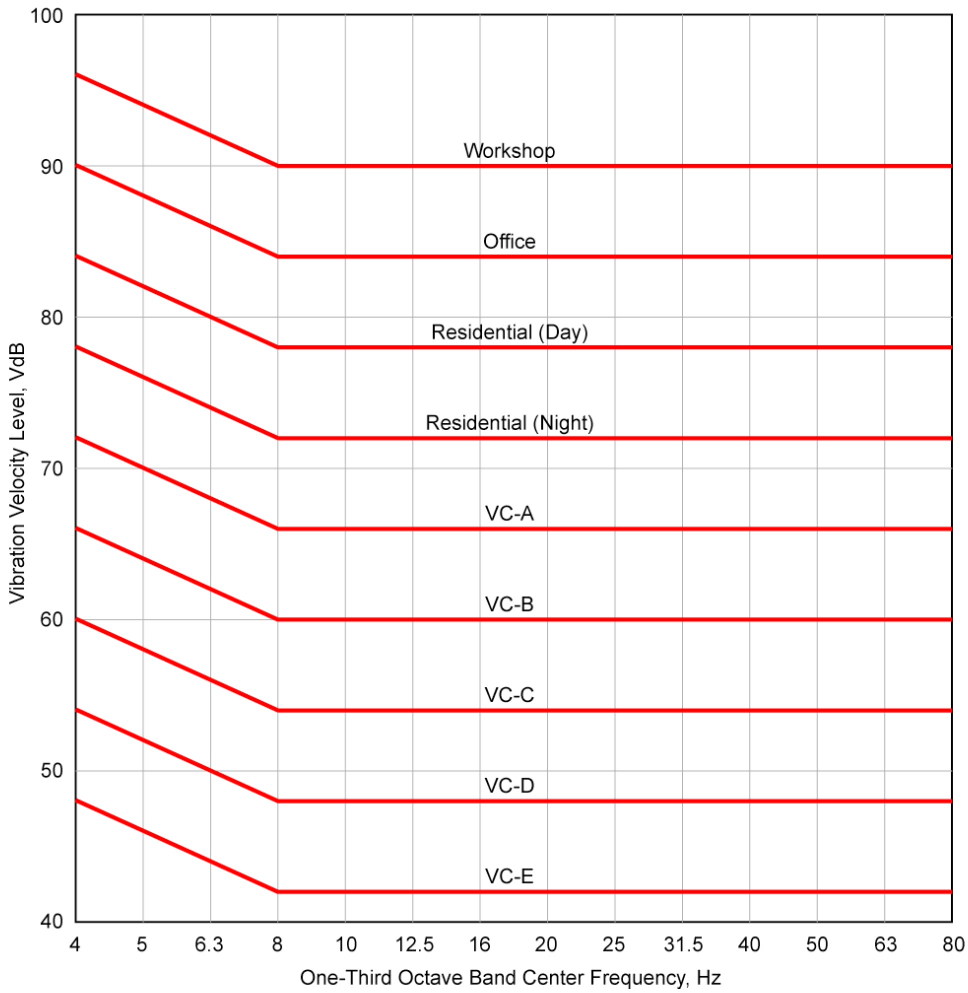
Measurements of MBTA commuter trains on the MBTA Lowell Line at Tufts University and vibration propagation characteristics of the soil show that MBTA commuter trains operating at 50 mph on ballast and tie track with continuous welded rail generate maximum vibration levels of 74 to 87 VdB at a distance of 50 feet from the track centerline along the Project corridor. Maximum vibration levels of MBTA commuter trains typically occur in the 50-Hz one-third octave band.

Based on measurements on the MBTA Lowell Line at Tufts University, Amtrak commuter trains operating at 50 mph on ballast and tie track with continuous welded rail generate maximum vibration levels of approximately 72 VdB at a distance of 50 feet from the track centerline.

Vibration Prediction Model

- Vibration levels are projected at sensitive receptors based on the detailed vibration analysis methodology in the FTA guidance manual. Future vibration levels from the commuter trains are projected based on reference measurements of the commuter and Green Line trains and measurements of the vibration propagation characteristics of the soil.
- Wheel impacts at special trackwork are assumed to cause localized vibration increases of 5 to 10 VdB.
- A two-decibel factor of safety has been added to vibration projections.

Figure 5.8-1 Criteria for Detailed Vibration Analysis



5.8.2 Vibration Impacts

The Green Line Extension Project would add a new vibration source to the environment along the proposed corridor. While there is existing vibration exposure from sources such as commuter trains and automobiles, introducing an additional vibration source and relocating the commuter rail lines have the potential to increase future vibration at some sensitive receptors. The Project involves relocating the commuter rail lines up to 18 feet to the east along some portions of the corridor and adding the proposed Green Line tracks on the west side of the corridor.

Potential vibration impact has been assessed for the Build Alternatives. Vibration level projections for sensitive receptors that may be exposed to vibration impact without any mitigation measures are shown in Table 5.8-4. This table shows the vibration-sensitive receptor location, side of tracks, the distances to the near-track centerline and vibration projections for the existing commuter line, future commuter line and Green Line, the number of impacted buildings, and the railway causing impact. Potential vibration impact locations are shown in Figures 5.8-2 through 5.8-6.

All of the receptors listed in this table are single-family and/or multi-family residential properties unless specified. Institutional land uses that are projected to be exposed to vibration impact include the Science and Technology Center, Outside the Line Artist Studio, and Bacon Hall at Tufts University.

Vibration impact from the commuter trains generally occurs within 60 feet of the future commuter rail near track centerline and within 40 feet of the proposed Green Line near track centerline. Most receptors projected to be exposed to vibration impact from commuter train activity are located on the east side of the MBTA Lowell Line or the south side of the MBTA Fitchburg Line where the proposed commuter rail near track is planned to shift up to 18 feet closer than its current location. Shifting the existing commuter rail lines 18 feet closer to sensitive receptors is generally expected to increase vibration levels 10 to 13 VdB. Most receptors projected to be exposed to vibration impact from Green Line train activity are located on the west side of the MBTA Lowell Line.

Airborne noise, ground-borne noise and vibration were projected and assessed at the Somerville Community Access Television studio and no impact is projected.

The building at 200 Boston Avenue which houses the Tufts University Nanolab with vibration-sensitive equipment is expected to be acquired as part of the project under Alternatives 2, 4 and 5 and therefore would not be impacted by vibration.

Table 5.8-4 Potential Vibration Impacts at Sensitive Receptors Without Mitigation

Vibration Sensitive Receptor Location	Side of Tracks	Distance to Near Track (feet): Existing Comm. Line	Distance to Near Track (feet): Future Comm. Line	Distance to Near Track (feet): Green Line	Maximum Vibration Velocity Level in any 1/3-Octave band from 4 to 80 Hz (VdB re: 1 µ-in.sec): Existing Comm. Line	Maximum Vibration Velocity Level: Future Comm. Line	Maximum Vibration Velocity Level: Green Line	Total Number of Impacted Buildings	Rail Line Causing Impact
Segment between Lechmere Station and Medford Hillside - Alternatives 1, 2, 3, 4, 5									
Brickbottom Lofts (northeast façade)	West	n/a	n/a	18	n/a	n/a	77[2]	1	Green.
Alston Street near Cross Street	West	59	59	25	77	77	98[1]	4	Both
Avon Place	East	33	33	61	91	91	69	4	Comm.
Auburn Avenue near McGrath Highway	East	46	46	74	83	83	65	7	Comm.
Aldrich Street	East	43	43	71	89[1]	84	65	2	Comm.
Gilman Street near Aldrich Street	East	58	58	86	77	77	61	3	Comm.
Gilman Street near Walnut Street	East	32	32	60	92	92	69	9	Comm.
Medford Street west of Walnut Street	West	77	79	37	67	66	74	4	Green.
Pearl Street near Medford Street	East	32	29	57	82	85	54	1	Comm.
Montrose Court and Jerome Court	West	58	70	42	70	63	72	5	Green.
Richdale Street	East	59	45	73	69	78	61	22	Comm.
Willoughby Street near Sycamore Street	West	60	74	46	69	62	80[1]	1	Green.
Vernon Street near Lowell Street	East	39	29	57	78	88	58	3	Comm.
Lowell Street near Vernon Street	East	57	42	70	71	81	58	1	Comm.
Nashua Street, Henderson Street, Hinckley Street	East	55	37	65	81[1]	95[1]	58	4	Comm.
Hinckley Street	East	55	37	65	81[1]	95[1]	59	2	Comm.
Berwick Street	East	72	54	82	72[1]	82[1]	58	2	Comm.
Murdock Street	West	39	57	29	78	65	83[1]	1	Green.
Murdock Street near Cedar Street	West	43	61	33	80	68	89[1]	1	Green.
Cedar Street	East	40	22	50	78	90	66	1	Comm.
Newbern Avenue	East	51	33	61	68	77	55	1	Comm.
Morton Avenue, Granville Avenue	East	33	15	43	83	99	65	4	Comm.
Winchester Place	East	37	19	47	80	93	64	1	Comm.
Winchester Place	East	60	42	70	70	78	58	1	Comm.
Winchester Place	East	47	29	57	75	85	63	1	Comm.
Winchester Court	East	51	33	61	73	82	63	1	Comm.
Tufts - Science and Technology Center	East	45	27	55	68	79	56	1	Comm.
Tufts – Outside the Line Art Studio	East	45	27	55	68	79	56	1	Comm.
Tufts – Bacon Hall	West	29	47	17	77	67	84[1]	1	Green.
Totals between Lechmere Station and Medford Hillside - Alternatives 1, 2, 3, 4, 5								90	
Segment between Medford Hillside and Mystic Valley Parkway - Alternatives 2, 4, 5									
Brookings Street	East	62	48	76	69	75	60	2	Comm.
Piggot Road near North Street	West	71	78	35	67	65	82[1]	7	Green.
Segment between Medford Hillside and Mystic Valley Parkway - Alternatives 2, 4, 5								9	
Segment on Fitchburg Mainline between McGrath Highway and Prospect Street (Union Square) - Alternatives 1, 2, 3, 4, 6									
Horace Street (1st row)	South	35	21	35	80	92	91[1]	2	Both
Horace Street (2nd row)	South	57	43	57	67	74	80[1]	1	Green.
Totals on Fitchburg Mainline between McGrath Highway and Prospect Street (Union Square) - Alternatives 1, 2, 3, 4, 6								3	

Source: Harris Miller Miller & Hanson Inc., August 2008.
1 Projected vibration levels include contribution from special trackwork
2 Green Line is on elevated structure at this location.

Table 5.8-5 shows the summary of vibration-sensitive receptors that are projected to be exposed to impact for each alternative with and without vibration mitigation.

Table 5.8-5 Summary of Potential Vibration Impact

Alternative	Residential Buildings Impacted		Institutional Buildings Impacted[1]	
	Without Mitigation	With Mitigation	Without Mitigation	With Mitigation
1	90	28	3	0
2	99	28	3	0
3	90	28	3	0
4	99	28	3	0
5	96	26	3	0
6	3	2	0	0

Source: Harris Miller Miller & Hanson Inc., August 2008.
1 Institutional buildings include schools, libraries, theaters, churches, cemeteries, monuments, museums, campgrounds, recreational facilities, and certain historical sites and parks.

For Alternative 1, vibration impact is projected at 90 single-family and multi-family residential buildings and at three institutional buildings (Science and Technology Center, Outside the Line Artist's Studio, and Bacon Hall at Tufts University).

For Alternative 2, vibration impact is projected at 99 single-family and multi-family residential buildings and at the same institutional buildings as Alternative 1.

For Alternative 3, vibration impact is projected at 90 single-family and multi-family residential buildings and at the same institutional buildings as Alternative 1. These results are the same as Alternative 1 because the in-street segment of the Union Square Branch for Alternative 3 would not result in any vibration impacts.

For Alternative 4, vibration impact is projected at 99 single-family and multi-family residential buildings and at the same institutional buildings as Alternative 1. These results are the same as Alternative 2 because the in-street segment of the Union Square Branch for Alternative 4 would not result in any vibration impacts.

For Alternative 5, vibration impact is projected at 96 single-family and multi-family residential buildings and at the same institutional buildings as Alternative 1.

For Alternative 6, vibration impact is projected at 3 single-family and multi-family residential buildings.

5.8.2.1 Temporary Construction Vibration Impacts

Temporary vibration impacts along the proposed corridor could result from construction activities associated with the Green Line Extension Project. The potential for vibration impact would be greatest at locations near pile driving and vibratory compactor operations.

5.8.3 Vibration Mitigation

The purpose of vibration mitigation is to minimize adverse effects from a project at sensitive locations. While the consideration of noise mitigation is well-defined, there is more variability in the approach to vibration mitigation and the specific measures that may be considered. The goal for mitigating potential vibration impact from the proposed Green Line Extension Project is to reduce future vibration below the impact criteria which is 72 VdB for Green Line trains and 75 VdB for commuter trains. At some locations, mitigation measures that will reduce vibration levels 5 decibels or more will be considered reasonable and effective with the intention of keeping future vibration levels at or below existing vibration levels.

The effectiveness of specific vibration mitigation measures is dependent on several factors such as the component design, installation techniques, axle loads of the trains and frequencies of concern. The following are common vibration mitigation options:

- Resilient rail fasteners which are specially-designed fasteners between the rails and the ties. Resilient rail fasteners may reduce vibration by 5 to 10 VdB at frequencies above 30 to 40 Hz.
- Ballast mats are rubber or other elastomer pads placed in the trackform between the ballast and the sub-grade or ground may be effective in reducing vibration levels 10 to 15 VdB at frequencies above 25 Hz.
- Resiliently supported ties have a rubber or other resilient material placed between the ties and the ballast. These ties may be effective in reducing vibration 10 VdB at frequencies above 15 Hz.
- Floating slab trackforms consist of a concrete slab supported on resilient elements such as rubber or elastomer pads. Floating slabs can be very effective at controlling vibrations down to frequencies near 10 Hz. Drawbacks towards floating slab trackforms include difficulties in designing for heavy axle loads, difficulties in designing for outdoor exposure to the elements and the relatively high cost.
- Similar to noise, special trackwork such as turnouts and crossovers increase vibration levels of the trains. Mitigation includes using special hardware (e.g. by using flange-bearing or moveable-point frogs in place of standard rigid frogs), relocating special trackwork away from sensitive areas and using continuous welded rail rather than jointed rail.
- Maintenance programs can also be essential for controlling vibration. Maintaining a proper wheel/rail profile, minimizing the number and extent of wheel flats and minimizing potential rail corrugation are important factors. Rail grinding, truing wheels and monitoring wheel/rail profiles can be effective means of reducing potential vibration impact.

- The Project may introduce a "boat section" for the commuter train and Green Line train tracks. A "boat section" is a concrete slab approximately two to three feet thick that may damp vibrations from the trains due to the increased mass of the trackform. The boat section could be effective in limited applications along the extended Green Line corridor.

Table 5.8-6 summarizes the locations, length and rail line of proposed vibration mitigation for the maximum proposed extension of the Green Line (Alternatives 2 and 4). Figures 5.8-2 through 5.8-6 show the vibration mitigation locations.

Table 5.8-6 Summary of Proposed Vibration Mitigation[a]

Vibration Mitigation Location	Length (feet)	Rail Line
1[b]	500	Green Line
2[b]	300	Green Line
3[b]	950	Commuter
4[b]	800	Commuter
5[b]	400	Green Line
6[b]	200	Commuter
7[b]	900	Commuter
8[b]	600	Green Line
9[b]	1,200	Commuter
10[b]	400	Green Line
11[b]	150	Commuter
12[b]	1,100	Commuter
13[b]	700	Commuter
14[b]	200	Green Line
15[b]	250	Commuter
16[b]	250	Commuter
17[c]	450	Green Line
18[d]	250	Green Line
19[d]	250	Commuter

Source: Harris Miller Miller & Hanson Inc., August 2008.
a Ballast mats or resilient fasteners.
b Mitigation needed only for Alternatives 1, 2, 3, 4, and 5.
c Mitigation needed only for Alternatives 2, 4 and 5.
d Mitigation needed only for Alternatives 1, 2, 3, 4, and 6.

Generally, well-designed and properly-installed ballast mats or resilient rail fasteners would be effective in reducing vibration levels up to 15 VdB for the Green Line trains and up to 10 VdB for commuter trains, keeping future vibration levels generated from commuter trains at or below existing levels and reducing vibration levels generated from Green Line trains below the impact criterion. Vibration mitigation generally performs better for light rail vehicles because they do not weigh as much as commuter trains. Although these mitigation measures would provide a substantial reduction in vibration levels and future levels would be less than existing levels, future vibration levels are still projected to be above the impact criteria at some locations. These locations are considered to be residual vibration impacts from the Project.

During the preliminary engineering phase of the project, vibration measurements will be conducted at several properties expected to be impacted by vibration. These measurements will further refine the vibration reduction needed to mitigate potential impact. A vibration reduction goal for mitigation measures, such as ballast mats or resilient fasteners, will be specified in the bid documents. Suitable mitigation measures will be introduced into the Project to achieve the mitigation goal.

Assuming that both tracks of a particular rail line are mitigated, a total of 19,700 track-feet of vibration mitigation is proposed to mitigate potential impacts (based on the impacts of Alternatives 2 and 4). An estimated cost for installed ballast mats is $3.5 million based on a cost of $180 per track-foot and an estimated cost for resilient fasteners is $5.9 million based on a cost of $300 per track-foot.

Special trackwork (turnouts and crossovers) cause local increase in vibration levels of up to 10 VdB. In addition to the locations of proposed vibration mitigation shown above, relocating special trackwork (turnouts and crossovers) away from sensitive receptors or using specially-engineered trackwork (flange-bearing or moveable-point frogs) would minimize potential vibration impact at some locations. Table 5.8-7 provides a summary of existing crossovers and turnout locations that are recommended for specially-engineered trackwork or relocation. These special-trackwork locations are also shown on Figures 5-8.2 to 5.8-6.

Table 5.8-7 Potential Vibration Mitigation Measures for Crossovers and Turnouts

Special Trackwork Location (Civil Station No.)	Type of Special Trackwork	Rail Line
A	Number 8 Double Crossover	Green Line
B	Turnout	Commuter
C	Number 8 Double Crossover	Green Line
D	Turnout	Commuter
E	Crossover	Commuter
F	Crossover	Commuter
G	Crossover	Commuter
H	Crossover	Commuter
I	Number 8 Double Crossover	Green Line
J	Crossover	Green Line
K	Crossover	Green Line
L	Turnout	Green Line

Source: Harris Miller Miller & Hanson Inc., August 2008.

5.8.3.1 Construction Vibration Mitigation

The following mitigation measures will be applied where feasible to minimize temporary construction vibration impacts:

- Avoiding nighttime construction in residential neighborhoods; and
- Using alternative construction methods to minimize the use of impact and vibratory equipment (e.g. pile drivers and compactors).

5.8.4 Summary

Depending on the alternative, up to 102 vibration-sensitive buildings may potentially be exposed to impact due to the Project without vibration mitigation. This includes 99 single-family and multi-family residential buildings and three institutional buildings (Science and Technology Center, Outside the Line Artist's Studio and Bacon Hall at Tufts University).

Vibration mitigation, including up to 19,700 track-feet of vibration mitigation such as ballast mats or resilient fasteners on the proposed Green Line tracks and the relocated commuter rail tracks and the relocation or use of specially-engineered trackwork (flange-bearing or moveable-point frogs) for 12 crossovers and turnouts, would be effective in keeping future vibration levels at or below existing levels for commuter trains and reducing future vibration from Green Line trains below the impact criterion.

5.9 Stormwater

The Secretary's Certificate specified 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 MassDEP Stormwater Management Policy (now the Stormwater Management Standards). This section discusses the effects of each alternative on stormwater discharges and how any new construction under the Build Alternatives would meet the Massachusetts Stormwater Management Standards.

5.9.1 Methodology

Impacts to stormwater are generally determined based on changes in grading, surface cover, and land use. Replacing undisturbed land and vegetation with paved surfaces could affect both the quantity and quality of stormwater discharges. Changes in the amount of impervious surface in the Project area or changes to the flow and discharge of stormwater runoff would have to be managed in accordance with the Massachusetts Stormwater Management Standards.

Adding impervious surfaces to a watershed may change the hydrology by reducing infiltration and increasing both the volume and the rate of runoff from precipitation. Without mitigation, increased runoff can increase peak flows in surface waters and potentially increase flooding.

Roads and urban and industrial land uses also offer many more potential pollutant sources than natural, undisturbed land such as forests. Pollutants can collect on impervious surfaces and contaminate runoff, particularly the "first flush" of runoff at the beginning of a storm. Without mitigation, adding roads or urban land uses to a watershed could increase the pollutant loading to local water resources and impair the intended use of those resources.

Given the urban character of the Project area, the changes proposed under the Build Alternatives would occur on existing developed land rather than undisturbed sites, which greatly decreases the potential for new stormwater-related impairment. However, any increases in impervious surfaces or pollutant sources would require mitigation to ensure that the new stormwater discharges would not increase the pollutant loading or flood potential of the existing discharges. Therefore, this analysis focuses on changes in urban character and increases in impervious surfaces for each alternative.

The new impervious surfaces would occur within existing urbanized areas and would receive only foot and bicycle traffic. Rooftop surfaces would only collect pollutants from airborne deposition. The rail corridors themselves would not create impervious surfaces as rail ballast (i.e., crushed stone) allows rapid stormwater drainage. The use of existing streets and rail corridor helps minimize the amount of impervious area required, and the removal of existing structures and pavement would partially offset the new impervious area for each alternative.

5.9.2 No-Build Alternative

No structures would be built under the No-Build Alternative, resulting in no new impervious surfaces and no changes to stormwater flows. Therefore, this alternative would require no changes to the existing municipal stormwater management systems described in Section 4.10, *Stormwater*, and would not require any review under the Massachusetts Stormwater Management Standards.

5.9.3 Baseline Alternative

No structures would be built under the Baseline Alternative, resulting in no new impervious surfaces and no changes to stormwater flows. Therefore, this alternative would require no changes to the existing municipal stormwater management systems described in Section 4.10, *Stormwater*, and would not require any review under the Massachusetts Stormwater Management Standards.

5.9.4 Build Alternatives

The six Build Alternatives would use similar drainage designs because they use the same station locations and infrastructure improvements. At this stage of design, the discharge points and estimated impervious area changes have been determined for each alternative, along with the stormwater management measures necessary to meet the Massachusetts Stormwater Management Standards. These conceptual designs are the same for all of the Build Alternatives. The specific sizing and construction designs of the stormwater modifications would be developed for the Preferred Alternative prior to construction.

The existing designs strive to minimize impervious surfaces through the use of existing streets and rail corridor and by reusing existing developed sites for the stations wherever possible. Additional efforts will be taken during preliminary engineering and final design to reduce the net increase in impervious surfaces in order to minimize stormwater runoff and associated impacts.

The existing drainage system along the MBTA commuter rail corridors would have to be removed and installed new in a different location to accommodate the shift in the commuter rail track alignment and the proposed Green Line track alignment. The discharges from the new and relocated portions of the drainage system would use existing drainage trunk lines beyond the railroad corridor that discharge to the Mystic River and the Charles River, as the existing drainage system does.

Due to the tight confines of the right-of-way, surface drainage ditches would no longer be practical in the Project area. Instead, new underdrains would be installed within the ballast (crushed stone) supporting the rails to collect stormwater from the right-of-way and direct it to the existing municipal stormwater systems. All proposed underdrains within the rail corridor would be 12-inch perforated high-density polyurethane (HDPE) and would be installed within the ballast along each side of the rail corridor with manholes located every 300 feet. Station roof drains would be connected directly to drainage trunk lines when possible. Otherwise, roof drainage would be conveyed to the trunk lines through the proposed underdrain system.

It is assumed that the Community Path project proposed by the City of Somerville would be constructed after the Green Line Extension Project is completed. The path would run parallel to and west of the MBTA Lowell Line from Lowell Street to Washington Street, where it would cross over the rail corridor and travel east toward the Inner Belt area. The proposed stormwater management system for the Green Line Extension Project would be designed to handle runoff from all contributory areas along the corridor, including the portions of the proposed Somerville Community Path that would fall within the topographic drainage area of the Project.

5.9.4.1 Stations

Table 5.9-1 lists the net impervious surface changes estimated for each station, and Figure 5.9-1 shows the six proposed discharge points into the existing municipal stormwater system and the segments of the Project area that would drain to each of them. The stations would each result in between 0.1 and 0.6 acres of new pavement and rooftops for the structures and platforms needed for each station location.

Table 5.9-1 Impervious Surface Changes by Station

Station	Additional Impervious Area (acres)	Discharge Point into Municipal System	Receiving Water
Lechmere Station	0.0	Red Bridge (east of Yard 8)	Charles River
Brickbottom Station	0.4	New Washington Street/Inner Belt Road (Brickbottom Station)	Mystic River
Gilman Square Station	0.4	Medford Street (Gilman Square)	Mystic River
Lowell Street Station	0.3	Medford Street (Gilman Square)	Mystic River
Ball Square Station	0.4	Harvard Street (west of Ball Square)	Mystic River
College Avenue Station	0.3	Mystic Valley Parkway/Route 16	Mystic River
Mystic Valley Parkway/Route 16 Station	0.6	Mystic Valley Parkway/Route 16	Mystic River
Union Square Station (via commuter rail right-of-way)	0.2	Prospect Street (Union Square)	Charles River
Union Square Station (via Somerville Avenue and McGrath Highway)	0.1	Prospect Street (Union Square)	Charles River

The relocated Lechmere Station would not create any new impervious surfaces as the station would be elevated above the existing site. Roadway changes in this developed area would not result in a net increase in impervious area. Stormwater runoff from this area and nearby sections of the right-of-way would discharge into the existing stormwater system southeast of Red Bridge, which discharges to the Charles River. A surface detention system may be installed near Red Bridge to maintain existing discharge rates.

Brickbottom Station would require 0.4 acres of new impervious surfaces. Stormwater runoff from this station and nearby sections of the right-of-way would discharge into the existing MBTA drainage system in New Washington Street, which connects to a Combined Sewer Overflows (CSO) in Inner Belt Road and discharges to the Mystic River. A subsurface detention/infiltration system may be installed under the station to maintain existing discharge rates.

Gilman Square Station and Lowell Street Station would require 0.4 acres and 0.3 acres of new impervious surfaces, respectively. Runoff from these stations and nearby sections of the right-of-way would be directed into a CSO in Medford Street at Gilman Square, which discharges to the Mystic River. A subsurface detention/ infiltration system may be installed near Gilman Square Station to maintain existing discharge rates.

Ball Square Station would require 0.4 acres of new impervious surfaces. Stormwater runoff from this station and nearby sections of the right-of-way would discharge into the existing Harvard Street drainage system west of Ball Square, which discharges to the Mystic River.

College Avenue Station and Mystic Valley Parkway/Route 16 Station would require 0.3 acres and 0.6 acres of new impervious surfaces, respectively. The Preferred Alternative has no parking at Mystic Valley Parkway/Route 16 Station, although a 300-space parking garage was considered for the station. If a garage were included at the station, the reuse or removal of the existing parking garage located near the station would result in no net increase in impervious area due to parking. Runoff from these stations and nearby sections of the right-of-way would be directed to the Mystic Valley Parkway/Route 16 drainage system, which discharges to the Mystic River. A subsurface detention/infiltration system may be installed near Mystic Valley Parkway/Route 16 Station to maintain existing discharge rates.

Union Square Station would require 0.2 acres of new impervious surfaces using the commuter rail right-of-way only or 0.1 acres of new impervious surfaces if Somerville Avenue and McGrath Highway were used. The Somerville Avenue and McGrath Highway option would have less impervious surface due to increased property acquisitions. The in-street portion of this option would not increase impervious cover as the track would be built in Somerville Avenue, which is already paved. Under either option, runoff from the station and nearby sections of the right-of-way would be directed into the existing Union Square stormwater system and discharged to the Charles River. A subsurface detention/infiltration system may be installed near Union Square Station to maintain existing discharge rates.

5.9.4.2 Maintenance Facility

The new maintenance facility at Yard 8 would add 4.8 acres of impervious surfaces to the site. The stormwater management system will include many of the same features found in the station and railway drainage. Proposed management measures include:

- Deep sump catch basins to collect runoff from paved areas;
- Hydrodynamic particle separators to treat pavement runoff;
- Roof drains from building connected to an underground pipe storm drainage system;
- Underground infiltration chambers to store and infiltrate runoff; and

- Overflow outlets from the infiltration chambers to direct excess flow into the municipal storm drainage system in Inner Belt Road.

5.9.4.3 Net Effects of Build Alternatives

Table 5.9-2 summarizes the net effect of each Build Alternative. The variation between each alternative is due to the choice of station locations included in the alternatives. As shown in Table 5.9-2, Alternatives 1 through 5 are similar in their increased impervious surfaces, with between 6.6 and 7.4 acres of new impervious surface. Between 2.0 and 2.5 acres of impervious surface would be from station roofs and platforms, while 4.8 acres would be from the maintenance facility. Alternative 6 would have a smaller increase (5.0 acres) than the other alternatives as it would include only one new station.

Table 5.9-2 Summary of Impervious Surface Changes by Alternative

	Increase in Impervious Area (acres)[1]			
Alternative	Medford Branch	Union Square Branch	Maintenance Facility	Total
Alternative 1	1.8	0.2	4.8	6.8
Alternative 2	2.3	0.2	4.8	7.4
Alternative 3	1.8	0.1	4.8	6.6
Alternative 4	2.3	0.1	4.8	7.2
Alternative 5	2.3	0.0	4.8	7.1
Alternative 6	0.0	0.2	4.8	5.0

1 Values are rounded.

Given the dense urban character of the cities and neighborhoods involved, these impervious surface changes are negligible from a regional water quality perspective. However, the stormwater management system would need to be upgraded throughout the Project area to prevent localized flooding. Without proper design to control flow rates, increases in impervious area could cause the stormwater drainage system to overflow during larger storm events.

5.9.5 Mitigation Measures

The proposed stormwater management system would include detention/infiltration systems as needed to maintain existing flow rates at existing outfalls. The extent of infiltration for each system would be determined during a later phase of the design based on actual soil analysis at the proposed system location. The infiltration systems would be sized taking into consideration soil conditions, and the remaining volume of runoff would be stored and released through a controlled outlet to match the existing rate of flow. Where infiltration is not possible due to poor soils or high groundwater subsurface detention systems would be sized to maintain predevelopment flow rates at each design point.

The Massachusetts Stormwater Management Standards require controlling flow rates to prevent flooding and removing total suspended solids (TSS) to improve water quality. The proposed drainage system would include detention/infiltration systems to maintain existing flow rates at existing outfalls. The extent of infiltration for each system would be determined for the final design based on actual soil analysis at the proposed system location. The remaining volume of runoff would be stored and released through an outlet control structure to match the existing rate of flow at each design point. Where infiltration/exfiltration is not possible due to poor soils or high groundwater, the subsurface detention system would be sized to maintain predevelopment flow rates at each design point. Maintaining existing flow rates would avoid exacerbating the existing effects of CSOs on the receiving waters.

TSS removal would not be necessary since the right-of-way would generate negligible TSS as it is not salted or sanded as roads and parking lots are. Where needed, TSS removal would be accomplished by way of proprietary water quality devices such as Vortechs units, which use whirlpool-like chambers to remove floating and suspended solids. These units would be installed prior to the proposed detention systems or before each connection to the existing drainage system. Each device would be sized to treat the 10-year flow rate at the proposed outfall and to maintain the predevelopment rate of flow in the existing drainage system.

5.9.6 Operations and Maintenance

The proposed stormwater management system would require regular maintenance in order to ensure its continued effectiveness. Detention systems, infiltration structures, and any water quality devices such as Vortechs units should be inspected quarterly during the first year of operation to determine the rate of sediment and debris accumulation. Afterwards, these structures would need to be inspected and cleaned at least once a year based on accumulation rates. A detailed long-term operations and maintenance plan will be developed during final design of the stormwater management system.

5.9.7 Regulatory Compliance

The Massachusetts Stormwater Management Standards do not apply to the Project, as the Project would not discharge to any wetlands and would involve redevelopment of existing disturbed areas rather than new development. Regardless, the new system would be designed to meet the Massachusetts Stormwater Management Standards as described above. The MBTA would need to apply for coverage under the Multi-Sector General Permit for Stormwater Discharges Associated with Industrial Activity (MSGP) for the maintenance facility proposed at

Yard 8.[7] This general permit requires numerous control measures and operational plans to control spills, manage potential contaminant sources, and prevent the impairment of any water bodies receiving runoff from industrial facilities. A new National Pollutant Discharge Elimination System (NPDES) permit for an industrial use would be required. This permit would require a new Stormwater Pollution Prevention Plan (SWPPP) to address maintenance and monitoring and a Spill Prevention, Control, and Countermeasures (SPCC) plan to demonstrate vigilance and preparedness for hazardous spills.

5.9.8 Summary

All of the Build Alternatives would result in increased impervious area compared to the No-Build Alternative. These increases would be minimized by locating the stations and maintenance facility on previously-disturbed sites wherever possible and by keeping the limits of the right-of-way as close to the proposed tracks as possible. As summarized in Table 5.9-2, the increases in impervious area range from 5.0 acres under Alternative 6 to 7.4 acres under Alternative 2. Given the existing urban environment, these changes would not be significant, could be accommodated with an expanded stormwater drainage system, and would not increase the impairment or risk of flooding of the Charles River or Mystic River.

5.10 Fish, Wildlife, and Plants

The Secretary's Certificate required that the Project consider options to retain trees and vegetation along the corridor, and comment letters on the EENF raised concerns about the potential loss of wildlife habitat. This section discusses the effects of each alternative on vegetation and wildlife habitat.

5.10.1 Methodology

The loss of wildlife habitat would be considered a direct impact. Indirect impacts would include fragmenting existing habitat or reducing the existing wildlife populations. For this analysis, vegetated areas within the limit of grading for a given alternative were assumed to be removed. The value and condition of the areas involved are based on the habitat assessment in Section 4.12, *Fish, Wildlife, and Plants*.

7 The MSGP is part of the National Pollutant Discharge Elimination System (NPDES), which requires permits for various stormwater and industrial discharges in order to prevent the contamination and impairment of receiving waters. The EPA is responsible for issuing NPDES permits in Massachusetts, and the permits are also reviewed by MA DEP. The MSGP covers most types of industrial discharges and requires general control measures as well as specific measures tailored to specific industrial uses. Industrial facilities applying for coverage under the MSGP must demonstrate compliance with all requirements and submit copies of their SWPPPs and SPCCs for review.

5.10.2 No-Build Alternative

No structures or tracks would be built under the No-Build Alternative, resulting in no loss of existing vegetation or wildlife habitat. The MBTA would continue to manage vegetation within the right-of-way.

5.10.3 Baseline Alternative

No structures or tracks would be built under the Baseline Alternative, resulting in no loss of existing vegetation or wildlife habitat. MBTA would continue to manage vegetation within the right-of-way.

5.10.4 Build Alternatives

Table 5.10-1 summarizes the wildlife habitat impacts of the Build Alternatives. Wildlife habitat that could be affected by the Project is located within the MBTA Lowell Line. Five of the six Build Alternatives would use the MBTA Lowell Line and would affect varying areas of habitat. The one exception, Alternative 6, goes only to Union Square (mostly using existing streets) and does not affect the MBTA Lowell Line. Alternative 6 would have no impact to wildlife habitat due to the lack of potential habitat around Union Square.

Table 5.10-1 Direct Vegetated Habitat Impacts by Alternative

	Habitat Area Removed (acres)		
Alternative	**Low-Value Habitat**	**Medium-Value Habitat**	**Total**
Alternative 1	2.6	1.1	3.7
Alternative 2	2.6	2.2	4.7
Alternative 3	2.6	1.1	3.7
Alternative 4	2.6	2.2	4.7
Alternative 5	2.6	2.2	4.7
Alternative 6	0	0	0

Alternatives 1 and 3 would have a direct impact to 2.6 acres of low-value habitat, including areas near Brickbottom Station (0.9 acres), Gilman Square Station (0.6 acres), and Lowell Street Station (1.1 acres). As described in Section 4.12, *Fish, Wildlife, and Plants*, these areas are dominated by non-native and invasive species and provide limited wildlife habitat. Minor fragmentation would occur near Brickbottom Station. However, these low-value habitat areas are already severely fragmented, due in part to the many bridges passing over the right-of-way that are associated with gaps in vegetated cover. These alternatives would also have a direct impact to approximately 1.1 acres of medium-value wildlife habitat near College Avenue Station. Even though the extended Green Line would end at College Avenue Station, these impacts would extend north of the station to approximately Winthrop Street due to track realignment to accommodate the Green Line rails to the south. This habitat contains a more diverse plant community and could support a greater quantity and variety of wildlife than the low-value habitat found elsewhere. The compatible habitat on opposite sides of the right-of-way near College Avenue is already fragmented by the existing tracks. Some additional fragmentation would occur between College Avenue and Winthrop Street.

Alternatives 2, 4, and 5 would have a direct impact to the same 2.6 acres of low-value habitat identified for Alternatives 1 and 3 and would have the same minor fragmentation effects near Brickbottom Station. These alternatives would have a direct impact to approximately 2.2 acres of medium-value wildlife habitat between College Avenue Station and Mystic Valley Parkway/Route 16 Station. Habitat fragmentation would increase more under these alternatives due to the additional habitat north of Winthrop Street that would be impacted. However, this habitat is already fragmented due to bridges and several gaps in vegetation along the right-of-way.

In total, Alternatives 1 and 3 would both affect 3.7 acres of wildlife habitat, Alternatives 2, 4, and 5 would each affect 4.7 acres of wildlife habitat, and Alternative 6 would affect no wildlife habitat. Given the existing urban environment, wildlife habitat is not a significant function of the Project Area or its surroundings. The areas affected are limited to the right-of-way and the edges of adjacent properties and are not part of larger, continuous habitat areas. The majority of the land affected for each alternative is low-value habitat that does not provide significant benefits. None of these impacts are expected to have any significant effects on wildlife in the Project area.

5.11 Parks and Recreation Areas

This section provides an analysis of the Project's compliance with Section 4(f) provisions of the U.S. DOT Act of 1966[8] and the Commonwealth's Article 97 Land Disposition Policy "to protect, preserve and enhance all open space areas."[9]

Section 4(f) provisions of the U.S. DOT Act of 1966 state that "the Secretary of Transportation will not approve any program or project that requires the use of any publicly owned land from a public park, recreation area, or wildlife and waterfowl refuge of national, state, or local significance or land from an historic site of national, state, or local significance as determined by the officials having jurisdiction thereof, unless there is no feasible and prudent alternative to the use of such land and such

8 Section 4(f) of the United States Department of Transportation Act of 1966 (Amended March 12, 2008 in 73 FR 13395; implemented at 23 U.S.C. 138 and 49 U.S.C Section 303(c).
9 Executive Office of Environmental Affairs. Article 97 Land Disposition Policy. February 19, 1998.

program, and the project includes all possible planning to minimize harm resulting from the use."

The Article 97 Land Disposition Policy states the "EOEA and its agencies shall not sell, transfer, lease, relinquish, release, alienate, or change the control or use of any right or interest of the Commonwealth in and to Article 97 land. An Article 97 land disposition is defined as: a) any transfer or conveyance of ownership or other interests; b) any change in physical or legal control; and c) any change in use, in and to Article 97 land or interests in Article 97 land owned or held by the Commonwealth or its political subdivisions, whether by deed, easement, lease or any other instrument effectuating such transfer, conveyance or change." The EOEA Secretary will not approve any program or project that requires using or affecting Article 97 land unless "all other options to avoid Article 97 disposition have been explored and no feasible and substantially equivalent alternatives exist..."

The Secretary's Certificate required EOT to consider Project implications to other on-going planning initiatives, including the proposed Somerville Community Path. The Community Path, a planned 2.5-mile extension between the Minuteman Bikeway and Cambridge Linear Park to the Charles River Path and downtown Boston, would abut the MBTA Lowell Line. This multi-use path would provide additional opportunities for bicycling, walking, jogging, and inline skating. Section 3.8, *Community Paths*, discusses the coordination of the Project design with the design of the proposed Somerville Community Path.

This section identifies direct, indirect and construction related impacts, if any, of each Project alternative. For any Project impacts, this section will identify consequences of the Project that would result in a "use" of Section 4(f) resources or Article 97 lands, and will analyze and document alternatives and mitigation measures that would avoid and/or minimize potential adverse effects to the protected open space and recreational resources. Historic and archaeological resources protected under Section 4(f) are discussed in Section 5.13, *Historic and Archaeological Resources*, and in the *Draft Section 4(f) Evaluation* located in Appendix I.

5.11.1 Methodology

This section describes any potential direct, indirect and/or construction related effects of the Project to determine if there would be a "use" of any Section 4(f) resource previously identified in Section 4.12. A direct impact is permanent land acquisition of protected open space through fee or easement, or physical disturbance of protected open space that would affect the property's designated use.

An indirect impact or "constructive use" is an effect of the Project, other than land acquisition or physical disturbance that would substantially impair the protected activities, features, or attributes that qualify the property for protection under Section 4(f). Indirect impacts include noise impacts, access restrictions, vibration impacts, ecological intrusions, and visual impacts that substantially diminish the activities, features or attributes of a resource that contribute to its significance or enjoyment. For outdoor recreational areas such as parks, athletic fields, and outdoor music shells, noise levels of up to 75 dB DNL are compatible with these uses. Moderate or substantial noise increases above that level may result in an impact to the use of that facility under Section 4(f).

5.11.2 Environmental Consequences and Mitigation

As documented throughout this chapter, none of the alternatives would result in direct impacts to any Section 4(f) or Article 97 property. Direct impacts could include acquisition or physical disturbance, air quality or vibration impacts, or alteration of the visual setting, ecology, or access of these properties.

As documented in Section 5.7, *Noise*, one Section 4(f) property, Trum Playground, would be indirectly impacted by moderate noise level increases. Sound levels would increase by 3.5 dBA, from 68.6 dBA [Leq] to 72.0 dBA [Leq] under Alternatives 1 through 5. Trum Playground, located at the corner of Cedar Street and Franey Road across from Trum Field in Somerville, is a passive recreational playground owned and operated by the City of Somerville. According to the FTA's noise criteria, Trum Playground is a Category 3 land use, which applies to recreational resources that are not sensitive to noise. Without mitigation, Trum Playground would experience these impacts 40 feet from the commuter train track centerline. No other Section 4(f) resources or Article 97 lands would be indirectly impacted by the Build Alternatives.

Any indirect noise impacts to this resource would be mitigated to a condition equivalent, or better than, that which would occur if the Project were not built, as determined after consultation with the official(s) with jurisdiction of the Section 4(f) resource. Noise barrier construction is the most common path noise control treatment and can be very effective at reducing noise levels in the community. Noise barriers ranging between six and 12 feet in height would be effective in reducing noise levels from the Project generally seven to 11 decibels. Under Alternatives 1 to 5, proposed noise mitigation to this Section 4(f) resource would include raising the existing six-foot noise barrier at the right-of-way to a height of 10 feet.

In accordance with Section 73 FR 13395, Part 774.15,[10] a constructive use occurs when the transportation project does not incorporate land from a Section 4(f) property, but the project's proximity impacts are so severe that the protected activities, features, or attributes that qualify the property for protection under Section 4(f) are substantially impaired. Substantial impairment occurs only when the protected activities, features, or attributes of the property are substantially diminished, for example, by noise impacts, access restrictions, vibration impacts, ecological intrusions, and/or visual

10 Section 4(f) of the United States Department of Transportation Act of 1966 (amended March 12, 2008 in 73 FR 13395).

impacts. Noise impacts must be at a level high enough to amount to a taking of the property or a portion of the property. Moderate noise increase levels projected at Trum Playground under Alternative 1 through Alternative 5 without mitigation would not substantially impair this Section 4(f) property and would not result in a constructive use.

5.11.3 Summary

In summary, none of the alternatives would directly impact (use) or result in a constructive use of Section 4(f) or Article 97 land. Noise barrier mitigation at Trum Playground would effectively eliminate any indirect noise impacts to this resource to a condition equivalent to, or better than, that which would occur if the Project were not built. The proposed noise barrier improvements would be effective in mitigating all potential noise impacts from the Project, and no residual impacts would be expected.

5.12 Visual Environment

The Secretary's Certificate required that the Project consider options to retain trees and vegetation along the corridor, and comment letters on the EENF raised concerns about potential changes to the visual environment, especially near the Mystic River Reservation. This section discusses the potential visual effects of each alternative. The existing visual environment in and around the Project Area is discussed in Section 4.14.

5.12.1 No-Build Alternative

There would be no construction under the No-Build Alternative, resulting in no changes to the visual environment.

5.12.2 Baseline Alternative

There would be no construction under the Baseline Alternative, resulting in no changes to the visual environment.

5.12.3 Common Effects of the Build Alternatives

All Build Alternatives would require acquiring property, demolishing buildings, constructing new Green Line track and stations, and relocating the commuter rail track within the existing right-of-way. Some existing vegetation would be removed, and new retaining walls and noise barriers would be built. The Overhead Catenary

System (OCS) to power the Green Line would include support poles up to 22 feet high within the right-of-way.

Fences, trees, and steep slopes on each side of the right-of-way minimize the rail corridor's visibility. The right-of-way is only visible to the public from certain locations, such from bridges or through fences. Since the changes would occur in urbanized areas within and adjacent to the existing right-of-way, they would have little overall visual impact on the public. New planting and screening efforts along the right-of-way and atop the retaining walls would be done in coordination with abutting residents and businesses to ensure that no undue visual impacts are imposed on local neighborhoods. The Project will incorporate vegetation in and above these walls and at the stations in order to maximize the amount of vegetation along the expanded right-of-way. These will reduce the net loss of vegetation and reduce the visual impact of any tree removal on the neighborhood. The retaining wall design, including any vegetated features, will be developed in the final design for the Preferred Alternative.

The stations themselves would be along and within the right-of-way to the greatest extent possible, minimizing the overall visual impact. The major materials used in the stations themselves will be masonry, steel and glass. Landscaping will be designed to provide protection from the elements without obscuring visibility. Landscaping will be inviting both to the users of the stations and to the passers-by, using small trees and low shrubs, which are easily maintained and of a design which encompasses lighting and defensible space for safety. The new stations would be visible from their street access points and from nearby bridges.

All of the Build Alternatives would require some degree of noise mitigation, usually consisting of noise barriers to protect sensitive receptors such as residences from increases in train noise. Noise barriers would range from 6 to 12 feet tall and would block the view of the right-of-way for adjacent homes. While this would reduce the visibility of the green space surrounding the right-of-way, it would also prevent any further visual impacts by obscuring the trains and rails that would otherwise be visible from residential back yards.

Alternatives 1, 2, 3, 4, and 5 would require a new Green Line support facility. The proposed facility would be located at Yard 8 in Somerville and on an adjacent parcel. The support facility would result in some visual changes to the local area. Yard 8 would be used to store Green Line train cars when not in use, and an adjacent support facility building would be required for actual maintenance activities.

Yard 8 has been in continuous use as a rail facility since 1835, and train cars would use the layover tracks mostly at night. Therefore, the use of this area for Green Line car storage would not result in a major visual change.

The support facility building would be located directly across the right-of-way from the Brickbottom Artist Buildings. The building would be easily visible from the east-facing windows of the Artist Buildings. Given the existing industrial and commercial buildings visible from this area, the support facility would result in a minor change to the local landscape.

The support facility would be an enclosed building, resulting in minimal light exposure to the surrounding area. Any outdoor lighting would be directed downward and towards the building with fixture hoods to prevent any direct lighting impacts on neighboring buildings such as the Brickbottom Artist Buildings.

Development of "air rights" over the support facility has been discussed as a part of future economic development. Building a structure to cover the layover tracks and support facility would completely obscure the support facility as a whole. Any such structure would likely introduce additional visual changes and would decrease the overall industrial character of the neighborhood.

5.12.4 Individual Effects of the Build Alternatives

Alternative 1 would remove 3.7 acres of existing vegetation and require numerous noise barriers between Brickbottom Station and College Avenue Station to mitigate noise impacts on the sensitive receptors affected along the MBTA Lowell Line and additional barriers for the sensitive receptors affected along the MBTA Fitchburg Line. The noise barriers would block the view of the right-of-way from residential back yards. New retaining walls would be needed to support steeper slopes and make room for new tracks. These walls would take the place of much of the vegetation removed along the right-of-way and would be planted with vegetation as described above to minimize the visual impact. Six buildings would be acquired and demolished, potentially making some parts of the right-of-way more visible than before. The stations would be positioned along or within the right-of-way, minimizing the overall visual impact to the local neighborhoods. None of these changes would affect any undisturbed areas or cause significant changes to the local visual environment.

Impacts of Alternative 2 would be similar to Alternative 1. This alternative would remove 4.7 acres of existing vegetation and require numerous noise barriers between Brickbottom Station and Mystic Valley Parkway/Route 16 Station to mitigate noise impacts on the sensitive receptors affected along the MBTA Lowell Line and additional barriers for the sensitive receptors affected along the MBTA Fitchburg Line. Mystic Valley Parkway/Route 16 Station would likely be visible from some parts of the Mystic River Reservation because the existing commercial/industrial buildings at the site are visible from the reservation. The new station would include the same materials (steel, masonry, and glass) as the existing buildings and would include additional landscaping. Therefore, while the new station would change the exact view from the surrounding areas, it would not increase the urbanized character of the location or introduce a new visual intrusion. None of these changes would affect any undisturbed areas or cause significant changes to the local visual environment.

Impacts of Alternative 3 would be similar to Alternative 1. A total of 10 buildings would be acquired and demolished, potentially making some parts of the right-of-way more visible than before. The stations would be positioned along or within the right-of-way, minimizing the overall visual impact to the local neighborhoods. The installation of tracks and overhead catenary in Somerville Avenue would add Green Line trains to the existing surface traffic in Union Square and would change the visual setting slightly. Since Union Square is an existing urban center with significant street traffic, including trucks and transit buses, this would not represent a significant change to the area's character. None of these changes would affect any undisturbed areas or cause significant changes to the local visual environment.

Impacts of Alternative 4 would be similar to Alternative 2. A total of 13 buildings would be acquired and demolished, potentially making some parts of the right-of-way more visible than before. The installation of tracks and OCS in Somerville Avenue would add Green Line trains to the existing surface traffic in Union Square and would change the visual setting slightly. Since Union Square is an existing urban center with significant street traffic, including trucks and transit buses, this would not represent a significant change to the area's character. None of these changes would affect any undisturbed areas or cause significant changes to the local visual environment.

Impacts of Alternative 5 would be the same as Alternative 2, but would have no impacts in the Union Square area.

Alternative 6 would not significantly impact areas of existing vegetation. This alternative would require noise barriers along the MBTA Fitchburg Line to protect the sensitive receptors affected by noise. Three buildings would be acquired and demolished, potentially making some parts of the right-of-way more visible than before. Union Square Station would be positioned along the right-of-way, minimizing the overall visual impact to the local neighborhood. None of these changes would affect any undisturbed areas or cause significant changes to the local visual environment.

5.12.5 Summary

The changes proposed under the Build Alternatives would occur in urbanized areas within and adjacent to the existing right-of-way and would have little overall visual impact on the public. The most significant changes would be the loss of forested areas along the right-of-way under Alternatives 1, 2, 3, 4, and 5, reducing the green space visible from local residential areas, and the introduction of the OCS to power the Green Line trains, which would require support poles up to 22 feet high within the right-of-way. The addition of landscaping at the stations and both on and above the retaining walls will reduce the overall visual effect of vegetation losses. The building for the support facility would change the local visual environment slightly by introducing an additional industrial building to this largely commercial/industrial neighborhood. The noise barriers proposed for all Build Alternatives would block the view of the right-of-way for adjacent homes and prevent any further visual impacts by obscuring the trains and rails that would otherwise be visible from residential back yards. None of the Build Alternatives would have a significant effect on the local visual environment.

5.13 Historic and Archaeological Resources

The Secretary's Certificate noted that the Project corridor includes several historic resources and properties included in the *Inventory of Historic Assets of the Commonwealth* maintained by the Massachusetts Historical Commission (MHC) and directed EOT to consult with the MHC to evaluate impacts and develop appropriate mitigation. The Secretary's Certificate required that the DEIR include maps that identify historic resources within the Project corridor that are likely to be impacted by air quality, noise, vibration and other impacts associated with the Project and measures that will be employed to avoid, minimize and mitigate impacts to these resources be described. The FTA is the lead Federal agency for the Green Line Extension Project with responsibility for compliance with Section 106 of the National Historic Preservation Act (NHPA) of 1966 and other Federal statutes. This document also serves as the Draft EA prepared under NEPA and as such addresses compliance with Section 106 of the NHPA and Section 4(f) of the DOT Act of 1966.

The results of the reconnaissance historic survey completed for the Green Line Extension are provided in Section 4.15, *Historic and Archaeological Resources*, including maps, tables, and narrative that identify the resources. This section describes the potential impacts to resources, and steps that can be taken to eliminate, reduce, or mitigate adverse impacts to significant cultural resources. As required by the Certificate, EOT has initiated consultation with MHC and provided MHC with information on Section 106 resources, potential effects to those resources, and mitigation measures.

5.13.1 Methodology

Project impacts to historic and archaeological resources were assessed within the areas of potential effect (APE), as defined by the Advisory Council on Historic Preservation's regulations at 36 CFR 800.16(d). The 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 right-of-way, 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 which includes visual, auditory, vibration, and other impacts. The 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 (along O'Brien Highway/Route 28 at the southern end of the Project in Cambridge and partly in Somerville) railroad right-of-way segments; new station locations, the new layover/maintenance facility, as well as any other ancillary work areas and land takings.

5.13.2 Environmental Consequences – Historic Resources

This section discusses the potential impacts to historic resources for each alternative.

5.13.2.1 No-Build and Baseline Alternatives

The No-Build Alternative involves no changes to existing conditions or service and therefore has no effect on historic resources. The Baseline Alternative will consist of moderate increased bus service along existing routes with no new infrastructure or construction and, therefore, will have no effect on historic resources within the Project APE.

5.13.2.2 Alternative 1 – Extension to Medford Hillside and Union Square (via commuter rail right-of-way)

The effects of Alternative 1 on historic resources may be permanent or temporary and may be direct or indirect. Project work elements in Alternative 1 consist of track realignment in existing rail rights-of-way, bridge replacements, stations and station access elements (sidewalks, bus lanes, signage), Lechmere Station relocation, a new support facility at Yard 8, seven new stations, 12 bridge reconstructions, and acquisition of 38 properties.

Direct Impacts

Work within the existing rail right-of-way is not likely to directly affect significant historic resources, as no significant resources are found inside the rail right-of-way, with the exception of the south end of the Project area, which intersects with the Cambridge steel elevated portion of the Lechmere Viaduct, which is eligible for listing in the National Register as part of the Viaduct. The concrete Viaduct itself is a contributing structure in the Charles River Basin Historic District, a National Register-listed property, and also individually eligible.

A number of historic architectural resources immediately abut the right-of-way, including the Susan Russell House which is listed in the National Register and properties that are eligible for National Register listing – Whitehead Metal Products, Jackson and Newton Co., A&P Grocery Warehouse, Hill Michie Co. Auto Garage, Reid & Murdock Warehouse, Somerville High School and Superintendent's Office, Derby Desk Company, Agar Manufacturing Co., Carlisle Ayer Co., Warner and Childs Division Factory Mill and Garage, Tufts University, Bray Memorial Laboratory and Curtis Hall/Commons Building.

Removing the existing Lechmere Station structure and constructing a new station on the east side of O'Brien Highway will affect a property which is recommended as National Register-eligible and will require mitigation. Takings, new construction, and site and road work at the stations that are directly adjacent to National Register-listed or eligible historic districts or individual properties are expected to be minor and to have no effect on those districts and properties. Gilman Square Station will have an effect on the Gilman Square Area and Central Hill Area through the introduction of new visual elements. The two areas are recommended as National Register-eligible and flank the right-of-way at the station site; however, the station will be at track level in the right-of-way cut between the backs of an industrial building and the High School and will have no adverse effect. No other stations are located near historic areas or individual properties that are listed or eligible for the National Register.

The construction of a maintenance support facility at or near Yard 8 in Somerville will not affect historic properties.

The bridge reconstruction work will not affect historic resources, as neither of the two National Register-eligible bridges on McGrath Highway in the APE are included. All the bridges proposed for reconstruction have been previously altered.

Indirect Impacts

Indirect impacts from Alternative 1 may include visual, auditory, or other environmental effects on the setting or other character-defining features of historic architectural properties. Indirect impacts from the addition of new rail infrastructure elements in the right-of-way are anticipated to be low. Catenary would be visible from five historic districts, two multiple property listings and 13 individual properties that are National Register-eligible or listed within the APE.

The introduction of additional rail service will result in increased noise and vibration during operations that could affect adjacent individual historic architectural resources that abut the right-of-way and listed in the National Register, i.e. the Susan Russell House, or that are eligible for National Register listing – Whitehead Metal Products, Jackson and Newton Co., A&P Grocery Warehouse, Hill Michie Co. Auto Garage, Reid & Murdock Warehouse, Somerville High School and Superintendent's

Office, Derby Desk Company, Agar Manufacturing Co., Carlisle Ayer Co., Warner and Childs Division Factory Mill and Garage.

Most historic properties are expected to experience no effect or no adverse effect from noise and vibration. Historic properties meeting the criteria for noise and vibration screening and affected by noise are:

- A & P Warehouse (Brickbottom Lofts), National Register-eligible, severe impact;
- Susan Russell House, National Register-listed, moderate impact;
- Michael Cotter House, listed in the State Register and not a designated receptor, but next to residential receptors with severe impact; and
- Warner & Childs (Tufts Bacon Hall), moderate impact.

None of these properties are considered sensitive to noise – the increase in noise would not alter the characteristics that qualify these properties for listing in the National Register.

Proposed mitigation for noise impacts includes sound insulation for individual properties and up to 19 noise walls, each 6 to 12 feet high. The seven-foot noise wall proposed at the National Register-listed Susan Russell House and an eight-foot-tall noise wall proposed near the State Register-listed Michael Cotter House would have a visual effect. Mitigation measures for insulating sound in individual historic buildings, including new windows and doors, would affect the appearance, character, and physical fabric of such structures.

New construction, including stations, relocation of Lechmere Station, support facility, bridge replacements, and any roadway/intersection changes, would have indirect visual impacts on the setting of nearby historic architectural resources, but the effects are not expected to be adverse.

Construction Impacts

Construction impacts from Alternative 1 are expected to include noise, vibration, dust, construction traffic, and traffic management. These impacts are expected to be temporary and to terminate when construction is complete. Construction would have no effect on historic architectural resources.

5.13.2.3 Alternative 2 – Extension to Mystic Valley Parkway/Route 16 and Union Square (via commuter rail right-of-way)

The effects of Alternative 2 will be the same as Alternative 1 with the addition of effects to historic properties located between College Avenue Station and Mystic Valley

Parkway/Route 16 Station. There are many historic buildings in this segment, but only one historic district (Mystic Valley Parkway) and one individual property (B&M Railroad Bridge at Mystic Valley Parkway) are listed in the National Register. No National Register-eligible resources were identified in this section, with the exception of the Middlesex Canal, an archaeological site that is discussed in Section 5.13.3.

Direct Impacts

In addition to effects described in Alternative 1, the Mystic Valley Parkway, and one individual property, B&M Railroad Bridge at Mystic Valley Parkway, (which are listed in the National Register), are within the APE but will not be directly affected by construction at Mystic Valley Parkway/Route 16 Station.

Indirect Impacts

In addition to effects described in Alternative 1, Mystic Valley Parkway, and one individual property, B&M Railroad Bridge at Mystic Valley Parkway, (which are listed in the National Register), are within the APE but will not be indirectly affected by construction at Mystic Valley Parkway/Route 16 Station.

Construction Impacts

In addition to effects described in Alternative 1, Mystic Valley Parkway, and one individual property, B&M Railroad Bridge at Mystic Valley Parkway, (which are listed in the National Register), are within the APE but will not be affected by short-term construction activities at Mystic Valley Parkway/Route 16 Station.

5.13.2.4 Alternative 3 – Extension to Medford Hillside (via commuter rail right-of-way) and Union Square (via McGrath Highway and Somerville Avenue)

The effects of Alternative 3 will be the same as Alternative 1 except that instead of following the commuter rail right-of-way to Union Square (where there are no historic properties listed or eligible for listing in the National Register), Alternative 3 follows McGrath Highway and Somerville Avenue to Union Square. There is an historic survey area and there are a number of historic buildings along this route, but none are listed or eligible for listing in the National Register.

Direct Impacts

In addition to effects described in Alternative 1, demolition of existing buildings is proposed near Union Square Station. However, there will be no direct effect on historic properties listed or eligible for the National Register.

Indirect Impacts

Indirect impacts from Alternative 3 will be the same as Alternative 1, and there will be no new indirect effects on historic properties listed or eligible for the National Register along McGrath Highway and Somerville Avenue.

Construction Impacts

Construction impacts from Alternative 3 will be the same as Alternative 1, and there will be no new temporary effects on historic properties listed or eligible for the National Register along McGrath Highway and Somerville Avenue.

5.13.2.5 Alternative 4 – Extension to Mystic Valley Parkway/Route 16 (via commuter rail right-of-way) and Union Square (via McGrath Highway and Somerville Avenue)

The effects of Alternative 4 will be the same as Alternative 2 except that instead of following the commuter rail right-of-way to Union Square (where there are no historic properties listed or eligible for listing in the National Register), Alternative 4 follows McGrath Highway and Somerville Avenue to Union Square. There is an historic survey area and there are a number of historic buildings along this route, but none are listed or eligible for listing in the National Register, with the exception of the Middlesex Canal, an archaeological site that is discussed in Section 5.13.3.

Direct Impacts

In addition to effects described in Alternative 1, demolition of existing buildings is proposed in Alternative 4 near Union Square Station. However, there will be no direct effect on historic properties listed or eligible for the National Register.

Indirect Impacts

Indirect impacts from Alternative 4 will be the same as Alternative 2, and there will be no new indirect effects on historic properties listed or eligible for the National Register along McGrath Highway and Somerville Avenue.

Construction Impacts

Construction impacts from Alternative 4 will be the same as Alternative 2, and there will be no new temporary effects on historic properties listed or eligible for the National Register along McGrath Highway and Somerville Avenue.

5.13.2.6 Alternative 5 – Extension to Mystic Valley Parkway/Route 16 (via commuter rail right-of-way)

The effects of Alternative 5 will be the same as Alternative 2 without the extension to Union Square (where there are no historic properties listed or eligible for listing in the National Register) , with the exception of the Middlesex Canal, an archaeological site that is discussed in Section 5.13.3.

Direct Impacts

Direct impacts from Alternative 5 will be the same as Alternative 2 without the extension to Union Square (where there are no historic properties listed or eligible for listing in the National Register).

Indirect Impacts

Indirect impacts from Alternative 5 will be the same as Alternative 2 without the extension to Union Square, where there are no historic properties listed or eligible for listing in the National Register.

Construction Impacts

Construction impacts from Alternative 5 will be the same as Alternative 2 without the extension to Union Square, where there are no historic properties listed or eligible for listing in the National Register.

5.13.2.7 Alternative 6 – Extension to Union Square (via commuter rail right-of-way)

The effects of Alternative 6 will be the same as Alternative 1 without the extension to Medford Hillside or Mystic Valley Parkway/Route 16. There are no historic properties listed or eligible for listing in the National Register along the Alternative 6 alignment.

5.13.3 Environmental Consequences – Archaeological Resources

This section discusses possible impacts to archaeological resources for each of the alternatives.

5.13.3.1 No-Build and Baseline Alternatives

The No-Build and Baseline Alternatives involve no changes to existing conditions and service and, therefore, have no effect on archaeological resources. The Baseline Alternative will consist of moderate increased bus service along existing routes with no new infrastructure or construction and therefore will have no effect on archaeological resources within the Project APE.

5.13.3.2 Build Alternatives

Table 5.13-1 summarizes potential impacts to archaeologically sensitive areas.

Table 5.13-1 Potential Impacts to Archaeologically Sensitive Areas

	Alternative					
Area	1	2	3	4	5	6
24/30 Joy Street	X	X	X	X	X	
Middlesex Canal		X		X	X	
Yard 8	X	X	X	X	X	X
160/216 McGrath Highway			X	X		
32 Prospect Street			X	X		
30 Prospect Street			X	X		

X indicates a potential impact.

Alternative 1 contains one archaeological sensitive area identified for landtaking at 24 Joy Street and 30 Joy Street (Figure 5.2-2), needed for the proposed Brickbottom Station (parking and access). This sensitive area is documented as having the potential to contain significant belowground remains associated with mid-late nineteenth-century worker housing that characterized the Joy Street section of Somerville during the late industrial period.

There is also the potential for archaeologically sensitive strata below railroad and upper fill deposits in the Yard 8 support facility area where the new vehicle maintenance building is proposed. Project-related impacts below the fill into sensitive Native American strata are currently unknown.

Alternative 2 contains four archaeologically sensitive areas. Three of these are related to a buried-over section of the historic Middlesex Canal (SMV-HA-1) crossing under the MBTA Lowell Line via a stone arch bridge. The rail line right-of-way, proposed Mystic Valley Parkway/Route 16 Station, and areas needed for station parking and access (Figure 5.2-7) contain sensitive areas where significant canal-related remains (including the bridge structure, canal prism, and tow path) may be present within and beneath mid-late-nineteenth and twentieth century railroad and commercial/industrial period fill deposits. The buried-over sections of the Middlesex Canal in Medford, Somerville, Cambridge, and Boston have recently been listed on the State and National Registers of Historic Places. The fourth sensitive area is the area of 24 Joy Street and 30 Joy Street identified for Alternative 1.

Alternative 2 also includes the Yard 8 support facility and potential for archaeologically sensitive strata.

Alternative 3 contains four archaeologically sensitive areas. One of these is associated with 24 Joy Street and 30 Joy Street discussed above. Another sensitive area is associated with 160 and 216 McGrath Highway (Figure 5.2-9), needed for the Somerville Avenue route. It consists of the portion of the documented late nineteenth-early twentieth century North meat-packing plant factory complex that was situated on the north side of the MBTA Fitchburg Line. This complex played an important role in the socioeconomic development of Somerville during the late industrial-early modern period. Belowground remains associated with the cooper shop and box factory, smokehouse, and sled and wagon sheds may be present in intact portions of the various lots that comprise this landtaking area.

The remaining two sensitive areas are associated with 32 Prospect Street and 30 Prospect Street needed for parking and access for the Union Square Station proposed for Alternatives 3 and 4 (Figure 5.2-9). Part of the property connected to 32 Prospect Street contains the documented house site of Clark Bennett, a prominent Somerville resident in the early-mid-nineteenth century. He is credited with a number of significant civic improvements in the town during the early industrial period. Intact portions of the area could contain remains of the house, outbuildings, and yard areas. Part of the property connected to 30 Prospect Street is also associated with Clark Bennett, and was subdivided from his original house estate. It became the site of a late-nineteenth-century dwelling built by either Clark or his heirs as a rental property for local factory workers, specifically those affiliated with the Union Glass Works. This lot could contain remains of the dwelling structure and associated outbuildings.

Alternative 3 also includes the Yard 8 support facility and potential for archaeologically sensitive strata.

Alternative 4 contains six archaeologically sensitive areas, discussed above, including:

- 24/30 Joy Street;
- Middlesex Canal;
- 160/216 McGrath Highway;
- 32 Prospect Street;
- 30 Prospect Street; and

- Yard 8.

Alternative 5 contains three of the above-described archaeologically sensitive areas, the historic Middlesex Canal crossing associated with the MBTA Lowell Line, Mystic Valley Parkway/Route 16 Station, and the existing structures at 600 Mystic Valley Parkway/Route 16 and 200 Boston Avenue; the worker housing on Joy Street associated with 24/40 Joy Street; and the Yard 8 support facility and potential for archaeologically sensitive strata.

Alternative 6 contains one archaeologically-sensitive area, the Yard 8 support facility.

5.13.4 Mitigation

Mitigation would be provided for individual and district historic resources that are listed or eligible for listing in the National Register and that would be adversely affected by permanent aspects of the Project. Attention to the historic character of Somerville will be integrated into the design of stations, although the stations would not adversely affect historic properties. Mitigation at Lechmere Station, which is proposed to be demolished, would consist of archival documentation and consideration of salvage of architectural elements. Historic interpretive signage may also be included. Noise mitigation would include noise walls and sound insulation, treatments which in themselves have the potential for adverse effect. Noise walls that are proposed adjacent to the Susan Russell House, Michael Cotter House, and Hill-Michie Co. Auto Garage would be of a material and color that is compatible with the historic character of the properties to minimize any additional visual affect from noise walls. The introduction of new doors, windows, or other insulating treatments would be appropriate for the historic property and meet the Secretary of the Interiors Standards for Rehabilitation. Affected historic properties proposed to be subject to sound insulation mitigation consist of the A & P Warehouse (Brickbottom Lofts) and Warner and Childs Garage (Tufts Bacon Hall). Vibration mitigation would consist of measures incorporated into the rail bed, ballast, and track design and therefore there would be no effects and no need for additional mitigation. Mitigation for temporary construction impacts would include pre-construction status documentation and monitoring during construction in sensitive areas.

For archaeological resources, final design of the Preferred Alternative will seek to avoid the archaeologically sensitive areas discussed above. If avoidance through Project redesign is not possible, then subsurface testing as part of an intensive (locational) archaeological survey may be warranted in consultation with the FTA, EOT, and MHC. The intensive survey would be designed to locate and identify any potentially significant archaeological resources that may be impacted by the Project. The intensive survey would be conducted under a state archaeological permit issued by the MHC/State Archaeologist following a research design and testing strategy developed specifically for each sensitive area according to the type of expected archaeological resource(s).

Should any significant and National Register-eligible archaeological resources be identified during the intensive survey or subsequent site evaluation testing, then measures to avoid, minimize, or mitigate any adverse effects of the Project on the National Register-eligible resource(s) will need to be determined by the FTA and EOT, in consultation with the MHC and other consulting and interested parties. Mitigation measures for archaeological sites that will be adversely affected by construction activities will include an archaeological data recovery program designed in accordance with state and Federal guidelines and standards for the excavation of National Register-eligible archaeological sites.

5.13.5 Regulatory Compliance

The FTA is the lead Federal agency for the Project with responsibility for compliance with Section 106 of the NHPA of 1966, DOT Section 4(f), and other Federal statutes. EOT serves as the lead state agency for the Project and is responsible for identifying and evaluating properties through archaeological and historic architectural surveys in accordance with Massachusetts General Law (MGL) Ch. 9 Sections 26-27C, as amended; 950 CMR 71.00, 950 CMR 70.00 and the MEPA). The FTA and EOT will seek the comments of the MHC, the Cambridge Historical Commission, the Somerville Historical Commission, and the Medford Historical Commission on the historic and archaeological resources identification and evaluation and on potential Project impacts. Following a determination of effect by the FTA and EOT, and concurrence by MHC consultation with the MHC and other consulting and interested parties will occur as Project planning proceeds in order to consider alternatives and measures that would avoid, minimize, or mitigate any adverse effects of the Project on significant historic and archaeological resources. A Memorandum of Agreement (MOA) (Appendix J) has been developed that specifies the measures that will be implemented by the FTA to mitigate the adverse effects. Mitigation measures include archival photographic documentation and historical interpretation.

Properties protected under Section 106 are also protected under Section 4(f) of the U.S. DOT Act of 1966. The DOT Act states that "the Secretary of Transportation will not approve any program or project that requires the use of any publicly owned land from a public park, recreation area, or wildlife and waterfowl refuge of national, state, or local significance or land from an historic site of national, state, or local significance as determined by the officials having jurisdiction thereof, unless there is no feasible and prudent alternative to the use of such land and such program, and the project includes all possible planning to minimize harm resulting from the use."

5.13.6 Summary

Impacts to historic resources from the Green Line Extension Project may be permanent or temporary during construction activities. Many of the permanent impacts are expected to be confined to the rail right-of-way, and will not affect, or have no adverse effect on, historic properties. Project work elements consists of track realignment in existing rail right-of-ways, bridge replacements, stations and station access elements (e.g., sidewalks, bus lanes, drop-off areas, ramps, signage), and a layover/maintenance facility. Several elements are common to all of the Medford Branch alternatives (Alternatives 1, 2, 3, 4 and 5). Project elements that have the potential to impact historic resources in all alternatives include relocating the existing Lechmere Station, which is recommended as potentially National Register-eligible, to the north side of the O'Brien Highway in Somerville. A total of eight stations are proposed at Lechmere, Brickbottom, Gilman Square, Lowell Street, Ball Square, College Ave, Mystic Valley Parkway/Route 16, and Union Square. Due to their location primarily within the existing right-of-way and their design, the stations will have no effect or no adverse effect on historic properties in the surrounding APE.

Aside from the relocation of Lechmere Station, the Build Alternatives would have no direct effects on any historic properties. Indirect effects may include changes to the visual setting surrounding the rail right-of-way due to construction of noise barriers. at the National Register-listed Susan Russell House and near the State Register-listed Michael Cotter House. The barriers would be necessary to prevent adverse noise effects on sensitive receptors under Alternatives 1, 2, 3, 4, and 5. The noise barriers will be designed to match the local environment as much as possible in order to minimize visual changes to the neighborhood. The design of the noise barriers will be developed through consultation with the affected neighborhoods. The construction of new stations, replacement bridges, and the maintenance facility will alter the local environment but will not have an adverse impact on historic structures.

Five areas within the Green Line Extension Project are identified as having sensitivity for potentially significant archaeological resources. These sensitivity areas are associated with Alternatives 1, 2, 3, 4, and 5. The potential resources consist of nineteenth-century transportation (Middlesex Canal), domestic (residences and worker housing), and industrial sites that may be present in intact portions of the MBTA Lowell Line and landtaking areas identified for proposed stations. Yard 8 may also contain deeply buried archaeologically sensitive strata that could be impacted by construction associated with the proposed new vehicle maintenance building. Alternative 6 would involve the Yard 8 area only.

Avoidance of the archaeologically sensitive areas is recommended. If avoidance is not possible, then an intensive (locational) archaeological survey is recommended for the sensitive areas that will be included in the Project. The intensive survey will be designed to locate and identify any potentially significant archaeological site(s) that may warrant further study as part of a site evaluation to determine their National

Register eligibility. Should an archaeological site be determined significant and National Register-eligible, then mitigation measures in the form of avoidance or a data recovery program may be warranted in consultation with the FTA, EOT, and MHC.

5.14 Hazardous Materials

The Secretary's Certificate noted that there are areas where impacted soil in the vicinity of the railroad right-of-way and proposed stations may be present and will require soil and/or groundwater remediation as the Project design progresses. The remediation includes removing contaminated soil and pumping contaminated groundwater in accordance with the provisions of the Massachusetts Contingency Plan (MCP), MGL Chapter 21E and 21C, and the Resource Conservation and Recovery Act (RCRA).

This section describes how contaminated soil will be evaluated, managed, and disposed, as well as summarizes each alternative and potential oil and/or hazardous materials (OHM) impacts. Also included is a discussion of the relative effects based on the Recognized Environmental Conditions (RECs) that were identified in Section 4.16, *Hazardous Materials*. A list of hazardous waste sites that were identified as potentially impacting the right-of-way or proposed station are provided on the following tables for each alternative, along with the respective release tracking numbers.

5.14.1 Methodology for Performing a Phase I Environmental Site Assessment (ESA)

In order to permit a user or purchaser of a property to satisfy one of the requirements to qualify for the "innocent landowner, contiguous property owner, or bona fide prospective purchaser" limitations on the landowner liability protection, it is customary practice to conduct a Phase I ESA on the prospective property. The ESA constitutes "all appropriate inquiry" (AAI) into the previous ownership and uses of the property consistent with good commercial or customary practice. An AAI or ESA is conducted to determine if RECs, defined below, are likely to be present at the prospective property. For all the properties which are part of the land acquisition for the proposed Green Line Extension Project, a Phase I ESA was performed.

The American Society for Testing Materials (ASTM) "Standard Practice for Environmental Site Assessments: Phase I ESA Process" (the ASTM Standard) E 1527-05, was created to develop the methods to determine if a REC is present. The ASTM Standard includes a review of databases, a site reconnaissance, interviews, and a review of historic aerial photographs, topographic maps, and Sanborn maps by an Environmental Professional to determine if RECs are present at the property. The ASTM Standard defines a REC as "the presence of likely presence of any hazardous substance or petroleum products on a property under conditions that indicate an existing release, a past release, or a material threat of a release of any hazardous substances or petroleum products into structures on the property or into the ground, ground water, or surface water of the property."

The ASTM Standard requires an Opinion regarding the potential for each REC to affect the site. The potential impact for each REC identified, based on available information, is classified as either high, medium, or low.

RECs that are deemed to have a high potential impact consist of sites such as those with confirmed soil, groundwater, and/or indoor air impacts that were reported to the MassDEP and have undergone some type of cleanup or remain an active case.

Properties with RECs that are deemed to have a medium potential impact consist of properties such as those with potential sources of OHM with limited or inconclusive information. For instance, a single-walled steel underground storage tank (UST) in which the UST has been removed, but no documentation was available to show that proper sampling was conducted at the time of the UST removal to confirm that the UST did not leak, may be deemed a REC of medium potential impact.

RECs that have low potential to impact a site include off-site properties where releases have occurred but have been cleaned up or USTs where proper documentation is available indicating a release has not occurred, as well as for properties that have more recently installed USTs equipped with leak detection, are double walled, and/or contain overfill protection and spill containment.

The Opinion also includes a section for potential environmental concerns or de minimis conditions. They have less of an impact than RECs, as they generally do not present a threat to human health or the environment and would not be the subject of an enforcement action if brought to the attention of appropriate governmental agencies. An example of a potential environmental concern or de minimis condition would be the potential presence of asbestos containing materials and lead based paint based on the age of the building which would have to be properly managed during building demolition.

A detailed description of each REC is provided in the *Executive Summary and Findings* section of each of the ASTM Phase I Reports which were prepared for the proposed Green Line Extension Project. Also included in the report, and in the tables provided in the following sections, is the list of state hazardous waste sites and corresponding Release Tracking Numbers (RTNs) from which the RECs are based.

The following section is a description of each REC and its relative impact that was identified for the proposed locations.

5.14.2 No-Build and Baseline Alternatives

No construction would be performed under the Baseline or No-Build Alternative; therefore, no contaminated media would need to be managed, which eliminates the possibility of any hazardous materials impacts.

5.14.3 Build Alternatives

The Build Alternatives will require construction, including soil removal, within the existing MBTA Fitchburg and Lowell Lines, and Yard 8 Maintenance Facility (former rail property). Station construction will largely be within the right-of-way; however, up to 52 properties will need to be acquired (in part or in full) for station construction, including the demolition of up to 11 buildings. Phase I ESAs conducted for these properties identified several RECs that would be addressed during construction. Potential impacts include encountering contaminated soils or groundwater; disposing of contaminated materials; and disposing of solid waste containing lead-based paint, asbestos, or other regulated materials.

One potential environmental concern or *de minimis* condition has been identified for the majority of the buildings located on the properties to be demolished, based on the age of the buildings. Asbestos containing materials, including roof flashing, tiles, and other materials may be present in the building materials. In addition, lead based paint, mercury, and polychlorinated biphenyls (PCBs) may also be present in the building materials and/or fixtures.

5.14.3.1 Lechmere Station, Cambridge (All Alternatives)

Environmental reports that were obtained at the MassDEP were reviewed for the MBTA Water Street Garage property located at 21 Water Street in Cambridge due to known soil and groundwater contamination from petroleum USTs. This property is located northwest of the proposed relocated Lechmere Station. Remedial actions have consisted of the removal of approximately six tons of petroleum-contaminated soil.

Groundwater monitoring wells installed throughout this property initially showed the existence of gasoline-related compounds above the applicable groundwater standards. During the latest sampling round which occurred in May 2008, only xylene was detected in four monitoring wells above the applicable standards. The depth to groundwater at the property ranges from 17 to 22 feet below the ground surface. However, the monitoring wells located closest to the proposed relocated Lechmere Station property are below the applicable 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 property.

Given the depth to groundwater and the groundwater flow direction, it is unlikely that impacted groundwater from this property will have an effect on the proposed construction activities for the relocated Lechmere Station.

5.14.3.2 Alternative 1: Extension to Medford Hillside and Union Square

For this alternative, a total of 18 RECs were identified. One of the RECs was evaluated as having a "high" impact, nine RECs were evaluated with "medium" impacts, and eight RECs were evaluated as having "low" impacts. Table 5.14-1 lists each of the RECs by station/facility location to Medford Hillside and Table 5.14-2 lists each REC for Union Square via the commuter rail right-of-way. Under Alternative 1, five buildings would be demolished.

Table 5.14-1 RECs and Potential Impacts for Alternatives 1 and 3 - Extension to Medford Hillside

Station/Facility	REC(s)	RTN(s)	Relative Impact
Maintenance Facility	Releases of PCBs and Other Contaminants at Nearby Properties	See below*	Medium
	Historic Use of Site at Rail Yard	Not applicable	Medium
Brickbottom	Releases of PCBs and Other Contaminants at Nearby Properties	See below**	Medium
Gilman Square	Release at Somerville High School, 81 Highland Avenue	3-26487	Medium
	Potential of a Underground Storage Tank at the Homan's Building	Not applicable	Medium
	Release at 350 Medford Street	3-17076	Low
Lowell Street	Underground Storage Tank Located at 20 Vernon Street	Not applicable	Medium
	Historic and Current Use of 20 Vernon Street	Not applicable	Medium
Ball Square	Historic Use of 662-664 Boston Avenue Property as Auto Repair Garage	Not applicable	Medium
	Release at 294 Harvard Street	3-833	Low
	Release at Shell Service Station, 620 Broadway	3-1322	Low
	Release at Analetto Brothers, 590 Broadway	3-18017	Low
College Avenue	Release and Historic and Current Use of 175-179 College Avenue Buildings	3-17417	Low
	Historic Use of Building Adjacent to 474 Boston Avenue as a Chemical Laboratory	Not applicable	Low

* 3-11444, 3-13471, 3-2312, 3-21316, 3-13535, 3-11570, 3-3364, 3-18392, 3-974, 3-18363, 3-22964, 3-2534, 3-24428, and 3-19075.
** 3-11444, 3-13471, 3-2312, 3-21316, 3-13535, 3-11570, 3-3364, and 3-18392.

Table 5.14-2 RECs and Potential Impacts for Alternatives 1, 2, and 6 - Extension to Union Square (via commuter rail right-of-way)

Station	RECs	RTN(s)	Relative Impact
Union Square	Historic Use of 51 Allen Street, Previous Existence of USTs, and Release Site	3-24339 and 3-24921	High
	Releases of PCBs and Other Contaminants at Nearby Properties	3-2849, 3-16632, and 3-22153	Medium
	Underground Storage Tanks at 120 McGrath Highway	Not applicable	Low
	Underground Storage Tanks at One Fitchburg Street	Not applicable	Low

5.14.3.3 Alternative 2: Extension to Mystic Valley Parkway/Route 16 and Union Square

For this alternative, a total of 21 RECs were identified. One of the RECs was evaluated as having a "high" impact, 11 RECs were evaluated with "medium" impacts, and nine RECs were evaluated as having "low" impacts. Table 5.14-3 lists each of the RECs by station/facility location to Mystic Valley Parkway/Route 16. Table 5.14-2, provided above in Section 5.14.3.2, lists each REC for Union Square via the commuter rail right-of-way. Under Alternative 2, eight buildings would be demolished.

Table 5.14-3 RECs and Potential Impacts for Alternatives 2, 4, and 5 - Extension to Route 16/Mystic Valley Parkway

Station/Facility	REC(s)	RTN(s)	Relative Impact
Maintenance Facility	Releases of PCBs and Other Contaminants at Nearby Properties	See below*	Medium
	Historic Use of Site at Rail Yard	Not applicable	Medium
Brickbottom	Releases of PCBs and Other Contaminants at Nearby Properties	See below**	Medium
Gilman Square	Release at Somerville High School, 81 Highland Avenue	3-26487	Medium
	Potential of a Underground Storage Tank at the Homan's Building	Not applicable	Medium
	Release at 350 Medford Street	3-17076	Low
Lowell Street	Underground Storage Tank Located at 20 Vernon Street	Not applicable	Medium
	Historic and Current Use of 20 Vernon Street	Not applicable	Medium
Ball Square	Historic Use of 662-664 Boston Avenue Property as Auto Repair Garage	Not applicable	Medium
	Release at 294 Harvard Street	3-833	Low
	Release at Shell Service Station, 620 Broadway	3-1322	Low
	Release at Analetto Brothers, 590 Broadway	3-18017	Low
College Avenue	Release and Historic and Current Use of 175-179 College Avenue Buildings	3-17417	Low
	Historic Use of Building Adjacent to 474 Boston Avenue as a Chemical Laboratory	Not applicable	Low
MVP/Route 16	Historic Use of Properties as Wool and Leather Manufacturers	Not applicable	Medium
	Potential for Underground Storage Tanks	Not applicable	Medium
	Current Use of 600 Mystic Valley Parkway as Vehicle Maintenance and Repair	Not applicable	Low

* 3-11444, 3-13471, 3-2312, 3-21316, 3-13535, 3-11570, 3-3364, 3-18392, 3-974, 3-18363, 3-22964, 3-2534, 3-24428, and 3-19075.
** 3-11444, 3-13471, 3-2312, 3-21316, 3-13535, 3-11570, 3-3364, and 3-18392.

5.14.3.4 Alternative 3: Extension to Medford Hillside and Union Square (via McGrath Highway and Somerville Avenue)

For this alternative, a total of 20 RECs were identified. One of the RECs was evaluated as having a "high" impact, ten RECs were evaluated with "medium" impacts, and nine RECs were evaluated as having "low" impacts. Table 5.14-1, provided above in Section 5.14.3.2, lists each of the RECs by station/facility location to Medford Hillside and Table 5.14-4, provided below, lists each REC for Union Square via McGrath Highway and Somerville Avenue. Under Alternative 3, eight buildings would be demolished.

Table 5.14-4 RECs and Potential Environmental Impacts for Alternatives 3 and 4 – Extension to Union Square via McGrath Highway and Somerville Avenue

Station	REC(s)	RTN(s)	Relative Impact
Union Square	Documented Presence of OHM at Areas 63, 64, and 65	3-2849	High
	Releases of PCBs and Other Contaminants at Nearby Properties	3,16632, 3-24339, 3,24921, 3-22153	Medium
	Underground Storage Tanks at 216 McGrath Highway	Not applicable	Low
	Underground Storage Tank and Stained Soil at 200 McGrath Highway	Not applicable	Medium
	Underground Storage Tanks at 120 McGrath Highway	Not applicable	Low
	Underground Storage Tanks at One Fitchburg Street	Not applicable	Low

5.14.3.5 Alternative 4: Extension to Mystic Valley Parkway/Route 16 and Union Square (via McGrath Highway and Somerville Avenue)

For this alternative, a total of 23 RECs were identified. One of the RECs was evaluated as having a “high” impact, 12 RECs were evaluated with “medium” impacts, and ten RECs were evaluated as having “low” impacts. Table 5.14-3, provided above in Section 5.14.3.3 above, lists each of the RECs by station/facility location to Mystic Valley Parkway/Route 16 and provides the level of impact and Table 5.14-4, provided above in Section 5.14.3.4, lists each REC for Union Square via McGrath Highway and Somerville Avenue. Under Alternative 4, 11 buildings would be demolished.

5.14.3.6 Alternative 5: Extension to Mystic Valley Parkway/Route 16

For this alternative, a total of 17 RECs were identified. None of the RECs were evaluated as having a “high” impact, ten RECs were evaluated with “medium” impacts, and seven RECs were evaluated as having “low” impacts. Table 5.14-3, provided in Section 5.14.3.3 above, lists each of the RECs by station/facility location to Mystic Valley Parkway/Route 16. Under Alternative 5, six buildings would be demolished.

5.14.3.7 Alternative 6: Extension to Union Square

For this alternative, a total of six RECs were identified. One of the RECs was evaluated as having a “high” impact, three RECs were evaluated with a “medium” impact, and two RECs were evaluated as having "low" impacts. Table 5.14-2, provided in Section 5.14.3.2 above, lists each REC for Union Square via the commuter rail right-of-way. Table 5.14-5, provided below, lists each REC for the Yard 8 Maintenance Facility. Under Alternative 6, two buildings would be demolished.

Table 5.14-5 RECs and Potential Impacts for Alternative 6 – Yard 8 Maintenance Facility

Facility	REC(s)	RTN(s)	Relative Impact
Maintenance Facility	Releases of PCBs and Other Contaminants at Nearby Properties	See below*	Medium
	Historic Use of Site at Rail Yard	Not applicable	Medium

*3-11444, 3-13471, 3-2312, 3-21316, 3-13535, 3-11570, 3-3364, 3-18392, 3-974, 3-18363, 3-22964, 3-2534, 3-24428, and 3-19075.

5.14.4 Management of Contaminated Media and Regulatory Compliance

Asbestos containing materials, including roof flashing, tiles, and other materials may be present in the building materials for the buildings that will be undergoing demolition, based on their age. In addition, lead based paint, mercury, and PCBs may also be present in the building materials and/or fixtures. It is recommended that prior to demolition, a licensed asbestos and hazardous materials contractor sample the building material, including roof flashing, tiles, and other materials, as well as the potential lead based paint, mercury, and PCBs. If these hazardous materials are found to be present in the structures, then they must be removed by a licensed contractor in accordance with state regulations.

In addition, health and safety procedures must be performed under the guidelines of the Occupational Safety and Health Administration (OSHA). All construction workers involved in performing the response actions must be appropriately health and safety trained in accordance with the applicable provisions of OSHA, which mandates specific procedures that must be followed to be protective from exposure to contaminated media.

Prior to soil excavation, limited subsurface investigations and soil testing will be done in all areas where soil disturbance will take place within the rail rights-of-way for the construction of the Green Line Extension, as contaminated media may be present due to historic releases that were not reported to MassDEP and/or the potential presence of urban fill that may contain contaminated soil.

Soil impacted with oil and/or hazardous materials (OHM) generated during the implementation of the Green Line Extension Project should be managed appropriately in accordance with MBTA's Design Construction Standard Specifications, Section 02282, entitled *Handling, Transportation and Disposal of Excavated Material*. Preliminary assessment activities may assist in identifying the type and quantity of OHM impacted media which will require management under these protocols and help select the optimal disposal methods and/or destination prior to generation. The MBTA specifications are summarized below.

5.14.4.1 Soil

Should OHM-impacted soil be generated during excavation activities associated with Project that requires export or on-site re-use, this material should be properly characterized and managed in accordance with applicable regulations. Proper management will ensure appropriate re-use on the Project site to prevent exposure to contaminants or export to an appropriate destination(s). Characterization may entail the collection of soil samples and analysis for specific parameters specified in MassDEP policies for reuse and disposal of contaminated soil. Any excess soil should be stockpiled onsite pending characterization and if export is needed, generation of the required paperwork.

To facilitate characterization, the soil may be segregated into approximately 500 cubic yard sections and placed on and covered with polyethylene sheeting of 10 mil or greater thickness. Covers shall be placed on each stockpile at the end of each day's operations, and shall be secured in place to prevent runoff and erosion. A composite soil sample will be collected from each of the 500 cubic yard segments. The soil samples shall be submitted, at a minimum, for the following chemical analyses: RCRA 8 metals using Method 6010/7471, volatile organic compounds (VOCs) via EPA Method 8260, PCBs via EPA Method 8081, total petroleum hydrocarbons (TPH) via modified EPA Method 8100, semi-volatile organic compounds (SVOCs) via EPA Method 8270, reactive cyanide and sulfide using EPA Method SW-846, ignitability using EPA Method 1010, corrosivity using EPA Method 9045, and conductivity using EPA Method 120.1. Any samples found to contain contaminant concentrations equal to or greater than 20 times their hazardous waste toxicity threshold (i.e., the 20-times rule) shall be analyzed for toxicity characteristic leachate procedure (TCLP).

It is assumed that the analysis of pesticides and herbicides will not be required; however, this assumption may be modified based on the requirements of the disposal facility and history of the generator site. Should alternate soil disposal options such as asphalt batching be pursued, analytical requirements may vary depending on the analytical requirements for that facility. Based on the results of the characterization, a Bill of Lading will be prepared to facilitate the export of the soil to the selected disposal facility. The Bill of Lading will need to be prepared and/or certified by a Licensed Site Professional (LSP).

5.14.4.2 Groundwater

If OHM impacted groundwater is encountered and generated during the Project, it may also need to be managed in accordance with applicable regulations. If the volume will be limited and subsequent offsite disposal is deemed to be the most cost effective disposal option, the groundwater can be temporarily stored in a 21,000 gallon fractionation tank. It will then be characterized, at a minimum, via laboratory analysis for the following parameters: VOCs via EPA Method 8260, TPH via EPA Method 8100 and SVOCS by EPA Method 8720. For managing larger volumes of groundwater, it may be more cost effective to obtain an EPA Construction General Permit or Remediation General Permit for discharge to surface waters/storm drains or a permit from the local sewer authority, if allowed, for discharge to sanitary sewers.

5.14.5 Summary and Comparison of Alternatives

Table 5.14-6 summarizes the number of RECs and the impact that were identified for each alternative.

Table 5.14-6 Summary of RECs and their Impacts by Alternative

Alternative	Number of Stations/ Facilities	Number of Total RECs	Number of Low Impact RECs	Number of Medium Impact RECs	Number of High Impact RECs
Alternative 1	7	18	8	9	1
Alternative 2	8	21	9	11	1
Alternative 3	7	20	9	10	1
Alternative 4	8	23	10	12	1
Alternative 5	7	17	7	10	0
Alternative 6	2	6	2	3	1

Alternative 6, with only one station and one facility, has the least RECs, with only six identified, while Alternative 4, with eight stations/facilities, has the most RECs that were identified (23 total). The station in Alternative 4 with the majority of RECs is located in Union Square utilizing the McGrath Highway/Somerville Avenue loop. Alternative 2, which also has eight stations/facilities, has 21 RECs, because this alternative reaches Union Square along the existing MBTA Fitchburg Line, which has two fewer RECs than the Union Square alternatives utilizing the McGrath Highway/Somerville Avenue loop (Alternatives 3 and 4).

Alternatives 1, 3, and 5 have seven stations/facilities each and have 18, 20, and 17 RECs, respectively. Again, Alternative 1 utilizes Union Square along the existing MBTA Fitchburg Line but does not include the Route 16/Mystic Valley Parkway station. Alternative 3 utilizes Union Square via the McGrath Highway/Somerville Avenue loop but does not include the Route 16/Mystic Valley Parkway station. Alternative 5 extends up to the Route 16/Mystic Valley Parkway station but does not include service to Union Square.

The alternatives that have the greatest environmental benefits would be the alternatives with the most RECs since these properties are the most likely to have contaminated environmental media that will be cleaned up for the proposed Green Line Extension Project. The alternative that consists of only one station will have the least environmental benefit. Alternatives 2 and 4 would have the greatest environmental benefits (21 and 23, respectively).

The recommendations for mitigation measures during construction may include special handling, dust control, and management and disposal of contaminated soil and groundwater in order to prevent construction delays and to provide adequate protection to workers and any nearby sensitive receptors. All response actions must ensure that any nearby or adjacent receptors are adequately protected.

At the completion of response actions for which an RTN was obtained from the MassDEP, but a closure report consisting of a Response Action Outcome (RAO) has not yet been submitted, a condition of No Significant Risk must exist as defined by the MCP. The preferred outcome is a Class A-1 RAO in which contamination is reduced to background levels. In some situations, the confirmatory sampling results may not support a Class A-1 RAO, and in these situations, the EOT will evaluate alternatives to a Class A-1 RAO. EOT will consult with the MassDEP regarding the planning and implementation of demolition and management of contaminated soil to ensure consistency with the applicable regulations.

5.15 Indirect and Cumulative Effects

The CEQ regulations at 40 CFR 1500 et seq. require an assessment of indirect and cumulative impacts for Federally-assisted projects. MEPA regulations require an assessment of short-term and long-term impacts and cumulative impacts of the Project, any other projects, and other work or activity in the immediate surroundings and region (301 CMR 11.07). The Secretary's Certificate required that the DEIR evaluate the consistency of the Project with ongoing and planned projects, including several that are specifically listed. This section provides an assessment of the indirect and cumulative effects of the Project and other ongoing and planned projects in the corridor and the surrounding region (see Section 4.2, *Land Use*, for information on the affected environment and Section 5.2, *Land Use*, for an assessment of direct effects).

5.15.1 Overview

Indirect impacts are defined by CEQ as "effects which are caused by the [proposed] action and are later in time or farther removed in distance, but are still reasonably foreseeable. Indirect effects may include growth-inducing effects and other effects related to changes in the pattern of land use, population density, or growth rate…" For this analysis indirect effects are defined as potential land use impacts of the

Project. In comparison, direct land use impacts are displacements of properties required for the Project.

Cumulative impacts are defined by CEQ as "the impact on the environment which results from the incremental impact of the action when added to other past, present, and reasonably foreseeable future actions regardless of what agency (Federal or non-Federal) or person undertakes such actions. Cumulative impacts can result from individually minor, but collectively significant, actions taking place over a period of time." Cumulative impacts include the direct and indirect impacts of a project together with the reasonably foreseeable future actions of others.

5.15.2 Methodology

The Project has the potential to produce indirect and cumulative effects. Indirect effects anticipated from the Project would result from possible redistribution of growth and changes in development densities. A qualitative assessment of indirect effects was based on land use analyses, field inspections and information provided by Planning Departments in the Project corridor municipalities (Cambridge, Somerville, and Medford) and the MAPC regarding future development.

Federal guidance was used in evaluating the Project's cumulative effects, specifically CEQ's *Considering Cumulative Effects under the National Environmental Policy Act* (CEQ 1997).

5.15.2.1 Timeframe for the Analysis

The timeframe for the cumulative impacts analysis included two components: the time period covering past, known effects and a period covering future, predicted effects. The time period of the past analysis is the time since the start of the corridor's development (1840-1920). Modest growth occurred in the corridor after 1920, with a few exceptions: substantial redevelopments in East Cambridge starting in the 1980s (Kendall Square, Lechmere, the East Cambridge waterfront and NorthPoint), and redevelopment of the Inner Belt District in Somerville after the land was cleared in the 1960s for the Inner Belt Highway. Therefore, the beginning year for analysis is 1980. Generally, the time for future effect analysis extends from the present day to the reasonably foreseeable year of 2030, the horizon year for the Green Line Extension.

5.15.2.2 Geographic Limits for the Analysis

Geographic areas of effect are typically discussed in three categories:

- **Project Region**: The Project region encompasses the entire municipal areas of Cambridge, Somerville and Medford (Figure 1-1).

- **Project Corridor**: the Project corridor encompasses the Project area between the NorthPoint development in East Cambridge and Mystic Valley Parkway/ Route 16 along the Medford/Somerville line, and between the NorthPoint development and Union Square in Somerville (Figure 1-1). The boundary extends a ½ -mile in each direction from the proposed route of the Green Line Extension.

- **Station Areas**: Station areas are the areas within ½-mile of a proposed station site, which is generally considered easy walking distance (see Figures 4.2-1 through 4.2-9).

Indirect effects of the Project are likely to occur within the station areas. The station areas are where the greatest changes in access to the transit system would occur; these are also likely to be the areas where development and change in development densities can be reasonably expected in response to the Project.

The cumulative effects analysis considers both the Project corridor and Project region. Known or foreseeable projects and developments in the Project corridor are incorporated in the analysis.

5.15.3 Corridorwide Indirect Effects

Future development will be greatly influenced by factors outside the control of the MBTA, the Project sponsor, or any of the other planned projects. The economy of the U.S. and technology trends such as the growth in the life sciences sector can affect the economy of Massachusetts and how, when, and to what degree land is developed in the Project. The growth projections in the corridor are predicated on current information. Actual growth may be more or less than projected.

Based on current information, the economy in the Project region is robust, with a strong base in economic sectors that are growing and are projected to experience continued growth: education, information technology, life sciences, and the arts. Regardless of whether the Project is built or not, current plans by the Cities of Cambridge and Somerville in particular anticipate considerable growth and redevelopment in the corridor. They also anticipate growth in areas outside the Project corridor.

Based on analysis of data provided by MAPC (2005), 35 percent of the three municipalities' total population of 234,909 in 2000 was located within walking distance (½ mile) of the stations in the Project corridor. Assuming the Baseline Alternative, by 2030 the population in these three cities is projected to increase by eight percent to 253,717, with 34 percent residing within walking distance of the Project corridor. This level and concentration of growth within the Project corridor is consistent with public policy and plans. These data are shown in Table 5.15-1.

Table 5.15-1 Cambridge, Somerville, Medford, and Station Area Populations (2000 and 2030)

	Population	
	2000	2030
Cambridge	101,650	116,222
Somerville	77,493	79,867
Medford	55,766	57,628
Total	234,909	253,717
Population in the Station Areas (within 0.5 miles of a proposed Green Line station)	81,663	87,115

Source: 2000 estimates and 2030 projections by municipality and TAZ prepared by MAPC, December 2005. Station Area values were calculated by overlaying the ½ mile radius zones on the TAZs and assuming the population within a TAZ is proportional to its area.

5.15.4 Indirect Effects of the Baseline Alternative

Conditions for future development are based on the economy and market demands. As noted above, the regional economy is robust. As the area is already mostly developed, most future growth in the corridor will take place as infill development or redevelopment of underused lands. Under the Baseline Alternative, redevelopment and changes in land use would likely continue, much as they do today. The following could occur:

- Traffic and congestion in the Project corridor may place greater market pressure to develop underused lands outside the corridor rather than redevelopment of land within the corridor, thus contributing to urban sprawl.
- Growth, particularly north of the Project corridor (in the I-93 corridor) would likely be automobile-oriented, similar to what has occurred to date (low-to moderate density, single-family and some multi-family housing and shopping centers with parking lots).
- Degradation of the walking/transit environment in the Project corridor could occur over time as automobile-oriented land uses continue to grow and the number of automobile trips increases relative to transit and other modes.
- On-site parking requirements that are higher than they would be under the Build Alternatives could limit the density of redevelopment that occurs within the Project corridor.

5.15.5 Indirect Effects Common to All Build Alternatives

None of the Build Alternatives are likely to generate additional regional growth in jobs or population. However, the alternatives may affect where that growth occurs, the form of the growth, and the pace of redevelopment.

At the Project corridor level, the Build Alternatives would support a number of major redevelopment projects that are planned and underway near the proposed station sites (see Table 5.15-7), particularly in the NorthPoint area of Cambridge. Improved mobility, access to a wider range of transportation options, and less traffic congestion relative to the Baseline Alternative would make these projects particularly appealing.

Within the station areas, the Green Line Extension combined with supportive public policies could attract transit-supportive development that would otherwise locate outside station areas in less transit-supportive forms. If one of the Build Alternatives is implemented, it is likely that Cambridge, Somerville and Medford would adopt zoning rules that would allow for more dense development around transit stations relative to existing conditions and surrounding areas. Cambridge and Somerville have already taken steps in this direction. The NorthPoint, Union Square and the developing Brickbottom and Inner Belt area plans in particular stress development in concert with the Project.

Indirect effects of the proposed maintenance and facility for the Project are likely to be varied. The facility is to be sited on Yard 8 (a former railroad yard) located adjacent and north of the transit corridor and just east of the Brickbottom Station site. The vehicle maintenance building and overnight rail car storage area are compatible with much of the existing industrial land uses along this segment of the railroad corridor. However, its development character and impacts may potentially affect future non-industrial development opportunities in adjacent areas. The facility would be similar in appearance to other MBTA maintenance facilities serving the Green Line (e.g., Riverside and Reservoir), emit noise occasionally from passenger rail cars entering and leaving the car storage area, and generate truck and automobile traffic in the area. To encourage planned mixed use development near the Brickbottom station and in the Inner Belt area, consistent with City of Somerville planning policies for the area, mitigation measures may be necessary. The design of an aesthetic building facade, the enabling of potential air rights development (perhaps through zoning amendments), and dense screening landscaping may be necessary to create a more compatible facility with future non-industrial land uses.

Although the addition of transit does not directly cause development to occur, plans and policies that provide incentives for new development to be located near transit stations can significantly influence where development takes place and the form of the development. These policies and the presence of a transit system can also have an indirect positive effect on property values near station sites, as has been demonstrated in other cities with transit systems.

5.15.5.1 Transit-Oriented Development

Transit-oriented development (TOD) is generally defined as more concentrated development patterns, and features a mix of uses, moderate to high-density development, good pedestrian access to transit and less parking. The City of

Somerville is developing a TOD ordinance, which is expected to be enacted if the Project is built. As with the Baseline Alternative, development in the Project corridor, whether auto-oriented or TOD, would be based on market demands.

Pursuant to the policy, if adopted, TOD would be expected in certain station areas. The increased mobility and accessibility that the Green Line Extension would provide would also increase the desirability and value of land near the stations, thereby attracting new real estate investment nearby. Therefore, the Project's primary indirect effect would be to alter development near the stations, bringing higher densities than presently planned or could otherwise be developed in these areas.

These land use effects could take the form of TOD or transit-supportive development (TSD). TSD includes land uses such as office space and multi-story residential buildings near transit stations but includes ample parking. Office uses generate more transit riders per square foot of space than any other land use. In comparison, TOD is more intensive and deliberately planned to integrate with transit and generally includes pedestrian-oriented moderate to high-density mixed uses and reduced parking.

It is not expected that the Green Line Extension Project would lead to an increase in the overall level of growth in the region. Rather, it would focus the growth into patterns that would increase the number of viable travel options available to corridor residents and employees, including transit, walking, and bicycling. As an additional benefit, compact TOD development reduces the cost of providing utilities, facilities, and services to new residential and commercial developments.

The potential for TOD differs at each station site. Factors that could spur TOD development, beyond the addition of a transit station, include available and vacant land, adoption of TOD zoning and policies, other real estate investment in the area, and market demand for new and additional floor space.

TOD Potential

Of the eight station sites being considered, only one, Lechmere, is in an area that can be characterized as already having TOD. Four stations with high potential for TOD are Lechmere, Brickbottom, Mystic Valley Parkway/Route 16 and Union Square. Two station sites have moderate potential for TOD, and two have low potential due to a lack of available developable land. Those stations with moderate potential have strong public planning support for TOD and in some cases have redevelopment plans for the future. Table 5.15-2 summarizes the TOD potential for each station site and Table 5.15-3 summarizes the TOD potential by alternative.

Table 5.15-2 TOD Potential at Proposed Station Sites

	TOD Potential			
Station Site	**High**	**Moderate**	**Low**	**Comments**
Lechmere, Cambridge (relocated)	X			Existing and planned future high density, mixed-use development is transit-oriented. Much vacant land exists in the NorthPoint Planned Unit Development zone. Surrounding area is already TOD.
Brickbottom, Somerville	X			City plans that are under development for Brickbottom and Inner Belt districts are transit-oriented. The area has much vacant and underused land.
Gilman Square, Somerville		X		The City could redevelop its adjacent parcel for high-density, mixed uses and include cross-track air rights development.
Lowell Street, Somerville			X	Planned housing development is transit supportive but not mixed-use TOD. No other space is available for TOD.
Ball Square, Medford		X		TOD would require redevelopment of occupied parcels and/or air rights development. New signs of increased activity and economic vitality may support redevelopment.
College Avenue, Medford			X	Tufts University controls most nearby land. TOD potential would require redevelopment of institutional properties to more public uses. Tufts could redevelop some of its properties to higher density and has considered air-rights development in its most recent Master Plan.
Mystic Valley Parkway/Route 16, Medford	X			Redevelopment of U-Haul site, 200 Boston Avenue, and 196 Boston Avenue for mixed uses in conjunction with the station presents an opportunity for TOD.
Union Square, Somerville	X			City plans for Union Square and Boynton Yards and related zoning initiatives promote TOD.
Total	**4**	**2**	**2**	

Table 5.15-3 TOD Potential by Alternative

Alternative	TOD Potential
Baseline Alternative	High potential where TOD already exists (NorthPoint in Cambridge, by Lechmere Station)
Alternative 1	High potential at three sites; moderate potential at two sites
Alternative 2	High potential at four sites; moderate potential at two sites
Alternative 3	High potential at three sites; moderate potential at two sites
Alternative 4	High potential at four sites; moderate potential at two sites
Alternative 5	High potential at three sites; moderate potential at two sites
Alternative 6	High potential at one site

5.15.5.2 Property Values

Changes in property values that result from construction of a rail transit system are also considered indirect effects. Research based on rail transit systems in U.S. cities has shown that residential property values can increase close to a transit station

(Table 5.15-4). While most studies of rail transit's impact on real estate value show increases, they cannot explicitly isolate transit benefits from other market forces.

Table 5.15-4 Rail System Benefits on Real Estate Values

Rail System	Rail Technology	Increase in Home Sales Price for Every 100 Feet Closer to Station
BART - San Francisco[1]	Rapid Transit	$1,578
MTA - New York City[1]	Rapid Transit	$2,300
San Diego[2]	Light Rail	$83
San Jose[2]	Light Rail	$60
MAX - Portland[3]	Light Rail	$202
METRO - Washington, D.C.[4]	Rapid Transit	$0.23 * *increase in per square foot rent*

Sources:

1 Lewis-Workman S. and D. Brod, "Measuring the neighborhood benefits of rail transit accessibility," *Transportation Research Record,* 1576: 147-153, 1997.

2 Landis, J., R. Cervero, S. Guhathukurta, D. Loutzenheiser, and M. Zhang, *Rail transit investments, real estate values, and land use change: A comparative analysis of five California rail transit systems,* Monograph 48, Institute of Urban and Regional Studies, University of California at Berkeley, 1995.

3 Al-Mosaind, M.A., K.J. Dueker, and J.G. Strathman, *Light rail transit stations and property values: a hedonic price approach,* Portland, Oregon Center for Urban Studies, Preprint, Transportation research Board 72nd Annual Meeting, 1993.

4 U.S. Department of Transportation, Federal Transit Administration, *Transit benefits 2000 working papers: a public choice policy analysis,* 2000.

A case study of potential impacts of commuter rail service on residential property values in the Boston metropolitan area, *Evaluation of the Accessibility Effects and Proximity Related Externalities of Commuter Rail Service,*[11] seems to support these national trends, although the study considered commuter rail, not rapid or light rail transit. The study compared the sales prices in five communities (Ipswich, Needham, Norfolk, Acton, and Winchester) of single family homes generally located within a ½-mile distance of a commuter rail station with the sales prices of similarly assessed properties located one mile or more from the station. The results indicated an average increase in sales price of 5.5 percent for the five communities, although the results for individual communities and properties varied. The study concluded that there is a statistically significant positive effect on property values associated with increased accessibility in communities with commuter rail service.

Value increases near a transit station are realized in real estate sales prices or rents. For residential properties, these increases probably reflect better access to the transit system and associated reductions in vehicle costs. For commercial properties, transit proximity potentially broadens the customer base, increases foot traffic near the business, and contributes to employee accessibility.

11 Armstrong, Robert J. *Evaluation of the Accessibility Effects and Proximity Related Externalities of Commuter Rail Service*, Massachusetts Institute of Technology Master's Thesis, September 1997.

In some cases, transit has had a negative effect on real estate values due to what are often called "nuisance" effects—noise, unsightly infrastructure, transit-associated parking lots, and increased bus traffic. These factors can reduce the desirability of properties near the station or railroad corridor. However, such an effect is unlikely with the Project, given its proposed location in an existing commuter railroad right-of-way (except for the Union Square via McGrath Highway and Somerville Avenue alternative). Such nuisance effects would likely occur in areas where value is attributable to factors such as isolation and other aesthetic characteristics. If the transit system does not provide travel-time savings or accessibility benefits, the system may more likely depress values than increase them. Because the Green Line Extension Project is forecast to result in travel-time savings, the likelihood of negative effects on property values in the Project corridor is minimal.

Housing affordability has been an ongoing concern in the Project corridor and throughout the Project region. The region has many characteristics that make it attractive and expensive - its dense, walkable cities and squares; a vibrant economy and proximity to jobs in downtown Boston and Kendall Square; a high concentration of universities and institutions; and its networks of parks and waterways.

Housing prices in the Project corridor have increased significantly over the last 20 years. The extension of the Red Line to Davis Square made an already desirable location even more desirable and increased real estate values in the neighborhood, including Ball Square. Student demand for housing near Tufts University has helped to keep rents and housing prices high near College Avenue. The NorthPoint development is geared toward high-end residential. The areas with the greatest potential for transit-related price increases are the areas with the greatest potential for high-end redevelopment – Union Square, with the potential redevelopment of Boynton Yards, and Brickbottom, with the potential redevelopment of the Brickbottom and Inner Belt industrial areas. To avoid potential displacement of current residents and middle-income individuals and families, the cities should make housing affordability a central theme in the planning for these areas.

5.15.6 Indirect Effects at Proposed Station Sites

This section describes the potential indirect effects on land use within a ½-mile radius of each proposed station site. This represents the maximum distance riders are willing to walk. If TOD were to be approved, it would likely be sited within one-quarter mile from a station. See Figures 4.2-1 to 4.2-9 for station areas and the half- and one-quarter mile radius zones. EOT has committed to perform land use workshops with the affected communities to further identify community needs and issues regarding land use and redevelopment.

Some of the land acquired for station construction would remain largely vacant when the Green Line Extension Project is complete, as the new stations would not occupy all of the acquired area. This excess land could be sold for redevelopment or applied towards other local needs and uses.

The introduction of new high capacity transit into a community will increase the mobility and accessibility in that community. These increases will tend to also increase land values as has been the case in other cities (see Table 5.15-4), particularly for parcels near the new station. The increases in mobility, accessibility, and land values as well as specific changes in municipal land use planning policies were used to assess the indirect effects discussed below.

5.15.6.1 Relocated Lechmere Station, East Cambridge

Most of the underused land near the proposed relocated Lechmere Station is already programmed as part of the NorthPoint development project, which will occupy 46.3 acres and 20 buildings when completed, and other planned projects described below. Full build-out of these developments would be made more attractive by construction of the Green Line Extension, which would make the area more accessible to a larger region.

The development plan for the NorthPoint project includes mixed-use and multi-family residential buildings (2,480 units of residential; 2.1 million square feet of office/laboratory space; and 75,000 square feet of retail space) and a 5-acre central park. The first phase, which includes two residential buildings (329 units), garaged parking, and the central park, was nearly completed in August 2008. Full build-out is projected to take 15 years. The NorthPoint project is an example of TOD.

Adjacent to the NorthPoint project is the Charles E. Smith/Archstone residential development. Phase I, which includes 437 rental units, was completed in 2007. Phase II is permitted for 426 units. Construction had not yet begun on Phase II as of August 2008.

Adjacent to the proposed station site is the 2.4-acre site for a 392-unit triple-tower residential/parking/open space project proposed by Catamount Holdings. The development would occupy the vacant site of the former headquarters of the Mac-Gray Company at 22 Water Street, behind the Hampton Inn Hotel on O'Brien Highway. The project has been approved by the Cambridge Planning Department.

Across O'Brien Highway from the proposed station site is the 1.7-acre site of the existing Lechmere station, which is proposed for redevelopment for residential uses (90,000 square feet) and a hotel (90,000 square feet).

Additional land use impacts in the station area are uncertain, as there are few other vacant sites available for development. However, the improved Lechmere Station (which will have daily 11,100 boardings under the Preferred Alternative) and the proposed future developments are likely to increase land values in the area, making existing underused parcels attractive sites for potential redevelopment.

5.15.6.2 Brickbottom Street Station and Proposed Maintenance Facility, Somerville

The proposed Brickbottom Station site is located in an industrial/commercial area southeast of Washington Street between Joy Street and Inner Belt Road, with a residential neighborhood to the north. The proposed maintenance facility site is in the same area, on the opposite side of the existing right-of-way from Brickbottom Station and the Brickbottom Lofts.

The City of Somerville's new land use planning policies will encourage TOD near stations. This means that existing underused and low intensity industrial parcels near these stations sites will tend to be replaced over time with mixed-use higher density uses that are more transit supportive and more consistent with higher land values. The City of Somerville is developing plans that would encourage the conversion of the currently commercial/industrial Brickbottom and Inner Belt districts into mixed-use districts. The redevelopment may include a 20,000-seat soccer stadium for the New England Revolution, a franchise of Major League Soccer. In addition, there is a study to explore redevelopment of land surrounding the Cobble Hill apartments to create a mixed income community. The viability of these plans would be supported by the new station and its improved access to downtown Boston and points north and west.

The station would serve the Brickbottom area, residential neighborhoods north and west of the station, and the Inner Belt area, if it were redeveloped. Pedestrian access would be from the surrounding streets and, if the Inner Belt area is redeveloped, potentially via new pedestrian connections over the railroad tracks.

The potential for TOD is high because of the supply of vacant and underused parcels and city planning policy to encourage dense, mixed-use redevelopment. Air rights development over the proposed maintenance facility at Yard 8, which would be in keeping with the MBTA's desire for a covered facility, should be considered as a way to minimize potential adverse visual, noise and access impacts and to enhance the potential for TOD. Moreover, the aesthetic features of the exterior of the maintenance facility structure should enhance the possibility of quality redevelopment nearby. Heavy visual screening by landscaping or walls should be considered, especially adjacent to the outdoor rail car storage area. Consideration should be give to the development of a deck for parking or other purposes over the storage yard, which would provide weather protection to the Green Line cars while screening the visual impacts. Air rights development could also be used to create new open space, such as playing fields, which is scarce in the Brickbottom/Inner Belt region. The Brickbottom and Inner Belt areas also are intended to accommodate the alignment of the

Community Path along the corridor. Therefore, the site planning and design of the maintenance facility are critical with regard to enhancing positive indirect effects.

5.15.6.3 Gilman Square Station, Somerville

The proposed Gilman Square Station site is located behind the Somerville High School/City Hall/Library "campus," within walking distance of over 18,000 residents, more than any other station in the corridor. TOD potential in this location is moderate, as the adjacent, vacant City-owned property (the Homan's building) would need to be demolished and the site redeveloped. The City campus is not available for redevelopment in the foreseeable future; however, air rights development over the tracks is a possibility. The steep embankment on the south side of the station site presents both a challenge and a development opportunity. If the site conditions could be overcome by innovative design, a development concept spanning the tracks could provide access to the station from both the north and the south sides while providing space for the planned Somerville Community Path. There are no other substantial vacant parcels near the station that could be redeveloped.

5.15.6.4 Lowell Street Station, Somerville

The proposed Lowell Street Station site is located in a primarily residential area. Two vacant industrial buildings adjacent to the railroad corridor are planned to be redeveloped as the MaxPak Square residential development. The project includes 199 housing units with below-ground parking and landscaped open space. The development plan was approved by the City before the station site was proposed, and there is no planned direct connection to the station. The TOD potential could be improved by refining the design to take the station into account, and by incorporating mixed uses. There are no other substantial vacant or underused sites near the station, limiting TOD potential.

Access to light rail transit at the Lowell Street Station site would support the proposed MaxPak Square development and may increase the value of homes within walking distance of the station.

5.15.6.5 Ball Square Station, Medford/Somerville

The proposed Ball Square Station site is located at the southeastern edge of a neighborhood commercial district on Broadway and the southern edge of an area with low-density commercial/light industry on Boston Avenue. TOD would require redevelopment of adjacent, occupied properties and would be enhanced by development of air rights over the proposed station. The area experienced an increase in property values following expansion of the Red Line to Davis Square and redevelopment of sites along Broadway that were destroyed by a fire in the mid-1990s. Construction of a new station in Ball Square may further increase land values and create additional redevelopment opportunities near the proposed station site.

5.15.6.6 College Avenue Station, Medford

The proposed station site located at College Avenue is surrounded by Tufts University properties. Athletic facilities with associated parking are located to the east; science and technology facilities are located to the south; and the main campus is located to the west. A large, university-owned parking garage with limited public parking and a student center is located immediately west of the proposed station. The area has limited TOD potential beyond the station site, as it is dominated by institutional uses. However, Tufts could convert some of its parking lots and smaller buildings to higher density uses through redevelopment. Proximity to the 8,500-student main campus of the university represents both strong transit ridership and a potential market for mixed-use air-rights development at the station site.

5.15.6.7 Mystic Valley Parkway/Route 16 Station, Somerville at Medford Boundary

The proposed station site at Mystic Valley Parkway/Route 16 near Boston Avenue is in a commercial and industrial area surrounded by medium-density residential uses. The station would displace the existing U-Haul storage building on Mystic Valley Parkway/Route 16 as well as have an impact on commercial buildings at 196 and 200 Boston Avenue. There is high potential for TOD in conjunction with the proposed station, which could also spur transit-supportive redevelopment of nearby commercial buildings on Boston Avenue and the adjacent shopping center on Mystic Valley Parkway/Route 16.

5.15.6.8 Union Square Station, Somerville

The proposed Union Square Station would be located either in the existing MBTA Fitchburg Line in a cut below the Prospect Street Bridge or on the surface on Prospect Street near Somerville Avenue. Land use impacts of the station in the railroad right-of-way could be significant if it spurs redevelopment of the adjacent 10-acre Boynton Yards as a transit-oriented, mixed-use residential, commercial and research and development district, as proposed by the City. If the station were located at the surface on Prospect Street, closer to Union Square, the TOD potential would also be high as the City has proposed redevelopment of the City-owned parcels at the Kiley Barrel site and the old Public Safety Building. The new station would also support redevelopment of other parcels in Union Square at a higher density, as proposed by the City.

5.15.7 Cumulative Effects Overview

This section describes the cumulative effects of the Baseline and Build Alternatives. The cumulative effects of the action were evaluated by analyzing past, present, and future actions and impacts. The analysis of cumulative effects addresses the effects of both the Green Line Extension Project and other projects included in the analysis.

5.15.7.1 Past Actions

Between 1870 and 1915, the Project region experienced major population growth: Cambridge population nearly tripled; Medford population more than quadrupled; and Somerville's population increased six fold. Much of this growth can be attributed to expansion of Boston's growth and influence across the Charles River. Growth rates decreased steadily in subsequent decades and leveled off during the 1990s. More recently, the population decreased in Somerville between 2000 and 2006 by four percent, while it remained approximately stable in Medford and Cambridge (Table 5.15-5).

Table 5.15-5 Populations of Cambridge, Somerville and Medford (2000 and 2006)

Municipality	2000	2006
Cambridge	101,355	101,365
Somerville	77,478	74,554
Medford	55,765	55,681
Total	234,598	231,600

Source: U.S. Census Bureau, Census 2000, and 2006 Population Estimates. Note that the 2000 estimates differ slightly from the estimates by TAZ provided by MAPC.

The most notable past action affecting the Project region and corridor was the development of the northwest suburbs of Boston in the 1840s. This suburbanization continued, and the Project corridor through Cambridge, Somerville and Medford was virtually built-out by the 1920s.

Transportation projects such as the construction of the I-93 highway and the O'Brien Highway viaduct in the late 1950s, and major transit improvements in the 1970s and 1980s supported this push into the northwest suburbs. The construction of the MBTA Orange Line extension to Oak Grove (1977), the Red Line extension to Alewife (1984), and improvements in the commuter rail line through the Project corridor helped improve accessibility between Boston, Cambridge and Somerville and indirectly reinforced regional growth and development.

Areas of growth and major change since the 1950s have been concentrated in the eastern portion of the Project corridor. In the 1960s, the Inner Belt District in Somerville was cleared for a highway that was never built and was subsequently redeveloped for primarily low-density commercial and industrial uses. Since the

1980s, East Cambridge has been substantially transformed with a mix of new uses along the Lechmere Canal, the East Cambridge Waterfront, and more recently in NorthPoint. East Cambridge and the industrial areas of Somerville (Brickbottom, the Inner Belt District, and Boynton Yards) are the only sections of the study area with large tracts of land potentially available for major redevelopment.

5.15.7.2 Present and Reasonably Foreseeable Actions

Assuming No Action, MAPC projects that the population in the Project corridor within ½-mile of a station will be 87,115 in the year 2030, an approximately four-percent increase from 2010 (Table 5.15-6). Employment in 2030 is projected to be 39,892, an approximate 18 percent increase from 2010.

Table 5.15-6 Projected Population and Employment Within One-half Mile of Proposed Station Sites (2010 and 2030)

	2010	2030
Population	83,495	87,115
Employment	33,894	39,892

Source: Population and employment forecasts by TAZ prepared by MAPC, December 14, 2005.
Population and employment in the ½ mile radius around each station were calculated by assuming the percent of the population and employment in the radius is proportional to the percent of the TAZ in the radius.

Table 5.15-7 lists the major proposed and reasonably foreseeable projects in Cambridge, Somerville and Medford that may contribute to cumulative impacts in the Project region. Figure 5.15-1 shows the locations of these proposed projects. These projects are largely concentrated in the eastern half of the corridor, where there is more industrial and underused land. A number of these projects have already been identified in the Indirect Effects section above; however, they may also contribute to the cumulative effects of the Project and need to be included here. “Planned projects” are those that have received most or all of their permits and approvals. “Proposed projects” are projects that have been discussed or studied but are not yet officially approved.

Table 5.15-7 Proposed and Reasonably Foreseeable Projects in the Project Corridor

Project Name and/or Location	Description	Effects	Status
Lechmere Station Area:			
1. NorthPoint, Cambridge	Private, 46-acre mixed-use development. 329 residential units and a 5-acre central park are nearly completed. Future work includes 2,151 residential units, 2.1 million square feet of office/lab space, and 75,000-square feet of retail space.	Project would increase development density near the station. Higher densities, especially office uses, would increase ridership potential.	Planned
2. 22 Water Street, Cambridge	Private redevelopment to create 392 residential units in high-rise towers with structured parking.	Project would increase residential density near the station by redeveloping vacant properties.	Planned
3. Charles E. Smith/ Archstone Phase II, Cambridge	Phase II of a private development to create 341 residential units in addition to the recently completed 437 units.	Project would increase residential density near the station.	Planned
4. Redevelopment of Existing Lechmere Station site	Proposal by state to redevelop existing Lechmere Station site for residential (90,000-square feet) and hotel (90,000-square feet) uses.	Project would increase density near the station.	Proposed
5. Binney Street Life Sciences Development, Cambridge	Proposal by a private developer to redevelop 16-acres of industrial land over the next 10 years to create 1.5 million square feet of laboratory and office space for life sciences.	Project would increase employment density near the station.	Proposed
6. The Urban Ring	A proposed 25-mile bus rapid transit system that would connect Cambridge, Somerville, and Medford with Boston, Brookline, Chelsea, and Everett. A stop at the relocated Lechmere Station is proposed.	Project would significantly improve access to cross-regional destinations.	Proposed
7. Reconstruction of McGrath Highway/Route 28	A concept favored by the City of Somerville to remove the elevated section of this roadway (near the proposed Lechmere and Brickbottom stations) and replace it with an at-grade roadway.	Reduced capacity could increase traffic congestion and depress land values, however this effect may be offset by increased transit rider-ship and improved connectivity between Union Square and the Brickbottom District.	Proposed
Brickbottom Station Area:			
8. Brickbottom and Inner Belt Districts, Somerville	Ongoing planning study by the City of Somerville to explore redevelopment of low-density commercial and industrial land in Brickbottom and Inner Belt Districts as mixed-use and TOD. May include a 20,000-seat, Major League Soccer stadium.	Project would substantially alter the character of the area and increase residential and employment densities near the station. Stadium would create periodic peak demands on the transit system.	Proposed
9. Cobble Hill, Somerville	Ongoing planning study by the City to explore redevelopment of land surrounding a 400-unit senior housing complex on Washington Street.	Likely redevelopment would be higher density, mixed use.	Proposed
Gilman Square Station Area:			
10. Homans Bldg (350 Medford Street), Somerville	Recommendation in City-sponsored study to redevelop this City-owned, 56,000-sq. ft. industrial building for artist's live/work/study.	Building would need to be acquired to construct Gilman Square Station. Redevelopment would likely be TOD.	Proposed
11. Walnut Street, Somerville	Recognition by City planners of potential for existing auto-body shops to be redeveloped as residential uses.	Unknown.	Proposed
Lowell Street Station Area:			
12. MaxPak Development, Somerville	Private plans to raze two vacant industrial buildings at 56 and 61 Clyde Street and construct 199 residential units on this 5.49-acre site.	Project would increase residential density near the station.	Planned

Table 5.15-7 Proposed and Reasonably Foreseeable Projects in the Project Corridor (Cont'd.)

Project Name and/or Location	Description	Effects	Status
College Avenue Station Area:			
13. Boston Avenue between Fitchburg Branch & Harvard Street, Medford	Tufts University concept to construct an Integrated Lab Complex and several other new structures by infill and redevelopment.	Redevelopment would increase development density near the station.	Proposed
Mystic Valley Parkway/ Route 16 Station Area:			
14. Medford Hillside (Boston Avenue from Mystic Valley Parkway to Warner Street)	Identification of this area in the 2004 Medford Community Development Plan as an economic development area with potential for TOD.	Redevelopment would increase development density near the station.	Proposed
15. Minuteman to Mystic Valley Parkway Path	Proposed multi-use path would connect Minuteman Path at Alewife with paths along the Mystic Valley Parkway.	Multi-use path connection would improve pedestrian and bicycle access to the Mystic Valley Parkway/Route 16 station and enhance regional connectivity.	Proposed
Union Square Station Area:			
16. Somerville Avenue and Washington Street, Somerville	Effort by the City to re-zone streets as a Corridor Commercial District.	Rezoning would allow for increased density near the station.	Proposed
17. Old Public Safety Building (228 Washington Street), Somerville	Designation by City as a Priority Development Site (PDS). Anticipated redevelopment as high-density commercial with some residential.	Higher density redevelopment, especially office, would increase ridership potential.	Proposed
18. Kiley Barrel Site (226 Somerville Avenue), Somerville	Designation by City as PDS. Anticipated redevelopment as high-density commercial with some residential.	Higher density redevelopment, especially office, would increase ridership potential.	Proposed
19. Boynton Yards (10-acre site abutting west side of Fitchburg Line), Somerville	Ongoing Master Planning effort by the City to explore redevelopment of industrial area as high density residential, commercial, and laboratory uses with ground floor retail.	Higher density redevelopment, especially office, would increase ridership potential.	Proposed
20. Citizens Bank Block (Bow Street between Stone and Warren), Somerville	2003 Union Square Master Plan recommendation to redevelop as mixed retail, office and residential.	Higher density, redevelopment, especially office, would increase ridership potential.	Proposed
21. South side of Somerville Avenue between Prospect Street and Webster Avenue, Somerville	2003 Union Square Master Plan recommendation to redevelop as mixed retail, office and residential uses.	Higher density redevelopment, especially office, would increase ridership potential.	Proposed
22. Prospect Street Corridor, Somerville	2003 Union Square Master Plan recommendation to redevelop as Transit-Oriented Development.	Higher density redevelopment, especially office, would increase ridership potential.	Proposed
23. Somerville Avenue and Washington Street east and west of Union Square core	2003 Union Square Master Plan recommendation for infill development.	Higher density redevelopment, especially office, would increase ridership potential.	Proposed
24. Old Bow Street Police Station (50 Bow Street), Old Union Square Fire Station/SCAT Building, and Recreation Commission Building	2003 Union Square Master Plan recommendations for re-use as office, retail, housing.	Higher density redevelopment, especially office, would increase ridership potential.	Proposed

5.15.8 Summary of Indirect and Cumulative Effects

This section provides a summary of indirect and cumulative effects of the Project by topic and highlights how the effects would differ among alternatives. Only those alternatives that would differ from the statement under "Effects with the Project" are listed as bullets.

5.15.8.1 Land Use

Effects without the Project

A significant amount of redevelopment is planned or proposed in the Project corridor, and much of this redevelopment is likely to occur with or without the Project. Under the Baseline Alternative there would be fewer opportunities for TOD, and there would likely be greater on-site parking requirements, resulting in lower density redevelopment.

Effects with the Project

The Build Alternatives are likely to result in higher density redevelopment, more TOD, and lower on-site parking requirements in areas that are within walking distance of the stations. The following station areas have the greatest potential for higher density redevelopment and TOD: Relocated Lechmere; Brickbottom; Mystic Valley Parkway/Route 16; and Union Square.

- **Alternatives 1 and 3**: With no station at Mystic Valley Parkway/Route 16, there would be no strong incentive to convert existing auto-oriented uses near the proposed station site to higher density TOD.
- **Alternative 5**: Redevelopment of underused parcels in Union Square and in Boynton Yards would likely be more gradual and at a lower density without transit service.
- **Alternative 6**: With no MBTA Lowell Line branch, the incentive for higher density redevelopment and TOD along the corridor would be reduced, and redevelopment plans in the Brickbottom and Inner Belt Districts would likely be curtailed.

5.15.8.2 Transportation and Traffic

Effects without the Project

Traffic congestion on major arterials has steadily worsened as development has increased in the inner Boston metropolitan area. Projects such as the Urban Ring, the Minuteman to Mystic Valley Parkway Path, the Somerville Community Path, and improvements in MBTA bus service would improve the regional transportation network. However, without a new transit option, growth and redevelopment in the Project corridor would likely increase traffic and degrade the pedestrian and cycling environment over time.

Effects with the Project

The Green Line Extension Project would provide a new transit option northwest of NorthPoint that would mitigate potential traffic increases from continued growth and redevelopment in the Project corridor. Combined with the Urban Ring, the Somerville Community Path, and the Alewife Brook Parkway to Mystic Valley Path, the Green Line Extension would improve the regional transportation network and reduce regional traffic and congestion.

- **Alternatives 1 and 3**: Alternatives that terminate at College Avenue provide less regional connectivity than those that include a station at Mystic Valley Parkway/Route 16. There would be a missing link between the northwest regional bicycle network (including the Minuteman Trail and the proposed Mystic Valley Parkway Path) and the Green Line Extension, reducing opportunities for multi-modal commuting.
- **Alternative 5**: Lack of a new transit station at Union Square would limit connectivity of this densely populated area and the redeveloping Boynton Yards with other areas in the region would likely lead to an increase in traffic and congestion.
- **Alternative 6**: With no MBTA Lowell Line branch, transit connectivity to the northwest communities of Somerville and Medford would remain limited, and growth and redevelopment along the corridor would likely lead to an increase in traffic and congestion.

5.15.8.3 Property Values

Effects without the Project

Property values in the Project corridor are likely to increase over time with or without the Green Line Extension, particularly in the areas slated for redevelopment (Union Square and Boynton Yards, the Brickbottom District, and the Inner Belt District). Redevelopment would likely occur more gradually under the Baseline Alternative than under the Build Alternatives; however, housing affordability would continue to be an ongoing concern.

Effects with the Project

Property values are likely to increase in areas within walking distance of the stations. However, the increases are likely to be modest, as the Project corridor is already highly desirable, and housing affordability is already a concern. The greatest increases are likely to occur in areas that are planned for significant redevelopment: Union Square, Boynton Yards, the Brickbottom District, and the Inner Belt District. Public policy to preserve affordability for moderate-income residents and small businesses should be implemented to mitigate transit-related increases in land values.

- **Alternatives 3 and 4**: Alternatives that include the branch to Union Square via McGrath Highway and Somerville Avenue may reduce land values for properties that are immediately adjacent to the surface street portion of the transit route. However, the effects could be minor, as these streets are already high-traffic corridors, and there would be benefits associated with access to new transit.
- **Alternative 5**: Lack of a new transit station at Union Square would likely curtail redevelopment of Boynton Yards and slow the pace of land value increases relative to the Build Alternatives.
- **Alternative 6**: With no MBTA Lowell Line branch, redevelopment along the corridor, particularly in the Brickbottom and Inner Belt districts, would likely be slowed or curtailed, tempering the pace of land value increases along the corridor.

5.15.8.4 Economy

Effects without the Project

The regional economy has undergone a gradual transition from one based on industry and trade to one based on services, knowledge-based industries, life sciences, and technology. More recently, public policy has also highlighted the importance of the arts-based economy in the state and the region. This transition would likely continue under the Baseline Alternative. However, with growth-related increases in traffic and congestion, some businesses in these growth industries may choose to locate outside the Project corridor.

Effects with the Project

Continued transition away from the industrial and trade sectors toward the services, knowledge-based industries, life sciences, technology and the arts is anticipated and is supported by public policy. Planned and proposed projects that would expand employment centers in the corridor (redevelopments in East Cambridge, Brickbottom and Inner Belt districts, Union Square and Boynton Yards) would support this trend and are more likely to proceed under the Build alternatives.

- **Alternative 5**: Lack of a new transit station in Union Square would reduce the attractiveness of the Boynton Yards as a major redevelopment district and employment center.

- **Alternative 6**: With no MBTA Lowell Line branch, planned and proposed projects that would create jobs near new Lechmere Station and in the Brickbottom and Inner Belt districts would likely be slowed or curtailed.

5.15.8.5 Neighborhoods

Effects without the Project

Redevelopment of underused land in the Project corridor has been occurring at a fairly rapid pace, affecting the character of some of the local neighborhoods. Redevelopment in East Cambridge has transformed Lechmere Canal, the East Cambridge Waterfront, and more recently, the NorthPoint area into vibrant mixed-use districts. Proposed redevelopment in the Inner Belt and Brickbottom districts and Boynton Yards would follow this trend.

Redevelopment of underused parcels in the corridor would likely continue under the Baseline Alternative, but it would likely occur more gradually and on a smaller scale without the benefit of transit.

Effects with the Project

Redevelopment of underused land in the Project corridor would be enhanced by the addition of a new and improved transit alternative. The greatest changes would likely occur in the Brickbottom and Inner Belt districts and in Boynton Yards, where planning is underway for potential redevelopment of these lower rent, commercial/industrial neighborhoods as mixed-use employment centers. Public policy to preserve affordability for moderate-income residents and small businesses should be implemented to minimize impacts of redevelopment on existing neighborhoods.

- **Alternative 5**: Lack of a new transit station in Union Square would likely reduce the pace of redevelopment in the Boynton Yards and result in more gradual neighborhood changes.
- **Alternative 6**: With no MBTA Lowell Line branch, the proposed transformation of the Brickbottom and Inner Belt districts from commercial/industrial neighborhoods to higher rent, mixed-use neighborhoods would not have the benefit of new transit to serve as a catalyst.

5.15.8.6 Environmental Justice

Effects without the Project

The Project corridor includes many ethnically and economically diverse neighborhoods, particularly in the eastern end. Housing affordability in these neighborhoods and throughout the corridor has been an ongoing concern and would continue to be a concern under the Baseline Alternative.

Effects with the Project

Environmental justice populations would benefit from the addition of a reliable transit alternative that would provide more opportunities to live and work in places throughout the region. However, increases in land values near new stations, particularly around Brickbottom and Union Square, may impact small businesses and limit affordable housing opportunities. Public policy to help preserve small businesses and maintain housing affordability should be implemented to help maintain diverse communities in the corridor.

- **Alternative 5**: Without a new transit station in Union Square, environmental justice populations in the densely populated neighborhoods surrounding the commercial center would not have improved access to jobs throughout the region.
- **Alternative 6**: With no MBTA Lowell Line branch, environmental justice communities in the eastern end of the corridor would not benefit from transit improvements that would enhance mobility and provide access to jobs throughout the region.

5.15.8.7 Historic, Archaeological and Cultural Resources

Effects without the Project

Historic, archaeological and cultural resources are located throughout the Project corridor but particularly in Union Square, which has a large concentration of older and historic buildings. Efforts to identify, protect, and preserve these resources would continue under the Baseline Alternative.

Effects with the Project

Although there would be no direct effects expected to historic resources, the Build Alternatives could stimulate redevelopment of historic resources at a faster pace than the Baseline Alternative, particularly in Union Square. Local ordinances and public policy should be used to protect valuable historic, archaeological and cultural resources that have not yet been designated in areas near the station sites. The potential archaeological resources identified for the Build Alternatives could be affected by future development near the Project area.

- **Alternative 5**: Without a new transit station in Union Square, development that could impact historic resources in Union Square would likely proceed at the current pace.
- **Alternative 6**: As noted in Section 5.13, *Historic and Archaeological Resources*, the only archaeologically-sensitive area would be at Yard 8. With no MBTA Lowell Line branch under this alternative, development that could impact historic, archaeological, and cultural resources along the corridor would likely proceed at the current pace.

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6

Draft Section 61 Findings and Mitigation Commitments

6.1 Introduction

This chapter presents the proposed mitigation program of the Executive Office of Transportation (EOT) to address adverse environmental impacts associated with construction and operation of the proposed Green Line Extension Project. This chapter also provides draft Section 61 Findings for the Proposed Project.

6.2 Project Benefits

The Proposed Project is expected to generate 52,000 new daily boardings and alightings at the Project's seven stations and generate new systemwide transit ridership of 7,900 boardings per day and a reduction of 25,018 Vehicle Miles Traveled (VMTs) per day (projected to the year 2030). The increased transit access and ridership will improve corridor mobility, improve traffic conditions, improve regional air quality, increase services to environmental justice populations, and support future smart growth initiatives and sustainable development.

6.3 Project Mitigation

Potential permanent impacts resulting from constructing the Proposed Project would be mitigated to the extent practicable, as described in Chapter 5 of this Draft Environmental Impacts Report/Environmental Assessment (DEIR/EA) and summarized in Table 6-1.

Table 6-1 Project Mitigation Commitments

Environmental Categories	Mitigation Measure	Implementation Schedule	Implementation Responsibility
Traffic	Provide roadway and signal modifications at six specific intersections in order to prevent adverse traffic impacts from the Project.	Completion of construction	EOT/MBTA
	Provide pedestrian improvements at 29 specific locations to improve pedestrian flow and safety.	Completion of construction	EOT/MBTA
	Work with cities to develop station-area parking enforcement plans.	Completion of construction	EOT/MBTA
Noise	Provide noise mitigation in the form of noise barriers, home sound insulation, and rail lubrication to mitigate all moderate and severe noise impacts.	Completion of construction	EOT/MBTA
	Install continuously welded rail for light rail tracks.	Completion of construction	EOT/MBTA
Vibration	Provide vibration mitigation in the form of ballast mats and special trackwork to mitigate vibration impacts.	Completion of construction	EOT/MBTA
Water Quality/ Stormwater	Prepare a Stormwater Pollution Prevention Plan (SWPPP).	Prior to construction	EOT/MBTA
	Implement all aspects of the SWPPP including recommendations in annual updates based on new or improved procedures or changes to operations.	Ongoing	EOT/MBTA
	Update the Operation and Maintenance (O&M) plan in the SWPPP to include a detailed outline of inspection and cleaning schedules for stormwater management practices, including detention areas and deep sump catch basins.	Ongoing	EOT/MBTA
	Install detention and infiltration systems to prevent any increase in peak flows to municipal stormwater drainage systems and to remove TSS from stormwater runoff prior to discharge.	During construction	EOT/MBTA
Visual Environment	Provide vegetation on and/or above retaining walls to minimize visual changes.	Completion of construction	EOT/MBTA
	Work with affected communities on design of noise barriers and vegetated walls.	Prior to construction	EOT/MBTA
Historical and Cultural Resources	Perform archival documentation of historic structures to be removed or altered.	Prior to demolition	EOT/MBTA
	Construct noise barriers with materials and colors compatible with adjacent historic properties.	Completion of construction	EOT/MBTA
	Provide noise mitigation (sound insulation) for sensitive historic structures that cannot be protected using noise barriers.	Completion of construction	EOT/MBTA
	Perform intensive archaeological survey before disturbing any archaeologically-sensitive areas.	Prior to construction	EOT/MBTA

6.4 Construction Period Mitigation

Temporary, short-term impacts from construction activities would be mitigated to the extent practicable. Appropriate construction mitigation measures would be incorporated into the contract documents and specifications governing the activities of contractors and subcontractors constructing elements of the Project. On-site resident engineers and inspectors will monitor all construction activities to ensure that mitigation measures are properly implemented. The construction mitigation measures are summarized in Table 6-2, and described in detail in Section 3.7.6 of this DEIR/EA.

Table 6-2 Summary of Construction Mitigation Measures

Mitigation Measures
Traffic ■ Temporary detours would be established to minimize traffic disruption due to construction. ■ Bridge reconstruction would be timed so as to minimize temporary bridge closures and to ensure that adjacent bridges were not closed simultaneously.
Air Quality ■ Apply water to dry soil to prevent dust production. ■ Use water for compaction in the fill areas and as a dust retardant in both the soil cut areas and haul roads. ■ Follow existing MBTA retrofit procedures for construction equipment to reduce emissions.
Noise ■ Use specially quieted equipment with enclosed engines and/or high-performance mufflers. ■ Avoid nighttime construction in residential neighborhoods. ■ Keep truck idling to a minimum. ■ Route construction equipment and vehicles through areas that would cause the least disturbance to nearby receptors where possible. ■ Fit any air-powered equipment with pneumatic exhaust silencers. ■ Locate stationary construction equipment as far as possible from noise-sensitive sites. ■ Construct noise barriers, such as temporary walls or piles of excavated material, between noisy activities and noise-sensitive receivers.
Vibration ■ Avoid nighttime construction in residential neighborhoods. ■ Use alternative construction methods to minimize the use of impact and vibratory equipment (e.g. pile drivers and compactors).
Water Quality/Stormwater ■ Develop and implement a SWPPP in accordance with NPDES and MA DEP standards. ■ Stabilize any highly erosive soils with erosion control blankets and other stabilization methods, as necessary. ■ Reinforce slopes using a hydroseed mix with a resin base, native vegetation, or other approved methods. ■ Use dewatering controls, if necessary. ■ Install a gravel entrance to prevent sediment from being tracked onto roadways and potentially discharged to surface waters. ■ Maintain construction equipment to prevent oil and fuel leaks.

Table 6-2 Summary of Construction Mitigation Measures (continued)

Mitigation Measures
Hazardous Materials and Solid Waste ■ Implement special management procedures for any hazardous, contaminated or special wastes generated during construction, including special handling, dust control, and management and disposal of contaminated soil. Procedures should protect both workers and nearby receptors. ■ Perform subsurface investigations for any planned excavation to test for possible contamination. ■ Prepare a site-specific Health and Safety Plan. ■ Conduct pre-demolition inspections to identify any hazardous materials such asbestos and lead-based paint.

6.5 Proposed Section 61 Findings

These Proposed Section 61 Findings for the Project have been prepared to comply with the requirements of Massachusetts General Laws, Chapter 30, Section 61, and in accordance with the Massachusetts Environmental Policy Act (MEPA) regulations at 301 CMR 11.07(6)(k), which requires state agencies and authorities to review, evaluate, and determine the impacts on the natural environment of all projects or activities requiring permits issued by the state, and to issue findings describing the environmental impacts, if any, and certifying that all feasible measures have been taken by the Project Proponent to avoid or minimize these impacts. As described below, EOT has reviewed the environmental effects of the Proposed Project. Based on the review, EOT finds that all feasible measures have been taken first to avoid and then minimize those effects.

6.5.1 Project Description

Alternative 1, Green Line Extension to Medford Hillside and Union Square (using commuter rail rights-of-way), has been selected as the "Proposed Project" for the Green Line Extension Project, as it provides a balance of cost, ridership, and environmental impacts. EOT also believes that this alternative will help the Commonwealth achieve its goal of providing expanded transportation services and improve regional air quality. This alternative extends to Union Square via the MBTA Fitchburg Line right-of-way, which would require fewer acquisitions of private property, have more operational reliability, and have a lower capital cost than the Somerville Avenue option. Alternative 1 would meet all project goals, would be operationally practical, and would generate a high number of new systemwide transit trips. This is the project for which EOT is currently seeking approval by the FTA.

A total of seven stations are included in the Proposed Project: Lechmere, Brickbottom, Gilman Square, Lowell Street, Ball Square, College Avenue and Union Square. The route length would be about three miles to Medford Hillside with an approximately one-mile spur to Union Square. The primary infrastructure improvements of the Proposed Project would include relocating existing commuter rail lines, and constructing approximately four miles of new light rail track and systems, 11 bridge structures and a maintenance facility to support the extension service. The environmental impacts of the Proposed Project have been fully evaluated and are described in detail in this DEIR/EA.

The Green Line Extension Project is envisioned to provide service to Union Square and to Medford using a two-branch operation, both in existing commuter rail rights-of-way. One branch would operate from Relocated Lechmere Station to Medford along the MBTA Lowell Line. This branch would begin at relocated Lechmere Station and head northwest, meeting the MBTA Lowell Line just south of Washington Street in Somerville. From Washington Street, the alignment would run parallel to the MBTA Lowell Line to Medford, terminating its route at Medford Hillside in the vicinity of College Avenue. The second branch would operate along the MBTA Fitchburg Line from Lechmere Station into a terminus at Union Square in Somerville. The Union Square Branch would begin at relocated Lechmere Station and head northwest, following the MBTA Fitchburg Line to Prospect Street in the Union Square area.

The Project would include one relocated Green Line station, six new Green Line stations, and a maintenance facility. The stations would be:

- Relocated Lechmere Station, Cambridge (relocated to east side of O'Brien Highway);
- Union Square Station, Somerville;
- Brickbottom Station, Somerville;
- Gilman Square Station, Somerville;
- Lowell Street Station, Somerville;
- Ball Square Station, Medford; and
- College Avenue Station, Medford.

6.5.2 History of MEPA Review

An Expanded Environmental Notification Form (EENF) was submitted to the Executive Office of Energy and Environmental Affairs (EEA) on October 10, 2006. The Secretary of EEA issued a Certificate on the EENF on December 1, 2006, requiring a Draft Environmental Impact Report (DEIR) for the proposed Project.

Since the submission of the EENF, the Project area has been expanded to include the relocation of Lechmere Station. Relocating Lechmere Station was previously reviewed under MEPA as part of the NorthPoint development project (EEA 12651), but has not been reviewed under National Environmental Policy Act (NEPA). This DEIR/EA includes an evaluation of relocating Lechmere Station to the location and in the same configuration previously reviewed under MEPA.

6.5.3 Related Permits and Approvals

The Proposed Project will require permits and approvals from several local, state and Federal agencies. Table 6-3 below lists the permits and approvals that are anticipated for the Proposed Project.

Table 6-3 Possible Permits or Approvals

Agency	Approval or Permit
FTA	Finding of No Significant Impact Section 4(f) Determination Section 106 Finding Federal funding approval
U.S. Environmental Protection Agency Region I	NPDES Permit for stormwater discharges and construction period
EOT	State funding approval Section 61 Finding
MassHighway	Access permits
City of Medford	Approval for reconstruction of bridges and associated temporary closings/detours for construction Building permits as needed for construction
City of Somerville	Approval for reconstruction of bridges and associated temporary closings/detours for construction Building permits as needed for construction
City of Cambridge	Building permits as needed for construction

6.5.4 Overview of Project Impacts and Mitigation Measures

This section summarizes the impacts to environmental resources and the mitigation measures proposed to prevent or reduce these impacts.

6.5.4.1 Environmental Justice

Transit ridership modeling results indicate a substantial increase in transit access for the local area under the Project, including equal or greater benefits for disability and environmental justice populations. The increase in transit access is expected to promote economic development and provide economic benefits for the region.

Five buildings would be purchased and demolished for the Proposed Project that located within environmental justice areas. These areas have similar racial demographics to the rest of the local area, and the impacts to environmental justice areas are not disproportionate. An estimated 18 jobs could be displaced due to building acquisition located in environmental justice areas. The displacement of these jobs does not represent a substantial or disproportionate economic change for the local area.

With no mitigation, the Proposed Project would result in moderate to severe noise impacts on 84 buildings in environmental justice areas. Approximately 58 percent of the noise impacts would be in environmental justice areas. Given that 60.0 percent of the combined populations of Medford, Cambridge, and Somerville live in environmental justice areas, there would be no disproportionate impact to environmental justice populations. After mitigation through measures such as noise barriers and sound insulation, there would be no residual impacts to these areas.

The maintenance facility proposed at Yard 8 would require acquiring two pieces of land adjacent to Inner Belt Road. Like the other maintenance facility sites considered, this site is within a designated environmental justice area. However, no buildings would be acquired or demolished, and no residential land would be acquired, resulting in no direct effect on local environmental justice populations. The proposed maintenance facility site is located in an existing industrial area next to the MBTA Fitchburg and Lowell Lines. There would be no moderate or severe impacts from noise after mitigation was implemented. Therefore, there would be no disproportionate noise impacts to environmental justice populations from the proposed maintenance facility. The maintenance facility would not affect air quality as it would be servicing Green Line trains, which are electrically powered and have no emissions.

Overall, none of the impacts to environmental justice populations would be disproportionate. These populations would also stand to gain an equal or greater share of the transit access improvements expected under the Proposed Project.

6.5.4.2 Traffic

The Proposed Project would improve existing traffic conditions at eight signalized intersections. Without mitigation, the Project would result in adverse traffic impacts and would increase existing traffic problems at five signalized intersections. Traffic mitigation is proposed at six intersections for the Proposed Project:

- Boston Avenue at Winthrop Street;
- Boston Avenue at College Avenue;
- Washington Avenue at McGrath Highway;
- Prospect Street at Somerville Avenue;
- Washington Street at Somerville Avenue/ Webster Street; and
- Medford Street at Pearl Street.

With this mitigation in place, the Proposed Project would improve existing traffic conditions at three additional signalized intersections and one unsignalized intersection and would cause no net adverse impact on traffic operations in the region.

Pedestrian traffic will increase as a result of the Project. Pedestrian mitigation is proposed at 29 locations to improve pedestrian flow and reduce delays. With this mitigation in place, the Proposed Project would improve pedestrian traffic conditions and would have no adverse impacts on pedestrians.

6.5.4.3 Air Quality

On a mesoscale (regional) level, the Project would decrease the emission of volatile organic compounds (VOCs), nitrogen oxides (NO_X), particulate matter (PM_{10}), and the greenhouse gas carbon dioxide (CO_2) relative to the No-Build Alternative. On a microscale (local) level, the Project would decrease carbon monoxide (CO) and PM_{10} over existing conditions and would cause some localized decreases or increases in CO, PM_{10}, and $PM_{2.5}$. These increases would not exceed the National Ambient Air Quality Standards (NAAQS) and would not threaten human health or require mitigation.

6.5.4.4 Noise

A total of 161 noise-sensitive receptors would be exposed to noise impact in the absence of mitigation for the Proposed Project. These include 120 moderate impacts and 41 severe impacts at single-family and multi-family residential buildings, moderate impact at three institutional buildings (Science and Technology Center, Outside the Line Artist's Studio and Bacon Hall at Tufts University), moderate impact at Trum Playground and severe noise impact at the Walnut Street Center (a non-profit support center for adults with developmental disabilities) near Union Square.

Noise mitigation including noise barriers, potential sound insulation treatments, and rail lubrication would be feasible, reasonable, and effective in mitigating all potential noise impact due to the Proposed Project. The noise barriers would be effective in reducing noise levels from transit sources generally seven to 11 decibels and would result in substantial reduction in future noise levels in comparison to existing noise levels. With mitigation, there would be no severe noise impacts from the Proposed Project.

6.5.4.5 Vibration

The Proposed Project is projected to cause vibration impacts at 90 single-family and multi-family residential buildings and at three institutional buildings (Science and Technology Center, Outside the Line Artist's Studio and Bacon Hall at Tufts University). A total of 19,700 track-feet of vibration mitigation is proposed to mitigate potential impact. In addition, 12 segments of special trackwork (turnouts and crossovers) will need to be relocated away from sensitive receptors or implemented with specially-engineered solutions (flange-bearing or moveable-point frogs) to minimize potential vibration impact at some locations. These mitigation measures would be effective in keeping future vibration levels at or below existing levels for commuter trains and reducing future vibration from Green Line trains below the impact criterion. (Note: This criterion is for human annoyance, not structural damage.)

6.5.4.6 Water Quality/Stormwater

The Proposed Project would require 6.8 acres of new impervious surfaces, including roofs, walkways, platforms, and other pavement for both the maintenance facility and the new stations. New and expanded stormwater management systems would be required to collect the runoff from these areas. These systems would discharge into the existing municipal stormwater drainage systems. The new stormwater systems would include treatment and detention/infiltration structures to prevent any increased risk of flooding downstream and to maintain the existing quality of the rivers that receive discharge from these municipal systems. Proposed stormwater management devices include:

- Deep sump catch basins to collect runoff from paved areas;
- Underdrains beneath the rail ballast to collect runoff within the rail corridor;
- Hydrodynamic particle separators to treat pavement runoff;
- Roof drains from building connected to an underground pipe storm drainage system;
- Underground infiltration/detention chambers to store and infiltrate runoff; and
- Overflow from the underground chambers to municipal storm drainage systems.

With these measures in place, no increases in flooding or impairment of the receiving waters are expected.

6.5.4.7 Historic Resources

Direct permanent impacts from work within the existing railroad right-of-way is not likely to directly affect significant historic resources, as no significant resources are found inside the railroad right-of-way, with the exception of the south end of the Project area which intersects with the Cambridge steel elevated portion of the Lechmere Viaduct, which eligible for listing in the National Register as part of the Viaduct.

A number of historic architectural resources immediately abut the right-of-way, including the Susan Russell House which is listed in the National Register and properties that are eligible for listing in the National Register: Whitehead Metal Products, Jackson and Newton Co., A&P Grocery Warehouse, Hill Michie Co. Auto Garage, Reid & Murdock Warehouse, Somerville High School and Superintendent's Office, Derby Desk Company, Agar Manufacturing Co., Carlisle Ayer Co., Warner and Childs Division Factory Mill and Garage, Tufts University, Bray Memorial Laboratory and Curtis Hall/Commons Building.

Removing the existing Lechmere Station structure and constructing a new station on the east side of O'Brien Highway/Route 28 will affect a property which is recommended as National Register-eligible and will require mitigation as stipulated in the Memorandum of Agreement. Gilman Square Station will have an effect on the Gilman Square area and Central Hill area through the introduction of new visual elements.

The Proposed Project would affect one archaeologically sensitive area, a potential mid-late nineteenth-century worker housing site at the proposed Brickbottom Station. There is also the potential for archaeologically sensitive strata below railroad and upper fill deposits in the Yard 8 support facility area where the new vehicle maintenance building is proposed.

Mitigation will be provided for individual and district historic resources that are listed or eligible for listing in the National Register and that will be adversely affected by permanent aspects of the Proposed Project. Mitigation at Lechmere Station, which is proposed to be demolished, will consist of archival documentation and consideration of salvage of architectural elements. Historic interpretive signage may also be included. Noise mitigation will include noise walls and sound insulation, treatments which in themselves have the potential for adverse effect. Noise walls that are proposed adjacent to the Susan Russell House, Michael Cotter House, and Hill-Michie Co. Auto Garage will be of a material and color that is compatible with the historic character of the properties to minimize any additional visual affect from noise walls. The introduction of new doors, windows, or other insulating treatments will be appropriate for the historic property and meet the Secretary of the Interiors Standards for Rehabilitation. Affected historic properties proposed to be subject to sound insulation mitigation consist the A & P Warehouse (Brickbottom Lofts) and Warner and Childs Garage (Tufts Bacon Hall). Vibration mitigation will consist of measures incorporated into the rail bed, ballast, and track design and, therefore, there will be no effects and no need for additional mitigation.

For archaeological resources, subsurface testing as part of an intensive (locational) archaeological survey may be warranted in consultation with the Federal Transit Authority (FTA), EOT, and Massachusetts Historic Commission (MHC). The intensive survey would be designed to locate and identify any potentially significant archaeological resources that may be impacted by the Project.

Should any significant and National Register-eligible archaeological resources be identified during the intensive survey or subsequent site evaluation testing, then measures to avoid, minimize, or mitigate any adverse effects of the Project on the National Register-eligible resource(s) will need to be determined by the FTA and EOT, in consultation with the MHC and other consulting and interested parties. Mitigation measures for archaeological sites that will be adversely affected by construction activities will include an archaeological data recovery program designed in accordance with state and Federal guidelines and standards for the excavation of National Register eligible archaeological sites.

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Distribution List

In accordance with Section 11.16 of the Massachusetts Environmental Policy Act (MEPA) regulations at 301 CMR 11.00 and the MEPA Expanded Environmental Notification Form (EENF) Certificate, this Draft Environmental Impact Report/Environmental Assessment (DEIR/EA) is being distributed to the following governmental agencies and other parties.

It is expected that notice of the availability of this DEIR/EA will be published in *The Environmental Monitor* on or about October 26, 2009. Per Section 11.06(1) of the MEPA regulations, the public review period for a DEIR/EA lasts 30 days. However, due to the expanded nature of this single DEIR/EA and the hope that this will be accepted as final, Executive Office of Transportation and Public Works (EOT) is requesting an extended public review period of 45 days. Thus, written comments are due by December 9, 2009.

Copies of this report will also be posted on the Project website (http://www.mass.gov/greenlineextension) and also made available at the listed libraries. To request a copy of this document, please contact Regan Checchio at (617) 357-5772 or at rchecchio@reginavilla.com.

7.1 Federal Agencies and Elected Officials

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Interim Senator Paul Kirk, Jr.
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Cambridge, MA 02141

Representative Edward Markey
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Medford, MA 02155

Advisory Council on Historic Preservation
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7.2 State and Regional Agencies and Elected Officials

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Senator Anthony Petrucelli
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Massachusetts Highway Department
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Massachusetts Historical Commission
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Metropolitan Area Planning Council
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Metropolitan Area Planning Council
Attn: Marc Draisen, Executive Director
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7.3 Municipalities

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Somerville Board of Aldermen
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Somerville Bicycle Committee, City Hall
Attn: Alan Moore, Chair
93 Highland Avenue
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Somerville Board of Aldermen
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Somerville City Clerk
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Somerville Conservation Commission
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Somerville Office of Strategic Planning and Community Development
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Cambridge

Cambridge City Hall
Attn: Honorable E. Denise Simmons
795 Massachusetts Avenue
Cambridge, MA 02139

Cambridge City Clerk
Attn: Margaret Drury
City Hall
795 Massachusetts Avenue
Cambridge, MA 02139

Cambridge City Council
Attn: Henrietta Davis
City Hall, 2nd Floor
795 Massachusetts Avenue
Cambridge, MA 02139

Cambridge City Council
Attn: Majorie C. Decker
City Hall, 2nd Floor
795 Massachusetts Avenue
Cambridge, MA 02139

Cambridge City Council
Attn: Craig A. Kelley
City Hall, 2nd Floor
795 Massachusetts Avenue
Cambridge, MA 02139

Cambridge City Council
Attn: David P. Maher
City Hall, 2nd Floor
795 Massachusetts Avenue
Cambridge, MA 02139

Cambridge City Council
Attn: Kenneth E. Reeves
City Hall, 2nd Floor
795 Massachusetts Avenue
Cambridge, MA 02139

Cambridge City Council
Attn: Sam Seidel
City Hall, 2nd Floor
795 Massachusetts Avenue
Cambridge, MA 02139

Cambridge City Council
Attn: Larry Ward
City Hall, 2nd Floor
795 Massachusetts Avenue
Cambridge, MA 02139

Cambridge City Manager
Attn: Robert W. Healy
795 Massachusetts Avenue
Cambridge, MA 02139

Cambridge Community Development Department
Attn: William Deignan
Cambridge City Hall Annex
344 Broadway
Cambridge, MA 02139

Cambridge Conservation Commission
344 Broadway
Cambridge, MA 02139

Cambridge Health Department
119 Windsor Street, Ground Floor
Cambridge, MA 02139

Medford

Medford City Hall
Attn: Honorable Michael McGlynn
85 George P. Hassett Drive
Medford, MA 02155

Medford Board of Health
Medford City Hall
85 George P. Hassett Drive, Room 311
Medford, MA 02155

Medford City Clerk
Attn: Edward P. Finn
85 George P. Hassett Drive, Room 103
Medford, MA 02144

Medford City Council
Attn: Paul A. Camuso
85 George P. Hassett Drive, Room 207
Medford, MA 02155

Medford City Council
Attn: Frederick DelloRusso
85 George P. Hassett Drive, Room 207
Medford, MA 02155

Medford City Council
Attn: Breanna Lungo-Koehn, President
85 George P. Hassett Drive, Room 207
Medford, MA 02155

Medford City Council
Attn: Michael J. Marks
85 George P. Hassett Drive, Room 207
Medford, MA 02155

Medford City Council
Attn: Robert Maiocco
85 George P. Hassett Drive, Room 207
Medford, MA 02155

Medford City Council
Attn: Stephanie Muccini Burke
85 George P. Hassett Drive, Room 207
Medford, MA 02155

Medford City Council
Attn: Robert M. Penta
85 George P. Hassett Drive, Room 207
Medford, MA 02155

Medford Conservation Commission
Medford City Hall
85 George P. Hassett Drive
Medford, MA 02155

Medford Office of Community Development
Attn: Lauren DiLorenzo, Director
85 George P. Hassett Drive, Room 308
Medford, MA 02155

7.4 Libraries

The State Library of Massachusetts
Government Documents Department
State House, Room 442
Boston, MA 02133

State Transportation Library
10 Park Plaza, 2nd Floor
Boston, MA 02116

Somerville Public Library – Central Library
79 Highland Avenue
Somerville, MA 02143
Attn: Reference Desk

Somerville Public Library – East Branch
115 Broadway
Somerville, MA 02145
Attn: Reference Desk

Somerville Public Library – West Branch
40 College Avenue
Somerville, MA 02144
Attn: Reference Desk

Cambridge Public Library – Main Library
359 Broadway
Cambridge, MA 02139
Attn: Reference Desk

Cambridge Public Library – Boudreau Branch
245 Concord Avenue
Cambridge, MA 02138
Attn: Reference Desk

Cambridge Public Library – Central Square Branch
45 Pearl Street
Cambridge, MA 02139
Attn: Reference Desk

Cambridge Public Library – Collins Branch
64 Aberdeen Avenue
Cambridge, MA 02138
Attn: Reference Desk

Cambridge Public Library – O'Connell Branch
48 Sixth Street
Cambridge, MA 02141
Attn: Reference Desk

Cambridge Public Library – O'Neill Branch
70 Rindge Avenue
Cambridge, MA 02140
Attn: Reference Desk

Cambridge Public Library – Valente Branch
826 Cambridge Street
Cambridge, MA 02141
Attn: Reference Desk

Medford Public Library
111 High Street
Medford, MA 02155
Attn: Reference Desk

7.5 Advisory Group Members

David Aposhian
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Somerville, MA 02143

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Davis Square Task Force
17 Chapel Street
Somerville, MA 02144

Noah Chesnin
Conservation Law Foundation
62 Summer Street
Boston, MA 02110

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Harvard University
P.O. Box 381801
Cambridge, MA 02238

Rita Donnelly
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Medford, MA 02155

Mimi Graney
Union Square Main Street
68-70 Union Square, PO Box 1
Somerville, MA 02143

Joe Guelpa
11 Trull Street
Somerville, MA 02145

David Jordan
Senator Jehlen's Office
State House, Room 213
Boston, MA 02133

Ken Krause
Medford Green Line Neighborhood Alliance
50 Mystic Street
Medford, MA 02155

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Somerville Chamber of Commerce
2 Alpine Street, P.O. Box 440343
Somerville, MA 02144

Jim McGinnis
26 Bow Street
Somerville, MA 02143

Ellin Reisner
Somerville Transportation Equity Partnership
51 Mount Vernon Street
Somerville, MA 02145

Barbara Rubel
Tufts University
169 Holland Street
Somerville, MA 02144

William Wood
25 Bussell Road
Medford, MA 02155

7.6 Additional EENF Commenters and Other Interested Parties

- Mary Anne Adduci
- Ruth Alfasso
- Susan Altman
- Arlington Transportation Advisory Committee, Edward Starr
- Elisabeth Bayle
- James and Christine Bennett
- Melissa Bennett
- Sarah Bergstrom
- Fred Berman and Lori Segall
- Susan Brown
- John Buckley
- John Burckhardt
- Natasha Burger and Jasper Vicenti
- Roberta Cameron
- Doug Carr
- Priscilla Chew
- Theodora Clark
- Sara Cohen
- Stacy Colella
- Paul Cote
- Cummings Foundation, Inc.
- John F. Deacon
- Darlene Domain
- Downtown North Association, Robert O'Brien
- Catherine D'Urso and Deborah Silva
- John Roland Elliott
- Robert Feigin
- James Feldman
- Green Line Community Forum, Ellin Reisner
- Stephanie Groll
- Lois Grossman
- Groundwork Somerville, Jennifer Lawrence

- John Haroutunian
- Joseph Jaquinta
- R. Kangas
- Jerry Lauretano
- Scott Lever
- Jeffrey Levine
- Thomas Lincoln
- Suzanne Lipsky
- Joseph Lynch, Jr.
- Kenneth Martin
- Mass Central Rail Trail Coalition, Craig Della Penna
- Jean McCarvill
- Lynn McWhood
- Medford Green Line Neighborhood Alliance (MGNA), Jared Ingersoll
- Peter Micheli
- Barbara Monagle
- Steve Mulder
- Angela Murphy
- Nelson/Nygaard Consulting Associates, Stephanie Groll
- John J. O'Donoghue
- Crispin Olson
- Catherine and Alan Peterson
- David Phillips
- Nancy Phillips
- Ruth Piscitelli
- Jeffrey Reese
- Barry Steinberg
- Maura Swan and Ben Lavery
- Charles Tolson
- Union Square Main Streets, Livingston Parsons
- Tufts University, Lawrence Bacow
- Pete Varga
- Walk Boston, Robert Sloane
- Donald Walker and Victoria Halal
- Lynn Wiles
- Carolyn Rosen et al
- Paula Woolley